

Bellway Homes Limited (Thames Valley)

Land at Battle Hospital, Portman Way, Reading

Geo-environmental Site Assessment

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1 INTRODUCTION

On the instructions of Bellway Homes Thames Valley (the 'Client'), RSK Environment (RSK) has conducted a geo-environmental site appraisal of the land at Battle Hospital, off Portman Way in Reading.

This report is subject to the RSK service constraints given in **Appendix A**.

1.1 Objective and aims

The project was commissioned to address the following objectives:

- To review the site investigation report (previously prepared by RSK for Royal Berkshire NHS Foundation Trust, during March 2012) in relation to a revised development proposal;
- To further assess the ground conditions in the northern section of the site and determine the full extent of the backfilled area;
- To assess the ground conditions in the southern section of the site (off Valentia Road) with respect to its contamination status under a residential scenario; and
- To provide information on the engineering characteristics of the ground and provide recommendations to enable the structural design and construction of the development.

1.2 Background

The northern/central portion of the site was the subject of a previous ground investigation undertaken by RSK in September 2012. The scope of the investigations was limited to an initial review of a desk based study and an intrusive investigation comprising of the excavation of shallow and deep boreholes with associated laboratory soil and groundwater testing.

By way of background, the site was largely part of a hospital originally constructed in the 1860s (initially operated as a work infirmary). A number of potential sources of contamination were recorded during the initial desk based assessment, principally relating to on site operations and ancillary activities. These include, fuel storage tanks, electricity sub-station, laundry, sterilisation unit, motor vehicle work shop, waste oil drums. Anecdotal evidence suggests the possible presence of upfilling in the northern portion of the study area.

The 2012 investigation confirmed the underlying geological succession to generally comprise a variable cover of made ground ranging between 0.30m and 1.30m below existing ground level. Conversely, a deeper area of made ground was recorded in the

northern margins, extending to a maximum depth of 4m. Superficial deposits of Alluvium and Taplow Gravel was recorded beneath the made ground with the white Chalk sub-Group at depth. The groundwater levels were variable and generally reflect perched water within the made ground and drift deposits.

The report concluded that the ground conditions were unsuitable for the adoption of traditional spread foundations owing to the thickness of made ground recorded and the variable nature of the drift deposits. As the foundations were required to be deepened, extending into consistently competent bearing strata (i.e. White Chalk), it was recommended that piled foundations be adopted.

A number of samples recovered from the made ground were analysed for a general suite of contaminants and analysed initially assessed against generic assessment criteria values. In summary, the following was identified.

- Hydrocarbon (TPH) contamination locally within the Made Ground (PH1, PH2, PH6, and visually in PH3 and BH2), considered to be associated with an oil loss from the area of bulk fuel storage and filling;
- Elevated concentrations of arsenic, lead and PAHs within Made Ground across the site;
- Aliphatic hydrocarbons C10-12 and C12-16 exceed the relevant assessment criteria for these compounds in PH2 and PH6 with respect vapour inhalation;
- Elevated concentrations of pyto-toxic metals (copper, zinc and nickel) were recorded in the made ground;
- Elevated concentrations of TPH and PAH compounds were recorded in the central parts of the site with the potential to pose a risk to potable pipes;
- TPH and PAH compounds (benzo(a)anthracene, chrysene, fluoranthene, benzo(a)pyrene, pyrene) within groundwater at PH6, PH2 and PH3. TPH carbon bands showing the highest concentrations are heavy-end fractions ranging from C12-35 (as are the marginally elevated PAH compounds chrysene, fluoranthene, benzo(a)pyrene, pyrene);
- The ground gas monitoring identified maximum concentrations recorded of methane (54% PH9) and carbon dioxide (19.7% PH9) with flow rates <0.1l/h.

A copy of the RSK report is presented in **Appendix C**.

1.3 Project brief and scope

The scope of works for the assessment included:

- An assessment of previous analytical data in line with the current guidance and identification of outline mitigation measures for complete pollutant linkages;

- An intrusive investigation consisting of three deep cable percussive boreholes and six shallow boreholes by drive-in sampler techniques with laboratory analysis plus subsequent groundwater and gas monitoring;
- Development of a refined conceptual site model followed by generic quantitative risk assessment (GQRA) to assess complete pollutant linkages that may require the implementation of mitigation measures to facilitate redevelopment;
- A factual and interpretative report with recommendations for further works (i.e. undertake a remedial options appraisal to identify appropriate mitigation measures/produce a remedial implementation and verification plan) and/or remediation as necessary; and
- A preliminary assessment of the potential waste classification implications of soil arisings.

1.4 Limitations

The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows may vary from those reported due to seasonal, or other, effects.

2 THE SITE

2.1 Description and geographical setting

The site covers approximately 3.2 hectares and is located off Portman Road, Reading, Berkshire at National Grid reference TQ 695 738. For the purpose of discussion the following areas have been considered:

Area A - occupied by buildings forming part of the former Battle Hospital, which include ambulance storage, (maintenance) workshops, offices, sterilization centre, laundry, a former incinerator and vacant storage units. External areas are hardstanding car parks or roads with occasional areas of soft landscaping.

Area B - characterised by the residential tower block with associated soft landscaping and external hardstanding.

The area surrounding the site comprises commercial units (various uses) to the north beyond Portman Road, residential units to the east and south and a Tesco superstore and garage to the southwest and west.

An extract of the 1:50,000 Ordnance Survey map showing the location of the site is included in **Figure 1** and an existing site layout plan in **Figure 2**.

2.2 Proposed development

It is understood that the site is to be redeveloped for a residential end-use, comprising low-rise houses and apartments with associated private and communal gardens and infrastructure. **Figure 3** is presented as a proposed development layout plan.

2.3 Site reconnaissance walkover

The site was visited on the 07th February 2017. The aim of the survey was to identify the range of potentially contaminative activities carried out on the site and in the immediate vicinity, and any obvious potential sources of ground contamination. The characteristics of the site observed during the site reconnaissance visit are summarised in **Table 1.**

Table 1: Site description

Feature	Description
Physical characteristics	
Area of site	Approximately 3.2 hectares.
Existing buildings on site	***Area A*** A large warehouse is present within the eastern quarter of the site, which is predominately empty other than storage of some paramedic equipment and an occasional damaged ambulance. Adjacent to the warehouse toward the central part of the site is an ambulance maintenance workshop and offices. The central south part of the site is occupied by Synergy where medical equipment is sanitised and distributed. A small office building is present within the central north part of the site, which is occupied by ambulance mobility. A small office block is present within the northwest of the site currently occupied by the NHS. A large warehouse (believed to be the former laundry) and a smaller adjacent building (with chimney believed to be the former boiler and incinerator) are present within the southwest of the site. The large warehouse building is temporarily being used by Bovis as a site compound whilst the other is redundant. ***Area B*** Three storey residential tower block with associated communal soft landscaped areas and car park
Ground levels	The site gently slopes towards the south-east with ground levels typically ranging between 38m to 40mAOD.
Depressions in the ground surface	None observed.
Waterlogged or marshy ground	None observed.
Surface water	There are no streams or drainage ditches on or immediately adjacent to the site.
Trees and hedges	Mature deciduous trees are present along the sites boundaries. In addition, occasional juvenile shrubs are present between site buildings within small landscaped areas.
Basements on site	No evidence of existing or infilled basements was observed, although their presence cannot be discounted (owing to the fact that access was not possible to all units).
External hardstanding	Concrete or bituminous hardstanding areas are present through the majority of the sites external areas.
Retaining walls	Retaining walls were not noted.

Feature	Description
Made ground, earthworks and quarrying	Made ground is anticipated to be present on site associated with the existing and historical development of the site.
Buried services present	There are a number of manhole covers on site. A possible borehole abstraction was noted in a small building within the northern part of the site.
Environmental characteristics	
Tank storage and dispensing facilities	***Area A*** The following redundant/non-operational tanks were observed during the course of the investigation: • An underground fuel storage tank (UST), an above ground tank (AST) and dispenser in the northeast of the site; • Two large above ground fuel oil tanks noted centrally off the main access road (associated with the generator / boiler / incinerator building across the road); • An above ground fuel storage tank was also noted adjacent to the boiler room in the central part of the site; • Two above ground storage tanks were noted to the rear of the maintenance workshop. It is understood that one is used for storage of waste oil and the other for high-grade oil storage. ***Area B*** None observed during the walkover.
Potentially hazardous materials storage and use	A hazardous chemical store is noted within the vehicle workshop located centrally, however inaccessible at the time of the walkover.
Asbestos-containing materials	Possible asbestos containing materials were noted in the form of cement bonded roofing materials associated with the some of the buildings on site, namely the maintenance unit. Asbestos presence within existing structures and made ground cannot be discounted. Prior to demolition of existing buildings, an asbestos survey must be carried out by an approved contractor. Asbestos containing materials are classified as being hazardous and must therefore be disposed off site at a suitably licensed waste facility should they be encountered.
Waste storage	A number of lubrication drums were located adjacent to the warehouse in the east of the site.
Electricity sub-stations	None observed within site boundary.
Evidence of possible land contamination on site	Staining of the ground surface was generally not observed (however access to all areas was not possible during the walkover) although given the history of the site and activities that have taken place ground contamination is likely to be present at the site.

Feature	Description
Potential off-site sources of ground contamination	None observed during the site walkover.
Invasive plants	No invasive plant species such as Japanese Knotweed or Giant Hogweed were noted on site, although their presence cannot be discounted.

3 PRELIMINARY RISK ASSESSMENT

3.1 Ground conditions

3.1.1 Geology

Published geological records (1:50,000 British Geological Survey, sheet No. 268 'Reading') for the area indicates the site is underlain by alluvium overlying the Taplow Gravel which in turn overlies the Upper Chalk Formation.

The full geological succession is presented in **Table 2**.

Table 2: Geology at the site

Geological unit	Description	Estimated thickness (m)
Alluvium	Variable sand, silt and clay locally shelly with peat and tufa layers	Superficial
Taplow Gavel	Sand and Gravel	Superficial
White Chalk Formation	Nodular Chalk	Solid

The existing topography and history of development of the site suggests that, in addition to these natural strata, made ground should be expected beneath the site. This is supported by the previous ground investigation beneath Area A.

3.1.2 Chalk-related subsidence risk

In view of the prevailing ground conditions, it is normal practice to consider the potential risk of ground subsidence related to the presence of swallow holes and other natural chalk solution features or man-made cavities.

Solution features form by the gradual dissolution of chalk by aggressive groundwater. The "risk" of solution feature occurrence is a function of the geological, hydrogeological and topographic conditions present at a site. The greatest risk of solution feature occurrence may be expected where feathering margins of granular cover deposits directly overlying the White Chalk Subgroup coincide with former drainage paths.

Stress relief associated with the formation of solution features can result in fissures, which act as preferential pathways for water to flow towards these features. Therefore concentrated inflows of water in proximity to existing solution features represent a risk of activating surface settlements and instability.

Based on the Edmund's risk assessment model for natural dissolution features referred to in CIRIA Report C574 (Lord et al. 2002), the site falls into the 'moderately low anticipated subsidence risk' category.

In addition, The Edmunds database indicates no records of features within 500m radius of the site. The nearest natural feature (solution pipe) is noted 699m south-east of the site.

Whilst no records exist pertaining to natural cavities on site or in the immediate vicinity, the absence of existing records should not be considered as conclusive. The distribution of known natural solution features relate to similar geological and geomorphological conditions to those present at the site itself.

3.1.3 Radon

The environmental database report indicates that the site is not located within an 'Affected Area'. Therefore, the risk of significant ingress of radon into structures on-site is considered to be low and radon protective measures are not required within new dwellings at the site.

3.1.4 Mining and landfilling

Evidence has been sought to identify any mining and landfilling operations, past and present, which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- The environmental database report;
- The RSK previous report;
- Old Ordnance Survey maps and plans; and
- Geological maps.

With reference to the above there are no recorded mines or quarries on or in the immediate vicinity of the site. However, there are a number of references to surface workings within a 250m radius of the site. The majority of which relate to former unspecified pits (c.1898 to 1956) located between 109m to 225m to the east and a historical pond (c.50m) located east. These features correspond to those recorded within the review of historical mapping.

With regards to land reclamation, there is the potential for uncontrolled backfilling of the former mineral extraction pits/pond (identified above) to have taken place.

Furthermore, based on the historical review, the site's northern margins encroached onto the surrounding low lying marshland susceptible to flooding. A former drain traversed the site east to west in parallel with the northern boundary (serving as a relief channel). It has been assumed that in order to facilitate the construction of the hospital building, the rear parcel of land was raised to mitigate any risk associated with flooding.

As such the subject area was considered to have been the subject of uncontrolled landfilling.

3.2 Hydrogeology

3.2.1 Aquifer characteristics

Based on the published geological map referred to above, the hydrogeology of the site is likely to be characterised by the presence of an unconfined shallow aquifer comprising the Taplow Gravel. Immediately beneath the Taplow Gravel, the Chalk forms an unconfined deep aquifer. It is considered that these two units will be in hydraulic continuity and therefore have been considered as a single aquifer unit.

The anticipated depth to the water table in the Taplow Gravel/Chalk i.e. the thickness of the unsaturated zone, is in the order of a few metres below ground level. Shallow groundwater in the site area is anticipated to flow in a northly/north-easterly direction, i.e. towards and in the direction of flow of the River Thames (c. 1km).

In addition to the above, it is possible that localised perched groundwater may be present in the made ground and the alluvial soils beneath the site.

3.2.2 Vulnerability of groundwater resources

The site has been classified by the Environment Agency (EA) to overlie a:

- Secondary (Undifferentiated) – Alluvium: permeable, although alluvial soils associated with the River Thames is classified as Secondary Undifferentiated, which suggests variable permeability;
- Secondary (A aquifer) - Taplow Gravel: 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; and
- Principal aquifer – White Chalk Sub-Group: layers of rock or drift deposit that have high intergranular and/or fracture permeability (usually providing a high level of water storage). They may support water supply and/or river base flow on a strategic scale.

The soils beneath the site are classified as having an HIGH (H) leaching potential.

H – soils of high leaching potential are those with little ability to attenuate diffuse source pollutants and where non-adsorbed diffuse source pollutants and liquid discharges can move rapidly to underlying strata or shallow groundwater.

3.2.3 Licensed groundwater abstraction

Six groundwater abstractions have been identified within a 500m radius of the site. One of the six abstractions is listed as being on the site itself and operated by Battle Hospital. It is understood that this abstraction was associated with general use (sanitary, washing

and cooking), albeit it is currently redundant. The remaining five are located c.360m to 430m north/north-west. These relate to general farming and domestic use.

Information available on the EA website indicates that the site does not lie within a currently designated groundwater Source Protection Zone.

3.3 Hydrology

3.3.1 Surface watercourses

There are no ponds, streams or drainage ditches on or adjacent to the site. The nearest identified surface water feature is an unnamed brook/ditch approximately 218m to the east of the site.

3.3.2 Surface water abstractions

There are no surface water abstractions identified, using the environmental database within a 1km radius of the site.

3.3.3 Site drainage

Surface drainage from the site appears to be discharged into the main public sewers.

3.3.4 Preliminary flood risk assessment

The indicative floodplain map for the area, published by the Environment Agency (EA), shows that the site lies within an indicative Zone 2 floodplain (i.e. extreme flooding from rivers without defences).

This report is not intended to replace a full hydrological study and it is recommended that additional specialist studies be conducted to confirm flood risks at the site.

3.4 History of site and surrounding area

The history of the land-use and development of the site and surrounding area has been assessed based on the following sources:

- Historical maps within the environmental database from 1878 to 2014;
- Pre-Ordnance Survey (County Series) maps;
- Aerial photography.

Copies of OS and County Series maps are included in the environmental database report in **Appendix C**. Reference to historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.

Table 3: Summary of historical development

Date	Land use/features on site	Land use/features in vicinity of site (of relevance to the assessment)
1880s	• Open undeveloped marshland occupying the northern portion of the site.	• Gravel pits around 200m to the southeast. • Battle Farm around 50m to the southeast. • Infirmary around 250m to the south. • Railway around 260m to the north.
1900s	• No significant change.	• Gravel pits no longer shown. • Large residential development of Victorian terrace properties 250m to the southeast beyond a small tin works. • Workhouse and hospital 250m to the south and southwest.
1930s	• Undeveloped although now shown to be part of the grounds to the battle hospital to the south.	• Expansion of Battle Hospital to the south and southwest otherwise no significant change noted.
1960s	• No significant change.	• Single detached unnamed unit 50m to the south.
1969-1972	• No significant change with the exception of the NHS accommodation in the southern portion of the site.	• Various works (e.g. engineering and computer), warehouses and light industrial units beyond Portman Road to the north. • Residential development immediately to the east. • Further expansion of Battle Hospital to south and southwest with unnamed units.
1975-1976	• Site appears to have been redeveloped as part of Battle Hospital. Seven unmarked units are shown to be present on site.	• Large hospital building developed around 50m to the southwest. • Large car park now shown immediately to the west. • Other directions no significant change.
1990s	• Site appears to reach its current configuration with numerous unmarked buildings shown to occupy the site. Tanks and an electrical sub station are shown to be present within the central parts.	• Further expansion of Battle Hospital site to south, with some of the previous units having been altered or replaced altogether. • In other directions no significant changes.
2006	No significant change.	No significant change.
2012-2014	No significant change.	A superstore and residential units have replaced Battle Hospital immediately to the south and southwest.

3.5 Sensitive land uses

No national or internationally designated sensitive land uses such as sites of special scientific interest (SSSI) were identified in the vicinity of the site. The Department for Environment, Food and Rural Affairs, does however, record the site as being within a Nitrate Vulnerable Zone.

3.6 Initial conceptual model

The information presented in Sections 2 and 3.1 to 3.5, has been used to compile an initial conceptual model. The identified potential sources of contamination, associated contaminants and receptors have been considered with plausible pathways that may link them. The resulting potential pollutant linkages are considered in Section 3.6.5. The risk classification has been estimated in accordance with information in **Appendix D**.

3.6.1 Summary of potential contaminant sources

Potential sources and contaminants of concern are summarised in **Table 4**.

Table 4: Potential sources and types of contamination

Potential sources	Contaminants of concern
On-site (Historical and Current)	
Made Ground (i.e. fill material) associated with former phases of development of the site (i.e. reconfiguration and development of hospital buildings) including infilling within the northern portions of Area A.	Unknown fill material (but potentially including heavy metals, ash, clinker, sulphates, polycyclic aromatic hydrocarbons (PAHs), asbestos and hazardous ground gases (methane and carbon dioxide) etc.)
Historical land use through Area A and associated site operations, including: • Storage/handling/dispensing of fuel oils and maintenance work on tanks; • Storage of hazardous chemicals/waste oils/high grade oils associated with the motor workshop; • Electricity sub-station located centrally; • Laundry/incinerator/workshops/storage warehouses and sterilisation unit.	Hydrocarbons (including petroleum hydrocarbons and oil/fuel hydrocarbons), methyl tertiary butyl ether (MTBE), oil and waste oil, polychlorinated biphenyls (PCBs), chlorinated and non-chlorinated solvents, asbestos, metals
Off-site	
Petrol filling station, located approximately 43m to east of the site	Hydrocarbons, petroleum spirit, ethylene glycol, methyl tertiary butyl ether (MTBE), oil and waste oil, chlorinated and non-chlorinated solvents, asbestos, sulphuric acid, metal and metal

Potential sources	Contaminants of concern
	compounds
Former landfill sites located between 200m to 900m from the site	Landfill gasses, leachate
Various current and former industrial land uses to the north of the site, including Work and engineering facilities.	Fuel oils, lubricating oils, heavy metals, polychlorinated biphenyls (PCBs), PAHs, solvents and other common industrial contaminants
Former Hospital (c.1920s – 2000s) located immediately to the south of the site (although now redeveloped for housing and superstore).	Heavy metals, CN- free, nitrates, sulphates, sulphides, asbestos, pH, oil/fuel hydrocarbons, chlorinated aliphatic hydrocarbons, chlorinated aromatic hydrocarbons and PCBs

3.6.2 Sensitive receptors

On the basis that the site is for residential development, and given the site setting, the following sensitive receptors that may be affected by potential contamination sources identified above include:

- Human health (future site users);
- Controlled Waters (Secondary A Aquifer and Principal aquifer);
- Building infrastructure (notably water supply pipes); and
- Proposed vegetation.

Please note that construction workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures including CDM regulations.

3.6.3 Summary of plausible pathways

Pathways by which potential contaminants may impact sensitive receptors may include:

- Leaching and dissolve phase migration of any potential contaminants into groundwater within underlying soils;
- Migration of contaminants present in groundwater to the wider groundwater body;
- Direct human ingestion, dust inhalation and/or dermal contact;
- Migration of vapours along backfill around service pipes and through strata;
- Inhalation of vapours via volatilisation;
- Ground gas migration in permeable soils or along service runs;
- Permeation of potential contaminants through proposed utility pipes including water supply pipes; and
- Uptake by vegetation

3.6.4 Potentially complete pollutant linkages

An estimate of the risk associated with each linkage is summarised in **Table 5**. The risk classification has been undertaken in accordance with CIRIA C552 (Rudland et al., 2001), a summary of which is included in **Appendix D**.

Table 5: Risk estimation for potentially complete pollutant linkages

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
Made Ground (i.e. fill material) associated with former phases of development of the site.	Residential end-users	Ingestion, inhalation and dermal contact	Likely	Medium	Moderate risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Direct contact with on-site buildings and services	Likely	Mild	Moderate to low risk: Building material and infrastructure (including plastic water supply pipes) are likely to come into contact with disturbed soils during the construction phase.
		Migration and accumulation of gas within on-site buildings and services	Low likelihood	Medium	Moderate to low risk: There is a low likelihood of there being a gas generation source in the made ground.
		Migration and accumulation of gas within off-site buildings and services	Low likelihood	Medium	Moderate to low risk: There is a low likelihood of there being a gas generation source in the made ground.
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Low likelihood	Medium	Moderate to low risk: It is considered that there is a low to moderate likelihood of a significant source of groundwater pollution existing in the made ground.
	Groundwater in the wider aquifer body.	Migration of mobile contaminants	Low likelihood	Medium	Moderate to low risk: It is considered that there is a low to moderate likelihood of a significant source of groundwater pollution existing in the made ground.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
	Surface watercourses, including the River Thames and associated surface water abstractions	Migration of mobile contaminants	Unlikely	Mild	Very low risk: It is unlikely that a pathway exists between the site and the River Thames.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.
Infilled (landfilled) former sand and gravel pits located at the site.	Residential end-users	Ingestion, inhalation and dermal contact	Highly likely	Medium	High risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Direct contact with on-site buildings and services	Highly likely	Mild	Moderate risk: Building material and infrastructure (including plastic water supply pipes) are highly likely to come into contact with infill materials during the construction phase.
		Migration and accumulation of gas within on-site buildings and services	Highly likely	Medium	High risk: It is highly likely that there is a gas generation source in the infill materials.
		Migration and accumulation of gas within off-site buildings and services	Highly likely	Medium	High risk: It is highly likely that there is a gas generation source in the infill materials.
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there may be source of groundwater pollution in the infill materials.
	Groundwater in the wider aquifer body.	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there may be source of groundwater pollution in the infill materials.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
	Surface watercourses, including the River Thames and associated surface water abstractions	Migration of mobile contaminants	Unlikely	Mild	Very low risk: It is unlikely that a pathway exists between the site and the River Thames.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.
Above and Underground fuel storage tanks and dispensers. In addition oils stored within historical electrical substation.	Residential end-users	Ingestion, inhalation and dermal contact	Highly likely	Medium	High risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Direct contact with on-site buildings and services	Highly likely	Mild	Moderate risk: Building material and infrastructure (including plastic water supply pipes) are highly likely to come into contact with hydrocarbon contamination during the construction phase.
		Migration and accumulation of gas within on-site buildings and services	Highly likely	Medium	High risk: It is highly likely that if hydrocarbon contamination is present there will be gas / vapour.
		Migration and accumulation of gas within off-site buildings and services	Highly likely	Medium	High risk: It is highly likely that if hydrocarbon contamination is present there will be gas / vapour.
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there may be source of groundwater pollution related to the bulk fuel storage.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
	Groundwater in the wider aquifer body.	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there may be source of groundwater pollution related to the bulk fuel storage.
	Surface watercourses, including the River Thames and associated surface water abstractions	Migration of mobile contaminants	Unlikely	Mild	Very low risk: It is unlikely that a pathway exists between the site and the River Thames.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.
Historic and current industrial activity at the site, including a laundry, incinerator, storage units, workshop and sterilisation unit.	Residential end-users	Ingestion, inhalation and dermal contact	Likely	Medium	Moderate risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Direct contact with on-site buildings and services	Likely	Mild	Moderate to low risk: Building material and infrastructure (including plastic water supply pipes) are likely to come into contact with affected soils during the construction phase.
		Migration and accumulation of gas within on-site buildings and services	Low likelihood	Medium	Moderate to low risk: There is a low likelihood of there being a gas generation source at the site from historic and current on-site industrial activity.
		Migration and accumulation of gas within off-site buildings and services	Low likelihood	Medium	Moderate to low risk: There is a low likelihood of there being a gas generation source at the site from historic and current on-site industrial activity.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there maybe a source of groundwater pollution from historic and current activity at the site.
	Groundwater in the wider aquifer body.	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there maybe a source of groundwater pollution from historic and current activity at the site.
	Surface watercourses, including the River Thames and associated surface water abstractions	Migration of mobile contaminants	Unlikely	Mild	Very low risk: It is unlikely that a pathway exists between the site and the River Thames.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.
Various current and historical industrial land uses surrounding the site, including petrol filling station, works buildings, engineering facilities and the former Battle Hospital	Residential end-users	Migration of mobile contaminants and inhalation	Likely	Medium	Moderate risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Migration of mobile contaminants and direct contact with on-site buildings and services	Likely	Mild	Moderate to low risk: Building material and infrastructure (including plastic water supply pipes) are likely to come into contact with affected soils during the construction phase.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there maybe a source of groundwater pollution migrating on to site from off site sources.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.

To summarise, the preliminary CSM has identified evidence of possible ground contamination on the site, probable pathways for contamination to migrate and sensitive receptors potentially at risk. Plausible pollutant linkages are therefore deemed to exist.

4 SITE INVESTIGATION METHODOLOGY

RSK carried out the intrusive investigation works through Areas A and B in two separate phases: 6th to 10th February 2012 and 1st to 7th February 2017 plus subsequent ground gas and groundwater monitoring to confirm the potential pollutant linkages identified in the outline conceptual model and to inform geotechnical constraints.

4.1 Sampling strategy and methodology

The techniques adopted for the investigation have been chosen considering the anticipated ground conditions, existing land use and the proposed development. A mixture of cable percussive boreholes and drive-in sampler boreholes were used in order to assess the nature and extent of the made ground on site, install monitoring wells and inform geotechnical constraints on deeper soils.

4.1.1 Health and safety considerations

All works were conducted in accordance with RSK's Health and Safety policy and site specific health and safety plan. Copies of which can be made available on request.

4.1.2 Investigation locations

The following site work have been carried out to date:

- Sixteen drive-in sampler boreholes to a maximum depth of 4m bgl (Area A, August 2012);
- Three deep boreholes by means of cable percussive to a maximum depth of 13m bgl (Area A, August 2012);
- Six drive-in sampler boreholes to a maximum depth of 4.45m bgl (Area B, February 2017);
- Two deep boreholes by means of cable percussive to a maximum depth of 25m bgl (Area A, February 2017);
- A single deep borehole by means of cable percussive to a maximum depth of 25m bgl (Area B, February 2017)
- Ground gas and groundwater monitoring was completed between August/September 2012 and February 2017.

The exploratory hole records are presented in **Appendices C and E**.

The locations of the intrusive investigations are shown in **Figure 2**. The rationale for these locations is given in **Table 6**. The investigation contained a mixture of targeted locations to

identify impact from identified sources of contamination and non-targeted locations to enable site wide coverage as per the rationale table.

Table 6: Exploratory hole location rationale

Exploratory hole number	Location	Rationale
PH2, PH4, PH6, PH10, PH14 and BH2	Area A (northern/central portion of the site)	To assess the ground conditions in the vicinity of the fuel storage tanks (ASTs/USTs), associated dispensers, waste oil tanks and electricity sub-station.
BH4, BH6 and PH13	Area A (northern portion of the site)	To determine the full extent of the infilled area to the north and assess the migration of ground gases. In addition to obtain geotechnical information for foundation design.
PH1	Area A (central portion of the site)	To assess the ground conditions in the vicinity of the former sterilisation centre.
PH5	Area A (along the southern margins)	To assess the ground conditions in the vicinity of the boiler room.
PH8, PH9	Area A (western portion of the site)	To assess the ground conditions in the vicinity of the former laundry.
PH11, PH12 and PH16	Area A (eastern portion of the site)	To assess the ground conditions beneath the former storage/warehouse distribution building
PH15	Area A (central portion of the site)	To assess the ground conditions in the vicinity of the motor vehicle workshop.
BH5, WS1 to WS6, PH3 and PH7.	Area A (northern portion) and B (southern portion)	Positioned in areas of low risk and enable collection of background data and obtain geotechnical information for foundation design.

The investigation points were located approximately by reference to a topographical survey and physical features present on the site at the time of investigation.

4.1.3 Soil sampling, in-situ testing and laboratory analysis

Selected samples were placed in polythene bags for headspace screening with a photo-ionisation detector (PID) fitted with a 10.2eV bulb. Soils collected for laboratory analysis were collected in a variety of containers appropriate to the anticipated testing suite required. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

Representative samples were recovered from the shallow boreholes and recorded together with their depths and the PID screening results on the exploratory hole records in **Appendices C/E**. The samples were transported to the laboratory in chilled cool boxes. Laboratory chain of custody forms can be provided if required.

Standard Penetration Tests (SPTs) were carried out within selected deep boreholes to determine in-situ strength of the underlying soil material. Test results are given on the exploratory records presented in **Appendices C/E**.

4.1.3.1 Environmental analysis

The testing was carried out to assess the levels of contamination within the made ground and natural soils encountered on the site with regard to identified receptors as detailed within the Conceptual Model. Testing was undertaken by a UKAS accredited laboratory (Envirolab) as detailed within **Table 7**. MCERTS accredited test methods were specified where applicable. The results are presented in **Appendices C/E**.

Table 7: Scheduled analysis – soil

Stratum	Analyte
Made Ground	Metals, asbestos screen, pH, total organic carbon, total petroleum hydrocarbons (TPH) with ID, speciated TPH, speciated polycyclic aromatic hydrocarbons (PAH), leachable metals, volatile organic compounds (VOCs).

4.1.3.2 Geotechnical analysis

The programme of geotechnical tests undertaken is presented in **Table 8**, the main purpose of which was to classify the engineering properties of the soils. Where appropriate, testing was undertaken in accordance with BS 1377:1990 Method of Tests for Soils for Civil Engineering Purposes within a RSK UKAS accredited laboratory. The results are presented in **Appendix C**.

Table 8: Summary of geotechnical testing programme

Stratum	Analyte
Alluvium / Taplow Gravel	Particle size distribution (PSD), moisture content, liquid limit, plastic limit, pH and soluble sulphate.

4.1.4 Groundwater monitoring and levelling

Depths to groundwater were recorded using an electronic dip meter during drilling and subsequently between 21st August 2012 and 28th February 2017. The monitoring results are discussed in **Section 5**.

4.1.5 Groundwater developing, sampling and analysis

Subsequent to the installation of groundwater monitoring wells the installations were developed at least one week before sampling. Groundwater samples were retrieved using a United States Environment Protection Agency (USEPA) approved low-flow purging and sampling methodology. The low-flow method relies on moving groundwater through the well screen at approximately the same rate as it flows through the geological formation. This

results in a significant reduction in the volume of water extracted before sampling and significantly reduces the amount of disturbance of the water in the monitoring well during purging and sampling. Drawdown levels in the monitoring well and water quality indicator parameters (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) are monitored during low-flow purging and sampling, with stabilisation indicating that purging is complete and sampling can begin. As the flow rate used for purging, in most cases, is the same or only slightly higher than the flow rate used for sampling, and because purging and sampling are conducted as one continuous operation in the field, the process is referred to as low-flow purging and sampling.

In-situ water quality measurements undertaken during the low-flow sampling process are provided in **Appendix C**.

The groundwater samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation. Samples were transported directly to the testing laboratory under chain of custody documentation. The rationale for groundwater analysis is presented in **Table 9**.

Table 9: Scheduled analysis – groundwater

Exploratory hole no.	Analyte	Rationale
PH2	Speciated total petroleum hydrocarbon, polycyclic aromatic hydrocarbons, metals, pH	Assessment of groundwater quality with respect to risk to controlled waters and human health.
PH3		
PH5		
PH6		
BH1		
BH2		
BH3		
BH4		
BH5		
BH6		

4.1.6 Ground gas monitoring

An infrared gas meter was used to measure gas flow, concentrations of carbon dioxide (CO_2), methane (CH_4) and oxygen (O_2) in percentage by volume, while hydrogen sulphide (H_2S) and carbon monoxide (CO) were recorded in parts per million. Initial and steady state concentrations were recorded. In addition, during the first monitoring round, all wells were screened with a PID to establish if there are any interferences and cross-sensitivity of other hydrocarbons with the infrared gas meter.

The atmospheric pressure before and during monitoring, together with the weather conditions, was recorded.

All monitoring results together with the temporal conditions are contained within **Appendix C/E** and discussed in **Section 5**.

5 GROUND CONDITIONS

The results of the intrusive investigations undertaken to date and subsequent laboratory analysis undertaken are detailed below. The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, in-situ testing and details of monitoring well installations are included on the exploratory hole records presented in **Appendix B and C**.

5.1 General Succession of Strata

The exploratory holes (combined with the previous field records prepared by RSK in 2012) revealed that the site is underlain by a variable thickness of made ground extending up to 5 in northern portion of the site (Area A). This in turn was underlain by drift deposits comprising alluvial and river terrace deposits (Taplow Gravel) with the White Chalk Sub-Group at depth. This appears to confirm the stratigraphical succession described within the initial conceptual model. For the purpose of discussion, the ground conditions are summarised in **Table 10** and the strata discussed in subsequent subsections.

Table 10: General succession of strata encountered

Strata	Exploratory holes encountered	Depth to top of stratum m bgl	Thickness (m)
Made ground	WS1 to WS6, BH4 to BH6 *(March 2017)* BH1 to BH3, PH2 to PH5 & PH8 to P16 *(September 2012)*	0.00 (GL)	0.30 to 5.0
	PH1, PH6 & PH7 *(September 2012)*	0.00 (GL)	Proven to the full depth of the investigation (4m bgl)
Alluvium	PH11, PH16, PH8, PH10, PH15, BH2 & BH3 *(September 2012)* WS2 *(March 2017)*	0.50 to 3.90	0.55 to 3.8
	PH2, PH3, PH4 and PH13 *(September 2012)*	2.2 to 3.1	Proven to the full depth of the investigation (4m bgl)
Taplow Gravel (River Terrace Deposits)	BH1 to BH3, PH11, PH16, PH5 and PH9 *(September 2012)* WS2, WS3, WS5, WS6, BH4 & BH5 *(March 2017)*	0.30 to 5.0	0.30 to 4.3
	PH8, PH10, PH15, PH12, PH14 *(September 2012)* WS4 *(March 2017)*	0.60 to 3.95	Proven to the full depth of the investigation (4m bgl)

Strata	Exploratory holes encountered	Depth to top of stratum m bgl	Thickness (m)
White Chalk Sub-Group	BH1 to BH3, PH11, PH16, PH5 and PH9 *(September 2012)* WS2, WS3, WS5, WS6, BH4 & BH5 *(March 2017)*	1.2 to 9.3	Proven to the full depth of the investigation (25m bgl)

5.1.1 Made ground

5.1.1.1 Area A

The exploratory holes encountered a variable thickness of made ground across the site ranging from 0.80 to 5.0m. In the southern section of the area, made ground measured <1.5m bgl, while the northern section measured 2.0 to 5.0m. The greater thickness of made ground is considered to be attributable to historical infilling.

The made ground encountered was heterogeneous in nature and references should be made to the individual records, however in general an initial layer of bituminous hardstanding/loose gravel was encountered within the majority of the exploratory locations overlying a granular sub-base layer (variable aggregate). Beneath the sub-base layer the made ground typically comprised a variable proportion of anthropogenic material (ash, clinker, plastic, concrete, glass, charcoal), flint and chalk within a black/brown slightly organic locally clayey sand matrix. Reworked alluvial soils are noted locally within BH4.

The following visual and olfactory evidence of contamination was observed during the course of the investigation:

- Light to heavy staining with moderate to strong hydrocarbon odours were recorded locally within a number of exploratory points (BH2 at 0.80m, PH13 at 2.2m, PH1 at 1.2m, PH2 at 0.8m, PH3 at 2m, PH4 at 1.3m, PH6 at 1.2m);
- Sulphurous odour was noted locally in two locations (BH6 at 0.5 and PH7 at 2.0m)
- Solvent odour was noted locally in a single location (PH9 at 0.5m);
- PID screening of disturbed samples identified the potential presence of volatile organic compounds with concentrations ranging between 20ppm to 42ppm (PH1, 25-35ppm, PH2, 20-36ppm and PH6, 22-42ppm).

5.1.1.2 Area B

The exploratory holes recorded a thin veneer of made ground generally ranging between 0.30m and 0.8m bgl. The nature of the made ground material recorded was similarly characterised by the presence of chalk, flint, plastic, ash, charcoal, brick, concrete, ceramic, glass fragments within a black/brown sandy matrix. Reworked river terrace deposits are noted locally in WS2 comprising clayey gravelly sand with fragments of chalk and flint. With

the exception of rare wood fragments, no olfactory/visual evidence of significant contamination was recorded. PID screening of disturbed samples recorded concentrations of volatile organic compounds below 1ppm.

5.1.2 Alluvium

This stratum was encountered beneath the made ground in the northern, eastern and western margins of the site and comprised a layer of soft slightly organic silty clay/clayey silt with rare fine to coarse flint gravel and locally interbeded with spongy peaty lenses.

5.1.3 Taplow Gravel

The Taplow Gravel was found to be lateral and horizontally variable in nature and typically comprised dense gravelly fine to coarse clayey gravelly sand, sandy gravel, clayey gravel with variable proportions of flint and chalk. Locally loose medium dense gravelly sand was recorded in WS4. No olfactory/visual evidence of significant contamination was recorded. PID screening of disturbed samples recorded concentrations of volatile organic compounds below 1ppm.

5.1.4 White Chalk Sub-Group

The White Chalk Sub-Group was initially recovered as a structureless chalk consisting of off white/cream gravelly sandy silt (estimated Grade Dm), grading into a clast dominated (estimated Grade Dc) chalk. The stratum contained variable proportions of nodular black flint, recovered as fine gravel to cobble sized clasts. No olfactory/visual evidence of significant contamination was recorded. PID screening of disturbed samples recorded concentrations of volatile organic compounds below 1ppm.

5.1.5 Groundwater

Groundwater was encountered during the investigation as detailed in **Table 11**.

Table 11: A summary of the groundwater results during the investigations

BH	Stratum	Strike (m bgl)	Rise (m)
BH1	WCSG/TG	13.50	1.50
BH2	WCSG/TG	13.50	1.50
BH3	WCSG/TG/All	12.50	1.80
BH4	WCSG/TG	5.2	3.00
BH5	WCSG	5.2	3.30
PH13	All	4.0	0.90
PH9	TG/WCSG	2.0	2.00
PH7	MG	1.50	1.50

BH	Stratum	Strike (m bgl)	Rise (m)
PH1	MG	1.50	1.30
PH2	MG/All	4.0	1.40
PH3	MG/All	4.0	1.70
PH4	MG/All	3.0	1.15
PH6	MG	4.0	1.30
PH5	TG/WCSG	3.0	1.90
PH8	MG/All/TG	4.0	2.00
PH10	MG/All/TG	4.0	1.20
PH11	All/TG/WCSG	3.0	1.20
PH12	MG/TG	4.0	1.50
PH14	MG/TG	3.0	1.40
PH15	MG/TG	4.0	1.00
PH16	MG/TG/WCSG	3.0	1.50
Note: MG – Made Ground; All – Alluvium; TG – Taplow Gravel; WCSG – White Chalk Sub-Group			

The results of the subsequent groundwater monitoring and well surveying exercise are summarised in **Table 12**.

Table 12: Groundwater monitoring data – Area A (21st August & 8th September 2012)

Monitoring well	Depth to product (m)	Depth to water m (mAOD)	Product thickness (m)	Depth of the monitoring well (m)
PH2	-	1.22 – 1.28	-	2.71
PH3	-	1.146 – 1.21	-	2.96
PH5	-	1.66 – 1.68	-	2.87
PH6	-	1.25 – 1.32	-	2.45
PH8	-	1.42 – 1.464	-	2.95
PH10	-	0.20 – 0.278	-	3.50
PH12	-	1.42 – 1.335	-	3.44
BH1	-	1.2	-	8.03
BH2	-	1.075	-	1.48
BH3	No data			

Table 13: Groundwater monitoring data – Area A (20th & 28th February 2017)

Monitoring well	Depth to product (m)	Depth to water m (mAOD)	Product thickness (m)	Depth of the monitoring well (m)
PH2	-	1.18	-	2.65
PH3	-	1.08	-	2.95
PH5	No data			
PH6	No data			
PH8	No data			
PH10	No data			
PH12	No data			
BH1	-	0.13	-	1.10
BH2	-	1.04	-	3.08
BH3	-	1.84	-	4.88
BH4	-	1.64	-	6.63
BH6	-	1.30	-	5.26

Table 14: Groundwater monitoring data – Area B (21st August & 8th September 2012)

Monitoring well	Depth to product (m)	Depth to water (m)	Product thickness (m)	Depth of the monitoring well (m)
WS2	-	2.21	-	2.20
WS4	-	Dry	-	2.93
WS6	-	3.19	-	4.60

The findings reflect an inconsistent groundwater table in the underlying soils at an elevation of between approximately 40m AOD in the south/south-east (Area B) and 38m AOD in the north/west (Area A). It is anticipated that perched water in the Alluvium may flow radially. Given the nature of the heterogeneous Made Ground, perched water levels are likely to be inconsistent across the site. With regards to the White Chalk Sub-Group and Taplow Gravel, ground water strikes were recorded at variable depths indicating the possible presence of perched water.

It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal variations. Ongoing monitoring would be required to establish both the full range of conditions and any trends in groundwater levels.

5.2 Ground gas regime

The results of the ground gas monitoring and testing carried out are given in **Appendix B and C**. The minimum and maximum results are recorded in **Table 15.**

Table 15: Summary of ground gas monitoring results

Borehole	Methane (%)	Carbon dioxide (%)	Oxygen (%)	Flow rate (l/hr)	Atmospheric pressure (mbar)	Observations
BH1	<0.1	0.1	20.7	0	1014	Response zone full saturated. Water above slotted section of standpipe.
BH2	<0.1	7.1	5.7	0	1014	
BH3	<0.1	2	18.7	0	1014	Multiple response zone including alluvial lenses and chalk.
BH4	0.20	0.5	20.6	0	1014	High water level. Response zone includes chalk.
BH5	<0.1	0	20.7	0	1014	Response zone includes chalk.
BH6	<0.1	3	19.2	0	1014	Response zone includes significant made ground.
PH2	<0.1 – 0.9	16.9 - 19.7	3.3 – 1.80	0	981-1022	Response zone includes made ground impacted with hydrocarbon staining. In the vicinity of the ASTs.
PH3	54.1 – 40.4	11.1 - 12.5	1.7 – 0.10	0	981-1022	
PH5	<0.1	3.9 – 4.5	16.3 – 16.5	0	1019-1022	Response zone includes chalk.
PH6	<0.1	18 – 18.2	0.3 – 0.1	0	1019-1022	High groundwater level. Response zone includes the chalk.
PH8	<0.1	16.5 - 18.7	4 – 4.7	0	1019-1022	Targeting the made ground.
PH10	0.60	0.9	17.3	0	1019-1022	Response zone full saturated. Water above the slotted section of the standpipe.
PH12	<0.1	1.9 – 2.3	17.5 – 17.6	0	1019-1022	Underlying granular material potential fully saturated
WS2	<0.1	0.4	20.8	0	981	Targeting the alluvial soils. No groundwater recorded.
WS4	<0.1	2.5	20.8	0	981	No groundwater recorded.
WS6	<0.1	0.1	21.3	0	981	Response zone includes chalk.

5.3 Refinement of the initial conceptual site model

The investigation generally confirmed the predicted ground model (as encountered during the previous phase of investigation), which was anticipated to comprise a variable thickness of made ground overlying the superficial deposits of the Alluvium/Taplow Gravel over the White Chalk Sub-Group. Variable depth of groundwater was noted generally reflecting the presence of perched water. Visual or olfactory signs of contamination were observed in the form of staining and hydrocarbon odour, notably through Area A. No free product was noted. A review of the in-situ PID screening results confirmed the possible presence of volatiles locally within the made ground. Several sources of ground gas/volatiles were identified which include historic landfilling to the north, organic rich deposits within natural/made ground soils and hydrocarbon impacted soil material in the vicinity of the former tanks. Laboratory analysis indicates the average TOC content to be between 8% (ranging between 2% to 21%). On this basis the ground gas generation potential is considered to be low to moderate.

The linkages that remain complete and require further consideration by undertaking a generic quantitative risk assessment are:

- Human health - direct contact with contaminants in made ground by future residents of communal soft landscaping areas;
- Human health - ingress of hazardous soil gases/voltailes into poorly ventilated areas.
- Vegetation - uptake of contaminants by vegetation in proposed soft landscaping areas;
- Controlled waters – Leaching and dissolved phase migration to the underlying aquifers; and
- Building materials - permeation of plastic utility supply pipes.

5.3.1 Uncertainty

A spatial extent of the investigation was limited due to the presence of remnant structures/buildings, which occupy 50%-60% of the site. Furthermore, the access restrictions encountered in the southern portion (Area B) necessitated the removal of WS1.

With respect to the groundwater monitoring, the groundwater table within the Taplow/White Chalk was not fully established during the course of the investigations.

The presence of hydrocarbons may interfere with the operation of infra-red gas monitors, since methane is filtered at a frequency specific to hydrocarbon bonds. Therefore, if other hydrocarbons are present within the sample (e.g. ethane, propane, butane or even petroleum vapours), the reported methane reading will be higher (never lower) that the actual methane concentration being monitored. The extent to which the methane reading is affected depends upon the concentration of the methane in the sample, the types of hydrocarbons present and the concentration(s) of the other hydrocarbons. The effect is non-linear and difficult to predict.

6 QUANTITATIVE RISK ASSESSMENT

In line with CLR11 (EA, 2014), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil, groundwater and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory/in-situ results or following statistical analysis depending upon the sampling procedure that was adopted. DQRA involves the development of site specific assessment criteria (SSAC) which essentially explores each of the exposure pathways, modifying the generic assumptions used in the derivation of GACs in order to better reflect site conditions.

6.1 Linkages for assessment

Section 5.3 presents the refined conceptual model which identified the linkages that required assessment after the findings of the site investigation had been considered. These linkages together with the method of assessment are presented in **Table 16**.

Table 16: Linkages for generic quantitative risk assessment

Potentially relevant pollutant linkage	Assessment method
1. Direct contact via ingestion and dermal contact (Human Health)	Precise details of the finalised development layout is unknown however based on the preliminary drawings (**Figure 3**), the proposal comprises a residential-led mixed use scheme with associated private gardens and communal soft landscaped areas. To provide an initial assessment of the potential human health risk, the chemical results have been directly compared against generic assessment criteria values under residential scenarios for with and without home grown (**Appendix G**) as these are considered to be the most suitable guidelines to protect the most critical targets from contaminants. Chemical analyses have been performed on a total of 29No. soil samples of the made ground/natural superficial deposits down to a maximum depth of 3.0m bgl.
2. Inhalation exposure of future residents to asbestos fibres	In addition to the chemical analyses, a total of 18No. samples recovered from the near surface soil material (i.e. general Made Ground) and the fill material towards the northern portion of the site (Area A) were screened in the laboratory for the presence of asbestos materials. Currently, due to uncertainty regarding risk assessment (in particular appropriate toxicological criterion and soil to air relationships), no acceptable concentration of asbestos in soil exists. Qualitative assessment based on the asbestos minerals present, their form, concentration, location and the nature of the proposed development.

Potentially relevant pollutant linkage	Assessment method
3. Inhalation exposure in the vapour phase	To assess the vapour pathway particularly in areas where the vapour pathway is the predominant pathway (i.e. in the vicinity of the former tanks notably in the northern portion of the site – Area A), soil results have been assessed against residential GACs. With respect to assessing the volatilisation pathway from groundwater, results have been compared against groundwater assessment criteria (GrAC) derived for a residential end-use scenarios (**Appendix G**). A total of 13No. groundwater samples (including form the previous RSK investigation) were recovered to date.
4. Concentrations of methane and carbon dioxide in ground gas entering and accumulating in: depressions and excavations that could affect workers enclosed spaces or small rooms in new buildings, which could affect future residents. In the case of methane this could create a potentially explosive atmosphere, while death by asphyxiation could result from carbon dioxide.	CIRIA C665 identifies two types of development, termed Situation A (modified Wilson and Card method), appropriate to all development excluding traditional low-rise construction, and Situation B (National House-Building Council, NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids. Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the gas screening value (GSV). The GSV (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume). The GSV have been compared with the following: 1. Wilson and Card classification presented within CIRIA report C665 (Wilson et al., 2007) for development comprising buildings with a ground floor slab – The northern portion of the site; and 2. Traffic Lights system, as presented within the NHBC ground gases guide (Boyle and Witherington, 2007) for development comprising low-rise housing with suspended floors – The remaining areas of the site.
5. Uptake of contaminants by vegetation potentially impacting plant growth	Several compounds can inhibit plant growth; hence it is important to have generic assessment criteria (GAC) to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields. The specified limits (designed to protect plant growth) of concentrations of selected elements in soil are outlined in updated 2nd Edition of the DoE Code of Practice and are presented in **Appendix H**.
6. Contaminants permeating potable water supply pipes	Comparison of chemical results against published data in general accordance with UKWIR (2010) guidance, 10/WM/03/21 (Appendix M). This technical guidance was introduced by UK water Industry Research to safeguard water quality by identifying suitable pipe materials to be used in potential contaminated ground. It should be noted that at the time of this investigation the future routes of water supply pipes had not been established, hence the investigation and sampling strategy may not be fully compliant with UKWIR recommendations.

Potentially relevant pollutant linkage	Assessment method
7. The Risk to controlled waters (i.e. Secondary – Alluvium and Taplow Gravel/Principal Aquifer – White Chalk Sub-Group) from leaching and dissolved phase migration of impacted material.	Comparison of leachate data against the target concentrations prescribed within **Appendix I**, which is considered to be the most suitable values for commonly encountered determinants. The potential for leaching was also considered qualitatively. Comparison of groundwater data against UK drinking water standards. In the absence of relevant guideline values, Environmental Water Quality Standards (EQS) has been adopted.

6.2 Methodology and results

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn .

6.2.1 Direct contact with impacted soil by future residents – Linkage 1

For the purpose of discussion, two separate areas have been considered, designated Area A and B, as shown in **Figure 2**. Since both targeted and non-targeted soil samples were obtained during the site investigation, the results of these have been evaluated in the following subsections.

6.2.1.1 Area A (Former Battle Hospital)

Non-targeted Assessment

The comparison of testing against the adopted GAC's are summarised within **Table 17**. Only those determinants where exceedances have been reported are included within the table.

Table 17: Chemical testing data summary table for combined human health pathways

Determinant	Data set / stratum	No. of samples tested	GAC* (mg/kg)	No of exceedances	Maximum concentration (mg/kg)	
					Value	Location / depth
Lead	Made Ground	2	200[1)]	1	950	PH3 (0.50)
			310[2)]	1	363	PH7 (0.40)
Dibenzo(ah)anthracene	Made Ground	2	0.32	1	0.4	PH7 (0.40)

*Given the TOC concentrations recorded within the made ground, the characteristic soil organic content (SOM) of 6.0% has been adopted for assessment purposes. 1) Residential with home grown produce 2) Residential without home grown produce

In addition to the simple comparison of data to the adopted screening values, the CIEH document 'Guidance on Comparing Soil Contamination Data with a Critical Concentration', dated May 2008 recommends a statistical review should be conducted to demonstrate the site's 'suitability for use' with a defined level of confidence. Given the targeted nature of the investigation, it is not considered appropriate to conduct a statistical assessment.

Targeted Assessment

Targeted investigation has been conducted in the vicinity of the former ASTs, USTs, redundant dispensers, motor vehicle work shop, waste oil drums, storage warehouse, laundry, incinerator, electricity sub-station, boiler room and infilled area. Review of the soil data indicates the following elevated concentrations of determinants locally within discrete areas across Area A.

Table 18: Chemical testing data summary table for combined human health pathways

Determinant	Data set / stratum	GAC* (mg/kg)	Maximum concentration (mg/kg)	
			Value	Location / depth
Lead	Made Ground	310[2)]	520	BH6 (0.30)
			825	PH6 (0.30)
			466	PH8 (0.40)
			1880	PH10 (0.50)
			760	PH4 (0.30)
		200[1)]	303	PH5 (0.40)
			1010	PH9 (0.50)
			564	PH12 (0.50)
			684	PH15 (0.40)
Dibenzo(ah)anthracene	Made Ground	0.32[2)]	0.65	BH6 (0.30)
			4.83	PH8 (0.40)
		0.30[1)]	3.9	PH12 (0.50)
Dibenzo(ah)anthracene	Re-worked Alluvium	0.32[2)]	0.34	BH4 (1.00)
			1.71	BH4 (2.00)
Chrysene	Made Ground	32[2)]	33.5	PH8 (0.40)
Benzo(b)fluoranthene	Made Ground	4.1[2)]	7.67	BH6 (0.30)
			44.49	PH8 (0.40)
	Re-worked Alluvium		19.7	BH4 (2.00)

Determinant	Data set / stratum	GAC* (mg/kg)	Maximum concentration (mg/kg)	
			Value	Location / depth
	Made Ground	3.7[1)]	3.7	PH12 (0.5)
Benzo(a)pyrene	Made Ground	5.3[2)]	36.2	PH8 (0.40)
	Reworked Alluvium		18.8	BH4 (2.00)
	Made Ground	5.0[1)]	29.0	PH8 (0.40)
Benzo(ah)anthracene	Made Ground	15[2)]	39.9	PH8 (0.40)
	Reworked Alluvium		18.5	BH4 (2.00)
	Made Ground	13[1)]	20	PH12 (0.50)
TPH CWG (Aromatic C_{16}-C_{21})	Made Ground	1900[2)]	2030	PH6 (1.3)
Benzene	Made Ground	3.3[2)]	9	PH9 (0.50)
		0.87[1)]	3	PH8 (0.40)

6.2.1.2 Area B (Residential Area In Southern Portion)

Non Targeted Assessment

The non-targeted chemical test results have been compared directly against the residential GACs calculated using the new CLEA software. No contaminants were present at concentrations greater than the calculated GACs, with the exception of WS5 where a single elevated concentration of PAH compound (Dibenzo(ah)anthracene) was recorded locally within the made ground soils. The source of the recorded PAH compounds is most likely associated with the rare ash recorded within the made ground soils at that location and therefore not considered of any significant concern.

6.2.2 Inhalation exposure to asbestos fibres – Linkage 2

The visual inspection at the laboratory identified no materials suspected of potentially containing asbestos. Albeit, the scheduled laboratory screening identified trace asbestos fibres within a number of samples as shown below.

Table 19: Summary of screening results

Sample reference	Asbestos Matrix (microscope)	Asbestos type	Quantification (%w/w)
Area A			
BH6 (0.30m)	Loose fibres	Chrysotile	0.001
BH6 (1.20m)	Loose fibres	Chrysotile	0.001
BH4 (0.50m)	Loose fibres	Chrysotile	0.001
BH4 (1.00m)	Loose fibres	Chrysotile	0.001
BH4 (2.00m)	Loose fibres	Chrysotile & Amosite	0.007
Area B			
WS4 (0.20m)	Loose fibres	Chrysotile	0.001

6.2.3 Inhalation exposure of future residents to contaminants in the vapour phase – Linkage 3

The following lines of evidence have been assessed in respect to the risk from VOC:

- The ground investigation indicated that the underlying made ground largely consists of inert material (i.e. ash, clinker, flint, brick and concrete). Albeit, evidence of potentially mobile/volatile contamination was recorded locally within the made ground in the northern portion of the site (i.e. in the vicinity of the tanks and infilled area). This is supported by high PID readings during (PH1, PH2, PH6, PH13, BH2).
- Sulphurous/solvent odour noted locally within discrete areas of the made ground (PH7, PH9 and BH6);
- Chemical analysis of soil samples identified little or no evidence of significant VOC concentrations (e.g. MTBE – fuel additives, ethylbenze, xylene, tuolene) albeit Benzene was recorded marginally above the assessment criteria locally within the made ground (PH9);
- The groundwater results have generally recorded low concentrations of petroleum hydrocarbons within the perched groundwater at WS5 and BH2;
- Chemical analysis of groundwater samples recovered in close proximity to the tanks (PH2, PH6 and BH2) identified concentrations of Aliphatic C_{12}-C_{16} above the GrAC threshold limits, albeit concentrations have reduced over the years;
- Low emission rates have been recorded during the gas monitoring <0.1l/hr.

6.2.4 Ground gas risk to future residents – Linkage 4

6.2.4.1 Risk assessment

As outlined earlier, CIRIA C665 identifies two types of development, termed Situation A (modified Wilson and Card method), appropriate to all development excluding traditional low-rise construction, and Situation B (National House-Building Council, NHBC) only appropriate to traditional low-rise construction with ventilated sub-floor voids.

Both methods are based on calculations of the limiting borehole gas volume flow for methane and carbon dioxide, renamed as the gas screening value (GSV). The GSV (litres of gas per hour) is calculated by multiplying borehole flow rate (litres per hour) and gas concentration (percent by volume).

It is important to note that the GSV thresholds are guideline values and not absolute. The GSV thresholds may be exceeded in certain circumstances, if the site conceptual model indicates it is safe to do so. Similarly, consideration of additional factors such as very high concentrations of methane, should lead to consideration of the need to adopt a higher risk classification than the GSV threshold indicates.

The site is to be redeveloped with the following:

- **Area A** – Northern/western portion characterised by residential apartment blocks with suspended floors given the made ground;
- **Area A** – central and eastern portion typically comprise conventional low-rise residential development with underfloor sub floor void; and
- **Area B** – Area occupied with conventional low rise residential units with underfloor sub floor void.

In view of the above, the site falls under Situations A and B. The system provides a risk-based approach that is designed to allow an identification of the required gas protection measures by comparing the measured gas emission rates to generic assessment values (based on the development). This includes typical maximum concentrations that are provided for initial screening purposes and risk-based GSVs for situations where the typical maximum concentrations are exceeded. The method uses both gas concentrations and borehole flow rates to define a characteristic situation for a site based on the limiting borehole gas volume flows for methane and carbon dioxide. Having calculated the worst case GSVs for methane and carbon dioxide, the Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

6.2.4.2 Assessment of the existing monitoring data - Area A

Through Area A, a single monitoring well, PH3, has recorded a significantly elevated concentration of methane returning a value of 54.1% v/v. Persistently elevated concentrations of carbon dioxide was recorded within four monitoring wells (BH2, PH2, PH3, PH6 and PH8). This is considered attributable to the presence of made

ground/historical spillages associated with the former fuel tanks. These concentrations are significantly elevated above those identified through the remainder of Area A, where a maximum methane concentration of 0.6% and a maximum carbon dioxide concentration of 1.9% have previously been recorded

Having calculated the worst case GSVs for methane and carbon dioxide, the Characteristic Situation is then determined from Table 8.5 of CIRIA C665.

The results of the assessment above are summarised in **Table 20** and monitoring results included in full in **Appendix E**.

Table 20: Worst Case - GSV calculations

Exploratory Hole ID	No off rounds	Maximum concentration (%)		Maximum flow rate (l/hr)	GSV (l/hr)		Characteristic situation
		CH4	CO2		CH4	CO2	
Situation A							
BH3	1	0	2	<0.1	0	0.2	CS2
BH4	1	0.2	0.5	<0.1	0.02	0.05	CS1
BH6	1	0	3	<0.1	0	0.3	CS1
PH2	3	0.1	19.7	<0.1	0.01	1.97	CS3
PH3	3	54.1	12.5	<0.1	5.41	1.25	CS4
PH6	2	0.1	18	<0.1	0.01	1.8	CS3
PH8	2	0.1	18.7	<0.1	0.01	1.87	CS3
PH10	2	0.6	0.9	<0.1	0.06	0.09	CS2
Situation B							
BH1	1	0	0.1	<0.1	0	0.01	Green
BH2	1	0	7.1	<0.1	0	0.71	Green
PH5	2	0.1	3.9	<0.1	0.01	0.39	Green
PH12	2	0.1	1.9	<0.1	0.01	0.19	Green

6.2.4.3 Assessment of the existing monitoring data - Area B

Through Area B, negligible methane concentration was detected and a maximum concentration of carbon dioxide of 2.5% together with a peak maximum gas flow rate of 0.1/hr has been recorded. Associated with these concentrations, the calculated GSV for methane is 0.00 l/hr and the GSV for carbon dioxide is 0.25 l/hr. Based on the calculated GSVs, the site is characterised as being a Green scenario (Situation B – Low Rise Buildings).

6.2.5 Uptake of contaminants by vegetation potentially inhibiting plant growth – Linkage 5

For this linkage, the results were assessed against the GAC derived from the DoE Code of Practice. The results are summarised in the table below.

Table 21: Summary of soil results with respect to plant phytotoxicity effects

Determinant	Generic assessment criteria (mg/kg)				Concentrations of determinants in excess of assessment value
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0	
Zinc	200	200	200	300	PH6, PH8, PH9, PH10, PH12, PH15, PH16, BH4, PH3 (238 to 1071mg/kg)
Copper	80	100	135	200	PH6, PH8, PH9, PH10, PH12, PH15, PH16, PH3 (328 to 726mg/kg)
Nickel	50	60	75	110	PH15 (110mg/kg)
Lead	300	300	300	300	BH6, PH4, PH5, PH6, PH8, PH9, PH10, PH12, PH15, PH3, PH7 (303 to 1880mg/kg)
Cadmium	3	3	3	3	None observed
Mercury	1	1	1	1	PH4, PH5, PH6, PH9, PH10, PH12, PH13, PH7 (1.07 to 2.46mg/kg)
Note: Only compounds with assessment criteria documented within the Directive 86/278/EEC have been included, although criteria for 5 additional compounds have been presented within the 2006 CoP.					

The results above indicate the potential for plant growth to be affected by the presence of contaminants within the ground.

6.2.6 Impact of organic contaminants on potable water supply pipes – Linkage 6

Since water supply pipes are typically laid at a minimum depth of 750mm below finished ground levels, sample results from depths between 0.50m and 1.5m below existing level were considered for assessing risks to water supply (in accordance with UKWIR Report).

The results of the chemical analysis identified local exceedances within the made ground for SVOC (PAH) and TPH when compared against the threshold limits. As such a relevant linkage may exist and the use of standard poly-ethylene and poly-vinyl chloride pipes are likely to be considered unsuitable.

6.2.7 Leaching of contaminants and migration to groundwater in principal aquifer – Linkage 7

Leachate samples were prepared from representative soil samples of the made ground recovered from the two deep boreholes in the northern section of the site to assess the mobility of contaminants identified. A copy of the chemical test results are presented in **Appendix F**. The results of the leachate analyses have been conservatively compared with the lowest of the water quality target concentrations. Based on the results, concentrations for leachable lead were recorded above the relevant target concentration (1.2µg/l) however the assessment is considered to be very conservative as the target concentration corresponds to the bio-available fraction of the metal. Bio-available metal is not the same metric as dissolved metal as only a fraction of the dissolved metal will usually be bio-available.

Two rounds of groundwater sampling have been undertaken to date (2012 and 2017 RSK), and laboratory results are presented within **Appendix F** and results have been compared against the relevant GAC presented in **Appendix I**. Contaminants of concern recorded beneath both areas (**Area A** and **B**) are principally associated with petroleum hydrocarbons.

When assessing the risks to controlled waters, various assessment criteria apply depending on the nature of the assessment and the conceptual site model. Based on the CSM outlined within the preliminary risk assessment, the appropriate water quality standard against which the analyses should be compared is considered to be UK Drinking Water Standards (DWS) have been used although the values are considered to be very conservative. In the absence of relevant target concentrations, Environmental Quality Standards (EQS) for fresh water (designed to be protective over surface water ecology) was adopted.

Determinants that have exceeded the assessment criteria within samples from the perched groundwater are summarised within **Table 22**.

Table 22: Exceedances against GAC

Determinant	GAC adopted (µg/l)	Exceedances	
		Aug-12	Feb-17
Arsenic	10	-	BH3 (12 µg/l)
Benzo(a)pyrene	0.001	PH2 (0.004 µg/l)	-
Total petroleum hydrocarbons	10	PH2 (3793 µg/l) PH6 (2927 µg/l)	BH1 (16 µg/l) BH2 (392 µg/l)

Notes: UK EQS for protection of aquatic life has been adopted for cyanide, represents annual average for surface waters. Ammoniacal Nitrogen assessment criterion is based on the River Basins District Typology for Ammonia, represents annual mean for freshwaters.

Detectable concentrations of metals were recorded however these are below the prescribed target values. Albeit, arsenic a single elevated concentration of arsenic (12 µg/l) is present within the ground water beneath the northern-west area of the site. Given that

BH3 is located hydraulically up gradient, it is likely indicative of an off-site source. Furthermore, the exceedance is marginal and therefore not considered to pose an unacceptable risk to groundwater quality.

The results further indicated elevated concentrations of hydrocarbons above the assessment criteria within a number of samples. The highest concentrations were recorded at PH2 and PH6, which corresponds to the hydrocarbon-impacted soils noted during the ground investigation. The results therefore suggest migration of dissolved phase hydrocarbons into the perched water within the made ground. Marginally concentrations were observed within the Secondary A aquifer within the Taplow Gravel (BH1).

6.3 Environmental assessment conclusions and recommendations

The site investigation findings and CSM, indicate that there is evidence of ground contamination and potential pollutant linkages on the site in relation to the proposed end-use. In summary this has included:

6.3.1 Summary of results with respect to human health via direct contact

- Through Area A, widespread Lead and Dibenzo(ah)anthracene soil bound contamination was identified within the made ground with the potential to pose an unacceptable risk;
- Localised elevated concentrations of Lead and PAH compounds were recorded within the made ground notably in the northern portions of the site (i.e. in the vicinity of the potential areas of concerns);
- Elevated petroleum hydrocarbon concentrations were identified locally within the made ground, with concentrations up to 13,100mg/kg. Where speciated results are available, these indicate that the elevated concentrations are generally associated with the heavier chain hydrocarbons range carbon banding. A representative sample was further analysed into aliphatic and aromatic fractions. The results recorded above the threshold limit for C12-C21 (aliphatic and aromatic);
- Exceedance of the theoretical soil saturation limit has been identified within the aliphatic fractions C10-C12 and C12-C16, which indicates the potential presence of freephase product within the unsaturated zone. Review of the field records concludes that staining (including a strong odour) was noted in a number of exploratory holes notably in the vicinity of the former tanks, however this is unlikely to be indicative of the presence of significant free-phase product. No Light Non Aqueous Phase Liquids (LNAPLs) was recorded during the course of the investigations.

6.3.2 Summary of results with respect to human health via inhalation of asbestos

- Loose asbestos fibres typically comprising of amosite and chrysotile were recorded locally within the made ground through Areas A and B;
- The results of our assessment indicate the following:

- The concentration of asbestos in soil is very low (less <0.007%);
- the soil type is predominantly granular with a high organic matter (upto 35%) which has a lower fibre release potential;
- The surface cover in the proposed development is to include gardens (soft landscaping, lawns, beds etc…), hard-standing (driveways, patios, decking etc…); and
- Future disturbance is likely to be limited to gardening activities which may include planting of large plants, landscaping and digging.

On the basis of the above the risk to future residents associated with asbestos is considered to be very low. It should however be noted that the ground conditions comprise a heterogenous Made Ground material and there is a potential that further asbestos will be encountered during more extensive groundworks..

6.3.3 Summary of results with respect to human health via vapour exposure

- The PID screening of samples identified the potential presence of volatiles within the made ground. The presence of light aliphatic fraction (C12-C16) with the potential to pose a risk was evident locally within ground water samples recovered from BH1 and BH2.

6.3.4 Summary of results with respect to human health via ground gas asphyxiation and explosion

- Elevated concentrations of methane (%v/v) was detected locally within PH2 and elevated concentrations of carbon dioxide (%v/v) recorded locally within PH2, PH3, PH6, PH8 and BH2 – all in Area A;
- Based on the GSVs, Area A (northern and western portion of the site) has been characterised by CS4 (Situation A) for which gas protection measures are necessary. This is most likely contributed by the potential presence of vapours.

6.3.5 Summary of soil results with respect to plant phytotoxicity effects

- Elevated concentrations of metals (copper, zinc, lead, mercury and nickel) with regards to plant phytotoxicity effects;
- It is considered unlikely that the made ground material are conducive to plant growth.

6.3.6 Summary of soil results with respect to performance of building materials

- Since water supply pipes are typically laid at a minimum depth of 750mm below finished ground levels, sample results from depths between 0.5m and 1.5m below current levels were considered for assessing risks to water supply;

- Laboratory results have been assessed and localised exceedances of the threshold values for PE and PVC pipes have been identified with respect, TPH fractions and SVOCs.

6.3.7 Summary of results with respect to controlled waters

- Detectable concentrations of PAH compounds including naphthalene although below guideline values; and
- Elevated concentrations of Benzene(a)pyrene and total petroleum hydrocarbons have been detected which correspond to the hydrocarbon impacted areas to the north and in the fill material.

6.3.8 Alleviation measures

Owing to the nature of this exploratory investigation, sufficient information is not available to determine fully the necessary alleviation measures to render the site fit for the purpose of the proposed development. However, at this stage, remedial works appear likely to be required - notably in the northern portion of the site, where hydrocarbon impacted soils are locally impacting the groundwater quality. This will generally involve the following points listed below in **Table 23**.

Table 23: Outline of Recommended Contamination Alleviation Measures

Potential Alleviation Measures	Area(s) of Site Likely to be Affected		Development Considerations
	Whole Site	Targeted Areas	
Removal of fuel storage tank located in the northern portion of the site		✔	Fuel/oil storage should be carefully emptied, "inerted" and removed off site in accordance with best industry practice with any hydrocarbon impacted soil to a suitably licensed waste management facility. The resulting remedial excavation will have to be validated by the Environmental Consultant prior to backfilling with 'clean' material.
Point source contamination (as per **Figure 6**).		✔	Removal of impacted in and around PH4, PH5, PH6, PH10, P12, P15, BH4 and BH6. Validate soils to ensure any additional potentially impacted soils are removed. Dispose as hazardous waste. An allowance should be made for approximate volumes ranging between 150 and 250m^3 to be removed off site.

Potential Alleviation Measures	Area(s) of Site Likely to be Affected		Development Considerations
	Whole Site	Targeted Areas	
Specialist demolition	✔		Prior to demolition of the existing buildings units it is recommended that a hazardous materials survey is carried out and all necessary measures stemming from the survey implemented.
Remove/seal existing drains/services	✔		To close off any existing drains/services ducts that could provide a pathway for contaminant migration
Provision of clean soil cover for all soft landscaped areas	✔		In soft landscaped areas provide a clean capping layer. Dependent on the proposed finished levels, this may involve the excavation and removal of some or all of the Made Ground. Elevated concentrations of metals, PAHs and asbestos fibres were recorded in a number of exploratory points that may pose an unacceptable risk to vegetation and human health. Contamination may however, be isolated below a suitable thickness of subsoil and topsoil cover (600mm in private gardens and 450mm in communal soft landscaped areas recommended), which will also provide a suitable growing medium. A non-woven hi-vis geo-textile membrane should be incorporated to separate the imported clean cover horizon with any residual made ground.
Use only validated sources of imported materials for clean soil cover.	✔		Proposed imported materials from each individual source should be validated with appropriate chemical test certificates and approved in advance of materials being delivered to site.
Selection of appropriate materials for buried water pipes in contact with the made ground.	✔		Where passing through potentially contaminated ground, buried services should be placed in a service corridor and surrounded with clean uncontaminated material. Alternatively adopting a barrier pipe to mitigate the potential risk.
Vapour membrane for residential apartment blocks in Area A		✔	Incorporation of passive sub floor void and VOC/hydrocarbon membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation.

Notwithstanding the alleviation measures detailed above, which are likely to be required within the proposed residential development, data gaps remain, which will require further assessment to fully establish the potential pollutant linkages requiring mitigation, the further assessment will include the following:

- Increased frequency of soil sampling to allow statistical assessment to be conducted;
- Increased frequency of sampling/testing for asbestos containing materials;
- Increased sampling within the previously inaccessible areas of the site;
- Additional monitoring of groundwater quality to provide additional confidence with the dataset;
- Additional ground gas monitoring events to fully establish the ground gas regime beneath the site;
- Soil vapour assessment in areas in close proximity to the former tanks.

Of particular concern is the remaining uncertainty regarding the potential presence of asbestos fibres, which have currently been recorded within 30% of the samples tested. Additional sampling/testing is considered essential to determine the implications for the health and safety of construction workers, waste classification and scope of remediation to protect the health of future residents.

It is possible that the works may reveal different conditions from those revealed by the site investigation i.e. beneath building not previously assessed. If suspect materials are encountered during site development, works should cease in the affected area. The area should then be suitably cordoned off pending sampling and analysis of any suspect materials by an environmental consultant.

Should sampling and analysis of any suspect materials reveal the presence of significant notifiable asbestos containing materials, such as lagging or fibreboard, then the continuation of works may require the use of licensed asbestos contactors to handle the materials. In this instance the HSE would need to be notified of the works via the submission of an ASB5 notification. To reduce the risk of such an eventuality, it is therefore considered essential to undertake further testing on site prior to commencing construction works. This would help to either prove the absence of more onerous ground conditions or, conversely reveal their presence at an early stage, allowing appropriate methodologies to be adopted prior to commencing construction works.

7 REUSE OF MATERIALS AND WASTE

7.1 Reuse of suitable materials

Under the Waste Framework Directive naturally occurring soils are not considered waste if re-used on the site of origin for the purposes of development.

In accordance with the definition provided in the Waste Framework Directive, materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Thus, soils that are not of clean and natural origin, i.e. made ground (whether contaminated or not) and other materials such as recycled aggregate, do not become waste until the aforementioned criteria are met.

The Definition of Waste: Development Industry Code of Practice (CL:AIRE, 2011) (CoP) was developed in consultation with the Environment Agency and development industry to enable the re-use of materials under certain scenarios and subject to demonstrating that specific criteria are met. The current re-use scenarios covered by the CoP comprise:

- Re-use on the site of origin (with or without treatment)
- Direct transfer of clean and natural soils between sites
- Use in the development of land other than the site of origin following treatment at an authorised Hub site (including a fixed Soil Treatment Facility).

The importation of made ground soils (irrespective of contamination status) or crushed demolition materials is not currently permitted under the CoP and requires either a standard rules environmental permit or a U1 waste exemption (see below).

In the context of excavated materials used on sites undergoing development, four factors are considered to be of particular relevance in determining if the material is a waste or when it ceases to be waste:

- the aim of the Waste Framework Directive is not undermined, i.e. if the use of the material will create an unacceptable risk of pollution of the environment or harm to human health it is likely to be waste
- the material is certain to be used
- the material is suitable for use both chemically and geotechnically
- only the required quantity of material will be used.

The CoP requires the preparation of a materials management plan (MMP) that confirms the above factors will be met. This plan needs to be reviewed by a 'Qualified Person' (QP) who will then issue a declaration form to the EA. As the project progresses, data must be collated and on completion a verification report produced that shows the MMP was followed and describes any changes.

The MMP establishes whether specific materials are classified as waste and how excavated materials will be treated and/or re-used in line with the CoP. The MMP is likely to form part of the site waste management plan.

The site has been developed previously and the investigation has confirmed the presence of made ground. Therefore, before any excavation works begin on-site, an MMP will need to be prepared, reviewed by a QP; and a Declaration lodged with the EA.

As noted above, under the Waste Framework Directive naturally occurring soils are not considered waste and therefore arisings of clean natural soils, e.g. from foundation and drainage excavations, may be re-used on the site. However, it is important that these soils should be stockpiled separately and not become cross-contaminated with made ground / contaminated soils or construction wastes.

If it is proposed to import clean and naturally occurring soils direct from another site, the receiving site's MMP would need to be updated in advance of importation.

7.2 Treatment to meet suitable-for-use criteria

Where materials do not meet the suitable for use criteria it may be possible to treat them under an environmental permit (mobile treatment licence) to enable them to be reused onsite.

To enable the treatment options to be determined, an options appraisal and a remediation strategy document will be necessary to support discussion of the issues with regulators and third parties.

7.3 Reuse of waste materials

If material is discarded as waste then its reuse on site may still be possible. Waste soils and recycled aggregate can be reused on site under a standard rules environmental permit or a U1 waste exemption from the Environmental Permitting (England and Wales) Regulations 2010 provided that they are suitable for the proposed use, i.e. not cause harm to human health or the environment. However, it should be noted that these have strict limits on the quantity of material that can be reused.

7.4 Wastes for landfill disposal

Wastes require pre-treatment prior to disposal at landfill. Pre-treatment must be a physical, thermal, chemical or biological process (including sorting) that changes the characteristics of the waste to reduce its volume, reduce its hazardous nature, facilitate its handling and enhance its recovery.

The latest, edition of the EA's 'Technical Guidance WM3' (2015) Guidance on the classification and assessment of waste, requires that within a mixed waste* the separately identifiable wastes are assessed separately. Mixing of different types of hazardous waste

and hazardous waste with other waste substances is prohibited under the Waste Framework Directive. Wastes that have been mixed must be separated whenever possible.

It is best practice to provide your waste carrier (or the disposal site) with details of how the waste has been treated. Your waste carrier may provide a pre-treatment confirmation form or space on the waste transfer note to detail the pre-treatment.

The classification of waste soil is carried out on a tiered approach. The initial stage being an assessment of whether the soil is considered hazardous or not following the guidance within Technical Guidance WM3.

7.4.1 Preliminary waste assessment

Given the level of data obtained, scale of the development and heterogeneity of the site soils the following assessment should be considered indicative and further assessment should be undertaken following the preparation of a Waste Sampling Plan. Envirolab (an RSK company) has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool for potential off-site disposal of materials in the future. A summary of those samples provisionally characterised as hazardous contained in **Table 24**.

Table 24: Results of waste soils characterisation assessment (HASWASTE)- Hazardous soils

Sample	Strata	Hazardous properties	Contaminant driving the assessment
BH6 (0.30)	Made ground typically comprising highly organic gravelly sandy SILT with ash clinker brick glass and sulphurous odour.	HP7 (carcinogenic) and HP11 (mutagenic)	TPH
PH1 (1.30)	MADE GROUND: black sandy matrix with wood, organic matter, ceramic tile, glass, flint and occasional brick. Moderate to strong hydrocarbon odour/ stain noted.	HP7 (carcinogenic) and HP11 (mutagenic	TPH
PH6 (1.30)		HP7 (carcinogenic) and HP11 (mutagenic	TPH
PH8 (0.40)	MADE GROUND: brown black silty sandy matrix with flint, ash, charcoal, ceramic and occasional brick, glass and organic matter	HP7 (carcinogenic) and HP14 Ecotoxic	PAH compounds, Lead and TPH
PH9 (0.50)			
PH10 (0.50)			

From the above it can be seen that several samples of the made ground soils analysed are anticipated to be classified as hazardous waste. These included samples retrieved from

made ground from the northern portion of the site the assessment for which is being driven by the presence of significantly elevated concentrations of Lead, TPH, PAH compounds.

The remainder of the samples assessed using HASWASTE have been shown not to be hazardous soils, and may comprise either non-hazardous or inert materials. Where samples have been classified as 'not-hazardous' WAC testing would be required to determine whether waste might be classified as inert or non hazardous.

With respect to asbestos, the latest, edition of Technical Guidance WM3, requires that within a mixed waste the separately identifiable wastes be assessed separately. For instance where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately.

Where samples have been analysed for asbestos, laboratory testing has confirmed the presence of asbestos containing materials in a total of six soil samples, albeit not as visually identifiable fragments. Where samples have been analysed for their percentage asbestos fibres by weight, the results are generally all below the hazardous waste threshold limit of 0.1% and therefore waste soils would be suitable for disposal to a non hazardous waste landfill (assuming the wastes are not classified as hazardous for other determinants).

7.4.2 Waste acceptance criteria

All inert, stable non-reactive hazardous and hazardous wastes have limit values (waste acceptance criteria) set out in legislation that must be met before that class of landfill can accept the waste. Currently, no WAC are in place for non-hazardous waste.

Soil and other materials that are found not to be hazardous may be classified as either non hazardous or inert. In order to determine whether they can be classed as inert the soil must be tested and found to be below the inert waste acceptance criteria.

The EA sets specific limits for a sub-set of the components that the waste producer must consider in characterising the material. These limits are independent of the test data used to determine if a waste is hazardous or nonhazardous. The WAC limits are based on:

- Total concentration limits for the organic components and pH;
- Leachable components.

Three WAC tests were undertaken (BH4, BH6 and WS2) to further assess the made ground. The results identified concentrations of total organic carbon and loss of ignition above the hazardous threshold limits. As such, the material will require disposal as hazardous.

Notwithstanding the above, it is important to note that this initial assessment given in this report is for guidance only and it is always necessary to confirm the actual classification with prospective landfill operators prior to disposal.

7.5 Landfill tax

Waste producers disposing of material to landfill are required to pay landfill tax by HM Revenue and Customs.

The tax is chargeable by weight (tonnage) and two rates apply, either standard or lower rate. The lower rate only applies to those less polluting wastes as set out in the Landfill Tax (Qualifying Material) Order 2011, which include naturally occurring rock and soil, concrete, some minerals, some furnace slags and ash, and some low-activity organic compounds. Evidence confirming that the waste qualifies for the lower rate will be required, and standard rate tax will apply for the whole waste load for any loads of mixed waste.

Currently (since 1st April 2016), standard rate landfill tax is £84.40 per tonne.

The lower rate of landfill tax applicable to less polluting wastes (i.e. 'inert' wastes) remains at £2.60 per tonne.

Material disposed of at a soil treatment centre will not be subject to landfill tax.

7.6 Groundwater

When there is an intention to discard groundwater, chemical test results will indicate the appropriate disposal options. This could include disposal to treatment facility, via consent (issued by the water authority) to foul sewer or via consent (issued by the EA) to a watercourse or land.

7.7 Recommendations

RSK recommends that consideration as to how potentially waste soils will be dealt with as part of this development/remediation is given as early in the project planning process as possible. Such planning can lead to cost savings where potentially waste soils are viewed as a resource and retained on-site as part of the development. We also recommend, where off-site disposal is being considered, that appropriate facilities are identified and discussions initiated to confirm suitability of the facility to take the material. Potentially, these may include soil treatment facilities as well as landfills.

RSK can provide specialist advice to assist in this process, which can be complex and subject to regular regulatory change.

Technical Guidance WM3 further sets out requirements for waste sampling to accurately characterise the material designated for off site disposal. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. At this stage RSK consider that the level of soil sampling carried out to date is sufficient to provide a preliminary assessment however additional sampling is recommended for additional confidence with the data set.

8 GEOTECHNICAL SITE ASSESSMENT

8.1 Engineering considerations

It is understood that consideration is being given to the construction of residential apartment blocks to the north and west of the site, while the central, eastern and southern portion typically comprise low-rise residential units. The development scheme further includes associated amenity space, private gardens and road infrastructure. At the time of reporting, no indicative loadings for the proposed structure were available, although it is considered that a maximum line load of 100kN/m is envisaged.

8.2 Geotechnical hazards

A summary of commonly occurring geotechnical hazards are given in **Table 25** together with an assessment of whether the site may be affected by each of the stated hazards.

Table 25: Summary of main potential geotechnical hazards that may affect site

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Lateral changes in ground conditions	√	Geological drift boundary (Alluvium/Taplow Gravel) and variable depth of made ground		Likely to affect ground engineering and foundation design and construction
Shrinkable clay soils	√	Medium to high volume change potential		Design to NHBC Standards Chapter 4 or similar
Highly compressible and low bearing capacity soils, (including peat and soft clay)	√	Soft clays present within a number of exploratory points.		Likely to affect ground engineering and foundation design and construction
Silt-rich soils susceptible to rapid loss of strength in wet conditions	√	Variable silt content of the underlying Alluvium and weathered surface of the white chalk		Likely to affect ground engineering and foundation design and construction
Running sand at and		√ Potential		Likely to affect ground

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
below water table		exists within the saturated granular soils		engineering and foundation design and construction
High groundwater table (including waterlogged ground)	√	Area A – ranging between 0.13m and 1.68m bgl Area B – ranging between 2.21m and 3.19m bgl		May affect temporary and permanent works
Underground mining			√	Likely to require special stabilisation measures
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures)	√	Foundations to existing buildings		Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)	√	Maximum depth of made ground proven to 5m in the northern portion of the site (Area A)		Likely to affect ground engineering and foundation design and construction
Note: Seismicity is not included in the above table as this is not normally a design consideration in the UK.				

8.3 Foundations

8.3.1 General suitability

Ground conditions on site have been found to be laterally variable owing to the presence of a geological drift boundary running across the site and the variable thickness of made ground trending from north to south. In the northern/eastern/western margins of the site, soft Alluvial deposits are present including extensive made ground (2.20m – 5m), which will preclude the use of conventional spread foundations. Alternatively, piled foundations could be adopted end bearing into the underlying Taplow Gravel / White Chalk. The White Chalk was encountered beneath the superficial drift soils, extending beyond the terminal depth of this investigation. The surface of the White Chalk was highly weathered and recovered as a Grade Dm (matrix dominated) chalk, grading into a Grade Dc (clast dominated) chalk below approximate depths between 6.50 to 11.00m.

There ere are parts of the site where the investigation has typically encountered Taplow Gravel beneath a variable cover of made ground at depths of <1.50m. These gravels appear suitable to allow for the conventional spread foundations to be placed upon them, however on a elatively small site it may not be cost effective to design and construct with two different foundation systems, especially given the extent of the lateral and vertical variability of the ground which has not been fully characterised by this ground investigation. We therefore recommend that piles are adopted for the whole of the site at this stage..

8.3.2 Piled Foundations

Recommendations for the design and construction of pile foundations in relation to the ground conditions are set out in **Table 26**.

Table 26: Design and construction of piled foundations

Design/construction considerations	Design/construction recommendations
Pile type & constraints	The construction of bored, CFA and driven piles are considered technically feasible, although the following points will need to be considered: • Driven piles may not be suitable from an environmental viewpoint where there is a risk of driving contaminated made ground soils below the groundwater table. • Driven piles may not be acceptable due to vibration and noise related problems. • Driven piles may reach premature 'set' in 'very dense' Taplow Gravel. • Continuous Helical Displacement piles (CHD) may provide a suitable alternative to driven piles in such circumstances. • Driven and CHD piles would have the benefit of not producing excess spoil. CFA piling is often the preferred technique on contaminated sites where controlled waters may be at risk.
Temporary casing	Given the presence of groundwater at relatively shallow depth within the Taplow Gravel and the Seaford Chal Formation, bored piles will require temporary casing throughout their depth. Alternatively, the use of continuous-flight-auger (CFA) injected bored piles usually overcomes this issue.
Hard strata	An allowance should be made for the presence of hard flint bands within the White Chalk
Man-made obstructions	Any buried sub-structures or other obstructions within made ground may lead to some difficulty during piling. It is recommended that once the proposed pile layout has been determined, pre-pile probing be carried out at each of the pile positions. Where buried obstructions are encountered, it will be necessary to either relocate the pile(s) or make allowance for removing the obstruction.

Design/construction considerations	Design/construction recommendations	
Contribution of made ground and drift deposits	For the purpose of assessing preliminary pile capacities the made ground and soft/compressible superficial deposits in the initial 5mbgl have been presumed not to contribute to the load-carrying capacity for the piles.	
Special precautions relating to bored pile shafts and bases	Bored pile concrete should be cast as soon after completion of boring as possible and in any event the same day as boring. Prior to casting the base of the pile bore should be clean, otherwise a reduced safe working load will be required. Similarly, if the pile bore is left open the shaft walls may relax/soften, leading to a reduced safe working load. Piling works should be carefully monitored for the potential presence of chalk solution features and appropriate advice sort if suspect conditions are encountered.	
Pile	Pile design parameter	CFA
Pile design parameters for granular deposits	Shaft Resistance (τ_{sf})	0.28
Soil and pile design parameters for White Chalk Deposits	Base Resistance	$0.8\sigma_v$' for SPT 'N' > 10
		Q = 200 N, limited to: Q_{all} = 600 – 800 kN/m^2 for SPT 'N' < 25 Q_{all} = 1000 – 1800 kN/m^2 for SPT 'N' > 25
General parameters	Factor of safety	2.5
	Limiting concrete stress	7.5N/mm^2
	Limiting shaft friction stress	110kN/m^2

The design procedure for piles varies considerably, depending on the proposed type of pile. However, for illustrative purposes **Table 27** gives likely working pile loads for traditional bored, cast-in-situ concrete piles of various diameters and lengths, based on the design parameters given in **Table 26**. For this purpose the soil profile in BH6 has been considered.

Table 27: Illustration of typical pile working loads for compression piles

Typical pile working loads (kN)			
Length of pile below ground level	Pile diameter		
	300mm	350mm	450mm
10	84	102	143
11	120	144	197
12	159	190	255
13	200	238	317
14	241	286	379

Typical pile working loads (kN)			
Length of pile below ground level	Pile diameter		
	300mm	350mm	450mm
15	283	335	442

It should be stressed that the above capacities do not take into consideration pile group effects, which is more pronounced for a large number of closely spaced piles.

Given the site is underlain with aquifers and the presence of contamination, it is recommended that a foundation works risk assessment is carried out.

8.3.3 Ground Improvement

Subject to consultation with a specialist contractor, consideration may be given to ground improvement, with particular reference to vibration techniques (i.e. vibro-stone columns) and improvement by admixtures (soil dry mixing). It should be noted that the high ground water and soft clays may preclude this option once a specialist contractor has assessed all the information.

8.3.4 Floor slabs

Suspended floor slabs will be required where the thickness of made ground exceeds 0.6m and where the new buildings overlap the footprints of the demolished buildings, as specified in the NHBC Standards Chapter 5.2, Suspended Ground Floors. It is therefore recommended that suspended floor slabs be adopted throughout.

8.3.5 Pavement construction

Field observations indicate that the formation subsoils are likely to comprise silty sand or in made ground (noted to be of variable composition). The engineering characteristics of such material are unpredictable and the CBR value of made ground does not predict overall settlements that may occur.

Due to the variability of the made ground (and that levels may change as part of the development), it would be prudent at this stage, to allow for a CBR value of 2 to 5% for initial design purposes.

To provide a more thorough assessment of CBR, it is recommended that in-situ testing be carried out once the road layout and pavement scheme including proposed reduced levels have been agreed.

It is recommended that all pockets of soft or loose material at formation level should be removed and replaced with well-compacted granular material. All formations should be compacted to make good any disturbance caused by excavation. It is recommended that the formation be not exposed for any period of time during inclement weather.

8.3.6 Soakaways

Based on ground conditions revealed during the site investigation, it is considered that soakaways will not prove suitable on the site. This recommendation is taken with view to the shallow groundwater level and depth of Made Ground (and in some areas contamination) underlying the site.

It is stressed that no infiltration tests (in accordance with BRE 365) have been performed to confirm this preliminary assessment and the actual infiltration characteristics of the sub soils.

8.3.7 Chemical attack on buried concrete

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance. For the purposes of this assessment of the aggressive chemical environment, the site should be considered as a site that has been subject to previous industrial development and does not contain pyrite. A suite of chemical analyses appropriate to this site classification was carried on 6No. soil samples to a maximum depth of 4.0mbgl. The results of these analyses are given in Appendix I.

The maximum water-soluble sulphate content in soil of 505mg/l has been taken as the characteristic value. As this value is below the limiting value of 3.7g/l consideration of magnesium is not required. Based on Table C2 in the guidance, result one for Design Sulphate Class for the site is DS-2.

Based on the permeable soil horizons encountered during the investigation it has been assumed that groundwater conditions are mobile. From consideration of the characteristic pH value, an Aggressive Chemical Environment for Concrete classification of AC-2 may be assumed for design purposes.

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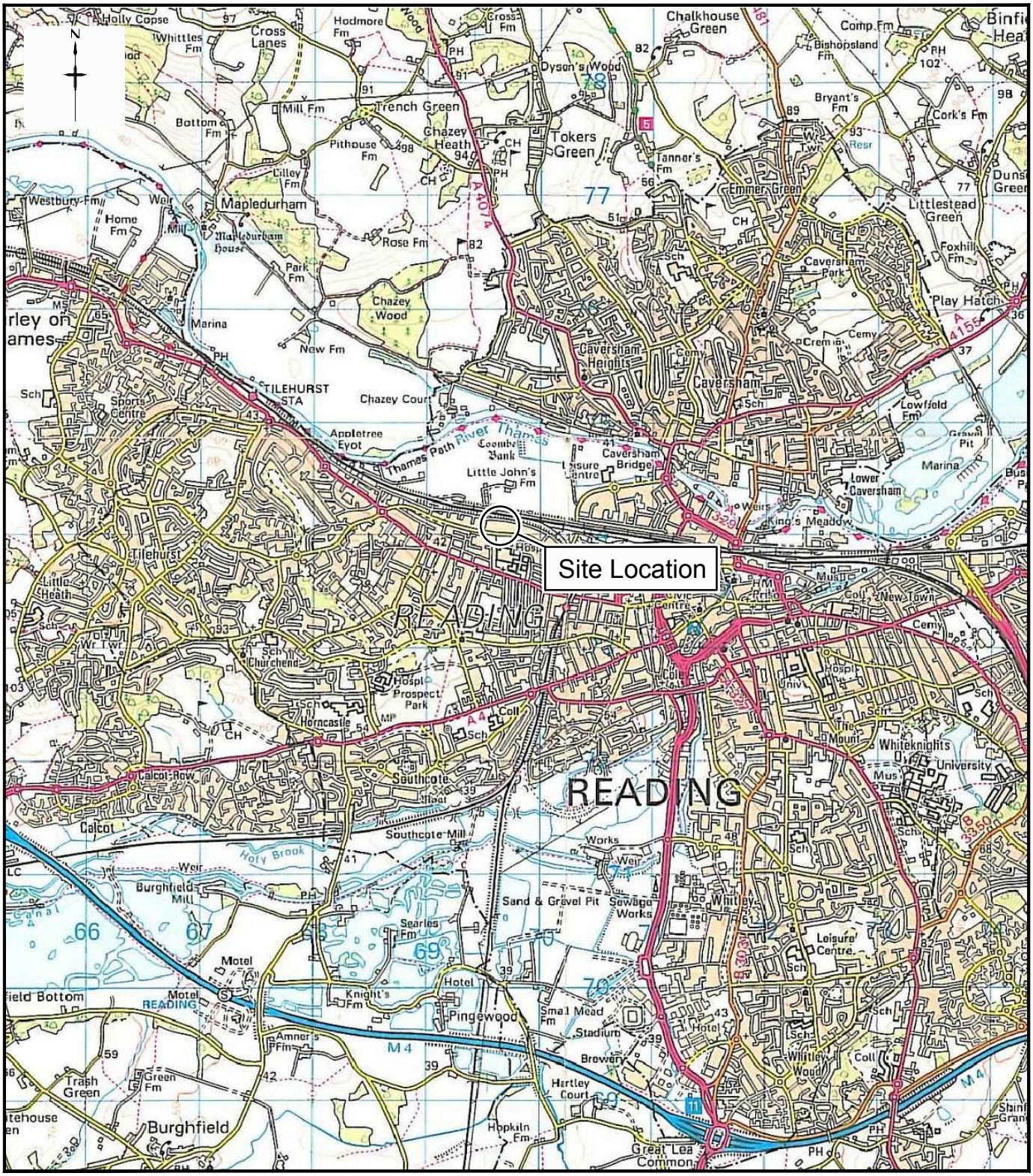
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FIGURES



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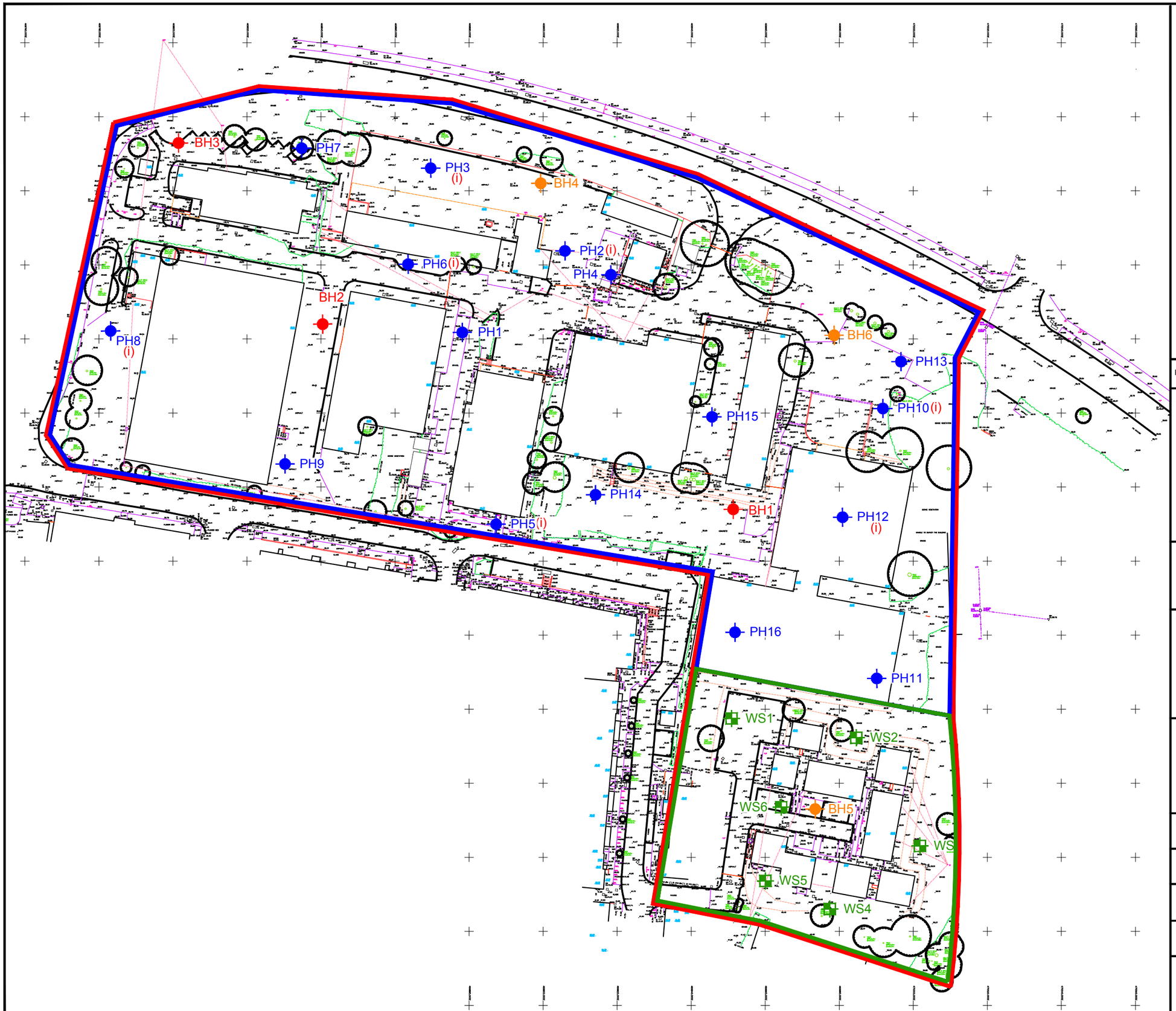
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Project Title: FORMER BATTLE HOSPITAL PORTMAN ROAD, READING

Drawing Title: SITE LOCATION MAP

Rev	Drawn	Date	Checked	Date	Approved	Date
P1	ASC	07.03.17	GW	07.03.17	GW	07.03.17

Dimensions	Scale	Original Size	Project Number	Drawing File	Drawing Number
m	1:50,000	A4	28916 - R01 (00)	28916 - SLP.dwg	FIGURE 1



LEGEND

- Site Boundary
- Zone A
- Zone B
- Borehole Location *(RSK, 2012)*
- Probehole Location *(RSK, 2012)*
- Cable Percussive Borehole Location *(RSK, 2017)*
- (i) Previous Installation Location
- Window Sample Location

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

RSK

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HP3 9RT
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Tel: +44 (0) 1442 437500
Fax: +44 (0) 1442 437550
Email: info@rsk.co.uk
Web: www.rsk.co.uk

Client

BELLWAY HOME LTD

Project Title

FORMER BATTLE HOSPITAL SITE, READING

Drawing Title

EXPLORATORY HOLE LOCATION PLAN

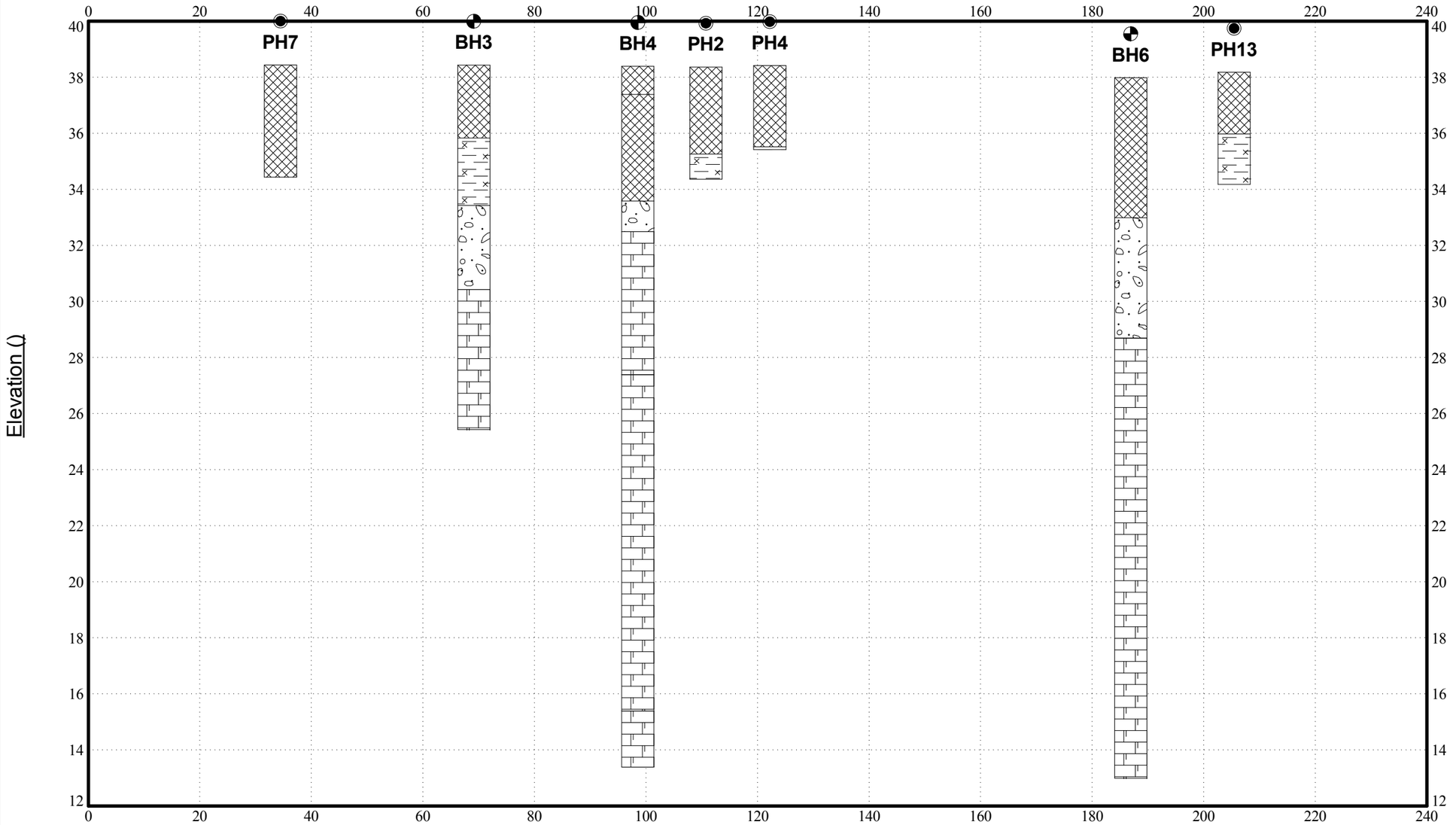
Drawn	Date	Checked	Date	Approved	Date
ASC	07.03.17	GW	07.03.17	GW	07.03.17

Scale	Orig Size	Dimensions
1:1000	A3	m

Project No.	Drawing File
28916 - R01 (00)	28916 (R01-00) Fig 2.dwg

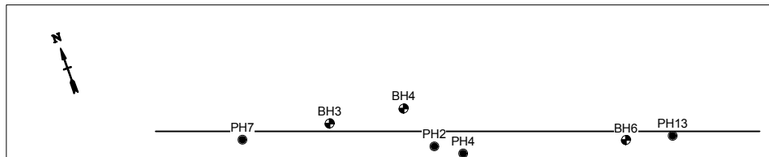
Drawing No.	Rev.
FIGURE 2	P1

SUBSURFACE SECTION DIAGRAM



Distance along the baseline (m)

SITEMAP AND SECTION BASELINE



MATERIAL LEGENDS

Sandy GRAVEL | Silty CLAY | MADE GROUND | CHALK

HOLE TYPE MARKER LEGENDS:

◕ = ???
◉ = ???

REV.	DATE	DESCRIPTION	BY	CHD.	APR.

Dimensions	Scale
m	Scale X = 1:828 Scale Y = 1:165

RSK Environment Ltd
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

CLIENT: **Bellway Homes**

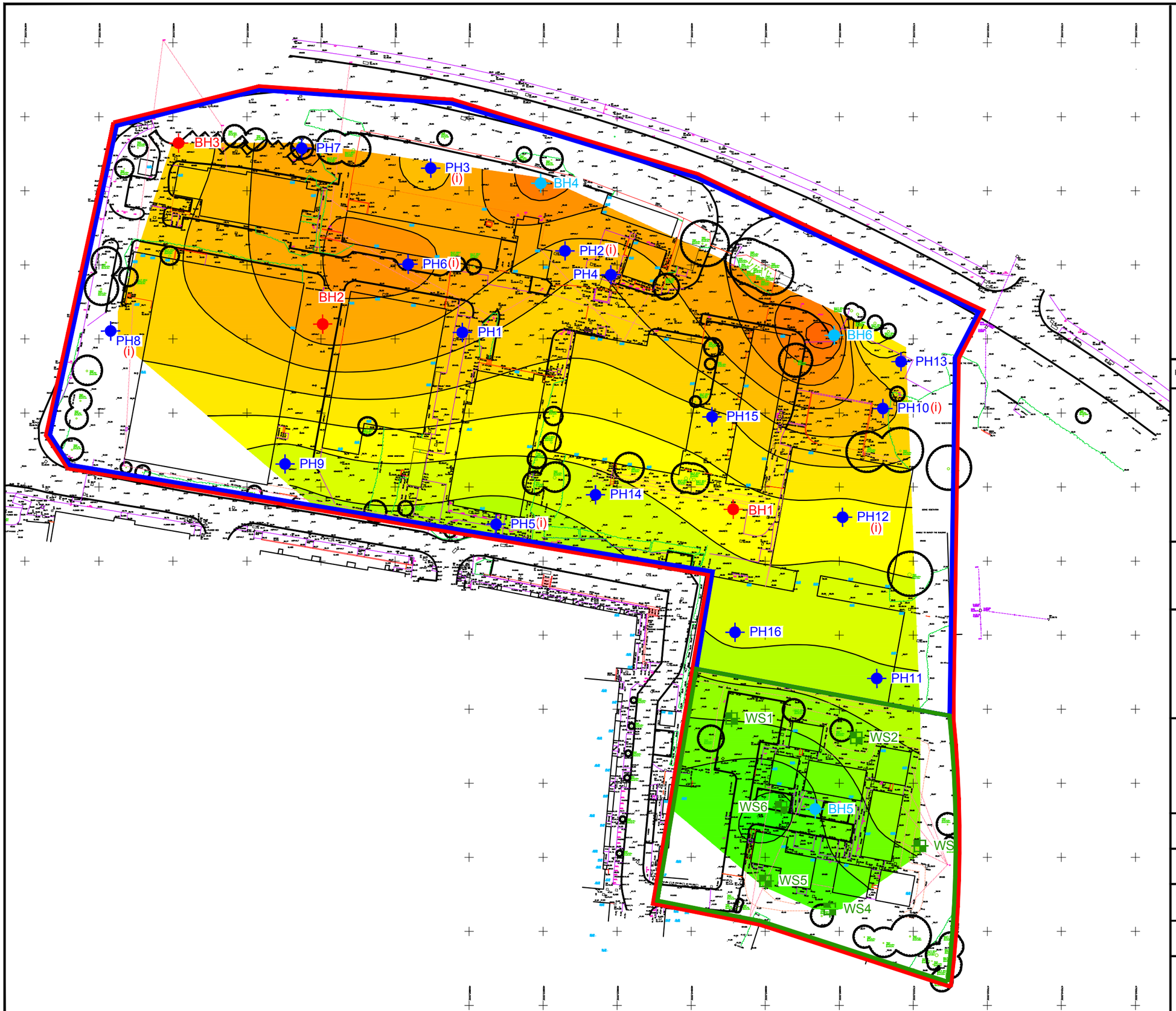
PROJECT: **Battle Hospital**

TITLE: **Geological Cross Section**

CONTRACT REF:	DRAWING REF:
28916	of

DRAWING STATUS:	FIGURE
	Figure 4

DRAWING TRACK CODE: GINT_LIBRARY_V8_06.GLB : STANDARD : A3 : LANDSCAPE : ELEV : 28916_BATTLE HOSPITAL READING.GPJ : 21/03/17 11:53 : ZH1 :



LEGEND

- Site Boundary
- Zone A
- Zone B
- Borehole Location *(RSK, 2012)*
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- Cable Percussive Borehole Location *(RSK, 2017)*
- (i) Previous Installation Location
- Window Sample Location

Rev.	Date	Amendment	Drawn	Chkd.	Appd.

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Client

BELLWAY HOME LTD

Project Title

FORMER BATTLE HOSPITAL SITE, READING

Drawing Title

MADE GROUND CONTOUR PLOT (MARCH 2017)

Drawn	Date	Checked	Date	Approved	Date
ASC	21.03.17	ZH	21.03.17	ZH	21.03.17

Scale	Orig Size	Dimensions
1:1000	A3	m

Project No.	Drawing File
28916 - R01 (00)	28916 (R01-00) Fig 5.dwg

Drawing No.	Rev.
FIGURE 5	P1

Scale

0 10 20 30 40 50m

]

PH7 (made ground) – lead and Dibenzo(ah)anthracene

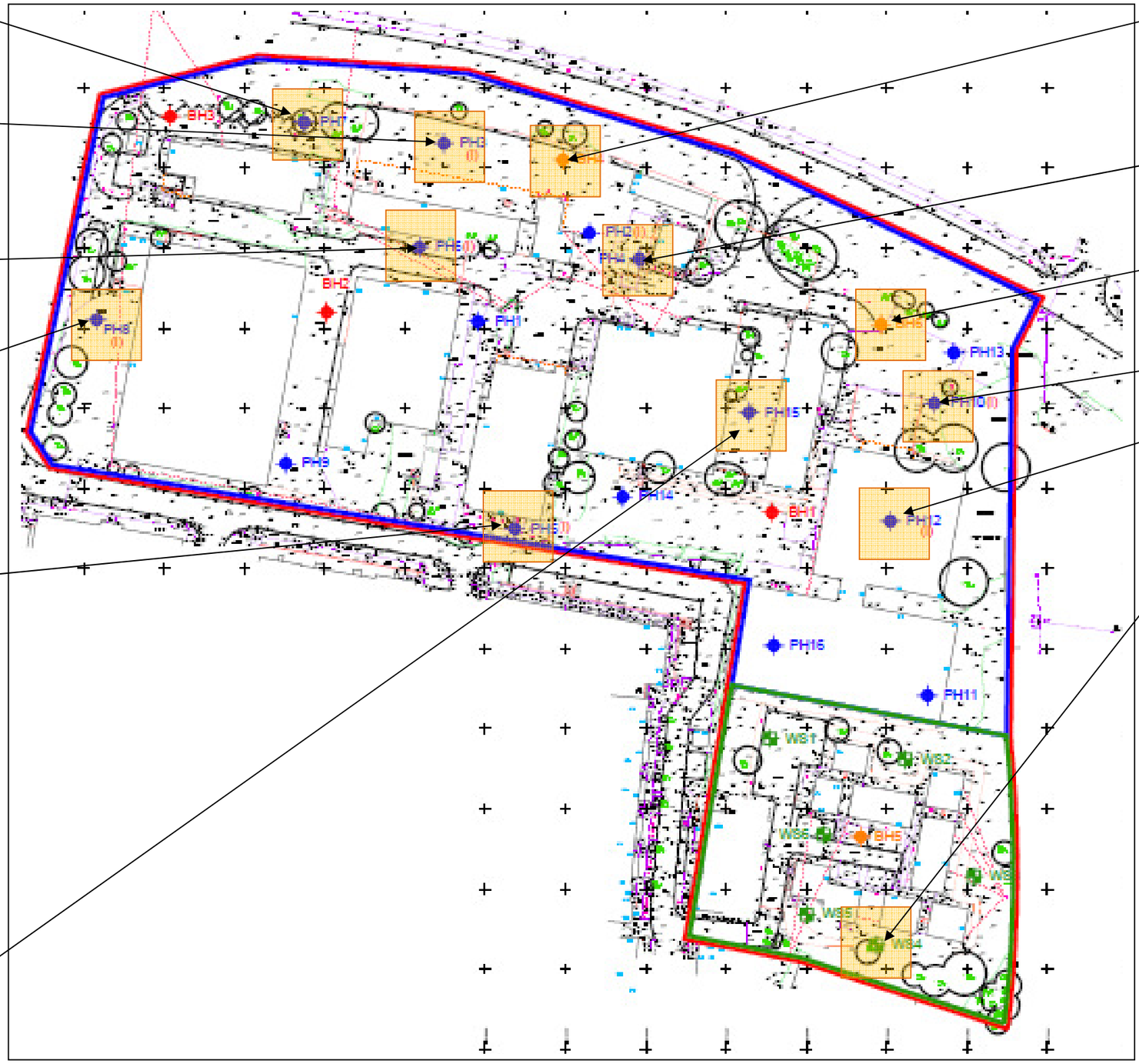
PH3 (made ground) – lead

PH6 (made ground) – lead and TPH CWG (Aromatic C_{16}-C_{21})

PH6 (made ground) – Lead, Dibenzo(ah)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene, Benzene

PH5 (made ground) – lead

PH15 (made ground) – lead



BH4 (made ground) – Asbestos loose fibres, Dibenzo(ah)anthracene, Benzo(a)pyrene and Benzo(ah)anthracene

PH4 (made ground) – lead

BH6 (made ground) – Asbestos loose fibres, Lead and Dibenzo(ah)anthracene & Benzo(b)fluoranthene

PH10 (made ground) – lead

PH12 (made ground) - Dibenzo(ah)anthracene, Benzo(b)fluoranthene, Benzo(ah)anthracene, Lead

WS4 (made ground) – Asbestos loose fibres

RSK	**SOIL CONTAMINATION PLAN**	Client:	Belway Homes Limited Thames Valley	Figure No:	6
		Site:	Battle Hospital	Job No:	28916-R01(00)
		Scale:	NTS	Source:	Client

APPENDIX A
SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Bellway Homes (Thames Valley) (the "client") in accordance with the terms of a contract between RSK and the "client". The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.

2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.

3. Unless otherwise agreed in writing the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**

4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.

5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.

6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.

7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.

8. The intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (boreholes, trial pits etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

APPENDIX B
SUMMARY OF LEGISLATION AND POLICY RELATING TO CONTAMINATED LAND

Part IIA of the Environmental Protection Act 1990 (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters are considered to include all groundwater, inland waters and estuaries.

In August 2006, the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented, which extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.

The intention of Part IIA of the EPA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012). This document replaces Annex III of Defra Circular 01/2006, published in September 2006 (the remainder of this document is now obsolete).

Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances
- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The 1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2010 provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2010 states: 'the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.'

Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

Planning Policy

Contaminated land is often dealt with through planning because of land redevelopment. This approach was documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use.

PPS23 was withdrawn early in 2012 and has been replaced by much reduced guidance within the National Planning Policy Framework (NPPF).

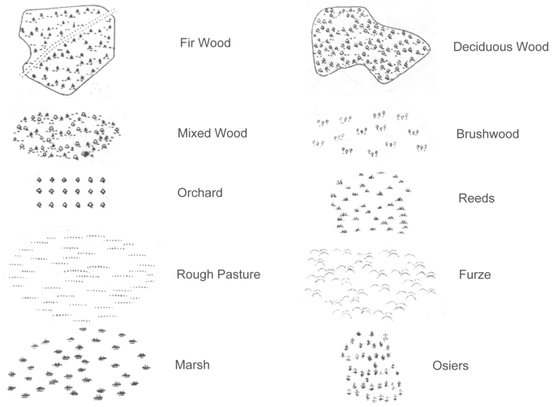
The new framework has only limited guidance on contaminated land, as follows:

- *"planning policies and decisions should also ensure that:*
    - *the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;*
    - *after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and*
    - *adequate site investigation information, prepared by a competent person, is presented".*

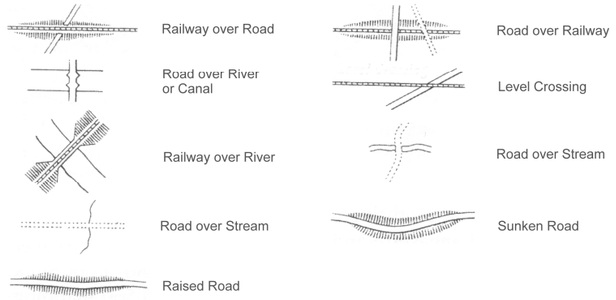
APPENDIX C
DESK STUDY INFORMATION & PREVIOUS GROUND INVESTIGATION

County Series 1:10,560 scale

VEGETATION



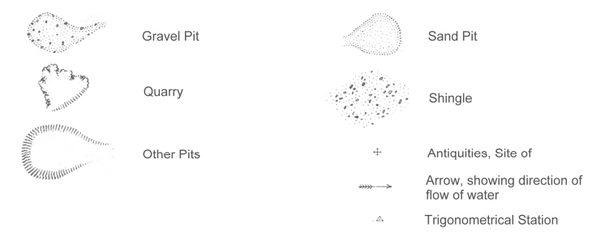
ROADS



RAILWAYS



GENERAL FEATURES



BOUNDARIES



National Grid 1:10,000 scale

HEIGHTS (METRES)

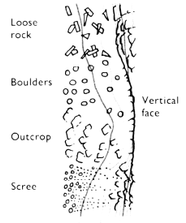
Values are given in metres above mean sea level at Newlyn.

Surface heights determined by: ground survey • 163m; air survey

Bench marks and their values are shown on large scale maps, and bench mark lists containing fuller and possibly later levelling information are obtainable from the Director General, Ordnance Survey.

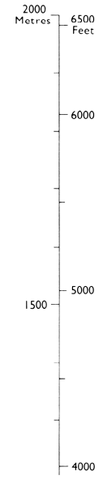
Contours are at 5 metres vertical interval.

ROCK FEATURES



CONVERSION SCALE

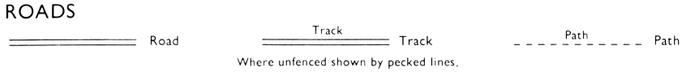
Metres - Feet



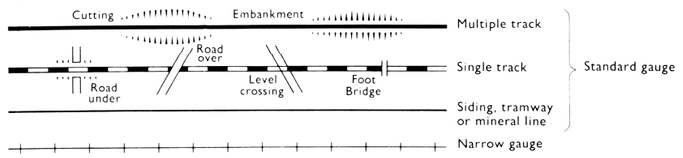
ABBREVIATIONS

BP,BS	Boundary Post or Stone	PO	Post Office
Ch	Church	PC	Public Convenience
CH	Club House	PH	Public House
F Sta	Fire Station	S	Stone
FB	Foot Bridge	Spr	Spring
Fn	Fountain	TCB	Telephone Call Box
GP	Guide Post	TCP	Telephone Call Post
MP,MS	Mile Post or Stone	TH	Town Hall
P	Pole or Post	W	Well
Pol Sta	Police Station	Y	Youth hostel

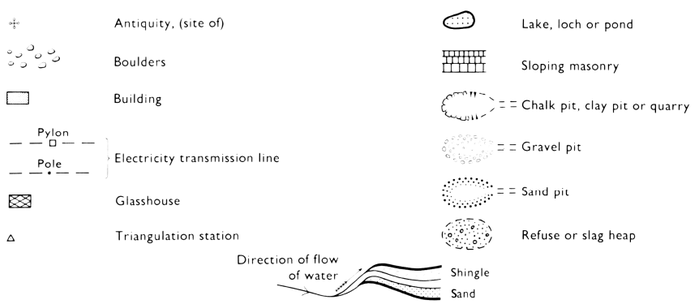
ROADS



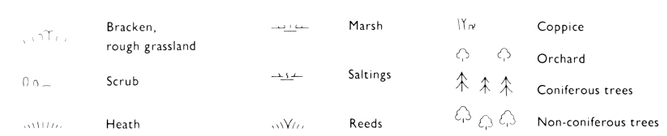
RAILWAYS



GENERAL FEATURES



VEGETATION



In some areas bracken ( ) and rough grassland ( ) are shown separately.

GroundSure

Historical Map Pack Legend

County Series & National Grid

1:10,560 scale

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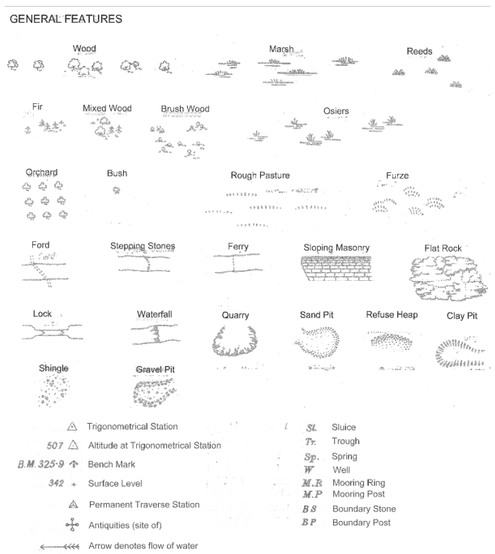
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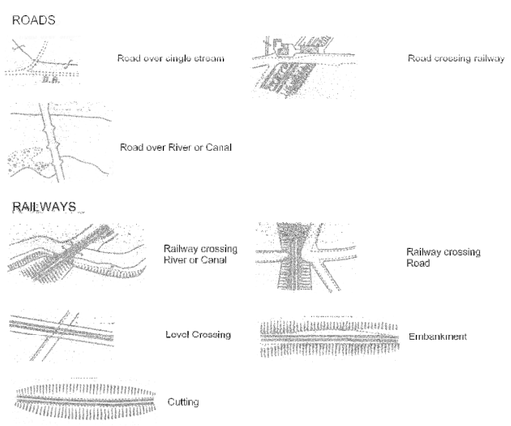
Technical Helpline

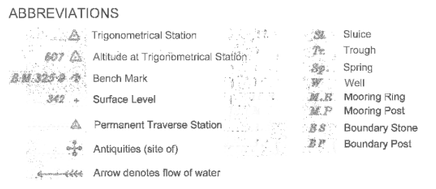
Tel 08444159000

groundsureinsight@groundsure.com
www.groundsure.com

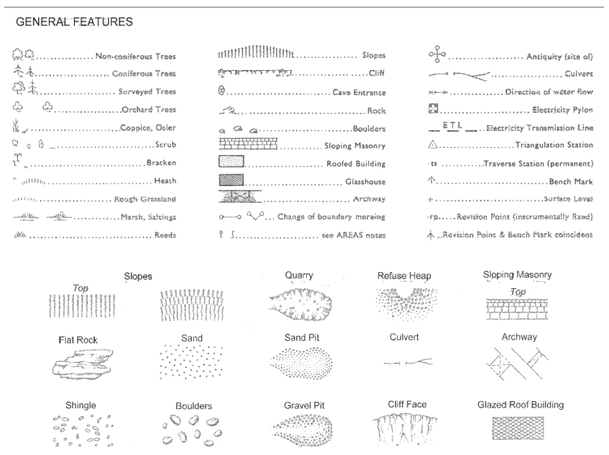
County Series 1:2,500 scale

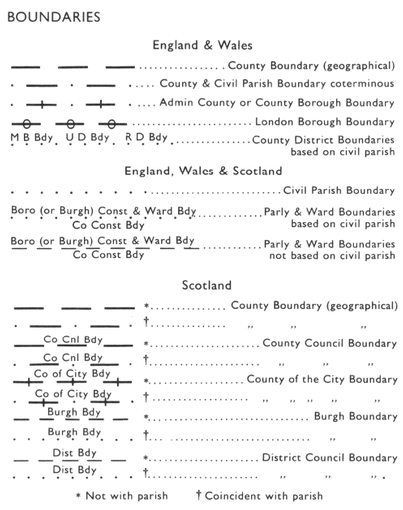


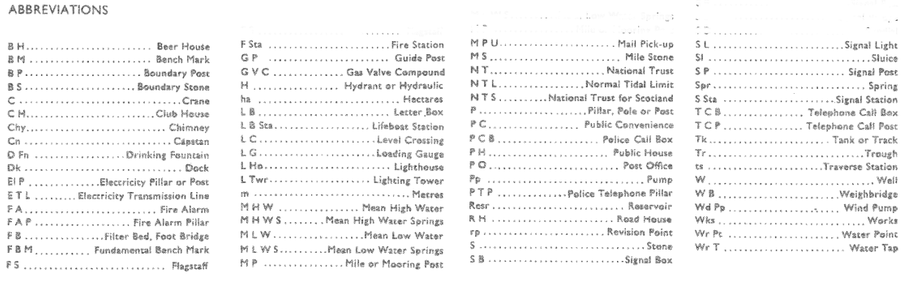




National Grid 1:2,500 / 1:1,250 scale







GroundSure

Historical Map Pack Legend

County Series

1:1,250 scale

~

County Series & National Grid

1:2,500 scale

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emapsite

Masdar House, 1 Reading Road,
Eversley, RG27 0RP

Report Reference: EMS-411382_549896

Your Reference: EMS_411382_549896

Report Date 15 Mar 2017

Report Delivery Method: Email - pdf

Groundsure Geo Insight

Address: Battle Hospital,

Dear Sir/ Madam,

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

If you would like further assistance regarding this report then please contact the emapsite customer services team on 0118 9736883 quoting the above report reference number.

Yours faithfully,

emapsite customer services team

Enc.
Groundsure Geo Insight

Groundsure Geo Insight

Address:	**Battle Hospital,**
Date:	**15 Mar 2017**
Reference:	**EMS-411382_549896**
Client:	**emapsite**

NW N NE

W E



SW S SE

Aerial Photograph Capture date:	20-Apr-2015
Grid Reference:	469909,173891
Site Size:	3.26ha

Groundsure
LOCATION INTELLIGENCE

emapsite™

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Overview of Findings

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

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

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

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

Section 2: Geology 1:50,000 Scale		
2.1 Artificial Ground	2.1.1 Is there any Artificial Ground/ Made Ground present beneath the study site?	No
	2.1.2 Are there any records relating to permeability of artificial ground within the study site*boundary?	No
2.2 Superficial Geology and Landslips	2.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?*	Yes
	2.2.2 Are there any records of permeability of superficial ground within 500m of the study site?	Yes
	2.2.3 Are there any records of landslip within 500m of the study site boundary?	No
	2.2.4 Are there any records relating to permeability of landslips within the study site* boundary?	No

Section 2: Geology 1:50,000 Scale

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

Section 3: Radon

3. Radon	3.1Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.
	3.2Radon Protection	No radon protective measures are necessary.

Section 4: Ground Workings	On-site	0-50m	51-250	251-500	501-1000
4.1 Historical Surface Ground Working Features from Small Scale Mapping	0	4	21	Not Searched	Not Searched
4.2 Historical Underground Workings from Small Scale Mapping	0	0	0	0	0
4.3 Current Ground Workings	0	0	1	0	3

Section 5: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
5.1 Historical Mining	0	0	0	0	0
5.2 Coal Mining	0	0	0	0	0
5.3 Johnson Poole and Bloomer Mining Area	1	0	1	0	3
5.4 Non-Coal Mining*	2	0	4	0	0
5.5 Non–Coal Mining Cavities	0	0	0	0	3
5.5 Natural Cavities	0	0	0	0	8

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

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

Section 7: Borehole Records	On-site	0-50m	51-250
7 BGS Recorded Boreholes	5	9	13

Section 8: Estimated Background Soil Chemistry	On-site	0-50m	51-250
8 Records of Background Soil Chemistry	7	8	0

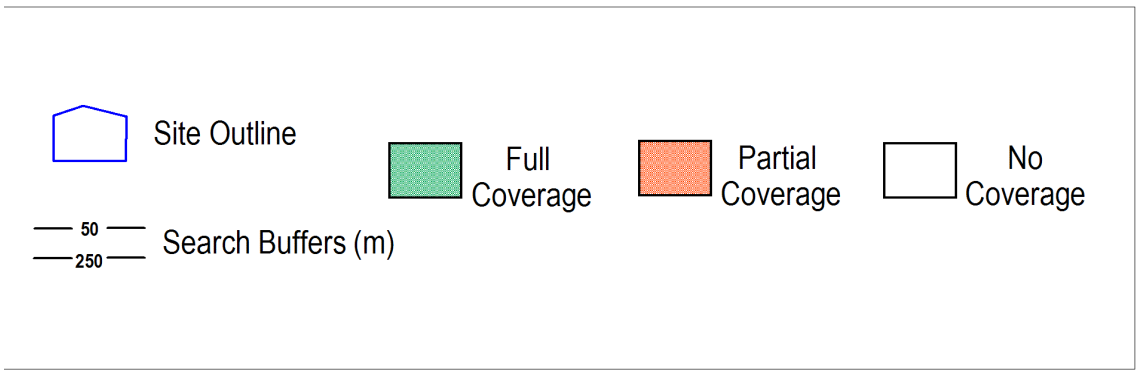
Section 9: Railways and Tunnels	On-site	0-50m	51-250	250-500
9.1 Tunnels	0	0	0	Not Searched
9.2 Historical Railway and Tunnel Features	0	0	59	Not Searched
9.3 Historical Railways	0	0	5	Not Searched
9.4 Active Railways	0	0	74	Not Searched
9.5 Railway Projects	0	0	0	0

1:10,000 Scale Availability



1_10,000 Availability Legend

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Availability of 1:10,000 Scale Geology Mapping

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

ID	Distance	Artificial Coverage	Superficial Coverage	Bedrock Coverage	Mass Movement Coverage
1	0.0	Some deposits are mapped	Full	Full	No coverage
2	0.0	Some deposits are mapped	Full	Full	No coverage
3	1012.0	Some deposits are mapped	Full	Full	No coverage
4	1024.0	Some deposits are mapped	Full	Full	No coverage

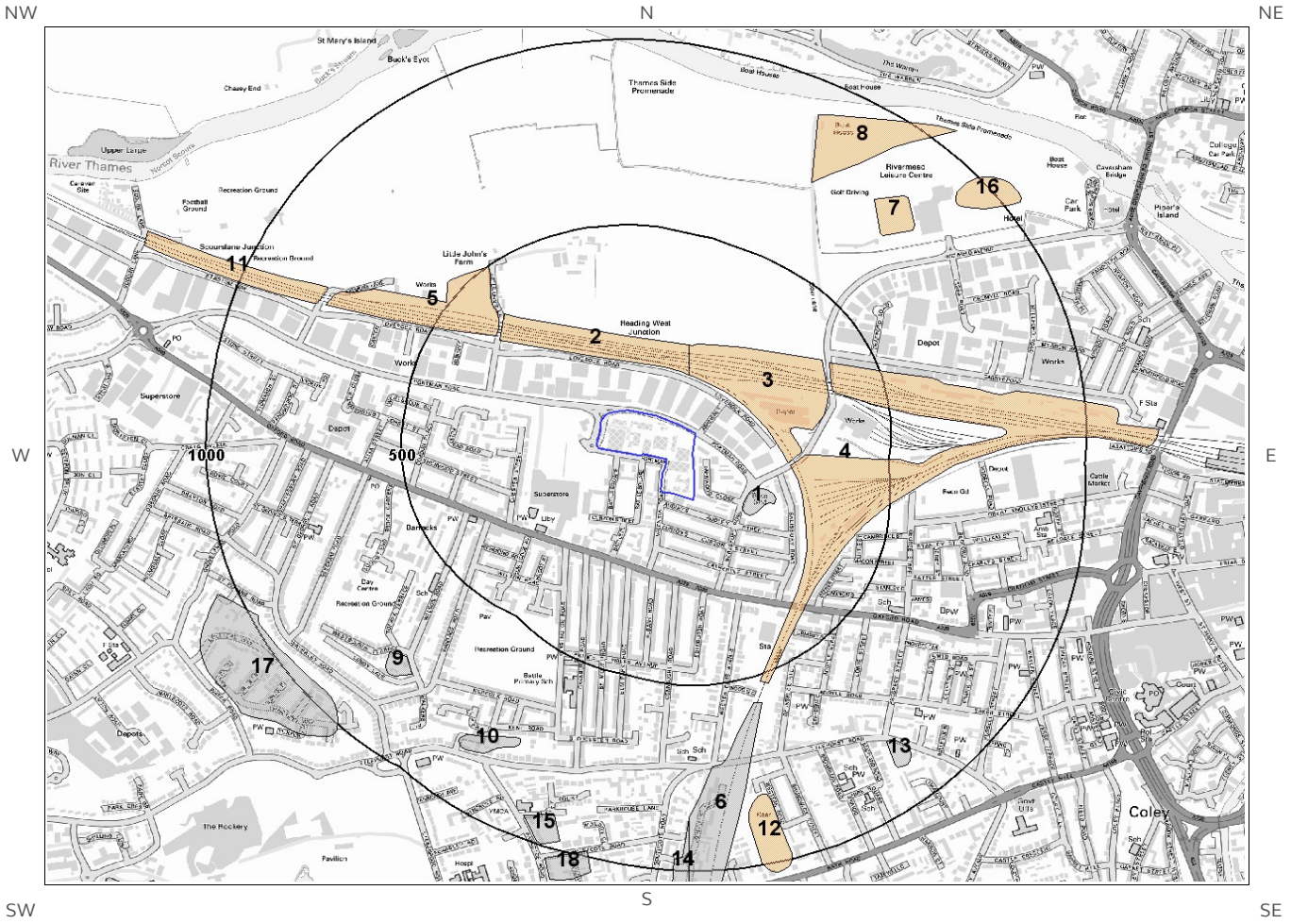
Guidance: The 1:10,000 scale geological interpretation is the most detailed generally available from BGS and is the scale at which most geological surveying is carried out in the field. The database is presented as four types of geology (artificial, mass movement, superficial and bedrock), although not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

The definitions of coverage are as follows:

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

1 Geology (1:10,000 scale).

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



Artificial Ground Legend

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Site Outline

500
1000
Search Buffers (m)

Made Ground (undivided)

Disturbed Ground (undivided)

Worked Ground (undivided)

Landscaped Ground (undivided)

Infilled Ground

Reclaimed Ground

1. Geology 1:10,000 scale

1.1 Artificial Ground

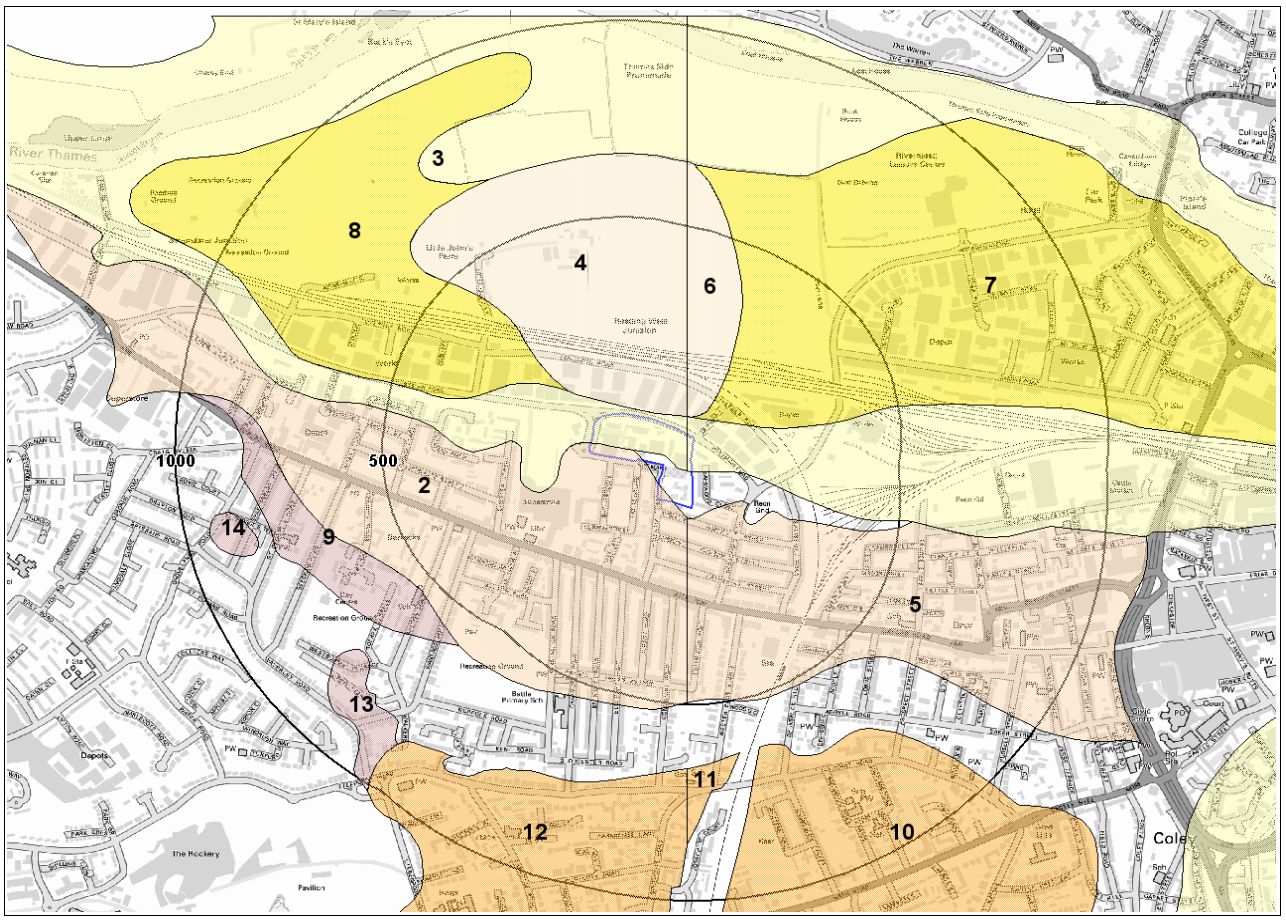
The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

Are there any records of Artificial/ Made Ground within 500m of the study site boundary at 1:10,000 scale? Yes

ID	Distance	Direction	LEX Code	Description	Rock Description
1	125.0	E	WGR-VOID	Worked Ground (Undivided)	Void
2	130.0	N	MGR-ARTDP	Made Ground (Undivided)	Artificial Deposit
3	133.0	NE	MGR-ARTDP	Made Ground (Undivided)	Artificial Deposit
4	247.0	E	MGR-ARTDP	Made Ground (Undivided)	Artificial Deposit
5	352.0	NW	MGR-ARTDP	Made Ground (Undivided)	Artificial Deposit

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

NW N NE



W E

SW S SE

Artificial Ground Legend

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Site Outline

500
1000
Search Buffers (m)

1.2 Superficial Deposits and Landslips

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

1.2.1 Superficial Deposits/ Drift Geology

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

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	ALV-Z	Alluvium - Silt (unlithified Deposits Coding Scheme)	Silt
2	0.0	On Site	TPGR-XSV	Taplow Gravel Formation - Sand And Gravel	Sand And Gravel
3	0.0	On Site	ALV-Z	Alluvium - Silt (unlithified Deposits Coding Scheme)	Silt
4	17.0	N	KPGR-XSV	Kempton Park Gravel Formation - Sand And Gravel	Sand And Gravel
5	24.0	SE	TPGR-XSV	Taplow Gravel Formation - Sand And Gravel	Sand And Gravel
6	39.0	NE	KPGR-XSV	Kempton Park Gravel Formation - Sand And Gravel	Sand And Gravel
7	43.0	NE	LASI-XCZ	Langley Silt Member - Clay And Silt	Clay And Silt
8	102.0	NW	LASI-XCZ	Langley Silt Member - Clay And Silt	Clay And Silt

1.2.2 Landslip

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

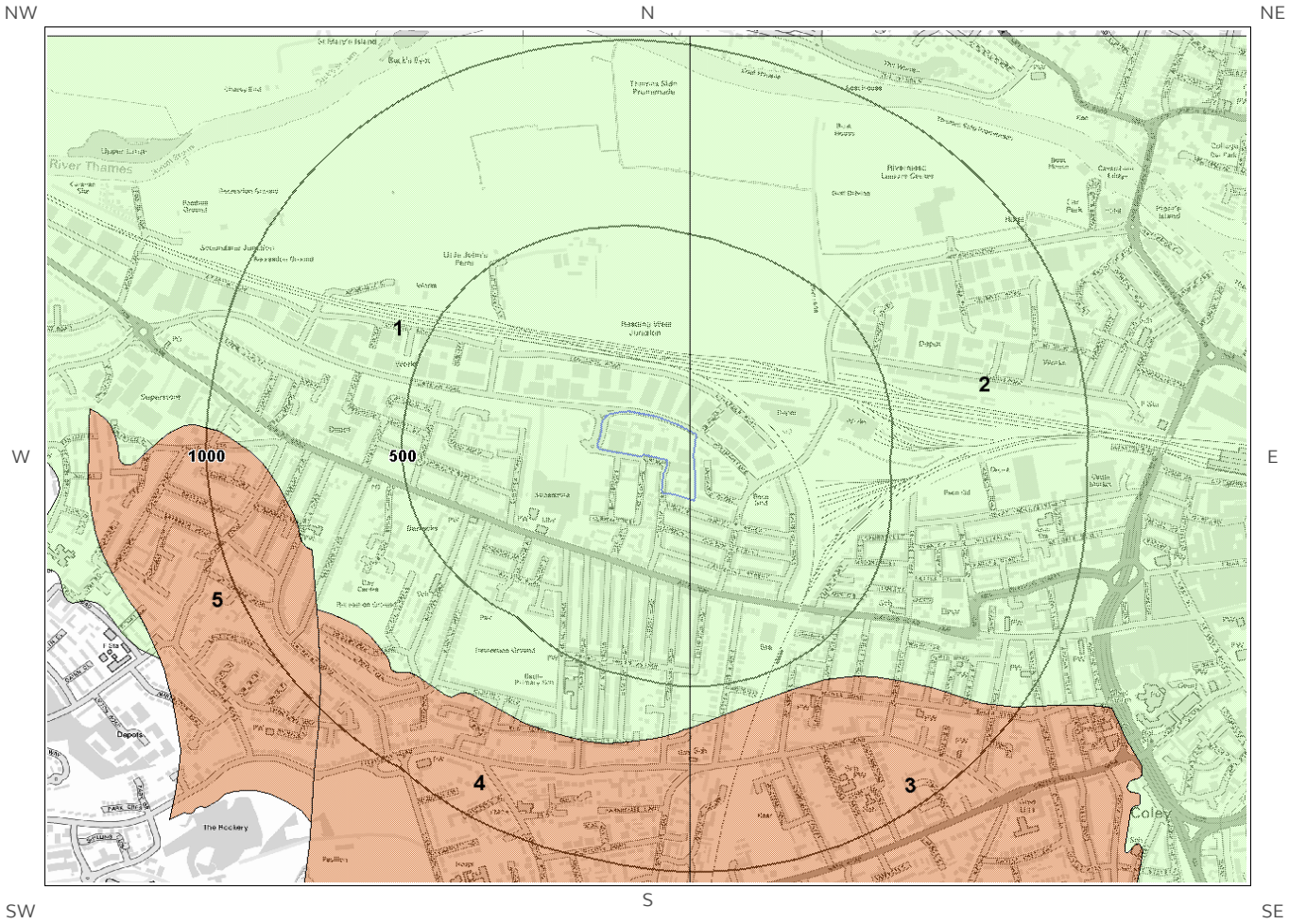
No

Database searched and no data found.

