Snow Capel Farm, Gloucester

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

On behalf of Bromford Homes

April 2022

Issue/Revision	First Issue	Second Issue	Third Issue	Fourth Issue	Fifth Issue	Sixth Issue	Seventh Issue
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1.0 INTRODUCTION

1.1 APPOINTMENT AND BRIEF

1.1.1 Development Design Partnership (DDP) Ltd has been commissioned by Bromford Homes to undertake a site-specific Flood Risk Assessment (FRA) for the proposed residential development at Snow Capel Farm, Gloucester.

1.2 OBJECTIVE OF STUDY

1.2.1 The objective of the study is to undertake an FRA in accordance with *'Chapter 10 – Meeting the Challenge of Climate Change, Flooding & Coastal Change'* of the National Planning Policy Framework published in February 2019.

1.2.2 The study assesses flood risk to:

- The Site and the proposed residential development; and
- Any impact on flood risk to any adjacent land as a result of the development.

1.2.3 Where required, flood risk mitigation measures have been proposed. The report also provides an outline drainage strategy for the foul and surface water flows from the proposed development site.

1.2.4 The report has been prepared to accompany a planning application for 190 dwellings.

1.3 STUDY METHODOLOGY

1.3.1 The appraisal process consisted of a desk study, data research and consultation with the regulatory authorities and third parties. A site review has been undertaken together with a site topographical survey to assess the general topography of the area and to identify any potential flood risk features that could affect the site.

1.3.2 A list of documents referred to, to obtain data in relation to the site and development is given in **APPENDIX A**.

1.3.3 This is an assessment of potential flooding from all possible sources, including fluvial, tidal, surface run-off, overland flows, groundwater, sewers and manmade infrastructure. The assessment also identifies and examines the residual flood risk to the proposed development.

1.4 LIMITATIONS

1.4.1 Confirmation of the foul water sewer capacity is to be undertaken with Severn Trent Water, while surface water discharge rates to be confirmed with LA. A copy of recent correspondence discussing these matters are included within **APPENDIX D**.

2.0 EXISTING SITE

2.1 SITE LOCATION

2.1.1 The site of 7.8ha gross area and is located in agricultural land at Snow Capel, Matson, Gloucester. It has a central Ordnance Survey Grid Reference of SO 851 141 and postcode GL4 6EQ, see **APPENDIX B** for site location plan.

2.2 SITE DESCRIPTION

2.2.1 Table 2.1 describes the general characteristics.

Table 2.1: Characteristics of the site

Area	Approximately 7.8 Hectares, roughly triangular.
General Topography	The development is located to the Southeast of Gloucester, England, Grid reference 385076E, 214223N. The site is currently greenfield and bounded by Winnycroft Lane to the West, M5 to the east. The parcel of land does include a schedule monument in the form of an ancient moat which is being retained.
Existing Surface	Currently grass land, open field.
Site Description	Development of 190 residential dwellings with conventional gardens. The central area around the scheduled monument will be soft landscaping providing a 25m buffer from the buildings. There will be a public open space/noise bund along the south-eastern boundary with the M5 motorway. Currently 100% grass/vegetation.
Boundaries	All four boundaries fence with hedge beyond. Some breaks in hedge on E boundary, framed by fences onto M5 motorway
Access	Access will be provided off Winnycroft Lane along the western boundary, via a loop road around the central public open space

2.2.2 See **APPENDIX C** for the topographical survey of the site.

3.0 EXISTING DRAINAGE

3.1 EXISTING FOUL DRAINAGE

The closest existing foul sewer network to the development is located approx. 200m north of the proposed site entrance at the junction of Winnycroft Lane and Sneedhams Road.

The Severn Trent Water Authority's public Sewer record plan is included in **APPENDIX D**.

3.2 EXISTING SURFACE WATER DRAINAGE

3.2.1 There is a sewer located within the residential area of Sneedhams Road approx. 200m north of the site entrance.

There are no existing surface water sewers on site.

3.3 WATERCOURSES

3.3.1 Small drainage ditch running N-S adjacent to Western site boundary. Water level 54.85m AOD Feb 2017.

Small moat located in the centre of site.

3.4 GEOLOGY AND HYDROGEOLOGY

3.4.1 The developer has carried out site investigation, Tier 2 Water Environment Assessment and Geotechnical and Contamination Report reports: produced by T&P Regen, JBA Consulting and *Intégrale* respectively. Copies of these reports are contained within APPENDIX

3.4.2 The British Geological Map for the site describes the geology as the *'CHARMOUTH MUDSTONE FORMATION - MUDSTONE*'. Further details are contained within **APPENDIX E**.

3.4.3 Hydrogeology information can be found in the annexed report '*ERX-JBAU-XX-XX-RP-Z-0001-S3-P02.docx'* undertaken by JBA Consulting on behalf of Edward Ware Homes. Extracts are listed below, and the full report can be found in **APPENDIX G.**

Aquifer Classification
The geological strata have been assessed for their hydrogeological properties. The Lias Group bedrock strata underlying the site are classified as a Secondary

undifferentiated aquifer. As rocks with essentially no groundwater, the BGS mapping describes the Lias group as comprising a largely mudstone sequence with limestone and marlstone Rock forming local aquifers, yielding small supplies. The Dyrham Formation to the northwest is classified as a Secondary A aquifer, whilst the oolite strata to the south of the site is a Principal Aquifer.

Groundwater Levels and Flows

Given the clayey nature of both the superficial and bedrock strata underlying the Moated Site, it is unlikely that there is hydraulic continuity between the groundwater and the local surface water drainage features.

Topographical control on the groundwater flow direction is likely and is, therefore, anticipated to be in the direction SE to NW locally within the Moated Site, and more broadly towards the north, following the direction of surface water drainage from the site.

This is supported by spot observations of groundwater levels on the Moated Site. From previous ground investigations, groundwater stands at 1.5-2.5 mbgl locally where old drainage ditches or the Moat occur (Intégrale, 2017). It is likely that this groundwater comprises a perched groundwater table within the Made Ground whilst the bedrock groundwater table may occur at some depth (e.g. 5-10 mbgl).

Groundwater was not encountered during drilling by T&P in 2018. Groundwater dip levels were subsequently recorded during gas monitoring visits between 54.8 and 61.9 mAOD.

Saturated ground was encountered during several monitoring visits, with surface water also observed within the moat area. This included some of the monitoring wells being flooded from surface water.

Similarly, groundwater was not encountered during drilling the T&P in December 2020 - January 2021.

3.5 HISTORICAL LAND USES

3.5.1 *Information obtained from the 'Intégrale', GEOTECHNICAL AND PHASE II CONTAMINATION REPORT August 2017* [1] outlines the historical land uses and change of use over the past century:

Historical maps obtained from a Groundsure Report are included in Appendix C. These indicate the following pertinent information:

Map Date	Site Features / Land Use	Adjacent Features (distance from site)
1883	Site composed of 3 fields. Moat in centre. Footpath running SW to NE.	Site set in agricultural land. Snow Caple farm adjacent to SW.
1884-1901	Footpath running parallel to N boundary.	-
1903-1923	As previous.	Track/road runs N-S adjacent to W boundary.
1924 - 1955	As previous.	Rifle Range 200m S.
1966-1971	As previous.	Motorway constructed adjacent to E boundary in cutting.
1974-1975	Footpath running SW to NE no longer marked.	-
1994-2014	Field boundaries removed	-

For further information and detailed maps please refer to Appendix C of the *'GEOTECHNICAL AND PHASE II CONTAMINATION REPORT August 2017 which is within **APPENDIX G** of this FRA document.*

3.6 HISTORICAL FLOOD RECORDS

3.6.1 No historical flood maps have been recovered**.**

3.7 FLOOD MAPPING

3.7.1 Inspection of the EA Flood Zone Maps indicates that the proposed development site is currently located within Flood Zone 1 (Low Probability). This is land designated as having a less than 0.1% annual probability of flooding from rivers or the sea in any year (less than a 1 in 1000 annual probability of flooding).

3.7.2 Refer to **APPENDIX F** for flood zone maps.

3.7.3 Flood zone designations ignore the presence of any flood defences and only consider flooding from fluvial and tidal sources.

3.7.4 The EA have stated that the flood maps provide a general estimate of the likelihood of flooding from rivers.

3.8 SITE WALKOVER/OBSERVATIONS

3.8.1 The following key observations were made on the site location:

No buildings were observed within the site area.

No significant quantities of fly-tipped materials and no areas of burnt ground were observed across the site area.

No potential asbestos containing materials (ACM's) have been observed on site.

Site covered in grass and wildflowers. Small copes of trees by Moat.

Small drainage ditch running N-S adjacent to W site boundary.

Moat located in the centre of site.

3.8.2 The development is located to the Southeast of Gloucester, England, Grid reference 385076E, 214223N. The site is currently greenfield and bounded by Winnycroft Lane to the West, M5 to the east. The parcel of land does include a schedule monument in the form of an ancient moat which is being retained.

4.0 PROPOSED DEVELOPMENT

4.1 DESCRIPTION

4.1.1 The proposed development of 7.8Ha in total area is to be serviced from a single access point off Winnycroft Lane. The proposal comprises 190 dwellings with associated roads, sewers, garages and private driveways.

4.1.2 It is proposed to maintain the existing boundary landscape features. The site falls from a high point of around 60.8m on the western boundary to 54.70m in the north wester corner at a grade of around 1 in 51.

APPENDIX J contains a preliminary layout for the proposed development while **APPENDIX L** illustrates the proposed surface and foul water drainage strategies.

5.0 PLANNING & POLICY CONTEXT

5.1 NATIONAL POLICY

5.1.1 NPPF Paragraph 163/164 sets out the requirements to assess Flood Risk and indicates when a site-specific FRA is required:

> *"When determining any planning applications, local authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that: a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location; b) the development is appropriately flood resistant and resilient; c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate; d) any residual risk can be safely managed; and e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."*
>
> *"Applications for some minor development and changes of use[51] should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote [50]."*
>
> *Footnote [50]: "A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use."*

5.1.2 Details of the definitions of the flood zones can be found in **APPENDIX F**

5.1.3 In Flood Zone 1, developers and regulatory authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of development and through the appropriate application of SUDS techniques as discussed in NPPF February 2019.

5.2 REGIONAL/LOCAL POLICY

5.2.1 Gloucester City Council undertook a '*SUB33 Land at Snow Capel Farm Site Historic Environment Assessments for Strategic Assessment of Land Availability (SALA)*' in March 2015 a copy of which is within **APPENDIX K.**

5.3 THE SEQUENTIAL TEST

5.3.1 As previously identified in Section 3.7, the proposed Snow Capel Development Site is located within Flood Zone 1 (low risk). Therefore, no sequential test is required.

5.4 STRATEGIC FLOOD RISK ASSESSMENT

5.4.1 The proposed development site is located within Flood Zone 1 (low risk) therefore no further mitigation is required.

5.4.2 *'Local Flood Risk Management Strategy Main Document Summer 2014'* can be found in **APPENDIX H** for further information.

6.0 ASSESSMENT OF POTENTIAL SOURCES OF FLOODING TO:

6.1 DEVELOPMENT SITE

6.1.1 This chapter identifies, assesses and quantifies (as far as practicably possible), potential sources and mechanisms which are assessed to determine their flood risk and where possible a statement given stating the considered level of risk – negligible, low or significant.

6.2 FLUVIAL

6.2.1 The site lies within Flood Zone 1 and is not directly adjacent to a known watercourse.

6.3 TIDAL

6.3.1 The site lies within Flood Zone 1 and is not near the coast or tidal estuary. It is many metres above sea level. Consequently, there is a negligible risk of flooding from coastal sources.

6.4 OVERLAND FLOWS AND FLOODING FROM LAND

6.4.1 The site slopes generally from the high point in the eastern most part of the site to the west and southern boundaries. Flows from the higher eastern catchment of the development are to contribute to water level within the moat, mimicking existing site conditions.

6.5 GROUNDWATER

6.5.1 Groundwater information can be found in the annexed report '*ERX-JBAU-XX-XX-RP-Z-0001-S3-P02.docx'* undertaken by JBA Consulting on behalf of Edward Ware Homes. Extracts are listed below, and the full report can be found in **APPENDIX G.**

Groundwater Levels and Flows
Given the clayey nature of both the superficial and bedrock strata underlying the Moated Site, it is unlikely that there is hydraulic continuity between the groundwater and the local surface water drainage features.

Topographical control on the groundwater flow direction is likely and is, therefore, anticipated to be in the direction SE to NW locally within the Moated Site, and more broadly towards the north, following the direction of surface water drainage from the site.

This is supported by spot observations of groundwater levels on the Moated Site. From previous ground investigations, groundwater stands at 1.5-2.5 mbgl locally where old drainage ditches or the Moat occur (Intégrale, 2017). It is likely that this groundwater comprises a perched groundwater table within the Made Ground whilst the bedrock groundwater table may occur at some depth (e.g. 5-10 mbgl).

Groundwater was not encountered during drilling by T&P in 2018. Groundwater dip levels were subsequently recorded during gas monitoring visits between 54.8 and 61.9 mAOD.

Saturated ground was encountered during several monitoring visits, with surface water also observed within the moat area. This included some of the monitoring wells being flooded from surface water.

Similarly, groundwater was not encountered during drilling the T&P in December 2020 - January 2021.

6.6 FLOODING AND DRAINAGE

6.6.1 There is minimal potential for flooding from existing surface water. There is an existing small drainage ditch on site running N-S adjacent to W site. There is also an existing moat feature to remain in situ and have a development standoff to allow maintenance procedures.

6.6.2 Copies of the Environmental Agency and LA [1] Flood Maps for Snow Capel can be found in **APPENDIX F**

(1) Open Government Licence (nationalarchives.gov.uk)

6.6.3 Severn Trent Water Authority's Sewer records are included in **APPENDIX D** for information.

6.7 CANALS, RESERVOIRS AND OTHER INFRASTRUCTURE

6.7.1 There are no reservoirs and other such infrastructure in the vicinity.

7.0 PROPOSED DEVELOPMENT AND FLOOD RISK MANAGEMENT

7.1 FLUVIAL

7.1.1 The fluvial risk to the development is low.

7.2 TIDAL

7.2.1 There is no Tidal flood risk; therefore, flood risk mitigation is not required.

7.3 OVERLAND FLOW

7.3.1 Having examined the local topography, the risk of overland flow and flooding from adjacent land is negligible.

7.4 GROUNDWATER

7.4.1 Please refer to 6.5.1 above.

7.5 FLOODING FROM SEWERS AND DRAINS

7.5.1 The potential for flooding from existing surface water sewers is low.

7.6 OUTLINE DRAINAGE STRATEGY

Sustainable Drainage Systems.

7.6.1 All developments present an opportunity to incorporate sustainable surface water drainage systems, which might include infiltration techniques or attenuation of flows to protect receiving sewers or watercourses. The choice of methods is dependent upon ground conditions and availability of suitable areas within the particular scheme layout.

7.6.2 The development proposals will incorporate sustainable drainage solutions to dispose of surface water runoff. The guidance given in the CIRIA report C697 “The SUDS Manual” will be followed during the detailed design of the proposed sustainable drainage solution. Runoff will be managed both at source and across the Site as a whole. SUDS will incorporate pollution control facilities to improve water quality.

7.6.3 Requirement H3 Part 3 of the Building Regulations Approved Document H (2010 Edition) states:

(3) Rainwater from a system provided pursuant to sub-paragraphs (1) and (2) should discharge to one of the following listed in order of priority:

(a) An adequate soakaway or some adequate infiltration system; or, where this is not reasonably practicable,

(b) A watercourse; or where this is not reasonably practicable,

(c) A sewer.

7.6.4 This development presents an opportunity to incorporate sustainable surface water drainage systems to employ SUDS techniques to accommodate both highway and domestic surface water by the use of domestic soakaways sited in gardens, highway/domestic soakaways located in areas of open space or permeable paving where appropriate.

7.6.5 The site investigation also provides evidence of ground water levels recorded during gas monitoring undertaken between December 2017 and February 2018. Table 3 within the T&P Regen Supplementary Ground Gas Risk Assessment dated 21st March 2018 confirms ground water between 54.8m and 61.9m AOD, this translates to being as shallow as 100mm below existing ground level. In accordance with best practice design any soakaway features is required to be a minimum of 1m above the existing water table. Based on the high ground water and the nature of the soils experienced on site it therefore unfeasible to discharge the surface water via infiltration.

7.6.6 A new surface water drainage network will be required to service the new development.

T&P Regen have undertaken a ground investigation which demonstrated the development is underlain by clay soils which are unlikely to prove favourable for utilising infiltration techniques as a method of discharging development runoff.

Due to the unfavourable clay soils the proposal for the proposed development is to convey surface water runoff to the ditch network sited along the western boundary along with the onsite moat where levels allow.

The development is intended to be split into two catchments with the Eastern parcel draining to the existing onsite moat, with all remining areas unable to drain to the moat by gravity to drain to an existing ditch alongside Winnycroft Lane at the development low point in the north-western corner of the development.
It is intended to restrict all future runoff from the development to existing greenfield runoff rates.

The existing Moat within the centre of site is to remain in situ with contributing flows in line with existing conditions. Discussions around the agreement with the LA that the moat is an acceptable point of discharge with STW can be found in **APPENDIX D**.

The runoff has been calculated utilising IH 124 methods with the development to be restricted to a Qbar rate of 3.414l/s/ha.

The network discharging into the moat will be limited to 11.6l/s whilst the western catchment to the ditch being restricted to 9.6l/s.

The surface water drainage network is to be designed to accommodate the required attenuation volumes generated by the restricted rates up to and including the 1 in 100 year event. The 1 in 100 year event will also include a factor of 40% for climate change.

All surface water apparatus beyond the curtilage of a single dwelling is intended to be offered for adoption by Severn Trent Water under a Section 104 agreement. It is the designs intention to offer storage up to the 1 in 30 year event for adoption by STW with the additional volume required to accommodate the 1 in 100 year event will be maintained by a management company.

7.6.7 Please refer to **APPENDIX L** for the drainage strategy plan and report.

7.6.8 A new foul water drainage network will be required to service the new development. The new network will collect and convey foul water discharge from the development to a connection point on the existing Severn Trent Water network. The proposed drainage strategy is included in the appendix. Current proposals are for a point of connection into STW manhole SO85140505 which is located within the junction of Winnycroft Lane and Sneedhams Road to the north of the development.

Based on a development of 190 units SSG's Design and Construction Guidance recommends a peak flow rate of 4,000l/day/unit dwelling for residential uses. On this basis an anticipated peak flow rate of 8.79l/s will be generated by the development.

Severn Trent Water have previously confirmed that the existing public sewerage network in the vicinity of the site currently has sufficient capacity to accommodate the additional flows from the new development. Capacity will need to be reconfirmed prior to commencement of the development.

All foul water apparatus beyond the curtilage of a single dwelling is intended to be offered for adoption by Severn Trent Water under a Section 104 agreement.

7.6.9 Severn Trent Water have confirmed the existing drainage network has the capacity to accommodate the proposed development.

7.6.10 In order to outfall the development to the existing STW system the sewer design is at minimum grade, however there is a potential clash with existing services. This has been discussed with STW and an agreement in principle has been provided in relation to including a siphon at the clash location(s). The correspondence in relation to this can be found in **APPENDIX D**.

7.7 RESIDUAL FLOOD RISK

7.7.1 The main residual flood risks for the proposed development are rainfall events greater than the design criteria and blockages in the existing and proposed drainage systems.

The development site will have in place a surface water maintenance schedule, in conjunction with other riparian owners' obligations to keep the watercourse clear within their boundaries, to prevent the culverts from blocking. A copy of the Suds Maintenance Requirements can be found in **APPENDIX M**.

7.7.2 Site levels have been designed to ensure that any resulting overland flow will run within POS, driveways and road corridors allowing drainage to avoid property flooding. The surface water drainage has also been designed in three catchments; this is to be able to mimic existing conditions where the moat is to be contributed to by the same proportion of the site as pre-development.

7.7.3 Taking in to account the above information the residual flood risk is therefore considered to be low.

8.0 CONCLUSIONS

8.1.1 This report demonstrates that the proposed development site is at negligible risk of flooding from all sewers and water courses within close proximity of the site.

8.1.2 No mitigation measures are required, with no impact on flood risk to other land provided that the site levels are carefully designed.

8.1.3 Access and egress through the site of the proposed development can be provided safely with no significant residual flood risk to the site or surrounding areas.

8.1.4 Surface water from the proposed development is intended to discharge to the existing surface water ditch, for storms up to and including the 100-year event plus 40% allowance for future climate change and urban creep.

8.1.5 Flows will be maintained to Greenfield runoff rate, Q Bar, for all return period storms up to 100-year events plus 40% for climate change. This ensures that the proposed development is reducing flood risk to the downstream catchment.

