



Intégrale

Understanding Ground Conditions

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Proposed Residential Conversion
Down Farm
The Pry
Purton
Swindon
Wiltshire, SN5 4JP

PHASE II CONTAMINATION REPORT

REPORT NO. 8830, December 2017

GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

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Proposed Residential Conversion
Phase II Contamination Report
Down Farm
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Wiltshire, SN5 4JP

Client: Mr F. J. Cremin

Intégrale Report No. 8830, December 2017

		Signature/Date
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CONFIDENTIALITY STATEMENT

This report is addressed to and may be relied upon by the following:

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LIST OF CONTENTS

- EXECUTIVE SUMMARY -

1.0	INTRODUCTION	1
2.0	THE SITE	2
2.1	Location and Description	2
2.2	Published Geology	2
2.2.1	British Geological Survey Mapping	2
2.2.2	BGS Previous Investigation Records	2
2.3	Previous Desk Study Assessment	3
2.3.1	Extracts from Hydrock Report	3
2.3.2	Review of Conceptual Model	4
2.4	Proposed Redevelopment	4
3.0	GROUND INVESTIGATION	5
3.1	Trial Pitting	5
3.2	Groundwater and Soils Gas Standpipe Installations and Monitoring	5
3.3	Geotechnical Laboratory Testing	5
3.4	Contamination Analyses	5
3.5	Referencing	5
4.0	GROUND & GROUNDWATER CONDITIONS	6
4.1	Summary of Strata Encountered	6
4.2	Strata Properties	6
4.2.1	Topsoil	6
4.2.2	Made Ground	6
4.2.3	Variably Weathered Oxford Clay	7
4.3	Groundwater	8
4.4	Ground Gas	8
5.0	GEOTECHNICAL CONSIDERATIONS	9
5.1	General	9
5.2	Site Preparation & Earthworks	9
5.3	Foundations & Ground Floor Slabs	9
5.4	Pavement Design	9
5.5	Earth Pressures & Retaining Walls	9
5.6	Protection of Buried Concrete	10
5.7	Slope Stability	10
6.0	GENERIC QUANTITATIVE CONTAMINATION ASSESSMENT	11
6.1	General	11
6.1.1	Generic Human Health Assessment	11
6.2	Summary of Soils Results with Respect to Phytotoxicity	11
6.3	Summary of Soils Results with Respect to WRAS	12
6.4	Controlled Waters	12
6.4.1	Conceptual Model	12
6.5	Gas Mitigation	12
6.6	Conceptual Exposure Model & Risk Assessment	13
6.7	Recommendations	13

6.7.1	For Protection of Human Health	13
6.7.2	For Protection of Building Materials & Services	13
6.7.3	For Protection of New Vegetation	13
6.7.4	Reuse and Disposal of Surplus Spoil	14
6.7.5	Recommended Further Specification	14

FIGURES

1. Site Plan
2. Tentative Geological Cross-Section

APPENDICES

- A. Site Location
- B. Site Description / Photographs
- C. Desk Study Information
- D. Trial Pits
- E. Gas & Groundwater Monitoring
- F. Results of Geotechnical Laboratory Testing
- G. Results of Contamination Analyses
- H. Proposed Redevelopment

EXECUTIVE SUMMARY **8830 – Down Farm, Purton**

Mr F. J. Cremin is proposing to convert an existing storage building into 2 No. residential dwellings.

The geology map reports Oxford Clay (unproductive Aquifer) beneath the entire site, with a siltstone (Secondary A Aquifer) lens, upslope and nearby to the southwest.

A previous geoenvironmental desk study identified that the site appears to have been used for agriculture since 1900. By 1970, the current building has been constructed, with various subsequent constructions/redevelopments adjacent. By 2006, the northern area appears to have been upfilled to form the level storage and parking area. The nearest surface water receptor is a pond approximately 140m to the east. A tributary of the River Ray is reported 350m southeast. There are no groundwater or surface water abstractions licences within 2km of the site.

Intrusive investigation by mechanical trial pitting has established that the existing building lies within slight (0.5-1m) cutting into firm becoming stiff variably Weathered Oxford Clay. A mantle of variable Made Ground has been identified beyond the building, thickening across the northern area confirming previous upfilling to form the level area. The groundwater table has not been encountered within 2-2.5m investigated. Perched water was locally encountered within Made Ground at one location.

The generic screening assessment has identified two areas of elevated polyaromatic hydrocarbons within the Made Ground. One of these locations also has chrysotile asbestos fibres/clumps identified.

Contamination assessment concludes that, following site strip:

- 600mm of clean subsoil/topsoil cover is required for soft landscaping.
- Validation tests should be completed on soft landscaping formations following excavations to confirm appropriate removal of asbestos impacted soils.
- New water pipes require protection.
- No Radon or gas protection measures are indicated.

1.0 INTRODUCTION

Mr F. J. Cremin is proposing to convert an existing storage building into 2 No. residential dwellings. The planning consultants are LPC Trull Limited.

A Geoenvironmental Desk Study was previously completed by Hydrock Consultants Limited (Ref: R/13144/001) in 2013 for a previous planning application for a larger redevelopment of Down Farm; the current site formed the eastern part of that study area. Recommendations for intrusive investigation were given.

The planning consultant submitted that desk study to Wiltshire Council to discharge the Prior Notification condition (Ref. 17/04998/PNCOU) relating to contaminated land; however the Environmental Health Officer concluded that a ground investigation would need to be undertaken to allow discharge of the condition.

Intégrale Limited (*Intégrale*) are commissioned to undertake a ground investigation and complete a Phase II Contamination Report. The investigation scope was based on the 2013 desk study recommendations.

This interpretative report summarises the previous desk study, describes the scope of fieldworks, laboratory investigations and monitoring, and discusses the ground and groundwater conditions encountered. Preliminary guidance on geotechnical aspects is also provided.

The results of contamination analyses and generic quantitative risk assessment are reported and used to establish an updated conceptual model of pollutant linkages. Potential implications for the development are discussed and recommendations for potential remedial works are given.

2.0 THE SITE

2.1 Location and Description

As shown in Appendix A, the site is located within the curtilage of Down Farm, The Pry, Purton, Swindon. It has an approximate central Ordnance Survey Grid Reference of SU 103 892, and postcode SN5 4JP.

Notes describing the site were prepared during the site visit and are included as Appendix B, together with typical photographs. The main features and pertinent aspects on the site and immediately adjacent land are summarised below, and annotated on Figure 1:

Current Use	Domestic storage building and storage yard for adjacent joinery workshop.
Site Area & Plan Shape	c.0.15 Hectares. Irregular shape.
Maximum Dimensions	c. 65m (NNE-SSW) x 10-40m (W-E).
Ground Slopes & Topography	Approximately 95m AOD. The site slopes very gently down to the N, and forms an upper plateau area for storage. Approximately 5m to the N and E of the site lies the crest of the bank, which steeply (1 on 1) slopes down to the adjacent land along the northern and eastern boundaries.
Buildings & Condition	Single storey, steel frame with masonry infill. Visually good condition. Solid concrete floor with no cracks or distress. Joinery workshop adjacent to the west is similar construction. Existing Barn Conversion (Cottage A) adjacent to the SW corner (off-site)
Surfacings & Condition	Predominantly compacted gravel with some areas of asphalt. Across the northern area. Concrete slab to the W of the building. Soft landscaping to south and southeast of the existing building.
Vegetation & Trees	None.
Water Courses	Tributary to the River Rey 350m SE.
Site Boundary Features	W – Masonry retaining wall and residential Cottage A & Workshop in southern half of site. No physical boundary in northern half. N & E – No physical boundary. Crest of bank c.5m remote. S – access road.
Contamination Issues	Potential range of contaminants in upfilled northern area. Bonfires. Nearby above ground fuel tanks.
Geotechnical Issues	Re-use of existing foundations and ground slabs if inadequately founded. Potential for thick Made Ground in the N.

2.2 Published Geology

2.2.1 British Geological Survey Mapping

BGS geological maps indicate the following strata beneath and adjacent to the site:

Map / Scale	Sheet 252 (Swindon) at 1:50,000 scale.
BGS On-Line Viewer	Viewed 3 rd November 2017.
Artificial Ground	None.
Superficial Deposits	None.
Solid Geology	Oxford Clay of Jurassic age. A subordinate lens within the Oxford Clay is mapped nearby to the south. The 1974 geological sheet lists this lens as Sand, whilst the online BGS viewer and Hydrock report the lens to be siltstone.
Geological Features	None.

2.2.2 BGS Previous Investigation Records

There are no previous investigation records available on the BGS website under the Open Government Licence within 500m of the site.

2.3 Previous Desk Study Assessment

2.3.1 Extracts from Hydrock Report

In April 2013, Hydrock Consultants Limited completed a Phase I Desk study and site walk-over on behalf of Mr Cremin for a previous residential redevelopment scheme proposed at that time. The 2013 study area was larger than the current site boundary, which formed the eastern part of that area. That scheme comprised the demolition of the existing buildings and construction of 4 No. dwellings. A copy of that report is included in Appendix C, but pertinent information is summarised below:

- Two outbuildings were noted across the larger area with possible asbestos sheet roofing. Hydrock's 'western building' lies within the current site boundary, and was being used as a workshop for carpentry and joinery activities. The eastern building lies adjacent to the current western site boundary, and previously used for general storage of both domestic and commercial items including lawnmowers, a classic car, general building machinery, and a JCB excavator. Some staining was recorded on the concrete floor beneath the JCB.
- A domestic sewerage treatment unit was observed adjacent to the west of the current site.
- 2 No. above ground fuel tanks were recorded to the west and southwest of the current site boundaries. No evidence for spills/leaks were noted.
- The site lies at approximately 95mAOD, with a slight slope up to the north. There is a short, steep slope down the northern and an eastern boundary, which was suggested, could be a filled slope.
- The historical maps were briefly reassessed for the current site:
In 1875, the site is largely covered with trees, an open field forms the southern area. Down Farm and associated outbuildings lie adjacent to the west. By 1900, the trees had been cut back in the northernmost area now forming a new open field. A small building was constructed adjacent to the southwest corner. By 1970, the eastern building had been constructed replacing the wood/orchard. A smaller outbuilding is shown in the northeast corner; by the early 1990s, this building had been demolished. The western outbuilding had also been constructed adjacent to the west. By 2006, the northern part has been upfilled forming the present layout.
- Hydrock concluded that "...the site has had some small scale development, however there is no evidence of industrial or potentially contaminative land use on or adjacent to the site...".
- The underlying Oxford Clay (mudstone) is defined as an Unproductive Aquifer. The siltstone bed adjacent to the southwest is defined as a Secondary A Aquifer. The site does not lie within a Source Protection Zone.
- There are no surface water courses recorded on site. Hydrock report various ponds, the closest being approximately 140m to the east. A tributary of the River Ray is reported 350m southeast, and the River Ray 750m east.
- There are no groundwater or surface water abstractions licences within 2km of the site.
- There are no former or operational landfills within 250m of the site boundary, the nearest reported is c.350m to the east.
- There is no hazard of compressible ground, dissolution of soluble strata, or running sand. Collapsible ground stability hazard was reported as 'very low' while shrink swell of clay strata was identified as a moderate risk.
- No radon protective measures were reported to be required.

The following potential sources of contamination were identified across the current site area:

- Made Ground from potential raising of site levels in the northern area.
- Asbestos in existing building.
- Hydrocarbon fuels & lubricant associated with the workshop
- Made Ground possibly including metals, metalloids, asbestos, PAH and petroleum hydrocarbons.
- PAHs associated with the burning of waste.
- Ground gases from potentially deep Made Ground.
- Elevated metals within natural soils.

The 2013 report identified two above ground fuel tanks, domestic sewerage treatment unit and a vegetable patch as a potential source. These are located outside of the current site boundary, and are now

considered potential offsite sources. The vegetable patch and sewerage treatment unit are down gradient of the site and too remote to pose a risk to the current site.

Hydrock identify the following receptors:

- Humans (neighbours, site users)
- Development end use (buildings, utilities and landscaping)
- Secondary A Aquifer adjacent to the southwest
- Surface water receptors (Pond, 140m east and tributary of River Ray, 350m southeast).

Hydrock identify the following potential pathways:

- Humans: Ingestion, skin contact, inhalation
- Buildings: Direct contact, ingress via permeable soils and/or construction gaps
- Underlying groundwater: migration of contaminant via leaching through the unsaturated zone
- Surface water: overland flow, drainage discharge, base flow from groundwater.

2.3.2 Review of Conceptual Model

Although Hydrock identify the above ground fuel tanks, domestic sewerage treatment unit and a vegetable patch as potential sources of contamination, these are located outside of the current site boundary, and are now considered potential offsite sources

In addition, the domestic vegetable patch and sewerage treatment unit are down gradient and too remote to pose a realistic risk to the current site.

The underlying Oxford Clay is defined as an unproductive aquifer and therefore not a controlled waters receptor. Hydrock identify that a Secondary A Aquifer lies adjacent to the southwest, however, this is upslope of the site and its likely hydraulic gradient, and therefore not considered at risk. The aquifer is not laterally continuous and unlikely to be in connection with any surface water receptors given the distance and extent of relatively impermeable Oxford Clay between. Similarly, the surface water receptors are at least 140m remote from the site and therefore not considered at risk. There are no groundwater or surface water abstraction licences within 2km of the site.

These observations and comments have been used to update the conceptual model, which is discussed in Section 6.0.

2.4 Proposed Redevelopment

The proposed redevelopment is the subject of prior notification 17/04998/PNCOU. Details of the proposed redevelopment are shown on drawings No. LPC/4166/SD1/I & 2 given in Appendix H.

In summary, the redevelopment will comprise:

- Conversion of existing Building into 2 No. single storey terraced-type residential dwellings.
- Hardstanding car parking will be provided across the majority of the northern area with access via the existing lane to the southeast.
- Soft landscaping is proposed around the building and to the north, east and west of the car parking area.

According to the developer, the existing concrete ground floor slab and foundations will be retained and used for the conversion with some minor refurbishment. No new foundations or below ground structure is anticipated.

3.0 GROUND INVESTIGATION

In view of the anticipated ground conditions, current site layout and proposed redevelopment, the following scope of investigation was completed.

3.1 Trial Pitting

8 No. trial pits were mechanically excavated using a JCB excavator on 21st November 2017. The trial pit locations, chosen by Intégrale, are shown on Figure 1 and were referenced as TPI-TP8. TP7 was excavated using hand tools due to anecdotal and detected nearby buried services. The general procedures adopted during trial pitting, together with the detailed trial pit records are included in Appendix D.

3.2 Groundwater and Soils Gas Standpipe Installations and Monitoring

Standpipes were installed in TPs 2, 6 and 8, typically to between 1.7m and 2.5m depth, details are given on the trial pit records. Monitoring has been undertaken on 3 No. occasions and the results are included in Appendix E, together with the general procedures adopted for installing standpipes.

3.3 Geotechnical Laboratory Testing

A schedule of complementary soils testing was prepared by Intégrale. The classification tests were completed in accordance with BS 1377 (1990) by CJA Geotechnical Limited and the results are provided in Appendices F, respectively, and the following shows the testing strategy:

Location	Depth (m)	Stratum	Testing	Criteria for test selection
TP4	0.8	Weathered Oxford Clay	BRE (reduced suite)	Current bearing stratum.
TP4	0.9		Atterberg limits, moisture content.	Current bearing stratum.

3.4 Contamination Analyses

In view of the desk study and fieldwork findings, a schedule of soils analyses was prepared. The analyses were completed by Chemtest Limited, and the results are provided in Appendix G. The following shows the testing strategy:

Location	Depth (m)	Stratum	Testing	Criteria for test selection
TPI	0.1	Made Ground	Generic suite.	Location of bonfire remains.
TPI	1.2		Generic suite, total TPH.	
TP2	0.25		Generic suite, total TPH, asbestos screen.	Upfilled area. Human health risk assessment.
TP2	1.2		Generic suite, TPH CWG, asbestos screen.	
TP3	0.4		Generic suite, TPH CWG	Site boundary with offsite above ground fuel tank.
TP4	1.0	Weathered Oxford Clay	Generic suite, total TPH	Adjacent to proposed conversion.
TP5	1.1		Generic suite, TPH CWG	Adjacent to above ground fuel tank.
TP7	0.1	Made Ground	Generic suite	Adjacent to offsite boiler/workshop.
TP7	0.6	Highly Weathered Oxford Clay	Generic suite, total TPH	
TP8	0.1	Made Ground	Generic suite.	Upfilled area. Human health risk assessment.
TP8	0.8		Generic suite, TPH CWG, asbestos screen	
TP8	1.5		Generic suite, TPH CWG	

3.5 Referencing

Locations of the exploratory positions were set out using taped offsets from existing features.

4.0 GROUND & GROUNDWATER CONDITIONS

4.1 Summary of Strata Encountered

The strata types encountered across the site are broadly similar. Variations in thickness across the site are shown on the tentative geological cross-section in Figure 2. The northern area has been upfilled to form the level storage area, and significantly thickens towards the north. For the purposes of this report the site has been separated into two areas based on the thickness of this Made Ground, as follows:

Southern Area (Around Existing Building): TPs 4-7

<u>Depth (m)</u>	<u>Description</u>
GL to 0.25/0.5	Localised Topsoil over MADE GROUND: (comprising loosely and moderately compact yellow-brown silty sandy Gravel, brown clayey gravelly Silt and red-brown Sand. Occasional plastic strips, and masonry).
0.25/0.5 to 0.65/1.5	Firm light brown mottled orange sandy CLAY. (HIGHLY WEATHERED OXFORD CLAY)
0.65/1.5 proven to 1.0/1.7	Firm becoming stiff and very stiff grey mottled orange sandy CLAY. (WEATHERED OXFORD CLAY)

Northern Uppilled Area: TPs 1-3 & 8

<u>Depth (m)</u>	<u>Description</u>
GL proven to 1.3/2.5+	MADE GROUND: (comprising loosely and moderately compact yellow-brown clayey gravelly Silt and silty gravelly Clay. Locally becoming dark brown and black organic slightly sandy Clay. Masonry rubble, timber plastic sheeting, straw and limestone boulders. Very thin localised ashy layers.).

It was not possible to prove the base of the Made Ground across the northern area. Based on the adjacent lower topography, it is inferred the fill could be at least 3-3.5m thick in some places as tentatively shown on the geological cross section in Figure 2.

TPI encountered very loosely compact rounded limestone gravel Made Ground which included old paint tins, timber, and masonry, and is inferred as a former soakaway.

A large concrete slab was encountered in TP3 at 0.6m which appears to extend at least 1.5m into the site from the western site boundary. It was not possible break out the obstruction.

4.2 Strata Properties

4.2.1 Topsoil

Topsoil (up to 200mm thick) was proven in TP5 and 6 only and showed no visual or olfactory evidence of contamination or contained any extraneous materials. No topsoil was present across the northern area, and was constrained to the existing soft landscaping to the south and southeast of the existing building onsite.

4.2.2 Made Ground

Made Ground was proven in all of the exploratory positions and can be categorised as:

Ash Fill:

Very thin (0.05-0.1m) layers of loosely compact ash and ashy clayey Silt were observed on the surface of TPI, and at 0.4m depth in TP8, presumably associated with former bonfires. TPI was a more recent bonfire, and contain burnt metal paint tins and other metal debris.

No other visual evidence of contamination was observed.

Rounded Limestone Gravel Fill:

This material was only encountered within TPI, and was observed beneath the ash fill and remains of a bonfire. The material was predominantly rounded limestone gravel, which was very loosely compact, which resulted in continuous side wall collapse. It was not possible to excavate deeper than 1.3m below existing ground level. Additional constituents included a minimal silt binder, occasional bricks, empty paint tins, the remains of a wooden crate and pieces of metal. A maximum thickness of 1.25m was proven within TPI.

According to a former site user, a former soakaway was excavated and constructed in this area on the northwestern boundary, and it is assumed that this material is the likely medium used. Continuous side wall collapse exposed clay fill in the eastern side wall of the trial pit suggesting the extent of the material.

Gravel Fill:

Moderately compact and well compact gravel was encountered in TPs 3, 4, 7 and 8, and ranged 0.1-0.3m in thickness. Typically, the material was observed at (or near) ground level, and was predominantly set in a silt and sand binder, locally becoming clayey. The material included brick and other masonry fragments and blocks.

No obvious contamination was encountered.

Organic Fill:

Below 1.2m depth in TP8, the material encountered became predominantly loosely dark brown and black slightly sandy Clay, proven to 2.15m (0.95m thick). Additional constituents included roots, remains of straw/hay, half bricks and a black plastic sheet. Small peat like pockets were also noted and the material had a distinct organic odour. It is possible this represents a former sump or pond.

No obvious contamination was encountered.

Sand Fill:

In TP7, a thin layer (0.1m) of loosely compact red-brown Sand was encountered at 0.15m depth, which appears to be backfilled around a buried service. No obvious contamination or extraneous materials were encountered.

Clay / Silt Fill:

The majority of the Made Ground encountered across this site was comprised of yellow-brown and brown gravelly silty Clay or gravelly clayey Silt, and was encountered in TPs 2, 5, 6 and 8. Locally the material was very plastic, and continuously became stuck to the excavator buckets requiring manual removal. The fill included limestone boulders, concrete and brick rubble, and occasional plastic sheeting and strips.

The fill ranged between 0.2m and 2m thickness and appeared loosely to moderately compact.

No visual signs of contamination were observed.

4.2.3 Variably Weathered Oxford Clay

For the purposes of this report the uppermost horizons of the natural ground have been defined as Highly Weathered where orange/brown and Weathered where becoming grey. The properties can be summarised as:

Stratum	Highly Weathered Oxford Clay	Weathered Oxford Clay
Min / Max Thickness (m)	0.3/1.15	0.1/0.6
Soil Strength / Properties	Firm – HSV = 50kN/m ²	Firm: HSV = 50kN/m ² in TP6 Stiff: HSV = 105kN/m ² in TP4. Very stiff: HSV = refused in TP5.
Atterberg Limits	-	MC = 27% LL = 49%

Stratum	Highly Weathered Oxford Clay	Weathered Oxford Clay
		PL = 21% PI = 28% Clay of Intermediate Plasticity.
Sulphate /pH	-	pH = 8.4 Water sol. Sulphate = <0.01g/l Total Sulphur = 0.02% Acid sol. Sulphate = 0.03%
Visual Contamination / Odours	None.	None.

4.3 Groundwater

The groundwater table was not proven in any of the exploratory positions. Perched water seepage was locally encountered in the Made Ground in TP8 at 1.2m depth. The subsequent monitoring visits recorded the perched water at 1.4-1.5m depth. Trial pits TP2 and TP6 were both dry during the first two visits. The third visit encountered standing water at 1.64m and 1.08m in TP6 and TP8. However, this visit followed a wet/heavy snow period, and the trial pit is likely acting as a sump.

4.4 Ground Gas

The monitoring indicates slightly elevated carbon dioxide at typically 1-3% volume within each of the standpipes. Although an initial peak reading of 4.6% carbon dioxide was recorded in TP8 during the second monitoring visit, this immediately reduced to a steady reading of 1-2%, which is considered more representative. A trace level of methane (0.1%) was recorded on the first visit in TP2. Methane has not been recorded in the other standpipes. No volatiles were present.

A maximum flow rate of 0.2l/hr was recorded. Summary results are detailed below with full information provided in Appendix E.

Exploratory Location	TP2	TP6	TP8
Response Zone (m) / Strata	0.5-1.28	0.5-1.78	0.5-2.02
Evidence of Contamination	None	None	None
Monitoring Visits (No.)	3	3	3
Methane (%)	0.0-0.1	0.0	0.0
Carbon Dioxide (%)	0.8-2.3	2.3-2.9	0.3-2.0 (Steady) 4.6% (initial reading 6/12/17)
Oxygen (%)	18.4-21.4	16.8-18.8	14.0-20.4
Gas Flow (litres/hr)	0.0-0.2	0.0-0.2	0.0-0.1
Atmospheric Pressure Range (mb)	982-1012	982-1012	982-1012

5.0 GEOTECHNICAL CONSIDERATIONS

5.1 General

The trial pits were excavated primarily for contamination purposes. According to the client and planning consultant, the proposed conversion of the existing building will not include any new foundations, ground floor slabs and other substructure, with the existing being either retained or refurbished. If for an unforeseen reason the above changes, then the following preliminary guidance is provided.

5.2 Site Preparation & Earthworks

Topsoil, limited to the northern area and any areas of particularly poor quality Made Ground should be removed from beneath proposed building and hardstanding areas.

Excavations to at least 1.5-2.5m depth are likely to be feasible with conventional soils excavating machinery, however pneumatic tools may be required to break out existing foundations or masonry obstructions. Spoil from excavations in clayey Made Ground is unlikely to be suitable for reuse.

Excavations to 1.5-2.5m depth may remain dry; however other shallow excavations may encounter perched groundwater seepages from the Made Ground. Such excavations can be kept dry by intermittent pumping from a convenient sump.

Temporary excavations in the existing Made Ground and variably weathered Oxford Clay will probably stand unsupported in the short term at gradients of about 1 on 2. Excavations below approximately 1m depth will require sheeting and shoring, particularly if personnel are to enter.

Formations in the clayey soils will be susceptible to deterioration due to site traffic and weather and should be protected immediately on exposure with lean mix concrete.

All desiccated and root invaded (particularly) clayey soils should be excavated and made good with well compacted granular material.

5.3 Foundations & Ground Floor Slabs

The investigation has proven that the existing building is founded on a continuous stratum of variably weathered firm becoming stiff Oxford Clay formed within a cutting into the original hillslope. A thick mantle of Made Ground has been identified across the proposed external parking northern area, and the base has not been proven. The groundwater table is below 2-2.5m depth, although perched water sits in the Made Ground locally. Allowable bearing pressures of 100kN/m² will be suitable for up to 1m wide foundations a minimum 300mm depth into the firm variably weathered Oxford Clay. All new foundations must be in line with the recommendations and guidance given in NHBC Chapter 4.2 'Building near Trees'.

New lightly loaded ground floor slabs may be suitable as ground bearing in 'firm' natural soil. In line with NHBC guidelines, suspended ground floor slabs (e.g. 'beam and block' type or similar) should be adopted where the slab will be underlain by 600mm or more of 'non-engineered' Made Ground.

All foundation, ground slab and other substructure formations should be checked and approved by a suitably qualified and experienced engineer or geotechnical specialist, who can also give guidance on the need for mesh reinforcement to even out formation compressibility.

5.4 Pavement Design

Design CBR values of at least 1-2% onto the existing Made Ground are feasible, and 2-3% onto firm variably weathered Oxford Clay. Where there could be rapid variations in formation strength, consideration should be given to a sandwiched geogrid construction which will help even out those variations to within acceptable limits.

5.5 Earth Pressures & Retaining Walls

Within the Made Ground and firm variably weathered Oxford Clay, effective angles of friction of 25°, cohesion of zero and bulk density of 1.8Mg/m³ could be assumed. The stiff Oxford Clay could have a higher

effective angle of friction of 28°. Foundations for new retaining walls can be based on the allowable design bearing pressures given above.

5.6 Protection of Buried Concrete

In line with BRE Special Digest 1:2005 'Concrete in Aggressive Ground', a representative sample of Weathered Oxford Clay indicates that pyrite is not present. It is therefore recommended that a Design Sulphate Class of DS-I and an ACEC Class of AC-I be adopted for budgeting purposes for new concrete.

However, based on past experience within similar ground conditions, higher soluble sulphate values could be anticipated. Unless a greater number of tests are completed, it may therefore be prudent to upgrade the concrete protection. Intégrale can give further advice if required.

5.7 Slope Stability

The downward slope to the north of the site, forming the upfilled area stands at a gradient of approximately 1 on 1. No formal retaining structure is present, and consideration should be given to the stability of the upfilled area. The crest of the bank lies outside of the site boundary, and is at least 5m remote. Without formal retaining works, instability could occur.

Any further development in this area will require further geotechnical investigations to prove the full thickness and profile of the Made Ground.

6.0 GENERIC QUANTITATIVE CONTAMINATION ASSESSMENT

6.1 General

The conceptual model based on the source-pathway-receptor linkages is summarised as:

SOURCE		PATHWAY		RECEPTOR
Contaminated soils	→	Dermal exposure	→	On-site female child
Contaminated soils	→	Inhalation of soil dust	→	On-site female child
Contaminated soils	→	Indoor inhalation of soil vapour	→	On-site female child
Contaminated soils	→	Outdoor inhalation of soil vapour	→	On-site female child
Contaminated soils	→	Direct ingestion of soil	→	On-site female child

A generic risk assessment has been undertaken by comparing proven concentrations of contaminants against generic assessment (or screening) criteria (AC).

The AC adopted are the published LQM/CIEH Suitable For Use Levels (S4UL's), for a generic residential without plant uptake end-use, adopted under licence no. 3580. These provide a precautionary approach, based on the principle of minimal or tolerable risk, but relying on conservative values for soil type (sandy loam) and organic matter contents of 1, 2.5 or 6% as appropriate. Where no S4UL is published, e.g. lead, the alternative AC is the most recently published industry standard value.

If the proven contaminant concentration is less than the respective AC, it is considered there is no significant risk to human health from these substances.

6.1.1 Generic Human Health Assessment

The soil samples where contaminants exceed the relevant assessment criteria are:

Standard	Substance	Result (vs. Threshold Criteria)	Stratum	Depth BEGL	Area / Zone
Assessment Criteria for Residential Use without Plant Uptake	Benzo(b)fluoranthene	9.7mg/kg (3.9mg/kg)	Made Ground	0.25m	TP2
	Benzo(a)pyrene	7.6mg/kg (3.2mg/kg)			
	Dibenz(a,h)anthracene	1.7mg/kg (0.31mg/kg)			
	Benzo(a)anthracene	11mg/kg (11mg/kg)	Made Ground	0.8m	TP8
	Benzo(b)fluoranthene	15mg/kg			
	Benzo(a)pyrene	11mg/kg			
	Dibenz(a,h)anthracene	1.8mg/kg			

Two hotspots of polyaromatic hydrocarbons (PAHs) were identified in Made Ground at TP2 and TP8 as highlighted above, which would pose a risk to human health. However, TP8 is in an area of proposed hardstanding, and the pathway to the receptor would be broken.

Fibres and clumps of chrysotile asbestos were detected by the laboratory in the shallow Made Ground sample in TP2 also. No obvious fragments were noted during the trial pitting and sampling.

6.2 Summary of Soils Results with Respect to Phytotoxicity

The soil samples where phytotoxic contaminants exceeded the former ICRCL 59/83 thresholds are:

Standard	Substance	Stratum	Depth BEGL	Area / Zone
Phytotoxic Target	Zinc	Made Ground	0.1m	TPI
	Copper	Made Ground	1.2m	TPI

Although samples of Made Ground taken from 0.1m and 1.2m depth in TPI indicate that the underlying soils will be phytotoxic due to zinc and copper concentrations, this area is likely to be beneath the proposed hardstanding car parking, and therefore would not pose a risk. However, the extent of this hotspot is unknown, and the nearby proposed soft landscaping could potentially be at risk. Therefore a conservative approach should be taken forward.

6.3 Summary of Soils Results with Respect to WRAS

The soil samples which exceeded the Water Regulations Advisory Scheme (WRAS) guidance on water supply pipes are:

Standard	Substance	Stratum	Depth BEGL	Area / Zone
WRAS	pH, arsenic, chromium	Made Ground	GL -1.5m	TPs 1-3, 7 & 8
	Total TPH & PAH	Made Ground	0.25-0.8m	TPs 2, 3 & 8
	pH & chromium	Variably weathered Oxford Clay	1-1.1m	TPs 4, 5 & 7

This suggests that new water pipes laid through the existing Made Ground and variably weathered Oxford Clay will need to be protective against chemical attack. Requirements should be confirmed with the water supply company.

6.4 Controlled Waters

6.4.1 Conceptual Model

The assessment of risks to controlled waters follows guidance provided by the Environment Agency, including their Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination (2006). The conceptual site model has been developed based on the source-pathway-receptor linkages identified during the desk study and fieldworks. Possible sources, pathways and receptors have been assessed, which identifies the potential pollutant linkages as:

SOURCE	PATHWAY	RECEPTOR
Contaminated soils	→ Leaching from soils or migration of liquid contaminants through the unsaturated zone.	→ Perched water
Contaminated soils	→ Leaching from soils or migration of liquid contaminants through service runs	→ Pond (140m east) or Tributary of River Ray (350m southeast)

As discussed in Section 2.3, the nearby Secondary A Aquifer is upslope and therefore not a realistic Controlled Waters receptor. The only possible receptor is considered to be the surface water receptors (ponds and tributary); however at distances greater than 140m these are not considered at risk given the extent of the unproductive Oxford Clay between. Based on the above, this report considers that the risk to Controlled Waters is negligible.

6.5 Gas Mitigation

The monitoring to date, based on the preliminary investigation only, indicates a Gas Regime classification of Characteristic Situation I.

The existing building lies on relatively low permeability natural Oxford Clay, and the Made Ground has been proven to mantle the proposed external area only, therefore there is no risk to future occupiers. The standpipe in TP6 is considered representative of the ground conditions beneath the building. The ground gas readings to date and the absence of a known gas source directly beneath the building are likely to be sufficient evidence to support these results as typical.

6.6 Conceptual Exposure Model & Risk Assessment

The potential hazards and risks from soils, water and gas contamination have been developed as a Conceptual Exposure Model, based on desk studies, proven ground conditions, analytical and monitoring results and the proposed redevelopment. Substances actually proven, or strongly suspected present, have been assessed against potential exposure pathways and available receptors.

The following hazard-pathway-receptor linkages are therefore established for this site:

- Two hotspots of PAHs are present at concentrations that potentially pose a risk to human health, in the upper 1m of Made Ground at TP2 and TP8.
- Chrysotile asbestos fibres/clumps have also been identified in the TP2 hotspot at 0.25m depth.
- Zinc and copper is present at concentrations which potentially pose a risk to new vegetation and plant life in TPI, which may affect nearby soft landscaping.
- WRAS Contaminant Threshold Concentrations are exceeded in the majority of the Made Ground and Oxford Clay.

6.7 Recommendations

6.7.1 For Protection of Human Health

Based on the generic screening assessment undertaken to date, the following remedial works and measures will be necessary to protect the health of groundworkers, neighbours, future occupiers and visitors:

- a) Removal of sufficient depth of Made Ground to allow a minimum of 600mm of clean imported subsoil and topsoil to be placed in all new soft landscaping/garden areas to break the contaminant pathway. Validation criteria for imported material should be agreed with the regulator. If any existing topsoil is to be reused this should be checked tested and validated against Acceptance Criteria.
- b) Following a) above, validation check samples should be taken to confirm whether the shallow depth asbestos fibres identified in TP2 have been removed within the upper 600mm. As a conservative approach, this validation testing should be completed on each formation. If encountered, a physical break should be provided beneath 600mm depth, which could be in the form of a geotextile or 150mm of compacted granular 6F2 type material. Alternatively, new permanent and robust hardstandings would also provide a sufficient pathway break.
- c) Provision of suitable pavings, hardstandings and floor slabs in all other areas to break the contaminant pathway.
- d) Advice and protection to groundworkers during excavations
- e) Dust suppression during all groundworks and wheelwashing of all haulage vehicles operating in the northern area (Made Ground) before leaving site.

6.7.2 For Protection of Building Materials & Services

To protect new building materials the following precautions will be necessary:

- a) Use of protective pipework for all water supplies.

6.7.3 For Protection of New Vegetation

The recommendations given above for human health will be also suitable to reduce the potential impact from soils contaminants on new planting.

6.7.4 Reuse and Disposal of Surplus Spoil

Surplus spoil from excavations must be categorised and stockpiled as either suitable for reuse, contaminated for selective reuse and/or treatment, or contaminated for disposal off-site and/or treatment.

Where spoil is to be reused, it will be necessary to place it beneath suitably designed hardsurfacings or a cover system to break the contaminant pathway. Where feasible it is recommended that asbestos contaminated soils be excavated and disposed of offsite.

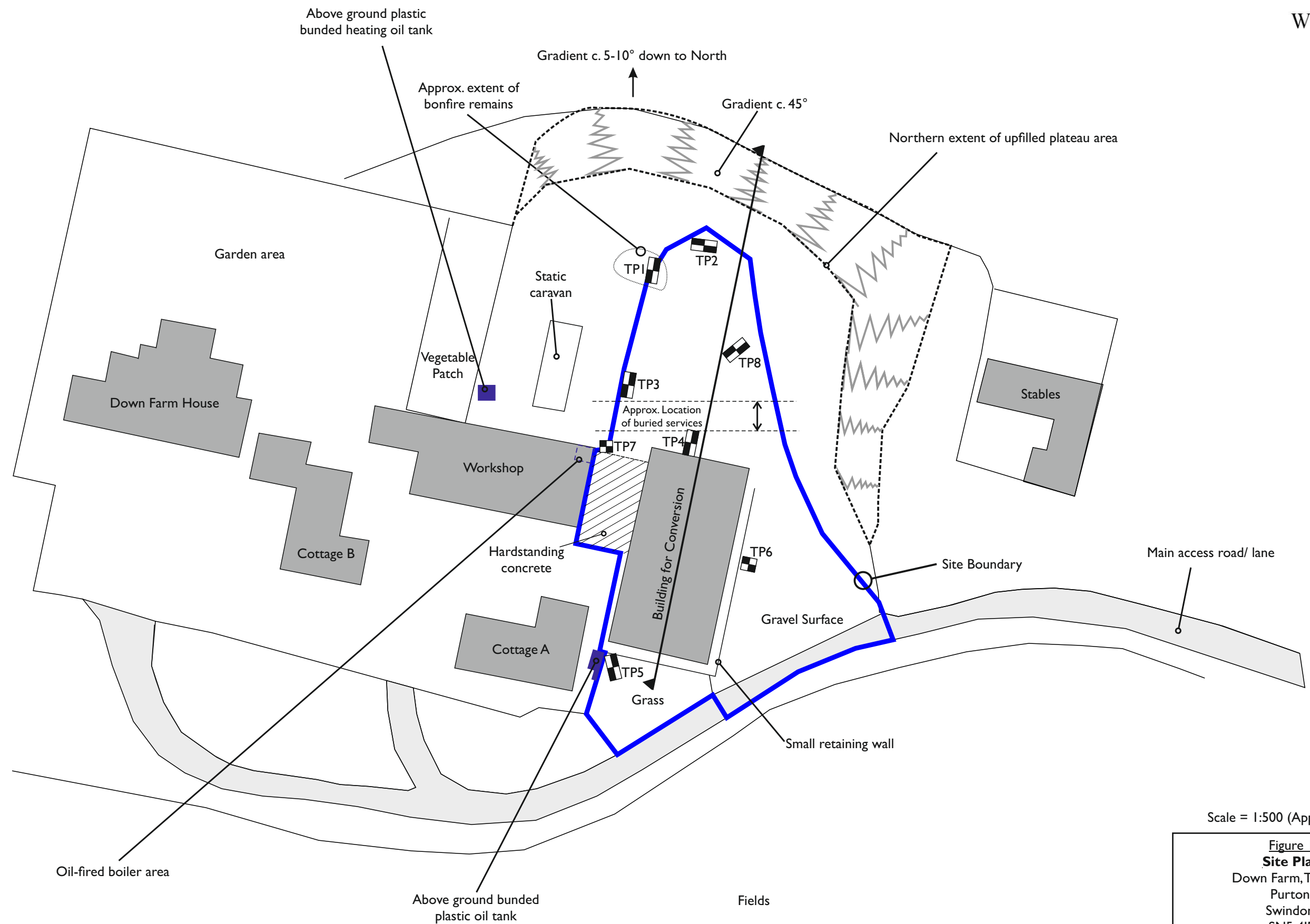
Should soils need removal to a suitably licensed tip, waste characterisation and classification in accordance with the Environment Agency's Technical Guidance will need to be undertaken to comply with the Duty of Care. Consideration should be given to whether it will be a requirement to prepare a Materials Management Plan for all soils excavation, reuse or disposal.

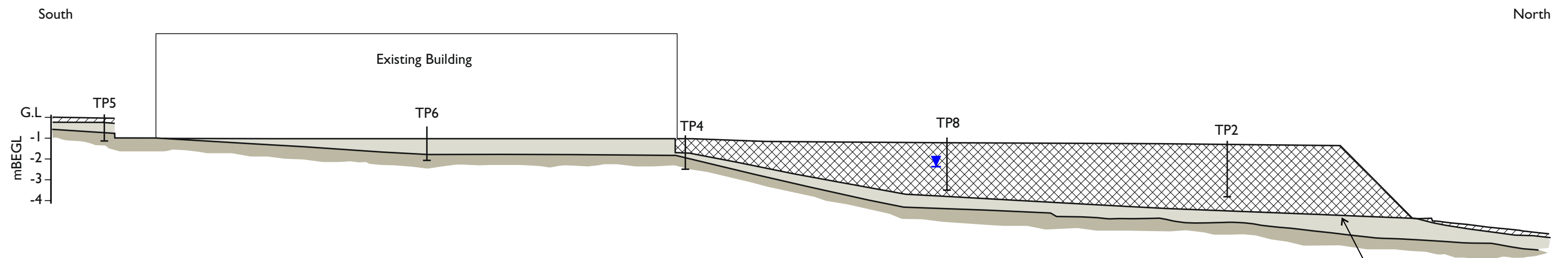
6.7.5 Recommended Further Specification

To discharge the planning condition it will be necessary to specify the scope of remediation, by completing a Remedial Method Specification and agree this with the regulators. The remedial works will need to be supervised, validated by sampling and monitoring, and a verification report prepared.

A watching brief should be kept at all times while groundworks are occurring. Should any signs of unforeseen contamination be found during groundworks, Intégrale should be contacted immediately to determine the best course of action.

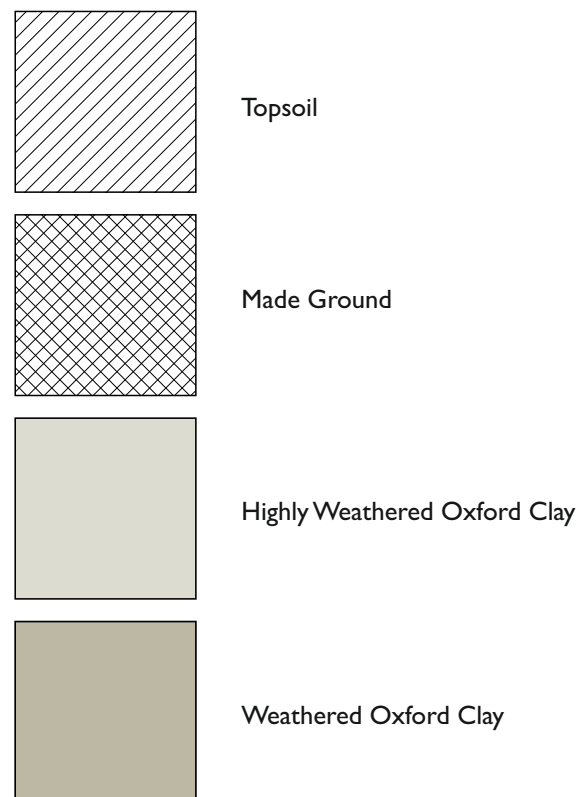
Copies of this report should be provided to the local authority and Environment Agency to confirm their agreement with the findings and recommendations.





Note:

- Thickness of Made Ground not proven across the northern upfilled area.
- No topographic survey. Gradients shown based on field observations and therefore only schematically shown.
- Ground conditions inferred across this area.



Scale = 1:500 (Approx. @ A3)

Figure 2
Tentative Geological Cross-section
 Down Farm, The Pry,
 Purton,
 Swindon,
 SN5 4JP

Job No: 8830
 December 2017

 **Intégrale**
 Understanding Ground Conditions

Appendix A

Site Location



Intégrale

Understanding Ground Conditions

Suite 7, Westway Farm Business Park
Wick Road, Bishop Sutton, Somerset,
BS39 5XP, United Kingdom

Tel: 01275 333036
www.integrale.uk.com

Project: Down Farm, The Pry, Purton, Swindon, Wiltshire, SN5 4JP

Job No: 8830

Site Location Plan



GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

Intégrale is a trading name of Intégrale Limited. Registered Office: The Granary, Chewton Fields, Ston Easton, Somerset, BA3 4BX United Kingdom
Company Registration No. 2855366 England VAT Reg. No. 609 7402 37

Appendix B

Site Description/Photographs

REFERENCES	
Project No.	8830
Site Address	Down Farm, The Fry, Purton, Swindon, SN5 4JP
Grid Reference	SU 103 892
Date of Visit	21 st November 2017
Names of site owners/ developers/ engineers met with on site	Mr. F. Cremlin.
Prepared by	JH
SITE – GENERAL	
Plan of site	See Figure 1.
Current use (occupants and operations)	The existing Building for conversion is currently used for storage of domestic and commercial items. The external yard across northern area is used for storage of empty IBCs, building materials and car parking. Workshop adjacent to the W is used for joinery/carpentry.
Site Area	0.15 Hectares
Maximum Dimensions	c. 65m (NNE-SSW) x 10-40m (W-E).
Boundaries – e.g. wooden fence/ retaining wall	W – Masonry retaining wall and residential Cottage A & Workshop B in southern half of site. No physical boundary in northern half. N & E – No physical boundary. Crest of bank c.5m remote. S – access road.
SITE – BUILDINGS	
Age of building(s)	1970s-1990s.
Building appearance: no. of storeys, basement, roofing type, chimneys / stacks?, car park, service areas;	Single storey, steel frame with masonry infill. Good condition. Solid concrete floor with no cracks or distress.
State of buildings, i.e. cracks; structural distress etc.	See above.
Tanks: location (internal / external : above or below ground), age / condition, size / capacity, type, bunding (condition), refuelling point, evidence of stains / spills	None onsite.
Heating : electric/gas/oil	Assumed oil based on Workshop B and offsite tank.
Chemical storage : drums, other chemical stores	None.
Gas control measures (e.g. vents, cowls, monitoring / alarms)	None seen.
Other evidence of industrial activity	None.
Asbestos / deleterious materials – any asbestos surveys?, removal programmes?	None. Metal cladding. Asbestos survey being completed independently.
Electrical equipment / Transformers – check for PCBs? Backup power supplies (generators)	None.

SITE – EXTERNAL	
Hard surfacings : type (asphalt/concrete etc.), staining, weathering, subsidence, repairs. Specific reinstatement required.	Predominantly compacted gravel with some areas of asphalt. Across the northern area. Concrete slab to the west of the building.
Landscaped areas/ soft landscaping: vegetation dieback/ growth	None.
Invasive species noted (e.g. Japanese Knotweed). Note: absence indicated here by non-specialist does not infer that JKn is not present.	None.
Site topography – flat / sloping, Level compared to surroundings & mAOD.	Approximately 95m AOD. The site slopes very gently down to the north, and forms an upper plateau area for storage. Approximately 5m to the north and east of the site lies the crest of the bank, which steeply (1 on 1) slopes down to the adjacent land along the northern and eastern boundaries.
Evidence of filling or raising, earthworks, mounds/ hummocks, soil creep, soil fluctuation, mass movement, steep/ vertical faces, crater-like holes (in chalk/limestone areas). Sloping ground – any indication of instability (cracks in ground, bulges, leaning trees, walls or poles), rotational slip scars.	The northern plateau area described above appears upfilled due to the steep bank and surrounding adjacent gently sloping hillside.
Soil drainage – marshy/ marsh vegetation/ dry/ surfaces cracked/ surface rutting etc.	Appears well drained.
Trees – effects on buildings, condition, species and height; location; maturity; leaning/ upright; rotated trees?	None on site.
Rock/ soil exposures – height/ extent description etc.	Topsoil exposed in adjacent hillside from site traffic.
Drainage : interceptors, disposal of storm water / waste water, mains water supply.	None.
Other evidence of Services, e.g. overhead cables, Gas ‘yellow headstone’.	Manholes adjacent to W boundary indicates services passing NE to second manhole of E boundary. Services include water, electricity and possible communications.
Vehicle maintenance : washdown areas, workshops, refuelling points.	None.
Waste : skips / compounds, any hazardous waste? Burning grounds or incinerators.	Remains of a bonfire in NE area/boundary.
Sub-stations : age, condition, transformers, operator, servicing?	None.
Ecological features of note – Burrows, bats, nest sites, designated preservation areas.	None.
Any seepages on or adjacent to site.	None.
Watercourses, water levels, direction and rate of flow.	None.
Other features of note within site.	None

SURROUNDING LAND USES	
General site context – industrial, commercial, urban, agricultural etc.	Commercial use adjacent to residential dwellings.
Land use – north (give distances)	Open fields.
Land use – south (give distances)	Open fields.
Land use – east (give distances)	Stables, then open fields.
Land use – west (give distances)	Residential and gardens, then open fields.
Nearby (<500m) sources of pollution – landfills, filling stations, industrial activity.	Above ground plastic banded heating oil tank adjacent to SW corner associated with Cottage A. A second above ground oil tank is located c.15m to the west of the site and supplies Workshop.
Nearby river / surface water features – culverted, banks, flood plain. If visible, condition of watercourse.	Tributary to the River Rey 350m SE. Pond, 140m E.
Local ground profiles and signs of instability.	None.
Evidence of structural distress on nearby buildings.	None.
Evidence of mining history (colliery spoil heap, miners cottage).	None.
Nearby rock/ soil outcrops.	None.
Vegetation – distinctive change in vegetation (e.g. hydrophyllic veg).	None.
Adjacent geotechnical features of note – cuttings, quarries, embankments, slopes (particularly if failed), major excavations, deep basements, sources of vibrations (railway or heavy machinery).	None.
Other features of note adjacent to site.	None.

Photo 1: S view of Proposed Conversion Building



Photo 2: N view of above ground heating oil tank adjacent to SW corner



Photo 3: N view of upfilled northern area



Photo 4: W view of E elevation of proposed conversion building

Photo 5: Remains of bonfire in NW corner around TP1



Photo 6: Inside proposed conversion building



Photo 7: W view of upfilled bank onto gently sloping northern fields.

Photo 8: W view from W boundary of offsite above ground fuel tank

Appendix C

Desk Study Information



**Desk Study at Down Farm,
The Pry, Purton**

Final Report

Prepared by

Dr. Joanna Fortune

for

Mr. Fred Cremin

Hydrock Ref: R/13144/001

April 2013

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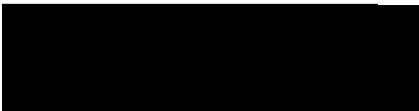
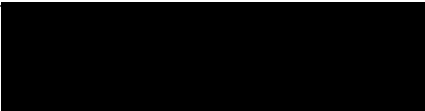
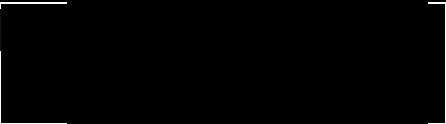
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1	April 2013	Original issue.

Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above named Client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

CONTENTS

1.0	INTRODUCTION	1
2.0	PRELIMINARY INVESTIGATION (PHASE 1 STUDY).....	2
3.0	PRELIMINARY RISK ASSESSMENT.....	9
4.0	DESK STUDY CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK.....	16
5.0	UNCERTAINTIES AND LIMITATIONS.....	17
6.0	RECOMMENDATIONS FOR FURTHER WORK.....	18
7.0	REFERENCES	19

APPENDICES

Appendix A DRAWINGS

Appendix B SITE WALKOVER PHOTOGRAPHS

Appendix C HISTORICAL ORDNANCE SURVEY MAPS

Appendix D DESK STUDY RESEARCH INFORMATION

Appendix E HYDROCK METHODOLOGY

EXECUTIVE SUMMARY AND CONCEPTUAL SITE MODEL

SITE INFORMATION & SETTING	Purpose of this report	Phase 1 desk study.
	Client	Mr. Fred Cremin
	Site	Down Farm
	Site Location	The Pry, Purton SN5 4JP to the northwest of Swindon at NGR 410370E 189290N.
	Current Land Use & Description	Site is currently occupied by two large workshops, a static caravan and areas of hardstanding. An above ground fuel tank was noted as well as several skips containing general waste.
	Development	Demolition of existing buildings and construction of 4 residential properties with associated infrastructure and gardens. No further information currently available.
PHASE 1 (DESK STUDY)	Site History	Originally farm land. Subsequently developed with farm buildings. No other usage known.
	Unexploded Ordnance	Zetica UXB map shows low bomb risk. No further consideration of UXO is required, but may be prudent (e.g. a preliminary risk assessment in accordance with CIRIA C681, Chapter 5).
	Geology	Underlying geology is mapped as the mudstones of the Oxford Clay. Off-site to the west the Oxford Clay is shown as a siltstone.
	Ground Stability	Moderate risk from shrink swell of clays. Northern and eastern boundaries are sloping and inappropriate development may cause instability.
	Hydrogeology	The Oxford Clay is an unproductive stratum.
	Hydrology	Various ponds recorded, the closest being 142m east. Tributary of the River Ray located 350m southeast.
	Flood Risk	The site is in Flood Zone 1.
	Environmental Sensitivity	The site is in a nitrate vulnerable zone but this is not pertinent to the proposed development.
	Regulatory Enquiries	None at the time of reporting.
	Previous Site Data	None made available to Hydrock.
	Geotechnical Hazards- from Desk Study	• Potentially deep Made Ground on northern section of the site where ground level may have been raised to create a level area. • Buried structures from existing foundations and services. • Potential for instability along the northern boundary where a relatively steep slope exists. • Potential for sulfates within the natural soils.

	Possible Contaminant linkages of Moderate or Greater Risk Level - from Desk Study	The possible pollutant linkages on an un-remediated site determined by desk study and walk-over are summarised below for risk levels of moderate or greater.	
		Source(s)	◀ potential Impact on ▶ Receptor(s)
		Metals and other in-organics within Made Ground.	Future occupiers Groundwater Plant life
		Ground Gases from within Made Ground.	Future occupiers
		Asbestos	Future occupiers
ASSESSMENT & CONSIDERATIONS	Conclusions	Based on historic land uses and its current operational use, the overall risk from land contamination at the site is considered to be low for the current development, and low to moderate for a re-developed site, but would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation. It is considered that it is unlikely that the site would be classified as Contaminated Land under Part IIA of the EPA 1995. Based on the available desk study and walk-over information, the following geotechnical issues need to be addressed in exploratory investigation: - determine the depth of Made Ground across the site; - determine the strata and soil strength profile beneath the site; and - assess the sulfate concentration with depth.	
	Uncertainties & Limitations	No intrusive investigation has been undertaken at the time of reporting.	
	Further Work	In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken. Based on the current data, this site investigation is proposed to comprise: - the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability and depth to suitable founding stratum. - gas and groundwater monitoring installations to allow gas concentrations and groundwater levels to be monitored if potentially gas generating material is identified in the Made Ground. - geotechnical testing of soils; and - contamination analyses of soil and groundwater if encountered.	

This Executive Summary forms part of Hydrock Consultants Limited report number R/13144/001 (Issue 1) and should not be used as a separate document.

1.0 INTRODUCTION

1.1 Terms of Reference

In March 2013, Hydrock Consultants Limited (Hydrock) was commissioned by Mathewson Waters Architects on behalf of Mr Fred Cremin to undertake a desk study of Down Farm, The Pry, Purton, Swindon, SN5 4JP.

The site is currently two large agricultural outbuildings used as storage and workshops and an area of hardstanding located in the northern area of the site. The site surroundings include various farms and agricultural fields with the original Down Farm farmhouse located off site to the west beyond converted barns now occupied as houses.

The proposed development is currently understood to comprise demolition of the existing buildings and construction of 4 residential properties with associated infrastructure. No further information is available.

A site location plan (Drawing 13144-G001) and an existing site plan provided by Mathewson Waters architects are presented in Appendix A. No proposed development plan was available at the time of writing.

1.2 Objectives

The objectives of this investigation are to assess the readily available information on the likely ground conditions at the site, in order to assist in the characterisation and likely ground conditions to be encountered during the development.

In accordance with CLR11 (2004) , this report presents an initial review of existing ground information, and the creation of a conceptual site model outlining the potential risks associated with the proposed development.

1.3 Scope

The scope of work for this commission comprises a desk study and site walk-over reconnaissance to determine the nature of the site and its surroundings including current and former land uses, geology, hydrogeology, hydrology and geo-environmental data.

See Appendix E for detailed reporting methodology.

1.4 Provided Information

The following has been provided to Hydrock by Mathewson Waters Architects for use in the preparation of this report:

- location plan; and
- plan of the buildings that are to be removed.

2.0 PRELIMINARY INVESTIGATION (PHASE 1 STUDY)

A number of desk study sources have been used to assemble the following information, including a proprietary environmental data report which has been obtained for the site (dated 11th March 2013) and is presented in Appendix D.

2.1 Site Referencing

The site is referenced in Table 2.1.

Table 2.1: Site Referencing Information

Item	Brief Description
Site name	Down Farm, The Pry, Purton, Swindon
Site location and Grid reference	Off the B4553, Purton, nearest postcode is SN5 4JP. Approximate National Grid Reference 410370E 189290N.

A site location plan is provided in Appendix A (Drawing 13144-G001).

2.2 Site Description and Walk-Over Survey

The basic description of the current site conditions is summarised in Table 2.2.

Table 2.2: Site Description

Item	Brief Description
Site access	Via B4553
Elevation, topography etc.	Approximately 95m OD. The site slopes gently up to the north and has a short steep slope down to adjacent land along the northern and eastern boundaries where site level may have been raised in the past.
Site boundaries	Existing residential properties immediately to the west. The original farmhouse is present to the far west while converted brick built barns are present immediately adjacent to the west which have been converted to residential properties. Otherwise the site is generally surrounded by open fields with some stables off the eastern site boundary.
Geomorphic features	None noted.

Item	Brief Description
Present land use	The land is currently occupied by two large outbuildings of blockwork construction with potentially asbestos sheet roofing. Both buildings have concrete floors. The eastern building is used as a workshop for carpentry / joinery activities. The western building is used for general storage of both domestic and commercial items. Domestic items include lawnmowers and children's play equipment and a classic car. Commercial items, associated with building work activities, include general building machinery / hand tools as well as a JCB. Some staining of the concrete was noted beneath the JCB. In addition, the building is used for storage of electrical wiring / components, paints and cement etc. A static caravan is present to the north of the western building and a further caravan is parked to the south of the western building. To the north of the static caravan there is evidence for a domestic sewage treatment unit with a stack visible at ground level. To the west of the static caravan there is an above-ground fuel tank elevated on a blockwork base. No evidence for spills / leaks was noted but this cannot be discounted fully at this stage. A second newer looking self-bunded fuel tank is present associated with the adjacent residential property. This tank is sited on an area of hardstanding on a small brick built base. On the northern section of the site there is an area of rough gravelled hardstanding accessed off a tarmac driveway from the southern access road. This area has been used for general waste storage in skips with evidence for bonfires and potentially asbestos containing material. Large dumpy bags of sand / gravel are also stored here. On the far northeastern boundary a manhole cover was noted. The cover was not lifted and therefore the use is unknown.
Vegetation	Small grassed area to the south of the larger eastern barn, rough scrub along the northern area and some trees along the eastern boundary. An area of vegetable beds is present in the northwestern section of the site.
Surrounding land	To the north at the base of the slope are open fields where horses were grazing at the time of the visit. To the west are the two barn conversions as well as the original Down Farm farmhouse, all occupied at the time of the visit. To the south are further open fields and to the east is a stable block.

Photographs for the site walkover undertaken to confirm the findings of the desk study and to visually assess any potential hazards and receptors are presented in Appendix B.

2.3 Site History

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

Table 2.3: Key Features from Historical Mapping

Map Edition and Scale	Key Features on Site	Key Features off Site
1875: 1:2,500 & 1887: 1:10,560	There appear to be a number of buildings on the subject site, one in the far northwest and two roughly centrally along the western boundary. The northeastern section of the site is mapped as a wood / orchard.	The wood / orchard extends off site to the north and east. Various buildings are shown on land immediately east with associated garden areas of Down Farm. A pond is shown approximately 20m southwest. Some small, assumed agricultural, buildings are mapped approximately 100 to 150m east. Beyond these buildings and wooded area are open fields with occasional small ponds. Roughly 300m east of the site is a road running roughly

Map Edition and Scale	Key Features on Site	Key Features off Site
		north south and immediately beyond this is the Wiltshire and Berkshire Canal (North Wilts branch). Woodwardbridge Farm is mapped approximately 500m northeast. Approximately 750m east of the site is the River Ray.
1900: 1:2,500 1900: 1:10,560 1923: 1:2,500	No significant change.	There is a building adjacent to the southwestern corner of the site. The wooded area is now only mapped to the east of the site. The section to the north is simply mapped as an open field. In 1900 a pump is mapped to the south of the buildings approximately 100m east. A windpump is also mapped approximately 150m southeast by 1923. Approximately 700m northeast of the site is Blunsdon railway station serving the midland and southern line running approximately northwest to southeast. A brickworks is mapped approximately 500m northwest.
1925: 1:10,560	No significant change.	Approximately 1km west of the site is a Milk Factory. The canal to the east is shown as disused.
1960-1961; 1:10,000	No significant change.	The canal appears to have been backfilled, at least in some sections.
1970: 1:2,500	The building roughly central to the site has approximately doubled in size occupying the location of the currently existing western outbuilding. A second large building has been constructed in the location of the current eastern workshop. The wood / orchard is no longer mapped and the boundary previously delineating its extent is no longer shown. A small building is shown immediately off-site to the northeast.	A pond is mapped approximately 200m northeast adjacent to some of the off-site buildings previously noted.
1973-1976: 1:10,000	No significant change.	The railway to the east is shown as disused. Downfield Farm is mapped approximately 500m southeast.
1984; 1:10,000	No significant change.	Folly Down Farm comprising various buildings and a farm track / access route are mapped approximately 250m northwest.
1991-1992; 1:10,000	No significant change.	The Swindon and Cricklade Railway is shown running along the route of the previously dismantled railway to the east.
2006: 1:10,000	No significant change.	No significant change.