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

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

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



Bedrock and Faults Legend

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Site Outline

500
1000
Search Buffers (m)

1.3 Bedrock and Faults

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

1.3.1 Bedrock/ Solid Geology

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

ID	Distance (m)	Direction	LEX Code	Description	Rock Age
1	0.0	On Site	LSNCK-CHLK	Lewes Nodular Chalk Formation, Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk	Campanian Age - Turonian Age
2	0.0	On Site	LSNCK-CHLK	Lewes Nodular Chalk Formation, Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk	Campanian Age - Turonian Age

1.3.2 Faults

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

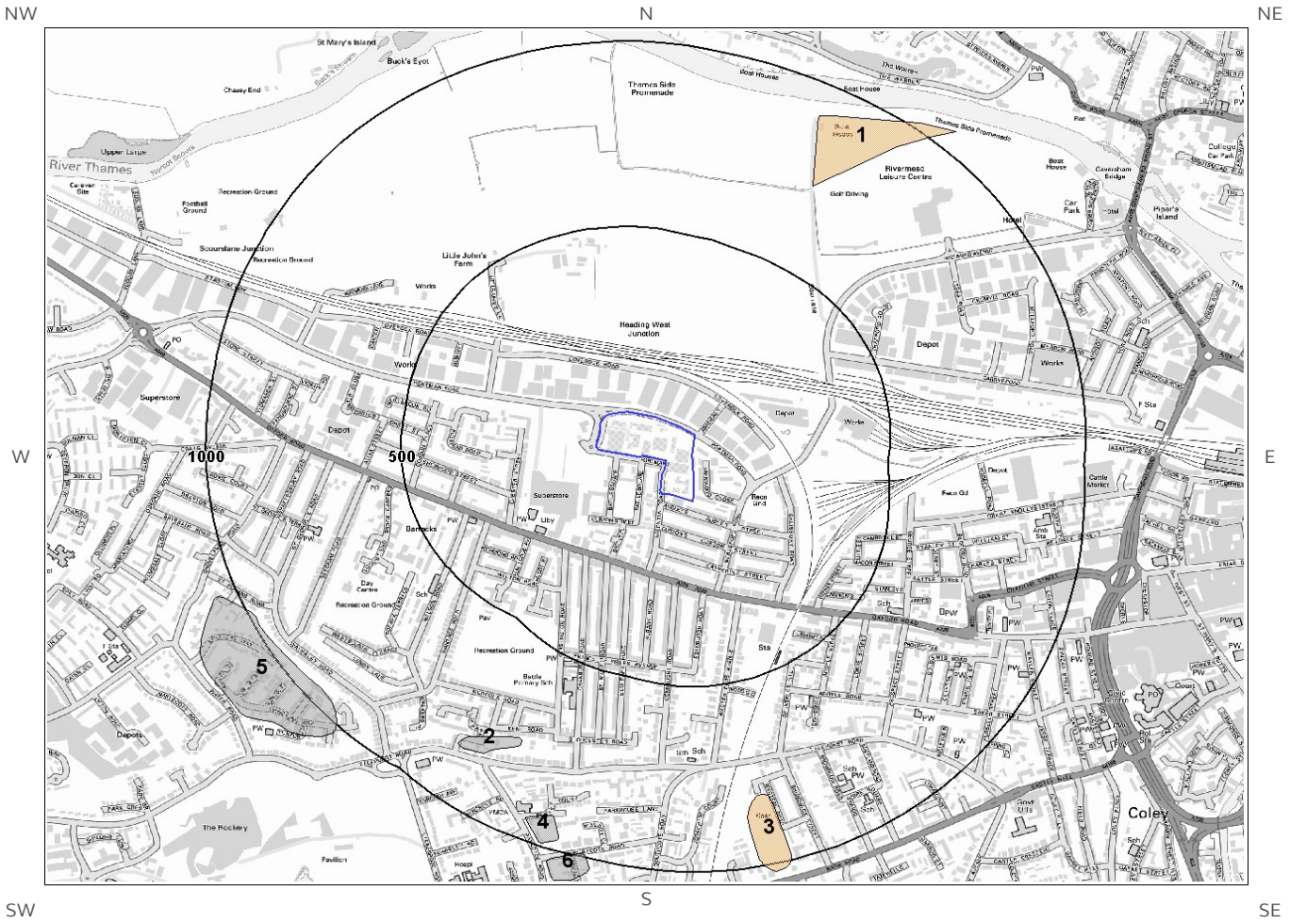
Database searched and no data found at this scale.

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

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

2 Geology 1:50,000 Scale

2.1 Artificial Ground Map



Ground Workings Legend

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Site Outline

500
1000
Search Buffers (m)

Made Ground (undivided)

Worked Ground (undivided)

Infilled Ground

Disturbed Ground (undivided)

Landscaped Ground (undivided)

Reclaimed Ground

2. Geology 1:50,000 scale

2.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 268

2.1.1 Artificial/ Made Ground

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

Database searched and no data found.

2.1.2 Permeability of Artificial Ground

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

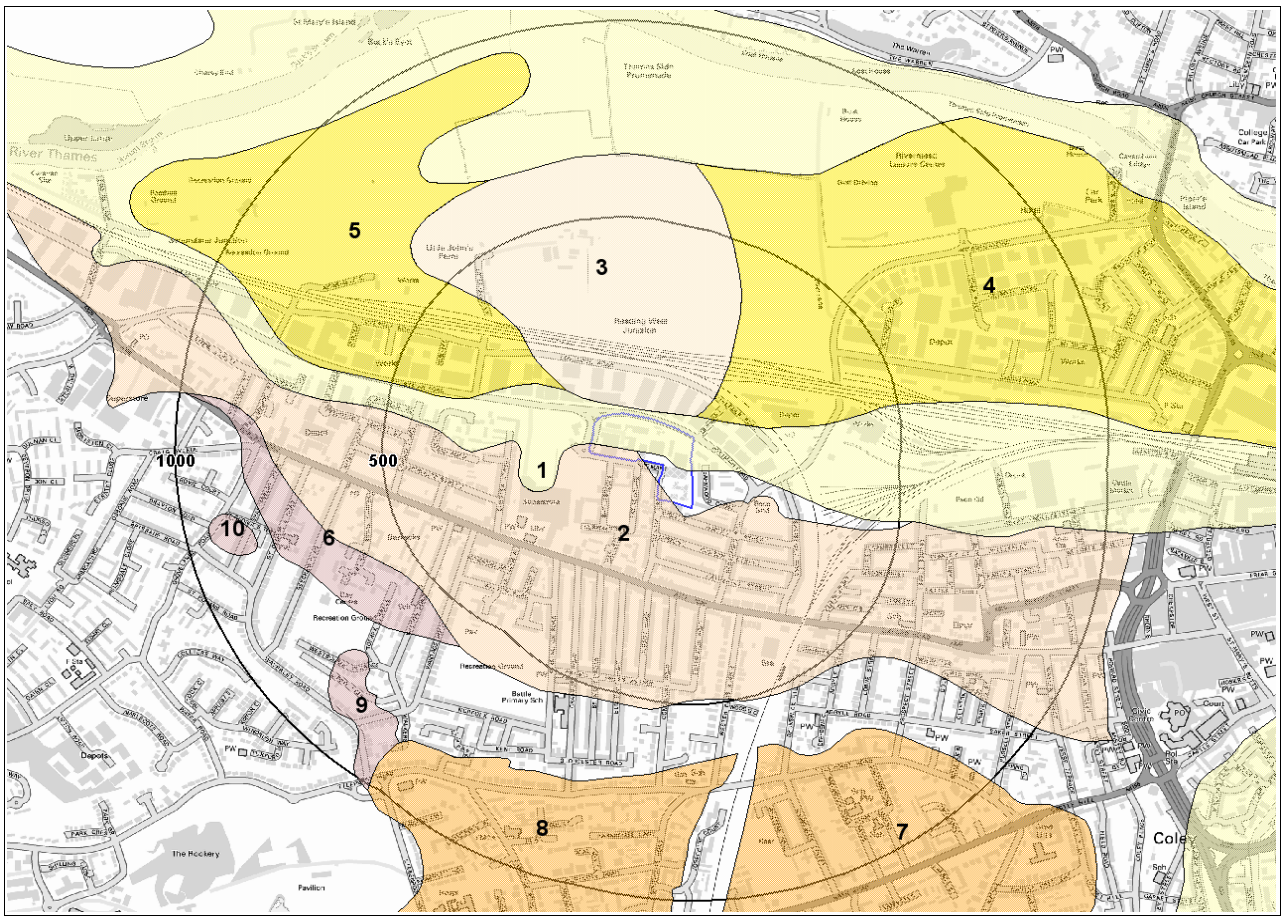
Database searched and no data found.

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

NW N NE

W E

SW S SE



Ground Workings Legend

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Site Outline

500
1000
Search Buffers (m)

2.2 Superficial Deposits and Landslips

2.2.1 Superficial Deposits/ Drift Geology

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

ID	Distance	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	ALV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL [UNLITHIFIED DEPOSITS CODING SCHEME]
2	0.0	On Site	TPGR	TAPLOW GRAVEL FORMATION	SAND AND GRAVEL [UNLITHIFIED DEPOSITS CODING SCHEME]
3	16.0	N	KPGR	KEMPTON PARK GRAVEL FORMATION	SAND AND GRAVEL [UNLITHIFIED DEPOSITS CODING SCHEME]
4	49.0	NE	LASI	LANGLEY SILT MEMBER	CLAY AND SILT [UNLITHIFIED DEPOSITS CODING SCHEME]
5	106.0	NW	LASI	LANGLEY SILT MEMBER	CLAY AND SILT [UNLITHIFIED DEPOSITS CODING SCHEME]

2.2.2 Permeability of Superficial Ground

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

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Intergranular	Very High	High
0.0	On Site	Intergranular	High	Very Low
0.0	On Site	Intergranular	High	Very Low
16.0	N	Intergranular	Very High	High
17.0	S	Intergranular	Very High	High
41.0	NE	Intergranular	Very High	High
49.0	NE	Mixed	Low	Very Low

2.2.3 Landslip

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

Database searched and no data found.

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

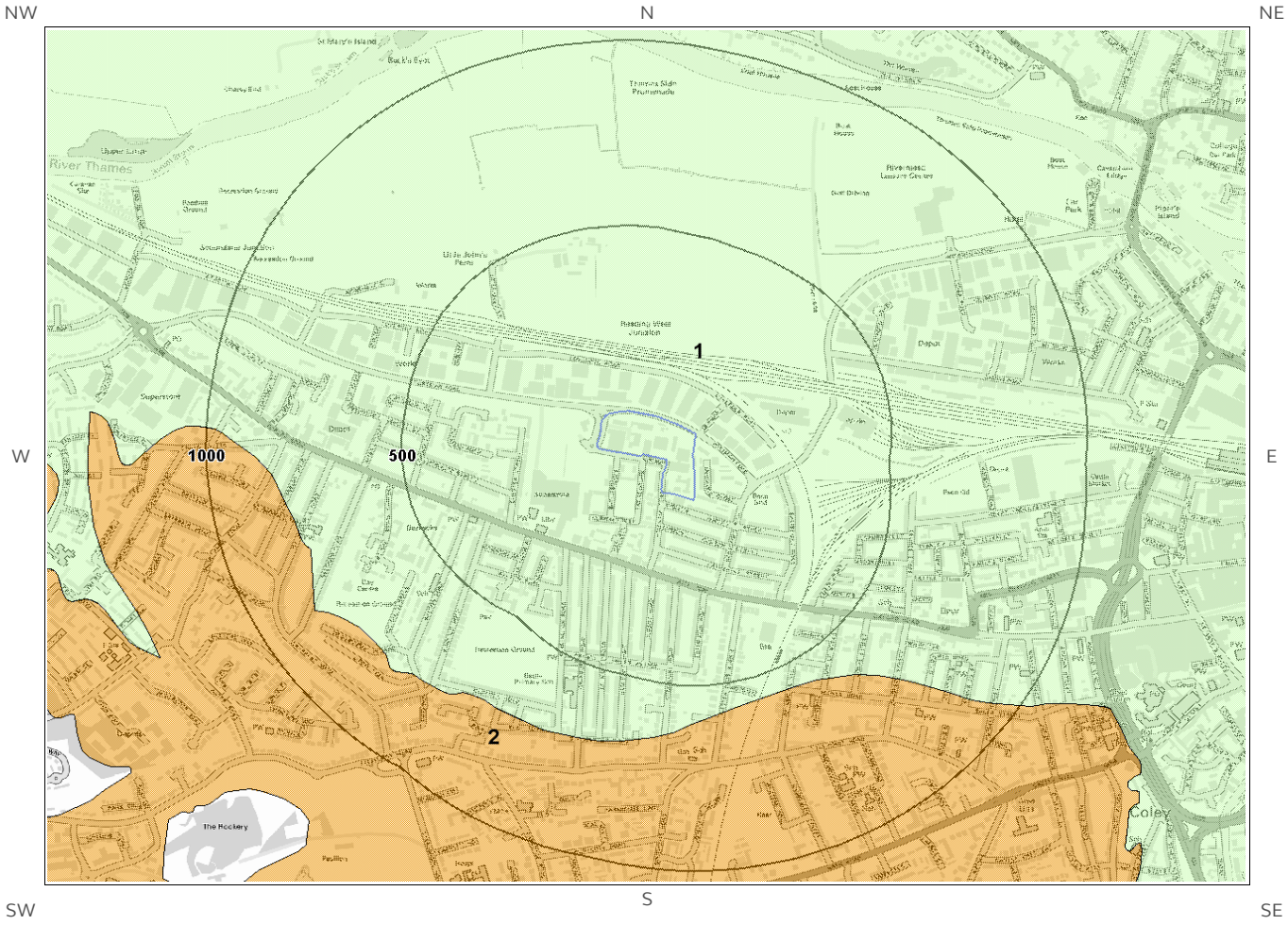
This Geology shows the main components as discrete layers, there are: Artificial/ Made Ground, Superficial/ Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

2.2.4 Landslip Permeability

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

Database searched and no data found.

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



Ground Workings Legend

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Site Outline

500
1000
Search Buffers (m)

2.3 Bedrock, Solid Geology & Faults

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 268

2.3.1 Bedrock/Solid Geology

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

ID	Distance	Direction	LEX Code	Rock Description	Rock Age
1	0.0	On Site	SNCK-CHLK	Seaford Chalk Formation And Newhaven Chalk Formation (undifferentiated) - Chalk	Campanian / Coniacian

2.3.2 Permeability of Bedrock Ground

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

Distance	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Fracture	Very High	Very High
0.0	On Site	Fracture	Very High	Very High

2.3.3 Faults

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

Database searched and no data found.

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

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

3 Radon Data

3.1 Radon Affected Areas

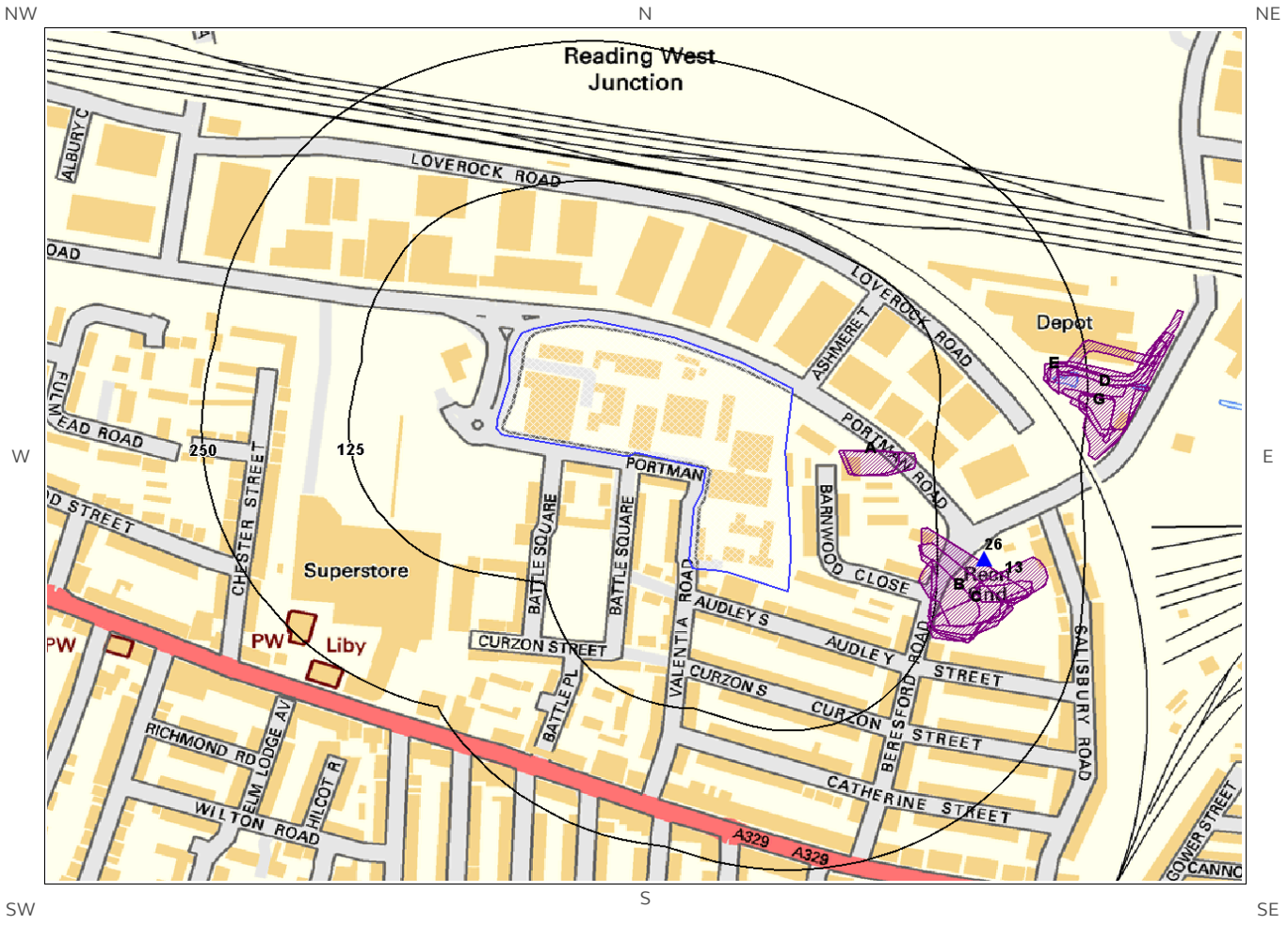
Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.

3.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment? No radon protective measures are necessary.

---

4 Ground Workings Map



Ground Workings Legend

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Site Outline

125
250
Search Buffers (m)

Historic Surface Ground Workings

Historic Underground Workings

Current Ground Workings

4 Ground Workings

4.1 Historical Surface Ground Working Features derived from Historical Mapping

This dataset is based on Groundsure's unique Historical Land Use Database derived from 1:10,560 and 1:10,000 scale historical mapping

Are there any Historical Surface Ground Working Features within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Use	Date
1A	46.0	E	470081 173860	Pond	1910
2A	46.0	E	470081 173860	Pond	1898
3A	46.0	E	470081 173860	Pond	1938
4A	49.0	E	470089 173860	Pond	1956
5B	109.0	E	470163 173744	Unspecified Pit	1956
6B	110.0	E	470149 173743	Gravel Pit	1898
7B	111.0	E	470170 173752	Unspecified Pit	1938
8C	122.0	E	470174 173727	Unspecified Pit	1989
9C	122.0	E	470174 173727	Unspecified Pit	1994
10B	122.0	E	470174 173727	Unspecified Pit	1977
11B	122.0	E	470174 173727	Unspecified Pit	1971
12C	128.0	E	470193 173727	Unspecified Ground Workings	1910
13	159.0	E	470202 173755	Old Gravel Pit	1898
14D	213.0	E	470284 173920	Unspecified Pit	1971
15D	213.0	E	470284 173920	Unspecified Pit	1977
16D	213.0	E	470284 173920	Unspecified Pit	1994
17D	213.0	E	470284 173920	Unspecified Pit	1989
18E	216.0	E	470237 173936	Unspecified Pit	1910
19E	216.0	E	470237 173936	Unspecified Pit	1938
20F	218.0	E	470324 173963	Unspecified Ground Workings	1956
21F	225.0	E	470320 173951	Unspecified Ground Workings	1938

ID	Distance (m)	Direction	NGR	Use	Date
22	226.0	E	470268 173969	Unspecified Ground Workings	1910
23D	228.0	E	470267 173905	Pond	1910
24G	243.0	E	470274 173899	Ponds	1938
25G	243.0	E	470289 173910	Ponds	1956

4.2 Historical Underground Working Features derived from Historical Mapping

This data is derived from the Groundsure unique Historical Land Use Database. It contains data derived from 1:10,000 and 1:10,560 historical Ordnance Survey Mapping and includes some natural topographical features (Shake Holes for example) as well as manmade features that may have implications for ground stability. Underground and mining features have been identified from surface features such as shafts. The distance that these extend underground is not shown.

Are there any Historical Underground Working Features within 1000m of the study site boundary? No

Database searched and no data found.

4.3 Current Ground Workings

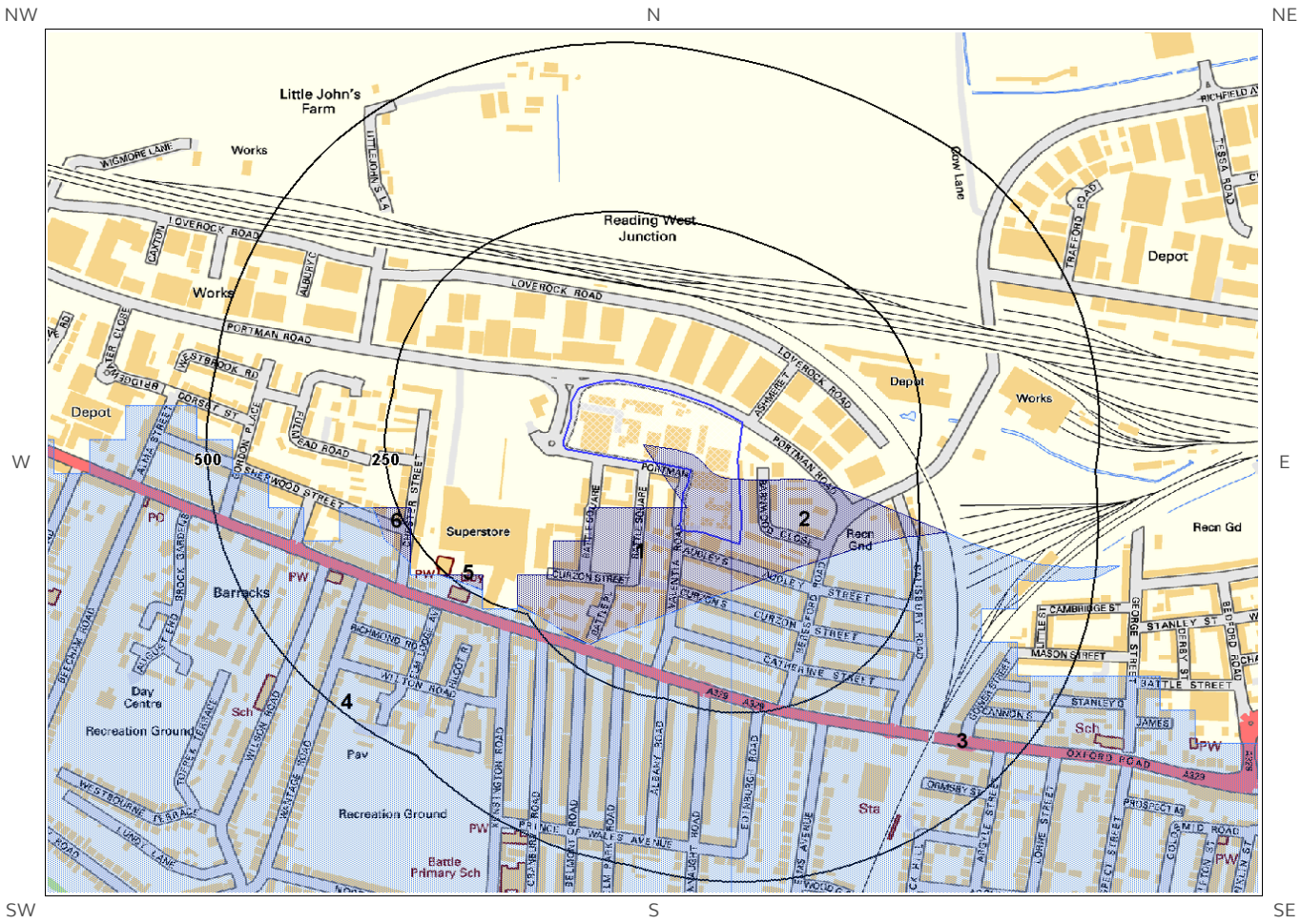
This dataset is derived from the BGS BRITPITS database covering active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles.

Are there any BGS Current Ground Workings within 1000m of the study site boundary? Yes

The following Current Ground Workings information is provided by British Geological Survey:

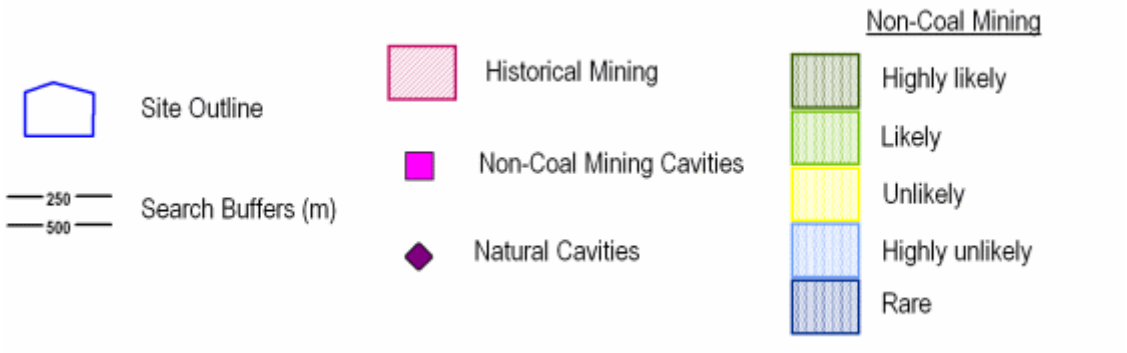
ID	Distance (m)	Direction	NGR	Commodity Produced	Pit Name	Type of working	Status
26	164.0	E	470178 173774	Sand & Gravel	Battle Farm Gravel Pit	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	766.0	SW	469514 173123	Clay & Shale	Prospect Park Brick Works	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	776.0	SW	469254 173304	Chalk	Grovelands Chalk Pit	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	972.0	SW	469199 173098	Sand & Gravel	Prospect Park Gravel Pit	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased

5 Mining, Extraction & Natural Cavities Map



Mining, Extraction and Natural Cavities Legend

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5 Mining, Extraction & Natural Cavities

5.1 Historical Mining

This dataset is derived from Groundsure unique Historical Land-use Database that are indicative of mining or extraction activities.

Are there any Historical Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.2 Coal Mining

This dataset provides information as to whether the study site lies within a known coal mining affected area as defined by the coal authority.

Are there any Coal Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.3 Johnson Poole and Bloomer

This dataset provides information as to whether the study site lies within an area where JPB hold information relating to mining.

Are there any JPB Mining areas within 1000m of the study site boundary? Yes

The following information provided by JPB is not represented on mapping: Whilst outside of an area where The Coal Authority have information on coal mining activities, Johnson Poole & Bloomer (JPB) have information such as mining plans and maps held within their archive of mining activities that have occurred within 1km of this property. Further details and a quote for services can be obtained by emailing this report to enquiries.gs@jpb.co.uk.

5.4 Non-Coal Mining

This dataset provides information as to whether the study site lies within an area which may have been subject to non-coal historic mining.

Are there any Non-Coal Mining areas within 1000m of the study site boundary? Yes

The following non-coal mining information is provided by the BGS:

ID	Distance (m)	Direction	Name	Commodity	Assessment of likelihood
1	0.0	On Site	Not available	Chalk	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered

ID	Distance (m)	Direction	Name	Commodity	Assessment of likelihood
2	0.0	On Site	Not available	Chalk	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered
3	60.0	S	Not available	Chalk	Localised small scale underground mining may have occurred. Potential for difficult ground conditions are unlikely or localised and are at a level where they need not be considered
4	70.0	S	Not available	Chalk	Localised small scale underground mining may have occurred. Potential for difficult ground conditions are unlikely or localised and are at a level where they need not be considered
5	220.0	SW	Not available	Chalk	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered
6	233.0	SW	Not available	Chalk	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered

5.5 Non-Coal Mining Cavities

This dataset provides information from the Peter Brett Associates (PBA) mining cavities database (compiled for the national study entitled “Review of mining instability in Great Britain, 1990” PBA has also continued adding to this database) on mineral extraction by mining.

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? Yes

The following Non-Coal Mining Cavities information provided by Peter Brett Associates:

ID	Distance (m)	Direction	NGR	Address	Superficial Deposits	Bedrock Deposits	Extracted Mineral
Not shown	616.0	SE	470300 173200	'Cooper's Brick & Lime Manufactory', Reading (West), Berkshire	Lynch Hill Gravel	Lambeth Group, Upper Chalk Formation	Chalk
Not shown	851.0	SW	469400 173100	'Elm Lodge/Jesse's Brick Field', Tilehurst, Berkshire	Lynch Hill Gravels	Lambeth Group, Upper Chalk Formation	Chalk
Not shown	891.0	SE	470500 173000	Reading (West), Berkshire	Lynch Hill Gravel	Lambeth Group, Upper Chalk Formation	Chalk

5.6 Natural Cavities

This dataset provides information based on Peter Brett Associates natural cavities database.

Are there any Natural Cavities within 1000m of the study site boundary? Yes

The following Natural Cavities information provided by Peter Brett Associates:

ID	Distance (m)	Direction	NGR	Superficial Deposits	Bedrock Deposits	Cavity Type and Number
Not shown	628.0	S	470240 173160	Lynch Hill Gravel	Chalk Group, Lambeth Group	Solution Pipe x 1
Not shown	632.0	S	470250 173160	-	Chalk Group, Lambeth Group	Solution Pipe x 1
Not shown	637.0	S	470240 173150	Lynch Hill Gravel	Chalk Group, Lambeth Group	Solution Pipe x 1
Not shown	735.0	S	470000 173010	-	Chalk Group, Lambeth Group	Solution Widened Joint or Fissure x 1
Not shown	827.0	SE	470370 173000	Lynch Hill Gravel	Chalk Group, Lambeth Group	Solution Pipe x 2
Not shown	840.0	SE	470380 172990	Lynch Hill Gravel	Chalk Group, Lambeth Group	Solution Pipe x 1
Not shown	927.0	S	469950 172820	Lynch Hill Gravel	Chalk Group, Lambeth Group	Sinkhole x 1, Solution Pipe x 1
Not shown	952.0	S	469900 172800	Lynch Hill Gravel	Chalk Group, Lambeth Group	Solution Pipe

5.7 Brine Extraction

This data provides information from the Coal Authority issued on behalf of the Cheshire Brine Subsidence Compensation Board.

Are there any Brine Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.8 Gypsum Extraction

This dataset provides information on Gypsum extraction from British Gypsum records.

Are there any Gypsum Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.9 Tin Mining

This dataset provides information on tin mining areas and is derived from tin mining records. This search is based upon postcode information to a sector level..

Are there any Tin Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.10 Clay Mining

This dataset provides information on Kaolin and Ball Clay mining from relevant mining records.

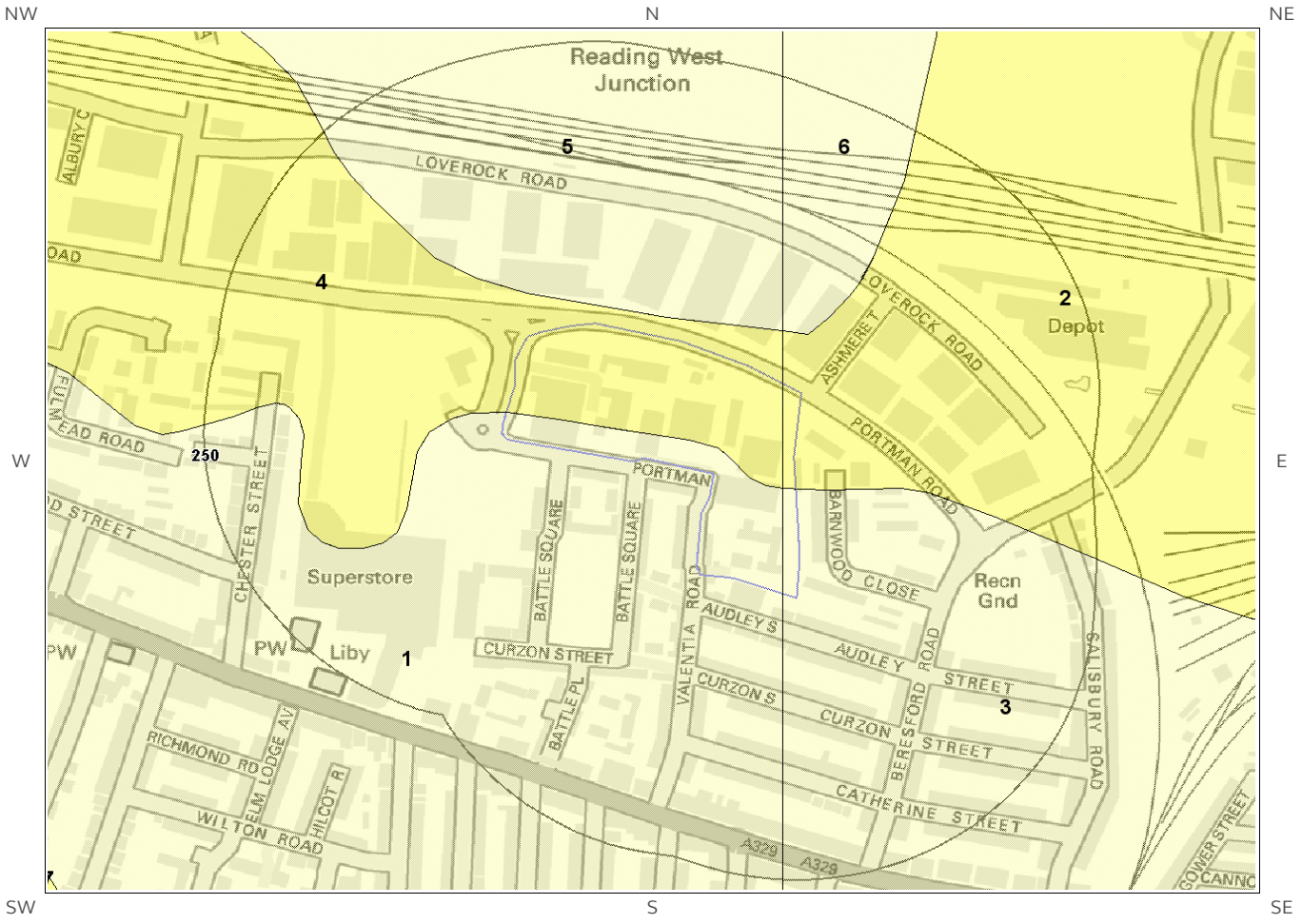
Are there any Clay Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

---

6 Natural Ground Subsidence

6.1 Shrink-Swell Clay Map

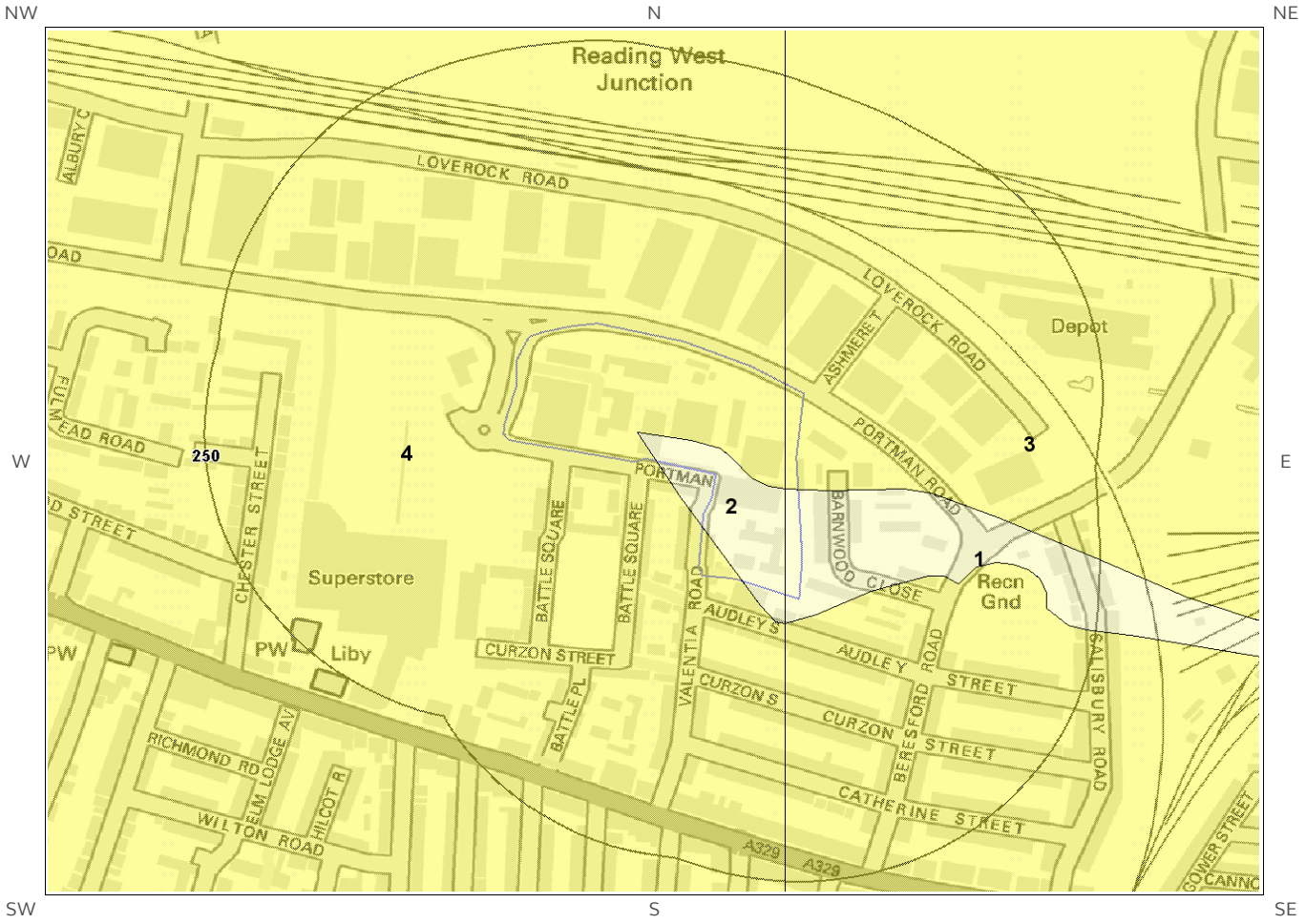


Shrink Swell Clay Legend

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6.2 Landslides Map

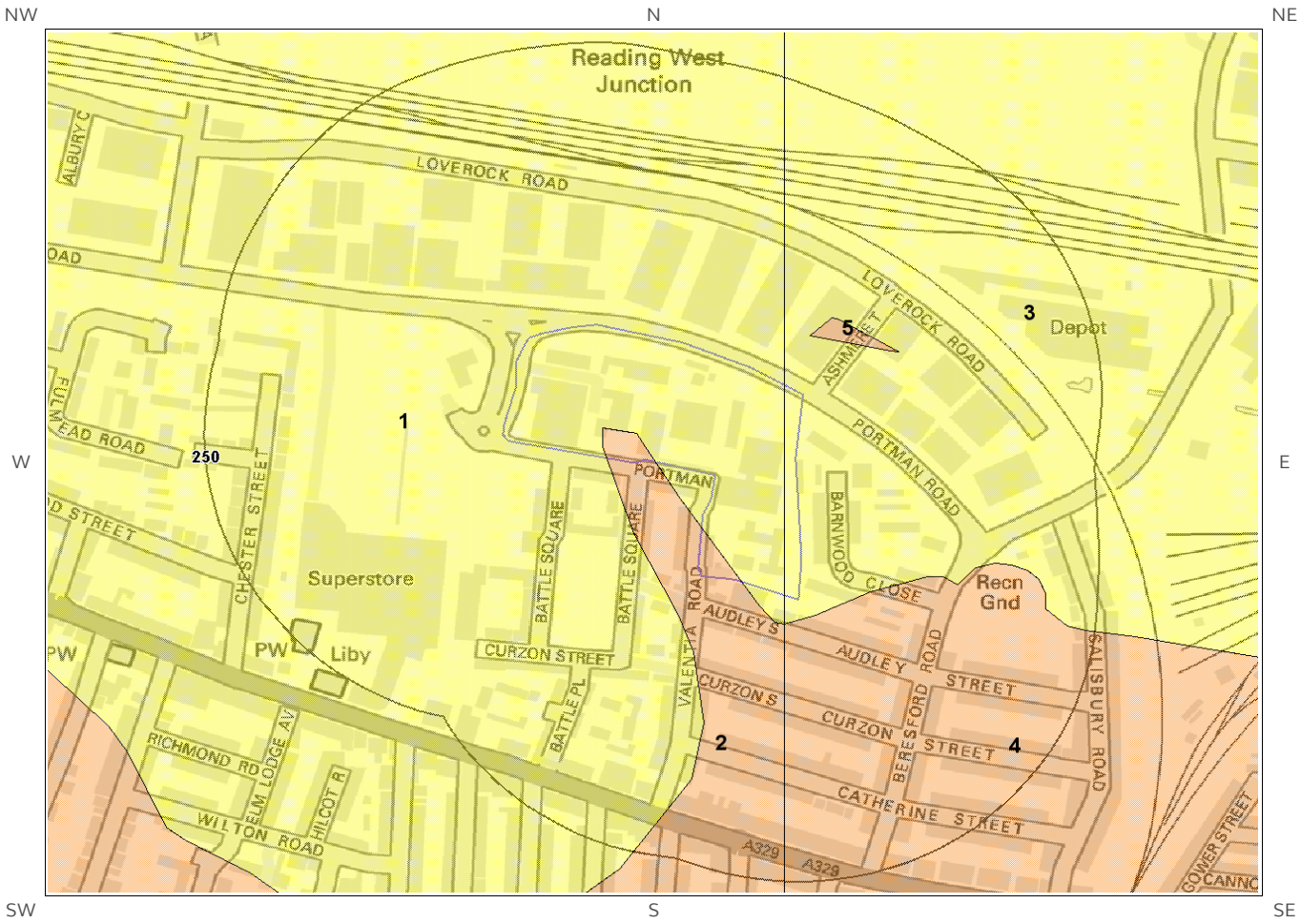


Landslides Legend

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6.3 Ground Dissolution of Soluble Rocks Map

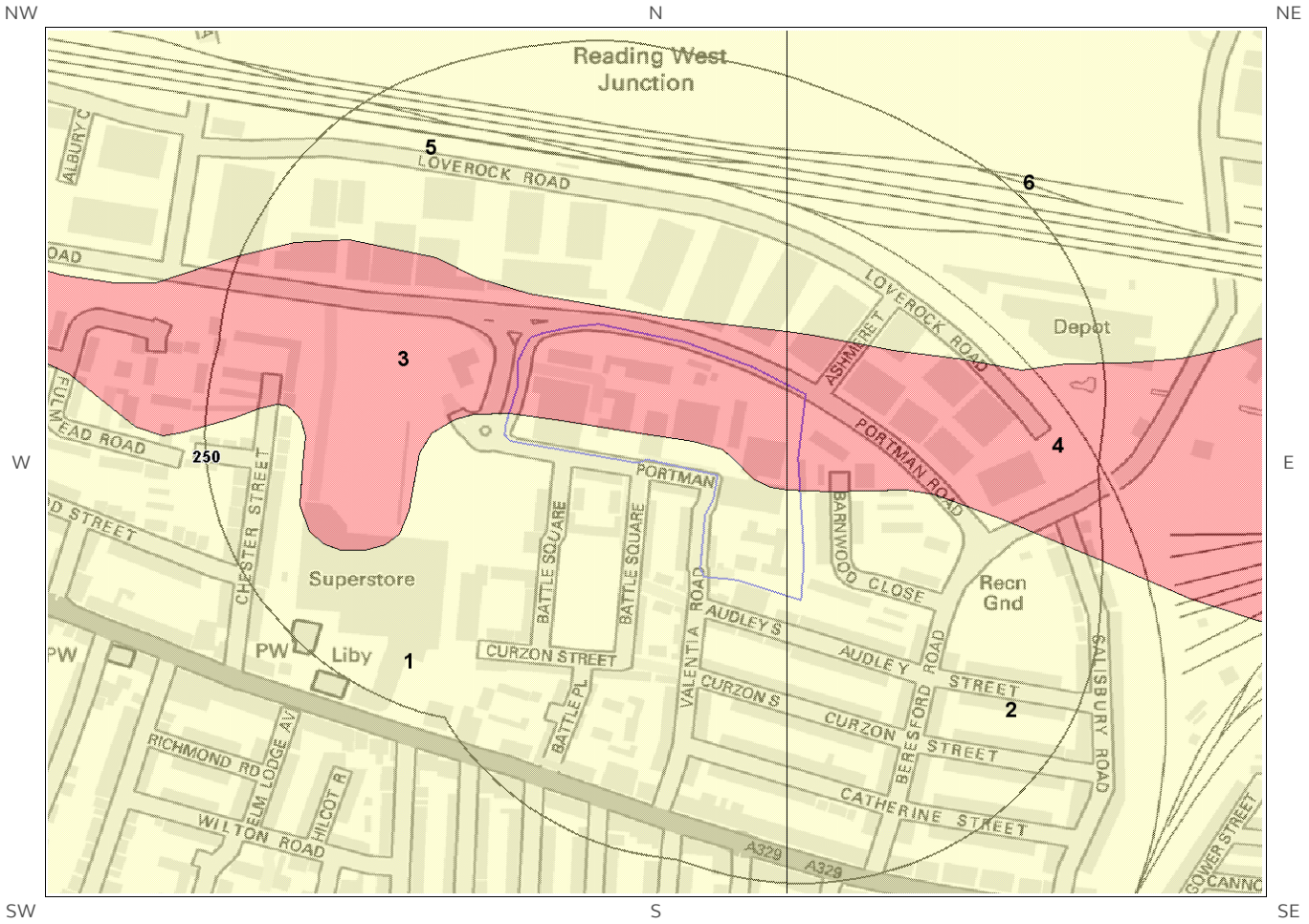


Ground Dissolution Soluble Rocks Legend

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6.4 Compressible Deposits Map

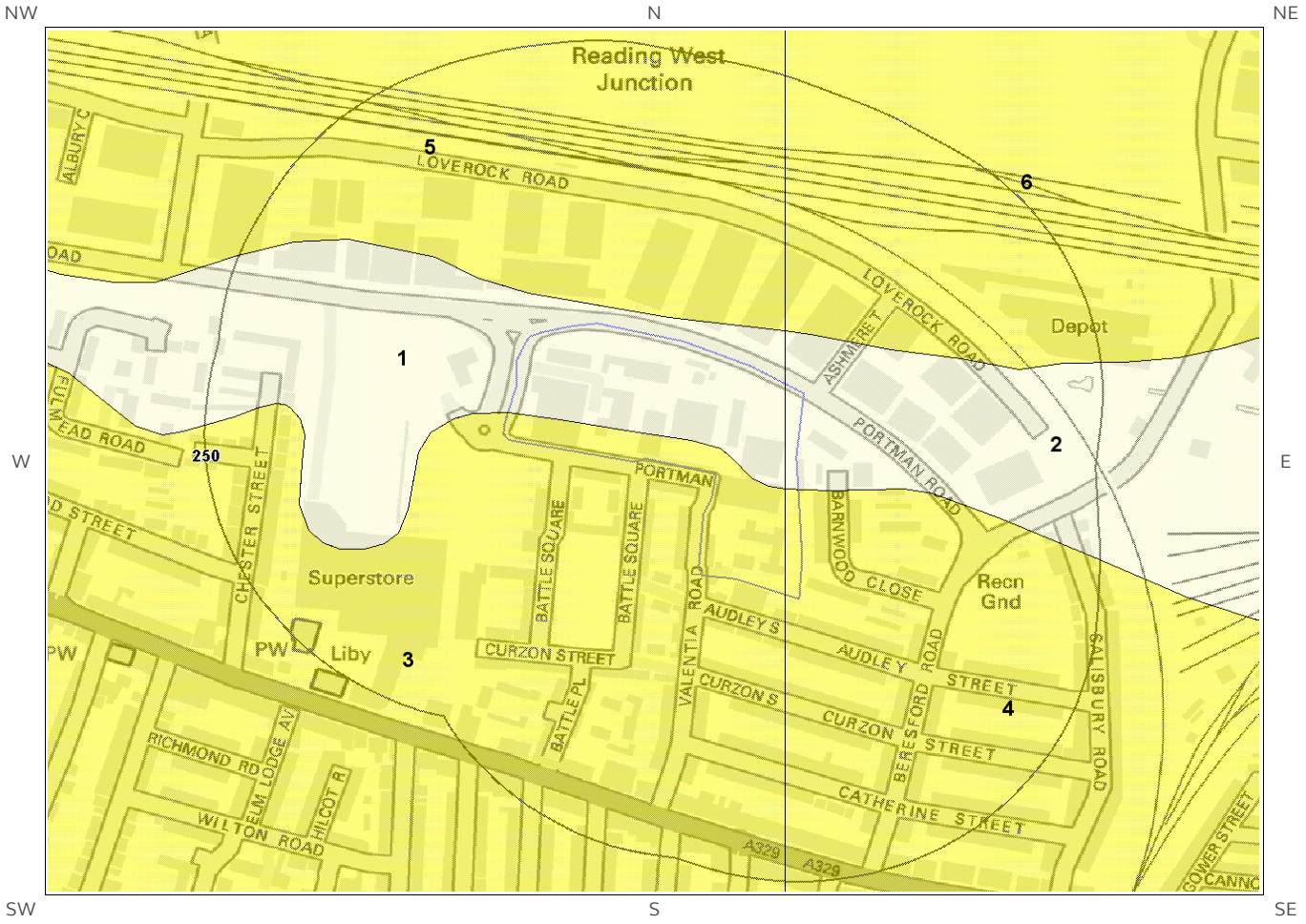


Compressible Deposits Legend

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6.5 Collapsible Deposits Map

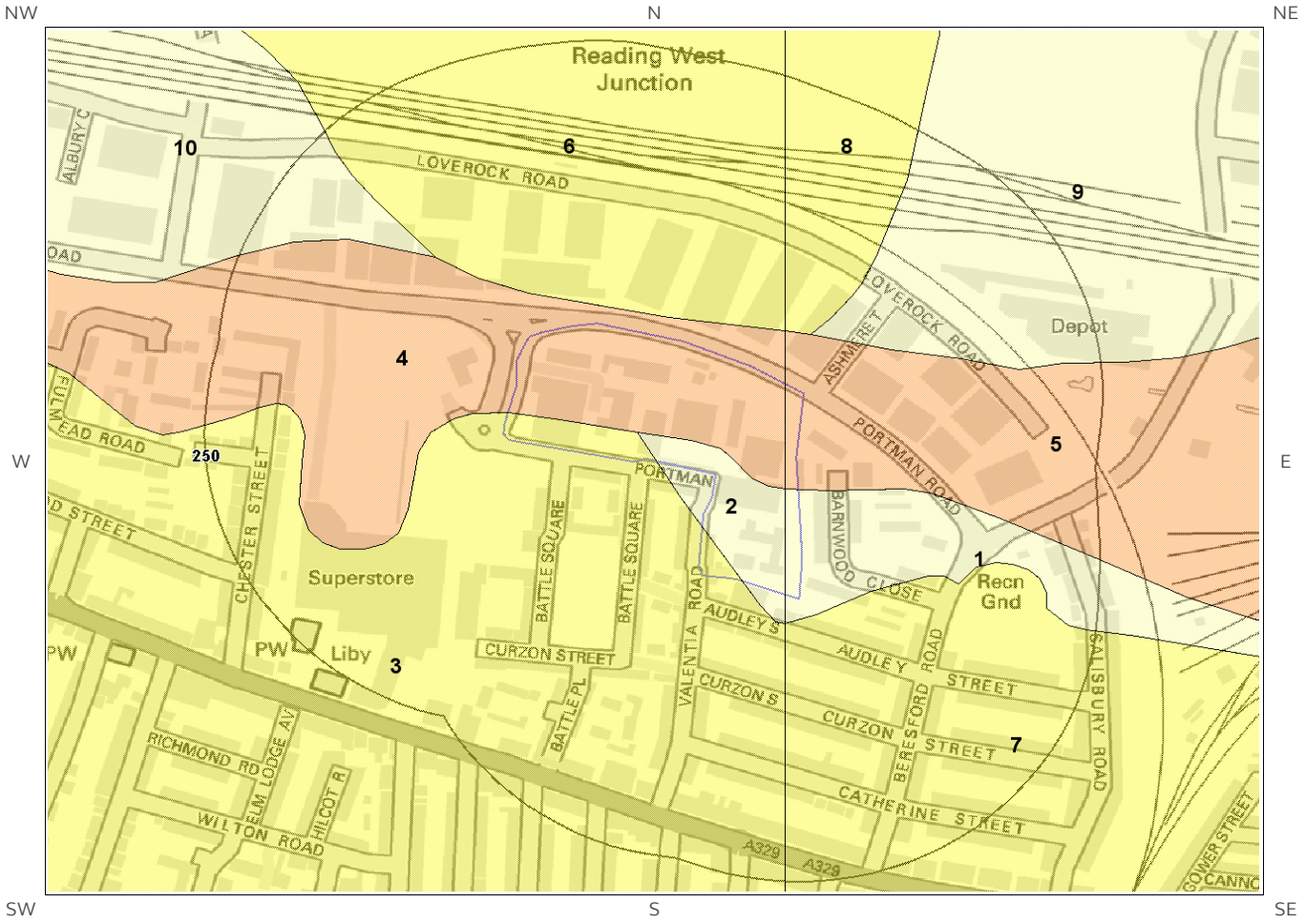


Collapsible Deposits Legend

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6.6 Running Sand Map



Running Sand Legend

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6 Natural Ground Subsidence

The National Ground Subsidence rating is obtained through the 6 natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS).

The following GeoSure data represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

What is the maximum hazard rating of natural subsidence within the study site*[*] boundary? Moderate

6.1 Shrink-Swell Clays

The following Shrink Swell information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.
2	0.0	On Site	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.
3	0.0	On Site	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.
4	0.0	On Site	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.
5	16.0	N	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.

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

ID	Distance (m)	Direction	Hazard Rating	Details
6	42.0	NE	Negligible	Ground conditions predominantly non-plastic. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely likely due to potential problems with shrink-swell clays.

6.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for slope instability identified. 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.
2	0.0	On Site	Negligible	No indicators for slope instability identified. 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.
3	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.
4	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

6.3 Ground Dissolution of Soluble Rocks

The following Ground Dissolution information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.

ID	Distance (m)	Direction	Hazard Rating	Details
2	0.0	On Site	Low	Significant soluble rocks are present. Low possibility of subsidence occurring naturally, but may be possible in adverse conditions such as high surface or subsurface water flow. Consider implications for stability when changes to drainage or new construction are planned. For new build - site investigation should consider potential for dissolution problems on the site and its surroundings. Care should be taken with local drainage into the bedrock. Some possibility groundwater pollution. For existing property - possible increase in insurance risk due to soluble rocks.
3	0.0	On Site	Very Low	Significant soluble rocks are present. Problems unlikely except with considerable surface or subsurface water flow. No special actions required to avoid problems due to soluble rocks. No special ground investigation required or increased construction costs are likely. An increase in financial risk due to potential problems with soluble rocks is unlikely.
4	17.0	S	Low	Significant soluble rocks are present. Low possibility of subsidence occurring naturally, but may be possible in adverse conditions such as high surface or subsurface water flow. Consider implications for stability when changes to drainage or new construction are planned. For new build - site investigation should consider potential for dissolution problems on the site and its surroundings. Care should be taken with local drainage into the bedrock. Some possibility groundwater pollution. For existing property - possible increase in insurance risk due to soluble rocks.
5	49.0	NE	Low	Significant soluble rocks are present. Low possibility of subsidence occurring naturally, but may be possible in adverse conditions such as high surface or subsurface water flow. Consider implications for stability when changes to drainage or new construction are planned. For new build - site investigation should consider potential for dissolution problems on the site and its surroundings. Care should be taken with local drainage into the bedrock. Some possibility groundwater pollution. For existing property - possible increase in insurance risk due to soluble rocks.

6.4 Compressible Deposits

The following Compressible Deposits information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
2	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
3	0.0	On Site	Moderate	Significant potential for compressibility problems. Avoid large differential loadings of ground. Do not drain or de-water ground near the property without technical advice. For new build - consider possibility of compressible ground in ground investigation, construction and building design. Consider effects of groundwater changes. Extra construction costs are likely. For existing property - possible increase in insurance risk from compressibility, especially if water conditions or loading of the ground change significantly.
4	0.0	On Site	Moderate	Significant potential for compressibility problems. Avoid large differential loadings of ground. Do not drain or de-water ground near the property without technical advice. For new build - consider possibility of compressible ground in ground investigation, construction and building design. Consider effects of groundwater changes. Extra construction costs are likely. For existing property - possible increase in insurance risk from compressibility, especially if water conditions or loading of the ground change significantly.

ID	Distance (m)	Direction	Hazard Rating	Details
5	16.0	N	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.
6	42.0	NE	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

6.5 Collapsible Deposits

The following Collapsible Rocks information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for collapsible deposits identified. No actions required to avoid problems due to collapsible deposits. No special ground investigation required, or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
2	0.0	On Site	Negligible	No indicators for collapsible deposits identified. No actions required to avoid problems due to collapsible deposits. No special ground investigation required, or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
3	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
4	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
5	16.0	N	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
6	42.0	NE	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

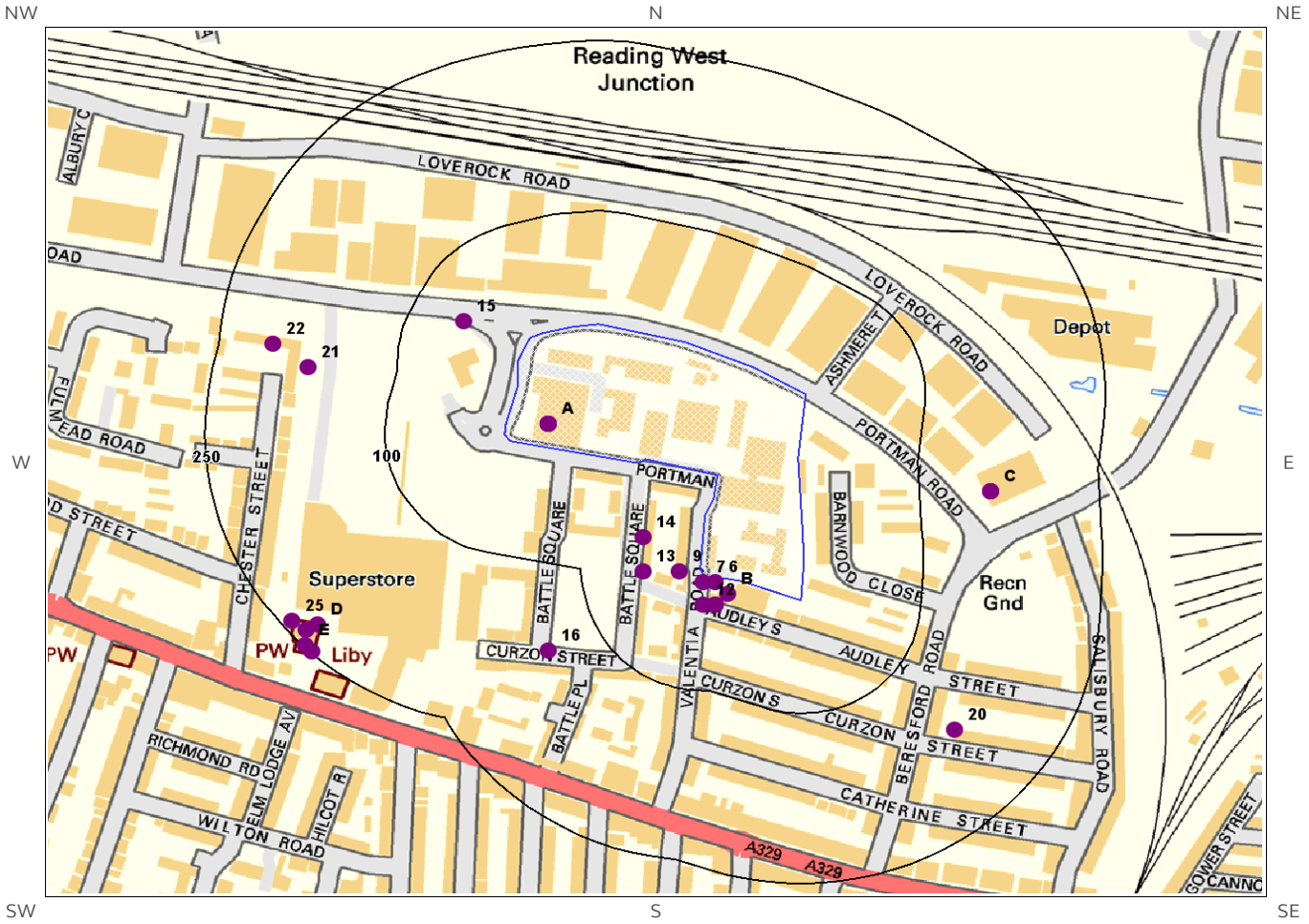
6.6 Running Sands

The following Running Sands information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
2	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
3	0.0	On Site	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

ID	Distance (m)	Direction	Hazard Rating	Details
4	0.0	On Site	Low	Possibility of running sand problems after major changes in ground conditions. Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should reduce likelihood of problems due to running sand. For new build - consider possibility of running sand into trenches or excavations if water table is high or sandy strata are exposed to water. Avoid concentrated water inputs to site. Unlikely to be an increase in construction costs due to potential for running sand. For existing property - no significant increase in insurance risk due to running sand problems is likely.
5	0.0	On Site	Low	Possibility of running sand problems after major changes in ground conditions. Normal maintenance to avoid leakage of water-bearing services or water bodies (ponds, swimming pools) should reduce likelihood of problems due to running sand. For new build - consider possibility of running sand into trenches or excavations if water table is high or sandy strata are exposed to water. Avoid concentrated water inputs to site. Unlikely to be an increase in construction costs due to potential for running sand. For existing property - no significant increase in insurance risk due to running sand problems is likely.
6	16.0	N	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
7	17.0	S	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
8	42.0	NE	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
9	49.0	NE	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

7 Borehole Records Map



Borehole Records Legend

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Site Outline

Borehole Locations

125
250
Search Buffers (m)

7 Borehole Records

The systematic analysis of data extracted from the BGS Borehole Records database provides the following information.

Records of boreholes within 250m of the study site boundary: 27

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
1A	0.0	On Site	469800 173900	SU67SE122	12.0	BATTLE HOSPITAL READING 1
2A	0.0	On Site	469800 173900	SU67SE124	15.0	BATTLE HOSPITAL READING 3
3A	0.0	On Site	469800 173900	SU67SE123	15.0	BATTLE HOSPITAL READING 2
4A	0.0	On Site	469800 173900	SU67SE125	12.0	BATTLE HOSPITAL READING 4
5A	0.0	On Site	469800 173900	SU67SE126	7.0	BATTLE HOSPITAL READING 5
6	5.0	S	469940 173760	SU67SE909	-1.0	BATTLE HOSPITAL READING 2
7	5.0	S	469930 173760	SU67SE911	-1.0	BATTLE HOSPITAL READING TP2
8B	14.0	S	469950 173750	SU67SE910	-1.0	BATTLE HOSPITAL READING TP1
9	18.0	W	469910 173770	SU67SE914	-1.0	BATTLE HOSPITAL READING TP5
10B	24.0	S	469940 173740	SU67SE913	-1.0	BATTLE HOSPITAL READING TP4
11B	24.0	S	469940 173740	SU67SE908	-1.0	BATTLE HOSPITAL READING 1
12	25.0	S	469930 173740	SU67SE912	-1.0	BATTLE HOSPITAL READING TP3
13	48.0	W	469880 173770	SU67SE915	-1.0	BATTLE HOSPITAL READING TP6
14	50.0	W	469880 173800	SU67SE916	-1.0	BATTLE HOSPITAL READING TP7
15	56.0	NW	469730 173990	SU67SE429	-1.0	CHESTER ST READING
16	146.0	SW	469800 173700	SU67SE101	45.72	BATTLE HOSPITAL READING
17C	159.0	E	470170 173840	SU77SW119	8.53	BATTLE FARM EST 3
18C	159.0	E	470170 173840	SU77SW118	15.24	BATTLE FARM EST 2
19C	159.0	E	470170 173840	SU77SW117	7.62	BATTLE FARM EST 1
20	172.0	SE	470140 173630	SU77SW680	13.71	44 CURZON STREET READING
21	173.0	W	469600 173950	SU67SE428	-1.0	CHESTER ST READING
22	205.0	W	469570 173970	SU67SE427	-1.0	CHESTER ST READING

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
23D	228.0	SW	469608 173723	SU67SE664	2.2	EMMANUEL METHODIST CHURCH READING TP 5
24D	239.0	SW	469598 173718	SU67SE660	15.0	EMMANUEL METHODIST CHURCH READING 1
25	242.0	SW	469586 173726	SU67SE663	2.1	EMMANUEL METHODIST CHURCH READING TP 4
26E	249.0	SW	469597 173705	SU67SE661	15.0	EMMANUEL METHODIST CHURCH READING 2
27E	249.0	SW	469603 173699	SU67SE665	2.2	EMMANUEL METHODIST CHURCH READING TP 6

The borehole records are available using the hyperlinks below: Please note that if the donor of the borehole record has requested the information be held as commercial-in-confidence, the additional data will be held separately by the BGS and a formal request must be made for its release.

#1A: scans.bgs.ac.uk/sobi_scans/boreholes/423539
#2A: scans.bgs.ac.uk/sobi_scans/boreholes/423541
#3A: scans.bgs.ac.uk/sobi_scans/boreholes/423540
#4A: scans.bgs.ac.uk/sobi_scans/boreholes/423542
#5A: scans.bgs.ac.uk/sobi_scans/boreholes/423543
#15: scans.bgs.ac.uk/sobi_scans/boreholes/423846
#16: scans.bgs.ac.uk/sobi_scans/boreholes/423518
#17C: scans.bgs.ac.uk/sobi_scans/boreholes/428271
#18C: scans.bgs.ac.uk/sobi_scans/boreholes/428270
#19C: scans.bgs.ac.uk/sobi_scans/boreholes/428269
#20: scans.bgs.ac.uk/sobi_scans/boreholes/428832
#21: scans.bgs.ac.uk/sobi_scans/boreholes/423845
#22: scans.bgs.ac.uk/sobi_scans/boreholes/423844
#23D: scans.bgs.ac.uk/sobi_scans/boreholes/15637512
#24D: scans.bgs.ac.uk/sobi_scans/boreholes/15637506
#25: scans.bgs.ac.uk/sobi_scans/boreholes/15637511
#26E: scans.bgs.ac.uk/sobi_scans/boreholes/15637509
#27E: scans.bgs.ac.uk/sobi_scans/boreholes/15637513

8 Estimated Background Soil Chemistry

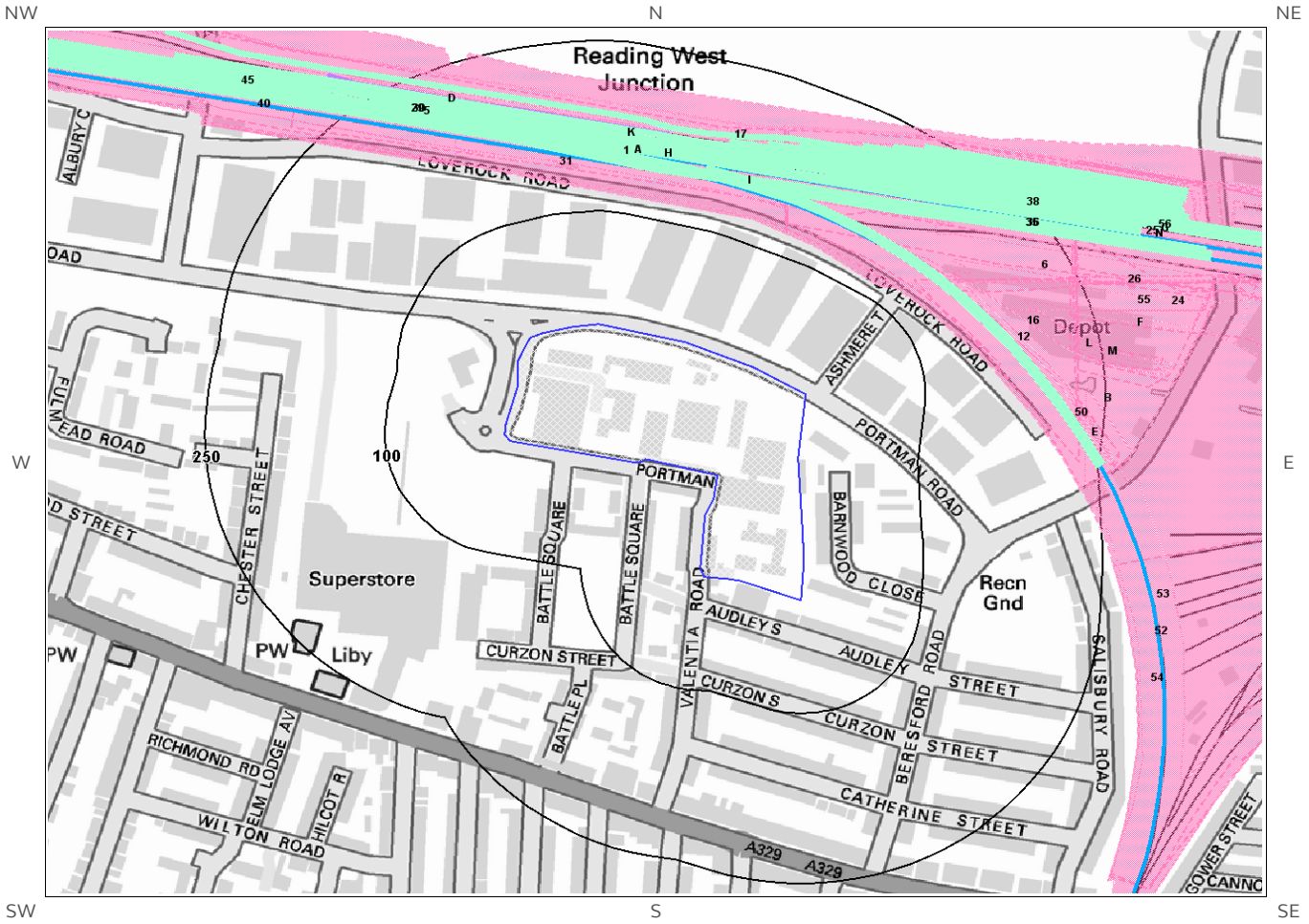
Records of background estimated soil chemistry within 250m of the study site boundary: 15

For further information on how this data is calculated and limitations upon its use, please see the Groundsure Geo Insight User Guide, available on request.

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	Sediment	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	Sediment	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	Sediment	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
0.0	On Site	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
12.0	N	Sediment	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
16.0	N	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
17.0	N	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
17.0	S	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
25.0	S	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
42.0	NE	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
42.0	NE	Sediment	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg
49.0	NE	Sediment	15 - 25 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	15 - 30 mg/kg	<100 mg/kg

*As this data is based upon underlying 1:50,000 scale geological information, a 50m buffer has been added to the search radius.

9 Railways and Tunnels Map



Railways and Tunnels Legend

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- Site Outline
- Search Buffers (m) — 250 / 500
- Underground or Partially Underground Railway / Subway System
- Railway Tunnel (OS Mapping)
- Abandoned or Dismantled Railway (OpenStreetMap)
- Railway Track (OS Mapping)
- Railway Track (OpenStreetMap)
- High Speed 2
- High Speed 2 Revised Proposed Route
- Crossrail 1
- Railway and/or Tunnel Feature from Historical Mapping

9 Railways and Tunnels

9.1 Tunnels

This data is derived from OpenStreetMap and provides information on the possible locations of underground railway systems in the UK - the London Underground, the Tyne & Wear Metro and the Glasgow Subway.

Have any underground railway lines been identified within the study site boundary? No

Have any underground railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

This data is derived from Ordnance Survey mapping and provides information on the possible locations of railway tunnels forming part of the UK overground railway network.

Have any other railway tunnels been identified within the site boundary? No

Have any other railway tunnels been identified within 250m of the site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

9.2 Historical Railway and Tunnel Features

This data is derived from Groundsure's unique Historical Land-use Database and contains features relating to tunnels, railway tracks or associated works that have been identified from historical Ordnance Survey mapping.

Have any historical railway or tunnel features been identified within the study site boundary? No

Have any historical railway or tunnel features been identified within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Details	Date
1	113	NE	469670 174167	Railway Sidings	1900
2A	119	NE	469658 174171	Railway Sidings	1932
3A	119	NE	469658 174171	Railway Sidings	1938
4A	119	NE	469658 174171	Railway Sidings	1910
5	119	N	469317 174238	Railway Sidings	1960
6	120	NE	471525 173860	Railway Sidings	1962

ID	Distance (m)	Direction	NGR	Details	Date
7B	127	NE	470437 173767	Railway Sidings	1971
8B	127	NE	470437 173767	Railway Sidings	1977
9C	129	N	471493 173844	Railway Sidings	1994
10C	129	N	471493 173844	Railway Sidings	1989
11I	131	N	469979 174110	Railway Sidings	1878
29	134	N	468357 174448	Railway Sidings	1960
12	135	NE	470211 173947	Railway Sidings	1932
30	135	N	469358 174251	Railway Sidings	1960
31	139	N	469816 174129	Railway Sidings	1993
13D	143	N	469700 174193	Railway Sidings	1974
14D	143	N	469700 174193	Railway Sidings	1982
15D	143	N	469700 174193	Railway Sidings	1991
32H	144	N	469405 174251	Railway Sidings	1934
33H	144	N	469405 174251	Railway Sidings	1913
34H	144	N	469405 174251	Railway Sidings	1936
35	144	N	470188 174076	Railway Sidings	1959
36	145	N	470250 174075	Railway Sidings	1959
37I	149	N	469999 174101	Railway Sidings	1959
38	151	N	470250 174075	Railway Sidings	1972
16	152	NE	470217 173965	Railway Sidings	1938
17	157	N	470053 174155	Railway Sidings	1901
39	158	N	469515 174219	Railway Sidings	1897
40	164	NW	n/a	Railway	1877
41K	166	N	469871 174154	Railway Sidings	1897
42J	167	NE	470230 173935	Railway Sidings	1959
43J	168	NE	470230 173934	Railway Sidings	1958
44K	168	N	469873 174156	Railway Sidings	1959
45	176	NW	n/a	Railway	1932
46L	186	NE	470254 173972	Railway Sidings	1959
47L	187	NE	470240 173972	Railway Sidings	1958

ID	Distance (m)	Direction	NGR	Details	Date
18M	224	E	470275 173964	Railway Sidings	1933
19E	226	E	470259 173894	Railway Sidings	1938
20E	226	E	470260 173882	Railway Sidings	1938
21E	226	E	470260 173882	Railway Sidings	1913
22F	226	E	470298 173977	Railway Sidings	1938
48E	226	E	470256 173892	Railway Sidings	1912
49E	226	E	470256 173892	Railway Sidings	1931
23F	228	E	470300 173979	Railway Sidings	1938
50	228	E	470247 173909	Railway Sidings	1900
51M	229	E	470265 173960	Railway Sidings	1931
24	232	E	470607 173955	Railway Sidings	1933
52	234	E	n/a	Railway	1900
53	234	E	n/a	Railway	1931
54	234	E	n/a	Railway	1879
55	236	E	470298 174003	Railway Sidings	1931
25	244	NE	470295 174077	Railway Sidings	1897
26	245	NE	470296 174025	Railway Sidings	1900
56	245	NE	n/a	Railway	1913
27G	246	NE	470440 174077	Railway Sidings	1938
28G	246	NE	470440 174077	Railway Sidings	1910
57N	246	NE	470414 174075	Railway Sidings	1936
58N	246	NE	470414 174075	Railway Sidings	1932
59N	246	NE	470414 174075	Railway Sidings	1913

Any records that have been identified are represented on the Railways and Tunnels Map.

9.3 Historical Railways

This data is derived from OpenStreetMap and provides information on the possible alignments of abandoned or dismantled railway lines in proximity to the study site.

Have any historical railway lines been identified within the study site boundary? No

Have any historical railway lines been identified within 250m of the study site boundary? Yes

Distance (m)	Direction	Status
168	N	Disused
169	N	Disused
174	N	Disused
175	N	Disused
250	NW	Disused

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels Map.

9.4 Active Railways

These datasets are derived from Ordnance Survey mapping and OpenStreetMap and provide information on the possible locations of active railway lines in proximity to the study site.

Have any active railway lines been identified within the study site boundary? No

Have any active railway lines been identified within 250m of the study site boundary? Yes

Distance (m)	Direction	Name	Type
142	N	Not given	Multi Track
142	N	Not given	Multi Track
143	N	Not given	Multi Track
143	N	Not given	Multi Track
143	N	Not given	Multi Track
143	N	Not given	Multi Track
143	N	Not given	Multi Track
143	N	Not given	Multi Track
144	N	Great Western Main Line	Rail
144	N	Not given	Multi Track
144	N	Not given	Multi Track
144	N	Great Western Main Line	Rail
145	N	Not given	Multi Track
145	N	Not given	Multi Track
146	NE	Not given	Rail
146	NE	Not given	Rail
147	N	Great Western Main Line	Rail
147	N	Not given	Rail
147	N	Great Western Main Line	Rail
147	N	Not given	Rail
148	N	Not given	Rail
148	N	Not given	Rail
149	N	Not given	Rail
149	N	Not given	Rail

Distance (m)	Direction	Name	Type
151	N	Not given	Rail
151	N	Not given	Rail
153	N	Great Western Main Line	Construction
153	N	Great Western Main Line	Construction
154	N	Not given	Multi Track
154	N	Not given	Multi Track
156	N	Not given	Rail
156	N	Not given	Rail
160	N	Not given	Rail
160	N	Not given	Rail
160	N	Not given	Rail
160	N	Not given	Rail
165	N	Great Western Main Line	Rail
165	N	Great Western Main Line	Rail
168	N	Not given	Rail
168	N	Not given	Rail
171	N	Not given	Rail
171	N	Not given	Rail
172	N	Great Western Main Line	Rail
172	N	Great Western Main Line	Rail
173	N	Not given	Rail
173	N	Not given	Rail
175	N	Great Western Main Line	Rail
175	N	Great Western Main Line	Rail
181	N	Not given	Rail
181	N	Not given	Multi Track
181	N	Not given	Multi Track
181	N	Not given	Rail
182	N	Not given	Rail
182	N	Not given	Rail
189	N	Not given	Rail
189	N	Not given	Rail
193	N	Not given	Rail
193	N	Not given	Rail
196	N	Not given	Rail
196	N	Not given	Rail
198	N	Not given	Rail
198	N	Not given	Rail
216	NE	Not given	Rail
216	NE	Not given	Rail
218	NE	Great Western Main Line	Construction
218	NE	Great Western Main Line	Construction
227	NE	Not given	Rail
227	NE	Not given	Rail
233	NW	Great Western Main Line	Rail
233	NW	Great Western Main Line	Rail
236	NW	Great Western Main Line	Rail
236	NW	Great Western Main Line	Rail
239	NE	Not given	Rail
239	NE	Not given	Rail

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels Map.

9.5 Railway Projects

These datasets provide information on the location of large scale railway projects High Speed 2 and Crossrail 1 .

Is the study site within 5km of the route of the High Speed 2 rail project?	No
Is the study site within 500m of the route of the Crossrail 1 rail project?	No

Further information on proximity to these routes, the project construction status and associated works can be obtained through the purchase of a Groundsure HS2 and Crossrail 1 Report.

The route data has been digitised from publicly available maps by Groundsure. The route as provided relates to the Crossrail 1 project only, and does not include any details of the Crossrail 2 project, as final details of the route for Crossrail 2 are still under consultation.

Please note that this assessment takes account of both the original Phase 2b proposed route and the amended route proposed in 2016. As the Phase 2b route is still under consultation, Groundsure are providing information on both options until the final route is formally confirmed. Practitioners should take account of this uncertainty when advising clients.

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Address:	**Battle Hospital,**
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Reference:	**EMS-411382_549897**
Client:	**emapsite**

NW N NE

W E

SW S SE



Aerial Photograph Capture date:	20-Apr-2015
Grid Reference:	469909,173891
Site Size:	3.26ha

Report Reference: EMS-411382_549897
Client Reference: EMS_411382_549897

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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	7	9	68	60
1.2 Additional Information – Historical Tank Database	4	0	9	19
1.3 Additional Information – Historical Energy Features Database	6	4	23	33
1.4 Additional Information – Historical Petrol and Fuel Site Database	0	0	0	2
1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database	0	0	0	2
1.6 Potentially Infilled Land	0	5	26	10

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	3	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	1	1	3
2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	1	0
2.1.8 Records of Licensed Discharge Consents	0	0	0	1
2.1.9 Records of Water Industry Referrals	0	0	1	1
2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site	0	0	0	1
2.2 Records of COMAH and NIHHS sites	0	0	1	0
2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents				
2.3.1 National Incidents Recording System, List 2	0	1	1	1
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	1

Section 3: Landfill and Other Waste Sites	On-site	0-50m	51-250	251-500	501-1000	1000-1500
3.1 Landfill Sites						
3.1.1 Environment Agency/Natural Resources Wales Registered Landfill Sites	0	0	0	0	0	Not searched
3.1.2 Environment Agency/Natural Resources Wales Historic Landfill Sites	0	0	1	0	1	0
3.1.3 BGS/DoE Landfill Site Survey	0	0	0	0	0	0
3.1.4 Records of Landfills in Local Authority and Historical Mapping Records	0	0	0	0	0	0
3.2 Landfill and Other Waste Sites Findings						
3.2.1 Operational and Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	1	0	Not searched	Not searched
3.2.2 Environment Agency/Natural Resources Wales Licensed Waste Sites	0	0	5	1	5	1

Section 4: Current Land Use	On-site	0-50m	51-250	251-500
4.1 Current Industrial Sites Data	5	12	52	Not searched
4.2 Records of Petrol and Fuel Sites	0	1	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)	1	0	0	5	7	8
6.4 Surface Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	5
6.5 Potable Water Abstraction Licences (within 2000m of the study site)	1	0	0	0	2	3
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)	2	0	2	0	Not searched	Not searched

Section 6: Hydrogeology and Hydrology

	0-500m					
	On-site	0-50m	51-250	251-500	501-1000	1000-1500
6.9 Is there any Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site?	No	No	No	No	No	No
6.10 Detailed River Network entries within 500m of the site	0	0	0	3	Not searched	Not searched
6.11 Surface water features within 250m of the study site	No	No	No	Not searched	Not searched	Not searched

Section 7: Flooding

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

Section 8: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	0
8.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0
8.3 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
8.4 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
8.5 Records of Ramsar sites	0	0	0	0	0	0
8.6 Records of Ancient Woodlands	0	0	0	0	0	1
8.7 Records of Local Nature Reserves (LNR)	0	0	0	0	0	5
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

Section 8: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.10 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	1
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	2	0	0	0	0	1
8.14 Records of Green Belt land	0	0	0	0	0	0

Section 9: Natural Hazards

9.1 What is the maximum risk of natural ground subsidence?	Moderate
9.1.1 What is the maximum Shrink-Swell hazard rating identified on the study site?	Very Low
9.1.2 What is the maximum Landslides hazard rating identified on the study site?	Very Low
9.1.3 What is the maximum Soluble Rocks hazard rating identified on the study site?	Low
9.1.4 What is the maximum Compressible Ground hazard rating identified on the study site?	Moderate
9.1.5 What is the maximum Collapsible Rocks hazard rating identified on the study site?	Very Low
9.1.6 What is the maximum Running Sand hazard rating identified on the study site?	Low
9.2 Radon	
9.2.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is 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?	Yes
10.3 Are there any brine affected areas within 75m of the study site?	No

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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.

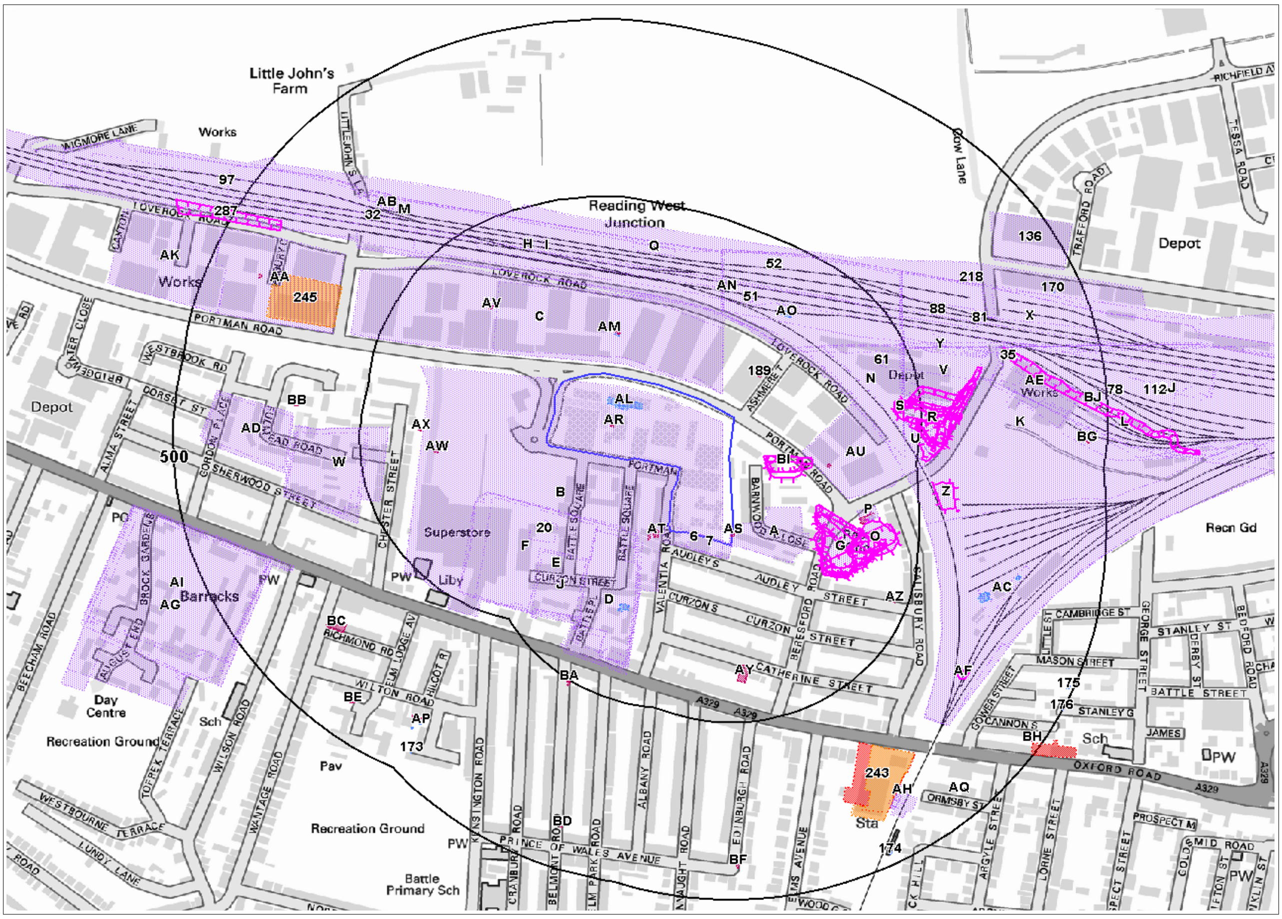
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1. Historical Land Use

NW N NE

W E



SW S SE

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Site Outline

Search Buffers (m): 250, 500

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: 144

ID	Distance [m]	Direction	Use	Date
1B	0	On Site	Hospital	1991
2A	0	On Site	Tin Works	1910
3A	0	On Site	Tin Works	1938
4B	0	On Site	Hospital	1982
5B	0	On Site	Hospital	1974
6	0	On Site	Unspecified Works	1960
7	0	On Site	Tin Works	1932
8C	15	N	Unspecified Works	1991
9C	15	N	Unspecified Commercial/Industrial	1982
10AM	19	N	Unspecified Commercial/Industrial	1974
11D	43	W	Workhouse	1898
12E	44	W	Hospital	1932
13D	44	W	Unspecified Workhouse	1898
14D	44	W	Unspecified Workhouse	1910
15E	45	W	Hospital	1960
16E	46	W	Hospital	1938
17F	90	S	Isolation Hospital	1910
18F	90	S	Infectious Hospital	1898
19AU	95	E	Unspecified Depot	1971
20	104	S	Infectious Diseases Hospital	1898
21G	109	E	Unspecified Pit	1962
22G	110	E	Gravel Pit	1898
23G	111	E	Unspecified Pit	1938
24G	112	E	Unspecified Pit	1932
25G	112	E	Unspecified Pit	1932
26G	113	E	Gravel Pit	1898
27H	113	NE	Railway Sidings	1900
28J	118	W	Hospital	1898
29H	119	NE	Railway Sidings	1932
30I	119	NE	Railway Sidings	1910
31I	119	NE	Railway Sidings	1938
32	119	N	Railway Sidings	1960

33J	120	W	Hospital	1910
34J	120	W	Hospital	1898
35	120	NE	Railway Sidings	1962
36G	122	E	Unspecified Pit	1989
37G	122	E	Unspecified Pit	1977
38G	122	E	Unspecified Pit	1971
39G	122	E	Unspecified Pit	1994
40K	127	NE	Railway Sidings	1971
41K	127	NE	Railway Sidings	1977
42	128	E	Unspecified Ground Workings	1910
43L	129	N	Railway Sidings	1994
44L	129	N	Railway Sidings	1989
45AN	131	N	Railway Sidings	1878
46N	135	NE	Railway Sidings	1932
47M	143	N	Railway Sidings	1982
48M	143	N	Railway Sidings	1974
49M	143	N	Railway Sidings	1991
50N	152	NE	Railway Sidings	1938
51	153	NE	Unspecified Tank	1878
52	157	N	Railway Sidings	1901
53O	159	E	Old Gravel Pit	1898
54O	163	E	Old Gravel Pit	1898
55P	167	E	Pumping Station	1989
56P	167	E	Pumping Station	1994
57P	175	E	Pumping Station	1977
58Q	178	N	Railway Building	1991
59Q	178	N	Railway Building	1982
60Q	178	N	Railway Building	1974
61	206	E	Railway Building	1932
62W	212	W	Nursery	1910
63R	213	E	Unspecified Pit	1989
64R	213	E	Unspecified Pit	1977
65R	213	E	Unspecified Pit	1971
66R	213	E	Unspecified Pit	1994
67S	216	E	Unspecified Pit	1910
68S	216	E	Unspecified Pit	1938
69T	218	E	Unspecified Ground Workings	1962
70T	224	E	Railway Sidings	1933
71T	225	E	Unspecified Ground Workings	1938
72T	226	E	Unspecified Ground Workings	1913
73U	226	E	Railway Sidings	1938
74U	226	E	Railway Sidings	1938
75U	226	E	Railway Sidings	1913

76V	226	E	Railway Sidings	1938
77V	228	E	Railway Sidings	1938
78	232	E	Railway Sidings	1933
79W	239	W	Nursery	1898
80W	242	W	Nursery	1898
81	244	NE	Railway Sidings	1897
82Y	245	NE	Railway Sidings	1900
83X	246	NE	Railway Sidings	1910
84X	246	NE	Railway Sidings	1938
85R	252	E	Railway Buildings	1977
86R	252	E	Railway Buildings	1962
87R	252	E	Railway Buildings	1971
88	264	NE	Railway Sidings	1900
89Y	264	E	Railway Sidings	1913
90Z	270	E	Cuttings	1977
91Z	270	E	Cuttings	1971
92Z	270	E	Cuttings	1989
93Z	270	E	Cuttings	1994
94AA	310	W	Unspecified Works	1974
95AA	310	W	Unspecified Commercial/Industrial	1982
96AA	310	W	Unspecified Commercial/Industrial	1991
97	313	NW	Railway Sidings	1900
98M	333	NW	Railway Building	1960
99AB	335	NW	Railway Building	1938
100AB	335	NW	Railway Building	1910
101AB	335	NW	Railway Building	1932
102AB	336	NW	Railway Building	1900
103AC	336	E	Railway Buildings	1971
104AC	336	E	Unspecified Depot	1977
105AC	336	E	Unspecified Depot	1989
106AC	336	E	Unspecified Depot	1994
107AB	339	NW	Railway Buildings	1974
108AD	341	W	Nursery	1898
109AD	342	W	Nursery	1898
110AE	344	E	Unspecified Depot	1977
111AE	344	E	Unspecified Depot	1971
112	348	E	Railway Sidings	1938
113AF	352	SE	Unspecified Pit	1938
114AF	352	SE	Unspecified Pit	1913
115AF	353	SE	Railway Building	1962
116AF	354	SE	Railway Building	1938
117AB	357	NW	Railway Building	1991
118AB	357	NW	Railway Building	1982
119	361	E	Railway Sidings	1938

120AJ	362	E	Railway Sidings	1913
121AE	362	E	Unspecified Depot	1989
122AE	362	E	Unspecified Depot	1994
123BJ	371	E	Refuse Heap	1913
124AG	381	SW	Barracks	1991
125AG	382	SW	Barracks	1974
126AG	401	SW	Barracks	1932
127AG	403	SW	Barracks	1960
128AH	403	SE	Railway Station	1994
129AH	403	SE	Railway Station	1977
130AH	403	SE	Railway Station	1989
131AI	407	SW	Barracks	1898
132AI	407	SW	Barracks	1938
133AI	407	SW	Barracks	1910
134AI	408	SW	Barracks	1898
135AH	409	SE	Railway Station	1971
136	412	NE	Unspecified Works	1962
137AH	415	SE	Railway Station	1932
138AH	416	SE	Railway Station	1910
139AH	416	SE	Railway Station	1938
140AH	418	SE	Railway Station	1962
141AJ	460	E	Railway Sidings	1898
142AK	465	W	Unspecified Works	1991
143AK	465	W	Unspecified Works	1982
144AK	465	W	Unspecified Depots	1974

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: 32

ID	Distance (m)	Direction	Use	Date
145AL	0	On Site	Tanks	1973
146AL	0	On Site	Tanks	1990
147AL	0	On Site	Tanks	1993
148AL	0	On Site	Tanks	1996
149AM	55	N	Unspecified Tank	1976
150AM	55	N	Unspecified Tank	1993
151D	119	SW	Tanks	1990
152D	119	SW	Tanks	1881
153AN	153	NE	Unspecified Tank	1936
154AO	156	NE	Unspecified Tank	1913

155AO	157	NE	Unspecified Tank	1959
156AO	157	NE	Unspecified Tank	1959
157AO	158	NE	Unspecified Tank	1988
158AC	338	E	Tanks	1993
159AC	339	E	Tanks	1971
160AC	342	E	Tanks	1988
161AC	383	E	Unspecified Tank	1993
162AC	384	E	Unspecified Tank	1971
163AC	384	E	Unspecified Tank	1960
164AP	424	SW	Unspecified Tank	1974
165AP	425	SW	Unspecified Tank	1959
166AP	425	SW	Unspecified Tank	1989
167AP	425	SW	Unspecified Tank	1960
168AP	436	SW	Unspecified Tank	1959
169AP	437	SW	Unspecified Tank	1972
170	459	NE	Unspecified Tank	1877
171AQ	462	SE	Unspecified Tank	1877
172AQ	462	SE	Unspecified Tank	1989
173	463	SW	Unspecified Tank	1932
174	480	SE	Unspecified Tank	1931
175	490	SE	Unspecified Tank	1988
176	497	SE	Unspecified Tank	

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: 66

ID	Distance (m)	Direction	Use	Date
177AR	0	On Site	Electricity Substation	1973
178AR	0	On Site	Electricity Substation	1993
179AR	0	On Site	Electricity Substation	1996
180AS	0	On Site	Electricity Substation	1971
181AS	0	On Site	Electricity Substation	1988
182AS	0	On Site	Electricity Substation	1993
183AT	15	W	Electricity Substation	1973
184AT	15	W	Electricity Substation	1993
185AT	15	W	Electricity Substation	1996
186AT	25	W	Electricity Substation	1990
187AM	57	N	Electricity Substation	1976
188AM	58	N	Electricity Substation	1971
189	65	NE	Electricity Substation	1988

190AU	130	E	Electricity Substation	1993
191AU	130	E	Electricity Substation	1976
192AV	140	NW	Electricity Substation	1973
193AV	140	NW	Electricity Substation	1996
194AW	144	W	Electricity Substation	1993
195AW	145	W	Electricity Substation	1973
196AW	145	W	Electricity Substation	1993
197AX	168	W	Electricity Substation	1996
198AX	168	W	Electricity Substation	1990
199AX	168	W	Electricity Substation	1988
200AX	168	W	Electricity Substation	1971
201AY	169	S	Electricity Substation	1988
202AY	169	S	Electricity Substation	1993
203P	169	E	Electricity Substation	1993
204AY	169	S	Electricity Substation	1971
205P	170	E	Electricity Substation	1988
206P	179	E	Electricity Substation	1993
207AZ	229	E	Electricity Substation	1996
208AZ	230	E	Electricity Substation	1993
209BA	242	SW	Electricity Substation	1990
210BA	252	SW	Electricity Substation	1968
211BA	252	SW	Electricity Substation	1971
212BB	335	W	Electricity Substation	1993
213BB	335	W	Electricity Substation	1988
214BB	336	W	Electricity Substation	1986
215BB	336	W	Electricity Substation	1988
216BB	336	W	Electricity Substation	1972
217BB	336	W	Electricity Substation	1993
218	368	NE	Electricity Substation	1971
219BC	371	SW	Electricity Substation	1968
220BC	371	SW	Electricity Substation	1986
221BC	371	SW	Electricity Substation	1988
222BC	372	SW	Electricity Substation	1988
223BC	372	SW	Electricity Substation	1969
224BC	372	SW	Electricity Substation	1993
225AP	419	SW	Electricity Substation	1973
226AP	419	SW	Electricity Substation	1996
227AP	419	SW	Electricity Substation	1990
228AP	419	SW	Electricity Substation	1976
229AP	420	SW	Electricity Substation	1974
230AA	426	NW	Electricity Substation	1989
231BD	437	S	Electricity Substation	1990
232BD	437	S	Electricity Substation	1973
233BE	444	SW	Electricity Substation	1996
234BE	444	SW	Electricity Substation	1993
235BE	445	SW	Electricity Substation	1993

236BE	445	SW	Electricity Substation	1978
237BF	445	S	Electricity Substation	1971
238BF	445	S	Electricity Substation	1988
239BF	446	S	Electricity Substation	1993
240BG	470	E	Electricity Substation	1993
241BG	470	E	Electricity Substation	
242BH	486	SE	Electricity Substation	

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: 2

ID	Distance (m)	Direction	Use	Date
243	326	SE	Filling Station	1978
244BH	490	SE	Filling Station	1978

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: 2

ID	Distance (m)	Direction	Use	Date
245	311	W	Garage	1976
246AH	338	SE	Garage	1971

1.6 Potentially Infilled Land

Records of Potentially Infilled Features from 1:10,000 scale mapping within 500m of the study site: 41

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

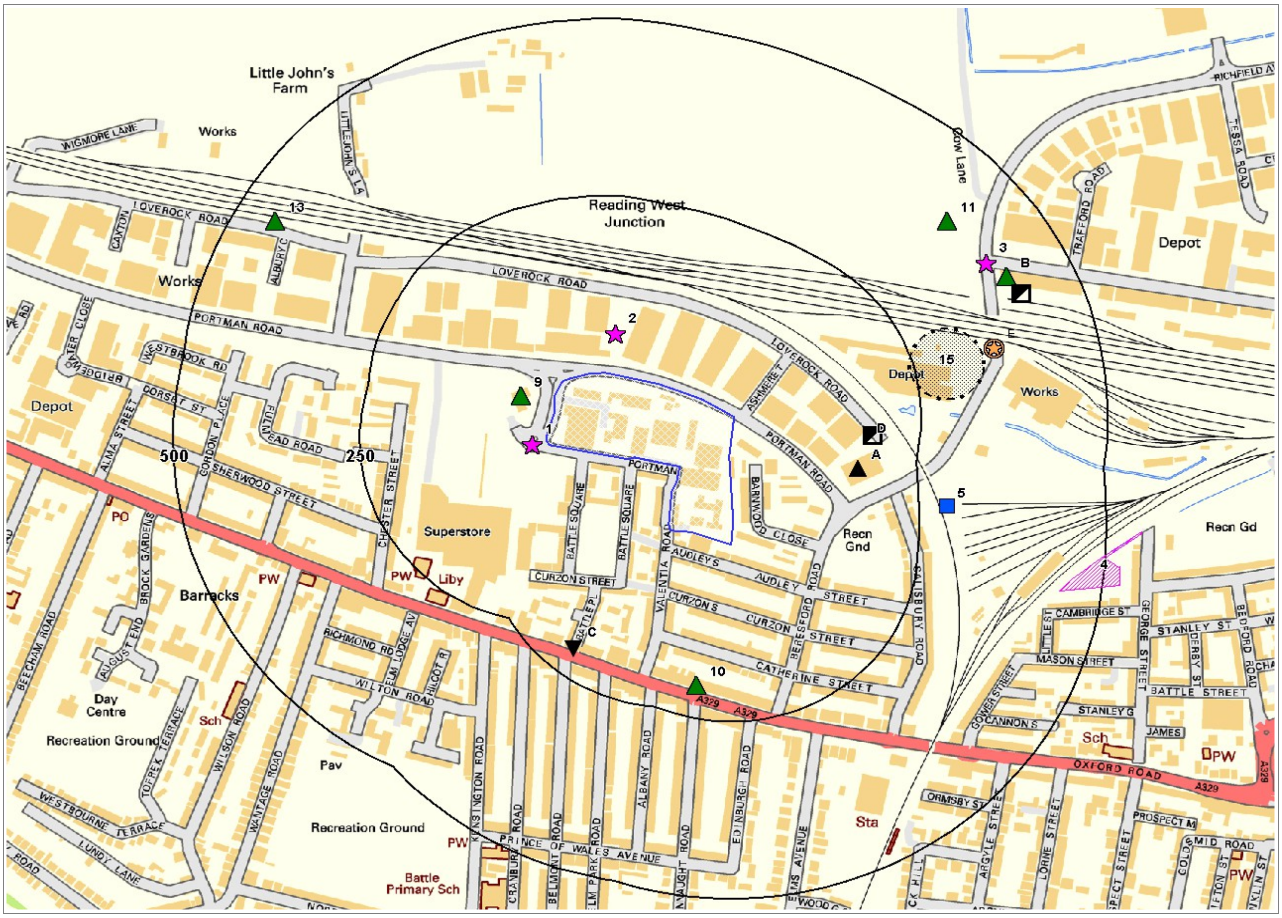
ID	Distance(m)	Direction	Use	Date
247BI	46	E	Pond	1938
248BI	46	E	Pond	1898
249BI	46	E	Pond	1910
250BI	48	E	Pond	1898
251BI	49	E	Pond	1962
252G	109	E	Unspecified Pit	1962

253G	110	E	Gravel Pit	1898
254G	111	E	Unspecified Pit	1938
255G	112	E	Unspecified Pit	1932
256G	112	E	Unspecified Pit	1932
257G	113	E	Gravel Pit	1898
258G	122	E	Unspecified Pit	1977
259G	122	E	Unspecified Pit	1989
260G	122	E	Unspecified Pit	1994
261G	122	E	Unspecified Pit	1971
262G	128	E	Unspecified Ground Workings	1910
263O	159	E	Old Gravel Pit	1898
264O	163	E	Old Gravel Pit	1898
265R	213	E	Unspecified Pit	1977
266R	213	E	Unspecified Pit	1989
267R	213	E	Unspecified Pit	1994
268R	213	E	Unspecified Pit	1971
269S	216	E	Unspecified Pit	1938
270S	216	E	Unspecified Pit	1910
271T	218	E	Unspecified Ground Workings	1962
272T	225	E	Unspecified Ground Workings	1938
273T	226	E	Unspecified Ground Workings	1913
274R	228	E	Pond	1913
275R	243	E	Ponds	1938
276R	243	E	Ponds	1962
277R	245	E	Pond	1938
278Z	270	E	Cuttings	1977
279Z	270	E	Cuttings	1971
280Z	270	E	Cuttings	1994
281Z	270	E	Cuttings	1989
282R	280	E	Pond	1938
283R	281	E	Pond	1913
284AF	352	SE	Unspecified Pit	1938
285AF	352	SE	Unspecified Pit	1913
286BJ	371	E	Refuse Heap	1913
287	435	NW	Pond	1901

2. Environmental Permits, Incidents and Registers Map

NW N NE

W E



SW S SE

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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/Natural Resources Wales and Local Authorities reveal the following information:

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

3

The following IPC Authorisations are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
19A	170	E	470180 173850	Operator: Oxkem Ltd Address: 1 Loverock Road, Reading, Berkshire, RG30 1DZ Process: Inorganic Chemical Processes	Permit Number: AW0784 Original Permit Number: IPCMINVAR Date Approved: 9-8-1996 Effective Date: 9-8-1996 Status: Superseded By Variation
20A	170	E	470180 173850	Operator: Oxkem Ltd Address: 1 Loverock Road, Reading, Berkshire, RG30 1DZ Process: Inorganic Chemical Processes	Permit Number: AO1128 Original Permit Number: IPCAIRAPP Date Approved: 28-11-1994 Effective Date: 5-12-1994 Status: Superseded By Variation
21A	170	E	470180 173850	Operator: Oxkem Ltd Address: 1 Loverock Road, Reading, Berkshire, RG30 1DZ Process: Inorganic Chemical Processes	Permit Number: BD6441 Original Permit Number: IPCMINVAR Date Approved: 24-11-1998 Effective Date: 30-11-1998 Status: Revoked - Now Ippc

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:

5

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	
9	46	W	469729 173952	Address: Tesco Stores Ltd, Portman Road, Reading, Berks, RG30 1AH Process: PG1/14 (06) Unloading of Petrol into Storage at Service Stations Status: Current Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified
10	207	S	469964 173544	Address: Bobbys 2H Dry Cleaning, 296 Oxford Road, Reading, RG30 1AD Process: Dry Cleaning Status: Current Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified
11	395	NE	470300 174200	Address: Wadham Kenning, 38-40 Portman Rd,Reading, 8-40 Portman Rd, RG30 1JG Process: Respraying of Road Vehicles Status: Historical Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified
12B	412	NE	470379 174121	Address: E Hillier & Son Ltd, Cardiff Road, RG1 8HX Process: metal process Status: Historical Permit Permit Type: Part B	Enforcement: No Enforcements Notified Date of Enforcement: No Enforcements Notified Comment: No Enforcements Notified

ID	Distance (m)	Direction	NGR	Details	
13	446	NW	469400 174200	Address: Nationwide Crash Repair Centres Ltd, Loverock Road, RG3 1DZ Process: Respraying of Road Vehicles 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:

1

The following RAS Licence (3 or 4) records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Address	Operator	Type	Permission Number	Dates	Status
22C	211	SW	469800 173600	Royal Berkshire Nhs Foundation Trust, Battle Hospital,oxford Road, Reading, Berkshire, RG30 1AG	Royal Berkshire Nhs Foundation Trust	Keeping And Use Of Radioactive Materials (was Rsa60 Section 1).	AB0600	Date of Approval:27/7/1993 Effective from:27/7/1993 Last date of update:2015-01-01	Revoked/cancelled

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

1

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

ID	Distance (m)	Direction	NGR	Details	
5	287	E	470300 173800	Address: Reading, Cow Lane, Reading, Cow Lane, -, - Effluent Type: SEWAGE DISCHARGES - PUMPING STATION - WATER COMPANY Permit Number: TEMP.1771 Permit Version: 1	Receiving Water: VASTERN DITCH Status: REVOKED - UNSPECIFIED Issue date: 02/11/1989 Effective Date: 02-Nov-1989 Revocation Date: 27/01/1997

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

2

The following Water Industry Referral records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	Address	Permission reference	Local Authority	First Date Received	Last Date Received	Status
23D	186	E	QUICK CIRCUITS LTD, 1 LOVEROCK ROAD, 1 LOVEROCK ROAD, READING, BERKSHIRE, RG3 1DZ	AE2269	READING BOROUGH COUNCIL	01-Jun-2001	08-Oct-2016	EFFECTIVE
24B	422	NE	E HILLIER AND SON (HOLDINGS) LTD, 215 CARDIFF ROAD, 215 CARDIFF ROAD, READING, BERKSHIRE, RG1 8HX	AF5158	READING BOROUGH COUNCIL	01-Jun-2001	08-Oct-2016	EFFECTIVE

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

1

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

ID	Distance (m)	Direction	Application Reference Number	NGR	Application Status	Application Date	Address	Details	Details of Enforcement Action
25E	359	E	920460	470362 174021	Approved	17/02/1993	Jewells Calor Gas, formerly J Mould, Cow Lane, Reading, RG1 8NA	The storage, sales and distribution of liquified petroleum gas in cylinders and bulk	Enforcement: No Enforcements Notified Date of Enforcement: No Enforcement Notified Comment: No Enforcement Notified

2.2 Dangerous or Hazardous Sites

Records of COMAH & NIHHS sites within 500m of the study site: 1

The following COMAH & NIHHS Authorisation records provided by the Health and Safety Executive are represented as polygons or buffered points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	Company	Address	Operational Status	Tier
15	243	E	Calor Gas Ltd	Calor Gas Ltd, Reading Calor Centre, Cow Lane, Reading, RG1 8HE	Historical NIHHS Site	-

2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents

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

3

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

ID	Distance (m)	Direction	NGR	Details	
1	21	W	469744 173886	Incident Date: 15-Nov-2002 Incident Identification: 121032 Pollutant: Oils and Fuel Pollutant Description: Gas and Fuel Oils	Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)
2	57	N	469856 174043	Incident Date: 29-Jan-2002 Incident Identification: 55194 Pollutant: Specific Waste Materials Pollutant Description: Household Waste	Water Impact: Category 4 (No Impact) Land Impact: Category 3 (Minor) Air Impact: Category 4 (No Impact)
3	399	NE	470352 174142	Incident Date: 18-Apr-2002 Incident Identification: 72625 Pollutant: Specific Waste Materials Pollutant Description: Metal Wastes	Water Impact: Category 4 (No Impact) Land Impact: Category 3 (Minor) Air Impact: Category 4 (No Impact)

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

0

Database searched and no data found.

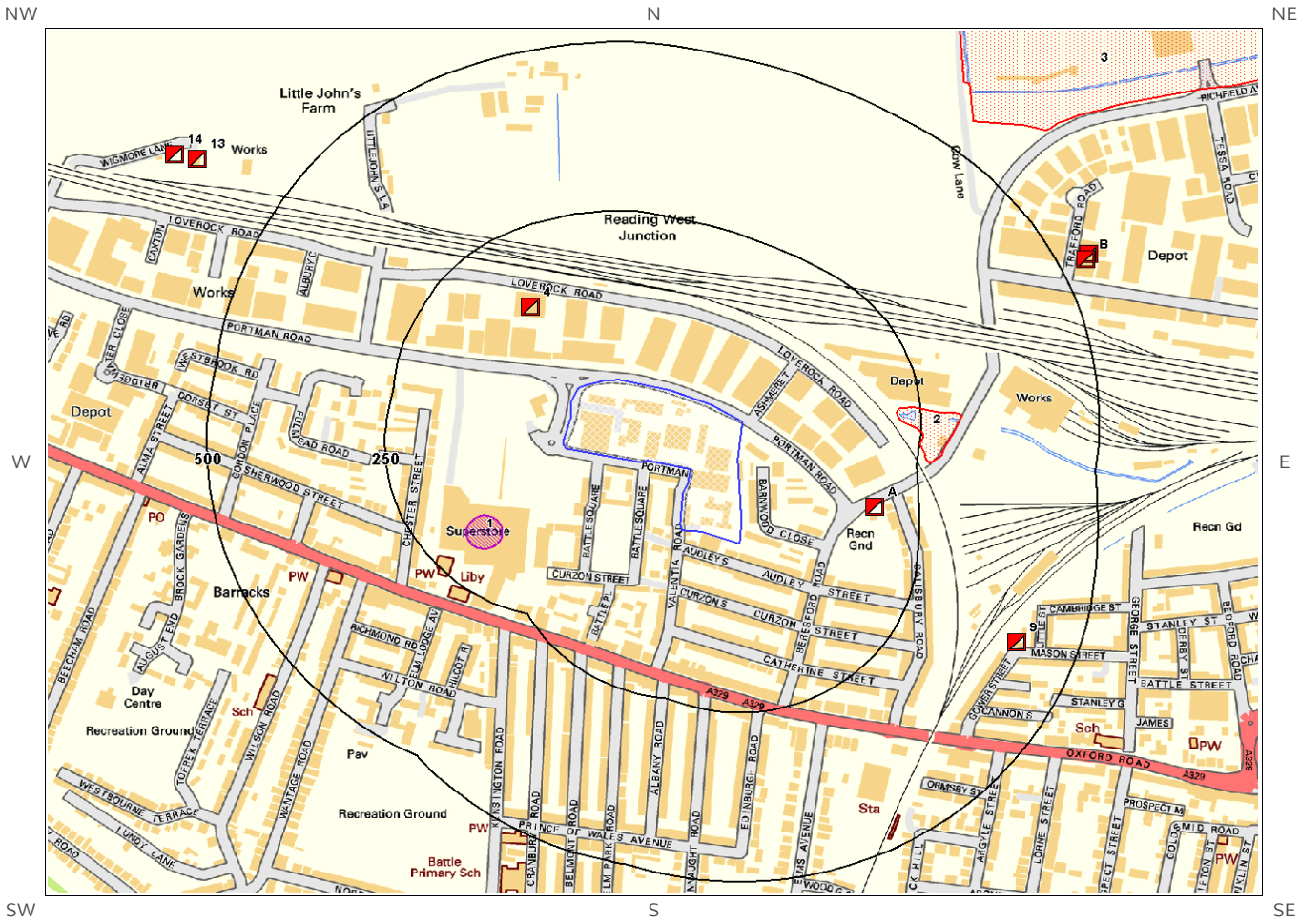
2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990

How many records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 are there within 500m of the study site? 1

The following records are represented as polygons on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Description	Location	Category	Year Identified
4	443	E	470470 173690	B(a)P in made ground and compost. Source of B(a)P probably ash added by allotment holders & adjacent railway runoff.	George Street Allotments, George Street, Reading	Potentially Contaminated Land	2008

3. Landfill and Other Waste Sites Map



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3. Landfill and Other Waste Sites

3.1 Landfill Sites

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

0

Database searched and no data found.

3.1.2 Records of Environment Agency/Natural Resources Wales 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	216	E	470200 173900	Site Address: Cow Lane, Reading, Berkshire Waste Licence: - Site Reference: TP0340, RDG4 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: Licence Surrendered: Licence Holder Address: - Operator: - Licence Holder: - First Recorded: 31-Dec-1950 Last Recorded: 31-Dec-1959
3	549	NE	470600 174500	Site Address: Richfield Avenue, Reading, Berkshire Waste Licence: - Site Reference: RDG11, TP0122 Waste Type: Commercial, Household, Liquid, sludge Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: Licence Surrendered: Licence Holder Address: - Operator: - Licence Holder: - First Recorded: 31-Dec-1970 Last Recorded: 31-Dec-1979

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

0

Database searched and no data found.

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

0

Database searched and no data found.

3.2 Other Waste Sites

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

1

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

ID	Distance (m)	Direction	NGR	Details		
1	144	SW	469653 173762	Type of Site: Recycling Centre Site Address: Tesco Superstore, Portman Road, READING, Berkshire, RG30 1AW	Planning Application Reference: 09/01913/FUL Date: 06/05/2010	Further Details: Scheme comprises replacement of recycling facilities with new TOMRA automated recycling centre in new location in car parking area, involving net loss of 3 car parking spaces. An application (ref: 09/01913/FUL) for detailed planning permission was granted by Reading B.C. A detailed planning application has been granted. Data Source: Historic Planning Application Data Type: Point

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

12

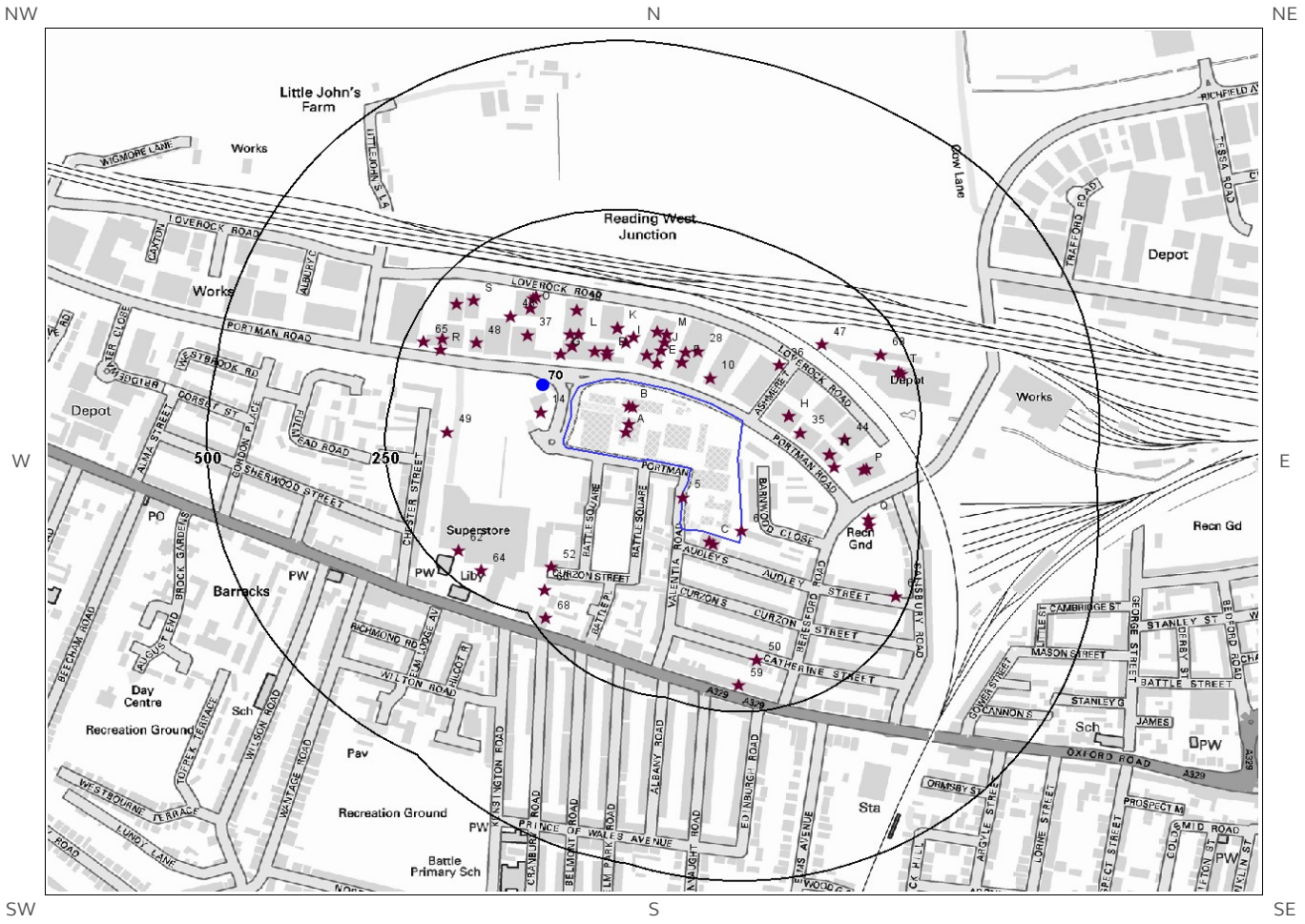
The following waste treatment, transfer or disposal sites records are represented as points on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details	
4	138	NW	469718 174096	Site Address: Part A, Unit B, 75, Loverock Road, Tilehurst, Reading, Berkshire, RG30 1DZ Type: 75kte HCI Waste TS + treatment Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: OAK056 EPR reference: EA/EPR/EP3993VE/A001 Operator: Oakford U K Ltd Waste Management licence No: 101222 Annual Tonnage: 74999.0	Issue Date: 18/11/2009 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Expired Site Name: Loverock Road Waste Transfer Station Correspondence Address: -

ID	Distance (m)	Direction	NGR	Details	
5A	187	E	470200 173800	Site Address: Elliot Metal Company Ltd, 3, Loverock Road, Battle Farm Indus Est, Reading, Berkshire, RG3 1NL Type: Metal Recycling Site (mixed MRS's) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: SIM001 EPR reference: EA/EPR/LP3199EB/V006 Operator: Sims Group U K Ltd Waste Management licence No: 86002 Annual Tonnage: 74999.0	Issue Date: 06/04/1993 Effective Date: 27/04/2002 Modified: 27/08/2014 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Sims Group U K Ltd Correspondence Address: -
6A	187	E	470200 173800	Site Address: Elliot Metal Company Ltd, 3, Loverock Road, Battle Farm Indus Est, Reading, Berkshire, RG3 1NL Type: Metal Recycling Site (mixed MRS's) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: PAR197 EPR reference: EA/EPR/CB3909KB/S002 Operator: Parsons Metal Recycling Limited Waste Management licence No: 86002 Annual Tonnage: 0.0	Issue Date: 06/04/1993 Effective Date: 26/06/2015 Modified: 27/08/2014 Surrendered Date: 08/03/2016 Expiry Date: - Cancelled Date: - Status: Surrendered Site Name: Parsons Metal Recycling Limited Correspondence Address: -
7A	187	E	470200 173800	Site Address: Elliot Metal Company Ltd, 3, Loverock Road, Battle Farm Indus Est, Reading, RG3 1NL Type: Metal Recycling Site (mixed MRS's) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: SIM001 EPR reference: - Operator: Simsmetal Uk Limited Waste Management licence No: 86002 Annual Tonnage: 4999.0	Issue Date: 06/04/1993 Effective Date: 27/04/2002 Modified: 26/04/2002 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Simsmetal U K Limited Correspondence Address: 4, The Uplands, Nailsea, Somerset, BS48 4RR
8A	187	E	470200 173800	Site Address: Elliot Metal Company Ltd, 3, Loverock Road, Battle Farm Indus Est, Reading, Berkshire, RG3 1NL Type: Metal Recycling Site (mixed MRS's) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: SIM001 EPR reference: EA/EPR/LP3199EB/V005 Operator: Sims Group Uk Limited Waste Management licence No: 86002 Annual Tonnage: 74999.0	Issue Date: 06/04/1993 Effective Date: 27/04/2002 Modified: 20/04/2010 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Sims Group U K Ltd Correspondence Address: -
9	414	E	470400 173600	Site Address: E.G.W Carter, 54, Gower Street, Reading, Berkshire, RG1 7PE Type: Metal Recycling Site (mixed MRS's) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: CAR001 EPR reference: EA/EPR/LP3699EF/S004 Operator: E G W Carter Waste Management licence No: 86001 Annual Tonnage: 9322.0	Issue Date: 19/03/1996 Effective Date: - Modified: - Surrendered Date: 23/07/1999 Expiry Date: - Cancelled Date: - Status: Surrendered Site Name: E G W Carter Correspondence Address: -
10B	538	NE	470497 174166	Site Address: 128, Cardiff Road, Reading, Berkshire, RG1 8PQ Type: 75kte Materials Recycling Facility Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: MCO003 EPR reference: EP3893VZ/A001 Operator: M Collard Waste Management Services Ltd Waste Management licence No: 101199 Annual Tonnage: 0.0	Issue Date: 11/02/2010 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: M Collard Waste Management Services Ltd Correspondence Address: -

ID	Distance (m)	Direction	NGR	Details	
11B	544	NE	470500 174174	Site Address: 128, Cardiff Road, Reading, Berkshire, RG1 8PQ Type: 75kte HCI Waste TS + treatment Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: RCO001 EPR reference: EA/EPR/EB3500KB/T001 Operator: R Collard Limited Waste Management licence No: 101199 Annual Tonnage: 74999.0	Issue Date: 11/02/2010 Effective Date: 11/10/2016 Modified: 09/07/2010 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Transferred Site Name: R Collard Limited Correspondence Address: -
12B	544	NE	470500 174174	Site Address: 128, Cardiff Road, Reading, Berkshire, RG1 8PQ Type: 75kte HCI Waste TS + treatment Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: MCO003 EPR reference: EA/EPR/EP3893VZ/V002 Operator: M Collard Waste Management Services Ltd Waste Management licence No: 101199 Annual Tonnage: 74999.0	Issue Date: 11/02/2010 Effective Date: - Modified: 09/07/2010 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: M Collard Waste Management Services Ltd Correspondence Address: -
13	633	NW	469251 174315	Site Address: Unit 3, 40, Wigmore Lane, Reading, Berkshire, RG30 1NP Type: Household, Commercial & Industrial Waste T Stn Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: REY002 EPR reference: EA/EPR/MP3195EA/A001 Operator: 1st Reynolds Skip Hire Ltd Waste Management licence No: 86373 Annual Tonnage: 4999.0	Issue Date: 11/08/2005 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Reynolds Skip Hire Correspondence Address: -
14	664	NW	469219 174322	Site Address: Fleetwood Grab Services Ltd, 1& 1a 40, Wigmore Lane, Reading, Berks, RG30 1NP Type: Treatment of waste to produce soil <75,000 tpy Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: FLE026 EPR reference: EA/EPR/JB3534RP/A001 Operator: Fleetwood Grab Services Ltd Waste Management licence No: 104488 Annual Tonnage: 74999.0	Issue Date: 03/12/2012 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Fleetwood Grab Services Ltd Correspondence Address: -
Not shown	1214	W	468638 174382	Site Address: I T P, Unit 1, Stadium Way, Tilehurst, Reading, Berkshire, RG30 6BX Type: Household, Commercial & Industrial Waste T Stn Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: ITP002 EPR reference: EA/EPR/BB3302TG/A001 Operator: International Technology Products (U K) Limited Waste Management licence No: 401209 Annual Tonnage: 760.0	Issue Date: 02/05/2014 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: I T P Correspondence Address: -

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: 69

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

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1A	0	On Site	Chimney	469851 173910	Chimney, RG30	Chimneys	Industrial Features
2B	0	On Site	Tank	469855 173948	Tank, RG30	Tanks (Generic)	Industrial Features
3A	0	On Site	Electricity Sub Station	469855 173922	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
4B	0	On Site	Tank	469861 173947	Tank, RG30	Tanks (Generic)	Industrial Features
5	0	W	Electricity Sub Station	469931 173813	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
6	1	E	Electricity Sub Station	470014 173763	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
7C	11	S	Harmony Pianos	469967 173747	Harmony Pianos, 92, Audley Street, Reading, RG30 1BS	Sports and Leisure Equipment Repair	Repair and Servicing
8C	14	S	The Welding Shop Ltd	469974 173743	The Welding Shop Ltd, 90a, Audley Street, Reading, RG30 1BS	Cutting, Drilling and Welding Services	Construction Services
9E	34	N	N C Auto Services Ltd	469895 174011	N C Auto Services Ltd, Unit 10 The Portman Centre 37-45, Loverock Road, Reading, RG30 1DZ	Vehicle Repair, Testing and Servicing	Repair and Servicing
10	36	N	Robert Bion & Co	469969 173989	Robert Bion & Co, 14, Portman Road, Reading, RG30 1EA	Metals Manufacturers, Fabricators and Stockholders	Industrial Products
11D	37	N	Car Bar Service Centre	469824 174023	Car Bar Service Centre, 16, Portman Road, Reading, RG30 1EA	Vehicle Repair, Testing and Servicing	Repair and Servicing
12D	42	N	Swift Flooring Supplies Ltd	469825 174028	Swift Flooring Supplies Ltd, 53, Loverock Road, Reading, RG30 1DZ	Construction Completion Services	Construction Services
13E	42	N	Self Adhesive Supplies	469881 174023	Self Adhesive Supplies, 7-9, The Portman Centre, Reading, RG30 1DZ	Adhesives and Sealants	Industrial Products
14	43	W	Tesco Reading West Extra	469732 173939	Tesco Reading West Extra, Portman Road, Reading, Berkshire, RG30 1EA	Petrol and Fuel Stations	Road and Rail
15F	43	N	Ac Mechanical Repairs	469930 174012	Ac Mechanical Repairs, 33, Loverock Road, Reading, RG30 1DZ	Vehicle Repair, Testing and Servicing	Repair and Servicing

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
16F	43	N	Thames Valley M O T's	469930 174012	Thames Valley M O T's, 33, Loverock Road, Reading, RG30 1DZ	Vehicle Repair, Testing and Servicing	Repair and Servicing
17D	45	N	Calcot Cars	469808 174029	Calcot Cars, 18, Portman Road, Reading, RG30 1EA	Vehicle Repair, Testing and Servicing	Repair and Servicing
18J	54	N	C K the Garage	469900 174030	C K the Garage, Unit 8 The Portman Centre 37-45, Loverock Road, Reading, RG30 1DZ	Vehicle Repair, Testing and Servicing	Repair and Servicing
19I	55	N	Tank	469852 174042	Tank, RG30	Tanks (Generic)	Industrial Features
20G	55	NW	Bodytec UK Ltd	469759 174024	Bodytec UK Ltd, 22, Portman Road, Reading, RG30 1EA	Vehicle Repair, Testing and Servicing	Repair and Servicing
21F	59	N	T W Flooring	469935 174027	T W Flooring, 31, Loverock Road, Reading, RG30 1DZ	Construction Completion Services	Construction Services
22G	60	N	Cleaver Cars Ltd	469776 174036	Cleaver Cars Ltd, 67, Loverock Road, Reading, RG30 1DZ	Vehicle Repair, Testing and Servicing	Repair and Servicing
23G	60	N	Koltrane Lighting	469776 174036	Koltrane Lighting, 20, Portman Road, Reading, RG30 1EA	Lampshades and Lighting	Consumer Products
24H	65	E	S & T Coachworks	470080 173933	S & T Coachworks, 10, Portman Road, Reading, RG30 1EA	Vehicle Repair, Testing and Servicing	Repair and Servicing
25H	65	E	Berkshire Van Hire	470080 173933	Berkshire Van Hire, 10, Portman Road, Reading, RG30 1EA	Vehicle Hire and Rental	Hire Services
26I	65	N	Electricity Sub Station	469862 174050	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
27J	66	N	F D S	469905 174041	F D S, Unit 6 The Portman Centre 37-45, Loverock Road, Reading, RG30 1DZ	Industrial Coatings and Finishings	Industrial Products
28	67	N	A to Z Auto Parts	469953 174029	A to Z Auto Parts, 21, Loverock Road, Reading, RG30 1DZ	Vehicle Parts and Accessories	Motoring
29L	74	N	Letterworks	469785 174053	Letterworks, 65, Loverock Road, Reading, RG30 1DZ	Published Goods	Industrial Products
30K	76	N	Harkstone	469839 174063	Harkstone, 49, Loverock Road, Reading, RG30 1DZ	Pumps and Compressors	Industrial Products
31K	76	N	Pirtek Ltd	469839 174063	Pirtek Ltd, 49, Loverock Road, Reading, RG30 1DZ	Industrial Repairs and Servicing	Repair and Servicing
32L	78	N	Jaystock	469772 174054	Jaystock, 69-71, Loverock Road, Reading, RG30 1DZ	Vehicle Parts and Accessories	Motoring
33M	78	N	Paul's Floors Ltd	469909 174053	Paul's Floors Ltd, Unit 4 The Portman Centre 37-45, Loverock Road, Reading, RG30 1DZ	Construction Completion Services	Construction Services
34M	80	N	Tuna Retail Sales Ltd	469895 174058	Tuna Retail Sales Ltd, Unit 3 The Portman Centre 37-45, Loverock Road, Reading, RG30 1DZ	Fish, Meat and Poultry Products	Foodstuffs
35	82	E	Hobs Reprographics Plc	470096 173908	Hobs Reprographics Plc, 8b, Portman Road, Reading, RG30 1EA	Published Goods	Industrial Products
36	97	NE	Electricity Sub Station	470067 174009	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
37	106	NW	Redland Healthcare	469713 174052	Redland Healthcare, 24a, Portman Road, Reading, RG30 1EA	Disability and Mobility Equipment	Consumer Products
38	110	N	Berkshire Food Products Ltd	469782 174090	Berkshire Food Products Ltd, 61-63, Loverock Road, Reading, RG30 1DZ	Dairy Products	Foodstuffs
39N	126	E	Digital Aerials & Satellites Ltd	470136 173875	Digital Aerials & Satellites Ltd, Unit 2 6, Portman Road, Reading, RG30 1EA	Electronic Equipment	Industrial Products
40N	126	E	Spurlite	470136 173875	Spurlite, Unit 1 6, Portman Road, Reading, RG30 1EA	Lampshades and Lighting	Consumer Products
41N	134	E	Electricity Sub Station	470144 173858	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
42O	134	NW	Warehouse	469718 174092	Warehouse, RG30	Container and Storage	Transport, Storage and Delivery
43	143	NW	Electricity Sub Station	469689 174081	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
44	144	E	Parsons Metals	470157 173898	Parsons Metals, 3, Loverock Road, Reading, RG30 1NL	Scrap Metal Merchants	Recycling Services
45O	146	NW	Depot	469722 174107	Depot, RG30	Container and Storage	Transport, Storage and Delivery
46O	147	NW	Taylor & Goodman Ltd	469725 174110	Taylor & Goodman Ltd, 75b, Loverock Road, Reading, RG30 1DZ	Mechanical Engineers	Engineering Services
47	158	NE	Pylon	470126 174039	Pylon, RG30	Electrical Features	Infrastructure and Facilities
48	158	NW	Works	469642 174042	Works, RG30	Unspecified Works Or Factories	Industrial Features
49	164	W	Electricity Sub Station	469601 173910	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
50	174	S	Electricity Sub Station	470035 173573	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
51P	175	E	Quick Circuits	470184 173853	Quick Circuits, 1, Loverock Road, Reading, RG30 1DZ	Electrical Components	Industrial Products
52	176	S	Electricity Sub Station	469747 173710	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
53Q	177	E	Electricity Sub Station	470191 173781	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
54P	179	E	Depot	470189 173855	Depot, RG30	Container and Storage	Transport, Storage and Delivery
55Q	179	E	Pumping Station	470193 173772	Pumping Station, RG30	Water Pumping Stations	Industrial Features
56S	196	NW	Warehouse	469638 174104	Warehouse, RG30	Container and Storage	Transport, Storage and Delivery
57R	199	W	Pumping Station	469591 174031	Pumping Station, RG30	Water Pumping Stations	Industrial Features
58R	203	NW	Rodmatic Ltd	469594 174047	Rodmatic Ltd, Battle Farm Trading Estate 30, Portman Road, Reading, RG30 1PD	Precision Engineers	Engineering Services
59	210	S	Eggfree Cake Box	470009 173535	Eggfree Cake Box, 278, Oxford Road, Reading, RG30 1AD	Baking and Confectionery	Foodstuffs
60	211	S	Electricity Sub Station	469738 173676	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
61S	211	NW	Depot	469614 174099	Depot, RG30	Container and Storage	Transport, Storage and Delivery
62	214	SW	Electricity Sub Station	469616 173735	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
63	216	NE	Depot	470208 174024	Depot, RG1	Container and Storage	Transport, Storage and Delivery
64	216	SW	Electricity Sub Station	469649 173705	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
65	225	NW	Electricity Sub Station	469567 174043	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
66T	230	E	Depot	470234 173999	Depot, RG1	Container and Storage	Transport, Storage and Delivery
67	232	E	Electricity Sub Station	470230 173667	Electricity Sub Station, RG30	Electrical Features	Infrastructure and Facilities
68	232	SW	Berkshire Fireplace Centre	469738 173634	Berkshire Fireplace Centre, 346-348, Oxford Road, Reading, RG30 1AQ	Fireplaces and Mantelpieces	Consumer Products
69T	233	E	Abbotts Confidential Waste Shredding Service	470238 173996	Abbotts Confidential Waste Shredding Service, Key House, Cow Lane, Reading, RG1 8NA	Waste Storage, Processing and Disposal	Infrastructure and Facilities

4.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site: 1

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

ID	Distance (m)	Direction	NGR	Company	Address	LPG	Status
70	46	NW	469735 173979	Tesco Extra	Tesco Reading West Extra, Portman Road, Reading, Berkshire, RG30 1AW	No	Open

4.3 National Grid High Voltage Underground Electricity Transmission Cables

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

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

Database searched and no data found.