8.1.6 The required attenuation storage will be provided within cellular storage located within the development site.

8.1.7 Foul water from the proposed development will discharge into the existing public foul sewer at the junction of Winnycroft Lane and Sneedhams Road as agreed with the local Water Authority.

Appendix A

List of Documents

APPENDIX A - LIST OF DOCUMENTS

APPENDIX B	-	Site Location Plan
APPENDIX C	-	Topographical Survey
APPENDIX D	-	Severn Trent Sewer Records
APPENDIX E	-	Geology Maps and Key/Descriptions
APPENDIX F	-	Environmental Agency and LA Flood Maps for Snow Capel
APPENDIX G	-	Ground/Site Investigation Reports: - *Site Investigation* - Tier 2 Water Environment Assessment - Geotechnical and Contamination
APPENDIX H	-	Gloucestershire County Council Local Flood Risk Management Strategy Main Document (Summer 2014)
APPENDIX I	-	Greenfield Run Off Calculation Sheet
APPENDIX J	-	Drawing '3250-O3S-ZZ-XX-GA-A-0030-ProposedSitePlan-S0-P16'
APPENDIX K	-	*SUB33 Land at Snow Capel Farm Site Historic Environment Assessments for Strategic Assessment of Land Availability (SALA)*'
APPENDIX L	-	Drainage Strategy
APPENDIX M	-	Suds Maintenance Requirements

Appendix B

Site Location Plan

— Site Boundary

Base Map
Company: - Autodesk License
DWG Title: -
DWG Number: -
Date: -

-	-	-	-	-
Drawn	Checked	Amendment	Date	Rev.

Client
Edward Ware Homes

Project
Snow Capel

Title
Site Location Plan

T&P

Unit 4 Brunel Lock Development, Smeaton Road, Bristol, BS1 6SE

[redacted]

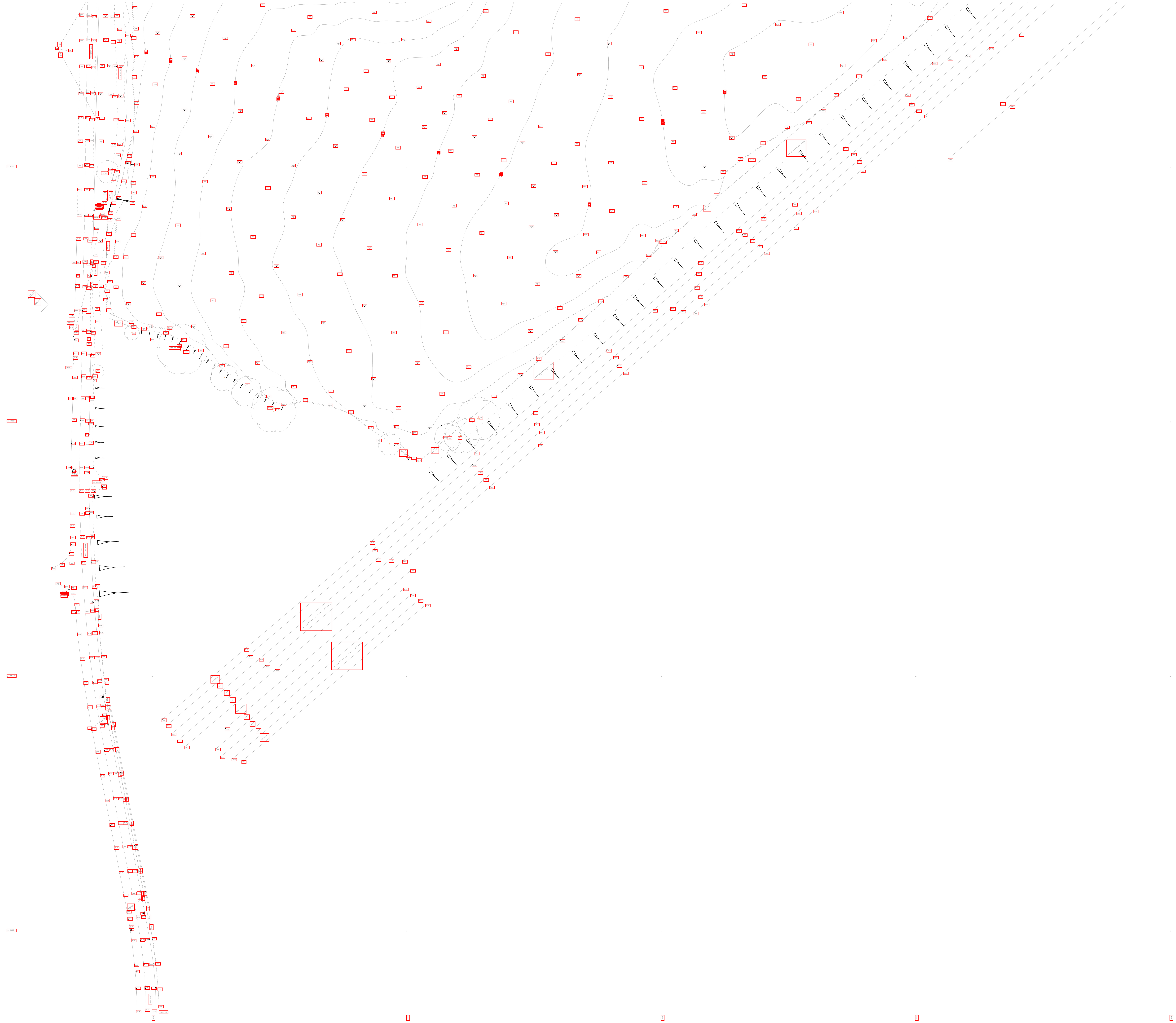
Scale	Date	Drawn by	Check by	Rev.	Drawing No.
1:5000@A3	12/11/20	AW	SH	-	P0274-01-002

0 125 250m

Scaled in Metres

Appendix C

Topographical Survey



CLIENT:–

EDWARD WARE HOMES

DRAWING:–

170308/1

SNOW CAPEL

GLOUCESTER

MARCH 2017

ABBREVIATIONS:–

BOL	BOLLARD	LP	LAMP POST
BT	BT SERVICE COVER	MH	MANHOLE
C/B	CLOSE BOARDED FENCE	MKR	MARKER
CL	COVER LEVEL	OHW	OVERHEAD WIRE
C/L	CHAIN LINK FENCE	P/R	POST & RAIL FENCE
CPS	CONCRETE PAVING SLABS	P/W	POST & WIRE FENCE
EP	ELECTRICITY POLE	RE	RODDING EYE
FL	FLOOR LEVEL	RG	ROAD GULLY
FH	FIRE HYDRANT	RS	ROAD SIGN
IC	INSPECTION CHAMBER	R/W	RETAINING WALL
IL	INVERT LEVEL	ST	STOP TAP
KO	KERB OUTLET	TCB	TELEPHONE CALL BOX
		TL	THRESHOLD LEVEL
		TP	TELEGRAPH POLE

LEGEND:–

BUILDING
KERB LINE
EDGE OF ROAD
PATH/CHANGE OF SURFACE
ROAD MARKINGS
WALL
VEGETATION
FENCE
BANK
OHW (ELEC)
OHW (BT)

N

LEVELS RELATIVE TO ORDNANCE DATUM
VIA GPS OBSERVATION
HEIGHTS ARE IN METRES

GRID IS UKNG BASED

K.J. HALL SURVEYORS LTD
22 Bower Hinton MARTOCK Somerset TA12 6JY
[redacted]


CLIENT:-
EDWARD WARE HOMES
DRAWING:-
170308/1
SNOW CAPEL
GLOUCESTER
MARCH 2017
ABBREVIATIONS:-
BOL BOLLARD
BT BT SERVICE COVER
C/B CLOSE BOARDED FENCE
CL COVER LEVEL
C/L CHAIN LINK FENCE
CPS CONCRETE PAVING SLABS
EP ELECTRICITY POLE
FL FLOOR LEVEL
FH FIRE HYDRANT
IC INSPECTION CHAMBER
IL INVERT LEVEL
KO KERB OUTLET
LP LAMP POST
MH MANHOLE
MKR MARKER
OHW OVERHEAD WIRE
P/R POST & RAIL FENCE
P/W POST & WIRE FENCE
RE RODDING EYE
RG ROAD GULLY
RS ROAD SIGN
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KERB LINE
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VEGETATION
FENCE
BANK
OHW (ELEC)
OHW (BT)
N
LEVELS RELATIVE TO
ORDNANCE DATUM
VIA GPS OBSERVATION
HEIGHTS ARE IN METRES
GRID IS UKNG BASED
[redacted]

Appendix D

Severn Trent Sewer Records

03 MAY 2017

SEVERN TRENT WATER

SEVERN TRENT WATER Ltd
Asset Data Management
GISmapping Team
PO Box 5344
Coventry
CV3 9FT

[redacted]

Our Ref: 01415

02 May 2017

<u>Apparatus Location Enquiry</u>

Further to your enquiry re: Snow Capel, Winnycroft Lane, Matson, Gloucester GL4 6EL
(Your ref: 602248-Snow Capel)

Enclosed is a copy of the plans showing the approximate positions of the **public sewers and water mains** situated within the vicinity of the land/property which is the subject of your enquiry.

There are NO sewer assets situated within tiles: SO8414SE, SO8514SW & SO8413NE.

There are NO water or sewer assets situated within tile: SO8513NW.

Asset Data Management can only provide plans of the location of the Company's underground assets. Therefore service pipes and drains are the responsibility of the property owner and should be anticipated during any excavation.

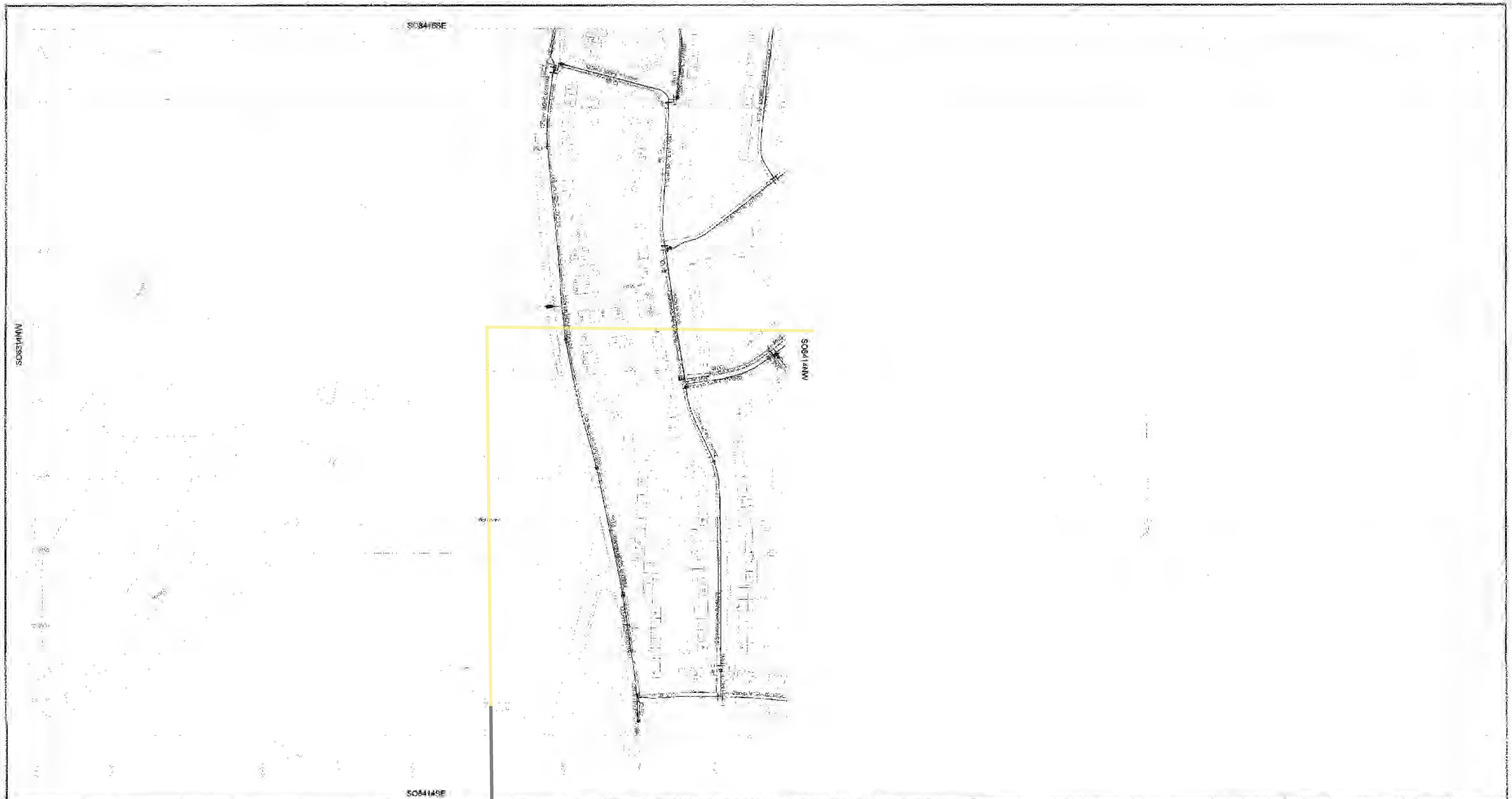
However, we wish to inform you that although most private lateral drains and sewers were transferred to Severn Trent Water's ownership on 1st October 2011, the Company does not possess complete records of these assets and therefore they may not be shown on these maps.

Please also find enclosed a copy of Severn Trent Water's General Conditions and Precautions for your information.

Please forward VAT receipt to your finance department.

Kind Regards
<u>GISmapping Team</u>

Enquiry received
GISmapping:
02 May 2017



Distribution Main	Pumping Facility	Water Isolation Valve (Closed)
Trunk Main (local/primary)	Booster Facility	Water Isolation Valve (Open)
Strategic Main	Potable Water Storage	Water Isolation Valve (Partially Open)
Fire Supply Main	Water Tower	Water Air Valve
[illegible] Main	Well / Borehole	Pressure Reducing Valve
Non-Domestic Customer Service Pipe	Intake	Pressure Sustaining Valve
Domestic Customer Service Pipe	Water Treatment Works / Chamber	Non-Return Valve
Abandoned Main	Draw-off Tower	Float Valve
Elevated Main	Service Point	Hydrant (Single/Double)
Aqueduct	Water Facility Connection	Washout (Single/Double)
Duct		Bulk Meter
Cable: Earthing		Water Hatch Box
Cable: Optical Fibre/Instrumentation		Pressure Tapping
Cable: Low Voltage		Insertion Flow Meter Point
Cable: High Voltage		
Cable: Other		

Water Chemical Injection Point	Housing, Building
Mobile Water Point	Housing, Kiosk
Quality Sample Point	Housing, Other
Change in Characteristic	Pipe Support Structure
Marker Post	Open Pipe
Cable Junction	Discharge
Anode	End Cap
Boundary Box	SSSI Area
Stop tap	Access Rights
Cross Plate	Pre 1989 / Properties
Strainer	
Listening Post	
Reference Meter	

MATERIALS

LINING

[redacted]

WATER MAINS RECORD (TILE)

O/S Map scale: 1:1250

Date of issue: 02.05.17

SO8414NE

Distribution Main
Trunk Main (bulk/primary)
Strategic Main
Fire Supply Main
Fire Main
Non-Domestic Customer Service Pipe
Domestic Customer Service Pipe
Abandoned Main
Elevated Main
Aqueduct
Duct
Cable, Earthing
Cable, Optical Fibre/Instrumentation
Cable, Low Voltage
Cable, High Voltage
Cable, Other

Pumping Facility
Booster Facility
Potable Water Storage
Water Tower
Well / Borehole
Intake
Water Treatment Works / Chamber
Draw-off Tower
Bowser Point
Water Facility Connection

Water Isolation Valve (Closed)
Water Isolation Valve (Open)
Water Isolation Valve (Partially Open)
Water Air Valve
Pressure Reducing Valve
Pressure Sustaining Valve
Non-Return Valve
Float Valve
Hydrant (Single/Double)
Washout (Single/Double)
Bulk Meter
Water Meter Box
Pressure Tapping
Insertion Flow Meter Point

Water Chemical Injection Point
Motive Water Point
Quality Sample Point
Change in Characteristic
Marker Post
Cable Junction
Anode
Boundary Box
Ferrule
Cross Rates
Strainer
Listening Point
Reservoir Main

Housing, Building
Housing, Kiosk
Housing, Other
Pipe Support Structure
Open Pipe
Discharge
End Cap
SSSI Area
Access Point
Pre-1937 Properties

MATERIALS

LINING

N
W
E
S

Severn Trent Water Limited
Asset Data Management
PO Box 4144
Coventry
[redacted]

WATER MAINS RECORD (TILE)

O/S Map scale: 1:1250
Date of issue: 02.05/17

This map is centred upon
O / S Tile reference:
SO8514NW

Disclaimer Statement

1. Do not scale off this Map

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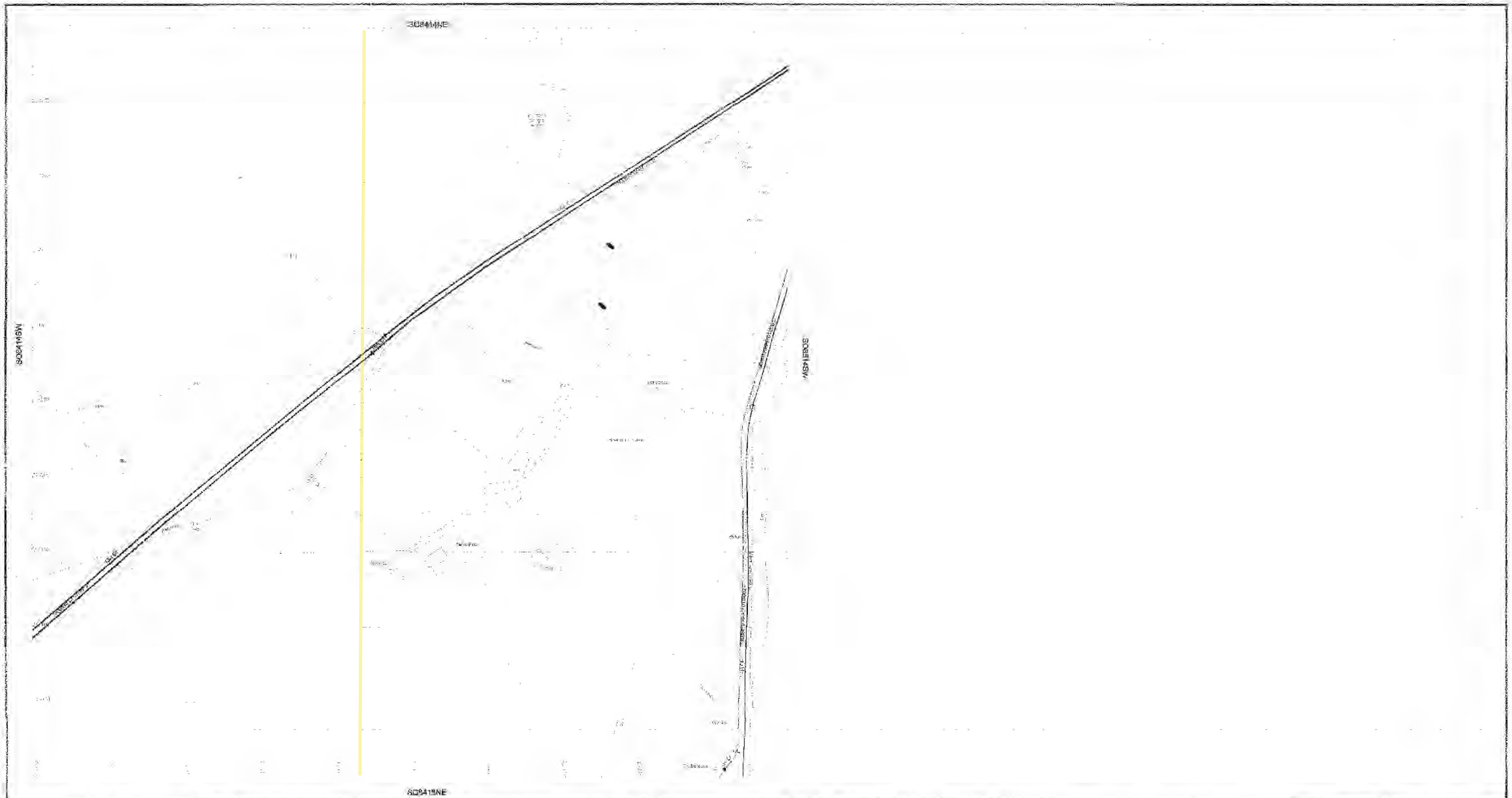