In summary, the map evidence shows that the site has had some small scale development, however there is no evidence of industrial or potentially contaminative land use on or adjacent to the site.

2.4 Unexploded Ordnance

In general accordance with CIRIA report C681 (Stone *et al* 2009) a non-UXO specialist screening exercise has been carried out for the site. This indicates:

- there is no indication of former military use from the desk study; and
- the Zetica UXB map (Wiltshire) indicates the site to be in an area where the bomb risk is low (further action to mitigate the risk is considered prudent by Zetica, although not essential). A copy of the map is presented in Appendix D.

2.5 Geology

The general geology of the site area is shown on the 1:50,000 geological of Swindon (Sheet E252) and is summarised in Table 2.4.

Table 2.4: Geology

Location	Age	Stratigraphic Name	Description
On Site	Oxfordian – Callovian	Oxford Clay Formation	Mudstone comprising grey slightly silty silicate mudstone with intermittent beds of limestone nodules.
Immediately off site to the southwest	Oxfordian – Callovian	Oxford Clay Formation	Siltstone

Due to the previous development of the site some Made Ground is anticipated across the site area, with potentially deep Made Ground in the northern area of the site to create a flat area of hardstanding.

2.1 Mining / Mineral Extraction

The site is not within areas of recorded mining. However, the Envirocheck report lists an opencast site 473m northwest at Hursted Farm Brickworks where common clay and shale of the Oxford Clay were extracted. This site is recorded as ceased.

2.2 Ground Stability

The site risk is reported to be at no hazard from compressible ground, dissolution of soluble strata and running sand from the environmental data reviewed.

The potential for collapsible ground stability hazards and landslide is very low. However, due to the nature of the Oxford Clay Formation the site may be affected by potential hazard of shrink or swell of the clay strata which is identified as a moderate risk in the Envirocheck report.

2.3 Hydrogeology

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

Table 2.5: Hydraulic Characteristics of Strata

Stratum	Aquifer Designation	Hydraulic Characteristics
Oxford Clay Formation - Mudstone	Unproductive strata	Dominated by extremely low permeability clays.
Oxford Clay Formation – Siltstone off site to the southwest	Secondary A Aquifer	Siltstone horizons within the Oxford Clay clay strata. Likely to have $kh > kv$.

Reference to the Environment Agency web site shows the following Groundwater Body beneath the site and the current chemical status (Table 2.6).

Table 2.6: Groundwater Body

Category	Label / Status
Waterbody ID	GB40603G000200
Waterbody name	Upper Thames Gravels
River basin district	Thames
Current quantitative status	Good
Current chemical status	Poor
Upward chemical trend	No
2015 predicted qualitative status	Good
2015 predicted chemical status	Poor
Overall risk	At risk
Protected area	Yes.

The site is not within a Source Protection Zone (SPZ).

There are no licensed groundwater abstractions within 2000m of the site and no discharge consents to ground / groundwater within 800m of the site.

2.4 Hydrology & Flooding

The surface water features in the vicinity of the site are listed in Table 2.7.

Table 2.7: Surface Water Features

Feature	Location Relative to Site
Various ponds / small isolated surface water features	Closest recorded 142m east of the site but many noted within 1km of the site, predominantly to the south and west.
Tributary of the River Ray	350m southeast
The River Ray	750m east

There are no surface water abstractions within 2000m of the site and no discharge consents to surface waters within 500m. The closest active discharge consent is recorded 598m northeast for discharge of final / treated effluent from a single domestic property to a tributary of the River Ray.

River Quality has been recorded on the River Ray on a reach 616m east with quality recorded as GQA Grade C. A river quality chemistry sampling point 886m northeast on the River Ray recorded an improving grade from E – poor in 1990 to B – good in 2009.

The site is in Flood Zone 1, with low probability of flooding.

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

2.5 Waste Management and Hazardous Substances

The following waste management sites are recorded in the vicinity of the site (Table 2.8).

Table 2.8: Waste Management Sites

Site Name	Details
Woodwards Bridge Farm, Purton, Wiltshire	Historical Landfill recorded 419m northeast / Local authority landfill recorded 347 east / 370m northeast. The provider reference is EAHLD13661, the WRC reference is 3900/0091 and another reference is given as TP0056, 440. No further information was given.
Pry Farm, Purton, Wiltshire	Historical Landfill recorded 639m southeast / Local authority landfill recorded 378m east / 520m southeast. The provider reference is EAHLD13662, the WRC reference is 3900/0092 and another reference is given as TP0493, G4/132/57, 441. No further information was given.
Tadpole Lane, land at Tadpole Bridge, Blunsdon, Swindon.	Historical Landfill 781m northeast. The provider reference is EAHLD10853, the WRC reference is 3900/0090 and another reference is given as Swindon Council-494. No further information was given.

The reference to a local authority landfill approximately 350m east is thought to relate to the backfilling of the canal based on the mapped evidence but no further substantiation of this has been identified.

There are no records relating to the storage of radioactive materials within 1km of the site.

There are no records of prosecutions relating to authorised processes in the vicinity of the site.

There are no Local Authority Pollution Prevention and Controls, COMAH sites, NIHHS sites, explosive sites, or Planning Hazardous Substance consents or enforcements within 1km of the site.

2.6 **Previous Evidence of Known Contamination Events**

A single pollution incident to controlled waters has been reported within the Envirocheck report approximately 800m northeast in 1989 when a miscellaneous pollutant was released. The incident was categorised as minor.

2.7 **Natural Soil Chemistry**

Information contained within the environmental data report (Appendix D) gives indicative natural concentration values (estimated) for the natural soils at the site for a selection of Contaminants of Potential Concern (CoPC). These have been reproduced in Table 2.9 below.

Table 2.9: Natural Soil Chemistry

CoPC	Estimated Concentrations (mg/kg)
Arsenic	15 - 25
Cadmium	<1.8
Chromium	60 - 90
Lead	<150
Nickel	15 - 30

2.8 **BR 211 Guidance on Radon**

Reference to the Annex A maps in BR 211 (Scivyer 2007), based on the indicative atlas of radon in England and Wales (Miles *et al* 2007) indicates that no radon protection is required for new dwellings at this location in line with current guidance. The Envirocheck report concurs.

2.9 **BGS Borehole Archive**

A number of borehole logs from the BGS archive have been obtained, including:

- SU18NW29 to the north of Down Farm where the log recorded topsoil to 0.3m depth overlying very stiff, dark grey clay with numerous pockets of red silt to 0.9m beneath which stiff, grey, mottled grey brown, silty clay with numerous calcareous nodules was recorded to the base of the borehole at 1.5m.
- SU18NW/30 to the southeast of Down Farm where the log recorded 0.2m of topsoil overlying firm, light brown, silty clay with chalk and flint gravel to 0.5m depth over a compact green-brown silty sand with frequent gravel extending to 1.35m depth. Beneath this a brown, silty sand and fine to medium gravel was recorded to 1.5m depth over a stiff fissured and friable silty clay with fossil traces to the base of the borehole at 2.0m depth.

3.0 PRELIMINARY RISK ASSESSMENT

3.1 Preliminary Ground Model

The findings of the Phase 1 investigation indicate that the site comprises two existing blockwork construction workshops used for woodworking and storage. The buildings potentially have asbestos sheet roofing and are outbuildings associated with the adjacent Down Farm farmhouse. No previous use of the site other than as part of the farm has been identified during the desk study searches. The remainder of the site area is occupied by hardstanding and some small areas of grass / rough vegetation. A static caravan is present on the northern section of the site as well as an above ground fuel tank. A domestic sewage treatment unit is also present on the north to the rear of the static caravan. The area of hardstanding on the northern section of the site has also been used for bonfires and parking of skips for general waste disposal and there was some evidence of potential for asbestos containing materials within this waste.

A relatively short steep slope marks the northern and northeastern boundary where the land slopes down to adjacent fields used to graze and stable horses. It is possible that this represents a reprofiling of the site to create this level area of hardstanding in the north. If so, there is the possibility of a significant thickness of Made Ground in this area of the site.

It is understood that the proposed redevelopment of the site comprises demolition of the existing buildings and the construction of 4 residential properties although no further information is available at the time of writing.

The natural soils comprise the Oxford Clay which is designated an unproductive strata immediately beneath the site. Off site to the west the strata are shown as a Secondary A aquifer where the Oxford Clay is mapped as a siltstone. The site is not in a Source Protection Zone and there are no groundwater or surface water abstractions recorded within 2km.

There are several small ponds in the surrounding area while the closest surface water course is thought to be a tributary of the River Ray approximately 350m southeast.

3.2 Preliminary Exposure Model

The exposure model is used for geo-environmental hazard identification and establishing potential contaminant linkages in line with the Statutory Guidance to Part 2A of the Environmental Protection Act 1990, also known as a 'potential pollution linkages' in the Model Procedures of CLR11 (DEFRA and Environment Agency, 2004). This is based on the contaminant-pathway-receptor linkage approach.

3.2.1 Potential Contaminants of Concern

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

Potential On-site Sources of Contamination

- Made Ground from potential raising of site levels on the northern site area;
- Asbestos in existing buildings and waste materials on site;
- Hydrocarbon fuels & lubricant associated with the workshops and above ground tank;
- Made Ground possibly including metals, metalloids, asbestos, PAH and petroleum hydrocarbons;
- PAHs associated with burning of waste on site;
- Pesticides and herbicides on the area of vegetable beds on the north western site area;
- Pathogens from the domestic sewage treatment unit;
- Ground gases (carbon dioxide and methane) from potentially deep Made Ground; and
- Elevated metals within natural soils.

Potential Off-site Sources of Contamination

- No potential off-site sources of contamination have been identified. It should be noted that ground gases from offsite sources (such as other landfills) have been excluded as there are no significant landfills within 500m of the site.

3.2.2 Potential Receptors

- Humans (neighbours, site end users).
- Development end use (buildings, utilities and landscaping).
- Groundwater: Secondary A aquifer status of the Oxford Clay siltstone strata to the southwest
- Surface waters: various ponds in the vicinity of the site and a tributary of the River Ray 350m southeast.

3.2.3 Potential Pathways

- Humans: Ingestion, skin contact, inhalation of dust and outdoor air.
- Buildings: Direct contact.
- Buildings: Ingress via permeable soils and/or construction gaps.
- Underlying groundwater: migration of contaminant via leachate dispersion through unsaturated zone.
- Surface water: overland flow.
- Surface water: drainage discharge.
- Surface water: base flow from groundwater.

3.2.4 Summary of Potential Contaminant Linkages

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

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

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

		Consequence			
Probability	<i>product</i>	Severe	Medium	Mild	Minor
	High Likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Low risk	Very low risk
	Low Likelihood	Moderate risk	Low risk	Low risk	Very low risk
	Unlikely	Low risk	Very low risk	Very low risk	Very low risk
	No Linkage	No risk			

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

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
Metals, Cyanide, Acids & bases - from general Made ground and waste materials. Sulfates – from ash, uncontrolled tipping of building rubble.	Ingestion, inhalation or direct contact.	Site workers.	Likely	Medium	Moderate	Potential for Made Ground of unknown composition across the site. However, much of the site is covered in building footprint and hardstanding and no evidence for deterioration of floor slabs during walkover.
	Ingestion, inhalation or direct contact.	Future occupiers	Low	Medium	Low	Potential for Made Ground of unknown composition across the site. However, much of the site is covered in building footprint and hardstanding and no evidence for deterioration of floor slabs during walkover.
	Inhalation of fugitive dust.	Neighbours.	Low	Medium	Low	Potential for release of dust during site works. Limited numbers of near neighbours and limited exposure during development.
	Root uptake.	Landscape planting.	Low	Mild	Low	Limited vegetation present on site at the moment. No information on proposed development with respect to planting and areas of softscaping. Significant site wide contamination is not anticipated but localised areas may cause detriment.
	Leaching through unsaturated zone.	Groundwater and possible abstractors or aquatic ecosystems.	Low	Medium	Low	The geology beneath the site is an unproductive stratum with a secondary aquifer to the west. No groundwater abstractions in the vicinity of the site. Limited potential for migration of contamination through groundwater due to cohesive nature of underlying soils.
	Leaching through unsaturated zone, surface run-off, base flow from contaminated groundwater.	Surface water and possible abstractors or ecosystems.	Low	Medium	Low	No surface water features within 250m of the site other than small isolated ponds. No surface water abstractions in the vicinity of the site.
	Direct contact with dissolved sulfates.	Building products (degradation).	Likely	Medium	Moderate	Standard concrete mixes are available for specification once the sulphate content of the soils is known.
Asbestos fibres from insulation or asbestos-containing materials in the buildings.	Fugitive dust.	Site workers.	Likely	Severe	High	From the age of the buildings there is potential for the presence of asbestos. A survey should be carried out prior to any alterations or demolition to mitigate potential risk.
		Future occupiers	Low	Severe	Moderate	
		Neighbours.	Low	Severe	Moderate	
Asbestos fibres from waste	Fugitive dust.	Site workers.	Likely	Severe	High	Potential for asbestos within waste noted along northern

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
materials		Future occupiers	Low	Severe	Moderate	site boundary and within skips. Careful removal of any potential asbestos containing materials should be undertaken prior to any development. Potential for asbestos to be present in the soils where uncontrolled burning of waste may have been carried out.
		Neighbours.	Low	Severe	Moderate	
Petroleum hydrocarbons – fuel, lubricants, from fuel tanks, vehicles, uncontrolled tipping Polynuclear aromatic hydrocarbons (PAH) – from used engine oil, combustion products from fires, uncontrolled tipping Phenols – from burning of general waste. Pathogens – from domestic sewage treatment unit	Ingestion, inhalation or direct contact.	Site workers	Low	Medium	Low	An above ground fuel tank is present on site but no evidence for spillage / leakage was noted. Various activities on site may have been associated with the use of petroleum hydrocarbons. The building floor slabs did not show any significant signs of spillages and were found to be in good condition. However, the potential for historic spillages cannot be ruled out. Burning of waste and skips of material of unknown composition were also noted on site. Presence of domestic sewage treatment unit on north of site. Contamination is thought likely to be localised.
	Ingestion, inhalation or direct contact.	Future occupiers	Low	Medium	Low	
	Inhalation of fugitive dust.	Neighbours.	Low	Mild	Low	Potential for release of dust during site works. Limited numbers of near neighbours and limited exposure during development.
	Root uptake.	Landscape planting.	Low	Mild	Low	Limited vegetation present on site at the moment. No information on proposed development with respect to planting and areas of softscaping. Significant site wide contamination is not anticipated but localised areas may cause detriment.
	Leaching through unsaturated zone.	Groundwater and possible abstractors or aquatic ecosystems.	Low	Medium	Low	The geology beneath the site is an unproductive stratum with a secondary aquifer to the west. No groundwater abstractions in the vicinity of the site. Limited potential for migration of contamination through groundwater due to cohesive nature of underlying soils.
	Leaching through unsaturated zone, surface run-off, base flow from contaminated groundwater.	Surface water and possible abstractors or ecosystems.	Low	Medium	Low	No surface water features within 250m of the site other than small isolated ponds. No surface water abstractions in the vicinity of the site.
Pesticides and herbicides from former farming activities	Ingestion, inhalation or direct contact.	Site workers	Low	Medium	Low	Possible due to former site uses.

Source(s)	Possible Pathway(s)	Receptor(s)	Probability	Consequence	Risk Level	Comments
and current allotment / vegetable areas on northwestern area.	Ingestion, inhalation or direct contact.	Future occupiers	Low	Medium	Low	
	Inhalation of fugitive dust.	Neighbours.	Low	Medium	Low	Potential for release of dust during site works. Limited numbers of near neighbours and limited exposure during development.
	Root uptake.	Landscape planting.	Low	Medium	Low	Limited vegetation present on site at the moment. No information on proposed development with respect to planting and areas of softscaping.
	Leaching through unsaturated zone.	Groundwater and possible abstractors or aquatic ecosystems.	Low	Medium	Low	The geology beneath the site is an unproductive stratum with a secondary aquifer to the west. No groundwater abstractions in the vicinity of the site. Limited potential for migration of contamination through groundwater due to cohesive nature of underlying soils.
	Leaching through unsaturated zone, surface run-off, base flow from contaminated groundwater.	Surface water and possible abstractors or ecosystems.	Low	Medium	Low	No surface water features within 250m of the site other than small isolated ponds. No surface water abstractions in the vicinity of the site.
Ground gases (methane & carbon dioxide) from biodegradable matter in the Made Ground	Migration through soils or groundwater to indoor air.	End users of new buildings (asphyxiation or explosion).	Low likelihood	Severe	Moderate	Potential for Made Ground of unknown composition from possible raising of ground levels on northern section of the site. Unlikely risk to off-site users / properties due to anticipated clay strata beneath the site.
		Users of off-site properties (asphyxiation or explosion).	Unlikely	Severe	Low	
		Neighbouring properties (damage by explosion).	Unlikely	Severe	Low	
Radon	Migration through soils or groundwater to indoor air.	End users of new buildings.	No Linkage			BR 211 (2007) radon report indicates no precautions required. The Envirocheck report concurs.

3.3 **Geotechnical Hazard Identification**

The **ground model** has been used to develop a preliminary list of geotechnical hazards to inform the required scope of intrusive investigation works for managing the identified geotechnical risks. Potential geotechnical hazards are listed below:

- Uncontrolled Made Ground – excessive settlement (creep and inundation settlement or differential settlement) of foundations and roads.
- Attack of buried concrete by aggressive ground conditions – the development site may contain unknown Made Ground and potentially sulfate bearing soils.
- Shrink / swell of clay – settlement / heave of foundations when located within the influence of trees and vegetation.
- Slope instability - the development is potentially close to a steep slope. Typical instability causes are inappropriate cutting at the toe or loading at the crest of marginally stable slopes or re-activation of relict slip surfaces.

4.0 **DESK STUDY CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER WORK**

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

Based on historic land uses and its current operational use, the overall risk from land contamination at the site is considered to be **low** for the current development. However, for redevelopment of the site for a residential end use the overall risk from land contamination would be considered to be **low to moderate** but would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation.

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

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

Risk Category	Definition
Very High Risk	A significant contaminant linkage, including actual evidence of significant harm or significant possibility and significant harm, is clearly identifiable at the site (e.g. from visual or documentary evidence) under current conditions, with potential for legal and/or financial consequences for the site owner or other Responsible Person. Remediation advisable based on acute impacts being likely. Immediate action should be considered.
High Risk	A contaminant linkage is identifiable at the site under current and future use conditions. Although likely, there is no obvious actual evidence of significant harm or significant possibility and significant harm under current conditions. Extent of risk is therefore subject to confirmation by investigation and risk assessment and most likely to be deemed significant. Realisation of the risk is likely to present a substantial liability to the site owner or other Responsible Person. Remediation required for redevelopment and may also be required under Part 2A for existing receptors.
Moderate Risk	A contaminant linkage is identifiable at the site under current and future use conditions. However, it is not likely to be a significant linkage under current conditions. It is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Actual extent of risk subject to confirmation by additional investigation and risk assessment and most likely to lie between no possibility of harm (under current conditions) and significant possibility of significant harm (under conditions created by new use). Remediation may be required for redevelopment.
Low Risk	Potential pathways and receptors exist but history of contaminative use or site conditions indicates that contamination is likely to be of limited extent and below the level of possibility of harm. It is unlikely that the site owner or other Responsible Person would face substantial liabilities from such a risk. Precautionary investigations and risk assessment advisable on change of use. Any subsequent remedial works are likely to be relatively limited.
Very Low Risk	No contaminant linkage likely to exist under current or future conditions, but this cannot be completely discounted. If harm is realised, it is likely at worst to be mild or minor. Site not capable of being determined under Part 2A (in accordance with PPS23) where the Local Authority inspects the site. No further action recommended.
No Risk	No contaminant linkage exists.

5.0 UNCERTAINTIES AND LIMITATIONS

5.1 General Comments

This report details the findings of work carried out in April 2013. The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all potential environmental constraints or liabilities associated with the site may not have been revealed.

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

Information provided by third parties has been used in good faith and is taken at face value; however, Hydrock cannot guarantee its accuracy or completeness.

The work has been carried out in general accordance with recognised best practice as detailed in guidance documents such as the CLR 11 Model Procedures (Environment Agency 2004), BS5930:1999 +A2:2010 and BS10175:2011. Important aspects of the risk assessment process are transparency and justification. The rationale behind the assessments carried out for this report is given in Appendix E. Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance.

Where the phrase “suitable for use” is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

Unless otherwise stated, the chemical testing carried out for this report was not scoped to comply with the requirements of the water supply company and further work may be required.

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

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

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

6.0 RECOMMENDATIONS FOR FURTHER WORK

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

- the excavation of trial pits to allow collection of samples for geotechnical and chemical analysis, to assess trench stability and identify a suitable founding stratum;
- gas monitoring installations in window sample boreholes to allow gas concentrations to be monitored if potentially gas generating material is identified within the trial pitting exercise;
- gas concentration and groundwater level monitoring if required;
- geotechnical testing of soils; and
- contamination analyses of soil and groundwater, if encountered and deemed necessary.

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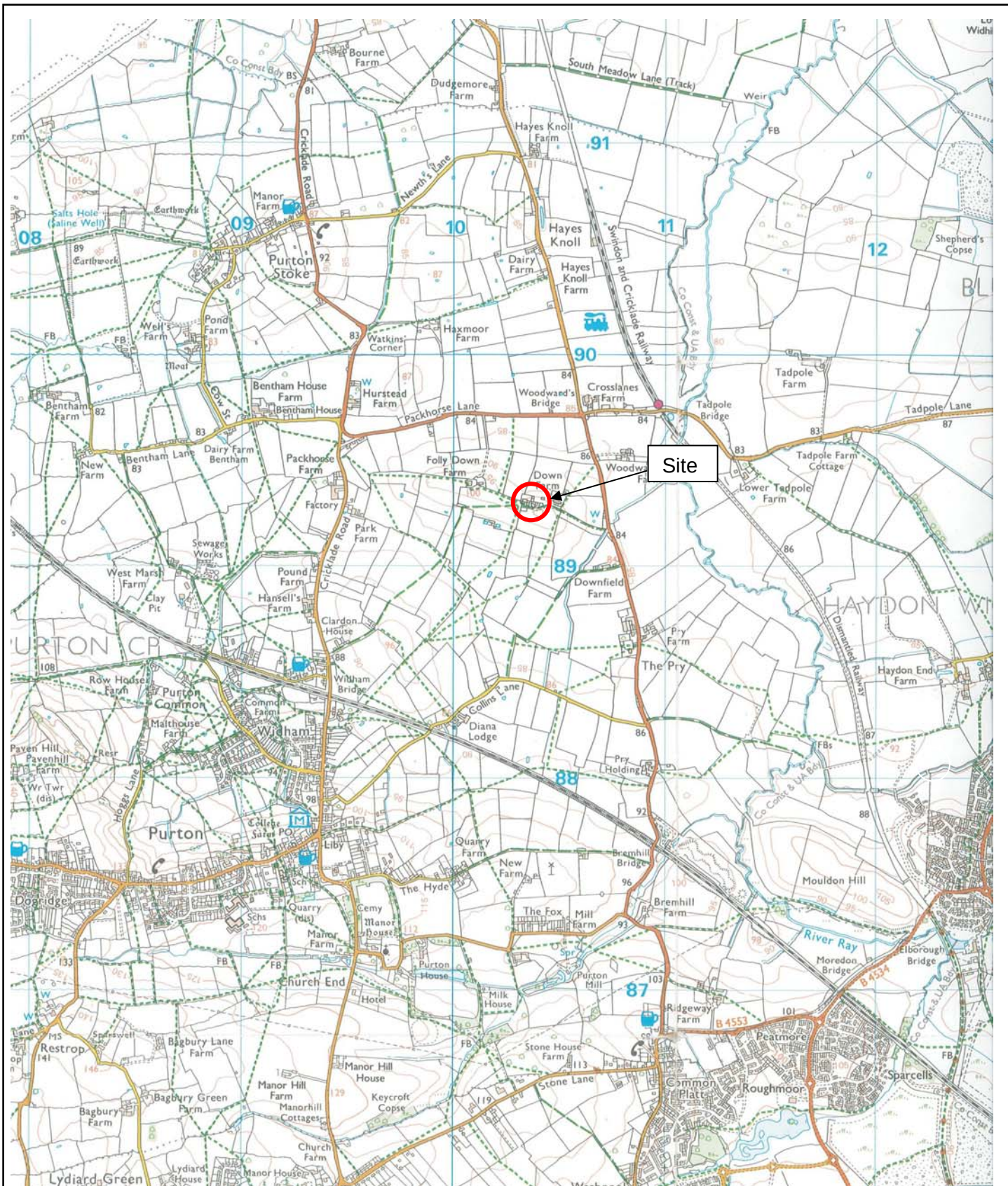
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Appendix A

DRAWINGS

Drawings Included in this report:

- 13144/G001 – Site Location Plan
- Site layout as existing provided by Mathewson Waters Architects



Reproduced from Cirencester and Swindon OS Explorer map [169 1:25 000] by permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office. © Crown copyright. All rights reserved. Licence number 100023353.

Client: Mr Fred Cremin

Site: Down Farm, The Pry

Drawing No: 13144/G001

Title: Site Location Plan

Scale: NTS

Hydrock
Consultants

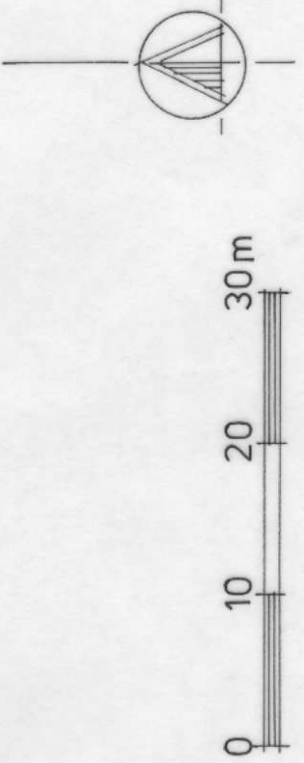
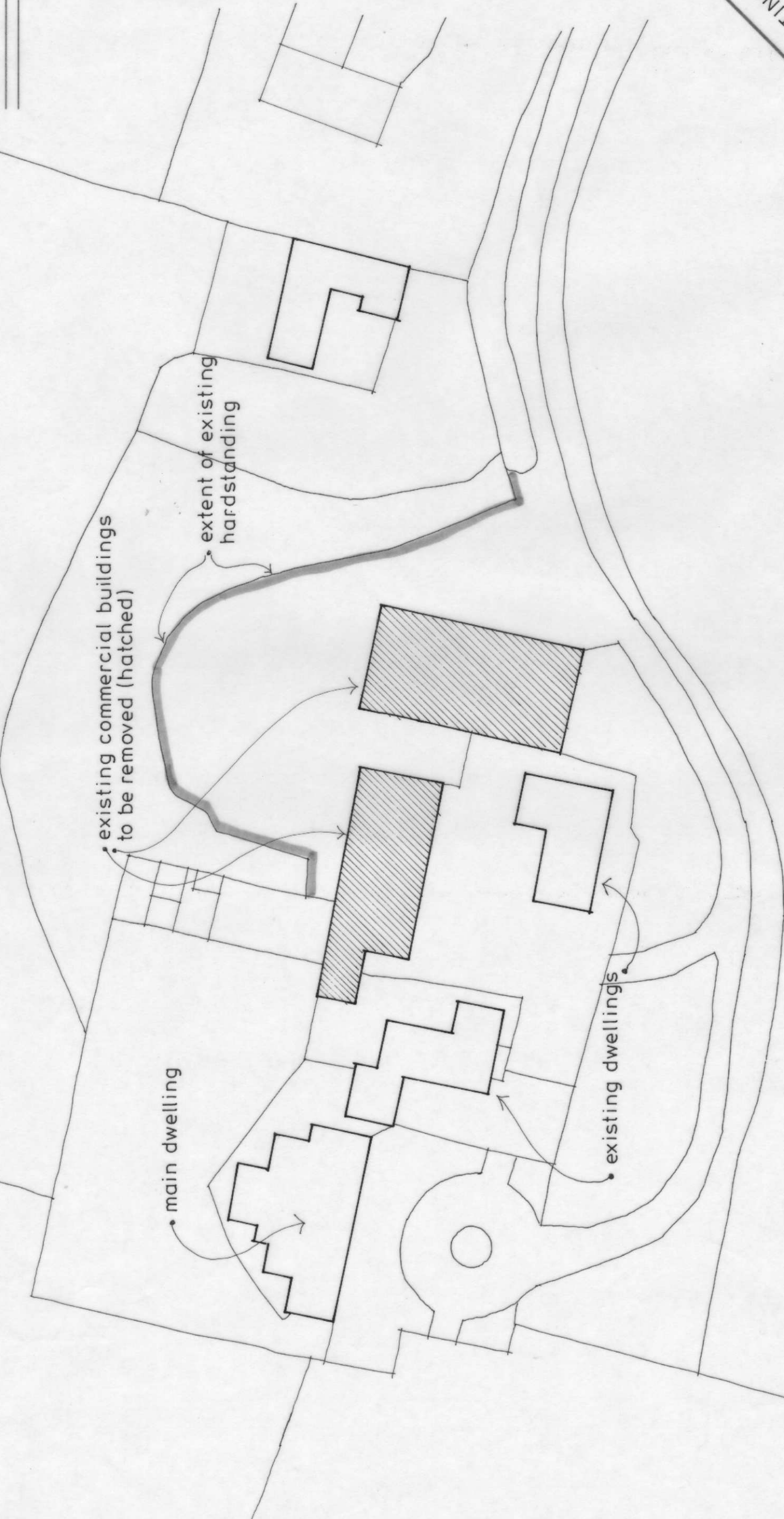
Over Court Barns
Over Lane
Almondsbury
Bristol BS32 4DF

Tel: +44 (0)1454 619 533
Fax: +44 (0)1454 614 125

ALL FIGURED DIMENSIONS ARE TO BE TAKEN IN PREFERENCE TO SCALED DIMENSIONS AND ANY INACCURACIES ARE TO BE REPORTED TO THE ARCHITECT.

DIMENSIONS TO BE CHECKED ON SITE BEFORE ANY WORK IS PUT IN HAND OR PREFABRICATED.

COPYRIGHT OF THIS DRAWING IS RETAINED BY THE ARCHITECT AND IT MUST NOT BE REPRODUCED WITHOUT HIS WRITTEN CONSENT.



SITE LAYOUT AS EXISTING

MATHEWSON WATERS ARCHITECTS

1:500

Project: FOUR SQUARE DESIGN LTD
The Old Surgery, Crowle Road, Lambourn, Berkshire, RG17 8NR
Telephone: (01488) 73131, Facsimile: (01488) 73207
Studio also at: 3, Walnut House, Eyre Road, Devizes, Wiltshire, SN10 5NK, Tel: (01286) 721954

Appendix B

SITE WALKOVER PHOTOGRAPHS



Figure 1: Western workshop used for carpentry / joinery looking north



Figure 2: Internal view of the western building



Figure 3: Eastern building used for general storage purposes looking southeast



Figure 4: View inside eastern building used for general storage



Figure 5: Storage of general equipment in eastern building.

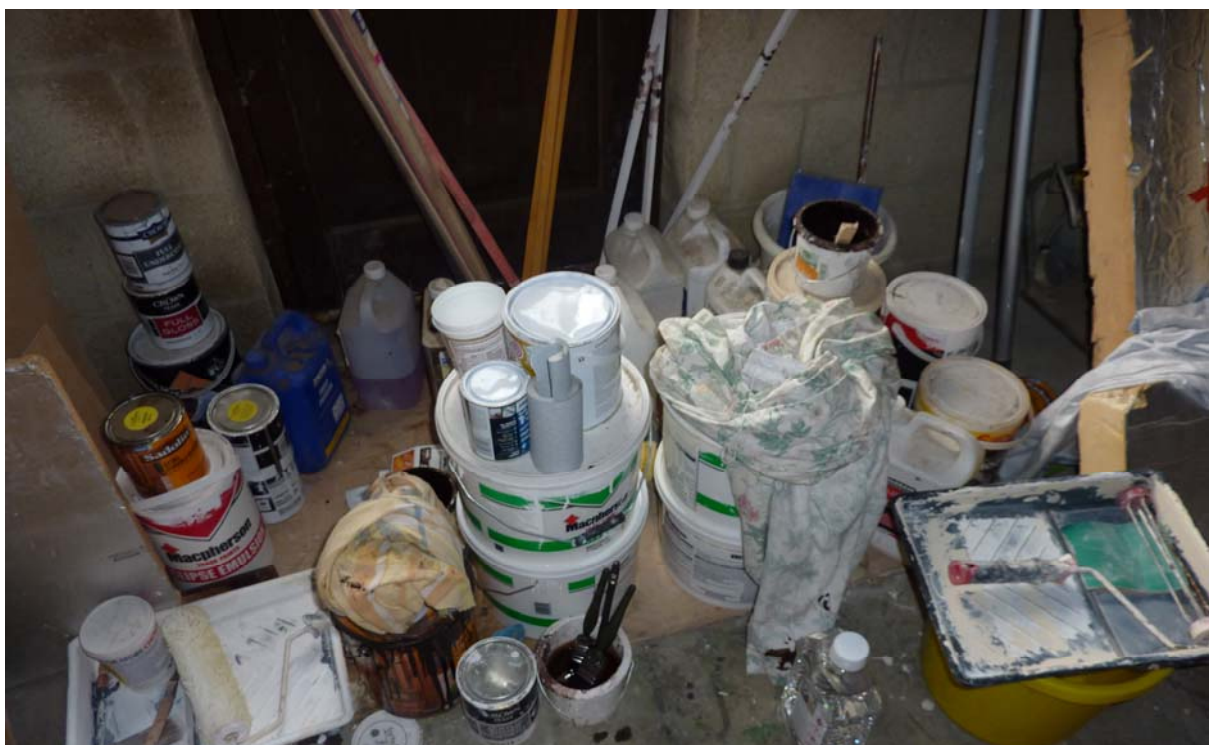


Figure 6: Paint equipment storage in eastern building



Figure 7: Staining on concrete floor beneath JCB in eastern building



Figure 8: Static caravan to rear of western building looking northeast



Figure 9: Above ground fuel tank



Figure 10: Domestic sewage treatment unit



Figure 11: Slope along northern boundary down to adjacent field.



Figure 12: Storage of building materials on northern site area.



Figure 13: Skips on northern site area.



Figure 14: Possible asbestos containing material near skips on northern site area.



Figure 15: Bonfire on northeastern site boundary



Figure 16: Manhole cover along north eastern site boundary. Off-site stables beyond.



Figure 17: Vegetable garden in north western section of the site.



Figure 18: Fuel tank for adjacent property to the west.



Figure 19: Converted barns to west of site.

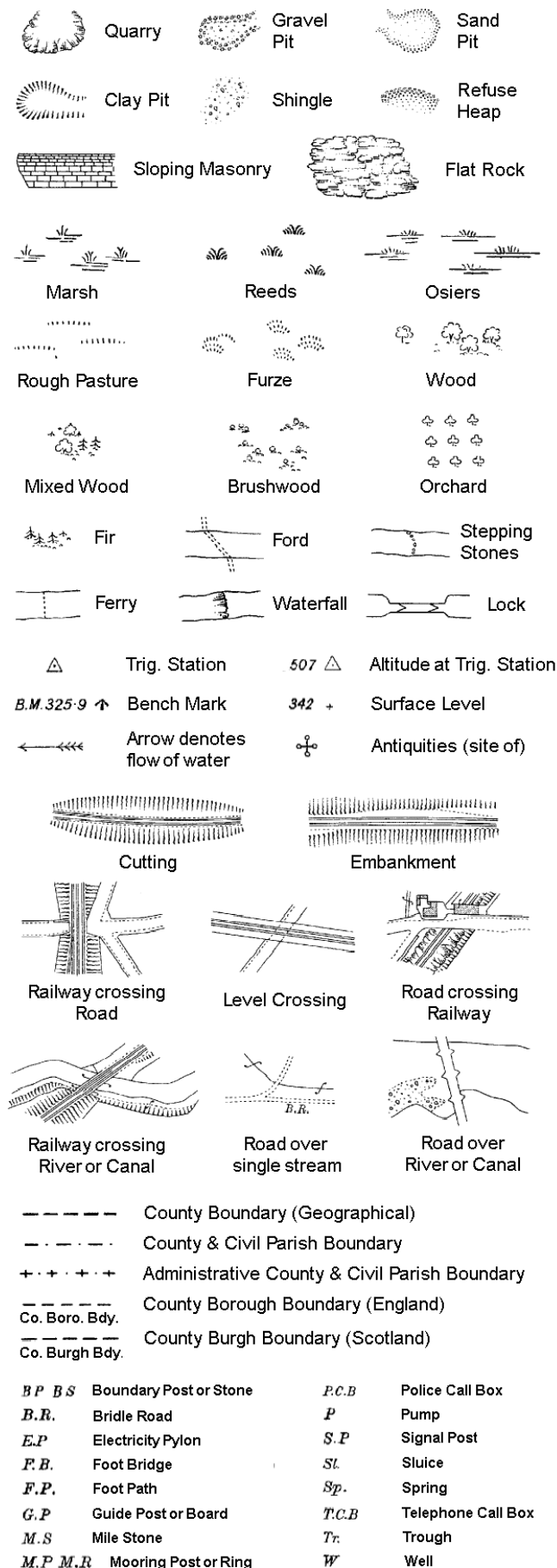
Appendix C

HISTORICAL ORDNANCE SURVEY MAPS

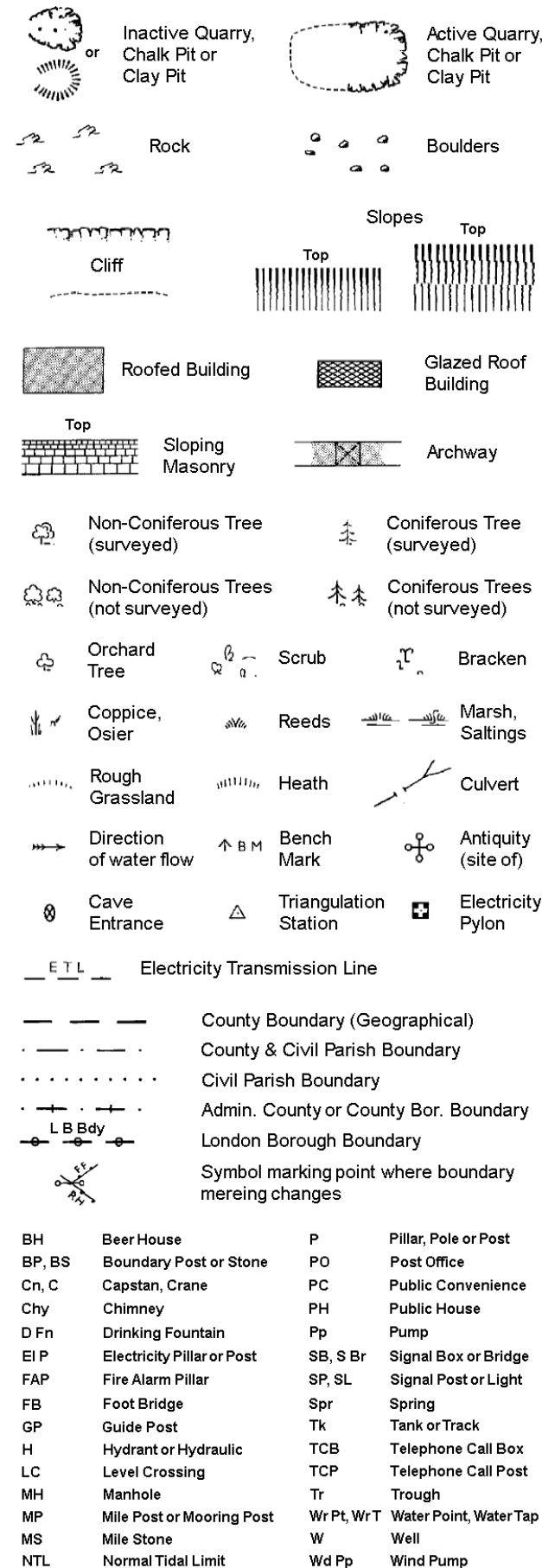
This appendix may not be included in the printed report to reduce the document size.
It is presented in the PDF version of the report on the CD enclosed with the printed report.

Historical Mapping Legends

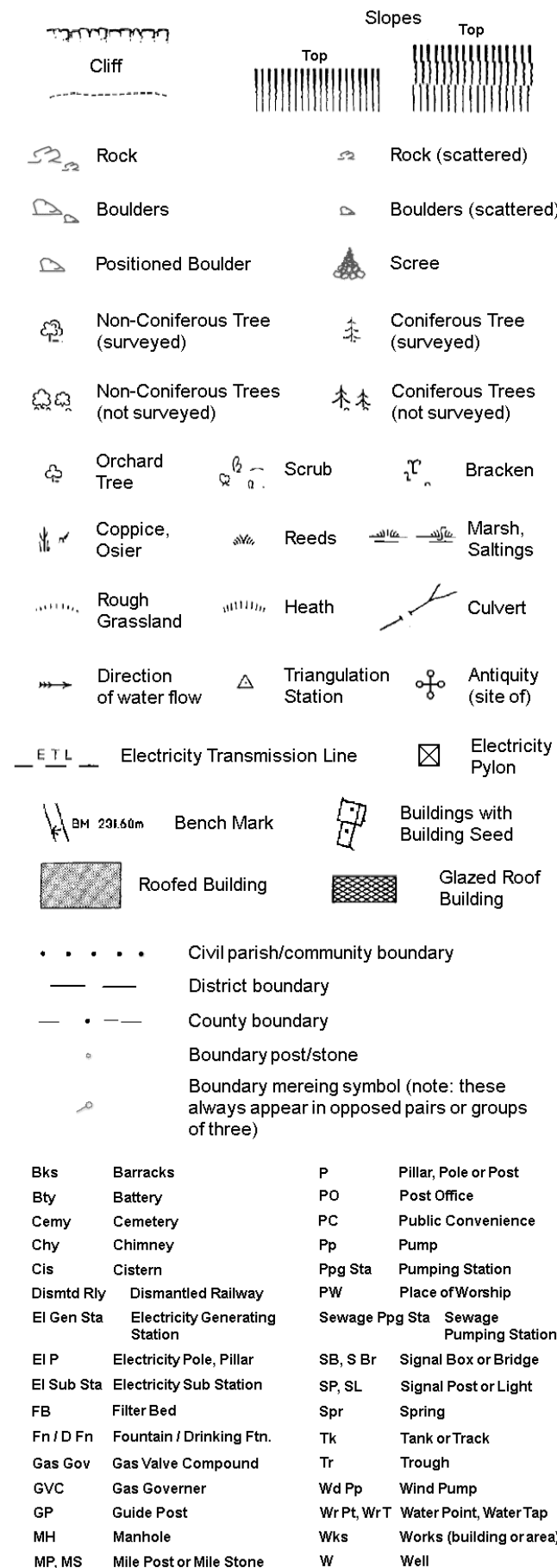
Ordnance Survey County Series and Ordnance Survey Plan 1:2,500



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



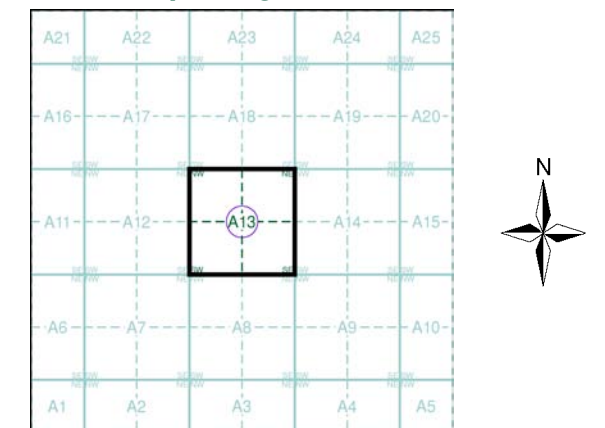
Large-Scale National Grid Data 1:2,500 and 1:1,250



Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Wiltshire	1:2,500	1875	2
Wiltshire	1:2,500	1900	3
Wiltshire	1:2,500	1923	4
Ordnance Survey Plan	1:2,500	1970	5
Additional SIMs	1:2,500	1989	6
Large-Scale National Grid Data	1:2,500	1993	7

Historical Map - Segment A13



Order Details

Order Number: 44751727_1_1
Customer Ref: C13144
National Grid Reference: 410370, 189290
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 100

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



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

Wiltshire

Published 1875

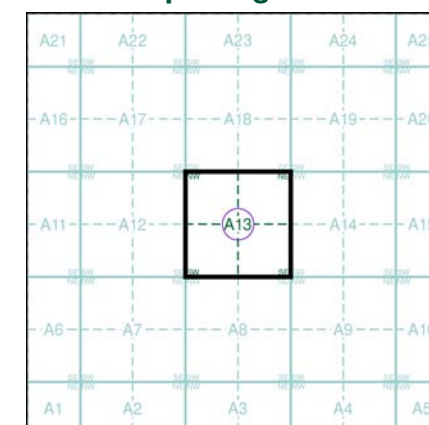
Source map scale - 1:2,500

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)

010_06
1875
1:2,500
010_10
1875
1:2,500

Historical Map - Segment A13

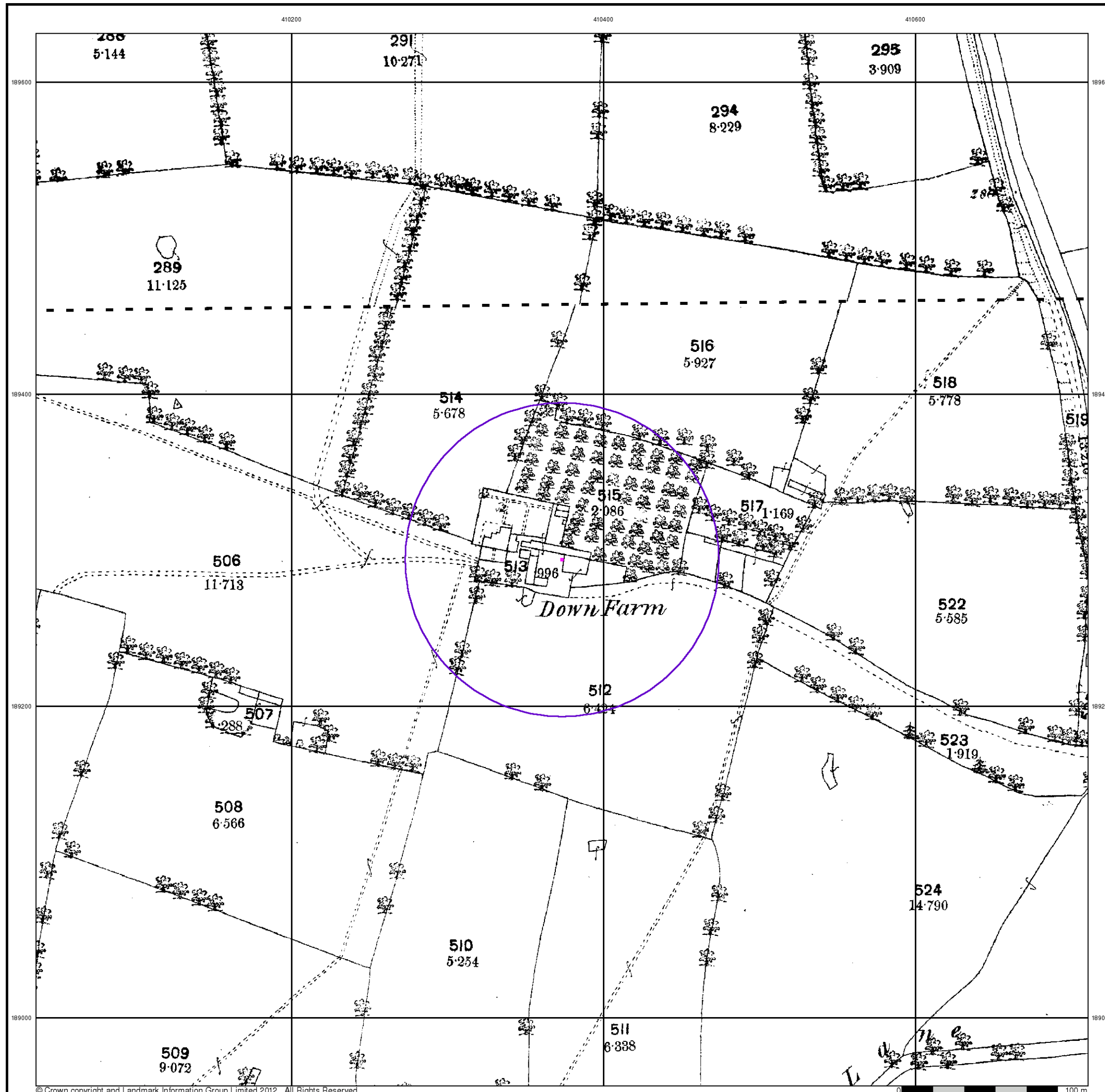


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 100

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Wiltshire

Published 1900

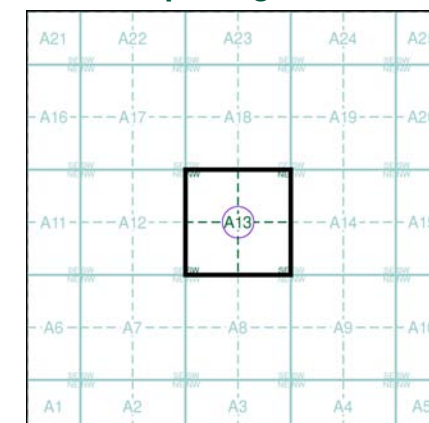
Source map scale - 1:2,500

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)

010_06
1900
1:2,500
010_10
1900
1:2,500

Historical Map - Segment A13

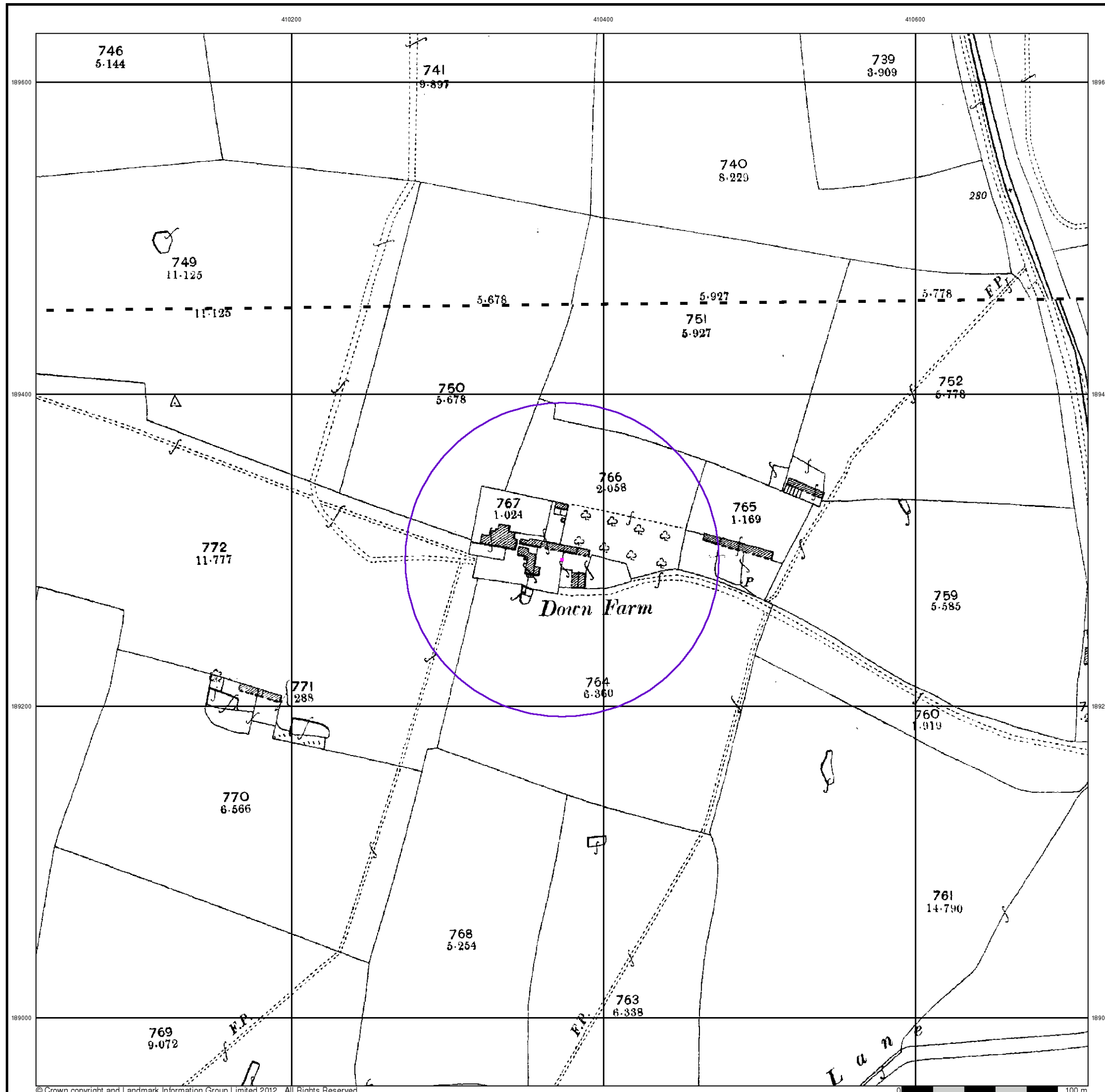


Order Details

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 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 100

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Wiltshire

Published 1923

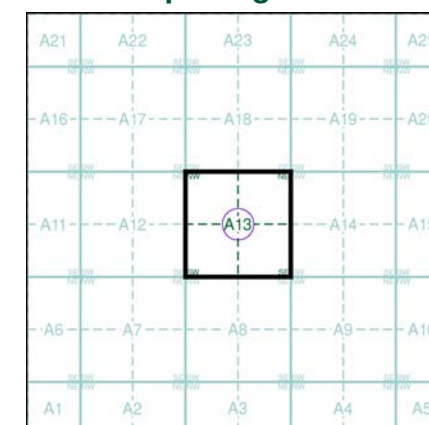
Source map scale - 1:2,500

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)

010_06
1923
1:2,500
010_10
1923
1:2,500

Historical Map - Segment A13

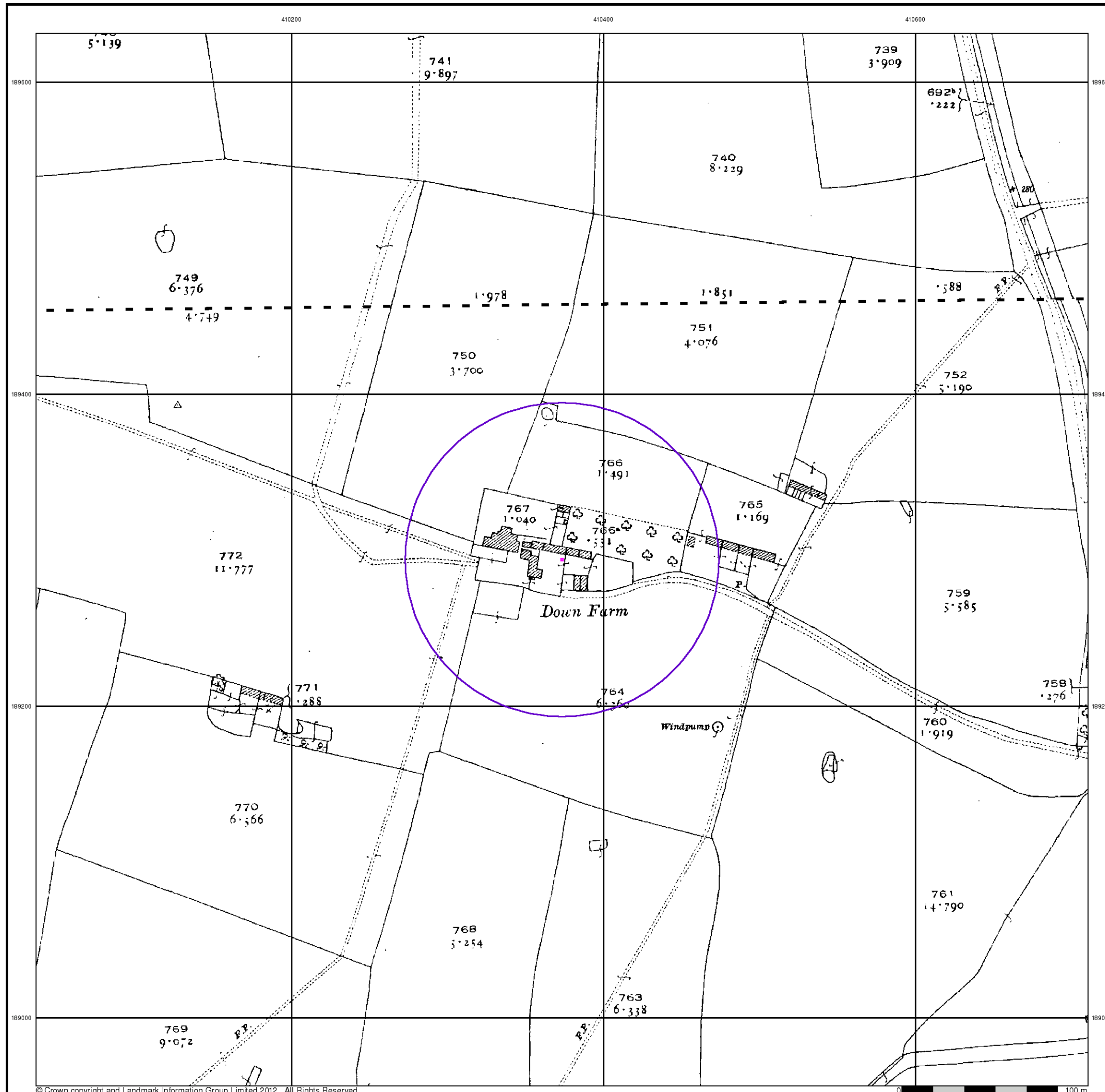


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 100

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Ordnance Survey Plan

Published 1970

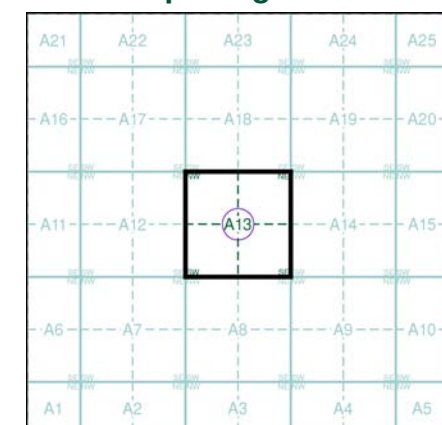
Source map scale - 1:2,500

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)

SU1089	1970	1:2,500
SU1088	1970	1:2,500

Historical Map - Segment A13

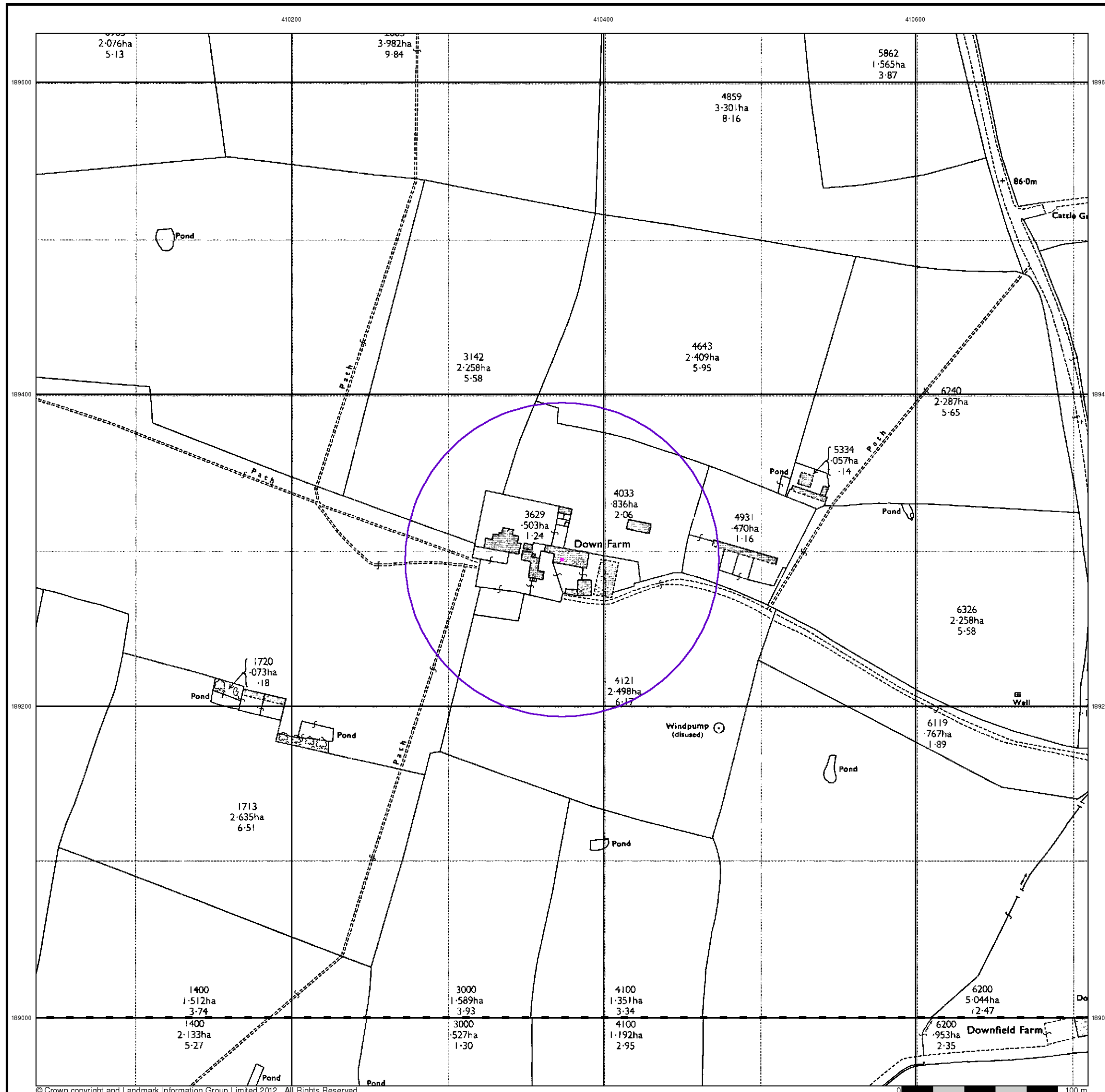


Order Details

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 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
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 Search Buffer (m): 100