4.4 National Grid High Pressure Gas Transmission Pipelines

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

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

Database searched and no data found.

5. Geology

5.1 Artificial Ground and Made Ground

Database searched and no data found.

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

5.2 Superficial Ground and Drift Geology

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

Lex Code	Description	Rock Type
ALV	ALLUVIUM	CLAY, SILT, SAND AND GRAVEL [UNLITHIFIED DEPOSITS CODING SCHEME]
TPGR	TAPLOW GRAVEL FORMATION	SAND AND GRAVEL [UNLITHIFIED DEPOSITS CODING SCHEME]
KPGR	KEMPTON PARK GRAVEL FORMATION	SAND AND GRAVEL [UNLITHIFIED DEPOSITS CODING SCHEME]
LASI	LANGLEY SILT MEMBER	CLAY AND SILT [UNLITHIFIED DEPOSITS CODING SCHEME]

5.3 Bedrock and Solid Geology

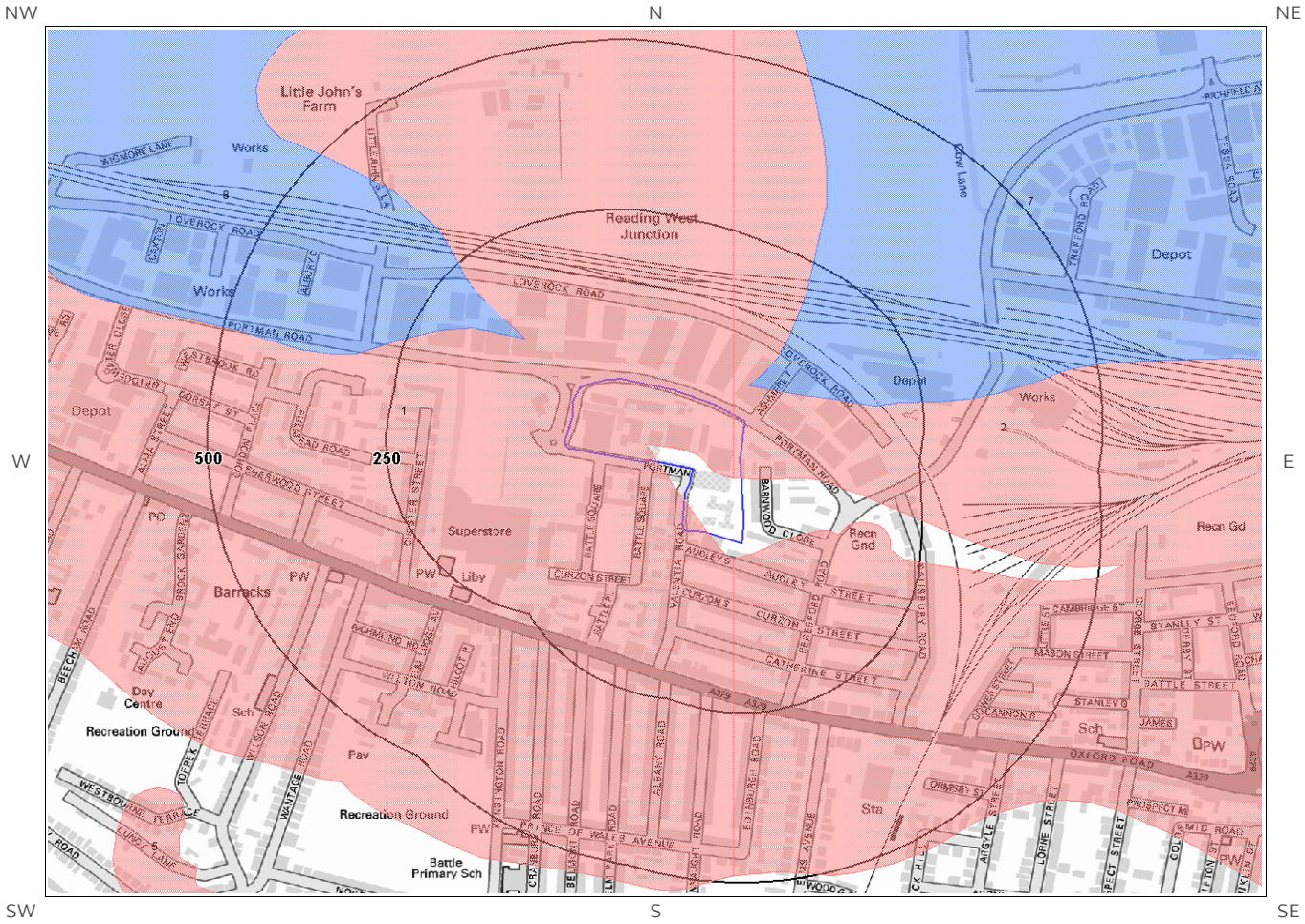
The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
SNCK-CHLK	SEAFORD CHALK FORMATION AND NEWHAVEN CHALK FORMATION (UNDIFFERENTIATED)	CHALK

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

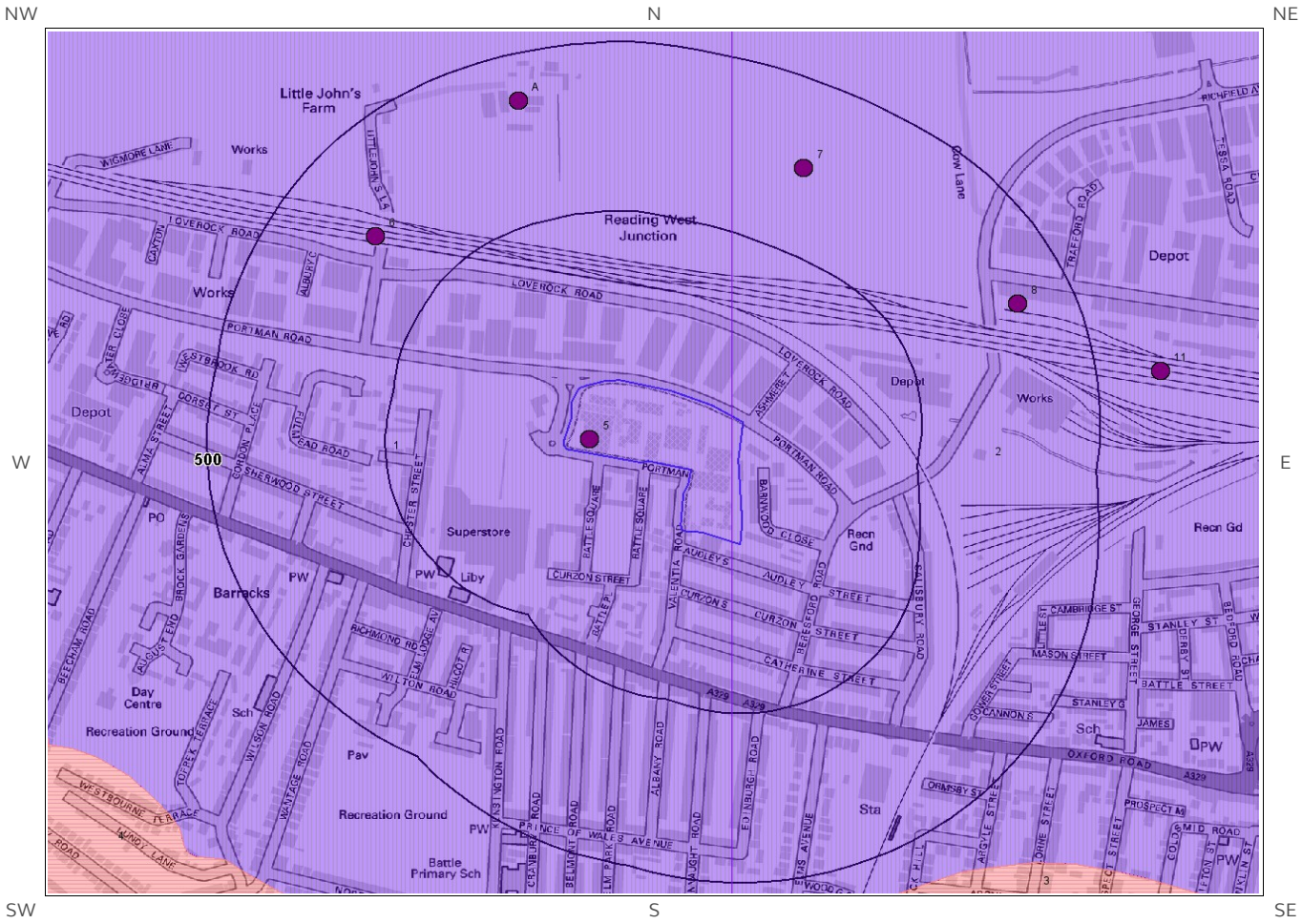
6 Hydrogeology and Hydrology

6a. Aquifer Within Superficial Geology



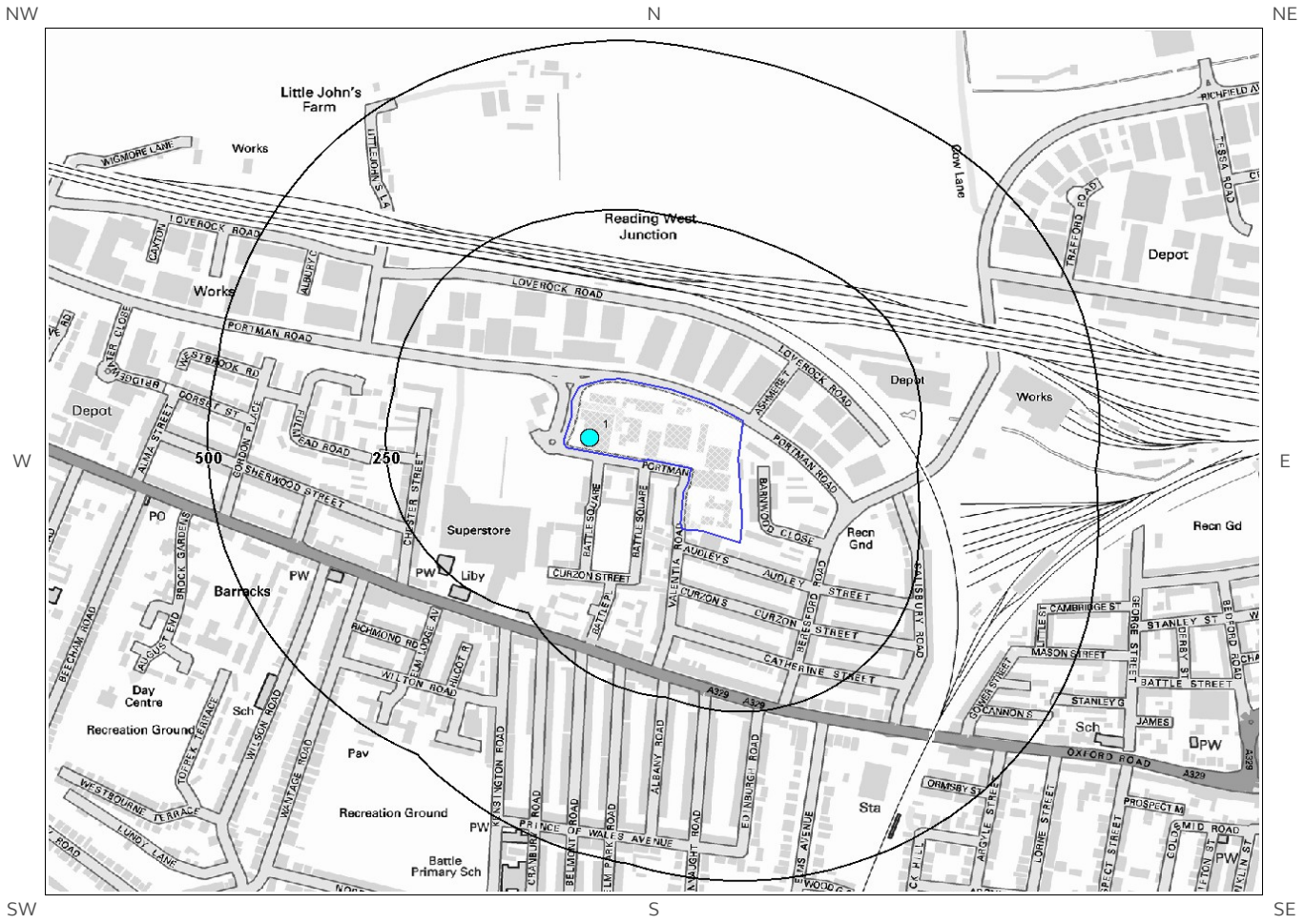
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6b. Aquifer Within Bedrock Geology and Abstraction Licenses



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



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Site Outline

250
500
Search Buffers (m)

Source Protection Zone 1 - Inner Catchment

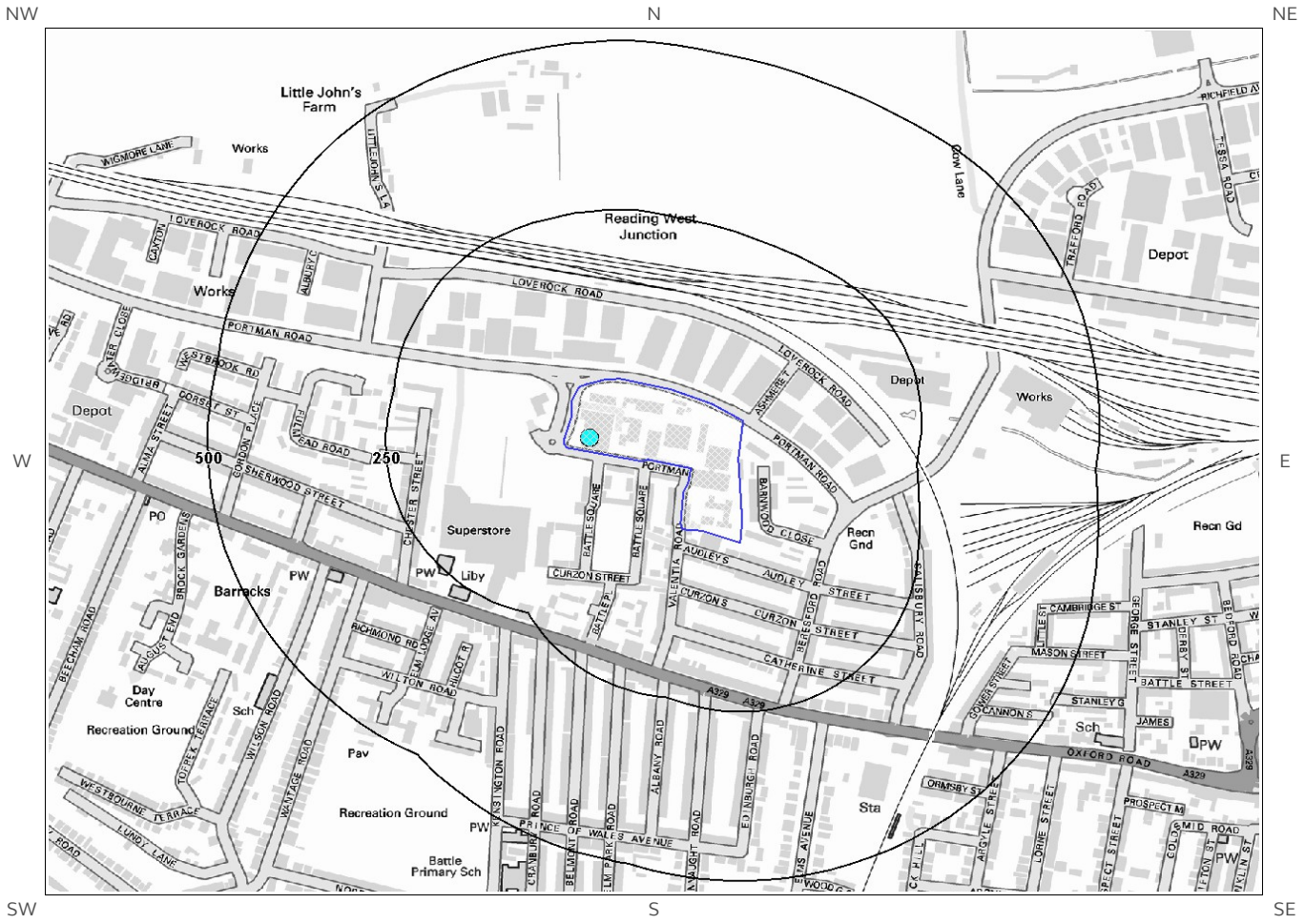
Source Protection Zone 2 - Outer Catchment

Source Protection Zone 3 - Total Catchment

Source Protection Zone 4 - Zone of Special Interest

Potable Water Abstraction Licence

6d. Hydrogeology – Source Protection Zones within confined aquifer



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Source Protection Zone 1 - Inner Catchment

Source Protection Zone 2C - Outer Catchment within Confined Aquifer

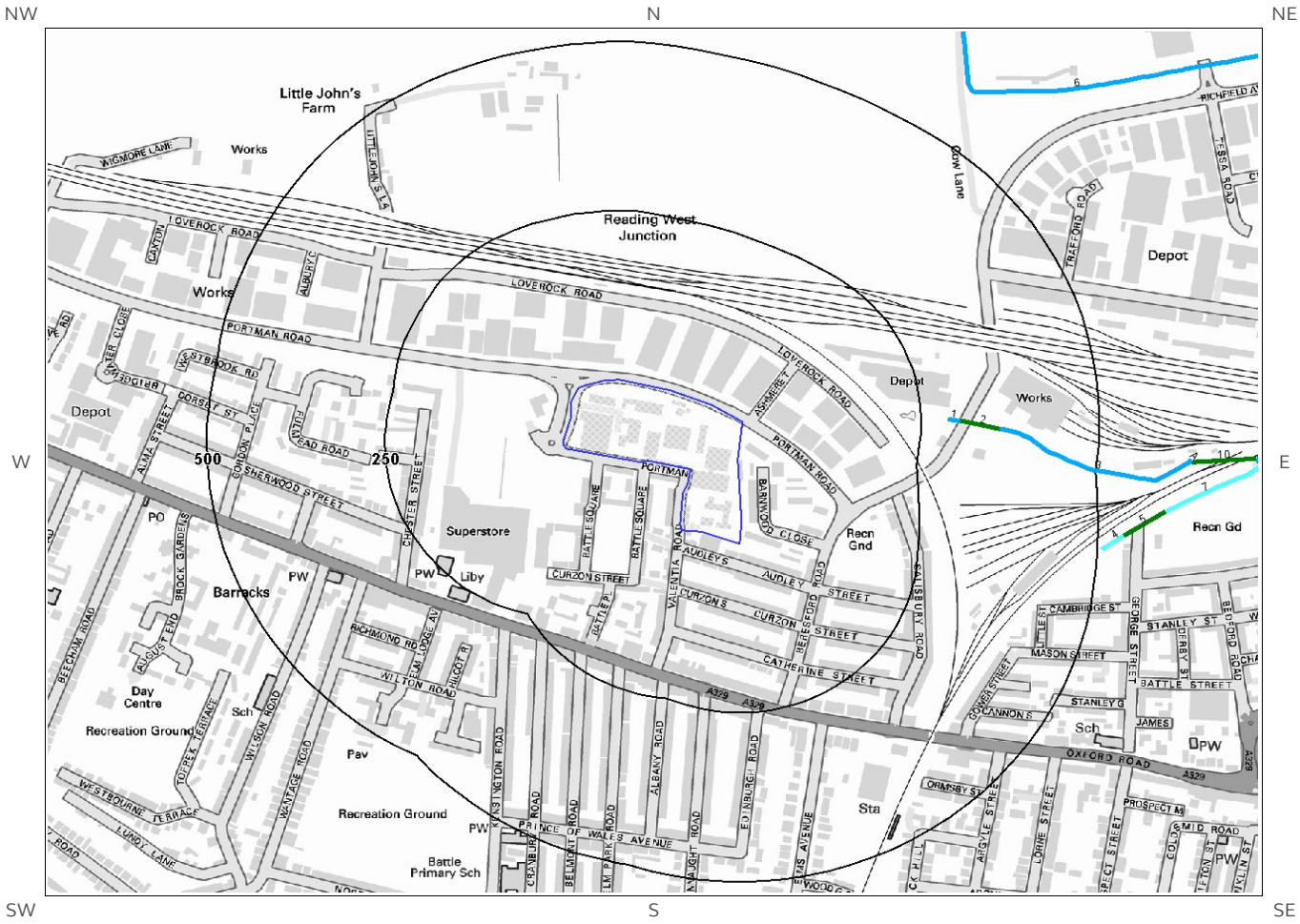
Source Protection Zone 3C - Total Catchment within Confined Aquifer

Potable Water Abstraction Licence

Site Outline

250
500
Search Buffers (m)

6e. Hydrology – Detailed River Network and River Quality



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6.Hydrogeology and Hydrology

6.1 Aquifer within Superficial Deposits

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

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

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

ID	Distance (m)	Direction	Designation	Description
1	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
2	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
7	49	NE	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
8	106	NW	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow

6.2 Aquifer within Bedrock Deposits

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

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

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

ID	Distance (m)	Direction	Designation	Description
1	0	On Site	Principal	Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers
2	0	On Site	Principal	Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers

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	
5	0	On Site	469800 173900	Status: Historical Licence No: 28/39/23/0181 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Battle Hospital, Oxford Road, Reading Data Type: Point Name: WEST BERKSHIRE HEALTH AUTHORITY	Annual Volume (m^3): 136875 Max Daily Volume (m^3): 400 Original Application No: WRA/5942 Original Start Date: 17/1/1992 Expiry Date: - Issue No: 100 Version Start Date: 7/1/1999 Version End Date:
6	363	NW	469500 174200	Status: Historical Licence No: 28/39/23/0070 Details: General Farming & Domestic Direct Source: Thames Groundwater Point: Little John's Farm, Reading (a) Data Type: Point Name: DRAYTON	Annual Volume (m^3): 9819 Max Daily Volume (m^3): 26.82 Original Application No: WR.A/3088 Original Start Date: 9/1/1967 Expiry Date: - Issue No: 100 Version Start Date: 9/1/1967 Version End Date:
7	373	N	470100 174300	Status: Historical Licence No: 28/39/23/0070 Details: General Farming & Domestic Direct Source: Thames Groundwater Point: Little John's Farm, Reading (e) Data Type: Point Name: DRAYTON	Annual Volume (m^3): 9819 Max Daily Volume (m^3): 26.82 Original Application No: WR.A/3088 Original Start Date: 9/1/1967 Expiry Date: - Issue No: 100 Version Start Date: 9/1/1967 Version End Date:
8	422	NE	470400 174100	Status: Historical Licence No: 28/39/23/0128 Details: Process Water Direct Source: Thames Groundwater Point: Cardiff Road, Reading Point A Data Type: Point Name: HILLIER GROUP OF COMPANIES	Annual Volume (m^3): 6682 Max Daily Volume (m^3): 27.28 Original Application No: WR.A/4547 Original Start Date: 22/1/1975 Expiry Date: - Issue No: 100 Version Start Date: 1/4/2008 Version End Date:
9A	431	N	469700 174400	Status: Historical Licence No: 28/39/23/0070 Details: General Farming & Domestic Direct Source: Thames Groundwater Point: Little Johm's Farm, Reading (b) Data Type: Point Name: DRAYTON	Annual Volume (m^3): 9819 Max Daily Volume (m^3): 26.82 Original Application No: WR.A/3088 Original Start Date: 9/1/1967 Expiry Date: - Issue No: 100 Version Start Date: 9/1/1967 Version End Date:
10A	431	N	469700 174400	Status: Historical Licence No: 28/39/23/0070 Details: General Farming & Domestic Direct Source: Thames Groundwater Point: Little John's Farm, Reading (c) Data Type: Point Name: DRAYTON	Annual Volume (m^3): 9819 Max Daily Volume (m^3): 26.82 Original Application No: WR.A/3088 Original Start Date: 9/1/1967 Expiry Date: - Issue No: 100 Version Start Date: 9/1/1967 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
11	589	E	470600 174000	Status: Historical Licence No: 28/39/23/0128 Details: Process Water Direct Source: Thames Groundwater Point: Cardiff Road, Reading Point B Data Type: Point Name: HILLIER GROUP OF COMPANIES	Annual Volume (m^3): 6682 Max Daily Volume (m^3): 27.28 Original Application No: WR.A/4547 Original Start Date: 22/1/1975 Expiry Date: - Issue No: 100 Version Start Date: 1/4/2008 Version End Date:
Not shown	655	N	470100 174600	Status: Historical Licence No: 28/39/23/0070 Details: General Farming & Domestic Direct Source: Thames Groundwater Point: Little John's Farm, Reading (d) Data Type: Point Name: DRAYTON	Annual Volume (m^3): 9819 Max Daily Volume (m^3): 26.82 Original Application No: WR.A/3088 Original Start Date: 9/1/1967 Expiry Date: - Issue No: 100 Version Start Date: 9/1/1967 Version End Date:
Not shown	901	E	470900 174100	Status: Historical Licence No: 28/39/23/0167 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Meadow Road, Reading, Berkshire Data Type: Point Name: MANROSE MANUFACTURING LTD	Annual Volume (m^3): 90920 Max Daily Volume (m^3): 727.4 Original Application No: - Original Start Date: 23/1/1990 Expiry Date: - Issue No: 101 Version Start Date: 30/6/2006 Version End Date:
Not shown	901	E	470900 174100	Status: Historical Licence No: 28/39/23/0167 Details: Non-Evaporative Cooling Direct Source: Thames Groundwater Point: Meadow Road, Reading, Berkshire Data Type: Point Name: MANROSE MANUFACTURING LTD	Annual Volume (m^3): 90920 Max Daily Volume (m^3): 727.4 Original Application No: - Original Start Date: 23/1/1990 Expiry Date: - Issue No: 101 Version Start Date: 30/6/2006 Version End Date:
Not shown	901	E	470900 174100	Status: Historical Licence No: 28/39/23/0041 Details: Non-Evaporative Cooling Direct Source: Thames Groundwater Point: Cardiff Road, Reading, Berkshire Data Type: Point Name: COX & WYMAN LTD	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/1988 Original Start Date: 11/7/1966 Expiry Date: - Issue No: 100 Version Start Date: 11/7/1966 Version End Date:
Not shown	901	E	470900 174100	Status: Historical Licence No: 28/39/23/0041 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Cardiff Road, Reading, Berkshire Data Type: Point Name: COX & WYMAN LTD	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/1988 Original Start Date: 11/7/1966 Expiry Date: - Issue No: 100 Version Start Date: 11/7/1966 Version End Date:
Not shown	927	NW	469100 174600	Status: Historical Licence No: 28/39/23/0137 Details: General Farming & Domestic Direct Source: Thames Groundwater Point: Scours Lane, Reading (a - R) Data Type: Point Name: READING BOROUGH COUNCIL	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/2453/4 Original Start Date: 17/11/1976 Expiry Date: - Issue No: 100 Version Start Date: 17/11/1976 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
Not shown	1029	NW	468900 174500	Status: Historical Licence No: 28/39/23/0131 Details: Spray Irrigation - Direct Direct Source: Thames Groundwater Point: Scours Lane, Reading Data Type: Point Name: PRUDENTIAL IBIS CLUB	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/A03/1 Original Start Date: 14/1/1967 Expiry Date: - Issue No: 100 Version Start Date: 1/5/1992 Version End Date:
Not shown	1029	NW	468900 174500	Status: Historical Licence No: 28/39/23/0131 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Scours Lane, Reading Data Type: Point Name: PRUDENTIAL IBIS CLUB	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/A03/1 Original Start Date: 14/1/1967 Expiry Date: - Issue No: 100 Version Start Date: 1/5/1992 Version End Date:
Not shown	1205	NW	468700 174500	Status: Historical Licence No: 28/39/23/0176 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Scours Lane, Reading Town F.c, Reading Data Type: Point Name: READING TOWN FOOTBALL CLUB	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/6223 Original Start Date: 30/9/1994 Expiry Date: - Issue No: 100 Version Start Date: 30/9/1994 Version End Date:
Not shown	1205	NW	468700 174500	Status: Historical Licence No: 28/39/23/0176 Details: Spray Irrigation - Direct Direct Source: Thames Groundwater Point: Scours Lane, Reading Town F.c, Reading Data Type: Point Name: READING TOWN FOOTBALL CLUB	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/6223 Original Start Date: 30/9/1994 Expiry Date: - Issue No: 100 Version Start Date: 30/9/1994 Version End Date:
Not shown	1213	E	471200 173500	Status: Historical Licence No: 28/39/23/0042 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Cheapside, Reading, Berkshire Data Type: Point Name: PRIMARK STORES LIMITED	Annual Volume (m^3): 14933 Max Daily Volume (m^3): 40.91 Original Application No: - Original Start Date: 11/7/1966 Expiry Date: - Issue No: 101 Version Start Date: 1/4/2008 Version End Date:
Not shown	1384	NW	469140 175200	Status: Historical Licence No: 28/39/23/0139 Details: General Farming & Domestic Direct Source: Thames Groundwater Point: Chazey Court Farm, Mapledurham Data Type: Point Name: EYSTON	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 23/3/1977 Expiry Date: - Issue No: 101 Version Start Date: 9/9/1999 Version End Date:
Not shown	1398	NW	469110 175200	Status: Historical Licence No: 28/39/23/0139 Details: General use relating to Secondary Category (Medium Loss) Direct Source: Thames Groundwater Point: Chazey Court Farm, Mapledurham, - Tubewell 'a' Data Type: Point Name: EYSTON	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 23/3/1977 Expiry Date: - Issue No: 101 Version Start Date: 9/9/1999 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
Not shown	1943	E	471900 174400	Status: Historical Licence No: 28/39/23/0020 Details: Laundry Use Direct Source: Thames Groundwater Point: 72 George Street, Caversham, - Borehole 'a' Data Type: Point Name: Berendsen UK Limited	Annual Volume (m^3): 68190 Max Daily Volume (m^3): 300.04 Original Application No: NPS/WR/021020 Original Start Date: 9/5/1966 Expiry Date: - Issue No: 102 Version Start Date: 12/1/2016 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	
Not shown	1517	E	471440 174450	Status: Historical Licence No: 28/39/23/0196 Details: Lake & Pond Throughflow Direct Source: Thames Surface Water - Non Tidal Point: Thames At Christchurch Meadow Data Type: Point Name: READING BOROUGH COUNCIL	Annual Volume (m^3): 31536 Max Daily Volume (m^3): 86.4 Application No: WRW/A/1115 Original Start Date: 12/5/2003 Expiry Date: 31/3/2016 Issue No: 1 Version Start Date: 1/4/2006 Version End Date:
Not shown	1517	E	471440 174450	Status: Historical Licence No: 28/39/23/0199/TR Details: Transfer Between Sources (Post Water Act 2003) Direct Source: Thames Surface Water - Non Tidal Point: River Thames - Christchurch Meadows Data Type: Point Name: READING BOROUGH COUNCIL	Annual Volume (m^3): 1752000 Max Daily Volume (m^3): 4800 Application No: WRW/A/1218 Original Start Date: 10/9/2008 Expiry Date: 31/3/2016 Issue No: 1 Version Start Date: 10/9/2008 Version End Date:
Not shown	1517	E	471440 174450	Status: Historical Licence No: 28/39/23/0196 Details: Transfer between sources Direct Source: Thames Surface Water - Non Tidal Point: Thames At Christchurch Meadow Data Type: Point Name: READING BOROUGH COUNCIL	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: WRW/A/1115 Original Start Date: 12/5/2003 Expiry Date: 31/3/2016 Issue No: 1 Version Start Date: 12/5/2003 Version End Date:
Not shown	1686	E	471590 173150	Status: Historical Licence No: 28/39/22/0594 Details: Lake & Pond Throughflow Direct Source: Thames Surface Water - Non Tidal Point: The Oracle Centre, Reading Data Type: Point Name: ORACLE SHOPPING CENTRE LTD	Annual Volume (m^3): - Max Daily Volume (m^3): - Application No: - Original Start Date: 16/2/2000 Expiry Date: - Issue No: 1 Version Start Date: 16/2/2000 Version End Date:
Not shown	1686	E	471590 173150	Status: Active Licence No: 28/39/22/0594 Details: Lake & Pond Throughflow Direct Source: Thames Surface Water - Non Tidal Point: St.giles Stream At The Oracle Centre, Reading Data Type: Point Name: ORACLE SHOPPING CENTRE LTD	Annual Volume (m^3): 737856 Max Daily Volume (m^3): 2016 Application No: - Original Start Date: 16/2/2000 Expiry Date: - Issue No: 1 Version Start Date: 16/2/2000 Version End Date:

6.5 Potable Water Abstraction Licences

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

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

ID	Distance (m)	Direction	NGR	Details	
1	0	On Site	469800 173900	Status: Historical Licence No: 28/39/23/0181 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Battle Hospital, Oxford Road, Reading Data Type: Point Name: WEST BERKSHIRE HEALTH AUTHORITY	Annual Volume (m^3): 136875 Max Daily Volume (m^3): 400 Original Application No: WRA/5942 Original Start Date: 17/1/1992 Expiry Date: - Issue No: 100 Version Start Date: Version End Date:
Not shown	901	E	470900 174100	Status: Active Licence No: 28/39/23/0167 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Meadow Road, Reading, Berkshire Data Type: Point Name: MANROSE MANUFACTURING LTD	Annual Volume (m^3): 90920 Max Daily Volume (m^3): 727.4 Original Application No: - Original Start Date: 23/1/1990 Expiry Date: - Issue No: 101 Version Start Date: Version End Date:
Not shown	901	E	470900 174100	Status: Historical Licence No: 28/39/23/0041 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Cardiff Road, Reading, Berkshire Data Type: Point Name: COX & WYMAN LTD	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/1988 Original Start Date: 11/7/1966 Expiry Date: - Issue No: 100 Version Start Date: Version End Date:
Not shown	1029	NW	468900 174500	Status: Historical Licence No: 28/39/23/0131 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Scours Lane, Reading Data Type: Point Name: PRUDENTIAL IBIS CLUB	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/A03/1 Original Start Date: 14/1/1967 Expiry Date: - Issue No: 100 Version Start Date: Version End Date:
Not shown	1205	NW	468700 174500	Status: Historical Licence No: 28/39/23/0176 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Scours Lane, Reading Town F.c, Reading Data Type: Point Name: READING TOWN FOOTBALL CLUB	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: WR.A/6223 Original Start Date: 30/9/1994 Expiry Date: - Issue No: 100 Version Start Date: Version End Date:
Not shown	1213	E	471200 173500	Status: Active Licence No: 28/39/23/0042 Details: Drinking, Cooking, Sanitary, Washing, (Small Garden) - Commercial/Industrial/Public Services Direct Source: Thames Groundwater Point: Cheapside, Reading, Berkshire Data Type: Point Name: PRIMARK STORES LIMITED	Annual Volume (m^3): 14933 Max Daily Volume (m^3): 40.91 Original Application No: - Original Start Date: 11/7/1966 Expiry Date: - Issue No: 101 Version Start Date: Version End Date:

6.6 Source Protection Zones

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

Database searched and no data found.

6.7 Source Protection Zones within Confined Aquifer

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

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

Database searched and no data found.

6.8 Groundwater Vulnerability and Soil Leaching Potential

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

Distance (m)	Direction	Classification	Soil Vulnerability Category	Description
0	On Site	Major 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.
0	On Site	Major 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.
171	N	Major Aquifer/Intermediate Leaching Potential	I1	Soils which can possibly transmit a wide range of pollutants.
171	N	Major Aquifer/Intermediate Leaching Potential	I1	Soils which can possibly transmit a wide range of pollutants.

6.9 River Quality

Is there any Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site? No

6.9.1 Biological Quality:

Database searched and no data found.

6.9.2 Chemical Quality:

Database searched and no data found.

6.10 Detailed River Network

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

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

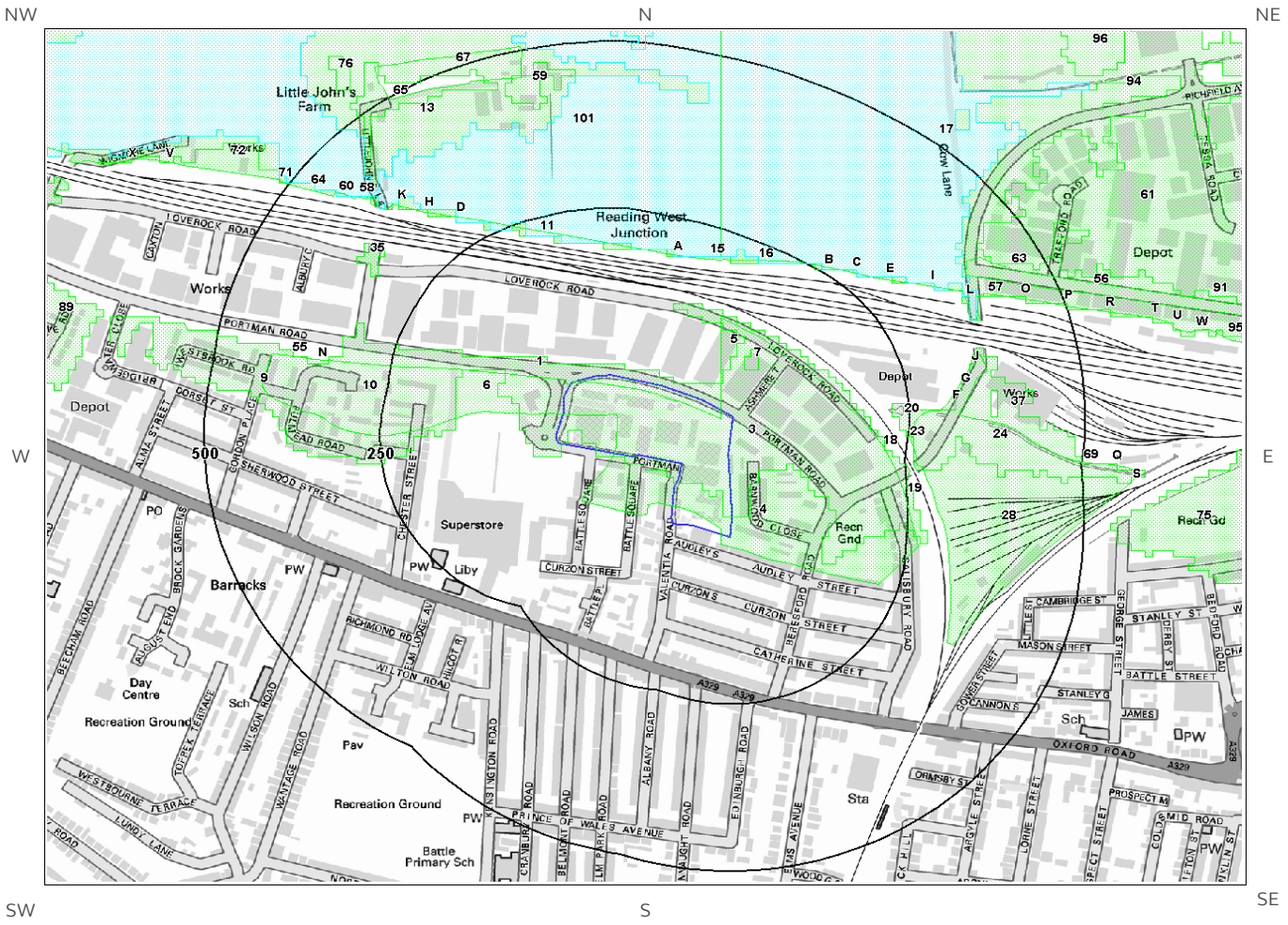
ID	Distance (m)	Direction	Details	
1	288	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
2	304	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
3	361	E	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined

6.11 Surface Water Features

Are there any surface water features within 250m of the study site? No

Database searched and no data found.

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



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Site Outline

100
250
Search Buffers (m)

Zone 2 Floodplain

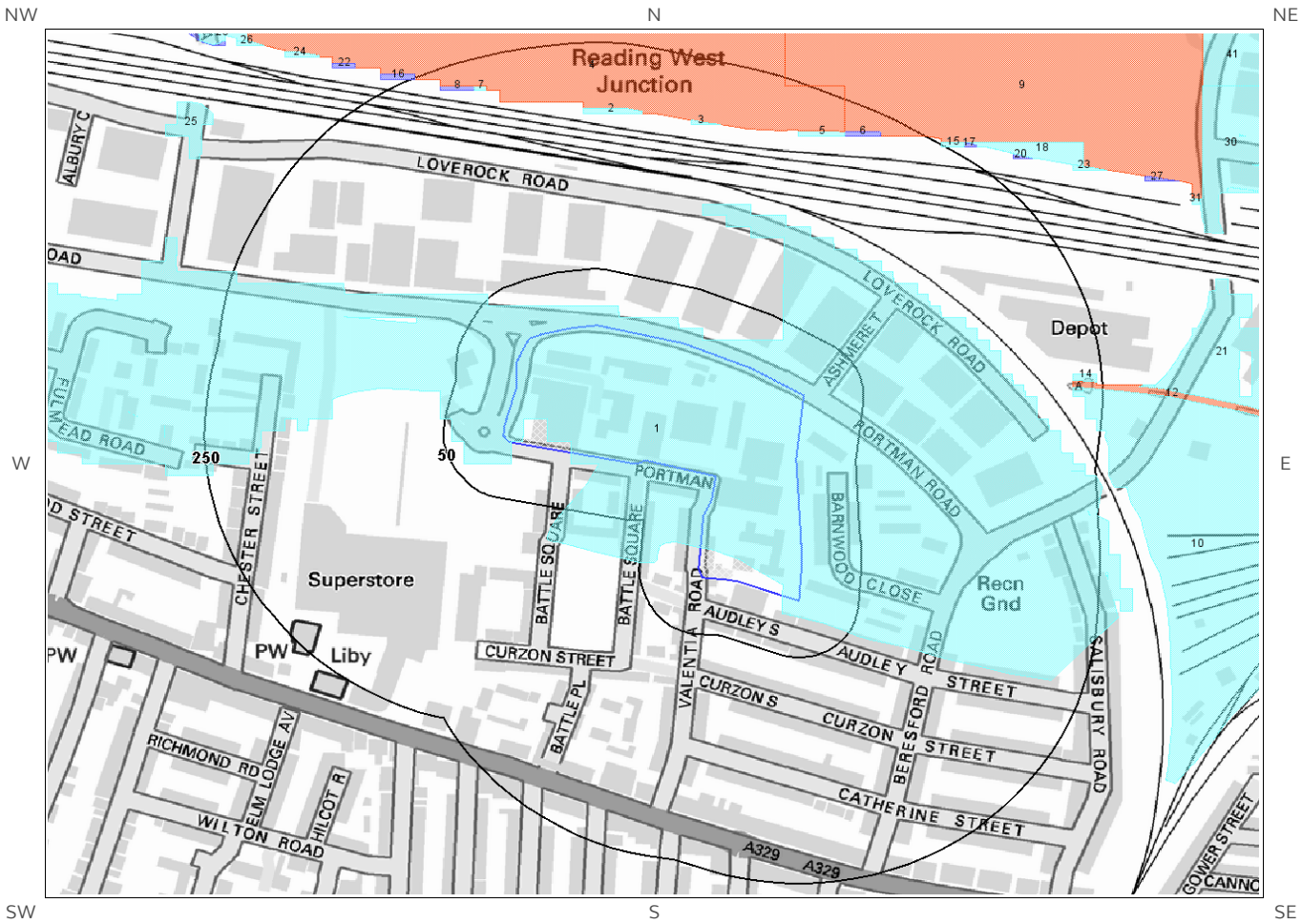
Zone 3 Floodplain

Flood Defences

Area used for Flood Storage

Area Benefiting from Flood Defences

7b. Environment Agency/Natural Resources Wales 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/Natural Resources Wales Zone 2 floodplain? Yes

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

ID	Distance (m)	Direction	Update	Type
1	0	On Site	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
2	0	On Site	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
3	0	On Site	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
4	0	On Site	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
5	35	NE	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
6	61	W	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
7	68	NE	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
8	108	N	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
9	144	W	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
10	146	W	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
11	188	N	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
12A	190	N	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
13	193	N	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
14A	193	N	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
15	196	N	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
16	206	N	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
17	211	N	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
18	219	E	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
19	221	E	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)

20	225	E	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)
21B	248	NE	01-Feb-2017	Zone 2 - (Fluvial /Tidal Models)

7.2 River and Coastal Zone 3 Flooding

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

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

ID	Distance (m)	Direction	Update	Type
1	190	N	01-Feb-2017	Zone 3 - (Fluvial Models)

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

What is the highest risk of flooding onsite? Low

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

RoFRaS data for the study site indicates the property is in an area with a 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? No

Database searched and no data found.

7.5 Areas benefiting from Flood Defences

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

7.6 Areas benefiting from Flood Storage

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

7.7 Groundwater Flooding Susceptibility Areas

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

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

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

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

Potential at Surface

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

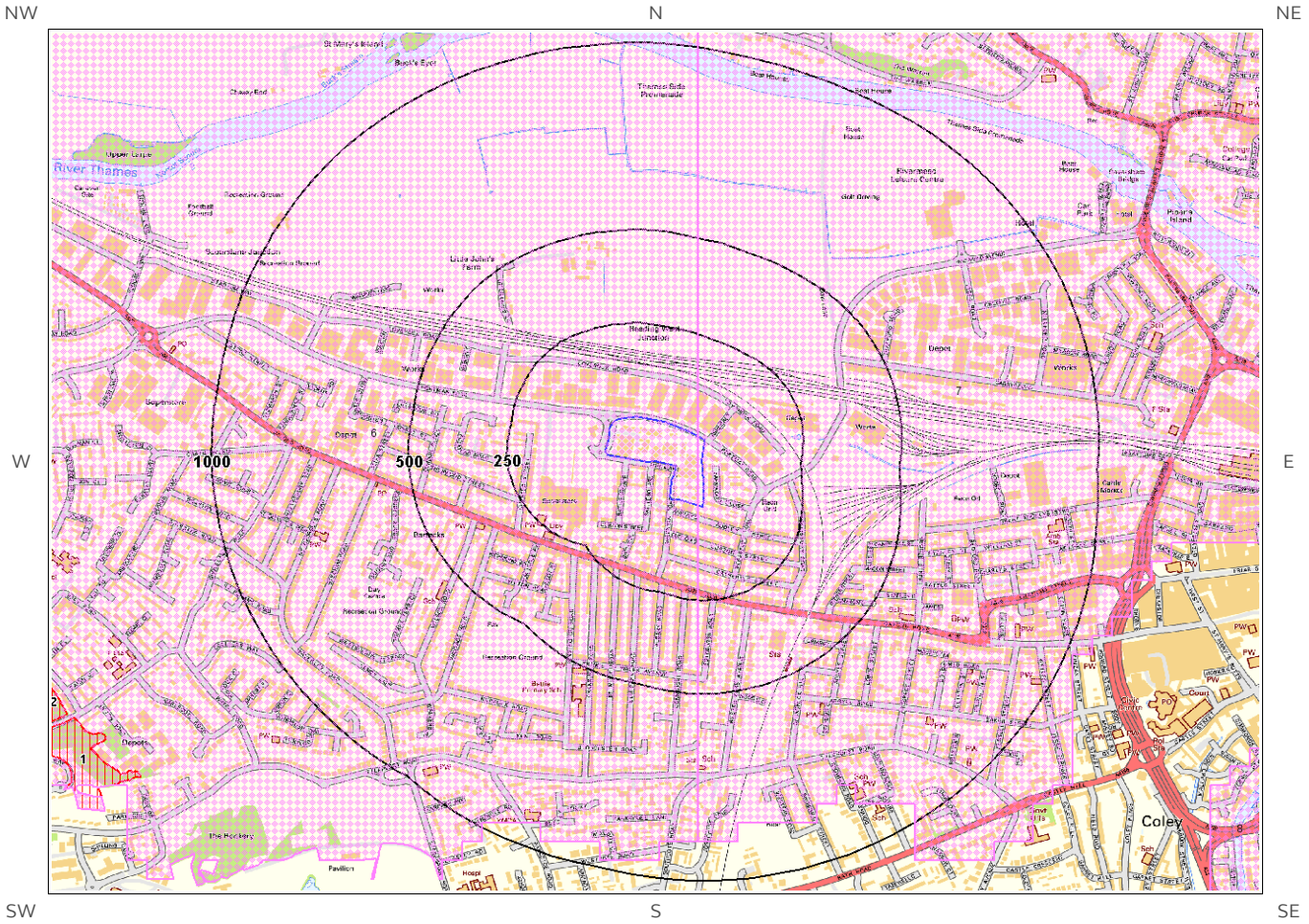
7.8 Groundwater Flooding Confidence Areas

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

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

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

8. Designated Environmentally Sensitive Sites Map



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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:

1

The following records of Designated Ancient Woodland provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
Not shown	1862	NW	UNKNOWN	Ancient Replanted Woodland

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

5

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

ID	Distance (m)	Direction	LNR Name	Data Source
1	1464	SW	Lousehill Copse	Natural England
2	1535	SW	Lousehill Copse	Natural England
Not shown	1703	W	McIlroy Park	Natural England
Not shown	1839	W	Round Copse	Natural England
Not shown	1870	W	Lousehill Copse	Natural England

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

1

The following Area of Outstanding Natural Beauty (AONB) records provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	AONB/NSA Name	Data Source
Not shown	1508	N	Chilterns	Natural England

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:

3

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
6	0	On Site	Existing	DEFRA
7	0	On Site	Existing	DEFRA
8	1488	SE	Existing	DEFRA

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

0

Database searched and no data found.

9. Natural Hazards Findings

9.1 Detailed BGS GeoSure Data

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

9.1.1 Shrink Swell

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

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

Hazard
Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.

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? Low

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

Hazard
Significant soluble rocks are present. Low possibility of subsidence occurring naturally, but may be possible in adverse conditions such as high surface or subsurface water flow. Consider implications for stability when changes to drainage or new construction are planned. For new build site investigation should consider potential for dissolution problems on the site and its surroundings. Care should be taken with local drainage into the bedrock. Some possibility groundwater pollution. For existing property possible increase in insurance risk due to 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? Moderate

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

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

9.1.5 Collapsible Rocks

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

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

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

9.1.6 Running Sand

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

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

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

9.2 Radon

9.2.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is 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? Yes

The following non-coal mining information is provided by the BGS:

Distance (m)	Direction	Name	Commodity	Assessment of likelihood
0.0	On Site	Not available	Chalk	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered
0.0	On Site	Not available	Chalk	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered

Past underground mine workings are uncommon, localised and of limited area. The rock types present in this area are such that minor mineral veins may be present within them on which it is possible that there have been attempts to work these by underground methods and/or it is possible that small scale underground extraction of other materials may have occurred. All such occurrences are likely to be restricted in size and infrequent. It should be noted, however, that there is always the possibility of the existence of other sub-surface excavations, such as wells, cess pits, follies, air raid shelters/bunkers and other military structures etc. that could affect surface ground stability but which are outside the scope of this dataset. However, if in a coalfield area you should still consider a Coal Authority mining search for the area of interest.

10.3 Brine Affected Areas

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

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

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

The Coal Authority
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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

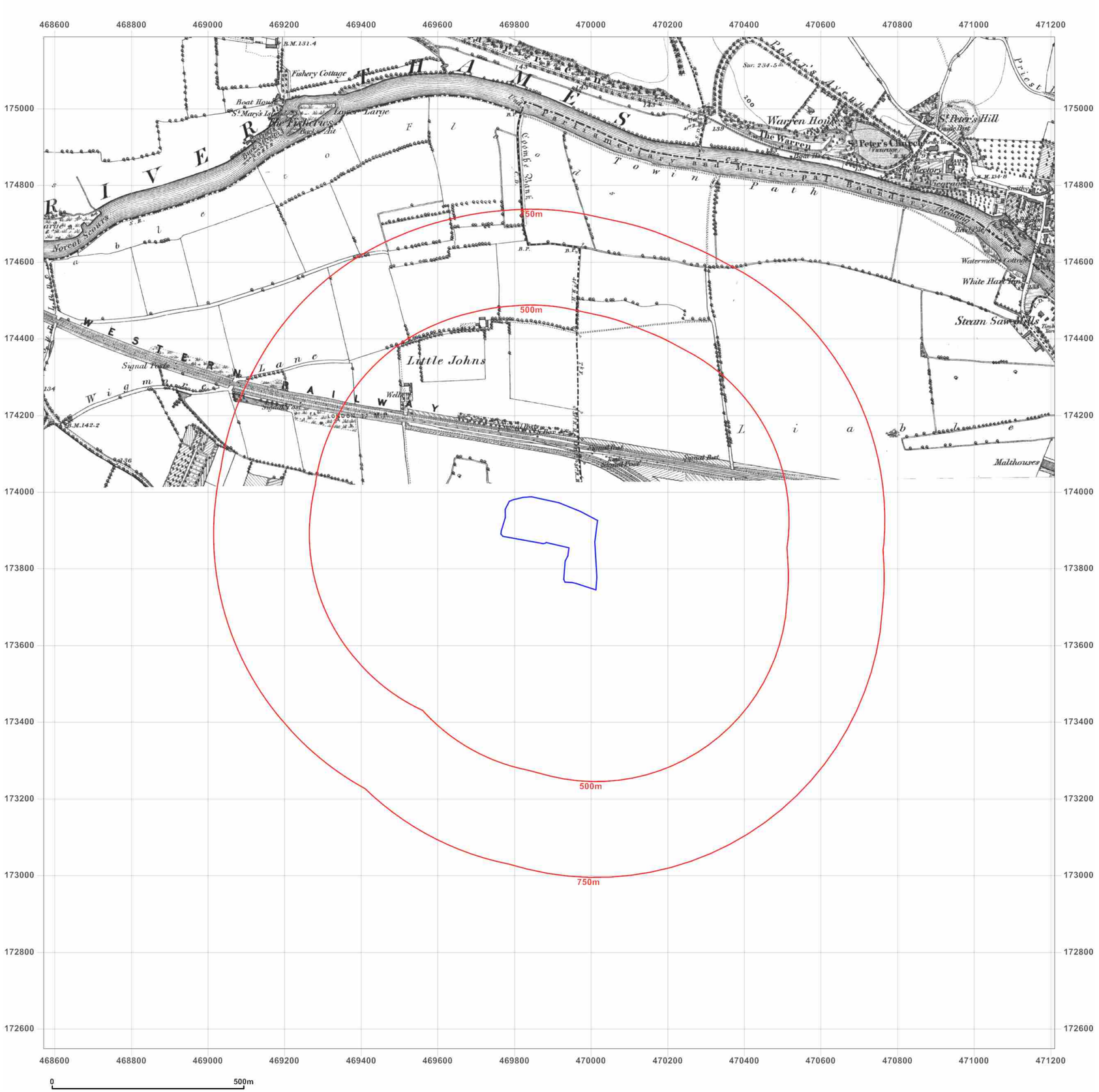
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Authority: Reading Borough Council
Phone: 0118 937 3787
Web: http://beta.reading.gov.uk/
Address: Civic Offices, Bridge Street, Reading, RG1 2LU

Gemapping PLC
Virginia Villas, High Street, Hartley Witney,
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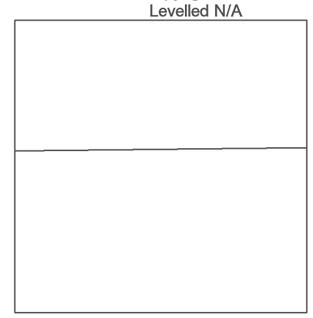
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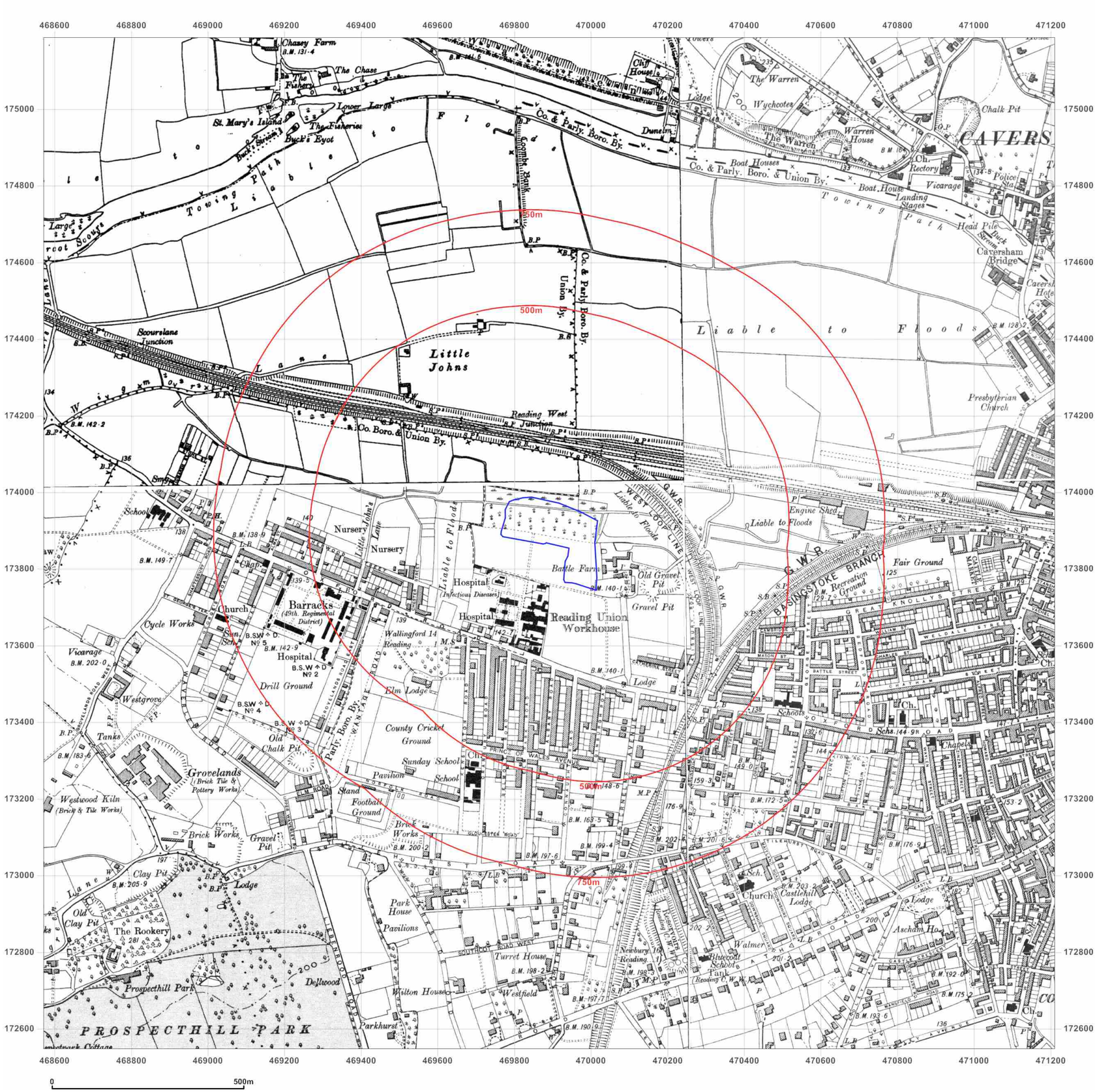
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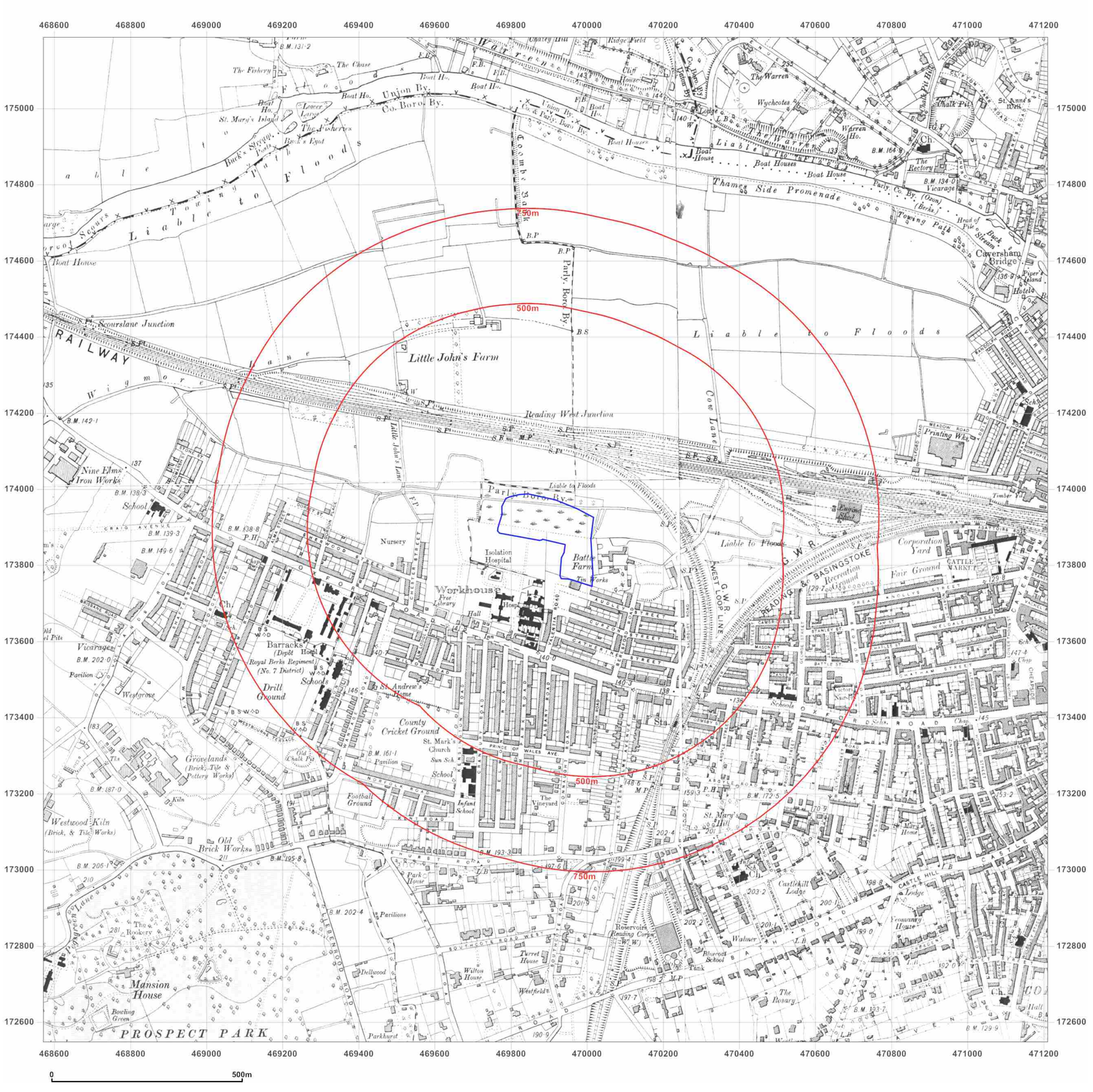
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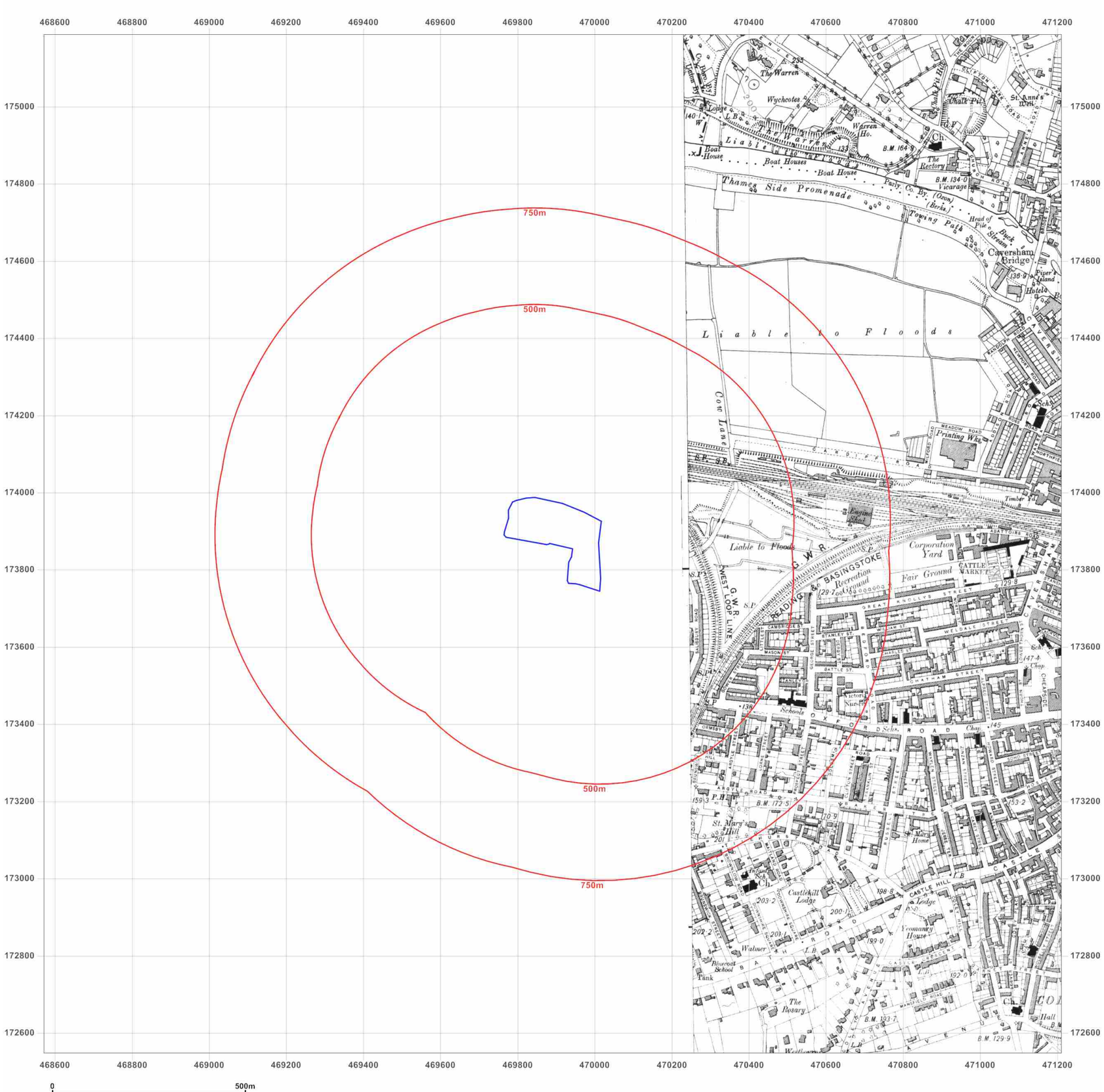
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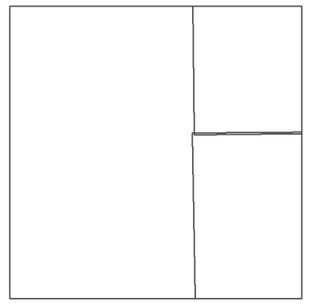
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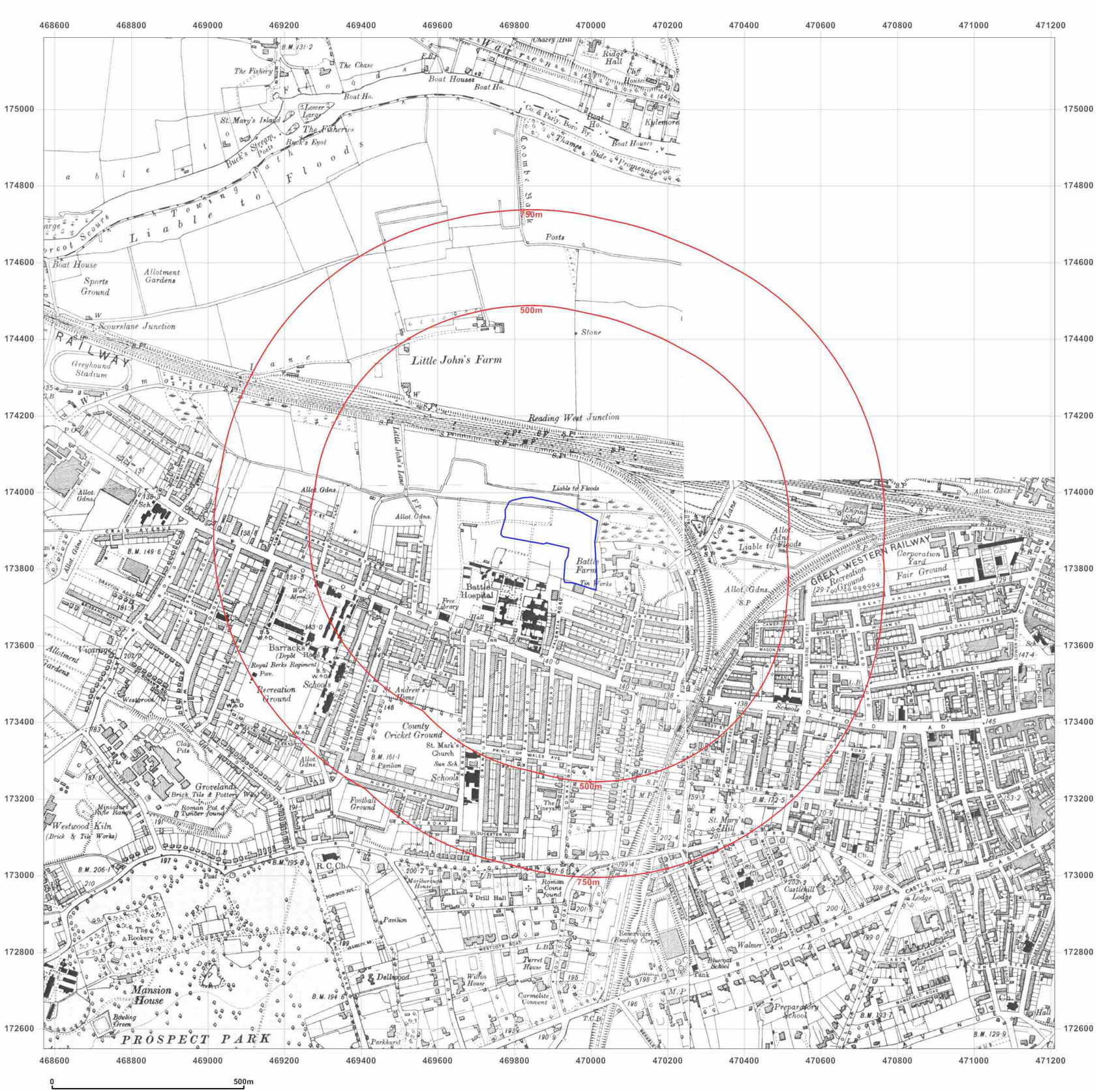
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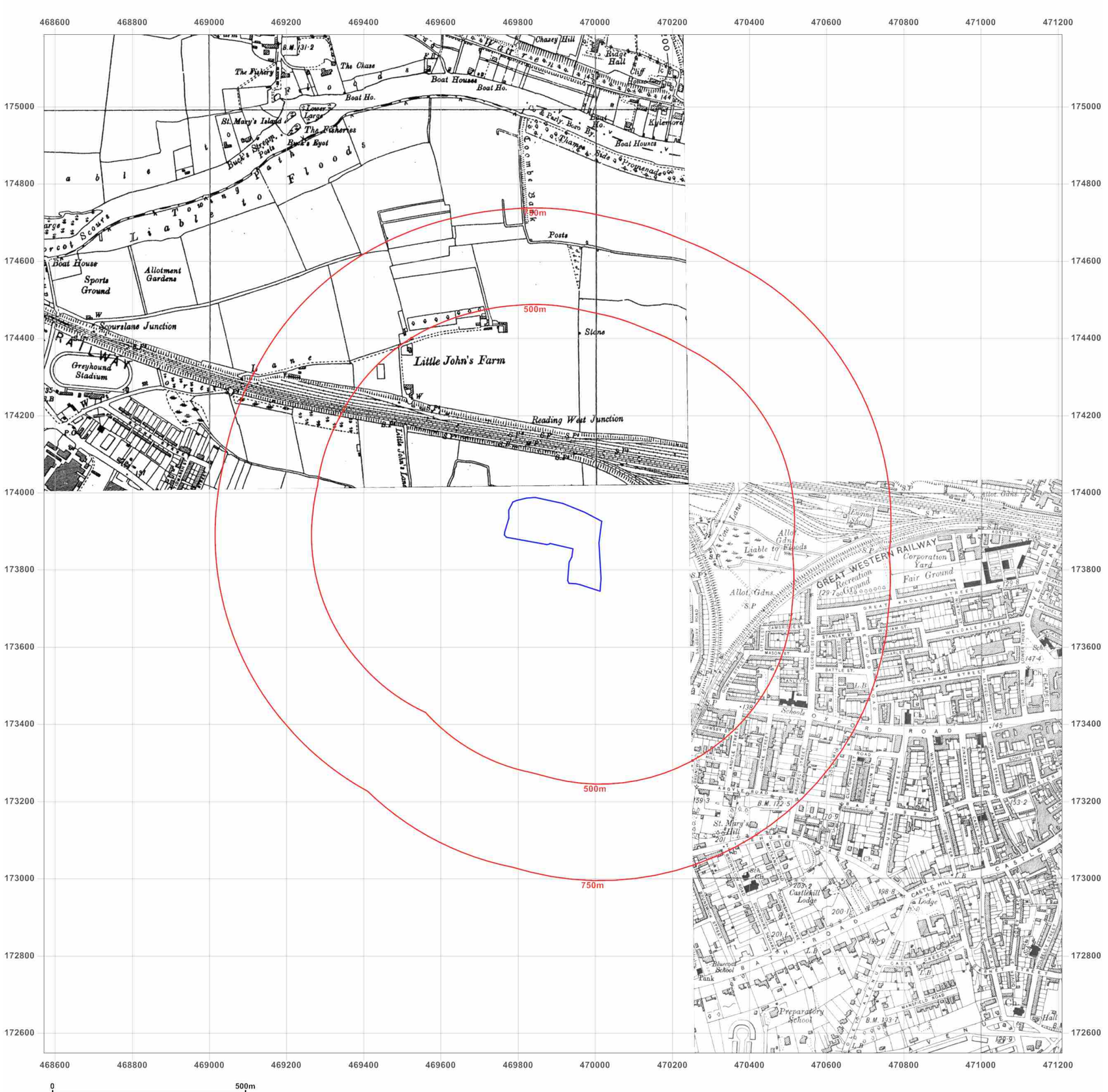
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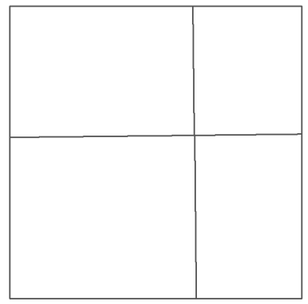
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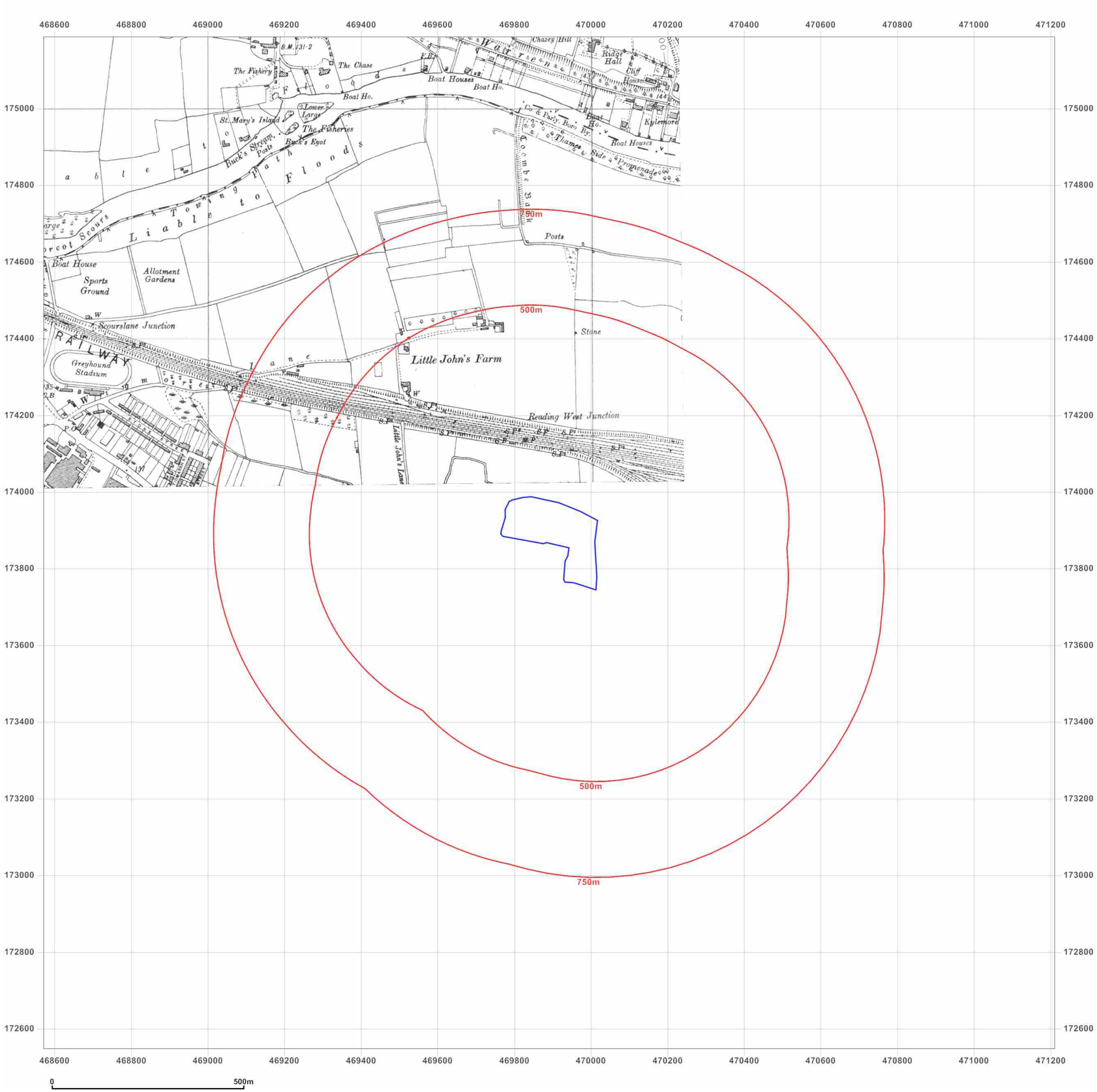
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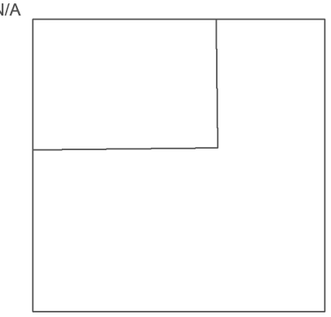
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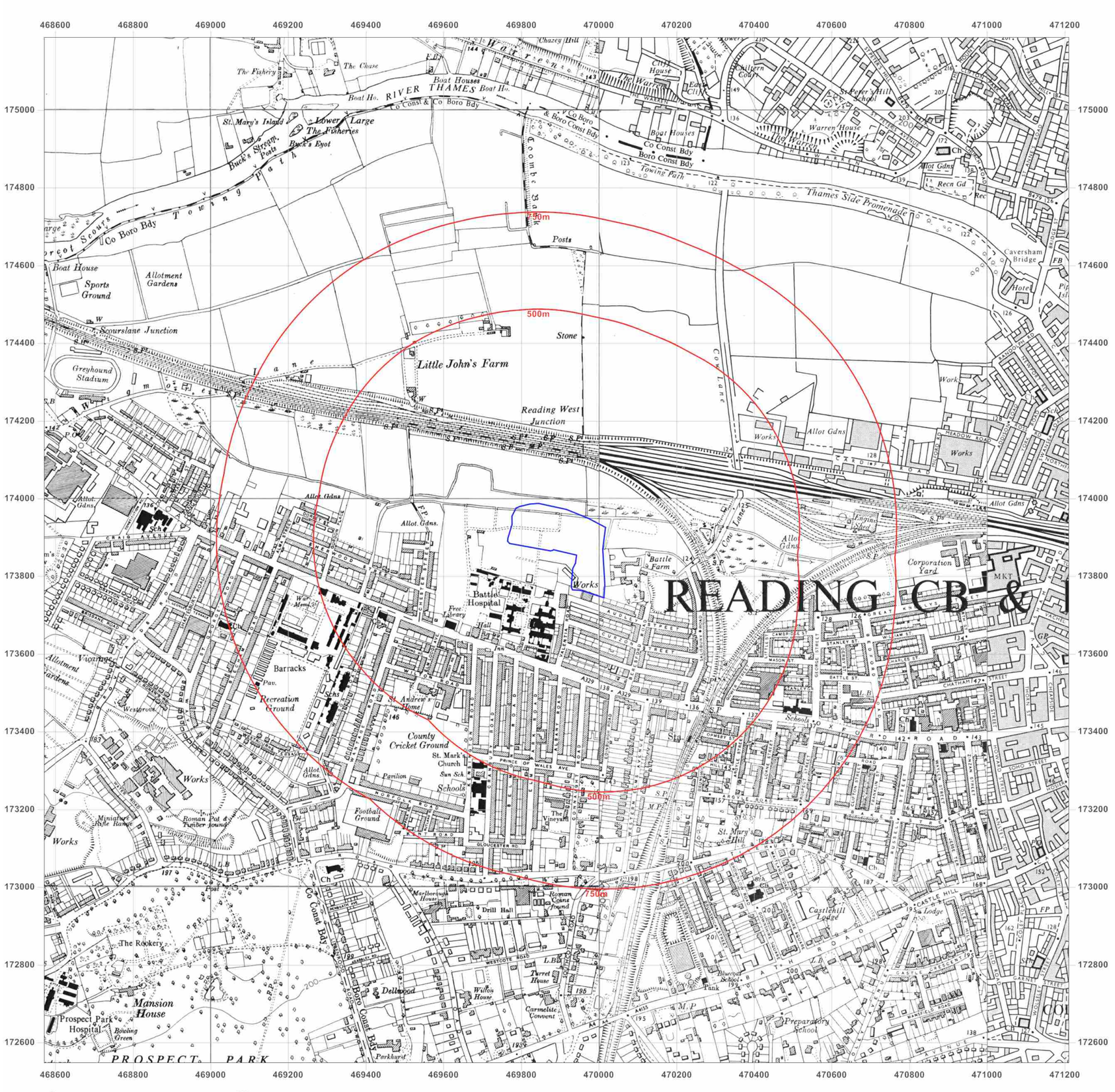
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Production date: 15 March 2017

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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: Provisional
Map date: **1960-1962**
Scale: 1:10,560
Printed at: 1:10,560

N
W E
S

Surveyed 1956
Revised 1956
Edition N/A
Copyright 1960
Levelled N/A

Surveyed 1877
Revised 1956
Edition N/A
Copyright 1961
Levelled N/A

Surveyed N/A
Revised 1960
Edition 1961
Copyright 1961
Levelled N/A

Surveyed 1959
Revised 1961
Edition N/A
Copyright 1962
Levelled N/A

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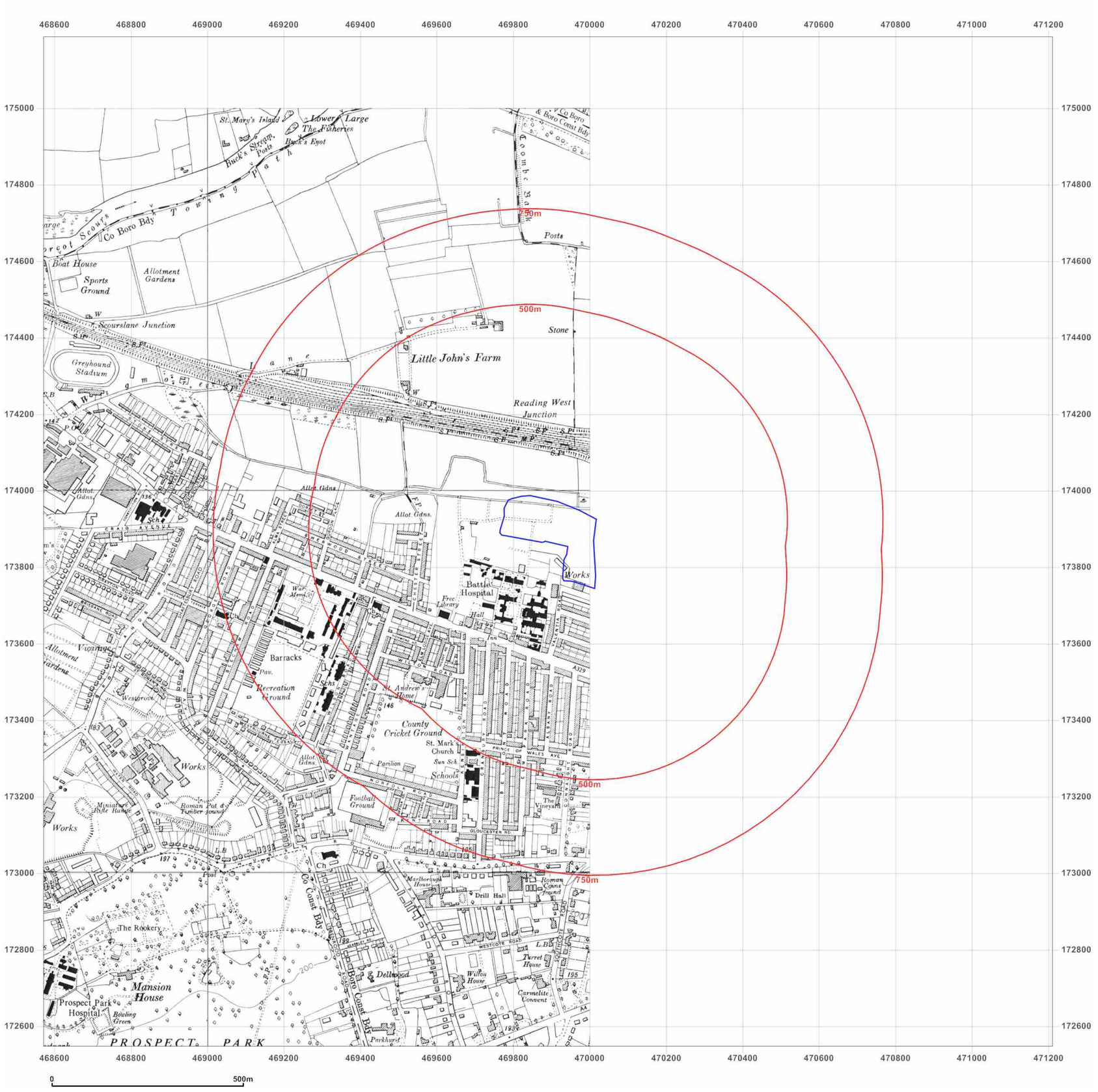
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Production date: 15 March 2017

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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

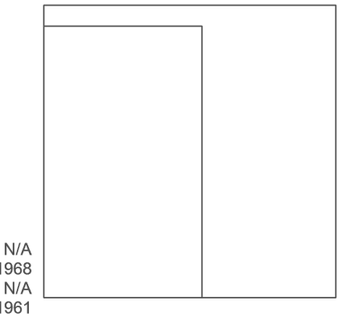
Map Name: Provisional

Map date: **1968**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed N/A
Revised 1968
Edition N/A
Copyright 1961
Levelled N/A

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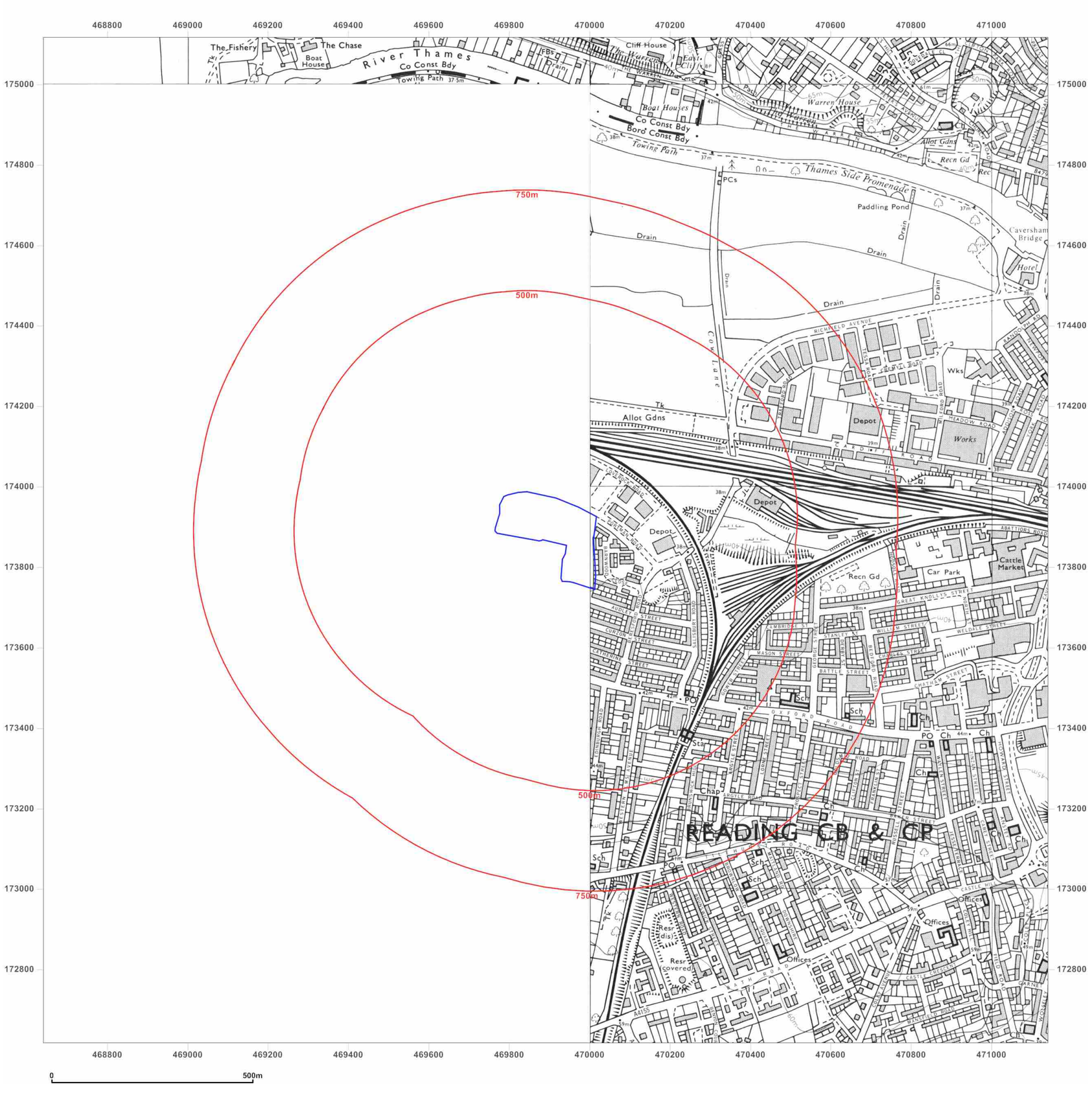
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

Map date: **1970-1973**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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Surveyed 1968
Revised 1970
Edition N/A
Copyright 1970
Levelled 1969

Surveyed 1971
Revised 1973
Edition N/A
Copyright 1973
Levelled 1969

Surveyed 1970
Revised 1973
Edition N/A
Copyright 1973
Levelled N/A

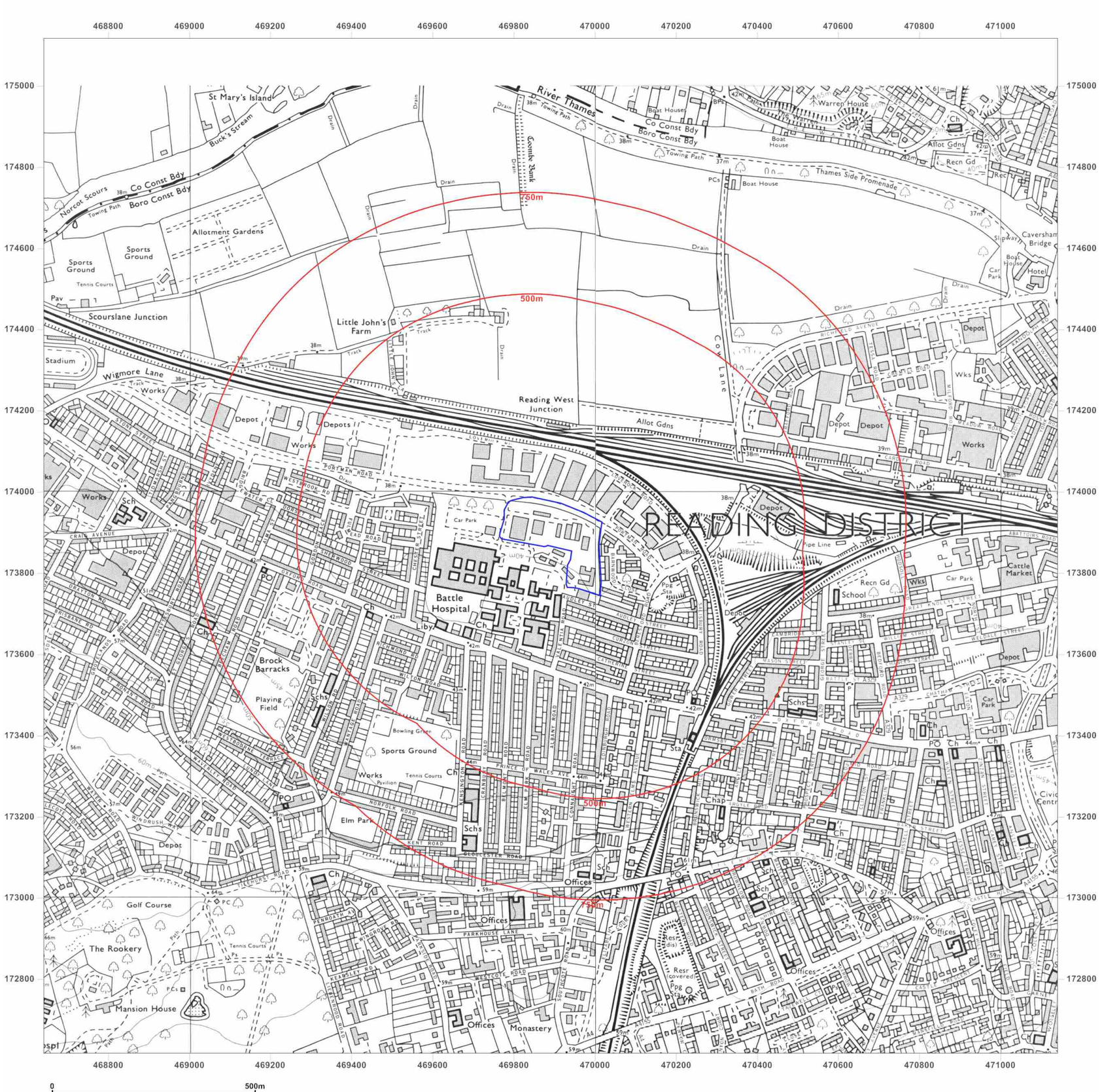
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

Map date: **1976-1979**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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Surveyed 1973
Revised 1975
Edition N/A
Copyright 1976
Levelled 1969

Surveyed 1977
Revised 1979
Edition N/A
Copyright 1979
Levelled 1969

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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

Map date: **1982-1983**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
S

Surveyed 1981
Revised 1983
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1981
Revised 1982
Edition N/A
Copyright N/A
Levelled N/A

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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

Map date: **1989-1991**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
S

Surveyed 1985
Revised 1990
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1990
Revised 1991
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1987
Revised 1989
Edition N/A
Copyright N/A
Levelled N/A

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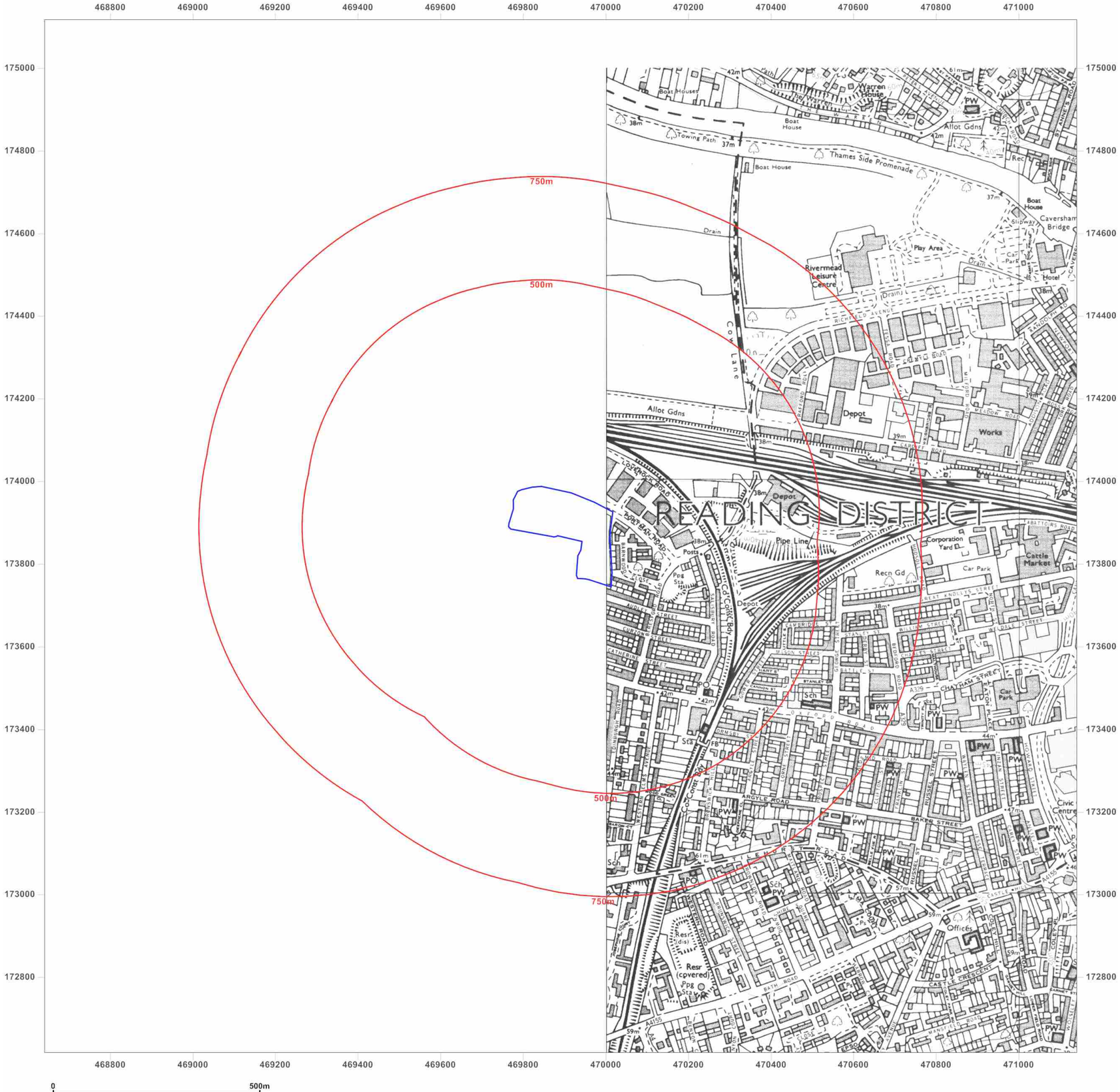
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

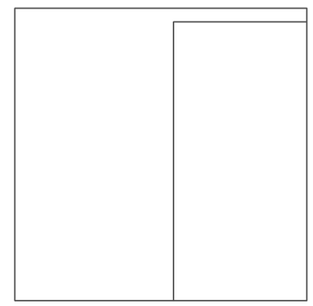
Map Name: National Grid

Map date: **1994**

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1987
Revised 1994
Edition N/A
Copyright N/A
Levelled N/A

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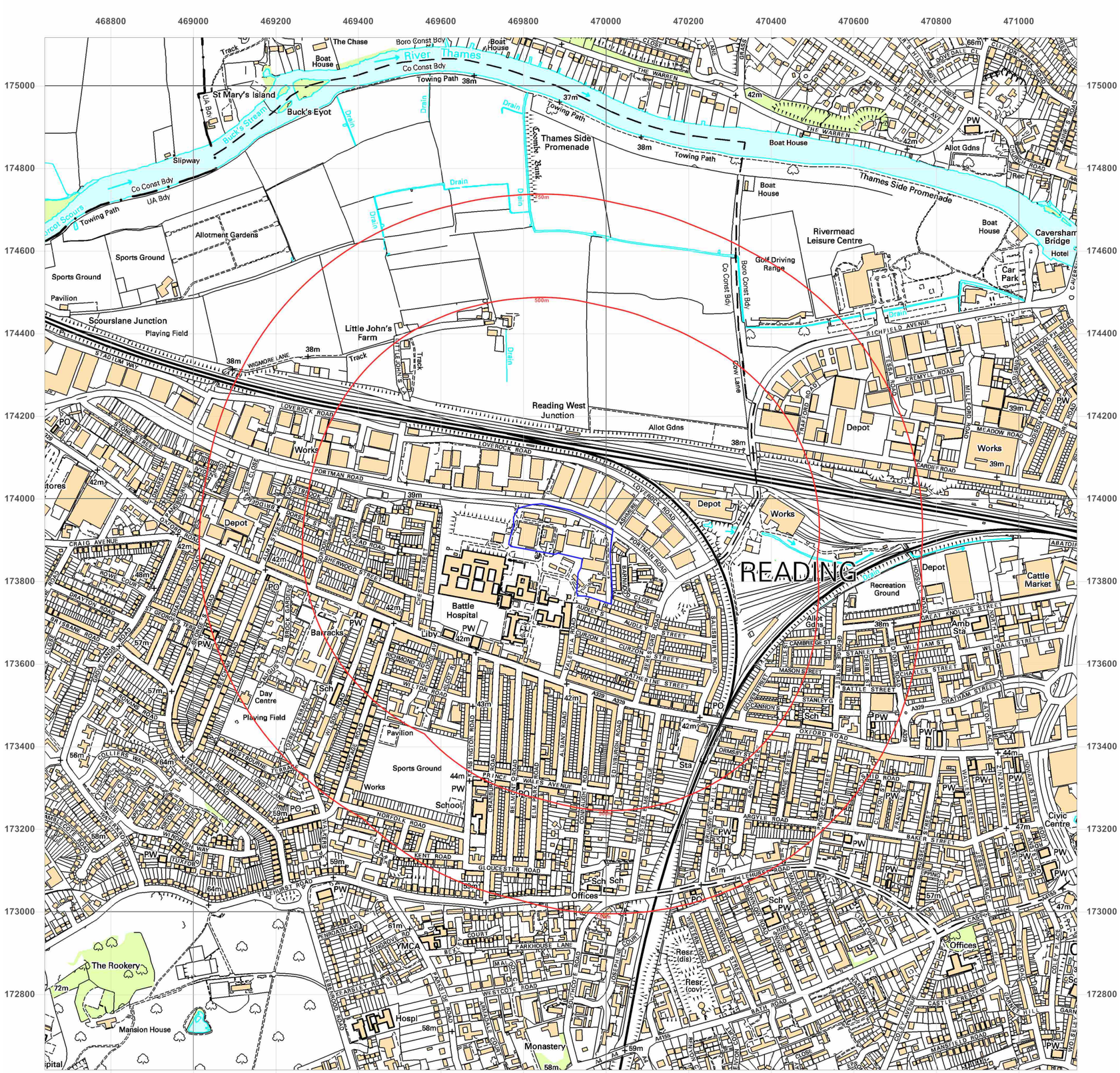
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: 1:10,000 Raster

Map date: **2002**

Scale: 1:10,000

Printed at: 1:10,000

N
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2002

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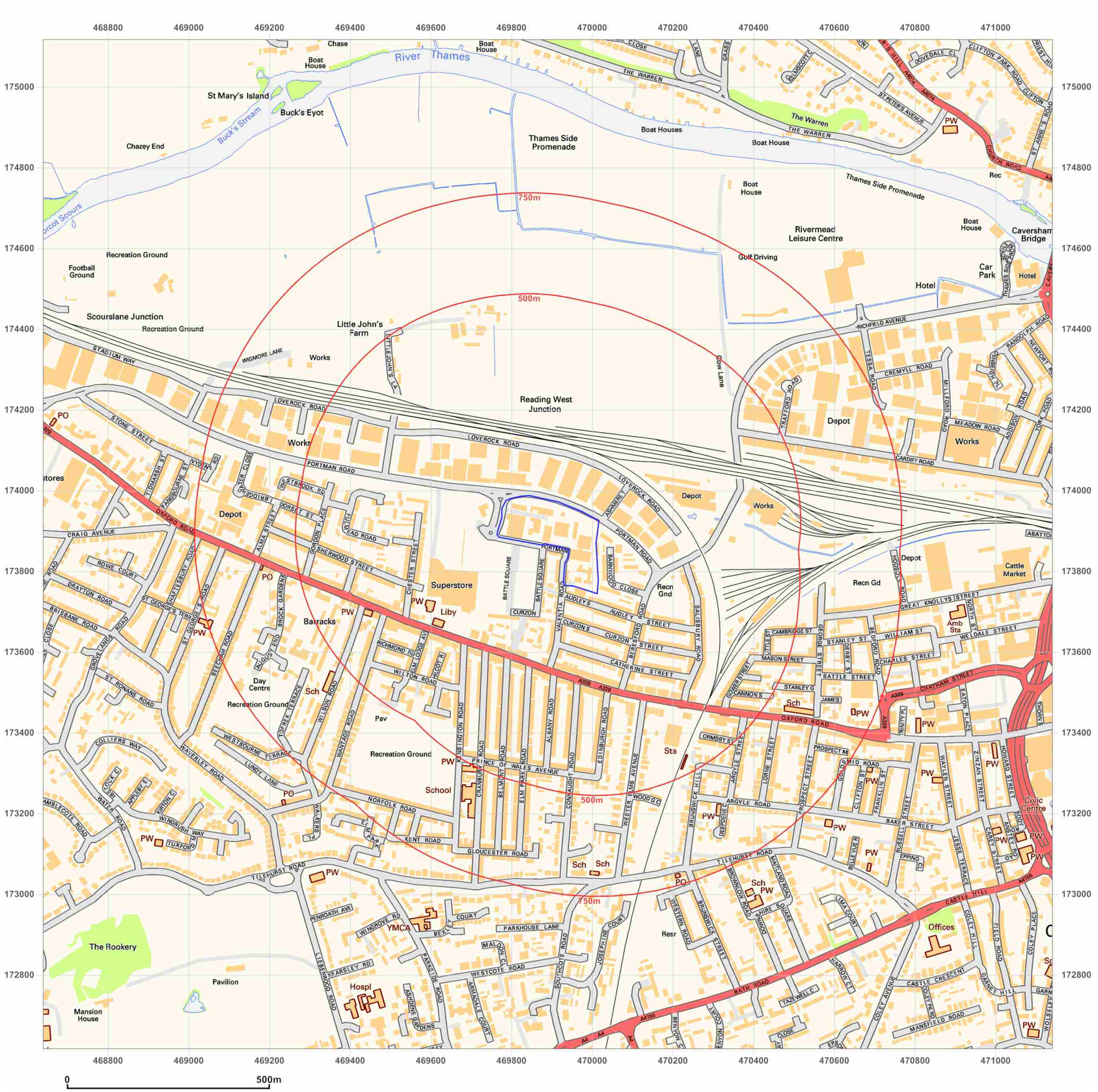
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

Map date: **2010**

Scale: 1:10,000

Printed at: 1:10,000

N
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2010

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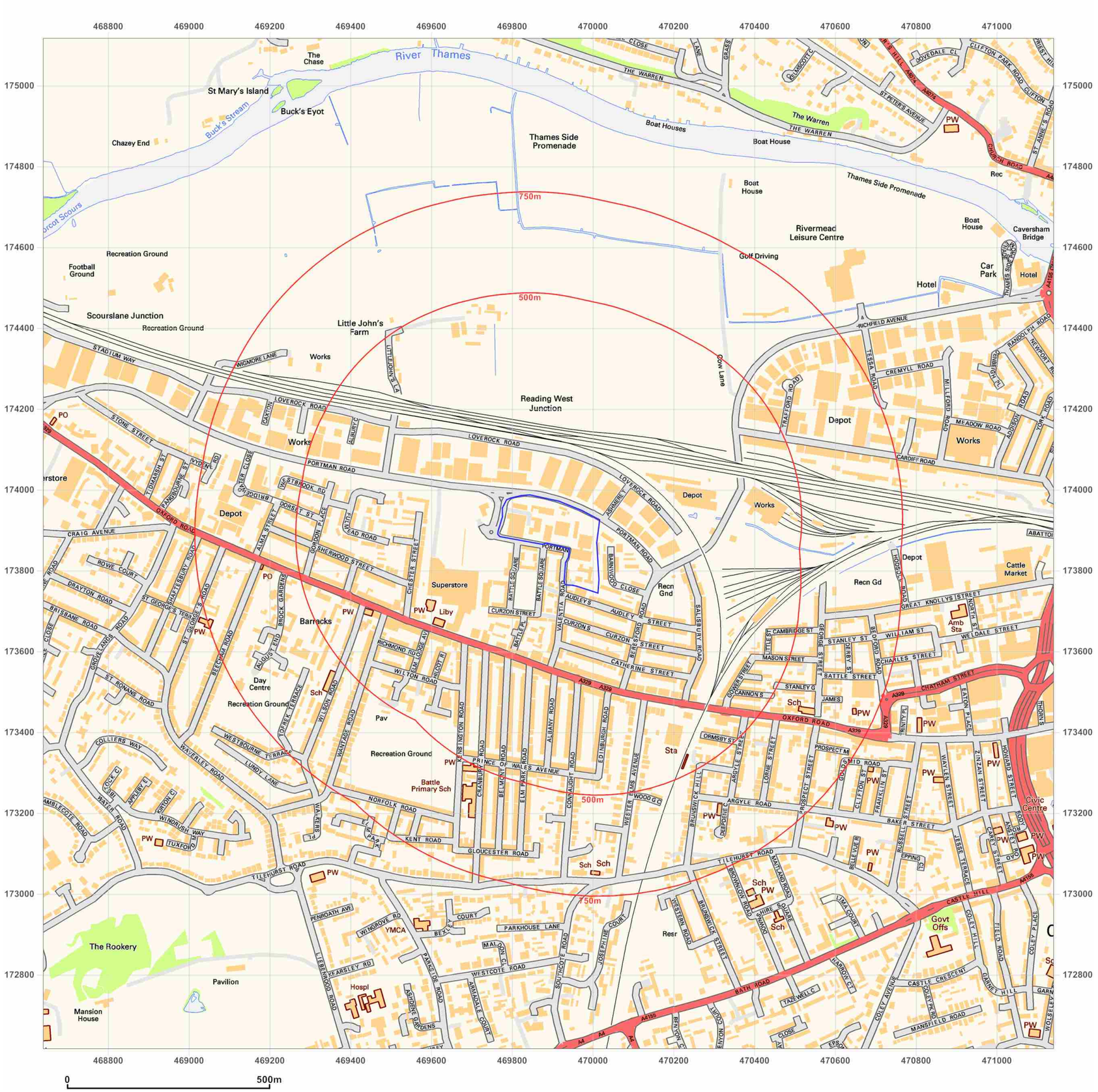
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

Map date: **2014**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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2014

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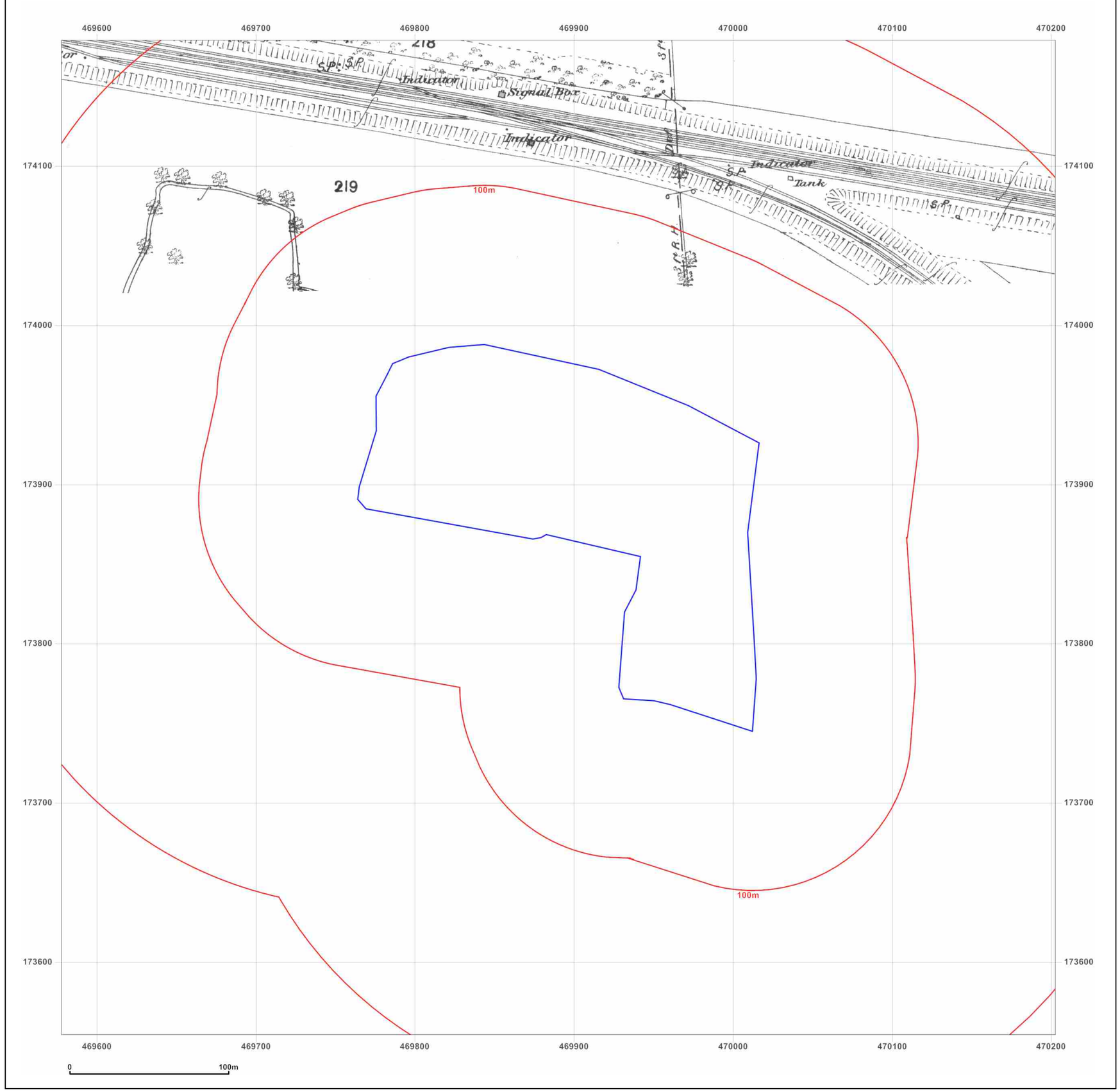
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: County Series

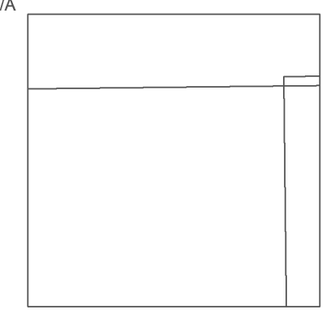
Map date: **1879-1881**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1881
Revised 1881
Edition N/A
Copyright N/A
Levelled N/A



Surveyed 1879
Revised 1879
Edition N/A
Copyright N/A
Levelled N/A

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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: County Series

Map date: **1881**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1881
Revised 1881
Edition N/A
Copyright N/A
Levelled N/A

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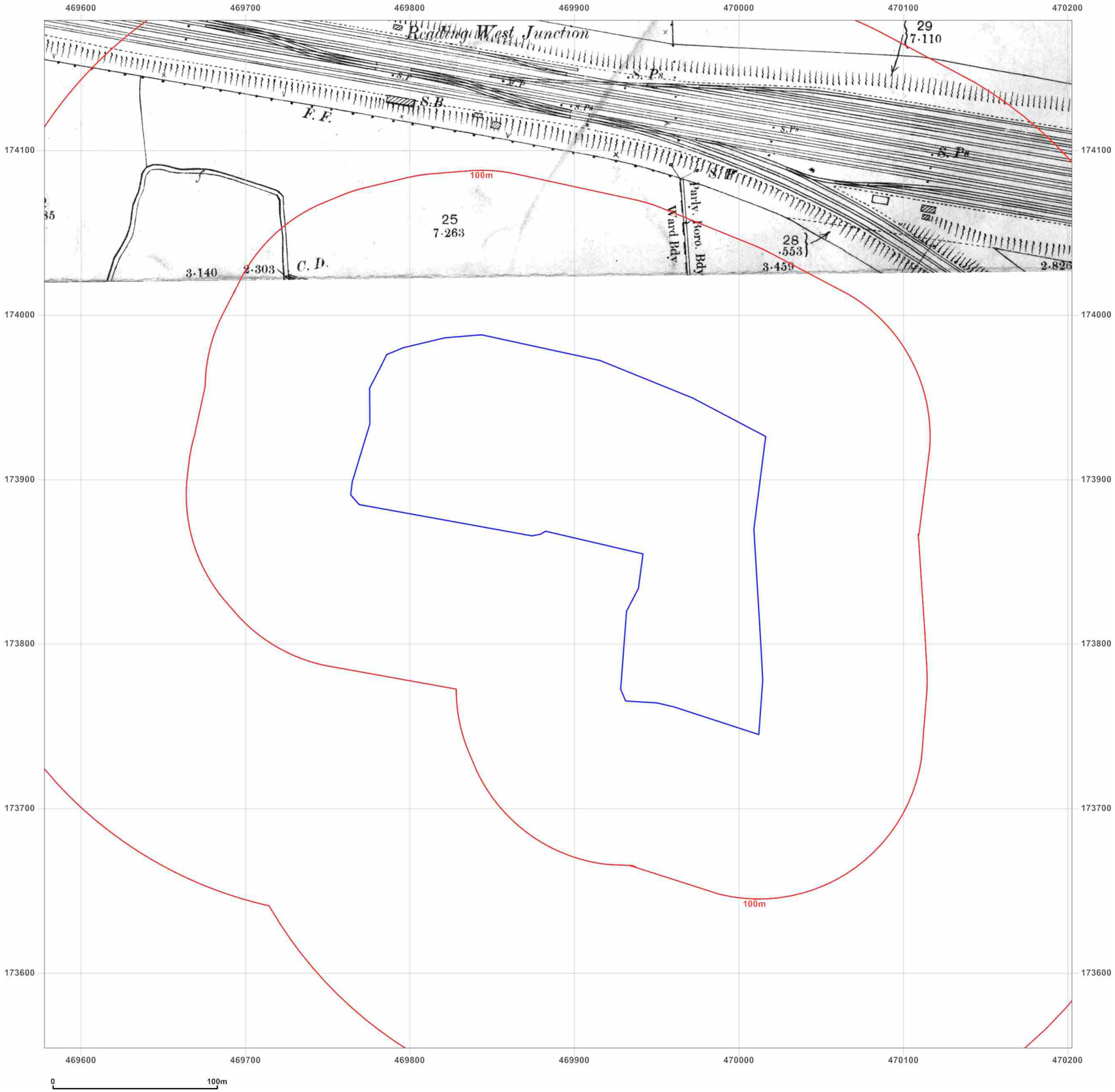
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: County Series

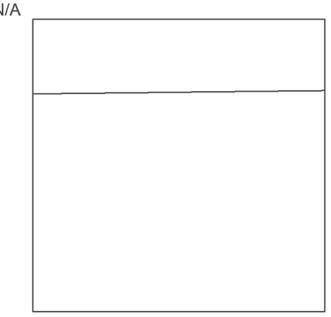
Map date: **1897**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1897
Revised 1897
Edition N/A
Copyright N/A
Levelled N/A



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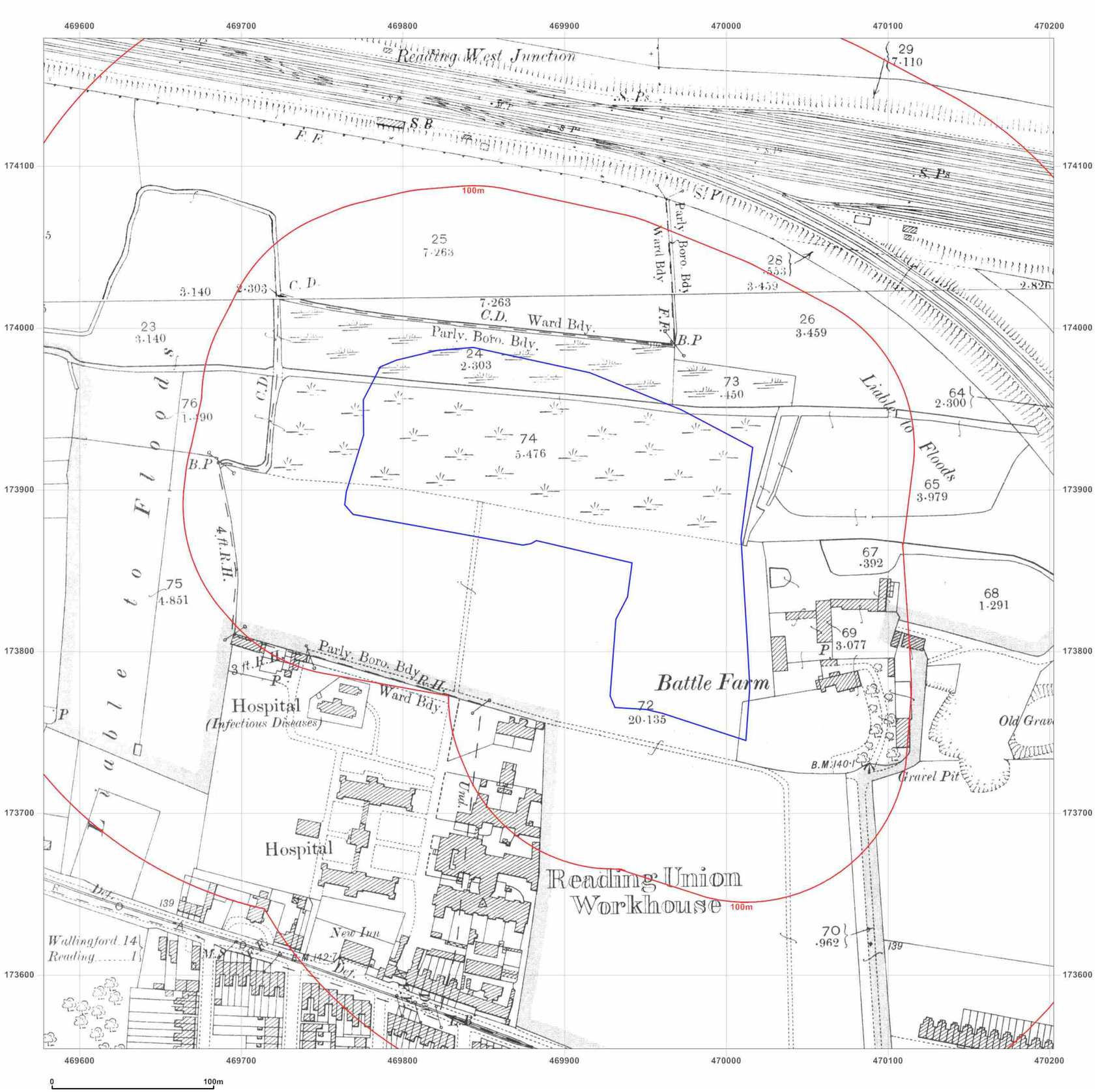
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: County Series

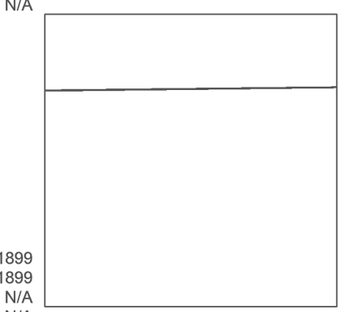
Map date: **1897-1899**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1897
Revised 1897
Edition N/A
Copyright N/A
Levelled N/A



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

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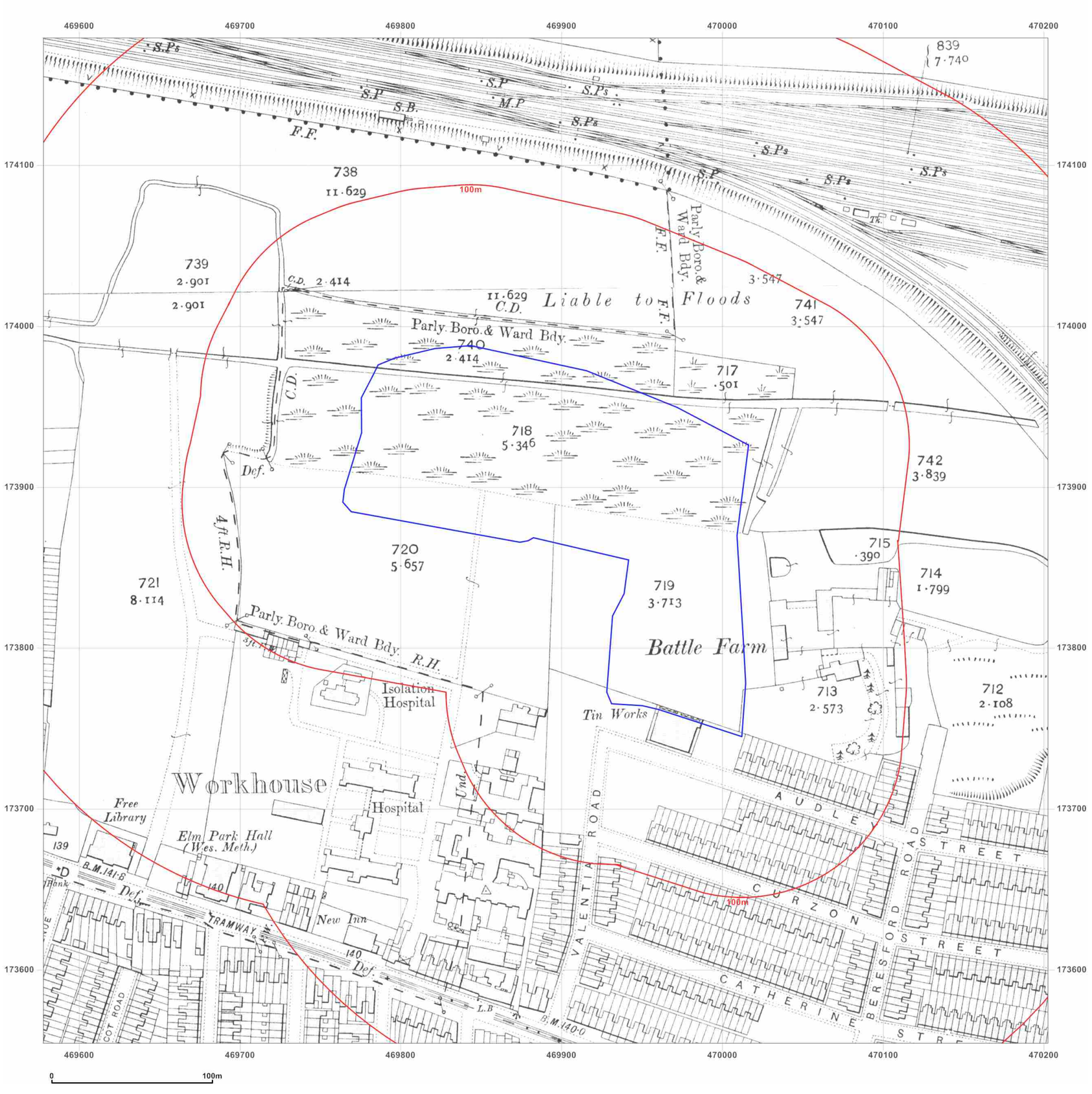
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: County Series

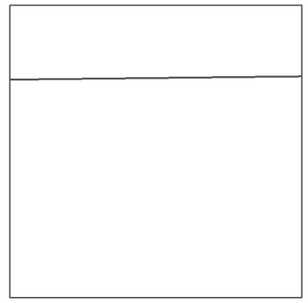
Map date: **1911-1913**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1913
Revised 1913
Edition N/A
Copyright N/A
Levelled N/A



Surveyed 1911
Revised 1911
Edition N/A
Copyright N/A
Levelled N/A

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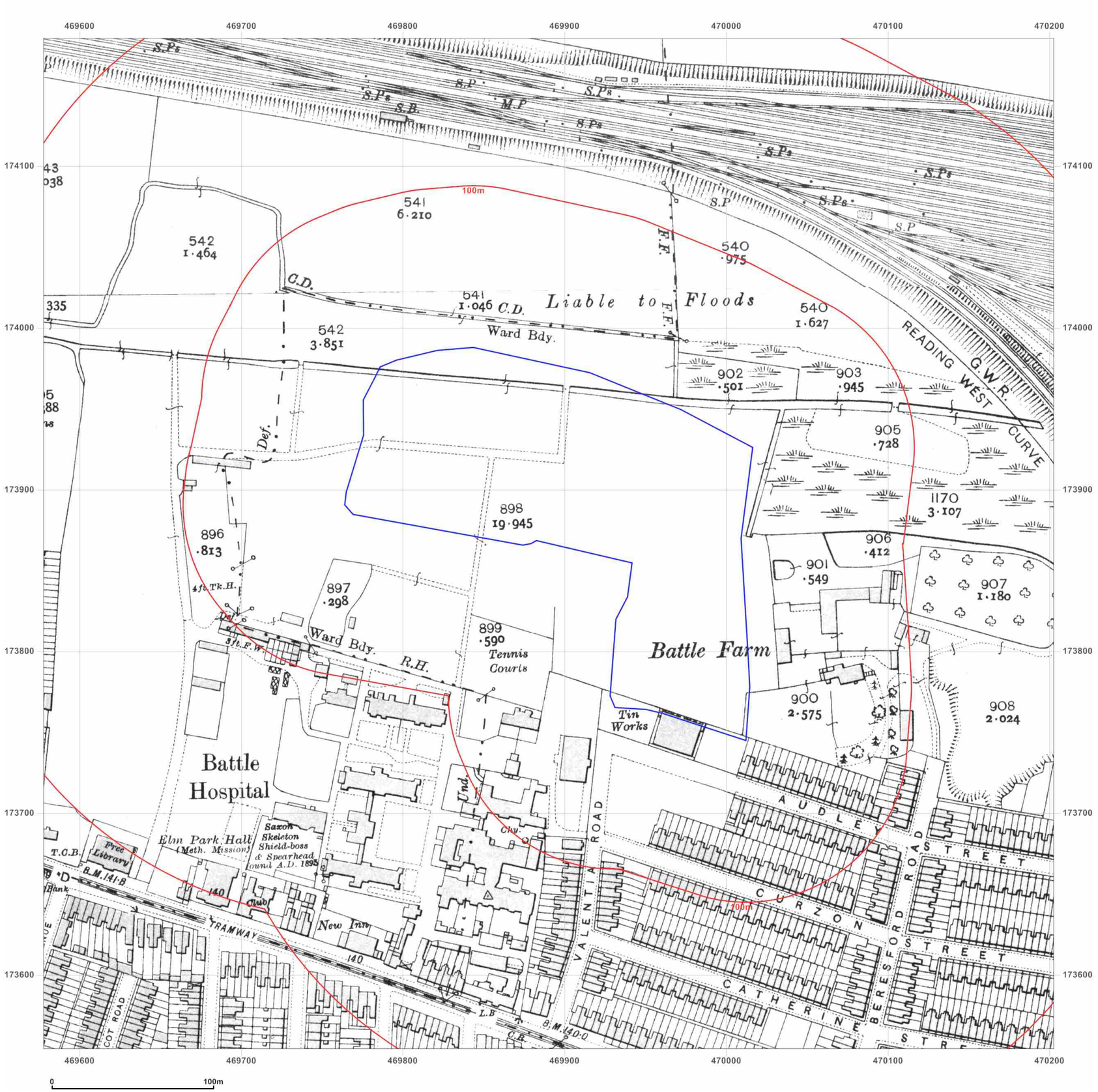
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: County Series

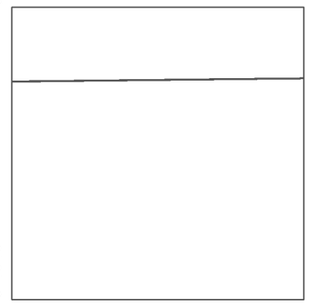
Map date: **1932-1934**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1934
Revised 1934
Edition N/A
Copyright N/A
Levelled N/A



Surveyed 1932
Revised 1932
Edition N/A
Copyright N/A
Levelled N/A

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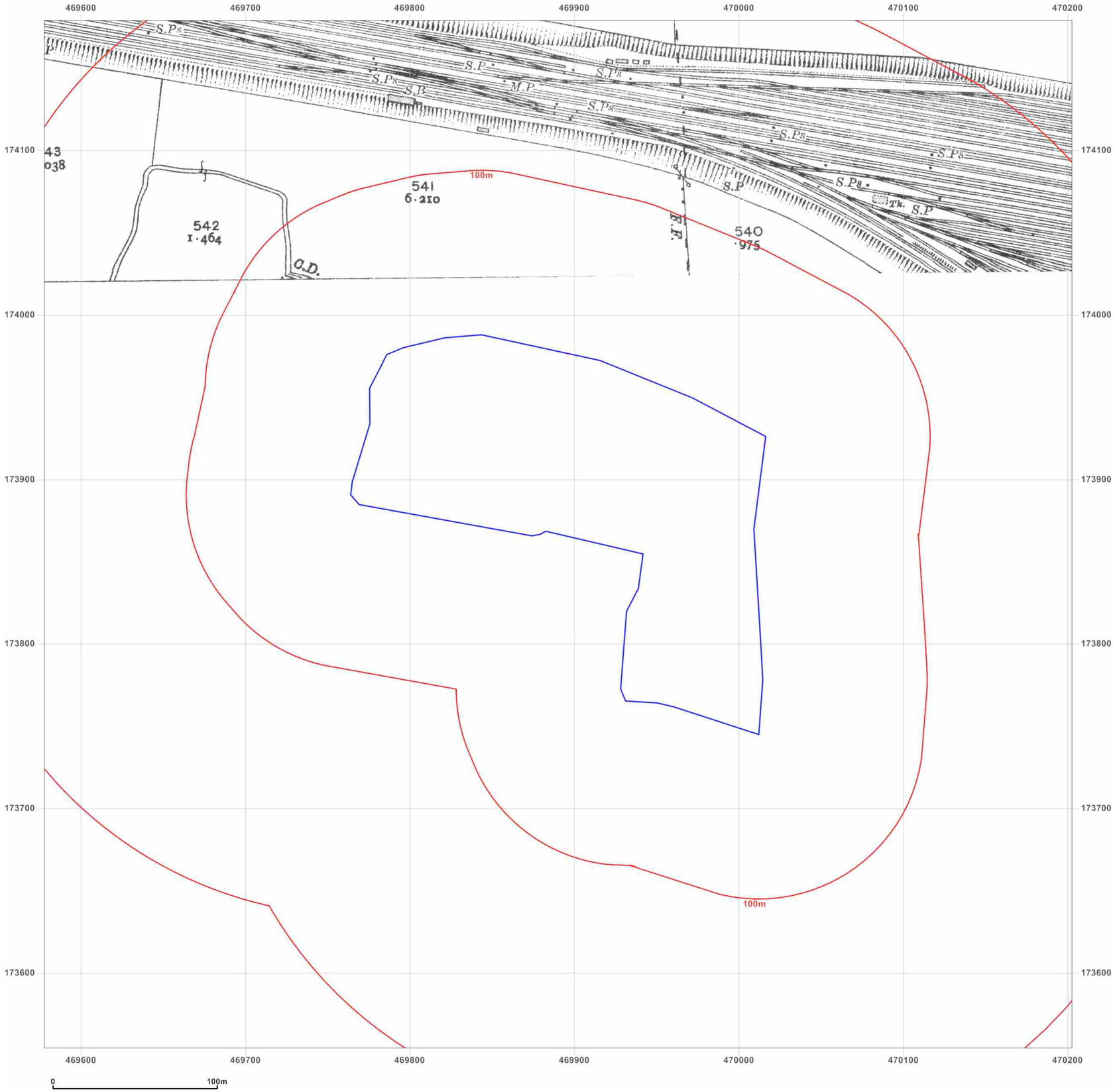
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: County Series

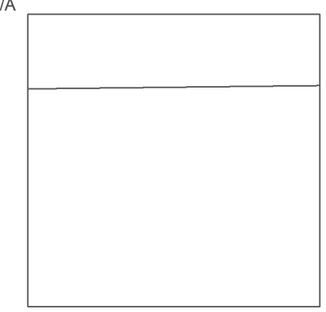
Map date: **1936**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1936
Revised 1936
Edition N/A
Copyright N/A
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

Map date: **1959**

Scale: 1:1,250

Printed at: 1:2,000

N
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Surveyed 1959 Revised 1959 Edition N/A Copyright 1959 Levelled 1951	Surveyed 1959 Revised 1959 Edition N/A Copyright 1959 Levelled 1951
Surveyed 1959 Revised 1959 Edition N/A Copyright 1959 Levelled 1951	Surveyed 1958 Revised 1958 Edition N/A Copyright 1959 Levelled 1951

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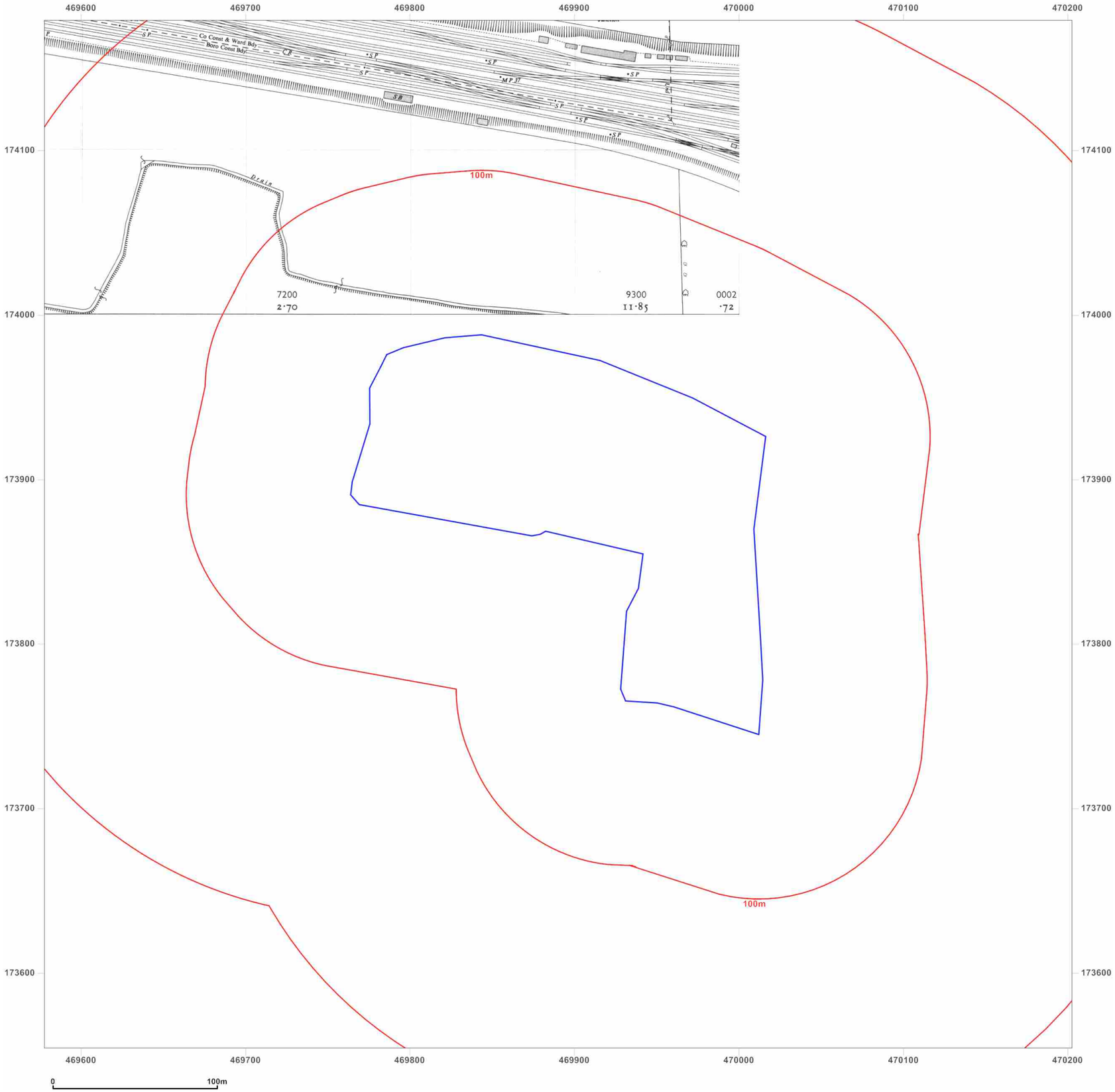
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

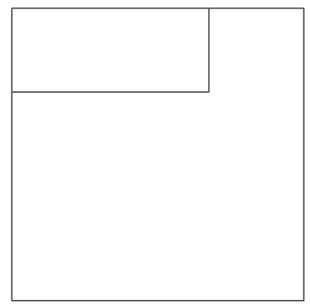
Map date: **1960**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1960
Revised 1960
Edition 1961
Copyright 1961
Levelled 1951



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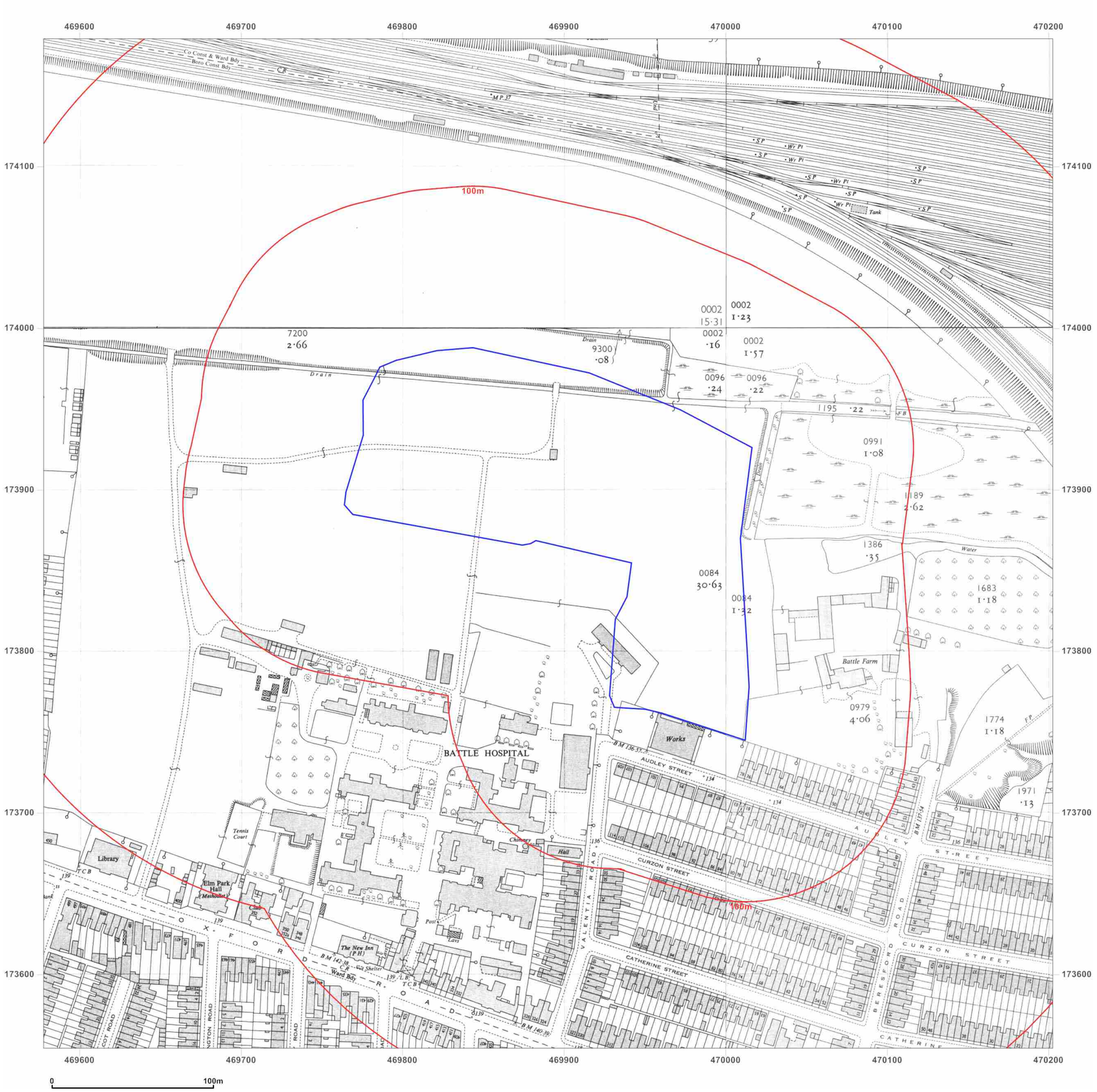
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Site Details:

Battle Hospital

Client Ref: EMS_411382_549895
Report Ref: EMS-411382_549895
Grid Ref: 469890, 173867

Map Name: National Grid

Map date: **1959-1962**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
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Surveyed 1960
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Report Ref: EMS-411382_549895
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Map Name: National Grid

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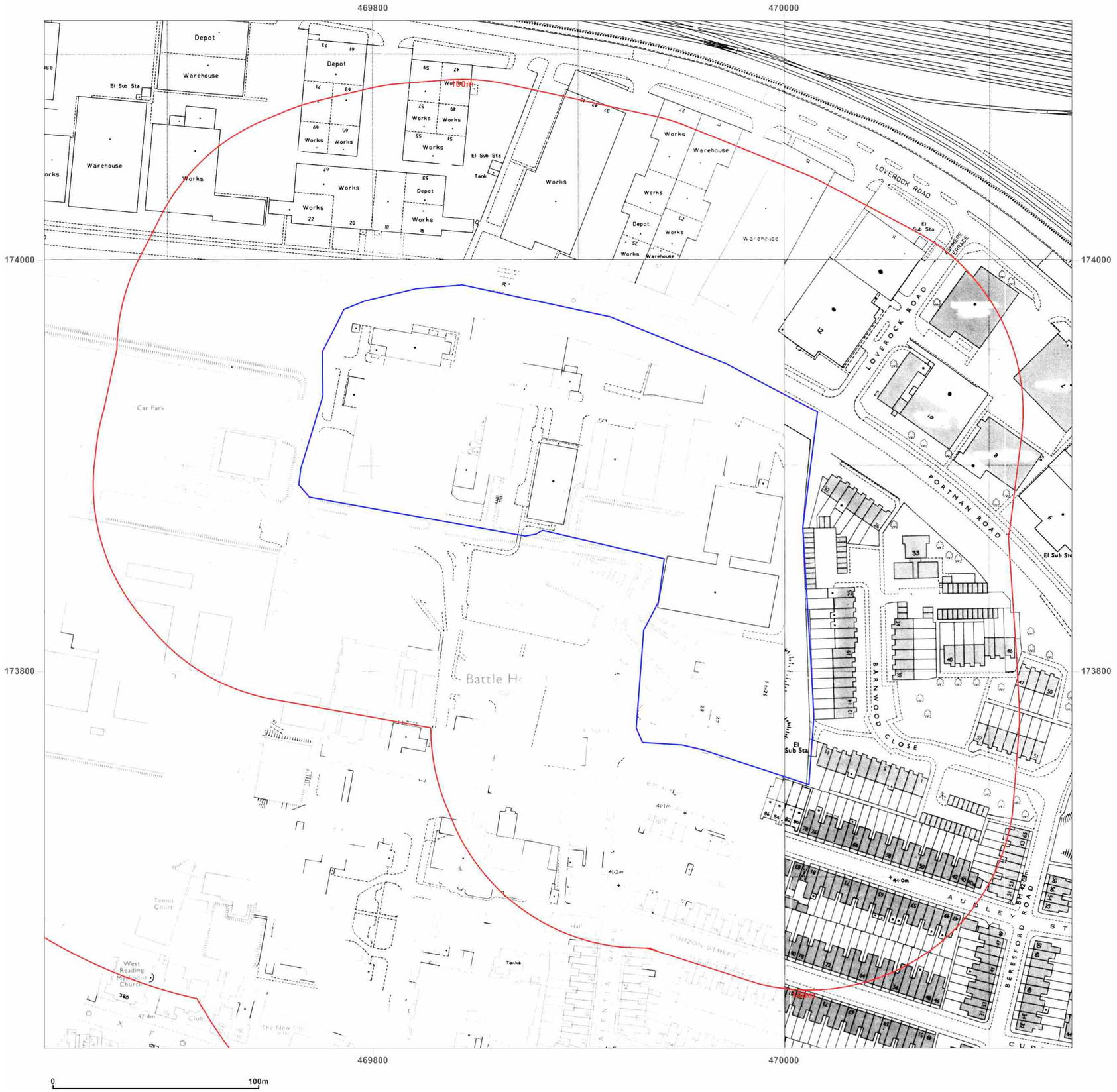
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Royal Berkshire NHS Foundation Trust, South Central Ambulance Service NHS Foundation Trust & Wates Development Limited

Former Battle Hospital, Reading

Preliminary Risk Assessment and Site Investigation

25520-R01

SEPTEMBER 2012

RSK GENERAL NOTES

Project No.: 25520-R01

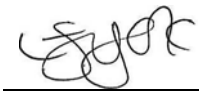
Title: PRA and Site Investigation: Former Battle Hospital Reading

Client: Royal Berkshire NHS Foundation Trust, South Central Ambulance Service NHS Foundation Trust & Wates Development Limited

Date: September 2012

Office: 18 Frogmore Road, Hemel Hempstead, Herts

Status: Final

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Date:	September 2012	Date:	September 2012
Project manager	Stuart Jeffery	**Quality reviewer**	Linda York
Signature		Signature	
Date:	September 2012		September 2012

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Environment Ltd.