Distribution Main
Trunk Main (local/primary)
Strategic Main
Fire Supply Main
Fire Main
Non-Domestic Customer Service Pipe
Domestic Customer Service Pipe
Abandoned Main
Elevated Main
Aqueduct
Duct
Cable: Earthing
Cable: Optical Fibre/Instrumentation
Cable: Low Voltage
Cable: High Voltage
Cable: Other

Pumping Facility
Booster Facility
Potable Water Storage
Water Tower
Well / Borehole
Intake
Water Treatment Works / Chamber
Drawoff Tower
Bowser Point
Water Facility Connection

Water Isolation Valve (Closed)
Water Isolation Valve (Open)
Water Isolation Valve (Partially Open)
Water Air Valve
Pressure Reducing Valve
Pressure Sustaining Valve
Non-Return Valve
Float Valve
Hydrant (Single/Double)
Washout (Single/Double)
Bulk Meter
Meter / Hatch Box
Pressure Tapping
Insertion Flowmeter Point

Water Chemical Injection Point
Marine Water Point
Quality Sample Point
Change In Characteristic
Marker Post
Cable Junction
Anode
Boundary Box
Stop tap
Cross Piece
Strainer
Indicator Post
Revenue Meter

Housing, Building
Housing, Kiosk
Housing, Other
Pipe Support Structure
Open Pipe
Discharge
End Cap
Stand Area
Access Right
Pre-1900 Properties

MATERIALS

LINING

N
W
E
S

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
[redacted]

WATER MAINS RECORD (TILE)

O/S Map scale: 1:1250

Date of issue: 02.06.17

This map is centred upon:
O/S Tile reference:

SO8414SE

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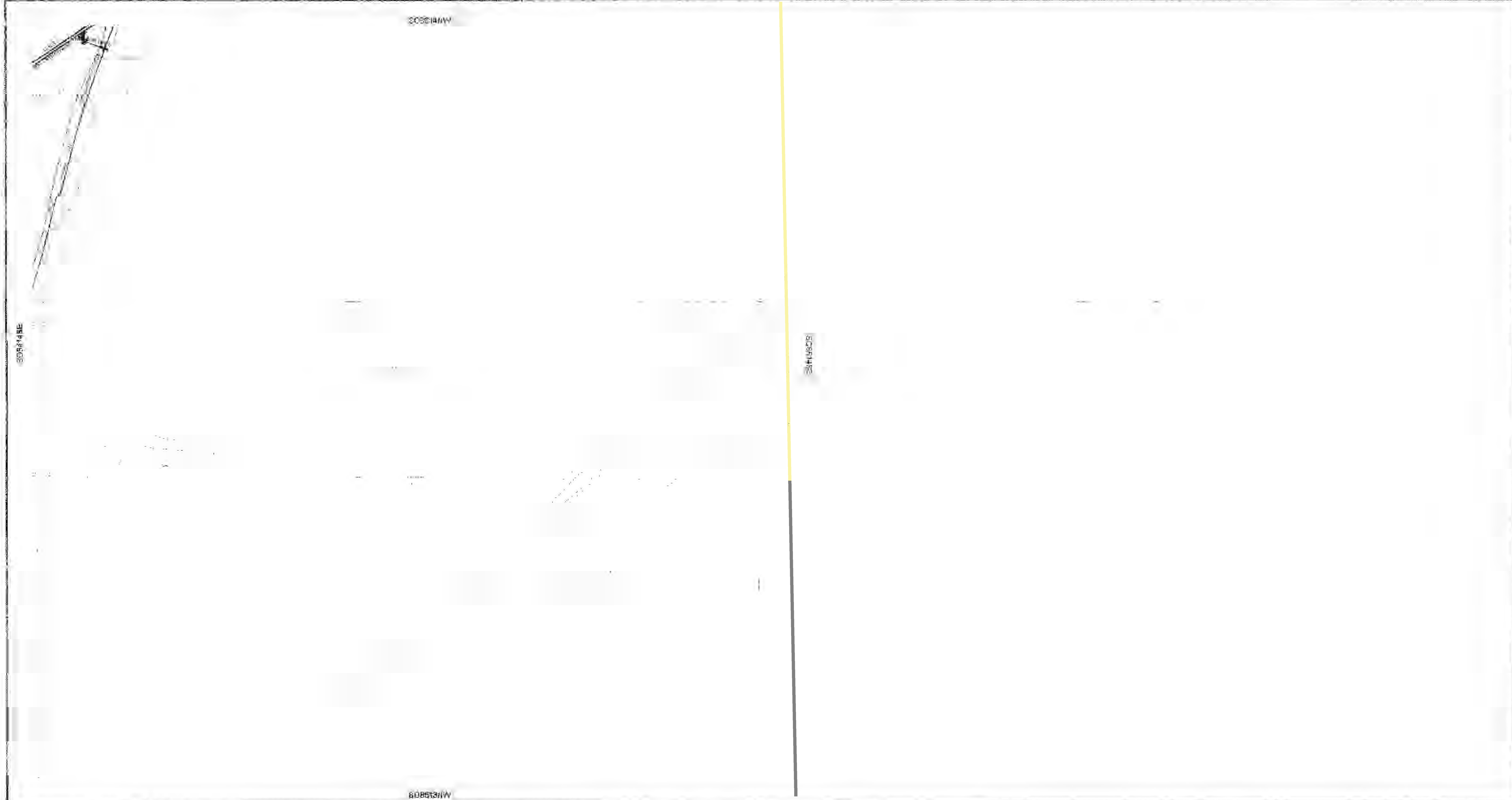


Distribution Main
Trunk Main
Fire Supply Main
Fire Main
Domestic Customer Service Pipe
Abandoned Main
Elevated Main
Duct
Cable, Earthing
Cable, Low Voltage
Cable, High Voltage
Cable, Other

Pumping Facility
Booster Facility
Potable Water Storage
Water Tower
Well / Borehole
Intake
Water Treatment Works
Water Facility Connection

Water Isolation Valve (Closed)
Water Isolation Valve (Open)
Water Isolation Valve (Partially Open)
Water Air Valve
Pressure Reducing Valve
Pressure Sustaining Valve
Non Return Valve
Hydrant (Single/Double)
Washout (Single/Double)
Bulk Meter
Water Hatch Box
Pressure Tapping

Mobile Water Point
Quality Sample Point
Change in Characteristic
Marker Post
Anode
Boundary Box
Strainer
Logging Point
Revenue Meter

Housing, Kiosk
Housing, Other
Pipe Support Structure
Open Pipe
End Cap
Shaft/Well

MATERIALS

[redacted]

WATER MAINS RECORD (TILE)

OS Map scale: 1:1250

Date of issue: 02.05.17

This map is centred upon:

O / S Tile reference:

SO8514SW

1. Do not scale off this Plan.

- Distribution Main
- Trunk Main (local/other)
- Fire Supply Main
- Fire Main
- Non-Domestic Customer Service Pipe
- Domestic Customer Service Pipe
- Abandoned Main
- Elevated Main
- Aqueduct
- Duct
- Cable, Earthing
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- Pumping Facility
- Booster Facility
- Potable Water Storage
- Water Tower
- Intake
- Water Treatment Works / Chamber
- Draw-off Tower
- Sewer Point
- Water Facility Connection
- Water Isolation Valve (Closed)
- Water Isolation Valve (Open)
- Water Isolation Valve (Partially Open)
- Water Air Valve
- Pressure Reducing Valve
- Pressure Sustaining Valve
- Non-Return Valve
- Flow Valve
- Hydrant (Single/Double)
- Washout (Single/Double)
- Bulk Meter
- Water Meter Box
- Pressure Tapping
- Insertion Flow Meter Point
- Water Chemical Injection Point
- Mobile Water Point
- Quality Sample Point
- Change In Characteristic
- Marker Post
- Cable Junction
- Anode
- Boundary Box
- Stop Tap
- Cross Piece
- Strainer
- Metering Point
- Revenue Meter
- Housing, Building
- Housing, Kiosk
- Housing, Other
- Pipe Support Structure
- Open Pipe
- Discharge
- End Cap
- SSSI Area
- Access Right
- Pre 1937 Properties

MATERIALS

LINING

[redacted]

WATER MAINS RECORD (TILE)

O/S Map scale: 1:1250

Date of Issue:

Sewer Node / Sewer Pipe Data

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SO84148501	58.30	57.30	56.69	S	CO	C	375	nil	17.45	nil
SO84148602	59.26	57.13	56.15	S	CO	C	375	nil	56.71	nil
SO84148603	60.61	nil	nil	nil	nil	nil	nil	nil	0.00	nil
SO84148701	62.67	60.17	57.16	S	CO	C	300	nil	35.45	nil
SO84148702	63.29	nil	nil	nil	nil	nil	nil	nil	0.00	nil
SO84148703	65.19	nil	nil	nil	nil	nil	nil	nil	0.00	nil
SO84148802	66.16	63.53	60.20	S	CO	C	300	nil	34.96	nil
SO84148803	69.76	nil	nil	nil	nil	nil	nil	nil	0.00	nil
SO84148901	71.09	68.73	68.22	S	CO	C	300	nil	119.86	nil
SO84148902	67.09	65.77	64.91	F	VC	C	150	nil	38.09	nil
SO84148904	70.50	68.20	63.55	S	CO	C	300	nil	19.84	nil
SO84148906	70.90	nil	nil	nil	nil	nil	nil	nil	0.00	nil
SO84148907	68.40	66.70	64.42	S	CO	C	225	nil	14.37	nil
SO84149500	nil	nil	nil	F	VC	U	100	nil	0.00	nil
SO84149502	58.44	54.04	52.03	F	VC	C	150	nil	31.34	nil
SO84149503	58.03	58.10	54.04	S	CO	C	375	nil	25.24	nil
SO84149504	58.40	54.02	52.65	S	CO	C	450	nil	41.66	nil
SO84149505	58.44	56.60	56.16	F	VC	C	150	nil	91.84	nil
SO84149602	57.40	55.19	54.61	F	VC	C	150	nil	100.00	nil
SO84149603	56.53	54.87	54.15	S	CO	C	300	nil	129.63	nil
SO84149604	56.65	54.60	54.05	F	VC	C	150	nil	107.29	nil
SO84149702	58.67	56.96	56.33	S	CO	C	225	nil	91.49	nil
SO84149703	58.62	56.32	55.90	F	VC	C	150	nil	98.57	nil
SO84149704	59.40	57.52	56.61	S	CO	C	225	nil	30.04	nil
SO84149705	59.30	57.08	56.21	F	VC	C	150	nil	29.79	nil
SO84149706	57.40	55.56	54.88	S	CO	C	300	nil	95.60	nil
SO84149801	61.37	56.98	54.70	F	VC	C	150	nil	39.04	nil
SO84149802	60.75	57.16	54.75	S	CO	C	300	nil	39.75	nil
SO84149803	64.55	61.61	61.20	F	VC	C	150	nil	63.66	nil
SO84149804	63.58	61.19	60.55	F	VC	C	150	nil	36.08	nil
SO84149805	62.73	61.00	59.26	S	VC	C	225	nil	36.89	nil
SO84149806	63.65	61.61	61.01	S	VC	C	225	nil	43.37	nil
SO84149807	62.82	60.52	58.94	F	VC	C	150	nil	27.29	nil
SO84149808	61.54	59.97	57.54	S	CO	C	225	nil	21.13	nil
SO84149809	61.58	59.68	57.10	F	VC	C	150	nil	22.05	nil
SO84149902	62.01	58.08	57.05	F	VC	C	150	nil	102.50	nil
SO84149903	65.98	63.53	61.66	S	VC	C	225	nil	50.34	nil
SO84149904	66.02	62.08	61.83	F	VC	C	150	nil	153.93	nil
SO84149905	61.65	57.61	57.23	S	CO	C	225	nil	60.56	nil
SO84149906	66.00	63.71	63.53	F	VC	C	150	nil	92.61	nil
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nil
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nil

- Abandoned Sewer
- Private Combined Gravity Sewer
- Private Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Public Combined Gravity Sewer
- Public Foul Gravity Sewer
- Public Surface Water Gravity Sewer
- Trunk Combined Gravity Sewer
- Trunk Foul Use Gravity Sewer
- Trunk Surface Water Gravity Sewer
- Combined Use Pressurised Sewer
- Foul Use Pressurised Sewer
- Surface Water Pressurised Sewer
- Highway Drain
- Combined Lateral Drain (SS)
- Foul Lateral Drain (SS)
- Surface Water Lateral Drain (SS)

- Cable, Earthing
- Cable Junction
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- Housing, Building
- Housing, Kiosk
- Disposal Site
- Sewage Treatment Works
- Housing, Other
- Pipe Support Structure
- Sewage Pumping Facility
- Sewer Facility Connection Inlet / Outlet

- Blind Shaft
- Combined Use Manhole
- Flushing Chamber
- Foul Use Manhole
- Grease Trap
- Head Node
- Hydrobrake
- Lamphole
- Outfall
- Overflow
- Penstock
- Petrol Interceptor
- Sewer Blockage
- Sewer Collapse

- Sewer Chemical Injection Point
- Sewer Junction
- Sewerage Air Valve
- Sewerage Hatch Box Point
- Sewerage Isolation Valve
- Soakaway
- Surface Water Manhole
- Vent Column
- Waste Water Storage
- Culverted Watercourse
- Pre-1937 Properties

MATERIALS

AC - ASBESTOS CEMENT
BR - BRICK
CC - CONCRETE BOX CULVERT
CI - CAST IRON
CO - CONCRETE
CSB - CONCRETE SEGMENTS (BOLTED)
CSU - CONCRETE SEGMENTS (UNBOLTED)
DI - DUCTILE IRON
GRC - GLASS REINFORCED CONCRETE
MAC - MASONRY IN REGULAR COURSES
MAR - MASONRY RANDOMLY COURSED
PE - POLYETHLENE
PF - PITCH
PP - POLYPROPYLENE
PSC - PLASTIC STEEL COMPOSITE
PVC - POLYVINYL CHLORIDE
RPM - REINFORCED PLASTIC MATRIX
SI - SPUN (GREY) IRON
XXX - OTHER

CATEGORIES

W - WEIR
C - CASCADE
DB - DAMBOARD
SE - SIDE ENTRY
FV - FLAP VALVE
BD - BACK DROP
S - SIPHON
HD - HIGHWAY DRAIN
S104 - SECTION 104

SHAPE

C - CIRCULAR
E - EGG SHAPED
O - OTHER
R - RECTANGLE
S - SQUARE
T - TRAPEZOIDAL
U - UNKNOWN

TABULAR KEY

A. Sewer pipe data refers to downstream sewer pipe.
B. Where [illegible] indicates downstream sewer pipe.
C. Gradient is stated a 1 in...

PURPOSE

C - COMBINED
E - FINAL EFFLUENT
F - FOUL
L - SLUDGE
S - SURFACE WATER

N
W
E
S

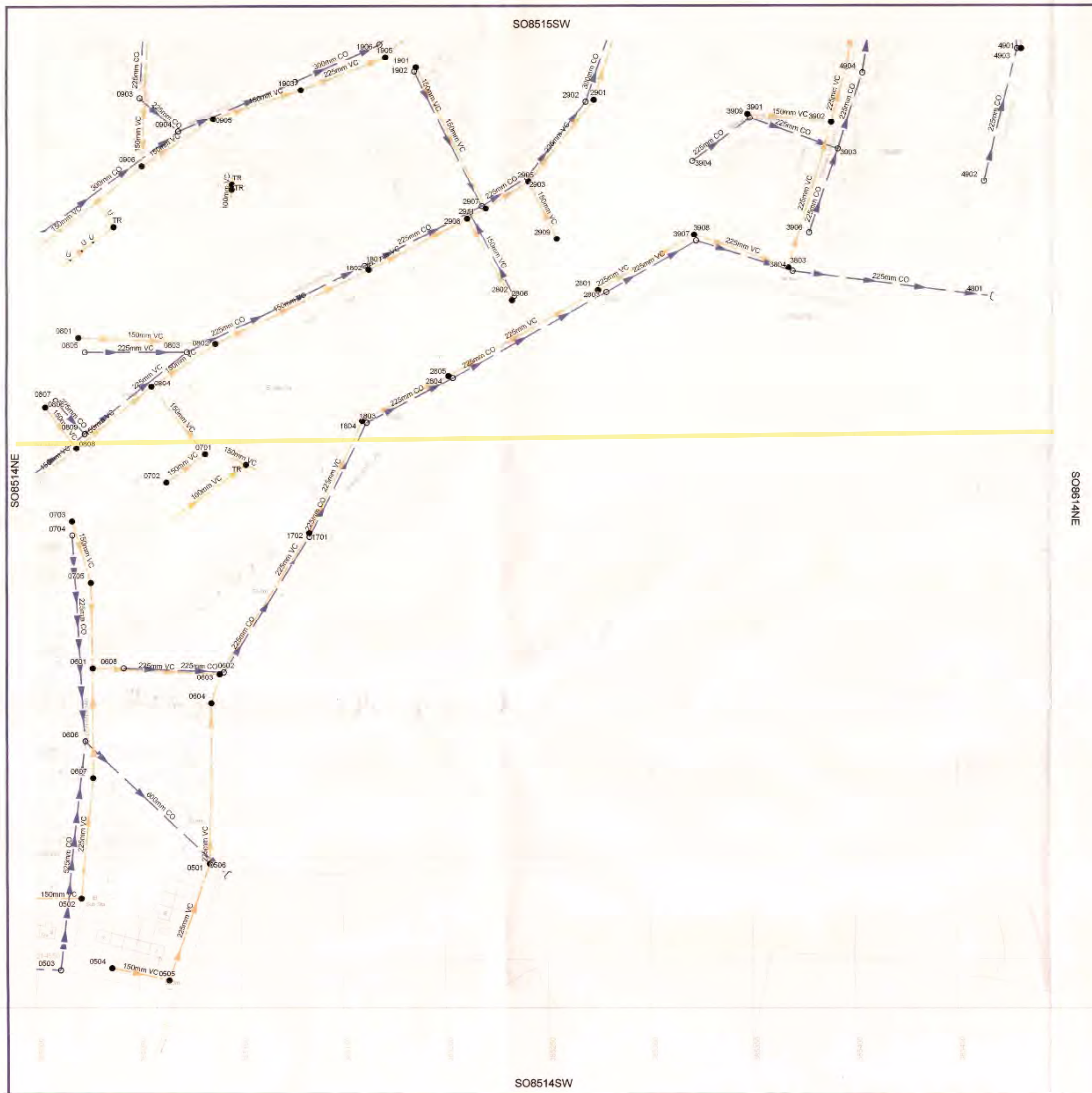
SEVERN TRENT WATER

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
[redacted]

SEWER RECORD (TABULAR)