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



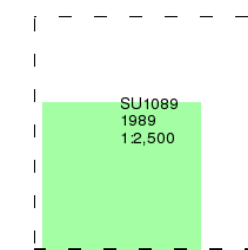
Additional SIMs

Published 1989

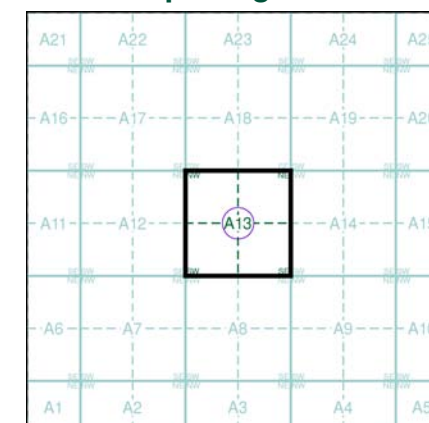
Source map scale - 1:2,500

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

Map Name(s) and Date(s)



Historical Map - Segment A13

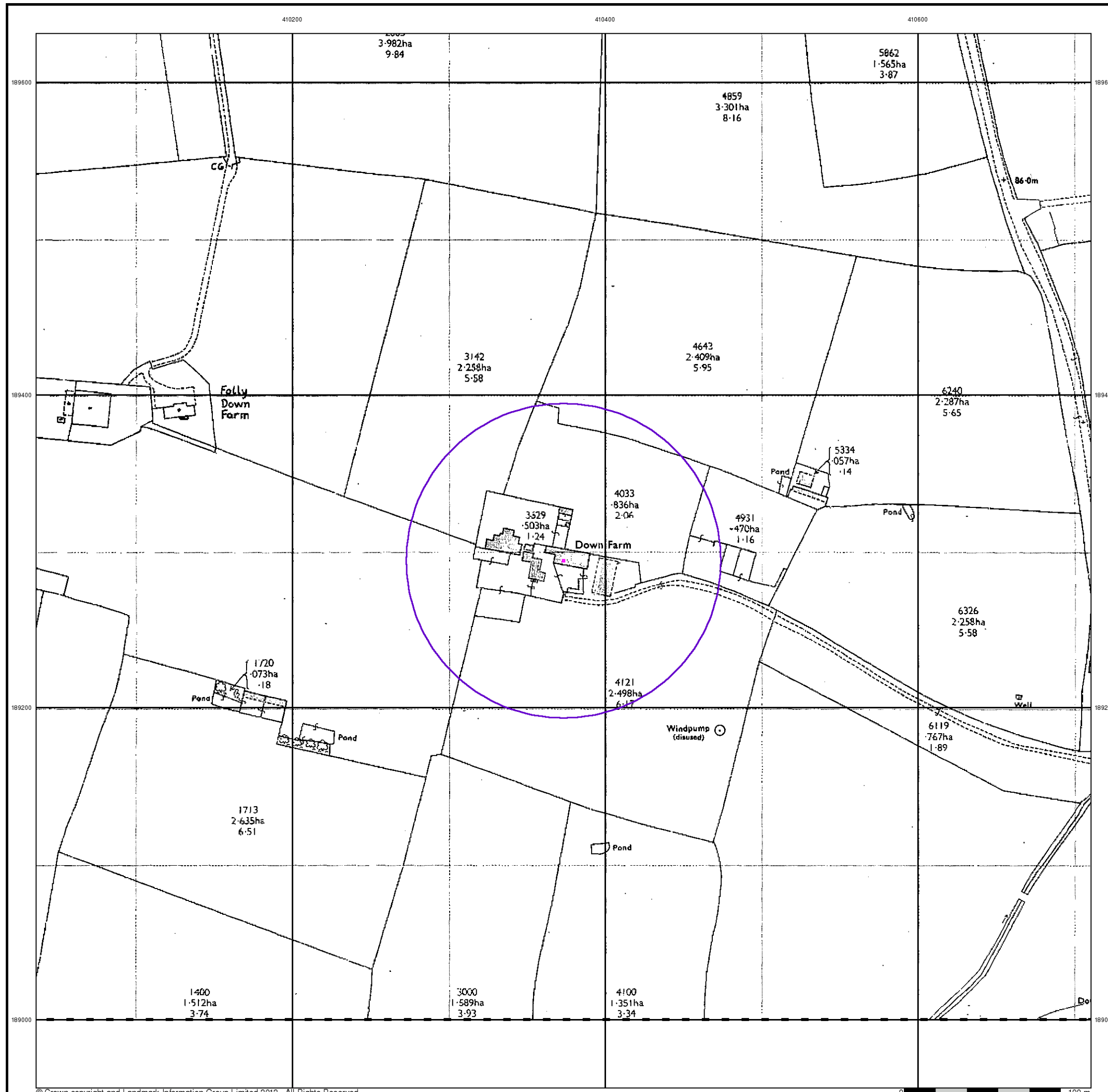


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 100

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Large-Scale National Grid Data

Published 1993

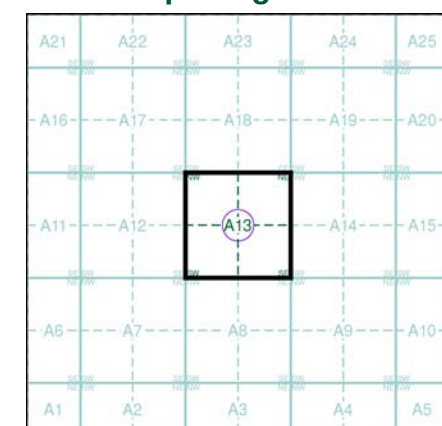
Source map scale - 1:2,500

'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)

SU1089	I
1993	I
1:2,500	I
SU1088	I
1993	I
1:2,500	I

Historical Map - Segment A13

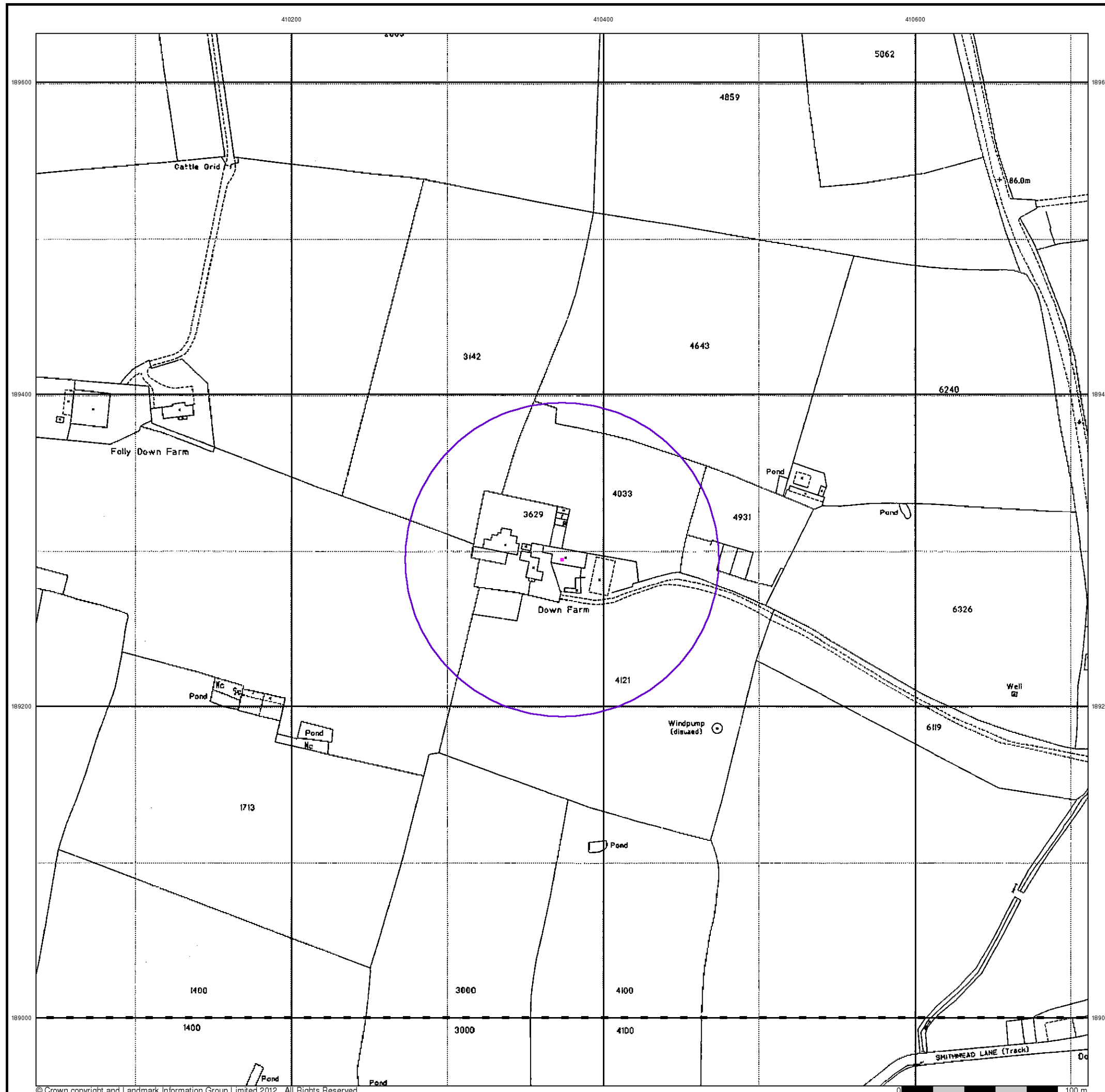


Order Details

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 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 100

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



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		Minor Roads		
	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				
	County Borough Boundary (England)				
	County Burgh Boundary (Scotland)				
	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
	Bracken		Heath
	Marsh		Reeds
	Building		Glasshouse
	Sloping Masonry		Pylon
	Cutting		Embankment
	Road Under		Road Over
	Level Crossing		Foot Bridge
	Standard Gauge Multiple Track		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
	Civil Parish		
	BP, BS Boundary Post or Stone		Police Station
	Church		Post Office
	Club House		Public Convenience
	Fire Engine Station		Public House
	Foot Bridge		Signal Box
	Fountain		Spring
	Guide Post		Telephone Call Box
	Mile Post		Telephone Call Post
	Mile Stone		Well

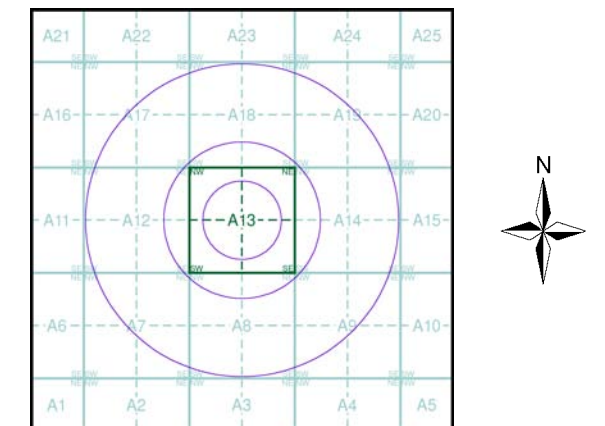
1:10,000 Raster Mapping

	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
	Mean high water (springs)		Mean low water (springs)
	Telephone line (where shown)		Electricity transmission line (with poles)
	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

Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Wiltshire	1:10,560	1887	3
Wiltshire	1:10,560	1900	4
Wiltshire	1:10,560	1925	5
Historical Aerial Photography	1:10,560	1945 - 1948	6
Ordnance Survey Plan	1:10,000	1960 - 1961	7
Ordnance Survey Plan	1:10,000	1973 - 1976	8
Ordnance Survey Plan	1:10,000	1984	9
Swindon	1:10,000	1988	10
Ordnance Survey Plan	1:10,000	1990 - 1992	11
10K Raster Mapping	1:10,000	2006	12
10K Raster Mapping	1:10,000	2012	13

Historical Map - Slice A



Order Details

Order Number: 44751727_1_1
Customer Ref: C13144
National Grid Reference: 410370, 189290
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

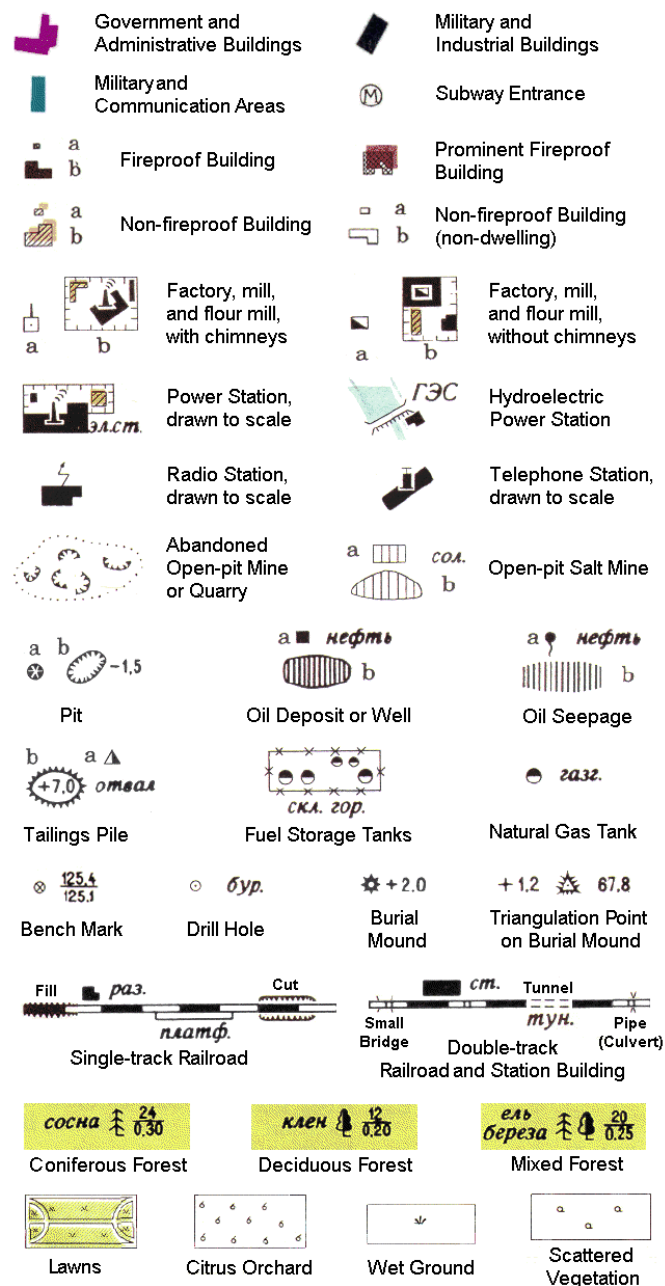
Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP

Russian Military Mapping Legends

1:5,000 and 1:10,000 mapping

a. Not drawn to scale b. Drawn to scale



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

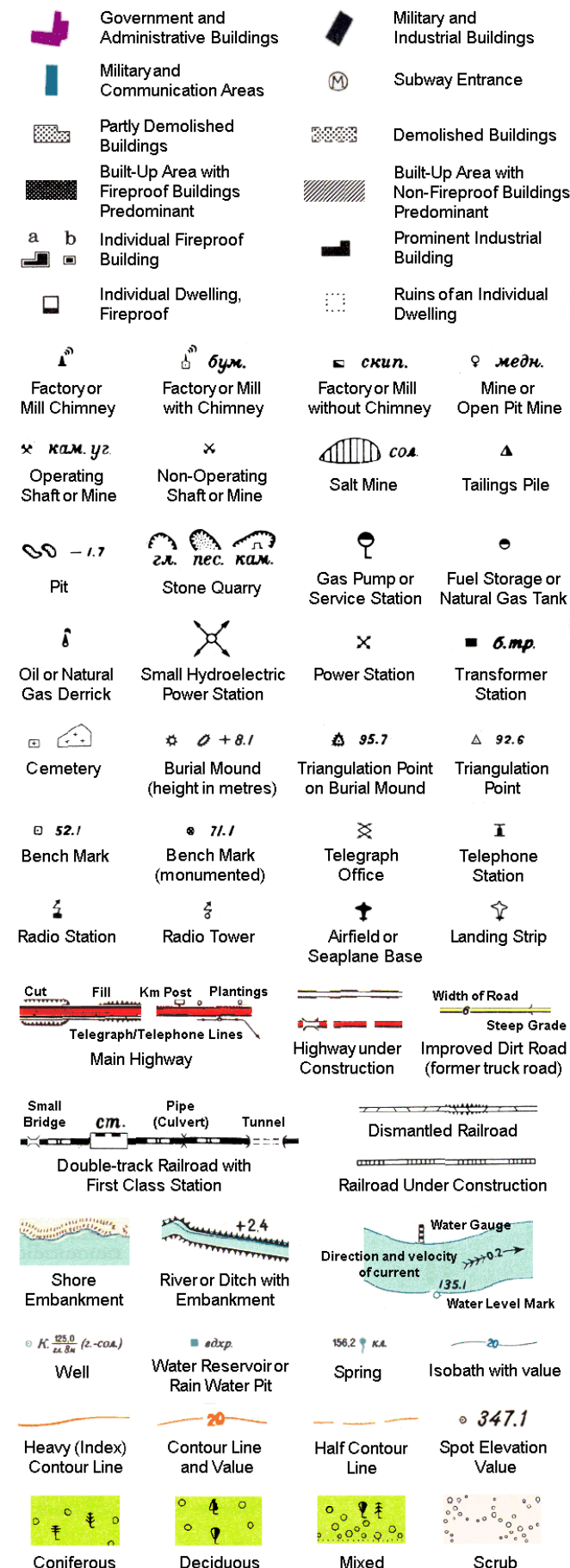
180/12 Fractional terms: length and capacity of bridges; depth of fords and condition of the river bottom; height of forest and the diameter of trees

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



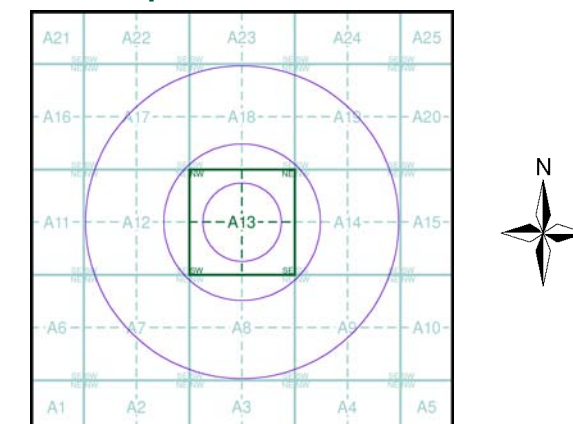
Key to Numbers on Mapping



Historical Mapping & Photography included:

Mapping Type	Scale	Date	Pg
Wiltshire	1:10,560	1887	3
Wiltshire	1:10,560	1900	4
Wiltshire	1:10,560	1925	5
Historical Aerial Photography	1:10,560	1945 - 1948	6
Ordnance Survey Plan	1:10,000	1960 - 1961	7
Ordnance Survey Plan	1:10,000	1973 - 1976	8
Ordnance Survey Plan	1:10,000	1984	9
Swindon	1:10,000	1988	10
Ordnance Survey Plan	1:10,000	1990 - 1992	11
10K Raster Mapping	1:10,000	2006	12
10K Raster Mapping	1:10,000	2012	13

Russian Map - Slice A



Order Details

Order Number: 44751727_1_1

Customer Ref: C13144

National Grid Reference: 410370, 189290

Slice: A

Site Area (Ha): 0.01

Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



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

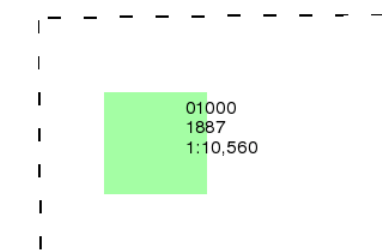
Wiltshire

Published 1887

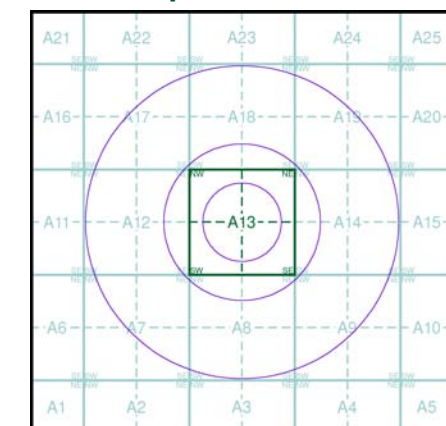
Source map scale - 1:10,560

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

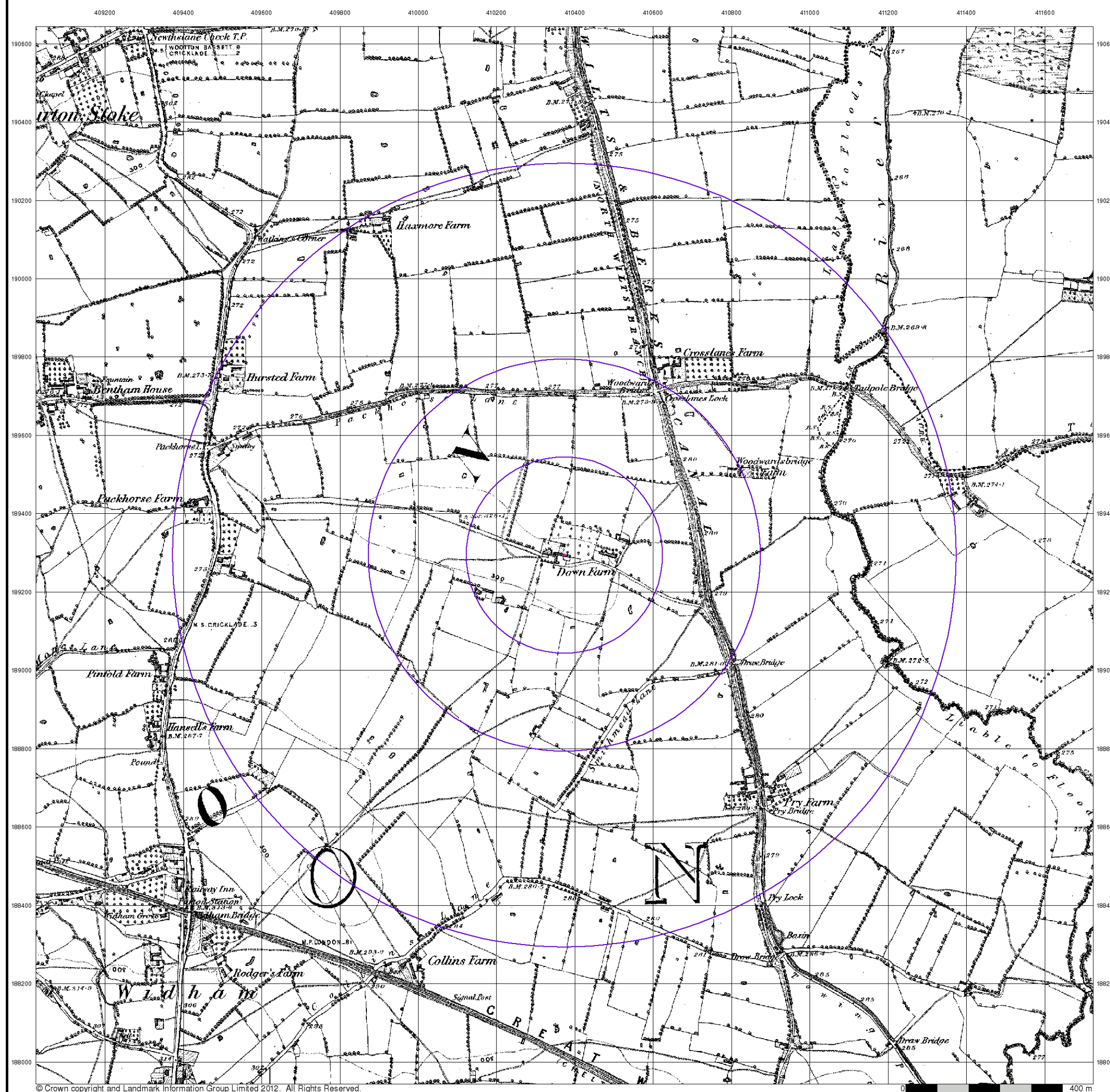


Order Details

Order Number: 44751727_1_1
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 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Wiltshire

Published 1900

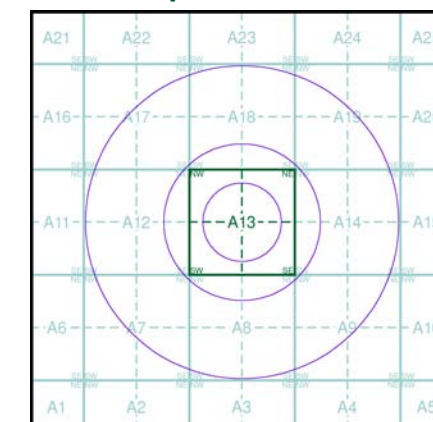
Source map scale - 1:10,560

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)

010NW	1900	1:10,560
010SW	1900	1:10,560

Historical Map - Slice A

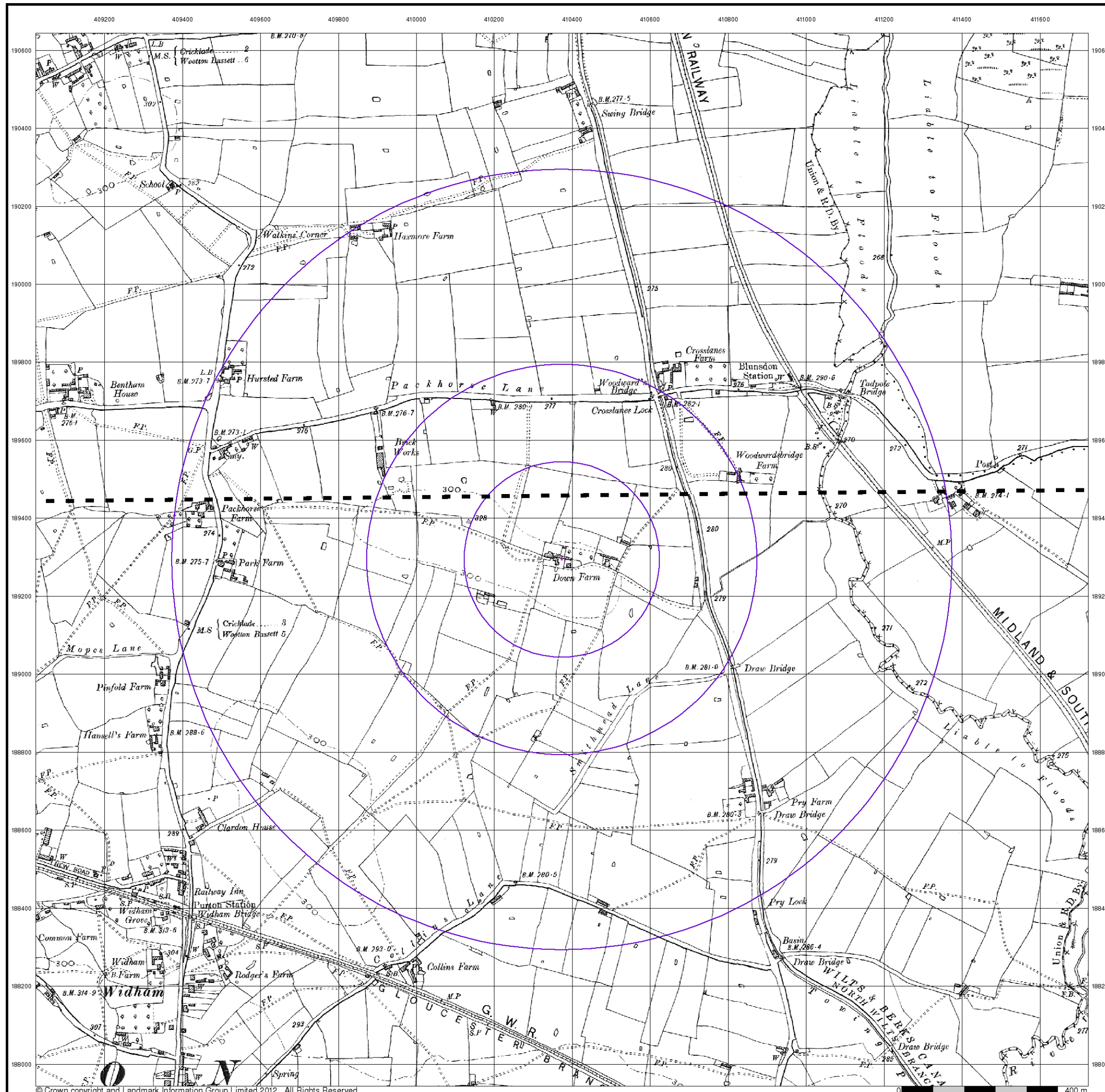


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Wiltshire

Published 1925

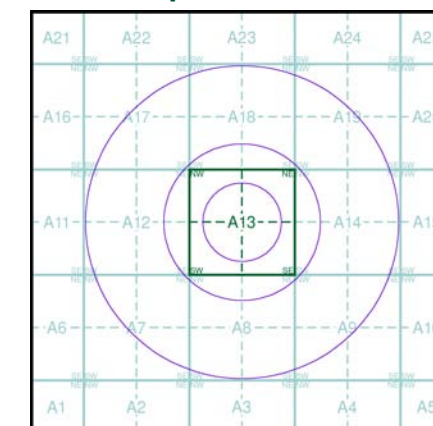
Source map scale - 1:10,560

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)

010NW	1925	1:10,560
010SW	1925	1:10,560

Historical Map - Slice A

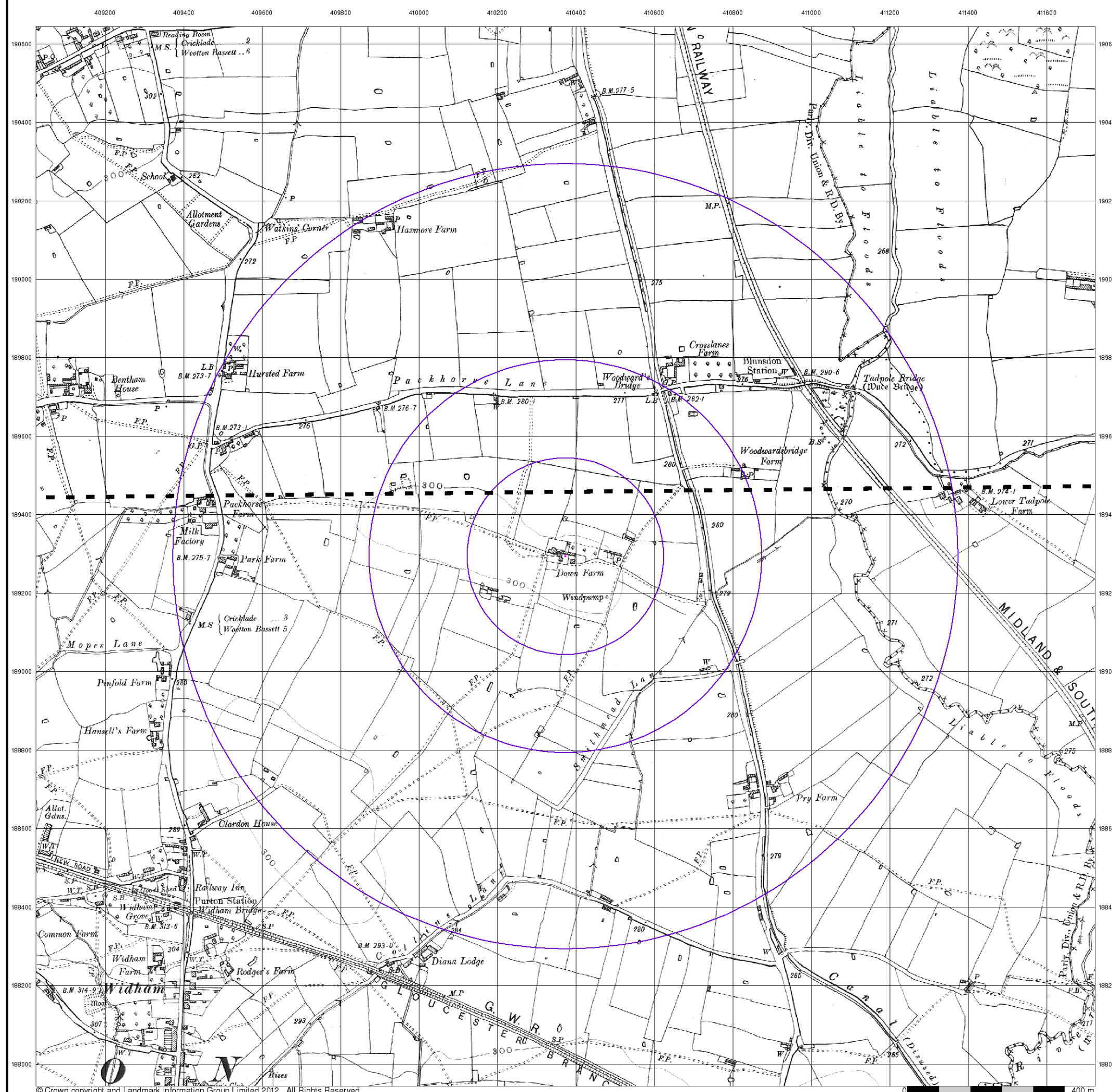


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Historical Aerial Photography

Published 1945 - 1948

Source map scale - 1:10,560

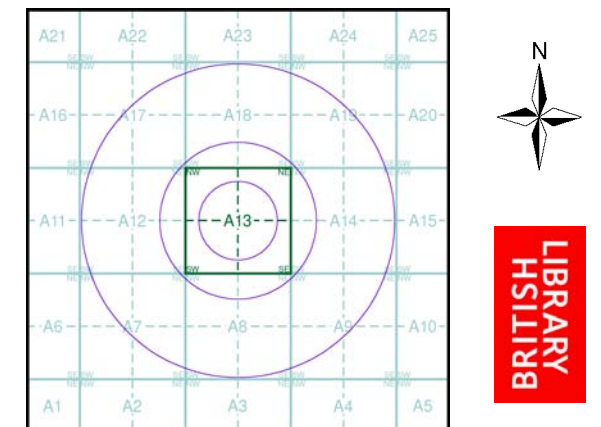
The Historical Aerial Photos were produced by the Ordnance Survey at a scale of 1:1,250 and 1:10,560 from Air Force photography. They were produced between 1944 and 1951 as an interim measure, pending preparation of conventional mapping, due to post war resource shortages. New security measures in the 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)

SU09SE 1945 1:10,560	SU19SW 1945 1:10,560
SU08NE 1945 1:10,560	SU18NW 1948 1:10,560

Historical Aerial Photography - Slice A



Order Details

Order Number: 44751727_1_1
Customer Ref: C13144
National Grid Reference: 410370, 189290
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP

Ordnance Survey Plan

Published 1960 - 1961

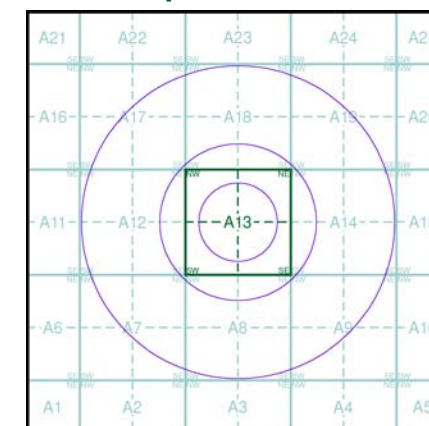
Source map scale - 1:10,000

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)

SU09SE	SU19SW
1960	1960
1:10,560	1:10,560
SU08NE	SU18NW
1960	1961
1:10,560	1:10,560

Historical Map - Slice A

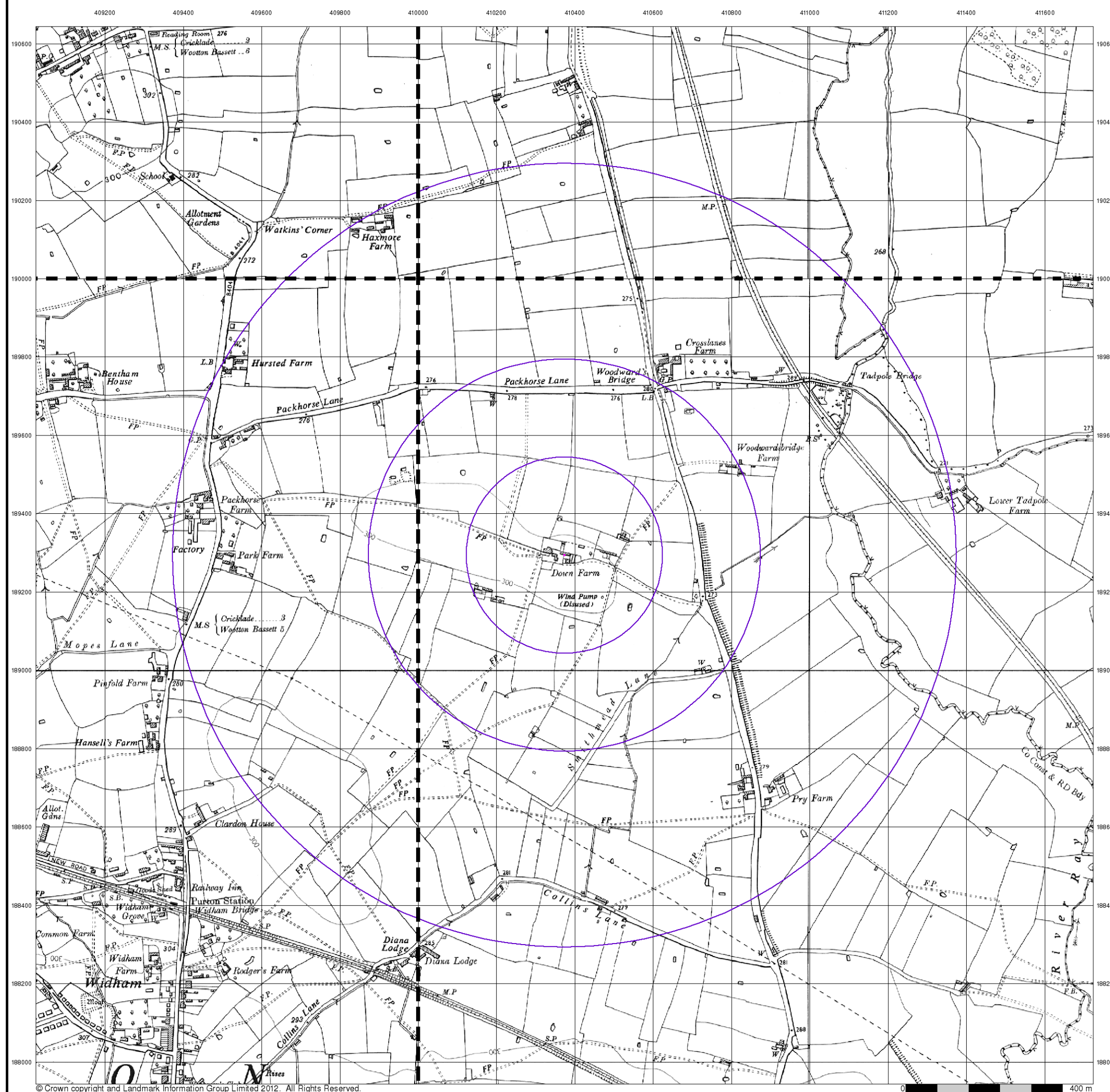


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Ordnance Survey Plan

Published 1973 - 1976

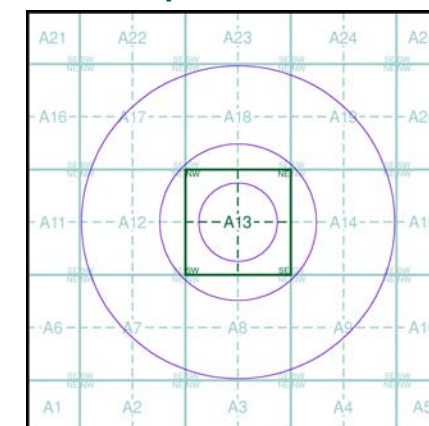
Source map scale - 1:10,000

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)

SU09SE	SU19SW
1975	1976
1:10,000	1:10,000
SU08NE	SU18NW
1973	1973
1:10,000	1:10,000

Historical Map - Slice A

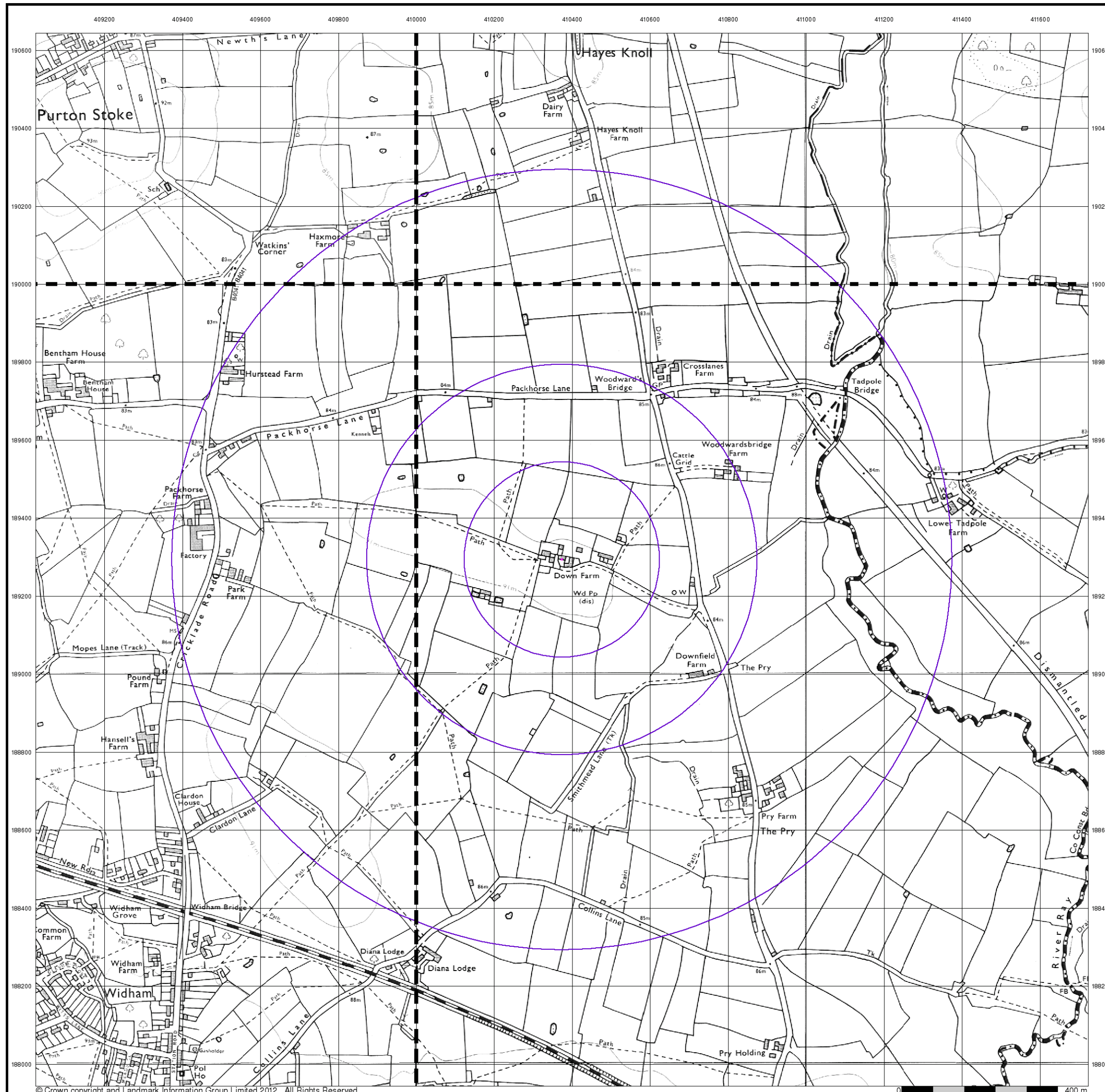


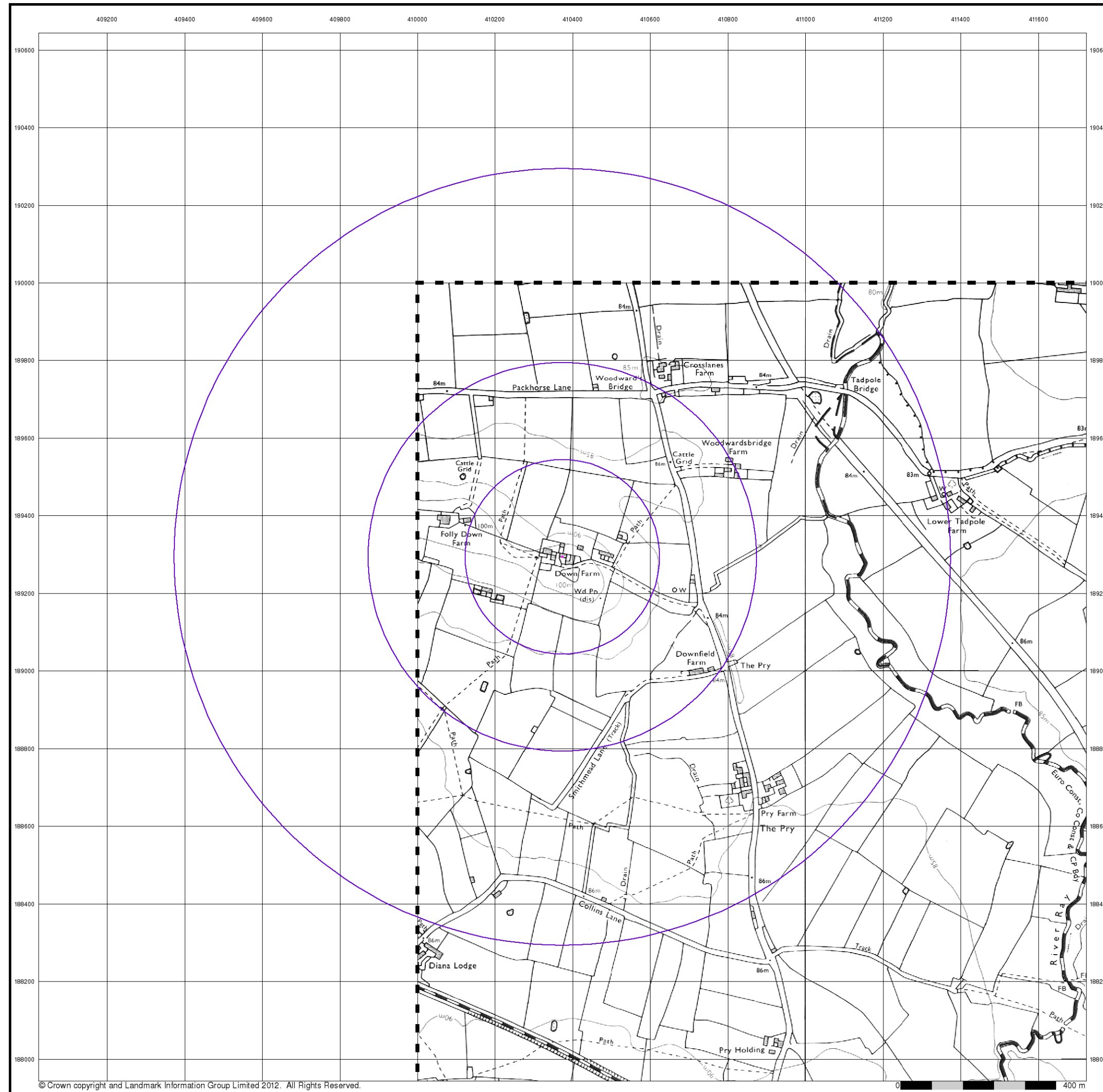
Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP





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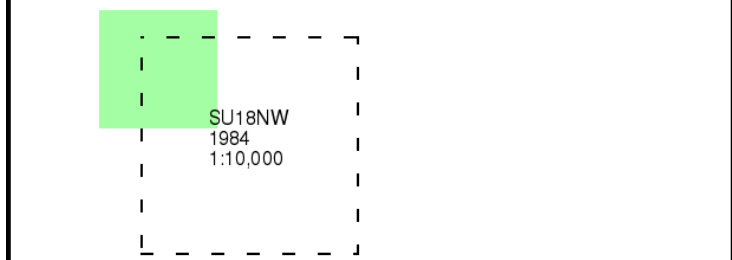
Ordnance Survey Plan

Published 1984

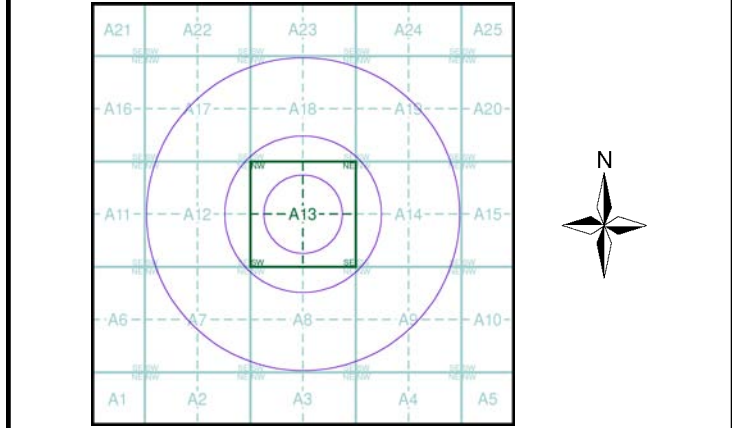
Source map scale - 1:10,000

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:	44751727_1_1
Customer Ref:	C13144
National Grid Reference:	410370, 189290
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details
The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Ordnance Survey Plan

Published 1990 - 1992

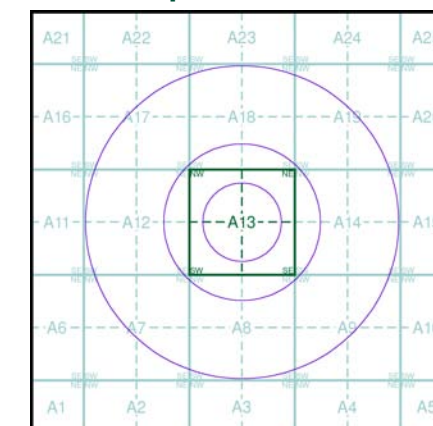
Source map scale - 1:10,000

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)

SU19SW	1990	1:10,000
SU08NE	1992	1:10,000
SU18NW	1990	1:10,000

Historical Map - Slice A

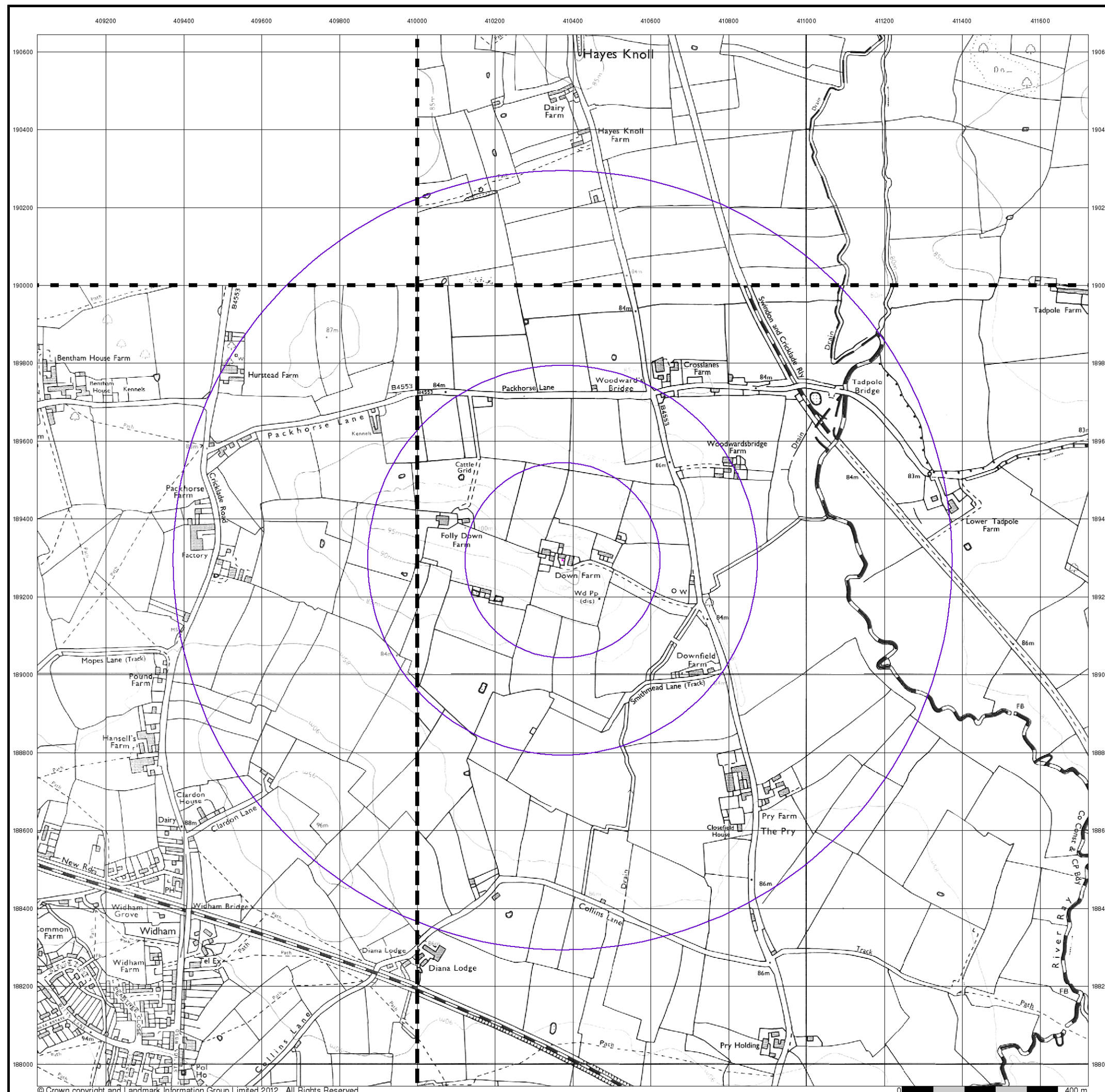


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



10k Raster Mapping

Published 2012

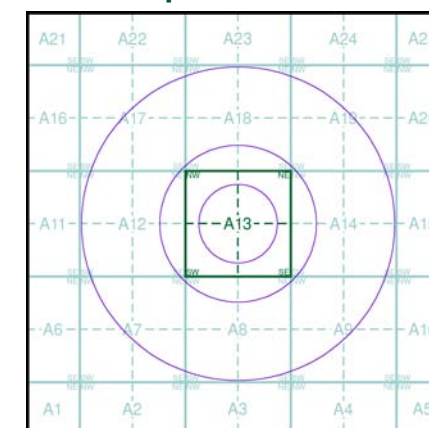
Source map scale - 1:10,000

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)

SU09SE	SU19SW
2012	2012
1:10,000	1:10,000
SU08NE	SU18NW
2012	2012
1:10,000	1:10,000

Historical Map - Slice A

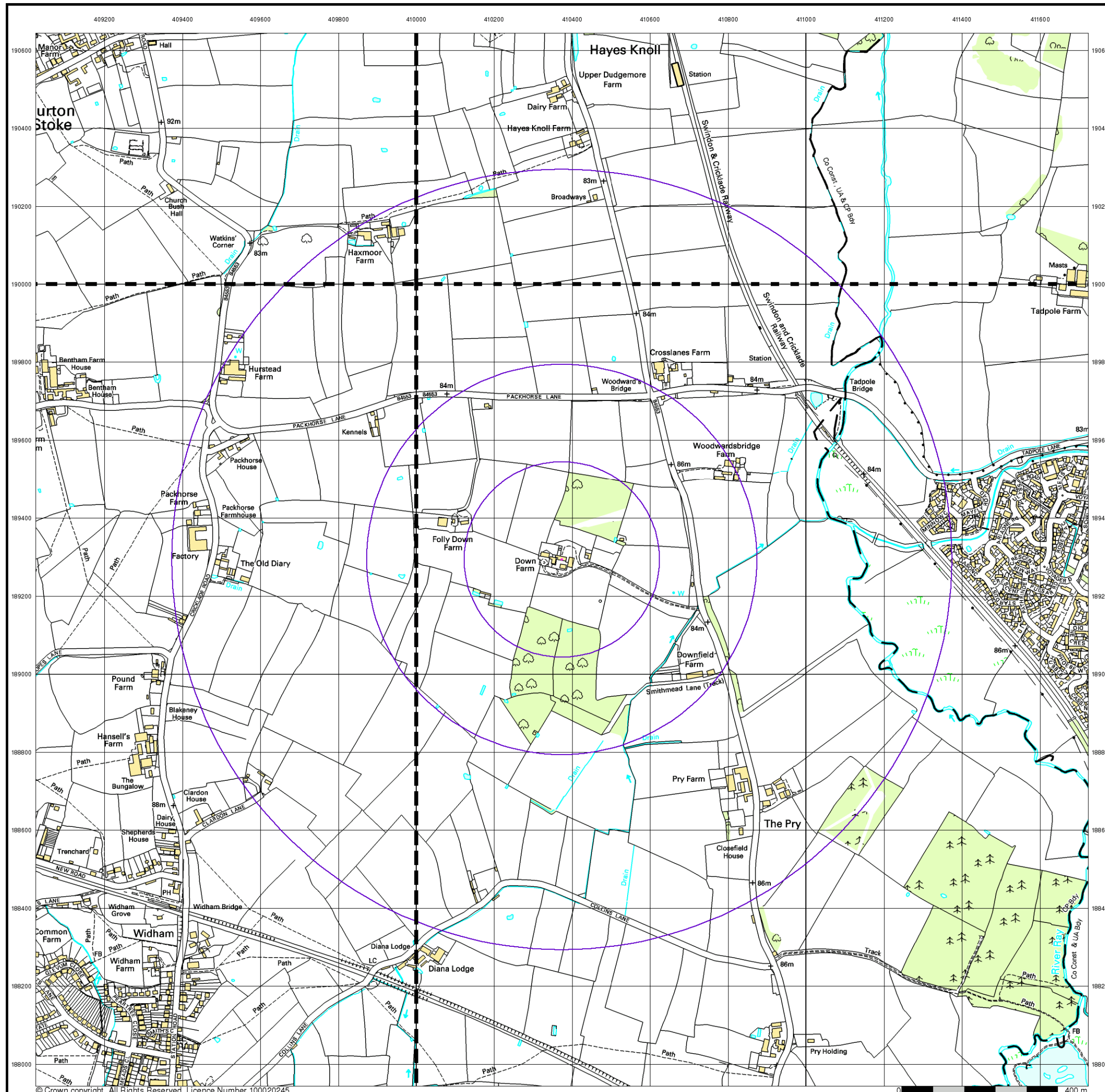


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



Appendix D

DESK STUDY RESEARCH INFORMATION

This appendix may not be included in the printed report to reduce the document size.
It is presented in the PDF version of the report on the CD enclosed with the printed report.

Envirocheck[®] Report:

Datasheet

Order Details:

Order Number:

44751727_1_1

Customer Reference:

C13144

National Grid Reference:

410370, 189290

Slice:

A

Site Area (Ha):

0.01

Search Buffer (m):

1000

Site Details:

The Old Cottage, Down Farm, The Pry
Purton, Purton Stoke
SWINDON
SN5 4JP

Client Details:

MS R Robertson
Hydrock Consultants
Over Court Barns
Over Lane
Almondsbury
Bristol
BS32 4DF

Prepared For:

Mr. F. Cremin
Down Farm
The Pry
Purton
Swindon
Wiltshire

Report Section	Page Number
Summary	-
Agency & Hydrological	1
Waste	5
Hazardous Substances	-
Geological	7
Industrial Land Use	11
Sensitive Land Use	12
Data Currency	13
Data Suppliers	18
Useful Contacts	19

Introduction

The Environment Act 1995 has made site sensitivity a key issue, as the legislation pays as much attention to the pathways by which contamination could spread, and to the vulnerable targets of contamination, as it does the potential sources of contamination. For this reason, Landmark's Site Sensitivity maps and Datasheet(s) place great emphasis on statutory data provided by the Environment Agency and the Scottish Environment Protection Agency; it also incorporates data from Natural England (and the Scottish and Welsh equivalents) and Local Authorities; and highlights hydrogeological features required by environmental and geotechnical consultants. It does not include any information concerning past uses of land. The datasheet is produced by querying the Landmark database to a distance defined by the client from a site boundary provided by the client.