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1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by Royal Berkshire NHS Foundation Trust, South Central Ambulance Service NHS Foundation Trust & Wates Development Limited to carry out a geo-environmental assessment of the land at Former Battle Hospital, Reading, Berkshire. It is understood that the site is being considered for redevelopment with residential dwellings with gardens.

This report is subject to the RSK service constraints given in Appendix A.

1.1 Objective and aims

The objective of the work is to support a planning application to include:

- An assessment of the site and surrounding area in terms of history and environment setting from which a conceptual site model can be collated to inform site investigation works;
- Obtain sufficient information regarding ground conditions from which risks to end-users, the environment and structures can be assessed plus geotechnical issues including the design of foundations and infrastructure; and
- Enable an assessment of the potential waste classification implications of soil arisings.

1.2 Scope

The scope of the investigation and layout of this report has been designed with consideration of CLR11 (Environment Agency, 2004a), BS 10175: 2011 (BSI, 2011) and PPS23 (ODPM, 2004), plus guidance on land contamination reports issued by the Environment Agency (2010a).

The project was carried out to an agreed brief as set out in RSK's email proposal (August 2011). The scope of works for the assessment included:

- A preliminary risk assessment (PRA) to include a review of existing reports, geological, hydrogeological and hydrological information, a commercially available environmental database, and historical plans; correspondence with regulatory authorities; and a site walkover – this information is used to develop an initial conceptual site model to consider any potentially complete pollutant linkages;
- A review of published geological data to assess ground stability;
- An intrusive investigation consisting of boreholes and probeholes with laboratory analysis;
- Development of a refined conceptual site model followed by generic quantitative risk assessment (GQRA) to assess complete pollutant linkages that may require mitigation measures to be implemented to facilitate redevelopment;
- Identification of outline mitigation measures for complete pollutant linkages or recommendations for further work;

- Interpretation of ground conditions and geotechnical data to provide recommendations with respect to foundations and infrastructure design; and
- A factual and interpretative report with recommendations for further works (i.e. undertake a remedial options appraisal to identify appropriate mitigation measures/produce a remedial implementation and verification plan) and/or remediation as necessary.

1.3 Existing reports

Site investigations were carried out on the site during 2011 by a previous interested party. RSK has not been provided with a copy of the report. However, we have been provided with a summary report compiled by Upton McGougan dated 10 November 2011. The Upton McGougan report provides an overview of the ground conditions but limited specific information about the environmental setting and statutory and development risks.

Pertinent information from the review and Upton McGougan's report is provided below.

A layer of made ground is present beneath the entire site with a variable thickness between 0.6 –1.2m to the south and 2.5 – 4m to the north. The deeper made ground in the north is said to present a former landfill. No details on the composition of the made ground or the nature of the landfill are available. Natural deposits are published as alluvial clay, silt, sand and gravel. The previous site investigation reported alluvium 0.8m thick increasing to 2m in the north of the site. A layer of gravels were encountered underlying the alluvium ranging from 1.6 – 2.7m thick, likely to represent the Taplow Gravels shown on maps along the southern edge of the site.

Solid geology is published as the Seaford Chalk Formation And Newhaven Chalk Formation (Undifferentiated). The site investigation reported chalk between 3.2m below ground in the south to 7.4m below ground in the north of the site.

The superficial deposits contain a Secondary A aquifer. The site investigation reported varying groundwater levels between 1.1m to 3.5m with evidence of perched water in places. The made ground is reportedly having an adverse effect on the perched ground water above the alluvium especially in the area of the underground fuel storage tank.

The chalk contains a Principal Aquifer. This was not encountered during the previous investigation and its depth is unknown.

Groundwater is not part of a Source Protection Zone, however it is classified as a Principal Aquifer of High Vulnerability. Current water quality is reported as qualitatively 'Good' and chemically 'Good but deteriorating' (Environment Agency 2012).

The nearest surface watercourse is the River Thames approximately 1km north of the site.

Surface topography and the underlying geology would suggest that groundwater flows in a northerly direction into this watercourse, most likely providing the base flow.

The site is situated within an area at risk of flooding by the River Thames from areas where defenses are not in place.

2 THE SITE

2.1 Site location and description

The site covers approximately 2.65 hectares and is located off Portman Road, Reading, Berkshire at National Grid reference TQ 695 738, as shown on Figure 1.

Currently the site is occupied by buildings forming part of the former Battle Hospital, which include ambulance storage, (maintenance) workshops, offices, a former incinerator and vacant storage units.

Filled ground is reported to be present beneath the northern half of the site, presumably utilised before expansion of the hospital northwards across the subject site. However the full extent of the filled ground is unknown.

External areas are hardstanding car parks or roads with occasional areas of soft landscaping.

The area surrounding the site comprises commercial units (various uses) to the north beyond Portman Road, residential units to the east and south units to the south (new build) and a Tesco superstore and garage to the southwest and west.

2.2 Proposed development

It is understood that the site is to be redeveloped for a residential end-use, comprising low-rise houses and apartments with associated private and communal gardens and infrastructure.

3 PRELIMINARY RISK ASSESSMENT (PRA)

3.1 Site walkover

The site was visited on the 1st August 2012. The aim of the survey was to identify the range of potentially contaminative activities carried out on the site and in the immediate vicinity, and any obvious potential sources of ground contamination. The characteristics of the site observed during the site reconnaissance visit and obtained from current Ordnance Survey maps are summarised in Table 1 and on Figure 2. Site photographs are presented in Appendix C.

Table 1: Site description

Feature	Description
Physical characteristics	
Area of site	Approximately 2.65 hectares.
Existing buildings on site	A large warehouse is present within the eastern quarter of the site, which is predominately empty other than storage of some paramedic equipment and an occasional damaged ambulance. Adjacent to the warehouse toward the central part of the site is an ambulance maintenance workshop and offices. The central south part of the site is occupied by Synergy where medical equipment is sanitised and distributed. A small office building is present within the central north part of the site, which is occupied by ambulance mobility. A small office block is present within the northwest of the site currently occupied by the NHS. A large warehouse (believed to be the former laundry) and a smaller adjacent building (with chimney believed to be the former boiler and incinerator) are present within the southwest of the site. The large warehouse building is temporarily being used by Bovis as a site compound whilst the other is redundant.
Ground levels	The site is generally level with ground levels typically around 40mAOD.
Depressions in the ground surface	None observed.
Waterlogged or marshy ground	None observed.
Surface water	There are no streams or drainage ditches on or immediately adjacent to the site.
Trees and hedges	Mature deciduous trees are present along the sites boundaries. In addition, occasional juvenile shrubs are present between site buildings within small landscaped areas.

Feature	Description
Basements on site	No evidence of existing or infilled basements was observed, although their presence cannot be discounted (owing to the fact that access was not possible to all units).
External hardstanding	Concrete or bituminous hardstanding areas are present through the majority of the sites external areas.
Retaining walls	Retaining walls were not noted.
Made ground, earthworks and quarrying	Made ground is anticipated to be present on site associated with the existing and historical development of the site.
Buried services present	There are a number of manhole covers on site. A possible borehole abstraction was noted in a small building within the northern part of the site.
Environmental characteristics	
Tank storage and dispensing facilities	An underground fuel storage tank (UST) and dispenser is present within the northeast of the site. It is understood from the site agent that the tank and dispenser is now redundant. An above ground storage (AST) tank and dispenser is present within the northern part of the site adjacent to the mobility offices. It is understood from the site agent that the tank and dispenser is now redundant Two large above ground fuel oil tanks are located centrally off the main access road. These appear to be associated with the generator / boiler / incinerator building across the road. At time of the site visit it was unclear as to whether the tanks are still operational. An above ground fuel storage tank was also noted to be presenting adjacent to the boiler room in the central part of the site. At time of the site visit access was not available to this area and therefore it was unclear as to whether the tank was still operational. Two above ground storage tanks were noted to be present to the rear of the maintenance workshop. It is understood that one is used for storage of waste oil and the other for high-grade oil storage.
Potentially hazardous materials storage and use	A hazardous chemical store is present within the vehicle workshop within central east part of the site. An inspection of the store was not possible during the site walkover.
Asbestos-containing materials	Possible asbestos containing materials were noted in the form of cement bonded roofing materials associated with the some of the buildings on site, namely the maintenance unit. Asbestos presence within existing structures and made ground cannot be discounted. Prior to demolition of existing buildings, an asbestos survey must be carried out by an approved contractor. Asbestos containing materials are classified as being hazardous and must therefore be disposed off site at a suitably licensed waste facility should they be encountered.
Waste storage	A number of lubrication drums were located adjacent to the warehouse in the east of the site.

Feature	Description
Electricity sub-stations	None observed within site boundary.
Landfilling	It is understood from the land agent that the northern portion of the site was historically landfilled (believed to be predominately within waste bottles)
Evidence of possible land contamination on site	Staining of the ground surface was generally not observed (however access to all areas was not possible during the walkover) although given the history of the site and activities that have taken place ground contamination is likely to be present at the site.
Potential off-site sources of ground contamination	None observed during the site walkover.
Invasive plants	No invasive plant species such as Japanese Knotweed or Giant Hogweed were noted on site, although their presence cannot be discounted.

3.2 Geology

Published geological records (1:50,000 British Geological Survey, sheet No. 268 'Reading') for the area indicates the site is underlain by alluvium overlying the Taplow Gravel which in turn overlies the Upper Chalk Formation.

The full geological succession is presented in Table 2.

Table 2: Geology at the site

Geological unit	Description	Type
Alluvium	Variable sand, silt and clay locally shelly with peat and tufa layers	Superficial
Taplow Gavel	Sand and Gravel	Superficial
White Chalk Formation	Nodular Chalk	Solid
Source: 1:50,000 BGS (Sheet No. 268 'Reading')		

The existing topography and history of development of the site suggests that made ground would be expected to overlie these natural strata in parts of the site.

3.2.1 Radon

The environmental database report (Envirocheck report, dated 31st July 2012) indicates that the site is not located within an 'Affected Area' as defined by the Documents of the National Radiological Protection Board (Radon Atlas of England and Wales, NRPB-W26-2002). Therefore, the risk of significant ingress of radon into structures on-site is considered to be low and no radon protective measures are required within new dwellings at the site.

3.2.2 Mining and quarrying

Evidence has been sought to identify any mining and quarrying operations, past and present, which have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- an environmental database report (Envirocheck report, dated 31st July 2012);
- records held by the Environment Agency;
- old Ordnance Survey maps and plans (see Appendix E); and
- geological maps (see Section 3.2.1).

These records indicate the following:

- Four man-made mining cavities within 1km of the site, the closest being 869m to the southwest listed as being historical brick/clay pits. In addition chalk working are listed 870m to the southeast.
- Five natural cavities within 1km of the site, the closest listed as being a solution pipe 699m to the southeast of the site;
- Four BGS recorded mineral sites within 1km of the site, the closest 179m to the southeast of the site. Operations are listed to have ceased at of the sites; and
- The site does not lie within the likely zone of influence on the surface from current or historical underground coal workings.

In addition, gravel pits are shown locally (mainly to the northeast) on the historical maps for the site area. Where historical quarrying of sands and gravels has occurred at the site and in the surrounding area, the ground has since been infilled. The infill materials are considered to be a significant potential source of landfill gasses and/or leachate at the site.

3.2.3 Landfilling and land reclamation

Evidence has been sought to identify any landfilling or land reclamation operations, past and present which have taken place in the vicinity of the site. The sources of information referenced previously have been consulted:

These records indicate the following:

- No BGS or registered landfill sites within 1km of the site;
- Two historical landfills sites within 1km, the closest 215m to the east of the site at Cow Lane;
- One Local Authority recorded landfill site located 907m to the northeast at Richfield Avenue;
- Five registered waste management facilities within 1km of the site, the closest being 137m to the northwest;
- Three registered waste treatment or disposal sites within 1km of the site, the closest being active is 145m to the east licensed to 'Simsmetals Uyk Ltd' at scrap metals. Historically an incinerator operated by Battle Hospital is listed as being 79m from the site (although this may have been closer or on the subject site); and
- One waste transfer sites registered located 268m to the southwest.

In addition to the above, previous site investigation (and anecdotal) information (as listed in Section 1.3) indicates, that the northern part of the site contains deeper Made Ground from historical infilling, possibly the result of uncontrolled abstraction of sands/gravels.

3.2.4 Ground gas

Given the anticipated ground conditions the risk associated with ground gas is considered high in accordance with CIRIA C665 (Wilson et al., 2007). Due to the high risk it is recommended that as a minimum that monitoring over 6 visits at differing atmospheric pressures (including at least one at <1000mb and falling) is carried out. It

would be prudent to carry out more visits, if there is a range of results, to obtain a more comprehensive database.

3.3 Hydrogeology

3.3.1 Aquifer characteristics

Based on the published geological records, the hydrogeology of the site is likely to be characterised by the presence of an unconfined aquifer in the Chalk overlain by the Taplow Gravel and Alluvium.

The anticipated depth to the (continuous) groundwater table is likely to be no greater than 1 to 2 m below ground level within the Alluvium (or Taplow Gravel). A deeper groundwater level may also be present within the Chalk.

Shallow groundwater in the site area is anticipated to flow in a north-easterly direction, i.e. towards the River Thames, located approximately 1km east of the site.

It is possible that localised perched groundwater may be present in the made ground on-site.

3.3.2 Vulnerability of groundwater resources

The site has been classified by the Environment Agency (EA) to overlie a:

- Secondary A aquifer (Alluvium/Taplow Gravel): 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; and
- Principal aquifer (Chalk): layers of rock or drift deposit that have high intergranular and/or fracture permeability (usually providing a high level of water storage). They may support water supply and/or river base flow on a strategic scale.

The soils beneath the site are classified as having an HIGH (H) leaching potential.

H – soils of high leaching potential are those with little ability to attenuate diffuse source pollutants and where non-adsorbed diffuse source pollutants and liquid discharges can move rapidly to underlying strata or shallow groundwater.

3.3.3 Licensed groundwater abstraction

Sixteen groundwater abstractions have been identified within a 1km radius of the site. One of the sixteen abstractions is listed as being on the site itself and operated by Battle Hospital. It is understood that this abstraction in no longer active.

Four of the next five abstractions nearest the site (at distances between 361m 432m to the north and northwest) are operated by Mr D A Drayton at Little Johns Farm. The abstractions are listed as being for domestic and general farming uses.

In terms of aquifer protection, the EA generally adopts a three-fold classification of source protection zones (SPZ) for public supply abstraction wells.

- zone 1 or ‘inner protection zone’ is located immediately adjacent to the groundwater source and is based on a 50-day travel time. It is designed to protect against the

effects of human activity and biological/chemical contaminants that may have an immediate effect on the source

- zone 2 or 'outer protection zone' is defined by a 400-day travel time to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants.
- zone 3 or 'total catchment' is the total area needed to support removal of water from the borehole, and to support any discharge from the borehole.

Information available on the EA website indicates that the site does not lie within a currently designated groundwater SPZ.

3.4 Hydrology

3.4.1 Surface watercourses

There are no ponds, streams or drainage ditches on or adjacent to the site. The nearest identified surface water feature is an unnamed brook/ditch approximately 218m to the east of the site.

Considering the high permeability of the both the Taplow and Chalk Formations, it is considered that there may also be a pathway for contaminants between groundwater beneath the site and the River Thames.

3.4.2 Surface water abstractions

No surface water abstractions were identified within a 1km radius of the site.

3.4.3 Site drainage

There may be surface and/or subsurface drainage infrastructure at the site associated with previous development at the site.

An assessment of the condition and serviceability of the on-site drainage could be included within the scope of a future site investigation.

3.4.4 Preliminary flood risk assessment

The indicative floodplain map for the area, published by the Environment Agency (EA), shows that the site lies within an indicative Zone 2 floodplain (i.e. extreme flooding from rivers without defences).

This report is not intended to replace a full hydrological study and it is recommended that additional specialist studies be conducted to confirm flood risks at the site.

3.5 History of site and surrounding area

The history of the land-use and development of the site and surrounding area has been assessed based on the following sources:

- historical maps within the environmental database (Envirocheck report, dated 31st July 2012) from 1882 to 2012;
- pre-Ordnance Survey (County Series) maps;
- company archives/Interviews with site staff; and
- aerial photography.

Copies of OS and County Series maps are included in the environmental database report in Appendix E. Other details of the development history of the site are also included in Appendix E. Reference to historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.

Table 3: Summary of historical development

Date	Land use/features on site	Land use/features in vicinity of site (of relevance to the assessment)
1881	Open undeveloped marshland with the site and surrounding area listed as being liable to flooding.	Gravel pits around 200m to the southeast. Battle Farm around 50m to the southeast. Infirmary around 250m to the south. Railway around 260m to the north.
1911	No significant change.	Gravel pits no longer shown. Large residential development of Victorian terrace properties 250m to the southeast beyond a small tin works. Workhouse and hospital 250m to the south and southwest.
1932	Undeveloped although now shown to be part of the grounds to the battle hospital to the south.	Expansion of Battle Hospital to the south and southwest otherwise no significant change noted.
1959	No significant change.	Single detached unnamed unit 50m to the south.
1969-1972	No significant change.	Various works (e.g. engineering and computer), warehouses and light industrial units beyond Portman Road to the north. Residential development immediately to the east. Further expansion of Battle Hospital to south and southwest with unnamed units.
1975-1976	Site appears to have been redeveloped as part of Battle Hospital. Seven unmarked units are shown to be present on site.	Large hospital building developed around 50m to the southwest. Large car park now shown immediately to the west. Other directions no significant change.
1993	Site appears to reach its current	Further expansion of Battle Hospital site to

	configuration with numerous unmarked buildings shown to occupy the site. Tanks and an electrical sub station are shown to be present within the central parts.	south, with some of the previous units having been altered or replaced altogether. In other directions no significant changes.
2006	No significant change.	No significant change.
2012	No significant change.	A superstore and residential units have replaced Battle Hospital immediately to the south and southwest.

Summary

The site remained undeveloped until the 1970s when it was developed as part of the Battle Hospital. Although uses are not indicated on the plans they are know to have included a laundry (southwest), a boiler and incinerator (central), storage warehouse (east), vehicle workshops (east) and offices (various).

In addition although not shown it is understood that the northern part of the site was used as an uncontrolled landfill (supposedly for the disposal of old bottles).

The immediate surrounding area was and remains predominately residential (east) or industrial (north) fields to the north and east. The Battle Hospital occupied land to the south and west until recently, when it is shown to have been redeveloped for housing and a superstore.

Associated with these land-uses, there is a relatively moderate to high risk of contamination impacting the site.

3.6 Sensitive land uses

No national or internationally designated sensitive land uses such as sites of special scientific interest (SSSI) were identified in the vicinity of the site. The Department for Environment, Food and Rural Affairs, does however, record the site as being within a Nitrate Vulnerable Zone.

3.7 Licences and permissions

Listed below are licences, permissions and registered incidents from the Envirocheck report (Appendix E) that may be pertinent to the site:

- One listed entry to the contaminated land register located 467m to the east at George Street Allotments;
- Seven listed discharge consents within 1km of the site, the nearest registered is 296m to the east, which relates to Thames Water Ltd for treated sewage discharging into the Vastern Ditch;
- Four integrated pollution controls listed within 1km of the site, all of which have been superseded or terminated;

- Four integrated pollution prevention and controls or integrated pollution controls within a 1km radius of the site, the closest is 596m to the northwest at Oxkem Limited;
- Sixteen listed entry for Local Authority pollution prevention and controls within a 1km radius, although only 7 within 500m. The nearest is located 43m to the west relating to the Tesco Filling Station;
- There are nine pollution incidents to controlled waters listed within a 1km radius. All were Category 3 Minor Incidents, other than one which took place in 1999 relating to an oil spill;
- Two listed registered radioactive substances within 1km of the site, all are listed as being located at the former Battle Hospital which is now defunct;
- Two listed water industry act referrals the nearest located 178m to the east at Quick Circuits on Loverock Road;
- The closest active fuel station is 43m to the west at Tesco; and
- There are fifty listed trade directories within 250m of the site, with various uses including garage, printers, commercial car dealers, scarp metal dealers and dairy.

3.8 Local authority environmental health department information

A formal request to the Local Authority for contaminated land information has been made however to date, a response has yet to be received.

3.9 Initial conceptual site model

The information presented in Sections 2 and 3, has been used to compile an initial conceptual site model. The identified potential sources of contamination, associated contaminants and receptors have been considered with plausible pathways that may link them. The risk classification has been estimated in accordance with information in Appendix D.

3.9.1 Summary of potential contaminant sources

Potential sources and contaminants of concern are summarised in Table 4 below.

Table 4: Potential sources and types of contamination

Potential sources	Contaminants of concern
On-site	
Made Ground (i.e. fill material) associated with former phases of development of the site (i.e. reconfiguration and development of hospital buildings)	Unknown fill material (but potentially including heavy metals, ash, clinker, sulphates, polycyclic aromatic hydrocarbons (PAHs), asbestos and hazardous ground gases (methane and carbon dioxide) etc.)
Infilled (landfilled) former sand and gravel pits thought to be located on the northern part of the site.	Unknown fill material (but potentially including heavy metals, ash, clinker, sulphates, polycyclic aromatic hydrocarbons (PAHs), asbestos and hazardous ground gases (methane and carbon dioxide) etc.)
Four above ground fuel storage tanks and one underground fuel storage tank within central and eastern parts of the site (locations shown on Figure 2). In addition dispensing and fill points associated with tanks.	Hydrocarbons (including petroleum hydrocarbons and oil/fuel hydrocarbons), methyl tertiary butyl ether (MTBE), oil and waste oil
Two oil tanks (one waste one high grade) within current vehicular workshop (locations shown on Figure 2).	Hydrocarbons (including petroleum hydrocarbons and oil/fuel hydrocarbons), methyl tertiary butyl ether (MTBE), oil and waste oil
Electrical substation in the central part of the site close to boiler.	Oil hydrocarbons, polychlorinated biphenyls (PCBs)
Historic and current activities at the site, including a laundry, incinerator, workshops, storage warehouses and sterilisation unit.	Hydrocarbons, petroleum spirit, ethylene glycol, methyl tertiary butyl ether (MTBE), oil and waste oil, chlorinated and non-chlorinated solvents, asbestos, sulphuric acid, metal and metal compounds
Off-site	
Petrol filling station, located approximately 43m to east of the site	Hydrocarbons, petroleum spirit, ethylene glycol, methyl tertiary butyl ether (MTBE), oil and waste oil, chlorinated and non-chlorinated solvents, asbestos, sulphuric acid, metal and metal compounds
Former landfill sites located between 200m to 900m from the site	Landfill gasses, leachate
Various current and former industrial land uses to the north of the site, including Work and engineering facilities.	Fuel oils, lubricating oils, heavy metals, polychlorinated biphenyls (PCBs), PAHs, solvents and other common industrial contaminants
Former Hospital (c.1920s – 2000s) located immediately to the south of the site	Heavy metals, CN- free, nitrates, sulphates, sulphides, asbestos, pH, oil/fuel hydrocarbons,

Potential sources	Contaminants of concern
(although now redeveloped for housing and superstore).	chlorinated aliphatic hydrocarbons, chlorinated aromatic hydrocarbons and PCBs

The northern part of the site comprises filled ground. The infill and landfill materials represent potentially significant sources of contamination at the site.

The site was developed with as part of the Battle Hospital and contained buildings with uses that include a laundry, incinerator, boiler, workshops and warehouses, which may have introduced associated made ground at the site. The made ground, as well as the activities associated with the various facilities that operated at the site, including the fuel storage tanks, are considered potentially significant sources of contamination at the site.

Potential sources of contamination identified in the area surrounding the site include various former and current industrial land uses to the north beyond Portman Road, former hospital site to the south, a petrol filling station to west and historical filled ground. The geology at the site and in the area surrounding the site comprises sands and gravels of high permeability. It is therefore considered that pathways between these potential off-site sources and the site may exist. Given this there is considered to be a moderate risk of contamination impacting the site from off site sources.

3.9.2 Sensitive receptors

On the basis that the site is for residential development, and given the site setting, the following sensitive receptors that may be affected by potential contamination sources identified above include:

- Current and future end-users of the site (occupants and services/buildings);
- Controlled Waters (Principal aquifer);
- Site operatives during redevelopment works;
- Adjacent site users;
- Building infrastructure (notably water supply pipes); and
- Proposed vegetation.

3.9.3 Summary of plausible pathways

Pathways by which potential contaminants may impact sensitive receptors may include:

- Surface water run-off and/or infiltration;
- Leaching and/or vertical migration of any potential contaminants into groundwater within underlying soils;
- Migration of contaminants present in groundwater to the wider groundwater body;
- Direct human ingestion, dust inhalation and/or dermal contact;
- Migration of vapours along backfill around service pipes and through strata;
- Inhalation of vapours via volatilisation;
- Ground gas migration in permeable soils or along service runs;
- Permeation of potential contaminants through proposed utility pipes including water supply pipes; and
- Uptake by vegetation.

3.9.4 Data gaps and uncertainties

Unspecified buildings have been on site since circa 1975. It is unknown what historical activities/processes are associated with these (although it is assumed they are part of the hospital) and therefore a general suite of potential source of contaminants are assumed.

3.9.5 Potentially complete pollutant linkages

The information collated as part of the Preliminary Risk Assessment review has been utilised to inform the development of an Outline Conceptual Site Model (CSM). This is presented in Table 5. The risk classification has been undertaken in accordance with CIRIA C552 (Rudland et al., 2001), a summary of which is included in Appendix D.

Table 5: Initial Site Conceptual Model

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
Made Ground (i.e. fill material) associated with former phases of development of the site.	Residential end-users	Ingestion, inhalation and dermal contact	Likely	Medium	Moderate risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Direct contact with on-site buildings and services	Likely	Mild	Moderate to low risk: Building material and infrastructure (including plastic water supply pipes) are likely to come into contact with disturbed soils during the construction phase.
		Migration and accumulation of gas within on-site buildings and services	Low likelihood	Medium	Moderate to low risk: There is a low likelihood of there being a gas generation source in the made ground.
		Migration and accumulation of gas within off-site buildings and services	Low likelihood	Medium	Moderate to low risk: There is a low likelihood of there being a gas generation source in the made ground.
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Low likelihood	Medium	Moderate to low risk: It is considered that there is a low to moderate likelihood of a significant source of groundwater pollution existing in the made ground.
	Groundwater in the wider aquifer body.	Migration of mobile contaminants	Low likelihood	Medium	Moderate to low risk: It is considered that there is a low to moderate likelihood of a significant source of groundwater pollution existing in the made ground.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
	Surface watercourses, including the River Thames and associated surface water abstractions	Migration of mobile contaminants	Unlikely	Mild	Very low risk: It is unlikely that a pathway exists between the site and the River Thames.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.
Infilled (landfilled) former sand and gravel pits located at the site.	Residential end-users	Ingestion, inhalation and dermal contact	Highly likely	Medium	High risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Direct contact with on-site buildings and services	Highly likely	Mild	Moderate risk: Building material and infrastructure (including plastic water supply pipes) are highly likely to come into contact with infill materials during the construction phase.
		Migration and accumulation of gas within on-site buildings and services	Highly likely	Medium	High risk: It is highly likely that there is a gas generation source in the infill materials.
		Migration and accumulation of gas within off-site buildings and services	Highly likely	Medium	High risk: It is highly likely that there is a gas generation source in the infill materials.
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there may be source of groundwater pollution in the infill materials.
	Groundwater in the wider aquifer body.	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there may be source of groundwater pollution in the infill materials.
	Surface watercourses, including the River Thames and associated surface water abstractions	Migration of mobile contaminants	Unlikely	Mild	Very low risk: It is unlikely that a pathway exists between the site and the River Thames.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
Above and Underground fuel storage tanks and dispensers. In addition oils stored within historical electrical substation.	Residential end-users	Ingestion, inhalation and dermal contact	Highly likely	Medium	High risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Direct contact with on-site buildings and services	Highly likely	Mild	Moderate risk: Building material and infrastructure (including plastic water supply pipes) are highly likely to come into contact with hydrocarbon contamination during the construction phase.
		Migration and accumulation of gas within on-site buildings and services	Highly likely	Medium	High risk: It is highly likely that if hydrocarbon contamination is present there will be gas / vapour.
		Migration and accumulation of gas within off-site buildings and services	Highly likely	Medium	High risk: It is highly likely that if hydrocarbon contamination is present there will be gas / vapour.
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there may be source of groundwater pollution related to the bulk fuel storage.
	Groundwater in the wider aquifer body.	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there may be source of groundwater pollution related to the bulk fuel storage.
	Surface watercourses, including the River Thames and associated surface water abstractions	Migration of mobile contaminants	Unlikely	Mild	Very low risk: It is unlikely that a pathway exists between the site and the River Thames.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.
Historic and current industrial activity at the site, including a laundry, incinerator, storage units, workshop and sterilisation unit.	Residential end-users	Ingestion, inhalation and dermal contact	Likely	Medium	Moderate risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Direct contact with on-site buildings and services	Likely	Mild	Moderate to low risk: Building material and infrastructure (including plastic water supply pipes) are likely to come into contact with affected soils during the construction phase.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
		Migration and accumulation of gas within on-site buildings and services	Low likelihood	Medium	Moderate to low risk: There is a low likelihood of there being a gas generation source at the site from historic and current on-site industrial activity.
		Migration and accumulation of gas within off-site buildings and services	Low likelihood	Medium	Moderate to low risk: There is a low likelihood of there being a gas generation source at the site from historic and current on-site industrial activity.
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there maybe a source of groundwater pollution from historic and current activity at the site.
	Groundwater in the wider aquifer body.	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there maybe a source of groundwater pollution from historic and current activity at the site.
	Surface watercourses, including the River Thames and associated surface water abstractions	Migration of mobile contaminants	Unlikely	Mild	Very low risk: It is unlikely that a pathway exists between the site and the River Thames.
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.
Various current and historical industrial land uses surrounding the site, including petrol filling station, works buildings, engineering facilities and the former Battle Hospital	Residential end-users	Migration of mobile contaminants and inhalation	Likely	Medium	Moderate risk: Children playing in domestic gardens are considered the most vulnerable receptor.
	Buildings and services	Migration of mobile contaminants and direct contact with on-site buildings and services	Likely	Mild	Moderate to low risk: Building material and infrastructure (including plastic water supply pipes) are likely to come into contact with affected soils during the construction phase.
	Groundwater beneath the site (Principal aquifer and Secondary A Aquifer)	Migration of mobile contaminants	Likely	Medium	Moderate risk: It is considered that there maybe a source of groundwater pollution migrating on to site from off site sources.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Risk and justification
	Vegetation	Migration of mobile contaminants, root uptake	Unlikely	Minor	Very low risk: Uptake by plants in residential gardens cannot be ruled out, though impact will be minor.

In summary it is considered that there is currently:

- A moderate to high risk to future occupants/site users that could be exposed to contaminants (if present) via direct soil/dust ingestion, dermal contact with soil/indoor dust and/or inhalation of indoor/outdoor dust/vapours. Surrounding occupants could also be exposed to contaminants (if present) via inhalation of indoor/outdoor dust/vapours;
- A moderate to high risk to groundwater of the (Principal and Secondary A aquifers) beneath the site and groundwater in the wider area from the migration of contaminants sourced from the historic and current industrial activity and made ground at the site;
- A very low risk to surface water receptors, including the River Thames, from mobile contaminants sourced from the former landfill, historic and current industrial activity and made ground at the site;
- A moderate risk to buildings and infrastructure of the proposed development, including water supply pipes, from the direct contact with contamination at the site; and
- A moderate risk to vegetation, including soft landscaping of the proposed development, from mobile contaminants sourced from mobile contaminants sourced from the former landfill, historic and current industrial activity and made ground at the site;

The overall environmental liability and risks associated with the site's future development are considered to be moderate to high. Further intrusive investigations and associated risk assessment would be needed to either remove these Pollutant Linkages or reduce the level of risk.

4 SITE INVESTIGATION METHODOLOGY

RSK carried out intrusive investigation work between 2 August 2012 and 12 August 2012 to further investigate the potential pollutant linkages identified in the outline conceptual site model and to provide information for the design of foundations and associated works.

4.1 Sampling strategy and methodology

It was considered that the preferred method of exploration would be drive-in sampler probeholes and LCP boreholes as these would allow for environmental and geotechnical testing as well as enabling monitoring wells to be installed to assess for soil gases and groundwater (should it be deemed necessary).

4.1.1 Health and safety considerations

Prior to intrusive any works, available service drawings were reviewed, with each of the exploratory locations cleared and marked out.

4.1.2 Investigation locations

The fieldwork comprised:

- Five boreholes designated BH1 to BH3 sunk by LCP rig to depths between 12.50mgbl and 13.5mbgl;
- Sixteen probeholes, designated PH1 to PH16, were sunk by percussive means using drive-in sampling techniques to a maximum depth of 4.0m;and
- 50mm diameter perforated standpipes were installed in the three boreholes and 35mm diameter perforated standpipes were installed in seven probeholes (PH2, PH3, PH5, PH6, PH8, PH10 and PH12) to enable future monitoring of groundwater levels and the flow rates, pressures and concentrations of gas.

Representative samples were taken from the exploratory positions and returned to the laboratory for analysis. The descriptions of the strata encountered together with comments on groundwater conditions and hole stability are given in the exploratory hole trial pit records presented in Appendix F.

The exploratory hole positions were chosen to provide good coverage of the site, whilst reflecting the potential sources of contamination identified by the PRA, and associated access constraints. The exploratory hole locations are identified in Figure 3. A summary of the exploratory hole rationale is presented in Table 6.

Table 6: Exploratory hole location rationale

Exploratory hole number	Location (see Figure 2)	Rationale
PH1 to PH4, PH6 and BH2	Central, North and East	Investigate the extent of any residual hydrocarbon contamination relating to above ground heating storage tanks and fill points.
PH4	Central	Investigate the extent of any residual hydrocarbon contamination relating to above ground storage tanks and dispensing unit.
PH10 and PH12	East	Investigate the extent of any residual hydrocarbon contamination relating to underground ground storage tank and dispensing unit
BH2 and PH1	Central	Allow assessment of any residual contamination relating to boiler room and above ground storage tank and possible electrical substation.
PH8 and PH9	Southwest	Targeted to allow assessment of shallow soils within the area of the former laundry.
BH1, PH14, PH15	South	Targeted to allow assessment of shallow soils in the area of the operational vehicle workshop. PH14 closest to above ground waste oil tanks.
PH11, PH12 and PH16	Southeast	Allow assessment of made ground underlying the warehouse units.
PH1 to PH16 and BH1 to BH3	Site wide but specifically northern and central parts of interest	Allow assessment shallow soils (i.e. made ground thickness) across site relating to historical quarrying / landfilling activities.
PH1 to PH16 and BH1 to BH3	Site wide	Provide coverage shallow soils across site area.
BH1 to BH3	Site-wide	To determine groundwater quality beneath site.
PH2, PH3, PH5, PH6, PH8, PH10 and PH12.	Site-wide	To determine ground gas regime. Also to allow assessment of shallow groundwater quality beneath site

The investigation points were located approximately by reference to physical features present on the site at the time of investigation.

Exploratory locations were not possible within the workshop/maintenance building or boiler /incinerator building at the time of the investigation, although consideration should be given to carrying out positions in these areas post demolition/vacant occupation.

4.1.3 Soil sampling, in situ testing and laboratory analysis

At least one soil sample was recovered from each stratum encountered. Where visual or olfactory evidence of contamination was observed, additional samples were obtained above, below and in the area of contamination. Samples were collected and stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination. The samples were transported to the laboratory in chilled cool boxes. Laboratory Chain of Custody Forms can be provided if required.

A programme of chemical laboratory testing was carried out on selected samples taken from various strata from the boreholes. All analysis was undertaken by UKAS and MCERTS certified laboratories. The rationale for soil sample chemical analysis is presented in Table 7 and laboratory results are report in Appendix I.

Table 7: Scheduled analysis – soil

Exploratory hole no. and sample depth (m bgl)	Analyte	Rationale
PH3 at 0.50m PH4 at 0.30m PH5 at 0.40m PH6 at 0.30m PH7 at 0.40m PH8 at 0.40m PH9 at 0.50m PH10 at 0.50m PH12 at 0.50m PH15 at 0.40m PH16 at 0.40m	Benzene, toluene, ethylbenzene, xylene (BTEX), MTBE, TPHCWG speciated TPH, USEPA speciated PAH, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc (metals suite), total organic carbon, and pH	Land quality assessment - comprising general suite to cover the most likely indicator chemicals based upon site history and on site observations.
PH6 at 0.30m PH7 at 0.40m PH9 at 0.50m PH10 at 0.50m PH15 at 0.40m	Asbestos Screen	To assess the presence of any asbestos in soils in potential high-risk areas
PH8 at 0.40m and at PH9 0.50m	VOC	To assess the presence of any VOC in soils in potential high-risk areas.
PH1 at 1.30m PH2 at 1.40m PH2 at 2.40m PH3 at 2.50m PH6 at 1.30m	TPH and BTEX	To allow assessment of hydrocarbon contamination in area of fuel tanks.

4.1.4 Geotechnical testing

A programme of geotechnical laboratory testing (presented in Table 8) was carried out on selected samples taken from various strata encountered in the exploratory holes.

Where appropriate, testing was undertaken in accordance with BS 1377:1990 Method of Tests for Soils for Civil Engineering Purposes within an RSK UKAS accredited laboratory (Structural Soils Limited).

The geotechnical laboratory results are presented in Appendices I and O.

Table 8: Summary of geotechnical testing

Exploratory Hole No. & Sample Depth (m bgl)	Analyte	Rationale
PH16 at 1.50m PH14 at 0.40m PH14 at 1.50m PH7 at 1.50m PH13 at 2.60m BH1 at 4.00m	BRE Suite	Chemical attack on buried concrete assessment (BRE).
BH1 at 1.40m	PSD analysis	Geotechnical parameters
BH3 at 3.70m PH10 at 2.60m	PI and NMC	Geotechnical parameters

4.1.5 Groundwater sampling and analysis

Depths to groundwater and non-aqueous phase liquid were recorded using an electronic dip meter/interface probe on 21 August 2012. The groundwater monitoring data are given in Appendix G.

Groundwater samples were retrieved using a United States Environment Protection Agency (USEPA) approved low-flow purging and sampling methodology. The low-flow method relies on moving groundwater through the well screen at approximately the same rate as it flows through the geological formation. This results in a significant reduction in the volume of water extracted before sampling and significantly reduces the amount of disturbance of the water in the monitoring well during purging and sampling. Drawdown levels in the monitoring well and water quality indicator parameters (pH, temperature, electrical conductivity, redox potential and dissolved oxygen) are monitored during low-flow purging and sampling, with stabilisation indicating that purging is complete and sampling can begin. As the flow rate used for purging, in most cases, is the same or only slightly higher than the flow rate used for sampling, and because purging and sampling are conducted as one continuous operation in the field, the process is referred to as low-flow purging and sampling.

The groundwater samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to

minimise volatilisation. Samples were transported directly to the testing laboratory under chain of custody documentation.

Groundwater samples were tested for the analytes listed in Table 9, below. All analysis was undertaken by UKAS and MCERTS certified laboratories. The results of the groundwater chemical testing are presented in Appendix J and discussed in subsequent sections of this report.

Table 9: Scheduled analysis – groundwater

Exploratory hole no. and sample depth (m bgl)	Analyte	Rationale
BH1 to BH3, PH2, PH3, PH5 and PH6	Benzene, toluene, ethylbenzene, xylene (BTEX), MTBE, TPHCWG speciated TPH, USEPA speciated PAH, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc (metals suite), total organic carbon, and pH	Baseline groundwater quality assessment - comprising general suite to cover the most likely indicator chemicals based upon site history and on site observations.

4.1.6 Ground gas monitoring

To date, gas monitoring events have been carried out on 21 August and 3 September 2012.

An infrared gas analyser was used to assess ground gas concentrations (methane, carbon dioxide, oxygen and Lower Explosive Limits), flow rates and atmospheric pressures. All monitoring results together with the temporal conditions are contained within Appendix G.

Depths to groundwater were recorded using an electronic dip meter on the same dates. Depths to groundwater are given in the monitoring data given in Appendix G.

5 GROUND CONDITIONS

The results of the intrusive investigation and subsequent laboratory analysis undertaken are detailed below. The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, samples taken, field observations of soil and groundwater, *in situ* testing and details of monitoring well installations are included on the exploratory hole records presented in Appendix F.

5.1 Soil

In general, ground conditions beneath the site were consistent with those anticipated from the geological map for the area.

In summary, beneath site surfacing (reworked topsoil/Made Ground), alluvium was found to be present in many locations overlying the Taplow Gravel which in turn was found to overlie the Chalk.

A summary of the ground conditions encountered is presented in Table 10.

Table 10: Ground conditions

Strata	Base depth Encountered (m bgl)
Made Ground: was encountered in all locations ranging in depths from 0.50m (PH11) to 4.45m (BH2). The Made Ground was variable in composition, generally comprising black, grey, brown sandy matrix with variable proportions of glass, plastic, brick, tile, ceramic, organic matter, wood, ash and charcoal. Perched groundwater was generally encountered at about 1 .5 mbgl. Deeper Made Ground was generally encountered through the northern part of the site in the area of historical landfilling. i.e. north of PH8, PH9, PH14, PH15 and PH10. Hydrocarbon contamination ranging from a slight to strong to moderate odour was noted within the Made Ground in PH1-PH3, PH6, PH13 and BH2.	GL to between 0.50m (PH11) and 4.45m (BH2)
Alluvium: Underlying the Made Ground in the northern parts of the site was a soft brown grey clayey sand silt with organic matter and in some positions peat lenses. This material was generally encountered to depths between 3.70m (PH10) and 5.0m in BH3, although in many locations the depth was not proved (i.e. to max depth of drilling). Underlying the Made Ground in southern areas was a loose silty sand with soft clay lenses, flint and chalk gravel. This material was generally encountered to depths between 1.5m (PH11) and 3.00m (PH15).	Typically between 3.70m and 5.0m but in many cases to the full extent of boring at 4.0m.
Taplow Gravel: Underlying either the sand or silt/clay was a brown grey fine to coarse sandy sometimes slightly clayey loose to medium dense gravel. This material was encountered between 3.6m and 8.00m within the boreholes, but was only encountered within PH10, PH12, PH14 and PH15 within the probeholes (and in all cases was proved to the extent of drilling at 4.0m). In most probeholes positions the material was either not proved or was found to be absent	Typically between 3.60 and 8.0m

Strata	Base depth Encountered (m bgl)
Chalk: where encountered (i.e. PH9, PH11, PH16, BH1, BH2 and BH3) underlying the alluvial materials was a low becoming medium dense highly weathered to weathered chalk to the full extent of boring at 13.50m (BH1).	Within probeholes 4.00m (final depth of boring) Within boreholes 12.50m to 13.50m (final depth of boring)

5.1.1 Visual/olfactory evidence of soil and groundwater contamination

Moderate to strong hydrocarbon stain/odour was noted within shallow soils in PH1, PH2, PH3, PH4, PH6, PH12 and BH2. PID results (see Appendix H) demonstrate this with slightly elevated concentrations recorded within PH1 (25-35ppm), PH2 (20-36ppm) and PH6 (22-42ppm). In addition a slight solvent odour was noted within the shallow soils in PH9.

In addition hydrocarbon odour and sheen was noted during groundwater sampling within PH6, PH3 and PH2 (although free phase product was not recorded).

Elsewhere across the site visual or olfactory contamination was not identified.

Samples of the above material were sampled and scheduled for appropriate chemical analysis.

5.1.2 Groundwater

Groundwater was generally encountered during the site investigation between 0.90m to 2.0m.

During subsequent monitoring visits, shallow groundwater was recorded between 0.20m (within PH10 likely to be perched) and 1.68m (PH5), but typically around 1.20m to 1.40m.

5.1.3 Groundwater regime

Groundwater monitoring data collected from the boreholes on the 21 August 2012. To date the boreholes levels are yet to be established and therefore groundwater flow direction has yet to be determined.

Desk based data indicates that groundwater flows northeast (i.e. toward the River Thames), which is considered to be consistent with the anticipated flow direction of the local area.

5.1.4 Ground gas regime

The results of the ground gas monitoring and testing carried out are summarised in Table 11 and given in Appendix G. The gas risk assessment for the site is discussed in section 6.2.5.

Table 11: Summary of ground gas monitoring data

Date	Methane (% by volume in air)		Carbon Dioxide (% by volume in air)		Oxygen (% by volume in air)		Flow Rate l/hr	
	Min	Max	Min	Max	Min	Max	Min	Max
21 August 2012	<0.1	40.9	0.1	19.7	0.3	20.9	0	0.1
3 September 2012	<0.1	54.1	0.1	18.2	0.1	21.4	0	0.1

Date	Temporal conditions during the monitoring round		
	Atmospheric Pressure	Rainfall	Other
21 August 2012	1015-1019	None	Breezy and overcast
3 September 2012	1019-1022	None	Sunny

Methane: Methane concentrations were recorded below 0.1% from all wells during the monitoring visits, except PH3 where concentrations ranged between 40.9 and 54.1.

Carbon Dioxide: Carbon dioxide concentrations have typically been recorded between 3 and 15%v/v across the site with a maximum concentration recorded in PH2 with a recorded concentration of 19.7%v/v; and

Flow Rates: Flow rates have remained typically low, with peak rates of 0.1l/hr.

5.2 Refinement of the initial conceptual site model

Based upon the findings of the site investigation it is considered that the following linkages require further assessment:

- Future occupants/site users could be exposed to contaminants (if present) via direct soil/dust ingestion, dermal contact with soil/indoor dust and/or inhalation of indoor/outdoor dust/vapours;
- Drinking water supply pipes could come into direct contact with contaminants (if present);
- Proposed vegetation could be exposed to contaminants (if present) via root uptake;
- Potential ground gas from made ground or from naturally occurring concentrations from alluvial soils containing peat materials; and
- Leaching of contaminants from contamination/made ground in soils to groundwater; and
- Risk to groundwater of the Principal (Chalk) and Secondary A aquifers (Alluvium/ Taplow Gravel) beneath the site and groundwater in the wider area from the migration of contaminants sourced from the former landfill/infilled sand and gravel pits, historic and current industrial activity and made ground at the site.

The linkages are discussed in Section 6.0.

6 QUANTITATIVE RISK ASSESSMENT

In line with CLR11 (Environment Agency, 2004a), there are two stages of quantitative risk assessment, generic and detailed. The GQRA comprises the comparison of soil, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that is appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results (Appendices I and J) or following statistical analysis depending upon the sampling procedure that was adopted.

The GAC used in this assessment are included in Appendix K for human health (together with details of their derivation) and in Appendices L, M and N for the assessment of phytotoxic effects and risks to building materials and controlled waters.

6.1 Linkages for assessment

Section 5.2 presents the refined conceptual model which identified the linkages that required assessment after the findings of the site investigation had been considered. These linkages together with the method of assessment are presented in Table 12.

Table 12: Linkages for generic quantitative risk assessment

Potentially relevant pollutant linkage	Assessment method
Direct contact with impacted soil by future residents	Human health GAC (Appendix K) for a proposed residential end use with private gardens since proposed end use includes residential gardens. Statistical analysis undertaken owing to majority of sampling locations being non-targeted and made ground of similar composition. Comparison of soil gas data against reference concentrations
Uptake of contaminants by vegetation potentially impacting plant growth	Comparison of soil data to GAC in Appendix L.
Groundwater contamination and migration of contaminants to wider aquifer body	Comparison of groundwater data to GAC in Appendix M.
Contaminants impacting building materials	Comparison of soil data to GAC in Appendix N for plastic water supply pipes and concrete assessment using UKWIR (2010) guidance.
Concentrations of methane and carbon dioxide in ground gas entering and accumulating in: Depressions and excavations during any site works and development that could affect site workers; and	Gas screening values (GSV) have been calculated using the monitoring data collected by CGL and RSK. The GSV have been compared with the NHBC Traffic Light System (for low-rise houses) and Revised Wilson and Card Classification (for residential apartments) as presented within CIRIA Report C665.

Potentially relevant pollutant linkage	Assessment method
Enclosed spaces or small rooms in new buildings, which could affect future residents. In the case of methane, this could create a potentially explosive atmosphere, whilst death by asphyxiation could result from carbon dioxide.	

6.2 Methodology and results

The methodology and results of the GQRA are presented for each relevant pollutant linkage in turn.

6.2.1 Direct contact with impacted soil by current and future residents

Two averaging area has been designated to assess the chemical results for the site as detailed below:

- General Made Ground across the site (typically upper 1m); and
- Targeted Made ground or natural soils where hydrocarbon / solvent impacted noted in the field (i.e. PH1, PH2, PH3, PH8, PH9 and PH6

The results are discussed in the following sections.

6.2.2 Statistical assessment of risks to human health from Made Ground

In line with current CL:AIRE and Chartered Institute of Environmental Health (CIEH) guidance the soil results obtained for the site have been assessed against the GAC following the published step by step process.

The site is being considered under the UK land use planning system and so the key question is **'Is there sufficient evidence that the true mean concentration of the contaminant (μ) is less than the critical concentration (C_c)?'.** Therefore, for planning permission to be obtained for the site, the Alternative **(H_1)** Hypothesis must be accepted. The Alternative **(H_1)** Hypothesis is defined as:

- **H_1** $\mu < C_c$, (i.e. the true mean concentration is less than the critical concentration and the weight of evidence is that the site is suitable for use).

For the purposes of the statistical assessment, the chemical test results obtained from typical Made Ground deposits collected between GL and approximately 1.0mbgl have been adopted for assessment. This is considered acceptable given that the Made Ground comprises the averaging area to which most human health receptors will be exposed.

Table 13: Statistical tests for risks to human health from (typical) Made Ground

Analyte and Generic Assessment Criteria (mg/kg)	Measured Range (mg/kg)	Distribution	Statistical Test		Outcome		Is the site suitable for use with regards to analyte ?
			Type	Justification	Upper Confidence Limit	Confidence Level [95% in planning]	
Arsenic (32)	10 to 50	Normal	Chebychev	Distribution type	60.3	0%	No – see discussion
Cadmium (10)	0.5 to 19	Non Normal	Chebychev	Distribution type	10.1	95%	Yes
Chromium (3000)	11 to 55	Normal	Chebychev	Distribution type	46.4	100%	Yes
Copper (4700)	17 to 1070	Non Normal	Chebychev	Distribution type	711.4	100%	Yes
Lead (300)	17 to 1010	Normal	Chebychev	Distribution type	1352.2	0%	No – see discussion
Mercury (7.4)	0.48 to 2.46	Normal	Chebychev	Distribution type	2.12	100%	Yes
Nickel (130)	14 to 99	Normal	Chebychev	Distribution type	100.47	98%	Yes
Selenium (350)	1 to 3	Non Normal	Chebychev	Distribution type	3.16	100%	Yes
Zinc (3800)	29 to 764	Normal	Chebychev	Distribution type	745.01	100%	Yes
Naphthalene (1.5)	0.01 to 1.7	Non Normal	Chebychev	Distribution type	0.99	98%	Yes
Acenaphthylene (170)	0.01 to 3.16	Non Normal	Chebychev	Distribution type	2.04	100%	Yes
Acenaphthene (210)	0.01 to 0.71	Non Normal	Chebychev	Distribution type	0.44	100%	Yes
Fluorene (160)	0.01 to 2.82	Non Normal	Chebychev	Distribution type	1.44	100%	Yes
Phenanthrene (92)	0.01 to 34.8	Non Normal	Chebychev	Distribution type	18.08	100%	Yes
Anthracene (2300)	0.1 to 8.46	Non Normal	Chebychev	Distribution type	4.4	100%	Yes
Fluoranthene (260)	0.01 to 74.3	Non Normal	Chebychev	Distribution type	42.29	100%	Yes
Pyrene (560)	0.1 to 61.2	Non Normal	Chebychev	Distribution type	37.02	100%	Yes
Benzo(a)Anthracene (3.1)	0.01 to 39.9	Non Normal	Chebychev	Distribution type	22.80	0%	No – see discussion
Benzo(b) Fluoranthene (5.6)	0.01 to 44.9	Non Normal	Chebychev	Distribution type	29.42	0%	No – see discussion
Benzo (k) Fluoranthene (8.5)	0.01 to 11	Non Normal	Chebychev	Distribution type	6.77	97%	Yes
Chrysene (6.0)	0.01 to 33.5	Non Normal	Chebychev	Distribution type	20.02	0%	Yes
Benzo(a)pyrene (0.83)	0.01 to 36.20	Non Normal	Chebychev	Distribution type	23.86	0%	No – see discussion
Indeno(123-cd)pyrene (3.2)	0.01 to 18.3	Non Normal	Chebychev	Distribution type	13.3	0%	No – see discussion

Dibenzo(a,h)Anthracene (0.76)	0.01 to 4.83	Non Normal	Chebychev	Distribution type	3.2	0%	No – see discussion
Benzo(ghi)perylene (44)	0.01 to 25.70	Non Normal	Chebychev	Distribution type	17.80	99%	Yes
Benzene (0.07)	0.01	Non Normal	Chebychev	Distribution type	0.01	100%	Yes
Toluene (120)	0.01	Non Normal	Chebychev	Distribution type	0.01	100%	Yes
Ethylbenzene (65)	0.01 to 0.16	Non Normal	Chebychev	Distribution type	0.01	100%	Yes
Xylene (100/45	0.01 to 0.57	Non Normal	Chebychev	Distribution type	0.01	100%	Yes
MTBE (1.8)	0.01	Non Normal	Chebychev	Distribution type	0.01	100%	Yes
Aliphatic C_5–C_6 (30)	0.01	Non Normal	Chebychev	Distribution type	0.00	100%	Yes
Aliphatic C_6–C_8 (73)	0.01	Non Normal	Chebychev	Distribution type	0.01	100%	Yes
Aliphatic C_8–C_{10} (19)	0.01 to 0.08	Non Normal	Chebychev	Distribution type	0.05	100%	Yes
Aliphatic C_{10}–C_{12} (48)	0.1 to 20.50	Non Normal	Chebychev	Distribution type	11.2	100%	Yes
Aliphatic C_{12}–C_{16} (24)	0.3 to 33.20	Non Normal	Chebychev	Distribution type	18.1	100%	Yes
Aliphatic C_{16}–C_{21} (8.48)	1.70 to 36.10	Non Normal	Chebychev	Distribution type	21.7	100%	Yes
Aliphatic C_{21}–C_{35} (8.48)	0.1 to 131	Non Normal	Chebychev	Distribution type	73.8	100%	Yes
Aromatic C_5–C_7 (-)	0.01	Non Normal	Chebychev	Distribution type	0.01	100%	Yes
Aromatic C_7–C_8 (130)	0.01	Non Normal	Chebychev	Distribution type	0.01	100%	Yes
Aromatic C_8–C_{10} (27)	0.01	Non Normal	Chebychev	Distribution type	0.03	100%	Yes
Aromatic C_{10}–C_{12} (69)	0.1 to 16.60	Non Normal	Chebychev	Distribution type	9.36	100%	Yes
Aromatic C_{12}–C_{16} (140)	0.1 to 34.70	Non Normal	Chebychev	Distribution type	20.9	100%	Yes
Aromatic C_{16}–C_{21} (250)	0.1 to 21.4	Non Normal	Chebychev	Distribution type	99.54	100%	Yes
Aromatic C_{21}–C_{35} (890)	0.1 to 707	Non Normal	Chebychev	Distribution type	396.18	100%	Yes

The statistical assessment of the chemical test results obtained from Made Ground, (typically within the upper metre) indicate that, generally H_1 can be accepted for the analytes at or above the 95% confidence limit. Therefore, H_1 is likely to be true, i.e. the true mean is less than the critical concentration and the 'site is suitable for use' with respect to these analytes for a residential end-use.

The exceptions to the above which indicates that H_1 cannot be accepted are:

- Arsenic;
- Lead;
- Dibenzo(a,h)Anthracene
- Indeno(123-cd)pyrene
- Benzo(a)pyrene
- Benzo(b) Fluoranthene
- Benzo(a)Anthracene

The H1 hypothesis cannot therefore not be accepted arsenic, lead, Dibenzo(a,h)Anthracene, Indeno(123-cd)pyrene, benzo(a)pyrene, Benzo(b) Fluoranthene, and Benzo(a)Anthracene where a potentially unacceptable risk to human health may be present if materials (made ground) are located in 'high risk' proposed soft landscaping/garden areas.

6.2.3 Assessment of Targeted Made Ground Deposits

Table 14 below summarises the results obtained in the investigation from Made Ground/ natural deposits (where hydrocarbon staining/odours were noted) against the GAC. Only those determinants where exceedances have been reported are included within the table.

Table 14: Direct comparison data summary table

Material	Determinant	No. of samples tested	GAC (mg/kg)	No of exceedances	Maximum concentration (mg/kg)	
					Value	Location/depth of exceedances
M/G	Aliphatic C10-12	5	93	3	522	PH1 at 1.30m PH2 at 1.40m PH6 at 1.30m
M/G	Aliphatic C12-16	5	744	3	3900	PH1 at 1.30m PH2 at 1.40m PH6 at 1.30m
M/G	Aromatic C12-16	5	140	3	1080	PH1 at 1.30m PH2 at 1.40m PH6 at 1.30m
M/G	Aromatic C16-21	5	250	2	2030	PH1 at 1.30m PH2 at 1.40m PH6 at 1.30m

TPH concentrations recorded (for the compounds tabled above) from PH1, PH2 and PH6 exceed the RSK GAC by direct comparison and therefore, a potentially unacceptable risk to human health may be present and therefore further assessment and/or remediation actions are considered necessary in this area (i.e. fuel tank(s) and fill point area).

Volatile Organic Compounds (VOCs)

The laboratory results indicate that all concentrations of VOCs are below either the RSK GAC or laboratory detection limit (LDL) at PH8 at 0.40m and PH9 at 0.50m and are therefore not considered to be significant.

Asbestos

Selected soil samples were screened for asbestos fibres. All five samples tested indicated an absence of asbestos containing materials (ACMs). Although not identified, asbestos may still be present within shallow soils underlying the site (i.e. in areas not accessible during this phase of investigation)

6.2.3.1 Summary

Concentrations of Lead, arsenic and PAH compounds (namely Dibenzo(a,h)Anthracene, Indeno(123-cd)pyrene, benzo(a)pyrene, Benzo(b) Fluoranthene, and Benzo(a)Anthracene were identified in Made Ground across the site where a potentially unacceptable risk to human health may be present if materials are located in proposed 'high risk' areas (i.e. soft landscaping/gardens) of the site.

In addition to the above number of elevated TPH compounds were recorded in Made Ground in the area of PH1, PH2 and PH6 where a potentially unacceptable risk to human health may be present. These concentrations are attributed to the use of the area for fuel storage and filling and therefore these areas will require further assessment and/or remediation.

Elsewhere across the site all concentrations were statistically and directly recorded below the GAC indicating that a relevant pollutant linkage to human health from these areas/materials does not exist and that specific remedial actions are not required.

6.2.4 Uptake of contaminants by vegetation potentially inhibiting plant growth

The results have been directly compared with the GAC presented in Appendix L for this linkage. The results indicate that a relevant pollutant linkage is may exist (with respect copper, zinc and nickel) to associated with phytotoxic effects. Given this and the physical nature of the Made Ground and the lack of topsoil at the site it is recommended that there will a requirement to provide a suitable growing medium in areas of soft landscaping/gardens as part of any redevelopment.

6.2.5 Impact of organic contaminants on potable water supply pipes

The results have been compared with the GAC presented in Appendix N for this linkage, which are reproduced from *UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (UKWIR, 2010).

Given that made ground was encountered in all locations and that elevated concentrations of TPH and PAH compounds were recorded in the central parts of the site, it is recommended that consultation be sought with the local water authority with respect to the design of buried water pipes. Given the previous historical usage of the site as a hospital (with part of the site being landfilled), it is likely that barrier pipe will be required.

6.2.6 Ground gas

In order to assess the significance of ground gases at the site, measured concentrations and flow rates have been used to generate Gas Screening Values (GSV's). These have then been compared with the NHBC Traffic Light System presented within CIRIA Report 665 as the site is to be developed with low-rise house or apartments.

A summary of ground gas conditions, based upon monitoring carried out to date are:

- Methane – Maximum concentration 54%v/v;
- Carbon Dioxide – Maximum concentration 19.7%v/v; and
- Flow – Maximum positive steady rate 0.1l/hr.

Based on the above concentrations, GSV's may be calculated as follows:

$GSV_{METHANE}$ = (54 / 100) * 0.1 = 0.054l/hr;

$GSV_{CARBON\ DIOXIDE}$ = (19.7 / 100) * 0.1 = 0.0197l/hr.

The high levels of methane (only PH3) and carbon dioxide (various but highest in PH2) recorded are seen as unacceptable to site workers and end users. Using the maximum concentrations recorded of methane (54% PH9) and carbon dioxide (19.7% PH9) ground gas screening values of 0.054l/hr and 0.197l/hr have been calculated for methane and carbon dioxide respectively.

Based on these and maximum recorded concentrations the site would be characterised as being Characteristic Situation CS2 for low-rise apartments and 'Amber 2' for traditional low-rise houses (although further assessment of the methane risk from PH3 should be undertaken see next paragraph). In addition in the area affected by hydrocarbon contamination (i.e. around BH2, PH1, PH2, PH3, PH4 and PH6) a vapour membrane should be incorporated (dependent on remedial actions undertaken).

The significantly elevated concentrations of methane are likely to be attributed to peat horizons within the alluvium or degradation of hydrocarbon contamination underlying this part of the site. However given the concentrations recorded (to date) it is recommended that trial trenches are carried out to better determine what the source of ground gas is in the area of PH3. If a source of gas is identified (e.g. a relic topsoil layer or continuous peat horizon) it may prove more economic to remove this and thus reduce the ground gas protection requirements for the development.

Notwithstanding the above it must be noted that this assessment is only based upon two visits and further visits may re-classify the site.

Since the assessment is only based upon two visits, it is recommended that further monitoring rounds (with at least one to be taken under low atmospheric pressure conditions) be undertaken prior to development in line with NHBC and Local Authority Guidance to allow for a comprehensive characterisation of the site in terms of its ground gas potential.

6.2.7 Inhalation exposure by future residents to contaminants from groundwater vapour

Inhalation exposure to TPH has initially been assessed through the direct comparison of groundwaterdata with the following criteria:

- Human health soil GrAC specific to inhalation exposure pathways (Appendix K).

The comparison indicates that aliphatic hydrocarbons C10-12 and C12-16 exceed the relevant GrAC for these compounds in PH2 and PH6 and therefore further assessment and/or remediation actions are considered necessary in this area (i.e. fuel tank(s) and fill point area.

All PAH compounds were recorded below the relevant GrAC or laboratory detection limit (LDL) and are therefore not considered to be significant.

6.3 Controlled waters assessment

The target concentrations for the controlled waters assessment are given in Appendix M along with their derivations.

6.3.1 NRA soil leachates

Leaching data is available for the metal contaminants being assessed and therefore these results can be compared directly to the target concentrations given in Appendix M. The results are summarised in Table 15.

Table 15: Summary of leachate test results – metals

Determinant	Target Concentration (mg/l)	Location of Exceedance
Arsenic	0.050[1]	None
Cadmium	0.005[1]	None
Chromium	0.050[2]	None
Copper	0.028[2]	None
Lead	0.020[2]	None
Nickel	0.200[2]	None
Selenium	0.010[3]	None
Zinc	0.125[2]	None
Mercury	0.001[1]	None

Notes:

1) Freshwater Environmental Quality Standard

2) Freshwater Environmental Quality Standard dependent upon alkalinity, hardness > 120mg/l on basis of laboratory data

3) Water Quality (Water Supply) Regulations 2001

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he results indicate that concentrations of leachable metals are all below the relevant target levels and therefore the site is unlikely to pose a risk to controlled waters either on or adjacent to the site.

6.3.2 Dissolved phase migration

Owing to the relatively small number of groundwater samples obtained, the laboratory data have been compared directly with the appropriate GAC (i.e EQS/DWS as contamination is already dissolved within the groundwater and due to site being underlain by a Principal Aquifer and its proximity to the River Thames). The laboratory data for groundwater is included in Appendix J. All determinants along with any which exceeded the target values are presented in Tables 16-18 below.

Table 16: Summary of controlled waters screening results – TPH and BTEX

Determinant	Target Value (µg/l)	Exceedances (µg/l)
Benzene	1	None
Toluene	4	None
Ethylbenzene	20	None
Xylene	3	None
Methyl t-Butyl ether	15	None
Total Petroleum Hydrocarbons	10	PH2 (3793 µg/l) and PH6 (2927µg/l)

Table 17: Summary of controlled waters screening results – PAH

Determinant	Target Value (µg/l)	Exceedances (µg/l)
Acenaphthene	5.8	None
Acenaphthylene	5.8	None
Anthracene	0.1	None
Benzo(a)anthracene	0.018	PH3 (0.02 µg/l)
Benzo(b)fluoranthene	0.1	None
Benzo(k)fluoranthene	0.1	None
Benzo(g,h,i)perylene	0.1	None
Indeno(1,2,3-cd)pyrene	0.1	None
Chrysene	0.01	PH2 (0.03µg/l) and PH3 (0.04µg/l)
Dibenzo(a,h)anthracene	0.01	None
Fluoranthene	0.01	PH2 (0.05µg/l) and PH3 (0.20µg/l)
Fluorene	2.1	None
Phenanthrene	3	None
Pyrene	0.04	PH2 (0.25µg/l) and PH3 (0.57µg/l)
Benzo(a)pyrene	0.01	PH3 (0.04 µg/l)
Naphthalene	2.4	None

Table 18: Summary of controlled waters screening results – metals suite

Determinant	Target Value (µg/l)	Exceedances (µg/l)
Arsenic	10	None
Cadmium	5	None
Chromium	50	None
Copper	28	None
Lead	25	None
Nickel	20	None
Selenium	10	None
Zinc	500	None
Mercury	1	None
Sulphate	400	None
EQS for Cyprinid Waters Hardness range >250mg/l CaC03 based on lab results		

Concentrations of TPH above the laboratory detection limits have been identified in PH2 and PH6 exceeding the target value of 10µg/l. All other boreholes recorded concentrations below the GAC.

Several PAH compounds (Benzo(a)anthracene, chrysene, fluoranthene, benzo(a)pyrene, pyrene) have been identified in groundwater in PH2 and PH3 which slightly exceed the target value.

All other concentrations of metals, BTEX and PAH compounds analysed above were found below the RSK target value or laboratory detection limits.

6.3.3 Conclusions of controlled waters assessment

The generic quantitative assessment of risks to Controlled Waters has indicated that concentrations of TPH and PAH compounds (benzo(a)anthracene, chrysene, fluoranthene, benzo(a)pyrene, pyrene) within groundwater at PH6, PH2 and PH3 potentially pose a risk to controlled waters.

Hydrocarbon contamination has been identified within shallow soils at these locations (where fuel storage and filling has historically taken place), therefore it is assumed that a historic fuel loss event is considered to be the most likely source.

To further assess risks to controlled waters from these contaminants, a review of the hydrocarbon composition has been undertaken, the TPH carbon bands showing the highest concentrations are heavy-end fractions ranging from C12-35 (as are the marginally elevated PAH compounds chrysene, fluoranthene, benzo(a)pyrene, pyrene). The Environment Agency produced a document in 2009 titled 'Hydrocarbons in groundwater supplementary guidance for Hydrogeological risk assessment', which presents a risk ranking for hydrocarbon fractions to determine their risk to groundwater and groundwater dependent receptors based on solubility and organic carbon partition coefficients (koc). The elevated TPH carbon bands and PAH compounds are in the most part ranked low for solubility and low koc with an overall risk ranking as low, therefore indicating that these compounds are unlikely to pose a risk to groundwater and groundwater dependent receptors.

In addition although hydrocarbon sheen was observed on the surface of groundwater during the groundwater monitoring event on 21 August 2012 a measurable thickness of free phase was not encountered.

Given the nature of the contamination and its perceived low risk to the wider groundwater body and the River Thames it is considered that the process of natural attenuation (degradation) will sufficiently occur over time to remove the dissolved phase hydrocarbon without the need for human intervention (i.e. specific remedial works).

Based upon the above RSK recommends further groundwater sampling to confirm that natural attenuation is occurring (and at a sufficient rate) and that the state of the groundwater improves over time. This testing should include (MNA) parameters suitable for the assessment of natural attenuation to provide a robust assessment of the biodegradation processes occurring.

If conditions are found to change at the site following subsequent monitoring and assessment remediation maybe required. These measures might include treatment of groundwater during excavation of hydrocarbon impacted soils (via carbon filter plants) or in situ treatment via boreholes.

7 ENVIRONMENTAL ASSESSMENT CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Comparison of the laboratory data to screening criteria and more detailed modelling indicates that potentially unacceptable risks exist to:

- Future occupants of the site could be exposed to elevated Lead, arsenic and PAHs in the general Made Ground located across the site should it remain in high risk soft landscaping areas;
- Future end-users from TPH contamination in the area of PH1, PH2 and PH6 (i.e. fuel storage and filling area;
- Groundwater within in the Secondary / Principal Aquifers (where TPH and PAH contamination recorded in PH2, PH3 and PH6);
- Future end-users from ground gas and possible hydrocarbon vapour concentrations from groundwater and soils;
- Future water supply pipes from contaminated soils within which the supply pipes are likely to be laid;
- Future end-users and adjacent site users from possible asbestos within current buildings; and
- Vegetation in soft landscaping areas.

These potential risks are discussed further in section 7.2.

7.2 Recommendations

In order to manage risks associated with the potentially complete pollutant linkages, it is recommended that allowance be made for the implementation of the following:

- Due to elevated arsenic, lead and PAHs within Made Ground across the site, it is recommended that a clean capping medium comprising a 600mm thickness (or to the natural basal soils should they be encountered sooner) be adopted across the site within communal and private soft landscaped areas. Given the depth and composition of Made Ground (esp. within the northern parts) at the site a marker/capillary break layer is also recommended to prevent mixing of imported soils with underlying Made Ground. The topsoil/subsoil will provide a clean growth medium for proposed vegetation, whilst limiting the potential for contact with underlying Made Ground by future residents. Outside of garden and soft landscaped areas (i.e. beneath proposed buildings and roads), a plausible pathway (for human health) is unlikely to be present and therefore no specific remedial actions are considered necessary. Depending on site levels Made Ground could be re-used under hardstanding areas;
- Hydrocarbon (TPH) contamination has been identified within the Made Ground in the area of PH1, PH2, PH6 (and visually in PH3 and BH2), which is considered to be associated with an oil loss from the area of bulk fuel storage and filling. It is

therefore recommended that any shallow impacted/affected soils above the groundwater table be removed (recommendation with respect contamination within groundwater is dealt with separately below) off site as part of the site redevelopment. It would be prudent to classify this as hazardous although additional testing may allow this to be reduced to non hazardous. It may also be of benefit to carryout further sampling in this area (post demolition) to allow delineation and further quantification of this material. Only suitably qualified contractors should undertake groundworks and remediation in this area;

- In addition to the area noted above, the underground storage tank (and dispenser) in the area of PH10 and the above ground storage tank (and dispenser) in the area of PH4 should be decommissioned and removed off site along with any localised hydrocarbon contaminated soils;
- Hydrocarbon contamination has been identified within groundwater in PH2, PH3 and PH6. This is considered to be related to oil loss from the bulk fuel storage area (that is now effectively dissolved (given the absence of free phase product) within the groundwater within the land filled area). Although not considered to pose a significant risk to the wider groundwater body (see section 6.3.3) it is recommended that further groundwater sampling is undertaken to confirm that natural attenuation is occurring and that groundwater quality will improve over time. If following subsequent monitoring and assessment the groundwater conditions are shown to improve/remain stable (i.e plume is not migrating) then specific remediation relating groundwater is considered unlikely. If however conditions are found to change at the site following subsequent monitoring and assessment then remediation maybe required. These measures might include treatment of groundwater during excavation of hydrocarbon impacted soils (via carbon filter plants) or in situ treatment via boreholes.
- The ground gas risk assessment has identified elevated concentrations of Methane (in PH3 only) and carbon dioxide (site wide) where ground gas protection would be required. The data (to date) indicates that Amber 2 and CS2/3 conditions should be adopted for the site (This involves an appropriate membrane and that floor slabs should be suspended and passively ventilated). The significantly high concentrations of methane recorded from PH3 are likely to be attributed to peat horizons within the alluvium or degradation of hydrocarbon contamination underlying this part of the site. It is recommended that further assessment is undertaken to better determine what the source of ground gas is as determining the source and carrying out localised remediation may prove beneficial (i.e. reduce the ground gas protection requirements for the development). Notwithstanding the above this assessment is based on only 2 visits and therefore further ground gas monitoring in line with NHBC guidance is recommended to fully characterise the ground gas regime of the site;
- In addition to the ground gas assessment above, elevated concentrations of TPH were recorded within the groundwater (around PH2 and PH6) where a vapour risk has been identified with respect end users of the site. It is therefore recommended that an independently installed hydrocarbon vapour resistant membrane be installed in these impacted areas (namely the areas around PH1 to PH6 and BH2. Vapour sampling/future remedial actions may reduce this requirement;
- Service pipes may need to be protected in some fashion. Individual service providers should be contacted over construction material requirements;
- Although asbestos was not identified (within the soils) as part of the investigation, its presence within made ground cannot be discounted. In addition prior to demolition of existing buildings, an asbestos survey must be carried out by an approved contractor. Asbestos containing materials are classified as being hazardous and must therefore be disposed off site at a suitably licensed waste facility should they be encountered; and

- In view of the ground conditions encountered and the historical uses of the site (i.e. industrial) it is recommended that additional shallow investigations are undertaken within identified areas of concern and areas unable to be accessed as part of this investigation, (i.e. shallow soils beneath current operational buildings like vehicle workshop etc) to inform shallow ground conditions further and to enable design of a comprehensive remedial strategy for the site.

In addition to the above, the following should also be noted:

- The historical uses of the site should be noted and the potential for further contamination to be identified during demolition and site clearance works recognised. Any visual or olfactory evidence of contamination should be notified to an Environmental Engineer so that appropriate sampling can be implemented to determine any additional remedial requirements;
- All imported material should be from a known source, preferably 'Greenfield', with haulage certification provided to confirm collection and delivery addresses. The material should be tested at source and on site to confirm it is suitable for placement in areas of soft landscaping.
- Validation should be carried out for all remedial works and within soft landscaping areas to confirm that the topsoil and subsoil is of a suitable thickness and that it is suitable for its intended use. Validation of topsoil should be reported to the contaminated land officer for approval and sign off.
- Risks to construction workers must be managed through the use of appropriate PPE and compliance with current guidance such as CDM and Construction on Brownfield Sites; and
- During the construction phase, dust should be managed particularly during dry or windy periods to reduce risks to adjacent residents;
- Japanese knotweed was not identified during the site although it presence can not be discounted. If encountered a specialist contractor should be contacted to treat and eradicate (prior to any disturbance); and
- A copy of this report be provided to the following regulatory authorities for their comment and approval (i.e. The Local Authority Contaminated Land Officer, Environment Agency, and The National House Building Confederation (NHBC) (if appropriate)).

8 GEOTECHNICAL SITE ASSESSMENT

8.1 Engineering considerations

It is understood that consideration is being given to the construction of residential houses and apartments with associated private gardens, amenity areas and associated infrastructure.

At the time of reporting, no indicative loadings for the proposed structure were available, although it is considered that a maximum line load of 125kN/m is envisaged.

The northern part of the site has been the subject of a 'landfilling' exercise with significantly deeper Made Ground.

8.2 Geotechnical hazards

A summary of commonly occurring geotechnical hazards are given in Table 19 together with an assessment of whether the site may be affected by each of the stated hazards.

Table 19: Summary of main potential geotechnical hazards that may affect site

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
Lateral changes in ground conditions		√		Likely to affect ground engineering and foundation design and construction
Shrinkable clay soils		√		Design to NHBC Standards Chapter 4 or similar
Highly compressible and low bearing capacity soils, (including peat and soft clay)	√	√		Likely to affect ground engineering and foundation design and construction
Silt-rich soils susceptible to rapid loss of strength in wet conditions		√		Likely to affect ground engineering and foundation design and construction
Running sand at and		√		Likely to affect ground

Hazard category (excluding contamination issues)	Hazard status based on investigation findings and proposed development			Engineering considerations if hazard affects site
	Found to be present on site	Could be present but not found	Unlikely to be present and/or affect site	
below water table				engineering and foundation design and construction
High groundwater table (including waterlogged ground)	√			May affect temporary and permanent works
Underground mining			√	Likely to require special stabilisation measures
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures)		√		Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)	√			Likely to affect ground engineering and foundation design and construction
Note: Seismicity is not included in the above table as this is not normally a design consideration in the UK.				

8.3 Foundations

8.3.1 General suitability

Based upon the ground conditions encountered it is felt that there are number of factors to be considered when assessing the correct solution for the proposed foundations at this site:

- Thickness of Made Ground across the central and northern parts of the site (i.e. greater thickness than 3m);
- Thickness and variability of the shallow soft to firm clay and loose to medium dense sand and gravel;
- The presence of a relatively high groundwater table (encountered between 0.20m and 1.68m and widely around 1.2-1.40m); and
- The likely instability of side walls during any excavation.

Based upon the above, any conventional strip foundations are likely to be impractical. It may however be possible to treat the soils (within southern and western areas) using vibro replacement to support proposed foundations and floor slabs. If ground improvement is considered not to be appropriate / cost effective, then piled foundations (CFA or HDP) taken into the underlying competent strata are the recommended.

As for all sites underlain by chalk, consideration should be given to the possible existence of solution features. Such features are known to exist in locally. Although evidence of such structures were not observed during the investigation, their possible existence cannot be ruled out. Consequently all excavations should be carefully monitored and if anomalous ground conditions are encountered then further advice must be sought.

8.3.2 Piled Foundations

Recommendations for the design and construction of pile foundations in relation to the ground conditions are set out in Table 20.

Table 20: Design and construction of piled foundations

Design/construction considerations	Design/construction recommendations
Pile type	Bored or CFA piles are considered to be most appropriate for the prevailing ground conditions.
Possible constraints on choice of pile type	Given the close proximity of the site to other buildings it is considered that possible vibration/noise associated with driven piles may not be acceptable. Further, driven piles may also reach premature set in the treated made ground materials and lead to downward migration of contaminated soils into the groundwater table.
Temporary casing	Given the presence of groundwater over the depths of the investigation bored piles will require temporary casing throughout their depth. Alternatively, the use of continuous-flight-auger (CFA) injected bored piles usually overcomes this issue.
Made ground or soft to firm clay with loose sand parts	For the purpose of assessing preliminary pile capacities, the made ground is presumed not to contribute to the load-carrying capacity for the piles.
Man-made obstructions	Any buried sub-structures or other obstructions within made ground may lead to some difficulty during piling. It is recommended that once the proposed pile layout has been determined, pre-pile probing be carried out at each of the pile positions. Where buried obstructions are encountered, it will be necessary to either relocate the pile(s) or make allowance for removing the obstruction.
Special precautions relating to bored pile shafts and bases	Bored pile concrete should be cast as soon after completion of boring as possible and in any event the same day as boring. Prior to casting the base of the pile bore should be clean, otherwise a reduced safe working load will be required. Similarly, if the pile bore is left open the shaft walls may relax/soften, leading to a reduced safe working load.

Design/construction considerations	Design/construction recommendations
	Piling works should be carefully monitored for the potential presence of chalk solution features and appropriate advice sort if suspect conditions are encountered.

8.3.3 Guidelines for the design of piles in Chalk

Piling in chalk has been the subject of an extensive review, which is presented in CIRIA Report C574. The design methods given below have been based on this information and it is recommended they are used in an assessment of pile carrying capacities.

8.3.4 Bored and CFA piles

The indications are that the shaft resistance of bored piles should not be related solely to the SPT (N) values.

It is recommended the unit ultimate shaft resistance of bored piles in low and medium density chalk should be based on the empirical relationship:

Unit ultimate shaft resistance (f) = 0.8 x σ'_v, where σ'_v average effective overburden pressure over pile length in chalk.

For CFA piles where there is the potential for reduced skin friction during construction, the unit ultimate shaft resistance should be taken as follows:

(f) =0.45 x σ'_v

End Bearing

The unit ultimate end bearing resistance, q_u, may be determined from the 'N' values taken within a depth of different diameters of toe of the pile, as follows:

Bored piles q_u =200N kN/m^2

CFA piles q_u =200N kN/m^2

Illustrative load carrying capacities have been calculated for single bored and CFA piles with an overall factor of safety of 2.5. The results for allowable capacities are given in the **Table 21 & 22** below and are based on in-situ testing, principally SPT 'N' values given in the boreholes records (BH1) and laboratory data (see Appendix O). The variation of SPT (N) values Vs depth is given in Appendix P. It has been assumed that little or no positive skin friction will be obtained from the made ground, which has been assumed to be generally 3.5m in thick. For design purpose, groundwater level has been assumed at 1.2mbgl.

Table 21: Pile capacity for bored piles

Depth of pile (m)	Diameter of pile (m)	Shaft Friction Fs (kN)	End bearing Qb (kN)	Ultimate Pile Capacity (kN)	Allowable Pile Capacity (kN) FoS = 2.5
8	0.30	371	99	470	188
	0.35	432	135	567	227
	0.40	494	176	670	268
	0.45	556	223	779	311
	0.50	618	275	893	357
	0.60	741	396	1137	455
9	0.30	765	156	921	368
	0.35	893	212	1105	442
	0.40	1021	276	1297	519
	0.45	1148	350	1498	599
	0.50	1276	432	1708	683
	0.60	1531	622	2153	861
10	0.30	623	170	792	317
	0.35	726	231	957	383
	0.40	830	302	1132	453
	0.45	934	382	1315	526
	0.50	1038	471	1509	603
	0.60	1245	679	1924	769
11	0.30	765	212	977	391
	0.35	893	289	1182	473
	0.40	1021	377	1398	559
	0.45	1148	477	1625	650
	0.50	1276	589	1865	746
	0.60	1531	848	2379	952

Table 22: Pile capacity for CFA piles

Depth of pile (m)	Diameter of pile (m)	Shaft Friction Fs (kN)	End bearing Qb (kN)	Ultimate Pile Capacity (kN)	Allowable Pile Capacity (kN) FoS = 2.5
8	0.30	222	99	321	128
	0.35	259	135	393	157
	0.40	295	176	471	189
	0.45	332	223	555	222
	0.50	369	275	644	258
	0.60	443	396	839	336
9	0.30	289	156	445	178
	0.35	337	212	549	220
	0.40	386	276	662	265
	0.45	434	350	784	314
	0.50	482	432	914	366
	0.60	578	622	1201	480
10	0.30	363	170	533	213
	0.35	424	231	655	262
	0.40	484	302	786	314
	0.45	545	382	927	371
	0.50	605	471	1077	431
	0.60	727	679	1405	562
11	0.30	444	212	656	262
	0.35	518	289	806	322
	0.40	591	377	968	387
	0.45	665	477	1143	457
	0.50	739	589	1328	531
	0.60	887	848	1735	694

It should be noted that behaviour of pile/pile groups under working loads should be determined as part of the detailed design work. The carrying capacity of piles depends to a large extent on the method and care taken during their installation. It is therefore recommended that the advice of a specialist-piling contractor should be sought as to the most suitable type of pile in the ground conditions found at the site and also as to their lengths and diameters to support the actual working loads.

8.3.5 Ground Improvement

Subject to consultation with a specialist contractor, it is recommended that consideration may be given to ground improvement (especially within southern areas) by the adoption of vibro stone columns (VSC).

Typically stone columns are installed at 2.5m centres and to a maximum depth of about 8m. At this site bottom feed techniques considered to be the most appropriate.

Following installation, reinforced strip foundations may be adopted upon treated ground where typically a net allowable bearing pressure of 100kN/m^2 is specified.

If VSC to be adopted for any of the proposed structures, it is recommended that supplementary investigation be carried out in the areas not previously assessed to confirm the suitability of the ground conditions for the adoption of VSC.

8.3.6 Foundation works risk assessment

A foundation works risk assessment report may be required by the Environment Agency given that both soil and groundwater contamination have been identified and that deeper foundation options (vibro and/or piles) are being recommended.

8.3.7 Floor slabs

Suspended floor slabs will be required where the thickness of made ground exceeds 0.6m and where the new buildings overlap the footprints of the demolished buildings, as specified in the NHBC Standards Chapter 5.2, Suspended Ground Floors. It is therefore recommended that suspended floor slabs be adopted throughout.

The floor slab must incorporate appropriate gas protection measures as described in 7.2.

8.3.8 Pavement construction

Field observations indicate that the formation subsoils are likely to comprise silty sand or in made ground (noted to be of variable composition). The engineering characteristics of such material are unpredictable and the CBR value of made ground does not predict overall settlements that may occur.

Due to the variability of the made ground (and that levels may change as part of the development), it would be prudent at this stage, to allow for a CBR value of 2 to 5% for initial design purposes.

To provide a more thorough assessment of CBR, it is recommended that in-situ testing be carried out once the road layout and pavement scheme including proposed reduced levels have been agreed.

It is recommended that all pockets of soft or loose material at formation level should be removed and replaced with well-compacted granular material. All formations should be compacted to make good any disturbance caused by excavation. It is recommended that the formation be not exposed for any period of time during inclement weather.

8.3.9 Soakaways

Based on ground conditions revealed during the site investigation, it is considered that soakaways will not prove suitable on the site. This recommendation is taken with view to the shallow groundwater level and depth of Made Ground (and in some areas contamination) underlying the site.

8.3.10 Chemical attack on buried concrete

This assessment of the potential for chemical attack on buried concrete is based on current BRE guidance. For the purposes of this assessment of the aggressive chemical environment, the site should be considered as a site that has been subject to previous industrial development and does not contain pyrite. A suite of chemical analyses appropriate to this site classification was carried on 6No. soil samples to a maximum depth of 4.0mbgl. The results of these analyses are given in Appendix I.

The maximum water-soluble sulphate content in soil of 505mg/l has been taken as the characteristic value. As this value is below the limiting value of 3.7g/l consideration of magnesium is not required. Based on Table C2 in the guidance, result one for Design Sulphate Class for the site is DS-2.

Based on the permeable soil horizons encountered during the investigation it has been assumed that groundwater conditions are mobile. From consideration of the characteristic pH value, an Aggressive Chemical Environment for Concrete classification of AC-2 may be assumed for design purposes.

9 REUSE OF MATERIALS AND WASTE

In accordance with the *CL:AIRE Code of Practice* (2011) (CoP) materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Thus, contaminated material does not become waste until the aforementioned criteria are met.

Under the CoP, soil may be re-used on the site where they were produced provided they are:

- certain to be used;
- are suitable for use both chemically and geotechnically; and
- only the required quantity is used.

The CoP requires the preparation of a materials management plan that confirms the three criteria above will be met. This plan needs to be reviewed by a 'Qualified Person' who will then issue a declaration form to the Environment Agency. RSK has 'Qualified Persons' to enable compliance with the CoP.

9.1 Treatment to meet suitable-for-use criteria

Where materials do not meet the suitable for use criteria it may be possible to treat them under an environmental permit (mobile treatment licence) to enable them to be reused onsite. RSK holds an environmental permit to enable this treatment to be completed.

To enable the treatment options to be determined, RSK can prepare an appraisal of the options and prepare a remediation strategy document to support discussion of the issues with regards to regulators and third parties.

9.2 Reuse of waste materials

If material is discarded as waste then its reuse on site is possible. Waste soils can be reused on site under a standard rules environmental permit or a U1 waste exemption from the Environmental Permitting (England and Wales) Regulations 2010. However, it should be noted that these have strict limits on the quantity of material that can be reused.

9.3 Wastes for landfill disposal

Wastes require pre-treatment prior to disposal at landfill. Pre-treatment must be a physical, thermal, chemical or biological process (including sorting) that changes the characteristics of the waste to reduce its volume, reduce its hazardous nature, facilitate its handling and enhance its recovery. It is best practice to provide your waste collector (or the disposal site) with details of how the waste has been treated.

Your waste collector may provide a pre-treatment confirmation form or space on the waste transfer note to detail the pre-treatment. Alternatively a standard form produced by the Environment Agency may be used (http://www.environment-agency.gov.uk/commondata/acrobat/annex1_1898741.pdf).

Envirolab (an RSK company) has developed a waste soils characterisation assessment tool, which follows the guidance within the Environment Agency's 'Technical Guidance WM2' (2003), Interpretation of the definition and classification of hazardous waste. The analytical results have been run through this assessment tool for potential off-site disposal of materials in the future.

Based upon the laboratory data it is considered that:

- Shallow natural soils on site would likely to be classified as ***inert*** (sand ands gravel or reworked sand and gravel);
- Typical shallow 'made ground' would be classified as ***non-hazardous,*** although the areas around PH8, PH9 and PH10 may be classified as ***hazardous*** based upon the lead and copper values, and
- The area of hydrocarbon contamination identified within PH1, PH2, PH6 (and BH2) as ***hazardous***.

9.4 Waste acceptance criteria

All inert, stable non-reactive hazardous and hazardous wastes must be tested and found to be below the waste acceptance criteria (WAC) leaching limit values for the classification of landfill they are being disposed in. Currently, no WAC are in place for non-hazardous waste.

At present WAC testing has not been carried out on soil samples recovered from the site. Further assessment of the soils will be undertaken once the development is underway.

9.5 Landfill tax

Waste producers disposing of material to landfill are required to pay landfill tax by HM Revenue and Customs unless an exemption is available.

Currently (since April 2012), landfill tax is £64 per tonne and the tax rate will increase annually by £8 until the cost hits £80 in 2014. Further, the Treasury has confirmed that for five years thereafter the tax will not fall below £80.

Material disposed of at a soil treatment centre will not be required to pay landfill tax.

9.6 Groundwater

Although unlikely, where there is an intention to discard groundwater, chemical test results will indicate the appropriate disposal options. This could include disposal to treatment facility, via consent (issued by the water authority) to foul sewer or via consent (issued by the Environment Agency) to watercourse. RSK can arrange for these consents to be obtained if required.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Environmental

In order to manage risks associated with the potentially complete pollutant linkages, it is recommended that allowance be made for the implementation of the following:

- Due to elevated arsenic, lead and PAHs within Made Ground across the site, it is recommended that a clean capping medium comprising a ***600mm*** thickness (or to the natural basal soils should they be encountered sooner) be adopted across the site within communal and ***private soft landscaped areas***. Given the depth and composition of Made Ground (esp. within the northern parts) at the site a marker/capillary break layer is also recommended to prevent mixing of imported soils with underlying Made Ground. The topsoil/subsoil will provide a clean growth medium for proposed vegetation, whilst limiting the potential for contact with underlying Made Ground by future residents. Outside of garden and soft landscaped areas (i.e. beneath proposed buildings and roads), a plausible pathway (for human health) is unlikely to be present and therefore no specific remedial actions are considered necessary. Depending on site levels Made Ground could be re-used under hardstanding areas;
- Hydrocarbon contamination has been identified within groundwater in PH2, PH3 and PH6. This is considered to be related to oil loss from the bulk fuel storage area (that is now effectively dissolved (given the absence of free phase product) within the groundwater within the land filled area). Although not considered to pose a significant risk to the wider groundwater body (see section 6.3.3) it is recommended that further groundwater sampling is undertaken to confirm that natural attenuation is occurring and that groundwater quality will improve over time. If following subsequent monitoring and assessment the groundwater conditions are shown to improve/remain stable (i.e. plume is not migrating) then specific remediation relating groundwater is considered unlikely. If however conditions are found to change at the site following subsequent monitoring and assessment then remediation maybe required. These measures might include treatment of groundwater during excavation of hydrocarbon impacted soils (via carbon filter plants) or in situ treatment via boreholes;
- In addition to the area noted above, the underground storage tank (and dispenser) in the area of PH10 and the above ground storage tank (and dispenser) in the area of PH4 should be decommissioned and removed off site along with any localised hydrocarbon contaminated soils;
- Hydrocarbon contamination has been identified within groundwater in PH2, PH3 and PH6. This is considered to be related to oil loss from the bulk fuel storage area (that is now effectively dissolved (given the absence of free phase product) within the groundwater within the landfilled area). Although not considered to pose a significant risk to the wider groundwater body (see section 6.3.3) it is recommended that further groundwater sampling is undertaken to confirm that natural attenuation is occurring and that groundwater quality will improve over time. If following subsequent monitoring assessment the groundwater conditions are shown to improve then specific remediation relating groundwater is considered unlikely. If however conditions are found to change at the site following subsequent monitoring and assessment then active remediation maybe required. These measures might include treatment of groundwater during excavation of hydrocarbon impacted soils (via carbon filter plants) or in situ treatment via boreholes.

- The ground gas risk assessment has identified elevated concentrations of Methane (in PH3 only) and carbon dioxide (site wide) where ground gas protection would be required. The data (to date) indicates that Amber 2 and CS2/3 conditions should be adopted for the site (This involves an appropriate membrane and that floor slabs should be suspended and passively ventilated). The significantly high concentrations of methane recorded from PH3 are likely to be attributed to peat horizons within the alluvium or degradation of hydrocarbon contamination underlying this part of the site. It is recommended that further assessment is undertaken to better determine what the source of ground gas is as determining the source and carrying out localised remediation may prove beneficial (i.e. reduce the ground gas protection requirements for the development). Notwithstanding the above this assessment is based on only 2 visits and therefore further ground gas monitoring in line with NHBC guidance is recommended to fully characterise the ground gas regime of the site;
- In addition to the ground gas assessment above, elevated concentrations of TPH were recorded within the groundwater (around PH2 and PH6) where a vapour risk has been identified with respect end users of the site. It is therefore recommended that an independently installed hydrocarbon vapour resistant membrane be installed in these impacted areas (namely the areas around PH1 to PH6 and BH2. Vapour sampling/future remedial actions may reduce this requirement;
- Service pipes may need to be protected in some fashion. Individual service providers should be contacted over construction material requirements;
- Although asbestos was not identified (within the soils) as part of the investigation, its presence within made ground cannot be discounted. In addition prior to demolition of existing buildings, an asbestos survey must be carried out by an approved contractor. Asbestos containing materials are classified as being hazardous and must therefore be disposed off site at a suitably licensed waste facility should they be encountered; and
- In view of the ground conditions encountered and the historical uses of the site (i.e. industrial) it is recommended that additional shallow investigations are undertaken within identified areas of concern and areas unable to be accessed as part of this investigation, (i.e. shallow soils beneath current operational buildings like vehicle workshop etc) to inform shallow ground conditions further and to enable design of a comprehensive remedial strategy for the site.

A copy of this report will be provided to the following regulatory authorities for their comment and approval (i.e. The Local Authority Contaminated Land Officer, Environment Agency, and The National House Building Confederation (NHBC) (if appropriate)).

10.2 Waste

Based upon the laboratory data it is considered that:

- Shallow natural soils on site would likely to be classified as ***inert*** (sand ands gravel or reworked sand and gravel);
- Typical shallow 'made ground' would be classified as ***non-hazardous,*** although the areas around PH8, PH9 and PH10 may be classified as ***hazardous*** based upon the lead and copper values, and
- The area of hydrocarbon contamination identified within PH1, PH2, PH6 (and BH2) as ***hazardous***.

10.3 Geotechnical

Conventional strip foundations are likely to be impractical. It may however be possible to treat the soils for those units upto 2-3 storey. For those > 3 then piled foundations should be allowed for using vibro replacement to support proposed foundations and floor slabs. If ground improvement is considered not to be appropriate/cost effective, then piled foundations (CFA or HDP) taken into the underlying competent strata are the recommended.

As for all sites underlain by chalk, consideration should be given to the possible existence of solution features. Such features are known to exist in locally. Although evidence of such structures were not observed during the investigation, their possible existence cannot be ruled out. Consequently all excavations should be carefully monitored and if anomalous ground conditions are encountered then further advice must be sought.

It is recommended that all floors are suspended and designed in accordance with NHBC standards.

Road and pavements be initially designed on a CBR value of 2 to 5%.

It is considered that soakaway drainage is unlikely to be feasible due to shallow groundwater and depth of Made Ground (with northern parts of the site).

A foundation works risk assessment report may be required given that both soil and groundwater contamination have been identified and that deeper foundation options (vibro and piles) are being recommended.

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FIGURES



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Client: WATES DEVELOPMENTS

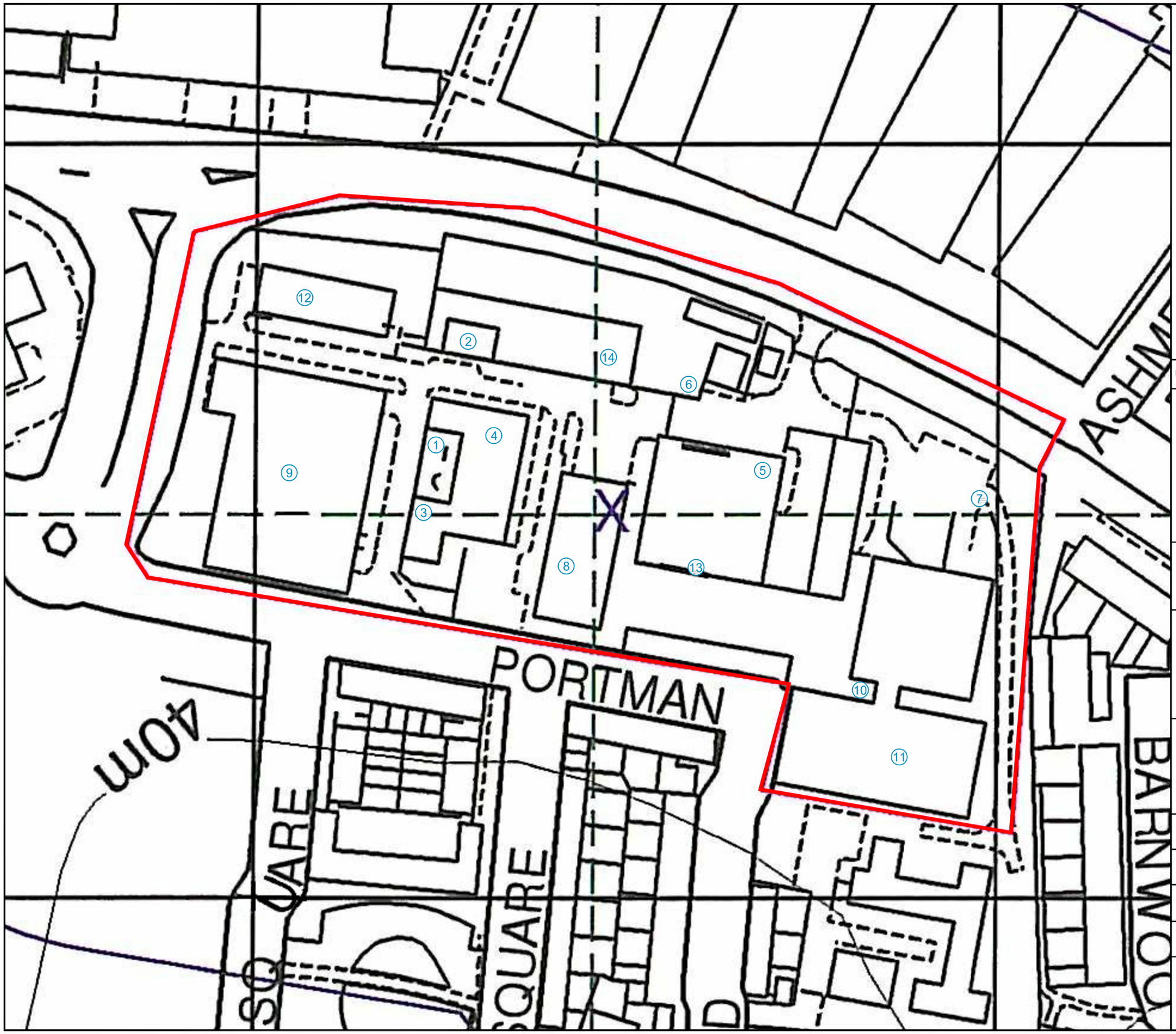
Project Title: FORMER BATTLE HOSPITAL
PORTMAN ROAD, READING

Drawing Title: SITE LOCATION MAP

Rev	Drawn	Date	Checked	Date	Approved	Date
P1	WA	09.08.12	SJ	09.08.12	SJ	09.08.12

Dimensions	Scale	Original Size
m	1:50,000	A4

Project Number	Drawing File	Drawing Number
25520-1 (00)	25520 - SLP.dwg	FIGURE 1



Key

1. 1 No. Above ground oil storage tank
2. 2 No. Above ground oil storage tanks (Vertical)
3. Incinerator
4. Boiler Room
5. Motor vehicle workshop containing Hazchem storage
6. Above ground storage tank and dispencer
7. Underground oil storage tank and dispencer
8. Sterilization centre
9. Former laundry currently used as site compound for David Wilson Homes
10. Lubricant drums
11. Former storage and distribution warehouse
12. Offices
13. Waste Oil Tanks
14. Unused Borehole Abstraction

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
P1	09.08.12	First Issue	WA	SJ	SJ

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Client

WATES DEVELOPMENTS

Project Title

FORMER BATTLE HOSPITAL
PORTMAN ROAD
READING

Drawing Title

SITE WALK OVER PLAN

Drawn	Date	Checked	Date	Approved	Date
WA	09.08.12	SJ	09.08.12	SJ	09.08.12

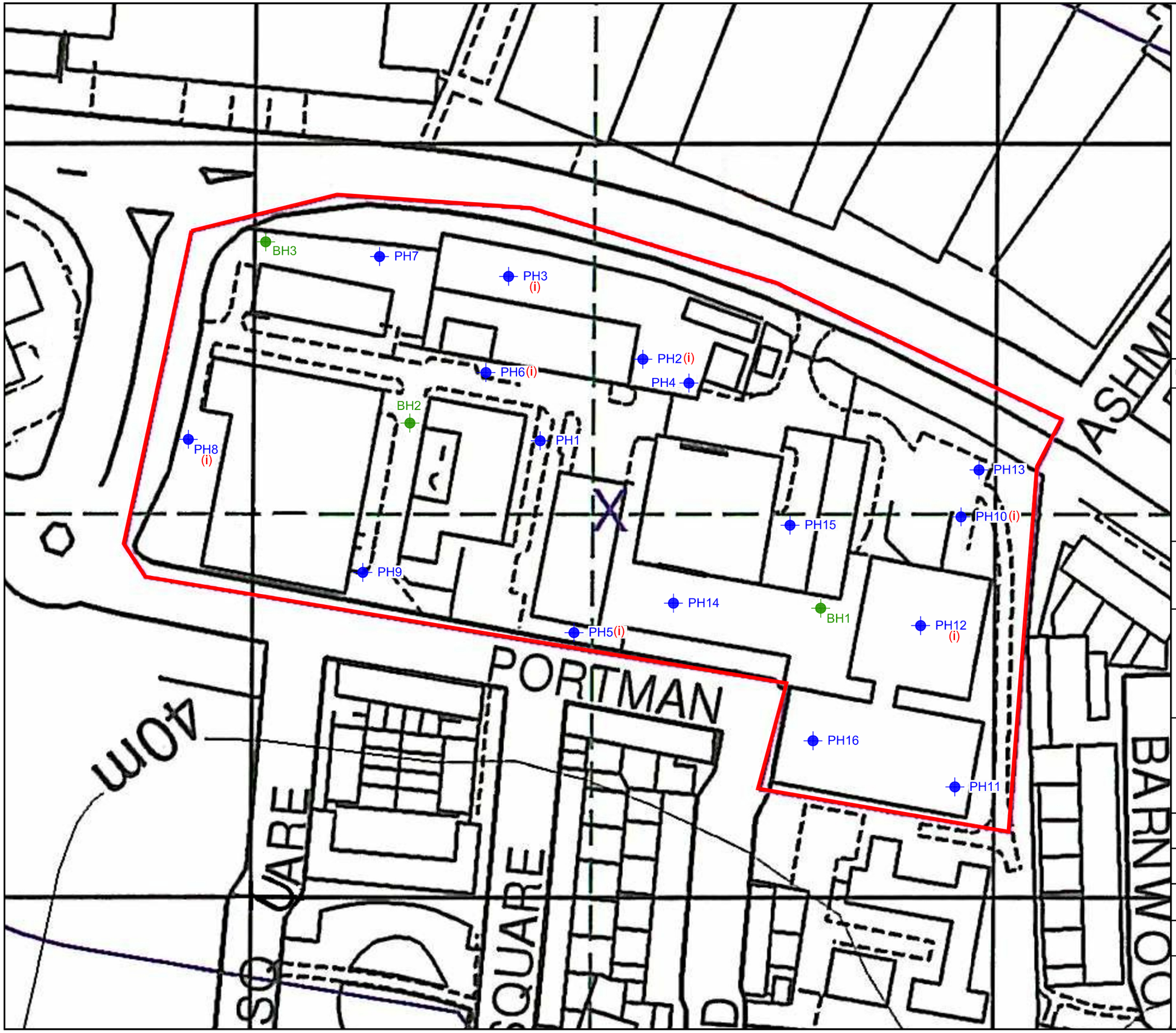
Scale	Orig Size	Dimensions
1:1000	A3	m

Project No.	Drawing File
25520-1 (00)	25520 (R01-00).dwg

Drawing No.	Rev.
FIGURE 2	P1

Scale

0 10 20 30 40 50m



LEGEND

- Probehole Location
- (i) Probehole Location
- Borehole Location

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
P1	09.08.12	First Issue	WA	SJ	SJ

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Client

WATES DEVELOPMENTS

Project Title

FORMER BATTLE HOSPITAL
PORTMAN ROAD
READING

Drawing Title

EXPLORATORY HOLE
LOCATION PLAN

Drawn	Date	Checked	Date	Approved	Date
WA	09.08.12	SJ	09.08.12	SJ	09.08.12

Scale	Orig Size	Dimensions
1:1000	A3	m

Project No.	Drawing File
25520-1 (00)	25520 (R01-00).dwg

Drawing No.	Rev.
FIGURE 3	P1

Scale

0 10 20 30 40 50m

APPENDIX A
SERVICE CONSTRAINTS

RSK ENVIRONMENT LIMITED SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Royal Berkshire NHS Foundation Trust, South Central Ambulance Service NHS Foundation Trust & Wates Development Limited (the "client") in accordance with the terms of a contract between RSK and the "client", dated April 2012 The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the client.
2. Other than that expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed the Services were performed by RSK exclusively for the purposes of the client. RSK is not aware of any interest of or reliance by any party other than the client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be** well advised to seek independent advice from a competent environmental consultant and/or lawyer.
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date hereof, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a walk-over survey of the site together with RSK's interpretation of information including documentation, obtained from third parties and from the client on the history and usage of the site. The Services are also based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely. The Services clearly are limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the walk-over survey. Further RSK was not authorised and did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services. RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the client and RSK.
8. The phase II or intrusive environmental site investigation aspects of the Services is a limited sampling of the site at pre-determined borehole and soil vapour locations based on the operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the soil and groundwater conditions, together with the position of any current structures and underground facilities and natural and other activities on site. In addition chemical analysis was carried out for a limited number of parameters [as stipulated in the contract between the client and RSK] [based on an understanding of the available operational and historical information,] and it should not be inferred that other chemical species are not present.
9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan, but is (are) used to present the general relative locations of features on, and surrounding, the site.

APPENDIX B
SUMMARY OF LEGISLATION AND POLICY RELATING TO CONTAMINATED LAND

Part IIA of the Environmental Protection Act 1990 (EPA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters are considered all groundwater, inland waters and estuaries.

In August 2006, the statutory regime was extended and now consists of Part IIA of the EPA, as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. Associated with these changes the Radioactive Contaminated Land (Enabling Powers) (England) Regulations 2005 (SI 2005/3467), the Radioactive Contaminated Land (Modification of Enactments) (England) Regulations 2006 (SI 2006/1379) and the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented.

The intention of Part IIA of the EPA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Defra Circular 01/2006, published in September 2006, for definitions of what is significant harm: http://www.defra.gov.uk/publications/files/pb12112-circular01-2006-060817.pdf). This circular replaces DETR Circular 02/2000, published in March 2000, and has two functions: it promulgates the statutory guidance as now amended, which is an essential part of the regime, and it sets out the way in which the extended regime is expected to work by providing a summary of Government policy in this field, a description of the regime and a guide to the other relevant regulations.

Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances

- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The 1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2010 provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2010 states: 'the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.'

Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

Contaminated land is often dealt with through planning because of land redevelopment. This approach is documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land

affected by contamination and carry out sufficient remediation to render the land suitable for use. The overall aim of the planning and pollution control policy is to promote the sustainable and beneficial use of land (in particular, encouraging reuse of previously developed land in preference to greenfield sites). Within this aim, polluting activities that are necessary for society and the economy should be so sited and planned, and subject to such planning conditions, that their adverse effects are minimised and contained to within acceptable limits.

APPENDIX C
SITE PHOTOGRAPHS

PHOTOGRAPHIC LOG

Client Name: Wates Construction	Site Location: Portman Road, Reading	

Photo No. 1	Date: Aug 12
Direction Photo Taken: East	
Description: UST and fuel dispenser in area of PH10.	



Photo No. 2	Date: Aug 12
Direction Photo Taken: South	
Description: Area of PH15.	



PHOTOGRAPHIC LOG

Client Name: Wates Construction	Site Location: Portman Road, Reading	

Photo No. 3	Date: Aug 12

Direction Photo Taken:
South

Description:
Vehicle workshop.



Photo No. 4	Date: Aug 12

Direction Photo Taken:
South

Description:
Small above ground fuel oil tank in the area of PH4.



PHOTOGRAPHIC LOG

Client Name: Wates Construction	Site Location: Portman Road, Reading	

Photo No. 5	Date: Aug 12

Direction Photo Taken:
West

Description:
Looking back toward PH6 and the large vertical fuel tanks.



Photo No. 6	Date: Aug 12

Direction Photo Taken:
N/A

Description:
Fuel filling points located in the central area by PH6.



PHOTOGRAPHIC LOG

Client Name: Wates Construction	Site Location: Portman Road, Reading	

Photo No. 7	Date: Aug 12

Direction Photo Taken:
N/A

Description:
Above ground fuel storage tank to rear of boiler room in central part of site.



Photo No. 8	Date: Aug 12

Direction Photo Taken:
N/A

Description:
Water tanks on roof of former laundry.



APPENDIX D
RISK ASSESSMENT METHODOLOGY

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: preliminary, generic quantitative and detailed quantitative. An outline conceptual model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (source–pathway–receptor) and is used as the basis for the design of the site investigation. The outline conceptual model is updated as further information becomes available, for example as a result of the site investigation.

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- highly likely: the event 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: it is probable that an event will occur or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term
- low likelihood: circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term
- unlikely: circumstances are such that it is improbable the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- severe: short term (acute) risk to human health likely to result in ‘significant harm’ as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short-term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in ‘Draft Circular on Contaminated Land’, DETR 2000)
- medium: chronic damage to human health (‘significant harm’ as defined in ‘Draft Circular on Contaminated Land’, DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in ‘Draft Circular on Contaminated Land’, DETR 2000)

- mild: pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment
- minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the likelihood of an event occurring and its severity have been classified, a risk category can be assigned the table below.

		Consequences			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**Highly likely**	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low likelihood	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low

Definitions of these risk categories are as follows together with an assessment of the further work that may be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability; urgent investigation and remediation are likely to be required.
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required. Remedial works may be necessary in the short term and are likely over the long term.
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term.
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild.
- Very low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

APPENDIX E
ENVIROCHECK EXTRACT

Geology 1:50,000 Maps Legends

Artificial Ground and Landslip

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	MGR	Made Ground (Undivided)	Artificial Deposit	Holocene - Holocene
	WGR	Worked Ground (Undivided)	Void	Holocene - Holocene
	WMGR	Infilled Ground	Artificial Deposit	Present Day - Present Day

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Flandrian - Flandrian
	KPGR	Kempton Park Gravel Formation	Sand and Gravel	Devensian - Devensian
	LASI	Langley Silt Member	Clay and Silt	Devensian - Devensian
	TPGR	Taplow Gravel Formation	Sand and Gravel	Wolstonian - Wolstonian
	LHGR	Lynch Hill Gravel Member	Sand and Gravel	Wolstonian - Wolstonian
	BHT	Boyn Hill Gravel Member	Sand and Gravel	Wolstonian - Hoxnian
	WIHG	Winter Hill Gravel	Sand and Gravel	Anglian - Anglian
	BPGR	Black Park Gravel Member	Sand and Gravel	Anglian - Anglian
	HEAD	Head	Gravel, Sand, Silt and Clay	Quaternary - Quaternary
	HEAD	Head	Clay, Silt, Sand and Gravel	Quaternary - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	LC	London Clay Formation	Clay, Silt and Sand	Eocene - Eocene
	LMBE	Lambeth Group	Clay, Silt and Sand	Paleocene - Paleocene
	SNCK	Seaford Chalk Formation and Newhaven Chalk Formation (Undifferentiated)	Chalk	Campanian - Coniacian
		Faults		

RSK

Geology 1:50,000 Maps

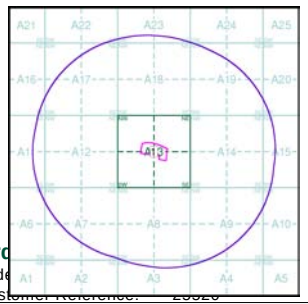
This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published paper maps.

The various geological layers - artificial and landslip deposits, superficial geology and solid (bedrock) geology are displayed in separate maps, but superimposed on the final 'Combined Surface Geology' map. All map legends feature on this page. Not all layers have complete nationwide coverage, so availability of data for relevant map sheets is indicated below.

Geology 1:50,000 Maps Coverage

Map ID:	**1**
Map Sheet No:	**268**
Map Name:	**Reading**
Map Date:	**2000**
Bedrock Geology:	**Available**
Superficial Geology:	**Available**
Artificial Geology:	**Available**
Faults:	**Available**
Landslip:	**Not Available**
Rock Segments:	**Not Available**

Geology 1:50,000 Maps - Slice A



Orc

Orde

Customer Reference: [illegible]

National Grid Reference: 469900, 173900

Slice: A

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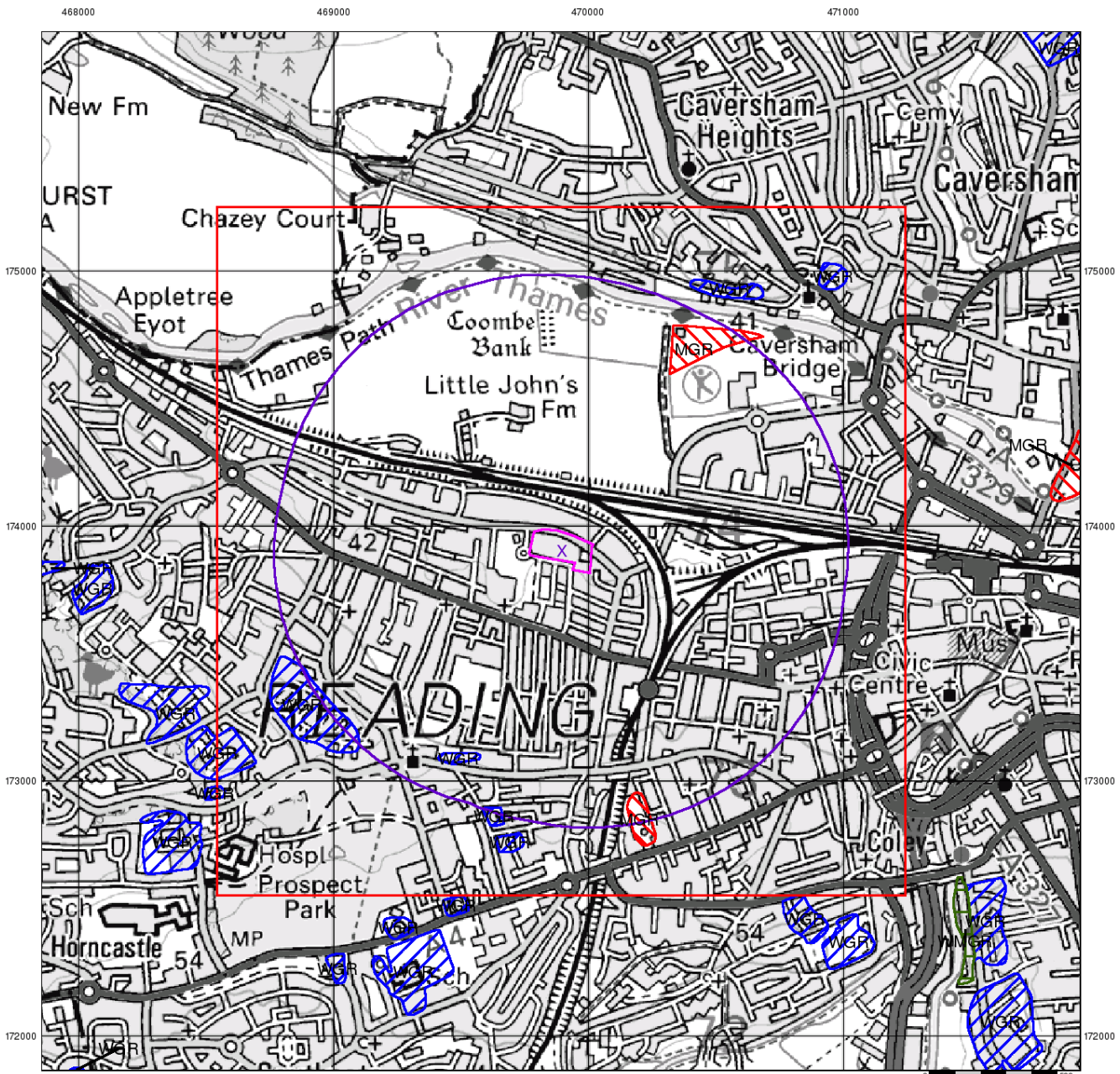
Search Buffer (m): 1000

Site Details:

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

Landmark Information Group

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



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Artificial Ground and Landslip

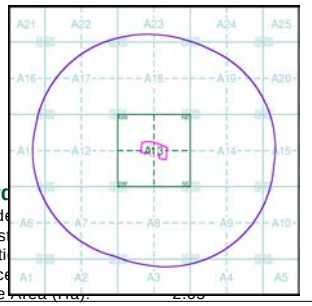
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions and unstable ground.

Artificial ground includes:

- Made ground - man-made deposits such as embankments and spoil heaps on the natural ground surface.
- Worked ground - areas where the ground has been cut away such as quarries and road cuttings.
- Infilled ground - areas where the ground has been cut away then wholly or partially backfilled.
- Landscaped ground - areas where the surface has been reshaped.
- Disturbed ground - areas of ill-defined shallow or near surface mineral workings where it is impracticable to map made and worked ground separately.

Mass movement (landslip) deposits on BGS geological maps are primarily superficial deposits that have moved down slope under gravity to form landslips. These affect bedrock, other superficial deposits and artificial ground. The dataset also includes foundered strata, where the ground has collapsed due to subsidence.

Artificial Ground and Landslip Map - Slice A





Orc

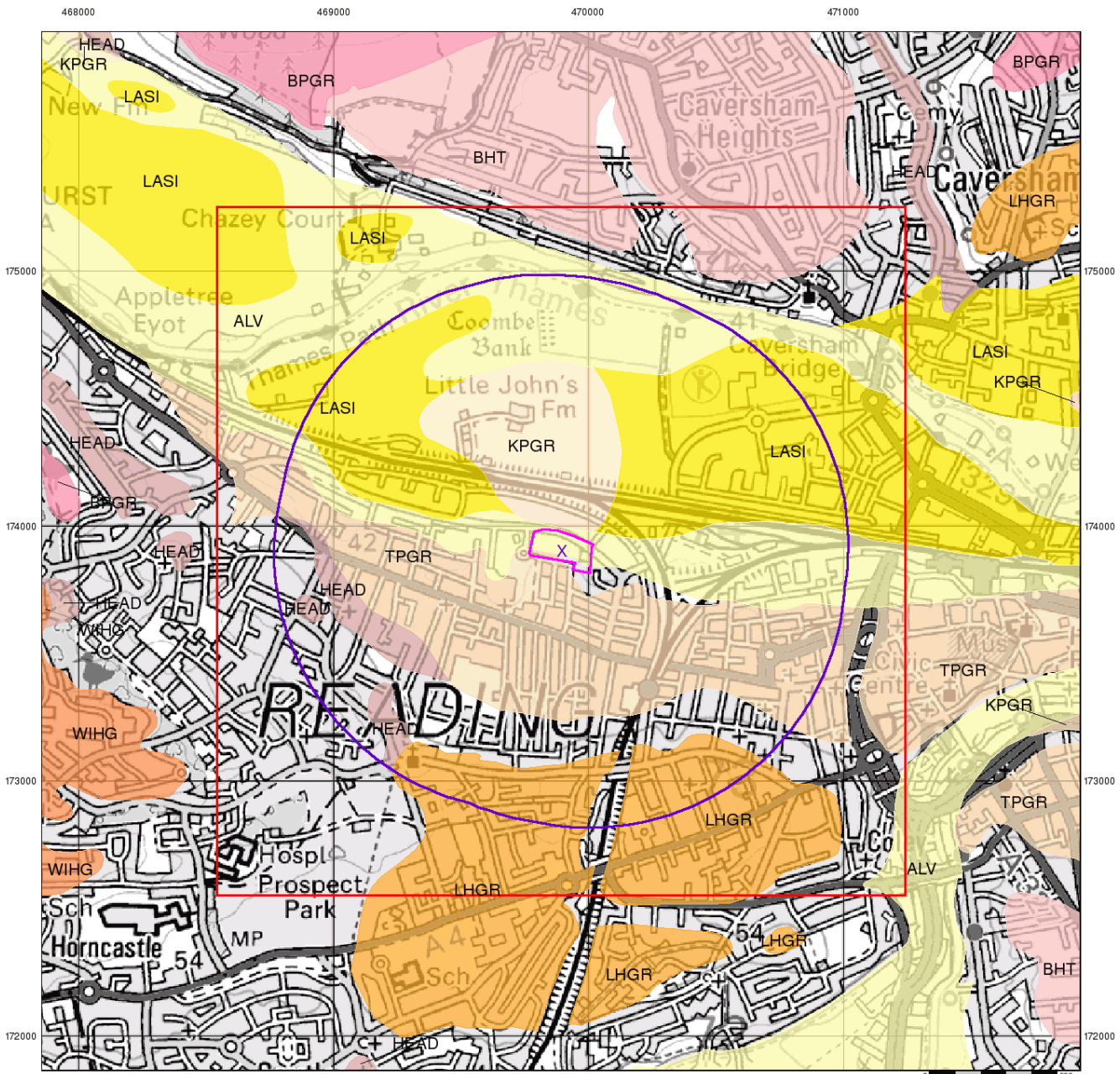
Orde
Cust
Nati
Slice
Site Area (Ha): 2.09

Search Buffer (m): 1000

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RSK

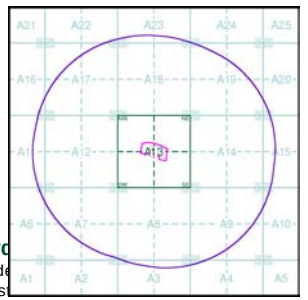
Superficial Geology

Superficial Deposits are the youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 1.8 million years from the present.

They rest on older deposits or rocks referred to as Bedrock. This dataset contains Superficial deposits that are of natural origin and 'in place'. Other superficial strata may be held in the Mass Movement dataset where they have been moved, or in the Artificial Ground dataset where they are of man-made origin.

Most of these Superficial deposits are unconsolidated sediments such as gravel, sand, silt and clay, and onshore they form relatively thin, often discontinuous patches or larger spreads.

Superficial Geology Map - Slice A



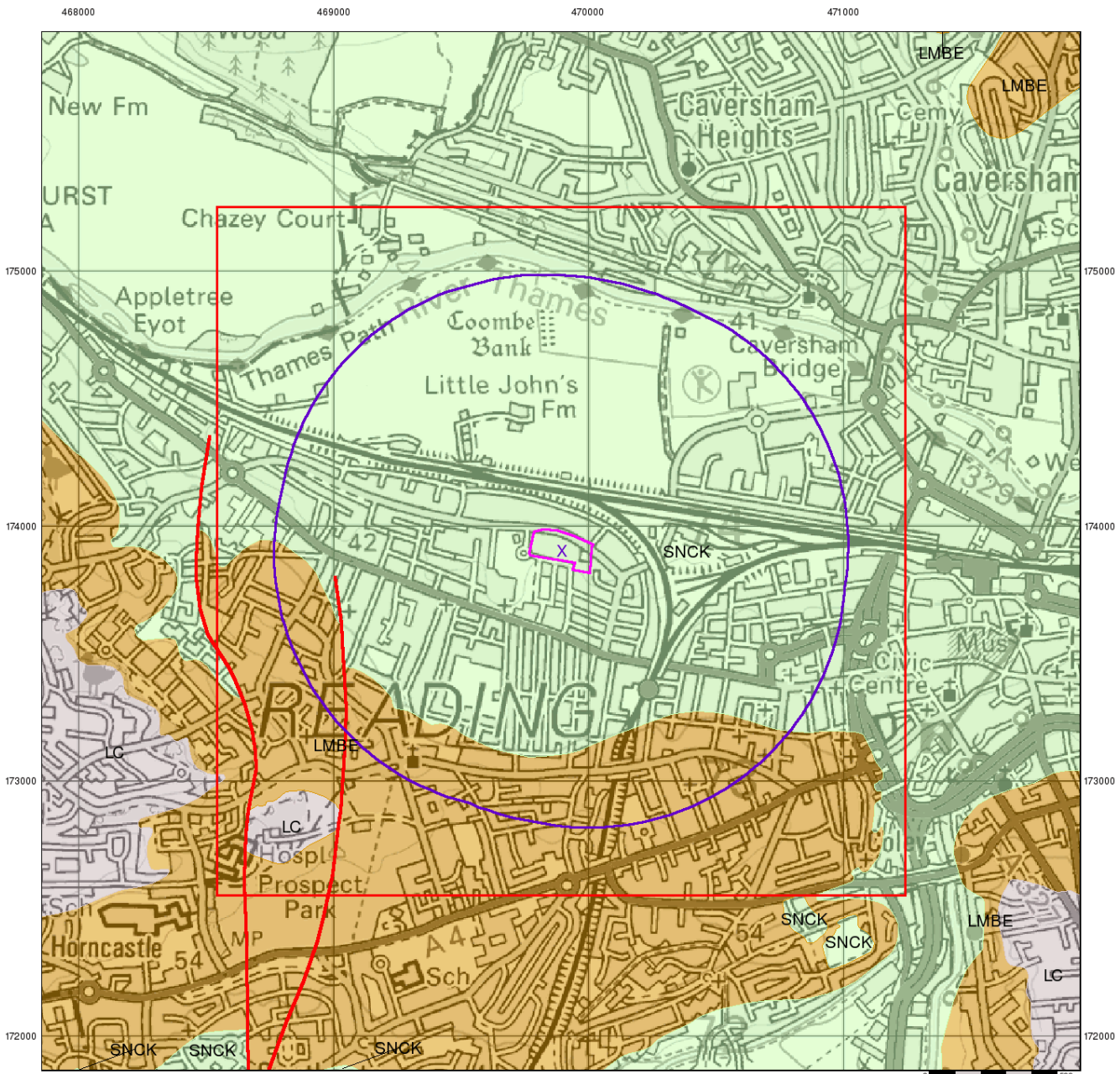
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Cus

National Grid Reference: 469900, 173900
Slice: A
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Bedrock and Faults

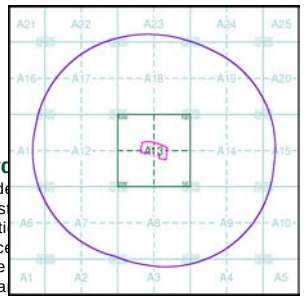
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago, or older, up to the relatively young Pliocene, 1.8 million years ago.