O/S Map scale: 1:1250
Date of issue: 02.05.17
Sheet No. 1 of 1

This map is centred upon:
O / S Tile reference:
SO8414NE



Sewer Node / **Sewer Pipe Data**

REFERENCE	COVER LEVEL	INV LEVEL UPSTR	INV LEVEL DOWNSTR	PURP	MATL	SHAPE	MAX SIZE	MIN SIZE	GRADIENT	YEAR LAID
SO85140501	52.91	51.28	50.91	F	VC	C	225	nil	213.54	nil
SO85140502	53.82	51.98	51.63	F	VC	C	225	nil	131.78	nil
SO85140503	54.20	52.58	51.82	S	CO	C	525	nil	148.21	nil
SO85140504	53.65	51.92	51.57	F	VC	C	150	nil	81.83	nil
SO85140505	53.20	51.58	51.28	F	VC	C	225	nil	215.75	nil
SO85140601	54.20	51.14	50.87	F	VC	C	225	nil	229.89	nil
SO85140602	53.02	51.36	50.96	S	CO	C	225	nil	196.58	nil
SO85140603	53.04	50.85	50.56	F	VC	C	225	nil	282.21	nil
SO85140604	52.98	50.90	50.87	F	VC	C	225	nil	485.33	nil
SO85140606	53.47	51.81	51.71	S	CO	C	600	nil	933.80	nil
SO85140607	53.66	51.52	51.16	F	VC	C	225	nil	150.00	nil
SO85140608	54.28	51.60	51.35	S	CO	C	225	nil	222.91	nil
SO85140701	56.12	54.33	53.96	F	VC	C	150	nil	113.54	nil
SO85140702	56.96	54.46	54.34	F	VC	C	150	nil	196.67	nil
SO85140703	57.47	55.58	54.17	F	VC	C	150	nil	22.21	nil
SO85140704	57.07	55.37	52.10	S	CO	C	225	nil	30.94	nil
SO85140705	56.07	54.15	52.37	F	VC	C	150	nil	23.60	nil
SO85140801	58.02	57.52	54.10	F	VC	C	150	nil	19.61	nil
SO85140802	56.12	53.24	51.81	F	VC	C	150	nil	51.04	nil
SO85140803	56.41	53.84	52.19	S	CO	C	225	nil	55.21	nil
SO85140804	57.20	53.92	53.27	F	VC	C	150	nil	67.60	nil
SO85140805	58.73	57.84	54.88	S	VC	C	225	nil	16.89	nil
SO85140806	59.42	57.01	55.90	F	VC	C	150	nil	22.52	nil
SO85140807	59.24	57.48	56.33	S	CO	C	225	nil	18.49	nil
SO85140808	58.61	55.88	55.30	F	VC	C	150	nil	82.12	nil
SO85140809	58.40	56.30	54.82	S	VC	C	225	nil	43.26	nil
SO85140903	56.37	55.86	54.84	S	CO	C	225	nil	30.29	nil
SO85140904	57.56	54.73	52.56	S	CO	C	300	nil	28.50	nil
SO85140905	55.86	53.59	52.38	F	VC	C	150	nil	37.37	nil
SO85140906	56.42	54.63	53.52	F	VC	C	150	nil	41.47	nil
SO85141701	53.50	50.58	50.22	F	VC	C	225	nil	164.36	nil
SO85141702	53.51	50.96	50.66	S	CO	C	225	nil	215.90	nil
SO85141801	54.14	52.16	50.33	S	CO	C	225	nil	31.28	nil
SO85141802	54.11	51.59	50.00	F	VC	C	225	nil	34.04	nil
SO85141803	54.28	50.64	50.49	S	CO	C	225	nil	318.07	nil
SO85141804	54.30	50.26	nil	F	VC	C	225	nil	0.00	nil
SO85141901	52.22	50.23	49.82	F	VC	C	150	nil	128.10	nil
SO85141902	52.21	50.84	50.08	S	VC	C	150	nil	131.77	nil
SO85141903	56.01	51.57	50.27	F	VC	C	225	nil	33.65	nil
SO85141904	55.04	52.46	50.71	S	CO	C	300	nil	25.59	nil
SO85141905	52.74	50.24	49.26	F	VC	C	225	nil	85.00	nil
SO85141906	52.74	50.60	49.61	S	CO	C	375	nil	61.64	nil
SO85142801	50.85	48.58	48.26	F	VC	C	225	nil	23.36	nil
SO85142802	52.44	51.27	50.38	S	VC	C	150	nil	52.28	nil
SO85142803	50.82	48.96	47.21	S	VC	C	225	nil	28.76	nil
SO85142804	53.06	nil	48.60	F	VC	C	225	nil	0.00	nil
SO85142805	53.11	50.46	48.98	S	CO	C	225	nil	57.68	nil
SO85142806	52.48	50.85	50.05	F	VC	C	150	nil	57.08	nil
SO85142901	49.85	47.84	46.14	F	VC	C	225	nil	29.31	nil
SO85142902	49.62	48.11	46.49	S	CO	C	300	nil	32.80	nil
SO85142903	51.22	49.29	48.14	S	CO	C	300	nil	40.88	nil
SO85142905	51.20	48.82	47.68	F	VC	C	225	nil	44.93	nil
SO85142906	51.99	50.29	50.07	S	CO	C	225	nil	30.50	nil
SO85142907	51.79	49.55	48.84	F	VC	C	225	nil	34.79	nil
SO85142908	52.06	49.92	49.68	F	VC	C	225	nil	30.29	nil
SO85142909	51.41	49.35	48.95	F	VC	C	150	nil	78.25	nil
SO85142911	51.83	50.02	49.32	S	CO	C	225	nil	37.20	nil
SO85143803	46.89	45.49	43.14	F	VC	C	225	nil	31.51	nil
SO85143804	46.87	44.13	42.89	S	CO	C	225	nil	77.22	nil
SO85143901	47.59	45.46	43.16	F	VC	C	150	nil	17.91	nil
SO85143902	45.65	43.11	42.57	F	VC	C	225	nil	51.66	nil
SO85143903	46.03	43.93	42.99	S	CO	C	225	nil	41.38	nil
SO85143904	49.10	48.01	46.05	S	CO	C	225	nil	17.86	nil
SO85143905	44.75	42.55	41.70	F	VC	C	225	nil	91.87	nil
SO85143906	47.16	45.19	43.96	S	CO	C	225	nil	35.22	nil
SO85143907	49.30	45.56	44.15	S	CO	C	225	nil	35.24	nil
SO85143908	49.46	46.23	45.51	F	VC	C	225	nil	67.64	nil
SO85143909	47.41	45.98	43.96	S	CO	C	225	nil	22.86	nil
SO85144901	42.65	41.62	40.98	F	VC	C	150	nil	70.33	nil
SO85144902	43.70	42.24	41.28	S	CO	C	225	nil	68.73	nil
SO85144903	42.80	41.28	40.85	S	CO	C	225	nil	71.10	nil
SO85144904	44.74	42.95	42.16	S	CO	C	300	nil	109.91	nil
nil	nil	nil	nil	C	VC	nil	nil	nil	0.00	nil
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nil
nil	nil	nil	nil	F	VC	nil	nil	nil	0.00	nil

- Abandoned Sewer
- Private Combined Gravity Sewer
- Private Foul Gravity Sewer
- Private Surface Water Gravity Sewer
- Public Combined Gravity Sewer
- Public Foul Gravity Sewer
- Public Surface Water Gravity Sewer
- Trunk Combined Gravity Sewer
- Trunk Foul Use Gravity Sewer
- Trunk Surface Water Gravity Sewer
- Combined Use Pressurised Sewer
- Foul Use Pressurised Sewer
- Surface Water Pressurised Sewer
- Highway Drain
- Combined Lateral Drain (SS)
- Foul Lateral Drain (SS)
- Surface Water Lateral Drain (SS)
- Cable, Earthing
- Cable Junction
- Cable, Optical Fibre/Instrumentation
- Cable, Low Voltage
- Cable, High Voltage
- Cable, Other
- Housing, Building
- Housing, Kiosk
- Disposal Site
- Sewage Treatment Works
- Housing, Other
- Pipe Support Structure
- Sewage Pumping Facility
- Sewer Facility Connection Inlet / Outlet
- Blind Shaft
- Combined Use Manhole
- Flushing Chamber
- Foul Use Manhole
- Grease Trap
- Head Node
- Hydrobrake
- Lamphole
- Outfall
- Overflow
- Penstock
- Petrol Interceptor
- Sewer Blockage
- Sewer Collapse
- Sewer Chemical Injection Point
- Sewer Junction
- Sewerage Air Valve
- Sewerage Hatch Box Point
- Sewerage Isolation Valve
- Soakaway
- Surface Water Manhole
- Vent Column
- Waste Water Storage
- Culverted Watercourse
- Pre-1937 Properties

MATERIALS

- AC - ASBESTOS CEMENT
- BR - BRICK
- CC - CONCRETE BOX CULVERT
- CI - CAST IRON
- CO - CONCRETE
- CSB - CONCRETE SEGMENTS (BOLTED)
- CSU - CONCRETE SEGMENTS (UNBOLTED)
- DI - DUCTILE IRON
- GRC - GLASS REINFORCED CONCRETE
- MAC - MASONRY IN REGULAR COURSES
- MAR - MASONRY RANDOMLY COURSED
- PE - POLYETHYLENE
- PF - PITCH
- PP - POLYPROPYLENE
- PSC - PLASTIC STEEL COMPOSITE
- PVC - POLYVINYL CHLORIDE
- RPM - REINFORCED PLASTIC MATRIX
- SI - SPUN (GREY) IRON
- XXX - OTHER

CATEGORIES

- W - WEIR
- C - CASCADE
- DB - DAMBOARD
- SE - SIDE ENTRY
- FV - FLAP VALVE
- BD - BACK DROP
- S - SIPHON
- HD - HIGHWAY DRAIN
- S104 - SECTION 104

SHAPE

- C - CIRCULAR
- E - EGG SHAPED
- O - OTHER
- R - RECTANGLE
- S - SQUARE
- T - TRAPEZOIDAL
- U - UNKNOWN

PURPOSE

- C - COMBINED
- E - FINAL EFFLUENT
- F - FOUL
- L - SLUDGE
- S - SURFACE WATER

TABULAR KEY

A. Sewer pipe data refers to downstream sewer pipe.

B. Where the node information (splits) 8 and 9 indicates downstream sewer pipe.

C. Gradient is stated a 1 in...

N
W E
S

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
[redacted]

SEWER RECORD (TABULAR)

O/S Map scale:	1:1250	**This map is centred upon:**	
Date of issue:	02.05.17	**O / S Tile reference:**	
Sheet No.	1 of 1		SO8514NW

SEVERN TRENT WATER

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your Contractor on site. If any damage is caused to STW apparatus, the person, Contractor or Subcontractor responsible must inform STW immediately on:

[redacted] (24 hours)

These general conditions and precautions apply to the public sewerage, water distribution and telemetry systems. The conditions include sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991 and mains installed in accordance with the Agreement for the self construction of water mains. Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.

On request, STW will issue a copy of the plan showing the approximate locations of STW apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan is furnished as a general guide only and no warranty as to its accuracy is given or implied. The plan must not be relied upon in the event of excavations or other works in the vicinity of STW apparatus. No person or Company shall be relieved from liability for damage caused by reason of the actual position and/or depths of STW apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any apparatus the following should be observed:

1. All STW apparatus should be located by hand digging prior to the use of mechanical excavators.

2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to our apparatus. You or your contractor must ensure the safety of our equipment and will be responsible for the cost of repairing any damage caused.

3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.

4. During construction work, where heavy plant will cross the line of STW apparatus, specific crossing points must be agreed with the Company and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW apparatus at other locations must be prevented.

5. Where it is proposed to carry out piling or boring within 20 metres of any STW apparatus, STW should be consulted to enable any affected STW apparatus to be surveyed prior to the works commencing.

6. Where excavation of trenches adjacent to any STW apparatus affects its support, the STW apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.

7. Where a trench is excavated crossing or parallel to the line of any STW apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause

damage to the STW apparatus. In special cases, it may be necessary to provide permanent support to STW apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW apparatus.

8. No apparatus should be laid along the line of STW apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW apparatus.

9. A minimum radial clearance of 300 millimetres should be allowed between any plant being installed and existing STW apparatus. - We reserve the right to increase this distance where strategic assets are affected.

10. Where any STW apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged.

11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such apparatus in order to determine any necessary alterations in advance of the works.

12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.

13. You are advised that Severn Trent Water Limited will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,

14. No explosives are to be used in the vicinity of any STW apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW apparatus.

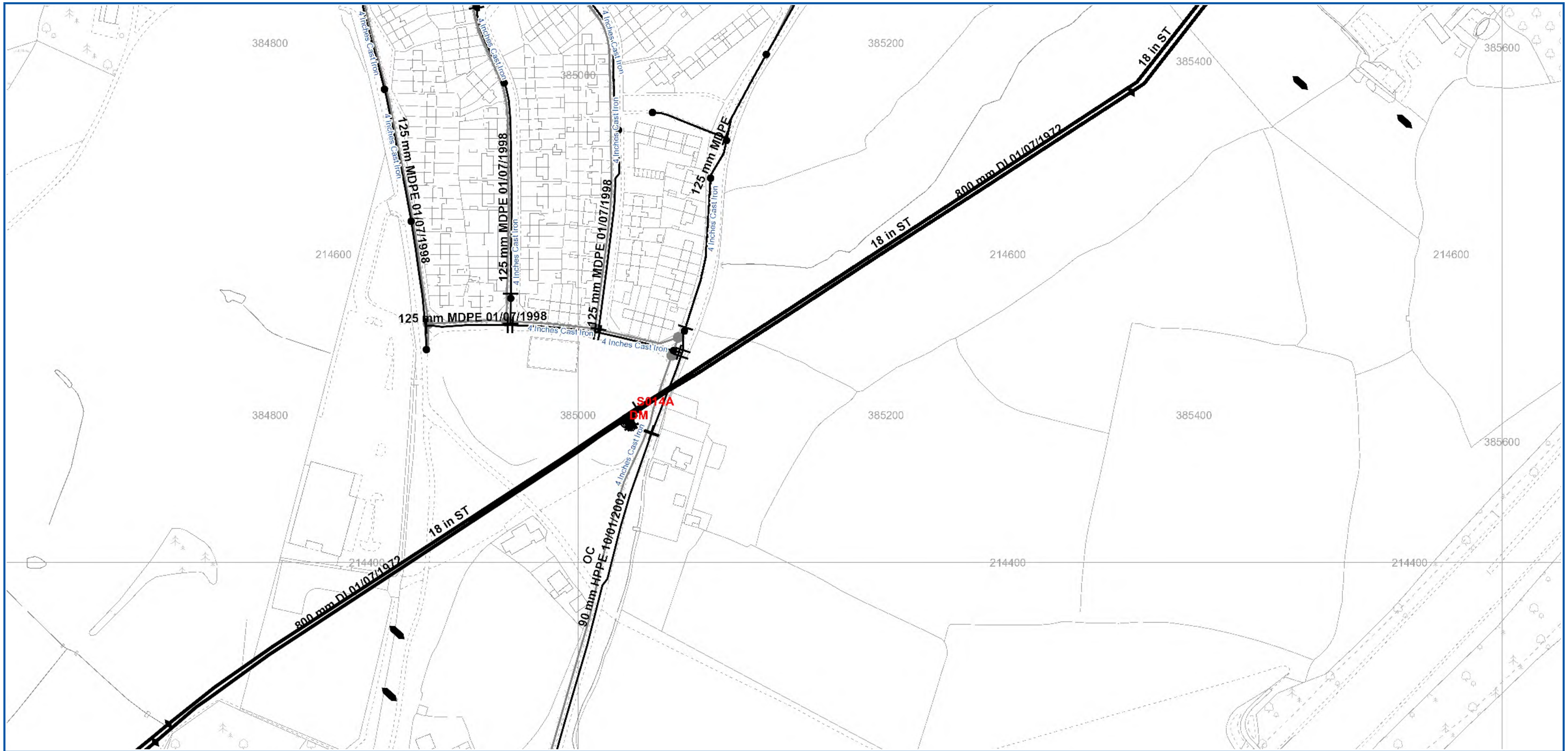
15. Please ensure that, in relation to STW apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.

16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW apparatus.

17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear.

18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW apparatus.

19. In certain circumstances, both the Company and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.



LEGEND

Distribution Pipe
- Discharge Pipe
- Distribution Main
- Intermediate Trunk
- Local Trunk
- Water Internal Site Pipe
- Water Siphon
- Water Tap Pipe

Service Pipe
- Company Service Pipe
- Domestic Customer Service Pipe
- Fire Main
- Fire Supply Main
- Fire Spinkler System
- Non-Domestic Customer Service Pipe

Transmission Pipe
- Resource Main
- Strategic Trunk

Flow Control
- Float Valve
- Closed Water Isolation Valve
- Fully Opened Water Isolation Valve
- Partially Closed Water Isolation Valve
- Water Non Return Valve
- Flow Regulating Water Regulating Valve
- Pressure Reducing Water Regulating Valve
- Pressure Sustaining Water Regulating Valve

Fitting
- Bend / Elbow
- Coupler
- Cross Piece
- End Cap
- Flange Adapter Plate
- Reducer / Taper
- Stepped Coupling
- Tee Piece
- Y Branch

Hydrant
- Wash Out
- Hydrant

Meter
- Data Logger
- Flow Meter
- Insertion Flow Meter
- Revenue Meter

Pipe Connection
- Air Bleed Tap
- Discharge
- Facility Connector
- Motive Water Point
- Pressure Tapping
- Quality Sample Point
- Strainer
- Water Air Valve

- Water Chemical Injection point
- Water Hatch Box
- Water Open Pipe

ServicePoints
- Boundary Box
- Manifold
- Stop Tap

Abandoned Water Pipe
- Company Service Pipe
- Conduit
- Discharge Pipe
- Distribution Main
- Domestic Customer Service Pipe
- Duct
- Fire Main
- Fire Sprinkler System
- Fire Supply Main
- Intermediate Trunk
- Local Trunk
- Non-Domestic Customer Service Pipe
- Resource Main
- Strategic Trunk
- Tunnel
- Water Internal Site Pipe
- Water Siphon
- Water Tap Pipe

Abandoned Water Point

- Print200mLine

MATERIALS

AC	- ASBESTOS CEMENT
AK	- ALKATHENE
C	- CONCRETE
CI	- CAST IRON
CU	- COPPER
DI	- DUCTILE IRON
GF	- GLASS FIBRE
GR	- GLASS REINFORCED CONCRETE
GRP	- GLASS REINFORCED PLASTIC
HDPE	- HIGH DENSITY POLY
HPPE	- HIGH PERFORMANCE POLY
LDPE	- LOW DESITY POLY
MDPE	- MEDIUM DENSITY POLY
O	- OTHER
PC	- PRE-STRESSED CONCRETE
PF	- PITCH FIBRE
PP	- POLY PROPYLENE
PSC	- PLASTIC STEEL COMPOSITE
PVC	- POLY VINYL CHLORIDE
RPM	- REINFORCED PLASTIC MATRIX
SI	- SPUN IRON
SST	- STAINLESS STEEL
ST	- STEEL
UPVC	- UNPLASTICISED PVC

LINING

BI	- BITUMEN
CL	- CEMENT
PL	- PLASTIC
RL	- FLAP VALVE
O	- OTHER

SEVERN TRENT

Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
[redacted]

WATER MAINS RECORD

O/S Map Scale: 1:2,500

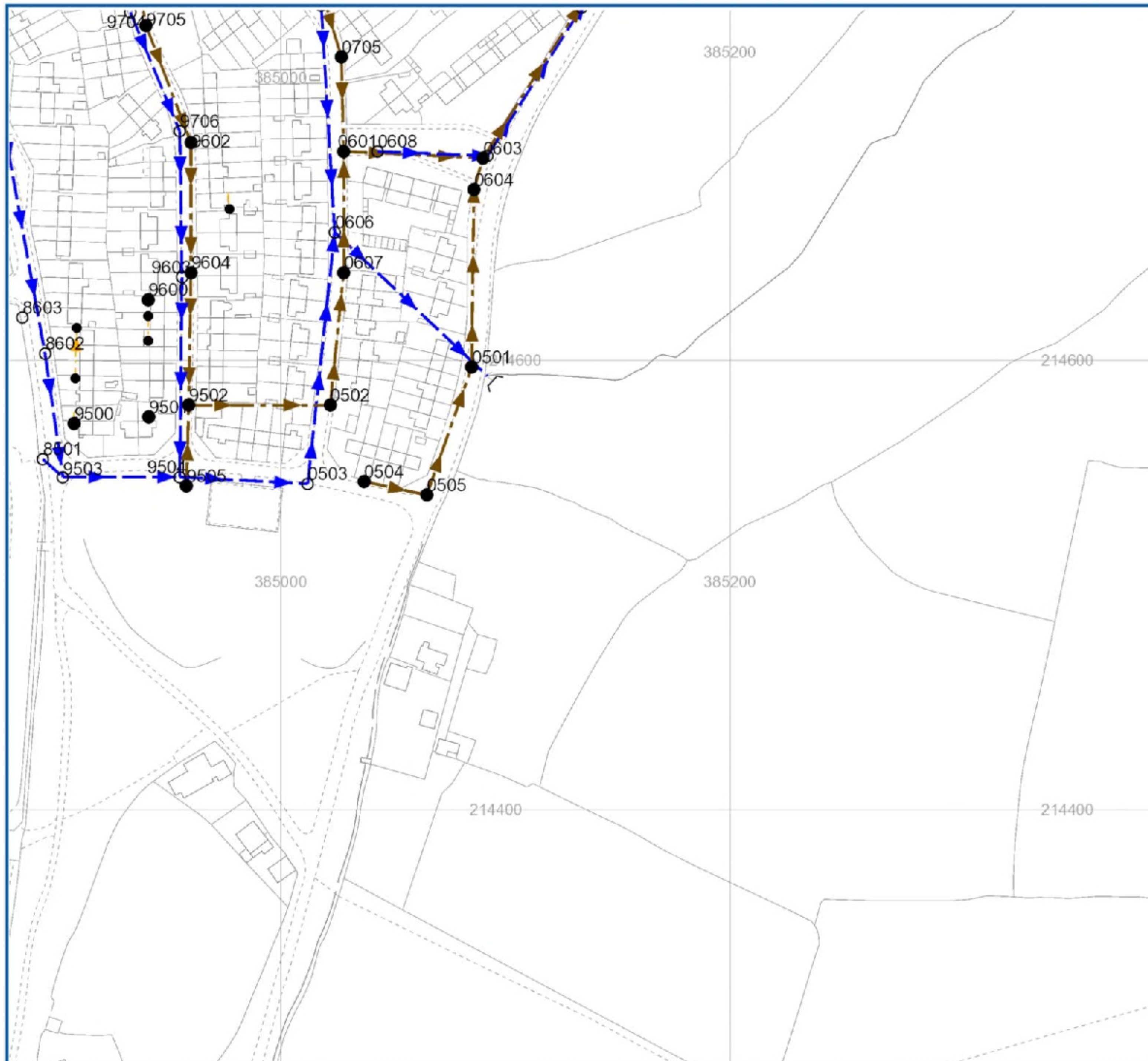
This map is centred upon:

Date of Issue: 22-04-22

X: 385133.51 **Y:** 214520.39

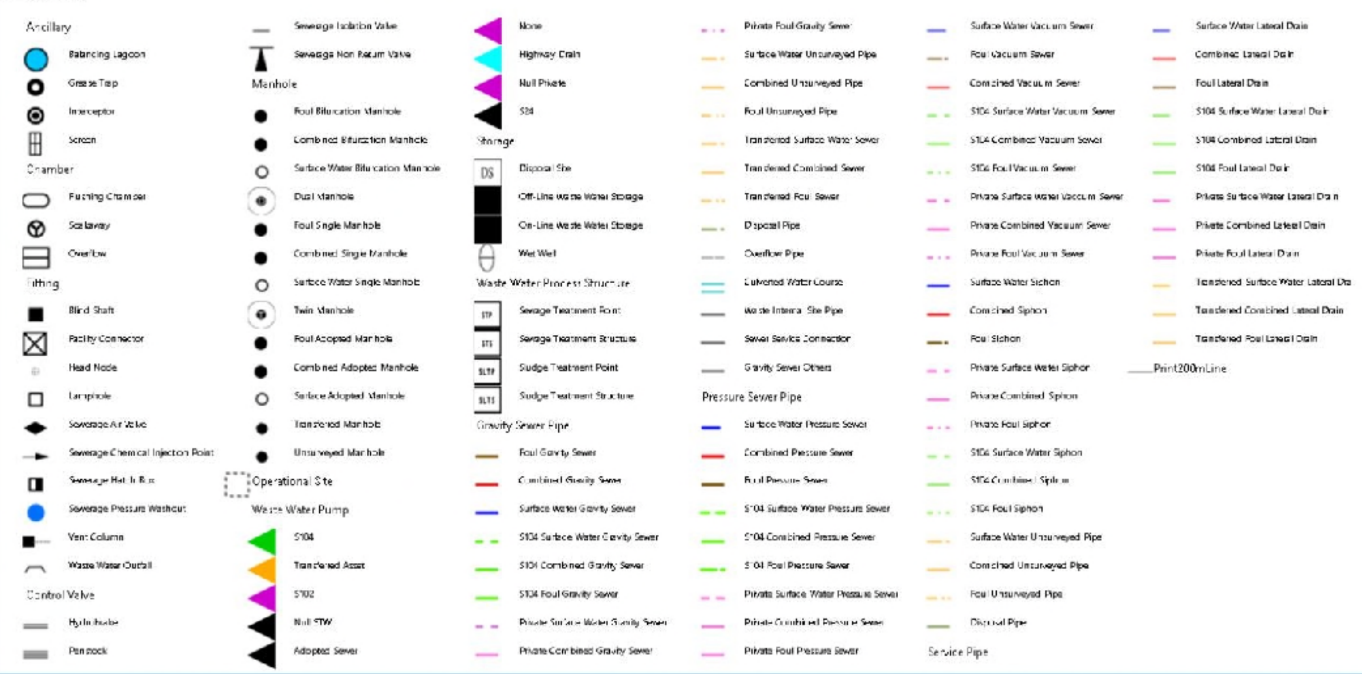
Disclaimer Statement:

1. **Do not scale off this Map.**
2. This plan and any information supplied with it is furnished as a general guide, is only valid at the date of issue and no warranty as to its correctness is given or implied. In particular this plan and any information shown on it must not be relied upon in the event of any development or works (including but not limited to excavations) in the vicinity of SEVERN TRENT WATER assets or for the purposes of determining the suitability of a point of connection to the sewerage or distribution systems.
3.
4. Ordnance Survey licence number **100031673**
5. Document users other than SEVERN TRENT WATER business users are advised that this document is provided for reference purpose only and is subject to copyright, therefore, no further copies should be made from it.



Reference	Cover Level	Invert Level Upstream	Invert Level Downstream	Purpose	Material	Pipe Shape	Max Size	Min Size	Gradient	Year Laid
SO84149603	56.5299	54.87	54.15	S	CO	C	300	<UNK>	123.63	31/12/1899 00:00:00
SO84149604	56.65	54.6	54.05	F	VC	C	150	<UNK>	107.29	31/12/1899 00:00:00
SO85140504	53.65	51.92	51.57	F	VC	C	150	<UNK>	81.83	31/12/1899 00:00:00
SO85140602	53.02	51.36	50.96	S	CO	C	225	<UNK>	195.58	31/12/1899 00:00:00
SO85141702	53.5099	50.95	50.66	S	CO	C	225	<UNK>	215.9	31/12/1899 00:00:00
SO84149503	58.0299	56.1	54.04	S	CO	C	375	<UNK>	25.24	31/12/1899 00:00:00
SO84149704	59.4	57.52	55.61	S	CO	C	225	<UNK>	30.04	31/12/1899 00:00:00
SO84149504	56.4	54.02	52.65	S	CO	C	450	<UNK>	41.66	31/12/1899 00:00:00
SO84149505	56.4399	54.6	54.16	F	VC	C	150	<UNK>	81.84	31/12/1899 00:00:00
SO84149602	57.4	55.19	54.61	F	VC	C	150	<UNK>	100	31/12/1899 00:00:00
SO84149706	57.4	55.56	54.88	S	CO	C	300	<UNK>	95.6	31/12/1899 00:00:00
SO85140601	54.2	51.14	50.87	F	VC	C	225	<UNK>	229.89	31/12/1899 00:00:00
SO84149502	56.4399	54.04	52.03	F	VC	C	150	<UNK>	31.34	31/12/1899 00:00:00
SO85140604	52.9799	50.9	50.87	F	VC	C	225	<UNK>	485.33	31/12/1899 00:00:00
SO85140503	54.2	52.58	51.82	S	CO	C	525	<UNK>	148.21	31/12/1899 00:00:00
SO85140505	53.2	51.56	51.28	F	VC	C	225	<UNK>	215.75	31/12/1899 00:00:00
SO85140606	53.47	51.81	51.71	S	CO	C	600	<UNK>	933.8	31/12/1899 00:00:00
SO84148602	59.2599	57.13	56.15	S	CO	C	375	<UNK>	56.71	31/12/1899 00:00:00
SO85140502	53.9199	51.98	51.53	F	VC	C	225	<UNK>	131.78	31/12/1899 00:00:00
SO85140603	53.04	50.85	50.56	F	VC	C	225	<UNK>	282.21	31/12/1899 00:00:00
SO85140608	54.2799	51.6	51.38	S	CO	C	225	<UNK>	222.91	31/12/1899 00:00:00
SO84148501	58.38	57.38	56.69	S	CO	C	375	<UNK>	17.45	31/12/1899 00:00:00
SO85140501	52.9099	51.28	50.91	F	VC	C	225	<UNK>	213.54	31/12/1899 00:00:00
SO85140607	53.6599	51.52	51.16	F	VC	C	225	<UNK>	150	31/12/1899 00:00:00
SO85140705	56.0699	54.15	52.37	F	VC	C	150	<UNK>	23.6	31/12/1899 00:00:00
SO84149500	<UNK>	<UNK>	<UNK>	F	VC	U	100	<UNK>	<UNK>	31/12/1899 00:00:00
SO84149501	<UNK>	<UNK>	<UNK>	F	VC	U	100	<UNK>	<UNK>	31/12/1899 00:00:00
<UNK>	<UNK>	<UNK>	<UNK>	F	VC	<UNK>	<UNK>	<UNK>	<UNK>	19/02/2021 00:00:00
<UNK>	<UNK>	<UNK>	<UNK>	F	VC	<UNK>	<UNK>	<UNK>	<UNK>	22/03/2022 00:00:00

LEGEND



MATERIALS
- \- NONE
- AC - ASBESTOS CEME
- BR - BRICK
- CC - CONCRETE BOX CULVERT
- CI - CAST IRON
- CO - CONCRETE
- CSB - CONCRETE SEGMENTS (BOLTED)
- CSU - CONCRETE SEGMENTS (UNBOLTED)
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- PSC - PLASTIC STEEL COMPOSITE
- PVC - POLYVINYL CHLORIDE
- RPM - REINFORCED PLASTIC MATRIX
- SI - SPUN (GREY) IRON
- ST - STEEL
- U - UNKNOWN
- VC - VITRIFIED CLAY
- XXX - OTHER

CATEGORIES
- W - WEIR
- C - CASCADE
- DB - DAMBOARD
- SE - SIDE ENTRY
- FV - FLAP VALVE
- BD - BACK DROP
- S - SIPHON
- D - HIGHWAY DRAIN
- S104 - SECTION 104

SHAPE
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PURPOSE
- C - COMBINED
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Severn Trent Water Limited
Asset Data Management
PO Box 5344
Coventry
CV3 9FT
[redacted]

SEWER RECORD (Tabular)

O/S Map Scale: 1:2,500 **This map is centred upon:**

Date of Issue: 22-04-22 **X:** 385133.51 **Y:** 214520.39

Disclaimer Statement:

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3 On 1 October 2011 most private sewers and private lateral drains in Severn Trent Water's sewerage area, which were connected to a public sewer as at 1 July 2011, transferred to the ownership of Severn Trent Water and became public sewers and public lateral drains. A further transfer takes place on 1 October 2012. Private pumping stations, which form part of these sewers or lateral drains, will transfer to ownership of Severn Trent Water on or before 1 October 2016. Severn Trent Water does not possess complete records of these assets. These assets may not be displayed on the map.

5 Ordnance Survey licence number: **100031673**

HJ [redacted]

Reply | Reply All | Forward | ...

Wed 23/03/2022 17:08

2. Standard PreApp advice Gloucester.docx
17 KB

Hi [redacted]

There are no ACDPs within Gloucestershire, however all sites over 1ha require an FRA so your client will need to do one.

From the information you've provided at this stage 3.414 l/s/ha appears to be reasonable and limiting the runoff rate to QBar would also address runoff volume. However, acceptable runoff rates can only be confirmed through the official planning process and may be subject to change once more is known about the site. As part of the planning process you will also need to provide further information about how the moat drains into the watercourse and who will be responsible for the maintenance of the drainage infrastructure for the lifetime of the development. Please also be aware that any structures in the watercourse/ditch, such as a headwall, may require Land Drainage Consent which is additional to planning permission.

I have attached a copy of our standard pre-app advice.

Kind regards,

[redacted]
Flood Risk Management Officer
Flood Risk Management (Strategic Infrastructure)
Gloucestershire County Council
1st Floor (West), Block 5, Shire Hall, Gloucester, GL1 2TH

[redacted]

[redacted]

From: [redacted]
Sent: 22 April 2022 10:41
To: [redacted]
Cc: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832
Attachments: A3L_Water_Record.pdf; A3L_Sewer_Tabular.pdf

ST Classification: OFFICIAL PERSONAL

Hi [redacted]

I've had a look at the siphon and I would suggest making the siphon as short as possible by moving the start of the siphon as close as possible to the culvert and to have the sewers between F14A-F14 and F15-F15A set at 45 degrees. This should increase the gradient between the invert levels of F14A and F15A and improve the siphon's velocities. Once we have done this then the design, in principal, will be acceptable however we still need to get the culvert invert levels to confirm it is not possible to get under this.

Please see attached our water and sewers records as requested.

Kind Regards
[redacted]
Waste Infrastructure Senior Design Specialist
Developer Services
[redacted]

SEVERN TRENT

[Codes for Adoption](#)

Codes for Adoption went live April 2020 - Please click on the above link for more information on the new processes for sewer adoptions

Did you know that you can now apply online for some of our services? Going forward, online applications will be our primary approach method as it not only results in faster processing time but also making a payment is much easier via debit, credit card and BACS payment. You can find all our forms and guidance documents following this link https://www.stwater.co.uk/building-and-developing/regulations-and-forms/application-forms-and-guidance/

Postal Address
Developer Services
Severn Trent Centre
PO Box 5311
Coventry
CV3 9FL
Sat Nav CV1 2LU

www.stwater.co.uk

From: [redacted]
Sent: 06 April 2022 09:44
To: [redacted]

Cc: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

Good afternoon [redacted]

Further to our discussion last week please find attached the proposals for an inverted siphon with an average gradient through the siphon of 1 in 80.

As discussed we have also shallowed the gradient downstream of the siphon to the 1 in 200 discussed.

Also, I would be grateful if you could provide the current STW record plans for both sewers and water mains, our current versions are quite faded and difficult to read.

I will also request confirmation from our client regarding the maintenance of the existing moat and ditch.

Kind Regards,

[redacted]
DDP Limited
Tel: [redacted]

From: [redacted]
Sent: 24 March 2022 16:01
To: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

Good afternoon [redacted]

Have you managed to have a look at the below?

If you wish to discuss please do not hesitate to give me a call.

Kind Regards,

[redacted]
DDP Limited
Tel: [redacted]

From: [redacted]
Sent: 15 March 2022 16:14
To: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

Good afternoon [redacted],

Further to the below email please find attached a foul plan and section for the outfall. I have also responded to the queries below .

a) Based on the topographical survey undertaken the water level is 56.180m within the Moat,
b) The level around the fenced area of the moat ranges from 56.23 on the west to 56.70 in the eastern section.
c) We do not have any data relating to previous usage; however it has been confirmed from the SI that infiltration is not viable, water discharge would be limited to evapotranspiration and discharge via the ditch.
d) Based on the manning equation we estimate that the rate of the ditch in its current capacity is 256l/s our calculations are below based on a water depth of 200mm and width of bank as 3.14m

A	B	C
Manning Equation		
A	0.314	m3
P	3.165	m
S	0.018	
R	0.099	m
n	0.035	
V	0.816	m/s
Q	0.256	m3/s
Q	**256**	**l/s**

Kind Regards,

[redacted]
DDP Limited
Tel: [redacted]

From: [redacted]
Sent: 25 January 2022 09:36
To: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

ST Classification: OFFICIAL PERSONAL

Morning [redacted],

Thank you for this.

I've now looked over the information and had a discussion with my manager regarding the moat as an effective discharge point for a part of this site. We feel that as you are looking to only emulate the original flows into the moat that will be lost due to the development is acceptable however we are concerned on it's effectiveness it terms of water levels and how regularly the overflow ditch will be used. Can you please confirm the following:

a) The water levels of the moat.
b) The freeboard from the top water level to the top of the moat.
c) Data on the overflow ditch – Any data on previous usage and confirm at what storm event the ditch will be used.
d) What is the capacity of the ditch and how much water will it discharge.

Regarding the possible foul syphon, can you please provide a plan showing where the culvert(s) are located and provide a plan showing the route of the proposed foul with gradients etc showing. Foul syphons are not ideal and are considered a high risk. I don't want to rule out the option but if we aren't able to provide steep enough gradients for the syphon is might become impossible to do so.

Thank you

Kind Regards
[redacted]
Waste Infrastructure Senior Design Specialist
Developer Services

[redacted]

[Codes for Adoption](#)

Codes for Adoption went live April 2020 - Please click on the above link for more information on the new processes for sewer adoptions

Did you know that you can now apply online for some of our services? Going forward, online applications will be our primary approach method as it not only results in faster processing time but also making a payment is much easier via debit, credit card and BACS payment. You can find all our forms and guidance documents following this link https://www.stwater.co.uk/building-and-developing/regulations-and-forms/application-forms-and-guidance/

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CV3 9FL
Sat Nav CV1 2LU

www.stwater.co.uk

From: [redacted]
Sent: 24 January 2022 13:50
To: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

Good afternoon [redacted]

Please find below a fresh link.

https://we.tl/t-TptWbc6kkG

Please do not hesitate to get in contact should you have any queries.

Kind Regards,

[redacted]
DDP Limited
[redacted]

From: [redacted]
Sent: 24 January 2022 12:11
To: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

ST Classification: OFFICIAL PERSONAL

Hi [redacted]

Really sorry for the delay.

Can you please send me a fresh link to the WeTransfer and I will look at this ASAP to provide further comment.

Regarding the foul siphon, this will be more problematic compared to surface water so will need to be looked at carefully.

I will look at these both together and get back to you once I receive the new link.

Thank you

Kind Regards
[redacted]
Waste Infrastructure Senior Design Specialist
Developer Services
[redacted]

SEVERN TRENT

[Codes for Adoption]

Codes for Adoption went live April 2020 - Please click on the above link for more information on the new processes for sewer adoptions

Did you know that you can now apply online for some of our services? Going forward, online applications will be our primary approach method as it not only results in faster processing time but also making a payment is much easier via debit, credit card and BACS payment. You can find all our forms and guidance documents following this link https://www.stwater.co.uk/building-and-developing/regulations-and-forms/application-forms-and-guidance/

Postal Address
Developer Services
Severn Trent Centre
PO Box 5311
Coventry
CV3 9FL
Sat Nav CV1 2LU

www.stwater.co.uk

From: [redacted]
Sent: 18 January 2022 17:24
To: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

Hi [redacted],

Further to the previous correspondence we have also have had some radar surveying carried out to see the impact on the foul sewer.

Based on the information to hand it appears our proposed gravity foul line to STW manhole SO85140505 in Winnycroft Lane clashes with an existing surface water culvert crossing the road. To negate the need for a pumping station would STW find it acceptable to incorporate an inverted siphon around this culvert?

Our proposed foul outfall route requires around 210m of 150mm diameter at a gradient of 1 in 150 to service the 190 dwellings of the development.

Kind Regards,

[redacted]
DDP Limited
[redacted]

From: [redacted]
Sent: 04 January 2022 10:53
To: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

Good morning [redacted]

Further to the below emails have you had an opportunity to review the proposals further?

Kind Regards,

[redacted]
DDP Limited
[redacted]

From: [redacted]
Sent: 22 November 2021 14:52
To: [redacted]
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

Thank you [redacted] for the meeting and prompt comments.

I enclose the topographical survey for your viewing, I have also created an extract specific to the moat in a larger scale.

From the information I have on file I cannot locate any infiltration testing having been undertaken however I note the following ground conditions. I have also enclosed the Water Environment Assessment for this development confirming current inflow arrangements, section 4.3 also details the outgoing flow and flow. Will this be sufficient in the absence to confirm ground permability?

Table 4.1 Summary of ground conditions

Stratum	Top depth range (mbgl)	Base depth range (mbgl)	Exploratory holes	General description/ comments
Topsoil	0.00	0.10	All holes	Brown slightly gravelly silty CLAY
Made Ground	0.10	1.10 – 2.60	TP201 & TP202	Orangish brown mottled bluish grey slightly gravelly silty CLAY with rare wood fragments
Relict Topsoil	1.10	1.30	TP202	Dark bluish brown silty CLAY with high organic material
Charmouth Mudstone Formation	0.50 – 1.30	2.00 – 2.20	TP201 & TP208	Firm to stiff orangish brown mottled bluish grey silty CLAY
	2.20 – 2.60	>2.50 - >3.60 (base not proven)	All holes	Stiff dark bluish grey laminated CLAY

I have also included the sections through the moat outfall.

https://we.tl/t-2l9HKLHadz
Link will expire in 7 days

Kind Regards,

[redacted]
DDP Limited
[redacted]

From: [redacted]
Sent: 22 November 2021 12:05
To: [redacted]
Subject: PDSD @ Winnycroft Lane, Gloucester - 1023832

ST Classification: UNMARKED

Hi [redacted],

Thank you for your time earlier to discuss the design for the above development. To confirm, we at Severn Trent are trying to ascertain if the moat qualifies as a regulated point of discharge as per the Water Industry Act and therefore can accept the surface water design for adoption. Below I have noted the main points of our discussion:

- You confirmed that the flows into the moat are to protect and continue it existing functionally which is why roughly half of the site has been designed to discharge at this point around 11 l/s. Can you please send over the survey of the moat.
- It is believed the moat is rather impermeable, can you please provide or arrange the tests to confirm the permeability.
- You confirmed the moat will not be usage as storage and the proposed outfall has been designed to minimise disruption.
- It is believed the overland flows are regular, can you please try to obtain the data on this to confirm.
- You confirmed the overland flow is a 200-300mm deep channel similar to a swale which then discharges into the ditchcourse located on the western side of the site boundary. Can you please provide a cross section of this.
- We discussed the possibility of a bypass to the ditchcourse if the moat is not considered a regulated point of discharge however I was not able to confirm as yet if this would be acceptable. I will look into this further.
- As discussed, please see attached our latest "pre-approved of use list" regarding pipes and tanks.
- As discussed, please see attached our "Position Statement" regarding the adoption of SUDS features.