In the attached datasheet the National Grid References (NGRs) are rounded to the nearest 10m in accordance with Landmark's agreements with a number of Data Suppliers.

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Radon Potential dataset Copyright Notice

Information supplied from a joint dataset compiled by The British Geological Survey and the Health Protection Agency.

Report Version v47.0

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Agency & Hydrological					
Contaminated Land Register Entries and Notices					
Discharge Consents	pg 1				7
Enforcement and Prohibition Notices					
Integrated Pollution Controls					
Integrated Pollution Prevention And Control					
Local Authority Integrated Pollution Prevention And Control					
Local Authority Pollution Prevention and Controls					
Local Authority Pollution Prevention and Control Enforcements					
Nearest Surface Water Feature	pg 2		Yes		
Pollution Incidents to Controlled Waters	pg 2				1
Prosecutions Relating to Authorised Processes					
Prosecutions Relating to Controlled Waters					
Registered Radioactive Substances					
River Quality	pg 2				1
River Quality Biology Sampling Points					
River Quality Chemistry Sampling Points	pg 3				1
Substantiated Pollution Incident Register					
Water Abstractions					
Water Industry Act Referrals					
Groundwater Vulnerability	pg 3	Yes	n/a	n/a	n/a
Bedrock Aquifer Designations	pg 3	Yes	n/a	n/a	n/a
Superficial Aquifer Designations			n/a	n/a	n/a
Source Protection Zones					
Extreme Flooding from Rivers or Sea without Defences				n/a	n/a
Flooding from Rivers or Sea without Defences				n/a	n/a
Areas Benefiting from Flood Defences				n/a	n/a
Flood Water Storage Areas				n/a	n/a
Flood Defences				n/a	n/a
Waste					
BGS Recorded Landfill Sites					
Historical Landfill Sites	pg 5			1	2
Integrated Pollution Control Registered Waste Sites					
Licensed Waste Management Facilities (Landfill Boundaries)					
Licensed Waste Management Facilities (Locations)					
Local Authority Recorded Landfill Sites	pg 5			3	3
Registered Landfill Sites					
Registered Waste Transfer Sites					
Registered Waste Treatment or Disposal Sites					

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Hazardous Substances					
Control of Major Accident Hazards Sites (COMAH)					
Explosive Sites					
Notification of Installations Handling Hazardous Substances (NIHHS)					
Planning Hazardous Substance Consents					
Planning Hazardous Substance Enforcements					
Geological					
BGS 1:625,000 Solid Geology	pg 7	Yes	n/a	n/a	n/a
BGS Estimated Soil Chemistry	pg 7	Yes	Yes	Yes	Yes
BGS Recorded Mineral Sites	pg 10			1	
BGS Urban Soil Chemistry					
BGS Urban Soil Chemistry Averages					
Brine Compensation Area			n/a	n/a	n/a
Coal Mining Affected Areas			n/a	n/a	n/a
Mining Instability			n/a	n/a	n/a
Man-Made Mining Cavities					
Natural Cavities					
Non Coal Mining Areas of Great Britain				n/a	n/a
Potential for Collapsible Ground Stability Hazards	pg 10	Yes		n/a	n/a
Potential for Compressible Ground Stability Hazards				n/a	n/a
Potential for Ground Dissolution Stability Hazards				n/a	n/a
Potential for Landslide Ground Stability Hazards	pg 10	Yes		n/a	n/a
Potential for Running Sand Ground Stability Hazards				n/a	n/a
Potential for Shrinking or Swelling Clay Ground Stability Hazards	pg 10	Yes		n/a	n/a
Radon Potential - Radon Affected Areas			n/a	n/a	n/a
Radon Potential - Radon Protection Measures			n/a	n/a	n/a
Industrial Land Use					
Contemporary Trade Directory Entries	pg 11		1	1	2
Fuel Station Entries					

Data Type	Page Number	On Site	0 to 250m	251 to 500m	501 to 1000m (*up to 2000m)
Sensitive Land Use					
Areas of Adopted Green Belt					
Areas of Unadopted Green Belt					
Areas of Outstanding Natural Beauty					
Environmentally Sensitive Areas					
Forest Parks					
Local Nature Reserves					
Marine Nature Reserves					
National Nature Reserves					
National Parks					
Nitrate Sensitive Areas					
Nitrate Vulnerable Zones	pg 12	1			
Ramsar Sites					
Sites of Special Scientific Interest					
Special Areas of Conservation					
Special Protection Areas					

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
1	Discharge Consents Operator: Messrs F G Smith & Sons Property Type: Mixed Farming Location: Pry Farm, Purton, Swindon, Wilts Authority: Environment Agency, Thames Region Catchment Area: Not Supplied Reference: Ctr.1736 Permit Version: 1 Effective Date: 6th January 1981 Issued Date: 6th January 1981 Revocation Date: 26th July 1991 Discharge Type: Discharge Of Other Matter-Fish Farm Discharge: Freshwater Stream/River Environment: Receiving Water: Trib Of Ray Status: Authorisation revokedRevoked Positional Accuracy: Located by supplier to within 100m	A8NE (S)	510	1	410500 188800
2	Discharge Consents Operator: John & Fenella Dernie Property Type: Domestic Property (Single) Location: Cross Lanes Farm House Purton Stoke Near Swindon Wiltshire Sn5 9jn Authority: Environment Agency, Thames Region Catchment Area: Not Given Reference: CAWM.0086 Permit Version: 1 Effective Date: 6th December 1999 Issued Date: 19th January 2000 Revocation Date: Not Supplied Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge: Freshwater Stream/River Environment: Receiving Water: Tributary Of River Ray Status: New Consent (Water Resources Act 1991, Section 88 & Schedule 10 as amended by Environment Act 1995) Positional Accuracy: Located by supplier to within 10m	A18SE (NE)	598	1	410690 189800
3	Discharge Consents Operator: Swindon And Cricklade Railway Company Property Type: Railways Location: Locomotive Shed, Blunsdon Station, Blunsdon, Wilts Authority: Environment Agency, Thames Region Catchment Area: Not Supplied Reference: Ctwc.1119 Permit Version: 1 Effective Date: 13th August 1986 Issued Date: 13th August 1986 Revocation Date: 6th November 1991 Discharge Type: Discharge Of Other Matter-Surface Water Discharge: Freshwater Stream/River Environment: Receiving Water: River Ray Status: Authorisation revokedRevoked Positional Accuracy: Located by supplier to within 100m	A14NW (NE)	698	1	411000 189600
4	Discharge Consents Operator: Mr Andrew Bull Property Type: Domestic Property (Single) Location: The Granary Cricklade Road Purton Swindon Wiltshire Sn5 4hs Authority: Environment Agency, Thames Region Catchment Area: Thames Reference: Npswqd007573 Permit Version: 1 Effective Date: 7th May 2009 Issued Date: 7th May 2009 Revocation Date: Not Supplied Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge: Freshwater Stream/River Environment: Receiving Water: The River Key Status: New Consent (Water Resources Act 1991, Section 88 & Schedule 10 as amended by Environment Act 1995) Positional Accuracy: Located by supplier to within 10m	A12SW (W)	869	1	409506 189247

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
5	Discharge Consents Operator: Associated Dental Products Ltd. Property Type: Medical & Surgical Equipment Location: Kemdent Works, Cricklade Road, Purton, Swindon, Wiltshire Authority: Environment Agency, Thames Region Catchment Area: Not Given Reference: CNTW.0919 Permit Version: 1 Effective Date: 14th January 1991 Issued Date: 14th January 1991 Revocation Date: 9th August 2006 Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge: Irrigation Area Environment: Receiving Water: Oxford Clay Status: Transferred from Water Act 1989 Positional Accuracy: Located by supplier to within 100m	A12NW (W)	915	1	409460 189330
5	Discharge Consents Operator: Associated Dental Products Ltd. Property Type: Medical & Surgical Equipment Location: Kemdent Works, Cricklade Road, Purton, Swindon, Wiltshire Authority: Environment Agency, Thames Region Catchment Area: Not Supplied Reference: Cntw.0919 Permit Version: 2 Effective Date: 12th July 2006 Issued Date: 14th January 1991 Revocation Date: 31st March 2019 Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge: Into Land Environment: Receiving Water: Oxford Clay Status: Transferred from Water Act 1989 Positional Accuracy: Located by supplier to within 10m	A12NW (W)	915	1	409460 189330
6	Discharge Consents Operator: Mr. V.H. & Mrs Hill Property Type: Domestic Property (Single) Location: Land By Glentor, Hyde Lane, Purton, Swindon, Wiltshire Authority: Environment Agency, Thames Region Catchment Area: Not Given Reference: CNTM.1647 Permit Version: 1 Effective Date: 14th November 1994 Issued Date: 14th November 1994 Revocation Date: Not Supplied Discharge Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Discharge: Irrigation Area Environment: Receiving Water: Coral Rag Status: New Consent, by Application (Water Resources Act 1991, Section 88) Positional Accuracy: Located by supplier to within 100m	A7NW (SW)	946	1	409600 188750
	Nearest Surface Water Feature	A13NE (E)	142	-	410507 189339
7	Pollution Incidents to Controlled Waters Property Type: Not Given Location: PURTON Authority: Environment Agency, Thames Region Pollutant: Miscellaneous - Unknown Note: Not Supplied Incident Date: 5th March 1989 Incident Reference: W1890130 Catchment Area: Not Given Receiving Water: Not Given Cause of Incident: Not Given Incident Severity: Category 3 - Minor Incident Positional Accuracy: Located by supplier to within 100m	A19SW (NE)	806	1	411000 189800
	River Quality Name: Ray GQA Grade: River Quality C Reach: Haydon Wick Bk - Thames Estimated Distance (km): 7.8 Flow Rate: Flow less than 1.25 cumecs Flow Type: River Year: 2000	A14NW (E)	616	1	410967 189457

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
8	River Quality Chemistry Sampling Points Name: Ray Reach: Haydon Wick Brook To Thames Estimated Distance: 7.80 Objective: Not Supplied Positional Accuracy: Located by supplier to within 100m Year: 1990 GQA Grade: River Quality Chemistry GQA Grade E - Poor Compliance: Not Supplied Year: 1993 GQA Grade: River Quality Chemistry GQA Grade E - Poor Compliance: Not Supplied Year: 1994 GQA Grade: River Quality Chemistry GQA Grade C - Fairly Good Compliance: Not Supplied Year: 1995 GQA Grade: River Quality Chemistry GQA Grade D - Fair Compliance: Not Supplied Year: 1996 GQA Grade: River Quality Chemistry GQA Grade D - Fair Compliance: Not Supplied Year: 1997 GQA Grade: River Quality Chemistry GQA Grade D - Fair Compliance: Not Supplied Year: 1998 GQA Grade: River Quality Chemistry GQA Grade D - Fair Compliance: Not Supplied Year: 1999 GQA Grade: River Quality Chemistry GQA Grade D - Fair Compliance: Not Supplied Year: 2000 GQA Grade: River Quality Chemistry GQA Grade C - Fairly Good Compliance: Not Supplied Year: 2001 GQA Grade: River Quality Chemistry GQA Grade C - Fairly Good Compliance: Not Supplied Year: 2002 GQA Grade: River Quality Chemistry GQA Grade B - Good Compliance: Not Supplied Year: 2003 GQA Grade: River Quality Chemistry GQA Grade C - Fairly Good Compliance: Not Supplied Year: 2004 GQA Grade: River Quality Chemistry GQA Grade C - Fairly Good Compliance: Not Supplied Year: 2005 GQA Grade: River Quality Chemistry GQA Grade C - Fairly Good Compliance: Not Supplied Year: 2006 GQA Grade: River Quality Chemistry GQA Grade C - Fairly Good Compliance: Not Supplied Year: 2007 GQA Grade: River Quality Chemistry GQA Grade B - Good Compliance: Not Supplied Year: 2008 GQA Grade: River Quality Chemistry GQA Grade B - Good Compliance: Not Supplied Year: 2009 GQA Grade: River Quality Chemistry GQA Grade B - Good Compliance: Not Supplied	A19SE (NE)	886	1	411100 189800
	Groundwater Vulnerability Soil Classification: Not classified Map Sheet: Sheet 38 Upper Thames & Bedfordshire Scale: 1:100,000	A13NE (N)	0	1	410373 189294
	Drift Deposits None				
	Bedrock Aquifer Designations Aquifer Desination: Unproductive Strata	A13NE (N)	0	2	410373 189294
	Superficial Aquifer Designations No Data Available				
	Extreme Flooding from Rivers or Sea without Defences None				
	Flooding from Rivers or Sea without Defences None				
	Areas Benefiting from Flood Defences None				

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	Flood Water Storage Areas None				
	Flood Defences None				

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
9	Historical Landfill Sites Licence Holder: Not Supplied Location: Purton, Wiltshire Name: Woodward's Bridge Farm Operator Location: Not Supplied Boundary Accuracy: As Supplied Provider Reference: EAHLD13661 First Input Date: Not Supplied Last Input Date: Not Supplied Specified Waste: Not Supplied Type: EA Waste Ref: Not Supplied Regis Ref: Not Supplied WRC Ref: 3900/0091 BGS Ref: Not Supplied Other Ref: TP0056, 440	A13NE (NE)	419	1	410675 189585
10	Historical Landfill Sites Licence Holder: Not Supplied Location: Purton, Wiltshire Name: Pry Farm Operator Location: Not Supplied Boundary Accuracy: As Supplied Provider Reference: EAHLD13662 First Input Date: Not Supplied Last Input Date: Not Supplied Specified Waste: Not Supplied Type: EA Waste Ref: Not Supplied Regis Ref: Not Supplied WRC Ref: 3900/0092 BGS Ref: Not Supplied Other Ref: TP0493, G4/132/57, 441	A9NW (SE)	639	1	410894 188923
11	Historical Landfill Sites Licence Holder: Not Supplied Location: Tadpole Lane, Blunsdon, Swindon Name: Land At Tadpole Bridge Operator Location: Not Supplied Boundary Accuracy: As Supplied Provider Reference: EAHLD10853 First Input Date: Not Supplied Last Input Date: Not Supplied Specified Waste: Not Supplied Type: EA Waste Ref: Not Supplied Regis Ref: Not Supplied WRC Ref: 3900/0090 BGS Ref: Not Supplied Other Ref: Swindon Council-494	A19SW (NE)	781	1	410981 189784
	Local Authority Landfill Coverage Name: Wiltshire County Council - Has supplied landfill data		0	3	410373 189294
	Local Authority Landfill Coverage Name: North Wiltshire District Council - Has no landfill data to supply		0	7	410373 189294
	Local Authority Landfill Coverage Name: Swindon Unitary Council - Has no landfill data to supply		686	8	411031 189491
12	Local Authority Recorded Landfill Sites Location: Woodward's Bridge, Farm, Purton Reference: 440 Authority: Wiltshire County Council (now part of Wiltshire Council) Last Reported Status: Unknown Types of Waste: Not Supplied Date of Closure: Not Supplied Positional Accuracy: Positioned by the supplier Boundary Quality: Moderate	A14NW (E)	347	3	410714 189355
13	Local Authority Recorded Landfill Sites Location: Woodward's Bridge, Farm, Purton Reference: 440 Authority: Wiltshire County Council (now part of Wiltshire Council) Last Reported Status: Unknown Types of Waste: Not Supplied Date of Closure: Not Supplied Positional Accuracy: Positioned by the supplier Boundary Quality: Moderate	A13NE (NE)	370	3	410664 189522

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
14	Local Authority Recorded Landfill Sites Location: Pry Farm, Purton Reference: 441 Authority: Wiltshire County Council (now part of Wiltshire Council) Last Reported Status: Unknown Types of Waste: Not Supplied Date of Closure: Not Supplied Positional Accuracy: Positioned by the supplier Boundary Quality: Moderate	A14SW (E)	378	3	410738 189196
15	Local Authority Recorded Landfill Sites Location: Pry Farm, Purton Reference: 441 Authority: Wiltshire County Council (now part of Wiltshire Council) Last Reported Status: Unknown Types of Waste: Not Supplied Date of Closure: Not Supplied Positional Accuracy: Positioned by the supplier Boundary Quality: Moderate	A14SW (SE)	520	3	410806 189005
16	Local Authority Recorded Landfill Sites Location: Unauthorised Site, T.B.C., Blunsdon Reference: Not Supplied Authority: Wiltshire County Council (now part of Wiltshire Council) Last Reported Status: Unknown Types of Waste: Not Supplied Date of Closure: Not Supplied Positional Accuracy: Located by supplier to within 100m Boundary Quality: Not Applicable	A19SW (NE)	806	3	411000 189800
17	Local Authority Recorded Landfill Sites Location: Handy'S Farm, Purton Reference: 442 Authority: Wiltshire County Council (now part of Wiltshire Council) Last Reported Status: Unknown Types of Waste: Not Supplied Date of Closure: Not Supplied Positional Accuracy: Positioned by the supplier Boundary Quality: Moderate	A9NW (SE)	825	3	410880 188643

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS 1:625,000 Solid Geology Description: Oxford Clay and Kellaways Beds	A13NE (N)	0	2	410373 189294
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 90 - 120 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 15 - 30 mg/kg	A13NE (N)	0	4	410373 189294
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 90 - 120 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 15 - 30 mg/kg	A13SW (SW)	47	4	410343 189259
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 90 - 120 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 15 - 30 mg/kg	A13SE (S)	294	4	410373 189000
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 90 - 120 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 15 - 30 mg/kg	A12SE (W)	374	4	410000 189274
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 90 - 120 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 15 - 30 mg/kg	A12NE (W)	374	4	410000 189294
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic Concentration: 15 - 25 mg/kg Cadmium Concentration: <1.8 mg/kg Chromium Concentration: 90 - 120 mg/kg Lead Concentration: <150 mg/kg Nickel Concentration: 30 - 45 mg/kg	A12SE (SW)	476	4	410000 189000

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic 25 - 35 mg/kg Concentration: Cadmium <1.8 mg/kg Concentration: Chromium 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel 30 - 45 mg/kg Concentration:	A14NW (E)	627	4	411000 189294
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic 25 - 35 mg/kg Concentration: Cadmium <1.8 mg/kg Concentration: Chromium 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel 30 - 45 mg/kg Concentration:	A14NW (E)	628	4	410995 189376
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic 25 - 35 mg/kg Concentration: Cadmium <1.8 mg/kg Concentration: Chromium 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel 30 - 45 mg/kg Concentration:	A14NW (E)	629	4	411000 189341
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic 15 - 25 mg/kg Concentration: Cadmium <1.8 mg/kg Concentration: Chromium 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel 15 - 30 mg/kg Concentration:	A14SW (SE)	693	4	411000 189000
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic 25 - 35 mg/kg Concentration: Cadmium <1.8 mg/kg Concentration: Chromium 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel 30 - 45 mg/kg Concentration:	A18NE (N)	707	4	410373 190000
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic 25 - 35 mg/kg Concentration: Cadmium <1.8 mg/kg Concentration: Chromium 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel 30 - 45 mg/kg Concentration:	A19SW (NE)	728	4	411000 189663

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 25 - 35 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel: 30 - 45 mg/kg Concentration:	A14NE (E)	765	4	411130 189402
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 25 - 35 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 60 - 90 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel: 15 - 30 mg/kg Concentration:	A7NE (SW)	777	4	409825 188744
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 25 - 35 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 120 - 180 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel: 30 - 45 mg/kg Concentration:	A17NE (NW)	799	4	410000 190000
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 25 - 35 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel: 30 - 45 mg/kg Concentration:	A14SE (E)	837	4	411157 189000
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 15 - 25 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 120 - 180 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel: 30 - 45 mg/kg Concentration:	A19NW (NE)	945	4	411000 190000
	BGS Estimated Soil Chemistry Source: British Geological Survey, National Geoscience Information Service Soil Sample Type: Sediment Arsenic: 15 - 25 mg/kg Concentration: Cadmium: <1.8 mg/kg Concentration: Chromium: 90 - 120 mg/kg Concentration: Lead Concentration: <150 mg/kg Nickel: 15 - 30 mg/kg Concentration:	A14SE (E)	992	4	411320 189000

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
18	BGS Recorded Mineral Sites Site Name: Hursted Farm Brick Works Location: , Purton, Swindon, Wiltshire Source: British Geological Survey, National Geoscience Information Service Reference: 55697 Type: Opencast Status: Ceased Operator: Unknown Operator Operator Location: Unknown Operator Periodic Type: Jurassic Geology: Oxford Clay Formation Commodity: Common Clay and Shale Positional Accuracy: Located by supplier to within 10m	A12NE (NW)	473	2	409957 189517
	BGS Measured Urban Soil Chemistry No data available				
	BGS Urban Soil Chemistry Averages No data available				
	Coal Mining Affected Areas In an area that might not be affected by coal mining				
	Non Coal Mining Areas of Great Britain No Hazard				
	Potential for Collapsible Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NE (N)	0	2	410373 189294
	Potential for Compressible Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NE (N)	0	2	410373 189294
	Potential for Ground Dissolution Stability Hazards No Hazard				
	Potential for Landslide Ground Stability Hazards Hazard Potential: Very Low Source: British Geological Survey, National Geoscience Information Service	A13NE (N)	0	2	410373 189294
	Potential for Running Sand Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13NE (N)	0	2	410373 189294
	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: Moderate Source: British Geological Survey, National Geoscience Information Service	A13NE (N)	0	2	410373 189294
	Potential for Shrinking or Swelling Clay Ground Stability Hazards Hazard Potential: No Hazard Source: British Geological Survey, National Geoscience Information Service	A13SW (SW)	47	2	410342 189259
	Radon Potential - Radon Protection Measures Protection Measure: No radon protective measures are necessary in the construction of new dwellings or extensions Source: British Geological Survey, National Geoscience Information Service	A13NE (N)	0	2	410373 189294
	Radon Potential - Radon Affected Areas Affected Area: The property is in a lower probability radon area, as less than 1% of homes are above the action level Source: British Geological Survey, National Geoscience Information Service	A13NE (N)	0	2	410373 189294

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
19	Contemporary Trade Directory Entries Name: Industrial Shredding Systems Ltd Location: Infinite House, The Pry, Purton, Swindon, Wiltshire, SN5 4JP Classification: Shredding Equipment & Services Status: Inactive Positional Accuracy: Automatically positioned to the address	A13SE (SE)	21	-	410383 189275
20	Contemporary Trade Directory Entries Name: Bevan Transport Ltd Location: Downfield Farm, The Pry, Purton, Swindon, SN5 4JP Classification: Road Haulage Services Status: Active Positional Accuracy: Automatically positioned to the address	A14SW (SE)	455	-	410714 188993
21	Contemporary Trade Directory Entries Name: A Complete Property Maintenance Ltd Location: 3 Crosslanes, Purton Stoke, Swindon, Wiltshire, SN5 4JN Classification: Asphalt & Coated Macadam Laying Contractors Status: Inactive Positional Accuracy: Manually positioned within the geographical locality	A19SW (NE)	570	-	410751 189720
22	Contemporary Trade Directory Entries Name: Pryton Engineering Location: 1, The Pry, Purton, Swindon, SN5 4JP Classification: Garage Services Status: Inactive Positional Accuracy: Automatically positioned to the address	A9NW (SE)	816	-	410903 188673

Map ID	Details	Quadrant Reference (Compass Direction)	Estimated Distance From Site	Contact	NGR
23	Nitrate Vulnerable Zones Name: Not Supplied Description: NVZ Area Source: Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	A13NE (N)	0	5	410373 189294

Agency & Hydrological	Version	Update Cycle
Contaminated Land Register Entries and Notices Cotswold District Council - Environmental Health Department Swindon Borough Council - Environmental Services Wiltshire Council - Environmental Health Department North Wiltshire District Council (now part of Wiltshire Council) - Environmental Services	April 2012 February 2013 July 2012 May 2008	Annual Rolling Update Annual Rolling Update Annually Not Applicable
Discharge Consents Environment Agency - South West Region Environment Agency - Thames Region	January 2013 January 2013	Quarterly Quarterly
Enforcement and Prohibition Notices Environment Agency - South West Region Environment Agency - Thames Region	March 2013 March 2013	Quarterly Quarterly
Integrated Pollution Controls Environment Agency - South West Region Environment Agency - Thames Region	October 2008 October 2008	Not Applicable Not Applicable
Integrated Pollution Prevention And Control Environment Agency - South West Region Environment Agency - Thames Region	January 2013 January 2013	Quarterly Quarterly
Local Authority Integrated Pollution Prevention And Control Wiltshire Council - Environmental Health Department Swindon Borough Council - Environmental Services North Wiltshire District Council (now part of Wiltshire Council) - Environmental Services Cotswold District Council - Environmental Health Department	August 2012 July 2012 September 2008 September 2012	Annually Annual Rolling Update Not Applicable Annual Rolling Update
Local Authority Pollution Prevention and Controls Wiltshire Council - Environmental Health Department Swindon Borough Council - Environmental Services North Wiltshire District Council (now part of Wiltshire Council) - Environmental Services Cotswold District Council - Environmental Health Department	August 2012 July 2012 September 2008 September 2012	Annually Annual Rolling Update Not Applicable Annual Rolling Update
Local Authority Pollution Prevention and Control Enforcements Wiltshire Council - Environmental Health Department Swindon Borough Council - Environmental Services North Wiltshire District Council (now part of Wiltshire Council) - Environmental Services Cotswold District Council - Environmental Health Department	August 2012 July 2012 September 2008 September 2012	Annually Annual Rolling Update Not Applicable Annual Rolling Update
Nearest Surface Water Feature Ordnance Survey	July 2012	Quarterly
Pollution Incidents to Controlled Waters Environment Agency - South West Region Environment Agency - Thames Region	September 1999 September 1999	Not Applicable Not Applicable
Prosecutions Relating to Authorised Processes Environment Agency - South West Region Environment Agency - Thames Region	March 2013 March 2013	Monthly Monthly
Prosecutions Relating to Controlled Waters Environment Agency - South West Region Environment Agency - Thames Region	March 2013 March 2013	Monthly Monthly
Registered Radioactive Substances Environment Agency - South West Region Environment Agency - Thames Region	January 2013 January 2013	Quarterly Quarterly
River Quality Environment Agency - Head Office	November 2001	Not Applicable
River Quality Biology Sampling Points Environment Agency - Head Office	July 2012	Annually
River Quality Chemistry Sampling Points Environment Agency - Head Office	July 2012	Annually

Agency & Hydrological	Version	Update Cycle
Substantiated Pollution Incident Register Environment Agency - South West Region - North Wessex Area Environment Agency - South West Region - Wessex Area Environment Agency - Thames Region - West Area	January 2013 January 2013 January 2013	Quarterly Quarterly Quarterly
Water Abstractions Environment Agency - South West Region Environment Agency - Thames Region	January 2013 January 2013	Quarterly Quarterly
Water Industry Act Referrals Environment Agency - South West Region Environment Agency - Thames Region	January 2013 January 2013	Quarterly Quarterly
Groundwater Vulnerability Environment Agency - Head Office	January 2011	Not Applicable
Drift Deposits Environment Agency - Head Office	January 1999	Not Applicable
Bedrock Aquifer Designations British Geological Survey - National Geoscience Information Service	October 2012	Annually
Superficial Aquifer Designations British Geological Survey - National Geoscience Information Service	October 2012	Annually
Source Protection Zones Environment Agency - Head Office	January 2013	Quarterly
Extreme Flooding from Rivers or Sea without Defences Environment Agency - Head Office	January 2013	Quarterly
Flooding from Rivers or Sea without Defences Environment Agency - Head Office	January 2013	Quarterly
Areas Benefiting from Flood Defences Environment Agency - Head Office	January 2013	Quarterly
Flood Water Storage Areas Environment Agency - Head Office	January 2013	Quarterly
Flood Defences Environment Agency - Head Office	January 2013	Quarterly

Waste	Version	Update Cycle
BGS Recorded Landfill Sites British Geological Survey - National Geoscience Information Service	June 1996	Not Applicable
Historical Landfill Sites Environment Agency - South West Region - North Wessex Area Environment Agency - South West Region - Wessex Area Environment Agency - Thames Region - West Area	January 2013 January 2013 January 2013	Quarterly Quarterly Quarterly
Integrated Pollution Control Registered Waste Sites Environment Agency - South West Region Environment Agency - Thames Region	October 2008 October 2008	Not Applicable Not Applicable
Licensed Waste Management Facilities (Landfill Boundaries) Environment Agency - South West Region - North Wessex Area Environment Agency - South West Region - Wessex Area Environment Agency - Thames Region - West Area	January 2013 January 2013 January 2013	Quarterly Quarterly Quarterly
Licensed Waste Management Facilities (Locations) Environment Agency - South West Region - North Wessex Area Environment Agency - South West Region - Wessex Area Environment Agency - Thames Region - West Area	January 2013 January 2013 January 2013	Quarterly Quarterly Quarterly
Local Authority Landfill Coverage Cotswold District Council - Environmental Health Department Gloucestershire County Council North Wiltshire District Council (now part of Wiltshire Council) - Environmental Services Swindon Borough Council Wiltshire County Council (now part of Wiltshire Council)	May 2000 May 2000 May 2000 May 2000 May 2000	Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable
Local Authority Recorded Landfill Sites Cotswold District Council - Environmental Health Department Gloucestershire County Council North Wiltshire District Council (now part of Wiltshire Council) - Environmental Services Swindon Borough Council Wiltshire County Council (now part of Wiltshire Council)	May 2000 May 2000 May 2000 May 2000 May 2000	Not Applicable Not Applicable Not Applicable Not Applicable Not Applicable
Registered Landfill Sites Environment Agency - South West Region - North Wessex Area Environment Agency - Thames Region - West Area	March 2003 March 2003	Not Applicable Not Applicable
Registered Waste Transfer Sites Environment Agency - South West Region - North Wessex Area Environment Agency - Thames Region - West Area	March 2003 March 2003	Not Applicable Not Applicable
Registered Waste Treatment or Disposal Sites Environment Agency - South West Region - North Wessex Area Environment Agency - Thames Region - West Area	March 2003 March 2003	Not Applicable Not Applicable

Hazardous Substances	Version	Update Cycle
Control of Major Accident Hazards Sites (COMAH) Health and Safety Executive	October 2012	Bi-Annually
Explosive Sites Health and Safety Executive	June 2012	Bi-Annually
Notification of Installations Handling Hazardous Substances (NIHHS) Health and Safety Executive	November 2000	Not Applicable
Planning Hazardous Substance Enforcements Gloucestershire County Council Wiltshire County Council (now part of Wiltshire Council) North Wiltshire District Council (now part of Wiltshire Council) Cotswold District Council - Development Control Administration Swindon Borough Council Wiltshire Council - Planning Department	April 2008 December 2008 June 2009 November 2012 November 2012 November 2012	Annual Rolling Update Annual Rolling Update Not Applicable Annual Rolling Update Annual Rolling Update Annually
Planning Hazardous Substance Consents Gloucestershire County Council Wiltshire County Council (now part of Wiltshire Council) North Wiltshire District Council (now part of Wiltshire Council) Cotswold District Council - Development Control Administration Swindon Borough Council Wiltshire Council - Planning Department	April 2008 December 2008 June 2009 November 2012 November 2012 November 2012	Annual Rolling Update Annual Rolling Update Not Applicable Annual Rolling Update Annual Rolling Update Annually
Geological	Version	Update Cycle
BGS 1:625,000 Solid Geology British Geological Survey - National Geoscience Information Service	August 1996	Not Applicable
BGS Estimated Soil Chemistry British Geological Survey - National Geoscience Information Service	January 2010	Variable
BGS Recorded Mineral Sites British Geological Survey - National Geoscience Information Service	October 2012	Bi-Annually
Brine Compensation Area Cheshire Brine Subsidence Compensation Board	August 2011	Not Applicable
Coal Mining Affected Areas The Coal Authority - Mining Report Service	January 2012	As notified
Mining Instability Ove Arup & Partners	October 2000	Not Applicable
Non Coal Mining Areas of Great Britain British Geological Survey - National Geoscience Information Service	February 2011	Not Applicable
Potential for Collapsible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Compressible Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Ground Dissolution Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Landslide Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Running Sand Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Potential for Shrinking or Swelling Clay Ground Stability Hazards British Geological Survey - National Geoscience Information Service	February 2011	Annually
Radon Potential - Radon Affected Areas British Geological Survey - National Geoscience Information Service	July 2011	As notified
Radon Potential - Radon Protection Measures British Geological Survey - National Geoscience Information Service	July 2011	As notified

Industrial Land Use	Version	Update Cycle
Contemporary Trade Directory Entries Thomson Directories	November 2012	Quarterly
Fuel Station Entries Catalist Ltd - Experian	February 2013	Quarterly
Sensitive Land Use	Version	Update Cycle
Areas of Adopted Green Belt Cotswold District Council North Wiltshire District Council (now part of Wiltshire Council) Swindon Borough Council	February 2013 February 2013 February 2013	As notified As notified As notified
Areas of Unadopted Green Belt Cotswold District Council North Wiltshire District Council (now part of Wiltshire Council) Swindon Borough Council	February 2013 February 2013 February 2013	As notified As notified As notified
Areas of Outstanding Natural Beauty Natural England	July 2012	Bi-Annually
Environmentally Sensitive Areas Natural England	February 2013	Annually
Forest Parks Forestry Commission	April 1997	Not Applicable
Local Nature Reserves Natural England	November 2012	Bi-Annually
Marine Nature Reserves Natural England	August 2012	Bi-Annually
National Nature Reserves Natural England	February 2013	Bi-Annually
National Parks Natural England	February 2013	Bi-Annually
Nitrate Sensitive Areas Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	February 2012	Not Applicable
Nitrate Vulnerable Zones Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA)	February 2013	Annually
Ramsar Sites Natural England	February 2013	Bi-Annually
Sites of Special Scientific Interest Natural England	February 2013	Bi-Annually
Special Areas of Conservation Natural England	February 2013	Bi-Annually
Special Protection Areas Natural England	February 2013	Bi-Annually

A selection of organisations who provide data within this report

Data Supplier	Data Supplier Logo
Ordnance Survey	
Environment Agency	
Scottish Environment Protection Agency	
The Coal Authority	
British Geological Survey	
Centre for Ecology and Hydrology	
Countryside Council for Wales	
Scottish Natural Heritage	
Natural England	
Health Protection Agency	
Ove Arup	
Peter Brett Associates	

Contact	Name and Address	Contact Details
1	Environment Agency - National Customer Contact Centre (NCCC) PO Box 544, Templeborough, Rotherham, S60 1BY	Telephone: 08708 506 506 Email: enquiries@environment-agency.gov.uk
2	British Geological Survey - Enquiry Service British Geological Survey, Kingsley Dunham Centre, Keyworth, Nottingham, Nottinghamshire, NG12 5GG	Telephone: 0115 936 3143 Fax: 0115 936 3276 Email: enquiries@bgs.ac.uk Website: www.bgs.ac.uk
3	Wiltshire County Council (now part of Wiltshire Council) County Hall, Bythesea Road, Trowbridge, Wiltshire, BA14 8JN	Telephone: 01225 713000 Email: communications@wiltshire.gov.uk Website: www.wiltshire.gov.uk
4	Landmark Information Group Limited Imperium, Imperial Way, Reading, Berkshire, RG2 0TD	Telephone: 0844 844 9952 Fax: 0844 844 9951 Email: customerservices@landmark.co.uk Website: www.landmarkinfo.co.uk
5	Department for Environment, Food and Rural Affairs (DEFRA - formerly FRCA) Government Buildings, Otley Road, Lawnswood, Leeds, West Yorkshire, LS16 5QT	Telephone: 0113 2613333 Fax: 0113 230 0879
6	Natural England Northminster House, Northminster Road, Peterborough, Cambridgeshire, PE1 1UA	Telephone: 0845 600 3078 Fax: 01733 455103 Email: enquiries@naturalengland.org.uk Website: www.naturalengland.org.uk
7	North Wiltshire District Council (now part of Wiltshire Council) - Environmental Services Monkton Park, Chippenham, Wiltshire, SN15 1ER	Telephone: 01249 706111 Fax: 01249 460810 Email: ehealth@northwiltshire.gov.uk Website: www.northwiltshire.gov.uk
8	Swindon Borough Council Premier House, Station Road, SWINDON, Wiltshire, SN1 1TZ	Telephone: 01793 463000 Fax: 01793 466362 Website: www.swindon.gov.uk
-	Health Protection Agency - Radon Survey, Centre for Radiation, Chemical and Environmental Hazards Chilton, Didcot, Oxfordshire, OX11 0RQ	Telephone: 01235 822622 Fax: 01235 833891 Email: radon@hpa.org.uk Website: www.hpa.org.uk
-	Landmark Information Group Limited Imperium, Imperial Way, Reading, Berkshire, RG2 0TD	Telephone: 0844 844 9952 Fax: 0844 844 9951 Email: customerservices@landmarkinfo.co.uk Website: www.landmarkinfo.co.uk

Please note that the Environment Agency / SEPA have a charging policy in place for enquiries.

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

Superficial Geology

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Flandrian - Flandrian
	SGAO	Sand and Gravel of uncertain age and Origin	Gravel, Sand, Silt and Clay	Quaternary - Quaternary
	NO1A	Northmoor Sand and Gravel Member, Lower Facet	Sand and Gravel	Quaternary - Quaternary

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	HYBK	Hazelbury Bryan Formation and Kingston Formation (Undifferentiated)	Sandstone, Siltstone and Mudstone	Oxfordian - Oxfordian
	STFD	Stanford Formation	Limestone	Oxfordian - Oxfordian
	OXC	Oxford Clay Formation	Mudstone	Oxfordian - Callovian
	OXC	Oxford Clay Formation	Siltstone	Oxfordian - Callovian
		Faults		



Geology 1:50,000 Maps

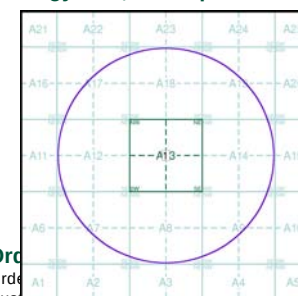
This report contains geological map extracts taken from the BGS Digital Geological map of Great Britain at 1:50,000 scale and is designed for users carrying out preliminary site assessments who require geological maps for the area around the site. This mapping may be more up to date than previously published 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:	252
Map Name:	Swindon
Map Date:	1974
Bedrock Geology:	Available
Superficial Geology:	Available
Artificial Geology:	Available
Faults:	Available
Landslip:	Available
Rock Segments:	Not Available

Geology 1:50,000 Maps - Slice A



Order

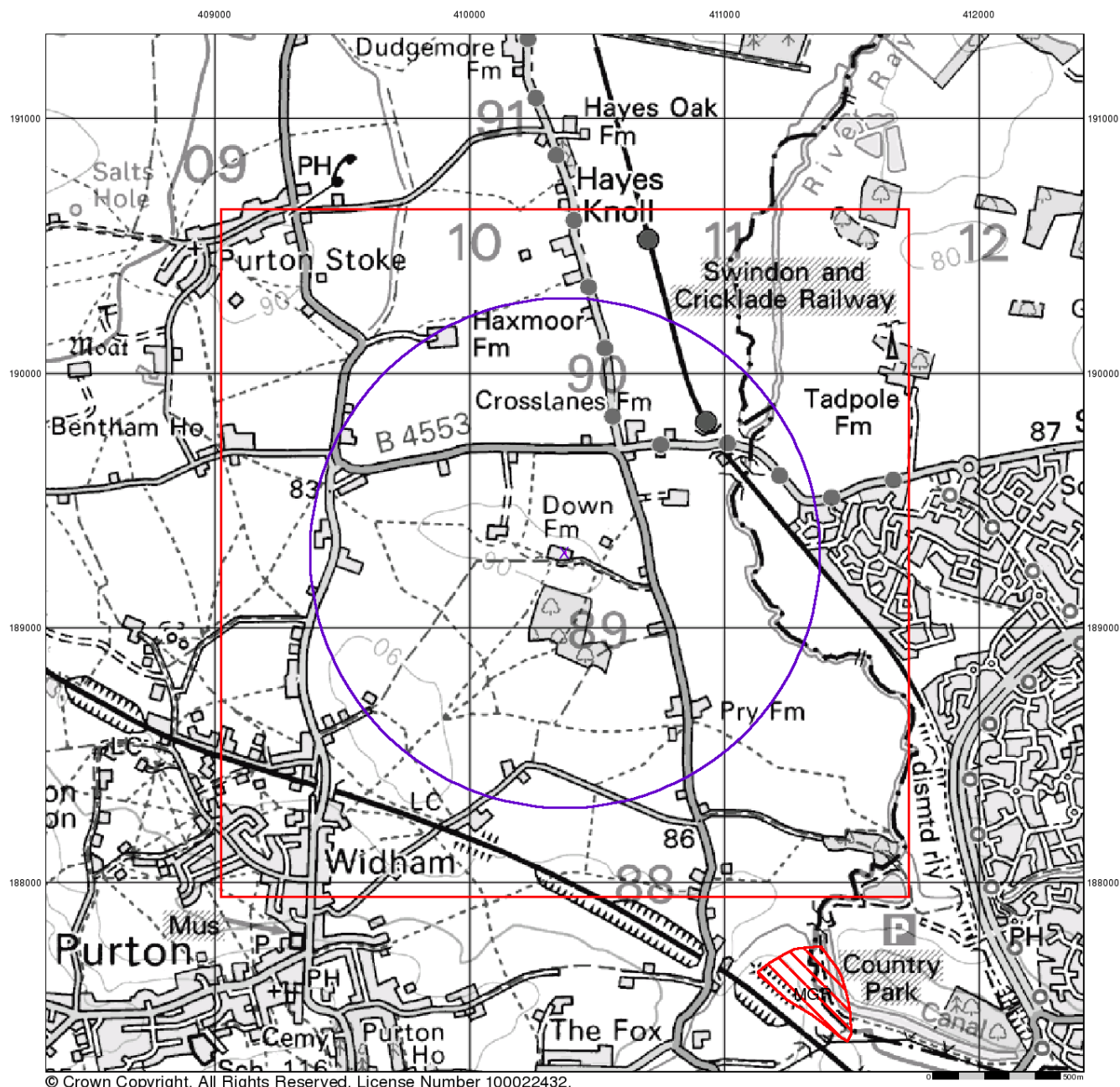
Order Reference: 010247
National Grid Reference: 410370, 189290
Slice: A
Site Area (Ha): 0.01
Search Buffer (m): 1000

Site Details:

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Artificial Ground and Landslip

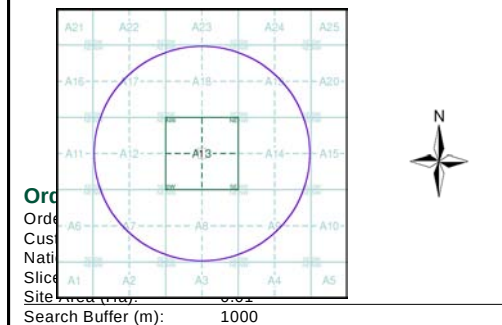
Artificial ground is a term used by BGS for those areas where the ground surface has been significantly modified by human activity. Information about previously developed ground is especially important, as it is often associated with potentially contaminated material, unpredictable engineering conditions 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

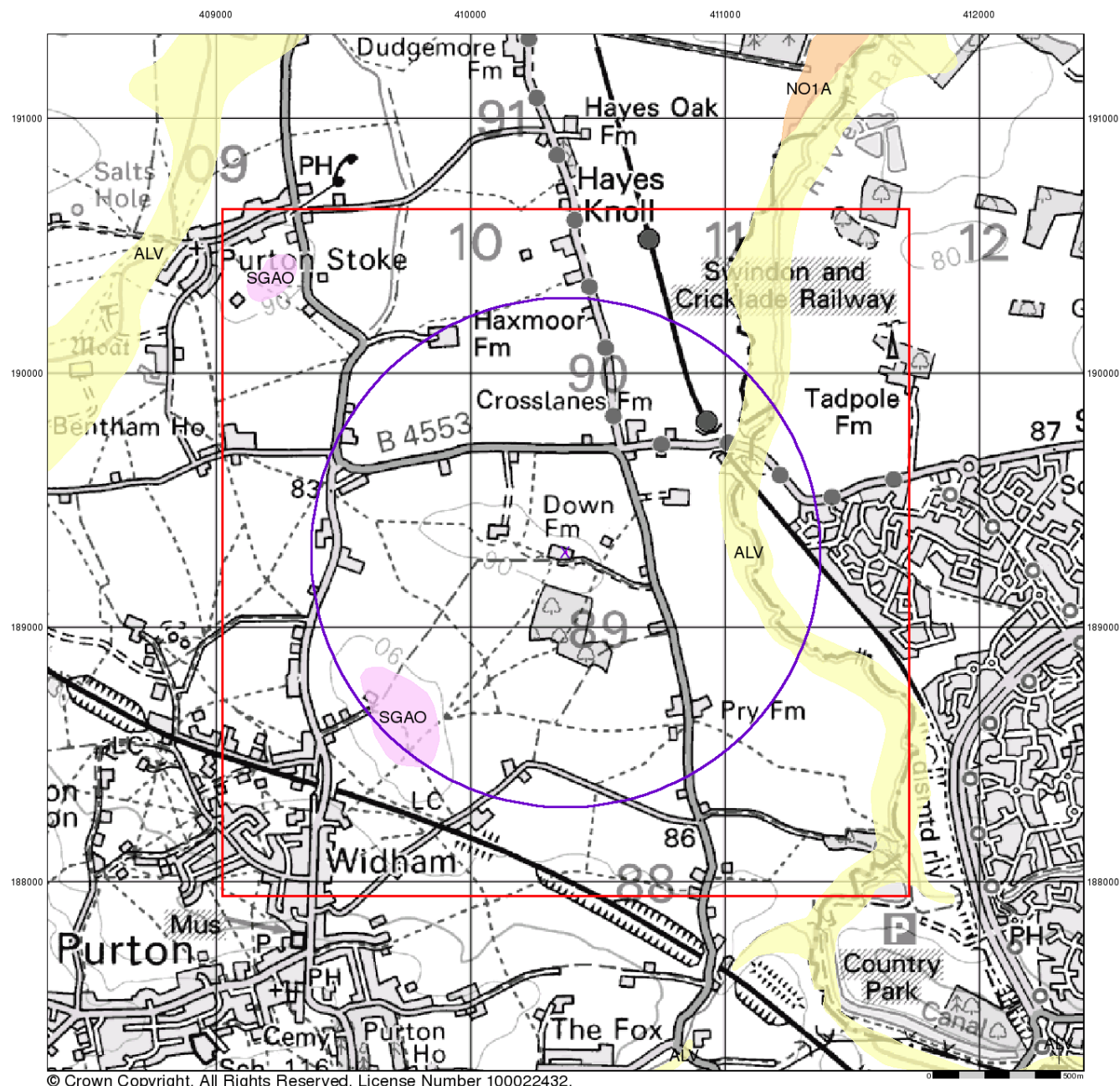


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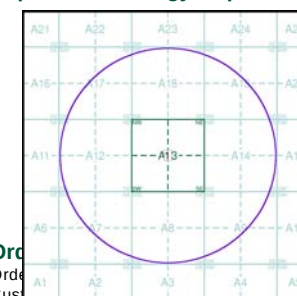
Superficial Geology

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



Order

Order

Cus

National Grid Reference: 410370, 189290

Slice: A

Site Area (Ha): 0.01

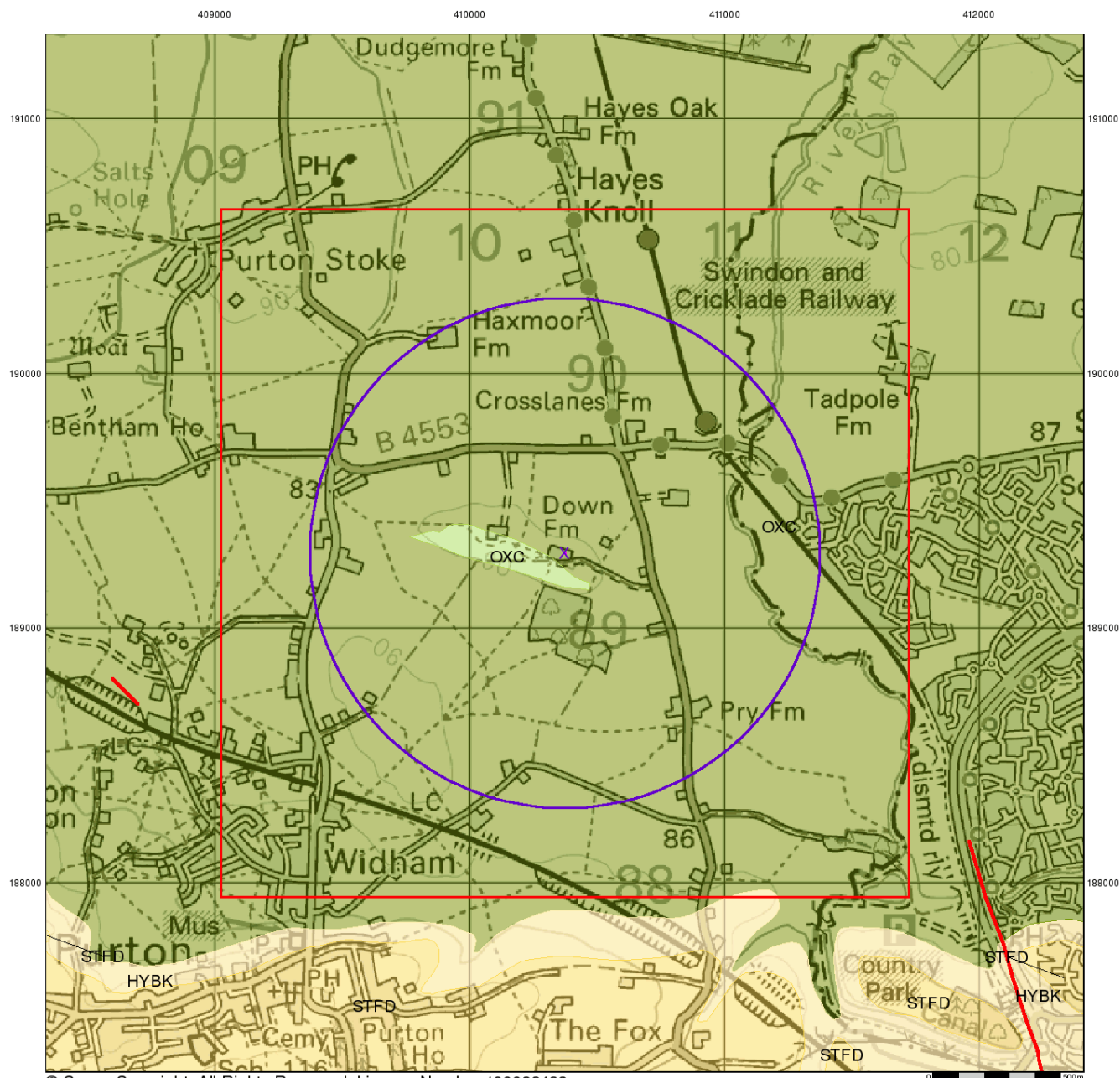
Search Buffer (m): 1000

Site Details:

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Bedrock and Faults

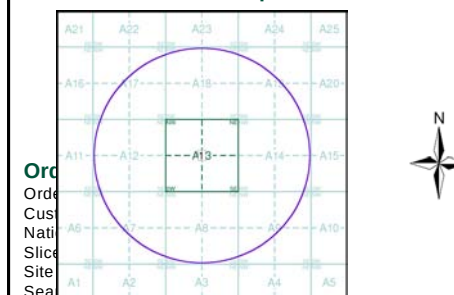
Bedrock geology is a term used for the main mass of rocks forming the Earth and are present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water.

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

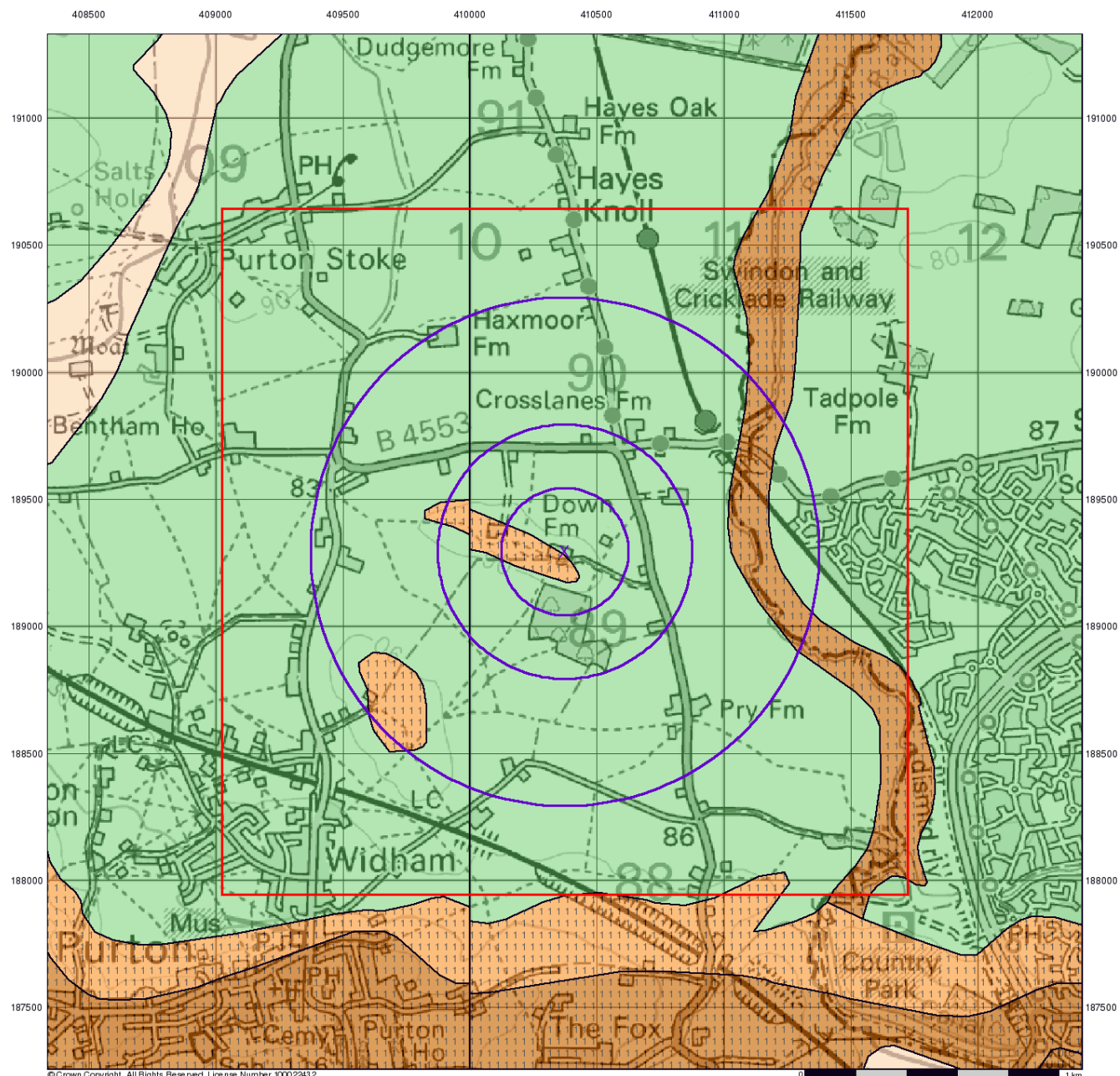


Site Details:

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0 1 km



Groundwater Vulnerability

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

Agency and Hydrological

Geological Classes

Major Aquifer (Highly Permeable)

Minor Aquifer (Variably Permeable)

Non Aquifer (Negligibly Permeable)

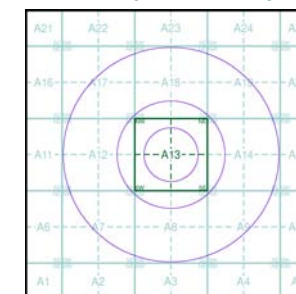
Water or Sea

Drift Deposit

Soil Classes

- High (H) 1, 2, 3, U
- Intermediate (I) 1, 2
- Low
- High (H) 1, 2, 3, U
- Intermediate (I) 1, 2
- Low

Site Sensitivity Context Map - Slice A



Order Details

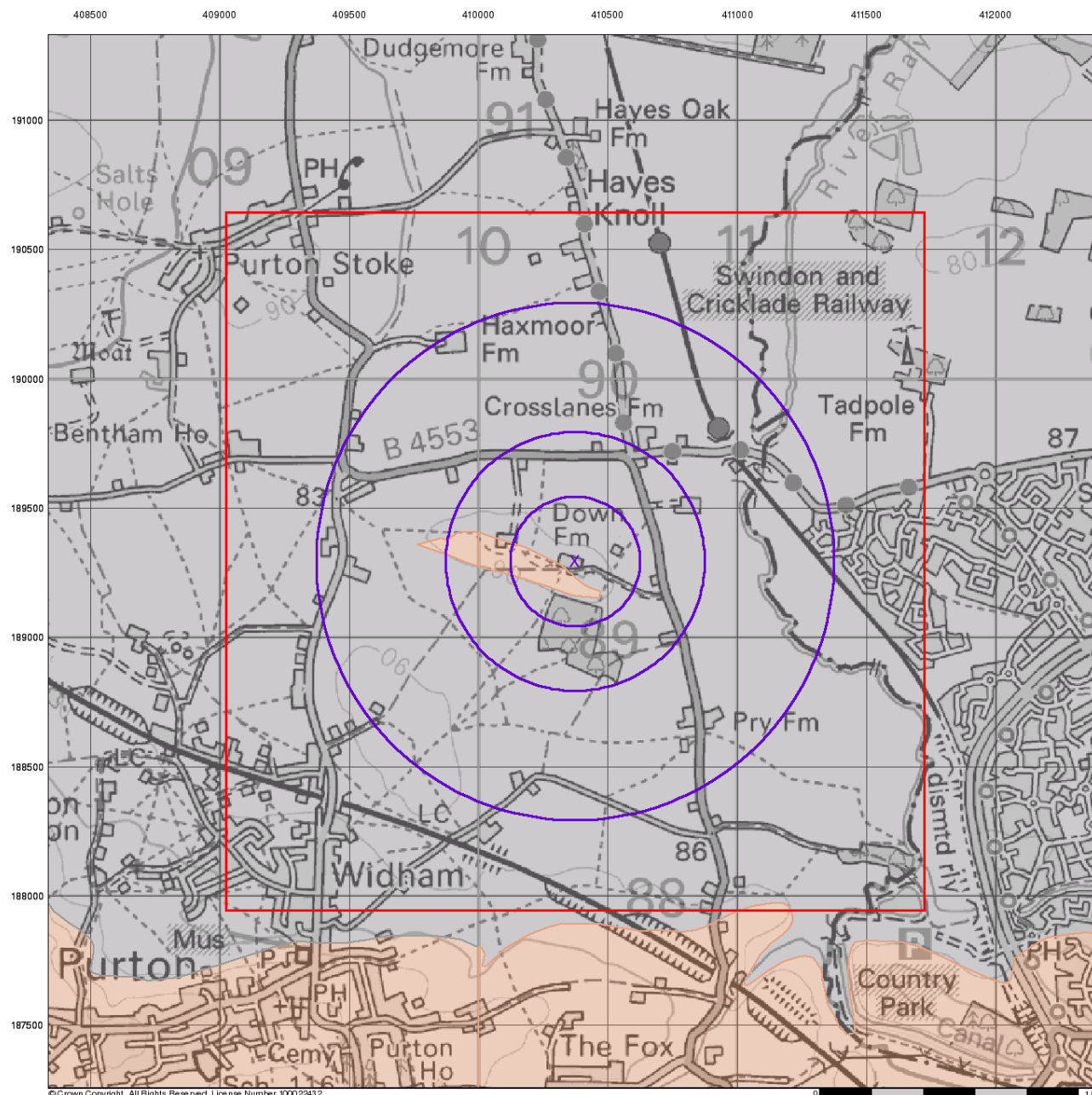
Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

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Bedrock Aquifer Designation

General

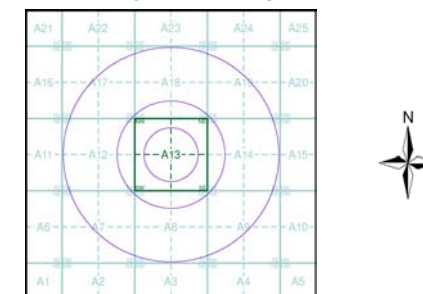
- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Slice
- Map ID