The bedrock geology includes many lithologies, often classified into three types based on origin: igneous, metamorphic and sedimentary.

The BGS Faults and Rock Segments dataset includes geological faults (e.g. normal, thrust), and thin beds mapped as lines (e.g. coal seam, gypsum bed). Some of these are linked to other particular 1:50,000 Geology datasets, for example, coal seams are part of the bedrock sequence, most faults and mineral veins primarily affect the bedrock but cut across the strata and post date its deposition.

Bedrock and Faults Map - Slice A

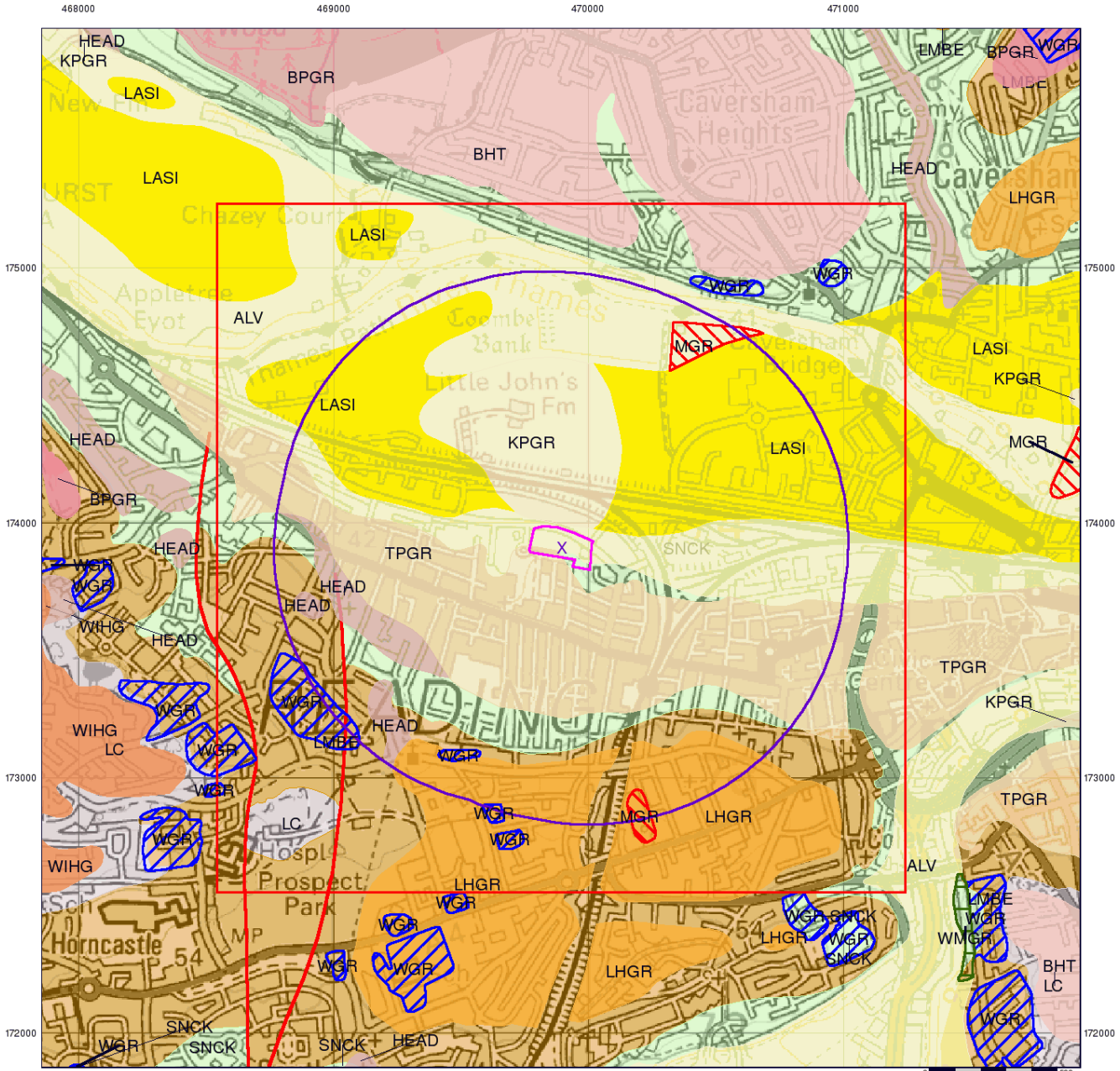


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Site
Sea

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Combined Surface Geology

The Combined Surface Geology map combines all the previous maps into one combined geological overview of your site.

Please consult the legends to the previous maps to interpret the Combined "Surface Geology" map.

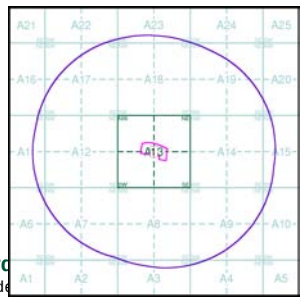
Additional Information

More information on 1:50,000 Geological mapping and explanations of rock classifications can be found on the BGS website. Using the LEX Codes in this report, further descriptions of rock types can be obtained by interrogating the 'BGS Lexicon of Named Rock Units'. This database can be accessed by following the 'Information and Data' link on the BGS website.

Contact

British Geological Survey
Kingsley Dunham Centre
Keyworth
Nottingham
NG12 5GG
Telephone: 0115 936 3143
Fax: 0115 936 3276
email: enquiries@bgs.ac.uk
website: www.bgs.ac.uk

Combined Geology Map - Slice A



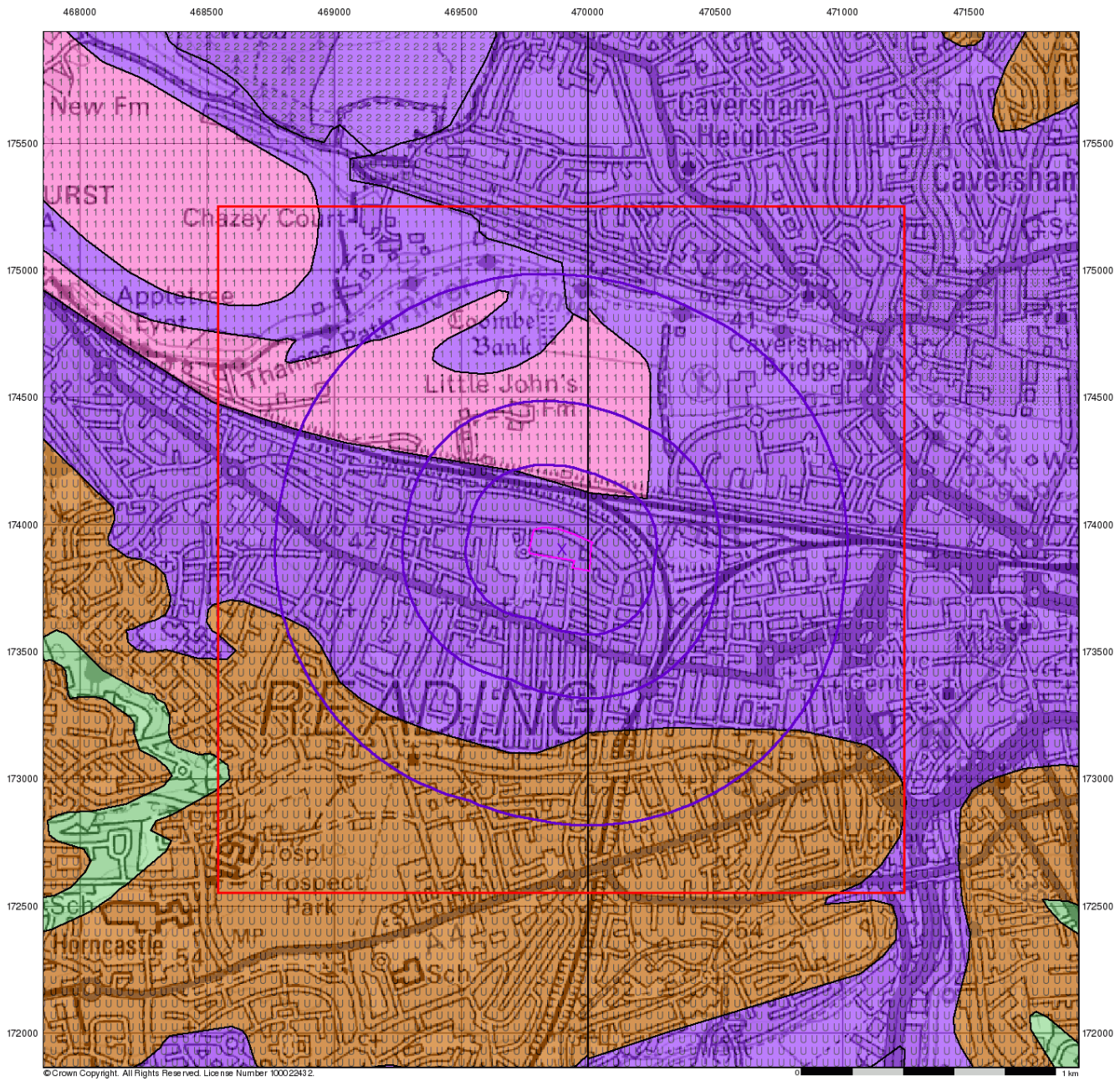
Orc

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Customer Reference:	25520
National Grid Reference:	469900, 173900
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Site Area (Ha):	2.65
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Groundwater Vulnerability

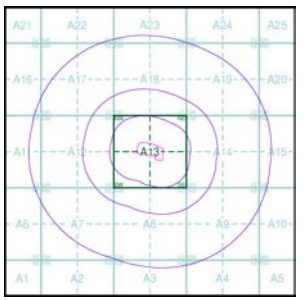
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes	Soil Classes
Major Aquifer (Highly Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Minor Aquifer (Variably Permeable)	High (H) 1, 2, 3, U
	Intermediate (I) 1, 2
	Low
Non Aquifer (Negligibly Permeable)	
Water or Sea	
Drift Deposit	

Site Sensitivity Context Map - Slice A



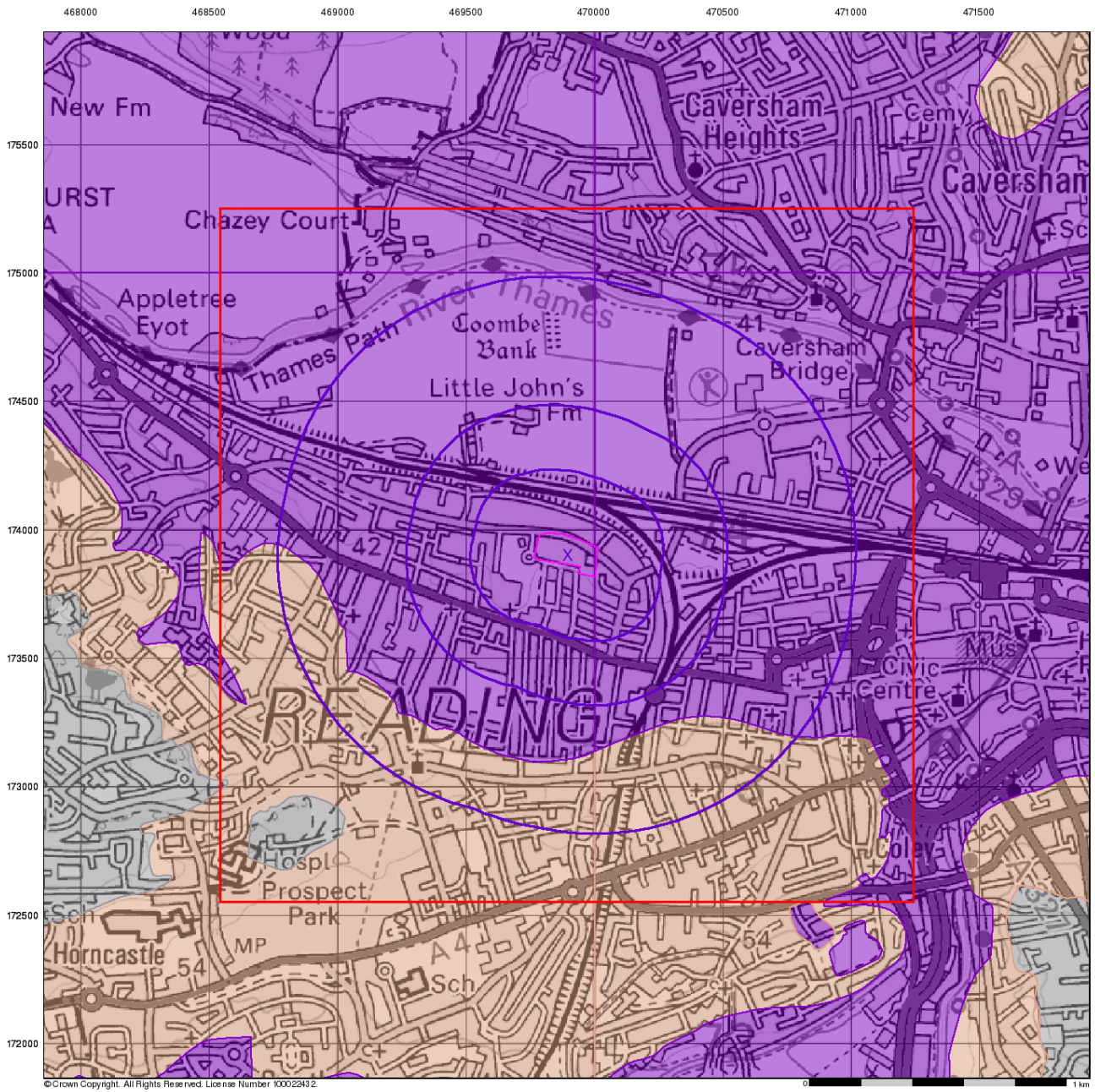
Order Details

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Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
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Bedrock Aquifer Designation

General

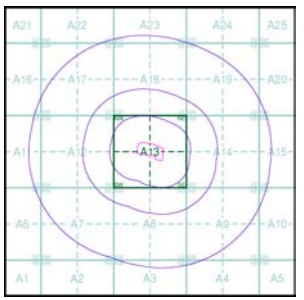
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown

Site Sensitivity Context Map - Slice A



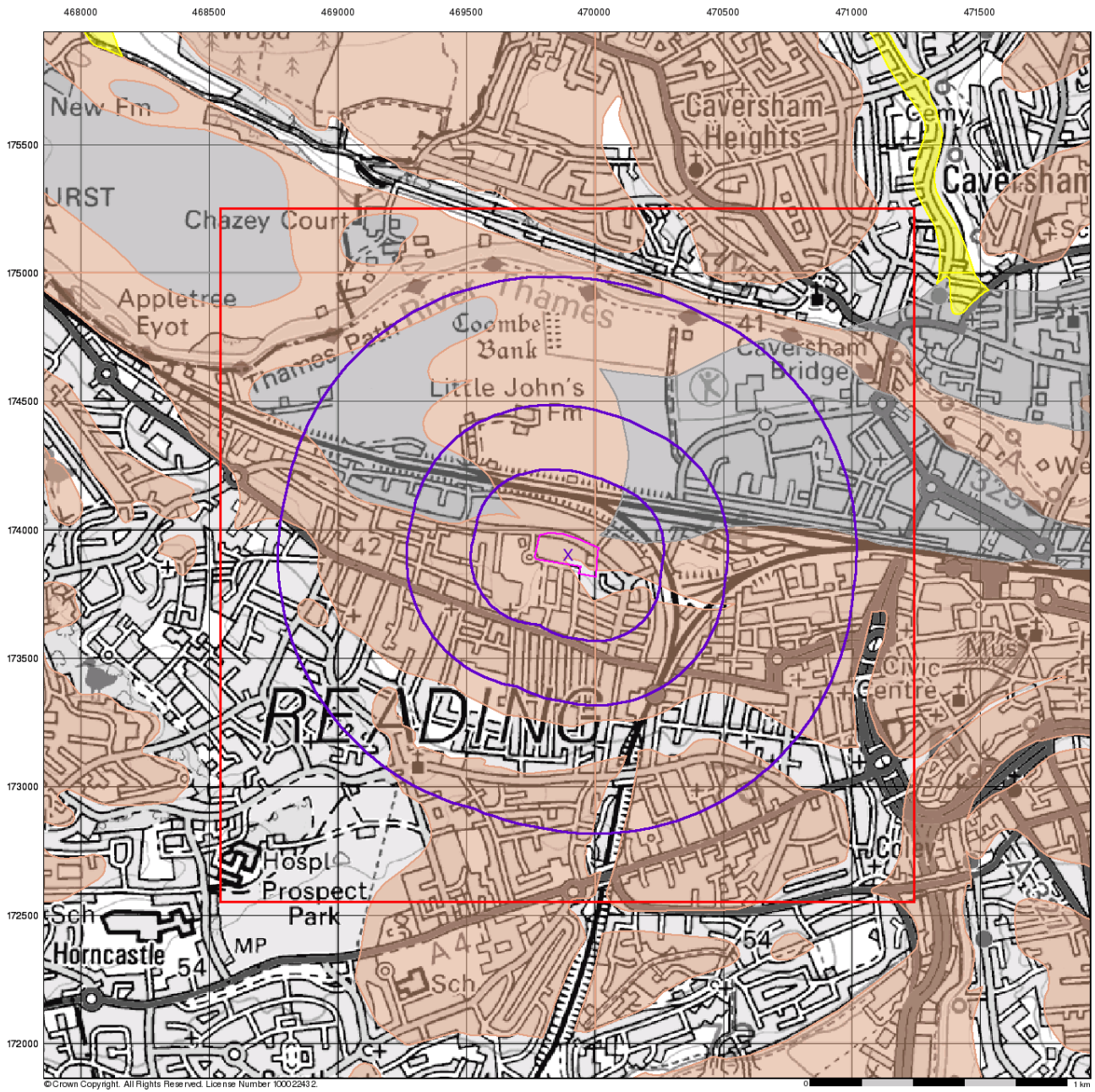
Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

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Superficial Aquifer Designation

General

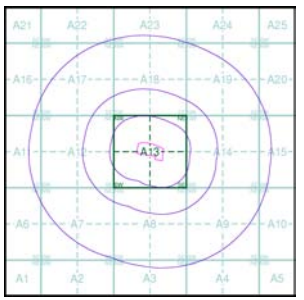
Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

Agency and Hydrological

Geological Classes

- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Secondary Undifferentiated
- Unproductive Strata
- Unknown

Site Sensitivity Context Map - Slice A



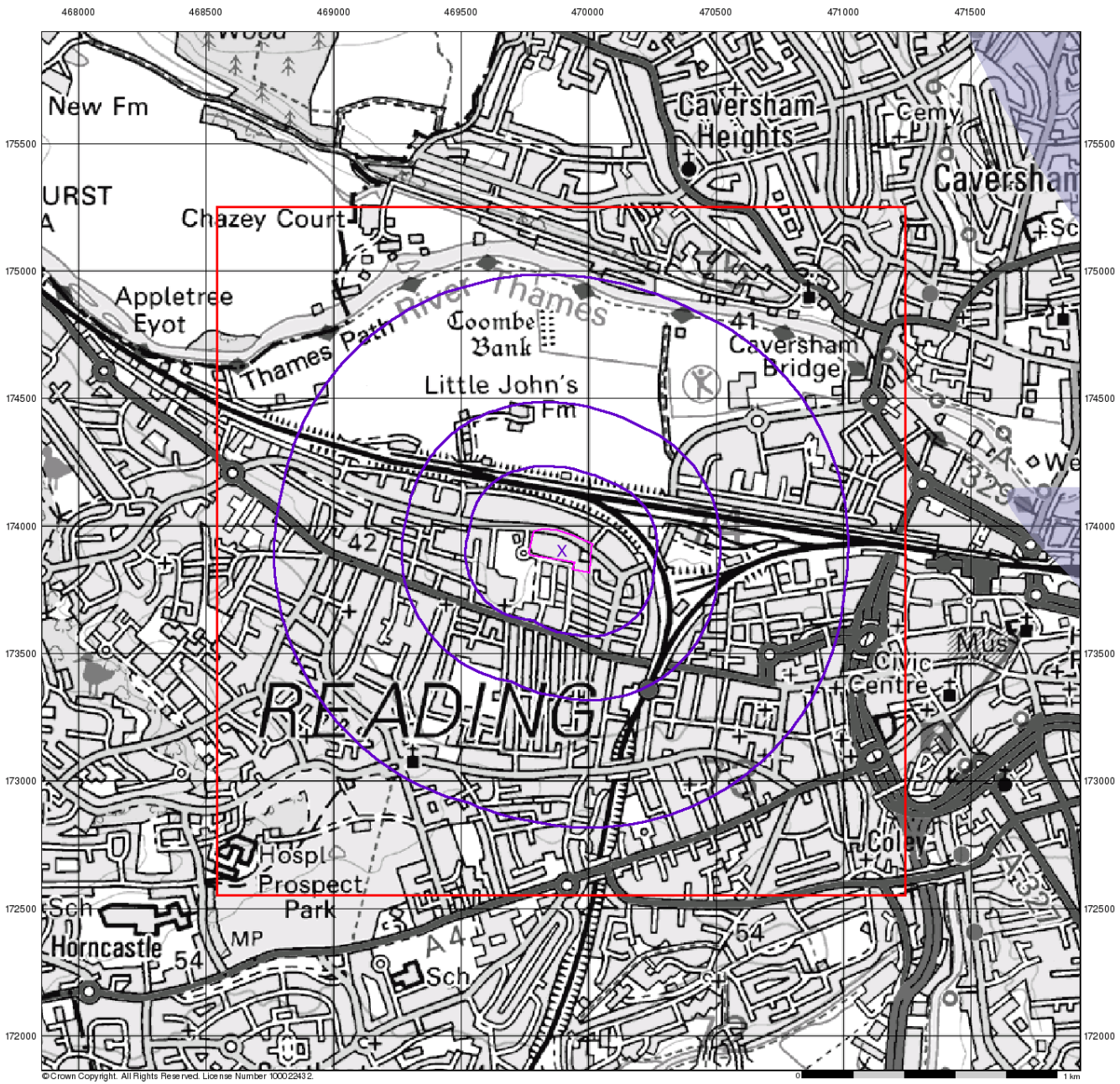
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Customer Ref:	25520
National Grid Reference:	469900, 173900
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Site Area (Ha):	2.65
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Source Protection Zones

General

Specified Site | Specified Buffer(s) | Bearing Reference Point

Slice | Map ID

Agency and Hydrological

Source Protection Zone I

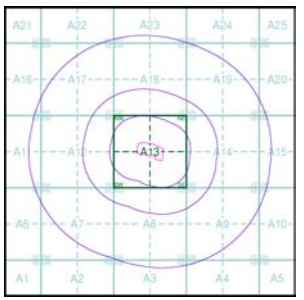
Source Protection Zone II

Source Protection Zone III

Zone of Special Interest

Source Protection Zone Borehole

Site Sensitivity Context Map - Slice A



Order Details

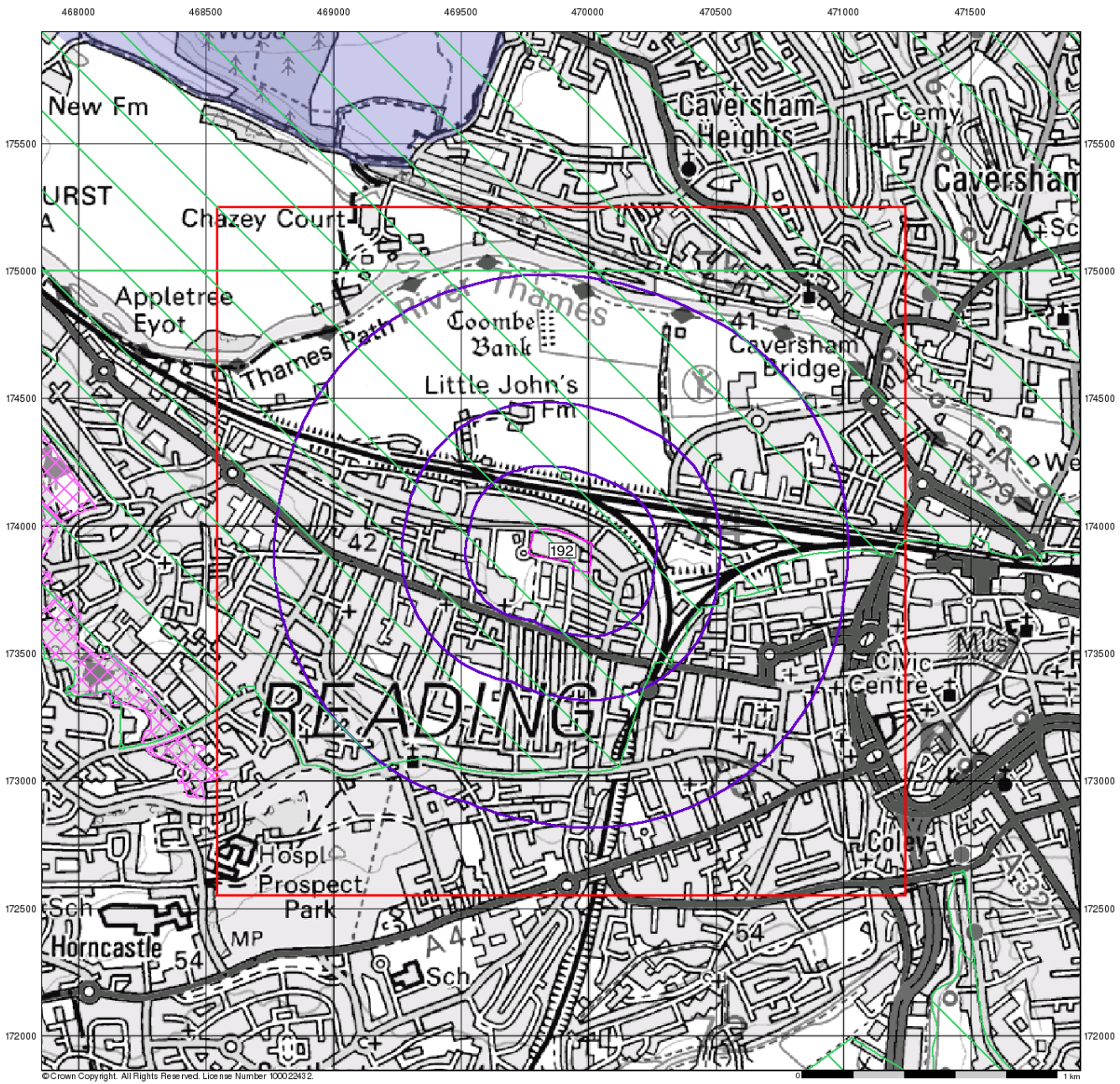
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Slice:	A
Site Area (Ha):	2.65
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Sensitive Land Uses

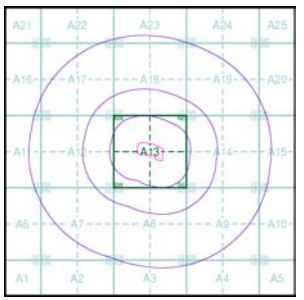
General

Specified Site | Specified Buffer(s) | Bearing Reference Point
Slice | Map ID

Sensitive Land Uses

- Area of Adopted Green Belt
- Area of Unadopted Green Belt
- Area of Outstanding Natural Beauty
- Environmentally Sensitive Area
- Forest Park
- Local Nature Reserve
- Marine Nature Reserve
- National Nature Reserve
- National Park
- Nitrate Sensitive Area
- Nitrate Vulnerable Zone
- Ramsar Site
- Site of Special Scientific Interest
- Special Area of Conservation
- Special Protection Area

Site Sensitivity Context Map - Slice A



Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
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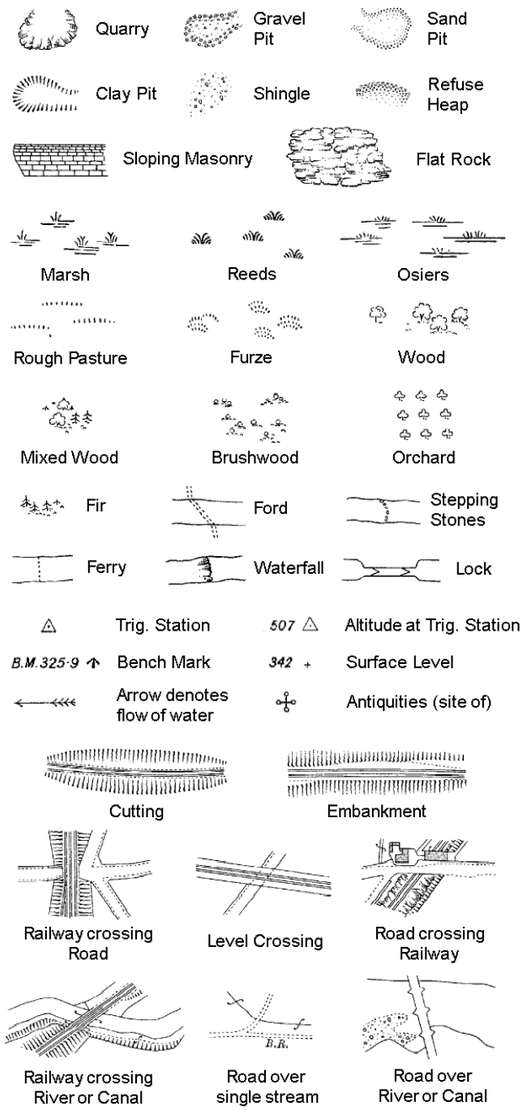
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Historical Mapping Legends

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



County Boundary (Geographical)

County & Civil Parish Boundary

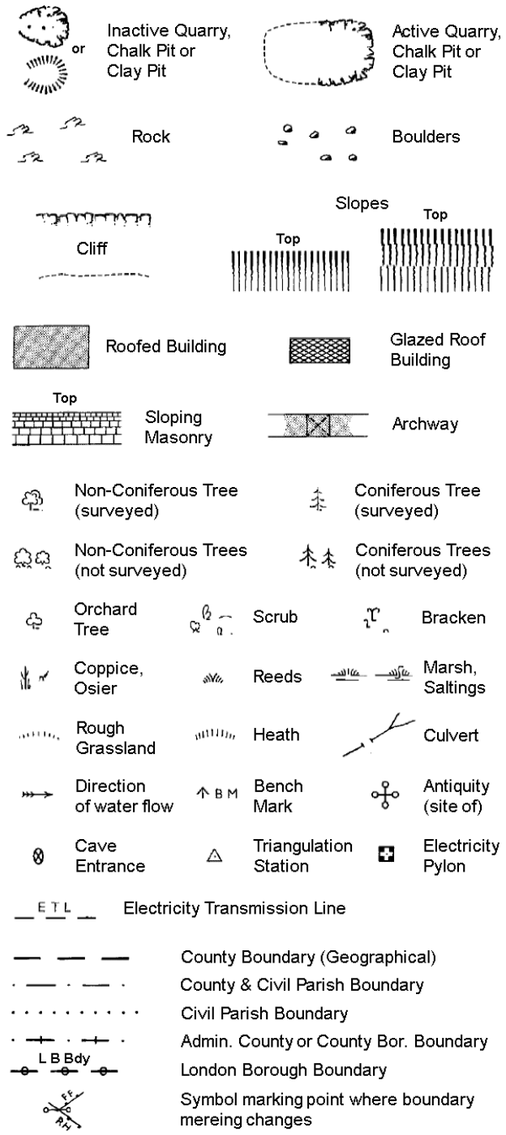
Administrative County & Civil Parish Boundary

Co. Boro. Bdy. County Borough Boundary (England)

Co. Burgh Bdy. County Burgh Boundary (Scotland)

B P B S	Boundary Post or Stone	P.C.B	Police Call Box
B.R.	Bridle Road	P	Pump
E.P	Electricity Pylon	S.P	Signal Post
F.B.	Foot Bridge	St.	Sluice
F.P.	Foot Path	Sp.	Spring
G.P	Guide Post or Board	T.C.B	Telephone Call Box
M.S	Mile Stone	Tr.	Trough
M.P M.R	Mooring Post or Ring	W	Well

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



County Boundary (Geographical)

County & Civil Parish Boundary

Civil Parish Boundary

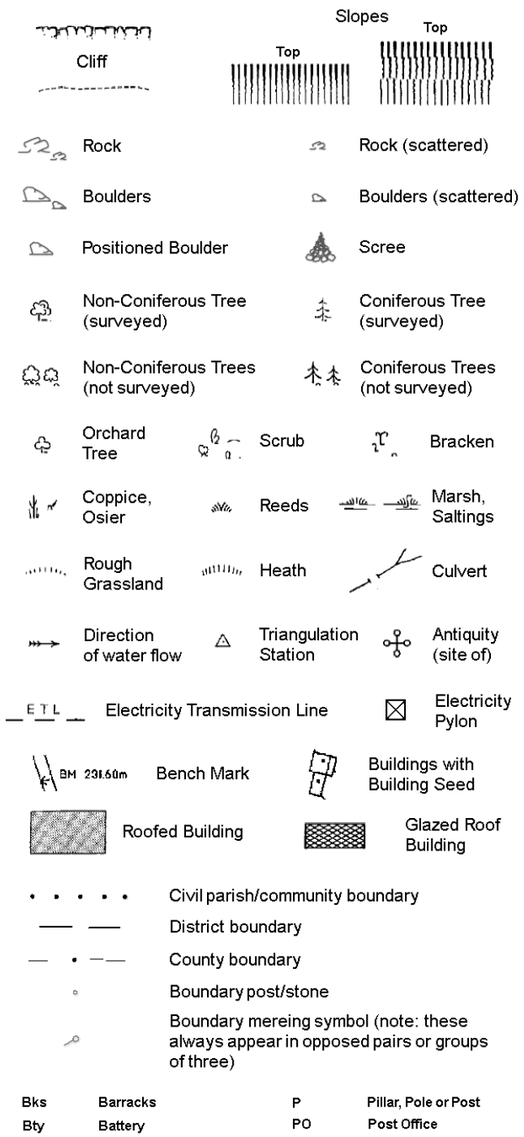
Admin. County or County Bor. Boundary

L B Bdy London Borough Boundary

Symbol marking point where boundary mereing changes

BH	Beer House	P	Pillar, Pole or Post
BP, BS	Boundary Post or Stone	PO	Post Office
Cn, C	Capstan, Crane	PC	Public Convenience
Chy	Chimney	PH	Public House
D Fn	Drinking Fountain	Pp	Pump
El P	Electricity Pillar or Post	SB, S Br	Signal Box or Bridge
FAP	Fire Alarm Pillar	SP, SL	Signal Post or Light
FB	Foot Bridge	Spr	Spring
GP	Guide Post	Tk	Tank or Track
H	Hydrant or Hydraulic	TCB	Telephone Call Box
LC	Level Crossing	TCP	Telephone Call Post
MH	Manhole	Tr	Trough
MP	Mile Post or Mooring Post	Wr Pt, Wr T	Water Point, Water Tap
MS	Mile Stone	W	Well
NTL	Normal Tidal Limit	Wd Pp	Wind Pump

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



Civil parish/community boundary

District boundary

County boundary

Boundary post/stone

Boundary mereing symbol (note: these always appear in opposed pairs or groups of three)

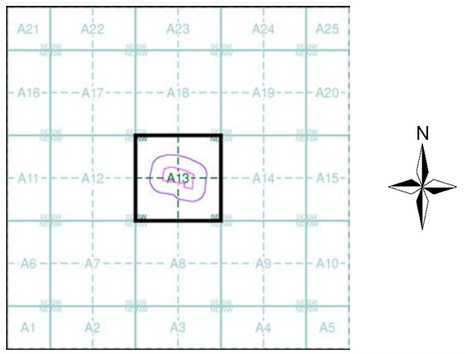
Bks	Barracks	P	Pillar, Pole or Post
Bty	Battery	PO	Post Office
Cemy	Cemetery	PC	Public Convenience
Chy	Chimney	Pp	Pump
Cis	Cistern	Ppg Sta	Pumping Station
Dismtd Rly	Dismantled Railway	PW	Place of Worship
El Gen Sta	Electricity Generating Station	Sewage Ppg Sta	Sewage Pumping Station
El P	Electricity Pole, Pillar	SB, S Br	Signal Box or Bridge
El Sub Sta	Electricity Sub Station	SP, SL	Signal Post or Light
FB	Filter Bed	Spr	Spring
Fn / D Fn	Fountain / Drinking Ftn.	Tk	Tank or Track
Gas Gov	Gas Valve Compound	Tr	Trough
GVC	Gas Governer	Wd Pp	Wind Pump
GP	Guide Post	Wr Pt, Wr T	Water Point, Water Tap
MH	Manhole	Wks	Works (building or area)
MP, MS	Mile Post or Mile Stone	W	Well

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Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Berkshire	1:2,500	1878 - 1881	2
Oxfordshire	1:2,500	1899	3
Berkshire	1:2,500	1899	4
Berkshire	1:2,500	1911 - 1913	5
Berkshire	1:2,500	1932 - 1936	6
Ordnance Survey Plan	1:1,250	1959	7
Ordnance Survey Plan	1:2,500	1961 - 1962	8
Ordnance Survey Plan	1:1,250	1969 - 1976	9
Ordnance Survey Plan	1:2,500	1969	10
Ordnance Survey Plan	1:1,250	1973	11
Supply of Unpublished Survey Information	1:1,250	1974	12
Additional SIMs	1:1,250	1988 - 1990	13
Large-Scale National Grid Data	1:1,250	1993	14
Large-Scale National Grid Data	1:1,250	1996	15

Historical Map - Segment A13



Order Details

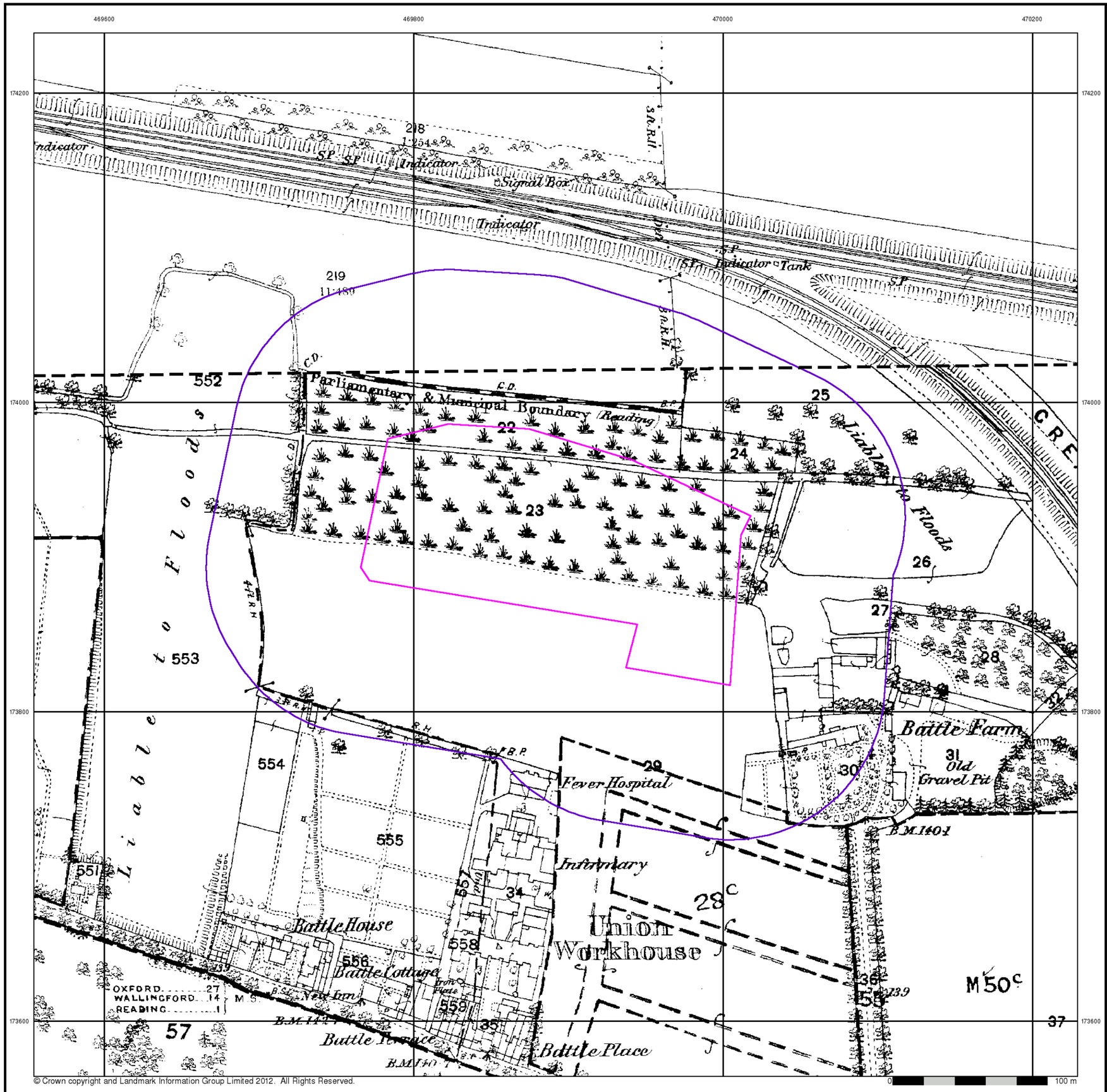
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Slice:	A
Site Area (Ha):	2.65
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Berkshire

Published 1878 - 1881

Source map scale - 1:2,500

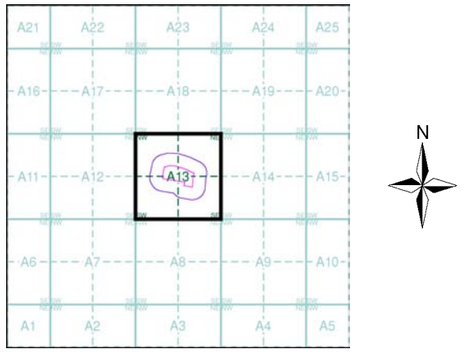
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

Map Name(s) and Date(s)

029_14
1878
1:2,500

037_02
1881
1:2,500

Historical Map - Segment A13



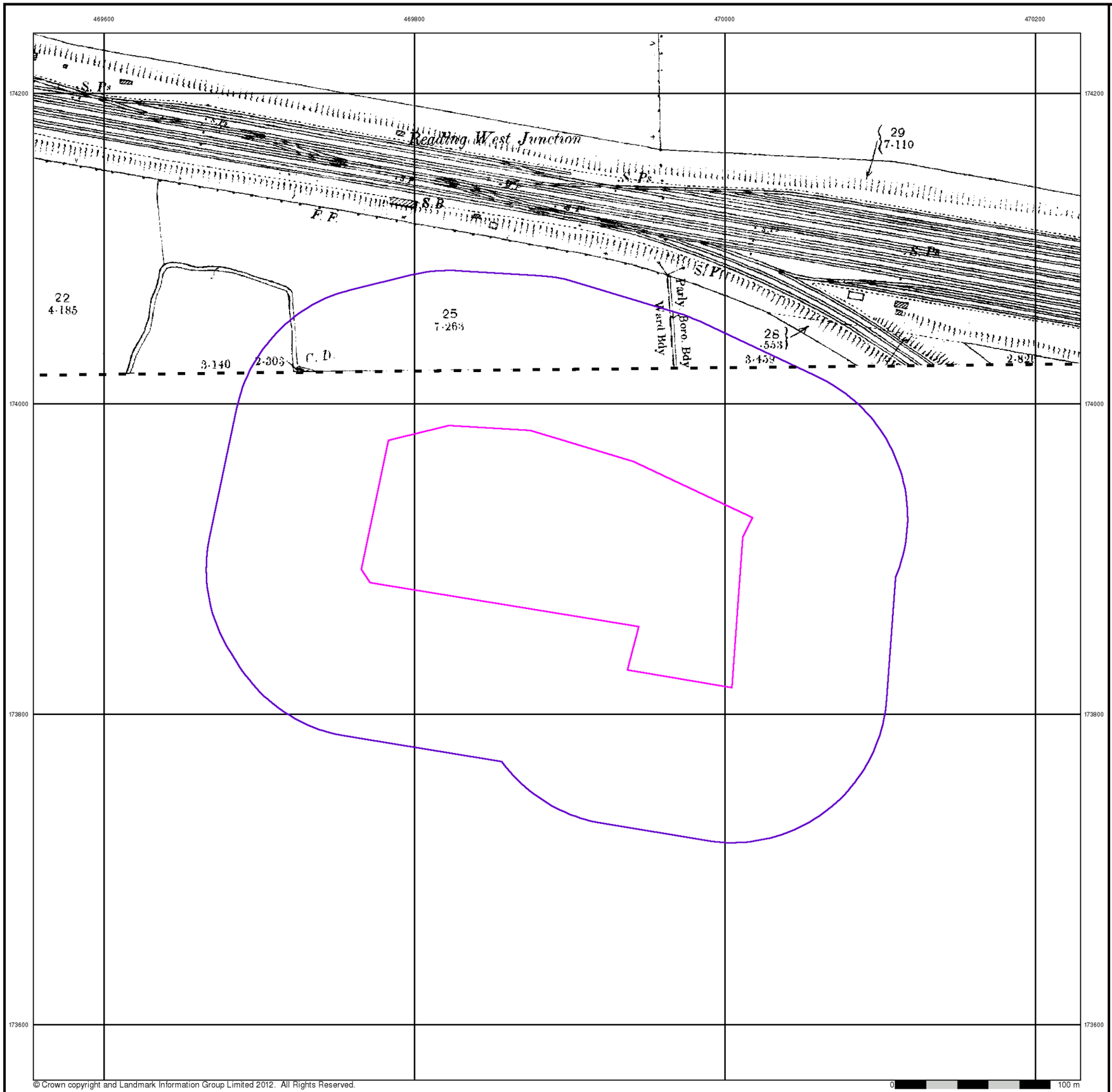
Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
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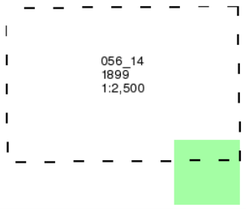
Oxfordshire

Published 1899

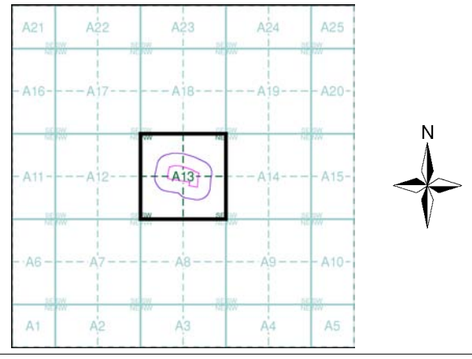
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



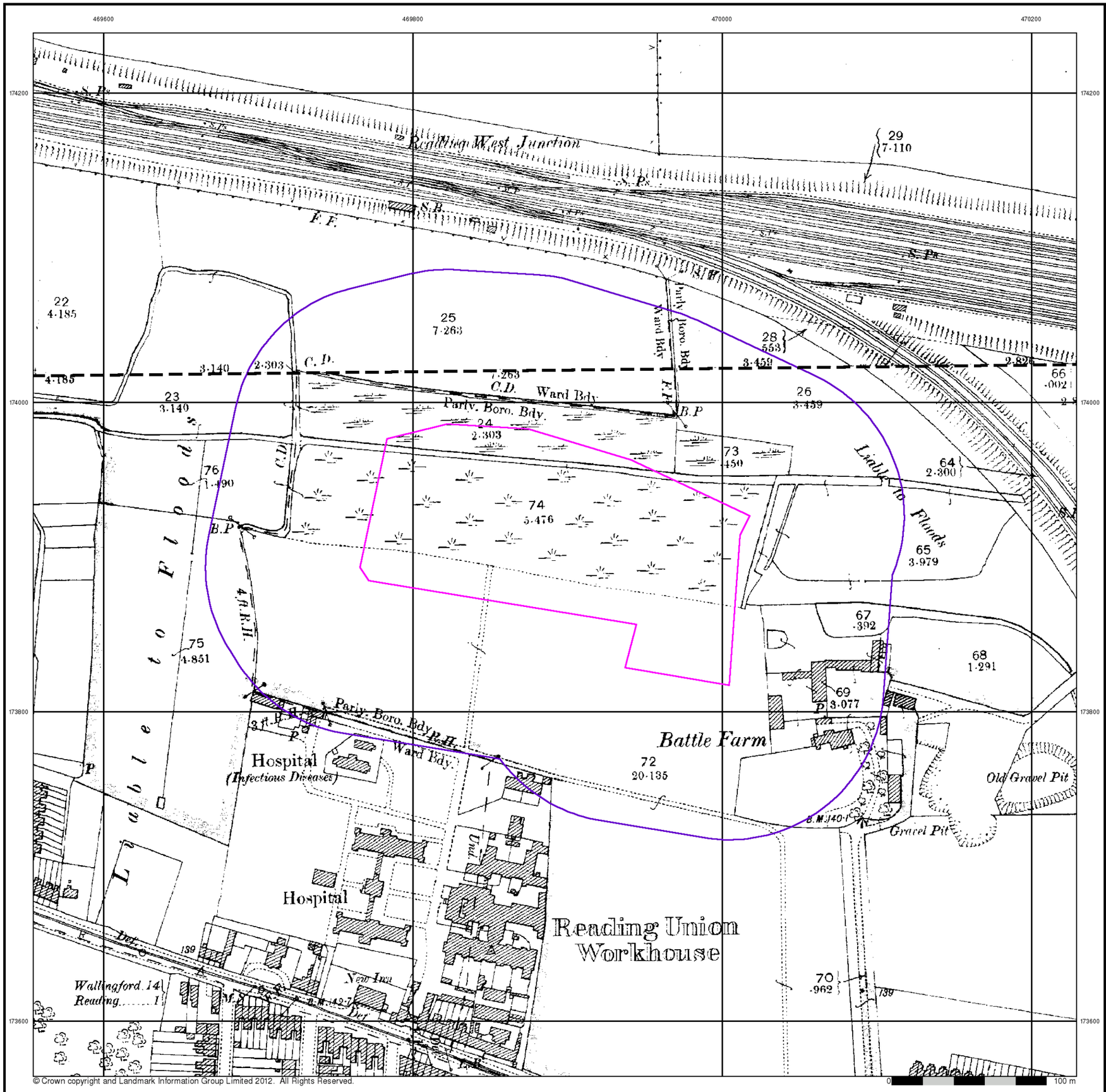
Order Details

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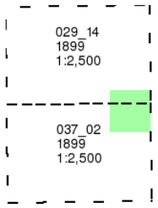
Berkshire

Published 1899

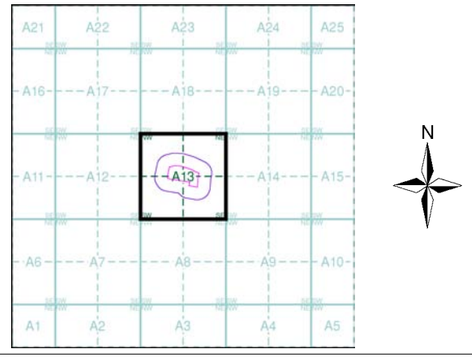
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



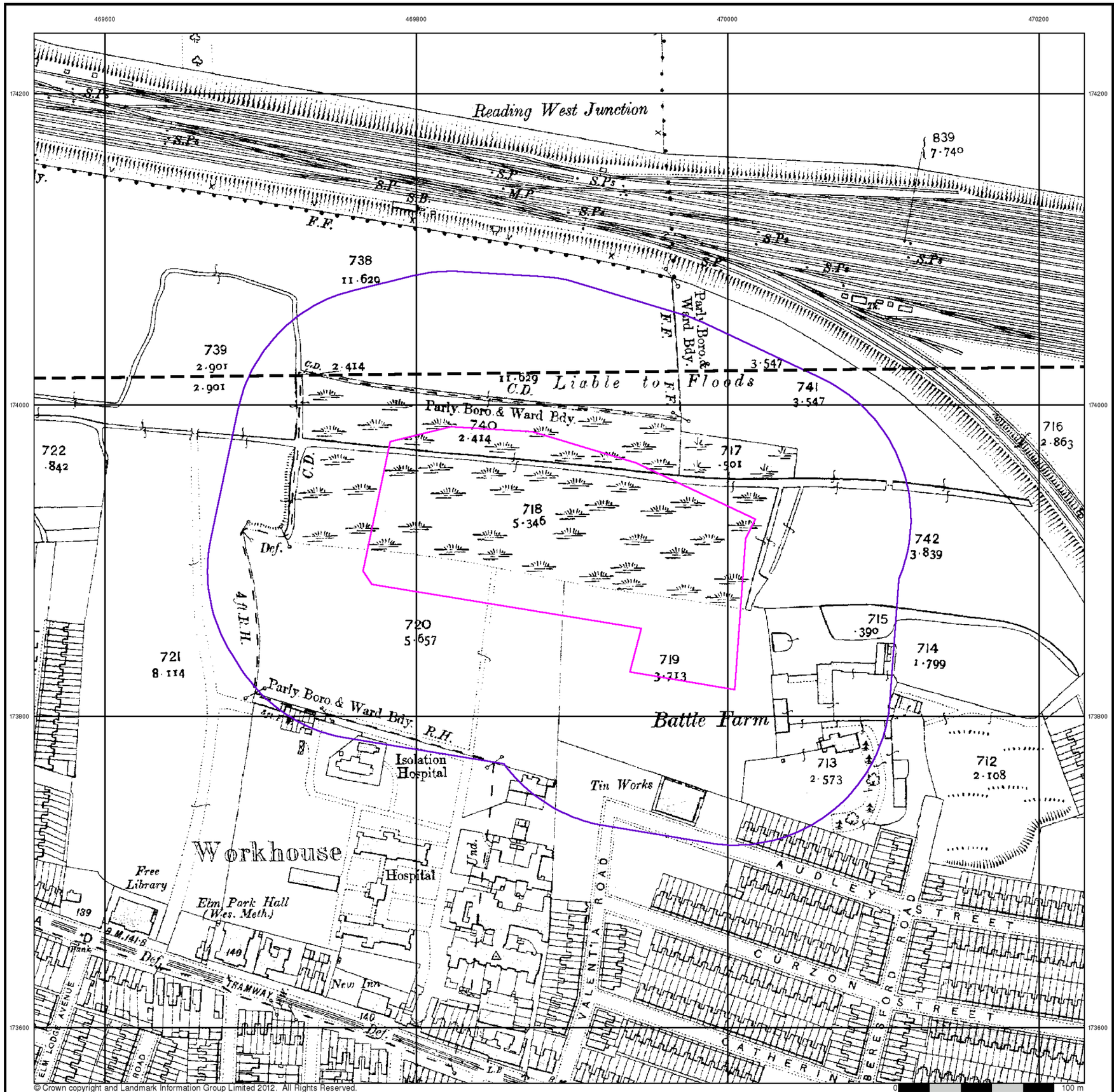
Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	100

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

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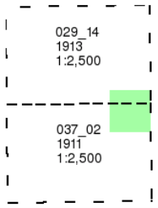
Berkshire

Published 1911 - 1913

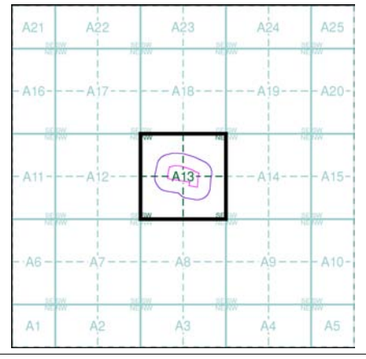
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



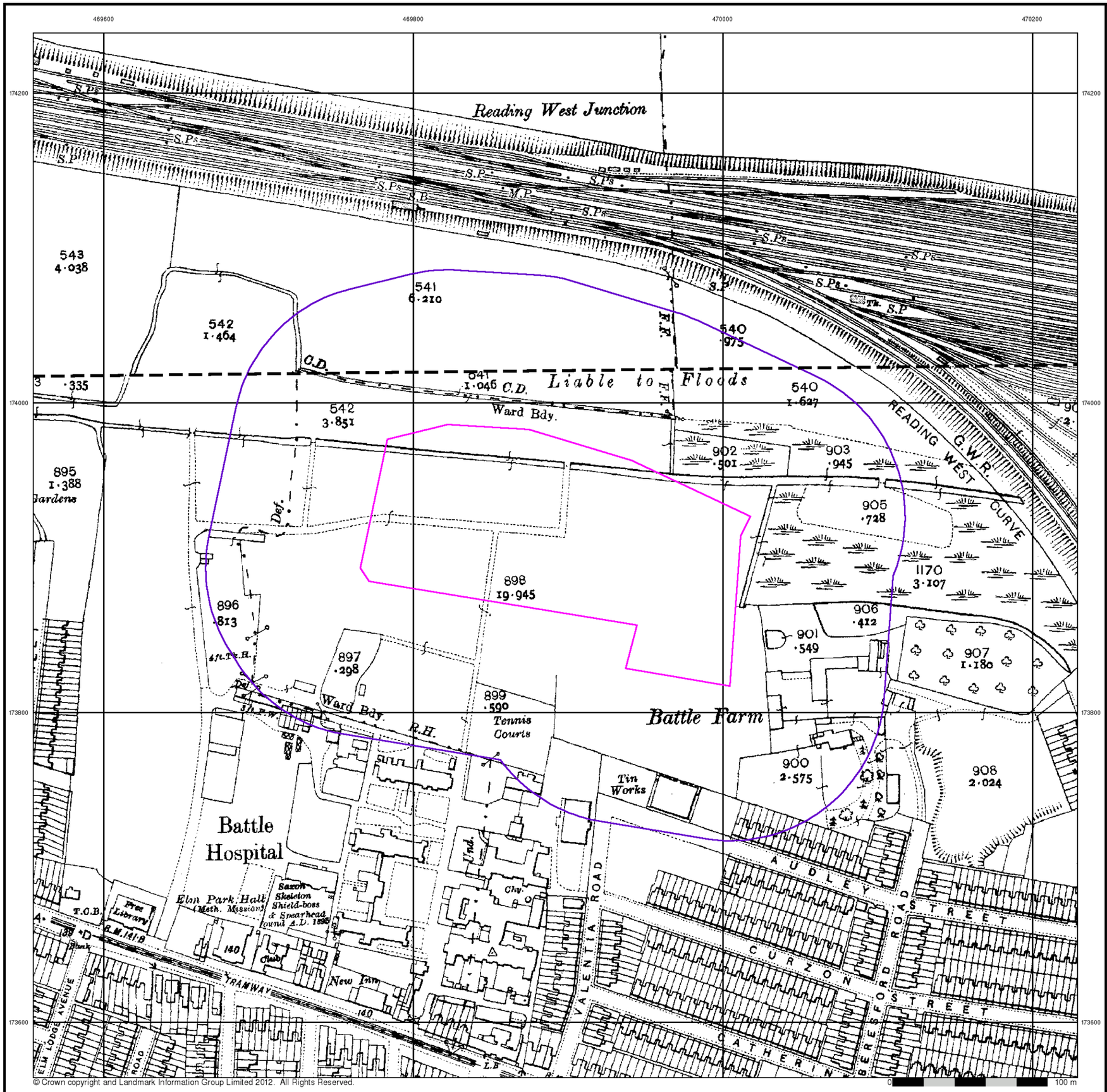
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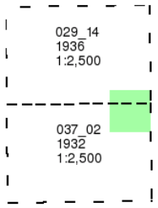
Berkshire

Published 1932 - 1936

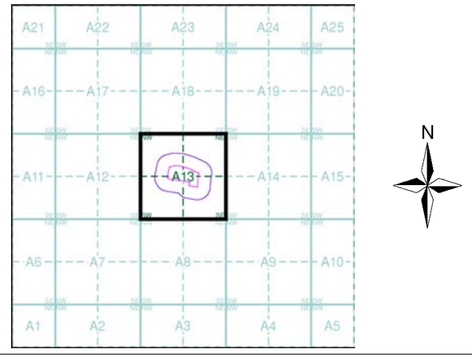
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



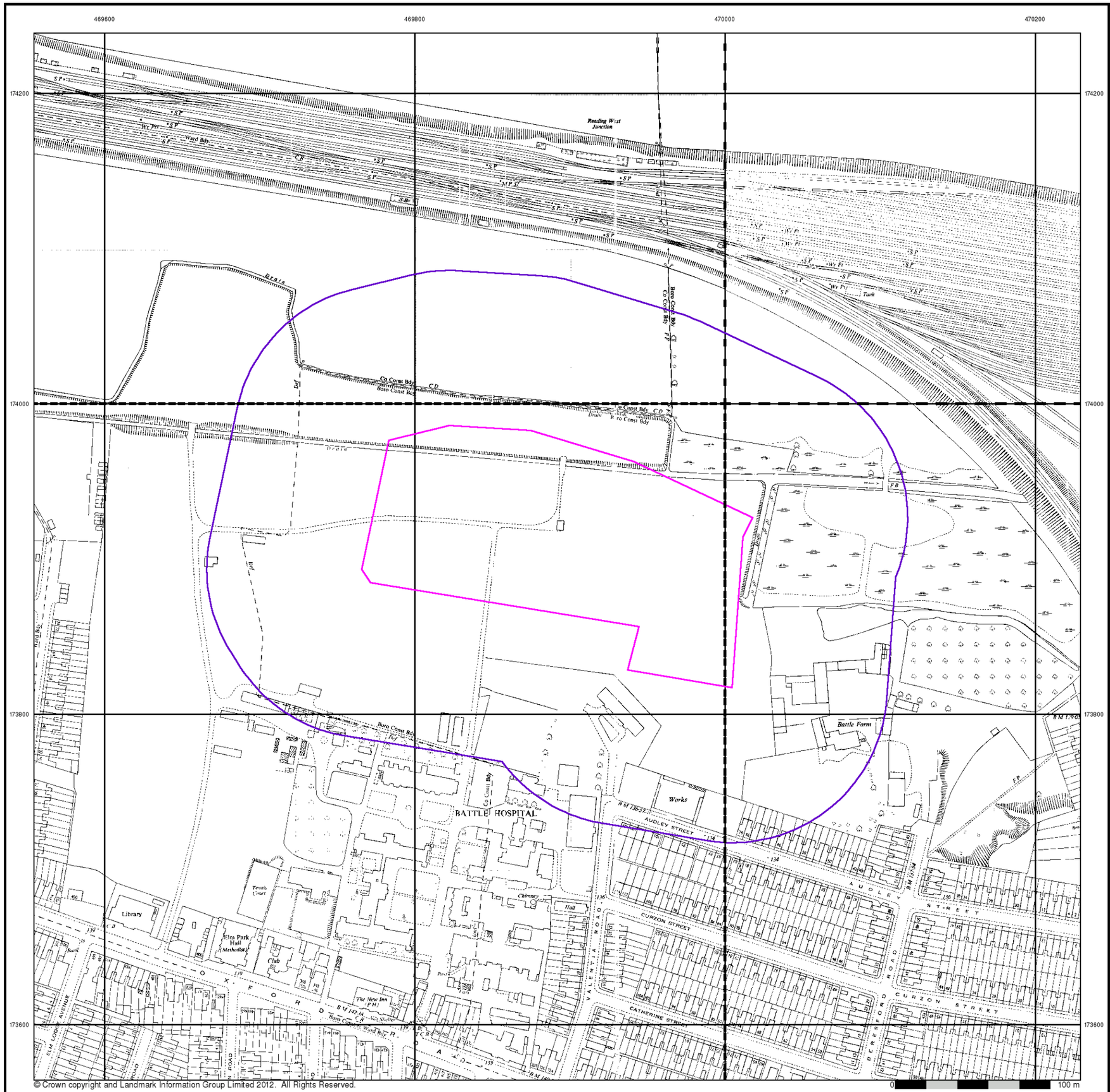
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Ordnance Survey Plan

Published 1959

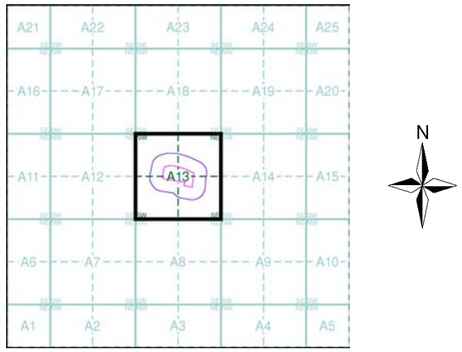
Source map scale - 1:1,250

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

Map Name(s) and Date(s)

SU6974SE 1959 1:1,250
SU7074SW 1959 1:1,250
SU6973NE 1959 1:1,250
SU7073NW 1959 1:1,250

Historical Map - Segment A13



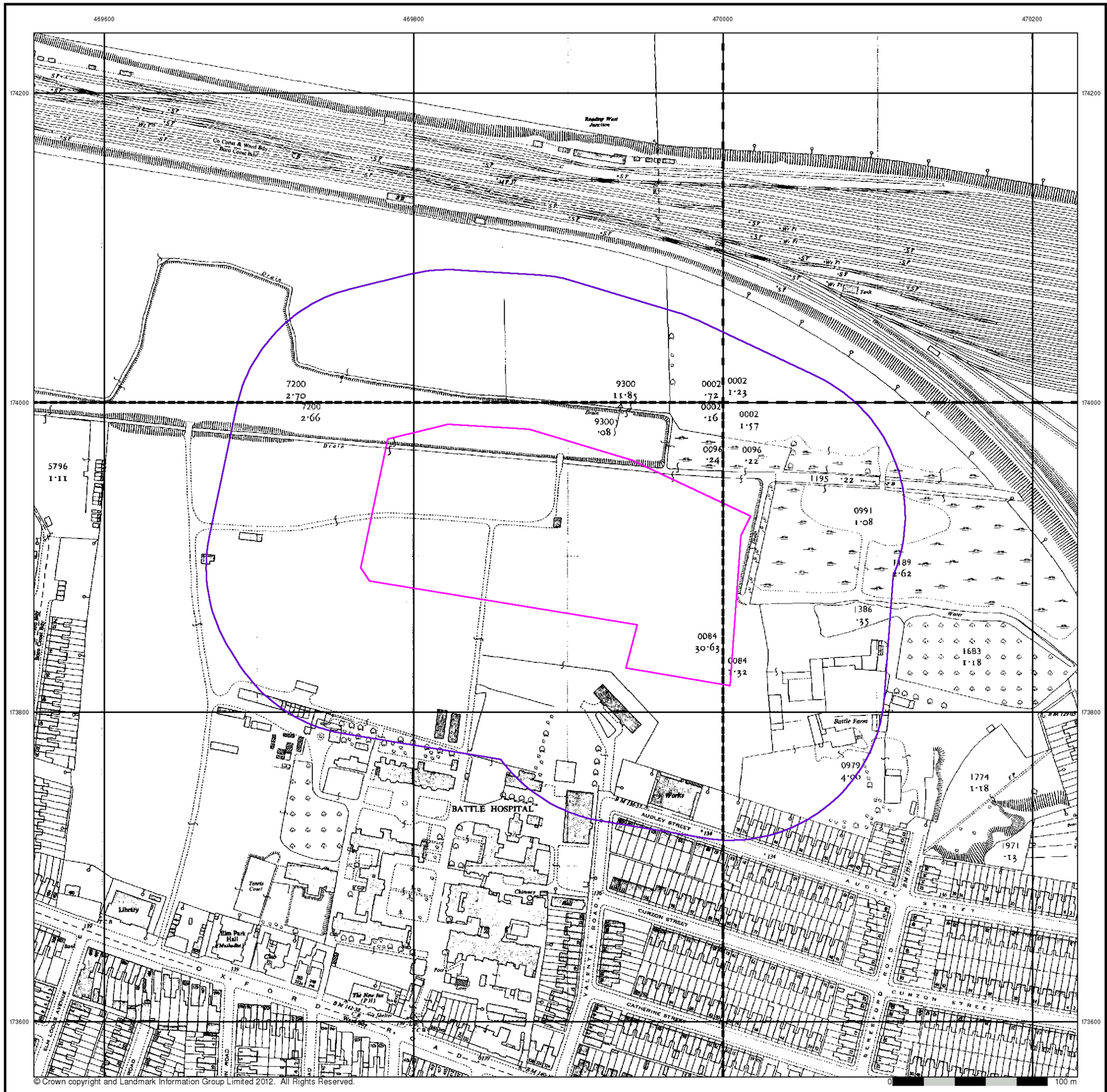
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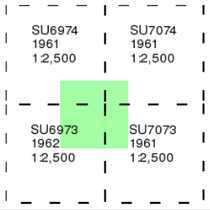
Ordnance Survey Plan

Published 1961 - 1962

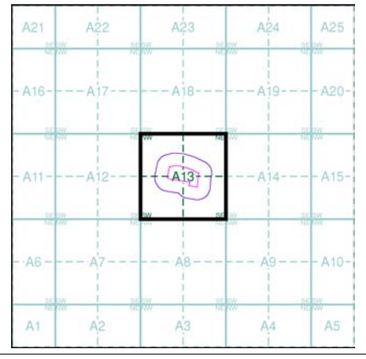
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13



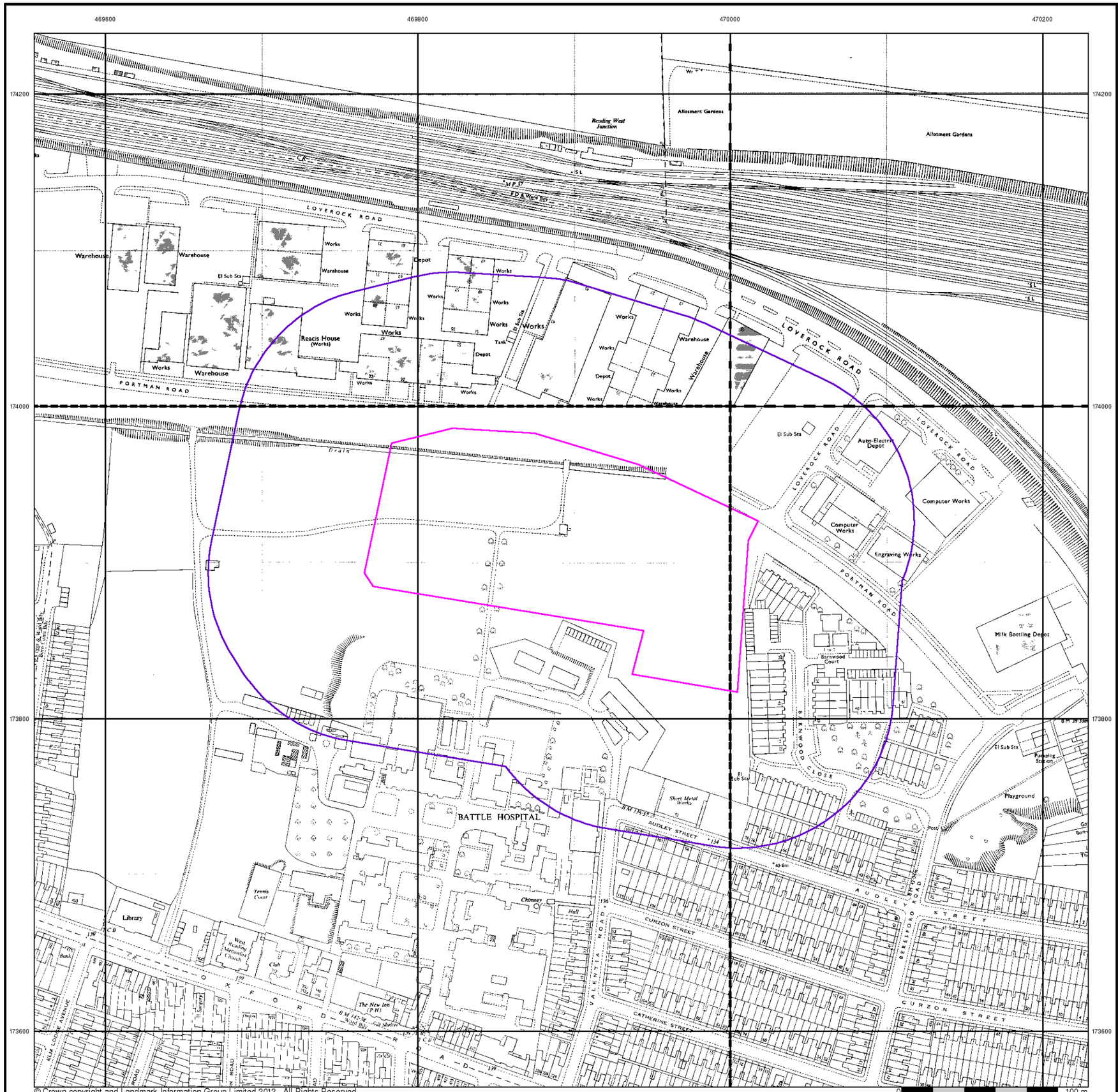
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Ordnance Survey Plan

Published 1969 - 1976

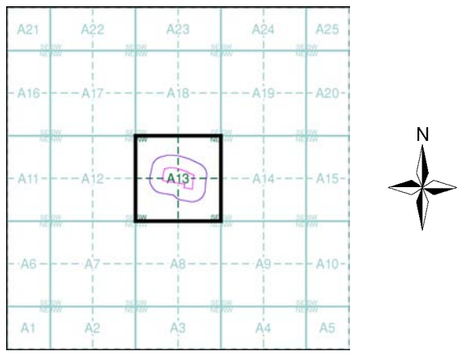
Source map scale - 1:1,250

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

Map Name(s) and Date(s)

SU6974SE 1976 1:1,250	SU7074SW 1972 1:1,250
SU6973NE 1969 1:1,250	SU7073NW 1971 1:1,250

Historical Map - Segment A13



Order Details

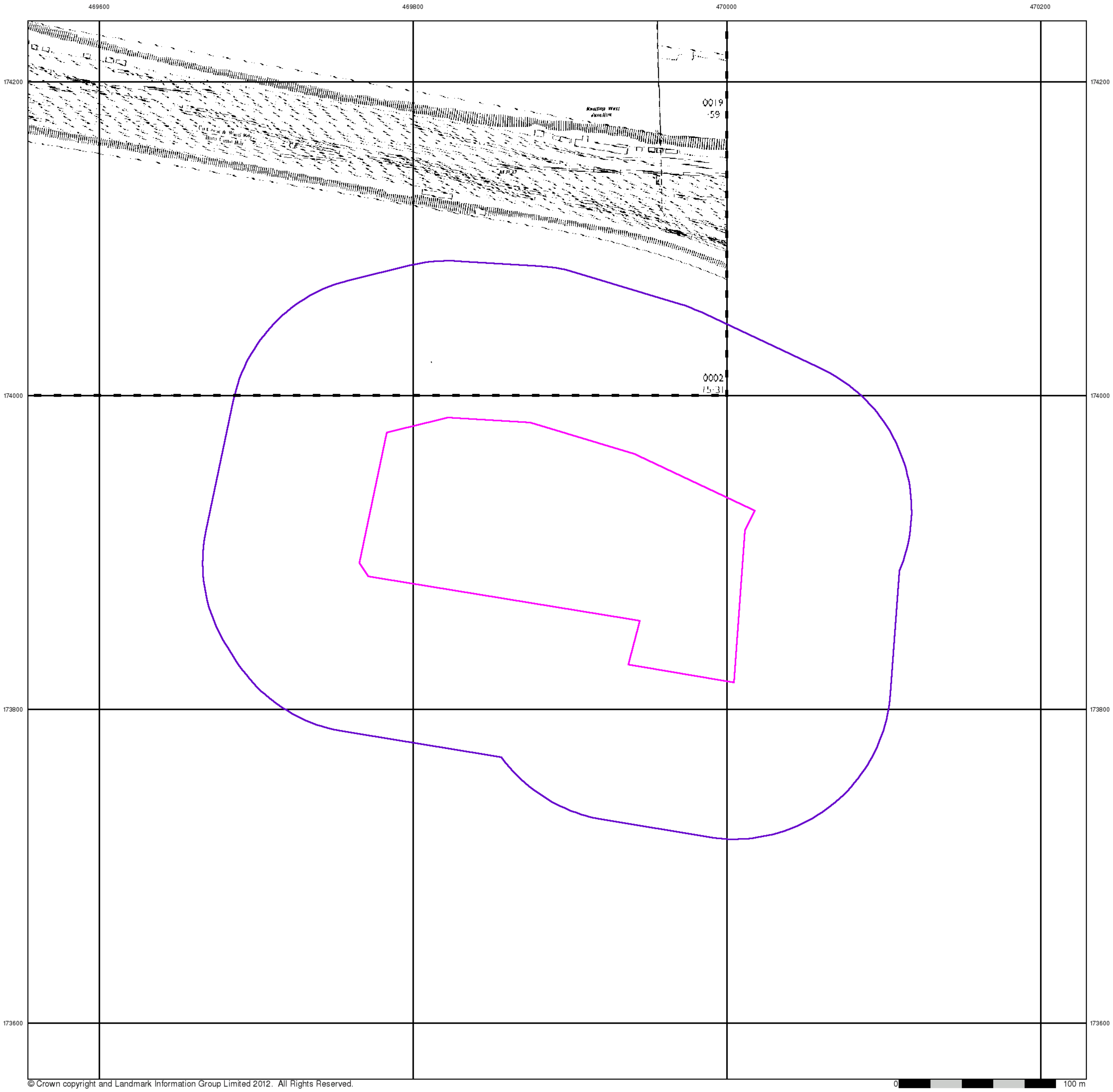
Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
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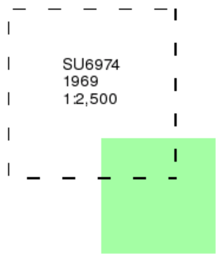
Ordnance Survey Plan

Published 1969

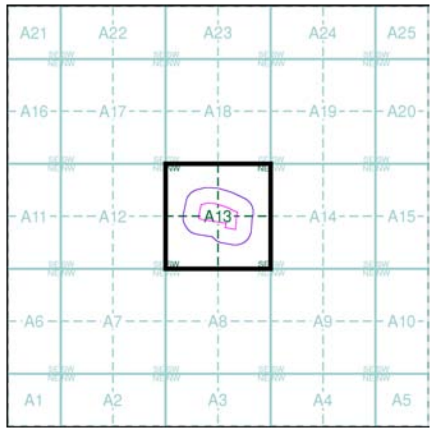
Source map scale - 1:2,500

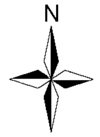
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1896 it covered the whole of what were considered to be the cultivated parts of Great Britain.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

Map Name(s) and Date(s)



Historical Map - Segment A13





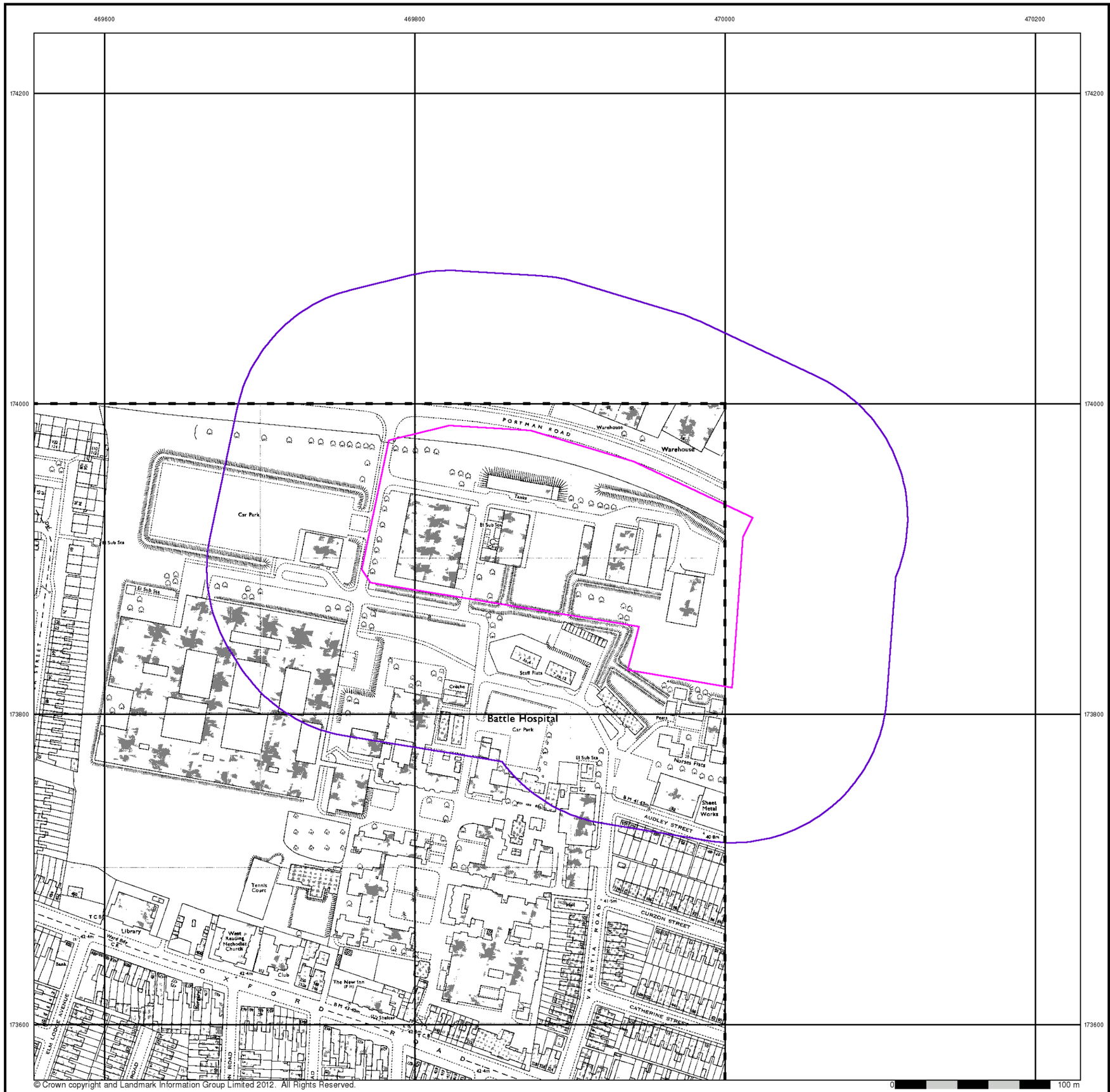
Order Details

Order Number: 40527939_1_1
Customer Ref: 25520
National Grid Reference: 469900, 173900
Slice: A
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Site Details

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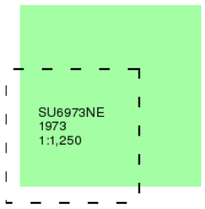
Ordnance Survey Plan

Published 1973

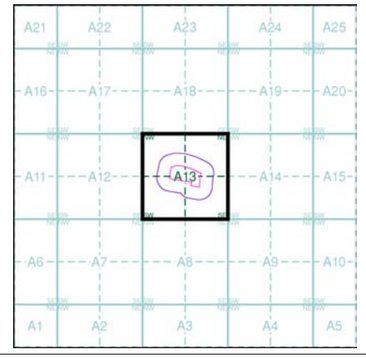
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	40527939_1_1
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Slice:	A
Site Area (Ha):	2.65
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Site Details

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Supply of Unpublished Survey Information

Published 1974

Source map scale - 1:1,250

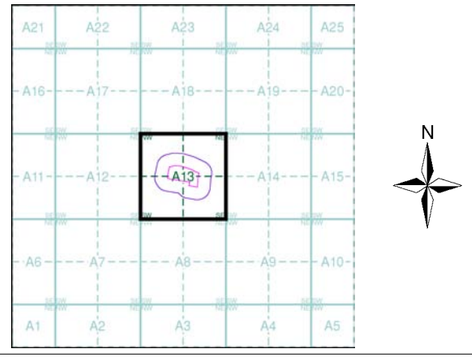
SUSI maps (Supply of Unpublished Survey Information) were produced between 1972 and 1977, mainly for internal use at Ordnance Survey. These were more of a `work-in-progress' plan as they showed updates of individual areas on a map. These maps were unpublished, and they do not represent a single moment in time. They were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)

SU6974SE
1974
1:1,250

SU6973NE
1974
1:1,250

Historical Map - Segment A13



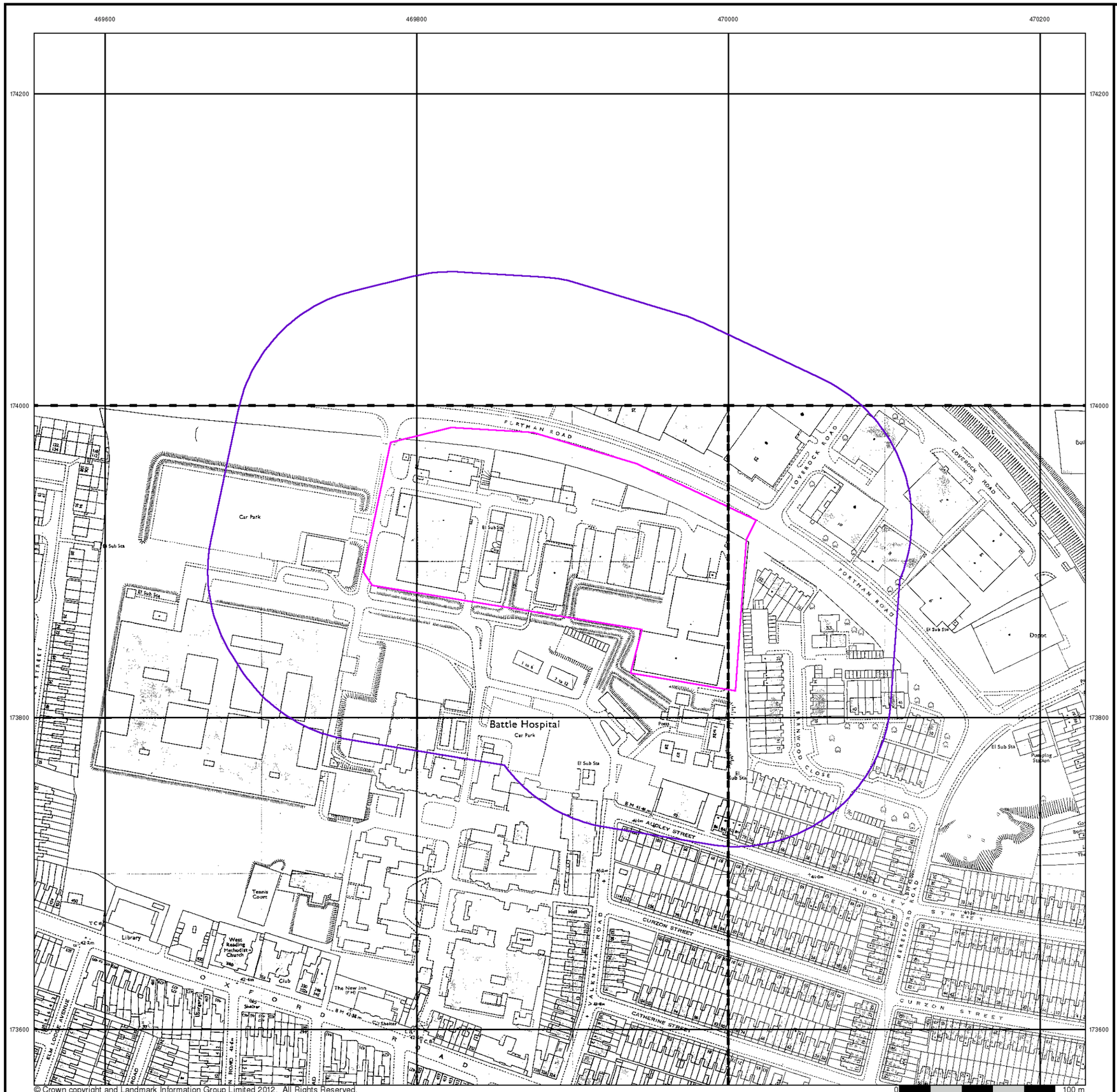
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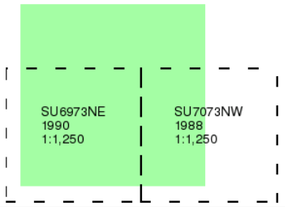
Additional SIMs

Published 1988 - 1990

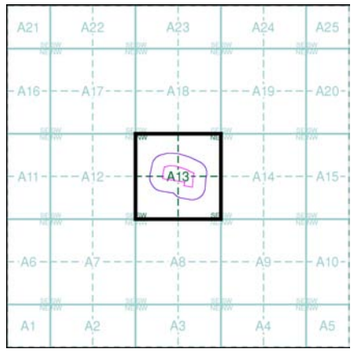
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



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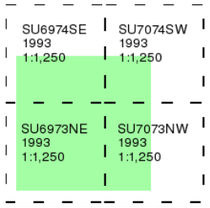
Large-Scale National Grid Data

Published 1993

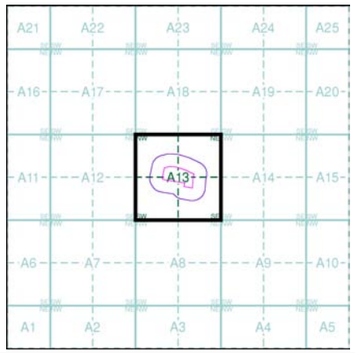
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



Historical Map - Segment A13



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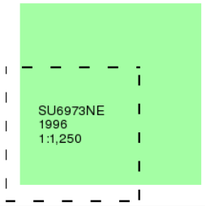
Large-Scale National Grid Data

Published 1996

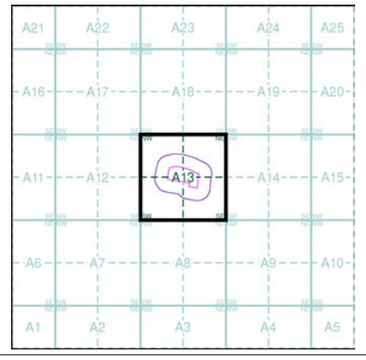
Source map scale - 1:1,250

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

Map Name(s) and Date(s)



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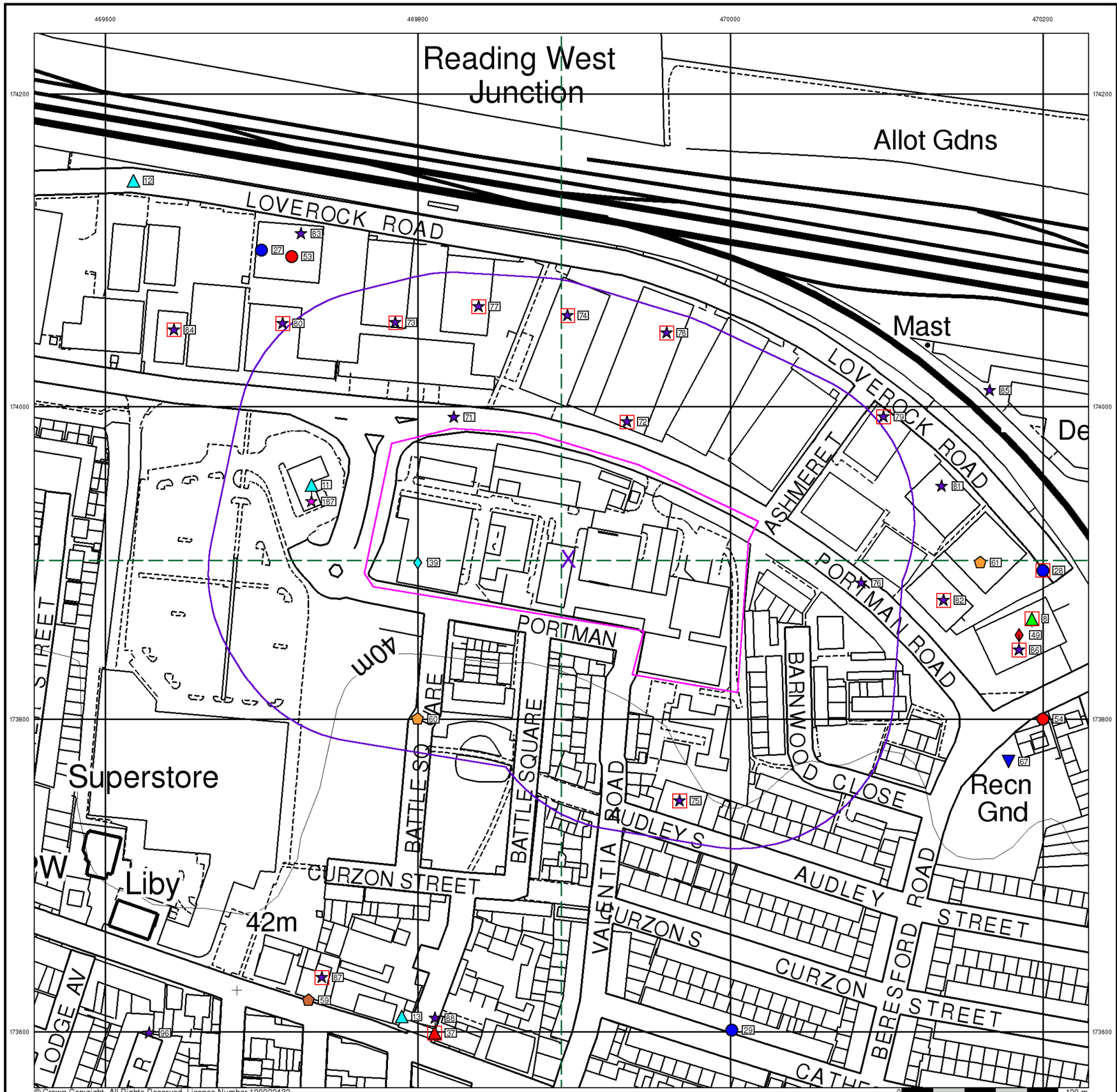
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General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID

Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Geological

- BGS Recorded Mineral Site

Industrial Land Use

- Contemporary Trade Directory Entry
- Fuel Station Entry

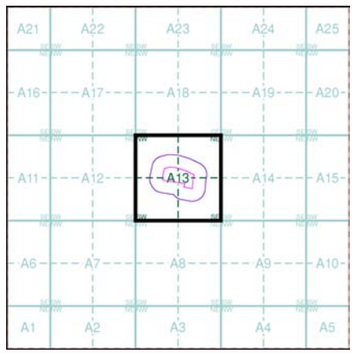
Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

Site Sensitivity Map - Segment A13



Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
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Historical Mapping Legends

Ordnance Survey County Series 1:10,560

Gravel Pit
Sand Pit
Other Pits
Quarry
Shingle
Orchard
Osiers
Reeds
Marsh
Mixed Wood
Deciduous
Brushwood
Fir
Furze
Rough Pasture
Arrow denotes flow of water
Trigonometrical Station
Site of Antiquities
Bench Mark
Pump, Guide Post, Signal Post
Well, Spring, Boundary Post
·285 Surface Level
Sketched Contour
Instrumental Contour
Main Roads
Fenced
Un-Fenced
Minor Roads
Fenced
Un-Fenced
Sunken Road
Raised Road
Road over Railway
Railway over River
Railway over Road
Level Crossing
Road over River or Canal
Road over Stream
Road over Stream
County Boundary (Geographical)
County & Civil Parish Boundary
Administrative County & Civil Parish Boundary
Co. Boro. Bdy. County Borough Boundary (England)
Co. Burgh Bdy. County Burgh Boundary (Scotland)
R.D. Bdy. Rural District Boundary
Civil Parish Boundary

Ordnance Survey Plan 1:10,000

Chalk Pit, Clay Pit or Quarry
Gravel Pit
Sand Pit
Disused Pit or Quarry
Refuse or Slag Heap
Lake, Loch or Pond
Dunes
Boulders
Coniferous Trees
Non-Coniferous Trees
Orchard
Scrub
Coppice
Bracken
Heath
Rough Grassland
Marsh
Reeds
Saltings
Building
Direction of Flow of Water
Shingle
Sand
Glasshouse
Pylon
Pylon
Electricity Transmission Line
Sloping Masonry
Cutting
Embankment
Standard Gauge Multiple Track
Road Under
Road Over
Level Crossing
Foot Bridge
Standard Gauge Single Track
Siding, Tramway or Mineral Line
Narrow Gauge
Geographical County
Administrative County, County Borough or County of City
Municipal Borough, Urban or Rural District, Burgh or District Council
Borough, Burgh or County Constituency
Shown only when not coincident with other boundaries
Civil Parish
Shown alternately when coincidence of boundaries occurs

BP, BS	Boundary Post or Stone	Pol Sta	Police Station
Ch	Church	PO	Post Office
CH	Club House	PC	Public Convenience
F E Sta	Fire Engine Station	PH	Public House
FB	Foot Bridge	SB	Signal Box
Fn	Fountain	Spr	Spring
GP	Guide Post	TCB	Telephone Call Box
MP	Mile Post	TCP	Telephone Call Post
MS	Mile Stone	W	Well

1:10,000 Raster Mapping

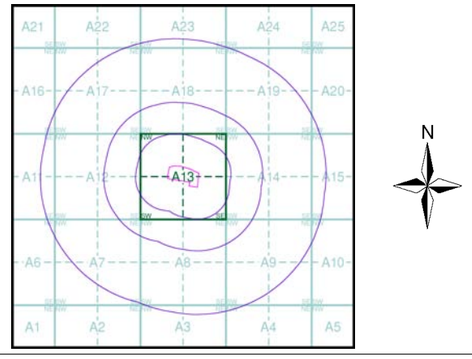
Gravel Pit
Refuse tip or slag heap
Rock
Rock (scattered)
Boulders
Boulders (scattered)
Shingle
Mud
Sand
Sand Pit
Slopes
Top of cliff
General detail
Underground detail
Overhead detail
Narrow gauge railway
Multi-track railway
Single track railway
County boundary (England only)
Civil, parish or community boundary
District, Unitary, Metropolitan, London Borough boundary
Constituency boundary
Area of wooded vegetation
Non-coniferous trees
Non-coniferous trees (scattered)
Coniferous trees
Coniferous trees (scattered)
Positioned tree
Orchard
Coppice or Osiers
Rough Grassland
Heath
Scrub
Marsh, Salt Marsh or Reeds
Water feature
Flow arrows
MHW(S) Mean high water (springs)
MLW(S) Mean low water (springs)
Telephone line (where shown)
Electricity transmission line (with poles)
BM 123.45 m Bench mark (where shown)
Triangulation station
Point feature (e.g. Guide Post or Mile Stone)
Pylon, flare stack or lighting tower
Site of (antiquity)
Glasshouse
General Building
Important Building

RSK

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Oxfordshire	1:10,560	1882	3
Berkshire	1:10,560	1883	4
Berkshire	1:10,560	1900	5
Oxfordshire	1:10,560	1900	6
Berkshire	1:10,560	1901	7
Oxfordshire	1:10,560	1901	8
Berkshire	1:10,560	1913 - 1914	9
Berkshire	1:10,560	1932 - 1933	10
Berkshire	1:10,560	1938	11
Berkshire	1:10,560	1938	12
Historical Aerial Photography	1:10,560	1947 - 1949	13
Ordnance Survey Plan	1:10,000	1960 - 1962	14
Ordnance Survey Plan	1:10,000	1968	15
Ordnance Survey Plan	1:10,000	1970 - 1976	16
Ordnance Survey Plan	1:10,000	1979	17
Ordnance Survey Plan	1:10,000	1983 - 1984	18
Ordnance Survey Plan	1:10,000	1990 - 1992	19
Reading	1:10,000	1990	20
Ordnance Survey Plan	1:10,000	1995	21
10K Raster Mapping	1:10,000	2006	22
10K Raster Mapping	1:10,000	2012	23

Historical Map - Slice A



Order Details

Order Number: 40527939_1_1
Customer Ref: 25520
National Grid Reference: 469900, 173900
Slice: A
Site Area (Ha): 2.65
Search Buffer (m): 1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

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Russian Military Mapping Legends

1:5,000 and 1:10,000 mapping

a. Not drawn to scale b. Drawn to scale

- Government and Administrative Buildings
- Military and Industrial Buildings
- Military and Communication Areas
- Subway Entrance
- Fireproof Building
- Prominent Fireproof Building
- Non-fireproof Building
- Non-fireproof Building (non-dwelling)
- Factory, mill, and flour mill, with chimneys
- Factory, mill, and flour mill, without chimneys
- Power Station, drawn to scale
- Hydroelectric Power Station
- Radio Station, drawn to scale
- Telephone Station, drawn to scale
- Abandoned Open-pit Mine or Quarry
- Open-pit Salt Mine
- Pit
- Oil Deposit or Well
- Oil Seepage
- Tailings Pile
- Fuel Storage Tanks
- Natural Gas Tank
- Bench Mark
- Drill Hole
- Burial Mound
- Triangulation Point on Burial Mound
- Single-track Railroad
- Double-track Railroad and Station Building
- Coniferous Forest
- Deciduous Forest
- Mixed Forest
- Lawns
- Citrus Orchard
- Wet Ground
- Scattered Vegetation

243,8 — Values for prominent elevations

186.0 — Numbers for spot elevations, depth soundings, contour lines, etc.

0,2 — Velocity of the current, width of river bed, depth of river

Fractional terms: length and capacity of bridges; depth of fords and condition of the river bottom; height of forest and the diameter of trees

Russian Alphabet (For reference and phonetic interpretation of map text)

А а (A)	З з (Z)	П п (P)	Ч ч (CH)
Б б (B)	И и (I)	Р р (R)	Ш ш (SH)
В в (V)	Й й (Y)	С с (S)	Щ щ (SHCH)
Г г (G)	К к (K)	Т т (T)	ъ (–)
Д д (D)	Л л (L)	У у (U)	ы (Y)
Е е (E)	М м (M)	Ф ф (F)	ь (')
Ё ё (YO)	Н н (N)	Х х (KH)	Э э (E)
Ж ж (ZH)	О о (O)	Ц ц (TS)	Ю ю (YU or IU)
			Я я (YA or IA)

1:25,000 mapping

a. Not drawn to scale b. Drawn to scale

- Government and Administrative Buildings
- Military and Industrial Buildings
- Military and Communication Areas
- Subway Entrance
- Partly Demolished Buildings
- Demolished Buildings
- Built-Up Area with Fireproof Buildings Predominant
- Built-Up Area with Non-Fireproof Buildings Predominant
- Individual Fireproof Building
- Prominent Industrial Building
- Individual Dwelling, Fireproof
- Ruins of an Individual Dwelling
- Factory or Mill Chimney
- Factory or Mill with Chimney
- Factory or Mill without Chimney
- Mine or Open Pit Mine
- Operating Shaft or Mine
- Non-Operating Shaft or Mine
- Salt Mine
- Tailings Pile
- Pit
- Stone Quarry
- Gas Pump or Service Station
- Fuel Storage or Natural Gas Tank
- Oil or Natural Gas Derrick
- Small Hydroelectric Power Station
- Power Station
- Transformer Station
- Cemetery
- Burial Mound (height in metres)
- Triangulation Point on Burial Mound
- Triangulation Point
- Bench Mark
- Bench Mark (monumented)
- Telegraph Office
- Telephone Station
- Radio Station
- Radio Tower
- Airfield or Seaplane Base
- Landing Strip
- Main Highway
- Highway under Construction
- Improved Dirt Road (former truck road)
- Double-track Railroad with First Class Station
- Dismantled Railroad
- Railroad Under Construction
- Shore Embankment
- River or Ditch with Embankment
- Direction and velocity of current
- Well
- Water Reservoir or Rain Water Pit
- Spring
- Isobath with value
- Heavy (Index) Contour Line
- Contour Line and Value
- Half Contour Line
- Spot Elevation Value
- Coniferous
- Deciduous
- Mixed
- Scrub

Key to Numbers on Mapping

SU67SE_Reading

No.	Description
6	Industrial Buildings (Use Unknown)
23	Military Barracks
39	Railway Station (Freight)

SU77SW_Reading

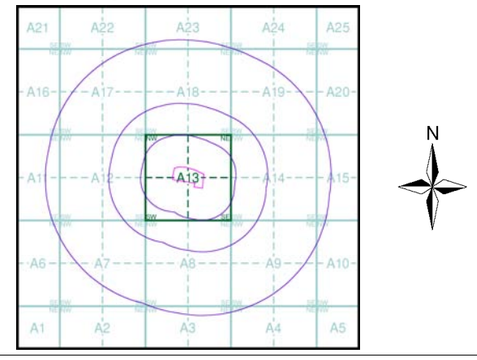
No.	Description
3	Factories (Including Machinery, Radio Electronics And Tubing)

RSK

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Oxfordshire	1:10,560	1882	3
Berkshire	1:10,560	1883	4
Berkshire	1:10,560	1900	5
Oxfordshire	1:10,560	1900	6
Berkshire	1:10,560	1901	7
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Ordnance Survey Plan	1:10,000	1983 - 1984	18
Ordnance Survey Plan	1:10,000	1990 - 1992	19
Reading	1:10,000	1990	20
Ordnance Survey Plan	1:10,000	1995	21
10K Raster Mapping	1:10,000	2006	22
10K Raster Mapping	1:10,000	2012	23

Russian Map - Slice A



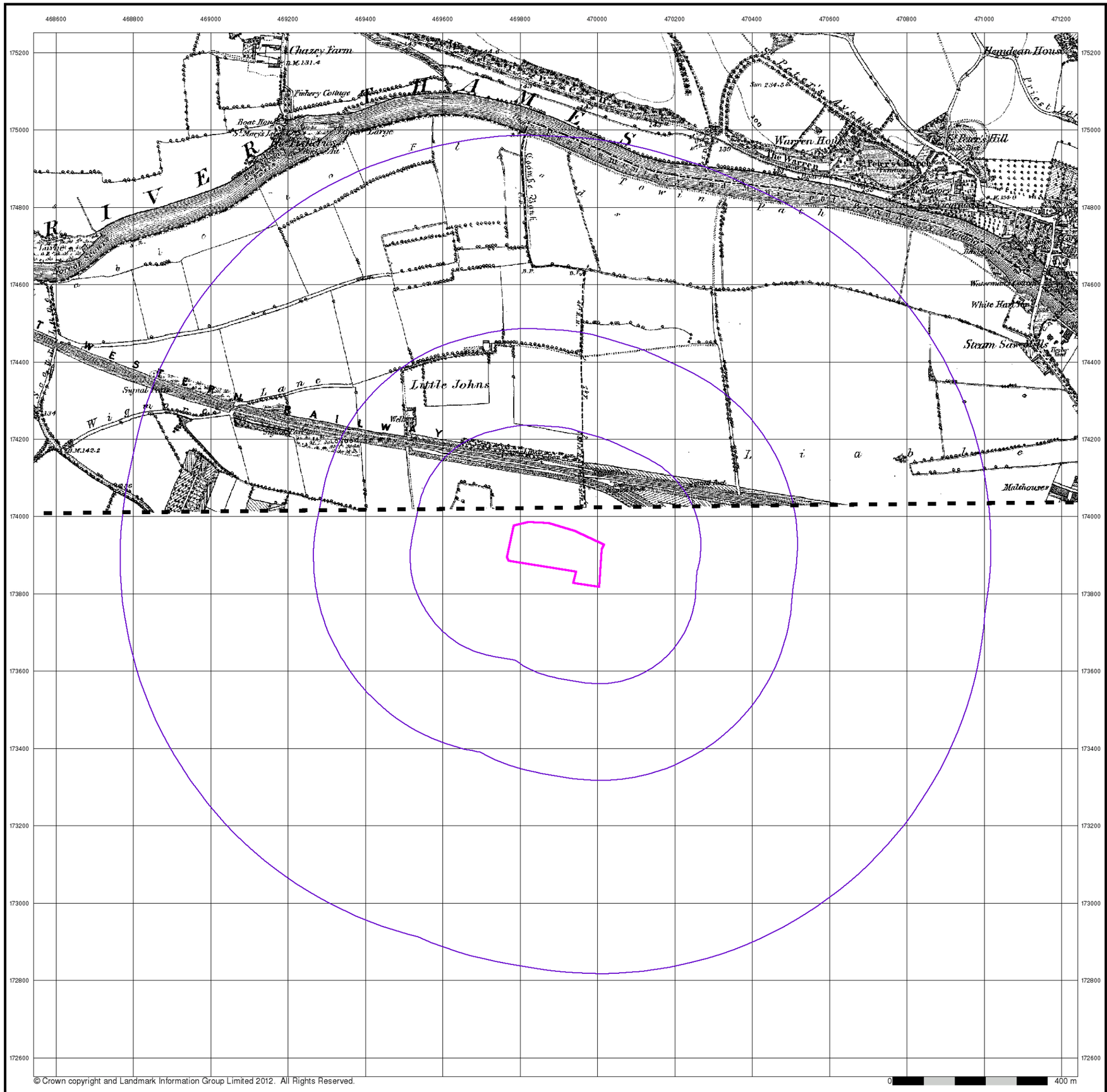
Order Details

Order Number: 40527939_1_1
Customer Ref: 25520
National Grid Reference: 469900, 173900
Slice: A
Site Area (Ha): 2.65
Search Buffer (m): 1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

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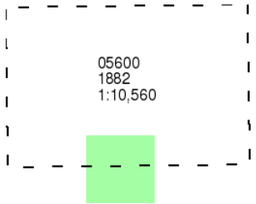
Oxfordshire

Published 1882

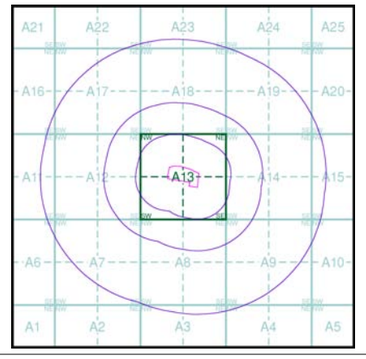
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

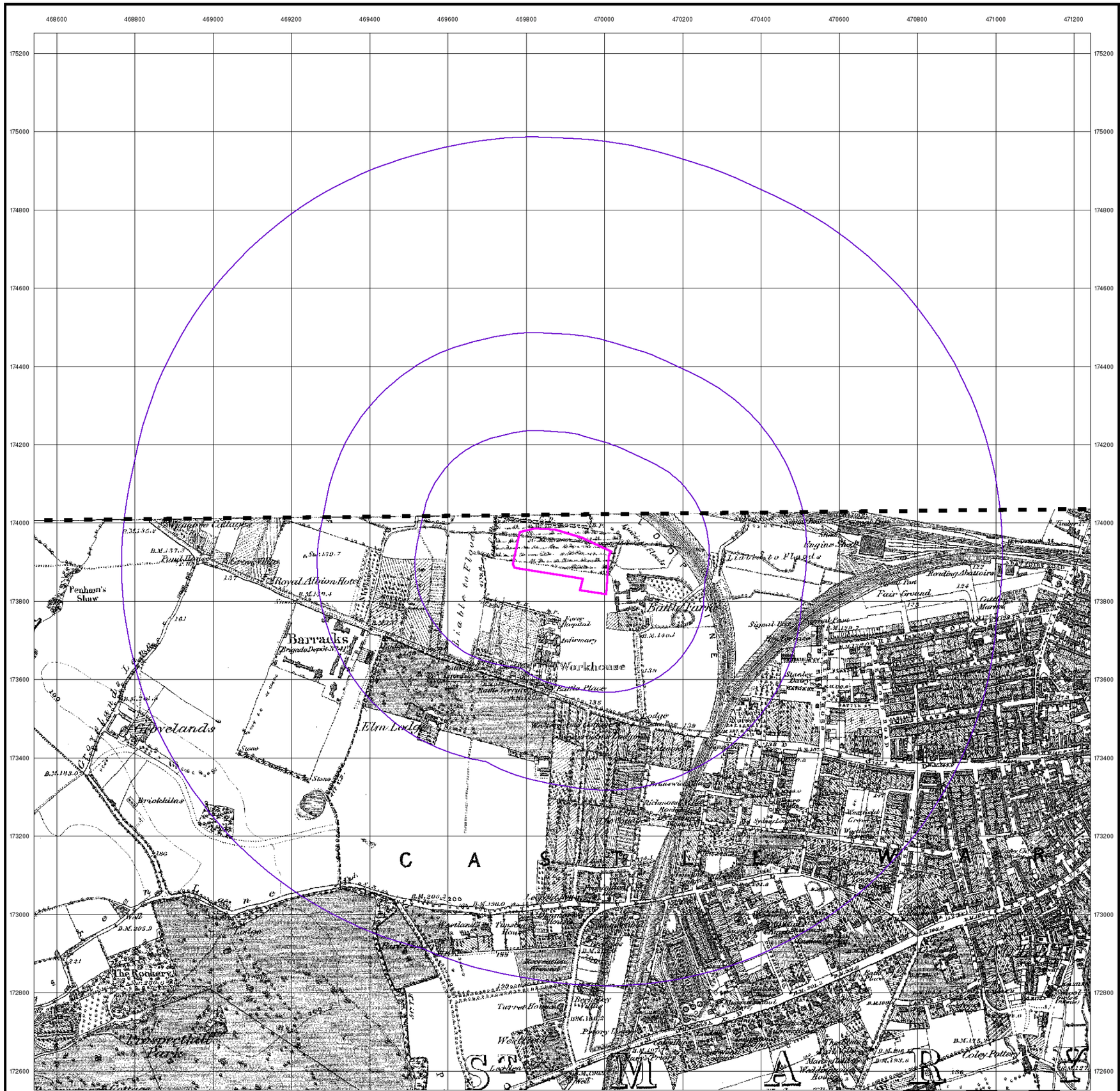
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National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
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Site Details

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RSK

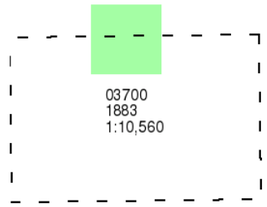
Berkshire

Published 1883

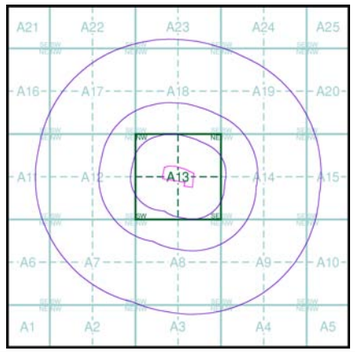
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



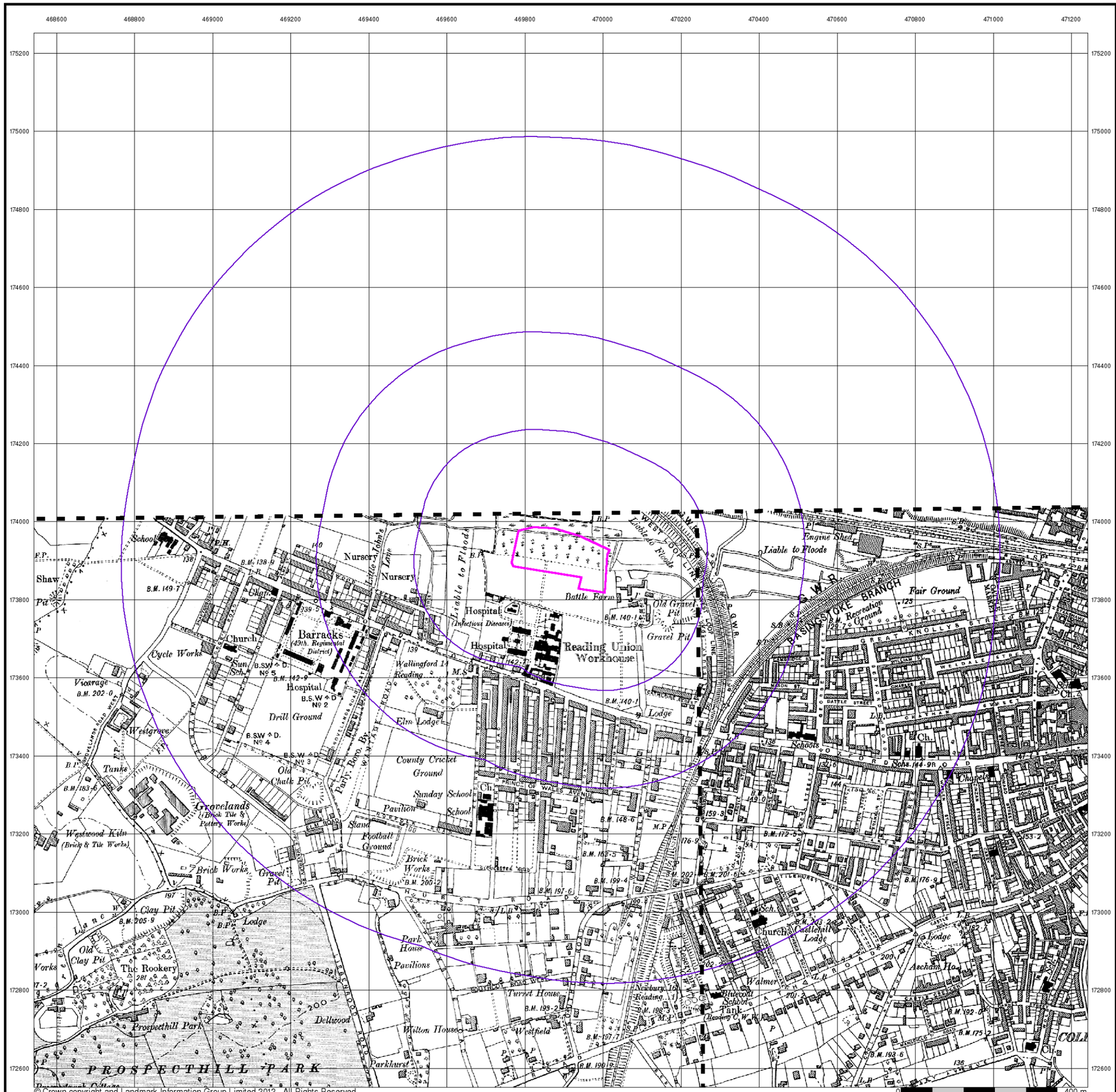
Order Details

Order Number:	40527939_1_1
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National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
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Site Details

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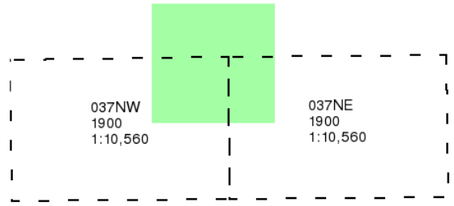
Berkshire

Published 1900

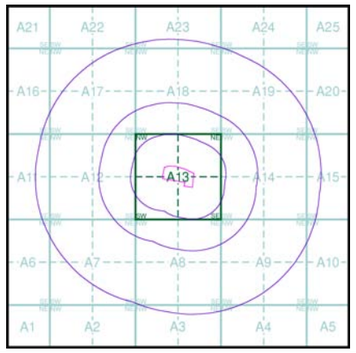
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

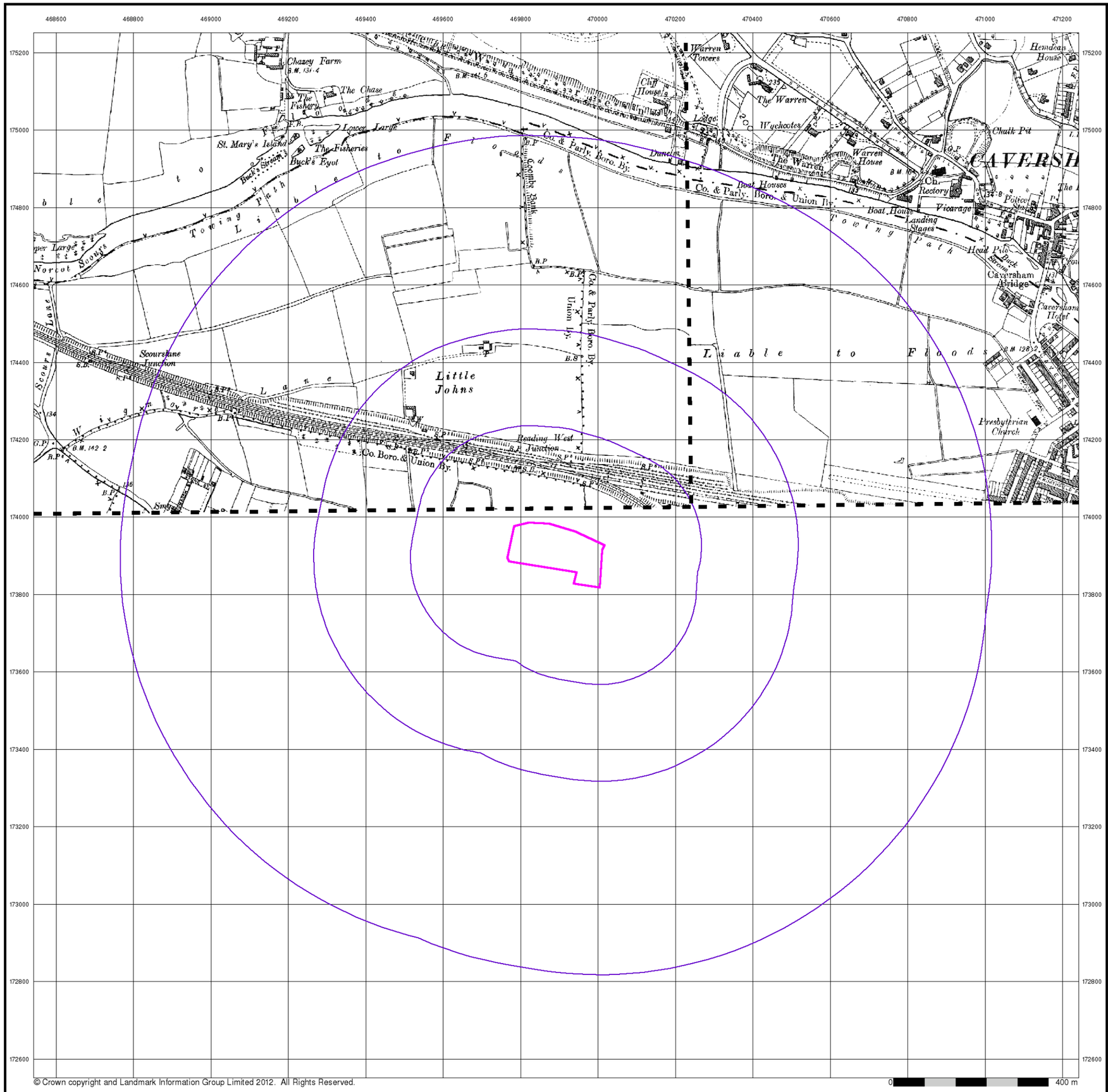
Order Number:	40527939_1_1
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RSK

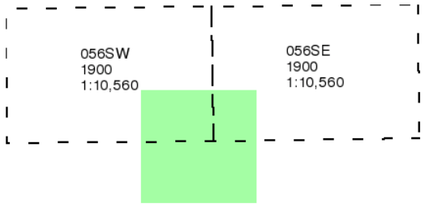
Oxfordshire

Published 1900

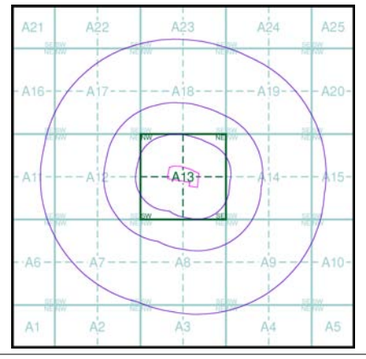
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
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Site Area (Ha):	2.65
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RSK

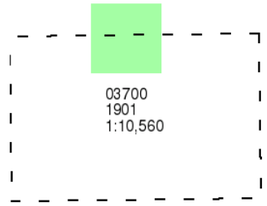
Berkshire

Published 1901

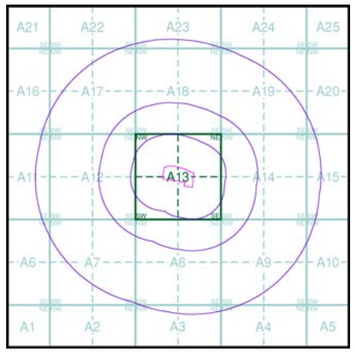
Source map scale - 1:10,560

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

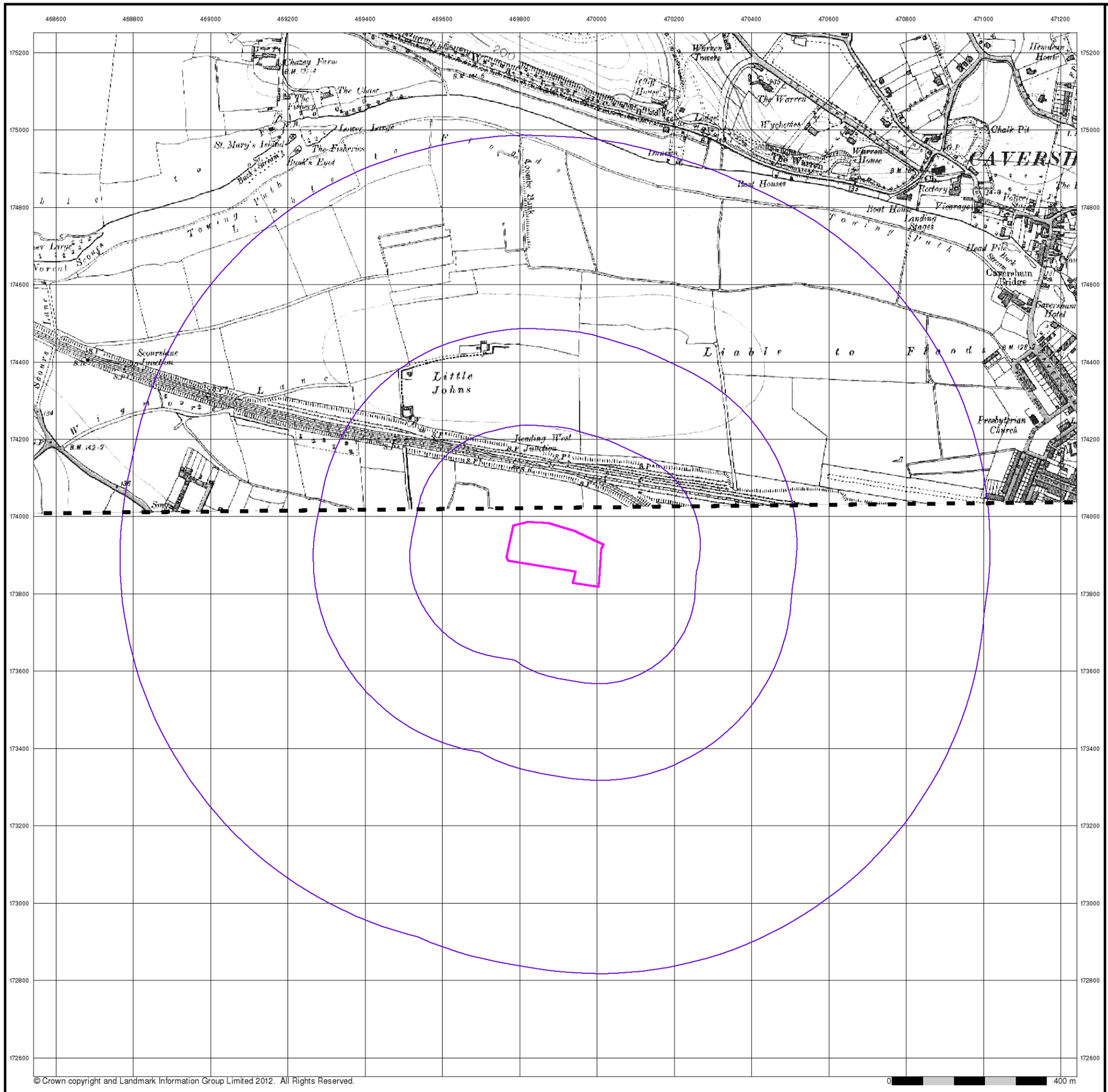
Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
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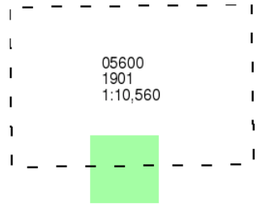
Oxfordshire

Published 1901

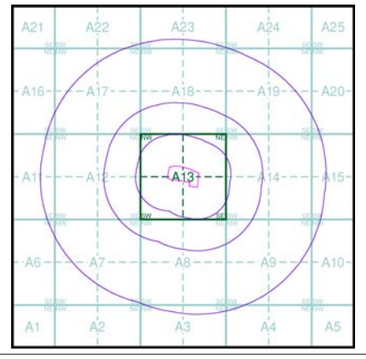
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The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



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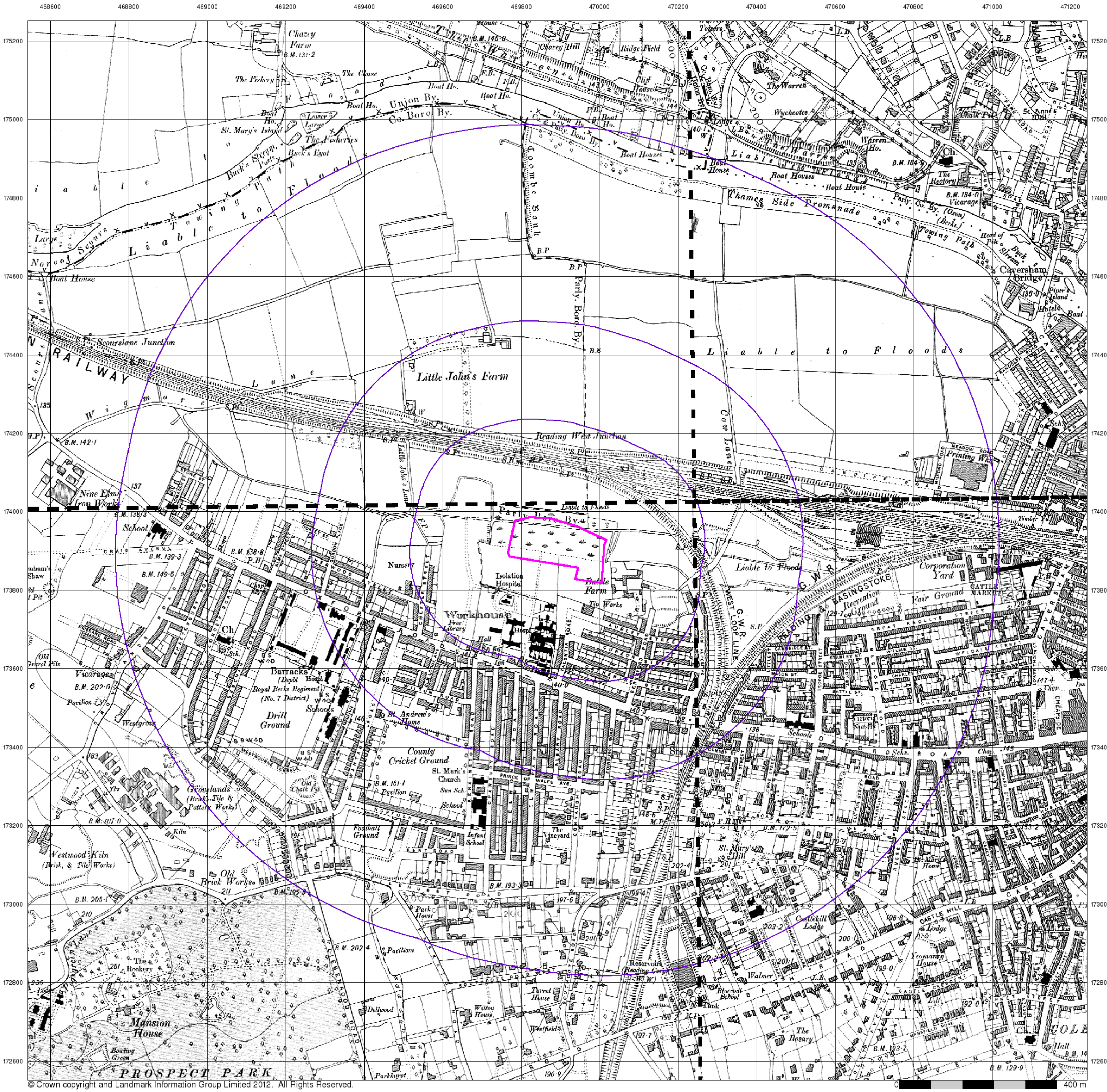
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Search Buffer (m):	1000

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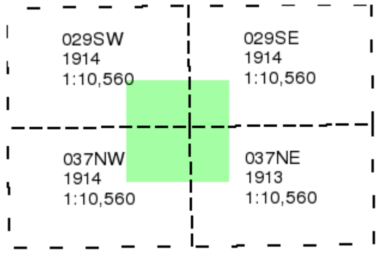
Berkshire

Published 1913 - 1914

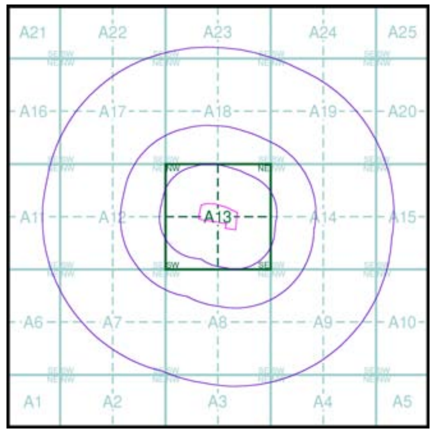
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Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number: 40527939_1_1
Customer Ref: 25520
National Grid Reference: 469900, 173900
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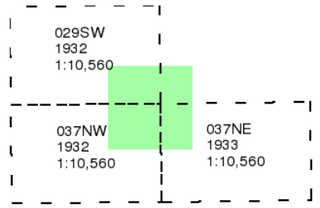
Berkshire

Published 1932 - 1933

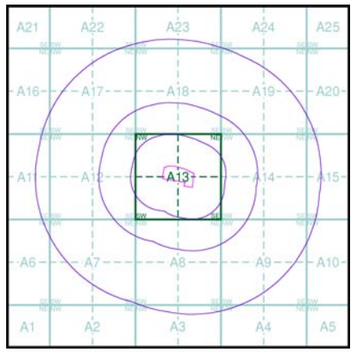
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The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



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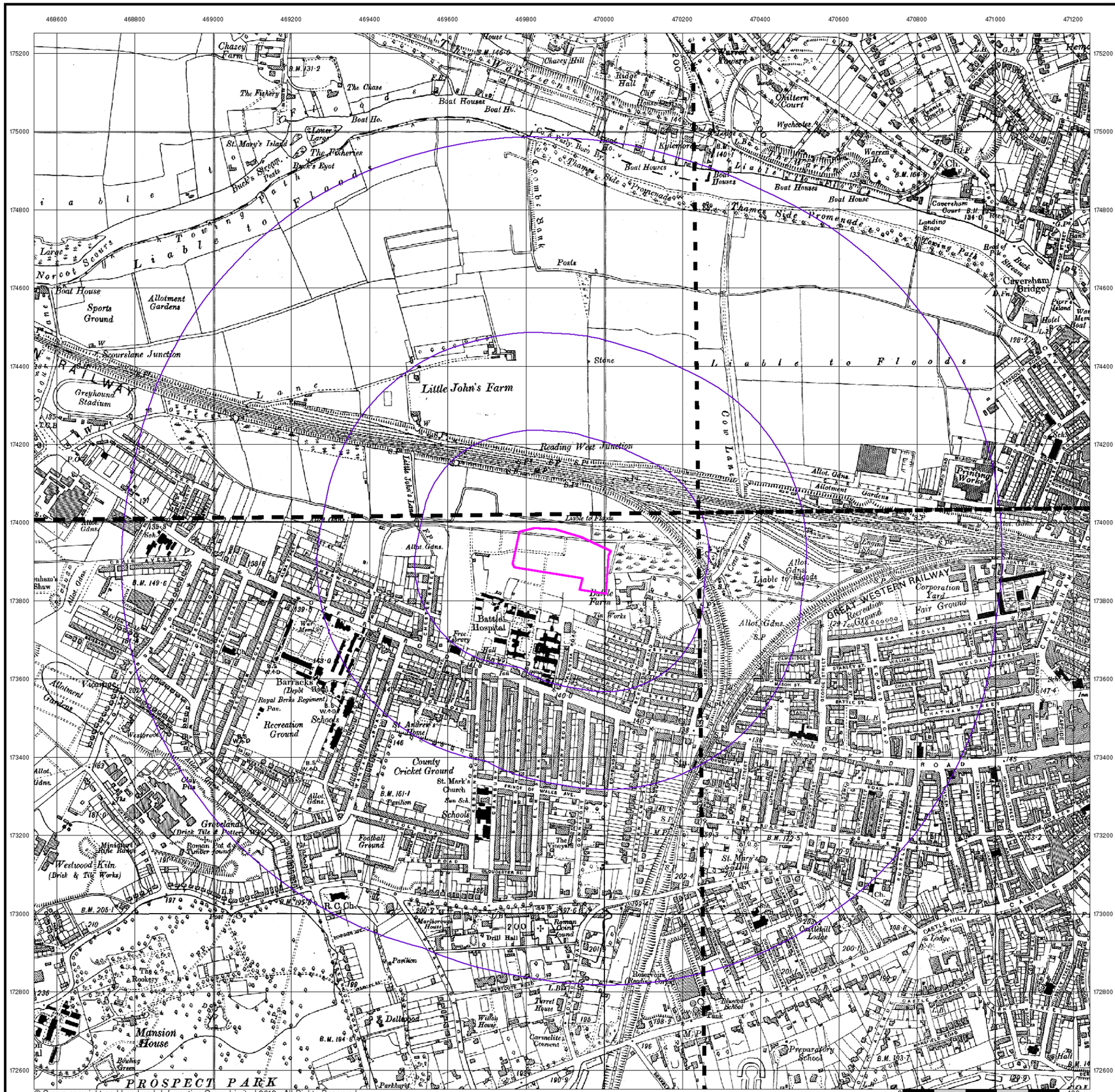
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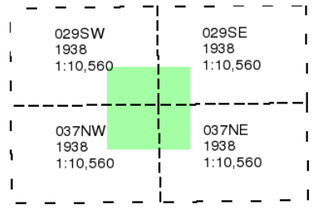
Berkshire

Published 1938

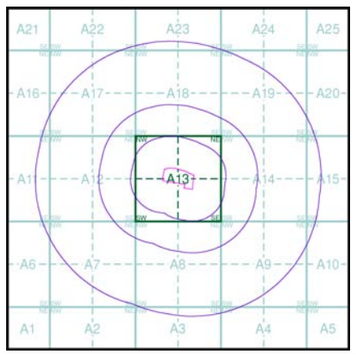
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Map Name(s) and Date(s)



Historical Map - Slice A



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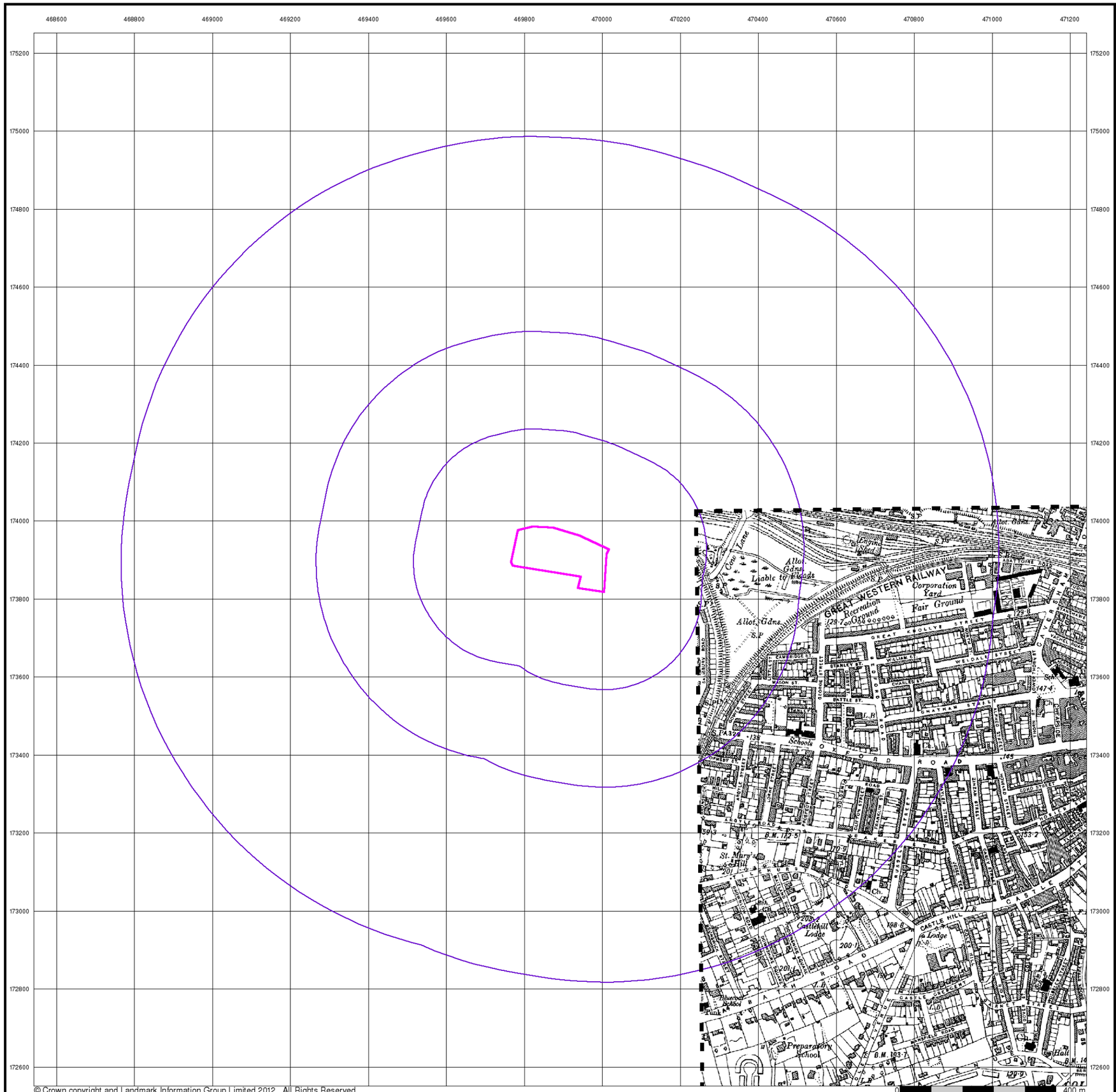
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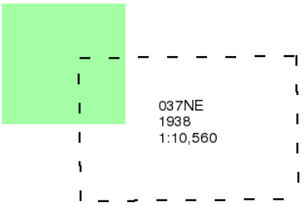
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Published 1938

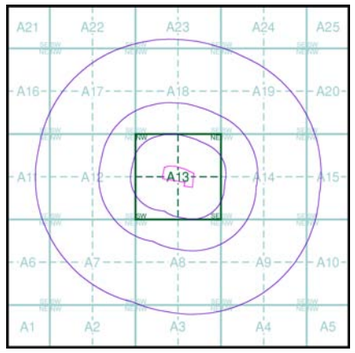
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Map Name(s) and Date(s)



Historical Map - Slice A



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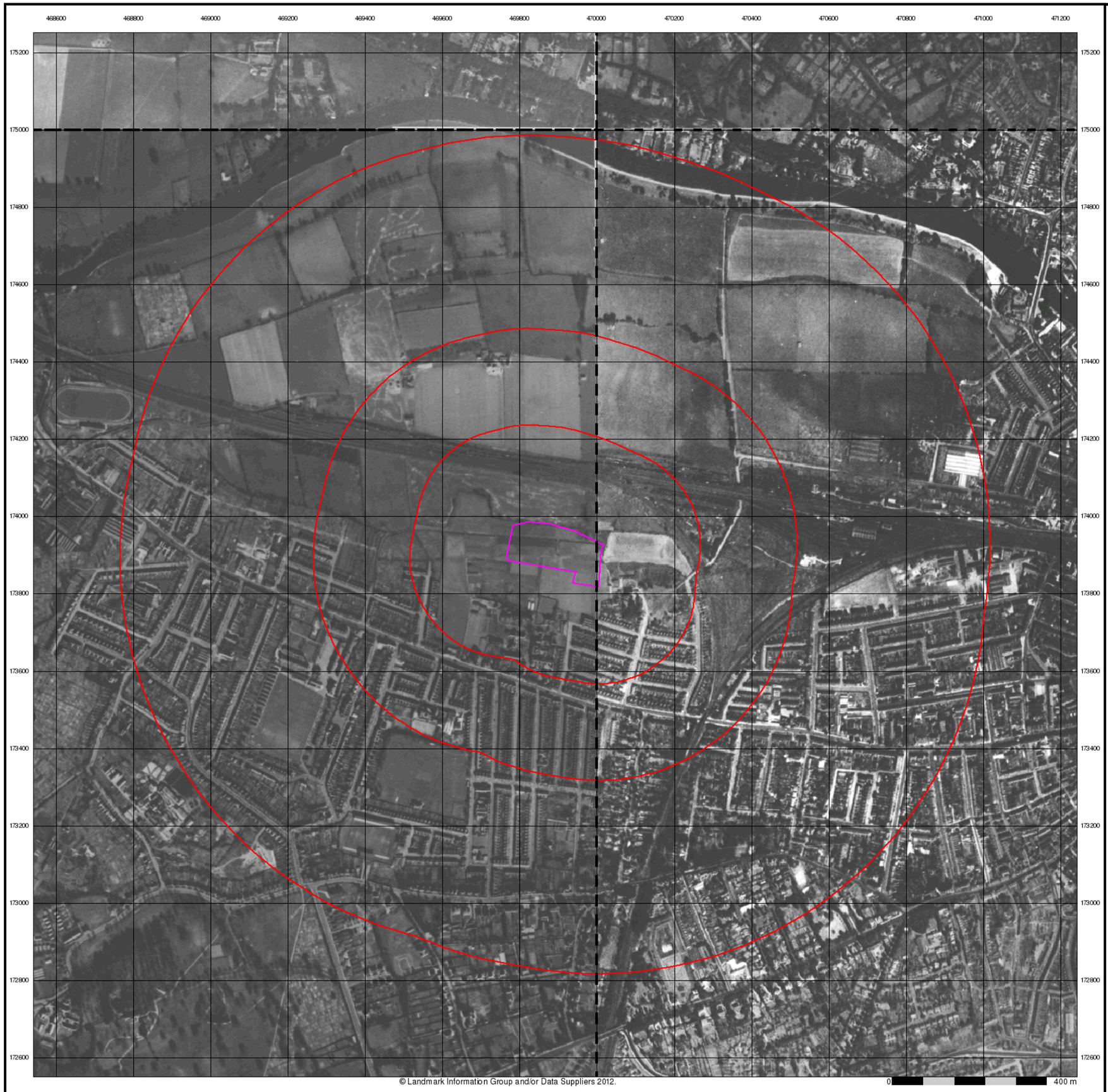
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Historical Aerial Photography

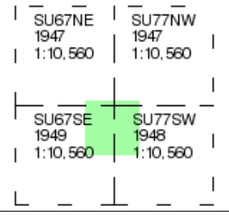
Published 1947 - 1949

Source map scale - 1:10,560

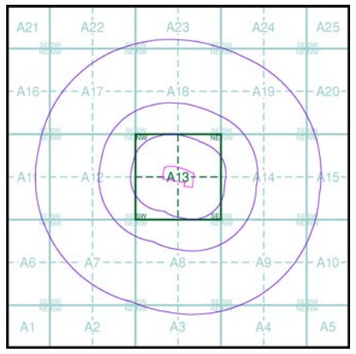
The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 1950's meant that every photograph was re-checked for potentially unsafe information with security sites replaced by fake fields or clouds. The original editions were withdrawn and only later made available after a period of fifty years although due to the accuracy of the editing, without viewing both revisions it is not easy to spot the edits. Where available Landmark have included both revisions.