Kind Regards

[redacted]
Waste Infrastructure Senior Design Specialist
Developer Services
[redacted]

SEVERN TRENT

Postal Address
Developer Services
Severn Trent Centre
PO Box 5311
Coventry
CV3 9FL
S**at Nav CV1 2LU**

www.stwater.co.uk

Severn Trent Plc (registered number 2366619) and Severn Trent Water Limited (registered number 2366686) (together the "Companies") are both limited companies registered in England & Wales with their registered office at Severn Trent Centre, 2 St John's Street, Coventry, CV1 2LZ This email (which includes any files attached to it) is not contractually binding on its own, is intended solely for the named recipient and may contain CONFIDENTIAL, legally privileged or trade secret information protected by law. If you have received this message in error please delete it and notify us immediately by telephoning +44 2477715000. If you are not the intended recipient you must not use, disclose, distribute, reproduce, retransmit, retain or rely on any information contained in this email. Please note the Companies reserve the right to monitor email communicationsin accordance with applicable law and regulations. To the extent permitted by law, neither the Companies or any of their subsidiaries, nor any employee, director or officer thereof, accepts any liability whatsoever in relation to this email including liability arising from any external breach of security or confidentiality or for virus infection or for statements made by the sender as these are not necessarily made on behalf of the Companies. Reduce waste! Please consider the environment before printing this email
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[redacted]

From: [redacted]
Sent: 12 May 2022 17:09
To: [redacted]
Cc:
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

Good afternoon [redacted]

Further to previous correspondence I have now received confirmation regarding the maintenance of the moat please see below a response received from our clients heritage consultant. I would be grateful if you could confirm if this is acceptable to allow STW to adopt the upstream surface water network.

"In respect of the moat we have set out in the Heritage Management Plan that the monument will be within a public space that is under the management of a private site management company who will be responsible for 'repairs to infrastructure, vegetation management and clearance of litter'."

Kind Regards,

[redacted]
DDP Limited
[redacted]

From: [redacted]
Sent: 22 April 2022 10:41
To: [redacted]
Cc:
Subject: RE: PDSD @ Winnycroft Lane, Gloucester - 1023832

ST Classification: OFFICIAL PERSONAL

Hi [redacted]

I've had a look at the siphon and I would suggest making the siphon as short as possible by moving the start of the siphon as close as possible to the culvert and to have the sewers between F14A-F14 and F15-F15A set at 45 degrees. This should increase the gradient between the invert levels of F14A and F15A and improve the siphon's velocities. Once we have done this then the design, in principal, will be acceptable however we still need to get the culvert invert levels to confirm it is not possible to get under this.

Please see attached our water and sewers records as requested.

Kind Regards

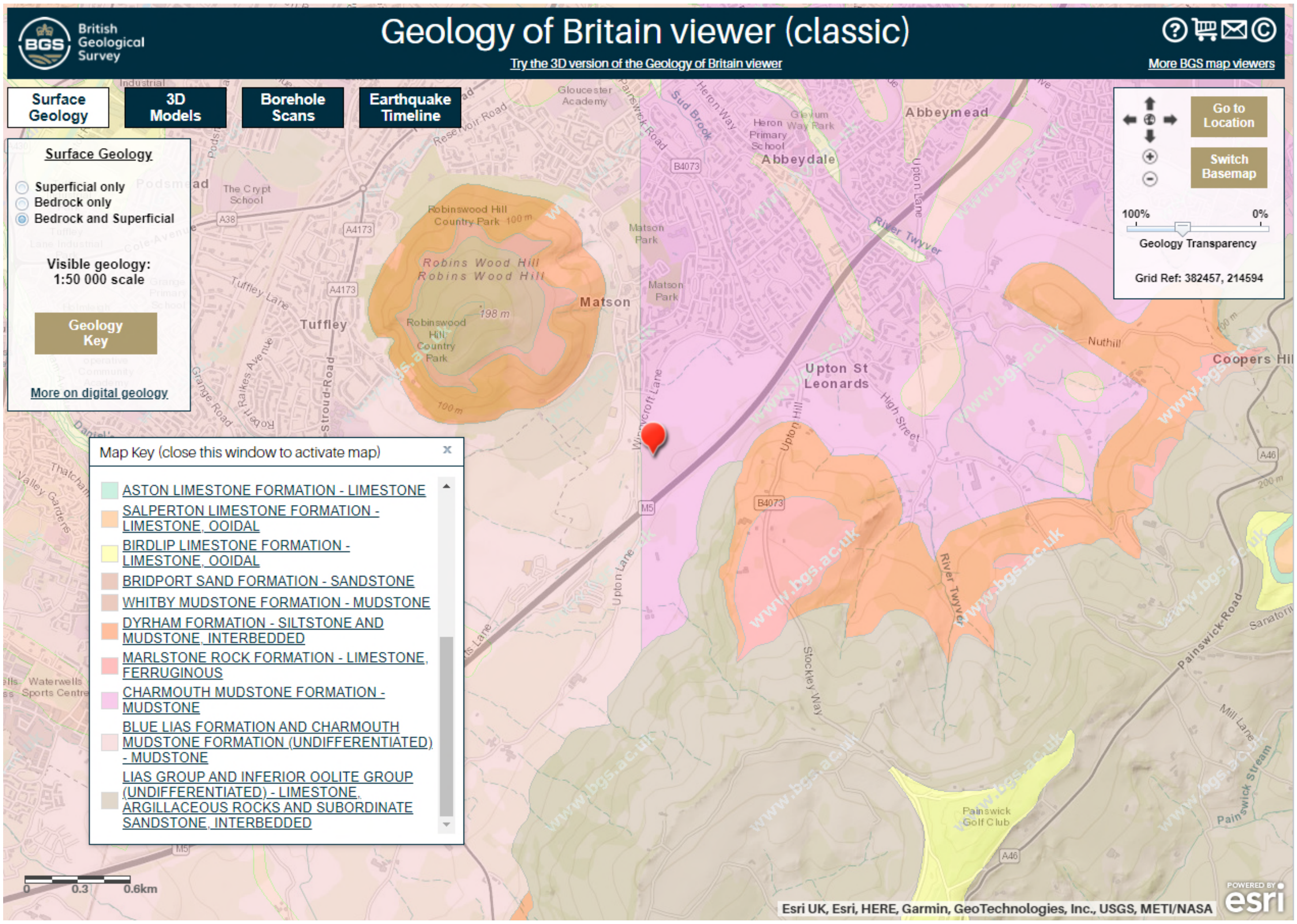
[redacted]
Waste Infrastructure Senior Design Specialist
Developer Services
[redacted]

SEVERN
TRENT

Codes for Adoption

Appendix E

Geology Maps and Key/Descriptions


British Geological Survey
Geology of Britain viewer (classic)
Try the 3D version of the Geology of Britain viewer
More BGS map viewers
Surface Geology
3D Models
Borehole Scans
Earthquake Timeline
Surface Geology
Superficial only
Bedrock only
Bedrock and Superficial
Visible geology: 1:50 000 scale
Geology Key
More on digital geology
Go to Location
Switch Basemap
100%
0%
Geology Transparency
Grid Ref: 382457, 214594
Map Key (close this window to activate map)
ASTON LIMESTONE FORMATION - LIMESTONE
SALPERTON LIMESTONE FORMATION - LIMESTONE, OOIDAL
BIRDLIP LIMESTONE FORMATION - LIMESTONE, OOIDAL
BRIDPORT SAND FORMATION - SANDSTONE
WHITBY MUDSTONE FORMATION - MUDSTONE
DYRHAM FORMATION - SILTSTONE AND MUDSTONE, INTERBEDDED
MARLSTONE ROCK FORMATION - LIMESTONE, FERRUGINOUS
CHARMOUTH MUDSTONE FORMATION - MUDSTONE
BLUE LIAS FORMATION AND CHARMOUTH MUDSTONE FORMATION (UNDIFFERENTIATED) - MUDSTONE
LIAS GROUP AND INFERIOR OOLITE GROUP (UNDIFFERENTIATED) - LIMESTONE, ARGILLACEOUS ROCKS AND SUBORDINATE SANDSTONE, INTERBEDDED
Robinswood Hill Country Park
Robins Wood Hill
198 m
Matson
Tuffley
Abbeymead
Abbeydale
Upton St Leonards
Coopers Hill
Nuthill
River Twyver
Painswick Golf Club
0 0.3 0.6km
Esri UK, Esri, HERE, Garmin, GeoTechnologies, Inc., USGS, METI/NASA
www.bgs.ac.uk

Appendix F

Environmental Agency and LA Flood Maps for Snow Capel

Flood risk summary for the area around:

SNOW CAPEL HOUSE, SNEEDHAMS GREEN, MATSON, GLOUCESTER, GL4 6EQ

Rivers and the sea

Very low risk

▼ What this information means

This flood risk summary is not property specific.

Very low risk means that each year this area has a chance of flooding of less than 0.1%.

This service takes into account any flood defences.

Surface water

Very low risk

What this information means

Surface water flooding, sometimes known as flash flooding:

- happens when heavy rain cannot drain away
- is difficult to predict as it depends on rainfall volume and location
- can happen up hills and away from rivers and other bodies of water
- is more widespread in areas with harder surfaces like concrete

Lead local flood authorities (LLFA) are responsible for managing the flood risk from surface water and may hold more detailed information.

Your LLFA is **Gloucestershire council**.

What's in your backyard?

Flood Map for Planning

Flood Map for Planning results page

Flood Map for Planning Risk

This map is for land-use planning. If you are planning a development, you will need to undertake a more detailed flood risk assessment to show how the flood risk to the site, or elsewhere as a result of proposed changes to the site, can be managed as part of your development proposal.

Local planning authorities should use this map alongside an up-to-date Strategic Flood Risk Assessment to:

- identify when a flood risk assessment is required
- identify when a consultation with the Environment Agency is needed
- apply the sequential test in the absence of a suitable Strategic Flood Risk Assessment

Flood Zone definitions are set out in the National Planning Policy Guidance:

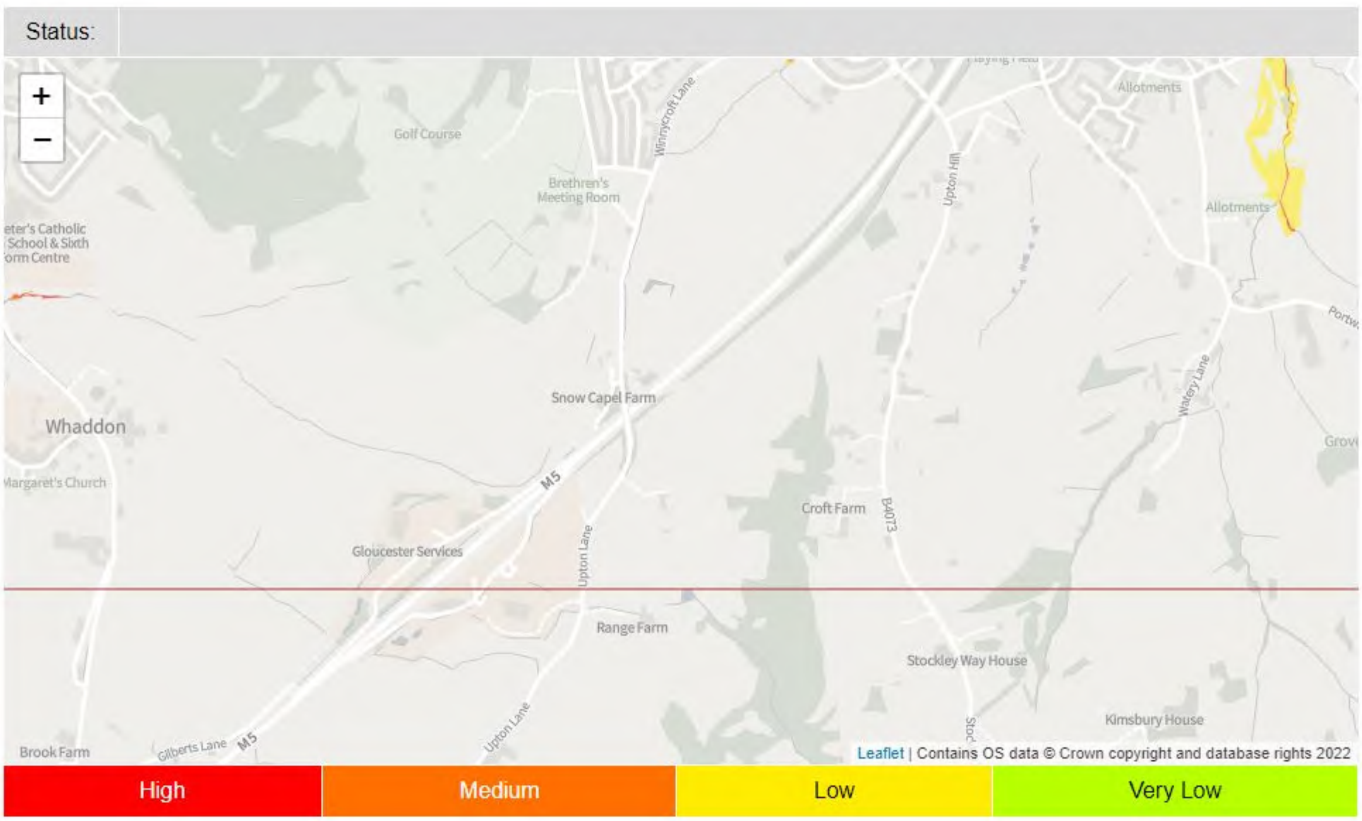
- Flood Zone 1 - land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)
- Flood Zone 2 - land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year
- Flood Zone 3 - land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year

Note: These flood zones refer to the probability of river and sea flooding, ignoring the presence of defences.

If you do not want information for planning purposes, but would like more information, you can also check your risk of flooding from:
http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=floodmap Rivers and the sea
http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=reservoir Reservoirs
http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=ufmfsw Water

Gloucester Flood Map

Map of Gloucester (Gloucestershire) postcodes and their flood risks. Each postcode is assigned a risk of high, medium, low, or very low, and then plotted on a Gloucester flood map. Most Gloucester postcodes are medium flood risk, with some low, and high flood risk postcodes.



Appendix G

Ground/Site Investigation Reports:

- *Site Investigation*
- *Tier 2 Water Environment Assessment*
- *Geotechnical and Contamination*

[redacted]
Edward Ware Homes Ltd
45 Oakfield Road
Clifton
Bristol
BS8 2AX

Date 21 March 2018
Our ref: 180321_SNO1877_HM

Dear [redacted]

Re: Snow Capel Farm, Matson, Gloucester, GL4 6EQ – Supplementary Ground Gas Risk Assessment

Further to the completion of a supplementary ground investigation and programme of gas monitoring at the above site, we are pleased to present the results of a supplementary gas risk assessment together with our conclusions and recommendations. A site location drawing is provided in Appendix A.

Background and Objectives

A third-party[1] ground investigation was undertaken in May 2017 at the above site which identified deep made ground which varied in thickness between 1.50-3.40 metres below ground level (mbgl), generally appearing to become thicker towards the south-west. This was found to comprise silt, mudstone gravel and clay with pockets of buried topsoil. The composition of the material was found to be very similar to the underlying natural strata. This material is assumed to be associated with historical placement of surplus excavated soils from the construction of the M5 motorway which lies adjacent to the south-eastern boundary of the site.

Groundwater and ground gas monitoring wells were installed within WS1, WS3, WS5 and WS8 and monitored on 2N^o occasions by Integrale during July 2017. The monitoring visits indicated high levels of methane (61.1-61.6%) and carbon dioxide (35.2-35.7%) within WS1 locally. Lower but still significant concentrations of carbon dioxide and methane were encountered in WS3 of 7.1-8.5% and 2.8-2.9% respectively. WS5 and WS8 recorded trace concentrations of methane but concentrations of carbon dioxide were <5%. There was negligible gas flow within all of the installations, where WS1 and WS8 had maximum values of 0.1l/hr.

Encountered methane concentrations in WS01 were reported to be consistent with a "red" classification, in accordance with the NHBC[2] traffic light scheme, but elsewhere results were indicative of Amber 1. It was acknowledged that only 2N^o gas monitoring results were undertaken and which may not be reflective of worst case conditions. Results from WS01 were inferred to be a localised occurrence; however, no

[1] Geotechnical and Phase II Contamination Report. Intégrale. August 2017. Ref: 1826
[2] Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present. NHBC. 2007.

consideration or discussion of the conceptual site model was provided in the context of the findings and the wider ground gas regime.

It is understood that the site is intended to be redeveloped for low rise residential housing. On this basis, the principal objective of this supplementary investigation and monitoring programme is to enable refinement of the conceptual site model and understanding of the ground gas regime at the site in order to make an updated assessment of the risk presented to future residents and possible remedial requirements.

Supplementary Ground Investigation

A supplementary ground investigation was completed on the 28th and 29th November 2017 which comprised the excavation of 8N° trial pits (TP101-TP108) to a maximum depth of 3.40mbgl and the drilling of 4N° dynamic windowless boreholes (WS101-WS104) to a maximum depth of 5.0mbgl, all of which were installed as ground gas monitoring wells. The locations of monitoring wells are shown the drawing within Appendix A. The rationale for selected exploratory locations is summarised in Table 1.

Table 1 – Exploratory Hole Rationale

Exploratory hole(s)	Response Zone (m)	Target
TP101	n/a	General site coverage.
TP102	n/a	Adjacent to historical borehole with high methane concentrations.
TP103	n/a	Delineation of buried topsoil.
TP104	n/a	
TP105	n/a	General site coverage.
TP106	n/a	
TP107	n/a	
TP108	n/a	
WS101	1.0-3.0	Delineation of high methane concentrations.
WS102	2.0-4.0	
WS103	1.0-4.0	General site coverage.
WS104	1.5-3.5	

A summary of ground conditions encountered during the November 2017 ground investigation is provided in Table 2. Borehole logs are provided in Appendix B, with site photographs included in Appendix C.

Table 2 – Summary of Ground Conditions				
Depth (m bgl)		**Exploratory holes identified**	**Soil type**	**General description/comments**
Top depth range	**Base depth range**			
Ground level	0.2-0.3	TP101-TP108. WS101-WS104.	Topsoil	Silty gravelly clay. [TOPSOIL]
0.2-0.3	0.6-0.7	TP101-TP106, TP108. WS101-WS104.	Made Ground	Firm to stiff bluish grey mottled orangish brown gravelly clay.
0.6-2.7	0.3-4.6	TP101-TP106, TP108. WS101-WS104.	Made Ground	Soft, firm and stiff dark grey clay with organic material.
1.2 - 2.7	1.3 – 3.4	TP102, TP103, TP105, TP106, TP108, WS101	Relict Topsoil	Dark brown and black clay with roots and rootlets.
0.2-4.6	>2.0-5.0	TP104-TP107. WS101-WS104.	Natural Ground	Stiff and very stiff orangish brown, bluish grey and dark grey gravelly clay. Extremely weak mudstone. [CHARMOUTH MUDSTONE FORMATION]

No visual or olfactory evidence of contamination was noted. Relict topsoil was encountered across the majority of the site within TP102, TP103, TP05, TP106, TP108 and WS101, ranging in depth between 1.20mbgl and 3.40mbgl. Relict topsoil was only identified within WS2 in the third-party investigation (1.45-1.55mbgl) which correlates with the depth of relict topsoil encountered within TP08 (1.20-1.30mbgl) in the same area.

Within TP02, the wood, twigs and plastic were encountered at depth (2.70mbgl) which indicates that the material above has been placed there relatively recently. The clay material above appears to be naturally derived as the descriptions match the natural strata encountered across the rest of the site. These observations, along with the large gradient change across the site indicate that reprofiling of the site has taken place in the past.

Selected soil samples from the investigation were forwarded to The Environmental Laboratory Ltd, a UKAS and MCERTS accredited laboratory for analysis for Total Organic Carbon. The concentrations of Total Organic Carbon (TOC) range between 0.3-1.1% which is a relatively low concentration for an organic material such as buried topsoil. Complete chemical results are provided in Appendix D.

Groundwater was not encountered during drilling. Groundwater levels were recorded during gas monitoring visits, as summarised in Table 3. Groundwater was recorded between 54.8 and 61.9 metres Above Ordnance Datum (mAOD). Saturated ground was encountered during several monitoring visits, with surface water also observed within the moat area. A selection of photos is provided in Appendix C.