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

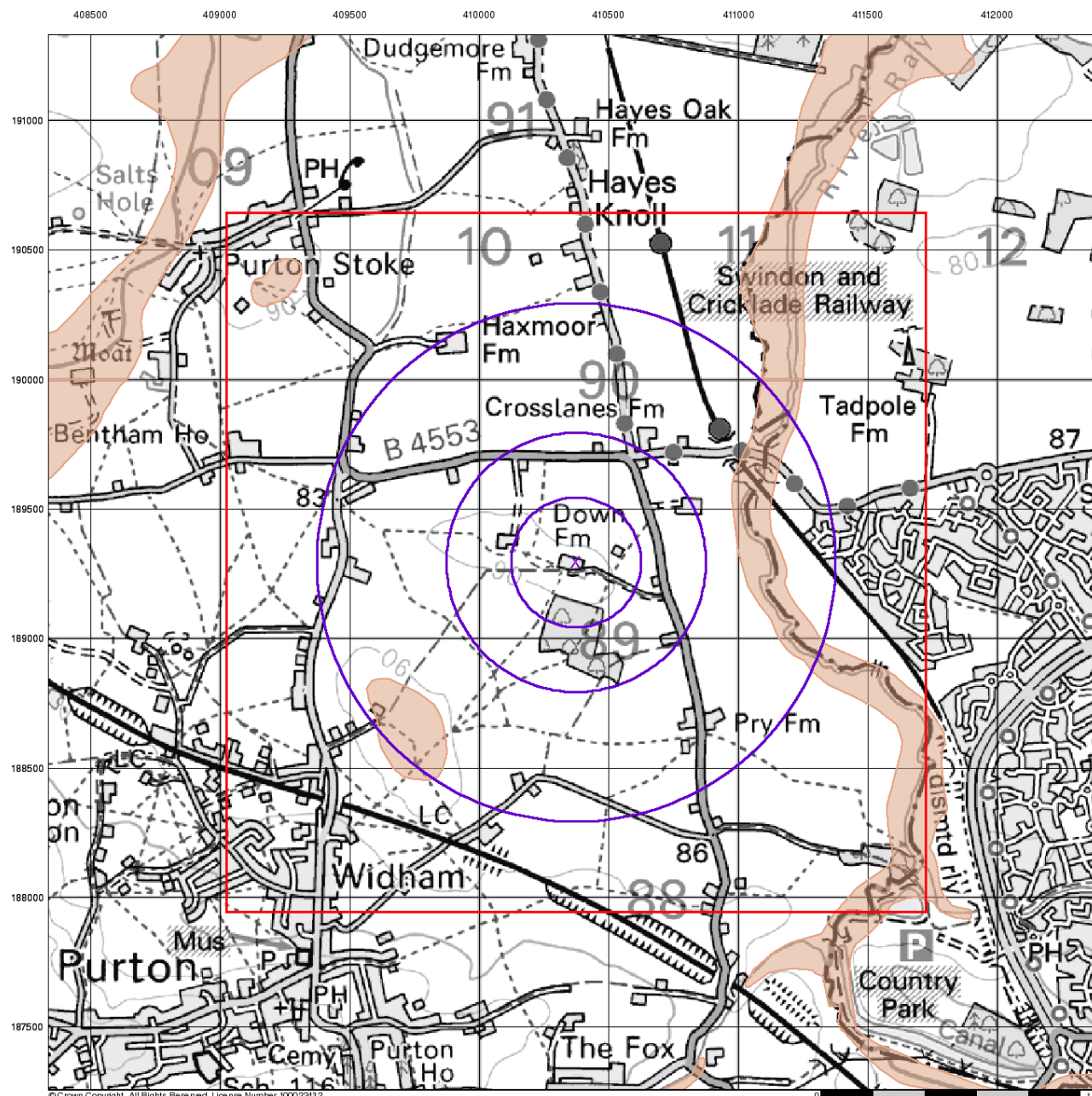
Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

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Superficial Aquifer Designation

General

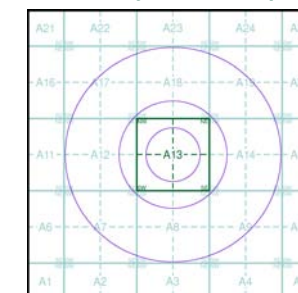
- ◇ Specified Site
- Specified Buffer(s)
- X Bearing Reference Point
- Slice
- B Map ID

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

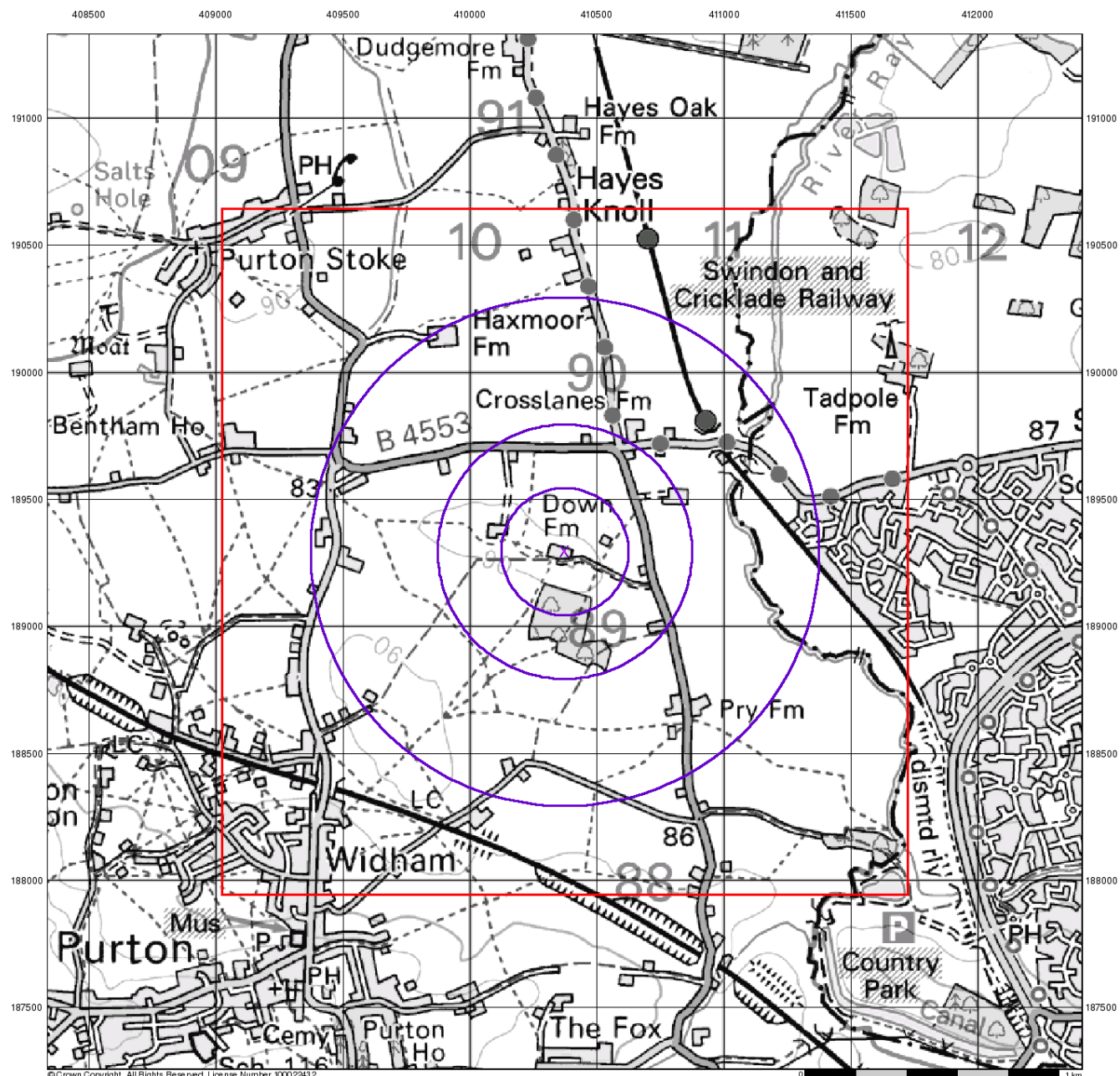
Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
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Site Details

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Source Protection Zones

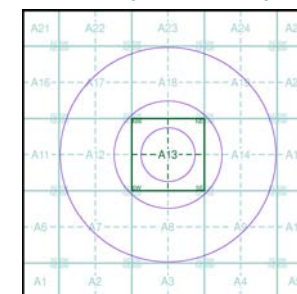
General

- ◆ Specified Site
- Specified Buffer(s)
- X Bearing Reference Point
- Slice
- B 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

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

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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

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

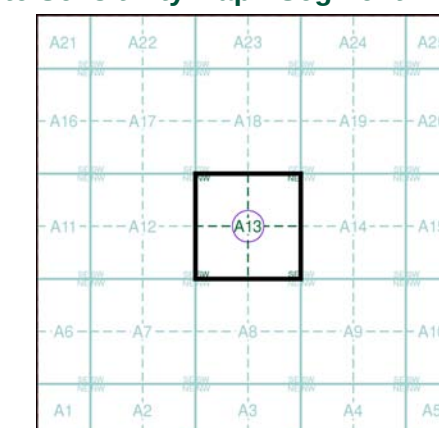
Geological

- BGS Recorded Mineral Site

Industrial Land Use

- Contemporary Trade Directory Entry
- Fuel Station Entry

Site Sensitivity Map - Segment A13

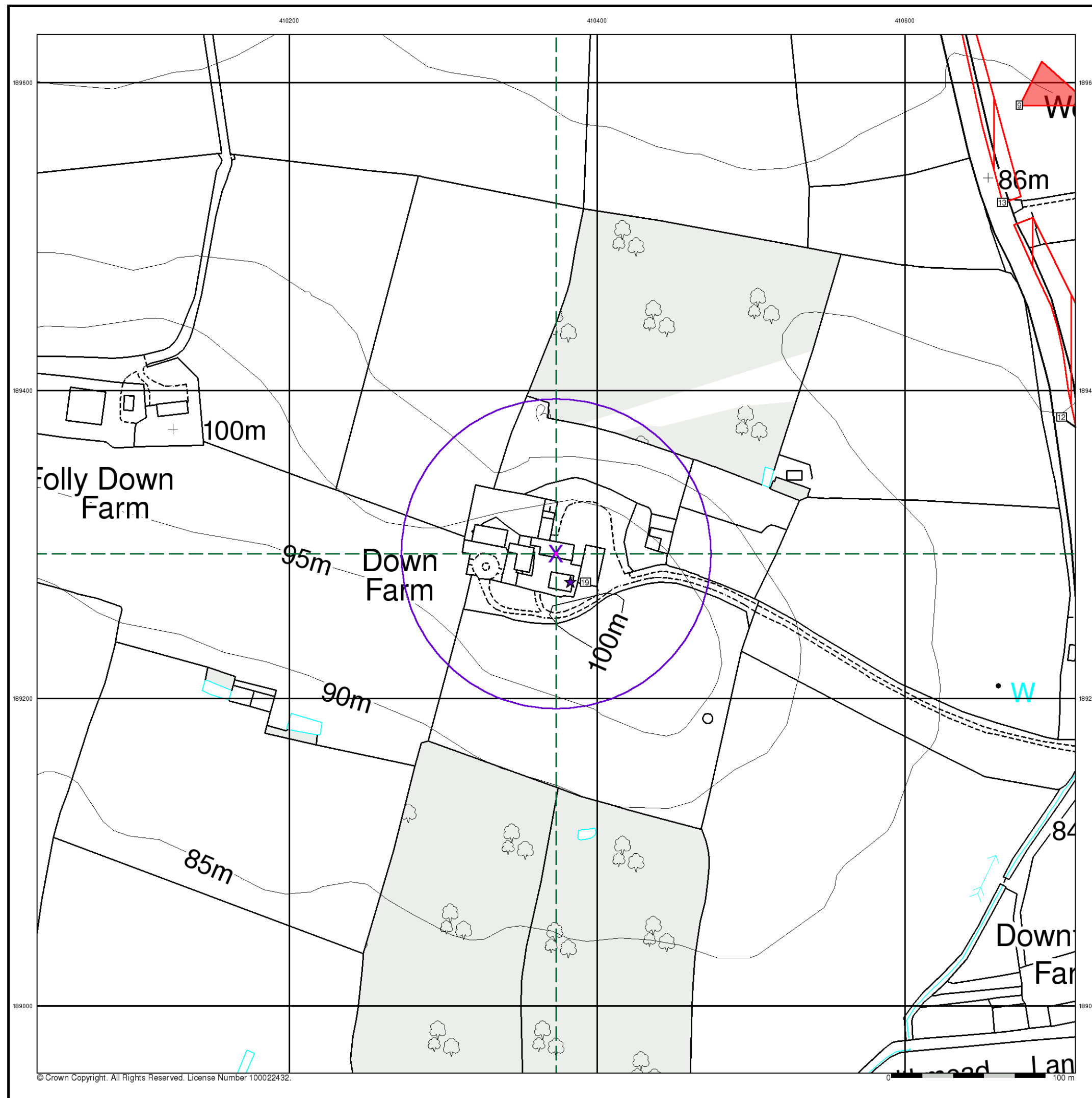


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP

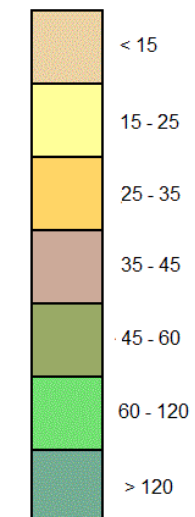


General

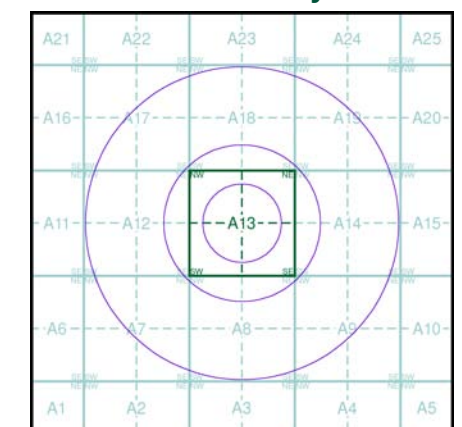
 Specified Site
  Specified Buffer(s)
  Bearing Reference Point

Estimated Soil Chemistry Arsenic

Arsenic Concentrations mg/kg



Estimated Soil Chemistry Arsenic - Slice A

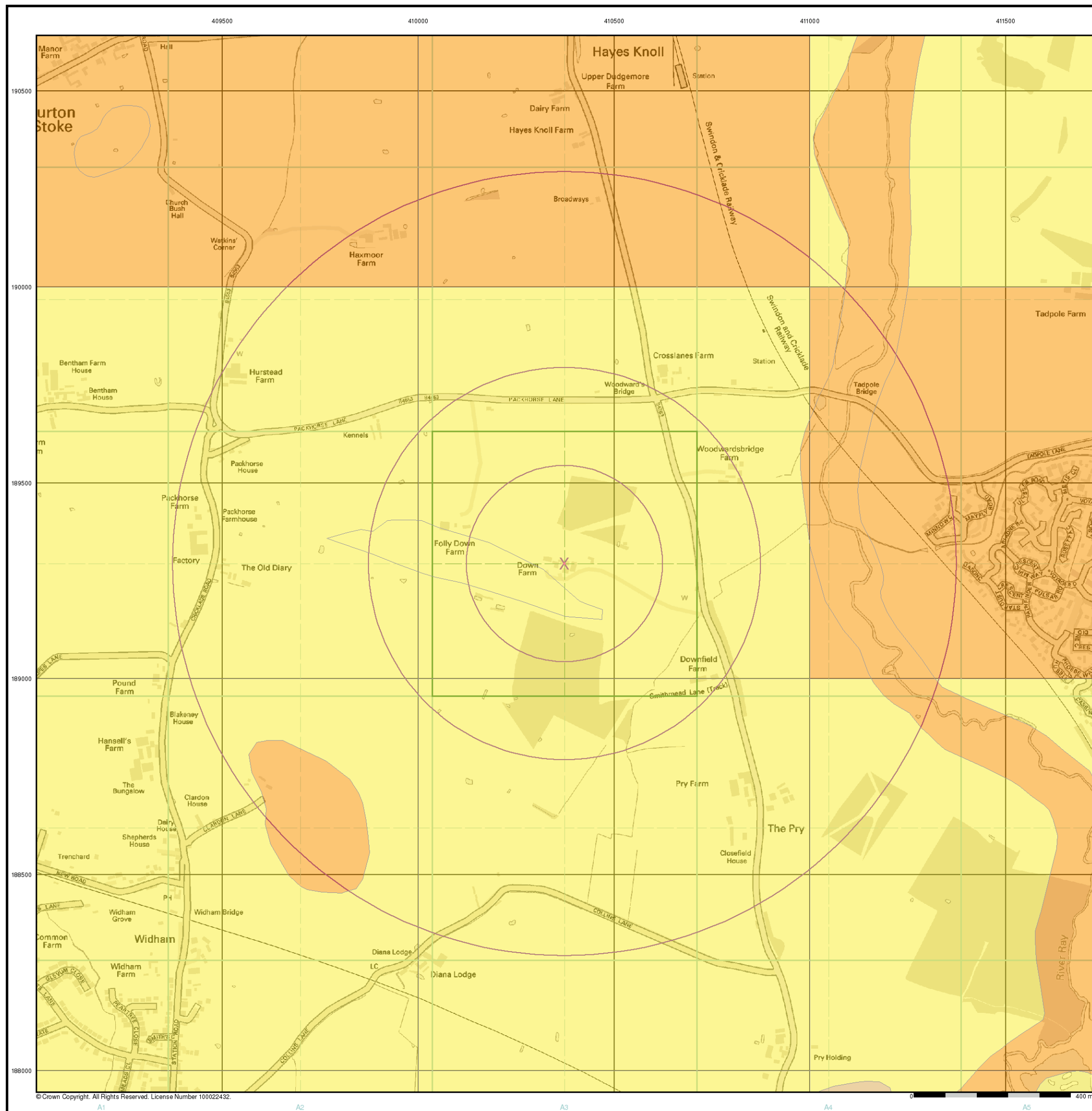


Order Details

Order Details: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP

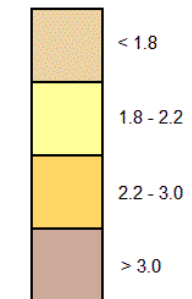


General

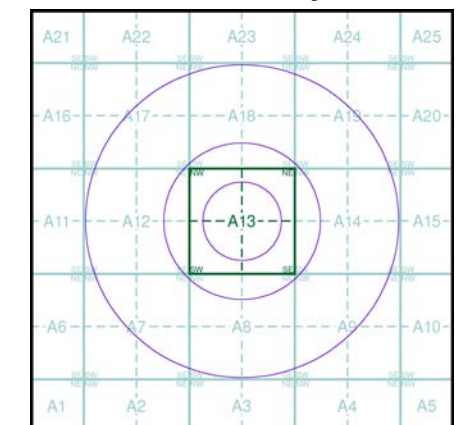
 Specified Site
  Specified Buffer(s)
  Bearing Reference Point

Estimated Soil Chemistry Cadmium

Cadmium Concentrations mg/kg



Estimated Soil Chemistry Cadmium - Slice A

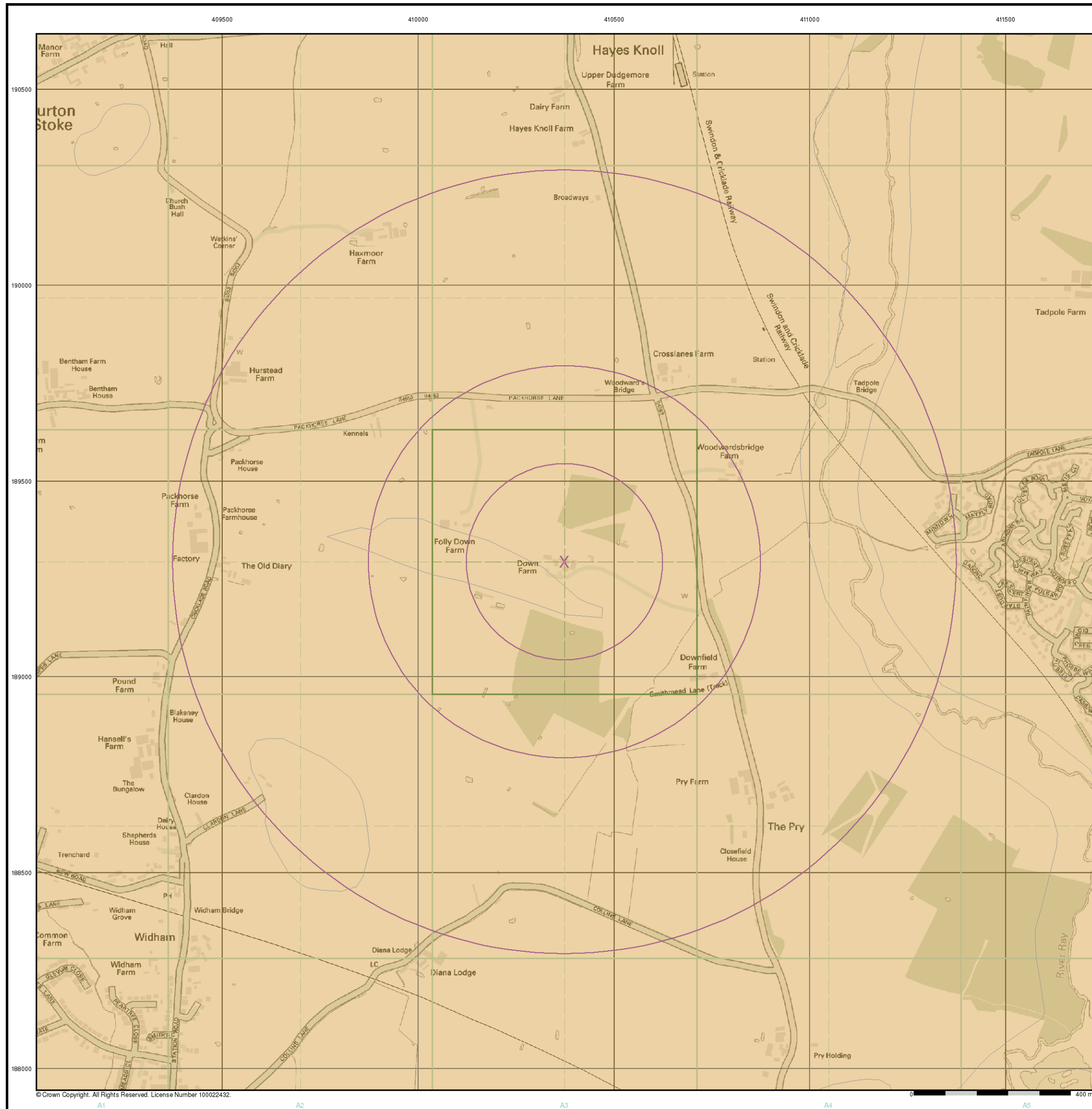


Order Details

Order Details: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP

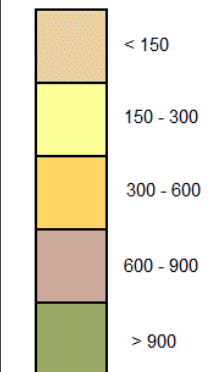


General

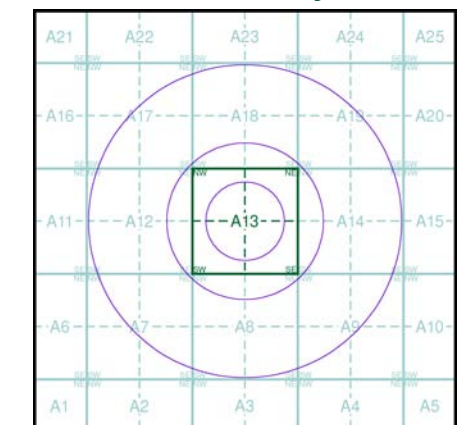
 Specified Site
  Specified Buffer(s)
  Bearing Reference Point

Estimated Soil Chemistry Lead

Lead Concentrations mg/kg



Estimated Soil Chemistry Lead - Slice A

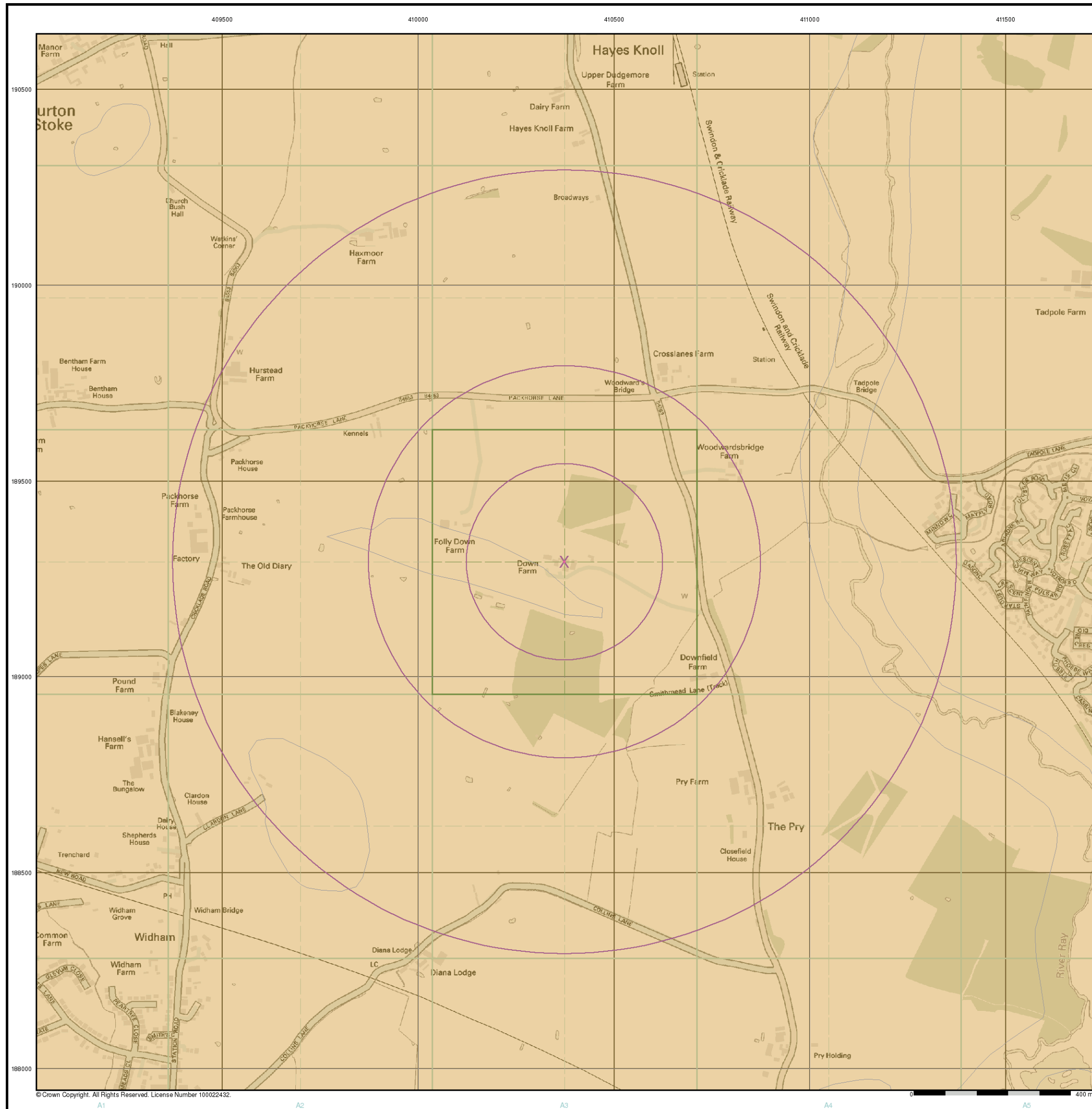


Order Details

Order Details: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP

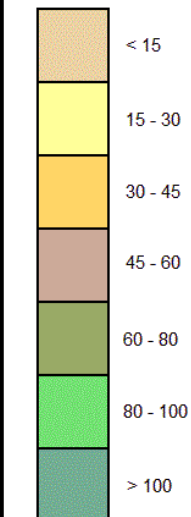


General

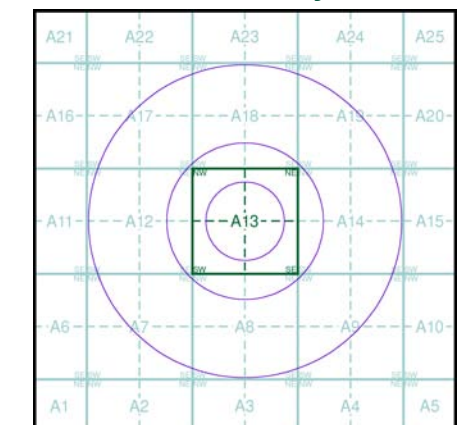
 Specified Site
  Specified Buffer(s)
  Bearing Reference Point

Estimated Soil Chemistry Nickel

Nickel Concentrations mg/kg



Estimated Soil Chemistry Nickel - Slice A

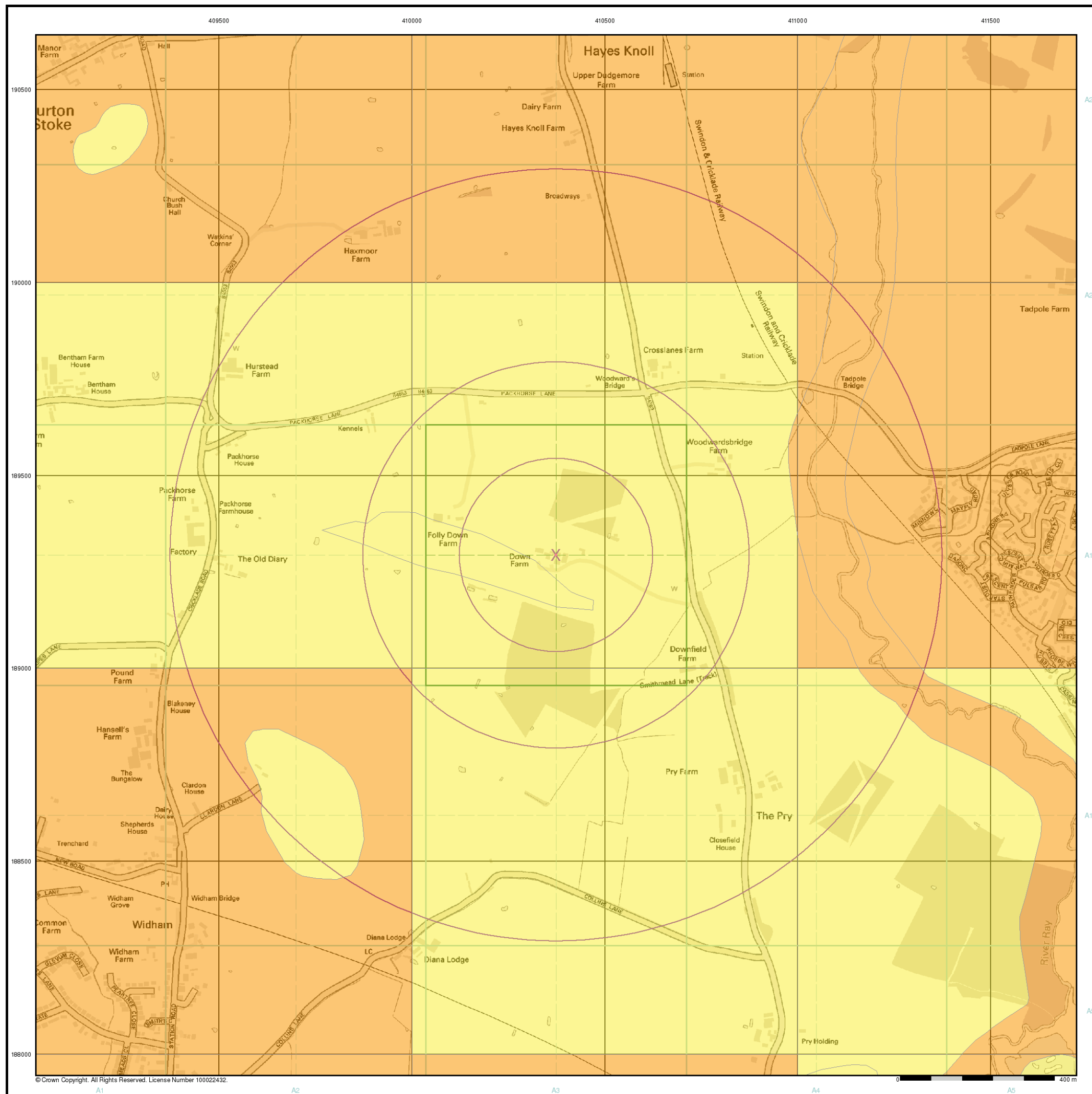


Order Details

Order Details: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



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
- BGS Recorded Mineral Site
- Contemporary Trade Directory Entry
- Fuel Station Entry
- 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

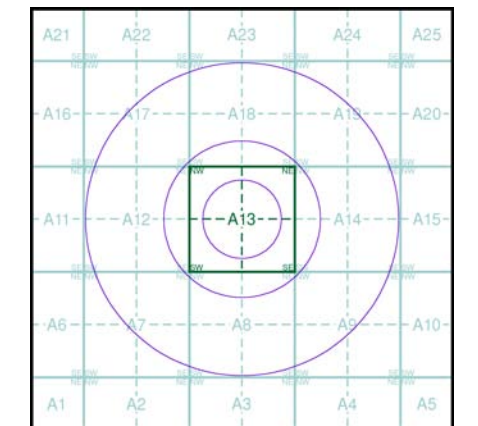
Geological

- BGS Recorded Mineral Site

Industrial Land Use

- Contemporary Trade Directory Entry
- Fuel Station Entry
- Planning Hazardous Substance Consent
- Planning Hazardous Substance Enforcement

Site Sensitivity Map - Slice A

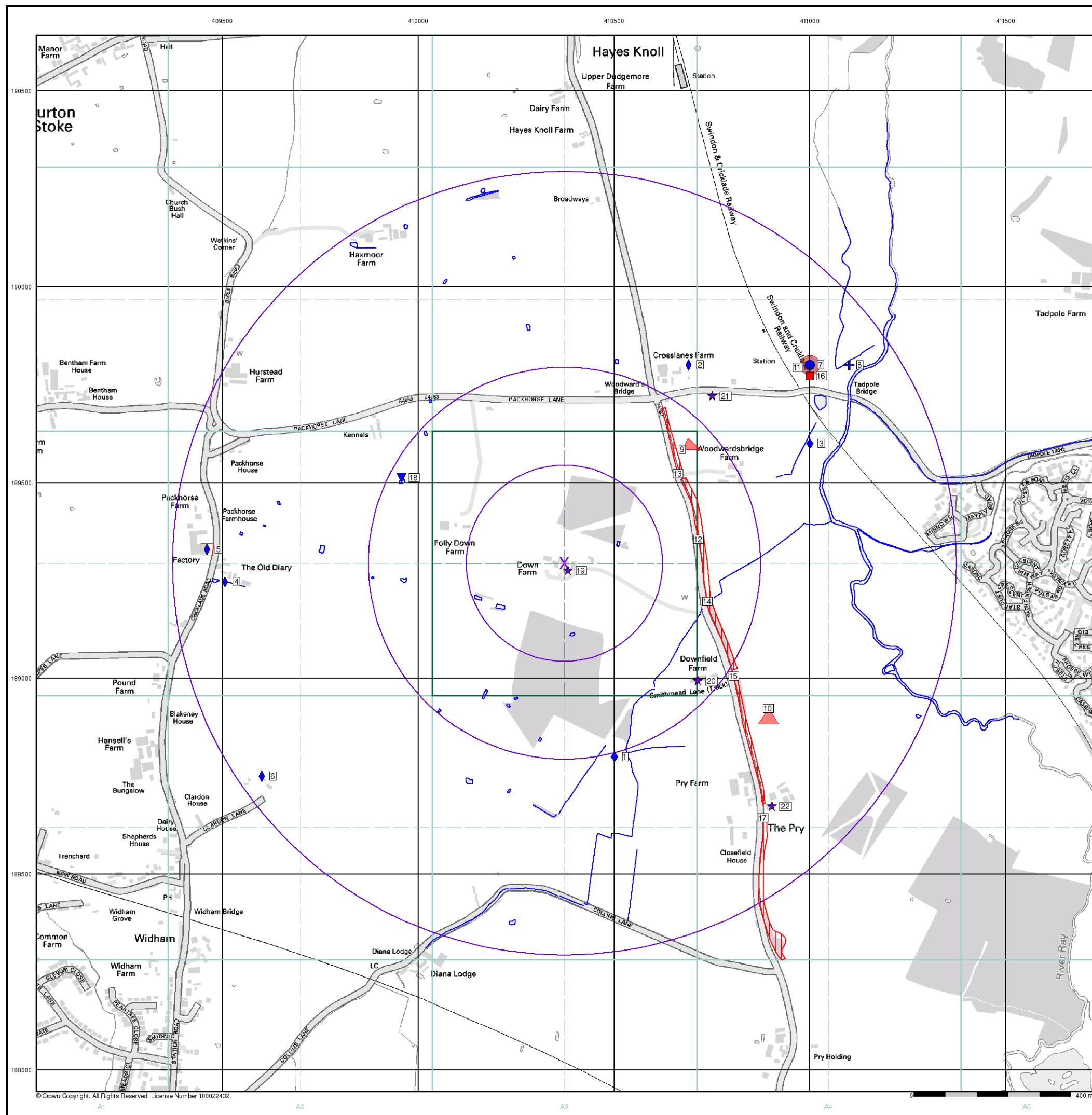


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
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 Search Buffer (m): 1000

Site Details

The Old Cottage, Down Farm, The Pry, Purton, Purton Stoke, SWINDON, SN5 4JP



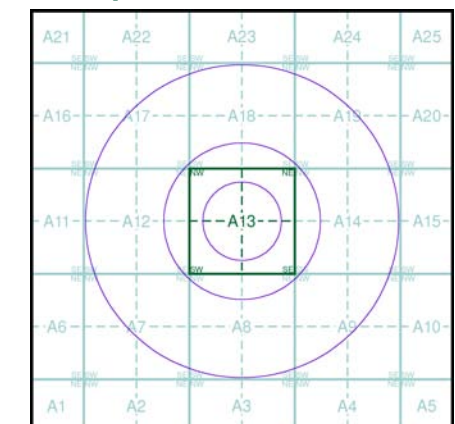
General

-  Specified Site
-  Specified Buffer(s)
-  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

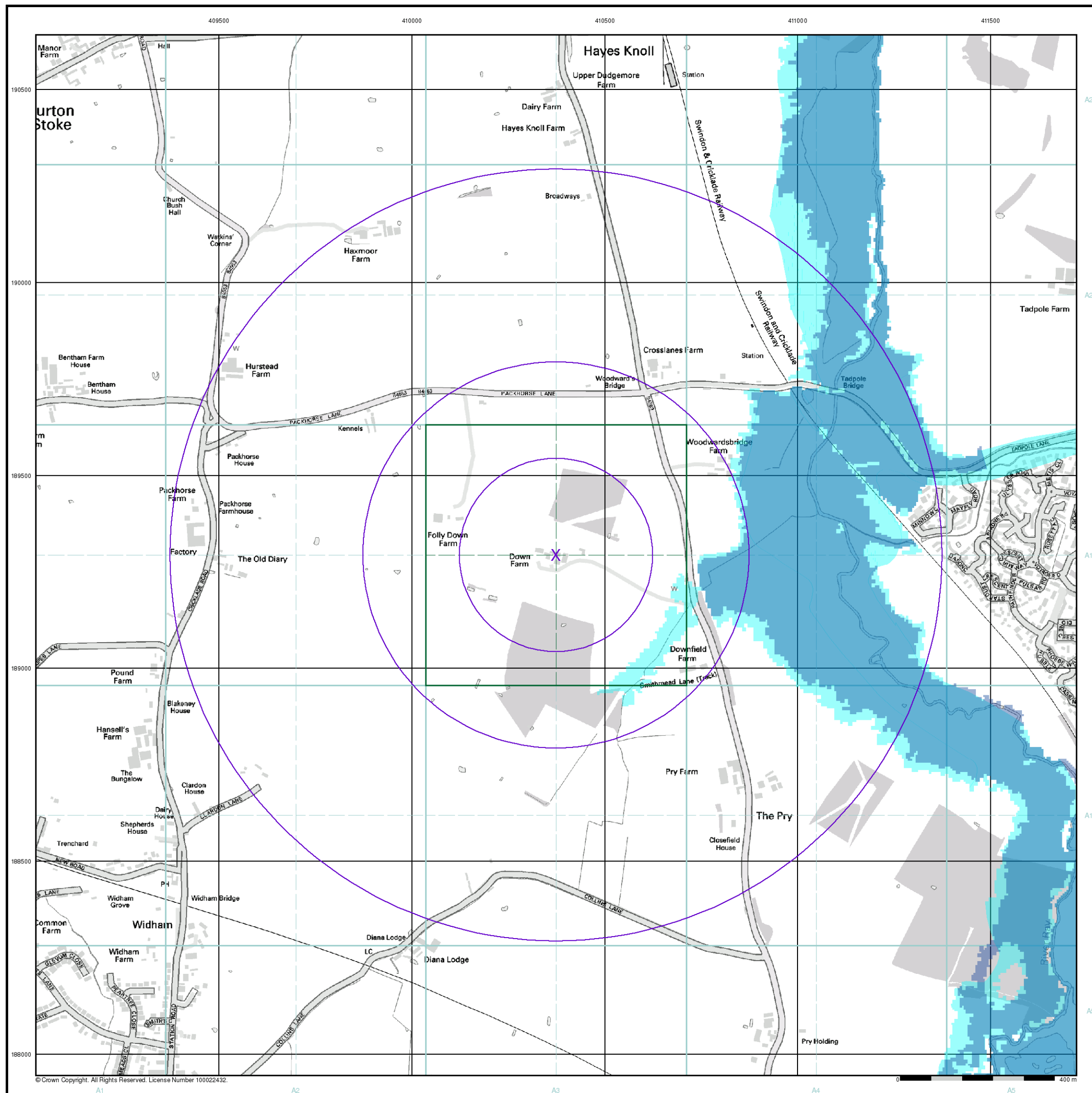


Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

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General

-  Specified Site
-  Specified Buffer(s)
-  Bearing Reference Point
-  Map ID
-  Several of Type at Location

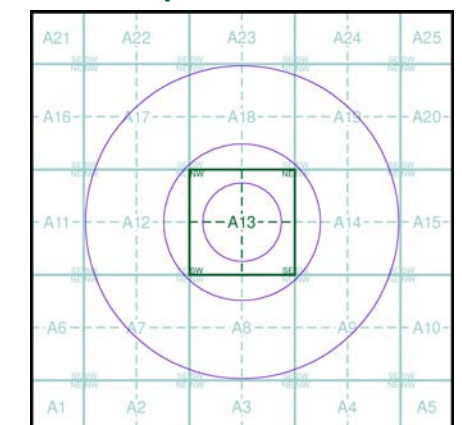
Agency and Hydrological (Boreholes)

-  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

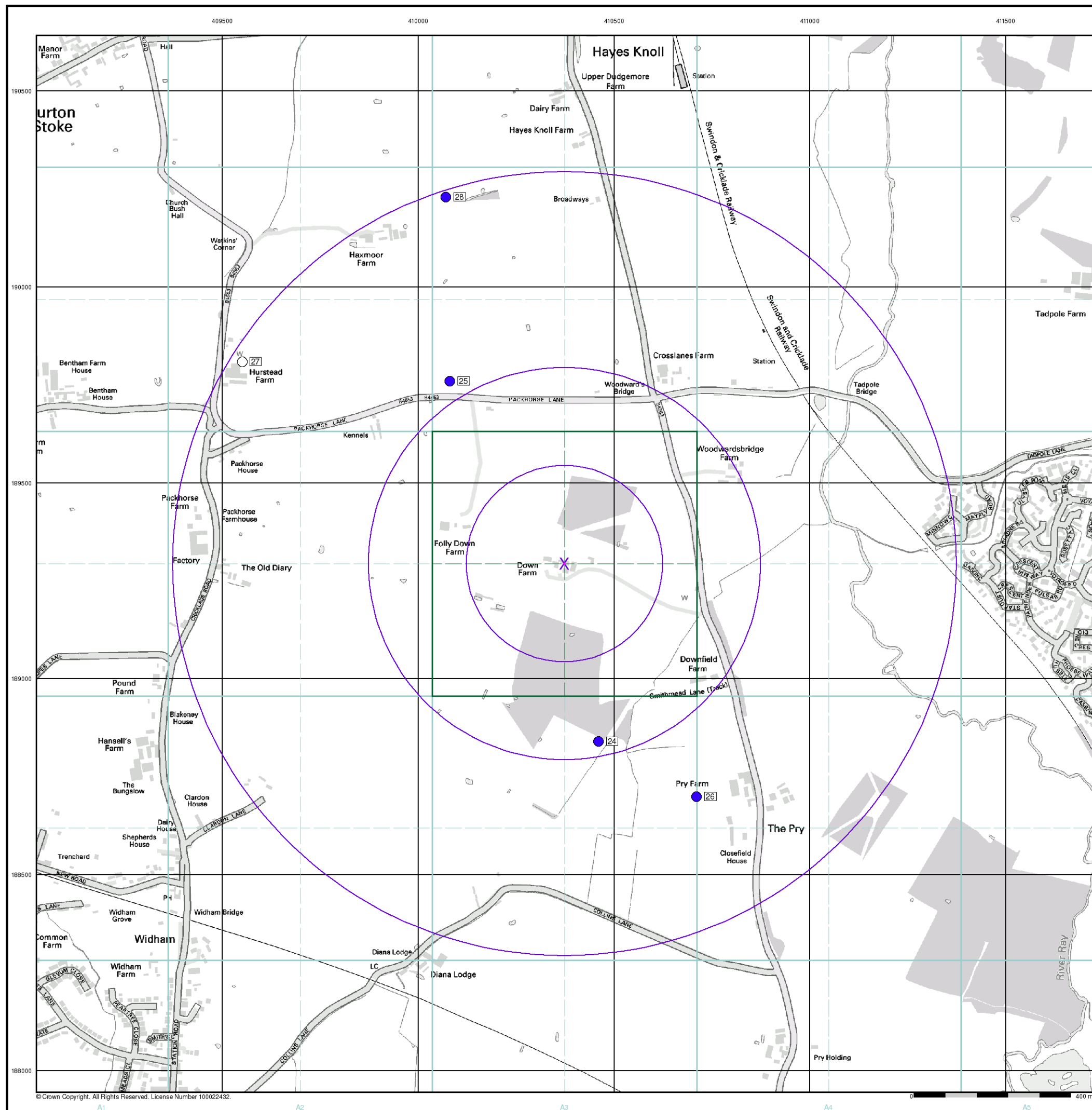


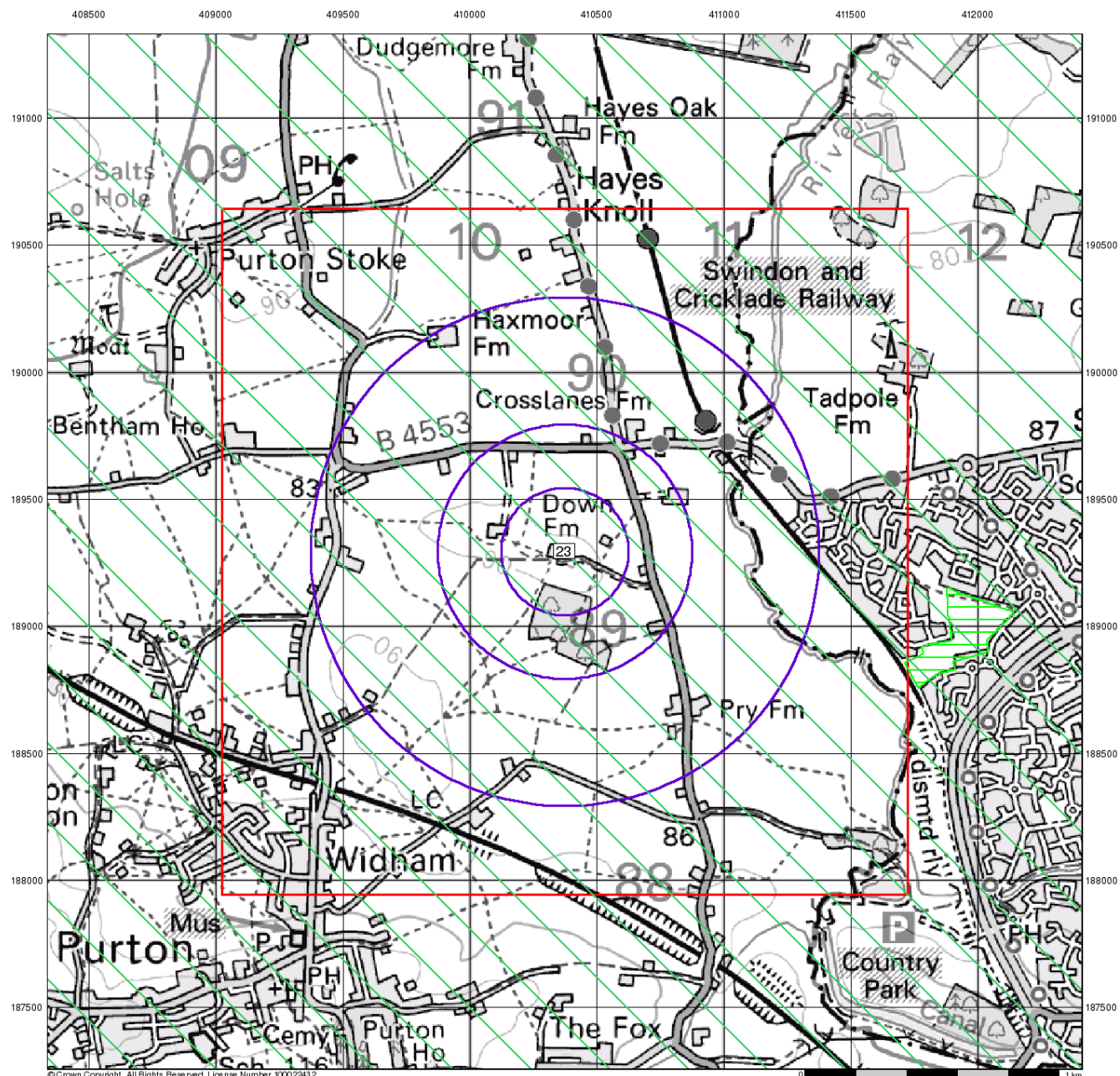
Order Details

Order Number: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
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Site Details

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Sensitive Land Uses

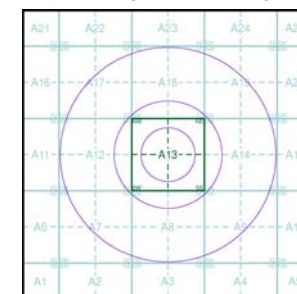
General

- 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: 44751727_1_1
 Customer Ref: C13144
 National Grid Reference: 410370, 189290
 Slice: A
 Site Area (Ha): 0.01
 Search Buffer (m): 1000

Site Details

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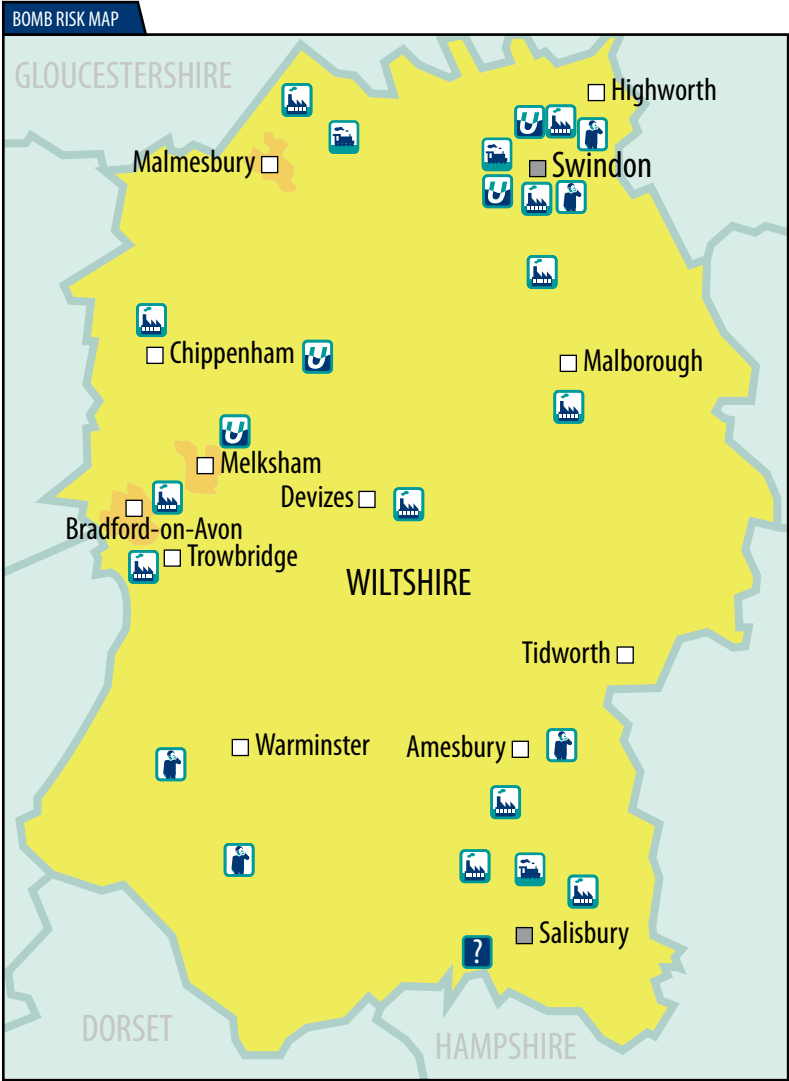


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REGIONAL UNEXPLODED BOMB RISK

WILTSHIRE

DENSITY OF BOMBS PER BOROUGH			
Borough	High explosive	Anti-personnel	Incendiary
Swindon	45	0	0
Malmesbury	175	0	0
Highworth	114	0	0
Devizes	194	0	0
Chippenham	18	0	0
Salisbury&Wilton	456	0	0
Marlborough&Ramsbury	175	0	0



OTHER WWII TARGETS

- military
- transport
- utilities
- industry
- docks
- other

BOMB TONNAGE

- >1000
- >500
- >100
- > 0
- unverified

BOMB RISK

- high
- moderate
- low

The information in this regional UXB risk map is derived from a number of sources and should be read in conjunction with the "Users' Guide" (printed overleaf). Zetica cannot guarantee the accuracy or completeness of the information or data.

This map covers regions of coast with beaches, estuaries and alike. Further consideration of the bomb risk is required in these areas. The often inaccessible nature and changing ground conditions (e.g. movement of silt that may contain ordnance) means that historical bombing records for these areas are often poor or inaccurate and further assessment of the bomb risk may be required as part of a site specific study.

A FOUR-STEP PROCESS

Risk assessment and method statement from a qualified explosive ordnance clearance (EOC) operative.

Surface geophysical survey to allow shallow groundwork.

MAGCONE detects UXBs and obstructions on piling layout to the no-risk depth.

Detected UXBs can be dealt with by our EOC engineers and a Clearance Certificate issued for the site.

For more details on this and related services, telephone: +44 (0) 1993 886682 or visit our website: www.zetica.com



BOMB MAP USERS' GUIDE

Sources of information and explanation of bomb risk

Why?

Unexploded bombs (UXB) still present a risk to construction projects long after the end of the Second World War (WWII). UXBs often entered the ground unnoticed at high velocity and penetrated to a depth of several metres. Here they remain – vulnerable to disturbances from construction work. Beyond the depth of shallow excavation work, the greatest risk is to piling, drilling and probing crews. A piling rig could repeatedly hit a UXBs with considerable force before the crew realises an obstruction has been impacted. It could then be up to 72 hours before the detonator activates.

Who?

The responsibility for avoiding UXB risk usually lies with construction companies or house builders particularly those who are redeveloping urban sites. In addition, project engineering or environmental consultants are expected to advise their clients of a site's history. Other interested parties include those organisations whose employees are physically at most risk from intrusive works, normally piling companies, drillers or probing operators.

How?

UXB risk should be assessed for every site, but especially those in known heavily bombed areas or those situated near war-time strategic installations that were priority targets for enemy aircraft, for example, airfields. Zetica's regional bomb risk map is therefore a first point of reference from which the relative, potential abundance of UXBs can be judged. Consultants then advise their clients that an ordnance-risk desk study is required, which they may obtain from external sources. Construction companies or house builders who assess their own risk could choose to come direct to Zetica.

When?

Do not wait for the piling or drilling company to be on site before thinking about UXB risk – it will inevitably cause delays and higher costs. Request the regional bomb risk map from Zetica as soon as a site is being considered, and then use it to help you or your clients to decide if an ordnance-risk desk study is required.

Where?

Maps can be obtained for any county in England, Scotland, Wales or Northern Ireland – or for any London borough. They can help determine the areas that were most heavily bombed – but no part of the country should be considered 100% safe from UXB risk. Even remote rural areas can have a high risk if, for example, they were locations for decoy airfields or beacons that were lit to fool enemy pilots into thinking they had located a burning city that had been successfully hit by others in the raid.

How to use this regional map

This map is designed to give you an indication of the potential risk from UXBs in your area. If you are conducting work that involves excavation, piling or other disturbance of the ground, then you should use the map to identify the category of risk for your site.

The risk boundaries are a guide, compiled from data based on the political areas for which records are held; being just outside a high-risk area does not mean there is no UXB risk. You should use the map to assist in your decision of whether to investigate the UXB risk further.

Information on the regional risk remaining from UXBs in the UK

Zetica has built the largest UXB database of its kind in the UK. It includes a unique digital library of bomb census data, and maps showing key strategic points and bombing densities from the First and Second World Wars. The main sources of information include records from central government (Public Records Office), the Ministry of Defence, and the German Luftwaffe.

Using information from this database, Zetica has published maps of UXB risk on a regional, county and borough scale. The maps indicate relative degrees of UXB risk based on available records for bombing densities and known targeted areas for regions within the UK. The risk is broken down into individual boroughs, towns or cities. The data are based on the historical boroughs and are then overlaid onto the modern map. It is important to note that more-detailed research may be required for individual sites, particularly where proximity to a potential WWII target means the local risk may be higher.

High risk

Areas designated as high risk are those that show a high density of bombing hits (50+ bombs per 1000 acres) and abundant potential WWII targets. In high-risk regions, further action to mitigate UXB risk is considered essential.

Moderate risk

Moderate-risk regions are those that show a bomb density of between 11 and 50 bombs per 1000 acres and that may contain potential WWII targets. Action to mitigate the risk is considered essential, albeit more likely that a reduced scope of work is required compared with that needed for high-risk regions.

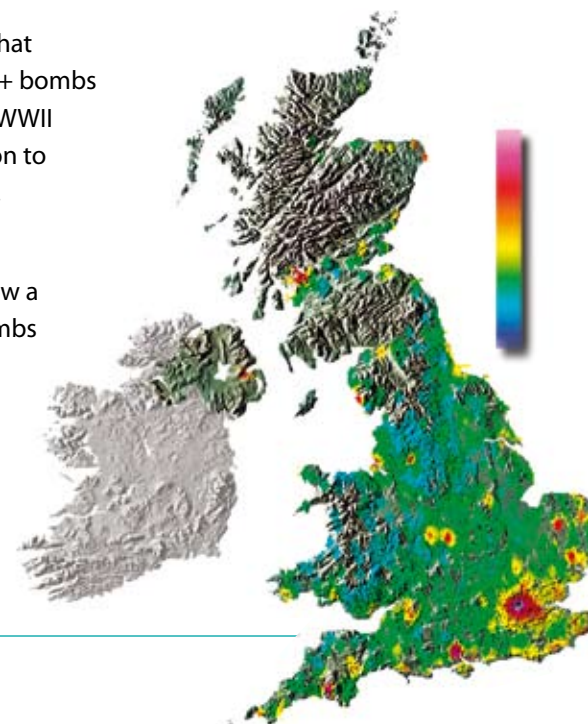
Low risk

Low-risk regions are those with a bombing density of up to 10 bombs per 1000 acres. These areas are considered to have a significant but low UXB risk. In general, further action to mitigate the risk is considered prudent, although not essential. Care is required when assessing the risk for specific sites where the risk may be higher because of local wartime activity.

Other WWII targets

Other regions with the risk of UXBs are key strategic points as defined by the government during WWII as representing potential enemy targets. Where these exist outside areas mapped as high, moderate or low risk, a site-specific assessment of the UXB risk may be required.

Relative UXB risk across UK



What to do if...

...you have a site that has a potential UXB risk

In the absence of current legislation requiring you to address the risk from UXBs, your responsibilities under health and safety legislation and regulations such as construction design and management require that you address all identified risks. The first stage is to request further advice from a professional adviser such as Zetica, or to gain more site-specific information by commissioning an ordnance-risk desk study. Then a strategy to deal with the risk can be established that is tailored to your proposed work.

...you find a suspect item or require advice

If during site works you find a suspect (ordnance-related) item, it is very important that you do not touch or move it (even if it has already been moved by an excavator). If it is clearly ordnance related, then dial 999 and ask for the police. Ensure that the area around the item is kept as clear as possible without placing yourself at risk. If you are unsure and do not wish to cause undue alarm, or you just require some advice, then you can call Zetica. We have experienced qualified UXB specialists on hand who can offer support and advice during any site works.

More-detailed procedures should be established in advance if you are in an area where the risk of finding a UXB is shown to be significant (moderate to high).

Site-specific desktop studies

Zetica is able to provide high-quality, site-specific UXB risk information for any residential, industrial or commercial property in the UK. These desktop studies provide details of the bombing density within an area and for the site itself, in order to indicate the risks of UXBs still being present. A risk assessment is provided to facilitate informed decision making on whether any further risk mitigation measures are required.

Appendix E

HYDROCK METHODOLOGY

Hydrock Report Appendix on Hydrock Methodology, version 02 updated 21-12-12 applies to this report.