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Map Name(s) and Date(s)



Historical Aerial Photography - Slice A



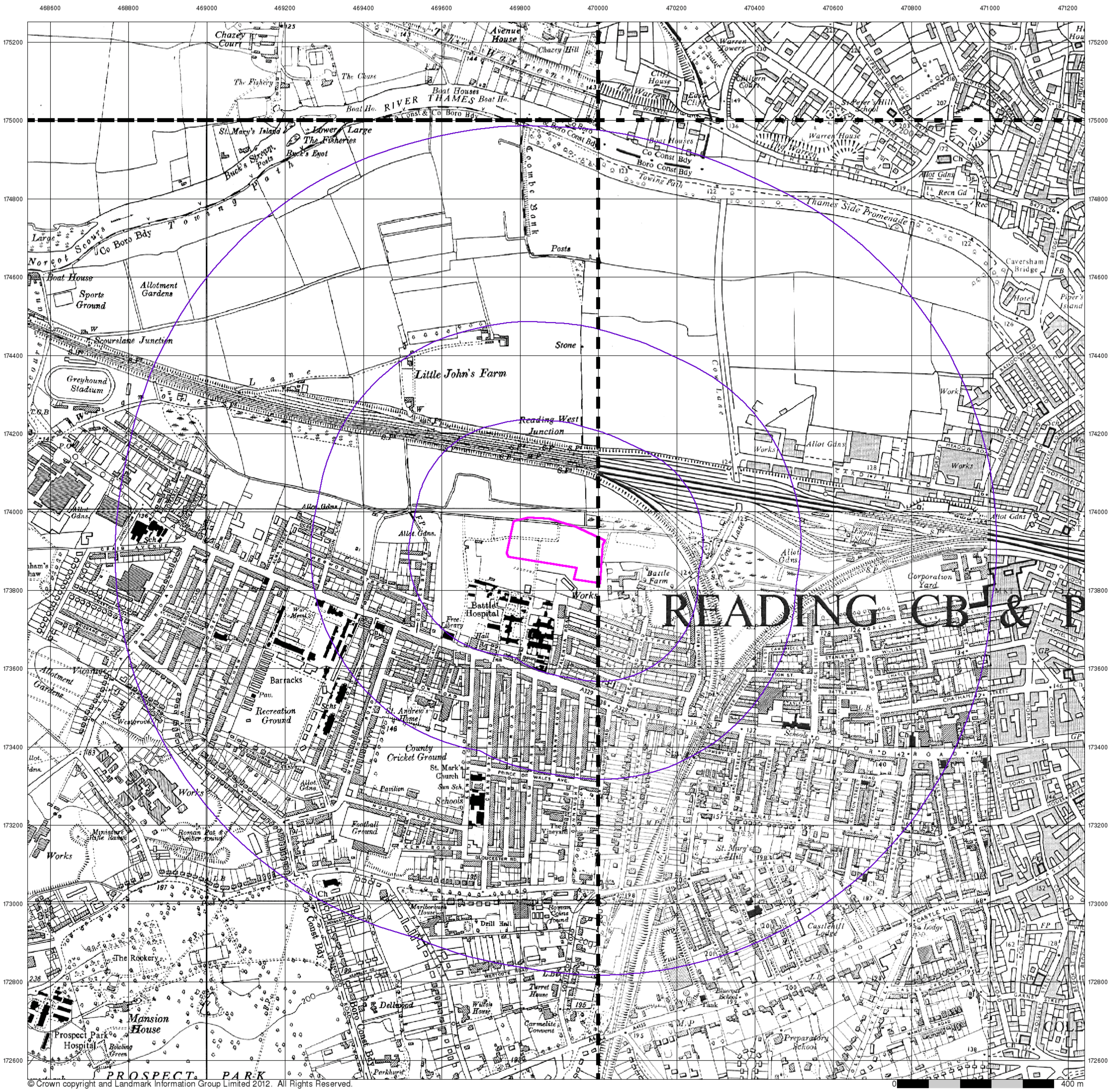
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Ordnance Survey Plan

Published 1960 - 1962

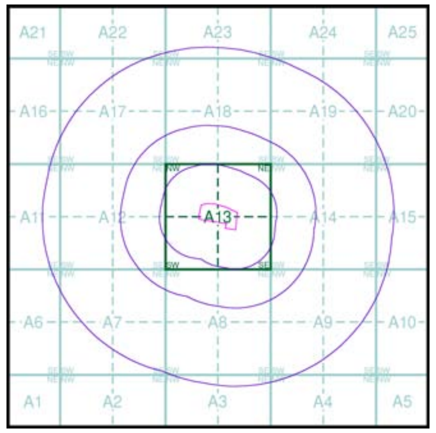
Source map scale - 1:10,000

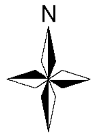
The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

SU67NE 1960 1:10,560	SU77NW 1961 1:10,560
SU67SE 1961 1:10,560	SU77SW 1962 1:10,560

Historical Map - Slice A





Order Details

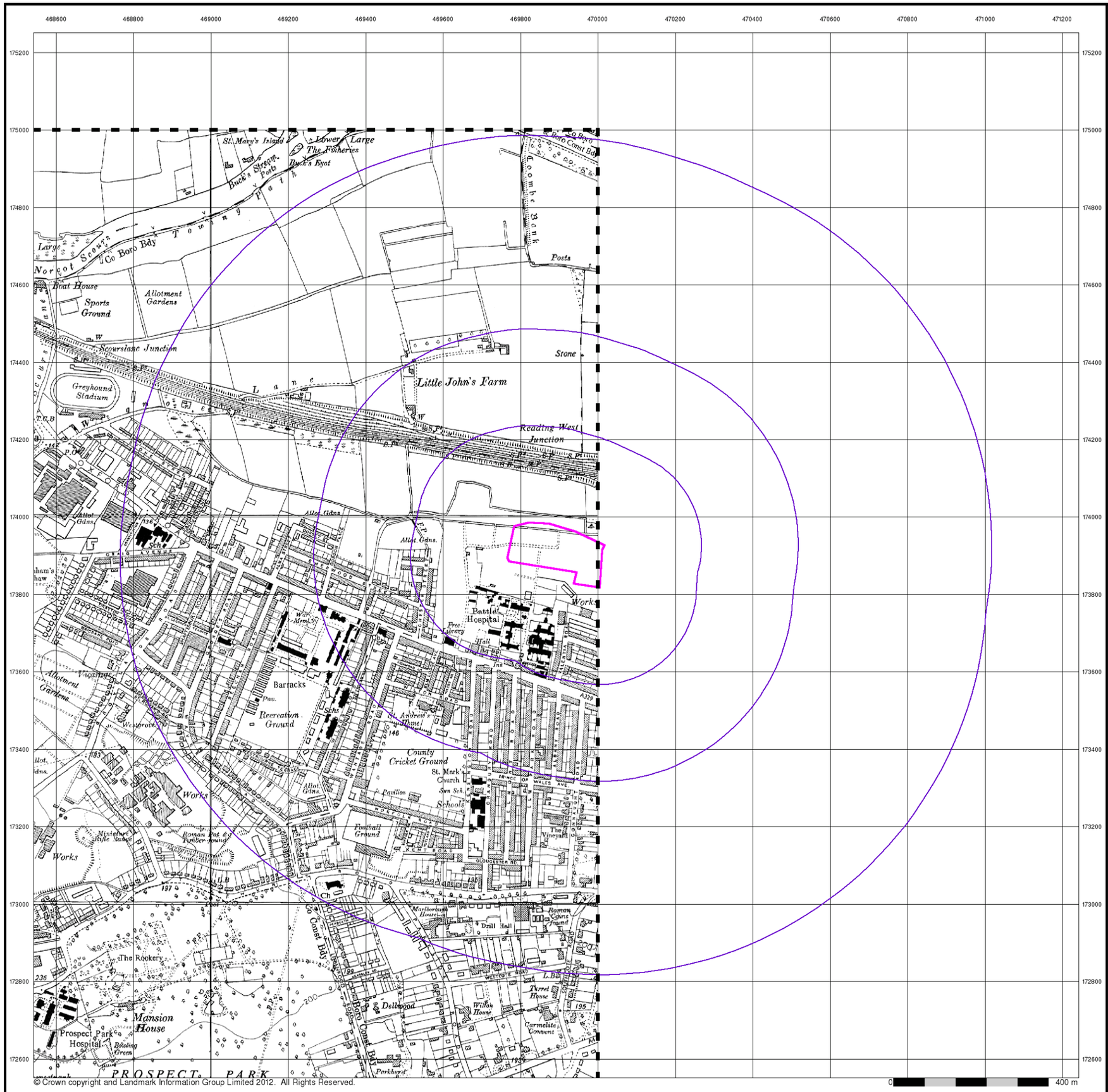
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Site Details

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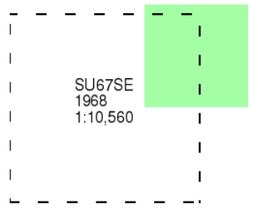
Ordnance Survey Plan

Published 1968

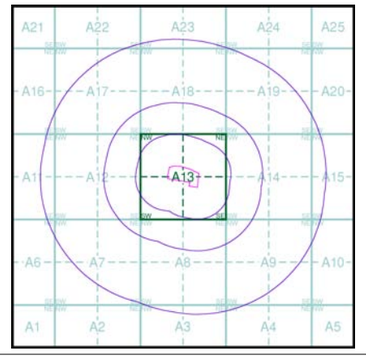
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Map Name(s) and Date(s)



Historical Map - Slice A



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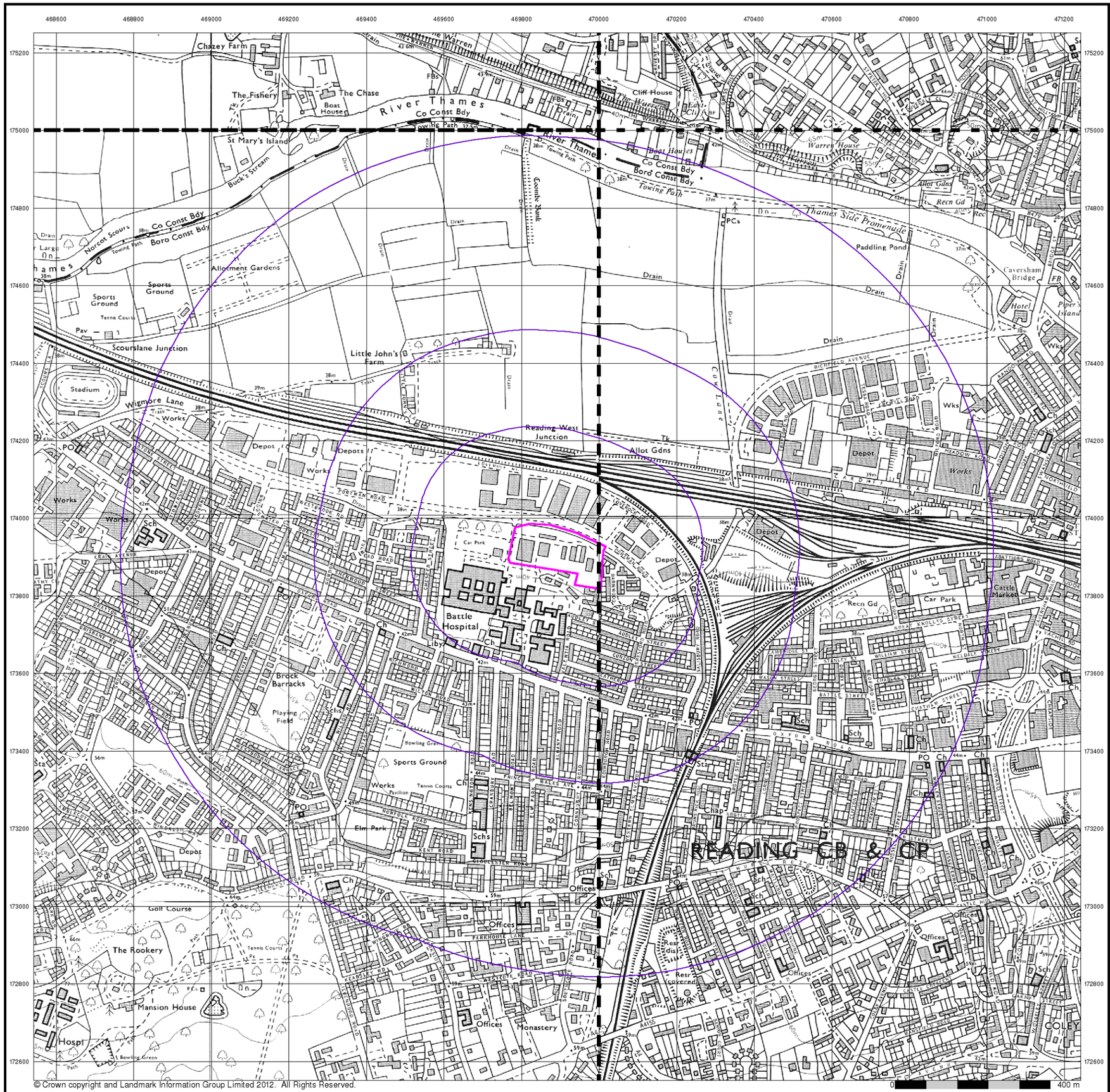
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Ordnance Survey Plan

Published 1970 - 1976

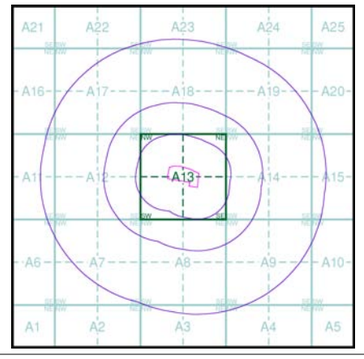
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Map Name(s) and Date(s)

SU67NE 1970 1:10,000	SU77NW 1973 1:10,000
SU67SE 1976 1:10,000	SU77SW 1973 1:10,000

Historical Map - Slice A



N

Order Details

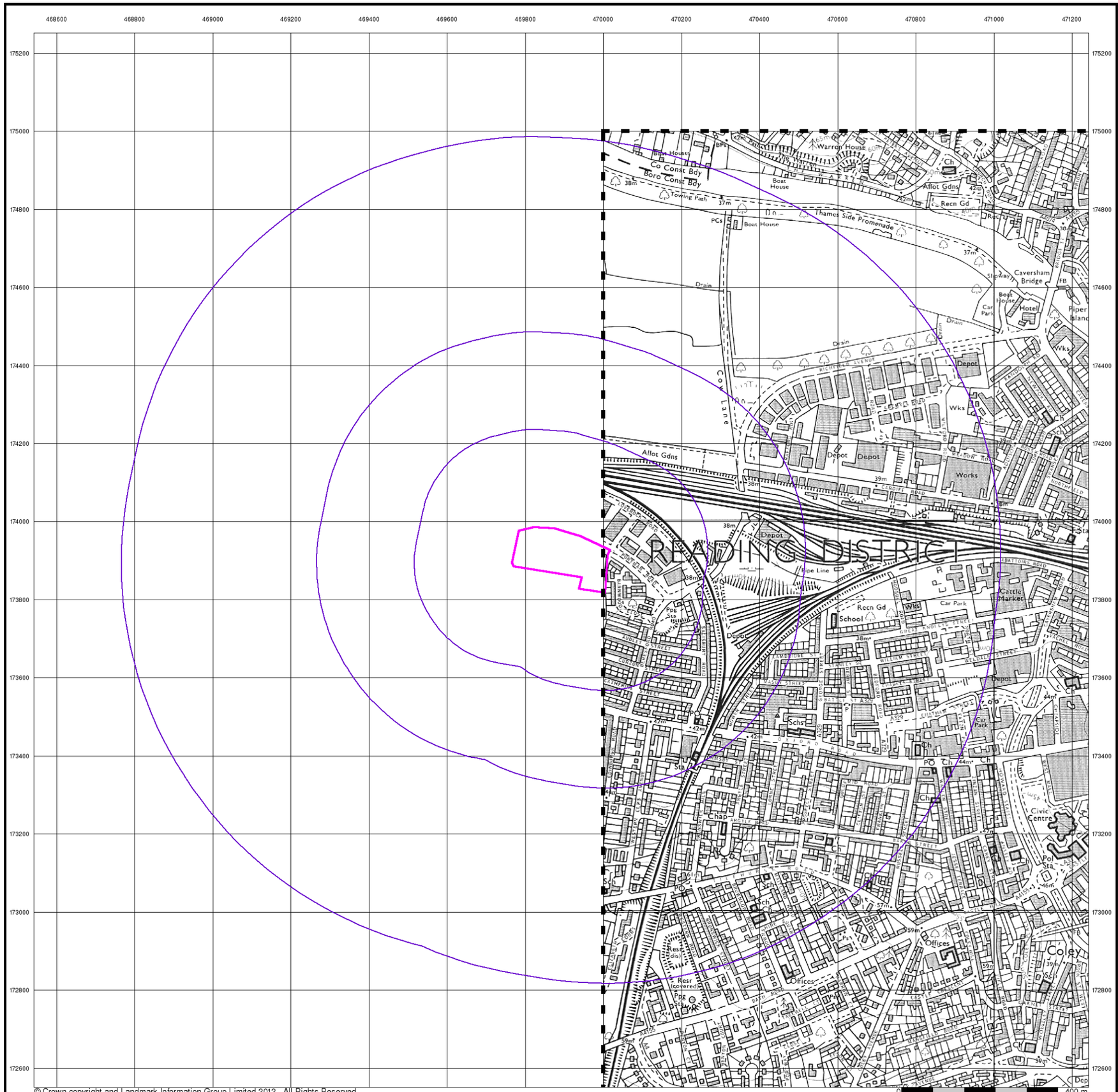
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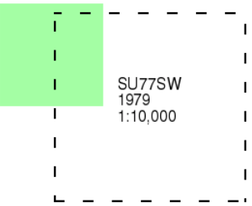
Ordnance Survey Plan

Published 1979

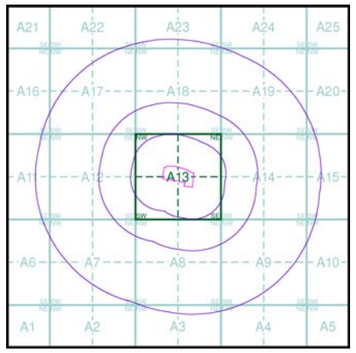
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Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

Order Number:	40527939_1_1
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RSK

Ordnance Survey Plan

Published 1983 - 1984

Source map scale - 1:10,000

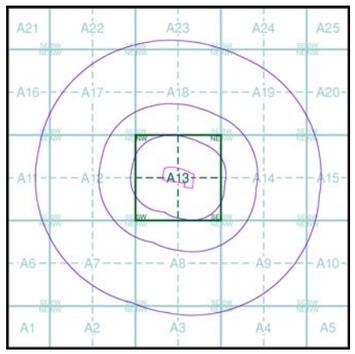
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Map Name(s) and Date(s)

SU67NE
1984
1:10,000

SU67SE
1983
1:10,000

Historical Map - Slice A



Order Details

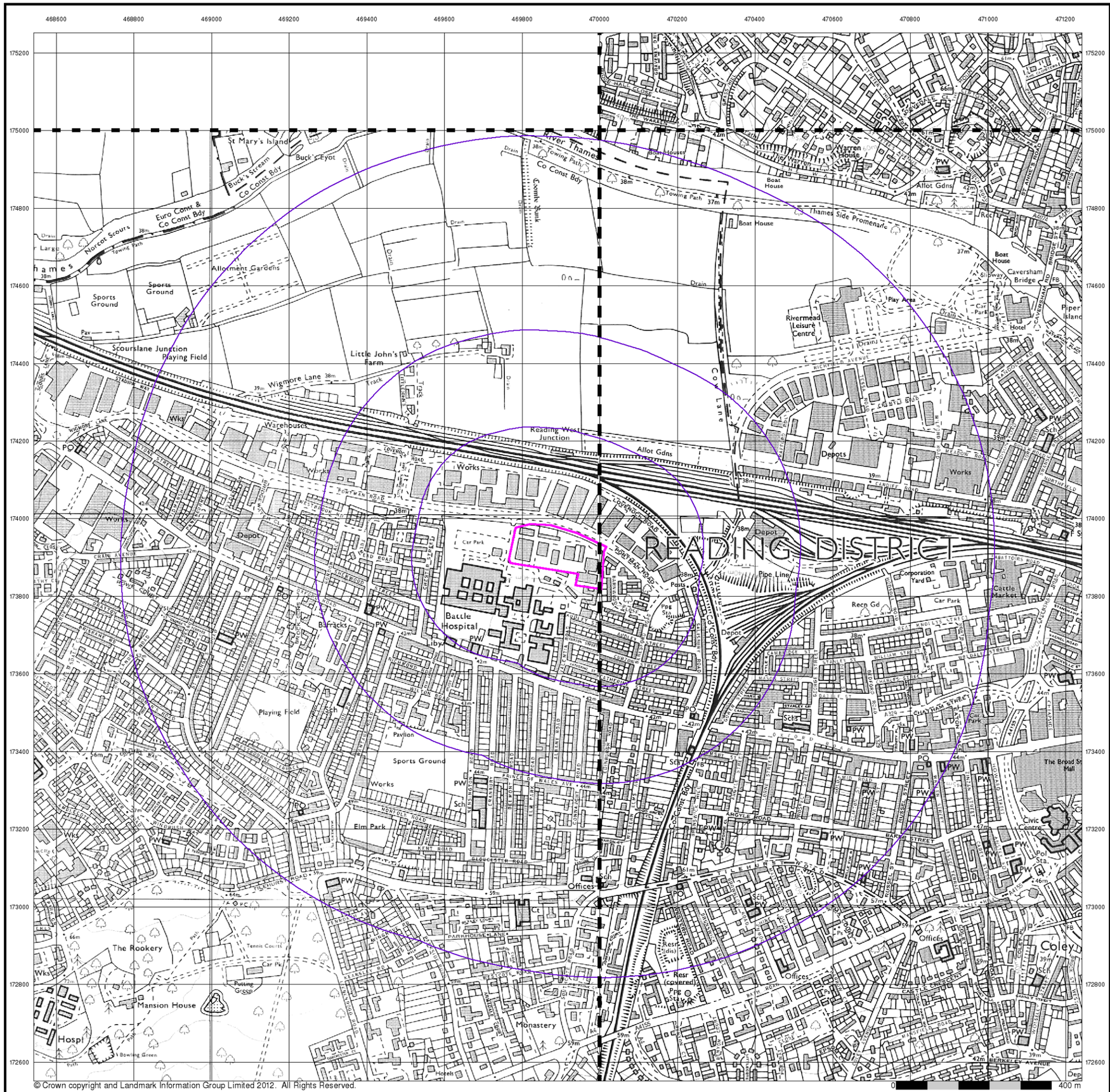
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Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

Landmark Information Group

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



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RSK

Ordnance Survey Plan

Published 1990 - 1992

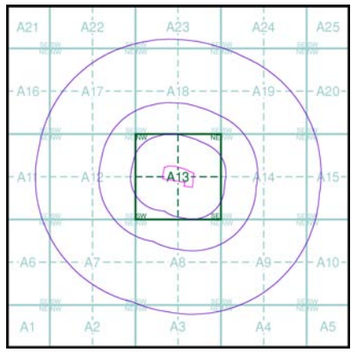
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)

SU77NW 1991 1:10,000
SU67SE 1992 1:10,000
SU77SW 1990 1:10,000

Historical Map - Slice A



Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

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Reading

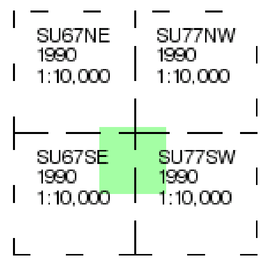
Published 1990

Source map scale - 1:10,000

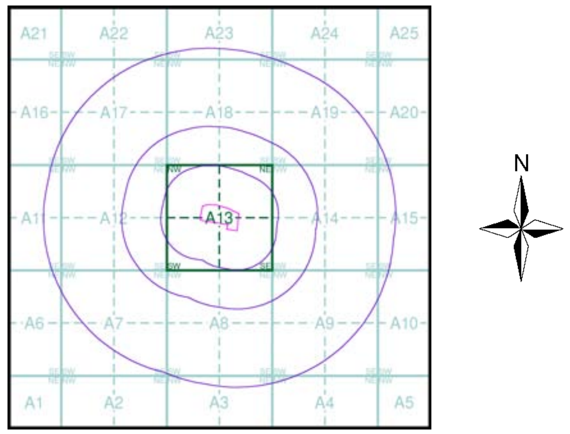
These maps were produced by the Russian military during the Cold War between 1950 and 1997, and cover 103 towns and cities throughout the U.K. The maps are produced at 1:25,000, 1:10,000 and 1:5,000 scale, and show detailed land use, with colour-coded areas for development, green areas, and non-developed areas. Buildings are coloured black and important building uses (such as hospitals, post offices, factories etc.) are numbered, with a numbered key describing their use.

They were produced by the Russians for the benefit of navigation, as well as strategic military sites and transport hubs, for use if they were to have invaded the U.K. The detailed information provided indicates that the areas were surveyed using land-based personnel, on the ground, in the cities that are mapped.

Map Name(s) and Date(s)



Russian Map - Slice A



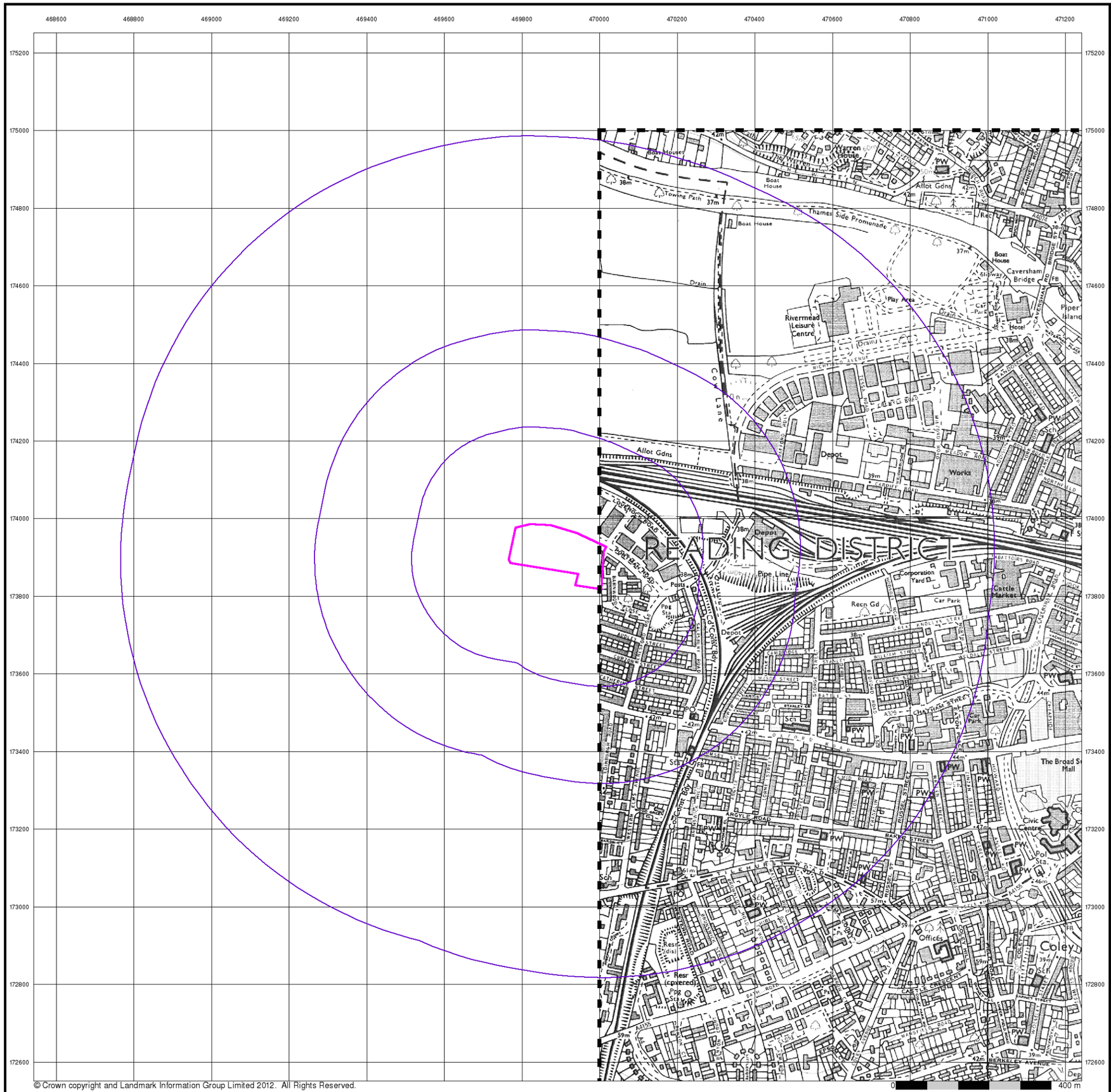
Order Details

Order Number: 40527939_1_1
Customer Ref: 25520
National Grid Reference: 469900, 173900
Slice: A
Site Area (Ha): 2.65
Search Buffer (m): 1000

Site Details

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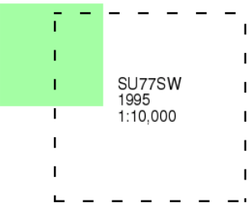
Ordnance Survey Plan

Published 1995

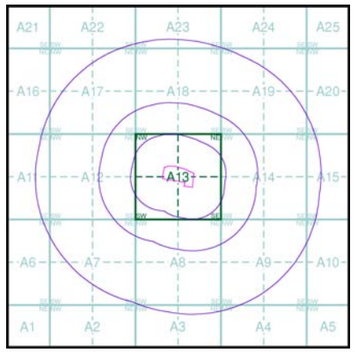
Source map scale - 1:10,000

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840`s. In 1854 the 1:2,500 scale was adopted for mapping urban areas; these maps were used to update the 1:10,560 maps. The published date given therefore is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas. In the late 1940`s, a Provisional Edition was produced, which updated the 1:10,560 mapping from a number of sources. The maps appear unfinished - with all military camps and other strategic sites removed. These maps were initially overprinted with the National Grid. In 1970, the first 1:10,000 maps were produced using the Transverse Mercator Projection. The revision process continued until recently, with new editions appearing every 10 years or so for urban areas.

Map Name(s) and Date(s)



Historical Map - Slice A



Order Details

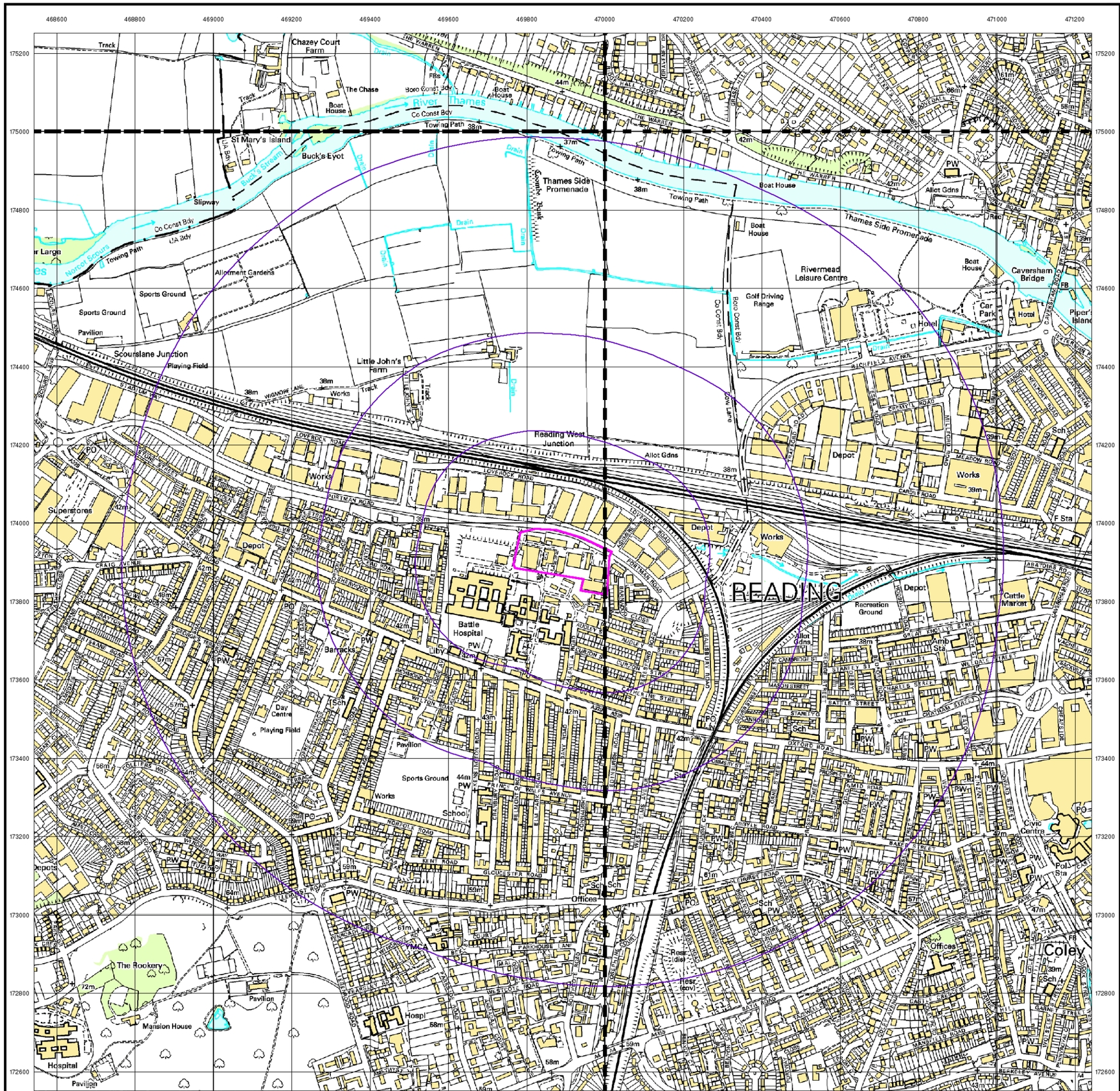
Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

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RSK

10k Raster Mapping

Published 2006

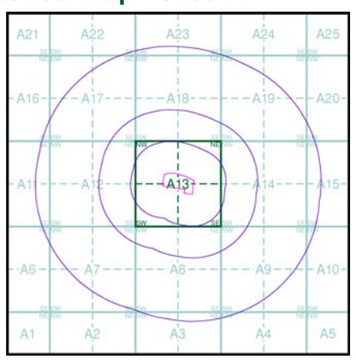
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey`s 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

SU67NE 2006 1:10,000	SU77NW 2006 1:10,000
SU67SE 2006 1:10,000	SU77SW 2006 1:10,000

Historical Map - Slice A



Order Details

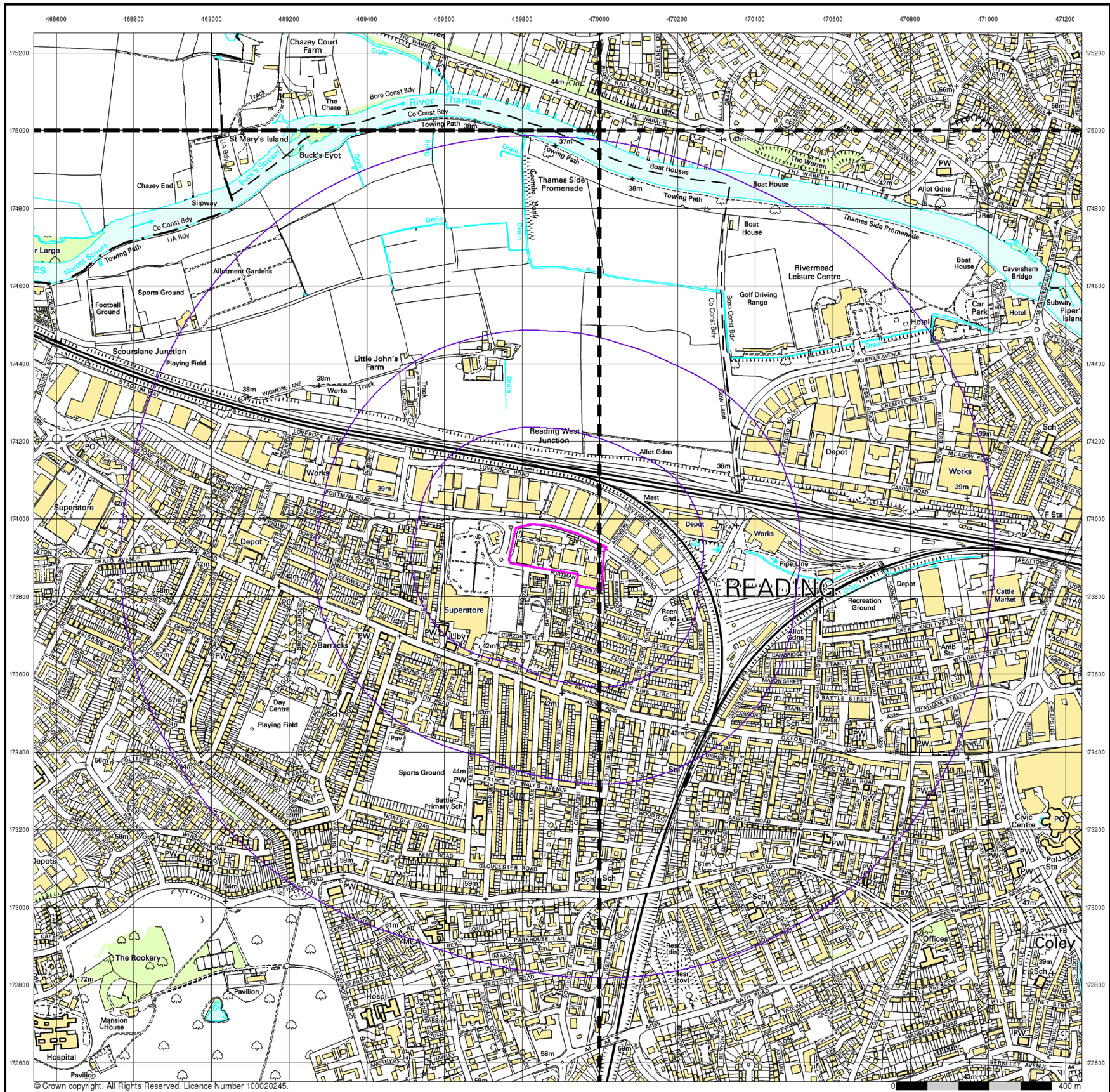
Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

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0 400 m

RSK

10k Raster Mapping

Published 2012

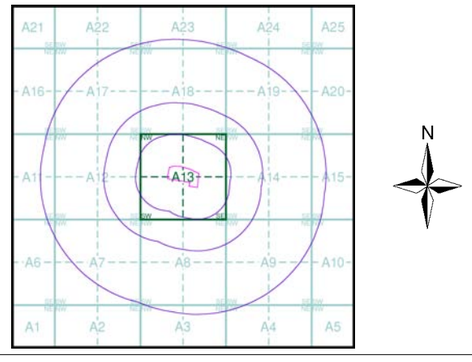
Source map scale - 1:10,000

The historical maps shown were produced from the Ordnance Survey`s 1:10,000 colour raster mapping. These maps are derived from Landplan which replaced the old 1:10,000 maps originally published in 1970. The data is highly detailed showing buildings, fences and field boundaries as well as all roads, tracks and paths. Road names are also included together with the relevant road number and classification. Boundary information depiction includes county, unitary authority, district, civil parish and constituency.

Map Name(s) and Date(s)

SU67NE 2012 1:10,000	SU77NW 2012 1:10,000
SU67SE 2012 1:10,000	SU77SW 2012 1:10,000

Historical Map - Slice A



Order Details

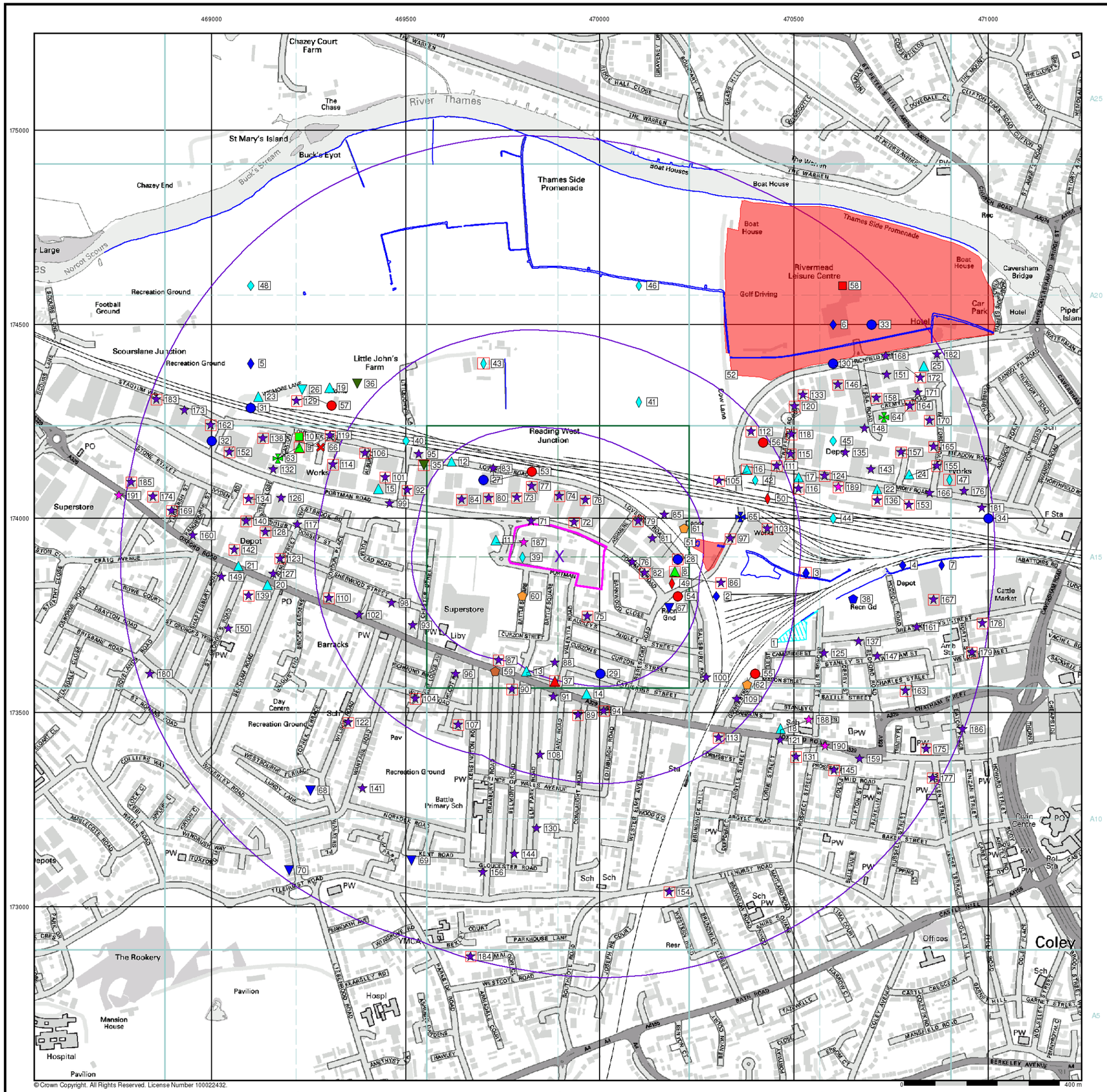
Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

Site Details

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RSK

General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Map ID
Several of Type at Location

Agency and Hydrological

- Contaminated Land Register Entry or Notice (Location)
- Contaminated Land Register Entry or Notice
- Discharge Consent
- Enforcement or Prohibition Notice
- Integrated Pollution Control
- Integrated Pollution Prevention Control
- Local Authority Integrated Pollution Prevention and Control
- Local Authority Pollution Prevention and Control
- Local Authority Pollution Prevention and Control Enforcement
- Pollution Incident to Controlled Waters
- Prosecution Relating to Authorised Processes
- Prosecution Relating to Controlled Waters
- Registered Radioactive Substance
- River Network or Water Feature
- River Quality Sampling Point
- Substantiated Pollution Incident Register
- Water Abstraction
- Water Industry Act Referral

Geological

- BGS Recorded Mineral Site

Industrial Land Use

- Contemporary Trade Directory Entry
- Fuel Station Entry

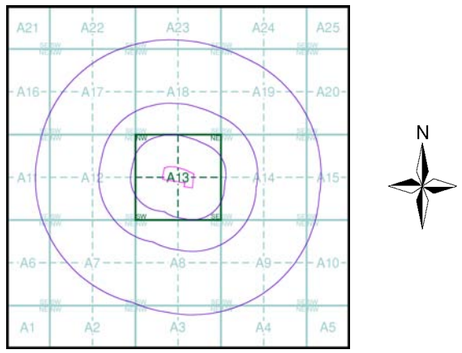
Waste

- BGS Recorded Landfill Site (Location)
- BGS Recorded Landfill Site
- EA Historic Landfill (Buffered Point)
- EA Historic Landfill (Polygon)
- Integrated Pollution Control Registered Waste Site
- Licensed Waste Management Facility (Landfill Boundary)
- Licensed Waste Management Facility (Location)
- Local Authority Recorded Landfill Site (Location)
- Local Authority Recorded Landfill Site
- Registered Landfill Site
- Registered Landfill Site (Location)
- Registered Landfill Site (Point Buffered to 100m)
- Registered Landfill Site (Point Buffered to 250m)
- Registered Waste Transfer Site (Location)
- Registered Waste Transfer Site
- Registered Waste Treatment or Disposal Site (Location)
- Registered Waste Treatment or Disposal Site

Hazardous Substances

- COMAH Site
- Explosive Site
- NIHHS Site
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

Site Sensitivity Map - Slice A



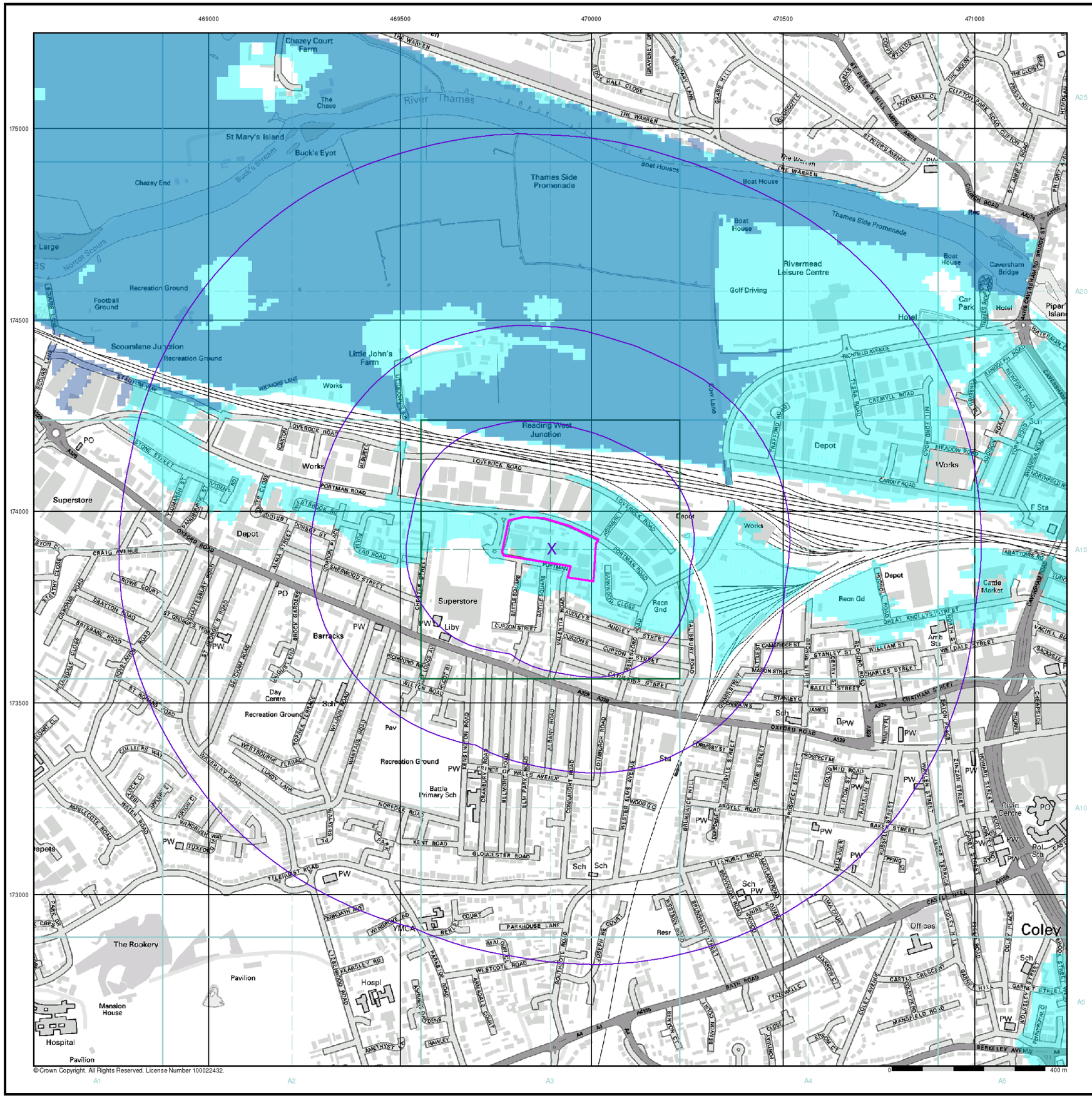
Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

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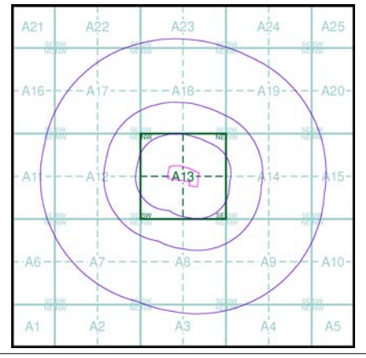
General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point

Agency and Hydrological (Flood)

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Flood Map - Slice A



Order Details

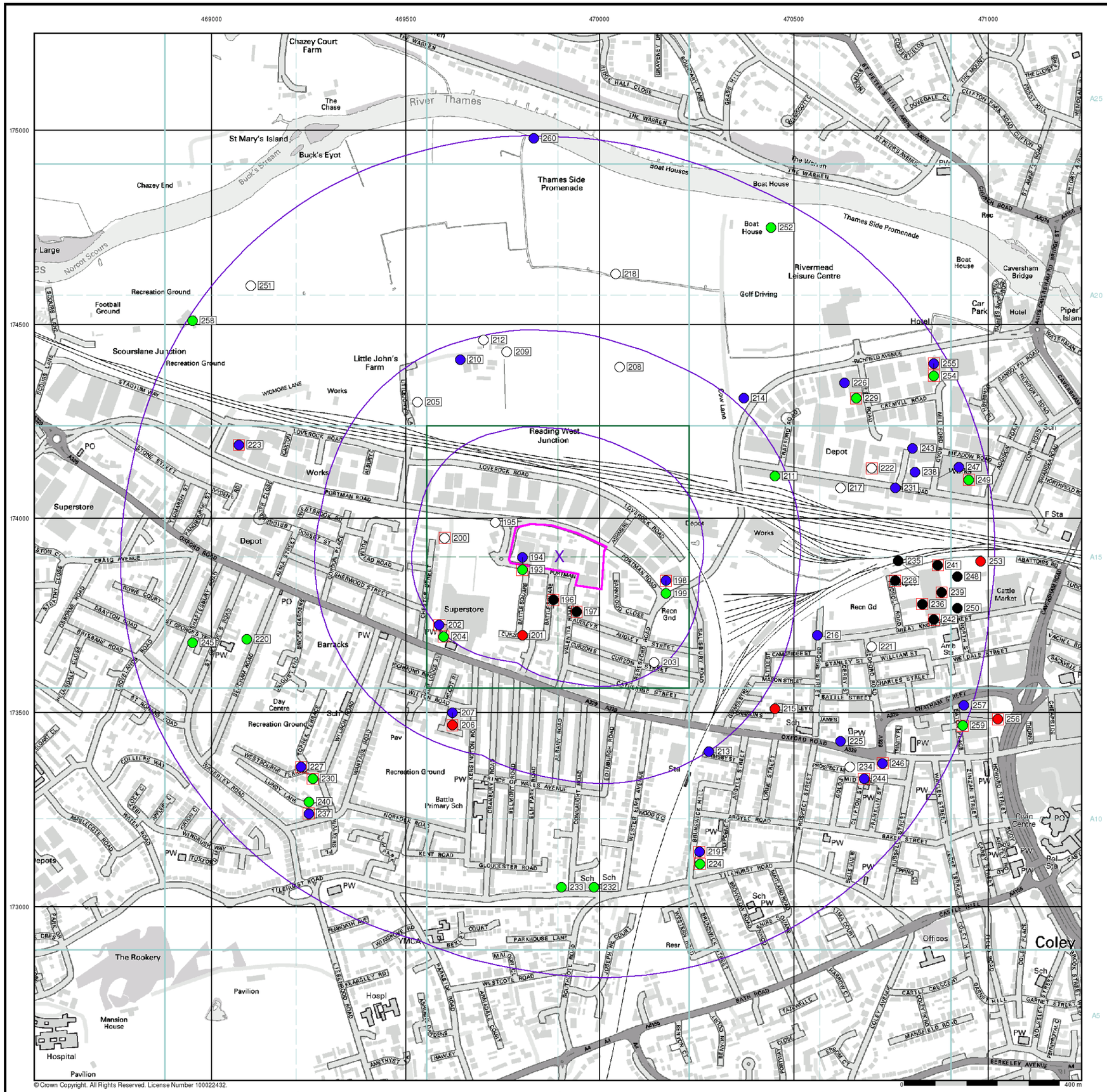
Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

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



RSK

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point
- Map ID
- Several of Type at Location

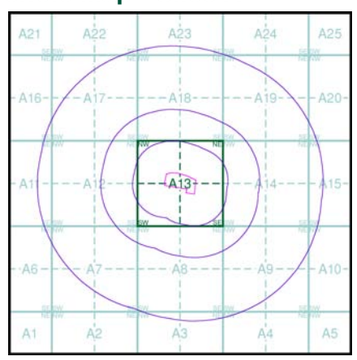
Agency and Hydrological (Boreholes)

- BGS Borehole Depth 0 - 10m
- BGS Borehole Depth 10 - 30m
- BGS Borehole Depth 30m +
- Confidential
- Other

For Borehole information please refer to the Borehole .csv file which accompanied this slice.

A copy of the BGS Borehole Ordering Form is available to download from the Support section of www.envirocheck.co.uk.

Borehole Map - Slice A



Order Details

Order Number:	40527939_1_1
Customer Ref:	25520
National Grid Reference:	469900, 173900
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	1000

Site Details

Dairy Crest Ltd, Portman Road, Reading West, READING, RG30 1EA

Landmark Information Group

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APPENDIX F
EXPLORATORY HOLE RECORDS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH1**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.50	1	D				MADE GROUND: brown black sand matrix with plastic, brick, ash, charcoal, flint, glass and occasional tile and metal Service ducts noted during hand pitting	(1.20) 1.20	
	1.30	2	D		1		MADE GROUND: wet black slighty clayey sand with organic matter, plastic, flint, ceramic tile and occasional metal and charcoal. Moderate to strong hydrocarbon (weathered diesel) stain/odour noted.	(0.30) 1.50	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		1.50	-		1.30

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log WINDOW SAMPLE LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:33 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk.

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH2**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**06.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							MADE GROUND: Bituminous paving over crushed aggregates	0.20	
	0.40	1	D				MADE GROUND: brown slightly cemented sand with concrete, brick and flint	(0.60)	
								0.80	
	1.40	2	D		1		MADE GROUND: grey black sandy matrix with flint, glass bottle fragments and ceramic tile. Moderate to strong hydrocarbon (weathered diesel) stain/odour noted. Wet below 1.50m	(2.30)	
	2.40	3	D					3.10	
	3.40	4	D				Soft brown grey silty CLAY / clayey SILT with organic matter and occasional very fine flint	(0.90)	
								4.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		1.40

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log WINDOW SAMPLE LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:34 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk.

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH3**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**06.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							MADE GROUND: Bituminous paving over red brown sand matrix with crushed aggregates	(0.50) 0.50	
	0.50	1	D		1		MADE GROUND: black occasionally brown sand matrix with flint, charcoal, ash, brick and more occasional wood, organic matter, glass and old roots	(1.50) 2.00	
	2.50	2	D				MADE GROUND: reworked black grey brown clayey sand with organic matter, flint and occasional brick, ash and glass bottle fragment. Slight to Moderate hydrocarbon veining (weathered diesel stain/odour) noted. wet below 2.0m	(1.10) 3.10	
	3.30	3	D				Soft brown grey silty CLAY / clayey SILT with organic matter and occasional very fine flint and shell gravel spongy peat lenses noted.	(0.90) 4.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		1.70

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log WINDOW SAMPLE LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:34 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk.

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH4**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**06.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Bituminous paving over crushed aggregates and concrete	(0.30) 0.30	
	0.30	1	D				MADE GROUND: brown black silty sand with flint, charcoal, ash, glass fragments, organic matter and occasional wood, ceramic tile and bone.	(1.00) 1.30	
	1.10	2	D		1		MADE GROUND: grey black sandy silty matrix with organic matter, glass and slight to moderate hydrocarbon odour/stain.	(1.60) 2.90	
	1.70	3	D				Soft brown grey silty CLAY / clayey SILT with organic matter and occasional very fine flint	3.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		3.00	-		1.15

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log WINDOW SAMPLE LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:34 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437550, Fax: 01442 437500, Web: www.rsk.co.uk.

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH5**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**06.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Bituminous paving over crushed aggregates	(0.30) 0.30	
	0.40	1	D				MADE GROUND: grey brown clayey sand with brick, ash, flint, charcoal and occasional glass	(0.50) 0.80	
	0.90	2	D				Loose becoming moderately compact brown clayey silty fine to medium SAND with fine to coarse flint and chalk gravel. Lenses of soft brown sandy clay noted.		
					1		Wet below 1.50m	(1.50) 2.30	
	1.90	3	D						
	2.50	4	D				Low density highly weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble	(0.70) 3.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		3.00	-		1.90

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log WINDOW SAMPLE LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:34 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437550, Fax: 01442 437500, Web: www.rsk.co.uk.

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH6**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**06.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Concrete over crushed aggregates	(0.30)	
								0.30	
	0.30	1	D				MADE GROUND: brown black sandy matrix with concrete, brick, ceramic tile, ash, flint, charcoal and occasional wood or organic matter	(0.90)	
					1			1.20	
	1.30	2	D				MADE GROUND: black sandy matrix with wood, organic matter, ceramic tile, glass, flint and occasional brick. Moderate to strong hydrocarbon odour/ stain noted. Wet below 1.50m Poor recovery between 2-3m	(2.80)	
	2.30	3	D						
								4.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		1.30

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	AGS

GINT_LIBRARY_V8_04.GLB|Log WINDOW SAMPLE LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:34 | SJ.
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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH7**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**06.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Bituminous Paving over crushed aggregates	(0.30) 0.30	
	0.40	1	D				MADE GROUND: brown grey occasionally black silty sandy matrix with brick, roots, concrete, glass, flint, ash and occasional ceramic and wood	(0.90) 1.20	
	1.50	2	D		1		MADE GROUND: reworked brown grey clayey sand or sandy clay with flint, brick, ash, organic matter and occasional glass and wood	(0.80) 2.00	
	2.50	3	D				MADE GROUND: black sandy silty matrix with glass, ceramic, flint, organic matter, brick and occasional wood. Very slight organic / sulphur odour noted.	(2.00) 4.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		1.50

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH8**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Bituminous paving over crushed aggregates	0.25	
	0.40	1	D				MADE GROUND: brown black silty sandy matrix with flint, ash, charcoal, ceramic and occasional brick, glass and organic matter	(2.85)	
					1		Poor recovery between 1.50m and 3.0m. Wet below 2.0m	3.10	
	3.20	2	D				Soft grey brown clay sandy SILT or silty sandy CLAY with fine flint and chalk gravel and occasional organic matter	(0.70)	
								3.80	
	3.90	3	D				Moderately compact brown occasionally grey silty medium to coarse SAND with fine to medium flint gravel. Gravel is subangular to subrounded	4.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		2.00

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH9**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Bituminous paving over crushed aggregated	0.25	
	0.50	1	D				MADE GROUND: black grey occasionally brown silty slightly clayey sand with charcoal, flint, brick, chalk and occasional glass, ceramic and wood. Slight to moderate solvent odour between 0.50m-1.0m.	(1.05) 1.30	
	1.50	2	D		1		Loose to moderately compact brown silty clayey fine to coarse SAND with frequent fine to coarse flint gravel. Wet below 2.0m	(1.30) 2.60	
	2.70	3	D				Low density highly weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble	(0.40) 3.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		3.00	-		2.00

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH10**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Concrete over crushed aggregates	(0.35) 0.35	
	0.50	1	D				MADE GROUND: black brown sandy matrix with ash, charcoal, brick, glass, shells, organic matter and wood		
					1		Wet below 1.0m	(1.95) 2.30	
	1.60	2	D						
	2.60	3	D				Soft grey clayey SILT or silty CLAY with sandy lenses, organic matter and very fine flint	(1.40) 3.70	
	3.70	4	D				Moderately compact grey sandy silty clayey fine to coarse flint GRAVEL. Gravel is sub angular to sub rounded	(0.30) 4.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		1.20

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH11**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Concrete over sub base aggregates in pinky sand matrix Wet below 1.10m	(0.50) 0.50	
	0.80	1	D		1		soft to firm brown silty to very silty sandy CLAY or clayey SAND	(0.70) 1.20	
	1.20	2	D				Loose (very wet) brown silty slightly clayey fine to coarse SAND	(0.30) 1.50	
	2.00	3	D				Low becoming medium density weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble	(1.50) 3.00	
	3.00	4	D				END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		3.00	-		1.20

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH12**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Concrete over crushed brick and flint	(0.50) 0.50	
	0.50	1	D				MADE GROUND: black grey sandy slightly clayey matrix with charcoal, ash, flint, fine brick and occasional glass	(0.80) 1.30	
	1.50	2	D		1		Loose grey silty clayey fine to coarse SAND with lenses of soft sandy clay and fine to coarse flint gravel Wet form 1.30m	(1.20) 2.50	
	2.50	3	D				Loose becoming moderately compact brown grey sandy clayey fine to coarse flint GRAVEL. Gravel is subrounded to subangular.	(1.50) 4.00	
	3.50	4	D						
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		1.50

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH13**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Concrete over crushed aggregates	0.25	
	0.60	1	D		1		MADE GROUND: brown grey silty sandy matrix with glass, ceramic, ash, crushed flint, brick and occasional wood	(0.75)	
								1.00	
							MADE GROUND: crushed glass and ceramic Wet from 1.0m	(1.00)	
								2.00	
	2.10	2	D				MADE GROUND: black sandy matrix with glass and organic matter. Slight to moderate hydrocarbon odour/stain noted.	2.20	
	2.40	3	D				Soft brown clayey slighty sandy SILT with organic matter and very fine flint gravel (peaty appearance)	(0.80)	
								3.00	
	3.60	4	D				Soft grey sandy SILT or very silty fine SAND with organic matter	(1.00)	
								4.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		0.90

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH14**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Crushed aggregates of brick, concrete and Bituminous paving	(0.30) 0.30	
	0.40	1	D				MADE GROUND: brown black grey sandy matrix with ash, charcoal, flint, brick and occasional plastic and organic matter	(0.70) 1.00	
					1		Loose grey silty clayey fine to coarse SAND with lenses of soft sandy clay and fine to coarse flint gravel Wet from 1.00m	(1.00) 2.00	
	1.60	2	D				Moderately compact brown sandy fine to coarse flint GRAVEL (very wet)	(0.30) 2.30	
	2.60	3	D				Moderately compact brown buff sandy clayey fine to medium occasionally coarse flint and chalk GRAVEL	(0.70) 3.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		3.00	-		1.40

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH15**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Bituminous Paving over crushed aggregates in sand matrix	(0.30)	
								0.30	
	0.40	1	D		1		MADE GROUND: grey brown black sandy matrix with ceramic, glass, organic matter, charcoal, ash, flint, clinker and occasional brick and wood		
							Wet from 1.00m	(1.90)	
	1.30	2	D						
								2.20	
	2.30	3	D				Soft (spongy) brown clayey sandy SILT with organic matter and occasional flint (peaty in places)	(0.80)	
								3.00	
	3.30	4	D				Soft grey clayey sandy SILT with organic matter and fine to coarse flint gravel	(0.95)	
								3.95	
							Moderately compact brown sandy fine to coarse flint GRAVEL. Gravel is subangular to subrounded.	4.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		4.00	-		1.00

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Former Battle Hospital	**Wates Construction**	**PH16**

Contract Ref:	Date:	Ground Level:	Co-ordinates:	Sheet:
25520	**07.08.12**	**---**	**---**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							Concrete over crushed aggregates	(0.30) 0.30	
	0.40	1	D				MADE GROUND: reworked brown silty sand with chalk, flint and occasional brick	(0.50) 0.80	
					1		Initially loose becoming moderately compact grey silty clayey fine to coarse SAND with fine to coarse flint gravel and occasional lenses of soft sandy clay Wet from 0.80m	(1.40) 2.20	
	1.50	2	D						
	2.50	3	D				Low becoming medium density weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble	(0.80) 3.00	
							END OF PROBEHOLE		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)
07/08/12		3.00	-		1.50

General Remarks

All dimensions in metres | Scale: **1:25**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**SJeffery**	

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BOREHOLE LOG

Contract:	Client:	Borehole:
Former Battle Hospital	**Wates Construction**	**BH1**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
25520	**02.08.12** End: **03.08.12**	**---**	**---**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
						Made Ground: Crushed aggregates	0.40	
0.40	12	D				MADE GROUND: dark brown grey sandy matrix with ash, charcoal, flint and occasional brick and organic matter	0.80	
0.80	13	D				Loose (wet appearing soft) brown silty slightly clayey fine to medium SAND with fine to coarse flint gravel	(0.50) 1.30	
1.30	14	D		1		Medium dense brown sandy fine to coarse flint GRAVEL. Gravel subangular to subrounded		
1.40-1.85	1	SPT	N=11					
1.40	15	D						
2.00-2.45	2	SPT	N=14				(2.30)	
2.00	16	D						
3.00-3.45	3	SPT	N=18				3.60	
3.00	17	D						
3.70	18	D				Low becoming medium density weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble		
4.00-4.45	4	SPT	N=4					
4.00	19	D						
5.00-5.45	5	SPT	N=10					
5.00	20	D						
6.50-6.95	6	SPT	N=9					
6.50	21	D						
8.00-8.45	7	SPT	N=10					
8.00	22	D					(9.90)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
02/08/12		13.50	-		1.50

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Cable tool rig**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log CABLE PERCUSSION LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:46 | SJ.
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BOREHOLE LOG

Contract:	Client:	Borehole:
Former Battle Hospital	**Wates Construction**	**BH1**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
25520	**02.08.12** End: **03.08.12**	**---**	**---**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
9.50-9.95 9.50	8 23	SPT D	N=14			Low becoming medium density weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble *(stratum text copied from layer at 3.60m depth from previous sheet)*		
11.00-11.45 11.00	9 24	SPT D	N=28					
12.00-12.45 12.00	10 25	SPT D	N=28					
13.00-13.45 13.00	11 26	SPT D	N=29					
							13.50	
						END OF BOREHOLE		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Cable tool rig**	**MB**	**SJeffery**	

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BOREHOLE LOG

Contract:	Client:	Borehole:
Former Battle Hospital	**Wates Construction**	**BH2**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
25520	**06.08.12** End: **07.08.12**	**---**	**---**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
						Bituminous Paving over crushed aggregates	0.20	
0.50	9	D				MADE GROUND: brown sandy clay with flint, brick, concrete, charcoal and occasional wood or organic matter	(0.60) 0.80	
1.20-1.65	1	SPT	N=4	1		MADE GROUND: brown black sandy clay with ash, brick, flint and occasional carpet and wood. Slight to moderate hydrocarbon odour/sheen noted.	(3.10) 3.90	
1.20	10	D						
1.50	11	D						
2.50	12	D						
3.00-3.45	2	SPT	N=2					
3.00	13	D						
3.90	14	D				Soft grey clayey SILT or silty CLAY with sandy lenses, organic matter and very fine flint	(0.55) 4.45	
4.00-4.45	3	SPT	N=18					
4.00	15	D						
4.70	16	D				Medium dense brown sandy fine to coarse flint GRAVEL with sand lenses. Gravel subangular to sub rounded	(1.85) 6.30	
5.00-5.45	4	SPT	N=12					
5.00	17	D						
6.30	18	D				Low becoming medium density weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble		
6.50-6.95	5	SPT	N=5					
6.50	19	D						
7.00	20	D						
7.50-7.95	6	SPT	N=11					
7.50	21	D						

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
06/08/12		12.50	-		1.20

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Cable tool rig**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log CABLE PERCUSSION LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:46 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk.

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Battle Hospital	**Wates Construction**	**BH2**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
25520	**06.08.12** End: **07.08.12**	**---**	**---**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
9.00-9.45 9.00	7 22	SPT D	N=12			Low becoming medium density weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble *(stratum text copied from layer at 6.30m depth from previous sheet)*	(6.20)	
10.50-10.95 10.50	8 23	SPT D	N=16					
12.00-12.45 12.00	9 24	SPT D	N=23					
						END OF BOREHOLE	12.50	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Cable tool rig**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log CABLE PERCUSSION LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:46 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk.

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Battle Hospital	**Wates Construction**	**BH3**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
25520	**09.08.12** End: **10.08.12**	**---**	**---**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
						Bituminous Paving over crushed aggregates	0.30	
0.70	9	D				MADE GROUND: brown sandy clay with flint, brick, concrete and ash	(0.90)	
1.20-1.65	1	SPT	N=1				1.20	
1.20	10	D		1		MADE GROUND: brown black sandy clay or clay sand matrix with flint, ash, organic matter, brick, glass and occasional carpet	(1.40)	
							2.60	
						Soft brown very organic silty PEAT	(1.10)	
3.00-3.45	2	SPT	N=3					
3.00	11	D					3.70	
3.70	12	D				Soft grey clayey SILT or silty CLAY with sandy lenses, organic matter and very fine flint	(1.30)	
4.00-4.45	3	SPT	N=2					
4.00	13	D					5.00	
5.00	14	D				Medium dense brown fine to coarse SAND with fine to coarse flint gravel	(1.50)	
6.00	15	D					6.50	
6.50-6.95	4	SPT	N=34			Dense brown sandy fine to coarser flint GRAVEL. Gravel is subangular to subrounded.	(1.50)	
							8.00	
8.00-8.45	5	SPT	N=4			Low becoming medium density highly weathered to weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble		
8.00	16	D						

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth
		13.00	-		1.80

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Cable tool rig**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log CABLE PERCUSSION LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:46 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk.

BOREHOLE LOG

Contract:	Client:	Borehole:
Former Battle Hospital	**Wates Construction**	**BH3**

Contract Ref:	Start:	Ground Level:	Co-ordinates:	Sheet:
25520	**09.08.12** End: **10.08.12**	**---**	**---**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Depth	No	Type	Results					
9.00	17	D				Low becoming medium density highly weathered to weathered CHALK recovered as a soft to firm cream to white clayey matrix with fine to coarse gravel sized weak intact fragments of chalk and occasional flint gravel or cobble *(stratum text copied from layer at 8.00m depth from previous sheet)*	(5.00)	
9.50-9.95	6	SPT	N=13					
9.50	18	D						
11.00-11.45	7	SPT	N=14					
11.00	19	D						
12.50-12.95	8	SPT	N=14					
12.50	20	D						
						END OF BOREHOLE	13.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:50**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Cable percussion	**Cable tool rig**	**MB**	**SJeffery**	

GINT_LIBRARY_V8_04.GLB|Log CABLE PERCUSSION LOG | 25520BATTLEHOSPITAL.GPJ - v8_04 | 11/09/12 - 14:46 | SJ.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk.

APPENDIX G
GROUND GAS AND LOW FLOW MONITORING SHEETS

GROUNDWATER SAMPLING DATA FORM

Well Number:	PH5	Sampling Date:	21/08/2012
Project Name:	Battle Hospital	Weather:	Cloudy
Project Number:	25520	Sampled By:	ARJ

Well Information

Well Type: Monitor Other:
Well Construction: PVC
Well Diameter: 35 (mm)
Screened Internval: to *mbTOC
Well Depth (mbTOC):
Well Headspace Reading (PID/FID):
Static Water Level (mbTOC): 1.255
Product Level, if present (mbTOC): N/R
Well Notes (well condition, odor, etc.): Good

Well Diameter (mm) =	**17(mm)**	**53**	**95**	**100**	**145**	**380**
Volume/meter (ltrs) =	**0.23(ltrs)**	**2.2**	**7.1**	**7.9**	**16.5**	**113**

Purging Information

Purge Method: **Low-Flow** Manual Bailing 3-Well Volumes Not Purged Other:
Pump: Submersible (____-mm) **Peristaltic** Manual Bailing Other:
Pump intake depth: 1.75 Purge water discharged to: Drum Ground Interceptor Other: Sewer
Pump/Cell Tubing: Polypropylene Teflon **Silicone** Other: PTFE /New Dedicated

Time (HH:mm)	Temp. (oC)	ECond (µS/cm)	D.O. (mg/l)	pH (unit)	REDOX (mV)		DTW (mbTOC)	Flow Rate (ltr/min)	Volume (litres)	Notes
12.21										
12.24	18.1	787	2.07	7.61	-70.2		1.26			
12.27	17.9	796	0.7	7.46	-72.3		1.26			
12.3	17.9	798	0.67	7.4	-73.6		1.27			
12.33	18	786	0.4	7.33	-77.4		1.27			

Total Volume Purged (ltrs): 1.5 Water Quality Meter Used: YS1 556 HH2022

Note: Record low-flow parameters at consistent 3 minute intervals until "stabilization criteria" met for 3 continuous readings

Record submersible pump parameters at consistent purge intervals (ex: once every 6 litres) until stabilized, but no less than 5 intervals.

Sampling Data

Groundwater Sample Field ID:
Sample Collection Time:
Sampling Method: Bailers: StainlessSteel / PVC / Disposable **Low-flow tubing** Other:
Sampling Observations (oil/colour/odour/sediment,etc.): Clear and hydro sheen and odour
Laboratory Analyses on C.O.C.:

Laboratory Name/Location:

Stabilization Criteria

Dissolved Oxygen (D.O.)	(+/-)	0.3mg/l
Turbidity	(+/-)	10%
Electric Conductivity (ECond)	(+/-)	3%
Reduction Potential (REDOX/ORP)	(+/-)	10mV
pH	(+/-)	0.1 unit

Comments/Calculations:

*mbTOC = meters below top of casing; C.O.C.= chain of custody

GROUNDWATER SAMPLING DATA FORM

Well Number:	PH5	Sampling Date:	21/08/2012
Project Name:	Battle Hospital	Weather:	Cloudy
Project Number:	25520	Sampled By:	OP

Well Information

Well Type: Monitor Other:
Well Construction: PVC
Well Diameter: 35 (mm)
Screened Internval: to *mbTOC
Well Depth (mbTOC): 2.875
Well Headspace Reading (PID/FID):
Static Water Level (mbTOC): 1.63
Product Level, if present (mbTOC): N/R
Well Notes (well condition, odor, etc.): Good

Well Diameter (mm) =	**17(mm)**	**53**	**95**	**100**	**145**	**380**
Volume/meter (ltrs) =	**0.23(ltrs)**	**2.2**	**7.1**	**7.9**	**16.5**	**113**

Purging Information

Purge Method: **Low-Flow** Manual Bailing 3-Well Volumes Not Purged Other:
Pump: Submersible (____-mm) **Peristaltic** Manual Bailing Other:
Pump intake depth: 2.1 Purge water discharged to: Drum Ground Interceptor Other: Sewer
Pump/Cell Tubing: Polypropylene Teflon **Silicone** Other: PTFE /New Dedicated

Time (HH:mm)	Temp. (oC)	ECond (µS/cm)	D.O. (mg/l)	pH (unit)	REDOX (mV)		DTW (mbTOC)	Flow Rate (ltr/min)	Volume (litres)	Notes
15.42	21.3			7.81	27.2		1.79			
15.43	21.4		1.02	7.54	23.5					
15.48	21.4		0.86	7.43	22.3		1.81			
15.51	21.2	882	0.63	7.39	15		1.81			
15.54	21.1	882	0.58	7.36	8.5		1.81			
15.57	21	883	0.57	7.32	4.4		1.81			

Total Volume Purged (ltrs): 1.5 Water Quality Meter Used: YS1 556 HH2022

Note: Record low-flow parameters at consistent 3 minute intervals until "stabilization criteria" met for 3 continuous readings

Record submersible pump parameters at consistent purge intervals (ex: once every 6 litres) until stabilized, but no less than 5 intervals.

Sampling Data

Groundwater Sample Field ID:
Sample Collection Time:
Sampling Method: Bailers: StainlessSteel / PVC / Disposable **Low-flow tubing** Other:
Sampling Observations (oil/colour/odour/sediment,etc.): Clear and no odour
Laboratory Analyses on C.O.C.:

Laboratory Name/Location:

Stabilization Criteria

Dissolved Oxygen (D.O.)	(+/-)	0.3mg/l
Turbidity	(+/-)	10%
Electric Conductivity (ECond)	(+/-)	3%
Reduction Potential (REDOX/ORP)	(+/-)	10mV
pH	(+/-)	0.1 unit

Comments/Calculations:

*mbTOC = meters below top of casing; C.O.C.= chain of custody

GROUNDWATER SAMPLING DATA FORM

Well Number:	PH3	Sampling Date:	21/08/2012
Project Name:	Battle Hospital	Weather:	Cloudy
Project Number:	25520	Sampled By:	ARJ

Well Information

Well Type: Monitor Other:
Well Construction: PVC
Well Diameter: 35 (mm)
Screened Internval: to *mbTOC
Well Depth (mbTOC): 2.97
Well Headspace Reading (PID/FID):
Static Water Level (mbTOC): 1.145
Product Level, if present (mbTOC): N/R
Well Notes (well condition, odor, etc.): Good

Well Diameter (mm) =	**17(mm)**	**53**	**95**	**100**	**145**	**380**
Volume/meter (ltrs) =	**0.23(ltrs)**	**2.2**	**7.1**	**7.9**	**16.5**	**113**

Purging Information

Purge Method: **Low-Flow** Manual Bailing 3-Well Volumes Not Purged Other:
Pump: Submersible (____-mm) **Peristaltic** Manual Bailing Other:
Pump intake depth: 1.5 Purge water discharged to: Drum Ground Interceptor Other: Sewer
Pump/Cell Tubing: Polypropylene Teflon **Silicone** Other: PTFE /New Dedicated

Time (HH:mm)	Temp. (oC)	ECond (µS/cm)	D.O. (mg/l)	pH (unit)	REDOX (mV)		DTW (mbTOC)	Flow Rate (ltr/min)	Volume (litres)	Notes
11.43	18.7			7.53	-138.2		1.15			
11.46	18.1	1344	1.11	7.45	-142.7		1.15			
11.49	17.5	1288	0.86	7.36	-142.8		1.15			
11.52	17.5	1281	0.77	7.35	-143.7		1.15			
11.55	17.4	1275	0.66	7.32	-144		1.15			

Total Volume Purged (ltrs): 1.5 Water Quality Meter Used: YS1 556 HH2022

Note: Record low-flow parameters at consistent 3 minute intervals until "stabilization criteria" met for 3 continuous readings

Record submersible pump parameters at consistent purge intervals (ex: once every 6 litres) until stabilized, but no less than 5 intervals.

Sampling Data

Groundwater Sample Field ID:
Sample Collection Time:
Sampling Method: Bailers: StainlessSteel / PVC / Disposable **Low-flow tubing** Other:
Sampling Observations (oil/colour/odour/sediment,etc.): Clear and hydro sheen and odour
Laboratory Analyses on C.O.C.:

Laboratory Name/Location:

Stabilization Criteria

Dissolved Oxygen (D.O.)	(+/-)	0.3mg/l
Turbidity	(+/-)	10%
Electric Conductivity (ECond)	(+/-)	3%
Reduction Potential (REDOX/ORP)	(+/-)	10mV
pH	(+/-)	0.1 unit

Comments/Calculations:

*mbTOC = meters below top of casing; C.O.C.= chain of custody

GROUNDWATER SAMPLING DATA FORM

Well Number:	PH2	Sampling Date:	21/08/2012
Project Name:	Battle Hospital	Weather:	Cloudy
Project Number:	25520	Sampled By:	ARJ

Well Information

Well Type: Monitor Other:
Well Diameter: 35 (mm)
Well Depth (mbTOC):
Static Water Level (mbTOC): 1.22
Well Notes (well condition, odor, etc.): Good

Well Construction: PVC
Screened Internval: to *mbTOC
Well Headspace Reading (PID/FID):
Product Level, if present (mbTOC): N/R

Well Diameter (mm) =	**17(mm)**	**53**	**95**	**100**	**145**	**380**
Volume/meter (ltrs) =	**0.23(ltrs)**	**2.2**	**7.1**	**7.9**	**16.5**	**113**

Purging Information

Purge Method: **Low-Flow** Manual Bailing 3-Well Volumes Not Purged Other:
Pump: Submersible (____-mm) **Peristaltic** Manual Bailing Other:
Pump intake depth: 1.75 Purge water discharged to: Drum Ground Interceptor Other: Sewer
Pump/Cell Tubing: Polypropylene Teflon **Silicone** Other: PTFE /New Dedicated

Time (HH:mm)	Temp. (oC)	ECond (µS/cm)	D.O. (mg/l)	pH (unit)	REDOX (mV)		DTW (mbTOC)	Flow Rate (ltr/min)	Volume (litres)	Notes
10.53	18.2			13.34	-119.7		1.22			
10.56	18	1547	1.53	14.51	-125.6		1.22			
10.59	17.8	1545	1.05	14.61	-127.8		1.22			
11.02	17.8	1541	0.97	14.59	-128.9		1.22			
11.05	17.9	1534	0.76	14.59	-129		1.22			

Total Volume Purged (ltrs): 2 Water Quality Meter Used: YS1 556 HH2022

Note: Record low-flow parameters at consistent 3 minute intervals until "stabilization criteria" met for 3 continuous readings

Record submersible pump parameters at consistent purge intervals (ex: once every 6 litres) until stabilized, but no less than 5 intervals.

Sampling Data

Groundwater Sample Field ID:
Sample Collection Time:
Sampling Method: Bailers: StainlessSteel / PVC / Disposable **Low-flow tubing** Other:
Sampling Observations (oil/colour/odour/sediment,etc.): Clear and slight sheen with odour (hydro)
Laboratory Analyses on C.O.C.:

Laboratory Name/Location:

Stabilization Criteria

Dissolved Oxygen (D.O.)	(+/-)	0.3mg/l
Turbidity	(+/-)	10%
Electric Conductivity (ECond)	(+/-)	3%
Reduction Potential (REDOX/ORP)	(+/-)	10mV
pH	(+/-)	0.1 unit

Comments/Calculations:

*mbTOC = meters below top of casing; C.O.C.= chain of custody

GROUNDWATER SAMPLING DATA FORM

Well Number:	BH3	Sampling Date:	21/08/2012
Project Name:	Battle Hospital	Weather:	Cloudy
Project Number:	25520	Sampled By:	SRJ

Well Information

Well Type: Monitor Other:
Well Construction: PVC
Well Diameter: 50 (mm)
Screened Internval: to *mbTOC
Well Depth (mbTOC): 11.67
Well Headspace Reading (PID/FID):
Static Water Level (mbTOC): 1.772
Product Level, if present (mbTOC): N/R
Well Notes (well condition, odor, etc.): Good

Well Diameter (mm) =	**17(mm)**	**53**	**95**	**100**	**145**	**380**
Volume/meter (ltrs) =	**0.23(ltrs)**	**2.2**	**7.1**	**7.9**	**16.5**	**113**

Purging Information

Purge Method: **Low-Flow** Manual Bailing 3-Well Volumes Not Purged Other:
Pump: Submersible (____-mm) **Peristaltic** Manual Bailing Other:
Pump intake depth: 2 Purge water discharged to: Drum Ground Interceptor Other: Sewer
Pump/Cell Tubing: Polypropylene Teflon **Silicone** Other: PTFE /New Dedicated

Time (HH:mm)	Temp. (oC)	ECond (µS/cm)	D.O. (mg/l)	pH (unit)	REDOX (mV)		DTW (mbTOC)	Flow Rate (ltr/min)	Volume (litres)	Notes
13.31							1.77			
13.33	16.8	1232	2.89	7.74	-14.8		1.77			
13.36	16.5	1226	1.96	7.69	-11.3		1.77			
13.39	16.2	1214	0.73	7.64	-8.9		1.77			
13.42	16..0	1206	0.62	7.59	-4.1		1.77			
13.45	15.8	1199	0.57	7.62	-1.3		1.77			

Total Volume Purged (ltrs): 2 Water Quality Meter Used: YS1 556 HH2022

Note: Record low-flow parameters at consistent 3 minute intervals until "stabilization criteria" met for 3 continuous readings

Record submersible pump parameters at consistent purge intervals (ex: once every 6 litres) until stabilized, but no less than 5 intervals.

Sampling Data

Groundwater Sample Field ID:
Sample Collection Time:
Sampling Method: Bailers: StainlessSteel / PVC / Disposable **Low-flow tubing** Other:
Sampling Observations (oil/colour/odour/sediment,etc.): Clear and odourless
Laboratory Analyses on C.O.C.:

Laboratory Name/Location:

Stabilization Criteria

Dissolved Oxygen (D.O.)	(+/-)	0.3mg/l
Turbidity	(+/-)	10%
Electric Conductivity (ECond)	(+/-)	3%
Reduction Potential (REDOX/ORP)	(+/-)	10mV
pH	(+/-)	0.1 unit

Comments/Calculations:

*mbTOC = meters below top of casing; C.O.C.= chain of custody

GROUNDWATER SAMPLING DATA FORM

Well Number:	BH2	Sampling Date:	21/08/2012
Project Name:	Battle Hospital	Weather:	Cloudy
Project Number:	25520	Sampled By:	SRJ

Well Information

Well Type: Monitor Other:
Well Construction: PVC
Well Diameter: 50 (mm)
Screened Internval: to *mbTOC
Well Depth (mbTOC): 1.48
Well Headspace Reading (PID/FID):
Static Water Level (mbTOC): 1.075
Product Level, if present (mbTOC): N/R
Well Notes (well condition, odor, etc.): Good

Well Diameter (mm) =	**17(mm)**	**53**	**95**	**100**	**145**	**380**
Volume/meter (ltrs) =	**0.23(ltrs)**	**2.2**	**7.1**	**7.9**	**16.5**	**113**

Purging Information

Purge Method: **Low-Flow** Manual Bailing 3-Well Volumes Not Purged Other:
Pump: Submersible (____-mm) **Peristaltic** Manual Bailing Other:
Pump intake depth: 2 Purge water discharged to: Drum Ground Interceptor Other: Sewer
Pump/Cell Tubing: Polypropylene Teflon **Silicone** Other: PTFE /New Dedicated

Time (HH:mm)	Temp. (oC)	ECond (µS/cm)	D.O. (mg/l)	pH (unit)	REDOX (mV)		DTW (mbTOC)	Flow Rate (ltr/min)	Volume (litres)	Notes
12.5	20.1			7.34	-118.4		1.075			
12.53	20	1026	1.55	7.33	-124.7		1.075			
12.56	19.9	1030	1.01	7.27	-131.3		1.075			
12.59	19.9	1037	0.8	7.23	-33.6		1.075			
13.02	19.8	1043	0.72	7.21	-132.6		1.075			
13.05	19.7	1053	0.61	7.2	-131.7		1.075			

Total Volume Purged (ltrs): 1.5 Water Quality Meter Used: YS1 556 HH2022

Note: Record low-flow parameters at consistent 3 minute intervals until "stabilization criteria" met for 3 continuous readings

Record submersible pump parameters at consistent purge intervals (ex: once every 6 litres) until stabilized, but no less than 5 intervals.

Sampling Data

Groundwater Sample Field ID:
Sample Collection Time:
Sampling Method: Bailers: StainlessSteel / PVC / Disposable **Low-flow tubing** Other:
Sampling Observations (oil/colour/odour/sediment,etc.): Clear and slight hydro odour /sheen surface
Laboratory Analyses on C.O.C.:

Laboratory Name/Location:

Stabilization Criteria

Dissolved Oxygen (D.O.)	(+/-)	0.3mg/l
Turbidity	(+/-)	10%
Electric Conductivity (ECond)	(+/-)	3%
Reduction Potential (REDOX/ORP)	(+/-)	10mV
pH	(+/-)	0.1 unit

Comments/Calculations:

*mbTOC = meters below top of casing; C.O.C.= chain of custody

GROUNDWATER SAMPLING DATA FORM

Well Number:	BH1	Sampling Date:	21/08/2012
Project Name:	Battle Hospital	Weather:	Cloudy
Project Number:	25520	Sampled By:	SRJ

Well Information

Well Type:	Monitor	Other:	
Well Construction:	PVC		
Well Diameter:	50 (mm)	Screened Internval:	to *mbTOC
Well Depth (mbTOC):	8.03	Well Headspace Reading (PID/FID):	
Static Water Level (mbTOC):	1.28	Product Level, if present (mbTOC):	N/R
Well Notes (well condition, odor, etc.):	Good		

Well Diameter (mm) =	**17(mm)**	**53**	**95**	**100**	**145**	**380**
Volume/meter (ltrs) =	**0.23(ltrs)**	**2.2**	**7.1**	**7.9**	**16.5**	**113**

Purging Information

Purge Method: **Low-Flow** Manual Bailing 3-Well Volumes Not Purged Other:

Pump: Submersible (____-mm) **Peristaltic** Manual Bailing Other:

Pump intake depth: 2 Purge water discharged to: Drum Ground Interceptor Other: Sewer

Pump/Cell Tubing: Polypropylene Teflon **Silicone** Other: PTFE /New Dedicated

Time (HH:mm)	Temp. (oC)	ECond (µS/cm)	D.O. (mg/l)	pH (unit)	REDOX (mV)		DTW (mbTOC)	Flow Rate (ltr/min)	Volume (litres)	Notes
14.39	18.3			7.71	-5.8		1.29			
14.42	18.2	670	0.91	7.49	-14.9		1.29			
14.45	18.1	670	0.75	7.42	-18.7		1.29			
14.48	18	670	0.66	7.39	-21.8		1.29			
14.51	18	670	0.6	7.36	-23.4		1.29			

Total Volume Purged (ltrs): 1.5 Water Quality Meter Used: YS1 556 HH2022

Note: Record low-flow parameters at consistent 3 minute intervals until "stabilization criteria" met for 3 continuous readings

Record submersible pump parameters at consistent purge intervals (ex: once every 6 litres) until stabilized, but no less than 5 intervals.

Sampling Data

Groundwater Sample Field ID:

Sample Collection Time:

Sampling Method: Bailers: StainlessSteel / PVC / Disposable **Low-flow tubing** Other:

Sampling Observations (oil/colour/odour/sediment,etc.): Clear and odourless

Laboratory Analyses on C.O.C.:

Laboratory Name/Location:

Stabilization Criteria

Dissolved Oxygen (D.O.)	(+/-)	0.3mg/l
Turbidity	(+/-)	10%
Electric Conductivity (ECond)	(+/-)	3%
Reduction Potential (REDOX/ORP)	(+/-)	10mV
pH	(+/-)	0.1 unit

Comments/Calculations:

*mbTOC = meters below top of casing; C.O.C.= chain of custody

Location	Depth to water (m bgl)	Flow (l/hr)	Atmospheric Pressure (Mb)	Time (seconds)	% by volume in air			LEL (%)	Water samples/observations
					Methane	Carbon Dioxide	Oxygen		
PH2	1.22	0	1019	0	<0.1	<0.1	20.9	0.0	Ground level to toc - 0.105m
				15	<0.1	14.5	7.8	0.0	Hole depth - 2.71 mtoc
				30	<0.1	14.6	7.6	0.0	PID - 0 ppm
				60	<0.1	15.1	5.4	0.0	
				90	<0.1	17.6	5.0	0.0	
				120	<0.1	18.4	4.1	0.0	
				180	<0.1	19.7	3.3	0.0	
PH3	1.146	0	1015	0	<0.1	<0.1	20.9	**0.0**	Gas tap open upon arrival, closed valve and began monitoring 30 minutes later.
				15	33.5	9.7	7.7	>>>>*	*Off scale
				30	33.7	9.7	5.9	>>>>	Ground level to toc - 0.10m
				60	34.4	9.8	5.0	>>>>	Hole depth - 2.96 mtoc
				90	35.2	11.1	4.1	>>>>	PID - 0 ppm
				120	38.6	11.6	2.6	>>>>	
				180	40.9	12.5	1.7	>>>>	
21 August 2012									

Location	Depth to water (m bgl)	Flow (l/hr)	Atmospheric Pressure (Mb)	Time (seconds)	% by volume in air			LEL (%)	Water samples/observations
					Methane	Carbon Dioxide	Oxygen		
PH5	1.66	0	1015	0	<0.1	<0.1	20.9	0.0	Gas tap open upon arrival, closed valve and began monitoring 30 minutes later. Ground level to toc - 0.155m Hole depth - 2.875 mtoc **PID - 40 ppm**
				15	<0.1	1.5	20.2	0.0	
				30	<0.1	1.6	19.6	0.0	
				60	<0.1	2.0	19.0	0.0	
				90	<0.1	2.3	18.4	0.0	
				120	<0.1	3.0	17.5	0.0	
				180	<0.1	3.9	16.3	0.0	
PH6	1.250	0	1017	0	<0.1	<0.1	21.1	0.0	Gas tap open upon arrival, closed valve and began monitoring 30 minutes later. Ground level to toc - 0.16m Hole depth - 2.45 mtoc **PID - 20 ppm**
				15	<0.1	6.2	15.1	0.0	
				30	<0.1	7.0	13.2	0.0	
				60	<0.1	9.4	10.4	0.0	
				90	<0.1	11.8	8.0	0.0	
				120	<0.1	13.9	4.9	0.0	
				180	<0.1	18.0	0.3	0.0	
21 August 2012									

Location	Depth to water (m bgl)	Flow (l/hr)	Atmospheric Pressure (Mb)	Time (seconds)	% by volume in air			LEL (%)	Water samples/observations
					Methane	Carbon Dioxide	Oxygen		
PH8	1.42	0	1017	0	<0.1	<0.1	21.2	0.0	Ground level to toc - 0.14m
				15	<0.1	16.3	7.5	0.0	Hole depth - 2.95 mtoc
				30	<0.1	16.9	5.7	0.0	**PID - 0 ppm**
				60	<0.1	17.5	5.2	0.0	
				90	<0.1	17.9	4.8	0.0	
				120	<0.1	18.2	4.6	0.0	
				180	<0.1	18.7	4.0	0.7	
PH10	0.20	0	1016	0	**<0.1**	**<0.1**	**21.0**	**0.0**	Ground level to toc - 0.11m
				15	0.6	0.9	17.3	0.0	Hole depth - 3.50 mtoc
				30	**Gas monitoring not completed due to high water level.**				PID - 0 ppm
				60					
				90					
				120					
				180					
21 August 2012									

Location	Depth to water (m bgl)	Flow (l/hr)	Atmospheric Pressure (Mb)	Time (seconds)	% by volume in air			LEL (%)	Water samples/observations
					Methane	Carbon Dioxide	Oxygen		
PH12	1.42	0	1015	0	<0.1	<0.1	21.0	0.0	Ground level to toc – 0.135m
				15	<0.1	3.5	14.8	0.0	Hole depth - 3.44 mtoc
				30	<0.1	3.1	12.6	0.0	**PID – 0.3 ppm**
				60	<0.1	3.2	12.4	0.0	
				90	<0.1	3.2	13.2	0.0	
				120	<0.1	2.3	14.7	0.0	
				180	<0.1	1.9	17.5	0.0	
21 August 2012									

Results of Gas Monitoring 21 August 2012

Atmospheric Pressure:	1015-1019 mb
Temperature:	20°C
Ground Conditions:	Dry
Weather Conditions:	Cloudy, hot, light breeze
Engineer:	Andrew James and Oliver Pengilly
Equipment Used:	GFM430 (HH104), Interface Probe (HH081), PID (HH038)

Location	Depth to water (m bgl)	Flow (l/hr)	Atmospheric Pressure (Mb)	Time (seconds)	% by volume in air			LEL (%)	Water samples/observations
					Methane	Carbon Dioxide	Oxygen		
PH2	1.279	0	1022	0	<0.1	<0.1	20.6	0.0	Hole depth - 2.61 mtoc
				15	<0.1	13.2	8.3	0.0	PID - 0 ppm
				30	<0.1	13.5	5.2	0.0	
				60	<0.1	14.0	4.1	0.0	
				90	<0.1	14.5	3.3	0.0	
				120	<0.1	15.7	2.3	0.0	
				180	<0.1	16.9	1.8	0.0	
PH3	1.210	0	1021	0	<0.1	<0.1	21.2	**0.0**	*Off scale
				15	53.8	10.2	3.3	>>>>*	Hole depth - 2.84 mtoc
				30	53.9	10.4	<0.1	>>>>	PID - 0 ppm
				60	54.1	10.6	<0.1	>>>>	
				90	54.1	10.7	<0.1	>>>>	
				120	54.0	10.8	<0.1	>>>>	
				180	54.1	11.1	<0.1	>>>>	
04 September 2012									

Location	Depth to water (m bgl)	Flow (l/hr)	Atmospheric Pressure (Mb)	Time (seconds)	% by volume in air			LEL (%)	Water samples/observations
					Methane	Carbon Dioxide	Oxygen		
PH5	1.684	0	1020	0	<0.1	<0.1	20.9	0.0	Hole depth - 2.875 mtoc
				15	<0.1	4.4	17.4	0.0	**PID - 0 ppm**
				30	<0.1	4.4	16.9	0.0	
				60	<0.1	4.5	16.8	0.0	
				90	<0.1	4.5	16.7	0.0	
				120	<0.1	4.5	16.7	0.0	
				180	<0.1	4.5	16.5	0.0	
PH6	1.320	0	1019	0	<0.1	<0.1	21.4	0.0	Hole depth - 2.46 mtoc
				15	<0.1	17.0	6.7	0.0	**PID - 1.5 ppm**
				30	<0.1	17.6	0.5	0.0	
				60	<0.1	18.0	0.1	0.0	
				90	<0.1	18.1	<0.1	0.0	
				120	<0.1	18.2	<0.1	0.0	
				180	<0.1	18.2	<0.1	0.0	
04 September 2012									

Location	Depth to water (m bgl)	Flow (l/hr)	Atmospheric Pressure (Mb)	Time (seconds)	% by volume in air			LEL (%)	Water samples/observations
					Methane	Carbon Dioxide	Oxygen		
PH8	1.464	0	1020	0	<0.1	<0.1	21.2	0.0	Hole depth - 2.94 mtoc
				15	<0.1	16.6	8.1	0.0	**PID - 0 ppm**
				30	<0.1	15.1	6.2	0.0	
				60	<0.1	15.4	5.9	0.0	
				90	<0.1	15.9	5.5	0.0	
				120	<0.1	16.1	5.3	0.0	
				180	<0.1	16.5	4.7	0.7	
PH10	0.278			0	**Gas monitoring not completed due to high water level.**				Hole depth - 3.50 mtoc
				15					PID - 0 ppm
				30					
				60					
				90					
				120					
				180					
04 September 2012									

Location	Depth to water (m bgl)	Flow (l/hr)	Atmospheric Pressure (Mb)	Time (seconds)	% by volume in air			LEL (%)	Water samples/observations
					Methane	Carbon Dioxide	Oxygen		
PH12	1.335	0	1020	0	<0.1	<0.1	21.2	0.0	Hole depth - 3.31 mtoc
				15	<0.1	2.9	16.9	0.0	**PID - 0 ppm**
				30	<0.1	3.0	15.4	0.0	
				60	<0.1	3.4	15.0	0.0	
				90	<0.1	3.9	14.4	0.0	
				120	<0.1	3.4	15.5	0.0	
				180	<0.1	2.3	17.6	0.0	
04 September 2012									

Results of Gas Monitoring — 04 September 2012

Atmospheric Pressure:	1022-1019 mb
Temperature:	26°C
Ground Conditions:	Dry
Weather Conditions:	Cloudy, hot, muggy
Engineer:	Andrew James
Equipment Used:	GFM430 (HH104), Interface Probe (HH081), PID (HH038)

APPENDIX H
PID RESULTS

Portman Road, Reading

PID Readings - Soil Samples

Borehole Location	Depth (m)	PID reading - ppm (v)
PH1	0.5	**25-35**
PH1	1.3	**0.5**
PH2	0.4	**0.4**
PH2	1.4	**25-36**
PH2	3.4	**10**
PH3	0.5	**6.5**
PH3	2.5	**1.4**
PH3	3.3	**0.9**
PH4	0.3	**0.9-1.4**
PH4	1.1	**0.3-1.9**
PH4	1.7	**27**
PH5	0.4	**0**
PH5	0.9	**0**
PH5	1.9	**1**
PH5	2.5	**0.6**
PH6	0.3	**1.4**
PH6	1.3	**22-42**
PH6	2.3	**10**
PH6	2.5	**1.4**
PH7	0.4	**1.4**
PH7	1.5	**1.4**
PH8	0.4	**0.7**
PH8	3.2	**0.8-1.0**
PH9	0.5	**20.5-25**
PH9	1.5	**1.2**
PH9	2.7	**0.8**
PH10	0.6	**1.2-1.4**
PH10	1.6	**0.8**
PH10	2.6	**0**
PH11	0.6	**0**
PH11	1.2	**0**
PH11	2	**0**
PH12	0.5	**0.8**
PH12	1.5	**0.4**
PH13	0.6	**1**
PH13	1.5	**13-22**
PH13	2.4	**0.4**
PH14	0.4	**0.1**

APPENDIX I
LABORATORY CERTIFICATES FOR SOILS ANALYSIS

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 12/03610
Issue Number: 1 **Date:** 28 August, 2012

Client:
RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Nigel Austin / Stuart Jeffery
Project Name: Battle Hospital
Project Ref: 25520
Order No: Not specified
Date Samples Received: 13/08/12
Date Instructions Received: 13/08/12
Date Analysis Completed: 28/08/12

Prepared by:
Melanie Marshall
Laboratory Coordinator

Approved by:
Iain Haslock
Analytical Consultant

Notes - Soil analysis
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 inert stones >10mm are removed or excluded from the sample prior to analysis and reported results corrected to a whole sample basis. For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis.
Notes - General
Subscript "A" indicates analysis performed on the sample as received, "D" indicates analysis performed on dried & crushed sample.
All analysis is performed on the dried and crushed sample for samples with Matrix Code 7 and this supercedes any "A" subscripts. Superscript "M" indicates method accredited to MCERTS. Results in italics are associated with a control limit flag.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling.
Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.
Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.
IS indicates Insufficient sample for analysis. NDP indicates No Determination Possible. NAD indicates No Asbestos Detected.
Superscript # indicates method accredited to ISO 17025.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME
UKAS TESTING 1247

Envirolab Job Number: 12/03610

Client Project Name: Battle Hospital

Client Project Ref: 25520

Lab Sample ID	12/03610/1	12/03610/2	12/03610/3	12/03610/4	12/03610/5	12/03610/6	12/03610/7	12/03610/8	Units	Method ref
Client Sample No										
Client Sample ID	PH1	PH2	PH2	PH3	PH6	PH3	PH4	PH5		
Depth to Top	1.30	1.40	2.40	2.50	1.30	0.50	0.30	0.40		
Depth To Bottom										
Date Sampled	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12		
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D		
Sample Matrix Code	3AE	5ABE	5ABD	5AD	5AB	4A	4A	4ABE		
pH_D M#	-	-	-	-	-	7.80	7.49	8.15	pH	A-T-031s
pH BRE_D M#	7.38	-	-	-	-	-	-	-	pH	A-T-031s
Sulphate (water sol 2:1)$_D$ M#	-	-	-	-	-	0.54	0.08	0.02	g/l	A-T-026s
Sulphate BRE (water sol 2:1)$_D$ M#	143	-	-	-	-	-	-	-	mg/l	A-T-026s
Sulphate (acid soluble)$_D$ M#	-	-	-	-	-	2800	1500	820	mg/kg	A-T-028
Total Organic $Carbon_D$ M#	21.8	-	-	-	-	11.9	-	-	% w/w	A-T-032s
$Arsenic_D$ M#	-	-	-	-	-	48	44	42	mg/kg	A-T-024
$Cadmium_D$ M#	-	-	-	-	-	1.8	1.9	1.2	mg/kg	A-T-024
$Copper_D$ M#	-	-	-	-	-	238	347	113	mg/kg	A-T-024
$Chromium_D$ #	-	-	-	-	-	32	34	22	mg/kg	A-T-024
$Lead_D$ M#	-	-	-	-	-	950	760	303	mg/kg	A-T-024
$Mercury_D$	-	-	-	-	-	2.01	1.81	1.34	mg/kg	A-T-024
$Nickel_D$ M#	-	-	-	-	-	64	72	34	mg/kg	A-T-024
$Selenium_D$ M#	-	-	-	-	-	2	2	<1	mg/kg	A-T-024
$Zinc_D$ M#	-	-	-	-	-	494	473	249	mg/kg	A-T-024

Envirolab Job Number: 12/03610

Client Project Name: Battle Hospital

Client Project Ref: 25520

Lab Sample ID	12/03610/1	12/03610/2	12/03610/3	12/03610/4	12/03610/5	12/03610/6	12/03610/7	12/03610/8	Units	Method ref
Client Sample No										
Client Sample ID	PH1	PH2	PH2	PH3	PH6	PH3	PH4	PH5		
Depth to Top	1.30	1.40	2.40	2.50	1.30	0.50	0.30	0.40		
Depth To Bottom										
Date Sampled	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12		
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D		
Sample Matrix Code	3AE	5ABE	5ABD	5AD	5AB	4A	4A	4ABE		
TPH CWG										
Ali >C5-C6$_A$#	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A$#	<0.05	<0.01	<0.01	<0.01	0.10	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C8-C10$_A$#	1.33	0.63	0.07	<0.01	9.00	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C10-C12$_A$#	216	158	0.7	1.6	522	3.1	1.3	1.5	mg/kg	A-T-023s
Ali >C12-C16$_A$#	1730	1030	8.0	5.1	3900	7.2	0.3	3.5	mg/kg	A-T-023s
Ali >C16-C21$_A$#	2870	1650	26.4	10.1	4100	14.9	1.7	6.2	mg/kg	A-T-023s
Ali >C21-C35$_A$#	900	465	47.4	39.1	827	31.7	<0.1	12.4	mg/kg	A-T-023s
Total Aliphatics$_A$#	5710	3310	82.6	56.0	9360	56.9	3.3	23.5	mg/kg	A-T-022+23s
Aro >C5-C7$_A$#	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A$#	<0.05	<0.01	<0.01	<0.01	<0.05	0.01	0.01	<0.01	mg/kg	A-T-022s
Aro >C8-C9$_A$#	*<0.05*	*<0.01*	*0.02*	*<0.01*	*<0.05*	*<0.01*	*0.02*	*<0.01*	mg/kg	A-T-022s
Aro >C9-C10$_A$#	<0.05	0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C10-C12$_A$#	36.2	19.0	*1.5*	1.2	63.7	1.2	<0.1	<0.1	mg/kg	A-T-023s
Aro >C12-C16$_A$#	840	314	5.5	2.9	1080	4.5	<0.1	0.9	mg/kg	A-T-023s
Aro >C16-C21$_A$#	1710	736	21.0	10.8	2030	13.1	2.8	9.6	mg/kg	A-T-023s
Aro >C21-C35$_A$#	779	381	75.6	41.0	558	32.8	11.4	21.4	mg/kg	A-T-023s
Total Aromatics$_A$#	3370	1450	104	56.0	3730	51.5	14.0	31.8	mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A$#	9080	4760	186	112	13100	108	17.3	55.3	mg/kg	A-T-022+23s
BTEX - Benzene$_A$#	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A$#	<0.05	<0.01	<0.01	<0.01	<0.05	0.01	0.01	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A$#	*<0.05*	<0.01	*<0.01*	<0.01	<0.05	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A$#	*<0.05*	*<0.01*	*<0.01*	*<0.01*	*<0.05*	*<0.01*	*<0.01*	*<0.01*	mg/kg	A-T-022s
BTEX - o Xylene$_A$#	<0.05	<0.01	*<0.01*	<0.01	<0.05	<0.01	<0.01	<0.01	mg/kg	A-T-022s
MTBE$_A$#	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	mg/kg	A-T-022s

Envirolab Job Number: 12/03610

Client Project Name: Battle Hospital

Client Project Ref: 25520

Lab Sample ID	12/03610/1	12/03610/2	12/03610/3	12/03610/4	12/03610/5	12/03610/6	12/03610/7	12/03610/8	Units	Method ref
Client Sample No										
Client Sample ID	PH1	PH2	PH2	PH3	PH6	PH3	PH4	PH5		
Depth to Top	1.30	1.40	2.40	2.50	1.30	0.50	0.30	0.40		
Depth To Bottom										
Date Sampled	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12	06-Aug-12		
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D		
Sample Matrix Code	3AE	5ABE	5ABD	5AD	5AB	4A	4A	4ABE		
PAH 16										
Acenaphthene$_A^{M\#}$	-	-	-	-	-	0.05	0.02	<0.01	mg/kg	A-T-019s
Acenaphthylene$_A^{\#}$	-	-	-	-	-	0.15	0.17	0.05	mg/kg	A-T-019s
Anthracene$_A^{\#}$	-	-	-	-	-	0.14	0.14	0.05	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	-	-	-	-	-	1.30	1.28	0.37	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	-	-	-	-	-	1.65	1.79	0.47	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A$	-	-	-	-	-	2.49	2.64	0.70	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	-	-	-	-	-	1.67	2.43	0.48	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A$	-	-	-	-	-	0.43	0.47	0.15	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	-	-	-	-	-	1.47	1.68	0.48	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A$	-	-	-	-	-	0.22	0.26	0.05	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	-	-	-	-	-	2.37	2.14	0.65	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	-	-	-	-	-	0.04	0.02	<0.01	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{\#}$	-	-	-	-	-	1.18	1.38	0.35	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	-	-	-	-	-	0.05	0.09	0.04	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	-	-	-	-	-	0.63	0.50	0.21	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	-	-	-	-	-	2.15	2.01	0.61	mg/kg	A-T-019s
Total PAH$_A$	-	-	-	-	-	16	17	4.69	mg/kg	A-T-019s

Envirolab Job Number: 12/03610

Client Project Name: Battle Hospital

Client Project Ref: 25520

Lab Sample ID	12/03610/9	12/03610/10	12/03610/11	12/03610/12	12/03610/13	12/03610/14	12/03610/15	12/03610/16	Units	Method ref
Client Sample No										
Client Sample ID	PH6	PH7	PH8	PH9	PH10	PH12	PH15	PH16		
Depth to Top	0.30	0.40	0.40	0.50	0.50	0.50	0.40	0.40		
Depth To Bottom										
Date Sampled	06-Aug-12	06-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12		
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D		
Sample Matrix Code	4AB	4ABDE	4AB	5ABD	5AB	5B	4AD	4A		
Asbestos in soil$_A^{\#}$	NAD	NAD	-	NAD	NAD	-	NAD	-		A-T-045
pH$_D^{M\#}$	7.91	7.86	7.97	7.66	7.73	7.81	7.91	8.72	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	1.30	0.13	0.15	0.10	0.22	0.10	0.12	0.01	g/l	A-T-026s
Sulphate (acid soluble)$_D^{M\#}$	10000	990	1500	1600	2000	1100	2400	520	mg/kg	A-T-028
Total Organic Carbon$_D^{M\#}$	-	-	-	-	17.7	-	-	-	% w/w	A-T-032s
Arsenic$_D^{M\#}$	46	25	33	48	50	18	66	10	mg/kg	A-T-024
Cadmium$_D^{M\#}$	2.0	1.1	2.3	2.2	1.7	1.2	2.1	<0.5	mg/kg	A-T-024
Copper$_D^{M\#}$	296	111	1070	465	252	481	354	17	mg/kg	A-T-024
Chromium$_D^{\#}$	42	25	31	33	55	28	36	11	mg/kg	A-T-024
Lead$_D^{M\#}$	825	363	466	1010	1880	564	684	17	mg/kg	A-T-024
Mercury$_D$	2.46	1.37	0.94	1.66	1.07	1.21	0.92	0.48	mg/kg	A-T-024
Nickel$_D^{M\#}$	73	37	62	80	99	36	110	14	mg/kg	A-T-024
Selenium$_D^{M\#}$	2	2	2	3	3	2	3	<1	mg/kg	A-T-024
Zinc$_D^{M\#}$	488	243	726	619	764	328	564	29	mg/kg	A-T-024

Envirolab Job Number: 12/03610

Client Project Name: Battle Hospital

Client Project Ref: 25520

Lab Sample ID	12/03610/9	12/03610/10	12/03610/11	12/03610/12	12/03610/13	12/03610/14	12/03610/15	12/03610/16	Units	Method ref
Client Sample No										
Client Sample ID	PH6	PH7	PH8	PH9	PH10	PH12	PH15	PH16		
Depth to Top	0.30	0.40	0.40	0.50	0.50	0.50	0.40	0.40		
Depth To Bottom										
Date Sampled	06-Aug-12	06-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12		
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D		
Sample Matrix Code	4AB	4ABDE	4AB	5ABD	5AB	5B	4AD	4A		
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C8-C10$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	mg/kg	A-T-022s
Ali >C10-C12$_A^{\#}$	1.8	0.9	2.6	20.5	3.8	2.2	2.3	2.8	mg/kg	A-T-023s
Ali >C12-C16$_A^{\#}$	4.0	0.7	6.3	33.2	2.4	2.5	1.5	3.3	mg/kg	A-T-023s
Ali >C16-C21$_A^{\#}$	11.1	2.2	36.1	4.9	7.9	4.6	2.8	1.9	mg/kg	A-T-023s
Ali >C21-C35$_A^{\#}$	52.2	<0.1	131	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	A-T-023s
Total Aliphatics$_A^{\#}$	68.9	3.8	176	58.6	14.1	9.3	6.7	8.0	mg/kg	A-T-022+23s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C8-C9$_A^{\#}$	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*0.05*	*<0.01*	mg/kg	A-T-022s
Aro >C9-C10$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	*<0.01*	<0.01	mg/kg	A-T-022s
Aro >C10-C12$_A^{\#}$	1.6	0.5	3.2	3.2	3.1	4.8	16.6	<0.1	mg/kg	A-T-023s
Aro >C12-C16$_A^{\#}$	6.5	1.7	13.8	3.4	6.6	12.5	34.7	<0.1	mg/kg	A-T-023s
Aro >C16-C21$_A^{\#}$	21.4	13.3	180	8.0	17.8	60.9	18.3	<0.1	mg/kg	A-T-023s
Aro >C21-C35$_A^{\#}$	90.5	37.4	707	18.4	39.3	248	154	<0.1	mg/kg	A-T-023s
Total Aromatics$_A^{\#}$	120	52.9	904	33.0	66.9	326	224	<0.1	mg/kg	A-T-022+23s
TPH (Ali & Aro)$_A^{\#}$	189	56.7	1080	91.6	81.0	335	230	8.0	mg/kg	A-T-022+23s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	*<0.01*	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*0.03*	*<0.01*	mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	*<0.01*	<0.01	mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s

Envirolab Job Number: 12/03610

Client Project Name: Battle Hospital

Client Project Ref: 25520

Lab Sample ID	12/03610/9	12/03610/10	12/03610/11	12/03610/12	12/03610/13	12/03610/14	12/03610/15	12/03610/16	Units	Method ref
Client Sample No										
Client Sample ID	PH6	PH7	PH8	PH9	PH10	PH12	PH15	PH16		
Depth to Top	0.30	0.40	0.40	0.50	0.50	0.50	0.40	0.40		
Depth To Bottom										
Date Sampled	06-Aug-12	06-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12		
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D		
Sample Matrix Code	4AB	4ABDE	4AB	5ABD	5AB	5B	4AD	4A		
PAH 16										
Acenaphthene$_A^{M\#}$	0.04	0.05	0.71	0.03	0.38	0.28	0.05	<0.01	mg/kg	A-T-019s
Acenaphthylene$_A^{\#}$	0.28	0.22	3.16	0.12	0.15	2.38	0.24	<0.01	mg/kg	A-T-019s
Anthracene$_A^{\#}$	0.20	0.29	8.46	0.11	0.58	2.14	0.23	<0.01	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	2.23	2.04	39.9	0.90	2.79	19.7	1.91	<0.01	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	3.07	2.66	36.2	1.23	2.33	28.8	2.26	<0.01	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A$	3.98	3.86	44.9	1.62	3.11	34.9	2.87	<0.01	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	3.49	2.71	22.4	1.35	2.32	25.7	2.39	<0.01	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A$	0.63	0.77	11	0.26	0.46	7.29	0.43	<0.01	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	2.61	2.45	33.5	1.06	2.80	19.4	2.12	<0.01	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A$	0.41	0.40	4.83	0.15	0.31	3.91	0.30	<0.01	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	3.92	4.21	74.3	1.51	7.12	35.3	3.44	<0.01	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.04	0.06	2.82	0.02	0.27	0.49	0.04	<0.01	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{\#}$	1.90	1.95	18.3	0.82	1.39	18	1.42	<0.01	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	0.06	0.08	0.67	1.70	0.09	0.63	0.10	<0.01	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.82	0.96	34.8	0.39	3.43	7.76	0.85	<0.01	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	3.94	3.88	61.2	1.45	5.95	37.6	3.24	<0.01	mg/kg	A-T-019s
Total PAH$_A$	27.6	26.6	397	12.7	33.5	244	21.9	<0.01	mg/kg	A-T-019s

Envirolab Job Number: 12/03610

Client Project Name: Battle Hospital

Client Project Ref: 25520

Lab Sample ID	12/03610/9	12/03610/10	12/03610/11	12/03610/12	12/03610/13	12/03610/14	12/03610/15	12/03610/16	Units	Method ref
Client Sample No										
Client Sample ID	PH6	PH7	PH8	PH9	PH10	PH12	PH15	PH16		
Depth to Top	0.30	0.40	0.40	0.50	0.50	0.50	0.40	0.40		
Depth To Bottom										
Date Sampled	06-Aug-12	06-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12		
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D		
Sample Matrix Code	4AB	4ABDE	4AB	5ABD	5AB	5B	4AD	4A		
VOC										
Dichlorodifluoromethane$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Chloromethane$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Vinyl Chloride$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Bromomethane$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Chloroethane$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Trichlorofluoromethane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,1-Dichloroethene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Carbon Disulphide$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Dichloromethane$_A$	-	-	<300	<300	-	-	-	-	µg/kg	A-T-006
trans 1,2-Dichloroethene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,1-Dichloroethane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
cis 1,2-Dichloroethene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
2,2-Dichloropropane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Bromochloromethane$_A^\#$	-	-	<5	<5	-	-	-	-	µg/kg	A-T-006
Chloroform$_A^\#$	-	-	<25	<25	-	-	-	-	µg/kg	A-T-006
1,1,1-Trichloroethane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,1-Dichloropropene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Carbon Tetrachloride$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,2-Dichloroethane$_A^\#$	-	-	<2	<2	-	-	-	-	µg/kg	A-T-006
Benzene$_A^\#$	-	-	3	9	-	-	-	-	µg/kg	A-T-006
Trichloroethene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,2-Dichloropropane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Dibromomethane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Bromodichloromethane$_A^\#$	-	-	<10	<10	-	-	-	-	µg/kg	A-T-006
cis 1,3-Dichloropropene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Toluene$_A^\#$	-	-	3	8	-	-	-	-	µg/kg	A-T-006
trans 1,3-Dichloropropene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,1,2-Trichloroethane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,3-Dichloropropane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006

Lab Sample ID	12/03610/9	12/03610/10	12/03610/11	12/03610/12	12/03610/13	12/03610/14	12/03610/15	12/03610/16	Units	Method ref
Client Sample No										
Client Sample ID	PH6	PH7	PH8	PH9	PH10	PH12	PH15	PH16		
Depth to Top	0.30	0.40	0.40	0.50	0.50	0.50	0.40	0.40		
Depth To Bottom										
Date Sampled	06-Aug-12	06-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12	07-Aug-12		
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D		
Sample Matrix Code	4AB	4ABDE	4AB	5ABD	5AB	5B	4AD	4A		
Tetrachloroethene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Dibromochloromethane$_A^\#$	-	-	<3	<3	-	-	-	-	µg/kg	A-T-006
1,2-Dibromoethane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Chlorobenzene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,1,1,2-Tetrachloroethane$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Ethylbenzene$_A^\#$	-	-	4	20	-	-	-	-	µg/kg	A-T-006
m & p Xylene$_A^\#$	-	-	16	84	-	-	-	-	µg/kg	A-T-006
o-Xylene$_A^\#$	-	-	1	18	-	-	-	-	µg/kg	A-T-006
Styrene$_A^\#$	-	-	5	<1	-	-	-	-	µg/kg	A-T-006
Bromoform$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Isopropylbenzene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,1,2,2-Tetrachloroethane$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,2,3-Trichloropropane$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
Bromobenzene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
n-propylbenzene$_A$	-	-	<1	3	-	-	-	-	µg/kg	A-T-006
2-Chlorotoluene$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,3,5-Trimethylbenzene$_A^\#$	-	-	<1	7	-	-	-	-	µg/kg	A-T-006
4-Chlorotoluene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
tert-Butylbenzene$_A^\#$	-	-	<2	<2	-	-	-	-	µg/kg	A-T-006
1,2,4-Trimethylbenzene$_A^\#$	-	-	3	12	-	-	-	-	µg/kg	A-T-006
sec-Butylbenzene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
4-Isopropyltoluene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,3-Dichlorobenzene$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,4-Dichlorobenzene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
n-Butylbenzene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,2-Dichlorobenzene$_A^\#$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,2-Dibromo-3-chloropropane$_A$	-	-	<2	<2	-	-	-	-	µg/kg	A-T-006
1,2,4-Trichlorobenzene$_A$	-	-	<3	<3	-	-	-	-	µg/kg	A-T-006
Hexachlorobutadiene$_A$	-	-	<1	<1	-	-	-	-	µg/kg	A-T-006
1,2,3-Trichlorobenzene$_A$	-	-	<3	<3	-	-	-	-	µg/kg	A-T-006

Envirolab Job Number: 12/03610

Client Project Name: Battle Hospital

Client Project Ref: 25520

Lab Sample ID	12/03610/17	12/03610/18	12/03610/19	12/03610/20	12/03610/21	12/03610/22			Units	Method ref
Client Sample No										
Client Sample ID	PH16	PH14	PH14	PH7	PH13	BH1				
Depth to Top	1.50	0.40	1.50	1.50	2.60	4.00				
Depth To Bottom		1.50								
Date Sampled	07-Aug-12	07-Aug-12	07-Aug-12	06-Aug-12	07-Aug-12	07-Aug-12				
Sample Type	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D	Soil - D				
Sample Matrix Code	5A	5A	5A	6	3	7				
pH $BRE_D^{M\#}$	8.73	7.59	8.29	7.47	7.55	8.63			pH	A-T-031s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	12	115	24	308	505	16			mg/l	A-T-026s

APPENDIX J
LABORATORY CERTIFICATES FOR GROUNDWATER ANALYSIS

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 12/03835
Issue Number: 1 **Date:** 06 September, 2012

Client:
RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Nigel Austin / Andrew James / Stuart Jeffery
Project Name: Battle Hospital, Reading
Project Ref: 25520
Order No: Not specified
Date Samples Received: 23/08/12
Date Instructions Received: 23/08/12
Date Analysis Completed: 29/09/12

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Liz Oliver
Project Coordinator

Notes - General
Subscript "A" indicates analysis performed on the sample as received, "D" indicates analysis performed on dried & crushed sample.
All analysis is performed on the dried and crushed sample for samples with Matrix Code 7 and this supercedes any "A" subscripts. Superscript "M" indicates method accredited to MCERTS. Results in italics are associated with a control limit flag.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling.
Predominant Matrix Codes - 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.
Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our MCERTS accreditation.
Secondary Matrix Codes - A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.
IS indicates Insufficient sample for analysis. NDP indicates No Determination Possible. NAD indicates No Asbestos Detected.
Superscript # indicates method accredited to ISO 17025.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.

UKAS TESTING
1247

Envirolab Job Number: 12/03835

Client Project Name: Battle Hospital, Reading

Client Project Ref: 25520

Lab Sample ID	12/03835/1	12/03835/2	12/03835/3	12/03835/4	12/03835/5	12/03835/6	12/03835/7		Units	Method ref
Client Sample No										
Client Sample ID	PH2	PH3	PH5	PH6	BH1	BH2	BH3			
Depth to Top	1.20	1.14	1.63	1.25	1.28	1.07	1.77			
Depth To Bottom										
Date Sampled	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12			
Sample Type	Water - W	Water - W	Water - W	Water - W	Water - W	Water - W	Water - W			
Sample Matrix Code										
Alkalinity (total) (w)$_A^{\#}$	-	-	-	155	186	-	175		mg/l Ca CO3	A-T-038
Arsenic (dissolved)$_A^{\#}$	6	<1	<1	6	3	4	<1		µg/l	A-T-025
Cadmium (dissolved)$_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-025
Copper (dissolved)$_A^{\#}$	<1	<1	5	<1	<1	<1	<1		µg/l	A-T-025
Chromium (dissolved)$_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-025
Lead (dissolved)$_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-025
Mercury (dissolved)$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		µg/l	A-T-025
Nickel (dissolved)$_A^{\#}$	2	<1	2	<1	4	<1	4		µg/l	A-T-025
Selenium (dissolved)$_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-025
Zinc (dissolved)$_A^{\#}$	3	1	2	1	4	4	4		µg/l	A-T-025

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Client Sample No										
Client Sample ID	PH2	PH3	PH5	PH6	BH1	BH2	BH3			
Depth to Top	1.20	1.14	1.63	1.25	1.28	1.07	1.77			
Depth To Bottom										
Date Sampled	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12			
Sample Type	Water - W	Water - W	Water - W	Water - W	Water - W	Water - W	Water - W			
Sample Matrix Code										
PAH 16MS (w)										
Acenaphthene (w)$_A$	0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Acenaphthylene (w)$_A$	0.02	<0.01	<0.01	0.02	<0.01	<0.01	<0.01		µg/l	A-T-019w
Anthracene (w)$_A$	0.06	0.02	<0.01	0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Benzo(a)anthracene (w)$_A$	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Benzo(a)pyrene (w)$_A$	0.04	<0.01	<0.01	<0.01	<0.01	<0.01	0.01		µg/l	A-T-019w
Benzo(b)fluoranthene (w)$_A$	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Benzo(ghi)perylene (w)$_A$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Benzo(k)fluoranthene (w)$_A$	0.05	0.03	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Chrysene (w)$_A$	0.03	0.04	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Dibenzo(ah)anthracene (w)$_A$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Fluoranthene (w)$_A$	0.05	0.20	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Fluorene (w)$_A$	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Indeno(123-cd)pyrene (w)$_A$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Naphthalene (w)$_A$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.02		µg/l	A-T-019w
Phenanthrene (w)$_A$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		µg/l	A-T-019w
Pyrene (w)$_A$	0.25	0.57	<0.01	<0.01	<0.01	0.03	<0.01		µg/l	A-T-019w
Total PAH (w)$_A$	0.59	0.88	<0.01	0.04	<0.01	0.03	0.03		µg/l	A-T-019w

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Client Sample No										
Client Sample ID	PH2	PH3	PH5	PH6	BH1	BH2	BH3			
Depth to Top	1.20	1.14	1.63	1.25	1.28	1.07	1.77			
Depth To Bottom										
Date Sampled	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12	21-Aug-12			
Sample Type	Water - W	Water - W	Water - W	Water - W	Water - W	Water - W	Water - W			
Sample Matrix Code										
TPH CWG										
Ali >C5-C6 $(w)_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w
Ali >C6-C8 $(w)_A^{\#}$	<1	1	<1	<1	<1	<1	<1		µg/l	A-T-022w
Ali >C8-C10 $(w)_A^{\#}$	8	2	<1	5	5	<1	2		µg/l	A-T-022w
Ali >C10-C12 $(w)_A^{\#}$	117	<5	<5	54	<5	<5	<5		µg/l	A-T-023w
Ali >C12-C16 $(w)_A^{\#}$	689	<5	<5	670	<5	<5	<5		µg/l	A-T-023w
Ali >C16-C21 $(w)_A^{\#}$	1400	<5	<5	1127	<5	<5	<5		µg/l	A-T-023w
Ali >C21-C35 $(w)_A^{\#}$	448	<5	<5	197	<5	<5	<5		µg/l	A-T-023w
Total Aliphatics $(w)_A^{\#}$	2661	<5	<5	2053	<5	<5	<5		µg/l	A-T-022+23w
Aro >C5-C7 $(w)_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w
Aro >C7-C8 $(w)_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w
Aro >C8-C9 $(w)_A^{\#}$	<1	1	<1	<1	2	<1	<1		µg/l	A-T-022w
Aro >C9-C10 $(w)_A^{\#}$	2	2	1	<1	<1	<1	<1		µg/l	A-T-022w
Aro >C10-C12 $(w)_A^{\#}$	25	<5	<5	15	<5	<5	<5		µg/l	A-T-023w
Aro >C12-C16 $(w)_A^{\#}$	338	<5	<5	204	<5	<5	<5		µg/l	A-T-023w
Aro >C16-C21 $(w)_A^{\#}$	545	<5	<5	520	<5	<5	<5		µg/l	A-T-023w
Aro >C21-C35 $(w)_A^{\#}$	223	<5	<5	135	<5	<5	<5		µg/l	A-T-023w
Total Aromatics $(w)_A^{\#}$	1132	<5	<5	874	<5	<5	<5		µg/l	A-T-022+23w
TPH (Ali & Aro) $(w)_A^{\#}$	3793	7	<5	2927	7	<5	<5		µg/l	A-T-022+23w
BTEX - Benzene $(w)_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w
BTEX - Ethyl Benzene $(w)_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w
BTEX - Toluene $(w)_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w
BTEX - m & p Xylene $(w)_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w
BTEX - o Xylene $(w)_A^{\#}$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w
MTBE $(w)_A$	<1	<1	<1	<1	<1	<1	<1		µg/l	A-T-022w

APPENDIX K
HUMAN HEALTH GENERIC ASSESSMENT CRITERIA

Generic assessment criteria for human health: residential scenario – private gardens

The human health generic assessment criteria (GAC) have been developed during a period of regulatory review and updating of the Contaminated Land Exposure Assessment (CLEA) project. Therefore, the Environment Agency (EA) is in the process of publishing updated reports relating to the CLEA project and the GAC presented in this document may change to reflect these updates. This issue was prepared following the publication of soil guideline value (SGV) reports and associated publications[(1)] for mercury, selenium, benzene, toluene, ethylbenzene and xylene in March 2009, arsenic and nickel in May 2009, cadmium and phenol in June 2009, dioxins, furans and dioxin-like polychlorinated biphenyls (PCBs) in September 2009. It was also produced following publication of GAC by LQM[(6)]. Where available, the published soil guideline values (SGV)[(1)] were used as the GAC. The GAC for lead is discussed separately below owing to it not being derived using the same approach as other compounds.