Table 3 – Summary of Groundwater Elevations														
Monitoring Well ID	**Screened Geological Unit**	**05/12/17**		**22/12/17**		**03/01/18[b]**		**16/01/18 [b]**		**30/01/18**		**13/02/18**		**Comment**
		mbgl	**mAOD**	**mbgl**	**mAOD**	**mbgl**	**mAOD**	**mbgl**	**mAOD**	**mbgl**	**mAOD**	**mbgl**	**mAOD**	
WS1	Made ground	NR	NR	2.60	55.84	0.70	57.74	0.80	57.64	1.08	57.36	-[a]	-[a]	-
WS3	Made ground	1.65	58.31	1.56	58.40	0.85	59.11	0.92	59.04	0.30	59.96	0.24	59.72	-
WS5	Made ground	NR	NR	-[a]	-[a]	0.36	61.54	0.45	61.45	0.43	61.90	0.15	61.75	-
WS8	Made ground	2.53	55.01	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	-[a]	Monitoring well flooded from surface water. Oily scum observed during 5th and 6th monitoring rounds which may be organic residue. No hydrocarbon odour recorded.
WS101	Relict topsoil/ Charmouth Mudstone	NR	NR	0.60[c]	57.26	0.48 [c]	57.38	0.52 [c]	57.34	0.32 [c]	57.54	0.10 [c]	57.76	-
WS102	Relict topsoil/ Charmouth Mudstone	3.77	54.79	3.10	55.46	1.50 [c]	57.06	2.50	56.06	-[a]	-[a]	0.11 [c]	58.45	-
WS103	Made ground	3.76	55.62	-[a]	-[a]	0.05 [c]	59.33	0.05 [c]	59.33	0.18 [c]	59.20	0.11 [c]	59.27	-
WS104	Relict topsoil/ Charmouth Mudstone	NR	NR	2.60	57.16	0.55 [c]	59.21	0.65 [c]	59.11	0.24 [c]	59.92	0.16 [c]	59.60	-

a Water level recorded above top of monitoring installation due to surface water flooding.
b Water levels reported prior to bailing, which was carried out to remove surface water/lower water levels.
c Water level recorded above slotted pipe section.
NR – Groundwater not recorded.

Ground Gas Monitoring

T&P attended site on 6N° separate occasions over a three-month period (December 2017 to February 2018) to monitor ground gases from initial ground gas monitoring wells (WS1, WS4, WS5 and WS8) and the supplementary installations (WS101-WS104). The monitoring schedule is summarised in Table 3.

Gas monitoring was undertaken using a hand held Infrared Gas Analyser with integral flow measuring capability. Concentrations of methane, hydrogen sulphide, carbon dioxide and oxygen were recorded from the standpipes along with gas flow rates, atmospheric pressure and general weather conditions. Volatile compounds were measured using a Photo-Ionisation Detector (PID).

Monitoring wells were found to be submerged under surface water on a number of occasions which prohibited completion of gas monitoring. On other occasions, where water levels within monitoring installations were recorded above the top of the slotted pipe section, water was removed via bailer. The bung was replaced following bailing for a minimum of 30 minutes before gas monitoring was completed.

Results

Monitoring was completed between December 2017 and February 2018. Complete soil gas monitoring records are included in Appendix E and summarised below:

- Atmospheric pressure conditions were recorded between 1035mB and 994mB during the monitoring period. The fist and fourth monitoring rounds were conducted during falling pressure conditions, with the remainder generally in rising conditions.
- Peak methane concentrations were recorded to be generally below instrument detection level (<0.1% v/v) in the majority of monitoring wells, with the exception of WS01 and WS102, located to the south of the scheduled monument. In WS01 a peak and steady value of 54% by volume was encountered during the second monitoring visit, with a steady value of 29.5% by volume on the first monitoring visit. In WS102 a peak value of 0.4% was measuring during the first visit, with all other occasions recording results below detection limit.
- Carbon dioxide levels were found to range from instrument detection level (<0.1%v/v) up to 17.0% by volume with the highest values recorded in WS01 located in the central part of the site. Levels of carbon dioxide were greater than 5% in WS03, WS101 and WS102 during the first and second monitoring rounds. All other results were recorded to be below 5% in all other monitoring well locations.
- Oxygen levels were found to vary between 9.8% and 21.4% by volume.
- Hydrogen sulphide concentrations were all found to be below instrument detection level (<0.1 parts per million (ppm)) with the exception of WS01, where a peak value of 19.5 ppmv was recorded during the first monitoring round only.
- Peak soil gas flow rates were recorded to range between instrument detection level (0.1litres/hour (l/h)) and 29.8l/h. The maximum peak flow rate was recorded

in WS01 during the first monitoring round, which correspondingly reduced to 11l/hr steady flow. Steady flow rates of 2.4 and 8.1l/hr were also recorded in WS03 and WS08 respectively during the second monitoring round. Negative flow rates were frequently recorded, which are likely to be associated with higher pressure conditions or windy conditions. Furthermore, gas flows are anticipated to be significantly influenced by variation in groundwater recorded during the monitoring period, and as such, recorded flows may not be indicative of significant gas generation, rather a response to changing pressure conditions.

- PID readings were generally low, with the exception of WS101 when a reading of 51ppm was encountered during the first visit. In addition, erroneously high readings were recorded in WS102 during two monitoring visits, which may be due to instrument interference due to high moisture content. As such, these results have been discounted as reliable.

Risk assessment

The following section provides an assessment and discussion of the risks posed to sensitive human receptors (future residents) from on-site sources of soil gas.

<u>Carbon dioxide and methane</u>

Guideline gas screening values (GSV) (Q_{hg}) for methane and carbon dioxide concentrations recorded at the site can be considered through calculation of the hazardous gas flow rate (Q_{hg}) in accordance with BS8485:2015 (*Code of Practice for the characterization and remediation from ground gas in affected development - 2007)* and CIRIA 665 (*Assessing risks posed by hazardous ground gases for buildings - 2007)* using the following equation:

$$Q_{hg} = \frac{C_{hg}}{100} \times q$$

Where 'C_{hg}' is the gas concentration measured as a percentage and 'q' is the flow rate in litres per hour (l/h). This calculation is undertaken separately for both carbon dioxide and methane in accordance with NHBC guidance[3]. The maximum Q_{hg} is considered for methane along with the peak flow rate, given the worst potential consequence of methane build up is explosion. For assessment of carbon dioxide, the steady state conditions are considered, as the build up of carbon dioxide would occur over time. Where no gas or flow is detected the gas detector limit of 0.1l/hr is employed in the calculation for conservatism. As a precautionary approach, peak flow rates have been utilised in these calculations, to determine a worst case GSV for each monitoring well individually. Where negative flow rates were measured, the instrument detection level has been utilised.

$$Q_{hg} \text{ (GSV)} – \text{methane} = 9.98 \text{ (WS01)}$$

[3] NHBC – Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present. Report Edition 04. 2007.

Q_{hg} (GSV) – carbon dioxide = 4.92 (WS01)

Results have been assessed against the NHBC traffic light classification scheme for a low-rise housing scheme.

With the exception of WS01, on the first monitoring round, all calculated GSVs were consistent with a "green" classification. GSVs for methane and carbon dioxide during the first round are classified as "red". This is consistent with the results of previous gas monitoring conducted by Integrale in 2017 which also identified results in WS01 consistent with a "red" classification. The closest monitoring wells installed during the supplementary investigation are WS101 and WS102, which do not record the same elevated results, supporting an assessment that this is a localised occurrence.

Maximum reported concentration of methane was 54%v/v and 33.5%v/v in WS01 during the second and first monitoring rounds respectively, both of which exceed the typical maximum concentration for a red site. Elsewhere on-site, concentrations were recorded as a maximum of 2.7%v/v or below detection limit. These results are consistent with previous findings.

Besides WS01, encountered concentrations of carbon dioxide were also above 5%v/v in WS101, WS102 during the first and second monitoring rounds, with steady state concentrations between 5.2 and 9.0%v/v, which are consistent with an Amber 1/2 classification. WS101 and WS102 are located in close proximity to WS01.

Carbon monoxide and hydrogen sulphide

In terms of carbon monoxide and hydrogen sulphide the guidance documents do not advocate the generation of a GSV with a more site-specific risk assessment required where these compounds are identified to be present at significant concentrations.

With the exception of an elevated result of hydrogen sulphide at 18.0 % ppmv in WS01 in the first monitoring round, no concentrations were recorded greater than the detection limit during all monitoring rounds. This result corresponds with very low oxygen results <10%v/v).

Discussion

Previous ground investigation identified the presence of localised buried topsoil in WS2 at 1.45-1.55mbgl in the south of the site. Elsewhere, approximately 3m of made ground comprising gravelly silty clay with localised organic content was identified. Alluvium was recorded within WS2 and WS8, with occasional organic fragments and wood.

Supplementary ground investigation by T&P established the presence of a generally site wide layer of relict topsoil with corresponding organic odour within TP101, TP102, TP103, TP105, TP106 and TP108 at between 1.2 and 3.1mbgl. In consideration of the adjacent M5 motorway and site topography, it is likely that cuttings from construction works were placed on the site above existing topsoil. With the exception of WS01, monitoring results and calculated GSVs across the site are consistent with a “green” classification. However, elevated levels of carbon dioxide in WS01, WS101 and WS102 which would correspond with an Amber 1/2 classification. Furthermore, marginally elevated levels of carbon dioxide were also recorded in WS03 in the south-east of the site at a steady level of 5.2% in the second monitoring round only. However, previous monitoring results showed levels of 8.5% and 7.2%, which would be consistent with an Amber 1 classification.

Given the general absence of significant gas flow and significantly elevated ground gas concentrations across the wider monitoring network at the site, it is considered unlikely that made ground/relict topsoil is a significant ongoing source of ground gases. This is further supported by chemical results which suggest a low organic content, with a maximum value of 1.9%, and an average value of 0.89%.

However, in TP102, located adjacent to WS01 where high methane and carbon dioxide results were recorded, the presence of wood and plastic was recorded at approximately 2.7mbgl, which corresponds with the findings in WS01. In consideration of the localised nature of the elevated methane and carbon dioxide, it is considered possible that a local source of physically distinct infilled ground may be generating elevated concentrations of hazardous ground gases which warrants further investigation.

It is noted that shallow groundwater/surface water flooding was encountered during later gas monitoring rounds, whereby water levels were above screened sections in monitoring wells. Where possible, water levels were lowered through bailing, although due to ingress of surface water in some instances, it was not possible to lower levels to be the slotted screen. As such, caution is recommended in interpreting these results, as an overburden of saturated ground gas influence ground gas migration.

Conclusions and Recommendations

Supplementary investigation and ground gas monitoring has been completed with the aim of investigating the source of previously identified elevated methane and carbon dioxide in the vicinity of WS1 to the south of the moat to inform further assessment of the ground gas regime at the site. Additional monitoring has confirmed elevated results consistent with a “red” classification to be limited to WS1, with results in nearby WS101 and WS102 showing results consistent with Amber 1/2. The next closest monitoring well WS103 showed results consistent with a “green” classification. Furthermore, locally elevated carbon dioxide was recorded in WS3, but which were lower in WS104. On this basis, as a precautionary approach, it is considered appropriate to consider the south-east area as requiring Amber 1 gas protection. Indicative zoning of the site from the perspective of gas protection requirements is provided in Appendix A.

Supplementary investigation of the source of elevated gases in the vicinity of WS01 is recommended to support this assessment, which it is anticipated could comprise excavation of trial pits in the vicinity of WS01. In the event of establishing/delineating a source, removal of this material may enable downgrading/reduction/removal of the “red” zone. Alternatively, it may be possible to review the development masterplan in light of these results, to site sensitive development at an appropriate distance from the designated “red” zone to provide suitable risk mitigation. At the same time, incorporation of gas protection measures in line with an Amber 2 classification within closest plots may be recommended as a precaution.

Given the presence of shallow groundwater/surface water flooding encountered during gas monitoring, and the limitations this presented to completion of gas monitoring across all 6N° monitoring rounds, it is also recommended that supplementary monitoring is undertaken, in the form of continuous down-hole monitoring during dryer months when flooding has receded or alternatively placement of flux boxes to measure ground gas release at surface to confirm these conclusions and to refine remedial recommendations.

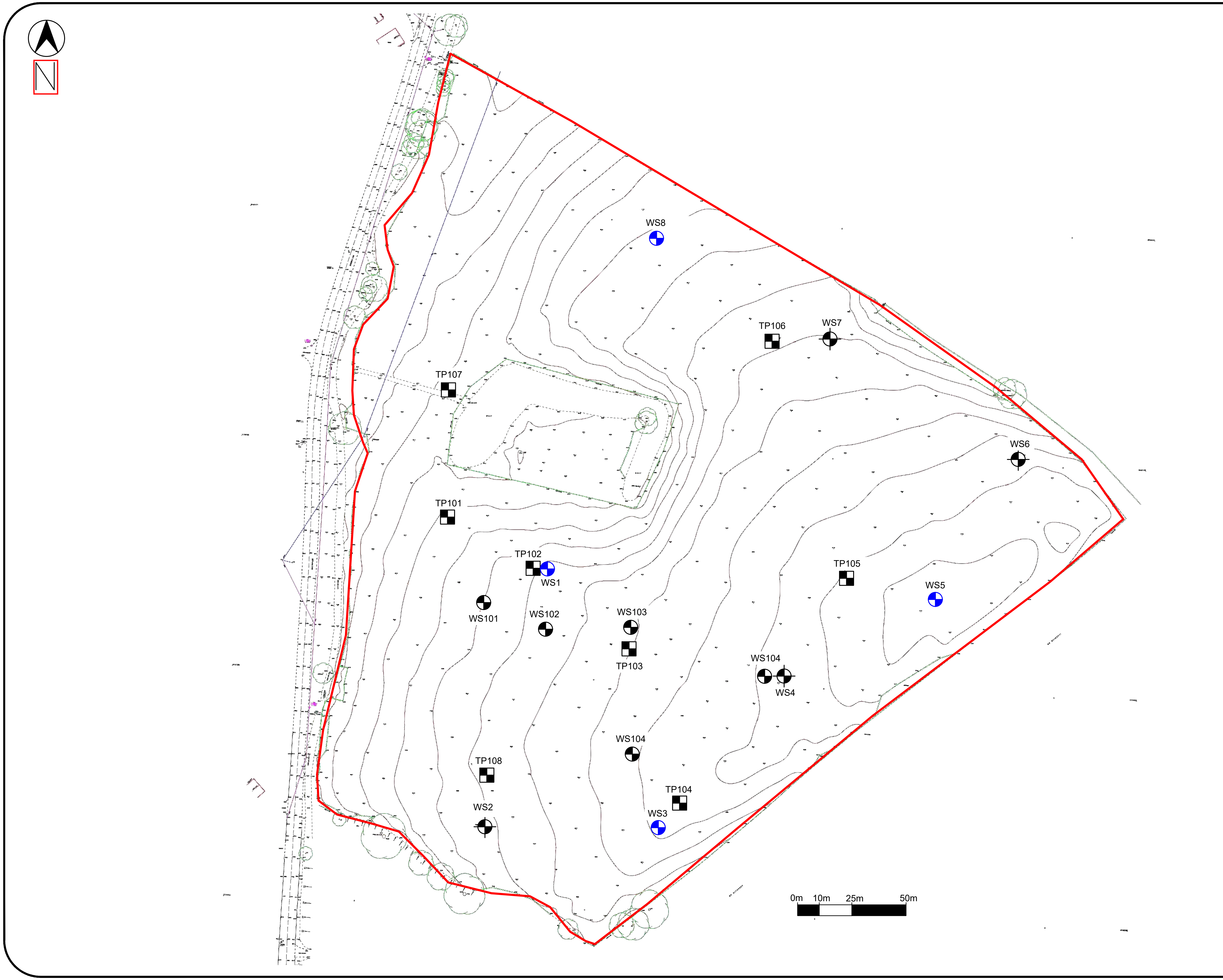
Should you have any further queries please do not hesitate to contact us.

Yours sincerely,

[redacted]

Appendix A – Drawings
Appendix B – Exploratory Logs
Appendix C – Photographs
Appendix D – Chemical Results
Appendix E – Ground Gas Monitoring Records

Appendix A – Drawings



Key:

- Site Boundary
- Trial Pit Locations (T&P Investigation Nov '17)
- Window Sample Locations (T&P Investigation Nov '17)
- Ground Gas Monitoring Wells (Integrale Investigation May '17)
- Window Sample Locations (Integrale Investigation May '17)

Rev.	Date	Amendment	Drawn	Checked

Base map source:K.J. Hall Surveys Ltd
Dwg No: 170105/1
Date: Feb 2017

T&P Regen

Unit 4 Brunel Lock Development, Smeaton Road, Bristol, BS1 6SE

Tel: [redacted]

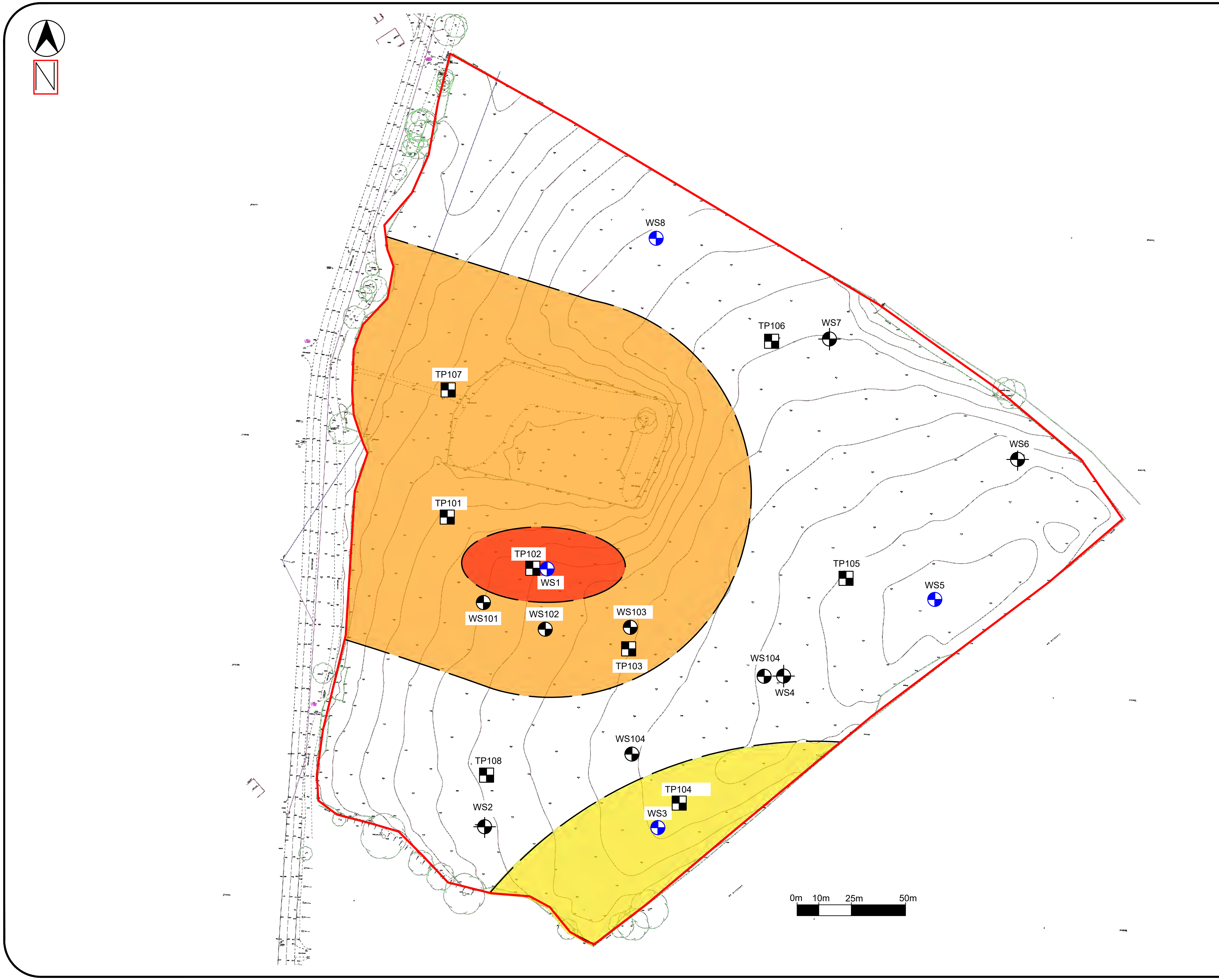
Project Name: Snow Capel Farm, Matson

Drawing Title: Exploratory Hole Plan

Client: Edward Ware Homes

Drawn by	Checked by	Date	Scale
LM	SB	21/03/2018	SBAR

Drawing No.	Rev.
SNO1877A_01-001	-



Key:

- Site Boundary
- Trial Pit Locations (T&P Investigation Nov '17)
- Window Sample Locations (T&P Investigation Nov '17)
- Ground Gas Monitoring Wells (Integrale Investigation May '17)
- Window Sample Locations (Integrale Investigation May '17)
- Inferred Boundary

NHBC Traffic Light Classification (NHBC, 2007)

- Red
- Amber 2
- Amber 1

- Remainder of site classified as "green" whereby no gas protection required.
- Zones are indicative only and should be recieved upon finalisation of master planning and completion of supplementary investigation/monitoring as required.