This appendix may not be included in the printed report to reduce the document size.

It is presented in the PDF version of the report on the CD enclosed with the printed report.

Alternatively, it can be supplied on request by quoting the version number and date.

1.0 **HYDROCK REPORT APPENDIX ON HYDROCK METHODOLOGY**

This appendix provides additional background information on certain approaches and methods used by Hydrock Consultants Ltd in the preparation of this report.

Throughout the report the term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements) and the term 'geo-environmental' is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. The geo-environmental sections are written in broad agreement with BS 10175:2011.

The **first stage** of a two-staged investigation and assessment of a site is the Preliminary Investigation (BS 10175:2011), often referred to as the Phase 1 Study¹, comprising desk study and walk-over survey, which culminates in the Preliminary Risk Assessment. A preliminary conceptual site model (CSM) is developed. From this are identified any geotechnical and geo-environmental hazards and the qualitative degree of risk associated with them. From the geo-environmental perspective, the Hazard Identification process uses professional judgement to evaluate all the hazards in terms of **possible contaminant linkages** (of source-pathway-receptor). Possible contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and generic risk assessment.

The **second stage** is the Ground Investigation, Generic Risk Assessment and Geotechnical Interpretation. This represents the further assessment mentioned above. The Ground Investigation comprises field work and laboratory testing based on the findings of the Preliminary Risk Assessment, to reduce uncertainty in the geotechnical and geo-environmental hazard identification. This may include the Exploratory, Main and Supplementary Investigations described in BS 10175:2011.

For the geotechnical aspects of the report, the general requirements of Eurocode 7 (BS EN 1997-2:2007) are to produce a Ground Investigation Report (GIR) which shall form part of the Geotechnical Design Report (GDR). The geotechnical section of this report is intended to fulfil the general requirements of the GIR as outlined in BS EN 1997-2, Section 6.

The GIR contains the factual information including geological features and relevant data, and a geotechnical evaluation of the information stating the assumptions made in the interpretation of the test results.

¹ Please note that it does not refer to a site development phase.

2.0 SITE INVESTIGATION INFORMATION

2.1 Unexploded Ordnance

Clients have a legal duty under the CDM 2007 Regulations to provide designers and contractors with project-specific health and safety information needed to identify hazards and risks. This includes the possibility of unexploded ordnance (UXO) being encountered on the site. Further details are given in CIRIA report C681 (Stone *et al* 2009).

A non-UXO specialist screening exercise has been carried out for the site by considering (a) any evidence of UK defence activities on or near the site evident from the gathered desk study information and (b) the unexploded aerial delivered bomb (UXB) regional risk maps produced by Zetica. Other data sources are available, but as a first stage screening exercise the freely available Zetica maps have been used. The level of risk stated is that determined by Zetica, a company experience in the desk study, field investigation and clearance of UXO/UXB.

2.2 Hydrogeology

Under the Water Framework Directive the designations of principal and secondary aquifers is based on the Environment Agency interactive aquifer designation map. Where aquifers have been mapped, and they are capable of sustaining a yield of 10 m³/day or supplying 50 people on a continuous basis, the Environment Agency has designated a number of Groundwater Bodies to help manage water quality under the River Basin Management Plans. Groundwater bodies are defined based on their support for ecosystems as well as their capacity to supply drinking water. Note that some localised small aquifers capable of supporting the above supply may be too small to map and can be identified only by investigation.

Where an aquifer exists and it contains groundwater but is incapable of sustaining the above supply, the groundwater is not part of a Groundwater Body and is not considered a strategic resource. In which case the groundwater is not a receptor, but can be a pathway to other receptors by virtue of its ability to transport contaminants.

2.3 Geotechnical Testing

Derived values of geotechnical parameters and/or coefficients are obtained from test results, by theory, correlation or empiricism in line with BS EN 1997-2:2007, Section 1.6.

Where derived geotechnical parameters are to be used in designs in accordance with EC7, there are two further stages of interpretation that will be carried out by the geotechnical designer. The first of these is the selection of **characteristic values** for geotechnical parameters using the derived values and complemented by well-established experience as per EN BS 1997-1:2004, Section 2.4.5.2. The characteristic value is a cautious estimate of the value affecting the occurrence of the limit state. Consequently, any particular material

type may have more than one characteristic value for each parameter because there may be more than one limit state depending what is being designed.

The second stage is the selection of **design values** as per EN BS 1997-1:2004, Section 2.4.6.2. The design values is either derived from the characteristic value by applying the relevant partial factor or is assessed directly. Similarly, there can be several design values for the same material type.

In the event that geotechnical designs are include in this report, selection of the characteristic and design values is included. Otherwise, it is the duty of the geotechnical designer to determine these within a separate design report.

3.0 **RISK ASSESSMENT RATIONALE**

The work presented in this report has been carried out in general accordance with recognised best practice as detailed in guidance documents such as in the CLR 11 Model Procedures (Environment Agency 2004a), BS5930:1999+A2:2010 and BS10175:2011. Important aspects of the risk assessment process are transparency and justification. The particular rationale behind the risk assessments presented is given in this appendix.

A preliminary risk assessment is made of both geotechnical and geo-environmental hazards identified at the desk study stage and confirmed (or amended) at the ground investigation stage. In the case of geo-environmental hazards this is based on a simple matrix of probability of occurrence versus the consequence, as explained below, and is referred to as the **exposure model**. In the case of the geotechnical hazard identification, this is referred to as the **ground model**.

The geo-environmental risk assessment process proceeds to the next level, the generic risk assessment, in which actual contaminant concentrations are considered.

3.1 **Preliminary Risk Assessment**

In line with the CLR 11 Model Procedures (Environment Agency 2004a), the Preliminary Risk Assessment includes a geo-environmental Hazard Identification, which seeks to list all the suspected contaminant **sources**, the **receptors** that might be harmed by those sources and the **pathways** via which the sources might reach the receptors to cause the harm. The source-pathway-receptor concept is known as a contaminant linkage (formerly a pollutant linkage) and only when a linkage is complete is there any possibility of risk of harm arising.

The Hazard Identification process uses professional judgement to evaluate all the hazards in terms of **possible contaminant linkages**. Possible contaminant linkages are potentially unacceptable risks in terms of the current contaminated land regime legal framework and require either remediation or further assessment. These are normally addressed via intrusive ground investigation and the chemical analysis of soil and water samples.

Where no ground investigation has been carried out (i.e. in a desk study only report) there is greater uncertainty in the information available and so a geoenvironmental consequences and probability assessment is undertaken.

Some linkages may be identified which constitute a theoretical connection between a source and a receptor, but professional judgement shows them not to be possible for some reason. These are labelled 'no linkage' in the summary table and no further action is required. If a linkage is possible, a comparison is made of consequence against probability in general accordance with the guidance given in CIRIA Report C552 (Rudland *et al* 2001).

Classification of consequences and probability are given in CIRIA C552 Tables 6.3 and 6.4, respectively, but there are a number of inconsistencies in the original Table 6.3, in particular

relating to 'significant harm or significant possibility of significant harm' (SH/SPOSH). Consequently, the table has been updated by Hydrock in line with current practice and the revision presented in R&D Publication 66, Annex 4 (NHBC and Environment Agency. 2008, and is given in Table 3.1 below.

The basis of the classification is that 'severe' and 'medium' are likely to result in SH/SPOSH as defined by the EPA 1990, Part 2A, with 'severe' resulting in acute harm. 'Mild' lies below the level of SH/SPOSH but above the level of 'no harm' as implied by the relevant Generic assessment criterion (GAC, see below). Minor lies below the 'no harm' level.

Table 3.1: Classification of Consequences of Geo-environmental Risks

Classification of Consequences for Geo-environmental Risks		
Classification	Definition	Examples
Severe	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. Highly elevated concentrations likely to result in "significant harm" to human health as defined by the EPA 1990, Part 2A, if exposure occurs. I.e. >>SH/SPOSH, concentrations are high enough to cause acute (short-term) effects. Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.	Human health: short-term (acute) effects likely to result in significant harm. E.g. high conc. of cyanide on the surface of an informal recreational area. Significant harm to humans is defined as death, disease*, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Planting: complete and rapid die-back of landscaped areas. Controlled waters: short-term pollution, e.g. major spillage into controlled water. Major fish kill in surface water from large spillage of contaminants from site. Highly elevated concentrations of List I and II substances present in groundwater close to small potable abstraction (high sensitivity). Buildings etc.: catastrophic damage, e.g. explosion causing collapse. (can also equate to immediate human health risk if buildings are occupied). Ecosystems: acute risk to a particular ecosystem or organism forming part of that ecosystem in a designated protected area, e.g. by contamination spillage. Damage to a protected area of international significance (e.g. Ramsar site). Site workers: risk assessment required to determine PPE and this may involve USEPA Level A, B or C protection.

Classification of Consequences for Geo-environmental Risks		
Classification	Definition	Examples
Medium	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of unacceptable intake or contact. Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs. I.e. >SH/SPOSH. Equivalent to EA Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.	Human health: long-term (chronic) effects likely to result in significant harm. E.g. high conc. of contaminants close to the surface of a development site. Significant harm to humans is defined as death, disease*, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Planting: stressed or dead plants in landscaped areas. Controlled waters: pollution of sensitive water resources, e.g. leaching into principal or secondary aquifers or rivers. Buildings etc.: damage renders unsafe to occupy e.g. foundation damage resulting in instability. Ingress of contaminants through plastic potable water pipes. Ecosystems: chronic death of species in a particular ecosystem in a designated protected area, e.g. by contamination spillage. Damage to a protected area of national significance (e.g. Site of Special Scientific Interest). Site workers: risk assessment required to determine PPE and this may involve USEPA Level B, C or D protection.
Mild	Concentration of contaminants is likely to (or is known from previous data to) exceed that indicative of no harm but not unacceptable intake or contact. Exposure to human health unlikely to lead to "significant harm". I.e. >SVG/GAC but <SH/SPOSH. Equivalent to EA Category 3 pollution incident including minimal or short lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.	Human health: harm but probably not significant harm unless particularly sensitive individual within the receptor group. May be aesthetic/olfactory impacts. Exposure could lead to slight short-term effects (e.g. mild skin rash). Planting: damage to plants in landscaped areas, e.g. stunted growth, discoloration. Controlled waters: pollution of non-sensitive water bodies e.g. leaching into non-classified groundwater or minor ditches. Buildings etc.: damage to sensitive buildings etc. Surface spalling of concrete. Ecosystems: minor change in a particular ecosystem in a designated protected area, but not significant harm. Damage to a locally important area. Site workers: risk assessment required to determine PPE and this may involve USEPA Level C or D protection.

Classification of Consequences for Geo-environmental Risks		
Classification	Definition	Examples
Minor	Concentration of contaminants is likely to (or is known from previous data to) be less than that indicative of no harm. No measurable effects on humans. I.e. <SGV/GAC. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structures and services.	No measurable effects, but simple PPE required (USEPA Level D protection, i.e. overalls, boots, goggles, hard hat). The loss of plants in a landscaping scheme. Discoloration of concrete.

CIRIA Table 6.4 is reproduced as Table 3.2 below. This provides an estimate of the probability that the event described by the contaminant linkage will occur. For example, the likelihood that pollution of groundwater will occur by leaching of metals into the aquifer.

Table 3.2: Classification of Probability of Geo-environmental Risks

Classification of Probability of Geo-environmental Risks	
Classification	Definition
High Likelihood	There is a contaminant linkage and an event that either appears very likely in the short term and almost inevitable over the long term, or there is evidence at the receptor of harm or pollution.
Likely	There is a contaminant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a contaminant linkage and circumstances are possible under which an event could occur. However, it is no means certain that even over a longer period such event could take place, and is less likely in the shorter term.
Unlikely	There is a contaminant linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

The perceived level of risk for each pathway is then derived from the probability versus consequences matrix, modified after CIRIA C552 Table 6.5, given in Table 3.3 below. Note that by definition, no contaminant linkage equates to no risk.

Table 3.3: Qualitative Risk Level from Consequence and Probability

		Consequence			
Probability	<i>product</i>	Severe	Medium	Mild	Minor
	High Likelihood	Very high risk	High risk	Moderate risk	Low risk
	Likely	High risk	Moderate risk	Low risk	Very low risk
	Low Likelihood	Moderate risk	Low risk	Low risk	Very low risk
	Unlikely	Low risk	Very low risk	Very low risk	Very low risk
	No Linkage	No risk			

This approach assumes an equivalence between probability and consequences and ignores the difficulty that can arise where to probability of occurrence appears to be almost negligible but the consequences are very severe. In such conditions there is a degree of subjectivity in assessing the level of risk and it could be low, moderate or high. Such risks may require specialist consideration beyond the scope of this standard report.

Finally, a description of the classified risks and the likely action required can be determined from Table 3.4 below.

Table 3.4: Description of the Classified Risks and Likely Action Required

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

3.2 Contaminant Analysis of Samples

The Model Procedures of CLR 11 provide guidance on key information sources with respect to potential contamination arising from past land uses of a site. In particular, the now withdrawn CLR 8 (Environment Agency 2002b), the DoE Industry Profile documents and ISO10381-5 provide good summaries of priority pollutants for UK sites. Additionally, the Environment Agency (2004b) has produced a list of priority pollutants for ecological risk assessment. These documents have been used, with the findings of the Phase 1 investigation, to scope the analyses of chemicals of potential concern. It should be noted that whilst CLR 8 was withdrawn in August 2008 it was not replaced and its findings are still considered useful.

Hydrock considers there to be a minimum requirement for soil chemical analysis, even for greenfield sites, in order to satisfy the 'suitable for use' criterion of the planning regime. This is represented by the 'Hydrock default list of determinands for solids'. The default list is derived from the above guidance, particularly Tables 2.1 and 2.2 of CLR 8, listing potential inorganic and organic contaminants on typical former **industrial** land in the UK.

Since not all redevelopment sites have former industrial land uses, the default list designed to screen for unacceptable risks to property development and future occupiers comprises those substances with human, vegetation and construction materials receptors. The list includes common metals, metalloids and inorganic species, pH, asbestos fibres and screening tests for common organic compound groups which are deemed chemicals of potential concern. Sulfate is a contaminant whose principal receptor is concrete in the ground and is not considered toxic except in extreme conditions. Sulfate analysis is included in the list of geotechnical tests. Some common determinands such as elemental sulfur and sulfide are not included because there is insufficient information available to calculate meaningful assessment criteria.

The Hydrock default list of determinands for water or soil leaching samples is based on the prevailing UK drinking water standards and the environmental quality standards (EQS) values specified by DEFRA (2009) under the UK's obligations under the European Water Framework Directive (WFD). It includes the most common contaminants for use as a screening exercise but does not represent a complete list.

The two Hydrock default lists of determinands are used as a minimum requirement whatever the findings of the Phase 1 investigation. Added to this may be other suites of determinands based on the findings and review of the aforementioned documents.

Assessment is made of all chemicals of potential concern recorded on the site above the laboratory reporting limit. The reporting limits are less than the generic assessment criteria where this is possible. There are two main reasons why this may not be the case.

Firstly, low-level detection may be available using a more detailed analysis method, but this would be disproportionately expensive for routine screening purposes. More detailed testing may be recommended in some instances as an additional phase of investigation once the results of the screening exercise are known.

Secondly, there may be no suitable laboratory method available. In which case it is impossible to give a definitive opinion.

3.3 Generic Risk Assessment Criteria for Human Health

3.3.1 Policy

Generic assessment criteria (GAC) are criteria derived using largely generic assumptions about the characteristics and behaviour of sources, pathways and receptors. These

assumptions will be conservative in a defined range of conditions. The Contaminated Land Exposure Assessment (CLEA) framework uses Soil Guideline Values (SGV) in assessing risks to human health from exposure to soils contaminated with selected contaminants. It has been assumed in this report that the exposure conditions are within the generic conditions used to derive the SGVs.

It should be noted that exceedance of GACs does not automatically mean that the soil is “contaminated”. The derivation of GACs includes a number of precautionary assumptions such that non-exceedance will indicate that risk to human health is acceptable and that the land is suitable for use, with regard to the contaminant in question. SGVs are not binding standards, but may be used to inform judgments about the need for action and the selection of remediation standards or target values for individual sites.

However, the legal test for land contamination under the statutory guidance of Part 2A of the Environment Protection Act 1990 (i.e. “significant harm or significant possibility of significant harm”) is **unacceptable** intake or direct bodily contact. DEFRA (September 2005 and July 2008) has made it clear that exceedance of a GAC does not necessarily meet this legal test, i.e. exceedance of a GAC does not necessarily equate to unacceptable risk. Consequently, the GACs must be considered as screening values only. The situation was clarified by DEFRA (July 2008) in its guidance on the legal definition of contaminated land and in 2012 by the publication of revised contaminated land statutory guidance. One of the key policy aspects of this revision is to clarify that GACs are only one tool in the decision-making process and that background concentrations and a number of other relevant factors should also be taken into account. The aim is to prevent over-cautious determination of land as being contaminated.

The Environment Agency (2009a) has stated that the Health Criteria Values (HCV) used to derive GACs represent minimal or tolerable risk for long-term human exposure to chemicals in the soil. “Science alone cannot answer the question of whether or not a given *possibility of significant harm* is *significant*, since what is either *significant* or *unacceptable* is a matter of socio-political judgement, and the law entrusts decisions on this to the enforcing authorities (DEFRA July 2008).”

The Health Protection Agency (2009) also describes how HCVs do not represent unacceptable intake and that unacceptable intake is not a toxicological parameter. It further asserts that “unacceptable intake is a policy decision which can only be taken by the local authority.” Pointers provided to local authorities in this regard are provided by the following: “The HCVs, and GACs based upon them represent trigger values above which there might be a possibility of significant harm. Whether there is a significant possibility will be linked to factors such as the margin of exceedance, the duration and frequency of exposure, and other site-specific factors.”

The 2012 National Planning Policy Framework states that the standard of remediation to be achieved through the grant of planning permission for new development, including permission for land remediation activities, is the removal of unacceptable risk and making sure the site is suitable for its new use. As a minimum, after carrying out the development

and commencement of its use, the land should not be capable of being determined as contaminated under Part 2A. The requirements for planning are, therefore, the same as for Part 2A.

The 2012 contaminated land statutory guidance says that GAC represent cautious estimates of levels of contaminants in soil at which there is considered to be no risk to health or, at most, a minimal risk to health. They may be used to indicate when land is very unlikely to pose a significant possibility of significant harm to human health. They should not:

- be used as direct indicators of whether a significant possibility of significant harm to human health may exist. Also, the local authority should not view the degree by which GACs are exceeded (in itself) as being particularly relevant to this consideration, given that the degree of risk posed by land would normally depend on many factors other than simply the amount of contaminants in soil.
- be seen as screening levels which describe the boundary between Categories 3 and 4 (see below);
- be viewed as indicators of levels of contamination above which detailed risk assessment would automatically be required under Part 2A or, under the planning system, in relation to ensuring that land affected by contamination does not meet the Part 2A definition of contaminated land after it has been developed; nor
- be used as generic remediation targets under the Part 2A regime.

Where it is judged that significant uncertainties remain following assessment against generic criteria, there are two options for the developer: either the implementation of an agreed remedial strategy, or to undertake additional testing and/or a detailed quantifiable risk assessment to determine whether remediation is indeed necessary.

3.3.2 Methodology

The sample analyses are divided into representative data sets for the assessment, based on the conceptual model and taking into account such characteristics as variation in soil properties or historical, existing or proposed land uses. The 'averaging area' is the area of soil to which a receptor is exposed or which otherwise contributes to the creation of hazardous conditions.

The determination of averaging areas is clarified in the CLEA Frequently Asked Questions (30 January 2006) document available from the Agency CLEA web pages. In applying statistical tests, the risk assessor is asking the question "are mean (95 percentile upper confidence limit) soil concentrations within the averaging area equal to, or greater than, the SGV/GAC?" If a garden lies within a larger averaging area, but that averaging area is representative of conditions within the garden, then this is the average concentration a receptor using the garden will be exposed to. An averaging area can, therefore, be larger than a single garden and part of a larger zoned area if:

- contaminant concentrations are within the same statistical population, the sample data being representative of the averaging area and the mean concentration of the averaging area;
- hot spots are treated as separate zones or averaging areas; and
- the sampling strategy takes into account uncertainty (spatial heterogeneity) in contaminant concentration.

The approach taken in this report is to characterize the materials that are likely to form the ground cover in garden areas by zoning the site. Each averaging area has been chosen to describe the area(s) of the site, zoned according to material type and existing conditions, within which assessment against GACs has taken place. As pointed out in P5-066/TR (Environment Agency 2000) and by Nathanail (2004), this is a logical way of investigating a large plot of land that is intended for residential use, particularly if the development layout may not have been finalised.

The original Soil Guideline Values were all withdrawn in August 2008 and the Agency started a programme of publishing replacements using its 'new approach', which involves a number of changes to the way exposure is assessed. This was started using the CLEA 1.04 software. The current version is CLEA 1.06. This programme was put in abeyance when DEFRA started to re-draft the Part 2A statutory guidance.

A significant change in the new approach is to publish SGVs only at 6% soil organic matter (SOM) content. This appears to be counter productive because in cases where the SGV varies with the SOM, the published SGV report states that "at a lower SOM, they may not be sufficiently protective." The SGV introduction report *Using Soil Guideline Values* states that in such circumstances a new GAC can be produced by adjusting the SGV.

Furthermore, the SGVs are no longer published for the residential without plant uptake land use.

Consequently, the approach taken by Hydrock is to take the various input parameters from the SGV reports and produce GACs for various SOM and for the residential without plant uptake land use, using CLEA 1.06. The GACs adopted by Hydrock for the standard CLEA land uses are given in Table 3.5 together with the source of the GAC. The table also lists GACs for open space (see below).

The absence of published SGVs for certain chemicals of potential concern has been addressed by the derivation of GAC using generic assumptions about the characteristics and behaviour of sources, pathways and receptors and the CLEA 1.06 software. Input data have been derived either from published GAC lists (EIC/AGS/CL:AIRE and LQM/CIEH) or by in-house research of the recommended data sources.

Please note also that CLEA 1.06 allows for other variations, most notably of soil type (9 options) and building type (5 residential options). The defaults are a sandy loam soil, a small

terraced house in the residential setting and a pre-1970s office block in the commercial setting. These are generally conservative and the resultant SGV/GAC are protective of other combinations (unlike the default SOM mentioned above). It is not practical to include all permutations in Table 3.5 and in the cases where specific GACs have been derived, this is referred to in the text of the report and the relevant values included in the assessment tables.

Lead is a special case as the former SGV was not based on the CLEA model, but equations utilising blood lead concentrations. There is currently no guidance on how to risk assess lead and the work-in-progress by the Environment Agency under to derive a new methodology using CLEA is in abeyance. Consequently, the former SGVs for lead have been retained by Hydrock until this has been clarified.

Further details including data sources can be obtained on request. It is Hydrock's policy to continually review GACs and updates are made in response to the latest Government guidance or as more data on the substances becomes available. The date of the last update of the table is indicated.

Table 3.5: Soil GACs Adopted by Hydrock (mg/kg) - on following pages

Updated 20/07/11		Human Health Generic Assessment Criteria (mg/kg)														
Contaminant	Source of GAC	Human health - residential without plant uptake (1%SOM)	Human health - residential without plant uptake (2.5%SOM)	Human health - residential without plant uptake (6%SOM)	Human health - residential with plant uptake (1%SOM)	Human health - residential with plant uptake (2.5%SOM)	Human health - residential with plant uptake (6%SOM)	Human health - allotments (1%SOM)	Human health - allotments (2.5%SOM)	Human health - allotments (6%SOM)	Human health - commercial (1%SOM)	Human health - commercial (2.5%SOM)	Human health - commercial (6%SOM)	Human health - open space (1%SOM)	Human health - open space (2.5%SOM)	Human health - open space (6%SOM)
		Default for SGV						Default for SGV			Default for SGV					
Hydrock Default Suite																
Arsenic	SGV report + CLEA 1.06	35	35	35	32	32	32	43	43	43	640	640	640	590	590	590
Beryllium	LQM/CIEH + CLEA 1.06	51	51	51	51	51	51	55	55	55	420	420	420	8600	8600	8600
Boron	LQM/CIEH + CLEA 1.06	1000	1000	1000	290	290	290	45	45	45	190000	190000	190000	45000	45000	45000
Cadmium	SGV report + CLEA 1.06	85	85	85	11	11	11	1.9	1.9	2	230	230	230	860	860	860
Chromium (III)	LQM/CIEH + CLEA 1.06	630	630	630	630	630	630	15000	15000	15000	8800	8800	8800	660000	660000	660000
Chromium (VI)	LQM/CIEH + CLEA 1.06	4.3	4.3	4.3	4.3	4.3	4.3	2.2	2.2	2.2	35	35	35	4400	4400	4400
Copper	LQM/CIEH + CLEA 1.06	6200	6200	6200	2300	2300	2300	520	520	520	72000	72000	72000	400000	400000	400000
Lead	SGV 10 (old method)	450	450	450	450	450	450	450	450	450	750	750	750	450	450	450
Lead	CLEA 1.06 (not yet in use)	220	220	220	220	220	220	590	590	590	5100	5100	5100	11000	11000	11000
Mercury, inorganic	SGV report + CLEA 1.06	240	240	240	170	170	170	80	80	80	3600	3600	3600	9900	9900	9900
Nickel	SGV report + CLEA 1.06	130	130	130	130	130	130	230	230	230	1800	1800	1800	38000	38000	38000
Selenium	SGV report + CLEA 1.06	600	600	600	350	350	350	120	120	120	13000	13000	13000	29000	29000	29000
Vanadium	LQM/CIEH + CLEA 1.06	190	190	190	74	74	74	18	18	18	3200	3200	3200	13000	13000	13000
Zinc	LQM/CIEH + CLEA 1.06	40000	40000	40000	3700	3700	3700	620	620	620	670000	670000	670000	1000000	1000000	1000000
Cyanide (free)	Hydrock + CLEA 1.06	760	760	760	750	750	750	2300	2300	2300	16000	16000	16000	21000	21000	21000
Phenol	SGV report + CLEA 1.06	310	420	520	180	290	420	66	140	280	3200	3200	3200	3000	3000	3000
Acenaphthene	LQM/CIEH + CLEA 1.06	2000	3100	3900	210	480	1000	34	85	200	85000	98000	100000	39000	39000	39000
Acenaphthylene	LQM/CIEH + CLEA 1.06	2000	3000	3900	170	400	850	28	69	160	84000	97000	100000	39000	39000	39000
Anthracene	LQM/CIEH + CLEA 1.06	20000	22000	23000	2300	4900	9200	380	950	2200	520000	540000	540000	200000	200000	200000
Benzo(a)anthracene	LQM/CIEH + CLEA 1.06	3.7	5.2	6.2	3.1	4.7	5.9	2.5	5.5	10	89	95	97	89	89	89
Benzo(a)pyrene	LQM/CIEH + CLEA 1.06	1.0	1.0	1.0	0.83	0.94	1.0	0.60	1.2	2.1	14	14	14	13.0	13.0	13.0
Benzo(b)fluoranthene	LQM/CIEH + CLEA 1.06	7.0	7.3	7.4	5.6	6.5	7.0	3.5	7.4	13	100	100	100	92	92	92
Benzo(ghi)perylene	LQM/CIEH + CLEA 1.06	47	47	47	44	46	47	140	120	160	650	660	660	590	590	590
Benzo(k)fluoranthene	LQM/CIEH + CLEA 1.06	10	10	10	8.5	9.6	10	6.8	14	23	140	140	140	130	130	130
Chrysene	LQM/CIEH + CLEA 1.06	8.8	9.7	10	6.0	8.0	9.3	2.6	5.8	12	140	140	140	130	130	130
Dibenz(ah)anthracene	LQM/CIEH + CLEA 1.06	0.86	0.91	0.93	0.76	0.86	0.90	0.76	1.5	2.3	13	13	13	12.0	12.0	12.0
Fluoranthene	LQM/CIEH + CLEA 1.06	970	990	1000	260	460	670	52	130	290	23000	23000	23000	8100	8100	8100
Fluorene	LQM/CIEH + CLEA 1.06	1900	2500	2900	160	380	780	27	67	160	64000	69000	71000	26000	26000	26000
Indeno(123cd)pyrene	LQM/CIEH + CLEA 1.06	4.2	4.4	4.4	3.2	3.9	4.2	1.8	3.8	7.1	60	61	62	56	56	56
Naphthalene	LQM/CIEH + CLEA 1.06	1.6	3.9	9.3	1.5	3.7	8.7	4.1	9.9	23	200	480	1100	13000	13000	13000
Phenanthrene	LQM/CIEH + CLEA 1.06	840	930	970	92	200	380	16	38	90	22000	22000	23000	8100	8100	8100
Pyrene	LQM/CIEH + CLEA 1.06	2300	2400	2400	560	1000	1600	110	270	620	54000	54000	55000	20000	20000	20000
TPH fractions																
TPH ali EC05-EC06	LQM/CIEH + CLEA 1.06	30	55	110	30	55	110	740	1700	3900	300	560	1200	100000	100000	100000
TPH ali >EC06-EC08	LQM/CIEH + CLEA 1.06	73	160	370	73	160	370	2300	5600	13000	140	320	740	100000	100000	100000
TPH ali >EC08-EC10	LQM/CIEH + CLEA 1.06	19	46	110	19	46	110	320	770	1700	78	190	450	41000	41000	41000
TPH ali >EC10-EC12	LQM/CIEH + CLEA 1.06	48	120	280	48	120	280	2200	4400	7300	48	120	280	41000	41000	41000
TPH ali >EC12-EC16	LQM/CIEH + CLEA 1.06	24	59	140	24	59	140	11000	13000	13000	24	59	140	41000	41000	41000
TPH ali >EC16-EC35	LQM/CIEH + CLEA 1.06	45000	64000	77000	45000	64000	76000	260000	270000	270000	1000000	1000000	1000000	81000	81000	81000
TPH ali >EC35-EC44	LQM/CIEH + CLEA 1.06	45000	64000	77000	45000	64000	76000	260000	270000	270000	1000000	1000000	1000000	81000	81000	81000
TPH aro EC05-EC07	LQM/CIEH + CLEA 1.06	260	480	980	65	130	280	13	27	57	1200	2300	4700	180000	180000	180000
TPH aro >EC07-EC08	LQM/CIEH + CLEA 1.06	610	1300	2700	120	270	610	22	51	120	870	1900	4400	180000	180000	180000
TPH aro >EC08-EC10	LQM/CIEH + CLEA 1.06	33	81	190	27	65	150	8.6	21	51	610	1500	3600	16000	16000	16000
TPH aro >EC10-EC12	LQM/CIEH + CLEA 1.06	180	420	870	69	160	350	13	31	74	360	900	2200	16000	16000	16000
TPH aro >EC12-EC16	LQM/CIEH + CLEA 1.06	1250	1600	1700	140	310	590	23	57	130	36000	37000	38000	16000	16000	16000
TPH aro >EC16-EC21	LQM/CIEH + CLEA 1.06	1300	1300	1300	250	480	770	46	110	260	28000	28000	28000	12000	12000	12000
TPH aro >EC21-EC35	LQM/CIEH + CLEA 1.06	1300	1300	1300	890	1100	1200	370	820	1600	28000	28000	28000	12000	12000	12000
TPH aro >EC35-EC44	LQM/CIEH + CLEA 1.06	1300	1300	1300	890	1100	1200	370	820	1600	28000	28000	28000	12000	12000	12000
TPH >EC44-EC70	LQM/CIEH + CLEA 1.06	1300	1300	1300	1200	1300	1300	1200	2100	3000	28000	28000	28000	12000	12000	12000
VOCs - BTEX & MTBE																
Benzene	SGV report + CLEA 1.06	0.27	0.49	1.0	0.08	0.16	0.33	0.017	0.035	0.075	28	50	95	240	240	240
Toluene	SGV report + CLEA 1.06	610	1300	2700	120	270	610	22	51	120	870	1900	4400	180000	180000	180000
Ethylbenzene	SGV report + CLEA 1.06	170	380	840	65	150	350	16	39	91	520	1200	2800	81000	81000	81000
Xylene, o-	SGV report + CLEA 1.06	60	140	320	45	110	250	28	67	160	480	1100	2600	150000	150000	150000
Xylene, m-	SGV report + CLEA 1.06	55	130	300	44	100	240	31	74	180	630	1500	3500	150000	150000	150000
Xylene, p- (use this for combined m & p)	SGV report + CLEA 1.06	53	130	290	42	98	230	29	70	160	580	1400	3200	150000	150000	150000
MTBE	EIC/AGS/CL/AIRE + CLEA 1.06	73	120	220	49	84	160	23	44	90	7900	13000	24000	240000	240000	240000
VOCs - other benzenes																
Iso-propylbenzene	EIC/AGS/CL/AIRE + CLEA 1.06	12	28	67	11	27	64	32	79	190	390	950	2300	81000	81000	81000
Propylbenzene	EIC/AGS/CL/AIRE + CLEA 1.06	40	97	230	34	82	190	34	83	200	400	980	2300	81000	81000	81000
1,2,4-Trimethylbenzene	EIC/AGS/CL/AIRE + CLEA 1.06	0.41	0.99	2.3	0.35	0.86	2.0	0.38	0.93	2.2	42	99	220	810	810	810
VOCs - chlorobenzenes																
Bromobenzene	EIC/AGS/CL/AIRE + CLEA 1.06	0.91	2.1	4.9	0.88	2.0	4.7	3.2	7.6	18	97	220	520	19000	19000	19000
Chlorobenzene	LQM/CIEH + CLEA 1.06	0.33	0.74	1.7	0.33	0.73	1.7	5.9	14	32	59	130	310	59000	59000	59000
1,2-Dichlorobenzene	LQM/CIEH + CLEA 1.06	17	40	94	16	39	91	94	230	540	570	1400	3200	1000000	1000000	10000

Updated 20/07/11		Human Health Generic Assessment Criteria (mg/kg)														
Contaminant	Source of GAC	Human health - residential without plant uptake (1%SOM)	Human health - residential without plant uptake (2.5%SOM)	Human health - residential without plant uptake (6%SOM)	Human health - residential with plant uptake (1%SOM)	Human health - residential with plant uptake (2.5%SOM)	Human health - residential with plant uptake (6%SOM)	Human health - allotments (1%SOM)	Human health - allotments (2.5%SOM)	Human health - allotments (6%SOM)	Human health - commercial (1%SOM)	Human health - commercial (2.5%SOM)	Human health - commercial (6%SOM)	Human health - open space (1%SOM)	Human health - open space (2.5%SOM)	Human health - open space (6%SOM)
Chloroethane	EIC/AGS/CL/AIRE + CLEA 1.06	8.4	11	18	8.3	11	18	110	210	380	960	1300	2100	1000000	1000000	1000000
Chloroethene (aka vinyl chloride)	LQM/ClEH + CLEA 1.06	0.00054	0.00070	0.0011	0.00047	0.00064	0.00099	0.00055	0.0010	0.0018	0.063	0.081	0.12	11	11	11
Chloromethane	EIC/AGS/CL/AIRE + CLEA 1.06	0.0085	0.0099	0.013	0.0083	0.0098	0.013	0.066	0.13	0.23	1.0	1.2	1.6	2000	2000	2000
1,1-Dichloroethane	EIC/AGS/CL/AIRE + CLEA 1.06	2.5	4.1	7.7	2.4	3.9	7.4	9.2	17	35	280	450	850	160000	160000	160000
1,2-Dichloroethane	LQM/ClEH + CLEA 1.06	0.0065	0.0093	0.016	0.0053	0.0080	0.014	0.0046	0.0083	0.016	0.71	1.0	1.8	97	97	97
1,1-Dichloroethene	EIC/AGS/CL/AIRE + CLEA 1.06	0.23	0.41	0.82	0.23	0.40	0.82	2.8	5.6	12	26	46	92	37000	37000	37000
Cis 1,2 Dichloroethene	EIC/AGS/CL/AIRE + CLEA 1.06	0.12	0.20	0.39	0.11	0.19	0.37	0.26	0.50	1.0	15	24	47	4700	4700	4700
Trans 1,2 Dichloroethene	EIC/AGS/CL/AIRE + CLEA 1.06	0.19	0.35	0.71	0.19	0.34	0.70	0.93	1.9	4.0	22	40	81	14000	14000	14000
Dichloromethane	EIC/AGS/CL/AIRE + CLEA 1.06	2.1	2.8	4.5	0.58	0.98	1.7	0.10	0.19	0.34	270	360	560	3500	3500	3500
1,2-Dichloropropane	EIC/AGS/CL/AIRE + CLEA 1.06	0.024	0.042	0.085	0.024	0.042	0.085	0.62	1.2	2.6	3.3	5.9	12	9400	9700	10000
Hexachloroethane	EIC/AGS/CL/AIRE + CLEA 1.06	0.22	0.54	1.3	0.20	0.48	1.1	0.27	0.67	1.6	8.2	20	48	410	410	410
Tetrachloroethene	LQM/ClEH + CLEA 1.06	1.0	2.3	5.3	0.94	2.1	4.8	1.6	3.7	8.7	130	290	660	11000	11000	11000
1,1,1,2-Tetrachloroethane	LQM/ClEH + CLEA 1.06	1.1	2.5	5.8	0.89	2.1	4.8	0.78	1.9	4.4	120	260	590	4700	4700	4700
1,1,2,2-Tetrachloroethane	LQM/ClEH + CLEA 1.06	2.9	5.8	13	1.4	2.9	6.5	0.41	0.89	2.0	300	600	1200	4700	4700	4700
Tetrachloromethane	LQM/ClEH + CLEA 1.06	0.018	0.040	0.09	0.018	0.039	0.089	0.16	0.37	0.85	3.0	6.7	15	1200	1200	1200
Trichloroethene	LQM/ClEH + CLEA 1.06	0.11	0.23	0.51	0.11	0.22	0.49	0.43	0.95	2.2	12	25	55	4200	4200	4200
1,1,1-Trichloroethane	LQM/ClEH + CLEA 1.06	6.3	13	28	6.2	13	28	48	110	240	700	1400	3100	480000	480000	480000
1,1,2 Trichloroethane	EIC/AGS/CL/AIRE + CLEA 1.06	0.88	1.8	3.9	0.60	1.2	2.7	0.28	0.61	1.4	95	190	400	3200	3200	3200
Trichloromethane	LQM/ClEH + CLEA 1.06	0.92	1.6	3.2	0.75	1.3	2.7	0.36	0.70	1.5	110	190	370	8100	8100	8100
Other phenols & chlorophenols																
2-Chlorophenol	LQM/ClEH + CLEA 1.06	65	94	120	3.7	8.4	18	0.58	1.4	3.2	3600	4000	4300	1000	1000	1000
2,4-Dichlorophenol	LQM/ClEH + CLEA 1.06	58	85	110	0.88	2.0	4.4	0.13	0.30	0.70	3500	4000	4200	1000	1000	1000
2,4-Dimethylphenol	EIC/AGS/CL/AIRE + CLEA 1.06	210	410	730	19	43	97	3.1	7.2	17	1400	3100	7200	16000	16000	16000
3-Methylphenol	EIC/AGS/CL/AIRE + CLEA 1.06	3700	5400	6900	82	180	400	13	28	64	16000	18000	18000	81000	81000	81000
4-Methylphenol	EIC/AGS/CL/AIRE + CLEA 1.06	4700	6300	7500	81	180	400	12	28	63	17000	18000	18000	81000	81000	81000
3-Methylphenol	EIC/AGS/CL/AIRE + CLEA 1.06	3800	5500	7000	81	180	400	12	28	63	16000	18000	18000	38000	38000	38000
Pentachlorophenol	LQM/ClEH + CLEA 1.06	22	31	35	0.55	1.3	3.0	0.084	0.21	0.49	1200	1300	1400	320	320	320
2,3,4,6-Tetrachlorophenol	LQM/ClEH + CLEA 1.06	82	110	130	0.87	2.0	4.7	0.13	0.31	0.73	3900	4200	4400	1000	1000	1000
2,4,6-Trichlorophenol	LQM/ClEH + CLEA 1.06	82	110	130	1.4	3.3	7.5	0.22	0.51	1.2	3900	4200	4400	1000	1000	1000
Phthalates																
Bis (2-ethylhexyl) phthalate	EIC/AGS/CL/AIRE + CLEA 1.06	2700	2800	2800	280	610	1100	48	120	280	85000	86000	86000	36000	36000	36000
Butyl benzyl phthalate	EIC/AGS/CL/AIRE + CLEA 1.06	43000	44000	44000	1400	3400	7300	220	550	1300	940000	940000	950000	410000	410000	410000
Diethyl Phthalate	EIC/AGS/CL/AIRE + CLEA 1.06	14	29	65	120	260	570	19	41	94	14	29	65	160000	160000	160000
Di-n-butyl phthalate	EIC/AGS/CL/AIRE + CLEA 1.06	4.7	11	450	13	31	67	2.0	5.0	12	4.7	15000	15000	6100	6100	6100
Di-n-octyl phthalate	EIC/AGS/CL/AIRE + CLEA 1.06	3400	3400	3400	2300	2800	3100	940	2100	3900	89000	89000	89000	37000	37000	37000
Pesticides																
Aldrin	LQM/ClEH + CLEA 1.06	2.1	2.1	2.2	1.7	2.0	2.1	1.3	2.6	4.0	54	54	54	23	23	23
Atrazine	LQM/ClEH + CLEA 1.06	31	32	32	0.24	0.56	1.3	0.037	0.085	0.20	870	880	880	370	370	370
DDE	Hydrock + CLEA 1.06	1300	1300	1300	860	1100	1200	380	770	1300	22000	22000	22000	33000	33000	33000
Hydrock	LQM/ClEH + CLEA 1.06	1100	1200	1200	770	940	1000	330	660	1100	21000	21000	21000	20000	20000	20000
Dichlvos	LQM/ClEH + CLEA 1.06	25	32	37	0.29	0.60	1.3	0.044	0.091	0.20	840	870	890	400	400	400
Dieldrin	LQM/ClEH + CLEA 1.06	3.5	3.8	3.9	0.69	1.4	2.2	0.13	0.32	0.73	90	91	92	39	39	39
Endosulfan - alpha	LQM/ClEH + CLEA 1.06	44	78	110	2.9	7.0	16	0.47	1.2	2.7	2300	3000	3400	1600	1600	1600
Endosulfan - beta	LQM/ClEH + CLEA 1.06	53	89	120	2.8	6.6	15	0.44	1.1	2.6	2600	3200	3500	1600	1600	1600
Hexachlorocyclohexanes - alpha (inc. Lindane)	LQM/ClEH + CLEA 1.06	460	580	650	19	46	100	3.0	7.4	18	14000	15000	15000	6500	6500	6500
Hexachlorocyclohexanes - beta (inc. Lindane)	LQM/ClEH + CLEA 1.06	50	52	52	1.7	3.9	8.5	0.26	0.64	1.5	1100	1100	1100	490	490	490
Hexachlorocyclohexanes - gamma (inc. Lindane)	LQM/ClEH + CLEA 1.06	18	22	23	0.58	1.4	3.0	0.089	0.22	0.52	530	550	550	240	240	240
Dioxins, furans & dioxin-like-PCBs																
Total dioxins, furans & DL-PCB (aerial dep.)	SGV report + CLEA 1.06	0.0099	0.0099	0.0099	0.0085	0.0087	0.0087	0.0073	0.008	0.0083	0.24	0.24	0.24	0.15	0.15	0.15
Non-dioxin-like PCBs																
PCB-28	Hydrock + CLEA 1.06	0.39	0.39	0.39	0.20	0.27	0.32	0.058	0.13	0.23	9.0	9.0	9.0	3	3	3
PCB-52	Hydrock + CLEA 1.06	0.39	0.39	0.39	0.20	0.28	0.34	0.062	0.14	0.28	9.0	9.0	9.0	3	3	3
PCB-101	Hydrock + CLEA 1.06	0.39	0.39	0.39	0.34	0.37	0.38	0.030	0.53	0.76	9.0	9.0	9.0	3	3	3
PCB-138	Hydrock + CLEA 1.06	0.39	0.39	0.39	0.36	0.37	0.38	0.41	0.67	0.89	9.0	9.0	9.0	3	3	3
PCB-153	Hydrock + CLEA 1.06	0.39	0.39	0.39	0.36	0.38	0.38	0.51	0.77	0.96	9.0	9.0	9.0	3	3	3
PCB-180	Hydrock + CLEA 1.06	0.39	0.39	0.39	0.37	0.38	0.39	0.60	0.87	1.1	9.0	9.0	9.0	3	3	3
Explosives																
HMX	LQM/ClEH + CLEA 1.06	6500	6500	6500	5.7	13	26	0.86	1.9	3.9	110000	110000	110000	190000	190000	190000
RDX	LQM/ClEH + CLEA 1.06	370	370	370	3.5	7.4	16	0.52	1.1	2.5	6400	6400	6400	8500	8500	8500
2,4,6-Trinitrotoluene	LQM/ClEH + CLEA 1.06	57	57	58	1.6	3.7	7.8	0.24	0.58	1.4	1000	1000	1100	940	940	940
Other inorganics																
Antimony	EIC/AGS/CL/AIRE + CLEA 1.06	370	370	370	180	180	180	52	52	52	6800	6800	6800	23000	23000	23000
Barium	EIC/AGS/CL/AIRE + CLEA 1.06	1300	1300	1300	780	780	780	260	260	260	22000	22000	22000	50000	50000	50000
Mercury, elemental	SGV report + CLEA 1.06	0.17	0.42	1.0	0.17	0.42	1.0	4.3	11	26	4.3	11	26	4.3	11	26
Molybdenum	EIC/AGS/CL/AIRE + CLEA 1.06	670	670	670	250	250	250	58	58	58	18000	18000	18000	37000	37000	37000
Thiocyanate	Hydrock + CLEA 1.06	8.9	8.9	8.9	8.8	8.8	8.8	28	28	28	190	190	190	81	81	81
Other organics																
Biphenyl	EIC/AGS/CL/AIRE + CLEA 1.06	34	84	200	34	84	200	1								

Updated 20/07/11		Human Health Generic Assessment Criteria (mg/kg)														
Contaminant	Source of GAC	Human health - residential without plant uptake (1%SOM)	Human health - residential without plant uptake (2.5%SOM)	Human health - residential without plant uptake (6%SOM)	Human health - residential with plant uptake (1%SOM)	Human health - residential with plant uptake (2.5%SOM)	Human health - residential with plant uptake (6%SOM)	Human health - allotments (1%SOM)	Human health - allotments (2.5%SOM)	Human health - allotments (6%SOM)	Human health - commercial (1%SOM)	Human health - commercial (2.5%SOM)	Human health - commercial (6%SOM)	Human health - open space (1%SOM)	Human health - open space (2.5%SOM)	Human health - open space (6%SOM)
Dimethyl phthalate	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Isopropyltoluene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sulfur (elemental)	Insufficient data (Hydrock)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,3,5-Trimethylbenzene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
tert butylbenzene	Insufficient data (EIC)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NOTES																
If > 1,000,000 is calculated, 1,000,000 is adopted.																
Red text - liquid at ambient temperature, calculated GAC exceeds saturation value and highlighted in red in CLEA - saturation value adopted for GAC																
Orange text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation not possible as only one HCV - saturated vapour concentration exceed, so saturation value adopted for GAC																
Blue text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation not possible as only one HCV - aqueous solubility exceed, so original red-highlighted value adopted for GAC																
Green text - solid at ambient temperature, calculated GAC exceeds saturation value and highlighted red in CLEA - manual calculation undertaken but result is greater than original red-highlighted value, so original red-highlighted value adopted for GAC.																

3.3.3 Exceedance of Saturation Limits

In some instances the CLEA 1.06 model produces GACs with a warning that the value exceeds the saturation value, which is either the solubility of the substance in water or the vapour saturation limit. Limited guidance is given in SR4 (Section 4.12) on how to assess the GAC in these circumstances. Precedence is also set in a number of SGV reports, to date those dealing with the BTEX compounds. These two sets of documentation are contradictory. The original issue of SR4 (CLEA 1.04) (Environment Agency 2009b) gives an example of how to carry out a manual calculation using data for ethylbenzene, whereas the BTEX SGV reports (e.g. Environment Agency March 2009) state that the GAC should be limited to the saturation level. The revised version of SR4 (CLEA 1.05/6) (Environment Agency 2009c) retains the example, but the name ethylbenzene has been removed.

There are three options: to adopt the value as calculated, to limit the GAC to the saturation value, or to undertake a manual calculation as per Section 4.12 of SR4. Again, the guidance is confusing. SR3 (Environment Agency 2009b) cautions against adopting the saturation limit, which is the most conservative, saying that it may be over-conservative. However, this is the approach taken in the BTEX SGV reports.

Clearly, the adoption of a GAC under conditions where the saturation level is exceeded is subjective and professional judgement is involved. With this in mind, the protocol adopted by Hydrock is as follows, and has been derived at by considering the possible values from the three methods given above.

1. For substances where the GAC is highlighted in amber in CLEA, this is adopted as the GAC. For substances where the GAC is highlighted in red, the following apply.
2. For VOCs including BTEX and the volatile TPH Fractions (less than EC10), the saturation value is adopted in line with the latest recommendations in the BTEX SGV reports.
3. For substances which are liquid at ambient temperature, the saturation value is adopted.
4. For substances which are solid at ambient temperature, the manual calculation is undertaken provided there are both oral and inhalation HCVs. The result is compared with the red-highlighted GAC and the lower of the two adopted as the GAC. If there is only one HCV and the calculation cannot be performed, the red-highlighted value is adopted as the GAC where the saturation limit exceed the aqueous solubility, but the saturation value is adopted where the saturation limit exceed the saturated vapour concentration.
5. In some instances the GACs shows a large difference between different SOM where the saturation value has been taken for, say, 1% SOM and the calculated values for 2.5% and 6% SOM. Whilst this may appear inconsistent on first inspection, the results have been adopted as they are and the difference must be attributed to the physico-chemical influence of organic matter in the soil as modelled by CLEA.

3.3.4 GACs for Public Open Space

One of the main reasons why the originally intended SGVs for public open space have never been developed is the difficulty in defining generic exposure scenarios for people using such land. Consider the difference in exposure to soil contaminants by someone playing rugby on a muddy pitch compared with someone walking a dog in an urban park. The CLEA 1.06 model does not contain an open space land use and in order to calculate GACs with the same degree of assurance it would be necessary to fully define the exposure profile for a number of potential receptors, to use the basic equations contained in the model and to determine which of the receptors is the critical one.

This is clearly a significant body of work, probably involving research into the various exposure scenarios and is beyond the scope of this report. Determining a UK generic land use pattern is probably something only a national government can do as it will involve policy as well as technical decisions.

In the absence of GACs for open space it is common to refer to those for the residential without plant uptake land use and to acknowledge that these are conservative because (a) there is no building and (b) the exposure period is likely to be much less than in a residential setting.

In order to investigate the degree of conservatism in the above approach, Hydrock has endeavoured to produce GACs for open space by using the 'site specific' options in the CLEA 1.06 model, using the residential without plant uptake land use as a starting point. (In fact, the same results are obtained if the allotments land use is taken as the starting point.) It is recognised that these may not necessarily be representative of the most critical exposure scenario, but are considered suitable as a first screening assessment in the absence of a UK formalised approach.

Accordingly, the method has been to use CLEA 1.06 (except for lead) starting with the residential without plant uptake land use and deleting the indoor exposure pathways. The default soil-to-skin adhesion factor and soil/dust ingestion rates for lifetime exposure are taken from Table 3 of the cadmium SGV report (Environment Agency June 2009). Finally, the exposure times were modified. There is little published guidance on exposure times. The New Zealanders assume 350 days/yr and a duration of 30 years, and the Australians 2 hr/day, 365 days/year over 70 years for parklands and recreational land use. The Canadians take 24 hrs/day, 365 days/year but also include residential land use with parklands. Hydrock has adopted the Australian model of 2 hours every day (active) for the entire lifetime, as being a very conservative estimate, but one which could be said to include for the uncertainties in how the land is actually used.

In addition to changing the exposure time to 2 hours per day in CLEA 1.06, it is also necessary to adjust the dust ingestion rates. Since people are asleep for 8 hours and awake for 16 hours, it is assumed that the soil and dust ingestion takes place during the waking hours. Consequently, if someone is on site for 2 hours, this is 2/16 of the waking period. So it is logical to pro-rata the soil and dust intake (i.e. 1/8 times the default). The defaults are

0.1g/day in Age Classes 1-12 and 0.5 g/day in Age Classes 13-18 (the latter being based on the cadmium SGV report, Table 3); these are replaced with 0.0125 and 0.00625, respectively. In addition, the outside soil to skin adhesion factor for the Age Classes 13 to 18 have been changed to 0.3, as per the cadmium SGV report, Table 3.

The calculated GACs are presented in Table 3.5 and are based on the a 75 year lifetime (all 18 CLEA age classes) and the CLEA standard sandy loam soil of pH 7 su.

Contamination by lead is a special case and CLEA is not applicable. The equations in SGV10 (DEFRA and The Environment Agency 2002) have been used instead. There are separate equations for children and adults. The child equation is based on uptake not intake and the GAC is dependent on the slope of the blood lead level versus soil lead concentration graph so there is no scope for adjusting the GAC for different exposure conditions as these are not inputs to the model. The equation for adults does include an exposure factor which is 8.5 hrs/day for 230 days/yr under the standard commercial land use scenario (for 43 years of working life). The exposure factor can be modified, therefore, to represent different exposures (2 hrs/day for 365 days/yr is equivalent to 8.5 hrs/day for 85.9 days/yr and so 85.9 days was used in the equation). The adult open space GAC for 57 years of exposure (75 less 18 pre-adult years) is calculated as 1135 mg/kg but this is greater than the child SGV of 450 mg/kg so 450 is adopted as the GAC for open space.

3.4 Note on PAHs

A number of authors have used to concept of PAH double ratio plots to investigate the possible source of PAHs in environmental samples.

NAVFAC (Appendix A, April 2003) defines three major source type: petrogenic - generated from organic matter in ancient sediments by geologic conditions; pyrogenic – generated by combustion of organic matter (wood, coal, petroleum, wastes etc.); and biogenic – generated by modern biological processes or by diagenetic processes (e.g. oxidation of organic matter). The following broad trends in the data were recognised:

- a ratio of fluoranthene to pyrene (Fl/Py) of <1 is indicative petrogenic sources, and of >1 is indicative of pyrogenic sources; and
- a ratio of anthracene to phenanthrene (An/Ph) of <0.2 is indicative of pyrogenic sources and of >0.2 is indicative of petrogenic sources.

Yunker *et al* (2002) carried out a literature study of published PAH ratios for a number of petroleum sources, combustion sources and environmental sources. They identified the following broad trends in the data:

- a ratio of fluoranthene to fluoranthene plus pyrene (Fl/(Fl+Py)) of <0.4 is indicative of petroleum hydrocarbon sources; of 0.4-0.5 is indicative of liquid fossil fuel

combustion products; and of >0.5 is indicative of grass, wood and coal combustion products;

- a ratio of benzo(a)anthracene to benzo(a)anthracene plus chrysene ($BaA/(BaA+Ch)$) of <0.2 is indicative of petroleum hydrocarbon sources; of $0.2-0.35$ is indicative of either petroleum hydrocarbon sources or combustion and of >0.35 is indicative of combustion products;
- a ratio of anthracene to anthracene plus phenanthrene ($An/(An+Ph)$) of <0.1 is indicative petroleum hydrocarbon sources, but can be emissions from lignite, diesel or oil combustion, and of >0.1 is indicative of combustion sources, but can be diesel, coal or some crude oil hydrocarbons;
- a ratio of indeno(1,2,3)pyrene to indeno(1,2,3)pyrene plus benzo(ghi)perylene ($IP/(IP+Bghi)$) of <0.2 is indicative of petroleum hydrocarbon sources; of $0.2-0.5$ is indicative of petroleum hydrocarbon combustion; and >0.5 is indicative of grass, wood or coal combustion products.

Note that in these authors' study of these and a number of other ratios they cautioned there are exceptions to these generalisations on account of the variability and complexity of, for example, different crude oil sources.

Costa *et al* (2004) and Costa and Sauer (2005) used plots of fluoranthene to pyrene (Fl/Py) against benzo(a)anthracene to chrysene (BaA/Ch), benzo(a)anthracene to benzo(a)pyrene (BaA/BaP) and chrysene to benzo(a)pyrene (Ch/BaP) to distinguish coal tar and creosote contaminants from combustion products they referred to as urban background. They report distinctive areas on the plots relating to the sites being studied. Litton (2006) has also used these ratios to similar effect on other sites.

ALcontrol Laboratories (2006) also uses plots of fluoranthene to pyrene (Fl/Py) against benzo(a)anthracene to chrysene (BaA/Ch). Jones (2008) confirms that the following broad trends are derived from unpublished work at the laboratory:

- a ratio of Fl/Py of <0.65 is indicative of used engine oil when the ratio of BaA/Ch is higher (approaching 1.40) or other petroleum products when the ratio of BaA/Ch is lower (above about 0.35);
- a ratio of F/Py of $0.65-1$ is indicative of petroleum combustion products; and
- a ratio of Fl/Py of <1 is indicative of coal when the ratio of BaA/Ch is higher (approaching 1.40) or other combustion soots when the ratio of BaA/Ch is lower (above about 0.35).

It is evident from the literature that if a cross plot is made of two ratios it is often possible to see a separation in samples from different sources and, together with other supporting

information, gain a better understanding of the likely source of the PAHs. Different ratios may give differing degrees of separation and so trying several plots is often useful.

3.5 Note on Petroleum Hydrocarbons

Petroleum hydrocarbon contamination is complex. The type of crude oil, its distillation, processing and blending, and the subsequent weathering in the environment all result in the development of petroleum residues of extreme chemical complexity (Environment Agency, 2003). The laboratory analysis of petroleum hydrocarbons is highly method dependent. In addition to contaminants such as fuels and lubricating oils, the analyses also pick up a range of other chemicals such as PAHs and phenols, together with naturally occurring substances like humic and fulvic matter in organic soils. For example, TPH determination on dried oak leaves can give a result of 18,000 mg/kg of TPH.

TPH can only be used as a surrogate for estimating the petroleum load of a soil if a spill is well defined but is generally not a sound basis for risk management and regulatory control. International approaches for assessing risks from petroleum hydrocarbons focus on dividing the components into groups and assigning toxicologically potency and fate-transport to each group.

Approaches have been developed internationally, one such proposal is discussed by the Dutch National Institute of Public Health and the Environment (RIVM) (Franken *et al* 1999). The approach is broadly to sub-divide the TPH into fractions based on equivalent carbon length for aliphatic (straight chain) and aromatic (cyclic) compounds. The choice of the fractions is based on work carried out by, amongst others, the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG). The Working Group is guided by a steering committee consisting of representatives from industry, government and academia, with the remit *to develop scientifically defensible information for establishing soil cleanup levels that are protective of human health at petroleum contaminated sites*.

Generic assessment criteria can be developed for each TPH fraction in the same way as they can be for named substances, providing certain assumptions are made regarding the applicability of the data to all the compounds in each fraction. A significant part of the TPHCWG activity has been in determining fraction boundaries to maximize confidence in the eventual criteria.

A modified TPHCWG approach has been adopted in a framework developed by the Environment Agency (2005) for use within the UK. The 13 original TPHCWG fractions have been adopted, with the addition of >EC35-EC44. An undifferentiated (i.e. without aliphatic – aromatic split) fraction of >EC44-EC70 has also been suggested but the Agency says it will be reviewing the need for this in due course, once research has been carried out into the toxicity of these heavy-end products like resins and asphaltenes.

The UK suggested approach to petroleum hydrocarbon risk assessment is summarised as follows:

- Measure indicator chemicals and compare with their GAC – these are chemicals which are considered as key risk drivers at petroleum hydrocarbon contaminated sites. The chemicals of potential concern depend on the type of hydrocarbon product, but a (non-exhaustive) list has been suggested by the Environment Agency (2005):

Non-threshold: benzene, benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3,cd)pyrene.

Threshold: toluene, ethylbenzene, xylene, naphthalene, fluoranthene, phenanthrene, pyrene.

- Measure TPH fractions and compare with their GAC, based on threshold toxicity only.

Aliphatic fractions: >EC5-EC6, >EC6-EC8, >EC8-EC10, >EC10-EC12, >EC12-EC16, >EC16-EC35, >EC35-EC44.

Aromatic fractions: >EC5-EC7, >EC7-EC8, >EC8-EC10, >EC10-EC12, >EC12-EC16, >EC16-EC21, >EC21-EC35, >EC35-EC44.

Undifferentiated: >EC44-EC77 (subject to review and confirmation by Agency).

- Carry out an additivity check on the TPH fractions if none of the individual fractions exceed their GAC. A Hazard Quotient is calculated for each fraction by dividing the measured concentration by the GAC and these are summed to give the Hazard Index. Where the Hazard Index exceeds unity, this can indicate a potentially significant risk to human health and consideration should proceed to the next stage (remediation or further assessment). Including all the fractions in a Hazard Index is conservative as it assumes all fractions add together in acting on the same target organ within the critical receptor. The Environment Agency (2005) has stated that fractions exhibiting different toxicological properties might be excluded from this process in due course, once research has been completed and further guidance published. The Louisiana Department of Environmental Quality (LDEQ) (2003) has published more detailed guidance, suggesting the following fractions be grouped: (a) aliphatic >EC8-EC10, >EC10-EC12 & >EC12-EC16, (b) aromatic >EC8-EC10, >EC10-EC12 & >EC12-EC16 and (c) aromatic >EC16-EC21 & >EC21-EC35.