Lead GAC derivation

The Environment Agency SGV and Tox reports for lead were withdrawn in 2009. In addition, the provisional tolerable weekly intake data published in the Netherlands were withdrawn in 2010 owing to concerns that they were not suitably protective of human health. The withdrawn SGVs were based on a target blood lead concentration of 10μg/dl. In the absence of current guidelines many consultants continue to use the withdrawn SGV. However, as this is not considered sufficiently protective of human health, after attendance at the SOBRA summer workshop June 2011, RSK has revised its GAC and is currently undertaking a review of recent toxicological developments that will be used to refine this GAC further in the coming months. In the meantime, RSK has undertaken sensitivity analysis using the Society of Environmental Geochemistry and Health (SEGH) equation and the CLEA model to produce an interim GAC value. The results are summarised below:

- Using CLEA with the former provisional tolerable weekly intake (PTWI) (25 μg/kg bw), assuming 100% lead is bioavailable, produces a GAC of 212 mg/kg
- Using CLEA with the former PTWI, assuming 50% lead is bioavailable, produces a GAC of 478 mg/kg
- Using the SEGH equation amended for a blood target concentration of 5.6 μg/dl (equal to the LOAEL for IQ defects) gives a negative GAC number unless other factors such as child background blood concentration or delta are amended. Without undertaking further research into these numbers, RSK can present sensitivity analysis to demonstrate the sensitivity of these input parameters but cannot justify one parameter over another. The results are:
    - GAC between 39mg/kg and 99mg/kg if the value of delta (the slope or response of blood Pb versus soil and dust Pb relationship) only is amended from 5 to 2μg/dl/1000μg/g. The value of 2 was chosen as it is within the reasonable range quoted in the former SGV report
    - GAC between 244mg/kg and 610mg/kg if the geometric mean of blood lead concentration in young children is reduced from 3.4μg/dl to 2μg/dl. This decrease has been simulated on the basis that blood concentrations are likely to decrease over time across the UK owing to a ban on lead in petrol, lead within paint used internally and water pipe replacement. This decrease is considered reasonable as the site is a new development

so lead-based paints will not be used internally and lead water supply pipelines will be absent.

Therefore, given the results above RSK proposes to use a GAC of **300mg/kg** for a residential with garden end use. This value is broadly in the middle of the range of sensitivity modelling results quoted above when background mean blood lead concentrations in children are reduced to reflect a new development. The value is also broadly in the middle of the range of sensitivity modelling results for a range of bioavailability of lead between 50% and 100%. This number is considered reasonably protective of human health while being practical for use.

GAC derivation for other metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using CLEA v1.06 and the supporting UK guidance[1–6]. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect the UK guidance[1–5]. The SAC and GrAC collectively are termed GAC.

Conceptual model

In accordance with EA Science Report SC050221/SR3[3], the residential with private garden scenario considers risks to a female child between the ages of 0 and 6 years old. In accordance with Box 3.1, SR3[3], the pathways considered for production of the SAC in the residential with gardens scenario are:

- direct soil and dust ingestion;
- consumption of home-grown produce;
- consumption of soil attached to home-grown produce;
- dermal contact with soil and indoor dust, and
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents while indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. Within RBCA, the solubility limit of the determinant restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. While the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

An assumption used in the CLEA model is that of simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[4]. The upper boundaries of this partitioning are represented by the aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous-based or the vapour based

saturation limits. Where model output cells are flagged red the soil or vapour saturation limit has been exceeded and further consideration of the SAC to be used within the assessment is required. One approach that could be adopted is to use the 'modelled' solubility saturation limit or vapour saturation limit of the compound as the SAC. However, as stated within the CLEA handbook[4] this is likely to not be practical in many cases because of the very low limits and, in any case, is highly conservative. Unless free-phase product is present, concentrations of the chemical are unlikely to be present at sufficient concentration to result in an exceedance of the health criteria value (HCV).

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH[6] whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limit given in brackets. Therefore, when using the SAC to screen laboratory analysis the assessor should take note if a given SAC has a corresponding solubility or vapour saturation limit (in brackets), and subsequently incorporate this piece of information within the screening analytical discussion. If further assessment is required following this process then an additional approach can be utilised as detailed within Section 4.12 of the CLEA model handbook[4], which explains how to calculate an effective assessment criterion manually.

Input selection

Chemical data was obtained from EA Report SC050021/SR7[5] and the health criteria values (HCV) from the UK TOX[1] reports where available. For SAC for total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH), toxicological and chemical specific parameters were obtained from the LQM/CIEH report[6]. Similarly, toxicological and specific chemical parameters for the volatile organic compound 1,2,4-trimethylbenzene were obtained from EIC/AGS/CL:AIRE[7].

For total petroleum hydrocarbons (TPH), aromatic hydrocarbons C_5-C_8 were not modelled since benzene and toluene are being modelled separately. The aromatic C_8-C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. Since ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for this band has been taken from styrene.

Owing to the lack of UK-specific data, default information in the RBCA model was used to evaluate methyl tertiary butyl ether (MTBE). No published UK data was available for 1,3,5-trimethylbenzene, so information was obtained from the US EPA as in the RBCA model. RBCA uses toxicity data for the inhalation pathway in different units to the CLEA model and cannot consider separately the mean daily intake (MDI), occupancy periods or breathing rates. Therefore, the HCV in RBCA was amended to take account of:

- amendments to the MDI using Table 3.4 of SR2[2]
- a child weighing 13.3kg (average of 0–6 year old female in accordance with Table 4.6 of SR3[3]) and breathing 11.85m^3 (average daily inhalation rate for a 0–6-year old female in accordance with Table 4.14 of SR3[3]

1. The 50% rule (for petroleum hydrocarbons, trimethylbenzenes and MTBE)[2] where MDI data is not available but background exposure is considered important in the overall exposure.

Physical parameters

For the residential with private gardens scenario, the CLEA default building is a small two-storey terrace house with concrete ground-bearing slab. The house is assumed to have a 100m^2 private garden consisting of lawn, flowerbeds and incorporating a 20m^2 plot for growing fruit and vegetables consumed by the residents. SR3[3] notes this residential building type to be the most conservative in terms of protection from vapour intrusion. The building parameters are outlined in Table 5.

The parameters for a sandy loam soil type were used in line with SR3[3]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this parameter, RSK has produced an additional set of SAC for an SOM of 1% and 2.5%. For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater.

GAC

The SAC were produced using the input parameters in Tables 1 to 5 and the GrAC using input parameters in Table 6. The final selected GAC are presented by pathway in Table 7 and the combined GAC in Table 8.

Figure 1: Conceptual model for CLEA residential scenario – private gardens

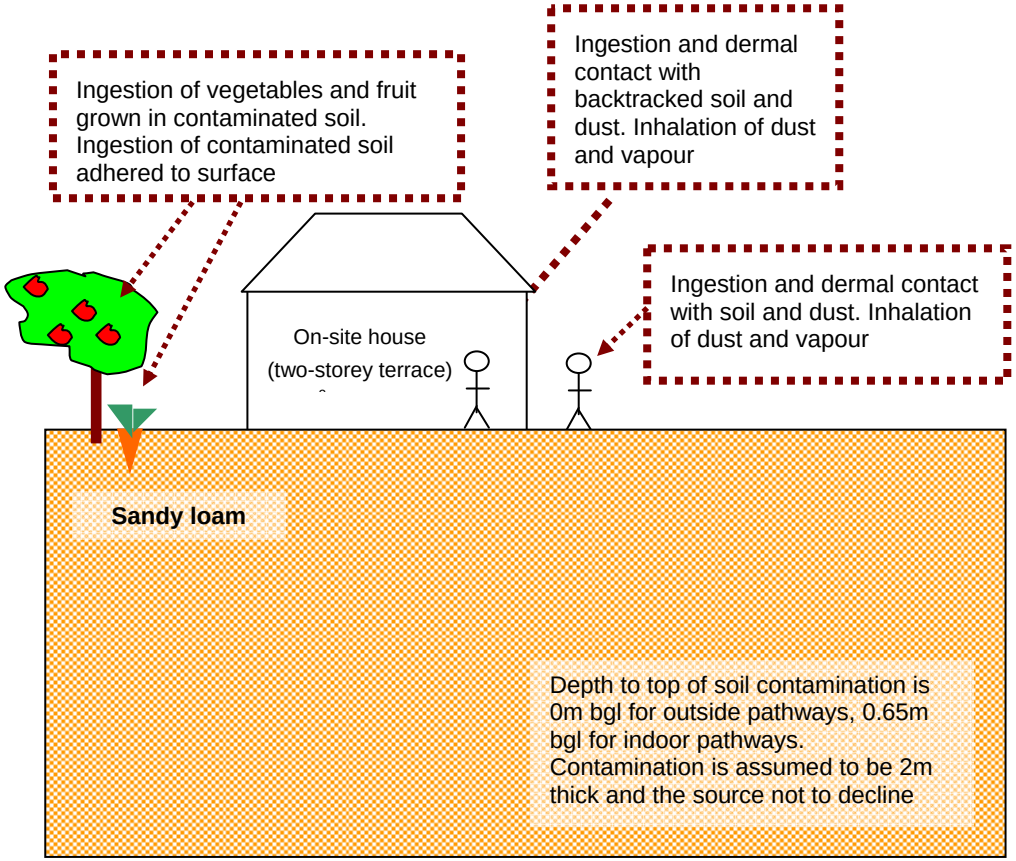


Table 1: Exposure assessment parameters for residential scenario - private gardens – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential with homegrown produce	Chosen land use
Receptor	Female child age 1 to 6	Key generic assumption given in Box 3.1, report SC050021/SR3[3]
Building	Small terraced house	Key generic assumption given in Box 3.1, report SC050021/SR3. Two storey small terraced house chosen as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, report SC050021/SR3)[3]
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, From Table 3.1, report SC050021/SR3)[3]
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged zero to six. From Box 3.1, report SC050021/SR3[3]
End AC (age class)	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential with private gardens –home-grown produce data for CLEA model

	Consumption rate (g FW kg^{-1} BW day^{-1}) by age class						Dry weight conversion factor	Home-grown fraction (average)	Home-grown fraction (high end)	Soil loading factor	Preparation correction factor
Name	1	2	3	4	5	6	g DW g^{-1} FW	-	-	g g^{-1} DW	-
Green vegetables	7.12	6.85	6.85	6.85	3.74	3.74	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.69	3.30	3.30	3.30	1.77	1.77	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16.03	5.46	5.46	5.46	3.38	3.38	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.96	3.96	3.96	1.85	1.85	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.54	0.54	0.54	0.16	0.16	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	11.96	11.96	11.96	4.26	4.26	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 4.17, SR3[3]						Table 6.3, SR3[3]	Table 4.19, SR3[3]		Table 6.3, SR3[3]	

Table 3: Residential with private gardens – land use data for CLEA model

Parameter	Unit	Age class					
		1	2	3	4	5	6
EF (soil and dust ingestion)	day yr^{-1}	180	365	365	365	365	365
EF (consumption of home-grown produce)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, indoor)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr^{-1}	180	365	365	365	365	365
EF (inhalation of dust and vapour, indoor)	day yr^{-1}	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr^{-1}	365	365	365	365	365	365
Justification		Table 3.1, SR3[3]					
Occupancy period (indoor)	hr day^{-1}	23	23	23	23	19	19
Occupancy period (outdoor)	hr day^{-1}	1	1	1	1	1	1
Justification		Table 3.2, SR3[3]					
Soil to skin adherence factor (indoor)	mg cm^{-2} day^{-1}	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02	6.00E-02
Soil to skin adherence factor (outdoor)	mg cm^{-2} day^{-1}	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Justification		Table 8.1, SR3[3]					
Soil and dust ingestion rate	g day^{-1}	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01	1.00E-01
Justification		Table 6.2, SR3[3]					

Of note, for **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} – are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not only in childhood but averaged over a longer time period. See the Environment Agency Science report: SC05002 / TOX 3 [1] and Science Report SC050021/Cadmium SGV [1] for more information.

Table 4: Residential with private gardens – receptor data for CLEA model

Parameter	Unit	Age Class						Justification
		1	2	3	4	5	6	
Body weight	kg	5.6	9.8	12.7	15.1	16.9	19.7	Table 4.6, SR3[3]
Body height	m	0.7	0.8	0.9	0.9	1	1.1	
Inhalation rate	m^3 day^{-1}	8.5	13.3	12.7	12.2	12.2	12.2	Table 4.14, SR3[3]
Max exposed skin fraction (indoor)	m^2 m^{-2}	0.32	0.33	0.32	0.35	0.35	0.33	Table 4.8, SR3[3]
Max exposed skin fraction (outdoor)	m^2 m^{-2}	0.26	0.26	0.25	0.28	0.28	0.26	

See cadmium note as per Table 3 above.

Table 5: Residential with private gardens – soil and building inputs for CLEA model

Parameter	Unit	Value	Justification
Soil properties for sandy loam			
Porosity, total	cm^3 cm^{-3}	0.53	Default soil type is sandy loam, Section 4.3.1, SR3[3] Parameters for sandy loam from Table 4.4, SR3[3]
Porosity, air filled	cm^3 cm^{-3}	0.20	
Porosity, water filled	cm^3 cm^{-3}	0.33	
Residual soil water content	cm^3 cm^{-3}	0.12	
Saturated hydraulic conductivity	cm s^{-1}	3.56E-03	
van Genuchten shape parameter (*m*)	-	3.20E-01	
Bulk density	g cm^{-3}	1.21	
Threshold value of wind speed at 10m	m s^{-1}	7.20	Default value taken from Section 9.2.2, SR3[3]
Empirical function (F_x) for dust model	-	1.22	Value taken from Section 9.2.2, SR3[3]
Ambient soil temperature	K	283	Annual average soil temperature representative of UK surface soils. Section 4.3.1, SR3[3]
Air dispersion model			
Mean annual wind speed (10m)	m s^{-1}	5.00	Default value taken from Section 9.2.2, SR3[3]
Air dispersion factor at height of 0.8m	g m^{-2} s^{-1} per kg m^{-3}	2400	Values for a 0.01 ha site, appropriate to a residential land use in Newcastle (most representative city for UK). (from Table 9.1, SR3)[3]
Air dispersion factor at height of 1.6m	g m^{-2} s^{-1} per kg m^{-3}	0	Assumed child of 6 is not tall enough to reach 1.6m
Fraction of site with hard or vegetative cover	m^2 m^{-2}	0.75	Section 3.2.6, SR3 [3] based on residential land use

Parameter	Unit	Value	Justification
Building properties for small terrace house with ground-bearing floor slab			
Building footprint	m^2	28	From Table 3.3 and 4.21, SR3[3]
Living space air exchange rate	hr^{-1}	0.50	
Living space height (above ground)	m	4.8	
Living space height (below ground)	m	0.0	Assumed no basement
Pressure difference (soil to enclosed space)	Pa	3.1	From Table 3.3, SR3[3]
Foundation thickness	m	0.15	
Floor crack area	cm^2	423	
Dust loading factor	$\mu g\ m^{-3}$	50	Default value for a residential site taken from Section 9.3, SR3[3]
Vapour model			
Default soil gas ingress rate	$cm^3\ s^{-1}$	25	Generic flow rate, Section 10.3, SR3[3]
Depth to top of source (beneath building)	cm	50	Section 3.2.6, SR3 [3] states source is 50cm below building or 65cm below ground surface
Depth to top of source (no building)	cm	0	Section 10.2, SR3 [3] assumes impact from 0m to 1m for outdoor inhalation pathway
Thickness of contaminant layer	cm	200	Model default for indoor air, Section 4.9, SR4[4]
Time average period for surface emissions	years	6	Time period of a 0 to 6 year old, Box 3.5, SR3[3]
User-defined effective air permeability	cm^2	3.05E-08	Calculated for sandy loam using equations in Appendix 1, SR3[3]

Figure 2: GrAC conceptual model for RBCA residential with private gardens scenario

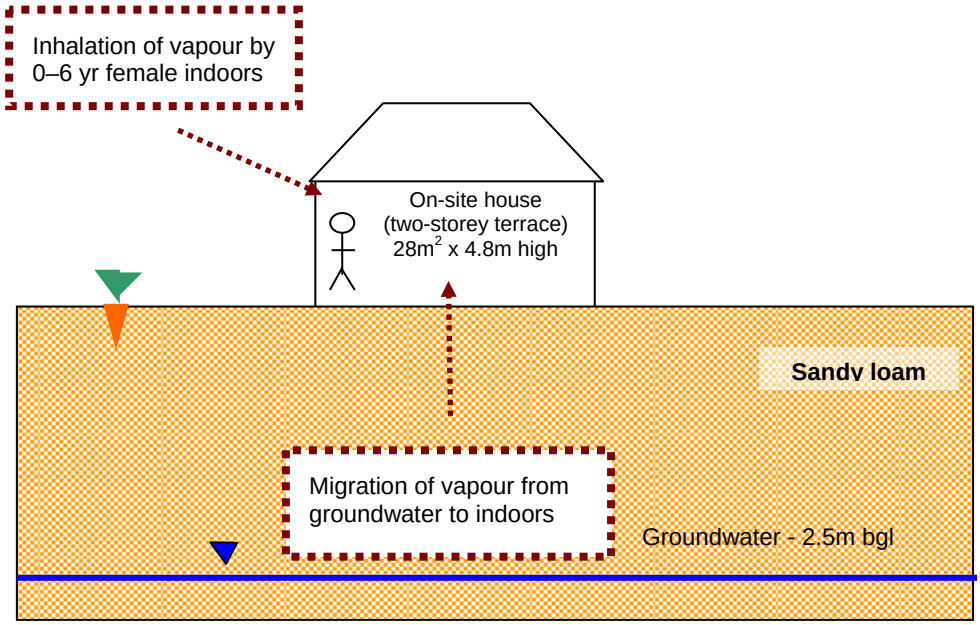


Table 6: Residential with private gardens – RBCA inputs

Parameter	Unit	Value	Justification
Receptor			
Averaging time	Years	6	From Box 3.1, SR3[3]
Receptor weight	kg	13.3	Average of CLEA 0–6 year old female data, Table 4.6, SR3[3]
Exposure duration	Years	6	From Box 3.1, report, SR3[3]
Exposure frequency	Days/yr	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
Soil type – sandy loam			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3}	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[3]
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3[3]
Capillary zone thickness	m	0.1	Professional judgement

Parameter	Unit	Value	Justification
Fraction organic carbon	%	(i) 0.0348	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[8]
		(ii) 0.0058	To provide SAC for sites where SOM < 6% as often observed by RSK
Building			
Building volume/area ratio	m	4.8	Table 3.3, SR3[3]
Foundation area	m^2	28	
Foundation perimeter	m	22	Calculated assuming building measures 7m x 4m to give 28m^2 foundation area
Building air exchange rate	d^{-1}	12	Table 3.3, SR3[3]
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.0151	Calculated from floor crack area of 423 cm^2 and building footprint of 28m^2 in Table 4.21, SR3[3]
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3[3]
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3[3]

References

1. Environment Agency (2009), 'Science Report SC050021/benzene SGV, toluene SGV, ethylbenzene SGV, xylene SGV, mercury SGV, selenium SGV, nickel SGV, arsenic SGV, cadmium SGV, phenol SGV, dioxins, furans and dioxin like PCBs SGVs', 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin- like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin- like PCBs', March 2009, May 2009 and September 2009.

2. Environment Agency (2009), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2*, January (Bristol: Environment Agency).

3. Environment Agency (2009), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).

4. Environment Agency (2009), Contaminated Land Exposure Assessment (CLEA) software, version 1.06.

5. Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).

6. Chartered Institute for Environmental Health and Land Quality Management (2009), 'The LQM/CIEH Generic Assessment Criteria for Human Health', second edition.

7. CL:AIRE (2009), *Soil Generic Assessment Criteria for Human Health Risk Assessment* (London: CL:AIRE).

8. Changes made to the CLEA framework documents after the three-month evaluation period in 2008, released January 2009 by the Environment Agency.

Table 7

Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound	Notes	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals														
Arsenic	(b)(c)	-	3.24E+01	8.50E+01	-	NR	3.24E+01	8.50E+01	-	NR	3.24E+01	8.50E+01	-	NR
Cadmium	(b)	-	1.12E+01	1.85E+02	1.10E+01	NR	1.12E+01	1.85E+02	1.10E+01	NR	1.12E+01	1.85E+02	1.10E+01	NR
Chromium (III) - oxide		-	1.84E+04	3.55E+03	2.98E+03	NR	1.84E+04	3.55E+03	2.98E+03	NR	1.84E+04	3.55E+03	2.98E+03	NR
Chromium (VI) - hexavalent		-	1.02E+01	4.25E+00	3.21E+00	NR	1.02E+01	4.25E+00	3.21E+00	NR	1.02E+01	4.25E+00	3.21E+00	NR
Copper		-	2.66E+03	1.04E+04	2.33E+03	NR	2.66E+03	1.04E+04	2.33E+03	NR	2.66E+03	1.04E+04	2.33E+03	NR
Lead	(a)	-	3.00E+02	-	-	NR	3.00E+02	-	-	NR	3.00E+02	-	-	NR
Elemental Mercury (Hg^0)	(b)(d)	9.40E-03	-	1.70E-01	-	4.31E+00	-	4.24E-01	-	1.07E+01	-	1.02E+00	-	2.58E+01
Inorganic Mercury (Hg^{2+})	(b)	-	1.81E+02	2.55E+03	1.69E+02	NR	1.81E+02	2.55E+03	1.69E+02	NR	1.81E+02	2.55E+03	1.69E+02	NR
Methyl Mercury (Hg^{4+})	(b)	2.00E+01	1.39E+01	1.59E+01	7.40E+00	7.33E+01	1.39E+01	3.08E+01	9.55E+00	1.42E+02	1.39E+01	6.53E+01	1.14E+01	3.04E+02
Nickel	(b)(d)	-	5.31E+02	1.27E+02	-	NR	5.31E+02	1.27E+02	-	NR	5.31E+02	1.27E+02	-	NR
Selenium	(b)(c)	-	3.50E+02	-	-	NR	3.50E+02	NR	-	NR	3.50E+02	-	-	NR
Zinc	(c)	-	3.75E+03	2.55E+07	-	NR	3.75E+03	2.55E+07	-	NR	3.75E+03	2.55E+07	-	NR
Cyanide		-	2.66E+01	3.97E+00	3.68E+00	NR	2.66E+01	3.97E+00	3.68E+00	NR	2.66E+01	3.97E+00	3.68E+00	NR
Volatile Organic Compounds														
Benzene	(b)	7.20E+00	1.12E-01	2.69E-01	7.92E-02	1.22E+03	2.28E-01	4.99E-01	1.57E-01	2.26E+03	4.89E-01	1.04E+00	3.32E-01	4.71E+03
Toluene	(b)	1.90E+03	1.47E+02	6.26E+02	1.19E+02	8.69E+02	3.35E+02	1.38E+03	2.70E+02	1.92E+03	7.59E+02	3.14E+03	6.11E+02	4.36E+03
Ethylbenzene	(b)	2.60E+02	1.06E+02	1.70E+02	6.52E+01	5.18E+02	2.51E+02	3.98E+02	1.54E+02	1.22E+03	5.70E+02	9.32E+02	3.54E+02	2.84E+03
Xylene - m	(b)	8.40E+01	2.02E+02	5.56E+01	4.36E+01	6.25E+02	4.80E+02	1.31E+02	1.03E+02	1.47E+03	1.09E+03	3.07E+02	2.40E+02	3.46E+03
Xylene - o		1.00E+02	1.85E+02	5.98E+01	4.52E+01	4.78E+02	4.38E+02	1.40E+02	1.06E+02	1.12E+03	9.96E+02	3.27E+02	2.46E+02	2.62E+03
Xylene - p		8.70E+01	1.91E+02	5.34E+01	4.17E+01	5.76E+02	4.51E+02	1.26E+02	9.82E+01	1.35E+03	1.02E+03	2.94E+02	2.28E+02	3.17E+03
Total xylene		8.40E+01	2.02E+02	5.56E+01	4.36E+01	6.25E+02	4.80E+02	1.31E+02	1.03E+02	1.47E+03	1.09E+03	3.07E+02	2.40E+02	3.46E+03
Methyl t-Butyl ether		2.20E+03	1.75E+00	1.84E+02	1.75E+00	1.66E+04	3.68E+00	2.40E+02	3.67E+00	2.16E+04	7.41E+00	3.70E+02	7.37E+00	3.34E+04
Trichloroethene		1.80E+00	2.83E+00	1.10E-01	1.06E-01	1.54E+03	6.25E+00	2.30E-01	2.22E-01	3.22E+03	1.40E+01	5.11E-01	4.93E-01	7.14E+03
Tetrachloroethene		3.60E+00	1.06E+01	1.03E+00	9.36E-01	4.24E+02	2.44E+01	2.30E+00	2.10E+00	9.51E+02	5.55E+01	5.28E+00	4.82E+00	2.18E+03
1,1,1-Trichloroethane		2.60E+01	3.20E+02	6.33E+00	6.21E+00	1.43E+03	6.97E+02	1.29E+01	1.27E+01	2.92E+03	1.55E+03	2.84E+01	2.79E+01	6.39E+03
1,1,1,2 Tetrachloroethane		1.40E+01	5.19E+00	1.08E+00	8.93E-01	2.60E+03	1.22E+01	2.50E+00	2.08E+00	6.02E+03	2.78E+01	5.83E+00	4.82E+00	1.40E+04
1,1,2,2-Tetrachloroethane		1.40E+01	2.70E+00	2.76E+00	1.37E+00	2.67E+03	5.85E+00	5.65E+00	2.87E+00	5.46E+03	1.30E+01	1.24E+01	6.34E+00	1.20E+04
Carbon Tetrachloride		5.50E-02	1.05E+00	1.81E-02	1.79E-02	1.52E+03	2.41E+00	3.97E-02	3.93E-02	3.32E+03	5.44E+00	8.99E-02	8.92E-02	7.54E+03
1,2-Dichloroethane		3.00E-01	3.06E-02	6.46E-03	5.34E-03	3.41E+03	5.53E-02	9.32E-03	7.98E-03	4.91E+03	1.05E-01	1.60E-02	1.39E-02	8.43E+03
Vinyl Chloride		1.90E-02	3.69E-03	5.43E-04	4.73E-04	1.36E+03	6.64E-03	7.02E-04	6.35E-04	1.76E+03	1.21E-02	1.07E-03	9.86E-04	2.69E+03
1,2,4-Trimethylbenzene		7.50E-02	-	3.51E-01	-	5.57E+02	-	8.55E-01	-	1.36E+03	-	2.10E+00	-	3.25E+03
1,3,5-Trimethylbenzene		4.70E-02	1.45E+01	4.60E-01	4.56E-01	9.47E+01	3.47E+01	1.10E+00	1.09E+00	2.26E+02	7.94E+01	2.59E+00	2.56E+00	5.33E+02
Semi-Volatile Organic Compounds														
Acenaphthene		3.20E+00	2.18E+02	3.46E+03	2.05E+02	5.70E+01	5.08E+02	8.54E+03	4.79E+02	1.41E+02	1.06E+03	2.03E+04	1.01E+03	3.36E+02
Acenaphthylene		4.20E+00	1.78E+02	3.27E+03	1.68E+02	8.61E+01	4.17E+02	8.03E+03	3.97E+02	2.12E+02	8.90E+02	1.91E+04	8.51E+02	5.06E+02
Anthracene		2.10E-02	2.31E+03	1.08E+05	2.26E+03	1.17E+00	5.03E+03	2.65E+05	4.93E+03	2.91E+00	9.33E+03	6.15E+05	9.19E+03	6.96E+00
Benzo(a)anthracene		3.80E-03	7.00E+00	5.55E+00	3.10E+00	1.71E+00	8.98E+00	9.83E+00	4.69E+00	4.28E+00	1.01E+01	1.41E+01	5.88E+00	1.03E+01
Benzo(b)fluoranthene		2.00E-03	8.06E+00	1.79E+01	5.56E+00	1.22E+00	9.78E+00	1.97E+01	6.53E+00	3.04E+00	1.07E+01	2.05E+01	7.02E+00	7.29E+00
Benzo(g,h,i)perylene		2.60E-04	6.68E+01	1.27E+02	4.38E+01	1.54E-02	7.04E+01	1.32E+02	4.59E+01	3.85E-02	7.19E+01	1.34E+02	4.68E+01	9.23E-02
Benzo(k)fluoranthene		8.00E-04	1.25E+01	2.66E+01	8.51E+00	6.87E-01	1.44E+01	2.83E+01	9.56E+00	1.72E+00	1.53E+01	2.91E+01	1.00E+01	4.12E+00
Chrysene		2.00E-03	8.76E+00	1.95E+01	6.00E+00	4.40E-01	1.20E+01	2.45E+01	8.04E+00	1.10E+00	1.41E+01	2.72E+01	9.27E+00	2.64E+00
Dibenzo(a,h)anthracene		6.00E-04	1.19E+00	2.13E+00	7.62E-01	3.93E-03	1.33E+00	2.42E+00	8.58E-01	9.82E-03	1.39E+00	2.56E+00	9.03E-01	2.36E-02
Fluoranthene		2.30E-01	2.59E+02	2.69E+04	2.57E+02	1.89E+01	4.67E+02	6.23E+04	4.63E+02	4.73E+01	6.78E+02	1.28E+05	6.74E+02	1.13E+02
Fluorene		1.90E+00	1.70E+02	4.35E+03	1.63E+02	3.09E+01	3.91E+02	1.07E+04	3.77E+02	7.65E+01	8.00E+02	2.54E+04	7.76E+02	1.83E+02
Indeno(1,2,3-cd)pyrene		2.00E-04	4.58E+00	1.04E+01	3.18E+00	6.13E-02	5.74E+00	1.17E+01	3.85E+00	1.53E-01	6.37E+00	1.22E+01	4.19E+00	3.68E-01
Phenanthrene		5.30E-01	9.35E+01	5.04E+03	9.18E+01	3.60E+01	2.04E+02	1.23E+04	2.01E+02	8.96E+01	3.81E+02	2.86E+04	3.76E+02	2.14E+02
Pyrene		1.30E-01	5.69E+02	6.18E+04	5.63E+02	2.20E+00	1.05E+03	1.44E+05	1.04E+03	5.49E+00	1.56E+03	2.97E+05	1.56E+03	1.32E+01
Benzo(a)pyrene		3.80E-03	1.21E+00	2.62E+00	8.26E-01	9.11E-01	1.42E+00	2.81E+00	9.43E-01	2.28E+00	1.52E+00	2.90E+00	9.98E-01	5.46E+00
Naphthalene		1.90E+01	2.68E+01	1.64E+00	1.54E+00	7.64E+01	6.36E+01	3.93E+00	3.70E+00	1.83E+02	1.43E+02	9.27E+00	8.71E+00	4.32E+02
Phenol	(b)	-	4.51E+02	3.11E+02	1.84E+02	4.16E+04	9.38E+02	4.20E+02	2.90E+02	8.15E+04	2.04E+03	5.21E+02	4.15E+02	1.74E+05

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH PRIVATE GARDENS

Table 7

Human Health Generic Assessment Criteria by Pathway for Residential Scenario - Private Gardens

Compound	Notes	GrAC (mg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons														
Aliphatic hydrocarbons EC_5-EC_6		1.00E+01	4.79E+03	2.98E+01	2.97E+01	3.04E+02	1.08E+04	5.47E+01	5.46E+01	5.58E+02	2.35E+04	1.13E+02	1.13E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		5.40E+00	1.43E+04	7.27E+01	7.26E+01	1.44E+02	3.21E+04	1.62E+02	1.62E+02	3.22E+02	6.36E+04	3.72E+02	3.71E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		2.30E-01	1.46E+03	1.89E+01	1.88E+01	7.77E+01	2.44E+03	4.60E+01	4.58E+01	1.90E+02	3.30E+03	1.09E+02	1.08E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		3.40E-02	3.52E+03	9.34E+01	9.28E+01	4.75E+01	4.01E+03	2.32E+02	2.29E+02	1.18E+02	4.24E+03	5.57E+02	5.37E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		7.60E-04	4.37E+03	7.82E+02	7.44E+02	2.37E+01	4.40E+03	1.95E+03	1.69E+03	5.91E+01	4.41E+03	4.68E+03	3.03E+03	1.42E+00
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(c)	-	4.51E+04	-	-	8.48E+00	6.38E+04	-	-	2.12E+01	7.61E+04	-	-	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	4.51E+04	-	-	8.48E+00	6.38E+04	-	-	2.12E+01	7.61E+04	-	-	5.09E+01
Aromatic hydrocarbons >EC_8-EC_9 (styrene)		7.40E+00	1.66E+02	2.65E+02	1.33E+02	6.20E+02	3.92E+02	6.47E+02	3.16E+02	1.52E+03	8.50E+02	1.54E+03	7.02E+02	3.61E+03
Aromatic hydrocarbons >EC_9-EC_{10}		7.40E+00	5.55E+01	3.33E+01	2.69E+01	6.13E+02	1.31E+02	8.16E+01	6.54E+01	1.50E+03	2.84E+02	1.94E+02	1.51E+02	3.58E+02
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.50E+01	7.97E+01	1.82E+02	6.91E+01	3.64E+02	1.86E+02	4.48E+02	1.62E+02	8.99E+02	3.87E+02	1.07E+03	3.46E+02	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		5.80E+00	1.40E+02	2.00E+03	1.38E+02	1.69E+02	3.13E+02	4.96E+03	3.08E+02	4.19E+02	6.01E+02	1.18E+04	5.93E+02	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(c)	-	2.47E+02	-	-	5.37E+01	4.82E+02	-	-	1.34E+02	7.66E+02	-	-	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(c)	-	8.88E+02	-	-	4.83E+00	1.11E+03	-	-	1.21E+01	1.22E+03	-	-	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(c)	-	8.88E+02	-	-	4.83E+00	1.11E+03	-	-	1.21E+01	1.22E+03	-	-	2.90E+01

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - the compound is not volatile and therefore a soil saturation limit not calculated within CLEA

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded. The SAC has been set as the model calculated SAC with the saturation limits shown in brackets.

Calculated SAC exceeds soil saturation limit but will not effect the SSV significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3

(a) Sensitivity analysis undertaken on SEGH equation and CLEA model, considered reasonable in absence of UK specific data

(b) GAC taken from the Environment Agency SGV reports published 2009.

(c) SAC for selenium, aliphatic and aromatic hydrocarbons >EC16 does not include inhalation pathway owing to absence of toxicity data. SAC for arsenic is only based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The same approach has been adopted for zinc.

(d) SAC for elemental mercury, chromium VI and nickel is based on the inhalation pathway only owing to an absence of toxicity for elemental mercury, in accordance with the SGV report for nickel and LQM report for chromium VI.

Table 8
Human Health Generic Assessment Criteria for Residential Scenario - Private Gardens

Compound	GrAC for Groundwater (mg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals				
Arsenic	-	32	32	32
Cadmium	-	10	10	10
Chormium (III) - oxide	-	3,000	3,000	3,000
Chromium (VI) - hexavalent	-	4.3	4.3	4.3
Copper	-	2,300	2,300	2,300
Lead	-	300	300	300
Elemental Mercury (Hg^0)	0.009	0.17	0.42	1.0
Inorganic Mercury (Hg^{2+})	-	170	170	170
Methyl Mercury (Hg^{4+})	20	7.4	9.6	11
Nickel	-	130	130	130
Selenium	-	350	350	350
Zinc	-	3,800	3,800	3,800
Cyanide	-	3.7	3.7	3.7
Volatile Organic Compounds				
Benzene	7	0.079	0.157	0.33
Toluene	1,900	120	270	610
Ethylbenzene	260	65	154	350
Xylene - m	100	44	103	240
Xylene - o	87	45	106	250
Xylene - p	84	42	98	230
Total xylene	84	44	103	240
Methyl tertiary butyl ether (MTBE)	2,200	1.8	3.7	7.4
Trichloroethene	1.8	0.11	0.2	0.49
Tetrachloroethene	3.6	0.94	2.1	4.8
1,1,1-Trichloroethane	26	6.2	12.7	28
1,1,1,2Tetrachloroethane	14	0.89	2.1	4.8
1,1,2,2-Tetrachloroethane	14	1.4	2.87	6.3
Carbon Tetrachloride	0.055	0.018	0.039	0.089
1,2-Dichloroethane	0.30	0.0053	0.0080	0.014
Vinyl Chloride	0.019	0.00047	0.0006	0.001
1,2,4-Trimethylbenzene	0.075	0.35	0.85	2.1
1,3,5-Trimethylbenzene	0.047	0.46	1.1	2.6
Semi-Volatile Organic Compounds				
Acenaphthene	3.2	210	480	1,000
Acenaphthylene	4.2	170	400	850
Anthracene	0.021	2,300	4,900	9,200
Benzo(a)anthracene	0.0038	3.1	4.7	5.9
Benzo(b)fluoranthene	0.0020	5.6	6.5	7.0
Benzo(g,h,i)perylene	0.00026	44	46	47
Benzo(k)fluoranthene	0.00080	8.5	9.6	10
Chrysene	0.0020	6.0	8.0	9.3
Dibenzo(a,h)anthracene	0.00060	0.76	0.86	0.90
Fluoranthene	0.23	260	460	670
Fluorene	1.9	160	380	780
Indeno(1,2,3-cd)pyrene	0.0002	3.2	3.8	4.2
Phenanthrene	0.53	92	200	380
Pyrene	0.13	560	1,000	1,600
Benzo(a)pyrene	0.0038	0.83	0.94	1.0
Naphthalene	19	1.5	3.7	8.7
Phenol	-	180	290	420
Total Petroleum Hydrocarbons				
Aliphatic hydrocarbons EC_5-EC_6	10	30	55	110
Aliphatic hydrocarbons >EC_6-EC_8	5.4	73	160	370
Aliphatic hydrocarbons >EC_8-EC_{10}	0.23	19	46	110
Aliphatic hydrocarbons >EC_{10}-EC_{12}	0.034	93 (48)	230 (118)	540 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	0.00076	744 (24)	1,700 (59)	3,000 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	-	45,100 (8.48)	64,000 (21)	76,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	-	45,100 (8.48)	64,000 (21)	76,000
Aromatic hydrocarbons >EC_8-EC_9 (styrene)	7.4	130	316	700
Aromatic hydrocarbons >EC_9-EC_{10}	7.4	27	65	150
Aromatic hydrocarbons >EC_{10}-EC_{12}	25	69	160	346
Aromatic hydrocarbons >EC_{12}-EC_{16}	5.8	140	310	593
Aromatic hydrocarbons >EC_{16}-EC_{21}	-	250	480	770
Aromatic hydrocarbons >EC_{21}-EC_{35}	-	890	1,100	1,230
Aromatic hydrocarbons >EC_{35}-EC_{44}	-	890	1,100	1,230

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, polycyclic aromatic hydrocarbons, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

The SAC has been set as the model calculated SAC with the saturation limit shown in brackets. For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. The GrAC conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

APPENDIX L
GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

APPENDIX L
GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

This appendix presents the generic assessment criteria (GAC) that RSK considers are suitable for assessing risks to:

- vegetation via the uptake of phytotoxic determinants through plant roots
- controlled waters.

The GAC for each of these receptors is discussed in turn.

Phytotoxic determinants to facilitate healthy plant growth

Copper and zinc can inhibit plant growth but are not normally hazardous to human health. The GAC for this pollutant linkage have been taken from Department of the Environment (1996) publication, *Code of Practice for Agricultural Use of Sewage Sludge*. The GAC for the phytotoxic determinants are presented in Table A1. The table also includes nickel as this is also phytotoxic. Please note that the human health GAC may not be suitably protective of the phytotoxic effects pathway depending on the soil pH.

Table A1: Generic assessment criteria for phytotoxic determinants

Determinant	Generic assessment criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110

APPENDIX M
GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

APPENDIX M
GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

The water environment in England and Wales is protected under a number of regulatory regimes, many regulated by the Environment Agency. The Environment Agency is consulted where there may be a risk that pollution of 'controlled waters' may occur or may have occurred in the past. Controlled waters are coastal waters, inland freshwaters and groundwaters. The EU Water Framework Directive (2000/60/EC) is implemented via various regulations and guidance, covering aspects of groundwater, surface water and drinking water supply policy. The regulations mainly apply to England and Wales, therefore if you are working on a site in Scotland or Northern Ireland, please review the equivalent legislation and guidance provided by the Scottish Environmental Protection Agency (SEPA) or the Northern Ireland Environment Agency (NIEA).

The main objectives of the protection and remediation of groundwater under threat from land contamination are set out in the Environment Agency's Groundwater Protection: Principles and Practice (GP3) series of documents(1). When assessing risks to groundwater the following needs to be taken into consideration:

- Where pollutants have not yet entered groundwater, all necessary and reasonable measures must be taken to;
  - *Prevent the input of hazardous substances into groundwater (see description of hazardous substances below)*
  - *Limit the entry of other (non-hazardous) pollutants into groundwater so as to avoid pollution, and to avoid deterioration of the status of groundwater bodies or sustained, upward trends in pollutant concentration.*
- Where hazardous substances or non-hazardous pollutants have already entered groundwater, the priority is to:
  - *Minimise further entry of hazardous substances and non hazardous pollutants into groundwater;*
  - *Take necessary and reasonable measures to limit the pollution of groundwater or impact on the status of the groundwater body from the future expansion of a contaminant 'plume', if necessary by actively reducing its extent.*

Definitions

Hazardous Substances are defined in the Water Framework Directive (WFD) 2000/60/EC as 'substances or groups of substances that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances which give rise to an equivalent level of concern. All List 1 substances under the old Groundwater Directive 80/68/EEC) are hazardous substances, all radioactive substances are hazardous substances.

Non-hazardous Substances are defined as 'substances capable of causing pollution that have not been classified as hazardous substances'. The non-hazardous list of pollutants does not simply replace the old WFD List II but includes a wider range.

For the current list of classified substances please visit the UKTAG website www.wfduk.org./jagdag/

When assessing the risks to surface waters, various standards apply, including Environmental Quality Standards which are protective of the water ecology[14].

The Water Supply (Water Quality) Regulations[2,3] are the primary source for assessing water bodies which may be used for public water supplies. There are also Private Water Supply Regulations which may be applicable in some cases.

This appendix presents the generic assessment criteria (GAC) that RSK considers are suitable for assessing risks to controlled waters.

The RSK GAC for controlled waters are presented in Table 1. In line with the Environment Agency's (2006b) Remedial Targets Methodology, the GAC for controlled waters are termed 'target concentrations'.

The target concentration can be derived by several means with consideration to:

- whether the substance is classified as hazardous or non-hazardous by the EU under the Water Framework Directive (2000/60/EC) and Groundwater Daughter Directive (2006/118/EC) implemented though the Environmental Permitting Regulations 2010;
- background concentrations in the aquifer;
- published guidance such as Environmental Quality Standards that are protective of ecology or The Water Supply (Water Quality) Regulations 2010 that are protective of drinking water; and
- Minimum Reporting Values (or method detection limits if MRV are not provided).

Table 1: Target concentrations for Controlled Waters

Analytes in bold are hazardous, *analytes in italics are non hazardous*, analytes in plain text are unclassified; according to JAGDAG Determination List June 2010

Target Concentrations shaded in GREEN are Statutory Values ORANGE are Non-Statutory Values

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional and Coastal Waters
Metals				
Arsenic	-	0.01[2]	0.05[13a]	0.025[13a]
Cadmium	0.0001[4]	0.005[2]	≤0.00008, 0.00008, 0.00009, 0.00015, 0.00025 [13b]	0.0002[13c]
Chromium (total)	-	0.05[2]	Use values for chromium III and VI	
Chromium (III)	-	Use value for total chromium	0.0047 [13a]	0.032[13c]
Chromium (VI)			0.0034 [13a]	0.0006[13a]
Copper	-	2.0[2]	0.001, 0.006, 0.01, 0.028[13e]	0.005[13a]
Lead	-	0.025 (before 25/12/2013), 0.01 (after 25/12/2013)[2]	0.0072[13c]	0.0072[13c]
Mercury	0.00001[4]	0.001[2]	0.00005[13c]	0.00005[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional and Coastal Waters
Nickel	-	0.02[2]	0.02[13c]	0.02[13c]
Selenium	-	0.01[2]	-	-
Zinc	-	5[3]	0.008, 0.05, 0.075, 0.125 [13e]	0.04[13a]
Chlorinated solvents				
Trichloroethene	0.0001[4]	0.01[2]	0.01[13c]	0.01[13c]
Tetrachloroethene	0.0001[4]	0.01[2]	0.01[13c]	0.01[13c]
1,1,1-Trichloroethane	0.0001[4]	-	0.1[13c]	0.1[13c]
1,1,2-Trichloroethane	0.0001[4]	-	0.4[13c]	0.3[13c]
Carbon tetrachloride (Tetrachloromethane)	0.0001[4]	0.003[2]	0.012[13c]	0.012[13c]
1,2-Dichloroethane	0.001[4]	0.003[2]	0.01[13c]	0.01[13c]
Vinyl chloride (Chloroethene)	-	0.0005[2]	-	-
Trihalomethanes	-	0.1[2, 5]	-	-
Chloroform (Trichloromethane) (one of the trihalomethanes included above)	0.0001[4]	0.1[2, 5]	0.0025[13c]	0.0025[13c]
Polycyclic aromatic hydrocarbons				
Acenaphthene	-	-	0.0058[10]	
Acenaphthylene	-	-	0.0058[10]	
Anthracene	-	-	0.0001[13c]	0.0001[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional and Coastal Waters
Benzo(a)anthracene	-	-	0.000018[10]	
Benzo(b)fluoranthene	-	0.0001[2]	0.00003[13f]	0.00003[13f]
Benzo(k)fluoranthene	-			
Benzo(g,h,i)perylene	-		0.000002[13g]	0.000002[13g]
Indeno(1,2,3-cd)pyrene	-			
Chrysene	-	-	0.00001[10]	
Dibenzo(a,h)anthracene	-	-	0.00001[10]	
Fluoranthene	-	-	0.0001[13c]	0.0001[13c]
Fluorene	-	-	0.0021[10]	
Phenanthrene	-	-	0.003[10]	
Pyrene	-	-	0.00004[10]	
Benzo(a)pyrene	-	0.00001[2]	0.00005[13c]	0.00005[13c]
Naphthalene	-	-	0.0024[13c]	0.0012[13c]
Petroleum hydrocarbons				
Total petroleum hydrocarbons	-	0.01[3]	0.01[3, 11]	
Benzene	0.001[4]	0.001[2]	0.01[13c]	0.008[13c
Toluene	0.004[4]	0.7[9]	0.05[13a]	0.04[13a]
Ethylbenzene	-	0.3[9]	0.02[12]	0.02[12]
Xylene	0.003[4]	0.5[9]	0.03[13c]	0.03[13c]

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional and Coastal Waters
Methyl tertiary butyl ether	-	0.015[7]		
Pesticides and herbicides				
Aldrin	0.000003[4]	0.00003[2]	0.00001[13d]	0.000005[13d]
Dieldrin	0.003[4]	0.00003[2]		
Endrin	0.000003[4]	0.0006[9]		
Isodrin	0.000003[4]	-		
Heptachlor	-	0.00003[2]		
Heptachlor epoxide	-	0.00003[2]		
Other pesticides	-	0.0001[2]		
Total pesticides	-	0.0005[2]		
Total DDT	0.000004[4]	0.001[9]	0.000025[13c]	0.000025[13c]
Azinphos – methyl	0.000001[4]	-	0.00001[1]	
Cyfluthrin	0.0001[4]	-	0.000001[14]	
Demeton	0.00005[4]	-	0.0005[14	
Dichlorvos	-	-	0.000001[13c]	0.00004[13c]
Dimethoate	0.00001[4]	-	0.00048[13a]	0.00048[13a]
Endosulphan	0.000005[4]	-	0.000005[13c]	0.0000005[13c]
Fenitrothion	0.000001[4]	-	0.00001[13c]	0.00001[13c]
Flucofuron	0.0001[4]	-	0.001[14]	

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional and Coastal Waters
Malathion	0.000001[4]	-	0.00001[13c]	0.00002[13c]
Mevinphos	0.000005[4]	-	0.00002[14]	-
Omethoate	0.0001[4]	-	0.00001[14]	
PCSDs (cyfluthrin, sulcofuron, flucofuron and **permethrin**)	-	-	0.00005[15]	
Permethrin	0.000001[4]	-	0.00001[13a]	0.00001[13]
Sulcofuron	0.0001[4]	-	0.025[8,14]	
Triazaphos	0.0001[4]	-	0.000005[8]	
Atrazine	0.00003[4]	-	0.0006[13c]	0.0006[13c]
Simazine	0.00003[4]	-	0.001[13c]	0.001[13c]
Bentazone	0.1[4]	-	0.5[13c]	0.5[13a]
Linuron	0.0001[4]	-	0.0005[13a]	0.0005[13a]
Mecoprop	0.00004[4]	-	0.018[13a]	0.018[13a]
Trifluralin	0.00001[4]	-	0.00003[13c]	0.00003[13c]
Miscellaneous				
Cyanide (Hydrogen cyanide)	-	0.05[2]	0.001[13a]	0.001[13a]
Phenol	0.0005[4]	-	0.0077[13a]	0.0077[13a]
Sodium	-	200[2]	-	
Chloride	-	250[2]	250[6,14]	-

Determinant	Target concentrations (mg/l)			
	Minimum Reporting Value	UK Drinking Water Standard or Best Equivalent	Environmental Quality Standard or Best Equivalent	
			Freshwater	Transitional and Coastal Waters
Ammonium (as NH_4^+)	-	0.5[2]	0.3[13a]	
Ammonia (NH_3)	-	-	0.025[15]	0.021[13a]
Sulphate	-	250[2]	400[6,14]	-
Iron	-	0.20[2]	1[13a]	1[13a]
Manganese	-	0.05[2]	0.03[6,14]	No EQS required [12]
Aluminium	-	0.2[2]	-	
Nitrate (as NO_3)	-	50[2]	-	
Nitrite (as NO_2)	-	0.1[2]	0.01[15]	-

Analytes in bold are hazardous, *analytes in italics are non hazardous*, analytes in plain text are unclassified;
according to JAGDAG Determination List June 2010

Notes:

1. Environment Agency. Groundwater Protection: Principles and Policy (GP3). Part 1 – 4. Part 4 and 5 under consultation.
2. Statutory Instrument 2000 No. 3184. The Water Supply (Water Quality) Regulations 2000, as amended by SI 2001/2885, SI 2002/2469, SI2005/2035, SI 2007/2734 and SI 2010/991 (applying from April 20 2010)
3. Statutory Instrument 1989 No. 1147. The Water Supply (Water Quality) Regulations 1989, as amended.
4. Minimum reporting values listed in Annex (j) of Horizontal Guidance Note H1 (H1 Environmental Risk Assessment Framework, Environment Agency, April 2010 v2.0). Note target concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene.
5. Statutory Instrument 2000 No. 3184. The Water Supply (Water Quality) Regulations 2000 – sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane.
6. Proposed list of EQS for implementation of the Dangerous Substances Directive (76/464.EEC).
7. Environment Agency MTBE guidance, dated 2006.
8. Freshwater Environmental Quality Standards: The Water Framework Directive 200/60/EC.
9. WHO's (2004) guidelines for drinking-water quality.
10. WRc plc (2002), R&D Technical Report P45. Where predicted no-effect concentration is below the laboratory method detection limit (LMDL) for chrysene, dibenzo(a,h)anthracene and fluoranthene, the target concentration has been set at the LMDL of 0.00001mg/l.
11. Please note this is a very conservative value. If necessary please refer to EA, 2009. *Petroleum hydrocarbons in Groundwater Supplementary Guidance for Hydrogeological Risk Assessment, which* provides advice on risk rankings of TPH CWG fractions. It may be possible to eliminate low risk fractions and/or those not detected above LMDL from concern.
12. Environment Agency Chemical Standards Database (May 2011). http://evidence.environment-agency.gov.uk/ChemicalStandards/home.aspx
13. The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010.
    - 13a. Annual mean concentration (mg/l) for 'Good' standard.
    - 13b. Applies to hardness ranges of <40mg/l $CaCO_3$, 40–<50mg/l $CaCO_3$, 50–<100mg/l $CaCO_3$, 100–<200mg/l $CaCO_3$ and >/=200mg/l $CaCO_3$. The target concentrations included in Table 1 are listed in order of increasing calcium carbonate concentrations.
    - 13c Annual Average EQS (surface waters).
    - 13d. Sum of aldrin, dieldrin, endrin and isodrin.
    - 13e. Applies to hardness ranges of 0–50mg/l $CaCO_3$, 50–100mg/l $CaCO_3$, 100–250mg/l $CaCO_3$ and >250mg/l $CaCO_3$. The target concentrations included in Table 1 are listed in order of increasing calcium carbonate concentrations; applies to annual mean concentration (mg/l) of $CaCO_3$. Applies to annual mean concentration of metal (mg/l) for 'Good' standard.

13f. Sum of benzo(b)fluoranthene and benzo(k)fluoranthene.

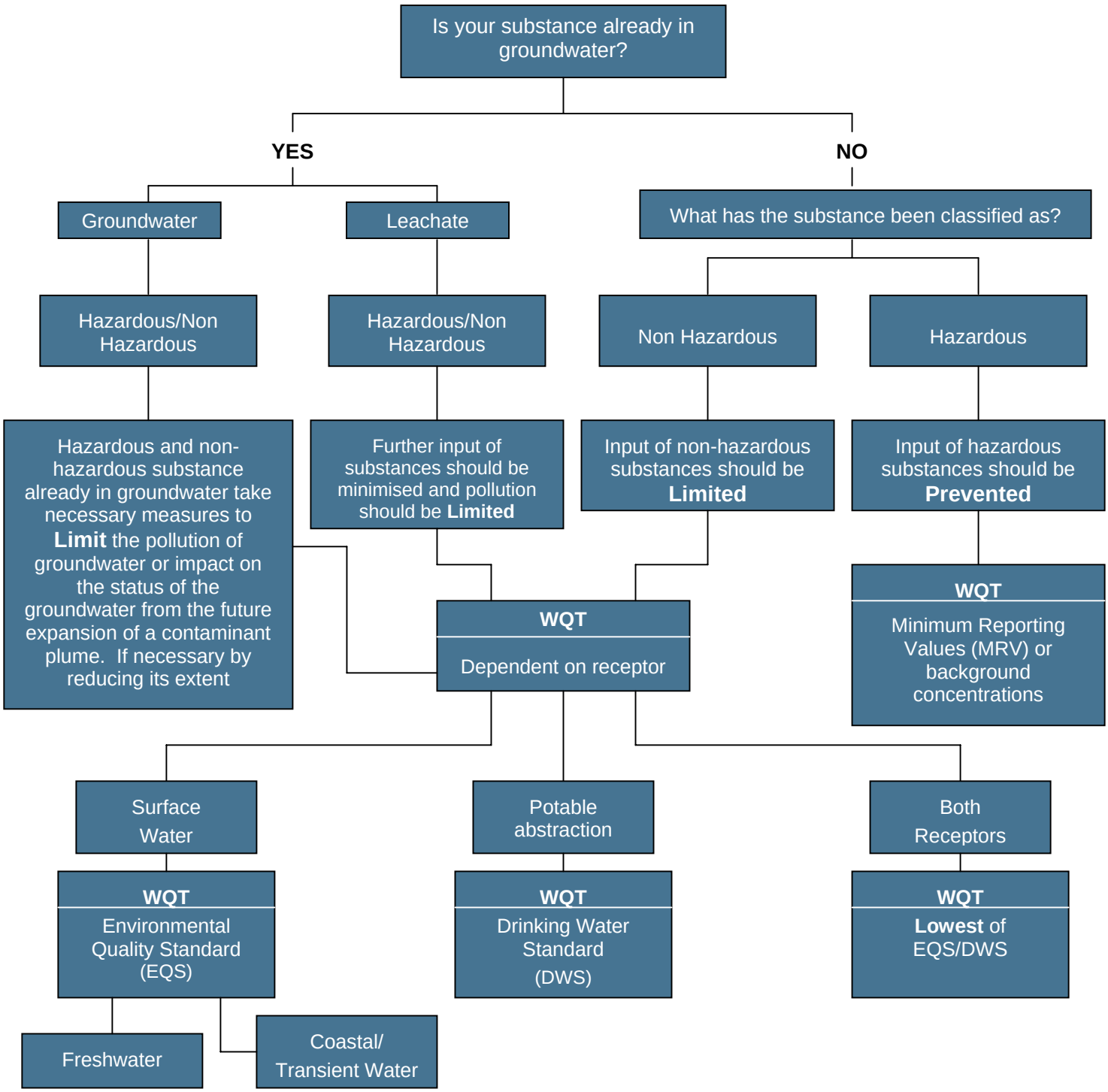
13g. Sum of benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene.

14. Council Directive on Pollution Caused by Certain Dangerous Substances Discharged into the Aquatic Environment of the Community (Dangerous Substances Directive)- List II Substances. Council Directive 76/464/EEC and Surface Waters (Dangerous Substances) (Classification) Regulations 1998

15. Council Directive on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life (Freshwater Fish Directive). Surface Waters (Fishlife) (Classification) Regulations 1997.

Note: '-' A target concentration is not available.

FLOW CHART TO ASSIST WITH SELECTION OF TARGET CONCENTRATIONS



WQT = Water Quality Target

When leachate is being assessed the 'compliance point' is the groundwater body. Therefore dilution within the groundwater body may be applied with caution before comparing with the WQT.

When directly assessing a receptor, e.g., a river, the appropriate WQT should be selected.

APPENDIX N
WATER SUPPLY PIPES

A range of pipe materials is available and careful selection, design and installation is required to ensure that water supply pipes are satisfactorily installed and meet the requirements of the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Byelaws 2000 in Scotland and the Northern Ireland Water Regulations. The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The water supply company has a statutory duty to enforce the regulations.

Contaminants in the ground can pose a risk to potable water supply by permeating plastic water supply pipes. To fulfil their statutory obligation, UK water supply companies require robust evidence from developers to demonstrate either that the ground in which new plastic supply pipes will be laid is free from specific contaminants, or that the proposed remedial strategy will mitigate any existing risk. If these requirements cannot be demonstrated to the satisfaction of the relevant water company, it becomes necessary to specify an alternative pipe material on the whole development or specific zones.

In 2010, UK Water Industry Research (UKWIR) published *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (Report Ref. No. 10/WM/03/21). This report reviewed previously published industry guidelines and threshold concentrations adopted by individual water supply companies.

The focus of the UKWIR research project was to develop clear and concise procedures, which provide consistency in the pipe selection decision process. It was intended to provide guidance that can be used to ensure compliance with current regulations and to prevent water supply pipe failing prematurely due to the presence of contamination.

Report 10/WM/03/21 concluded that in most circumstances only organic contaminants pose a potential risk to plastic pipe materials and Table 3.1 of the report provides threshold concentrations for PE and PVC pipes for the organic contaminants of concern. The report also makes recommendations for the procedures to be adopted in the design of site investigations and sampling strategies, and the assessment of data, to ensure that the ground through which water supply pipes will be laid is adequately characterised.

Risks to water supply pipes have therefore been assessed against the threshold concentrations for PE and PVC pipe specified in Table 3.1 of Report 10/WM/03/21, which have been adopted as the GACs for this linkage and are reproduced in Table A3 below.

Since water supply pipes are typically laid at a minimum depth of 750mm below finished ground levels, sample results from depths between 0.5m and 1.5m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be used providing the strata is the same as that in which water supply pipes are likely to be located. Report 10/WM/03/21 specifies that sampling should characterise the ground conditions to a minimum of 0.5m below the proposed depth of the pipe.

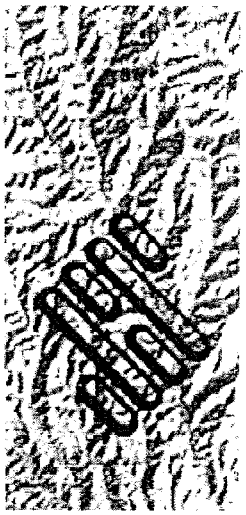
It should be noted that the assessment provided in this report is a guide and the method of assessment and recommendations should be checked with the relevant water supply company.

Table A3: Generic assessment criteria for water supply pipes

		Pipe material	
		GAC (mg/kg)	
	Parameter group	**PE**	**PVC**
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC	0.5	0.125
1a	+ BTEX + MTBE	0.1	0.03
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C_5–C_{10})	2	1.4
2e	+ Phenols	2	0.4
2f	+ Cresols and chlorinated phenols	2	0.04
3	Mineral oil C_{11}–C_{20}	10	Suitable
4	Mineral oil C_{21}–C_{40}	500	Suitable
5	Corrosive (conductivity, redox and pH)	Suitable	Suitable
Specific suite identified as relevant following site investigation			
2a	Ethers	0.5	1
2b	Nitrobenzene	0.5	0.4
2c	Ketones	0.5	0.02
2d	Aldehydes	0.5	0.02
6	Amines	Not suitable	Suitable
Notes: where indicated as ‘suitable’, the material is considered resistant to permeation or degradation and no threshold concentration has been specified by UKWIR.			

APPENDIX O
CERTIFICATES OF GEOTECHNICAL ANALYSIS

UKAS TESTING
No. 2652



STRUCTURAL SOILS LTD

SITE INVESTIGATION

SOIL, ROCK & MATERIAL TESTING

GEOTECHNICAL CONSULTANCY

CONTAMINATED LAND ASSESSMENT

Stuart Jeffery
RSK ENVIRONMENT LIMITED
18 Frogmore Road
Hemel Hempstead
Herts
HP3 9RT

10th September 2012

TESTING REPORT

YOUR REF: 25520

SITE: PORTMAN ROAD, READING

CERTIFICATE NUMBER: 582239

DATE SAMPLES RECEIVED: 20th August 2012
DATE TESTING COMMENCED: 20th August 2012

DATE OF SAMPLE DISPOSAL: 10th October 2012

INSTRUCTIONS: Please carry out Moisture Content, Atterberg Limits and Particle Size Distribution tests on samples provided

I have pleasure in enclosing the test report for the above project that you submitted to us for testing.

Yours sincerely

Justin Barrett
Laboratory Manager

Enc.

18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT
TEL: 01442 416660
FAX: 01442 437550
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www.soils.co.uk

HEAD OFFICE
Bristol

BRANCH OFFICES.
Castleford
Glasgow

SUMMARY OF SOIL CLASSIFICATION TESTS

In accordance with clauses 3.2,4.3,4.4,5.3,5.4,7.2,8.2,8.3 of BS1377:Part 2:1990

Exploratory Position ID	Sample Ref	Sample Type	Depth (m)	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index %	% <425um	Description of Sample
BH3		D	3.70	86	71	28	43	100	Brownish grey and dark brown organic CLAY with occasional fine roots
PH10		D	2.60	50	60	29	31	100	Grey organic CLAY with occasional fine roots

STRUCTURAL SOILS LTD

Contract: **Portman Road, Reading**

Contract Ref: **582239**

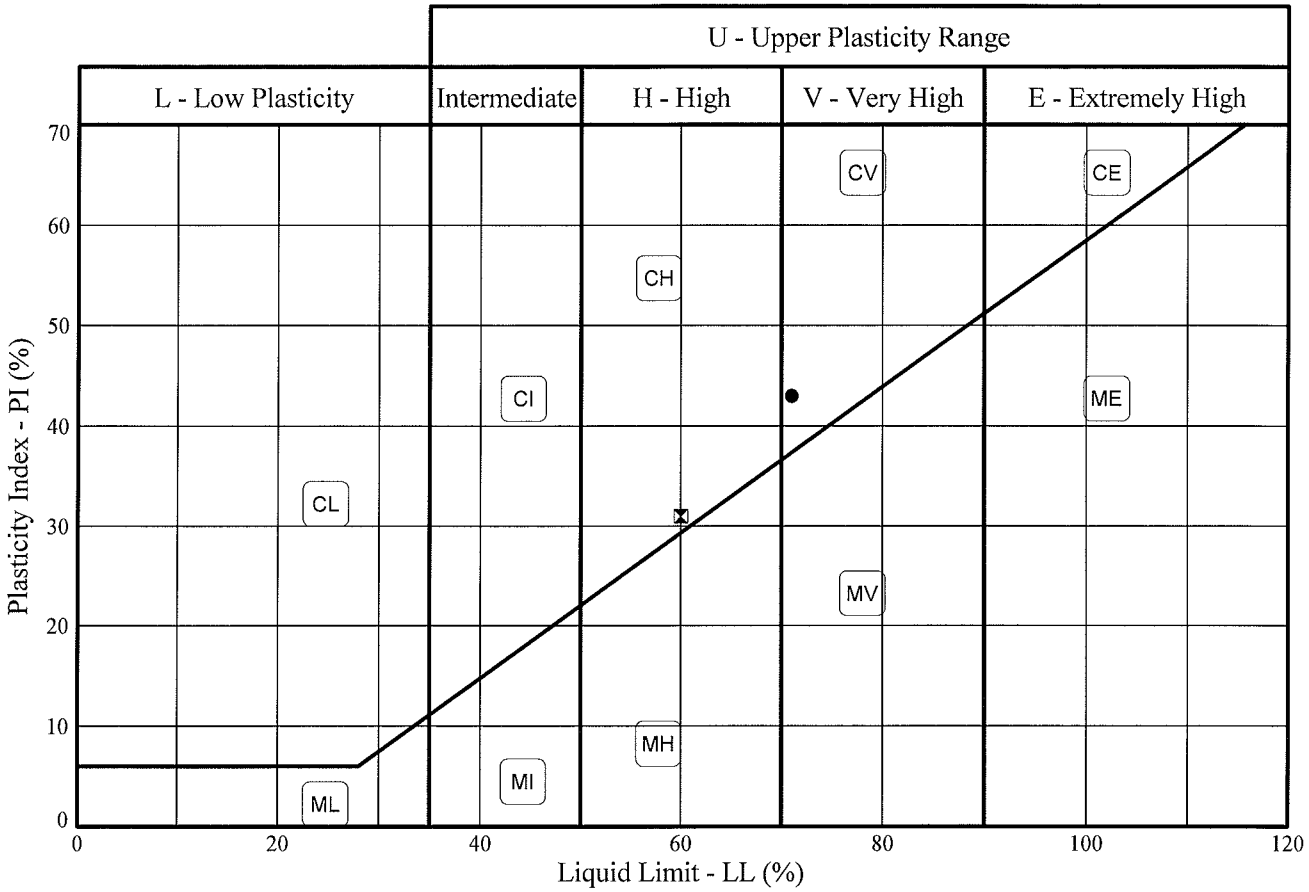
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PLASTICITY CHART - PI Vs LL

In accordance with clause 42.3 of BS5930:1999
Testing in accordance with BS1377-2:1990



Sample Identification				BS Test Method #	Preparation Method +	MC %	LL %	PL %	PI %	<425um %
	Exploratory Position ID	Sample	Depth (m)							
●	BH3	D	3.70	3.2/4.4/5.3/5.4	4.2.3	86	71	28	43	100
⊠	PH10	D	2.60	3.2/4.4/5.3/5.4	4.2.3	50	60	29	31	100

Tested in accordance with the following clauses of BS1377-2:1990.

3.2 - Moisture Content
4.3 - Cone Penetrometer Method
4.4 - One Point Cone Penetrometer Method
4.6 - One Point Casagrande Method
5.3 - Plastic Limit Method
5.4 - Plasticity Index

+ Tested in accordance with the following clauses of BS1377-2:1990.

4.2.3 - Natural State
4.2.4 - Wet Sieved

Key: * = Non standard test, NP = Non plastic.

Approved Signatories: J. BARRETT D. GRIFFIN S. CAIRNS M. BROOKMAN

STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By		Date
MBrookman	MELANIE BROOKMAN	10/09/12

Contract: **Portman Road, Reading**

Contract Ref: **582239**

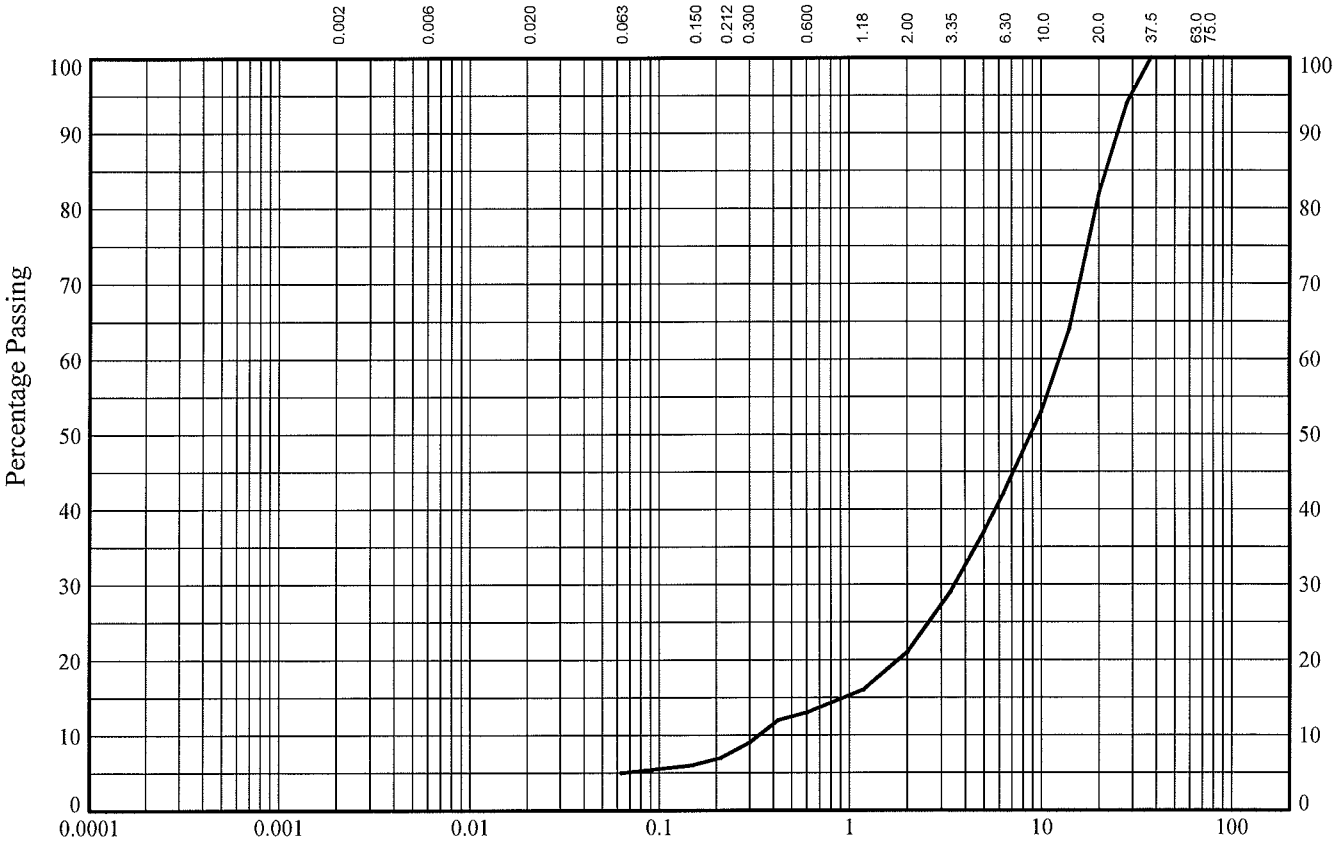
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Structural Soils Ltd, Branch Office - Hemel Hempstead: 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 262323, Fax: 01442 262683, Web: www.soils.co.uk, Email: ask@soils.co.uk.

PARTICLE SIZE DISTRIBUTION TEST

In accordance with clauses 9.2,9.5 of BS1377:Part 2:1990

Borehole : **BH1** Sample Ref: Sample Type: **B** Depth (m): **1.40**



CLAY	fine	medium	coarse	fine	medium	coarse	fine	medium	coarse	COBBLES
	SILT			SAND			GRAVEL			

BS Test Sieve (mm)	Percentage Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	94
20	82
14	64
10	53
6.3	42
5	37
3.35	29
2	21
1.18	16
0.6	13
0.425	12
0.3	9
0.212	7
0.15	6
0.063	5

Particle Diameter	Percentage Passing

Soil Fraction	Sieve Percentage
GRAVEL	**79**
SAND	**16**
SILT/CLAY	**5**

Soil Description:
Orange brown and grey clayey sandy GRAVEL

Approved Signatories: J. BARRETT D. GRIFFIN S. CAIRNS M. BROOKMAN

STRUCTURAL SOILS
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By		Date
MBrookman	**MELANIE BROOKMAN**	**10/09/12**

Contract: **Portman Road, Reading**

Contract Ref: **582239**

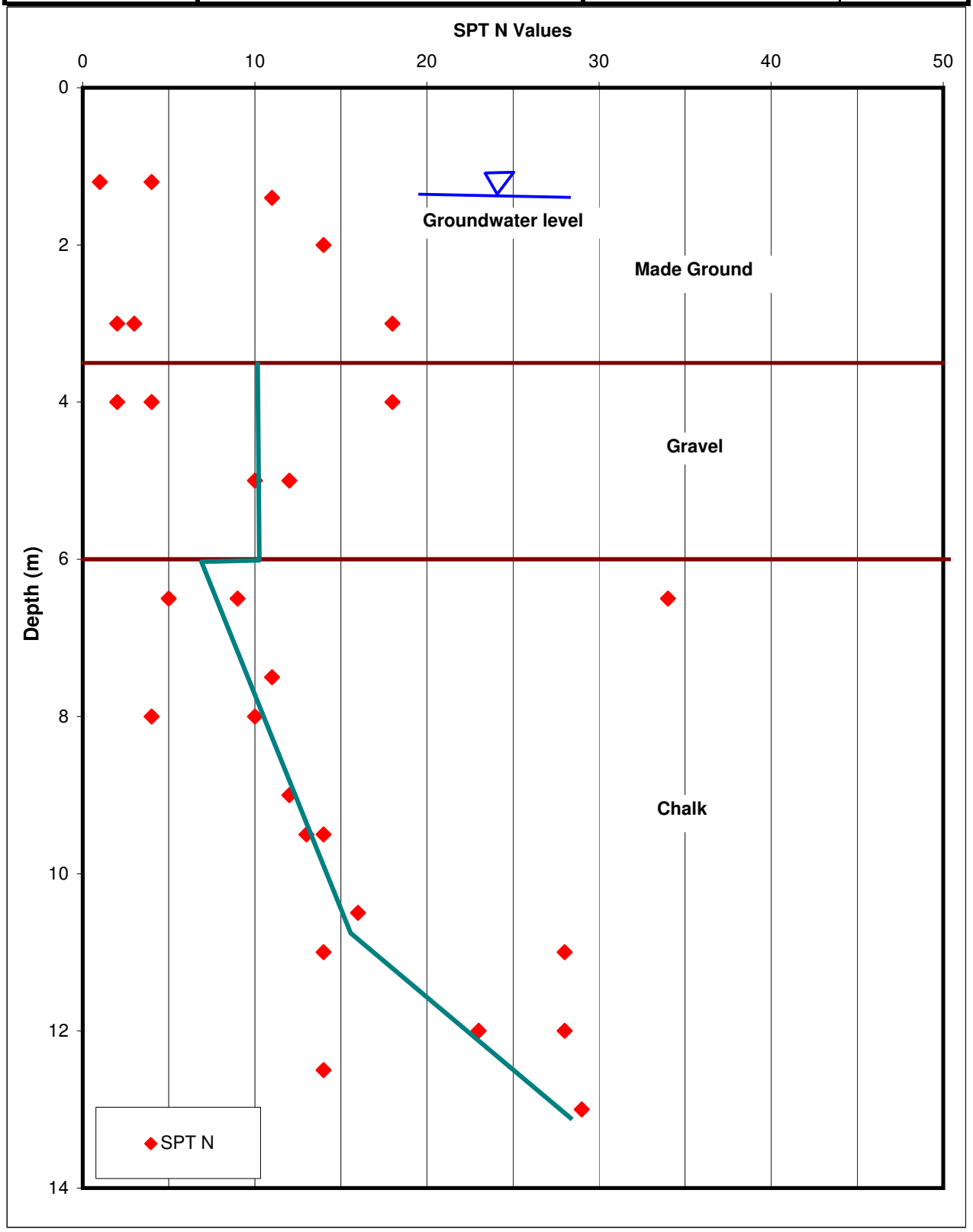
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Structural Soils Ltd, Branch Office - Hemel Hempstead: 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442-262323, Fax: 01442-262683, Web: www.soils.co.uk, Email: ask@soils.co.uk.

APPENDIX P
SHEAR STRENGTH PROFILE

	Site	SPT N Values - Depth Profile	
RSK	Former Battle Hospital	Client: Wates Construction	Job Number 25520



APPENDIX D
RISK ASSESSMENT METHODOLOGY

CLR11 outlines the framework to be followed for risk assessment in the UK. The framework is designed to be consistent with UK legislation and policies including planning. Under CLR11, three stages of risk assessment exist: preliminary, generic quantitative and detailed quantitative. An outline conceptual model should be formed at the preliminary risk assessment stage that collates all the existing information pertaining to a site in text, tabular or diagrammatic form. The outline conceptual model identifies potentially complete (termed possible) pollutant linkages (contaminant–pathway–receptor) and is used as the basis for the design of the site investigation. The outline conceptual model is updated as further information becomes available, for example as a result of the site investigation.

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, both the likelihood and the consequences of an event must be taken into account when assessing risk. RSK has adopted guidance provided in CIRIA C552 for use in the production of conceptual models.

The likelihood of an event can be classified on a four-point system using the following terms and definitions based on CIRIA C552:

- highly likely: the event 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: it is probable that an event will occur or circumstances are such that the event is not inevitable, but possible in the short term and likely over the long term
- low likelihood: circumstances are possible under which an event could occur, but it is not certain even in the long term that an event would occur and it is less likely in the short term
- unlikely: circumstances are such that it is improbable the event would occur even in the long term.

The severity can be classified using a similar system also based on CIRIA C552. The terms and definitions relating to severity are:

- severe: short term (acute) risk to human health likely to result in ‘significant harm’ as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resources. Catastrophic damage to buildings or property. Short-term risk to an ecosystem or organism forming part of that ecosystem (note definition of ecosystem in ‘Draft Circular on Contaminated Land’, DETR 2000)
- medium: chronic damage to human health (‘significant harm’ as defined in ‘Draft Circular on Contaminated Land’, DETR 2000), pollution of sensitive water resources, significant change in an ecosystem or organism forming part of that ecosystem

- mild: pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services ('significant harm' as defined in 'Draft Circular on Contaminated Land', DETR 2000). Damage to sensitive buildings, structures or the environment
- minor: harm, not necessarily significant, but that could result in financial loss or expenditure to resolve. Non-permanent human health effects easily prevented by use of personal protective clothing. Easily repairable damage to buildings, structures and services.

Once the probability of an event occurring and its consequences have been classified, a risk category can be assigned according to the table below.

		Consequences			
		Severe	**Medium**	**Mild**	**Minor**
Probability	**Highly likely**	Very high	High	Moderate	Moderate/low
	Likely	High	Moderate	Moderate/low	Low
	Low likelihood	Moderate	Moderate/low	Low	Very low
	Unlikely	Moderate/low	Low	Very low	Very low

Definitions of these risk categories are as follows together with an assessment of the further work that may be required:

- Very high: there is a high probability that severe harm could occur or there is evidence that severe harm is currently happening. This risk, if realised, could result in substantial liability; urgent investigation and remediation are likely to be required.
- High: harm is likely to occur. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required. Remedial works may be necessary in the short term and are likely over the long term.
- Moderate: it is possible that harm could arise, but it is unlikely that the harm would be severe and it is more likely that the harm would be relatively mild. Investigation is normally required to clarify the risk and determine the liability. Some remedial works may be required in the longer term.
- Low: it is possible that harm could occur, but it is likely that if realised this harm would at worst normally be mild.
- Very low: there is a low possibility that harm could occur and if realised the harm is unlikely to be severe.

APPENDIX E
FIELD RECORDS

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Battle Hospital	**Bellway Homes**	**WS2**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**07.02.17** End: **07.02.17**	**38.99**	**E:469984.6 N:173783.1**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instrumentation	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.20		ES				Blackish brown silty clayey gravelly SAND. Sand is fine to coarse. Gravel is angular to subangular flint, brick, ceramic and rare charcoal and ash. (MADE GROUND)	(0.30) 0.30	
	0.40 0.40-1.20		ES B				Brown reowkred slightly clayey slightly gravelly SAND. Sand is medium. Gravel is angular to subangular fine to coarse flint with fine chalk. (MADE GROUND)	(0.50) 0.80	
	1.00-1.45	1	SPT	N=7			Soft reddish brown slightly gravelly silty sandy CLAY. Sand is medium. Gravel is angular to subangular fine to coarse flint. (ALLUVIUM)	(0.70) 1.50	
	2.00-2.45	2	SPT	N=10			Medium dense yellowish-brown fine to coarse SAND, grading into very gravelly SAND. Gravel is fine to coarse angular to subangular flint. (TAPLOW GRAVEL)	(1.00) 2.50	
	3.00-3.45	3	SPT	N=10			Structureless CHALK composed of white gravelly SILT. Gravel is weak, low density chalk clasts with angular coarse flint. (WHITE CHALK SUBGROUP)	(0.95) 3.45	
							Window sample terminated at 3.45m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Hand dug inspection pit to 1.2m.
2. No groundwater encountered during drilling.
3. Gas monitoring installation at 2.5m.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Archway Competitor**	**Mark Bass**	**GWain**	

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_016 PrjVersion: v8_06 - Core+Logs - 002 | Log WINDOW SAMPLE LOG - A4P | 28916_BATTLE HOSPITAL READING.GPJ - v8_06.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437550, Fax: 01442 437500, Web: www.rsk.co.uk. | 22/03/17 - 15:32 | ZH1 |

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Battle Hospital	**Bellway Homes**	**WS3**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**07.02.17** End: **07.02.17**	**39.02**	**E:470001.8 N:173783.1**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.20		ES				Dark brown slightly gravelly silty SAND. Sand is fine to medium. Gravel is angular to subangular fine to coarse flint, brick and rare charcoal, ash and plastic. (MADE GROUND)	(0.35) 0.35	
	0.50		D				Orangish brown clayey slightly gravelly silty SAND. Sand is fine to medium. Gravel is subangular to medium flint. (TAPLOW GRAVEL)	(0.85) 1.20	
	1.00-1.45	1	SPT	N=5			Structureless CHALK composed of white gravelly SILT. Gravel is weak, low density chalk clasts with angular coarse flint. (WHITE CHALK SUBGROUP)	(3.25) 4.45	
	2.00-2.45	2	SPT	N=6					
	3.00-3.45	3	SPT	N=13					
	4.00-4.45	4	SPT	N=5					
							Window sample terminated at 4.45m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Hand dug inspection pit to 1.2m.
2. Soils damp at 2.00m depth.
3. Backfilled with arisings upon completion.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**Mark Bass**	**???**	

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_016 PrjVersion: v8_06 - Core+Logs - 002 | Log WINDOW SAMPLE LOG - A4P | 28916_BATTLE HOSPITAL READING.GPJ - v8_06.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk. | 22/03/17 - 15:32 | ZH1 |

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Battle Hospital	**Bellway Homes**	**WS4**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**07.02.17** End: **07.02.17**	**40.02**	**E:469977.4 N:173766.0**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.20		ES				Blacking brown silty gravelly SAND. Sand is fine to coarse. Gravel is angular to subangular fine to coarse brick, charcoal, flint and rare clinker. (MADE GROUND)	(0.60)	
								0.60	
	0.60-1.30		B				Loose to medium dense orangish brown clayey silty slightly gravelly SAND. Sand is fine to medium. Gravel is subangular fine to medium flint. (TAPLOW GRAVEL)		
	0.70		ES						
	1.00-1.45	1	SPT	N=2					
	2.00-2.45	2	SPT	N=15				(2.85)	
	3.00-3.45	3	SPT	N=5					
								3.45	
							Window sample terminated at 3.45m depth.		

Drilling Progress and Water Observations					
Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Hand dug inspection pit to 1.2m.
2. No groundwater encountered during drilling.
3. Gas monitoring installation at 3.00m.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**Mark Bass**	**GWain**	

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_016 PrjVersion: v8_06 - Core+Logs - 002 | Log WINDOW SAMPLE LOG - A4P | 28916_BATTLE HOSPITAL READING.GPJ - v8_06.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk. | 22/03/17 - 15:32 | ZH1 |

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Battle Hospital	**Bellway Homes**	**WS5**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**07.02.17** End: **07.02.17**	**39.79**	**E:469960.5 N:173773.6**	**1** of **1**

Progress	Samples / Tests				Water	Backfill	Description of Strata	Depth (Thickness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
	0.20		ES				Dark brown slightly gravelly silty SAND. Sand is fine to medium. Gravel is subangular to angular fine to coarse flint, ash and brick fragments. (MADE GROUND)	(0.50) 0.50	
	1.00		ES				Medium dense orangish brown slightly gravelly silty SAND. Sand is fine to medium. Gravel is angular to subangular fine to medium flint. (TAPLOW GRAVEL)	(2.20) 2.70	
	1.20		D						
	2.00-2.45	1	SPT	N=27					
	3.00-3.45	2	SPT	N=17			Structureless CHALK composed of white gravelly SILT. Gravel is weak, low density chalk clasts with angular coarse flint. (WHITE CHALK SUBGROUP)	(1.75) 4.45	
	3.50		D						
	4.00-4.45	3	SPT	N=6					
							Window sample terminated at 4.45m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Hand dug inspection pit to 1.2m.
2. Soils damp at 3.00m.
3. Borehole unstable upon completion.
4. Backfilled on completion.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Tracked window	**Archway Competitor**	**Mark Bass**	**GWain**	

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_016 PrjVersion: v8_06 - Core+Logs - 002 | Log WINDOW SAMPLE LOG - A4P | 28916_BATTLE HOSPITAL READING.GPJ - v8_06.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk. | 22/03/17 - 15:32 | ZH1 |

WINDOW SAMPLE LOG

Contract:	Client:	Window Sample:
Battle Hospital	**Bellway Homes**	**WS6**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**07.02.17** End: **07.02.17**	**40.05**	**E:469964.3 N:173793.6**	**1** of **1**

Progress	Samples / Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Window Run	Depth	No	Type	Results					
							BRICK surface/sand underlay. (MADE GROUND)	0.08	
							Reddish brown very sandy GFRAVEL. Sand is fine to coarse. Gravel is subangular fine to coarse (agreggate). (MADE GROUND)	0.30	
							Dense orangish brown slightly gravelly silty SAND. Sand is fine to medium. Gravel is angular to subangular fine to coarse flint. (TAPLOW GRAVEL)	(0.90)	
	1.00-1.45	1	SPT(c)	N=48				1.20	
	1.30		D				Dense brownish beige gravelly clayey SAND. Sand is fine to coarse. Gravel is angular to subangular fine to coarse flint. (TAPLOW GRAVEL)	(0.90)	
	2.00-2.45	2	SPT(c)	N=30				2.10	
							Structureless CHALK composed of white gravelly SILT. Gravel is weak, low density chalk clasts with angular coarse flint. (WHITE CHALK SUBGROUP)	(1.35)	
	3.00-3.45	3	SPT(c)	N=10				3.45	
							Window sample terminated at 3.45m depth.		

Drilling Progress and Water Observations

Date	Time	Borehole Depth (m)	Casing Depth (m)	Borehole Diameter (mm)	Water Depth (m)

General Remarks

1. Installed at 3.00m depth.
2. No groundwater.

All dimensions in metres | Scale: **1:28**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Tracked window sampling	**Archway Competitor**	**MB**	**GWain**	

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_016 PrjVersion: v8_06 - Core+Logs - 002 | Log WINDOW SAMPLE LOG - A4P | 28916_BATTLE HOSPITAL READING.GPJ - v8_06.
RSK Environment Ltd, 18 Frogmore Road, Hemel Hempstead, Hertfordshire, HP3 9RT. Tel: 01442 437500, Fax: 01442 437550, Web: www.rsk.co.uk. | 22/03/17 - 15:32 | ZH1 |

BOREHOLE LOG

Contract:	Client:	Borehole:
Battle Hospital	**Bellway Homes**	**BH4**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	End: **01.02.17**	**38.39**	**E:469899.3 N:173962.0**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
0.30	D1	D				Dark brown slightly silty gravelly SAND with occasional pockets of clay. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flint, concrete and brick with rare clinker. (MADE GROUND)	1.00	
0.80	D2	D						
1.20-1.65	1	SPT	N=1			. . . becoming very clayey with rare ceramics from 0.5m		
2.00-2.45	2	SPT	N=1			Dark brown silty sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flints. (MADE GROUND)	(3.80)	
3.00-3.45	3	SPT	N=2	▽1				
4.00-4.45	4	SPT	N=3			. . . no gravel from 3.0m		
4.80	D6	D		▽1			4.80	
5.00-5.45	5	SPT	N=10			Dark brown and white SAND and GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flints. (TAPLOW GRAVEL)	(1.10)	
							5.90	
6.50-6.95	6	SPT	N=15			Structureless chalk recovered as off white gravelly SILT. Gravels are weak, medium density offwhite chalk clasts with rare orangish red staining and frequent flints (Estimated CIRIA Grade Dm). (WHITE CHALK SUBGROUP)		
8.00-8.45	7	SPT	N=10				(5.10)	
9.50-9.95	8	SPT	N=16					
							11.00	
11.00-11.45	9	SPT	N=19			Structureless chalk recovered as silty sandy subangular to rounded GRAVEL. Gravel is weak medium density off white chalk clasts with occasional orangish brown staining with frequent flints (Estimated CIRIA Grade Dc). (WHITE CHALK SUBGROUP)		
12.50-12.95	10	SPT	N=18					
14.00-14.45	11	SPT	N=27					
15.50-15.95	12	SPT	N=25					
17.00-17.45	13	SPT	N=44				(12.00)	
18.50-18.91	14	SPT	7,4/5,16,22,9 for 30mm					

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Hand dug inspection pit to 1.2m.
2. Borehole drilled using clean drilling techniques. Drilled in 200mm casing to 4.5m. Reduced to 150mm.
3. Groundwater strike at 5.2m. Infow rate - steady.
4. Monitoring standpipe installed at 7.5m.

All dimensions in metres | Scale: **1:111**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 150**	**Mark Bass**	**GWain**	

GINT_LIBRARY_V8_06.GLB LibVersion: v8_06_016 PrjVersion: v8_06 - Core+Logs - 002 | Log CABLE PERCUSSION LOG - A4P | 28916_BATTLE HOSPITAL READING.GPJ - v8_06.
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BOREHOLE LOG

Contract:	Client:	Borehole:
Battle Hospital	**Bellway Homes**	**BH4**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	End: **01.02.17**	**38.39**	**E:469899.3 N:173962.0**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
20.00-20.40	15	SPT	7,7/17,18,15 for 20mm			Structureless chalk recovered as silty sandy subangular to rounded GRAVEL. Gravel is weak medium density off white chalk clasts with occasional orangish brown staining with frequent flints (Estimated CIRIA Grade Dc). (WHITE CHALK SUBGROUP) *(stratum copied from 11.00m from previous sheet)*		
21.50-21.95	16	SPT	N=50				23.00	
23.00-23.41	17	SPT	N=58*			Structureless chalk recovered as silty sandy subangular to rounded GRAVEL with a low cobble content. Gravel is weak medium density off white chalk clasts with occasional orangish brown staining with frequent flints (Estimated CIRIA Grade Dc). (WHITE CHALK SUBGROUP)	(2.00)	
24.50-24.95	18	SPT	N=51				25.00	
						Borehole terminated at 25.0m		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:111**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 150**	**Mark Bass**	**GWain**	

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BOREHOLE LOG

Contract:	Client:	Borehole:
Battle Hospital	**Bellway Homes**	**BH5**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**05.02.17** End: **06.02.17**	**39.83**	**E:469973.5 N:173793.1**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
0.40-0.70	B1	B				Dark brown slighty gravelly, clayey SAND. Sand is fine to coarse with frequent chalk. Gravel is subangular to rounded fine to coarse flints with rare brick and occasional chalk. (MADE GROUND)	0.80	
1.20-1.65	1	SPT(c)	N=32			Dense light brown silty SAND and GRAVEL. Sand is fine to coarse. Gravel is subangular to rounded flints with frequent chalk. (TAPLOW GRAVEL)	(1.70)	
2.00-2.45	2	SPT(c)	N=36				2.50	
3.00-3.45	3	SPT	N=5			Structureless chalk recovered as off white gravelly SILT. Gravels are weak, medium density offwhite chalk clasts with rare orangish red staining and frequent flints (Estimated CIRIA Grade Dm). (WHITE CHALK SUBGROUP)		
4.00-4.45	4	SPT	N=6			. . . cobbles more frequent from 4.0m		
5.00-5.45	5	SPT	N=10			. . . cobbles less frequent from 5.0m		
6.50-6.95	6	SPT	N=9				(10.00)	
8.00-8.45	7	SPT	N=11					
8.50-9.00	B8	B						
9.50-9.95	8	SPT	N=15					
11.00-11.45	9	SPT	N=17					
12.50-12.95	10	SPT	N=21			Structureless chalk recovered as silty sandy subangular to rounded GRAVEL with a low cobble content. Gravel is weak medium density off white chalk clasts with occasional orangish brown staining with frequent flints (Estimated CIRIA Grade Dc). (WHITE CHALK SUBGROUP)	12.50	
14.00-14.45	11	SPT	N=24					
15.50-15.95	12	SPT	N=45					
17.00-17.45	13	SPT	N=50					
18.50-18.91	14	SPT	N=59*				(12.50)	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Hand dug to 1.2m
2. Installed to 6m
3. Water struck at 5.2m and rose to 3.3m
4. Backfilled with arisings to 6m, sand/gravel to 2m and bentonite to surface level.

All dimensions in metres | Scale: **1:111**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 150**	**Mark Bass**	**GWain**	

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BOREHOLE LOG

Contract:	Client:	Borehole:
Battle Hospital	**Bellway Homes**	**BH5**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**05.02.17** End: **06.02.17**	**39.83**	**E:469973.5 N:173793.1**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
20.00-20.40	15	SPT(c)	N=60*			Structureless chalk recovered as silty sandy subangular to rounded GRAVEL with a low cobble content. Gravel is weak medium density off white chalk clasts with occasional orangish brown staining with frequent flints (Estimated CIRIA Grade Dc). (WHITE CHALK SUBGROUP) *(stratum copied from 12.50m from previous sheet)*		
21.50-21.95	16	SPT	N=50					
23.00-23.41	17	SPT	N=58*					
24.50-24.95	18	SPT(c)	N=50				25.00	
						Borehole terminated at 25.0m		

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:111**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 150**	**Mark Bass**	**GWain**	

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BOREHOLE LOG

Contract:	Client:	Borehole:
Battle Hospital	**Bellway Homes**	**BH6**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**02.02.17** End: **03.02.17**	**37.99**	**E:469978.6 N:173921.0**	**1** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
0.10-0.50	B1	B				Dark brown highly organic slightly gravelly sandy SILT. Sand is fine to coarse. Gravel is very fine subrounded flints, brick, ash, ceramic and clinker with occasional rootlets and rare glass and possible chalk. Material has a very faint sulphorous odour. (MADE GROUND)		
0.50-1.00	B2	B						
1.00-1.50	B3	B						
1.20-1.65	1	SPT(c)	N=2	1				
2.00-2.45	2	SPT	N=1			. . . no brick, more frequent glass and rare plastic (plastic/cork bottle cap) from 2.0m	(5.00)	
3.00-3.45	3	SPT	N=2					
4.00-4.45	4	SPT	N=4				5.00	
5.00-5.45	5	SPT(c)	N=9			Light brown slightly silty SAND and GRAVEL. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse flints. (TAPLOW GRAVEL)		
6.50-6.95	6	SPT(c)	N=47				(4.30)	
8.00-8.45	7	SPT(c)	N=48					
9.50-9.95	8	SPT(c)	N=14			Structureless chalk recovered as off white gravelly SILT. Gravels are weak, medium density offwhite chalk clasts with rare orangish red staining and frequent flints (Estimated CIRIA Grade Dm). (WHITE CHALK SUBGROUP)	9.30	
11.00-11.45	9	SPT	N=12					
12.50-12.95	10	SPT	N=16				(6.20)	
14.00-14.45	11	SPT	N=18					
15.50-15.95	12	SPT	N=30			Structureless chalk recovered as silty sandy subangular to rounded GRAVEL with a low cobble content. Gravel is weak medium density off white chalk clasts with occasional orangish brown staining with frequent flints (Estimated CIRIA Grade Dc). (WHITE CHALK SUBGROUP)	15.50	
17.00-17.45	13	SPT	N=30					
18.50-18.95	14	SPT	N=33					

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

1. Hand dug to 1.2m
2. Hole installed to 7.5m
3. No water strike
4. Hole backfilled with arisings to 7.5m, sand/gravel to 5.0m and bentonite to surface level.

All dimensions in metres | Scale: **1:111**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 150**	**Mark Bass**	**GWain**	

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BOREHOLE LOG

Contract:	Client:	Borehole:
Battle Hospital	**Bellway Homes**	**BH6**

Contract Ref:	Start:	Ground Level:	National Grid Co-ordinate:	Sheet:
28916	**02.02.17** End: **03.02.17**	**37.99**	**E:469978.6 N:173921.0**	**2** of **2**

Samples and In-situ Tests				Water	Backfill & Instru-mentation	Description of Strata	Depth (Thick ness)	Material Graphic Legend
Depth	No	Type	Results					
20.00-20.45	15	SPT	N=50			Structureless chalk recovered as silty sandy subangular to rounded GRAVEL with a low cobble content. Gravel is weak medium density off white chalk clasts with occasional orangish brown staining with frequent flints (Estimated CIRIA Grade Dc). (WHITE CHALK SUBGROUP) *(stratum copied from 15.50m from previous sheet)*	(9.50)	
21.50-21.95	16	SPT	N=39			. . . brown specks less frequent from 21.5m		
23.00-23.45	17	SPT	N=50					
24.00	D12	D						
24.50-24.95	18	SPT	N=29					
						Borehole terminated at 25.0m	25.00	

Boring Progress and Water Observations					
Date	Time	Borehole Depth	Casing Depth	Borehole Diameter (mm)	Water Depth

Chiselling / Slow Progress		
From	To	Duration (hh:mm)

General Remarks

All dimensions in metres | Scale: **1:111**

Method Used:	Plant Used:	Drilled By:	Logged By:	Checked By:
Inspection pit + Cable percussion	**Dando 150**	**Mark Bass**	**GWain**	

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IN-SITU GAS MONITORING RESULTS

[Pressures]	Previous	During	Start	End	Equipment Used & Remarks
Round 1	Constant	Constant	-	-	

Exploratory Position ID	Monitoring Round	Measured Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
BH3	1	---	20/02/2017	-	1015	0.0	-	0.0	0.0	20.8	0.0	0.0	0.0	
BH3	1	---	15 secs	-	1015	0.0	-	1.9	0.0	19.1	0.0	0.0	0.0	
BH3	1	---	30 secs	-	1015	0.0	-	2.0	0.0	19.0	0.0	0.0	0.0	
BH3	1	---	60 secs	-	1015	0.0	-	2.1	0.0	18.8	0.0	0.0	0.0	
BH3	1	---	90 secs	-	1015	0.0	-	2.1	0.0	18.8	0.0	0.0	0.0	
BH3	1	---	120 secs	-	1015	0.0	-	2.1	0.0	18.7	0.0	0.0	0.0	
BH3	1	---	150 secs	-	1015	0.0	-	2.1	0.0	18.7	0.0	0.0	0.0	
BH3	1	---	180 secs	-	1015	0.0	-	2.1	0.0	18.7	0.0	0.0	0.0	
BH4	1	---	20/02/2017	-	1015	-	-	0.1	0.0	20.7	0.0	0.0	-	
BH4	1	---	15 secs	-	1015	-	-	0.5	0.2	20.7	0.0	0.0	-	
BH4	1	---	30 secs	-	1015	-	-	0.5	0.2	20.7	0.0	0.0	-	
BH4	1	---	60 secs	-	1015	-	-	0.5	0.2	20.7	0.0	0.0	-	
BH4	1	---	90 secs	-	1015	-	-	0.5	0.2	20.7	0.0	0.0	-	
BH4	1	---	120 secs	-	1015	-	-	0.5	0.2	20.6	0.0	0.0	-	
BH4	1	---	150 secs	-	1015	-	-	0.5	0.2	20.6	0.0	0.0	-	
BH4	1	---	180 secs	-	1015	-	-	0.5	0.2	20.6	0.0	0.0	-	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

RSK Environment Ltd
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By	Date	Checked By	Date	Contract Ref:
	22/03/17			28916

Contract: **Battle Hospital**

GINT_LIBRARY_V8_06.GLB : E - GAS MON - REDUCED - 9A - A4L : 28916_BATTLE HOSPITAL READING.GPJ : 22/03/17 16:05 : ZH1 :

IN-SITU GAS MONITORING RESULTS

Exploratory Position ID	Monitoring Round	Installation Depth (mbgl)	Date & Time of Monitoring (elapsed time)	Borehole Pressure (mb)	Atmos Pressure (mb)	Gas Flow (l/hr)	Water Depth (mbgl)	Carbon Dioxide (% / vol)	Methane (% / vol)	Oxygen (% / vol)	LEL (%)	Carbon Monoxide (ppm)	Hydrogen Sulphide (ppm)	
BH5	1	---	20/02/2017	-	1015	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
BH5	1	---	15 secs	-	1015	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
BH5	1	---	30 secs	-	1015	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
BH5	1	---	60 secs	-	1015	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
BH5	1	---	90 secs	-	1015	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
BH5	1	---	120 secs	-	1015	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
BH5	1	---	150 secs	-	1015	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
BH5	1	---	180 secs	-	1015	-	-	0.0	0.0	20.7	0.0	0.0	0.0	
BH6	1	---	20/02/2017	-	1015	0.0	-	0.1	0.0	20.6	0.0	0.0	0.0	
BH6	1	---	15 secs	-	1015	0.0	-	3.1	0.2	19.6	0.0	0.0	0.0	
BH6	1	---	30 secs	-	1015	0.0	-	3.1	0.2	19.3	4.0	0.0	0.0	
BH6	1	---	60 secs	-	1015	0.0	-	3.1	0.2	19.3	4.0	0.0	0.0	
BH6	1	---	90 secs	-	1015	0.0	-	3.1	0.2	19.2	4.0	0.0	0.0	
BH6	1	---	120 secs	-	1015	0.0	-	3.1	0.2	19.2	4.0	0.0	0.0	
BH6	1	---	150 secs	-	1015	0.0	-	3.1	0.2	19.2	4.0	0.0	0.0	
BH6	1	---	180 secs	-	1015	0.0	-	3.1	0.2	19.2	4.0	0.0	0.0	

Key: I = Initial, P = Peak, SS = Steady State. Note: LEL = Lower Explosive Limit = 5% v/v.

RSK Environment Ltd
18 Frogmore Road
Hemel Hempstead
Hertfordshire
HP3 9RT

Compiled By	Date	Checked By	Date	Contract Ref:
	**22/03/17**			**28916**

Contract: **Battle Hospital**

Page: **2** of **2**

APPENDIX F
LABORATORY CERTIFICATES FOR SOIL & GROUNDWATER ANALYSIS

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 17/01523
Issue Number: 1 **Date:** 09 March, 2017

Client: RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Greg Wain/Nigel Austin
Project Name: Former Battle Hospital
Project Ref: 28916
Order No: N/A
Date Samples Received: 02/03/17
Date Instructions Received: 02/03/17
Date Analysis Completed: 09/03/17

Prepared by:

Kate Keningale
Administrative Assistant

Approved by:

John Gustafson
Director

UKAS TESTING
1247

Envirolab Job Number: 17/01523

Client Project Name: Former Battle Hospital

Client Project Ref: 28916

Lab Sample ID	17/01523/1								Units	Method ref
Client Sample No										
Client Sample ID	BH1									
Depth to Top										
Depth To Bottom										
Date Sampled	28-Feb-17									
Sample Type	Water - EW									
Sample Matrix Code	N/A									
pH (w)$_A^\#$	6.95								pH	A-T-031w
Sulphate (w)$_A^\#$	17								mg/l	A-T-026w
Arsenic (dissolved)$_A^\#$	<1								µg/l	A-T-025w
Cadmium (dissolved)$_A^\#$	<0.2								µg/l	A-T-025w
Copper (dissolved)$_A^\#$	1								µg/l	A-T-025w
Chromium (dissolved)$_A^\#$	9								µg/l	A-T-025w
Lead (dissolved)$_A^\#$	<1								µg/l	A-T-025w
Mercury (dissolved)$_A^\#$	<0.1								µg/l	A-T-025w
Nickel (dissolved)$_A^\#$	1								µg/l	A-T-025w
Selenium (dissolved)$_A^\#$	<1								µg/l	A-T-025w
Zinc (dissolved)$_A^\#$	6								µg/l	A-T-025w

Envirolab Job Number: 17/01523

Client Project Name: Former Battle Hospital

Client Project Ref: 28916

Lab Sample ID	17/01523/1								Units	Method ref
Client Sample No										
Client Sample ID	BH1									
Depth to Top										
Depth To Bottom										
Date Sampled	28-Feb-17									
Sample Type	Water - EW									
Sample Matrix Code	N/A									
PAH 16MS (w)										
Acenaphthene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Acenaphthylene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Anthracene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Benzo(a)anthracene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Benzo(a)pyrene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Benzo(b)fluoranthene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Benzo(ghi)perylene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Benzo(k)fluoranthene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Chrysene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Dibenzo(ah)anthracene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Fluoranthene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Fluorene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Indeno(123-cd)pyrene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Naphthalene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Phenanthrene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
Pyrene $(w)_A^{\#}$	<0.01								µg/l	A-T-019w
PAH (total 16) $(w)_A^{\#}$	<0.01								µg/l	A-T-019w

Envirolab Job Number: 17/01523

Client Project Name: Former Battle Hospital

Client Project Ref: 28916

Lab Sample ID	17/01523/1								Units	Method ref
Client Sample No										
Client Sample ID	BH1									
Depth to Top										
Depth To Bottom										
Date Sampled	28-Feb-17									
Sample Type	Water - EW									
Sample Matrix Code	N/A									
TPH CWG										
Ali >C5-C6 $(w)_A^{\#}$	<1								µg/l	A-T-022w
Ali >C6-C8 $(w)_A^{\#}$	2								µg/l	A-T-022w
Ali >C8-C10 $(w)_A^{\#}$	<1								µg/l	A-T-022w
Ali >C10-C12 $(w)_A^{\#}$	<5								µg/l	A-T-023w
Ali >C12-C16 $(w)_A^{\#}$	<5								µg/l	A-T-023w
Ali >C16-C21 $(w)_A^{\#}$	<5								µg/l	A-T-023w
Ali >C21-C35 $(w)_A^{\#}$	<5								µg/l	A-T-023w
Total Aliphatics $(w)_A$	<5								µg/l	A-T-022+23w
Aro >C5-C7 $(w)_A^{\#}$	<1								µg/l	A-T-022w
Aro >C7-C8 $(w)_A^{\#}$	<1								µg/l	A-T-022w
Aro >C8-C9 $(w)_A^{\#}$	<1								µg/l	A-T-022w
Aro >C9-C10 $(w)_A^{\#}$	<1								µg/l	A-T-022w
Aro >C10-C12 $(w)_A^{\#}$	<5								µg/l	A-T-023w
Aro >C12-C16 $(w)_A^{\#}$	8								µg/l	A-T-023w
Aro >C16-C21 $(w)_A^{\#}$	7								µg/l	A-T-023w
Aro >C21-C35 $(w)_A^{\#}$	<5								µg/l	A-T-023w
Total Aromatics $(w)_A$	14								µg/l	A-T-022+23w
TPH (Ali & Aro) $(w)_A$	16								µg/l	A-T-022+23w
BTEX - Benzene $(w)_A^{\#}$	<1								µg/l	A-T-022w
BTEX - Toluene $(w)_A^{\#}$	<1								µg/l	A-T-022w
BTEX - Ethyl Benzene $(w)_A^{\#}$	<1								µg/l	A-T-022w
BTEX - m & p Xylene $(w)_A^{\#}$	<1								µg/l	A-T-022w
BTEX - o Xylene $(w)_A^{\#}$	<1								µg/l	A-T-022w
MTBE $(w)_A^{\#}$	<1								µg/l	A-T-022w

REPORT NOTES

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All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 17/01337
Issue Number: 1 **Date:** 09 March, 2017

Client: RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Greg Wain/Nigel Austin
Project Name: Former Battle Hospital
Project Ref: 28916
Order No: N/A
Date Samples Received: 22/02/17
Date Instructions Received: 23/02/17
Date Analysis Completed: 09/03/17

Prepared by:



Richard Wong
Client Service Manager

Approved by:



Georgia King
Client Service Manager

UKAS TESTING
1247

Envirolab Job Number: 17/01337

Client Project Name: Former Battle Hospital

Client Project Ref: 28916

Lab Sample ID	17/01337/1	17/01337/2	17/01337/3	17/01337/4	17/01337/5				Units	Method ref
Client Sample No										
Client Sample ID	BH2	BH3	BH4	BH5	BH6					
Depth to Top										
Depth To Bottom										
Date Sampled	20-Feb-17	20-Feb-17	20-Feb-17	20-Feb-17	20-Feb-17					
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW					
Sample Matrix Code	N/A	N/A	N/A	N/A	N/A					
pH (w)$_A^{\#}$	6.80	7.04	7.61	7.48	7.16				pH	A-T-031w
Sulphate (w)$_A^{\#}$	52	41	10	71	164				mg/l	A-T-026w
Arsenic (dissolved)$_A^{\#}$	3	12	4	6	5				µg/l	A-T-025w
Cadmium (dissolved)$_A^{\#}$	<0.2	<0.2	<0.2	<0.2	<0.2				µg/l	A-T-025w
Copper (dissolved)$_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-025w
Chromium (dissolved)$_A^{\#}$	<1	2	4	2	3				µg/l	A-T-025w
Lead (dissolved)$_A^{\#}$	<1	<1	<1	<1	2				µg/l	A-T-025w
Mercury (dissolved)$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1				µg/l	A-T-025w
Nickel (dissolved)$_A^{\#}$	<1	1	1	6	7				µg/l	A-T-025w
Selenium (dissolved)$_A^{\#}$	<1	<1	<1	<1	1				µg/l	A-T-025w
Zinc (dissolved)$_A^{\#}$	3	1	4	5	24				µg/l	A-T-025w

Envirolab Job Number: 17/01337

Client Project Name: Former Battle Hospital

Client Project Ref: 28916

Lab Sample ID	17/01337/1	17/01337/2	17/01337/3	17/01337/4	17/01337/5				Units	Method ref
Client Sample No										
Client Sample ID	BH2	BH3	BH4	BH5	BH6					
Depth to Top										
Depth To Bottom										
Date Sampled	20-Feb-17	20-Feb-17	20-Feb-17	20-Feb-17	20-Feb-17					
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW					
Sample Matrix Code	N/A	N/A	N/A	N/A	N/A					
PAH 16MS (w)										
Acenaphthene $(w)_A^{\#}$	<0.01	<0.01	0.02	0.04	0.03				µg/l	A-T-019w
Acenaphthylene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Anthracene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Benzo(a)anthracene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Benzo(a)pyrene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Benzo(b)fluoranthene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Benzo(ghi)perylene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Benzo(k)fluoranthene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Chrysene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Dibenzo(ah)anthracene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Fluoranthene $(w)_A^{\#}$	<0.01	<0.01	0.14	0.02	0.02				µg/l	A-T-019w
Fluorene $(w)_A^{\#}$	<0.01	<0.01	<0.01	0.04	0.04				µg/l	A-T-019w
Indeno(123-cd)pyrene $(w)_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				µg/l	A-T-019w
Naphthalene $(w)_A^{\#}$	<0.01	<0.01	<0.01	0.31	0.22				µg/l	A-T-019w
Phenanthrene $(w)_A^{\#}$	<0.01	<0.01	<0.01	0.04	0.04				µg/l	A-T-019w
Pyrene $(w)_A^{\#}$	0.18	<0.01	0.11	0.02	0.01				µg/l	A-T-019w
PAH (total 16) $(w)_A^{\#}$	0.18	<0.01	0.27	0.47	0.36				µg/l	A-T-019w

Envirolab Job Number: 17/01337

Client Project Name: Former Battle Hospital

Client Project Ref: 28916

Lab Sample ID	17/01337/1	17/01337/2	17/01337/3	17/01337/4	17/01337/5				Units	Method ref
Client Sample No										
Client Sample ID	BH2	BH3	BH4	BH5	BH6					
Depth to Top										
Depth To Bottom										
Date Sampled	20-Feb-17	20-Feb-17	20-Feb-17	20-Feb-17	20-Feb-17					
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW					
Sample Matrix Code	N/A	N/A	N/A	N/A	N/A					
TPH CWG										
Ali >C5-C6 $(w)_A^{\#}$	<1	2	<1	<1	<1				µg/l	A-T-022w
Ali >C6-C8 $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
Ali >C8-C10 $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
Ali >C10-C12 $(w)_A^{\#}$	<5	<5	<5	<5	<5				µg/l	A-T-023w
Ali >C12-C16 $(w)_A^{\#}$	25	<5	<5	<5	<5				µg/l	A-T-023w
Ali >C16-C21 $(w)_A^{\#}$	73	<5	<5	<5	<5				µg/l	A-T-023w
Ali >C21-C35 $(w)_A^{\#}$	64	<5	<5	<5	<5				µg/l	A-T-023w
Total Aliphatics $(w)_A$	162	<5	<5	<5	<5				µg/l	A-T-022+23w
Aro >C5-C7 $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
Aro >C7-C8 $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
Aro >C8-C9 $(w)_A^{\#}$	<1	<1	<1	2	1				µg/l	A-T-022w
Aro >C9-C10 $(w)_A^{\#}$	<1	<1	<1	6	6				µg/l	A-T-022w
Aro >C10-C12 $(w)_A^{\#}$	23	<5	<5	<5	<5				µg/l	A-T-023w
Aro >C12-C16 $(w)_A^{\#}$	91	<5	<5	<5	<5				µg/l	A-T-023w
Aro >C16-C21 $(w)_A^{\#}$	78	<5	<5	<5	<5				µg/l	A-T-023w
Aro >C21-C35 $(w)_A^{\#}$	39	<5	<5	<5	<5				µg/l	A-T-023w
Total Aromatics $(w)_A$	231	<5	<5	7	8				µg/l	A-T-022+23w
TPH (Ali & Aro) $(w)_A$	392	<5	<5	7	8				µg/l	A-T-022+23w
BTEX - Benzene $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
BTEX - Toluene $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
BTEX - Ethyl Benzene $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
BTEX - m & p Xylene $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
BTEX - o Xylene $(w)_A^{\#}$	<1	<1	<1	<1	<1				µg/l	A-T-022w
MTBE $(w)_A^{\#}$	<1	2	<1	<1	<1				µg/l	A-T-022w

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Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed.
Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 17/01116
Issue Number: 1 **Date:** 06 March, 2017

Client: RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager: Greg Wain/Nigel Austin
Project Name: Former Battle Hospital, Reading
Project Ref: 28916
Order No: N/A
Date Samples Received: 15/02/17
Date Instructions Received: 15/02/17
Date Analysis Completed: 06/03/17

Prepared by:

G Walker

Gill Walker
Laboratory Manager

Approved by:

IBHaslock

Iain Haslock
Analytical Consultant

mCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME
UKAS TESTING 1247

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/1	17/01116/2	17/01116/3	17/01116/4	17/01116/5	17/01116/6	17/01116/7	17/01116/8	Units	Method ref
Client Sample No										
Client Sample ID	WS2	WS3	WS4	WS5	BH5	BH4	BH4	BH4		
Depth to Top	0.30	0.20	0.20	0.20	0.40	0.10	0.50	1.00		
Depth To Bottom						0.50	1.00	1.50		
Date Sampled	07-Feb-17	07-Feb-17	07-Feb-17	07-Feb-17	03-Feb-17	06-Feb-17	06-Feb-17	06-Feb-17		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	6AE	4AE	4AE	6AE	4AB	6AB	6A		
% Stones >10mm$_A^{\#}$	18.3	5.6	<0.1	2.2	7.4	24.0	<0.1	<0.1	% w/w	A-T-044
pH$_D^{M\#}$	7.74	7.72	8.77	7.79	8.30	9.53	8.54	7.90	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	-	<0.01	<0.01	<0.01	0.07	0.15	-	0.30	g/l	A-T-026s
Sulphate (acid soluble)$_D^{M\#}$	-	310	350	230	340	330	-	570	mg/kg	A-T-028s
Total Organic Carbon$_D^{M\#}$	6.13	2.06	0.93	3.86	0.62	0.68	2.34	4.05	% w/w	A-T-032s
Arsenic$_D^{M\#}$	-	17	18	17	15	6	-	16	mg/kg	A-T-024s
Cadmium$_D^{M\#}$	-	2.3	2.6	2.2	1.9	1.1	-	2.4	mg/kg	A-T-024s
Copper$_D^{M\#}$	-	36	13	54	19	12	-	88	mg/kg	A-T-024s
Chromium$_D^{M\#}$	-	21	18	24	19	14	-	28	mg/kg	A-T-024s
Lead$_D^{M\#}$	-	138	41	179	39	40	-	276	mg/kg	A-T-024s
Mercury$_D$	-	0.23	<0.17	0.29	0.31	0.34	-	0.75	mg/kg	A-T-024s
Nickel$_D^{M\#}$	-	25	37	29	19	11	-	28	mg/kg	A-T-024s
Selenium$_D$	-	<1	<1	<1	<1	<1	-	1	mg/kg	A-T-024s
Zinc$_D^{M\#}$	-	112	60	125	48	53	-	340	mg/kg	A-T-024s

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/1	17/01116/2	17/01116/3	17/01116/4	17/01116/5	17/01116/6	17/01116/7	17/01116/8	Units	Method ref
Client Sample No										
Client Sample ID	WS2	WS3	WS4	WS5	BH5	BH4	BH4	BH4		
Depth to Top	0.30	0.20	0.20	0.20	0.40	0.10	0.50	1.00		
Depth To Bottom						0.50	1.00	1.50		
Date Sampled	07-Feb-17	07-Feb-17	07-Feb-17	07-Feb-17	03-Feb-17	06-Feb-17	06-Feb-17	06-Feb-17		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	6AE	4AE	4AE	6AE	4AB	6AB	6A		
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{A}^{\#}$	NAD	NAD	Chrysotile	NAD	NAD	NAD	Chrysotile	Chrysotile		A-T-045
Asbestos Matrix (microscope)$_{A}$	-	-	Loose Fibres	-	-	-	Loose Fibres	Loose Fibres		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	-	<0.001	-	-	-	<0.001	<0.001	% w/w	A-T-054

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/1	17/01116/2	17/01116/3	17/01116/4	17/01116/5	17/01116/6	17/01116/7	17/01116/8	Units	Method ref
Client Sample No										
Client Sample ID	WS2	WS3	WS4	WS5	BH5	BH4	BH4	BH4		
Depth to Top	0.30	0.20	0.20	0.20	0.40	0.10	0.50	1.00		
Depth To Bottom						0.50	1.00	1.50		
Date Sampled	07-Feb-17	07-Feb-17	07-Feb-17	07-Feb-17	03-Feb-17	06-Feb-17	06-Feb-17	06-Feb-17		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	6AE	4AE	4AE	6AE	4AB	6AB	6A		
PAH 16										
Acenaphthene$_A^{M\#}$	-	<0.01	<0.01	0.04	<0.01	0.03	-	0.19	mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	-	0.02	0.06	0.14	0.03	0.02	-	0.06	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	-	0.03	0.07	0.20	0.04	0.07	-	0.48	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	-	0.33	0.80	2.04	0.38	0.50	-	2.95	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	-	0.41	1.10	2.96	0.53	0.66	-	3.02	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	-	0.41	1.10	3.14	0.51	0.65	-	3.87	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	-	0.24	0.63	1.72	0.30	0.46	-	1.35	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	-	0.14	0.37	1.05	0.21	0.22	-	1.29	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	-	0.37	0.94	2.49	0.46	0.58	-	3.77	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	-	0.06	0.14	0.33	0.07	0.10	-	0.34	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	-	0.53	1.35	3.85	0.64	0.79	-	8.97	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	-	<0.01	<0.01	0.05	<0.01	0.02	-	0.23	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	-	0.31	0.80	2.09	0.38	0.54	-	1.92	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	-	<0.03	<0.03	<0.03	<0.03	<0.03	-	<0.03	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	-	0.16	0.29	0.94	0.19	0.27	-	1.81	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	-	0.50	1.28	3.69	0.61	0.74	-	7.52	mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	-	3.48	8.94	24.7	4.35	5.64	-	37.8	mg/kg	A-T-019s

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/1	17/01116/2	17/01116/3	17/01116/4	17/01116/5	17/01116/6	17/01116/7	17/01116/8	Units	Method ref
Client Sample No										
Client Sample ID	WS2	WS3	WS4	WS5	BH5	BH4	BH4	BH4		
Depth to Top	0.30	0.20	0.20	0.20	0.40	0.10	0.50	1.00		
Depth To Bottom						0.50	1.00	1.50		
Date Sampled	07-Feb-17	07-Feb-17	07-Feb-17	07-Feb-17	03-Feb-17	06-Feb-17	06-Feb-17	06-Feb-17		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	6AE	4AE	4AE	6AE	4AB	6AB	6A		
TPH CWG										
Ali >C5-C6$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C8-C10$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Ali >C10-C12$_A^\#$	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C12-C16$_A^\#$	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C16-C21$_A^\#$	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Ali >C21-C35$_A^\#$	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Total Aliphatics$_A$	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C5-C7$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C8-C9$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C9-C10$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Aro >C10-C12$_A^\#$	-	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	mg/kg	A-T-023s
Aro >C12-C16$_A^\#$	-	<0.1	<0.1	0.9	1.9	1.0	-	1.6	mg/kg	A-T-023s
Aro >C16-C21$_A^\#$	-	2.2	2.3	9.5	21.1	6.2	-	4.4	mg/kg	A-T-023s
Aro >C21-C35$_A^\#$	-	5.0	2.5	22.9	65.8	27.4	-	8.4	mg/kg	A-T-023s
Total Aromatics$_A$	-	7.3	4.9	33.4	88.8	34.5	-	14.4	mg/kg	A-T-023s
TPH (Ali & Aro)$_A$	-	7.3	4.9	33.4	88.8	34.5	-	14.4	mg/kg	A-T-023s
BTEX - Benzene$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
BTEX - o Xylene$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
MTBE$_A^\#$	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	mg/kg	A-T-022s
Leachate Prep BS EN 12457-1 (2:1) (per 250ml prepared leachate)$_A$	-	*	*	*	*	*	-	-		A-T-001
pH (leachable)$_A^\#$	-	7.26	7.45	7.33	7.33	7.81	-	-	pH	A-T-031w
Alkalinity (total) (leachable) Colorimetry$_A$	-	70	81	85	70	63	-	-	mg/l Ca CO3	A-T-038w
Arsenic (leachable)$_A^\#$	-	8	6	6	2	11	-	-	µg/l	A-T-025w
Cadmium (leachable)$_A^\#$	-	<1	<1	<1	<1	<1	-	-	µg/l	A-T-025w
Copper (leachable)$_A^\#$	-	15	11	18	2	7	-	-	µg/l	A-T-025w
Chromium (leachable)$_A^\#$	-	<1	<1	<1	<1	6	-	-	µg/l	A-T-025w

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/1	17/01116/2	17/01116/3	17/01116/4	17/01116/5	17/01116/6	17/01116/7	17/01116/8	Units	Method ref
Client Sample No										
Client Sample ID	WS2	WS3	WS4	WS5	BH5	BH4	BH4	BH4		
Depth to Top	0.30	0.20	0.20	0.20	0.40	0.10	0.50	1.00		
Depth To Bottom						0.50	1.00	1.50		
Date Sampled	07-Feb-17	07-Feb-17	07-Feb-17	07-Feb-17	03-Feb-17	06-Feb-17	06-Feb-17	06-Feb-17		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	4AE	6AE	4AE	4AE	6AE	4AB	6AB	6A		
Lead (leachable)$_A^{\#}$	-	36	22	22	<1	25	-	-	µg/l	A-T-025w
Mercury (leachable)$_A^{\#}$	-	0.2	0.1	<0.1	<0.1	<0.1	-	-	µg/l	A-T-025w
Nickel (leachable)$_A^{\#}$	-	3	2	3	<1	1	-	-	µg/l	A-T-025w
Selenium (leachable)$_A^{\#}$	-	<1	<1	<1	<1	<1	-	-	µg/l	A-T-025w
Zinc (leachable)$_A^{\#}$	-	55	27	64	<1	27	-	-	µg/l	A-T-025w

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/9	17/01116/10	17/01116/11	17/01116/12	17/01116/13				Units	Method ref
Client Sample No										
Client Sample ID	BH4	BH6	BH6	BH6	BH6					
Depth to Top	2.00	0.30	1.20	2.00	3.00					
Depth To Bottom	2.50		1.60	2.50	3.50					
Date Sampled	06-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6A	4AE	6A	6AE	6A					
% Stones >10mm$_A^{\#}$	<0.1	<0.1	<0.1	<0.1	<0.1				% w/w	A-T-044
pH$_D^{M\#}$	7.14	8.36	8.00	7.91	7.83				pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.32	<0.01	-	0.59	0.59				g/l	A-T-026s
Sulphate (acid soluble)$_D^{M\#}$	250	<200	-	320	440				mg/kg	A-T-028s
Total Organic Carbon$_D^{M\#}$	4.99	6.71	4.61	11.2	11				% w/w	A-T-032s
Arsenic$_D^{M\#}$	19	25	-	19	14				mg/kg	A-T-024s
Cadmium$_D^{M\#}$	1.9	2.4	-	2.8	2.0				mg/kg	A-T-024s
Copper$_D^{M\#}$	59	90	-	124	122				mg/kg	A-T-024s
Chromium$_D^{M\#}$	19	19	-	26	21				mg/kg	A-T-024s
Lead$_D^{M\#}$	228	520	-	297	181				mg/kg	A-T-024s
Mercury$_D$	0.48	0.63	-	0.76	0.99				mg/kg	A-T-024s
Nickel$_D^{M\#}$	22	28	-	35	30				mg/kg	A-T-024s
Selenium$_D$	1	<1	-	2	4				mg/kg	A-T-024s
Zinc$_D^{M\#}$	265	196	-	284	207				mg/kg	A-T-024s

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/9	17/01116/10	17/01116/11	17/01116/12	17/01116/13				Units	Method ref
Client Sample No										
Client Sample ID	BH4	BH6	BH6	BH6	BH6					
Depth to Top	2.00	0.30	1.20	2.00	3.00					
Depth To Bottom	2.50		1.60	2.50	3.50					
Date Sampled	06-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6A	4AE	6A	6AE	6A					
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{A}^{\#}$	Amosite & Chrysotile	Chrysotile	Chrysotile	NAD	NAD					A-T-045
Asbestos Matrix (microscope)$_{A}$	Loose Fibres	Loose Fibres	Loose Fibres	-	-					A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A					
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	0.007	<0.001	<0.001	-	-				% w/w	A-T-054

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/9	17/01116/10	17/01116/11	17/01116/12	17/01116/13				Units	Method ref
Client Sample No										
Client Sample ID	BH4	BH6	BH6	BH6	BH6					
Depth to Top	2.00	0.30	1.20	2.00	3.00					
Depth To Bottom	2.50		1.60	2.50	3.50					
Date Sampled	06-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6A	4AE	6A	6AE	6A					
PAH 16										
Acenaphthene$_A^{M\#}$	1.32	0.06	-	<0.01	<0.01				mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	0.59	0.19	-	0.02	0.07				mg/kg	A-T-019s
Anthracene$_A^{M\#}$	3.99	0.35	-	0.09	0.06				mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	18.5	5.19	-	0.57	1.35				mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	18.8	5.03	-	0.66	1.58				mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	19.7	7.67	-	0.68	1.65				mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	7.45	2.79	-	0.27	0.50				mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	8.11	2.25	-	0.24	0.61				mg/kg	A-T-019s
Chrysene$_A^{M\#}$	19.5	6.87	-	0.69	1.73				mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	1.71	0.65	-	0.07	0.15				mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	44.6	9.44	-	1.30	2.93				mg/kg	A-T-019s
Fluorene$_A^{M\#}$	1.85	0.08	-	0.02	<0.01				mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	10.8	3.86	-	0.40	0.80				mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	0.25	<0.03	-	<0.03	<0.03				mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	16.6	1.89	-	0.42	0.54				mg/kg	A-T-019s
Pyrene$_A^{M\#}$	41	8.72	-	1.10	2.62				mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	215	55	-	6.56	14.6				mg/kg	A-T-019s

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/9	17/01116/10	17/01116/11	17/01116/12	17/01116/13				Units	Method ref
Client Sample No										
Client Sample ID	BH4	BH6	BH6	BH6	BH6					
Depth to Top	2.00	0.30	1.20	2.00	3.00					
Depth To Bottom	2.50		1.60	2.50	3.50					
Date Sampled	06-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6A	4AE	6A	6AE	6A					
TPH CWG										
Ali >C5-C6$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
Ali >C6-C8$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
Ali >C8-C10$_A^\#$	<0.01	<0.01	-	0.02	<0.01				mg/kg	A-T-022s
Ali >C10-C12$_A^\#$	<0.1	1.3	-	<0.1	<0.1				mg/kg	A-T-023s
Ali >C12-C16$_A^\#$	<0.1	3.6	-	<0.1	<0.1				mg/kg	A-T-023s
Ali >C16-C21$_A^\#$	<0.1	41.1	-	<0.1	<0.1				mg/kg	A-T-023s
Ali >C21-C35$_A^\#$	<0.1	834	-	<0.1	<0.1				mg/kg	A-T-023s
Total Aliphatics$_A$	<0.1	880	-	<0.1	<0.1				mg/kg	A-T-023s
Aro >C5-C7$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
Aro >C7-C8$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
Aro >C8-C9$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
Aro >C9-C10$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
Aro >C10-C12$_A^\#$	<0.1	3.9	-	<0.1	<0.1				mg/kg	A-T-023s
Aro >C12-C16$_A^\#$	0.6	1.4	-	<0.1	<0.1				mg/kg	A-T-023s
Aro >C16-C21$_A^\#$	1.4	12.0	-	<0.1	<0.1				mg/kg	A-T-023s
Aro >C21-C35$_A^\#$	1.8	210	-	<0.1	<0.1				mg/kg	A-T-023s
Total Aromatics$_A$	3.9	227	-	<0.1	<0.1				mg/kg	A-T-023s
TPH (Ali & Aro)$_A$	3.9	1110	-	<0.1	<0.1				mg/kg	A-T-023s
BTEX - Benzene$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
BTEX - Toluene$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
BTEX - m & p Xylene$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
BTEX - o Xylene$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
MTBE$_A^\#$	<0.01	<0.01	-	<0.01	<0.01				mg/kg	A-T-022s
Leachate Prep BS EN 12457-1 (2:1) (per 250ml prepared leachate)$_A$	-	*	-	*	-					A-T-001
pH (leachable)$_A^\#$	-	7.62	-	7.83	-				pH	A-T-031w
Alkalinity (total) (leachable) Colorimetry$_A$	-	103	-	145	-				mg/l Ca CO3	A-T-038w
Arsenic (leachable)$_A^\#$	-	4	-	2	-				µg/l	A-T-025w
Cadmium (leachable)$_A^\#$	-	<1	-	<1	-				µg/l	A-T-025w
Copper (leachable)$_A^\#$	-	17	-	6	-				µg/l	A-T-025w
Chromium (leachable)$_A^\#$	-	<1	-	<1	-				µg/l	A-T-025w

Envirolab Job Number: 17/01116

Client Project Name: Former Battle Hospital, Reading

Client Project Ref: 28916

Lab Sample ID	17/01116/9	17/01116/10	17/01116/11	17/01116/12	17/01116/13				Units	Method ref
Client Sample No										
Client Sample ID	BH4	BH6	BH6	BH6	BH6					
Depth to Top	2.00	0.30	1.20	2.00	3.00					
Depth To Bottom	2.50		1.60	2.50	3.50					
Date Sampled	06-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17	03-Feb-17					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6A	4AE	6A	6AE	6A					
Lead (leachable)$_A^{\#}$	-	18	-	<1	-				µg/l	A-T-025w
Mercury (leachable)$_A^{\#}$	-	<0.1	-	<0.1	-				µg/l	A-T-025w
Nickel (leachable)$_A^{\#}$	-	2	-	3	-				µg/l	A-T-025w
Selenium (leachable)$_A^{\#}$	-	<1	-	1	-				µg/l	A-T-025w
Zinc (leachable)$_A^{\#}$	-	20	-	33	-				µg/l	A-T-025w

REPORT NOTES

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Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure. These are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed.
Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,
E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

envirolab
Units 7 & 8, Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

Final Test Report

Envirolab Job Number:	17/01116		
Issue Number:	1	Date:	6-Mar-17

Client: RSK Environment Ltd Hemel
18 Frogmore Road
Hemel Hempstead
Hertfordshire
UK
HP3 9RT

Project Manager:	Greg Wain/Nigel Austin
Project Name:	Former Battle Hospital, Reading
Project Ref:	28916
Order No:	N/A
Date Samples Received:	15-Feb-17
Date Instructions Received:	15-Feb-17
Date Analysis Completed:	6-Mar-17

Notes - Soil analysis

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones >10mm are removed or excluded from the sample prior to analysis and reported results corrected to a whole sample basis.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis.

Notes - General

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Subscript "A" indicates analysis performed on the sample as received. "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve, unless asbestos is found to be present in which case all analysis is performed on the sample as received.

All analysis is performed on the dried and crushed sample for samples with Matrix Code 7 and this supercedes any "A" subscripts.

All analysis is performed on the sample as received for soil samples from outside the European Union and this supercedes any "D" subscripts

Superscript "M" indicates method accredited to MCERTS.

For complex, multi-compound analysis, quality control results do not always fall within chart limits for every compound and we have criteria for reporting in these situations.

If results are in italic font they are associated with such quality control failures and may be unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid

Predominant Matrix Codes: 1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER.

Samples with Matrix Code 7 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations.

Secondary Matrix Codes: A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

IS indicates Insufficient sample for analysis, NDP indicates No Determination Possible and NAD indicates No Asbestos Detected.

Superscript # indicates method accredited to ISO 17025.

Analytical results reflect the quality of the sample at the time of analysis only. Opinions and interpretations expressed are outside the scope of our accreditation.

Please contact us if you need any further information.