Hydrock has adopted the first two points from above approach and has developed generic assessment criteria for the TPH fractions up to EC35. These are used for assessment where an appropriate level of sampling and laboratory analysis has been carried out, but cannot be used where more generalised TPH analysis has been scheduled (such as DRO/GRO only).

There is, however, some uncertainty concerning the validity of the additivity check. The Environment Agency (2002a) stated in the now withdrawn CLR 9, Section 4.4, “that it is not valid to simply calculate the sum of the fractions ‘soil concentration divided by SGV’, and compare this with 1.”, because total intake, not just intake from soil, needs to be included. It is assumed that the 2005 document takes this into account and that it is erring on the side of conservatism. Until this is formally resolved, Hydrock will report the additivity check for information, using the LDEQ groupings, but will caution against its use in setting remedial goals without further study or publication of definitive guidance. It is more realistic to carry out the additivity test on individual samples rather than on US₉₅ values for the whole population, because it is unlikely that the TPH profile of the averaging area will be represented by the US₉₅s of every fraction. More likely, a sample high in one fraction will be low in another, particularly where a mixture of products is present in the ground.

The analysis required for the above methodology, using the aliphatic / aromatic split of TPH fractions, is referred to by Hydrock its “**TPH Level 2 suite**” of determinands. In instances where a full numerical risk assessment is not required, Hydrock carries out a screening analysis known as its “**TPH Level 1 suite**” of determinands. The TPH is divided into fractions, but without the aliphatic / aromatic split. This allows a semi-quantitative risk assessment on the basis of taking a worst case condition. The fraction split with the lowest GAC is deemed to apply to the whole fraction. For example, if the Level 1 analysis indicates the presence of >EC8-EC10, the result is compared to the GACs for the aliphatic >C8-C10 and the aromatic >EC8-EC10 fractions. The worst case would be to assume the whole fraction is aliphatic because this is the lower of the two GACs. This is a conservative approach, and if the test is passed, there is no need to proceed further. However, if the test is failed this does not necessarily indicate unacceptable risks and a more detailed risk assessment is required, with the full TPH Level 2 analysis suite.

3.6 Note on Cyanide

Cyanide toxicity is complicated but it is generally accepted that cyanide species exist in ‘free’ and ‘complex’ forms. Free cyanide species are toxic and it is generally agreed that free cyanide provides a more scientifically correct basis for the establishment of generic criteria. This approach has been followed in this report.

Metal-cyanide complexes (complex cyanide) are generally not considered toxic but in certain environmental fate reactions it is possible that dissociation may release toxic free cyanide into the water environment. This might occur where complex cyanides are exposed to direct sunlight and photolysis takes place. Such circumstances are considered very rare.

3.7 Note on Polychlorinated Biphenyls

PCBs fall into two groups, the dioxin-like (DL) and the non-dioxin-like (NDL), by virtue of their toxicity.

The Environment Agency methodology for DL-PCBs is included with dioxins and furans in the published dioxins SGV report (Science Report SC050021 / Dioxins SGV). The basis of this report is that because of the additive nature of these substances it is inappropriate to produce individual SGVs. The approach is to obtain speciated analyses of 12 DL-PCBs and, using an Agency spreadsheet, calculate a Hazard Index for a prescribed mixture of substances. SGVs can only be produced for atmospheric fall-out sites where the proportions of the individual substances are assumed to be uniform across the UK according to a table listed in the document.

For potentially industrially contaminated sites (such as where PCBs have escaped from transformers) only a Hazard Index can be produced. This can be converted into a GAC by calculation, but such a GAC is only applicable to conditions where the mixture of substances is unchanged. In effect, Hazard Indices will be calculated for each soil sample and provided these are all less than unity, the site poses no significant risk.

There is not Agency guidance with respect to NDL-PCBs. Hydrock has produced individual GACs for a number of these. A precautionary approach has been taken, in that the NDL-PCBs are assumed to have additive effects and the same approach is taken as with Hydrock's assessment of contamination by TPH fractions. Namely, each substance is compared with its GAC, but there is an additional stage in which a Hazard Index is also calculated. This is similar to the Agency's approach for DL-PCBs, but the Hazard Index calculation is performed at a different stage in the process.

Currently, these two approaches are separate. That is to say, there is no assumption of additivity of effect between DL- and NDL-PCBs. The logic for this is the fact that these two groups were established in the first place on account of their different effects.

The toxicity of the DL-PCBs is far greater than that of the NDL-PCBs. For example, the residential SGV for the full list of dioxins, furans and DL-PCBs under atmospheric fall-out conditions is 0.0087 mg/kg (NB: using only the 12 DL-PCBs in this list gives a GAC of 0.051 mg/kg), whilst the lowest GAC for the NDL-PCBs is 0.32 mg/kg under the same exposure conditions. Analyses for DL-PCBs must be undertaken with very low laboratory reporting limits (typically 1ng/kg).

In real life examples, it is almost certain that both forms of PCBs will be present at a site. This is because the marketed products (known as Aroclors) were mixtures of many PCB congeners and they all appear to contain members from both groups (according to literature researched by Hydrock). Perhaps this is why the Agency has only issued guidance on the DL-PCBs.

Logically, if a site contains any PCBs (for example as a 'total' analysis) it is likely to contain DL-PCBs. In which case, the safe concentrations will be very low and can only be confirmed by re-analysing using low detection methods and following the Agency methodology on a sample-by-sample basis. This in effect means that GACs for NDL-PCBs are redundant. The implications of the Agency methodology have yet to be fully understood by the contaminated land community. For example, it would appear that standard laboratory tests for NDL-PCBs are irrelevant. Furthermore, standard reporting limits are far too high, typically 1ug/kg. The only instance where NDL-PCBs become the risk driver at a PCB contaminated site would be if for some reason the DL-PCBs had preferentially degraded.

The Hydrock methodology for PCB risk assessment is to carry out analyses for the 12 DL-PCBs (commonly referred to as the WHO-12) and the 7 most persistent NDL-PCBs (commonly referred to as the ICES-7) at a detection limit of 1 ng/kg (Table 3.6). This is considered conservative because it covers both groups even though the risk driver is most likely to be the DL-PCB group.

The WHO-12 are assessed using the Environment Agency SGV report methodology, to produce a Hazard Index, and the ICES-7 are compared to Hydrock-derived GACs with additivity check. Note that PCB118 appears in both lists and so is assessed under the Environment Agency methodology as a DL-PCB.

Table 3.6: PCB Suites

WHO-12 (Dioxin-Like)	ICES-7 (Most Persistent)
PCB-77	PCB-28
PCB-81	PCB-52
PCB-126	PCB-101
PCB-169	PCB-118
PCB-105	PCB-138
PCB-114	PCB-153
PCB-118	PCB-180
PCB-123	(Non-dioxin-like apart from PCB-118)
PCB-156	
PCB-157	
PCB-167	
PCB-189	

3.8 Note on the Use of Non-UK Assessment Criteria

In rare instances reference to assessment criteria or other trigger values published by other authoritative bodies (other than those concerned with the UK contaminated land regime) may provide background information on the likely degree of contamination of a substance. Trigger levels indicative of naturally occurring concentrations or risk-based guidance from other countries often help place site analysis results into context. It must be remembered that use of non-UK assessment criteria is not in compliance with the UK contaminated land assessment regime given in the Model Procedures. However, these criteria can be of use as an aid to professional judgement and can help in determining a cost-effective and sustainable remedial strategy for a site, in consultation with the regulatory authorities.

3.9 Site Specific Assessment Criteria for Volatile Substances

The CLEA methodology includes the inhalation of indoor vapours where there are occupied buildings in the standard land use scenarios. For volatile substances such as those listed in Table 3.7 the percentage contribution of the indoor vapour pathway to the average daily exposure (ADE) can be seen to be significant (up to 100%). Consequently, if this pathway can be severed by the installation of a suitably designed and installed organic vapour barrier in the buildings only the remaining CLEA exposure pathways need to be considered for the site. Assessment criteria can be calculated for the remaining exposure pathways.

Site Specific Assessment Criteria (SSAC) have been calculated using CLEA UK using the same input parameters etc. as for the Hydrock GACs but with the indoor vapour pathway turned off in the model. The resulting SSACs can be used to inform on risk from these contaminants in the same way as GACs are used, but apply only if suitable membranes are provided and verified.

Table 3.7: Derivation of Site Specific Assessment Criteria for Volatile Substances for CLEA Standard Land Uses *Excluding the Indoor Vapour Pathway* (mg/kg) – on following page(s).

Contaminant	Human Health Generic Assessment Criteria (no indoor vapour pathway) (mg/kg)								
	Human health - residential without plant uptake, no indoor vapour (1%SOM)	Human health - residential without plant uptake, no indoor vapour (2.5%SOM)	Human health - residential without plant uptake, no indoor vapour (6%SOM)	Human health - residential with plant uptake, no indoor vapour (1%SOM)	Human health - residential with plant uptake, no indoor vapour (2.5%SOM)	Human health - residential with plant uptake, no indoor vapour (6%SOM)	Human health - commercial, no indoor vapour (1%SOM)	Human health - commercial, no indoor vapour (2.5%SOM)	Human health - commercial, no indoor vapour (6%SOM)
TPH fractions									
TPH ali EC05-EC06	220000	220000	220000	4800	11000	23000	300	560	1200
TPH ali >EC06-EC08	220000	220000	220000	14000	32000	64000	140	320	740
TPH ali >EC08-EC10	4400	4500	4500	1500	2400	3300	78	94000	94000
TPH ali >EC10-EC12	4500	4500	4500	3500	4000	4200	94000	95000	95000
TPH ali >EC12-EC16	4500	4500	4500	4400	4400	4400	94000	95000	95000
TPH ali >EC16-EC35	-	-	-	-	-	-	-	-	-
TPH ali >EC35-EC44	-	-	-	-	-	-	-	-	-
TPH aro EC05-EC07	20000	20000	20000	86	180	380	1200	2300	4700
TPH aro >EC07-EC08	20000	20000	20000	150	340	760	870	420000	420000
TPH aro >EC08-EC10	1800	1800	1800	56	130	280	38000	38000	38000
TPH aro >EC10-EC12	1800	1800	1800	80	190	390	38000	38000	38000
TPH aro >EC12-EC16	-	-	-	-	-	-	-	-	-
TPH aro >EC16-EC21	-	-	-	-	-	-	-	-	-
TPH aro >EC21-EC35	-	-	-	-	-	-	-	-	-
TPH aro >EC35-EC44	-	-	-	-	-	-	-	-	-
TPH >EC44-EC70	-	-	-	-	-	-	-	-	-
VOCs - BTEX & MTBE									
Benzene	26	26	26	0.11	0.23	0.49	530	530	540
Toluene	20000	20000	20000	150	340	760	870	420000	420000
Ethylbenzene	8800	8900	8900	110	250	570	180000	180000	190000
Xylene, o-	16000	16000	16000	190	440	1000	260000	290000	300000
Xylene, m-	15000	16000	16000	200	480	1100	260000	280000	300000
Xylene, p- (use this for combined m & p)	15000	16000	16000	190	450	1000	260000	280000	300000
MTBE	27000	27000	27000	150	290	590	550000	550000	560000
VOCs - other benzenes									
Iso-propylbenzene	8800	8900	8900	210	500	1100	180000	180000	180000
Propylbenzene	8900	8900	8900	220	520	1200	180000	190000	190000
1,2,4-Trimethylbenzene	89	89	89	2.4	5.8	13	1800	1800	1900
VOCs - chlorobenzenes									
Bromobenzene	2000	2100	2100	21	50	110	31000	35000	38000
Chlorobenzene	4300	4400	4400	39	90	200	65000	79000	93000
1,2-Dichlorobenzene	53000	54000	55000	620	1500	3400	600000	680000	740000
1,3-Dichlorobenzene	90	90	89	1.6	3.9	8.8	3100	3100	3100
1,4-Dichlorobenzene	6100	6100	6100	100	240	540	130000	130000	130000
Hexachlorobenzene	-	-	-	-	-	-	-	-	-
Pentachlorobenzene	-	-	-	-	-	-	-	-	-
1,2,3-trichlorobenzene	660	660	660	30	70	150	12000	13000	13000
1,2,4-trichlorobenzene	4400	4500	4500	200	460	960	51000	62000	70000
1,3,5-trichlorobenzene	640	650	650	30	40	150	9600	11000	12000
1,2,3,4-tetrachlorobenzene	-	-	-	-	-	-	-	-	-
1,2,3,5-tetrachlorobenzene	23	23	23	2.3	4.9	9.0	690	700	700
1,2,4,5-tetrachlorobenzene	-	-	-	-	-	-	-	-	-
VOCs - chloroalkanes & alkanes									
Bromodichloromethane	26	26	26	0.11	0.21	0.45	510	520	540
Bromoform	-	-	-	-	-	-	-	-	-

Updated 20/07/11	Human Health Generic Assessment Criteria (no indoor vapour pathway) (mg/kg)								
Contaminant	Human health - residential without plant uptake, no indoor vapour (1%SOM)	Human health - residential without plant uptake, no indoor vapour (2.5%SOM)	Human health - residential without plant uptake, no indoor vapour (6%SOM)	Human health - residential with plant uptake, no indoor vapour (1%SOM)	Human health - residential with plant uptake, no indoor vapour (2.5%SOM)	Human health - residential with plant uptake, no indoor vapour (6%SOM)	Human health - commercial, no indoor vapour (1%SOM)	Human health - commercial, no indoor vapour (2.5%SOM)	Human health - commercial, no indoor vapour (6%SOM)
Chloroethane	240000	240000	240000	760	1400	2500	2600	3500	5700
Chloroethene (aka vinyl chloride)	1.2	1.2	1.2	0.0037	0.0066	0.012	26	26	26
Chloromethane	220	220	220	0.44	0.86	1.6	1900	2200	3000
1,1-Dichloroethane	17000	17000	17000	62	120	230	1800	3000	5600
1,2-Dichloroethane	11	11	11	0.031	0.055	0.11	200	210	210
1,1-Dichloroethene	3900	4000	4000	19	37	78	2200	3900	8000
Cis 1,2 Dichloroethene	470	470	480	1.7	3.3	6.8	3900	6600	9900
Trans 1,2 Dichloroethene	1500	1500	1500	6.2	12	26	3400	6200	13000
Dichloromethane	270	270	270	0.68	1.2	2.3	7300	9000	9000
1,2-Dichloropropane	850	890	930	4.1	8.1	17	1200	2100	11000
Hexachloroethane	44	44	44	1.7	4	8.6	910	920	930
Tetrachloroethene	1200	1200	1200	11	24	55	420	950	26000
1,1,1,2-Tetrachloroethane	500	500	500	5.2	12	28	10000	11000	11000
1,1,2,2-Tetrachloroethane	500	500	500	2.7	5.9	13	11000	11000	11000
Tetrachloromethane	120	120	130	1.1	2.4	5.4	1500	2500	2500
Trichloroethene	450	460	460	2.8	6.3	14	1500	3200	9000
1,1,1-Trichloroethane	52000	52000	53000	320	700	1600	1400	2900	6400
1,1,2 Trichloroethane	350	350	350	1.9	4	8.9	7200	7300	7400
Trichloromethane	610	610	610	2.4	4.7	9.7	5200	9100	20000
Other inorganics									
Antimony	-	-	-	-	-	-	-	-	-
Barium	-	-	-	-	-	-	-	-	-
Mercury, elemental	4.3	11	26	4.3	11	26	4.3	11	26
Molybdenum	-	-	-	-	-	-	-	-	-
Thiocyanate	-	-	-	-	-	-	-	-	-
Other organics									
Biphenyl	-	-	-	-	-	-	-	-	-
Carbon disulphide	4300	4300	4400	32	67	150	2100	4200	75000
2,4-Dinitrotoluene	-	-	-	-	-	-	-	-	-
2,6-Dinitrotoluene	-	-	-	-	-	-	-	-	-
Hexachloro-1,3-butadiene	8.9	8.9	8.9	1.4	2.8	4.7	290	290	290
Mercury, methyl	-	-	-	-	-	-	-	-	-
Styrene	1100	1100	1100	10	24	55	23000	23000	23000
Tributyl tin oxide	-	-	-	-	-	-	-	-	-
2-Chloronaphthalene	-	-	-	-	-	-	-	-	-

Red text - liquid at ambient temperature, calculated GAC exceeds saturation value and highlighted in red in CLEA - saturation value adopted

3.10 **Determination of Contaminated Land Under Part 2A of the Environmental Protection Act 1990**

The legal test for land contamination under the statutory guidance of Part 2A of the Environment Protection Act 1990 (i.e. “significant harm or significant possibility of significant harm”) is **unacceptable** intake or direct bodily contact.

The situation was clarified by DEFRA (July 2008) in its guidance on the legal definition of contaminated land.

Part 2A does not prescribe number-based thresholds because it would be very difficult to produce numbers which are meaningful and proportionate, given the lack of scientific information about many substances and the site specific nature of risks. Instead, it relies on local authorities to assess risks posed on individual sites, then decide whether (in their view) the risks represent SPOSH, and thus whether land qualifies as *contaminated*.

The intention of the approach is that local authorities can use their judgement to ensure that Part 2A focuses on the SPOSH it was designed to address, whilst avoiding unnecessary burdens on land where contaminants may be present but there is no SPOSH.

In making Part 2A decisions, local authorities are likely to face some difficult decisions caused by uncertainty on the nature of risks. But they should be confident in exercising their judgement on the basis of available information. Part 2A clearly leaves judgements about what constitutes a SPOSH to local authorities, and it is up to them to make decisions.

GACs are not proxy thresholds for SPOSH, and should not be used as such. They describe levels (based on cautious estimates and assumptions in hypothetical example situations) at which concentrations of contaminants in soil may cease to pose *no appreciable/ minimal* risk. They do not seek to describe levels at which there might be a SPOSH.

Thus, if a GAC is exceeded, the assessor will usually need to conduct a detailed quantitative risk assessment to discover whether there is a *possibility of significant harm* and, if so, the nature of that risk. Whether or not SPOSH exists will depend on the results of risk assessment, the existence and nature of any pollutant linkages, and (ultimately) the judgement of the local authority.

As a general guide:

- (i) For substances where there is a GAC, the more the GAC is exceeded, the more likely it is that an authority should consider the risks to be SPOSH.
- (ii) Generally, the cautious nature of GACs means that local authorities may conclude that SPOSH is unlikely to exist at concentrations close to GACs.

- (iii) In some cases, land with concentrations of contaminants which marginally exceed a GAC (say, up to a few times the GAC) might give rise to SPOSH if, for example, the receptor is particularly sensitive; or if further assessment finds that exposure is higher than that estimated in the GAC; or if there is little uncertainty in the underlying toxicology and HCV.
- (iv) In other cases a GAC may be exceeded by tens of times and there might be no SPOSH (e.g. if further assessment found that exposure was much lower than that estimated using the GAC).

In view of the above, Hydrock has not attempted to derive numerical SPOSH concentrations, but to use GACs as screening values. Where GACs are exceeded, it is recommended that the linkages and the uncertainties in the data are reviewed in consultation the regulatory authority to aid its judgment on determination.

A possible next phase would be to refine the generic risk assessment with a detailed risk assessment. This would involve using site-specific input parameters relevant to the particular site, in the CLEA model.

Revised contaminated land statutory guidance was published by DEFRA in 2012 with respect to Part 2A. The Act itself is unchanged. A new four category test (and associated classifications) has been introduced to ensure a high standard without being excessive. The aims are to make the regime target higher risk sites more efficiently, remove excessive cost burdens and facilitate the development of technical tools to increase consistency over time. This includes supporting non-technical guidance including a possible framework to aid in deciding into which of the proposed four new Categories of land a site should be placed.

Conversely, the regime is not intended to intervene where there is only a low level of risk, particularly in cases where it is difficult to demonstrate anything other than a very small hypothetical risk, as might be the case with vast swathes of land.

DEFRA states that there is a need for a more pragmatic approach. In practice, deciding when regulatory intervention is justified involves making decisions about when to act on a wide spectrum of risk, with varying levels of uncertainty over the precise nature of the risks. A number of the changes are intended to clarify when land is “contaminated land”. These are most likely to affect the assessment and remediation of contaminated land and are listed below.

1. Statutory explanation of broad objectives of the regime to explain that regulators should seek a reasonable balance between dealing with unacceptable risks whilst ensuring that burdens on businesses and society are manageable and sustainable. The regime should be seen as an option of last resort; that land is in effect “innocent until proven guilty”. This should give greater clarity for all concerned on what the regime seeks to achieve, and what it seeks to avoid.

2. Local Authorities to produce risk summaries before land may be determined as “contaminated”. Summaries must be understandable to non-experts to provide greater transparency and accountability. Easier for all involved to understand what local authority considers risks to be. It should be easier for Local Authorities managers, lawyers and councillors to be involved in decision making, particularly more difficult sites where wider socio-economic effects need to be taken into account. Easier to share experience between Local Authorities leading to greater consistency in decision making.
3. Clarification of the legal test of significant harm to human health to mean serious unhealthy conditions of the body or part of it, and not minor/trivial complaints. This is unlikely to have a major effect because, to date, no site in England and Wales has been determined on grounds that significant harm to human health has actually been caused. However, greater clarity on the meaning of significant harm is likely to help clarify the related legal test of significant possibility of significant harm.
4. Explanation of how to decide when land is (and is not) “contaminated land”. A new four category test which recognises the spectrum of risk encountered by assessors, and the reality that some sites are clearly contaminated land (Category 1), some clearly are not (Category 4), and others need more detailed consideration before a decision can be taken (Categories 2 and 3). Greater clarity that decision making is a two stage process in which the regulator must first understand the risk before deciding whether the risk is sufficiently high to justify regulatory intervention. The aim is to create legal certainty around what definitely is, and is not, contaminated land, whilst leaving Local Authorities with discretion to exercise local judgement on less straightforward land.
5. Category 4 will include normal background levels of contamination unless there is some exceptional reason to consider otherwise. Clarification that land at SGV/GAC levels is likely to be well into Category 4. Statutory backing for the sector to develop new tests to describe the top of Category 4 (including the production of Category 4 Screening Levels). This should provide clarity on when land will not be caught, reduced uncertainty and costs for landowners and businesses and faster decision making on non-problematic land.
6. Clarify the status of GACs and how they should (and should not) be used including a legal backing for the use of robust GACs produced by reputable, non-governmental, organisations within the sector (LQM/CIEH, EIC/AGS/CL:AIRE). Backing the development of new GACs (or similar tools) as might be developed by the sector to help implement the new Guidance. Specific legal backing for the current set of SGVs/GACs, and clarity on how they can (and cannot) be used.
7. Category 1 land is clearly caught by the regime when there is clear evidence of an unacceptable risk (e.g. similar land is known to have caused significant harm). This should give clarity on when land is definitely “contaminated land”, and help frame the spectrum of risk raised by land contamination.

8. New category of land under which Local Authorities would decide whether a site is in Category 2 (contaminated land) or Category 3 (not contaminated land). The new test would rest on whether or not the local authority believes there is a strong case for regulatory action, taking account of the scientific evidence, the objectives of the regime, and other factors. The local authority would start by considering health risks alone, and if they clearly tend towards the Category 4 or the Category 1 the decision could be taken at this point. However, if this does not lead to a decision, the local authority would consider wider socio-economic factors (e.g. cost, views of local people, etc) before deciding. If the local authority still cannot decide, the default decision is that the site is not contaminated land.
9. Reduce “regulatory creep” (excessive remediation of land forced by regulatory uncertainty) with greater clarity on what the enforcing authority can “reasonably” require by way of remediation. Clarify that SGVs/GACs must not be used as “one size fits all” remediation requirements; and that Part 2A can only be used to force remediation to a level where land is no longer contaminated land (i.e. to a point where land is in Category 3), but it should not be used to force remediation beyond this point.
10. Guidance on the process of risk assessment: the need to take a strategic approach; the aim of dismissing low risk sites as soon as possible in order to focus on finding higher risk sites; and the general need to ensure that risk assessment is conducted in a timely and efficient manner. Clarify that in considering possible future risks the local authority should consider likely future situations (e.g. rather than hypothetical worst possible case situations). Recognise that in practice there is often a need for authorities to bring in external experts and act in accordance with their advice. Recognise that scientific and technical uncertainty is an inevitable part of contaminated land risk assessment, and set out broadly how regulators should deal with it. It is important that this is recognised in the Guidance to support the regulators who have to make decisions in the face of uncertainty.

In deciding whether or not a significant possibility of significant harm to human health exists, the local authority should first understand the possibility of significant harm from the relevant contaminant linkage(s) and the levels of uncertainty attached to that understanding, before it goes on to decide whether or not the possibility of significant harm is significant.

The term “possibility of significant harm” means the risk posed by one or more relevant contaminant linkage(s) relating to the land. It comprises:

- the estimated likelihood that significant harm might occur to an identified receptor, taking account of the current use of the land in question; and
- the estimated impact if the significant harm did occur i.e. the nature of the harm, the seriousness of the harm to any person who might suffer it, and (where relevant) the extent of the harm in terms of how many people might suffer it.

Having completed its estimation of the possibility of significant harm, the local authority should produce a risk summary.

The decision on whether the possibility of significant harm being caused is significant (SPOSH) is a regulatory decision to be taken by the relevant local authority. In deciding whether the possibility of significant harm being caused is significant, the authority is deciding whether the possibility of significant harm posed by contamination in, on or under the land is sufficiently high that regulatory action should be taken to reduce it, with all that would entail.

In deciding whether or not land is contaminated land on grounds of significant possibility of significant harm to human health, the local authority should use the four categorisations.

The decision between Categories 2 and 3 is a positive legal test, which means that the starting assumption should be that land does not pose a significant possibility of significant harm unless there is reason to consider otherwise. Category 3 may include land where the risks are not low, but nonetheless the authority considers that regulatory intervention under Part 2A is not warranted.

The local authority should first consider its assessment of the possibility of significant harm to human health, including the estimated likelihood of such harm, the estimated impact if it did occur, the timescale over which it might occur, and the levels of certainty attached to these estimates. If the authority considers, on the basis of this consideration alone, that the strong case does or does not exist, the authority should make its decision on whether the land falls into Category 2 or Category 3 on this basis regardless of any other factors.

However, if the authority considers that it cannot make a decision, it should consider other factors which it considers are relevant, including:

- The likely direct and indirect health benefits and impacts of regulatory intervention including benefits of reducing or removing the risk posed by contamination, any risks from contaminants being mobilised during remediation and any indirect impacts such as stress-related health effects that may be experienced by affected people, particularly local residents. If it is not clear to the authority that the health benefits of remediation would outweigh the health impacts, the authority should presume the land falls into Category 3 unless there is strong reason to consider otherwise.
- The authority's initial estimate of what remediation would involve; how long it would take; what benefit it would be likely to bring; whether the benefits would outweigh the financial and economic costs; and any impacts on local society or the environment from taking action that the authority considers to be relevant.

Deregulatory change to definition of contaminated land as it relates to water pollution.

DEFRA will commence Section 86 of the Water Act 2003 so that in future this would only be the case if there is significant pollution of controlled waters or significant possibility of such

pollution. To explain how to decide whether or not “significant” pollution is being caused, the Statutory Guidance introduced new Category 1-4 tests similar to those for deciding when there is a significant risk to human health as described above. There will be new technical guidance produced by the Environment Agency. In practice, this change is likely to have little effect on the practical implementation of the Part 2A regime because the Environment Agency has already been prioritising sites likely to meet the new “significance” test.

The ‘pollution of Controlled Waters’ means the entry into controlled Waters of any poisonous, noxious or polluting matter or any solid waste matter. Given that the Part 2A regime seeks to identify and deal with significant pollution (rather than lesser levels of pollution), the local authority should seek to focus on pollution which: (i) may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems; (ii) which may result in damage to material property; or (iii) which may impair or interfere with amenities and other legitimate uses of the environment.

In deciding whether significant pollution of Controlled Waters is being caused, the local authority should consider that this test is only met where it is satisfied that the substances in question are continuing to enter controlled Waters; or that they have already entered the waters and are likely to do so again in such a manner that past and likely future entry in effect constitutes on-going pollution.

3.11 Generic Risk Assessment Criteria for Risk to Plants

Soil contaminants, if present at sufficient concentrations, can have an adverse effect on the plant population. Phytotoxic effects can be manifested by a variety of responses, such as growth inhibition, interference with plant processes, contaminant-induced nutrient deficiencies and chlorosis (yellowing of leaves). All chemicals are probably capable of causing phytotoxic effects. Thus the phytotoxic potential of substances is dependent on the concentrations capable of having adverse effects on plants and the concentrations likely to be found at contaminated sites. Phytotoxicity is a difficult parameter to quantify given that experimental techniques vary widely and variations exist in plant tolerances, soil effects and synergistic/antagonistic reactions between chemicals.

Contaminants may be taken up and accumulated by plants through a range of mechanisms. The principal pathways are active and/or passive uptake through the plant root, adsorption to root surfaces and volatilisation from the soil surface followed by foliar uptake. After plant uptake, contaminants may be metabolised or excreted, or they may be bioaccumulated.

Many of the substances capable of adversely affecting vegetation exert this effect because of their water solubility, a characteristic that could result in their transport from contaminated sites into adjacent locations where the chemical may generate a phytotoxic response. This could be important if, for example, the adjacent site has important conservation status.

Whilst many contaminants may be phytotoxic, data are limited. Some heavy metals are essential as trace elements for plant growth but may become toxic at higher concentrations.

Toxicity may be displayed in many forms, including signs of stress such as reduction in growth or yellowing of the tissue. The concentration in soil at which substances become phytotoxic depend on a range of factors including plant type, soil type, pH, the form and availability of the contaminant and other vegetation stress factors that may be present (such as drought).

Hydrock has carried out a review of a number of current and former guidance documents and other texts on phytotoxicity. It is not possible to produce a definitive list of phytotoxic substances on account of the variables mentioned above. However, a number of metals are repeatedly cited as commonly occurring priority pollutants. As a result, the following list is adopted as Hydrock's indicators of the potential for phytotoxicity: As, B, Cr, Cu, Ni and Zn.

As the CLEA framework is a risk based approach, applied to humans, an alternative strategy is required to assess the risk to plants from substances that are phytotoxic. Reference to published criteria and background concentrations can help put site data into context.

Published assessment criteria for the protection of plant life from a number of countries are given in Table 3.8. Also included in the table are some measures of natural background concentrations in typical soils.

The most authoritative source is the British Standard for topsoil, but this only lists three elements. CLR 11 states that the ICRCL Guidance Note 70/90 can be used for initial screening criteria. This approach has been adopted by Hydrock where BS3882 is lacking, but where an ICRCL 70/90 criterion is lacking, the lowest criterion in Table 3.8 from, firstly MAFF, and, secondly, another country has been adopted. The adopted criteria are highlighted in Table 3.8. The MAFF value of 250 mg/kg has been chosen for As over the ICRCL value of 50 mg/kg as MAFF explains the 50 is applicable to vegetables and human health, whereas 250 is applicable to the plants themselves.

Table 3.8: Published Assessment Criteria and Natural Background Concentrations for Phytotoxic Elements (mg/kg)

Reference	As	B	Cr (total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
<i>Published Assessment Criteria (mg/kg)</i>								
British Standard for topsoil (BS3882:2007)						200 (pH>7)	110 (pH>7)	300 (pH>7)
						135 (pH 6-7)	75 (pH 6-7)	200 (pH 6-7)
						100 (pH 5.5-6.0)	60 (pH 5.5-6.0)	200 (pH 5.5-6.0)

Reference	As	B	Cr (total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
MAFF Code of Good Agricultural Practice for the Protection of Soil (1998)	250			unlikely to be toxic except in v low pH. 400 for sites containing sewage sludge		500 (grass) but may fall to 250 for clover and sensitive species (at pH≥6)	110 (pH>7) 75 (pH 6-7) 60 (pH 5.5-6.0)	1000 (clover & grass at pH 6), may fall to 300 for sensitive species (at pH 6-7)
Australian Guideline B(1) (1999), Interim Urban Ecological Investigation Level (EIL). Soils not generally considered phytotoxic below these EILs.	20			400	1	100	60	200
Considered toxic to plants - Ponnampetuma <i>et al</i> (1979)		5 (hot water soluble)						
Dutch ecotoxicological intervention value (Swartjes 1993 & 1994) *	40	7	230			190		
Alberta Environment (1990) Tier 1 (draft) *	10 acid sandy soils			600 acid sandy soils	25 acid sandy soils	130 acid sandy soils		
Ontario MoE (1989) *	20 acid sandy soils 25 clay soils							
ICRCL 59/83 (1987) now withdrawn for human health assessment		3 (hot water soluble)				130	70	300
ICRCL 70/90 (1990) threshold trigger value	50				25	250		1000
New Zealand guidelines for timber treatment sites (1997), estimated based on Cu bioavailability *						500-1000 clay soils		
New Zealand guidelines for timber treatment sites (1997), soil criteria for protection of plant life (residential/agricultural setting)	10-20	3 (soluble)		600	25	130		
Natural Background Concentrations (mg/kg)								
Dutch background level (target value) (VROM 2000)	29		100			36	35	140
UK ICRCL 42/80 (2nd ed. 1983) - Normal conc. In agricultural soil	0.1-40	2-100	5-500			2-100	5-500	10-300

Reference	As	B	Cr (total)	Cr (III)	Cr (VI)	Cu	Ni	Zn
UK ICRL 70/90 (1st ed. 1990) - Typical range (and mean) in agricultural soils	2.3 - 53 (11.0)					5.8-62 (19) [1.2-19 4.9) extractable]		29-210 (78.1) [1.5-21 (5.6) extractable]
Canadian assessment criteria (i.e. background) (CCME 1991)	5	1(hot water soluble)	20		2.5	30		60
New Zealand timber sites (1997) – background	2-30							
Australian Guideline B(1) (1999), typical background levels	1-50		5-1000			2-100	5-500	10-300
* cited in New Zealand Ministry for the Environment (1997) timber treatment chemicals guidelines.								

3.12 Generic Risk Assessment Criteria for Controlled Waters

The following aquifer definitions are adopted.

- **Principal aquifers** - These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
- **Secondary aquifers** - These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types:
 - **Secondary A** - permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers; and
 - **Secondary B** - predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
- **Secondary undifferentiated** - has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
- **Unproductive strata** - These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

The European Water Framework Directive (2000/60/EC) (WFD) and its daughter Directives establish a consolidated way of controlling water quality. The UK Government has set out a timetable for the adoption of the WFD which formalises the way in which the quality of surface water and groundwater are to be assessed. This is set out in *The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009*. The regime was established in December 2009, to be fully operational by December 2012. This involves the introduction of new regulations and water quality targets (WQT). The Environment Agency (November 2012) has issued a revised Groundwater Protection Policy (known as GP3) containing the legal framework, detailed policies, technical background and the tools to be used. There are a number of support documents produced by the UK Technical Advisory Group on the Water Framework Directive (UKTAG), including Paper 11B(iii) (September 2008) on standards for regulation.

A groundwater body is defined as groundwater in an aquifer capable of supporting an abstraction of 10 m³/day or 50 people over a sustained period under the WFD. Groundwater bodies are a strategic resource, even if there is no current abstraction. Lesser amounts of groundwater in an aquifer are not considered as receptors in their own right, but may still be pathways to other receptors such as surface water bodies or aquatic ecosystems.

Hydrock has followed the guidance in these documents as far as possible, but because the regime is being introduced over a period of several years, it will not always be possible to 'second guess' the exact requirements of the Agency during the transitional period and so early liaison is recommended.

One of the main objectives of the Agency is to 'prevent or limit' inputs of substances. The List I and List II groupings of substances under the 1980 Groundwater Directive (GD) no longer apply. Substances are instead treated as either 'hazardous substances' (initially broadly equating to the former List I) or non-hazardous pollutants' (analogous to the former List II, but potentially applying to all other pollutants).

The 'limit' objective refers to limiting any inputs of all other pollutants into groundwater so as to prevent pollution, deterioration in status or sustained upward trends. The existing GD already implements the limit objective, but for a limited range of substances (List 2) and activities. The major change in regulation is that now the WFD covers all other pollutants.

For practical purposes, the Agency interprets prevention of inputs of hazardous substances in relation to former List 1 substances and any other substances which meet the criteria for persistence, toxicity and bioaccumulation taking into account those substances listed in WFD Annex VIII. List I substances are effectively a (large) subset of the potentially wider group of hazardous substances.

Note, however, that the 'prevent' objective applies to active inputs such as industrial discharges and *de minimus* concentrations are set as a series of minimum reporting values (MRV). Inputs to controlled waters from contaminated land sites are classed as passive inputs under the WFD and, as such, are regulated under the Agency's 'limit' objective.

Acceptable water quality targets are defined for protection of human health (based on drinking water standards (DWS)) and for protection of aquatic ecosystems (environmental quality standards (EQS)).

There are no longer finite lists of substances over which control may be exercised under the 2006 WFD and the 2009 Groundwater Regulations. All substances which are not determined to be hazardous are potentially non-hazardous pollutants. This enables control to be exercised over polluting substances which have hitherto been beyond control purely because, regardless of their impact, they were not listed in the 1980 Groundwater Directive. In practice the Agency will need to deal with substances which are current priorities of concern. It is clearly not necessary to expand the field to include all other substances in all circumstances unless they are liable to cause pollution.

The final say lies with the Environment Agency and whilst the indicator substances analysed for by Hydrock in this report may be indicative of the likely risk of pollution of Controlled Waters, this report may not be definitive and the Agency may require additional work.

The definition of pollution is *“the direct or indirect introduction, as a result of human activity, of substances or heat into the air water or land which may be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems, which result in damage to material property, or which impair or interfere with amenities and other legitimate uses of the environment.”*

Pollution equates to harm. In order to protect receptors there is a regulatory regime. This involves setting an environmental standard at the receptor (i.e. minimum acceptable water quality). In recognition that pollutants may degrade *en route* to the receptor it is possible to set a limit value at the source of the pollution and compliance values at locations along the pathway, such that water reaching the receptor does not exceed the environmental standard. By definition, the target value is greater than or equal to the compliance value, which in turn is greater than or equal to the environmental standard, depending on the amount of degradation expected. This concept is used in the Remedial Targets Methodology (Environment Agency 2006) to determine how land contamination impacts on groundwater and surface water quality.

The applied environmental standards vary with the hydrogeological conditions and the perceived value of the water resource, and are subject to local assessment by the Agency. Note that protection of Controlled Waters may involve work over and above that required for 'suitable use' of a site for the proposed development.

Note also that Article 6.3(e)(ii) of the WFD enables the regulatory authorities to exempt measures from the prevent and limit requirements where it would be disproportionately costly to remove or control the further movement of pollutants that are already in the ground. Where a continuing source that has given rise in the past to land contamination this must be brought under control to prevent further unacceptable inputs to groundwater, but it is clear that the extent is limited by what is considered to be 'reasonableness'.

This report provides an initial assessment of the risks of pollution of Controlled Waters using water quality targets (WQT) as screening values. These are the drinking water standards (DWS) and the environmental quality standards (EQS), the latter designed to protect the surface water ecosystems. EQS are available for inland surface waters (freshwater) and other surface waters (transitional and marine).

DWS are given in the Water Supply Regulations 2010 (which amends to Water Quality (Water Supply) Regulations 2000, Schedule 1, Table B, Part 1 (Directive requirements) and Part 2 (national requirements)). Where no UK or EU drinking water standard exists, reference is made to the World Health Organization (2011).

The primary list of EQS has been published recently in European Directive 2008/105/EC, Annex I, Part A and these have been adopted by DEFRA in *The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009* (Part 5 Priority Substances).

In addition, each Member State has to define country-specific substances and their EQS. Those adopted by the UK are included in Part 4 (Specific Pollutants) of the above Directions. It should be noted that the UK Technical Advisory Group on the Water Framework Directive (UKTAG) is preparing a series of specific pollutant technical reports for the WFD, Annex VIII list of chemicals. These proposed EQS will only be used by Hydrock once they have been adopted formally by DEFRA and the Environment Agency.

The basis for the DWS and EQS used in this report is the Environment Agency Chemical Standards Database (<http://evidence.environment-agency.gov.uk/ChemicalStandards/home.aspx>).

The WFD imposes a duty on the Agency to classify surface water and groundwater bodies and to ensure long-term improvement (where necessary) to achieve acceptable standards. This includes the chemical status of the water. A new set of criteria for groundwater quality classification has been published, in addition to DWS and EQS. These are Threshold Values (TV) for individual groundwater bodies (GWB). Each GWB has been identified by the Agency and specific TVs calculated based on the perceived risks to that GWB. Failure of a TV is an indicator of potential adverse impact in specific circumstances. These TVs are not intended to be applied to meet the 'prevent or limit' objective of the Agency (UKTAG September 2008) and they are not used by Hydrock in this report.

Generic criteria for contaminated soils which might result in groundwater contamination can be derived from generic assumptions using the Environment Agency (2006) Remedial Targets Methodology. A tiered approach is detailed in this document. In accordance with CLR 11, EQS and DWS can be used as generic water quality targets with respect to contamination of controlled waters.

It is clearly not cost-effective to analyse every water sample for all determinands. Hydrock has produced a default *de minimus* suite which includes a number of common water quality indicators plus a selection of the more common chemicals of potential concern, drawn from

the lists of Specific Pollutants and Priority Substances / Priority Hazardous Substances in Parts 4 and 5, respectively, of the 2009 Directions, plus additional common contaminants listed in the EPA-H1 Part 2 document, as being indicators of Good water quality under the terms of the Directive.

In addition to this, Hydrock will add to this list any chemicals identified as potential risks by reference to the conceptual site model.

Using the WQTs discussed above, the risks to groundwater and surface water from contaminants on site have been assessed according to the remedial targets methodology (RTM) prescribed by the Environment Agency (2006).

The Level 1 soil zone assessment considers whether the contaminant concentrations in the soil moisture are sufficient to impact the water receptor(s). It is a conservative model and compares soil pore water concentrations with the above criteria, taking no account of dilution, dispersion or attenuation. Pore water concentrations can be estimated by analysis of perched water samples, analysis of eluates produced in the laboratory by standard leaching of soil samples, or by calculation from physico-chemical properties of the substances. Calculation may be more appropriate for poorly soluble substances where retention times may not be long enough during the standard leaching tests to reach equilibrium. However, the Environment Agency (2009d) cautions that the use of published k_d values to calculate pore water concentrations “can lead to a conservative estimate of risk” and suggest that leaching tests may be designed for non-volatile organics using BS18772:2008.

The Level 2 groundwater assessment is applicable where groundwater quality data are available and compares these with the above criteria, again taking no account of dilution, dispersion or attenuation.

The remedial targets methodology also allows for more detailed assessment (soil Level 2, 3 or 4, or groundwater Level 3 or 4) for substances which fail the above-mentioned assessments. These are progressively more complex assessments and do take into account attenuation and/or dilution, as applicable to the conceptual exposure model. Such assessment is beyond the scope of this report.

Where more than one water quality target is available it is important to apply the one relevant to the critical receptor. The DWS apply to groundwater or to surface water used for abstraction and the EQS apply to surface water where the aquatic ecosystem is the receptor. EQS are available for *inland* surface waters (freshwater) and *other* surface waters (transitional and marine). Where the most appropriate water quality target cannot be determined with certainty, the lowest one is adopted in line with the precautionary principle.

For the purposes of this report, the site data are compared with the various targets as set out in Table 3.9

Table 3.9: Summary of Water Quality Risk Assessment Protocol

Scenario	Water Body Receptors	Secondary Receptors	Example Contaminant linkages	RTM Level and Samples Used (if Available)	Water Quality Targets
A	Groundwater.	Human health (abstraction).	Contaminants from site leach or seep into groundwater body and this is a (potential/actual) source of human consumption or a strategic resource.	RTM Level 2 - Groundwater. RTM Level 1 - Soil leachate (including any calculated pore water concentrations) or pore water.	DWS
A	Groundwater. Surface water.	Human health (abstraction).	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be used for human consumption.		DWS
B	Groundwater. Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be an aquatic ecosystem.		EQS (inland)
C	Groundwater. Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be an aquatic ecosystem.		EQS (other)
D	Groundwater. Surface water.	Human health (abstraction). Aquatic ecosystem.	Contaminants from site leach or seep into groundwater body and this feeds surface water by base flow. The surface water may be used for human consumption and is an aquatic ecosystem.		DWS EQS (inland)
E	Surface water.	Human health (abstraction).	Contaminants from site leach or seep into surface water which may be used for human consumption.	RTM Level 1 - Soil leachate (including any calculated pore water concentrations) or pore water. Although not part of the RTM, these scenarios are used to compare surface water data to the water quality targets.	DWS
F	Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into surface water which may be an aquatic ecosystem.		EQS (inland)
G	Surface water.	Aquatic ecosystem.	Contaminants from site leach or seep into surface water which may be an aquatic ecosystem.		EQS (other)
H	Surface water.	Human health (abstraction). Aquatic ecosystem.	Contaminants from site leach or seep into surface water which may be used for human consumption and is an aquatic ecosystem.		DWS EQS (inland)
Notes: Some EQS are water hardness dependent. This is measured either in the receiving water or in groundwater (if it is part of the pathway), or is estimated from national maps. Inland waters EQS applicable to freshwater, other waters EQS applicable to marine or transitional waters. Where both DWS and EQS are applicable, it is assumed that the EQS is for inland waters. This table and the results of the assessment are considered as a first screening for potential risks of pollution of Controlled Waters. More specific requirements may be stipulated by the Environment Agency.					

Note that in some instances the reporting limit (or detection limit) quoted by the laboratory may be greater than the water quality target that it is being assessed against. Where this is the case it is noted in the table. The current exercise is an initial screening assessment.

There are three main possible reasons for this. Firstly, it may be that the 'standard' method gives a relatively higher reporting limit, but that a lower one could be obtained using a more specialised technique. However, it would be disproportionately expensive to adopt the more costly specialist technique for this initial screening exercise. Secondly, it may be that the sample in question was not 'clean' because the matrix was contaminated by other substances which interfere with the analysis and so a less sensitive method has been used to protect the laboratory equipment. Thirdly, it may be that no method exists that can reach the required limit. Hydrock has contacted the Environment Agency's own National Laboratory Service and even they cannot reach low enough limits for several of the substances in the Hydrock default suite (Cr(VI), total cyanide, phenols and certain PAHs). Consequently, and depending on the particular chemicals, it may be possible with additional effort to refine the assessment, or it may be the case that it is not possible to say for certainty because suitable techniques are not available. Methods are being continually updated and new ones may become available.

In some cases all samples are below the detection limit but above the water quality target. It is not possible to make any judgement about these. However, in other cases, even though the detection limit is greater than the water quality target, some sample results do exceed the target.

3.12.1 Petroleum Hydrocarbons in Water

With respect to hydrocarbons in water, the Water Supply (Water Quality) Regulations 1989 (as amended 1999) contained a prescribed concentration of 10 µg/l for "dissolved or emulsified hydrocarbons (after extraction with petroleum ether); mineral oils". This was removed from the 2000 (consolidated 2007) Regulations. It was confirmed by email from the Drinking Water Inspectorate to Hydrock (1 November 2005) that dissolved hydrocarbons are no longer a prescribed substance under the Regulations. However, the 10 µg/l limit did remain in the Private Drinking Water Regulations 1991 until their revision at the end of 2009.

In the absence of a prescribed concentration for drinking water, many Environment Agency officers continue to use the superseded value. This is perhaps because petroleum hydrocarbons are a hazardous substance (former List 1) under the WFD. There is, however, no clear UK policy on hydrocarbon contamination of controlled waters. This is partly because analyses for 'petroleum hydrocarbons' are fraught with complications concerning false positives, the results being method dependent and not restricted to petroleum products.

Guidance written by the Environment Agency on risk assessment of hydrocarbons in groundwater is dated 2009 but has never been officially released through the Agency's website, although the dissemination status of the document is given as publicly available. This gives a table of water quality targets for hydrocarbons and lists "TPH (dissolved or emulsified hydrocarbons)". No minimum reporting value (MRV) is quoted, the value that would equate to a *de minimus* concentration under the prevention objective. The target of 10 µg/l is given and this is described as coming from the "Private Water Supply Regulations SI 1991 No. 2790 (due to be updated in 2009)". As mentioned above, the 2009 Regulations no longer list dissolved hydrocarbons.

Furthermore, the guidance also states that in cases where petroleum hydrocarbons have already entered the water, the Agency will regulate under its limit objective, rather than the prevention objective. This means that EQS or DWS will be appropriate. However, none exist.

In the absence of definitive guidance on petroleum hydrocarbons in water Hydrock recognises that it is not possible to provide EQS and so regulation with respect to aquatic ecosystems is impossible. However, it is possible to extend the use of DWS by calculating screening criteria for the speciated TPH fractions. This provides a rational, transparent and risk-based approach using established scientific principles, rather than simply adopting a withdrawn standard.

Whilst not strictly applicable to aquatic ecosystems, at least this approach can help inform the judgement as to the degree of degradation of a water body.

Accordingly Hydrock has calculated guidelines for drinking water quality based on the methodology proposed by the World Health Organisation (WHO, 2005). This is based on an adult consuming 2 litres of water per day. Whereas the WHO document assumes a body weight of 60kg, Hydrock has assumed 70kg in keeping with the UK Contaminated Land CLEA methodology.

A conservative allocation of 10% of the oral Tolerable Daily Intake (TDI) has been attributed to intake from drinking water. It is noted by the WHO (2005) that exposure from other sources would be expected to be very small and that it would be possible to allocate a greater percentage to drinking water if required. In other words, this approach is very conservative and is appropriate as an initial screening value and allows for potential additive toxicity and simultaneous exposure from other sources.

The TDIs used are the same as those used in the derivation of soil GACs and are listed in Table 3.10 along with the calculated health-based water quality targets for drinking water. Note, however, that the Environment Agency (2009d) states that when considering carbon bands, one does not know the range of toxicities and health effects of the individual chemicals, and it is precautionary to assume that the toxicological effects are additive when setting water quality targets even though the toxic endpoints and modes of action might in reality be quite different. The recommendation is to adopt a precautionary approach whereby the water quality target for each band is divided by the number of bands with detected concentrations.

Table 3.10: Calculated Water Quality Targets for Petroleum Hydrocarbons in Drinking Water

Determinand	TDI (µg/kg/day)	Solubility (µg/l)	Water Quality Target (see note 1) (µg/l)	Notes
Ali EC5-EC6	5000	35900	17500¹	
Ali >EC6-EC8	5000	5370	17500¹	This concentration would be significantly above the solubility in water.
Ali >EC8-EC10	100	427	350¹	

Determinand	TDI (µg/kg/day)	Solubility (µg/l)	Water Quality Target (see note 1) (µg/l)	Notes
Ali >EC10-EC12	100	33.9	350¹	This concentration would be significantly above the solubility in water.
Ali >EC12-EC16	100	0.759	350¹	This concentration would be significantly above the solubility in water.
Ali >EC16-EC44	2000	0.00254	7000¹	This concentration would be significantly above the solubility in water.
Aro EC5-EC7	223	1780000	1¹	Based on the TDI for toluene as recommended by Environment Agency (2005) P5-080/TR3 gives 780. In reality the UK DWS for benzene = 1 takes precedence.
Aro >EC7-EC8	223	590000	700¹	Calculated as 780, WHO DWS = 700 takes precedence.
Aro >EC8-EC10	40	64600	140¹	
Aro >EC10-EC12	40	24500	140¹	
Aro > EC12-EC16	40	5750	140¹	
Aro >EC16-EC21	30	653	105¹	
Aro >EC21-EC44	30	6.61	105¹	This concentration would be significantly above the solubility in water.
Benzene	n/a	1780000	1	Calculation not possible as non-threshold substance, UK DWS = 1 takes precedence.
Toluene	223	590000	700	Calculated as 780, WHO DWS = 700 takes precedence.
Ethylbenzene	100	180000	300	Calculated as 350, WHO DWS = 300 takes precedence.
Xylene	180	200000	500	Calculated as 630, WHO DWS = 500 takes precedence.
MTBE	300	48000000	15	Calculated as 1050 so the odour threshold = 15 is adopted.
Note 1: The value to be used in a risk assessment (for carbon bands) is the value in the table divided by the number of bands with detected concentrations. Last updated 29/06/10				

In instances where a simple 'total' TPH is reported for water samples this should be considered indicative only. This is particularly the case if groundwater or surface water samples were not available and an indication of pore water quality has been derived by subjecting soil samples to a standard leaching procedure or calculation.

Where petroleum hydrocarbon contamination of Controlled Waters is suspected, Hydrock recommends that discussion with the Environment Agency is entered into at the earliest opportunity.

3.13 Statistical Tests of Soil Contamination Results

As discussed above, the sample analyses are divided into representative data sets for the assessment, based on the conceptual site model, and are referred to as 'averaging areas'. In this case it has been chosen to characterize materials that are likely to form the ground cover in critical receptor areas (e.g. gardens), on a material by material basis. The critical

part of the soil column is the upper metre in terms of contact with end users of a development site.

Under the **land use planning system** where the aim is to demonstrate 'suitability for use' the key question will usually be "can we say confidently that the level of contamination of this land is low relative to some appropriate measure of risk, sometimes referred to as the critical concentration?" The critical concentration can be, for example, the relevant GAC.

It is necessary to demonstrate that (for each contaminant) the mean concentration on the site is **below** the critical concentration. The true mean concentration of a contaminant is not known because all the site soil has not been tested. An estimation of the true mean can be obtained from the samples tested during the investigation. The greater the number of samples tested, the closer the mean of these values is to the true mean.

In practice, this involves calculation of a quantity known as the 95th Upper Confidence Limit (UCL) of the true population mean, also known as the US_{95} . This is the estimate of the true mean at a 95% level of confidence (i.e. there is a 95% probability that the true mean will not be greater than this, given the values obtained from the investigation sample testing).

The statistical test that is carried out, therefore, is used to demonstrate that there is a 95% probability that the true mean falls below critical concentration (typically the GAC in a screening exercise).

In statistical language, a **null hypothesis** is stated; *that the level of contamination is the same as, or higher than, the critical concentration*. The **alternative hypothesis** is *that the level of contamination is lower than the critical concentration*. The statistical test is used to decide whether or not the null hypothesis is rejected.

If it is rejected, the assessor can conclude that the alternative hypothesis is more likely to be true, i.e. that contaminant concentrations are low relative to the critical concentration and that, potentially, the land is suitable for use. Conversely, if the null hypothesis is not rejected, the assessor should conclude that contaminant concentrations may be the same as, or higher than, the critical concentration and further measures may be needed.

It should be noted that a similar, but opposite, set of propositions applies in the case of a potential Part 2A determination where the level of contamination must be higher than some appropriate level of risk (critical concentration) (e.g. that indicative of SPOSH). In this case, however, a lower standard of proof may be accepted and the guidance suggests that if the statistical test of significance at the 95% confidence level does not indicate rejection of the null hypothesis, then the test should be repeated at the 51% level to see if there is evidence to suggest the null hypothesis be rejected on the balance of probabilities.

A useful summary of the methodology is provided by CIEH & CL:AIRE (May 2008), which forms the basis for the approach adopted by Hydrock, and is described below.

Firstly, the data set is assessed for outliers and normality. This is mainly a visual exercise rather than following a particular statistical method. The reason for this approach was that the former guidance provided in CLR7 had the potential for misuse and that is why it was withdrawn. It is considered that a reasoned option is preferable to blindly following a particular test when it comes to outliers and normality.

Two graphs are considered, the data frequency histogram with a normal 'bell curve' for comparison and a quantile-quantile (q-q) plot. The closer the data points lie to the 45° line, the closer they are to a normal distribution. Kinks in the q-q plot are indicative of more than one data set. Individual points away from the 45° line are indicative of outliers.

Additional evidence of outliers is obtained through a simple method of robust statistics advocated by the Royal Society of Chemistry (2001) and others. The measure of the mean is taken to be the median value because this is less susceptible to outliers and non-normal data sets. A value known as the mean absolute deviation (MAD) is calculated and from this can be calculated a robust standard deviation estimate by multiplying by 1.483.

A z-score can then be calculated, which is the absolute value of the data value minus the median, divided by the robust standard deviation. This is then compared with a critical value which, if exceeded, suggests a possible outlier. The critical value represents the number of standard deviations from the mean (or in this case the median). A critical value of 3 to 3.5 is generally considered appropriate. The attraction of this approach is that it is a robust, non-parametric method suitable for all data sets. It is not considered as definitive, but merely a tool to aid decision making.

If a potential outlier is identified it could be a laboratory or typographic error. If this is not the case it could be representative of a different contaminative incident and, therefore, be a hot-spot. However, it could also be simply the result of heterogeneous ground conditions and a relatively low number of sampling points. The initial review of the data is then coupled to a knowledge of the conceptual site model before an outlier is removed from the data set. A good reason is required to justify the removal of outliers and this will be reported in the text.

The second stage of the assessment is to carry out the statistical test as described previously. Two alternative methods are highlighted in the CIEH/CL:AIRE document. The one-sample t-test is appropriate for normally distributed data (it is a parametric test) but is not sensitive to moderate departures from normality. The Chebychev Theorem is a non-parametric test which is suitable for all data distributions. It is a less powerful test (statistically) and gives a more cautious result than the t-test because there is less certainty about the shape of the distribution.

If there is significant departure from normality, perhaps because outliers are still included, the t-test will be chosen. Otherwise, the Chebychev Theorem will be used. The chosen method is applied and the outcome recorded with respect to whether or not the null hypothesis is rejected and the site is potentially suitable for use.

When considering potential Part 2A sites, updated guidance published by Barnes *et al* (2010) recommends the t-test for all data sets (unless the data are negatively skewed, something these authors have never seen in contaminated land data sets).

Please note that under certain circumstances a 'divided by 0' error can occur in the spreadsheets used in the statistical analyses. This happens when all the data points are the same integer value, for example where all results are <3 mg/kg and they have been assumed to be 3 mg/kg. To prevent this error, one of the results can be altered by a small amount (e.g. 3 becomes 2.99999). This allows the statistical tests to be carried out but makes no difference to the outcome. However, it does mean that the q-q and histogram plots show a spurious point, which should be ignored.

3.13.1 Note on Clustered Data Sets

The assumption behind the statistical tests is that each sample represents an equal fraction of the averaging area (Nathanail, 2004). If the data are clustered, i.e. the sampling points are not equally spaced, the calculated US_{95} would be too high if targeted sampling has taken place around suspected high concentration areas to determine the extent of the high contamination. Conversely, the calculated US_{95} would be too low if there is a high density of sampling in an area of low contaminant concentration.

The sampling pattern used in this report has been reviewed to determine if clustering of data points is likely to affect the statistical tests significantly. In cases where the area represented by each sample is judged to be similar, the tests have been carried out without modification. The error in this approach is likely to be conservative to human health because the Hydrock approach to targeted sampling is more likely to produce more closely spaced higher concentrations than more closely spaced lower concentrations.

Erring on the conservative side is, however, counter productive when it would indicate unnecessary remediation, i.e. remediation triggered by a US_{95} which is skewed by clustered data. This is taken into consideration in the risk evaluation part of the risk assessment exercise and can take the form of professional judgement, the modification of the averaging area datasets to decluster them, or the weighting of sample results to decluster the data set. The latter method involves weighting the measured concentrations according to the proportion of the area they represent, giving greater weight to samples representative of a larger area.

3.13.2 Statistical Tests and Risk to Controlled Waters

Where only a few water quality tests are available, the maximum concentrations are compared with the standards because the 95 percentile will be close to the maximum value. However, where a larger population is available, the 95 percentile is compared with the standards, as recommended by the Environment Agency.

3.14 Permanent Ground Gas Risk Assessment

The risks associated with the permanent ground gases methane (CH₄) and carbon dioxide (CO₂) are assessed using BS 8485:2007 and guidelines from CIRIA (Wilson *et al* 2007) and the NHBC (Boyle and Witherington 2007).

In the above guidance, 'Situation B' is defined as the specific development of low-rise (1 or 2 storey) housing with beam and block floors, vented sub-floor void and gardens. Initial risk classification can be made according to NHBC Table 8.1. This determines the appropriate risk strategy for protection, including the need to progress to generic quantitative risk assessment (GQRA). Even where no risk assessment is recommended by this table, one may be carried out if so desired. The GQRA is known as the 'NHBC traffic light classification' as it uses red, amber and green designations to portray levels of risk.

'Situation A' covers all other forms of development. This uses a modified version of the Wilson and Card (1999) methodology.

The idealised frequency of monitoring is suggested in CIRIA Tables 5.5a and 5.5b. These tables are adapted from Wilson and Haines (2005) Table 3 which gives examples of ground conditions with the various gas generation potentials, ranging from inert Made Ground (very low potential) to post 1960s domestic landfill (very high potential).

The report does not constitute a design for gas protection measures, but lists the recommendations given by the above-mentioned guidance for the particular "Situation" considered relevant. For information, BS 8485:2007, Table 3 is reproduced herein as Table 3.11.

Table 3.11: BS 8485:2007, Table 3 Recommended Measures Based on Sum of Scores from Table 2

Protection Element/System		Score	Comments
a) Venting/dilution (see BS 8485, Annex A)			
Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.). ^{A)}	Very good performance.	2.5	Ventilation performance in accordance with Annex A.
	Good performance.	1	If passive ventilation is poor this is generally unacceptable and some form of active system will be required.
Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.). ^{A)}		2.5	There have to be robust management systems in place to ensure the continued maintenance of any ventilation system. Active ventilation can always be designed to meet good performance. Mechanically assisted systems come in two main forms: extraction and positive pressurization.

Protection Element/System		Score	Comments
Ventilated car park (basement or undercroft).		4	Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F and IStructE guidance (design recommendations for multistorey and underground car parks, 3rd ed, 2002) .
b) Barriers			
Block and beam floor slab.		0	It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum. Breaches in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances.
Reinforced concrete ground bearing floor slab.		0.5	
Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab.		1.5	
Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints.		1.5	
Fully tanked basement.		2	
c) Membranes			
Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with verification. ^{B), C)}		0.5	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and the integrity of joints.
Proprietary gas resistant membrane to reasonable levels of workmanship/in line with current good practice under independent inspection (CQA). ^{B), C)}		1	
Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent verification.		2	
d) Monitoring and detection (not applicable to non-managed property, or in isolation)			
Intermittent monitoring using hand held equipment		0.5	Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe.
Permanent monitoring and alarm system. ^{A)}	Installed in the underfloor venting/dilution system.	2	
	Installed in the building.	1	
e) Pathway intervention			
Pathway intervention.		-	This can consist of site protection measures for off-site or on-site sources (see Annex A).
NOTE: In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection.			
A) It is possible to test ventilation systems by installing monitoring probes for post installation verification. B) If a 1200 g DPM material is to function as a gas barrier it should be installed according to BRE 212 (Hartless 1991)/BRE 414 (Johnson 2001), being taped and sealed to all penetrations. C) Polymeric Materials >1200 g can be used to improve confidence in the barrier. Remember that their gas resistance is little more than the standard 1200 g (proportional to thickness) but their physical properties mean that they are more robust and resistant to site damage.			

4.0 WATER SUPPLY PIPES

The current guidance on selection of materials for water supply pipes to be laid in contaminated land is contained in UKWIR Report 10/WM/03/02 (re-issued 2010) which sets out in Table 3.1 of that document threshold values for a selection of organic contaminants that may have a detrimental effect on pipes and fittings. The contaminants are divided into a number of 'parameter groups'. Also included are threshold values for certain parameters that could cause corrosion of metal pipes. This guidance supersedes the former WRAS guidance (October 2002).

Some water suppliers (e.g. Anglian, United Utilities, Wessex and Yorkshire) specify their own soil threshold values and material design requirements, however these are currently not nationally recognised.

The UKWIR guidance recommends a *mandatory* analytical suite in its Table G1 comprising five groups of substances as follows: extended VOC suite, BTEX & MTBE, extended SVOC suite, phenols, cresols and chlorinated phenols, mineral oil C11-C20, mineral oil C21-C40 and corrosive suite. Other groups and sub-groups are recommended on a site-specific basis: ethers, nitrobenzene, ketones, aldehydes and amines.

The Association of Geotechnical and Geoenvironmental Specialists (AGS, 9 July 2009) stated that the former WRAS guidance was out of date and should be withdrawn and that the internal guidance adopted by water companies is inconsistent in some respects. Unfortunately, the replacement UKWIR document also contains a number of technical errors and inconsistencies and to date has not been universally accepted. For example, it requires a desk study, but then gives a mandatory list of determinands that would negate the need for a desk study. Also, a number of substances are listed under the wrong groups in Table G1. The AGS continues to have concern.

The UKWIR suggested methodology includes a soil vapour survey in cored boreholes along the pipeline routes, the construction of sampling boreholes where water is detected within 1 m of the base of a proposed pipe trench and analysis of soil samples over a 30 m wide corridor along each pipe run. The sampling plan is to be agreed with the water company beforehand. There are significant cost and time implications associated with this approach and so it has **not** been followed as part of this report.

Note that the use of barrier pipe (PE-Al-PE) is applicable for all brownfield sites according to the UKWIR guidelines. Further work may be required if other types are contemplated.

As a minimum, the findings of this investigation can be compared to the threshold values in UKWIR Table 3.1 as far as is practicable and with the modifications shown in Table 4.1 (and ignoring obvious errors in Table G1) to give an indication of the possible restrictions to the use of plastic water pipes.

Table 4.1: UKWIR Threshold Values for Plastic Water Pipes (Modified by Hydrock Comments)

Parameter Group from UKWIR Table 3.1	Hydrock Comments	Trigger Value (mg/kg)	
		PE	PVC
1 – Extended VOC suite by purge & trap or head-space and GC-MS with TIC (total VOC concentration excluding BTEX and MTBE).	Sum of VOC excluding BTEX & MTBE from this report (if available).	0.5	0.125
1a – BTEX & MTBE (total concentration).	Sum of BTEX and MTBE from this report (if available).	0.1	0.03
2 – Extended SVOC suite by purge & trap or head-space and GS-MS with TIC (aliphatic and aromatic C5-C10) (total SVOC concentration excluding 2a to 2f listed below).	Sum of SVOC from this report excluding substances in 2a to 2f. Also excluding petroleum hydrocarbons aliphatic and aromatic C5-C10 listed by UKWIR because these are VOCs not SVOCs and it is presumed to be an error. These will be included in the VOC total automatically.	2	1.4
2e – Phenols (total concentration).	Sum of phenols from this report (if available).	2	0.4
2f – Cresols and chlorinated phenols (total concentration).	Sum of cresols and chlorinated phenols from this report (if available).	2	0.04
3 – Mineral oil C11-C20 (total concentration).	Sum of TPH fractions >EC10-EC21 from this report (if available).	10	No limit
4 – Mineral oil C21-C40 (total concentration).	Sum of TPH fractions >EC21-EC35 from this report (if available).	500	No limit
2a – Ethers (if site history suggests as a potential hazard) (total concentration).	Sum of ethers from this report (if available).	0.5	1
2b – Nitrobenzene.	Nitrobenzene (if available).	0.5	0.4
2c – Ketones (total concentration).	Sum of ketones from this report (if available).	0.5	0.02
2d – Aldehydes (total concentration).	Sum of aldehydes from this report (if available).	0.5	0.02
6 – Amines (total concentration).	The UKWIR report says the presence of amines precludes the use of PE. Since a less than detection limit value is not necessarily zero, logically PE cannot be used on site where the desk study leads to a suspicion of there being amines in the ground.	Fail	No limit

In view of the lack of clear and unambiguous guidance it is **strongly recommended** that site-specific approval of the materials for underground pipes to be used for water supply be obtained from the water company that will be supplying this site and/or adopting the pipework.

5.0 **FLOOD RISK**

The following additional information concerns the background to flood risk mentioned in the report. Guidance is given in the document *Technical Guidance to the National Planning Policy Framework* (DCLG March 2012) which retains key elements from the withdrawn Planning Policy Statement 25.

The Environment Agency flood maps are divided into Flood Zones, as follows.

- Flood Zone 1 is land outside the extent of extreme flooding and the annual risk is less than 1:1000, low probability (depicted as white on the web-based map).
- Flood Zone 2 is land unlikely to flood except in extreme conditions if no defences are present and the annual risk is between 1:100 and 1:1000 (for rivers) or 1:200 and 1:1000 (for the sea), medium probability (depicted as light blue on the web-based map).
- Flood Zone 3 is land within the floodplain at risk of flooding if no defences are present and the annual risk is greater than or equal to 1:100 (for rivers) or 1:200 (for the sea), high probability (depicted as dark blue on the web-based map).

The Agency flood maps also define the risk of flooding: as 'low' ($\leq 1:200$), 'moderate' ($> 1:200$ to $\leq 1:75$) or 'significant' ($> 1:75$), which are not the same divisions as those in the guidance mentioned above. Note that the published flood map only relates to flooding from rivers, estuaries and the sea and does not include other potential sources such as surface water, groundwater, sewers, canals and reservoirs. Note also that the presence on the map of flood defences, or areas benefiting from flood defences, should not be taken to imply that a proposed development in these areas is acceptable.

The **Environment Agency in England** has issued Flood Risk Standing Advice. However, this is to be reviewed following the publication of the NPPF (see <http://www.environment-agency.gov.uk/research/planning/33098.aspx> for updates and details).

The flood map mentioned above can be accessed at the Agency's website.

The Technical Guidance states:

- Within Flood Zone 1 all uses of land are appropriate. For development proposals on sites comprising one hectare or above, the vulnerability to flooding from other sources as well as from river and sea flooding; and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment (FRA) to accompany the planning application. This need only be brief unless the factors above or other local considerations require particular attention.

For development proposals less than one hectare no flood risk assessment (FRA) is required.

- Within Flood Zone 2, water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure (as defined in Technical Guidance, Table 2) are appropriate in this zone. The Sequential Test of PPS25 is required and must be passed and for highly vulnerable uses in Table 2 the Exception Test must be applied and passed also. All development proposals in this zone should be accompanied by a flood risk assessment (FRA).
- Flood Zone 3 is sub-divided into 3a and 3b, but these are not distinguished on the published maps. Flood Zone 3a is land having an annual probability of flooding of >1:100 (from rivers) or >1:200 (from the sea). The water-compatible and less vulnerable uses of land (as defined in Technical Guidance, Table 2) are appropriate in this zone. The highly vulnerable uses in Table 2 should not be permitted in this zone. The Sequential Test is required and must be passed and for the more vulnerable and essential infrastructure uses in Table 2 the Exception Test must be applied and passed also. Essential infrastructure permitted in this zone should be designed and constructed to remain operational and safe for users in times of flood. All development proposals in this zone should be accompanied by a flood risk assessment (FRA).

Flood Zone 3b is known as the 'functional floodplain' and comprises land where water has to flow or be stored in times of flood and should be identified on Strategic Flood Risk Assessments (SFRA) undertaken by the Local Planning Authority. Such land is defined as land which would flood with an annual probability of 1:20 or greater, or is *designed* to flood in an extreme (1:1000) flood, or at another probability to be agreed between the Local Planning Authority and the Environment Agency, including water conveyance routes). Only the water-compatible uses and the essential infrastructure (as defined in Technical Guidance, Table 2) that has to be there should be permitted in this zone. It should be designed and constructed to: remain operational and safe for users in times of flood; result in no net loss of floodplain storage; not impede water flows; and not increase flood risk elsewhere. The Sequential Test is required and must be passed and for essential infrastructure the Exception Test must be applied and passed also. All development proposals in this zone should be accompanied by a FRA.

The **Environment Agency Wales** flood map is not used for planning purposes (only to provide information on flood risk and to raise awareness). Development advice with respect to flooding is provided by the Welsh Assembly Government (July 2004) Technical Advice Note 15 (TAN15) and the accompanying development advice maps. An interactive map is available from the WAG web site.

The development advice map containing three zones (A, B and C with subdivision into C1 and C2) should be used to trigger the appropriate planning tests.

- Zone A is considered to be at little or no risk of fluvial or tidal/coastal flooding. The justification test (TAN15, Section 6) is not applicable and there is no need to consider flood risk further. This equates to Flood Zone 1 on the Agency maps.
- Zone B is land known to have been flooded in the past evidenced by sedimentary deposits. As part of a precautionary approach site levels should be checked against the extreme (1:1000) flood level. If site levels are greater than the flood levels used to define adjacent extreme flood outline there is no need to consider flood risk further. This land within Flood Zone 1 of the Agency maps but close to Flood Zone 2 or 3.

Zone C is based on the Environment Agency Wales extreme flood outline, equal to or greater than 1:1000 (river, tidal or coastal) and equates to Flood Zones 2 and 3 on the Agency map. Flooding issues should be considered as an integral part of decision making by the application of the justification test (TAN15, Section 6) including assessment of consequences (TAN15, Section 7) is required. Sub-division C1 is land in the floodplain which are developed and served by significant infrastructure, including flood defences. Development can take place subject to application of the justification test, including acceptability of consequences. Sub-division C2 is land in the floodplain without significant flood defence infrastructure. Only less vulnerable development should be considered subject to application of the justification test, including acceptability of consequences. Emergency services and highly vulnerable development should not be considered. The categories of land use are defined in TAN15, Figure 2.

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Appendix D

Trial Pits

STANDARD METHODOLOGY FOR MECHANICAL TRIAL PITTING

Trial pits are mechanically excavated using a wheeled or tracked backhoe or mini-excavator, typically fitted with toothed buckets. The trial pit locations are selected using information on the proposed redevelopment, existing buried services and structures, ongoing site use, reinstatement requirements and time constraints. Those positions are shown on Figure 1 and the trial pit records included as a separate appendix.

Trial pitting was directed and supervised full-time by an experienced engineering geologist who carried out insitu testing, kept a record of the strata encountered, noted the pit side stability and ease of digging, any water ingresses, took photographs and recovered representative disturbed samples.

Insitu testing comprised hand shear vane measurement in appropriate cohesive strata to provide a direct reading of insitu undrained shear strength. Tests were completed from within the pit to depths of approximately 1.2m below ground level and within excavated spoil below this. The hand shear vane is inserted into cohesive soil and rotated at an even speed equivalent to one rotation per 60 seconds. Three tests are typically taken and the average result used as the undrained shear strength in kN/m².

Mexicone penetrometer testing was undertaken either from ground level or at shallow depth within trial pits and the test results are included in the trial pit records. The mexicone penetrometer is a simple, hand-held device which gives a direct read out of equivalent CBR strength, on a cylindrical gauge. Readings are recorded for each 75mm penetration and where suitable soils are present, successive readings up to 0.6m total penetration can be achieved. However, the test can abort on coarse granular soils or other obstructions and in this case the term 'refusal' is given in the test records.

On completion the pits were backfilled with their spoil, compacted with the excavator bucket and the surplus left mounded to allow for subsequent consolidation settlement. If specific reinstatement has been requested by the client, this is confirmed in the main text of this report.

The trial pit records have been prepared using Gint software, taking into account both site descriptions and subsequent laboratory testing.



Trial Pit Log

Trialpit No

TP1

Sheet 1 of 1

Project Name: Down Farm, Purton

Project No.
8830

Co-ords: -
Level:

Date
21/11/2017

Location: Down Farm, The Pry, Purton, Swindon, SN5 4JP

Dimensions (m):

2.4

Depth
1.30

1.2

Scale
1:15

Logged
JH

Client: Mr. F. Cremin

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	ES		0.05			Ash and metal debris (Bonfire remains).
	1.20	ES		1.30			MADE GROUND: (comprising very loosely compact yellow limestone rounded Gravel with minimal silt binder. Occasional bricks. Old empty paint tins. A wooden crate. Metal strips. Pocket of brown/yellow clay in southern and eastern side wall).
							End of pit at 1.30 m

1

2

3

Remarks: Dry.
Pit terminated due to continuous sidewall collapse.
No obvious contamination.

Stability: Continuous side wall collapse.



Trial Pit Log

Trialpit No

TP2

Sheet 1 of 1

Project Name: Down Farm, Purton

Project No.
8830

Co-ords: -
Level:

Date
21/11/2017

Location: Down Farm, The Pry, Purton, Swindon, SN5 4JP

Dimensions
(m):

2.3

Depth
2.50

0.5

Scale
1:15

Logged
JH

Client: Mr. F. Cremin

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.25	ES		0.20			MADE GROUND: (comprising moderately compact grey and brown gravelly Clay. Occasional brick fragments. Piece of metal. Shale cobble).
				0.50			MADE GROUND: (comprising loosely to moderately compact dark brown clayey gravelly Silt. Occasional concrete rubble. Rare yellow-brown clay pockets).
	1.20	ES					MADE GROUND: (comprising loosely compact yellow-brown and brown silty gravelly Clay. Occasional brick rubble).
							Occasional limestone boulders and concrete rubble below 1.5m depth.
	2.40	ES		2.50			End of pit at 2.50 m

Remarks: Dry.
Standpipe to base.
No obvious contamination.

Stability: Minor sidewall collapse.



Trialpit No

TP3

Sheet 1 of 1

Project Name: Down Farm, Purton

Project No.
8830

Co-ords:	-
Level:	

Date
21/11/2017

Location: Down Farm, The Pry, Purton, Swindon, SN5 4JP

Dimensions
(m):

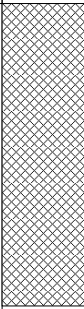
22

Depth
0.60

Scale
1:15

Logged
JH

Client: Mr. F. Cremin

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.40	ES		0.60			MADE GROUND: (comprising moderately compact light brown clayey silty Gravel. Frequent brick and masonry blocks. At base, concrete slab encountered. Pit extended 1.5m east, but did not prove edge of concrete).
							End of pit at 0.60 m

Remarks:	Dry. Pit refused on concrete hardstanding. No obvious contamination.
----------	--

Stability: Vertical and stable.



Trial Pit Log

Trialpit No

TP4

Sheet 1 of 1

Project Name:	Down Farm, Purton	Project No.	8830	Co-ords: -	Level:	Date	21/11/2017
Location:	Down Farm, The Pry, Purton, Swindon, SN5 4JP			Dimensions (m):	1.3	Scale	1:15
Client:	Mr. F. Cremin			Depth	1.00	Logged	JH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.10			MADE GROUND: (comprising compact limestone Gravel in a brown sandy silt binder).	
				0.40			MADE GROUND: (comprising moderately compact yellow-brown silty sandy Gravel. Occasional brick fragments. Locally becoming brown sandy gravelly Clay).	
	0.80	D					Firm to stiff becoming stiff blue-grey becoming grey silty sandy CLAY. Very thin white and light grey banding. Blue plastic water pipe at 0.7m depth along northern pit wall. (WEATHERED OXFORD CLAY)	
	0.90	D						
	1.00	ES		1.00			End of pit at 1.00 m	1
								2
								3

Remarks:	Dry. Footings proven to 0.75m depth. See separate sketch. No obvious contamination.
Stability:	Vertical and stable.



Trial Pit Log

Trialpit No

TP5

Sheet 1 of 1

Project Name: Down Farm, Purton

Project No.
8830

Co-ords: -
Level:

Date
21/11/2017

Location: Down Farm, The Pry, Purton, Swindon, SN5 4JP

Dimensions (m):

1.5

Depth
1.10

0.4

Scale
1:15

Logged
JH

Client: Mr. F. Cremin

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			Grass over TOPSOIL.
	0.40	ES					Firm light brown silty gravelly CLAY. Pocket of yellow-brown clayey Made Ground close behind adjacent masonry wall in northern pit wall alongside a large concrete boulder. (HIGHLY WEATHERED OXFORD CLAY)
				0.60			Stiff becoming very stiff grey mottled orange gravelly CLAY. Occasional limestone cobbles. (WEATHERED OXFORD CLAY)
	1.10	ES		1.10			End of pit at 1.10 m

1

2

3

Remarks: Dry.
Hand-held Shear Vane at 0.8m and 1m refused.
No obvious contamination.

Stability: Vertical and stable.



Intégrale

Understanding Ground Conditions

Trial Pit Log

Trialpit No

TP6

Sheet 1 of 1

Project Name:

Down Farm, Purton

Project No.

8830

Co-ords: -

Level:

Date

21/11/2017

Location:

Down Farm, The Pry, Purton, Swindon, SN5 4JP

Dimensions (m):

1.5

Depth
1.70

0.4

Scale

1:15

Logged
JH

Client:

Mr. F. Cremin

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20			Grass over TOPSOIL.	
	0.30	ES					MADE GROUND: (comprising moderately compact brown clayey gravelly Silt. Occasional concrete blocks and bricks. Plastic strip).	
	0.50	ES		0.45			Firm orange and grey sandy CLAY. (HIGHLY WEATHERED OXFORD CLAY)	
	0.80	D		0.70			Firm light brown mottled orange and grey sandy CLAY. (HIGHLY WEATHERED OXFORD CLAY)	
			HVP=50					1
				1.60			Firm grey sandy CLAY with very thin white and light grey banding and rare orange mottling. (WEATHERED OXFORD CLAY)	
			HVP=50	1.70			End of pit at 1.70 m	
								2
								3

Remarks:

Dry.
Standpipe to base.
No obvious contamination.

Stability:

Vertical and stable.



Trial Pit Log

Trialpit No

TP7

Sheet 1 of 1

Project Name: Down Farm, Purton

Project No.
8830

Co-ords: -
Level:

Date
21/11/2017

Location: Down Farm, The Pry, Purton, Swindon, SN5 4JP

Dimensions
(m):

0.5

Depth
0.60

0.5

Scale
1:15

Logged
JH

Client: Mr. F. Cremin

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	ES		0.15			MADE GROUND: (comprising moderately compact brown silty sandy Gravel).
				0.25			MADE GROUND: (comprising loosely compact red-brown Sand. At 0.25m depth, plastic pipe covering electricity cable trending east-west in southern pit wall). Firm light brown mottled orange sandy CLAY. At base, plastic pipe trending northeast from Workshop B corner. Pit terminated. (HIGHLY WEATHERED OXFORD CLAY)
	0.60	ES		0.60			End of pit at 0.60 m

1

2

3

Remarks: Dry.
Hand dug due to presence of services.
No obvious contamination.

Stability: Vertical and stable.



Trial Pit Log

Trialpit No

TP8

Sheet 1 of 1

Project Name: Down Farm, Purton

Project No.
8830

Co-ords: -
Level:

Date
21/11/2017

Location: Down Farm, The Pry, Purton, Swindon, SN5 4JP

Dimensions
(m):

2.5

Scale
1:15

Client: Mr. F. Cremin

Depth
2.15

0.6

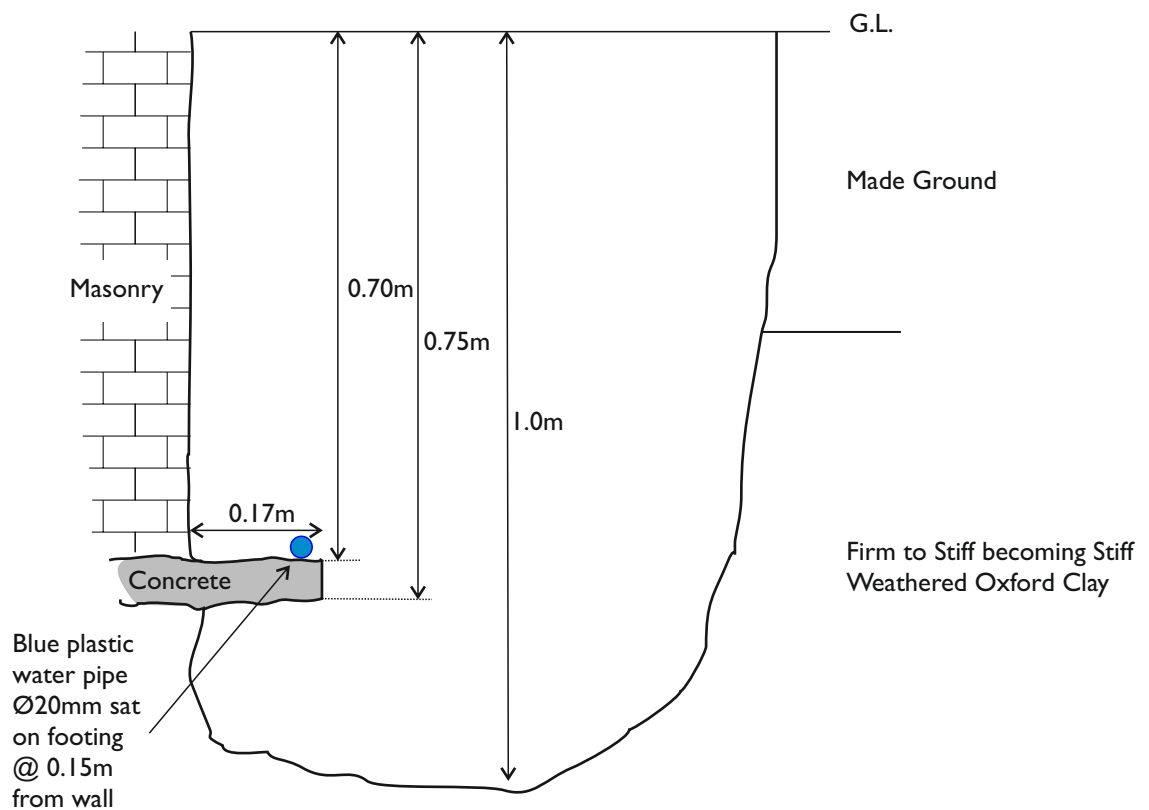
Logged
JH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.10	ES		0.15			MADE GROUND: (comprising well compact dark brown sandy Gravel).
	0.30	ES		0.40			MADE GROUND: (comprising moderately compact yellow and brown gravelly Clay).
				0.50			MADE GROUND: (comprising loosely compact black ashy clayey Silt).
	0.80	ES					MADE GROUND: (comprising moderately compact yellow and brown clayey gravelly Silt. Frequent limestone boulders. Concrete blocks. Bricks. Piece of timber. Plastic sheeting).
				1.20			
▼	1.50	ES					MADE GROUND: (comprising loosely compact dark brown, black and grey slightly sandy Clay. Frequent roots and remains of straw/hay. Small black peat like pockets. Organic odour. Rare half brick. Black plastic sheet).
				2.15			End of pit at 2.15 m

Remarks: Seepage at 1.2m, pooling at base.
Standpipe to base.
No obvious contamination.

Stability: Vertical and stable.

Project Name: Down Farm, The Pry, Purton, Swindon, SN5 4JP	Project No. 8830	Trial Pit Sketch: TP4
Client: Mr F. Cremin	Date Excavated: 21/11/2017	
Logged by: J.H.	Scale: 1:100 @ A4	



To be read in conjunction with full trial pit log.

GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

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Registered Office: The Granary, Chewton Fields, Ston Easton, Somerset, BA3 4BX, United Kingdom
Company Registration No. 2855366 England VAT Reg. No. 609 7402 37

Appendix E

Gas and Groundwater Monitoring

STANDARD METHODOLOGIES FOR STANDPIPE INSTALLATIONS, SAMPLING and MONITORING FOR GAS AND GROUNDWATER

Standpipe Installations in Trial Pits

Simple 30-50mm diameter plastic standpipes are installed in trial pits during backfilling. These consist of slotted pipe throughout the buried length to within 0.5m of the ground surface, with unslotted pipe above. These are capped off with removable stop-ends above ground level. They provide a useful guide to soil gas conditions within the backfilled trial pit, however some soil gas will be lost by dispersal within the loose backfill at the surface of the pit. They are commonly used for monitoring standing groundwater levels which would develop within excavations, however careful consideration has to be given to the possible infiltration of rainfall and throughflow into the sump created by the excavated pit.

Standpipe Installations in Boreholes

Simple standpipes to measure the hydrostatic head of groundwater are formed in boreholes using 50mm diameter pipe. The details of individual installations are provided on borehole records. Typically the lower length is formed in slotted pipe, with the upper 1m unslotted. The annulus between the riser pipe and the borehole wall is filled with clean granular material. Details of any bentonite seals or grouting are given on the borehole records. A removable gas tap is fitted where gas monitoring is required and standpipes typically have a metal access cover concreted in at ground level.

Standpipe piezometers are formed by using a Casagrande type piezometer tip at the base of the pipe, set in a granular response zone of sand or pea gravel. The response zone is isolated from the strata above and below by placing 500mm thick bentonite seals. The remaining annulus above the bentonite seal is filled with a cement bentonite grout or similar.

Groundwater Monitoring & Sampling

Details of return monitoring visits are included in this appendix. Groundwater standing levels are measured by inserting an electrically operated dip meter into the standpipe and recording the level to 2 decimal places, relative to existing ground level. Where groundwater levels are critical to calculation of hydraulic gradients or flow directions, the measurement is taken to 3 decimal places and to a marked point on the standpipe cover. That point is then surveyed and levelled to provide accurate calculations.

Groundwater samples are recovered using either Waterra valves and sample tubing or by manually lifting water from the standpipe using a bailer. For contamination analyses, the boreholes are initially purged by removing up to 3 borehole volumes of water, allowing the rest level to redevelop and taking a sufficient sample into custom containers. If groundwater does not recover sufficiently, the purged water may be used as the sample.

Gas Monitoring

Monitoring is usually completed in standpipes prior to groundwater measurements, using portable instruments. Details are given on the monitoring tables, and typically using a PhoCheck Tiger photoionisation detector to measure volatile organic compounds in ppm and a GA5000 Gas meter to measure oxygen, carbon dioxide and methane, both by % Lower Explosive Limit and % Volume. Atmospheric pressure and temperature are also recorded. Measurements are taken immediately on opening the gas valve and the highest to lowest levels recorded. If levels fluctuate, then this is recorded, with the maximum reading and a more typical or rest level given.



Intégrale

Understanding Ground Conditions

Suite 7, Westway Farm Business Park
Wick Road, Bishop Sutton, Somerset,
BS39 5XP, United Kingdom

Tel: 01275 333036
www.integrale.uk.com

Results of Gas & Groundwater Monitoring Visit No. 1

Site	Down Farm, The Pry, Purton, Swindon, SN5 4JP
Client	Mr F. J. Cremin
Date	29/11/2017

Job No.	8830
Monitored By	AY

Weather	Sunny
Air Temperature	3°C
Atmospheric Pressure (mbar)	1000
Ground Conditions	Damp

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP2	0	0.0	2.0	0.1	0.8	21.4	0.0	-	Dry	-	1.28
	30	0.1									
	60	0.2									
Comments:											
TP6	0	0.1	0.0	0.0	2.3	18.8	0.0	-	Dry	-	1.77
	30	0.1									
	60	0.1									
Comments:											
TP8	0	0.1	0.0	0.0	1.0	20.4	0.0	-	1.47	-	2.02
	30	0.1									
	60	0.1									
Comments:											

Equipment:

Type:	Serial No:	Used:
GA5000	G501893	✓
Tiger PID Gas Detector	T-108427	✓
Solinst Mini Interface Meter	I22 008236-1	✓
Dip Meter		✓

%LEL = Calculated Lower Explosive Limit
Worst case of six readings reported for each position/time

Results of Gas & Groundwater Monitoring Visit No. 2

Site	Down Farm, The Pry, Purton, Swindon, SN5 4JP
Client	Mr F. J. Cremin
Date	6/12/2017

Job No.	8830
Monitored By	AY

Weather	Overcast
Air Temperature	10°C
Atmospheric Pressure (mbar)	1012
Ground Conditions	Damp

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP2	0	0.0	0.0	0.0	2.3	18.8	0.0	None	Dry	-	1.28
	30	0.1									
	60	0.1									
Comments:											
TP6	0	0.1	0.0	0.0	2.9	16.9	0.0	None	Dry	-	1.78
	30	0.2									
	60	0.2									
Comments:											
TP8	0	0.1	0.0	0.0	4.6*	14.0	0.0	None	1.41	-	1.94
	30	0.1									
	60	0.1									
Comments:											
* Initial reading of 4.6%, then steady reading at 1-2%.											

Equipment:

<u>Type:</u>	<u>Serial No:</u>	<u>Used:</u>
GA5000	G501893	✓
Tiger PID Gas Detector	T-108427	✓
Solinst Mini Interface Meter	122 008236-1	✓
Dip Meter		

%LEL = Calculated Lower Explosive Limit
Worst case of six readings reported for each position/time

Results of Gas & Groundwater Monitoring Visit No. 3

Site	Down Farm, The Pry, Purton, Swindon, SN5 4JP
Client	Mr F. J. Cremin
Date	13/12/2017

Job No.	8830
Monitored By	AY

Weather	Dark, clear sky
Air Temperature	3°C
Atmospheric Pressure (mbar)	982
Ground Conditions	Wet

Position ID	Time Elapsed (secs)	Gas Flow (l/hr)	%LEL	Methane (%/vol)	Carbon Dioxide (%/vol)	Oxygen (%/vol)	VOC (ppm)	Depth to Product (mbgl)	Depth to Water (mbgl)	Product Thickness (mm)	Well Depth (mbgl)
TP2	0	0.0	0.0	0.0	2.0	18.4	0.0	None	Dry	-	1.30
	30	0.0									
	60	0.0									
Comments:											
TP6	0	0.1	0.0	0.0	2.7	16.8	0.0	None	1.64	-	1.75
	30	0.0									
	60	0.0									
Comments:											
TP8	0	0.0	0.0	0.0	0.3	17.8	0.0	None	1.08	-	2.00
	30	0.0									
	60	0.0									
Comments:											

Equipment:

<u>Type:</u>	<u>Serial No:</u>	<u>Used:</u>
GA5000	G501893	✓
Tiger PID Gas Detector	T-108427	✓
Solinst Mini Interface Meter	I22 008236-1	✓
Dip Meter		

%LEL = Calculated Lower Explosive Limit
Worst case of six readings reported for each position/time

Appendix F

Results of Geotechnical Laboratory Testing

STANDARD METHODOLOGY FOR GEOTECHNICAL SAMPLING

Soil samples are recovered from trial pits or borehole samples using a stainless steel trowel and immediately placed into airtight plastic tubs or bags, as appropriate for the testing. If required the soil samples may be wrapped in cling film, particularly in suspected desiccated soils. Samples are labelled with the site name, investigation location and depth and placed into either cool boxes or large bulk bags for transit from site. An analytical schedule is drawn up in line with the actual ground conditions proven, proposed site use and likely design parameters.

Samples are sent to a specialist testing laboratory. Testing is completed in line with BS1377 as far as possible and details of the test method and UKAS accreditation are provided by the laboratory on the results sheets in a separate appendix.

Laboratory Test Certificate

Site Down Farm, Purton
Client Integrale Ltd



F.A.O. James Higginson
Address Unit 7
Westway Farm Business Park
Wick RoadWick Road
Bishop Sutton
Somerset
BS39 5XP

Order Number 0035
Job Number AF0062
Lab Number L12665

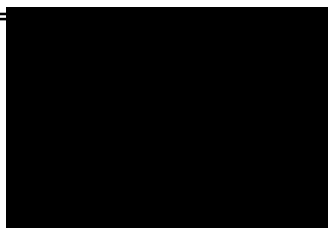
Number of samples submitted for testing:	2	sample (s)
--	---	------------

Natural Water Content	1	test(s)
Atterberg Limits	1	test(s)
BRE SD1 reduced suite	1	test(s)

Date (s) sample (s) received at laboratory:	23	Nov-17
Date of receipt of testing instructions	23	Nov-17
Date testing started:	24	Nov-17
Date of issue:	13	Dec-17

Please note that we will keep the sample (s) for one month after submission of our report and will then dispose of them without notice unless you ask us to store them. We will then make a separate charge for this.

Approved by :
Lorna Logan



[illegible]

Concept Life Sciences

Certificate of Analysis

Hadfield House
Hadfield Street
Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2468

Report Number: 699371-1

Date of Report: 01-Dec-2017

Customer: CJ Associates Ltd
King Road Avenue
Avonmouth
Bristol
BS11 9HF

Customer Contact: Ms Lorna Logan

Customer Job Reference: AF1162 - L12665 - S6633

Customer Site Reference: Down Farm Purton

Date Job Received at Concept: 27-Nov-2017

Date Analysis Started: 27-Nov-2017

Date Analysis Completed: 01-Dec-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual



1549

Report checked
and authorised by :
Aneta Dybek-Echtermeyer
Customer Service Advisor

Issued by :
Aneta Dybek-Echtermeyer
Customer Service Advisor

Concept Reference: 699371 Project Site: Down Farm Purton Customer Reference: AF1162 - L12665 - S6633					
Soil Suite B					
Analysed as Soil					
Concept Reference					699371 001
Customer Sample Reference					TP4 D
Depth					0.80
Date Sampled					23-NOV-2017
Determinand	Method	Test Sample	LOD	Units	
pH	T7	A40			8.4
(Water Soluble) SO4 expressed as SO4	T242	AR	0.01	g/l	<0.01
(Acid Soluble) SO4	T192	AR	0.01	%	0.03
Sulphur (total)	T6	A40	0.01	%	0.02

Index to symbols used in 699371-1

Value	Description
A40	Assisted dried < 40C
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Notes

These samples have been analysed exceeding recommended holding times of 5 days for pH. It is possible therefore that the results provided may be compromised.

Method Index

Value	Description
T242	2:1 Extraction/ICP/OES (TRL 447 T1)
T7	Probe
T192	HCl Extraction/ICP/OES (TRL 447 T2)
T6	ICP/OES

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	Concept References
pH	T7	A40			U	001
(Water Soluble) SO4 expressed as SO4	T242	AR	0.01	g/l	N	001
(Acid Soluble) SO4	T192	AR	0.01	%	N	001
Sulphur (total)	T6	A40	0.01	%	N	001

Appendix G

Results of Contamination Analyses

STANDARD METHODOLOGY FOR CONTAMINATION SAMPLING & SCHEDULING

Soil samples for contamination analyses are recovered from trial pits or borehole samples using a stainless steel trowel and immediately placed into airtight amber glass jars, vials, or plastic tubs, as appropriate for the testing. These samples are labelled with the site name, investigation location and depth and placed into cool boxes for transit from site. Groundwater samples recovered during subsequent monitoring visits are similarly treated.

An analytical schedule is drawn up in line with the desk study findings, guidance given in CLR 8 and any relevant industry information, the actual ground conditions proven and proposed site use.

Samples are sent via overnight courier to the specialist testing laboratory. Testing is scheduled for MCERTS accredited analyses as far as possible and details of the test method are provided by the laboratory on the results sheets in a separate appendix. A standard turnaround of 10 working days is adopted unless otherwise agreed with the client at the time of instruction.



2183

Final Report

Report No.: 17-31430-1

Initial Date of Issue: 01-Dec-2017

Client Integrale Limited

Client Address: Fieldworks Office
Unit 7 Westway Farm Business P
Wick Road
Bishops Sutton
BS39 5XP

Contact(s): James Higginson

Project 8830 Down Farm, Purton

Quotation No.:

Order No.:

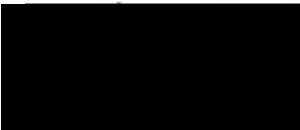
No. of Samples: 12

Turnaround (Wkdays): 5

Date Approved: 30-Nov-2017

Approved By:

Date Received: 24-Nov-2017**Date Instructed:** 24-Nov-2017**Results Due:** 30-Nov-2017

Details:  Robert Monk, Technical Manager

Legend:

W = Exceeds WRAS Guidelines

P = Potentially Phytotoxic

* = Poses a risk to Human Health

Results - Soil

Project: 8830 Down Farm, Purton

Client: Integrale Limited	Chemtest Job No.:				17-31430	17-31430	17-31430	17-31430	17-31430	17-31430	17-31430	17-31430	17-31430
Quotation No.:	Chemtest Sample ID.:				544967	544968	544969	544970	544971	544972	544973	544974	544975
	Client Sample ID.:				TP1	TP1	TP2	TP2	TP3	TP4	TP5	TP7	TP7
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.10	1.20	0.25	1.20	0.40	1.00	1.10	0.10	0.60
	Date Sampled:				21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017
	Asbestos Lab:						COVENTRY	COVENTRY					
Determinand	Accred.	SOP	Units	LOD									
ACM Type	U	2192		N/A			Fibres/Clumps	-					
Asbestos Identification	U	2192	%	0.001			Chrysotile	No Asbestos Detected					
Moisture	N	2030	%	0.020	6.8	7.6	18	17	10	16	14	6.4	14
pH	U	2010		N/A	9.8 W	8.8 W	8.2 W	8.3 W	8.7 W	8.7 W	8.6 W	8.9 W	8.6 W
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	1.8	2.4	0.57	0.70	0.40	< 0.40	< 0.40	0.69	< 0.40
Sulphur (Elemental)	U	2180	mg/kg	1.0	< 1.0	< 1.0	6.1	1.3	< 1.0	20	2.0	< 1.0	< 1.0
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Sulphide (Easily Liberatable)	U	2325	mg/kg	0.50	4.5	5.5	4.7	3.0	3.6	6.5	6.3	9.6	2.6
Sulphate (Total)	U	2430	%	0.010	0.088	0.22	0.13	0.098	0.11	0.032	0.061	0.11	< 0.010
Arsenic	U	2450	mg/kg	1.0	30 W	34 W	34 W	25 W	30 W	9.7	24 W	21 W	8.6
Barium	U	2450	mg/kg	10	49	230	160	35	42	13	16	120	24
Beryllium	U	2450	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	U	2450	mg/kg	0.10	0.18	0.64	0.83	0.16	0.23	< 0.10	0.15	0.40	< 0.10
Chromium	U	2450	mg/kg	1.0	24	31 W	40 W	11	12	10	15	16	7.0
Copper	U	2450	mg/kg	0.50	18	350 P	120	28	17	7.1	11	28	5.6
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	0.52	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	19	13	40	18	17	14	36	16	14
Lead	U	2450	mg/kg	0.50	10	46	190	27	30	9.4	8.9	64	10
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	U	2450	mg/kg	5.0	14	15	38	19	23	14	17	21	11
Zinc	U	2450	mg/kg	0.50	390 P	230	300	54	79	43	170	150	33
Chromium (Trivalent)	N	2490	mg/kg	1.0	24	31	40	11	12	10	15	16	7.0
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	1.6	0.76	4.3	1.2	1.5	0.48	0.47	4.8	< 0.40
Total TPH >C6-C40	U	2670	mg/kg	10			100 W			< 10			< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0				< 1.0	1.5		< 1.0		
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0				< 1.0	55		< 1.0		
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0				< 5.0	56		< 5.0		
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		

Results - Soil

Project: 8830 Down Farm, Purton

Client: Integrale Limited	Chemtest Job No.:				17-31430	17-31430	17-31430	17-31430	17-31430	17-31430	17-31430	17-31430	17-31430
Quotation No.:	Chemtest Sample ID.:				544967	544968	544969	544970	544971	544972	544973	544974	544975
	Client Sample ID.:				TP1	TP1	TP2	TP2	TP3	TP4	TP5	TP7	TP7
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.10	1.20	0.25	1.20	0.40	1.00	1.10	0.10	0.60
	Date Sampled:				21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017	21-Nov-2017
	Asbestos Lab:						COVENTRY	COVENTRY					
Determinand	Accred.	SOP	Units	LOD									
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0				2.0	< 1.0		< 1.0		
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0				40	21		< 1.0		
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0				< 1.0	< 1.0		< 1.0		
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0				42	21		< 5.0		
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0				42	77 W		< 10		
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	0.12	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	2.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	0.28	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	0.81	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	4.5	0.34	< 0.10	< 0.10	< 0.10	0.22	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	0.60	< 0.10	< 0.10	< 0.10	< 0.10	0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	11	0.65	0.24	< 0.10	< 0.10	0.36	0.21
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	11	0.57	< 0.10	< 0.10	< 0.10	0.39	0.20
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	7.1	0.33	< 0.10	< 0.10	< 0.10	0.23	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	8.7	0.13	< 0.10	< 0.10	< 0.10	0.13	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	9.7 *	0.35	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	3.8	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	7.6 *	0.37	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	5.3	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	1.7 *	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	4.8	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0	79 W	2.9	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

Project: 8830 Down Farm, Purton

Client: Integrale Limited	Chemtest Job No.:				17-31430	17-31430	17-31430
Quotation No.:	Chemtest Sample ID.:				544976	544977	544978
	Client Sample ID.:				TP8	TP8	TP8
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				0.10	0.80	1.50
	Date Sampled:				21-Nov-2017	21-Nov-2017	21-Nov-2017
	Asbestos Lab:					COVENTRY	
Determinand	Accred.	SOP	Units	LOD			
ACM Type	U	2192		N/A		-	
Asbestos Identification	U	2192	%	0.001		No Asbestos Detected	
Moisture	N	2030	%	0.020	6.8	13	34
pH	U	2010		N/A	8.8 W	8.4 W	8.4 W
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.51	0.48	2.3
Sulphur (Elemental)	U	2180	mg/kg	1.0	11	35	150
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Sulphide (Easily Liberatable)	U	2325	mg/kg	0.50	26	23	48
Sulphate (Total)	U	2430	%	0.010	0.21	0.14	0.41
Arsenic	U	2450	mg/kg	1.0	22 W	26 W	24 W
Barium	U	2450	mg/kg	10	140	210	83
Beryllium	U	2450	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Cadmium	U	2450	mg/kg	0.10	0.29	0.41	0.49
Chromium	U	2450	mg/kg	1.0	27 W	13	14
Copper	U	2450	mg/kg	0.50	59	12	36
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	25	21	22
Lead	U	2450	mg/kg	0.50	73	28	150
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20
Vanadium	U	2450	mg/kg	5.0	30	23	22
Zinc	U	2450	mg/kg	0.50	82	150	200
Chromium (Trivalent)	N	2490	mg/kg	1.0	27	13	14
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	5.0	2.9	7.8
Total TPH >C6-C40	U	2670	mg/kg	10			
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0		< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0		< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0		< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0		< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0		< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0		< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0		< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0		< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0		< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0		< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0		< 1.0	< 1.0

Project: 8830 Down Farm, Purton

Client: Integrale Limited	Chemtest Job No.:				17-31430	17-31430	17-31430
Quotation No.:	Chemtest Sample ID.:				544976	544977	544978
	Client Sample ID.:				TP8	TP8	TP8
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				0.10	0.80	1.50
	Date Sampled:				21-Nov-2017	21-Nov-2017	21-Nov-2017
	Asbestos Lab:					COVENTRY	
Determinand	Accred.	SOP	Units	LOD			
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0		< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0		6.2	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0		26	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0		2.3	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0		35	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0		35	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	0.13	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	0.63	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	1.6	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	1.3	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	0.46	6.3	< 0.10
Anthracene	U	2700	mg/kg	0.10	0.34	3.2	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	1.0	23	0.66
Pyrene	U	2700	mg/kg	0.10	1.1	24	0.70
Benzo[a]anthracene	U	2700	mg/kg	0.10	0.71	11 *	< 0.10
Chrysene	U	2700	mg/kg	0.10	0.66	12	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	15 *	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	5.4	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	11 *	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	7.3	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	1.8 *	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	6.5	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	4.3	130 W	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N-dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

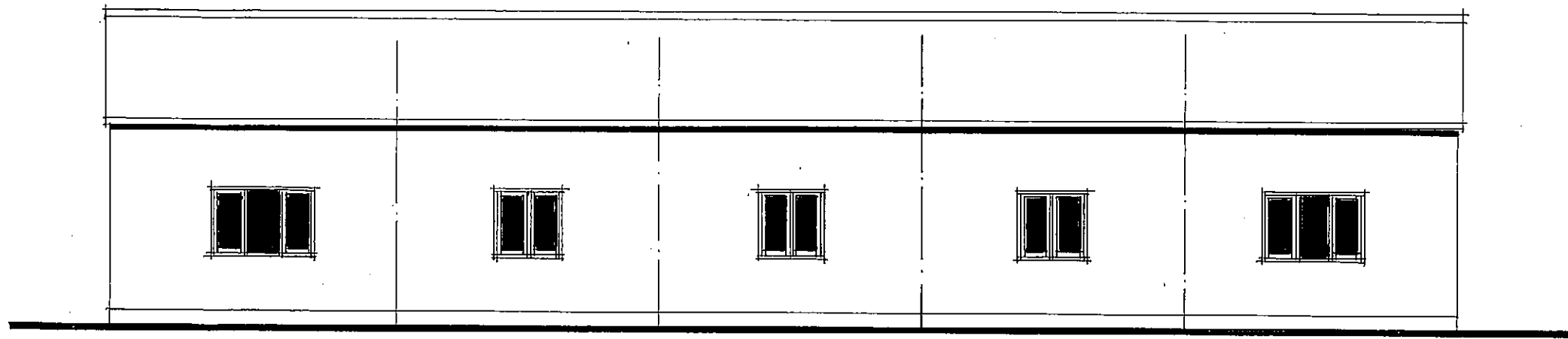
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

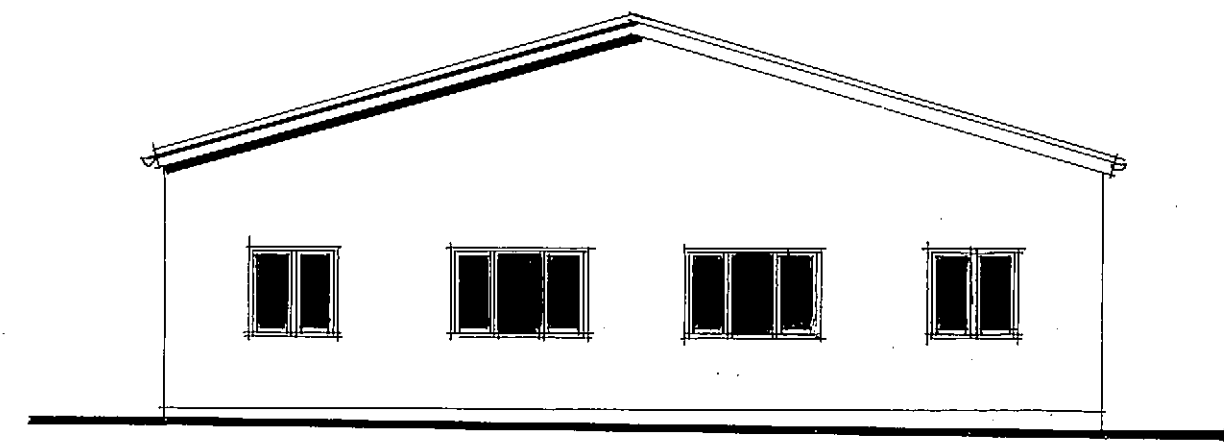
customerservices@chemtest.co.uk

Appendix H

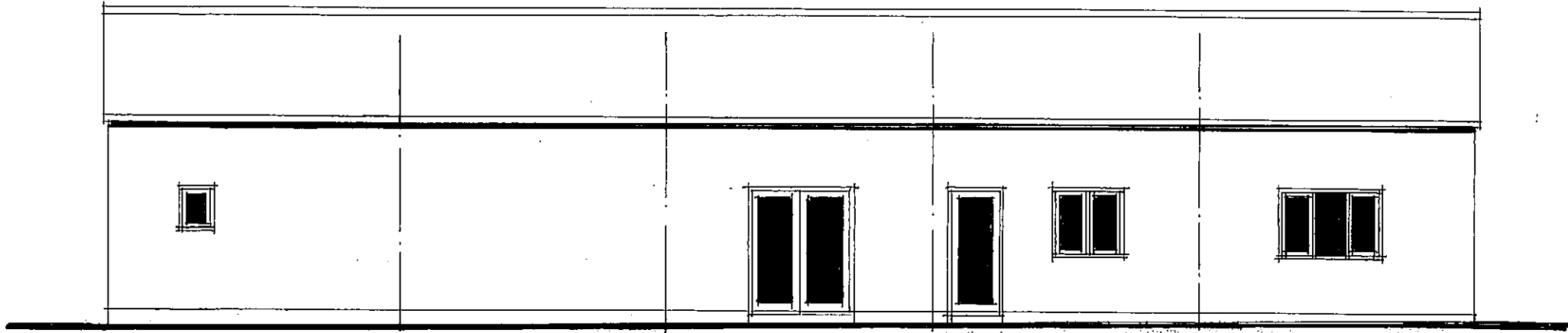
Proposed Redevelopment



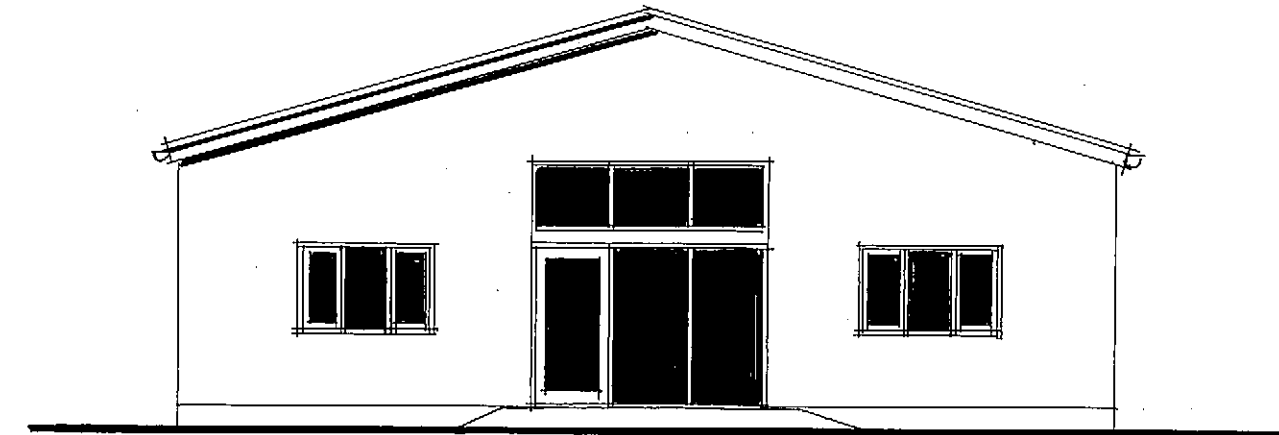
East Elevation



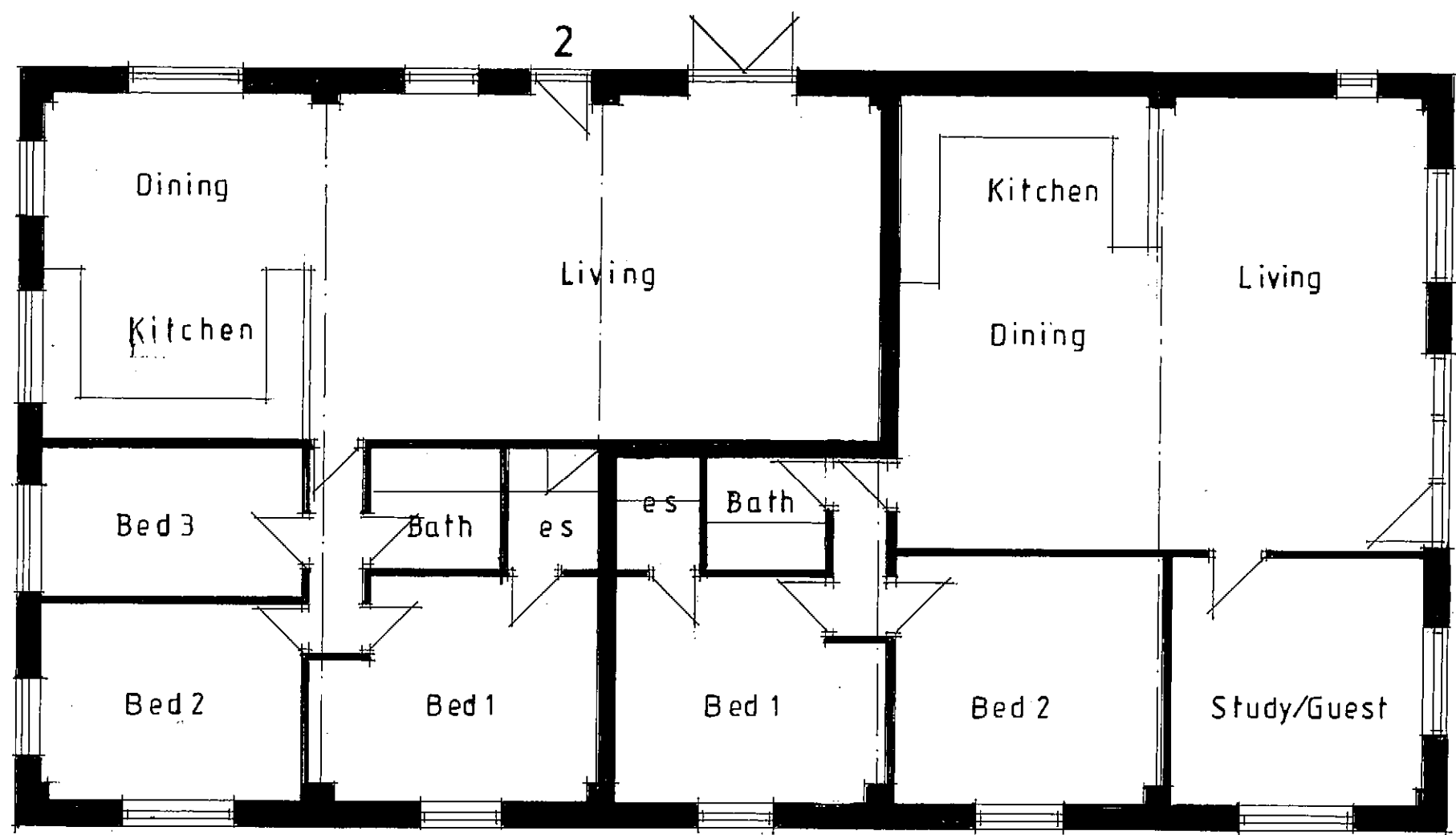
South Elevation



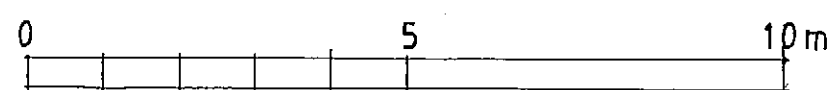
West Elevation



North Elevation



Ground Floor Plan
1:100



Client : Mr Cremin

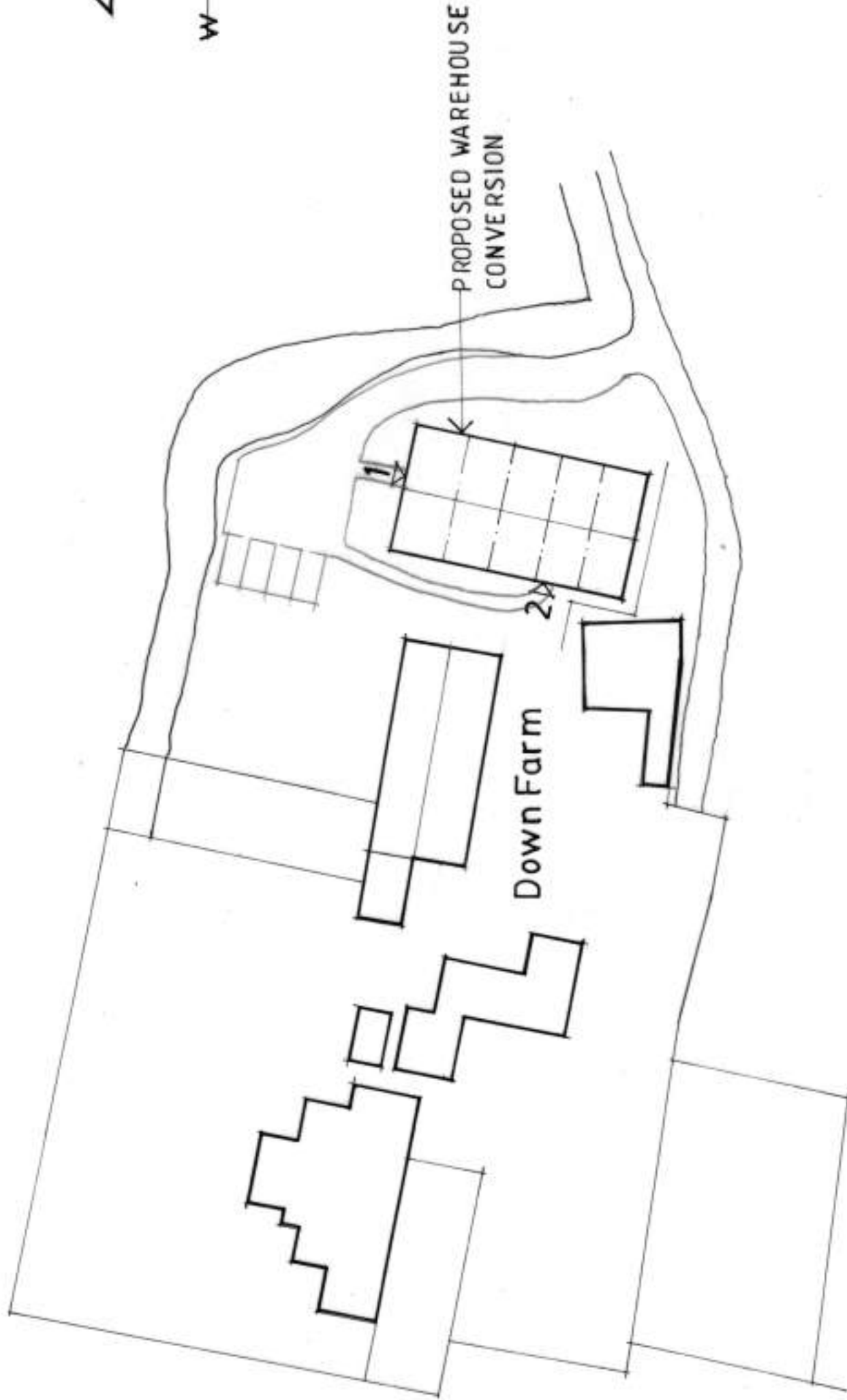
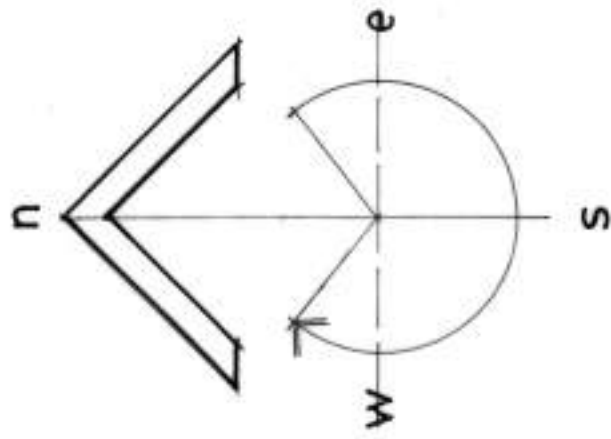
Project : Down Farm
The Pry
Purton

Drawing : SKETCH DESIGN 1
Ground Floor Plan + Elevations

Date : May 2017 Scale : 1:100

Drawing Number : LPC/4166/SD1/2





lpc

Planning Consultants
Tel : 01285 841433

Client : Mr Cremin

Project : Down Farm
The Pry
Purton

Drawing : SKETCH DESIGN 1
Site Layout Plan

Date : May 2017 Scale : 1:500

Drawing Number : LPC/4166/SD1/1

SITE LAYOUT PLAN

1:500