Prepared by:

G Walker

Gill Walker
Laboratory Manager

Approved by:

IBHaslock

Iain Haslock
Analytical Consultant

UKAS TESTING
No. 1247

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

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Sample Details						Landfill Waste Acceptance Criteria Limits		
Lab Sample ID	Method	ISO17025	MCERTS	17/01116/1				
Client Sample Number								
Client Sample ID				WS2				
Depth to Top				0.3				
Depth to Bottom								
Date Sampled				07/02/2017				
Sample Type				Soil - ES				
Sample Matrix Code				4AE				
Solid Waste Analysis								
pH (pH Units)$_D$	A-T-031	Y	Y	**7.74**		-	>6	-
ANC to pH 4 (mol/kg)$_D$	A-T-ANC	N	N	**0.26**		-	to be evaluated	to be evaluated
ANC to pH 6 (mol/kg)$_D$	A-T-ANC	N	N	**0.04**		-	to be evaluated	to be evaluated
Loss on Ignition (%)$_D$	A-T-030	Y	N	**11.2**		-	-	10
Total Organic Carbon (%)$_D$	A-T-032	Y	Y	**6.13**		3	5	6
PAH Sum of 17 (mg/kg)$_A$	A-T-019	N	N	**43**		100	-	-
Mineral Oil (mg/kg)$_A$	A-T-007	N	N	**<10**		500	-	-
Sum of 7 PCBs (mg/kg)$_D$	A-T-004	N	N	**<0.007**		1	-	-
Sum of BTEX (mg/kg)$_A$	A-T-022	N	N	**<0.01**		6	-	-
Eluate Analysis				**10:1 mg/l**	**10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic	A-T-025	Y	N	0.004	**0.040**	0.5	2	25
Barium	A-T-025	Y	N	0.046	**0.460**	20	100	300
Cadmium	A-T-025	Y	N	<0.001	**<0.01**	0.04	1	5
Chromium	A-T-025	Y	N	0.002	**0.020**	0.5	10	70
Copper	A-T-025	Y	N	0.010	**0.100**	2	50	100
Mercury	A-T-025	Y	N	<0.0005	**<0.005**	0.01	0.2	2
Molybdenum	A-T-025	Y	N	0.011	**0.110**	0.5	10	30
Nickel	A-T-025	Y	N	0.002	**0.020**	0.4	10	40
Lead	A-T-025	Y	N	0.016	**0.160**	0.5	10	50
Antimony	A-T-025	Y	N	0.002	**0.020**	0.06	0.7	5
Selenium	A-T-025	Y	N	<0.001	**<0.01**	0.1	0.5	7
Zinc	A-T-025	Y	N	0.065	**0.650**	4	50	200
Chloride	A-T-026	Y	N	1	**11**	800	15000	25000
Fluoride	A-T-026	Y	N	0.4	**4.0**	10	150	500
Sulphate as SO_4	A-T-026	Y	N	12	**124**	1000	20000	50000
Total Dissolved Solids	A-T-035	N	N	89	**890**	4000	60000	100000
Phenol Index	A-T-050	N	N	<0.01	**<0.1**	1	-	-
Dissolved Organic Carbon	A-T-032	N	N	<0.2	**<200**	500	800	1000
Leach Test Information								
pH (pH Units)	A-T-031	N	Y	7.7				
Conductivity (µS/cm)	A-T-037	N	N	178				
Mass Sample (kg)				0.246				
Dry Matter (%)	A-T-044	N	N	71.2				

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Sample Details						Landfill Waste Acceptance Criteria Limits		
Lab Sample ID	Method	ISO17025	MCERTS	17/01116/7				
Client Sample Number								
Client Sample ID				BH4				
Depth to Top				0.5				
Depth to Bottom				1.00		Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
Date Sampled				06/02/2017				
Sample Type				Soil - ES				
Sample Matrix Code				6AB				
Solid Waste Analysis								
pH (pH Units)$_D$	A-T-031	Y	Y	**8.54**		-	>6	-
ANC to pH 4 (mol/kg)$_D$	A-T-ANC	N	N	**0.54**		-	to be evaluated	to be evaluated
ANC to pH 6 (mol/kg)$_D$	A-T-ANC	N	N	**0.2**		-	to be evaluated	to be evaluated
Loss on Ignition (%)$_D$	A-T-030	Y	N	**4.3**		-	-	10
Total Organic Carbon (%)$_D$	A-T-032	Y	Y	**2.34**		3	5	6
PAH Sum of 17 (mg/kg) $_A$	A-T-019	N	N	**8.16**		100	-	-
Mineral Oil (mg/kg)$_A$	A-T-007	N	N	**15**		500	-	-
Sum of 7 PCBs (mg/kg)$_D$	A-T-004	N	N	**<0.007**		1	-	-
Sum of BTEX (mg/kg)$_A$	A-T-022	N	N	**<0.01**		6	-	-
Eluate Analysis				**10:1 mg/l**	**10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic	A-T-025	Y	N	0.008	**0.080**	0.5	2	25
Barium	A-T-025	Y	N	0.032	**0.320**	20	100	300
Cadmium	A-T-025	Y	N	<0.001	**<0.01**	0.04	1	5
Chromium	A-T-025	Y	N	<0.001	**<0.01**	0.5	10	70
Copper	A-T-025	Y	N	0.007	**0.060**	2	50	100
Mercury	A-T-025	Y	N	<0.0005	**<0.005**	0.01	0.2	2
Molybdenum	A-T-025	Y	N	0.006	**0.060**	0.5	10	30
Nickel	A-T-025	Y	N	0.001	**0.010**	0.4	10	40
Lead	A-T-025	Y	N	0.014	**0.140**	0.5	10	50
Antimony	A-T-025	Y	N	0.002	**0.020**	0.06	0.7	5
Selenium	A-T-025	Y	N	<0.001	**<0.01**	0.1	0.5	7
Zinc	A-T-025	Y	N	0.069	**0.690**	4	50	200
Chloride	A-T-026	Y	N	2	**22**	800	15000	25000
Fluoride	A-T-026	Y	N	0.4	**4.0**	10	150	500
Sulphate as SO_4	A-T-026	Y	N	137	**1366**	1000	20000	50000
Total Dissolved Solids	A-T-035	N	N	63	**630**	4000	60000	100000
Phenol Index	A-T-050	N	N	<0.01	**<0.1**	1	-	-
Dissolved Organic Carbon	A-T-032	N	N	<0.2	**<200**	500	800	1000
Leach Test Information								
pH (pH Units)	A-T-031	N	Y	7.3				
Conductivity (µS/cm)	A-T-037	N	N	125				
Mass Sample (kg)				0.207				
Dry Matter (%)	A-T-044	N	N	84.6				

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Sample Details						Landfill Waste Acceptance Criteria Limits		
Lab Sample ID	Method	ISO17025	MCERTS	17/01116/11				
Client Sample Number						Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
Client Sample ID				BH6				
Depth to Top				1.2				
Depth to Bottom				1.60				
Date Sampled				03/02/2017				
Sample Type				Soil - ES				
Sample Matrix Code				6A				
Solid Waste Analysis								
pH (pH Units)$_D$	A-T-031	Y	Y	**8.00**		-	>6	-
ANC to pH 4 (mol/kg)$_D$	A-T-ANC	N	N	**0.16**		-	to be evaluated	to be evaluated
ANC to pH 6 (mol/kg)$_D$	A-T-ANC	N	N	**0.05**		-	to be evaluated	to be evaluated
Loss on Ignition (%)$_D$	A-T-030	Y	N	**14.8**		-	-	10
Total Organic Carbon (%)$_D$	A-T-032	Y	Y	**4.61**		3	5	6
PAH Sum of 17 (mg/kg) $_A$	A-T-019	N	N	**2.15**		100	-	-
Mineral Oil (mg/kg)$_A$	A-T-007	N	N	**<10**		500	-	-
Sum of 7 PCBs (mg/kg)$_D$	A-T-004	N	N	**<0.007**		1	-	-
Sum of BTEX (mg/kg)$_A$	A-T-022	N	N	**<0.01**		6	-	-
Eluate Analysis				**10:1 mg/l**	**10:1 mg/kg**	**Limit values for compliance leaching test using BS EN 12457-3 at L/S 10 l/kg (mg/kg)**		
Arsenic	A-T-025	Y	N	0.002	**0.020**	0.5	2	25
Barium	A-T-025	Y	N	0.065	**0.650**	20	100	300
Cadmium	A-T-025	Y	N	<0.001	**<0.01**	0.04	1	5
Chromium	A-T-025	Y	N	<0.001	**<0.01**	0.5	10	70
Copper	A-T-025	Y	N	0.005	**0.050**	2	50	100
Mercury	A-T-025	Y	N	<0.0005	**<0.005**	0.01	0.2	2
Molybdenum	A-T-025	Y	N	0.011	**0.110**	0.5	10	30
Nickel	A-T-025	Y	N	0.003	**0.030**	0.4	10	40
Lead	A-T-025	Y	N	0.003	**0.030**	0.5	10	50
Antimony	A-T-025	Y	N	0.009	**0.090**	0.06	0.7	5
Selenium	A-T-025	Y	N	<0.001	**<0.01**	0.1	0.5	7
Zinc	A-T-025	Y	N	0.201	**2.010**	4	50	200
Chloride	A-T-026	Y	N	8	**85**	800	15000	25000
Fluoride	A-T-026	Y	N	0.3	**3.0**	10	150	500
Sulphate as SO_4	A-T-026	Y	N	124	**1240**	1000	20000	50000
Total Dissolved Solids	A-T-035	N	N	237	**2370**	4000	60000	100000
Phenol Index	A-T-050	N	N	<0.01	**<0.1**	1	-	-
Dissolved Organic Carbon	A-T-032	N	N	<0.2	**<200**	500	800	1000
Leach Test Information								
pH (pH Units)	A-T-031	N	Y	7.9				
Conductivity (µS/cm)	A-T-037	N	N	474				
Mass Sample (kg)				0.294				
Dry Matter (%)	A-T-044	N	N	59.5				

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APPENDIX G
HUMAN HEALTH GENERIC ASSESSMENT CRITERIA

Generic assessment criteria for human health: residential scenario with home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and adopts them as GAC for these six substances.

For all other substances the C4SL exposure modifications, with the exception of the "top two" produce type approach taken in the C4SL, have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) for residential land use, reducing exposure frequency for dermal contact outdoors for residential land use, and updated produce type consumption rates (90th percentile) based on recent data from the National Diet and Nutrition Survey.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015[7] or by the USEPA[14], where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.071, supporting EA guidance[5,8,9] and revised exposure scenarios published for the C4SL[3]. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 2.51 model with the Johnson and Ettinger model for soil and groundwater volatilisation. RSK has updated the inputs within RBCA to reflect EA guidance[1,5,8,9]. The SAC and GrAC collectively are termed GAC.

Conceptual model

In accordance with SR3[5], the residential with home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance

with Box 3.1 of SR3[5], the pathways considered for production of the SAC in the residential with home-grown produce scenario are

- direct soil and dust ingestion
- consumption of home-grown produce
- consumption of soil attached to home-grown produce
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium[1], the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents while indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. Within RBCA, the solubility limit of the chemical restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. While the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting

the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database and to outputs from the RBCA model for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated appendices[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[14]. Where a C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and has adopted them as GAC for these six substances. Toxicological and specific chemical parameters for aromatic hydrocarbon C_8–C_9 (styrene), 1,2,4-trimethylbenzene and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene and toluene, which are modelled separately. The aromatic C_8–C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for aromatic C_8–C_9 have been taken from styrene.

For the GrAC, the HCV used in the modelling were derived using the toxicological data for the SAC amended as follows:

- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3[5]) and breathing 8.77m^3 (average daily inhalation rate for a 0-6yr old female in accordance with SP1010 final project report for the C4SL (Table 3.2[3]) and USEPA data(14)
- Background inhalation (mean daily intake (MDI)) for a child (Age Classes 1-6)
- Residential amendments to the MDI for younger age groups following Table 3.4 and Section 3.4.1 of SR2[8],; amended to reflect average daily inhalation rates in accordance with SP1010 final project report for the C4SL (Table 3.2[3]) and USEPA data[12].

Physical parameters

For the residential with home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. The house is assumed to have a 100m^2 private garden consisting of lawn and flowerbeds, incorporating a 20m^2 plot for growing fruit and vegetables consumed by the residents. SR3[5] notes this residential building type to be

the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3[3], with a dust loading factor detailed in Section 9.3 of SR3[5]. The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater. The GrAC were produced using the input parameters in Table 4.

Summary of modifications to the default CLEA SR3[5] input parameters for residential with home-grown produce land-use scenario

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3[5]. Modifications to the default SR3[5] exposure scenarios based on the C4SL exposure scenarios[3] are presented in Tables 2 and 3 below.

The final selected GAC are presented by pathway in Table 5 and the combined GAC in Table 6.

Figure 1: Conceptual model for residential scenario with home-grown produce

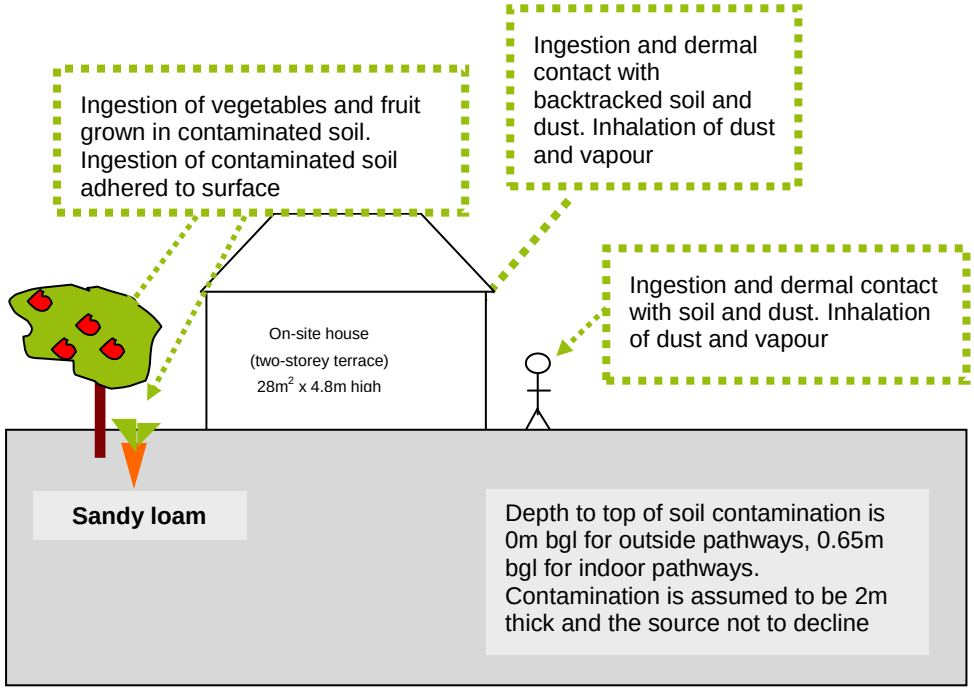


Table 1: Exposure assessment parameters for residential scenario with home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential with homegrown produce	Chosen land use
Receptor	Female child age 1 to 6	Key generic assumption given in Box 3.1, SR3[5]
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3)[5]
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3)[5]
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3[5]
End AC (age class)	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential with home-grown produce – modified home-grown produce data

Name	Consumption rate 90th percentile (g FW kg^{-1} BW day^{-1}) by age class						Dry weight conversion factor (g DW g^{-1} FW)	Home-grown fraction (average)	Home-grown fraction (high end)	Soil loading factor (g g^{-1} DW)	Preparation correction factor
	1	2	3	4	5	6					
Green vegetables	7.12	5.87	5.87	5.87	4.53	4.53	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.7	2.83	2.83	2.83	2.14	2.14	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16	6.6	6.6	6.6	4.95	4.95	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.39	3.39	3.39	2.24	2.24	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.46	0.46	0.46	0.19	0.19	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	10.3	10.3	10.3	5.16	5.16	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 3.4, SP1010 (3)						Table 6.3, SR3(5)	Table 4.19, SR3(5)		Table 6.3, SR3(5)	

Table 3: Residential with home-grown produce – modified and use and receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
EF (soil and dust ingestion)	day yr^{-1}	180	365	365	365	365	365
EF (consumption of home-grown produce)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, indoor)	day yr^{-1}	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr^{-1}	170	170	170	170	170	170
EF (inhalation of dust and vapour, indoor)	day yr^{-1}	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr^{-1}	365	365	365	365	365	365
Justification		Table 3.5, SP1010(3); Table 3.1, SR3(5)					
Soil to skin adherence factor (outdoor)	mg cm^{-2} day^{-1}	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010(3)					
Inhalation rate	m^3 day^{-1}	5.4	8.0	8.9/f	10.1	10.1	10.1
Justification		Mean value USEPA, 2011(12); Table 3.2, SP1010(3)					
Notes: For **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3(1), Science Report SC050021/Cadmium SGV(1) and the project report SP1010(3) for more information.							

Figure 2: GrAC conceptual model for RBCA residential with home-grown produce scenario

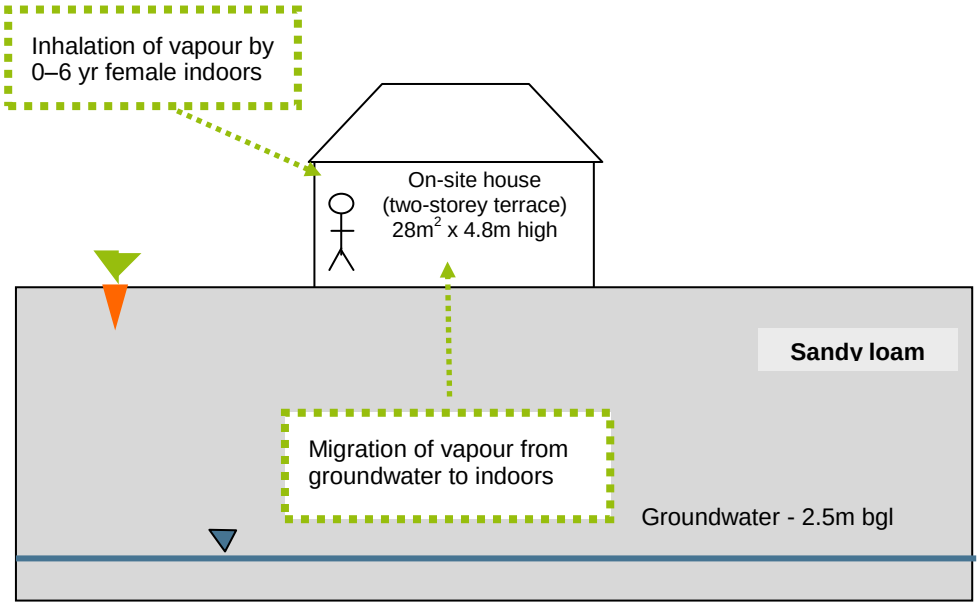


Table 4: Residential with home-grown produce – RBCA inputs

Parameter	Unit	Value	Justification
Receptor			
Averaging time	Years	6	From Box 3.1, SR3[5]
Receptor weight	kg	13.3	Average of CLEA 0–6 year old female data, Table 4.6, SR3[5]
Exposure duration	Years	6	From Box 3.1, report, SR3[5]
Exposure frequency	Days/yr	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
Soil type – sandy loam			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[5]
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3} or kg/L	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[5] equivalent to 307 cm/day
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3[5]
Capillary zone thickness	m	0.1	Professional judgement
Fraction organic carbon	%	0.0348	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
Building			
Building volume/area ratio	m	4.8	Table 3.3, SR3[5]
Foundation area	m^2	28	
Foundation perimeter	m	22	Calculated assuming building measures 7m x 4m to give 28m^2 foundation area
Building air exchange rate	d^{-1}	12	Table 3.3, SR3[5] Building air exchange rate equivalent to 1.4E-04 s^{-1}
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.0151	Calculated from floor crack area of 423 cm^2 and building footprint of 28m^2 in Table 4.21, SR3[5]
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3[5]
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3[5 Equivalent to 31 g/cm/s^2

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE

Table 5

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce Scenario

Compound	Notes	GrAC (µg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals														
Arsenic	(a,b)	-	3.71E+01	5.26E+02	NR	NR	3.71E+01	5.26E+02	NR	NR	3.71E+01	5.26E+02	NR	NR
Cadmium	(a)	-	2.30E+01	4.88E+02	2.21E+01	NR	2.30E+01	4.88E+02	2.21E+01	NR	2.30E+01	4.88E+02	2.21E+01	NR
Chromium (III) - trivalent	(c)	-	1.84E+04	9.07E+02	NR	NR	1.84E+04	9.07E+02	NR	NR	1.84E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	-	5.85E+01	2.06E+01	NR	NR	5.85E+01	2.06E+01	NR	NR	5.85E+01	2.06E+01	NR	NR
Copper		-	2.72E+03	1.41E+04	2.47E+03	NR	2.72E+03	1.41E+04	2.47E+03	NR	2.72E+03	1.41E+04	2.47E+03	NR
Lead	(a)	-	2.01E+02	NR	NR	NR	2.01E+02	NR	NR	NR	2.01E+02	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	1.29E+01	NR	2.35E-01	NR	4.31E+00	NR	5.60E-01	NR	1.07E+01	NR	1.22E+00	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		-	3.95E+01	3.63E+03	3.91E+01	NR	3.95E+01	3.63E+03	3.91E+01	NR	3.95E+01	3.63E+03	3.91E+01	NR
Methyl Mercury (Hg^{4+})		2.22E+04	1.26E+01	1.87E+01	7.52E+00	7.33E+01	1.26E+01	3.62E+01	9.34E+00	1.42E+02	1.26E+01	7.68E+01	1.08E+01	3.04E+02
Nickel	(d)	-	1.27E+02	1.81E+02	NR	NR	1.27E+02	1.81E+02	NR	NR	1.27E+02	1.81E+02	NR	NR
Selenium	(b)	-	2.58E+02	NR	NR	NR	2.58E+02	NR	NR	NR	2.58E+02	NR	NR	NR
Zinc	(b)	-	3.86E+03	3.63E+07	NR	NR	3.86E+03	3.63E+07	NR	NR	3.86E+03	3.63E+07	NR	NR
Cyanide (free)		-	1.37E+00	1.37E+04	1.37E+00	NR	1.37E+00	1.37E+04	1.37E+00	NR	1.37E+00	1.37E+04	1.37E+00	NR
Volatile Organic Compounds														
Benzene	(a)	2.30E+04	2.62E-01	9.01E-01	2.03E-01	1.22E+03	5.39E-01	1.68E+00	4.08E-01	2.26E+03	1.16E+00	3.48E+00	8.72E-01	4.71E+03
Toluene		5.90E+05	1.53E+02	9.08E+02	1.31E+02	8.69E+02	3.49E+02	2.00E+03	2.97E+02	1.92E+03	7.95E+02	4.55E+03	6.77E+02	4.36E+03
Ethylbenzene		1.25E+05	1.10E+02	8.34E+01	4.74E+01	5.18E+02	2.61E+02	1.96E+02	1.12E+02	1.22E+03	6.00E+02	4.58E+02	2.60E+02	2.84E+03
Xylene - m		1.16E+05	2.10E+02	8.25E+01	5.92E+01	6.25E+02	5.01E+02	1.95E+02	1.40E+02	1.47E+03	1.15E+03	4.56E+02	3.27E+02	3.46E+03
Xylene - o		1.41E+05	1.92E+02	8.87E+01	6.07E+01	4.78E+02	4.56E+02	2.08E+02	1.43E+02	1.12E+03	1.05E+03	4.86E+02	3.32E+02	2.62E+03
Xylene - p		1.21E+05	1.98E+02	7.93E+01	5.66E+01	5.76E+02	4.70E+02	1.86E+02	1.33E+02	1.35E+03	1.08E+03	4.36E+02	3.10E+02	3.17E+03
Total xylene		1.16E+05	1.92E+02	7.93E+01	5.66E+01	6.25E+02	4.56E+02	1.86E+02	1.33E+02	1.47E+03	1.05E+03	4.36E+02	3.10E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		9.32E+06	1.54E+02	1.04E+03	1.34E+02	2.04E+04	2.97E+02	1.69E+03	2.53E+02	3.31E+04	6.03E+02	3.21E+03	5.08E+02	6.27E+04
Trichloroethene		6.44E+01	2.83E-01	1.72E-02	1.62E-02	1.54E+03	6.26E-01	3.59E-02	3.40E-02	3.22E+03	1.41E+00	7.98E-02	7.55E-02	7.14E+03
Tetrachloroethene		4.08E+02	4.49E+00	1.79E-01	1.76E-01	4.24E+02	1.04E+01	4.02E-01	3.94E-01	9.51E+02	2.38E+01	9.21E-01	9.04E-01	2.18E+03
1,1,1-Trichloroethane		3.59E+04	3.33E+02	9.01E+00	8.77E+00	1.43E+03	7.26E+02	1.84E+01	1.80E+01	2.92E+03	1.62E+03	4.04E+01	3.94E+01	6.39E+03
1,1,1,2 Tetrachloroethane		2.84E+03	5.39E+00	1.54E+00	1.20E+00	2.60E+03	1.27E+01	3.56E+00	2.78E+00	6.02E+03	2.92E+01	8.29E+00	6.46E+00	1.40E+04
1,1,2,2-Tetrachloroethane		1.85E+04	2.81E+00	3.92E+00	1.64E+00	2.67E+03	6.10E+00	8.04E+00	3.47E+00	5.46E+03	1.36E+01	1.76E+01	7.67E+00	1.20E+04
Carbon Tetrachloride		6.10E+01	3.10E+00	2.58E-02	2.57E-02	1.52E+03	7.11E+00	5.65E-02	5.62E-02	3.32E+03	1.62E+01	1.28E-01	1.27E-01	7.54E+03
1,2-Dichloroethane		9.70E+01	3.17E-02	9.20E-03	7.13E-03	3.41E+03	5.73E-02	1.33E-02	1.08E-02	4.91E+03	1.09E-01	2.28E-02	1.88E-02	8.43E+03
Vinyl Chloride		6.20E+00	3.82E-03	7.73E-04	6.43E-04	1.36E+03	6.87E-03	1.00E-03	8.73E-04	1.76E+03	1.25E-02	1.53E-03	1.36E-03	2.69E+03
1,2,4-Trimethylbenzene		5.10E+03	NR	1.76E+00	NR	4.74E+02	NR	4.26E+00	NR	1.16E+03	NR	9.72E+00	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	-	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds														
Acenaphthene		4.11E+03	2.27E+02	4.86E+04	2.26E+02	5.70E+01	5.41E+02	1.18E+05	5.38E+02	1.41E+02	1.18E+03	2.68E+05	1.17E+03	3.36E+02
Acenaphthylene		7.95E+03	1.85E+02	4.59E+04	1.84E+02	8.61E+01	4.42E+02	1.11E+05	4.40E+02	2.12E+02	9.78E+02	2.53E+05	9.74E+02	5.06E+02
Anthracene		-	2.43E+03	1.53E+05	2.39E+03	1.17E+00	5.53E+03	3.77E+05	5.45E+03	2.91E+00	1.10E+04	8.76E+05	1.09E+04	6.96E+00
Benzo(a)anthracene		-	1.01E+01	2.47E+01	7.18E+00	1.71E+00	1.42E+01	4.37E+01	1.07E+01	4.28E+00	1.69E+01	6.26E+01	1.33E+01	1.03E+01
Benzo(b)fluoranthene		-	2.96E+00	1.93E+01	2.56E+00	1.22E+00	3.89E+00	2.13E+01	3.29E+00	3.04E+00	4.43E+00	2.22E+01	3.69E+00	7.29E+00
Benzo(g,h,i)perylene		-	3.77E+02	1.87E+03	3.14E+02	1.54E-02	4.09E+02	1.94E+03	3.38E+02	3.85E-02	4.23E+02	1.97E+03	3.48E+02	9.23E-02
Benzo(k)fluoranthene		-	8.92E+01	5.41E+02	7.66E+01	6.87E-01	1.10E+02	5.76E+02	9.22E+01	1.72E+00	1.21E+02	5.91E+02	1.00E+02	4.12E+00
Chrysene		-	1.66E+01	1.19E+02	1.46E+01	4.40E-01	2.54E+01	1.49E+02	2.17E+01	1.10E+00	3.19E+01	1.66E+02	2.67E+01	2.64E+00
Dibenzo(a,h)anthracene		-	2.90E-01	1.45E+00	2.41E-01	3.93E-03	3.43E-01	1.64E+00	2.84E-01	9.82E-03	3.69E-01	1.74E+00	3.04E-01	2.36E-02
Fluoranthene		-	2.87E+02	3.83E+04	2.85E+02	1.89E+01	5.63E+02	8.87E+04	5.60E+02	4.73E+01	9.00E+02	1.83E+05	8.96E+02	1.13E+02
Fluorene		-	1.77E+02	6.20E+03	1.72E+02	3.09E+01	4.19E+02	1.53E+04	4.07E+02	7.65E+01	8.98E+02	3.62E+04	8.77E+02	1.83E+02
Indeno(1,2,3-cd)pyrene		-	3.09E+01	2.12E+02	2.70E+01	6.13E-02	4.22E+01	2.38E+02	3.59E+01	1.53E-01	4.92E+01	2.50E+02	4.11E+01	3.68E-01
Phenanthrene		-	9.85E+01	7.17E+03	9.72E+01	3.60E+01	2.24E+02	1.76E+04	2.22E+02	8.96E+01	4.48E+02	4.07E+04	4.43E+02	2.14E+02
Pyrene		-	6.25E+02	8.79E+04	6.20E+02	2.20E+00	1.25E+03	2.04E+05	1.24E+03	5.49E+00	2.05E+03	4.23E+05	2.04E+03	1.32E+01
Benzo(a)pyrene	(a)	-	4.96E+00	3.51E+01	NR	9.11E-01	4.96E+00	3.77E+01	NR	2.28E+00	4.96E+00	3.89E+01	NR	5.46E+00
Naphthalene		1.90E+04	2.78E+01	2.33E+01	1.27E+01	7.64E+01	6.66E+01	5.58E+01	3.04E+01	1.83E+02	1.53E+02	1.31E+02	7.06E+01	4.32E+02
Phenol		-	1.60E+02	4.58E+02	1.20E+02	2.42E+04	2.96E+02	6.95E+02	2.09E+02	3.81E+04	5.86E+02	1.19E+03	3.93E+02	7.03E+04

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE

Table 5

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce Scenario

Compound	Notes	GrAC (µg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons														
Aliphatic hydrocarbons EC_5-EC_6		2.00E+04	4.99E+03	4.24E+01	4.23E+01	3.04E+02	1.13E+04	7.79E+01	7.78E+01	5.58E+02	2.50E+04	1.61E+02	1.60E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		5.37E+03	1.49E+04	1.04E+02	1.03E+02	1.44E+02	3.43E+04	2.31E+02	2.31E+02	3.22E+02	7.11E+04	5.29E+02	5.28E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		4.27E+02	1.61E+03	2.68E+01	2.67E+01	7.77E+01	2.91E+03	6.55E+01	6.51E+01	1.90E+02	4.26E+03	1.56E+02	1.54E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		3.39E+01	4.57E+03	1.33E+02	1.32E+02	4.75E+01	5.51E+03	3.31E+02	3.26E+02	1.18E+02	5.98E+03	7.93E+02	7.65E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		7.59E-01	6.27E+03	1.11E+03	1.06E+03	2.37E+01	6.34E+03	2.78E+03	2.41E+03	5.91E+01	6.36E+03	6.67E+03	4.34E+03	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(b)	-	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(b)	-	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC_8-EC_9 (styrene)		2.90E+05	1.08E+01	5.22E+02	1.06E+01	6.26E+02	2.53E+01	1.20E+03	2.48E+01	1.44E+03	5.81E+01	2.79E+03	5.69E+01	3.35E+03
Aromatic hydrocarbons >EC_9-EC_{10}		2.00E+04	5.76E+01	4.74E+01	3.45E+01	6.13E+02	1.38E+02	1.16E+02	8.38E+01	1.50E+03	3.07E+02	2.77E+02	1.94E+02	3.58E+02
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.45E+04	8.29E+01	2.58E+02	7.52E+01	3.64E+02	1.96E+02	6.39E+02	1.79E+02	8.99E+02	4.25E+02	1.52E+03	3.91E+02	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		5.75E+03	1.47E+02	2.85E+03	1.45E+02	1.69E+02	3.36E+02	7.07E+03	3.32E+02	4.19E+02	6.81E+02	1.68E+04	6.74E+02	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(b)	-	2.63E+02	NR	NR	5.37E+01	5.45E+02	NR	NR	1.34E+02	9.34E+02	NR	NR	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(b)	-	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(b)	-	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded.

Calculated SAC exceeds soil saturation limit but will not effect the SSV significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE

Table 6
Human Health Generic Assessment Criteria for Residential with home-grown produce

Compound	GrAC for Groundwater (µg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals				
Arsenic	-	37	37	37
Cadmium	-	22	22	22
Chromium (III) - trivalent	-	910	910	910
Chromium (VI) - hexavalent	-	21	21	21
Copper	-	2,500	2,500	2,500
Lead	-	200	200	200
Elemental Mercury (Hg^0)	12.90	0.2	0.6	1.2
Inorganic Mercury (Hg^{2+})	-	39	39	39
Methyl Mercury (Hg^{4+})	22180	10	10	10
Nickel	-	130	130	130
Selenium	-	258	258	258
Zinc	-	3,900	3,900	3,900
Cyanide (free)	-	1.4	1.4	1.4
Volatile Organic Compounds				
Benzene	23000	0.20	0.41	0.87
Toluene	590000	130	300	680
Ethylbenzene	124600	50	110	260
Xylene - m	115900	59	140	327
Xylene - o	141400	61	143	332
Xylene - p	121100	57	133	310
Total xylene	115900	57	133	310
Methyl tertiary-Butyl ether (MTBE)	9320000	130	250	510
Trichloroethene	64	0.02	0.03	0.08
Tetrachloroethene	408	0.2	0.4	0.9
1,1,1-Trichloroethane	35900	9	18	39
1,1,1,2 Tetrachloroethane	2800	1.2	2.8	6.5
1,1,2,2-Tetrachloroethane	18500	1.6	3.5	7.7
Carbon Tetrachloride	61	0.026	0.056	0.127
1,2-Dichloroethane	97	0.007	0.011	0.019
Vinyl Chloride	6	0.0006	0.0009	0.0014
1,2,4-Trimethylbenzene	5095	1.8	4.3	9.7
1,3,5-Trimethylbenzene	-	NR	NR	NR
Semi-Volatile Organic Compounds				
Acenaphthene	4110	230	540	1,170
Acenaphthylene	7950	180	440	970
Anthracene	-	2,400	5,500	10,900
Benzo(a)anthracene	-	7	11	13
Benzo(b)fluoranthene	-	2.6	3.3	3.7
Benzo(g,h,i)perylene	-	310	340	350
Benzo(k)fluoranthene	-	77	92	100
Chrysene	-	15	22	27
Dibenzo(a,h)anthracene	-	0.24	0.28	0.30
Fluoranthene	-	290	560	900
Fluorene	-	170	410	880
Indeno(1,2,3-cd)pyrene	-	27	36	41
Phenanthrene	-	100	220	440
Pyrene	-	620	1,240	2,040
Benzo(a)pyrene	-	5	5	5
Naphthalene	19000	13	30	71
Phenol	-	120	210	390
Total Petroleum Hydrocarbons				
Aliphatic hydrocarbons EC_5-EC_6	20000	42	78	160
Aliphatic hydrocarbons >EC_6-EC_8	5370	100	230	530
Aliphatic hydrocarbons >EC_8-EC_{10}	427	27	65	154
Aliphatic hydrocarbons >EC_{10}-EC_{12}	33.9	130 (48)	330 (118)	760 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	0.759	1,100 (24)	2,400 (59)	4,300 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	-	65,000 (8)	92,000 (21)	110,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	-	65,000 (8)	92,000 (21)	110,000
Aromatic hydrocarbons >EC_8-EC_9 (styrene)	290000	11	25	57
Aromatic hydrocarbons >EC_9-EC_{10}	20000	30	80	190
Aromatic hydrocarbons >EC_{10}-EC_{12}	24500	80	180	390
Aromatic hydrocarbons >EC_{12}-EC_{16}	5750	140	330	670
Aromatic hydrocarbons >EC_{16}-EC_{21}	-	260	540	930
Aromatic hydrocarbons >EC_{21}-EC_{35}	-	1,100	1,500	1,700
Aromatic hydrocarbons >EC_{35}-EC_{44}	-	1,100	1,500	1,700
Minerals				
Asbestos	-	No asbestos detected with ID or <0.001% dry weight[1]		

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

[1] LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC and GrAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS) The SAC has been set as the model calculated SAC with the saturation limit shown in brackets.
RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. The GrAC is conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

Generic assessment criteria for human health: residential scenario without home-grown produce

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and adopts them as GAC for these six substances.

For all other substances the C4SL exposure modifications relevant for residential without home-grown produce end use have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) and reducing exposure frequency for dermal contact outdoors.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015[7] or by the USEPA[14], where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.071, supporting EA guidance[5,8,9] and revised exposure scenarios published for the C4SL[3]. Groundwater assessment criteria (GrAC) protective of human health via the inhalation pathway were derived using the RBCA 1.3b model. RSK has updated the inputs within RBCA to reflect EA guidance[1,5,8,9]. The SAC and GrAC collectively are termed GAC.

Conceptual model

In accordance with SR3[5], the residential without home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance with Box 3.1 of SR3[5], the pathways considered for production of the SAC in the residential without home-grown produce scenario are

- direct soil and dust ingestion in areas of soft landscaping
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium[1], the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh}, are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

The pathway considered in production of the GrAC is the volatilisation of compounds from groundwater and subsequent vapour inhalation by residents while indoors. Figure 2 illustrates this linkage. Although the outdoor air inhalation pathway is also valid, this contributes little to the overall risks owing to the dilution in outdoor air. Within RBCA, the solubility limit of the chemical restricts the extent of volatilisation, which in turn drives the indoor air inhalation pathway. While the same restriction is not built into the CLEA model, the CLEA model output cells are flagged red where the soil saturation limit has been exceeded.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database and to outputs from the RBCA model for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated appendices[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[14]. Where a C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and has adopted them as GAC for these six substances. Toxicological and specific chemical parameters for aromatic hydrocarbon C_8–C_9 (styrene), 1,2,4-trimethylbenzene and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene and toluene, which are modelled separately. The aromatic C_8–C_9 hydrocarbon fraction comprises ethylbenzene, xylene and styrene. As ethylbenzene and xylene are being modelled separately, the physical, chemical and toxicological data for aromatic C_8–C_9 have been taken from styrene.

For the GrAC, the HCV used in the modelling were derived using the toxicological data for the SAC amended as follows:

- A child weighing 13.3kg (average of 0-6 year old female in accordance with Table 4.6 of SR3[5]) and breathing 8.77m^3 (average daily inhalation rate for a 0-6yr old female in accordance with SP1010 final project report for the C4SL (Table 3.2[3]) and USEPA data(14)
- Background inhalation (mean daily intake (MDI)) for a child (Age Classes 1-6)
- Residential amendments to the MDI for younger age groups following Table 3.4 and Section 3.4.1 of SR2[8],; amended to reflect average daily inhalation rates in accordance with SP1010 final project report for the C4SL (Table 3.2[3]) and USEPA data[12].

Physical parameters

For the residential without home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. SR3[5] notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3[3], with a dust loading factor detailed in Section 9.3 of SR3[5]. The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this

SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

For the GrAC, the depth to groundwater was taken as 2.5m based on RSK's experience of assessing the volatilisation pathway from groundwater. The GrAC were produced using the input parameters in Table 3.

Summary of modifications to the default CLEA SR3[5] input parameters for residential without home-grown produce

In summary, the RSK GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3[5]. Modifications to the default SR3[5] exposure scenarios based on the C4SL exposure scenarios[3] are presented in Table 2 below.

The final selected GAC are presented by pathway in Table 4 and the combined GAC in Table 5.

Figure 1: Conceptual model for CLEA residential scenario without home-grown produce

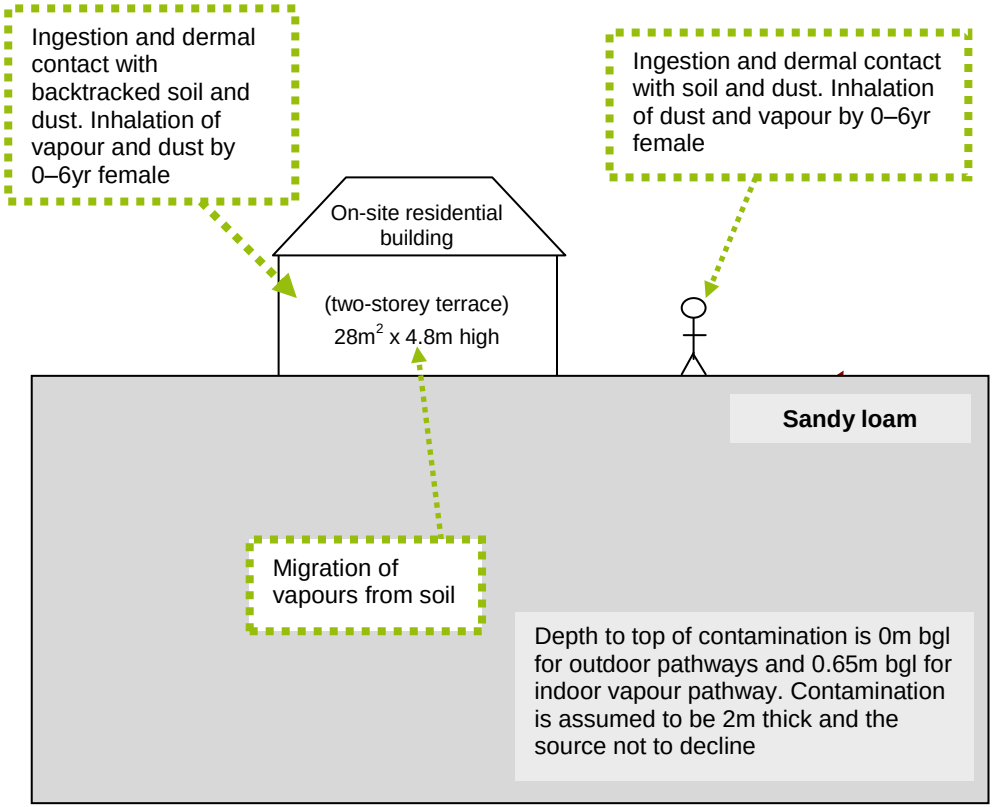


Table 1: Exposure assessment parameters for residential scenario without home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential without home-grown produce	Chosen land use
Receptor	Female child	Key generic assumption given in Box 3.1, SR3[5]
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3[5]. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3)[5]
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3)[5]
Start age class (AC)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3[5]
End AC	6	
SOM (%)	6	Representative of sandy loamy soil according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
	1	To provide SAC for sites where SOM <6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Residential without home-grown produce – modified receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
Soil to skin adherence factor – (outdoor)	mg soil/cm^2 skin	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010[3]					
Inhalation rate	m^3 day^{-1}	5.4	8.0	8.9	10.1	10.1	10.1
Justification		Mean value USEPA, 2011[12]; Table 3.2, SP1010[3]					
Notes: For **cadmium**, the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI_{oral} and TDI_{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3[1], Science Report SC050021/Cadmium SGV[1] and the project report SP1010[3] for more information.							

Figure 2: GrAC conceptual model for RBCA residential without home-grown produce scenario

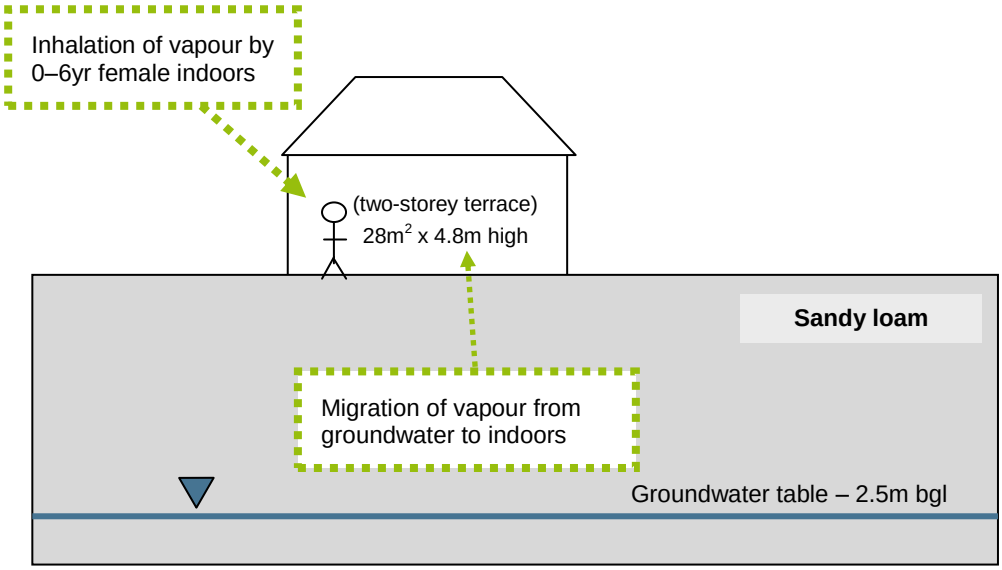


Table 4: Residential without home-grown produce – RBCA inputs

Parameter	Unit	Value	Justification
Receptor			
Averaging time	Years	6	From Box 3.1, SR3[5]
Receptor weight	kg	13.3	Average of CLEA 0-6 year old female data, Table 4.6, SR3[5]
Exposure duration	Years	6	From Box 3.1, report , SR3[5]
Exposure frequency	Days/yr	350	Weighted using occupancy period of 23 hours per day for 365 days of the year
Soil type – sandy loam			
Total porosity	-	0.53	CLEA value for sandy loam. Parameters for sandy loam from Table 4.4, SR3[5]
Volumetric water content	-	0.33	
Volumetric air content	-	0.20	
Dry bulk density	g cm^{-3} or kg/L	1.21	
Vertical hydraulic conductivity	cm s^{-1}	3.56E-3	CLEA value for saturated conductivity of sandy loam, Table 4.4, SR3[5] equivalent to 307 cm/day
Vapour permeability	m^2	3.05E-12	Calculated for sandy loam using equations in Appendix 1, SR3[5]
Capillary zone thickness	m	0.1	Professional judgement
Fraction organic carbon	%	0.0348	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
Building			
Building volume/area ratio	m	4.8	Table 3.3, SR3[5]
Foundation area	m^2	28	
Foundation perimeter	m	22	Calculated assuming building measures 7m x 4m to give 28m^2 foundation area
Building air exchange rate	d^{-1}	12	Table 3.3, SR3[5] Building air exchange rate equivalent to 1.4E-04 s^{-1}
Depth to bottom of foundation slab	m	0.15	
Foundation thickness	m	0.15	
Foundation crack fraction	-	0.0151	Calculated from floor crack area of 423cm^2 and building footprint of 28m^2 in Table 4.21, SR3[5]
Volumetric water content of cracks	-	0.33	Assumed equal to underlying soil type in assumption that cracks become filled with soil over time. Parameters for sandy loam from Table 4.4, SR3[5]
Volumetric air content of cracks	-	0.2	
Indoor/outdoor differential pressure	Pa	3.1	From Table 3.3, SR3[5] Equivalent to 31 g/cm/s^2

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 4

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	GrAC (µg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals														
Arsenic	(a,b)	-	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR	3.99E+01	5.26E+02	NR	NR
Cadmium	(a)	-	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR	1.95E+02	4.88E+02	1.49E+02	NR
Chromium (III) - trivalent	(c)	-	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR	1.98E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	-	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR	5.91E+01	2.06E+01	NR	NR
Copper		-	1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR	1.08E+04	1.41E+04	7.13E+03	NR
Lead	(a)	-	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR	3.14E+02	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	1.29E+01	NR	2.41E-01	NR	4.31E+00	NR	5.74E-01	NR	1.07E+01	NR	1.25E+00	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		-	5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR	5.71E+01	3.63E+03	5.62E+01	NR
Methyl Mercury (Hg^{4+})		2.22E+04	1.80E+01	1.87E+01	9.16E+00	7.33E+01	1.80E+01	3.62E+01	1.20E+01	1.42E+02	1.80E+01	7.68E+01	1.46E+01	3.04E+02
Nickel	(d)	-	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR	1.88E+02	1.81E+02	NR	NR
Selenium	(b)	-	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR	4.31E+02	NR	NR	NR
Zinc	(b)	-	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR	4.05E+04	3.63E+07	NR	NR
Cyanide (free)		-	4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR	4.03E+01	1.37E+04	4.02E+01	NR
Volatile Organic Compounds														
Benzene	(a)	2.30E+04	7.36E+01	9.01E-01	8.90E-01	1.22E+03	7.36E+01	1.68E+00	1.64E+00	2.26E+03	7.36E+01	3.48E+00	3.33E+00	4.71E+03
Toluene		5.90E+05	2.87E+04	9.08E+02	8.80E+02	8.69E+02	2.87E+04	2.00E+03	1.87E+03	1.92E+03	2.87E+04	4.55E+03	3.93E+03	4.36E+03
Ethylbenzene		1.25E+05	1.29E+04	8.34E+01	8.29E+01	5.18E+02	1.29E+04	1.96E+02	1.93E+02	1.22E+03	1.29E+04	4.58E+02	4.42E+02	2.84E+03
Xylene - m		1.16E+05	2.32E+04	8.25E+01	8.22E+01	6.25E+02	2.32E+04	1.95E+02	1.93E+02	1.47E+03	2.32E+04	4.56E+02	4.47E+02	3.46E+03
Xylene - o		1.41E+05	2.32E+04	8.87E+01	8.83E+01	4.78E+02	2.32E+04	2.08E+02	2.06E+02	1.12E+03	2.32E+04	4.86E+02	4.76E+02	2.62E+03
Xylene - p		1.21E+05	2.32E+04	7.93E+01	7.90E+01	5.76E+02	2.32E+04	1.86E+02	1.85E+02	1.35E+03	2.32E+04	4.36E+02	4.28E+02	3.17E+03
Total xylene		1.16E+05	2.32E+04	7.93E+01	7.90E+01	6.25E+02	2.32E+04	1.86E+02	1.85E+02	1.47E+03	2.32E+04	4.36E+02	4.28E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		9.32E+06	3.87E+04	1.04E+03	1.01E+03	2.04E+04	3.87E+04	1.69E+03	1.62E+03	3.31E+04	3.87E+04	3.21E+03	2.96E+03	6.27E+04
Trichloroethene		6.44E+01	6.45E+01	1.72E-02	1.72E-02	1.54E+03	6.45E+01	3.59E-02	3.59E-02	3.22E+03	6.45E+01	7.98E-02	7.97E-02	7.14E+03
Tetrachloroethene		4.08E+02	7.13E+02	1.79E-01	1.79E-01	4.24E+02	7.13E+02	4.02E-01	4.02E-01	9.51E+02	7.13E+02	9.21E-01	9.20E-01	2.18E+03
1,1,1-Trichloroethane		3.59E+04	7.74E+04	9.01E+00	9.01E+00	1.43E+03	7.74E+04	1.84E+01	1.84E+01	2.92E+03	7.74E+04	4.04E+01	4.04E+01	6.39E+03
1,1,1,2 Tetrachloroethane		2.84E+03	7.34E+02	1.54E+00	1.53E+00	2.60E+03	7.34E+02	3.56E+00	3.55E+00	6.02E+03	7.34E+02	8.29E+00	8.20E+00	1.40E+04
1,1,2,2-Tetrachloroethane		1.85E+04	7.34E+02	3.92E+00	3.90E+00	2.67E+03	7.34E+02	8.04E+00	7.95E+00	5.46E+03	7.34E+02	1.76E+01	1.72E+01	1.20E+04
Carbon Tetrachloride		6.10E+01	5.15E+02	2.58E-02	2.58E-02	1.52E+03	5.15E+02	5.65E-02	5.64E-02	3.32E+03	5.15E+02	1.28E-01	1.28E-01	7.54E+03
1,2-Dichloroethane		9.70E+01	1.55E+01	9.20E-03	9.20E-03	3.41E+03	1.55E+01	1.33E-02	1.33E-02	4.91E+03	1.55E+01	2.28E-02	2.27E-02	8.43E+03
Vinyl Chloride		6.20E+00	1.81E+00	7.73E-04	7.73E-04	1.36E+03	1.81E+00	1.00E-03	9.99E-04	1.76E+03	1.81E+00	1.53E-03	1.53E-03	2.69E+03
1,2,4-Trimethylbenzene		5.10E+03	NR	5.58E+00	NR	4.74E+02	NR	1.29E+01	NR	1.16E+03	NR	2.69E+01	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	-	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
Semi-Volatile Organic Compounds														
Acenaphthene		4.11E+03	7.64E+03	4.86E+04	6.60E+03	5.70E+01	7.64E+03	1.18E+05	7.17E+03	1.41E+02	7.64E+03	2.68E+05	7.43E+03	3.36E+02
Acenaphthylene		7.95E+03	7.65E+03	4.59E+04	6.55E+03	8.61E+01	7.65E+03	1.11E+05	7.15E+03	2.12E+02	7.65E+03	2.53E+05	7.42E+03	5.06E+02
Anthracene		-	3.82E+04	1.53E+05	3.06E+04	1.17E+00	3.82E+04	3.77E+05	3.47E+04	2.91E+00	3.82E+04	8.76E+05	3.66E+04	6.96E+00
Benzo(a)anthracene		-	1.98E+01	2.47E+01	1.10E+01	1.71E+00	1.98E+01	4.37E+01	1.36E+01	4.28E+00	1.98E+01	6.26E+01	1.50E+01	1.03E+01
Benzo(b)fluoranthene		-	4.97E+00	1.93E+01	3.95E+00	1.22E+00	4.97E+00	2.13E+01	4.03E+00	3.04E+00	4.97E+00	2.22E+01	4.06E+00	7.29E+00
Benzo(g,h,i)perylene		-	4.38E+02	1.87E+03	3.55E+02	1.54E-02	4.38E+02	1.94E+03	3.58E+02	3.85E-02	4.38E+02	1.97E+03	3.59E+02	9.23E-02
Benzo(k)fluoranthene		-	1.31E+02	5.41E+02	1.06E+02	6.87E-01	1.31E+02	5.76E+02	1.07E+02	1.72E+00	1.31E+02	5.91E+02	1.07E+02	4.12E+00
Chrysene		-	3.95E+01	1.19E+02	2.97E+01	4.40E-01	3.95E+01	1.49E+02	3.12E+01	1.10E+00	3.95E+01	1.66E+02	3.19E+01	2.64E+00
Dibenzo(a,h)anthracene		-	3.95E-01	1.45E+00	3.10E-01	3.93E-03	3.95E-01	1.64E+00	3.18E-01	9.82E-03	3.95E-01	1.74E+00	3.22E-01	2.36E-02
Fluoranthene		-	1.59E+03	3.83E+04	1.53E+03	1.89E+01	1.59E+03	8.87E+04	1.56E+03	4.73E+01	1.59E+03	1.83E+05	1.58E+03	1.13E+02
Fluorene		-	5.09E+03	6.20E+03	2.80E+03	3.09E+01	5.09E+03	1.53E+04	3.82E+03	7.65E+01	5.09E+03	3.62E+04	4.47E+03	1.83E+02
Indeno(1,2,3-cd)pyrene		-	5.65E+01	2.12E+02	4.46E+01	6.13E-02	5.65E+01	2.38E+02	4.56E+01	1.53E-01	5.65E+01	2.50E+02	4.60E+01	3.68E-01
Phenanthrene		-	1.58E+03	7.17E+03	1.30E+03	3.60E+01	1.58E+03	1.76E+04	1.45E+03	8.96E+01	1.58E+03	4.07E+04	1.52E+03	2.14E+02
Pyrene		-	3.82E+03	8.79E+04	3.66E+03	2.20E+00	3.82E+03	2.04E+05	3.75E+03	5.49E+00	3.82E+03	4.23E+05	3.79E+03	1.32E+01
Benzo(a)pyrene	(a)	-	5.34E+00	3.51E+01	NR	9.11E-01	5.34E+00	3.77E+01	NR	2.28E+00	5.34E+00	3.89E+01	NR	5.46E+00
Naphthalene		1.90E+04	2.50E+03	2.33E+01	2.31E+01	7.64E+01	2.50E+03	5.58E+01	5.46E+01	1.83E+02	2.50E+03	1.31E+02	1.25E+02	4.32E+02
Phenol		-	6.48E+04	4.58E+02	4.55E+02	2.42E+04	6.48E+04	6.95E+02	6.88E+02	3.81E+04	6.48E+04	1.19E+03	1.17E+03	7.03E+04

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 4

Human Health Generic Assessment Criteria by Pathway for Residential Scenario Without Home-Grown Produce

Compound	Notes	GrAC (µg/l)	SAC Appropriate to Pathway SOM 1% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 2.5% (mg/kg)			Soil Saturation Limit (mg/kg)	SAC Appropriate to Pathway SOM 6% (mg/kg)			Soil Saturation Limit (mg/kg)
			Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Total Petroleum Hydrocarbons														
Aliphatic hydrocarbons EC_5-EC_6		2.00E+04	3.23E+05	4.24E+01	4.24E+01	3.04E+02	3.23E+05	7.79E+01	7.79E+01	5.58E+02	3.23E+05	1.61E+02	1.61E+02	1.15E+03
Aliphatic hydrocarbons >EC_6-EC_8		5.37E+03	3.23E+05	1.04E+02	1.04E+02	1.44E+02	3.23E+05	2.31E+02	2.31E+02	3.22E+02	3.23E+05	5.29E+02	5.29E+02	7.36E+02
Aliphatic hydrocarbons >EC_8-EC_{10}		4.27E+02	6.45E+03	2.68E+01	2.68E+01	7.77E+01	6.45E+03	6.55E+01	6.53E+01	1.90E+02	6.45E+03	1.56E+02	1.55E+02	4.51E+02
Aliphatic hydrocarbons >EC_{10}-EC_{12}		3.39E+01	6.45E+03	1.33E+02	1.32E+02	4.75E+01	6.45E+03	3.31E+02	3.27E+02	1.18E+02	6.45E+03	7.93E+02	7.67E+02	2.83E+02
Aliphatic hydrocarbons >EC_{12}-EC_{16}		7.59E-01	6.45E+03	1.11E+03	1.06E+03	2.37E+01	6.45E+03	2.78E+03	2.42E+03	5.91E+01	6.45E+03	6.67E+03	4.37E+03	1.42E+02
Aliphatic hydrocarbons >EC_{16}-EC_{35}	(b)	-	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC_{35}-EC_{44}	(b)	-	6.50E+04	NR	NR	8.48E+00	9.25E+04	NR	NR	2.12E+01	1.11E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC_8-EC_9 (styrene)		2.90E+05	1.54E+03	5.22E+02	3.90E+02	6.26E+02	1.54E+03	1.20E+03	6.76E+02	1.44E+03	1.54E+03	2.79E+03	9.93E+02	3.35E+03
Aromatic hydrocarbons >EC_9-EC_{10}		2.00E+04	2.58E+03	4.74E+01	4.72E+01	6.13E+02	2.58E+03	1.16E+02	1.15E+02	1.50E+03	2.58E+03	2.77E+02	2.69E+02	3.58E+03
Aromatic hydrocarbons >EC_{10}-EC_{12}		2.45E+04	2.58E+03	2.58E+02	2.52E+02	3.64E+02	2.58E+03	6.39E+02	5.94E+02	8.99E+02	2.58E+03	1.52E+03	1.24E+03	2.15E+03
Aromatic hydrocarbons >EC_{12}-EC_{16}		5.75E+03	2.58E+03	2.85E+03	1.80E+03	1.69E+02	2.58E+03	7.07E+03	2.30E+03	4.19E+02	2.58E+03	1.68E+04	2.48E+03	1.00E+03
Aromatic hydrocarbons >EC_{16}-EC_{21}	(b)	-	1.86E+03	NR	NR	5.37E+01	1.90E+03	NR	NR	1.34E+02	1.92E+03	NR	NR	3.21E+02
Aromatic hydrocarbons >EC_{21}-EC_{35}	(b)	-	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC_{35}-EC_{44}	(b)	-	1.93E+03	NR	NR	4.83E+00	1.93E+03	NR	NR	1.21E+01	1.93E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly effect the interpretation of any exceedances since the contribution of the indoor and outdoor vapour pathway to total exposure is >10%. This shading has also been used for the RBCA output where the theoretical solubility limit has been exceeded.

Calculated SAC exceeds soil saturation limit but will not effect the SAC significantly since the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

For consistency where the theoretical solubility limit within RBCA has been exceeded in production of the GrAC, these cellls have also been hatched red.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITHOUT HOME-GROWN PRODUCE

Table 5
Human health generic assessment criteria for residential without home-grown produce

Compound	GrAC for Groundwater (µg/l)	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals				
Arsenic	-	40	40	40
Cadmium	-	149	149	149
Chromium (III) - trivalent	-	910	910	910
Chromium (VI) - hexavalent	-	21	21	21
Copper	-	7,100	7,100	7,100
Lead	-	310	310	310
Elemental Mercury (Hg^0)	12.9	0.2	0.6	1.2
Inorganic Mercury (Hg^{2+})	-	56	56	56
Methyl Mercury (Hg^{4+})	22180	9	12	15
Nickel	-	180	180	180
Selenium	-	430	430	430
Zinc	-	40,000	40,000	40,000
Cyanide (free)	-	40	40	40
Volatile Organic Compounds				
Benzene	23000	0.9	1.6	3.3
Toluene	590000	900 (869)	1,900	3,900
Ethylbenzene	124600	80	190	440
Xylene - m	115900	80	190	450
Xylene - o	141400	90	210	480
Xylene - p	121100	80	180	430
Total xylene	115900	80	180	430
Methyl tertiary-Butyl ether (MTBE)	9320000	1,000	1,600	3,000
Trichloroethene	64	0.02	0.04	0.08
Tetrachloroethene	408	0.2	0.4	0.9
1,1,1-Trichloroethane	35900	9.0	18.4	40.4
1,1,1,2 Tetrachloroethane	2800	1.5	3.5	8.2
1,1,2,2-Tetrachloroethane	18500	3.9	8.0	17.2
Carbon Tetrachloride	61	0.026	0.056	0.128
1,2-Dichloroethane	97	0.009	0.013	0.023
Vinyl Chloride	6.2	0.0008	0.0010	0.0015
1,2,4-Trimethylbenzene	5095	5.6	12.9	26.9
1,3,5-Trimethylbenzene	-	NR	NR	NR
Semi-Volatile Organic Compounds				
Acenaphthene	4110	6,600 (57)	7,200	7,400
Acenaphthylene	7950	6,600 (86)	7,200	7,400
Anthracene	-	31,000 (1.17)	35,000	37,000
Benzo(a)anthracene	-	11.0	13.6	15.0
Benzo(b)fluoranthene	-	4.0	4.0	4.1
Benzo(g,h,i)perylene	-	355	358	359
Benzo(k)fluoranthene	-	106	107	107
Chrysene	-	30	31	32
Dibenzo(a,h)anthracene	-	0.31	0.32	0.32
Fluoranthene	-	1,500	1,600	1,600
Fluorene	-	2,800 (31)	3,800 (77)	4,500 (183)
Indeno(1,2,3-cd)pyrene	-	45	46	46
Phenanthrene	-	1,300 (36)	1,450	1,520
Pyrene	-	3,700	3,800	3,800
Benzo(a)pyrene	-	5.3	5.3	5.3
Naphthalene	19000	23	55	125
Phenol	-	440*	688	1,170
Total Petroleum Hydrocarbons				
Aliphatic hydrocarbons EC_5-EC_6	20000	42	78	161
Aliphatic hydrocarbons >EC_6-EC_8	5370	100	230	530
Aliphatic hydrocarbons >EC_8-EC_{10}	427	27	65	155
Aliphatic hydrocarbons >EC_{10}-EC_{12}	33.9	130 (48)	330 (118)	770 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	0.759	1,100 (24)	2,400 (59)	4,400 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	-	65,000 (8)	92,000 (21)	111,000
Aliphatic hydrocarbons >EC_{35}-EC_{44}	-	65,000 (8)	92,000 (21)	111,000
Aromatic hydrocarbons >EC_8-EC_9 (styrene)	290000	390	676	993
Aromatic hydrocarbons >EC_9-EC_{10}	20000	47	115	269
Aromatic hydrocarbons >EC_{10}-EC_{12}	24500	300	600	1,200
Aromatic hydrocarbons >EC_{12}-EC_{16}	5750	1,800 (169)	2,300 (419)	2,500
Aromatic hydrocarbons >EC_{16}-EC_{21}	-	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{21}-EC_{35}	-	1,900	1,900	1,900
Aromatic hydrocarbons >EC_{35}-EC_{44}	-	1,900	1,900	1,900
Minerals				
Asbestos	-	No asbestos detected with ID or <0.001% dry weight[1]		

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

[1] LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry.

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC and GrAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, MTBE, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS) The SAC has been set as the model calculated SAC with the saturation limit shown in brackets.
RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.

For consistency where the GrAC exceeds the solubility limit, GrAC has been set at the solubility limit. The GrAC is conservative since concentrations of the chemical are very unlikely to be at sufficient concentration to result in an exceedance of the health criteria value at the point of exposure (i.e. indoor air) provided free-phase product is absent.

APPENDIX H
GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

GENERIC ASSESSMENT CRITERIA FOR PHYTOTOXIC EFFECTS

Several compounds can inhibit plant growth; hence it is important to have generic assessment criteria (GAC) to promote healthy plant growth. In the absence of other published GAC, the GAC have been obtained from legislation (UK and European) and guidance related to the use of sewage sludge on agricultural fields.

The Council of European Communities Sewage Sludge Directive (86/278/EEC) dated 1986, has been transposed into UK law by Statutory Instrument No. 1263, The Sludge (use in Agriculture) Regulations 1989 (Public Health England, Wales and Scotland), as ammended in 1990 and The Sludge (use in Agriculture) Regulations (Northern Ireland) SR No, 245, 1990. In addition the Department of Environment (DoE) produced a Code of Practice (CoP) (Updated 2nd Edition) in 2006 which provided guidance on the application of sewage sludge on agricultural land (however the status of this document is unclear as it is on the archive section of the Defra website).

The directive seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to "***prevent harmful effects on soil, vegetation, animals and man".*** To this end, it prohibits the use of untreated sludge on agricultural land unless it is injected or incorporated into the soil. Treated sludge is defined as having undergone "biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use". To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of sludge.

The specified limits of concentrations of selected elements in soil are presented in Table 4 of the updated 2nd Edition of the DoE Code of Practice and are designed to protect plant growth. It is noted that these values are more stringent than the values set in current UK regulations. However since they were ammended following recommendations from the Independent Scientific Committee in 1993. (MAFF/DOE 1993). The GAC are presented in Table 1.

Table 1: Generic assessment criteria

Determinant	Generic assessment criteria (mg/kg)			
	pH 5.0 < 5.5	pH 5.5 < 6.0	pH 6.0 < 7.0	pH >7.0
Zinc	200	200	200	300
Copper	80	100	135	200
Nickel	50	60	75	110
Lead	300	300	300	300
Cadmium	3	3	3	3
Mercury	1	1	1	1
Note: Only compounds with assessment criteria documented within the Directive 86/278/EEC have been included, although criteria for 5 additional compounds have been presented within the 2006 CoP.				

APPENDIX I
GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

GENERIC ASSESSMENT CRITERIA FOR CONTROLLED WATERS

Protection of the water environment

The water environment in the United Kingdom is protected under a number of regulatory regimes. The relevant environmental regulator is consulted where there may be a risk that pollution of 'controlled waters' may occur or may have occurred in the past.

The term 'controlled waters' refers to coastal waters, inland freshwaters and groundwater. The EU Water Framework Directive (WFD) (2000/60/EC) is implemented via domestic regulations and guidance, covering aspects of groundwater and surface water protection as well as drinking water supply policy. Domestic legislation and guidance will vary across the United Kingdom. Therefore, the relevant legislation for England, Wales, Northern Ireland and Scotland should be reviewed, alongside guidance provided by the Environment Agency (EA), Natural Resource Wales (NRW), the Scottish Environmental Protection Agency (SEPA) or the Northern Ireland Environment Agency (NIEA), as appropriate.

The main objectives of the protection and remediation of groundwater under threat from land contamination are set out in the Environment Agency's Groundwater Protection: Principles and Practice (GP3) guidance document(1). When assessing risks to groundwater the following need to be taken into consideration:

- Where pollutants have not yet entered groundwater, all necessary and reasonable measures must be taken to:
    - ***prevent*** *the input of* ***hazardous*** *substances into groundwater (see description of hazardous substances below)*
    - ***limit*** *the entry of other (non-hazardous) pollutants into groundwater so as to avoid pollution, and to avoid deterioration of the status of groundwater bodies or sustained, upward trends in pollutant concentration.*
- Where hazardous substances or non-hazardous pollutants have already entered groundwater, the priority is to
    - ***minimise*** *further entry of* ***hazardous substances*** *and non-hazardous pollutants into groundwater*
    - *take* ***necessary and reasonable measures*** *to* ***limit the pollution*** *of groundwater or impact on the status of the groundwater body from the future expansion of a contaminant 'plume', if necessary by actively reducing its extent if the economic, social and environmental benefits of doing so outweigh the costs.*

DEFINITIONS AND SUBSTANCE CLASSIFICATIONS

Risks to surface waters:

When assessing risks to surface waters, the following list of definitions should be understood:

Priority substances (PS) are harmful substances originally identified under the Water Framework Directive (WFD) 2000/60/EC as substances 'presenting a significant risk to or via the aquatic environment' at a European level. Member States are required to incorporate the identified **PS** into their country-wide monitoring programmes. There are currently 33 **PS** defined within the Priority Substances Directive (2013/39/EU; Annex 1), with a further 12 additional substances due to come into force from 22 December 2018. Directive 2013/39/EU has been transposed into domestic legislation for England and Wales by The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Under the umbrella of **PS**, there is a sub-set of substances identified as being "hazardous", and these are referred to as **Priority hazardous substances (PHS).** The list of **PHS** is defined at EU level within the Priority Substances Directive (2013/39/EU). The WFD defines hazardous substances as 'substances (or groups of substances) that are toxic, persistent and liable to bio-accumulate, and other substances or groups of substances that give rise to an equivalent level of concern.' There are currently 15 **PHS**, with a further 6 additional substances due to come into force from 22 December 2018.

There is also another group of substances defined at EU level and which are referred to as **other pollutants (OP)** in Directive 2013/39/EU**.** These are additional substances which although not **priority substances**, have EQS which are identical to those laid down in the legislation which applied prior to 13 January 2009 (Directive 2008/105/EU). The **OP** are listed along with the **priority substance (PS)** within the Priority Substances Directive (2013/39/EU),and their associated EQS are also listed therein. There are 6 **OP** defined within the Priority Substances Directive (2013/39/EU).

In addition to the EU level substances, there are also a group of pollutants defined at a Member State level, referred to as **Specific pollutants (SP)**. These substances are pollutants which are released in significant quantities into water bodies in each of the individual European Member States. Under the WFD, Member States are required to set their own EQS for these substances. An indicative list of **SP** is given in Annex VIII of the WFD. Many of the substances categorised as **SP** in the UK were formerly List 2 substances under the old Groundwater Directive (80/68/EEC). The **SP** are defined within Part 2 (Table 1) of The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

Risks to groundwater:

When assessing risks to groundwater, the following definitions should be understood:

Under the requirements of the Groundwater Daughter Directive (2006/118/EU), the UK has published a list of substances it considers to be **hazardous substances** with respect to groundwater. In their advisory capacity to the government, this list has been derived by the UK Joint Agencies Groundwater Directive Advisory Group (JAGDAG), of which the Environment Agency is a member. Although currently under review, the existing list of groundwater hazardous substances is largely based on the former List 1 substances which were defined under the (now repealed) Groundwater Directive (80/68/EEC), with the addition of radioactive substances which are also now classed as **hazardous substances**. The JAGDAG list of **hazardous substances** is extensive, and can be found in full at:
http://www.wfduk.org/sites/default/files/Media/Substances%20transferred%20from%20List%20I%20%26%20II%20to%20hazardous%20or%20non%20hazardous.pdf

Given the above classifications**,** any other pollutant which has not been classified as a hazardous substance by JAGDAG**,** is referred to as a **non-hazardous pollutant (NHP).**

Selecting the appropriate assessment criteria

When assessing the risks to controlled waters, various assessment criteria apply, depending on the nature of the assessment and the conceptual site model.

Where a surface water body is involved, then Environmental Quality Standards (EQS) are the relevant assessment criteria as they are designed to be protective of surface water ecology.

Where a public water supply or a Principal aquifer is involved, then the standards defined in The Water Supply (Water Quality) Regulations[(2)] are the primary source of assessment criteria. The Private Water Supplies Regulations[(3)] may also be applicable in some cases. For instances where there are no UK assessment criteria, then the World Health Organisation (WHO) drinking water guidelines[(4)] may be used.

This appendix presents the generic assessment criteria (GAC) that RSK considers suitable for assessing risks to controlled waters for our most commonly encountered determinants. A full list of EQS for England and Wales are included in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

The RSK GAC for controlled waters are presented in **Table 1**. In line with the Environment Agency's Remedial Targets Methodology, the GAC for controlled waters are termed 'target concentrations'.

The appropriate target concentrations should be selected with consideration to:

- the site conceptual model (i.e. the receptor at potential risk);
- whether the substance is already present in groundwater at the site;
- whether or not the substance is classified as a priority hazardous substance under the Priority Substances Directive (2013/39/EC) (see above), or as a hazardous substance according to the current list of JAGDAG determinations[(5)]; and
- background concentrations in the aquifer (if applicable).

It is important to remember that the WFD and GP3[(1)] guidance allow a risk-based and a cost-benefit approach to be applied to groundwater contamination. Exceedance of any target concentration does not necessarily imply that an unacceptable risk exists or that remediation is required either on a technical or cost-benefit basis.

Table 1: Target concentrations for controlled waters

Target concentrations shaded in green are statutory values	Target concentrations shaded in orange are non-statutory values

Note: Units µg/l throughout

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Metals & other inorganics						
-	Specific pollutant	Arsenic	-	10[2]	50[6a]	25[6a]
Hazardous substance	Priority substance	Cadmium	0.1[7]	5[2]	≤0.08, 0.08, 0.09, 0.15, 0.25 [6b]	0.2[6a]
-	-	Chromium (total)	-	50[2]	Sum values for chromium III and VI	
-	Specific pollutant	Chromium (III)	-	Use value for total chromium	4.7[6a]	-
-	Specific pollutant	Chromium (VI)			3.4[6a]	0.6[6a]
-	Specific pollutant	Copper	-	2,000[2]	1 bioavailable[6a]	3.76 dissolved, where DOC ≤1mg/l[6a]
						3.76µg/l + (2.677µg/l x ((DOC/2) – 0.5µg/l)) dissolved, where DOC >1mg/l[6a]

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
-	Priority substance	Lead	-	10[2]	1.2 bioavailable[6a]	1.3[6a]
Hazardous substance	**Priority hazardous substance**	Mercury	0.01[7]	1[2]	0.07[6c]	0.07[6c]
-	Priority substance	Nickel	-	20[2]	4.0 bioavailable[6a]	8.6[6a]
-	-	Selenium	-	10[2]	-	-
-	Specific pollutant	Zinc	-	3,000[8]	10.9 bioavailable[6a]	6.8 dissolved [6a]
-	Specific pollutant	Iron	-	200[2]	1000[6a]*1	1000[6a])*1
-	Specific pollutant	Manganese	-	50[2]	123 bioavailable[6a]	-
-	-	Aluminium	-	200[2]	-	-
Hazardous substance	**Priority hazardous substance**	Tributyltin compounds (Tributyltin-cation)	0.001[7]	-	0.0002[6a]	0.0002[6a]
-	-	Sodium	-	200,000[2]	-	-
-	Specific pollutant	Cyanide (Hydrogen cyanide)	-	50[2]	1[6a]	1[6a]
-	-	Total ammonia[$] (ammonium (as NH_4^+) plus ammonia (NH_3)	-	50[2]	300[6f]	-
-	Specific pollutant	Ammonia un-ionised (NH_3)	-	-	-	21[6a]
-	Specific pollutant	Chlorine	-	-	2[6a]	10[6d]
-	-	Chloride	-	250,000[2]	-	-

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
-	-	Sulphate	-	250,000[2]	-	-
-	-	Nitrate (as NO_3)	-	50,000[2]	-	-
-	-	Nitrite (as NO_2)	-	100[2]	10[9]	-
Volatile organic compounds (VOC)						
Hazardous substance	Other pollutant	Tetrachloroethene (tetrachloroethylene)	0.1[7]	10[2]	10[6a]	10[6a]
Hazardous substance	Other pollutant	Trichloroethene (trichloroethylene)	0.1[7]	10[2]	10[6a]	10[6a]
Hazardous substance	Specific pollutant	Tetrachloroethane	-	-	140[6a]	-
Hazardous substance	Other pollutant	Carbon tetrachloride (tetrachloromethane)	0.1[7]	3.0[2]	12[6a]	12[6a]
Hazardous substance	Priority substance	1,2-Dichloroethane	1.0[7]	3.0[2]	10[6a]	10[6a]
Hazardous substance	**-**	Vinyl chloride (chloroethene)	-	0.5[2]	-	-
Hazardous substance	Priority substance	Dichloromethane	-	20[4]	20[6a]	20[6a]
Hazardous substance	Priority substance	Trichlorobenzenes	0.01[7]	-	0.4[6a]	0.4[(6a)]
Hazardous substance	-	Trihalomethanes	-	100[2a]	-	-

Substance classification		Determinant	Target concentrations (µg/l)			
			Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
Groundwater receptors[5]	Surface water receptors[6]				Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Priority substance	Trichloromethane (Chloroform)	0.1[7]	(see "Trihalomethanes" above)	2.5[6a]	2.5[6a]
-	**Priority hazardous substance**	Di(2-ethylhexyl) phthalate (bis(2-ethylhexyl) phthalate, DEHP)	-	8[4]	1.3[6a]	1.3[6a]
-	Specific pollutant	Benzyl butyl phthalate	-	-	7.5[6a]	0.75[6e]
Hazardous substance	**Priority hazardous substance**	Hexachlorobutadiene	0.005[7]	0.6[4]	0.6[6c]	0.6[6c]
Semi-volatile organic compounds (SVOC)						
Hazardous substance	-	Acenaphthylene (C12-C16)	-	-	5.8[10]	
Hazardous substance	**Priority hazardous substance**	Anthracene (C16-C35)	-	-	0.1[6a]	0.1[6a]
Hazardous substance	Priority substance	Naphthalene (C10-C12)	-	-	2[6a]	2[6a]
Hazardous substance	Priority substance	Fluoranthene (C16-C35)	-	-	0.0063[6a]	0.0063[6a]

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	**Priority hazardous substance(s)**	Benzo(a)pyrene (C16-C35)	-	0.01[2]	0.00017[6a]	0.00017[6a]
Hazardous substance		Benzo(b)fluoranthene (C16-C35)	-	0.1[2]	No EQS for these substances. B(a)P should be used as the indicator compound instead.	
Hazardous substance		Benzo(k)fluoranthene (C16-C35)	-			
Hazardous substance		Benzo(g,h,i)perylene (C16-C35)	-			
Hazardous substance		Indeno(1,2,3-cd) pyrene (C16-C35)	-			
-	Specific pollutant	Phenol	0.5[7]	-	7.7[6a]	7.7[6a]
Hazardous substance	Specific pollutant	2,4-Dichlorophenol	0.1[7]	-	4.2[6a]	0.42[6a]
Hazardous substance	Priority substance	Pentachloro-phenol (PCP)	0.1[7]	9[4]	0.4[6a]	0.4[6a]
Petroleum hydrocarbons						
Hazardous substance	-	Total petroleum hydrocarbons	-	10[11]		
Hazardous substance	Priority substance	Benzene	1[7]	1[2]	10[6a]	8[6a]
Hazardous substance	Specific pollutant	Toluene	4[7]	700[4]	74[6a]	74[6a]

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	-	Ethylbenzene	-	300[4]	-	-
Hazardous substance	-	Xylene	3[7]	500[4]	-	-
-	-	Methyl tertiary butyl ether (MTBE)	-	15[12]	-	
Pesticides, fungicides, insecticides and herbicides						
Hazardous substance	Other pollutant (Cyclodiene pesticides)	Aldrin	0.003[7]	0.03[2]	0.01[6a]	0.005[6a]
Hazardous substance		Dieldrin	3[7]	0.03[2]		
Hazardous substance		Endrin	0.003[7]	0.1[2b]		
Hazardous substance		Isodrin*[2]	0.003[7]	0.1[2b]		
Hazardous substance	Other pollutant	DDT (total)	0.006[7]	1[4]	0.025[6a]	0.025[6a]
Hazardous substance	-	Total pesticides	-	0.5[2]	-	-
Hazardous substance	-	Other individual pesticides	-	0.1[2]		
Hazardous substance	Specific pollutant	Carbendazim	-	-	0.15[6a]	-

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	Specific pollutant	Chlorothalonil	-	-	0.035[6a]	-
Hazardous substance	Specific pollutant (until 22/12/18, after which it becomes a Priority substance)	Cypermethrin	-	-	0.0001[6a] From 22/12/18: 8.0E-5[6a]	0.0001[6a] From 22/12/18: 8.0E-6[6a]
Hazardous substance	Specific pollutant	Dimethoate	0.01[7]	-	0.48[6a]	0.48[6a]
-	Specific pollutant	Glyphosate	-	-	196[6a]	196[6a]
Hazardous substance	Specific pollutant	Linuron	0.1[7]	-	0.5[6a]	0.5[6a]
-	Specific pollutant	Mecoprop	0.04[7]	-	18[6a]	18[6a]
-	Specific pollutant	Methiocarb	-	-	0.01[6a]	-
-	Specific pollutant	Pendimethalin	-	20[4]	0.3[6a]	-
Hazardous substance	Specific pollutant	Permethrin	0.001[7]	-	0.001[6a]	0.0002[6a]
Hazardous substance	Priority substance	Alachlor	-	20[4]	0.3[6a]	0.3[6a]
Hazardous substance	Priority substance	Atrazine	0.03[7]	100[4]	0.6[6a]	0.6[6a]
Hazardous substance	Priority substance	Diuron	-	-	0.2[6a]	0.2[6a]

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters
Hazardous substance	**Priority hazardous substance**	Endosulphan	0.005[7]	-	0.005[6a]	0.0005[6a]
-	Priority substance	Isoproturon	-	9[4]	0.3[6a]	0.3[6a]
Hazardous substance	Priority substance	Simazine	0.03[7]	2[4]	1[6a]	1[6a]
Hazardous substance	**Priority hazardous substance**	Trifluralin	0.01[7]	20[4]	0.03[6a]	0.03[6a]
-	From 22/12/18: Priority substance	Dichlorovos	-	-	From 22/12/18: 6.0E-4[6a]	From 22/12/18: 6.0E-5[6a]
Hazardous substance	From 22/12/18: Priority substance	Heptachlor and heptachlor epoxide	-	0.03[2]	From 22/12/18: 2.0E-7[6a]	From 22/12/18: 1.0E-08[6a]
Miscellaneous						
-	Specific pollutant	Triclosan (antibacterial agent)	-	-	0.1[6a]	0.1[6a]
-	**From 22/12/18: Priority hazardous substance**	Perfluoro-octane sulfonic acid (and its derivatives) (PFOS)	-	-	From 22/12/18: 6.5E-4[6a]	From 22/12/18: 1.3E-4[6a]
-	**From 22/12/18: Priority hazardous substance**	Hexabromo cyclododecane (HBCDD)	-	-	From 22/12/18: 0.0016[6a]	From 22/12/18: 0.0016[6a]

Substance classification		Determinant	Target concentrations (µg/l)			
Groundwater receptors[5]	Surface water receptors[6]		Minimum reporting value	UK drinking water standard (or best equivalent)	EQS or best equivalent	
					Freshwater	Transitional (estuaries) and coastal waters

Note: '-' A target concentration is not available.

$Please note that total ammonia (NH_4^+ and NH_3) is equivalent to ammoniacal nitrogen in laboratory reports

*1 Please note that although iron is listed in the 2015 Direction as 1.000 µg/l, the EQS remains at 1mg/l in Scotland and it is assumed this is a mistake and should read either 1,000 or 1000µg/l.

*2 Please note that although Isodrin is not listed in name within the group of "Cyclodiene pesticides" in Table 1 of Schedule 3 Part 3 of the 2015 Direction[6], the CAS number for Isodrin (465-73-6) **is** listed and therefore it is assumed that it has been missed off the named list of substances.

"Bioavailable" in relation to copper, zinc, nickel and manganese (but not lead) is the generic EQSbioavailable[6a] derived from the Metal Bioavailability Assessment Tool (M-BAT) developed by the Water Framework Directive UK Technical Advisory Group (WFDTAG). Exceedance of this value should prompt a site-specific assessment using the M-BAT with pH, DOC and Ca to derive a site-specific EQS termed the $PNEC_{dissolved}$. http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat. For zinc, if there is an exceedance of the EQSbioavailable in an initial GQRA, Tier 2 required that the EQS for zinc should also have the ambient background concentration of zinc added as well (as listed by catchment in Table 2).

References

1. Environment Agency (2013), 'Groundwater Protection: Principles and Policy (GP3) v1.1'.
2. The Water Supply (Water Quality) Regulations 2016 (SI 2016/619)
    2a. Sum of chloroform, bromoform, dibromochloromethane and bromodichloromethane
    2b. Standard applies to individual pesticides except aldrin, dieldrin, heptachlor and heptachlor epoxide, for which a separate standard is defined.
3. The Private Water Supplies (England) Regulations 2016. SI 2016 / 618
4. WHO (2011), *Guidelines for drinking-water quality*, 4th edn
5. JAGDAG list of Substances transferred from List I & II to hazardous or non hazardous. Although currently under review, the existing list of groundwater hazardous substances and non-hazardous pollutants is largely based on the former List 1 and List 2 substances which were defined under the old (now repealed) Groundwater Directive (80/68/EEC). These have been taken to be hazardous substances and non-hazardous pollutants respectively, though these may be reviewed if new information is made available. JAGDAG has developed on a methodology for substance determination to fulfil the requirements of the WFD and the Groundwater Daughter Directive, which was finalised following consultation. The current list of substances can be found at: http://www.wfduk.org/sites/default/files/Media/Substances%20transferred%20from%20List%20I%20%26%20II%20to%20hazardous%20or%20non%20hazardous.pdf
6. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.
    6a. The EQS for these substances are based on a "long term mean" or an "annual average (AA)" EQS.
    6b. For cadmium and its compounds the EQS values vary depending on the hardness of the water as specified in five class categories (Class 1: < 40 mg CaCO3/l, Class 2: 40 to < 50 mg CaCO3/l, Class 3: 50 to < 100 mg CaCO3/l, Class 4: 100 to < 200 mg CaCO3/l and Class 5: ≥ 200 mg CaCO3/l).
    6c. The EQS for Mercury and hexachlorobutadiene are based on a "maximum acceptable concentration (MAC)" EQS in absence of an "annual average (AA)" EQS.
    6d. The EQS for chlorine in saltwater is based on the 95th percentile concentration of total residual oxidant, which refers to the sum of all oxidising agents existing in water, expressed as available chlorine.
    6e. The recommended saltwater standard is derived using a safety factor of 100. Where the standard is failed, it is recommended that supporting evidence of ecological damage should be obtained before committing to expensive action.
    6f. EQS for total ammonia is as per Schedule 3, Part 1, Table 7 of of the above directions. EQS applies to river types 1, 2 and 4 and 6 (namely upland and low alkalinity). The EQS for a lowland and high alkalinity rivers (types 3, 5 and 7) is 600µg/l (0.6mg/l).

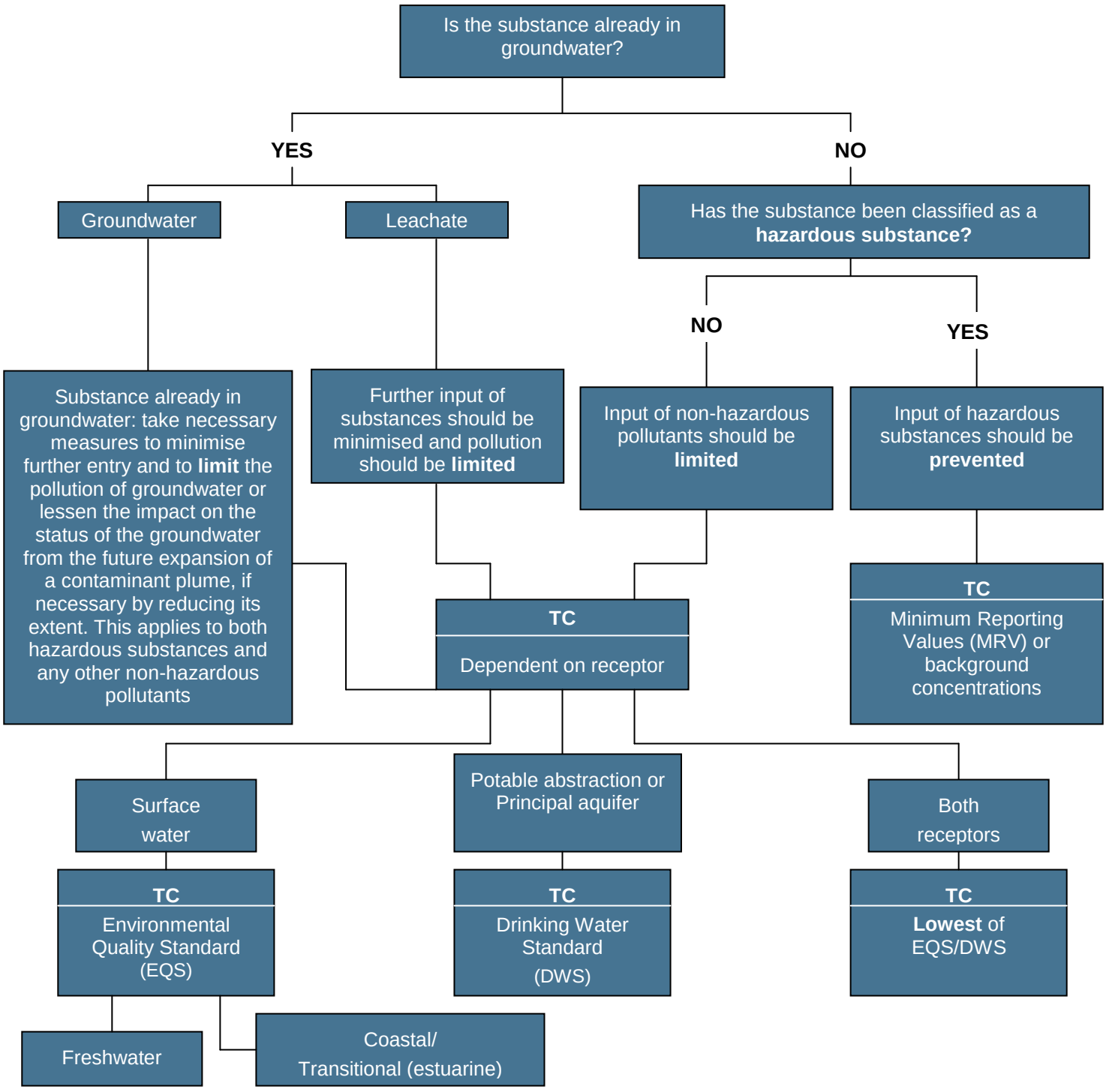
    Additional information on the Metal Bioavailability Assessment Tool (M-BAT) is available at http://www.wfduk.org/resources/rivers-lakes-metal-bioavailability-assessment-tool-m-bat
7. Minimum reporting values listed in Annex (J) of Horizontal Guidance Note H1 (H1 Environmental Risk Assessment Framework, Environment Agency, April 2010 v2.0). Note target concentration for xylenes is 0.003mg/l each for o-xylene and m/p xylene)
8. The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (as amended). SI 1996 / 3001

9. Council Directive on the Quality of Fresh Waters Needing Protection or Improvement in Order to Support Fish Life (Freshwater Fish Directive) (78/659/EEC)
10. WRc plc (2002), R&D Technical Report P45.
11. Environment Agency (2009), 'Petroleum hydrocarbons in groundwater: supplementary guidance for hydrogeological risk assessment'.

    NOTE: EA advice in the above document should be referred to with respect to risk rankings of TPH CWG fractions. It may be possible to eliminate low risk fractions and/or those not detected above LMDL from concern

12. Drinking Water Inspectorate (London, UK). Environmental Information Request on MTBE in drinking water. Ref. DWI 1/10/18; dated 28 November 2006. Value is based on the odour threshold for MTBE, which is lower than a health-based guideline value

FLOW CHART TO ASSIST WITH SELECTION OF TARGET CONCENTRATIONS



TC = Target concentration

When leachate is being assessed the 'compliance point' is the groundwater body. Therefore dilution within the groundwater body may be applied with caution before comparing with the TC.

When directly assessing a receptor, e.g., a river, the appropriate TC should be selected.

APPENDIX J
GENERIC ASSESSMENT CRITERIA FOR POTABLE WATER SUPPLY PIPES

A range of pipe materials is available and careful selection, design and installation is required to ensure that water supply pipes are satisfactorily installed and meet the requirements of the Water Supply (Water Fittings) Regulations 1999 in England and Wales, the Byelaws 2000 in Scotland and the Northern Ireland Water Regulations. The regulations include a requirement to use only suitable materials when laying water pipes and laying water pipes without protection is not permitted at contaminated sites. The water supply company has a statutory duty to enforce the regulations.

Contaminants in the ground can pose a risk to human health by permeating potable water supply pipes. To fulfil their statutory obligation, UK water supply companies require robust evidence from developers to demonstrate either that the ground in which new plastic supply pipes will be laid is free from specific contaminants, or that the proposed remedial strategy will mitigate any existing risk. If these requirements cannot be demonstrated to the satisfaction of the relevant water company, it becomes necessary to specify an alternative pipe material on the whole development or in specific zones.

In 2010, UK Water Industry Research (UKWIR) published *Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites* (Report Ref. No. 10/WM/03/21). This report reviewed previously published industry guidelines and threshold concentrations adopted by individual water supply companies.

The focus of the UKWIR research project was to develop clear and concise procedures, which provide consistency in the pipe selection decision process. It was intended to provide guidance that can be used to ensure compliance with current regulations and to prevent water supply pipe failing prematurely due to the presence of contamination.

The report concluded that in most circumstances only organic contaminants pose a potential risk to plastic pipe materials and Table 3.1 of the report provides threshold concentrations for polyethylene (PE) and polyvinyl chloride (PVC) pipes for the organic contaminants of concern. The report also makes recommendations for the procedures to be adopted in the design of site investigations and sampling strategies, and the assessment of data, to ensure that the ground through which water supply pipes will be laid is adequately characterised.

Risks to water supply pipes have therefore been assessed against the threshold concentrations for PE and PVC pipe specified in Table 3.1 of Report 10/WM/03/21, which have been adopted as the GAC for this linkage and are reproduced in Table A3 below.

Since water supply pipes are typically laid at a minimum depth of 0.75m below finished ground levels, sample results from depths between 0.5m and 1.5m below finished level are generally considered suitable for assessing risks to water supply. Samples outside these depths can be

used, providing the stratum is the same as that in which water supply pipes are likely to be located. The report specifies that sampling should characterise the ground conditions to a minimum of 0.5m below the proposed depth of the pipe.

It should be noted that the assessment provided in this report is a guide and the method of assessment and recommendations should be checked with the relevant water supply company.

Table A3: Generic assessment criteria for water supply pipes

		Pipe material	
		GAC (mg/kg)	
	Parameter group	**PE**	**PVC**
1	Extended VOC suite by purge and trap or head space and GC-MS with TIC (Not including compounds within group 1a)	0.5	0.125
1a	• BTEX + MTBE	0.1	0.03
2	SVOCs TIC by purge and trap or head space and GC-MS with TIC (aliphatic and aromatic C_5–C_{10}) (Not including compounds within group 2e and 2f)	2	1.4
2e	• Phenols	2	0.4
2f	• Cresols and chlorinated phenols	2	0.04
3	Mineral oil C_{11}–C_{20}	10	Suitable
4	Mineral oil C_{21}–C_{40}	500	Suitable
5	Corrosive (conductivity, redox and pH)	Suitable	Suitable
Specific suite identified as relevant following site investigation			
2a	Ethers	0.5	1
2b	Nitrobenzene	0.5	0.4
2c	Ketones	0.5	0.02
2d	Aldehydes	0.5	0.02
6	Amines	Not suitable	Suitable
Notes: where indicated as ‘suitable’, the material is considered resistant to permeation or degradation and no threshold concentration has been specified by UKWIR.			

APPENDIX K
HAS-WASTE ASSESSMENT

envirolab

Haswaste, developed by Dr. Iain Haslock.

Site Code and Name										
TP/WS/BH			WS2	WS3	WS4	WS5	BH5	BH4	BH6	BH6	BH6
Depth (m)			0.30	0.20	0.20	0.20	0.40	0.10	0.30	1.20	2.00
Envirolab reference											
% Moisture		%									
pH (soil)			7.74	7.72	8.77	7.79	8.30	9.53	8.36	8.00	7.91
pH (leachate)											
Arsenic		mg/kg		17	18	17	15	6	25		19
Cadmium		mg/kg		2.3	2.6	2.2	1.9	1.1	2.4		2.8
Copper	updated v5.4e	mg/kg		36	13	54	19	12	90		124
CrVI or Chromium		mg/kg		21	18	24	19	14	19		26
Lead		mg/kg		138	41	179	39	40	520		297
Mercury		mg/kg		0.23	<0.17	0.29	0.31	0.34	0.63		0.76
Nickel		mg/kg		25	37	29	19	11	28		35
Selenium		mg/kg		1	1	1	1	1	1		2
Zinc		mg/kg		112	60	125	48	53	196		284
Barium		mg/kg									
Beryllium		mg/kg									
Vanadium		mg/kg									
Cobalt		mg/kg									
Manganese		mg/kg									
Molybdenum		mg/kg									
Antimony		mg/kg									
Aluminium		mg/kg									
Bismuth		mg/kg									
CrIII		mg/kg									
Iron		mg/kg									
Strontium		mg/kg									
Tellurium		mg/kg									
Thallium		mg/kg									
Titanium		mg/kg									
Tungsten		mg/kg									
Ammoniacal N		mg/kg									
ws Boron		mg/kg									
PAH (Input Total PAH **OR** individual PAH results)											
Acenaphthene		mg/kg		0.01	0.01	0.04	0.01	0.03	0.06		0.00
Acenaphthylene		mg/kg		0.02	0.06	0.14	0.03	0.02	0.19		0.02
Anthracene		mg/kg		0.03	0.07	0.20	0.04	0.07	0.35		0.09
Benzo(a)anthracene		mg/kg		0.33	0.80	2.04	0.38	0.50	5.19		0.57
Benzo(a)pyrene		mg/kg		0.41	1.10	2.96	0.53	0.66	5.03		0.66
Benzo(b)fluoranthene		mg/kg		0.41	1.10	3.14	0.51	0.65	7.67		0.68
Benzo(ghi)perylene		mg/kg		0.24	0.63	1.72	0.30	0.46	2.79		0.27
Benzo(k)fluoranthene		mg/kg		0.14	0.37	1.05	0.21	0.22	2.25		0.24
Chrysene		mg/kg		0.37	0.94	2.49	0.46	0.58	6.87		0.69
Dibenzo(ah)anthracene		mg/kg		0.06	0.14	0.33	0.07	0.10	0.65		0.07
Fluoranthene		mg/kg		0.53	1.35	3.85	0.64	0.79	9.44		1.30
Fluorene		mg/kg		0.01	0.01	0.05	<0.01	0.02	0.08		0.02
Indeno(123cd)pyrene		mg/kg		0.31	0.80	2.09	0.38	0.54	3.86		0.40
Naphthalene		mg/kg		0.03	0.03	0.03	0.03	0.03	0.03		0.03
Phenanthrene		mg/kg		0.16	0.29	0.94	0.19	0.27	1.89		0.42
Pyrene		mg/kg		0.50	1.28	3.69	0.61	0.74	8.72		1.10
Coronene		mg/kg									
Total PAHs (16 or 17)		mg/kg									
TPH											
Petrol		mg/kg									
Diesel		mg/kg									
Lube Oil		mg/kg									
Crude Oil	new v5.4e	mg/kg									
White Spirit / Kerosene		mg/kg									
Creosote		mg/kg									
Unknown TPH with ID		mg/kg		7.3	4.9	33.4	88.8	34.5	1,110.0		0.1
Unknown TPHCWG		mg/kg									
Total Sulphide		mg/kg									
Complex Cyanide		mg/kg									
Free (or Total) Cyanide		mg/kg									
Thiocyanate		mg/kg									
Elemental/Free Sulphur		mg/kg									
Phenols Input Total Phenols HPLC **OR** individual Phenol results.											
Phenol		mg/kg									
Cresols		mg/kg									
Xylenols		mg/kg									
Resourcinol		mg/kg									
Phenols Total by HPLC		mg/kg									
BTEX Input Total BTEX **OR** individual BTEX results.											
Benzene		mg/kg									
Toluene		mg/kg									
Ethylbenzene		mg/kg									
Xylenes		mg/kg									
Total BTEX		mg/kg									
PCBs (POPs)											
PCBs Total (eg EC7/WHO12)		mg/kg									
PBBs (POPs)											
Hexabromobiphenyl (Total or PBB153; 2,2',4,4',5,5'- if only available)		mg/kg									

envirolab

Haswaste, developed by Dr. Iain Haslock.

Site Code and Name									
TP/WS/BH		WS2	WS3	WS4	WS5	BH5	BH4	BH6	BH6	BH6
Depth (m)		0.30	0.20	0.20	0.20	0.40	0.10	0.30	1.20	2.00
Envirolab reference										
POPs Dioxins and Furans Input Total Dioxins and Furans **OR** individual Dioxin and Furan results.										
2,3,7,8-TeCDD	mg/kg									
1,2,3,7,8-PeCDD	mg/kg									
1,2,3,4,7,8-HxCDD	mg/kg									
1,2,3,6,7,8-HxCDD	mg/kg									
1,2,3,7,8,9-HxCDD	mg/kg									
1,2,3,4,6,7,8-HpCDD	mg/kg									
OCDD	mg/kg									
2,3,7,8-TeCDF	mg/kg									
1,2,3,7,8-PeCDF	mg/kg									
2,3,4,7,8-PeCDF	mg/kg									
1,2,3,4,7,8-HxCDF	mg/kg									
1,2,3,6,7,8-HxCDF	mg/kg									
2,3,4,6,7,8-HxCDF	mg/kg									
1,2,3,7,8,9-HxCDF	mg/kg									
1,2,3,4,6,7,8-HpCDF	mg/kg									
1,2,3,4,7,8,9-HpCDF	mg/kg									
OCDF	mg/kg									
Total Dioxins and Furans	mg/kg									
Some Pesticides (POPs unless otherwise stated)										
Aldrin	mg/kg									
α Hexachlorocyclohexane (alpha-HCH) *(leave empty if total HCH results used)*	mg/kg									
β Hexachlorocyclohexane (beta-HCH) *(leave empty if total HCH results used)*	mg/kg									
α Cis-Chlordane (alpha) ***OR*** *Total Chlordane*	mg/kg									
δ Hexachlorocyclohexane (delta-HCH) *(leave empty if total HCH results used)*	mg/kg									
Dieldrin	mg/kg									
Endrin	mg/kg									
χ Hexachlorocyclohexane (gamma-HCH) (lindane) ***OR*** *Total HCH*	mg/kg									
Heptachlor	mg/kg									
Hexachlorobenzene	mg/kg									
o,p'-DDT *(leave empty if total DDT results used)*	mg/kg									
p,p'-DDT ***OR*** *Total DDT*	mg/kg									
χ Trans-Chlordane (gamma) *(leave empty if total Chlordane results used)*	mg/kg									
Chlordecone (kepone)	mg/kg									
Pentachlorobenzene	mg/kg									
Mirex	mg/kg									
Toxaphene (camphechlor)	mg/kg									
Tin										
Tin *(leave empty if Organotin and Tin excl Organotin results used)*	mg/kg									
Organotin										
Dibutyltin; DiBT	mg/kg									
Tributyltin; TriBT	mg/kg									
Triphenyltin; TriPT	mg/kg									
Tetrabutyltin; TeBT	mg/kg									
Tin excluding Organotin										
Tin excl Organotin	mg/kg									

envirolab

Haswaste, developed by Dr. Iain Haslock.

Site Code and Name										
TP/WS/BH		WS2	WS3	WS4	WS5	BH5	BH4	BH6	BH6	BH6
Depth (m)		0.30	0.20	0.20	0.20	0.40	0.10	0.30	1.20	2.00
Envirolab reference										
Asbestos in Soil	Thresholds									
Asbestos detected in Soil (enter Y or N)	Y									
		Asbestos in Soil above is "Y", the soil is Hazardous Waste HP5 and HP7								
Asbestos % Composition in Soil (Matrix Loose Fibres or Microscopic Identifiable Pieces only)	see "Carc HP7 % Asbestos in Soil (Fibres)" below	%								
Carcinogenic HP7 % Asbestos in Soil (fibres or micro pieces)	≥0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
		If Asbestos in Soil above is "Y", but Asbestos % above is "<0.1%", the soil is Non Hazardous Waste. You can only use Asbestos % results where loose fibres or micro pieces are only present. You cannot use Asbestos % results when visual identifiable pieces are present.								
Asbestos Identifiable Pieces visible with the naked eye detected in the Soil (enter Y or N)	Y									

If visual identifiable pieces of asbestos are present, you cannot use Asbestos % results and the whole soil sample is Hazardous Waste HP5 and HP7 Construction material containing Asbestos 17 06 05. Therefore, if Asbestos in Soil above is "Y", the Asbestos % above is "<0.1%", but the Asbestos Identifiable Pieces visible with the naked eye is "Y", the soil is Hazardous Waste.

Identifiable Pieces are Cement, Fragments, Board, Rope etc. ie anything ACM that is not Loose Fibres.

All visual asbestos pieces need to be removed leaving only fibres (or micro pieces) with an Asbestos % Composition in Soil result of <0.1% for the soil to become non-hazardous waste.

Hazardous Property	Thresholds	Cut Off Value								
Corrosive HP8	≥5%	<1%	0.00000	0.00628	0.00583	0.00685	0.00563	0.00348	0.00695	0.00000	0.00750
Irritant HP4	≥10%	<1%	0.00000	0.00631	0.00385	0.00835	0.00413	0.00215	0.01347	0.00000	0.01652
Irritant HP4	≥20%	<1%	0.00000	0.00919	0.00911	0.01246	0.00607	0.00369	0.01695	0.00000	0.02125
Specifc Target Organ Toxicity HP5	≥1%		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥20%		0.00000	0.00002	0.00003	0.00009	0.00002	0.00003	0.00019	0.00000	0.00004
Specifc Target Organ Toxicity HP5	≥1%		0.00000	0.00505	0.00747	0.00586	0.00384	0.00269	0.00566	0.00000	0.00707
Specifc Target Organ Toxicity HP5	≥10%		0.00000	0.01400	0.00750	0.01790	0.00888	0.00663	0.11100	0.00000	0.03550
Aspiration Toxicity HP5	≥10%		0.00000	0.00073	0.00049	0.00334	0.00888	0.00345	0.11100	0.00000	0.00001
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.25%	<0.1%	0.00000	0.00227	#VALUE!	0.00227	0.00201	0.00083	0.00336	0.00000	0.00258
Acute Toxicity HP6	≥5%	<0.1%	0.00000	0.00417	0.00360	0.00475	0.00379	0.00283	0.00379	0.00000	0.00527
Acute Toxicity HP6	≥25%	<1%	0.00000	0.03722	0.02098	0.04620	0.01616	0.01442	0.09372	0.00000	0.08674
Acute Toxicity HP6	≥0.25%	<0.1%	0.00000	0.00002	#VALUE!	0.00003	0.00003	0.00003	0.00006	0.00000	0.00008
Acute Toxicity HP6	≥2.5%	<0.1%	0.00000	0.00403	0.00346	0.00461	0.00365	0.00269	0.00365	0.00000	0.00499
Acute Toxicity HP6	≥15%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥55%	<1%	0.00000	0.00023	0.00026	0.00022	0.00019	0.00011	0.00024	0.00000	0.00028
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.5%	<0.1%	0.00000	0.00429	#VALUE!	0.00486	0.00387	0.00283	0.00395	0.00000	0.00535
Acute Toxicity HP6	≥3.5%	<0.1%	0.00000	0.00014	0.00014	0.00014	0.00014	0.00014	0.00014	0.00000	0.00028
Acute Toxicity HP6	≥22.5%	<1%	0.00000	0.03692	0.02054	0.04549	0.01589	0.01420	0.09233	0.00000	0.08628
Carcinogenic HP7	≥0.1%		0.00000	0.01380	0.00747	0.01790	0.00390	0.00400	0.05200	0.00000	0.02970
Carcinogenic HP7	≥0.1%		0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000
Carcinogenic HP7	≥1%		0.00000	0.00003	0.00008	0.00021	0.00004	0.00005	0.00039	0.00000	0.00004
Carcinogenic HP7 Unknown TPH with ID	≥1,000mg/kg		0.00	7.30	4.90	33.40	88.80	34.50	1110.00	0.00	0.10
Carcinogenic HP7 b(a)p marker test (Unknown TPH with ID only)	≥0.01%		#DIV/0!	5.61644	22.44898	8.86228	0.59685	1.91304	0.45315	#DIV/0!	660.00000
pH Corrosive HP8 pH (soil or leachate)	H8 ≥11.5		7.74	7.72	8.77	7.79	8.30	9.53	8.36	8.00	7.91
pH Corrosive HP8 pH (soil or leachate)	H8 ≤2		7.74	7.72	8.77	7.79	8.30	9.53	8.36	8.00	7.91
Toxic for Reproduction HP10	≥0.3%		0.00000	0.01400	0.00750	0.01790	0.00600	0.00663	0.05200	0.00000	0.03550
Toxic for Reproduction HP10	≥3%		0.00000	0.00403	0.00346	0.00461	0.00888	0.00345	0.11100	0.00000	0.00499
Mutagenic HP11	≥0.1%		0.00000	0.00403	0.00346	0.00461	0.00365	0.00269	0.00365	0.00000	0.00499
Mutagenic HP11 Unknown TPH with ID	≥1,000mg/kg		0.00	7.30	4.90	33.40	88.80	34.50	1110.00	0.00	0.10
Mutagenic HP11 b(a)p marker test (Unknown TPH with ID only)	≥0.01%		#DIV/0!	5.61644	22.44898	8.86228	0.59685	1.91304	0.45315	#DIV/0!	660.00000
Mutagenic HP11	≥1%		0.00000	0.00505	0.00747	0.00586	0.00384	0.00222	0.00566	0.00000	0.00707
Produces Toxic Gases HP12 Sulphide	≥1,400mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Cyanide	≥1,200mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Thiocyanate	≥2,600mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HP13 Sensitising	≥10%		0.00000	0.00505	0.00747	0.00586	0.00384	0.00269	0.00566	0.00000	0.00707
Ecotoxic HP14	≥1.0	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	0.00000	0.17587	#VALUE!	0.22088	#VALUE!	0.07519	0.46292	0.00000	0.37997
Ecotoxic HP14	≥25%	<0.1%	0.00000	0.04391	#VALUE!	0.05498	#VALUE!	0.01848	0.10482	0.00000	0.09503
Ecotoxic HP14	≥25%	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	0.00000	0.04463	#VALUE!	0.05823	#VALUE!	0.02190	0.21563	0.00000	0.09500
Ecotoxic HP14 individual substance specific thresholds (Benzo(a)anthracene, Dibenz(ah)anthracene (or Total PAH if only used), Sn, TriPT)	≥0.0025%		0.000000	0.000033	0.000080	0.000204	0.000038	0.000050	0.000519	0.000000	0.000057

Table 3.1 of the CLP, CL Inventory, ATPs, IARC, Concawe, MSDSs, REACH + Pesticide Properties databases. Worst case REACH + MSDS's used for "*" STOT + Acute Toxicity.

Haswaste, developed by Dr. Iain Haslock.

Site Code and Name									
TP/WS/BH		WS2	WS3	WS4	WS5	BH5	BH4	BH6	BH6	BH6
Depth (m)		0.30	0.20	0.20	0.20	0.40	0.10	0.30	1.20	2.00
Envirolab reference										
Ecotoxic HP14 individual substance specific thresholds (Co, γ-HCH, DiBT, TriBT)	≥0.025%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Persistent Organic Pollutant (PCB, PBB or POP Pesticides)	>0.005%	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
Persistent Organic Pollutant (Total Dioxins+Furans)	>0.0000015%	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
Persistent Organic Pollutant (Individual Dioxins+Furans)	>0.0000015%	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000

If other contaminants need adding to Haswaste, please contact Envirolab.

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Haswaste, developed by Dr. Iain Haslock.

Site Code and Name										
TP/WS/BH			BH6	BH4	BH4	BH4	PH1	PH2	PH6	PH4	PH5
Depth (m)			3.00	0.50	1.00	2.00	1.30	1.40	1.30	0.30	0.40
Envirolab reference											
% Moisture		%									
pH (soil)			7.83	8.54	7.90	7.14					
pH (leachate)											
Arsenic		mg/kg	14		16	19				44	42
Cadmium		mg/kg	2.0		2.4	1.9				1.9	1.2
Copper	updated v5.4e	mg/kg	122		88	59				347	113
CrVI or Chromium		mg/kg	21		28	19				34	33
Lead		mg/kg	181		276	228				760	303
Mercury		mg/kg	0.99		0.75	0.48				1.81	1.34
Nickel		mg/kg	30		28	22				72	34
Selenium		mg/kg	4		1	1				2	1
Zinc		mg/kg	207		340	265				473	249
Barium		mg/kg									
Beryllium		mg/kg									
Vanadium		mg/kg									
Cobalt		mg/kg									
Manganese		mg/kg									
Molybdenum		mg/kg									
Antimony		mg/kg									
Aluminium		mg/kg									
Bismuth		mg/kg									
CrIII		mg/kg									
Iron		mg/kg									
Strontium		mg/kg									
Tellurium		mg/kg									
Thallium		mg/kg									
Titanium		mg/kg									
Tungsten		mg/kg									
Ammoniacal N		mg/kg									
ws Boron		mg/kg									
PAH (Input Total PAH **OR** individual PAH results)											
Acenaphthene		mg/kg	0.00		0.19	1.32				0.02	0.01
Acenaphthylene		mg/kg	0.07		0.06	0.59				0.17	0.05
Anthracene		mg/kg	0.06		0.48	3.99				0.17	0.05
Benzo(a)anthracene		mg/kg	1.35		2.95	18.50				1.28	0.37
Benzo(a)pyrene		mg/kg	1.58		3.02	18.80				1.79	0.47
Benzo(b)fluoranthene		mg/kg	1.65		3.87	19.70				2.64	0.70
Benzo(ghi)perylene		mg/kg	0.50		1.35	7.45				2.43	0.48
Benzo(k)fluoranthene		mg/kg	0.61		1.29	8.11				0.47	0.15
Chrysene		mg/kg	1.73		3.77	19.50				1.68	0.48
Dibenzo(ah)anthracene		mg/kg	0.15		0.34	1.71				0.26	0.05
Fluoranthene		mg/kg	2.93		8.97	44.60				2.14	0.65
Fluorene		mg/kg	<0.01		0.23	1.85				0.02	0.01
Indeno(123cd)pyrene		mg/kg	0.80		1.92	10.80				1.38	0.35
Naphthalene		mg/kg	0.03		0.03	0.25				0.09	0.04
Phenanthrene		mg/kg	0.54		1.81	16.60				0.50	0.21
Pyrene		mg/kg	2.62		7.52	41.00				2.01	0.61
Coronene		mg/kg									
Total PAHs (16 or 17)		mg/kg									
TPH											
Petrol		mg/kg									
Diesel		mg/kg									
Lube Oil		mg/kg									
Crude Oil	new v5.4e	mg/kg									
White Spirit / Kerosene		mg/kg									
Creosote		mg/kg									
Unknown TPH with ID		mg/kg	0.1		14.4	3.9	1,710.0	736.0	2,030.0	2.8	9.6
Unknown TPHCWG		mg/kg									
Total Sulphide		mg/kg									
Complex Cyanide		mg/kg									
Free (or Total) Cyanide		mg/kg									
Thiocyanate		mg/kg									
Elemental/Free Sulphur		mg/kg									
Phenols Input Total Phenols HPLC **OR** individual Phenol results.											
Phenol		mg/kg									
Cresols		mg/kg									
Xylenols		mg/kg									
Resourcinol		mg/kg									
Phenols Total by HPLC		mg/kg									
BTEX Input Total BTEX **OR** individual BTEX results.											
Benzene		mg/kg									
Toluene		mg/kg									
Ethylbenzene		mg/kg									
Xylenes		mg/kg									
Total BTEX		mg/kg									
PCBs (POPs)											
PCBs Total (eg EC7/WHO12)		mg/kg									
PBBs (POPs)											
Hexabromobiphenyl (Total or PBB153; 2,2',4,4',5,5'- if only available)		mg/kg									

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Site Code and Name									
TP/WS/BH	BH6	BH4	BH4	BH4	PH1	PH2	PH6	PH4	PH5
Depth (m)	3.00	0.50	1.00	2.00	1.30	1.40	1.30	0.30	0.40
Envirolab reference									
POPs Dioxins and Furans Input Total Dioxins and Furans **OR** individual Dioxin and Furan results.									
2,3,7,8-TeCDD	mg/kg								
1,2,3,7,8-PeCDD	mg/kg								
1,2,3,4,7,8-HxCDD	mg/kg								
1,2,3,6,7,8-HxCDD	mg/kg								
1,2,3,7,8,9-HxCDD	mg/kg								
1,2,3,4,6,7,8-HpCDD	mg/kg								
OCDD	mg/kg								
2,3,7,8-TeCDF	mg/kg								
1,2,3,7,8-PeCDF	mg/kg								
2,3,4,7,8-PeCDF	mg/kg								
1,2,3,4,7,8-HxCDF	mg/kg								
1,2,3,6,7,8-HxCDF	mg/kg								
2,3,4,6,7,8-HxCDF	mg/kg								
1,2,3,7,8,9-HxCDF	mg/kg								
1,2,3,4,6,7,8-HpCDF	mg/kg								
1,2,3,4,7,8,9-HpCDF	mg/kg								
OCDF	mg/kg								
Total Dioxins and Furans	mg/kg								
Some Pesticides (POPs unless otherwise stated)									
Aldrin	mg/kg								
α Hexachlorocyclohexane (alpha-HCH) *(leave empty if total HCH results used)*	mg/kg								
β Hexachlorocyclohexane (beta-HCH) *(leave empty if total HCH results used)*	mg/kg								
α Cis-Chlordane (alpha) ***OR*** *Total Chlordane*	mg/kg								
δ Hexachlorocyclohexane (delta-HCH) *(leave empty if total HCH results used)*	mg/kg								
Dieldrin	mg/kg								
Endrin	mg/kg								
χ Hexachlorocyclohexane (gamma-HCH) (lindane) ***OR*** *Total HCH*	mg/kg								
Heptachlor	mg/kg								
Hexachlorobenzene	mg/kg								
o,p'-DDT *(leave empty if total DDT results used)*	mg/kg								
p,p'-DDT ***OR*** *Total DDT*	mg/kg								
χ Trans-Chlordane (gamma) *(leave empty if total Chlordane results used)*	mg/kg								
Chlordecone (kepone)	mg/kg								
Pentachlorobenzene	mg/kg								
Mirex	mg/kg								
Toxaphene (camphechlor)	mg/kg								
Tin									
Tin *(leave empty if Organotin and Tin excl Organotin results used)*	mg/kg								
Organotin									
Dibutyltin; DiBT	mg/kg								
Tributyltin; TriBT	mg/kg								
Triphenyltin; TriPT	mg/kg								
Tetrabutyltin; TeBT	mg/kg								
Tin excluding Organotin									
Tin excl Organotin	mg/kg								

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Site Code and Name									
TP/WS/BH	BH6	BH4	BH4	BH4	PH1	PH2	PH6	PH4	PH5
Depth (m)	3.00	0.50	1.00	2.00	1.30	1.40	1.30	0.30	0.40
Envirolab reference									
Asbestos in Soil	Thresholds								
Asbestos detected in Soil (enter Y or N)	Y								
		Asbestos in Soil above is "Y", the soil is Hazardous Waste HP5 and HP7							
Asbestos % Composition in Soil (Matrix Loose Fibres or Microscopic Identifiable Pieces only)	see "Carc HP7 % Asbestos in Soil (Fibres)" below	%							
Carcinogenic HP7 % Asbestos in Soil (fibres or micro pieces)	≥0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
		If Asbestos in Soil above is "Y", but Asbestos % above is "<0.1%", the soil is Non Hazardous Waste. You can only use Asbestos % results where loose fibres or micro pieces are only present. You cannot use Asbestos % results when visual identifiable pieces are present.							
Asbestos Identifiable Pieces visible with the naked eye detected in the Soil (enter Y or N)	Y								

If visual identifiable pieces of asbestos are present, you cannot use Asbestos % results and the whole soil sample is Hazardous Waste HP5 and HP7 Construction material containing Asbestos 17 06 05. Therefore, if Asbestos in Soil above is "Y", the Asbestos % above is "<0.1%", but the Asbestos Identifiable Pieces visible with the naked eye is "Y", the soil is Hazardous Waste.

Identifiable Pieces are Cement, Fragments, Board, Rope etc. ie anything ACM that is not Loose Fibres.

All visual asbestos pieces need to be removed leaving only fibres (or micro pieces) with an Asbestos % Composition in Soil result of <0.1% for the soil to become non-hazardous waste.

Hazardous Property	Thresholds	Cut Off Value								
Corrosive HP8	≥5%	<1%	0.00588	0.00000	0.00749	0.00616	0.00000	0.00000	0.00000	0.01234	0.01188
Irritant HP4	≥10%	<1%	0.01563	0.00000	0.01206	0.00918	0.00000	0.00000	0.00000	0.04502	0.01831
Irritant HP4	≥20%	<1%	0.02018	0.00000	0.01661	0.01746	0.00000	0.00000	0.00000	0.05404	0.01973
Specifc Target Organ Toxicity HP5	≥1%		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥20%		0.00005	0.00000	0.00018	0.00166	0.00000	0.00000	0.00000	0.00005	0.00002
Specifc Target Organ Toxicity HP5	≥1%		0.00606	0.00000	0.00566	0.00444	0.00000	0.00000	0.00000	0.01454	0.00687
Specifc Target Organ Toxicity HP5	≥10%		0.02588	0.00000	0.04250	0.03313	0.17100	0.07360	0.20300	0.07600	0.03113
Aspiration Toxicity HP5	≥10%		0.00001	0.00000	0.00144	0.00039	0.17100	0.07360	0.20300	0.00028	0.00096
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.25%	<0.1%	0.00195	0.00000	0.00219	0.00256	0.00000	0.00000	0.00000	0.00599	0.00568
Acute Toxicity HP6	≥5%	<0.1%	0.00460	0.00000	0.00552	0.00379	0.00000	0.00000	0.00000	0.00681	0.00648
Acute Toxicity HP6	≥25%	<1%	0.06438	0.00000	0.08703	0.07343	0.00000	0.00000	0.00000	0.18936	0.08128
Acute Toxicity HP6	≥0.25%	<0.1%	0.00010	0.00000	0.00008	0.00005	0.00000	0.00000	0.00000	0.00018	0.00013
Acute Toxicity HP6	≥2.5%	<0.1%	0.00403	0.00000	0.00538	0.00365	0.00000	0.00000	0.00000	0.00653	0.00634
Acute Toxicity HP6	≥15%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥55%	<1%	0.00020	0.00000	0.00024	0.00019	0.00000	0.00000	0.00000	0.00019	0.00012
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.5%	<0.1%	0.00433	0.00000	0.00569	0.00389	0.00000	0.00000	0.00000	0.00690	0.00659
Acute Toxicity HP6	≥3.5%	<0.1%	0.00056	0.00000	0.00014	0.00014	0.00000	0.00000	0.00000	0.00028	0.00014
Acute Toxicity HP6	≥22.5%	<1%	0.06382	0.00000	0.08570	0.06704	0.00000	0.00000	0.00000	0.18888	0.08106
Carcinogenic HP7	≥0.1%		0.01810	0.00000	0.02760	0.02280	0.00000	0.00000	0.00000	0.07600	0.03030
Carcinogenic HP7	≥0.1%		0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000
Carcinogenic HP7	≥1%		0.00008	0.00000	0.00019	0.00108	0.00000	0.00000	0.00000	0.00014	0.00004
Carcinogenic HP7 Unknown TPH with ID	≥1,000mg/kg		0.10	0.00	14.40	3.90	**1710.00**	736.00	**2030.00**	2.80	9.60
Carcinogenic HP7 b(a)p marker test (Unknown TPH with ID only)	≥0.01%		1580.00000	#DIV/0!	20.97222	482.05128	0.00000	0.00000	0.00000	63.92857	4.89583
pH Corrosive HP8 pH (soil or leachate)	H8 ≥11.5		7.83	8.54	7.90	7.14	0.00	0.00	0.00	0.00	0.00
pH Corrosive HP8 pH (soil or leachate)	H8 ≤2		7.83	8.54	7.90	7.14	0.00	0.00	0.00	0.00	0.00
Toxic for Reproduction HP10	≥0.3%		0.02588	0.00000	0.04250	0.03313	0.00000	0.00000	0.00000	0.07600	0.03113
Toxic for Reproduction HP10	≥3%		0.00403	0.00000	0.00538	0.00365	0.17100	0.07360	0.20300	0.00653	0.00634
Mutagenic HP11	≥0.1%		0.00403	0.00000	0.00538	0.00365	0.00000	0.00000	0.00000	0.00653	0.00634
Mutagenic HP11 Unknown TPH with ID	≥1,000mg/kg		0.10	0.00	14.40	3.90	**1710.00**	736.00	**2030.00**	2.80	9.60
Mutagenic HP11 b(a)p marker test (Unknown TPH with ID only)	≥0.01%		1580.00000	#DIV/0!	20.97222	482.05128	0.00000	0.00000	0.00000	63.92857	4.89583
Mutagenic HP11	≥1%		0.00606	0.00000	0.00566	0.00444	0.00000	0.00000	0.00000	0.01454	0.00687
Produces Toxic Gases HP12 Sulphide	≥1,400mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Cyanide	≥1,200mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Thiocyanate	≥2,600mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HP13 Sensitising	≥10%		0.00606	0.00000	0.00566	0.00444	0.00000	0.00000	0.00000	0.01454	0.00687
Ecotoxic HP14	≥1.0	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	#VALUE!	0.00000	0.38876	0.36915	0.06840	0.02944	0.08120	0.81359	0.37536
Ecotoxic HP14	≥25%	<0.1%	#VALUE!	0.00000	0.09723	0.09391	0.00000	0.00000	0.00000	0.20342	0.09377
Ecotoxic HP14	≥25%	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	#VALUE!	0.00000	0.09849	0.09264	0.17100	0.07360	0.20300	0.20365	0.09470
Ecotoxic HP14 individual substance specific thresholds (Benzo(a)anthracene, Dibenz(ah)anthracene (or Total PAH if only used), Sn, TriPT)	≥0.0025%		0.000135	0.000000	0.000295	0.001850	0.000000	0.000000	0.000000	0.000128	0.000037

Table 3.1 of the CLP, CL Inventory, ATPs, IARC, Concawe, MSDSs, REACH + Pesticide Properties databases. Worst case REACH + MSDS's used for "*" STOT + Acute Toxicity.

Haswaste, developed by Dr. Iain Haslock.

Site Code and Name									
TP/WS/BH		BH6	BH4	BH4	BH4	PH1	PH2	PH6	PH4	PH5
Depth (m)		3.00	0.50	1.00	2.00	1.30	1.40	1.30	0.30	0.40
Envirolab reference										
Ecotoxic HP14 individual substance specific thresholds (Co, γ-HCH, DiBT, TriBT)	≥0.025%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Persistent Organic Pollutant (PCB, PBB or POP Pesticides)	>0.005%	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
Persistent Organic Pollutant (Total Dioxins+Furans)	>0.0000015%	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
Persistent Organic Pollutant (Individual Dioxins+Furans)	>0.0000015%	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000

If other contaminants need adding to Haswaste, please contac

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Haswaste, developed by Dr. Iain Haslock.

Site Code and Name										
TP/WS/BH			PH6	PH8	PH9	PH10	PH12	PH15	PH16		
Depth (m)			0.30	0.40	0.50	0.50	0.50	0.40	0.40		
Envirolab reference											
% Moisture		%									
pH (soil)											
pH (leachate)											
Arsenic		mg/kg	46	33	48	50	18	66	10		
Cadmium		mg/kg	2.0	2.3	2.2	1.7	1.2	2.1	0.5		
Copper	updated v5.4e	mg/kg	296	1,071	465	252	481	354	17		
CrVI or Chromium		mg/kg	42	31	33	55	28	36	11		
Lead		mg/kg	825	466	1,010	1,880	564	684	17		
Mercury		mg/kg	2.46	0.94	1.66	1.07	1.21	0.92	0.48		
Nickel		mg/kg	73	62	80	99	36	110	14		
Selenium		mg/kg	2	2	3	3	2	3	1		
Zinc		mg/kg	488	726	619	764	328	564	29		
Barium		mg/kg									
Beryllium		mg/kg									
Vanadium		mg/kg									
Cobalt		mg/kg									
Manganese		mg/kg									
Molybdenum		mg/kg									
Antimony		mg/kg									
Aluminium		mg/kg									
Bismuth		mg/kg									
CrIII		mg/kg									
Iron		mg/kg									
Strontium		mg/kg									
Tellurium		mg/kg									
Thallium		mg/kg									
Titanium		mg/kg									
Tungsten		mg/kg									
Ammoniacal N		mg/kg									
ws Boron		mg/kg									
PAH (Input Total PAH **OR** individual PAH results)											
Acenaphthene		mg/kg	0.04	0.71	0.03	0.38	0.28	0.05	0.01		
Acenaphthylene		mg/kg	0.28	3.16	0.12	0.15	2.38	0.24	0.01		
Anthracene		mg/kg	0.20	8.46	0.11	0.58	2.14	0.23	0.01		
Benzo(a)anthracene		mg/kg	2.23	39.90	0.90	2.79	19.70	1.91	0.01		
Benzo(a)pyrene		mg/kg	3.07	36.20	1.23	2.33	28.80	2.26	0.01		
Benzo(b)fluoranthene		mg/kg	3.98	44.49	1.62	3.11	34.90	2.87	0.01		
Benzo(ghi)perylene		mg/kg	3.49	22.40	1.35	2.32	25.70	2.39	0.01		
Benzo(k)fluoranthene		mg/kg	0.63	11.00	0.26	0.46	7.29	0.43	0.01		
Chrysene		mg/kg	2.61	33.50	1.06	2.80	19.40	2.12	0.01		
Dibenzo(ah)anthracene		mg/kg	0.41	4.83	0.15	0.31	3.91	0.30	0.01		
Fluoranthene		mg/kg	3.93	74.30	1.51	7.12	35.30	3.44	0.01		
Fluorene		mg/kg	0.04	2.82	0.02	0.27	0.49	0.04	0.01		
Indeno(123cd)pyrene		mg/kg	1.90	18.30	0.82	1.39	18.00	1.42	0.01		
Naphthalene		mg/kg	0.06	0.67	1.70	0.09	0.63	0.10	0.01		
Phenanthrene		mg/kg	0.82	34.80	0.39	3.43	7.76	0.85	0.01		
Pyrene		mg/kg	3.94	61.20	1.45	5.95	37.60	3.24	0.01		
Coronene		mg/kg									
Total PAHs (16 or 17)		mg/kg									
TPH											
Petrol		mg/kg									
Diesel		mg/kg									
Lube Oil		mg/kg									
Crude Oil	new v5.4e	mg/kg									
White Spirit / Kerosene		mg/kg									
Creosote		mg/kg									
Unknown TPH with ID		mg/kg	21.4	180.0	8.0	17.8	60.9	18.3	0.1		
Unknown TPHCWG		mg/kg									
Total Sulphide		mg/kg									
Complex Cyanide		mg/kg									
Free (or Total) Cyanide		mg/kg									
Thiocyanate		mg/kg									
Elemental/Free Sulphur		mg/kg									
Phenols Input Total Phenols HPLC **OR** individual Phenol results.											
Phenol		mg/kg									
Cresols		mg/kg									
Xylenols		mg/kg									
Resourcinol		mg/kg									
Phenols Total by HPLC		mg/kg									
BTEX Input Total BTEX **OR** individual BTEX results.											
Benzene		mg/kg									
Toluene		mg/kg									
Ethylbenzene		mg/kg									
Xylenes		mg/kg									
Total BTEX		mg/kg									
PCBs (POPs)											
PCBs Total (eg EC7/WHO12)		mg/kg									
PBBs (POPs)											
Hexabromobiphenyl (Total or PBB153; 2,2',4,4',5,5'- if only available)		mg/kg									

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Site Code and Name									
TP/WS/BH		PH6	PH8	PH9	PH10	PH12	PH15	PH16		
Depth (m)		0.30	0.40	0.50	0.50	0.50	0.40	0.40		
Envirolab reference										
POPs Dioxins and Furans Input Total Dioxins and Furans **OR** individual Dioxin and Furan results.										
2,3,7,8-TeCDD	mg/kg									
1,2,3,7,8-PeCDD	mg/kg									
1,2,3,4,7,8-HxCDD	mg/kg									
1,2,3,6,7,8-HxCDD	mg/kg									
1,2,3,7,8,9-HxCDD	mg/kg									
1,2,3,4,6,7,8-HpCDD	mg/kg									
OCDD	mg/kg									
2,3,7,8-TeCDF	mg/kg									
1,2,3,7,8-PeCDF	mg/kg									
2,3,4,7,8-PeCDF	mg/kg									
1,2,3,4,7,8-HxCDF	mg/kg									
1,2,3,6,7,8-HxCDF	mg/kg									
2,3,4,6,7,8-HxCDF	mg/kg									
1,2,3,7,8,9-HxCDF	mg/kg									
1,2,3,4,6,7,8-HpCDF	mg/kg									
1,2,3,4,7,8,9-HpCDF	mg/kg									
OCDF	mg/kg									
Total Dioxins and Furans	mg/kg									
Some Pesticides (POPs unless otherwise stated)										
Aldrin	mg/kg									
α Hexachlorocyclohexane (alpha-HCH) *(leave empty if total HCH results used)*	mg/kg									
β Hexachlorocyclohexane (beta-HCH) *(leave empty if total HCH results used)*	mg/kg									
α Cis-Chlordane (alpha) ***OR*** *Total Chlordane*	mg/kg									
δ Hexachlorocyclohexane (delta-HCH) *(leave empty if total HCH results used)*	mg/kg									
Dieldrin	mg/kg									
Endrin	mg/kg									
χ Hexachlorocyclohexane (gamma-HCH) (lindane) ***OR*** *Total HCH*	mg/kg									
Heptachlor	mg/kg									
Hexachlorobenzene	mg/kg									
o,p'-DDT *(leave empty if total DDT results used)*	mg/kg									
p,p'-DDT ***OR*** *Total DDT*	mg/kg									
χ Trans-Chlordane (gamma) *(leave empty if total Chlordane results used)*	mg/kg									
Chlordecone (kepone)	mg/kg									
Pentachlorobenzene	mg/kg									
Mirex	mg/kg									
Toxaphene (camphechlor)	mg/kg									
Tin										
Tin *(leave empty if Organotin and Tin excl Organotin results used)*	mg/kg									
Organotin										
Dibutyltin; DiBT	mg/kg									
Tributyltin; TriBT	mg/kg									
Triphenyltin; TriPT	mg/kg									
Tetrabutyltin; TeBT	mg/kg									
Tin excluding Organotin										
Tin excl Organotin	mg/kg									

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Site Code and Name									
TP/WS/BH		PH6	PH8	PH9	PH10	PH12	PH15	PH16		
Depth (m)		0.30	0.40	0.50	0.50	0.50	0.40	0.40		
Envirolab reference										
Asbestos in Soil	Thresholds									
Asbestos detected in Soil (enter Y or N)	Y									
		Asbestos in Soil above is "Y", the soil is Hazardous Waste HP5 and HP7								
Asbestos % Composition in Soil (Matrix Loose Fibres or Microscopic Identifiable Pieces only)	see "Carc HP7 % Asbestos in Soil (Fibres)" below	%								
Carcinogenic HP7 % Asbestos in Soil (fibres or micro pieces)	≥0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
		If Asbestos in Soil above is "Y", but Asbestos % above is "<0.1%", the soil is Non Hazardous Waste. You can only use Asbestos % results where loose fibres or micro pieces are only present. You cannot use Asbestos % results when visual identifiable pieces are present.								
Asbestos Identifiable Pieces visible with the naked eye detected in the Soil (enter Y or N)	Y									

If visual identifiable pieces of asbestos are present, you cannot use Asbestos % results and the whole soil sample is Hazardous Waste HP5 and HP7 Construction material containing Asbestos 17 06 05. Therefore, if Asbestos in Soil above is "Y", the Asbestos % above is "<0.1%", but the Asbestos Identifiable Pieces visible with the naked eye is "Y", the soil is Hazardous Waste.

Identifiable Pieces are Cement, Fragments, Board, Rope etc. ie anything ACM that is not Loose Fibres.

All visual asbestos pieces need to be removed leaving only fibres (or micro pieces) with an Asbestos % Composition in Soil result of <0.1% for the soil to become non-hazardous waste.

Hazardous Property	Thresholds	Cut Off Value								
Corrosive HP8	≥5%	<1%	0.01414	0.01031	0.01267	0.01716	0.00775	0.01562	0.00343	0.00000	0.00000
Irritant HP4	≥10%	<1%	0.03952	0.12538	0.05888	0.03508	0.05673	0.04871	0.00324	0.00000	0.00000
Irritant HP4	≥20%	<1%	0.04872	0.14438	0.06892	0.04952	0.06664	0.06268	0.00475	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥1%		0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥20%		0.00008	0.00348	0.00004	0.00034	0.00078	0.00009	0.00000	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥1%		0.01475	0.01252	0.01616	0.02000	0.00727	0.02222	0.00283	0.00000	0.00000
Specifc Target Organ Toxicity HP5	≥10%		0.08250	0.09075	0.10100	0.18800	0.05640	0.07050	0.00363	0.00000	0.00000
Aspiration Toxicity HP5	≥10%		0.00214	0.01800	0.00080	0.00178	0.00609	0.00183	0.00001	0.00000	0.00000
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.25%	<0.1%	0.00632	0.00445	0.00650	0.00671	0.00250	0.00880	0.00137	0.00000	0.00000
Acute Toxicity HP6	≥5%	<0.1%	0.00835	0.00623	0.00676	0.01098	0.00566	0.00734	0.00225	0.00000	0.00000
Acute Toxicity HP6	≥25%	<1%	0.19240	0.28242	0.24767	0.33322	0.16375	0.20180	0.01013	0.00000	0.00000
Acute Toxicity HP6	≥0.25%	<0.1%	0.00025	0.00009	0.00017	0.00011	0.00012	0.00009	0.00005	0.00000	0.00000
Acute Toxicity HP6	≥2.5%	<0.1%	0.00806	0.00595	0.00634	0.01056	0.00538	0.00691	0.00211	0.00000	0.00000
Acute Toxicity HP6	≥15%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥55%	<1%	0.00020	0.00023	0.00022	0.00017	0.00012	0.00021	0.00005	0.00000	0.00000
Acute Toxicity HP6	≥0.1%	<0.1%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Acute Toxicity HP6	≥0.5%	<0.1%	0.00851	0.00628	0.00672	0.01084	0.00562	0.00721	0.00221	0.00000	0.00000
Acute Toxicity HP6	≥3.5%	<0.1%	0.00028	0.00028	0.00042	0.00042	0.00028	0.00042	0.00014	0.00000	0.00000
Acute Toxicity HP6	≥22.5%	<1%	0.19169	0.27090	0.24708	0.33197	0.15903	0.20112	0.01007	0.00000	0.00000
Carcinogenic HP7	≥0.1%		0.08250	0.04660	**0.10100**	**0.18800**	0.05640	0.06840	0.00283	0.00000	0.00000
Carcinogenic HP7	≥0.1%		0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000	0.000000000
Carcinogenic HP7	≥1%		0.00019	0.00183	0.00017	0.00014	0.00180	0.00014	0.00000	0.00000	0.00000
Carcinogenic HP7 Unknown TPH with ID	≥1,000mg/kg		21.40	180.00	8.00	17.80	60.90	18.30	0.10	0.00	0.00
Carcinogenic HP7 b(a)p marker test (Unknown TPH with ID only)	≥0.01%		14.34579	20.11111	15.37500	13.08989	47.29064	12.34973	10.00000	#DIV/0!	#DIV/0!
pH Corrosive HP8 pH (soil or leachate)	H8 ≥11.5		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
pH Corrosive HP8 pH (soil or leachate)	H8 ≤2		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Toxic for Reproduction HP10	≥0.3%		0.08250	0.09075	0.10100	0.18800	0.05640	0.07050	0.00363	0.00000	0.00000
Toxic for Reproduction HP10	≥3%		0.00806	0.01800	0.00634	0.01056	0.00609	0.00691	0.00211	0.00000	0.00000
Mutagenic HP11	≥0.1%		0.00806	0.00595	0.00634	0.01056	0.00538	0.00691	0.00211	0.00000	0.00000
Mutagenic HP11 Unknown TPH with ID	≥1,000mg/kg		21.40	180.00	8.00	17.80	60.90	18.30	0.10	0.00	0.00
Mutagenic HP11 b(a)p marker test (Unknown TPH with ID only)	≥0.01%		14.34579	20.11111	15.37500	13.08989	47.29064	12.34973	10.00000	#DIV/0!	#DIV/0!
Mutagenic HP11	≥1%		0.01475	0.01252	0.01616	0.02000	0.00727	0.02222	0.00283	0.00000	0.00000
Produces Toxic Gases HP12 Sulphide	≥1,400mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Cyanide	≥1,200mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Produces Toxic Gases HP12 Thiocyanate	≥2,600mg/kg		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HP13 Sensitising	≥10%		0.01475	0.01252	0.01616	0.02000	0.00727	0.02222	0.00283	0.00000	0.00000
Ecotoxic HP14	≥1.0	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	0.83694	**1.27064**	**1.04712**	**1.41145**	0.75809	0.87837	0.05504	0.00000	0.00000
Ecotoxic HP14	≥25%	<0.1%	0.20910	0.31934	0.26174	0.35303	0.18969	0.21949	0.01376	0.00000	0.00000
Ecotoxic HP14	≥25%	<0.1% (except CompCN + Thiocyanate + Xylene + BTEX 1%).	0.21116	0.33386	0.26250	0.35447	0.19500	0.22124	0.01377	0.00000	0.00000
Ecotoxic HP14 individual substance specific thresholds (Benzo(a)anthracene, Dibenz(ah)anthracene (or Total PAH if only used), Sn, TriPT)	≥0.0025%		0.000223	**0.003990**	0.000090	0.000279	0.001970	0.000191	0.000001	0.000000	0.000000

Table 3.1 of the CLP, CL Inventory, ATPs, IARC, Concawe, MSDSs, REACH + Pesticide Properties databases. Worst case REACH + MSDS's used for "*" STOT + Acute Toxicity.

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Site Code and Name									
TP/WS/BH		PH6	PH8	PH9	PH10	PH12	PH15	PH16		
Depth (m)		0.30	0.40	0.50	0.50	0.50	0.40	0.40		
Envirolab reference										
Ecotoxic HP14 individual substance specific thresholds (Co, γ-HCH, DiBT, TriBT)	≥0.025%	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Persistent Organic Pollutant (PCB, PBB or POP Pesticides)	>0.005%	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
Persistent Organic Pollutant (Total Dioxins+Furans)	>0.0000015%	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000
Persistent Organic Pollutant (Individual Dioxins+Furans)	>0.0000015%	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000	0.0000000000

If other contaminants need adding to Haswaste, please contac