Note:
WS2,4,6 and 7 are not geo-located.

Rev.	Date	Amendment	Drawn	Checked

Base map source:K.J. Hall Surveys Ltd
Dwg No: 170105/1
Date: Feb 2017

T&P Regen

Unit 4 Brunel Lock Development, Smeaton Road, Bristol, BS1 6SE
Tel: [redacted]

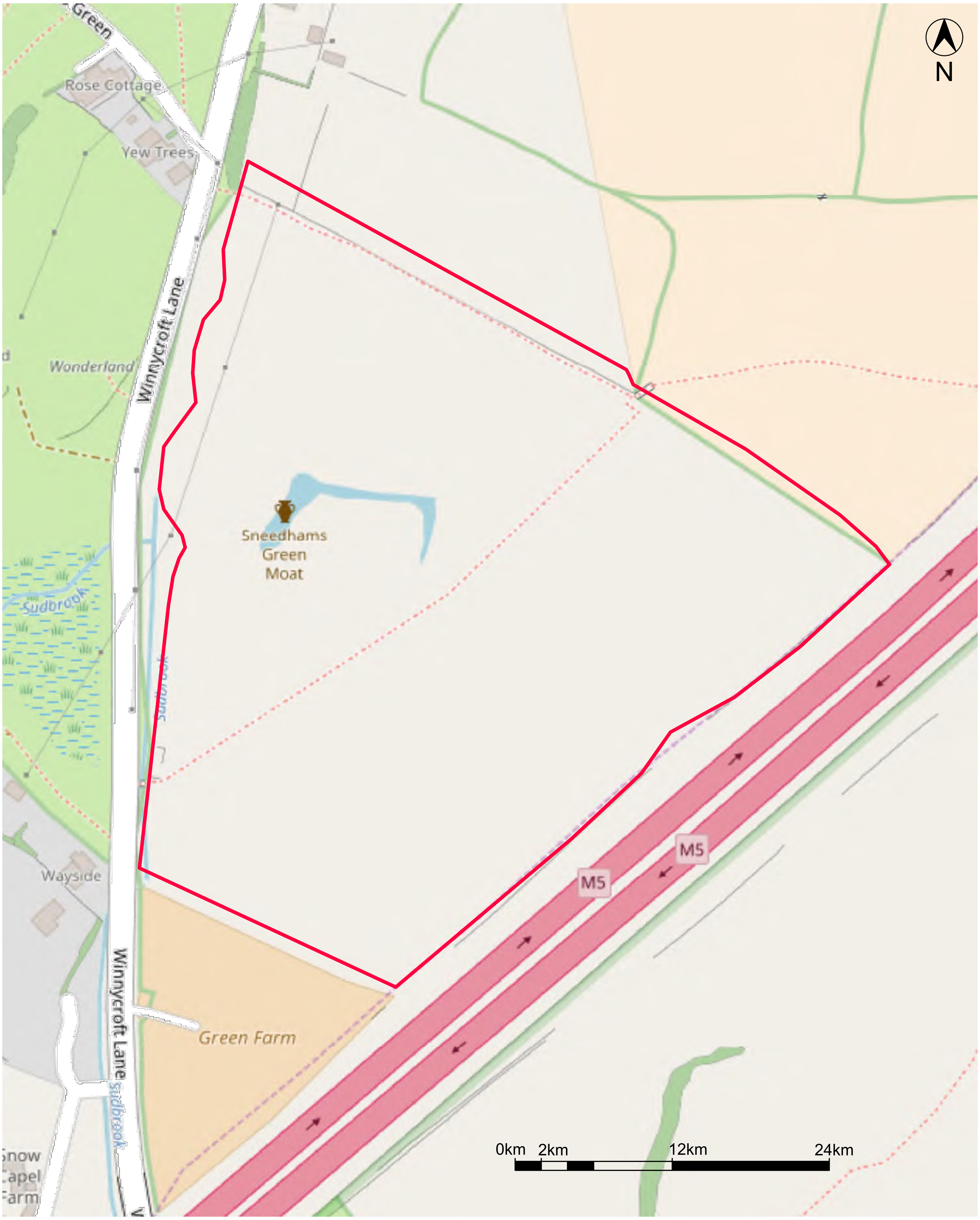
Project Name
Snow Capel Farm, Matson

Drawing Title
Indicative Gas Protection Zones

Client
Edward Ware Homes

Drawn by	Checked by	Date	Scale
LM	SB	21/03/2018	SBAR

Drawing No.	Rev.
SNO1877A_01-002	-



Rev.	Date	Amendment	Drawn	Checked

Project Name	Snow Capel, Matson	Client	Edward Ware Homes	
Drawing Title	Site Location Plan	Drawn by: LM	Checked by: SH	Date: 23/11/2017
		Scale: S-BAR	Drawing No.: SNO1877_01-SLP1	Rev.: -

T&P Regen

Unit 4 Brunel Lock Development, Smeaton Road, Bristol, BS1 6SE

Tel: [redacted] *Fax: 0117 927 6309*

Appendix B – Exploratory Logs

T&P Regen

www.tandpregeneration.co.uk

Trial Pit Log

Contract Name:	Client:	Trial Pit ID:
Snow Capel	Edward Ware Homes	TP101

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
SNO1877a	28/11/2017	SB	JF	FINAL	

Easting:	Northing:	Ground Level:	Plant Used:	Print Date:	Scale:
385027	214169	56.90mOD	JCB 3CX	04/12/2017	1:25

Weather: Sunny | Termination: Target depth achieved | Stability: Stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		
			56.60	(0.30) 0.30		MADE GROUND: Brown silty CLAY with rootlets. (Topsoil)		
			55.50	(1.10) 1.40		MADE GROUND: Stiff bluish grey mottled orangish brown slightly gravelly CLAY. Gravel is sub-angular fine to coarse of limestone.		
2.00 - 2.20	ES1		54.50	(1.00) 2.40		MADE GROUND: Stiff dark grey CLAY with pockets (10mm) of organic material.		
						End of Trial Pit at 2.40m		

Depth scale: 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Remarks:

Groundwater not encountered.

Dimensions:

Length:

Width:

Orientation: °

Groundwater Details

Depth encountered (m)	Remarks

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel			Client: Edward Ware Homes		Trial Pit ID: TP102
	Contract Number: SNO1877a	Date Started: 28/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 385069	Northing: 214146	Ground Level: 58.40mOD	Plant Used: JCB 3CX	Print Date: 04/12/2017	Scale: 1:25

Weather: Sunny | Termination: Target depth achieved | Stability: Stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		
			58.10	(0.30) 0.30		MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
			55.70	(2.40) 2.70		MADE GROUND: Stiff orangish brown mottled bluish grey slightly gravelly CLAY. Gravel is sub-angular fine to coarse of mudstone.		
			55.40	(0.30) 3.00		MADE GROUND: Firm dark bluish grey CLAY with wood, twigs and plastic. (Relict Topsoil) *Between 2.70-3.00mbgl: Strong organic odour.*		
						End of Trial Pit at 3.00m		

Depth scale: 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Remarks:

Groundwater not encountered.

Dimensions:

Length:

Width:

Orientation: °

Groundwater Details

Depth encountered (m)	Remarks

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel		Client: Edward Ware Homes			Trial Pit ID: TP103
	Contract Number: SNO1877a	Date Started: 28/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 385111	Northing: 214108	Ground Level: 59.47mOD	Plant Used: JCB 3CX	Print Date: 04/12/2017	Scale: 1:25

Weather: Sunny | Termination: Target depth achieved | Stability: Stable

Samples & In Situ Testing			Strata Details					
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water	Backfill
				(0.30)		MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
			59.17	0.30 (2.40)		MADE GROUND: Stiff orangish brown mottled bluish grey slightly gravelly CLAY. Gravel is sub-angular fine to coarse of mudstone and pottery.		
3.00 - 3.40	ES1		56.77	2.70 (0.70)		MADE GROUND: Stiff bluish grey slightly gravelly CLAY. Gravel is sub-angular fine to coarse of mudstone. Occasional pockets of black organic material. (Relict Topsoil) *Between 2.70-3.40mbgl: Strong organic odour.*		
			56.07	3.40		End of Trial Pit at 3.40m		

Depth scale: 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Remarks:

Groundwater not encountered.

Dimensions:

Length:

Width:

Orientation: °

Groundwater Details

Depth encountered (m)	Remarks

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel		Client: Edward Ware Homes			Trial Pit ID: TP104 Sheet 1 of 1
	Contract Number: SNO1877a	Date Started: 28/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	
Trial Pit Log	Easting: 385134	Northing: 214037	Ground Level: 60.20mOD	Plant Used: JCB 3CX	Print Date: 04/12/2017	Scale: 1:25

Weather: Sunny | Termination: Target depth achieved | Stability: Stable

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Water	Backfill
			60.00	0.20	MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
			59.60	(0.40) 0.60	MADE GROUND: Firm orangish brown silty CLAY.		
1.00 - 1.20	ES1		57.20	(2.40) 3.00	MADE GROUND: Soft dark grey CLAY. *Between 0.60-3.00mbgl: Strong organic odour.*		
			56.80	(0.40) 3.40	Stiff orangish brown and bluish grey mottled CLAY.		
					End of Trial Pit at 3.40m		

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Remarks:

Groundwater not encountered.

Dimensions:

Length:

Width:

Orientation: °

Groundwater Details

Depth encountered (m)	Remarks

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel		Client: Edward Ware Homes			Trial Pit ID: TP105 Sheet 1 of 1
	Contract Number: SNO1877a	Date Started: 28/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	
Trial Pit Log	Easting: 385211	Northing: 214141	Ground Level: 61.30mOD	Plant Used: JCB 3CX	Print Date: 04/12/2017	Scale: 1:25

Weather: Sunny | Termination: Target depth achieved | Stability: Stable

Samples & In Situ Testing			Strata Details					
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water	Backfill
			61.10	0.20		MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
			59.40	(1.70) 1.90		MADE GROUND: Stiff orangish brown mottled bluish grey CLAY.		
2.00 - 2.20	ES1		58.70	(0.70) 2.60		MADE GROUND: Firm dark bluish grey CLAY. (Relict Topsoil) *Between 1.90-2.60mbgl: Slight organic odour.*		
			57.90	(0.80) 3.40		Stiff bluish grey mottled orangish brown CLAY with sub-angular to sub-rounded fine to coarse gravel sized mudstone lithoreltics. (CHARMOUTH MUDSTONE FORMATION)		
						End of Trial Pit at 3.40m		

Depth scale (m): 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Remarks:

Groundwater not encountered.

Dimensions:

Length:

Width:

Orientation: °

Groundwater Details

Depth encountered (m)	Remarks

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel		Client: Edward Ware Homes			Trial Pit ID: TP106 Sheet 1 of 1
	Contract Number: SNO1877a	Date Started: 28/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	
Trial Pit Log	Easting: 385177	Northing: 214250	Ground Level: 58.93mOD	Plant Used: JCB 3CX	Print Date: 04/12/2017	Scale: 1:25

Weather: Sunny | Termination: Target depth achieved | Stability: Stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		
			58.73	0.20		MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
				(0.60)		MADE GROUND: Stiff orangish brown mottled bluish grey CLAY.		
			58.13	0.80				
				(0.70)		MADE GROUND: Firm dark grey CLAY.		
1.50 - 1.60	ES1		57.43	1.50		MADE GROUND: Dark grey CLAY with roots and rootlets. (Relict Topsoil) *Between 1.50-1.60mbgl: Slight organic odour.*		
			57.33	1.60				
				(1.10)		Stiff orangish brown mottled bluish grey CLAY with sub-angular fine to coarse gravel sized mudstone lithorelicts. (CHARMOUTH MUDSTONE FORMATION)		
			56.23	2.70		End of Trial Pit at 2.70m		

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Remarks:
Groundwater not encountered.

Dimensions:
Length:
Width:
Orientation: °

Groundwater Details

Depth encountered (m)	Remarks

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel		Client: Edward Ware Homes			Trial Pit ID: TP107 Sheet 1 of 1
	Contract Number: SNO1877a	Date Started: 28/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	
Trial Pit Log	Easting: 385028	Northing: 214228	Ground Level: 55.95mOD	Plant Used: JCB 3CX	Print Date: 04/12/2017	Scale: 1:25

Weather: Sunny	Termination: Target depth achieved	Stability: Stable

Samples & In Situ Testing			Strata Details				Water	Backfill
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description		
						MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
			55.75	0.20		Stiff dark grey gravelly CLAY. Gravel is sub-angular fine to coarse of limestone and shell fragments. (CHARMOUTH MUDSTONE FORMATION)		
				(0.60)				
			55.15	0.80		Firm orangish brown mottled bluish grey gravelly CLAY with sub-angular fine to coarse mudstone lithorelicts. (CHARMOUTH MUDSTONE FORMATION)		
				(1.20)				
			53.95	2.00		Stiff dark bluish grey mottled orangish brown laminated CLAY with sub-angular fine to coarse gravel sized mudstone lithorelicts. Frequent pockets of sand sized gypsum crystals. (CHARMOUTH MUDSTONE FORMATION)		
				(0.70)				
			53.25	2.70		End of Trial Pit at 2.70m		

1
2
3
4
5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Remarks:

Groundwater not encountered.

Dimensions:

Length:

Width:

Orientation: °

Groundwater Details

Depth encountered (m)	Remarks

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel			Client: Edward Ware Homes		Trial Pit ID: TP108
	Contract Number: SNO1877a	Date Started: 28/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	Sheet 1 of 1
Trial Pit Log	Easting: 385045	Northing: 214050	Ground Level: 58.25mOD	Plant Used: JCB 3CX	Print Date: 04/12/2017	Scale: 1:25

Weather: Sunny | Termination: Target depth achieved | Stability: Stable

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water	Backfill
			58.05	0.20		MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
			57.05	(1.00) 1.20		MADE GROUND: Firm orangish brown slightly gravelly CLAY. Gravel is fine to coarse of limestone, mudstone and shell fragments.		
			56.95	1.30		MADE GROUND: Dark brown and black CLAY with roots and rootlets. (Relict Topsoil) *Between 1.20-1.30mbgl: Slight organic odour.*		
			56.15	(0.80) 2.10		Firm to stiff orangish brown mottled bluish grey CLAY. (CHARMOUTH MUDSTONE FORMATION)		
						End of Trial Pit at 2.10m		

Depth scale: 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Remarks:

Groundwater not encountered.

Dimensions:

Length:

Width:

Orientation: °

Groundwater Details

Depth encountered (m)	Remarks

T&P Regen
www.tandpregeneration.co.uk

Windowless Sample Borehole Log	Contract Name: Snow Capel		Client: Edward Ware Homes			Borehole ID: WS101
	Contract Number: SNO1877a	Date Started: 29/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	Sheet 1 of 1
	Easting: 385044	Northing: 214130	Ground Level: 57.86mOD	Plant Used: Terrier Rig	Print Date: 04/12/2017	Scale: 1:25

Weather: Frosty | Termination: Target depth achieved

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Water Strike	Backfill / Installation
		0.00 - 1.00 = 95%		57.66	0.20	MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
		1.00 - 2.00 = 90%			(2.00)	MADE GROUND: Stiff orangish brown and bluish grey slightly gravelly CLAY. Gravel is sub-angular fine to coarse of mudstone with sand sized gypsum crystals.		
1.80 - 2.00	ES1	2.00 - 3.00 = 90%						
2.20 - 2.40	ES2			55.66	2.20			
				55.46	2.40	MADE GROUND: Firm black mottled dark grey CLAY with roots and rootlets. (Relict Topsoil) *Between 2.20-2.40mbgl: Strong organic odour.*		
2.50 - 2.60	ES3	3.00 - 4.00 = 95%			(1.60)	Stiff orangish brown and bluish grey CLAY. (CHARMOUTH MUDSTONE FORMATION)		
				53.86	4.00	End of Borehole at 4.00m		

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter Depth (m)	Borehole Diameter Dia (mm)	Casing Diameter Depth	Casing Diameter Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	3.00	SLOTTED	50

Remarks:
Groundwater not encountered.

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel			Client: Edward Ware Homes		Borehole ID: WS102
	Contract Number: SNO1877a	Date Started: 29/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	Sheet 1 of 1
Windowless Sample Borehole Log	Easting: 385072	Northing: 214118	Ground Level: 58.56mOD	Plant Used: Terrier Rig	Print Date: 04/12/2017	Scale: 1:25
Weather: Frosty		Termination: Target depth achieved				

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description
		0.00 - 1.00 = 100%		58.36	0.20	MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)
		1.00 - 2.00 = 100%		56.76	(1.60) 1.80	MADE GROUND: Stiff orangish brown mottled bluish grey slightly gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone.
1.40 - 1.60	ES1					
		2.00 - 3.00 = 95%		55.46	(1.30) 3.10	MADE GROUND: Firm bluish grey CLAY with occasional rootlets. *Between 1.80-3.10mbgl: Slight organic odour.*
2.20 - 2.40	ES2					
		3.00 - 4.00 = 90%		54.76	(0.70) 3.80	Stiff orangish brown mottled bluish grey CLAY with sub-angular fine to coarse mudstone lithorelicts. (CHARMOUTH MUDSTONE FORMATION)
3.20 - 3.40	ES3					
				54.56	4.00	Very stiff dark grey CLAY with sub-angular fine to coarse mudstone lithorelicts. (CHARMOUTH MUDSTONE FORMATION)
						End of Borehole at 4.00m

Groundwater: Water Strike | Backfill / Installation

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter Depth (m)	Borehole Diameter Dia (mm)	Casing Diameter Depth	Casing Diameter Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	2.00	PLAIN	50
2.00	4.00	SLOTTED	50

Remarks:
Groundwater not encountered.

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel			Client: Edward Ware Homes		Borehole ID: WS103
	Contract Number: SNO1877a	Date Started: 29/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	Sheet 1 of 1
Windowless Sample Borehole Log	Easting: 385112	Northing: 214118	Ground Level: 59.38mOD	Plant Used: Terrier Rig	Print Date: 04/12/2017	Scale: 1:25

Weather: Frosty | Termination: Target depth achieved

Samples & In Situ Testing				Strata Details				Groundwater	
Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill / Installation
		0.00 - 1.00 = 100%					MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)		
				59.18	0.20		MADE GROUND: Stiff orangish brown mottled bluish grey gravelly CLAY. Gravel is sub-angular fine to coarse of mudstone. *Between 0.20-1.20mbgl: Frequent rootlets and wood fibres.*		
		1.00 - 2.00 = 90%							
					(2.35)				
1.50 - 1.70	ES1								
		2.00 - 3.00 = 75%							
				56.83	2.55		MADE GROUND: Soft bluish grey silty CLAY. *Between 2.60-4.60mbgl: Slight organic odour.*		
2.60 - 2.80	ES2								
		3.00 - 4.00 = 50%							
					(2.05)				
3.80 - 4.00	ES3								
		4.00 - 5.00 = 75%							
				54.78	4.60		Extremely weak orangish brown MUDSTONE with shell fragments. (CHARMOUTH MUDSTONE FORMATION)		
					(0.40)				
				54.38	5.00		End of Borehole at 5.00m		

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	4.00	SLOTTED	50

Remarks:
Groundwater not encountered.

T&P Regen
www.tandpregeneration.co.uk

Windowless Sample Borehole Log

Contract Name: Snow Capel		Client: Edward Ware Homes			Borehole ID: WS104
Contract Number: SNO1877a	Date Started: 29/11/2017	Logged By: SB	Checked By: JF	Status: FINAL	Sheet 1 of 1
Easting: 385112	Northing: 214060	Ground Level: 59.76mOD	Plant Used: Terrier Rig	Print Date: 04/12/2017	Scale: 1:25

Weather: Frosty

Termination: Target depth achieved

Samples & In Situ Testing

Depth	Sample ID	Windowless Sample Recovery	Test Result
		0.00 - 1.00 = 100%	
		1.00 - 2.00 = 100%	
1.20 - 1.40	ES1		
1.50 - 1.70	ES2		
2.00 - 2.20	ES3	2.00 - 3.00 = 100%	
2.60 - 2.80	ES4		
3.00 - 3.20	ES5	3.00 - 4.00 = 100%	

Strata Details

Level (mAOD)	Depth (m) (Thickness)	Strata Description
59.56	0.20	MADE GROUND: Brown silty gravelly CLAY with rootlets. Gravel is sub-angular fine to coarse of mudstone. (Topsoil)
59.36	0.40	MADE GROUND: Stiff orangish brown slightly gravelly CLAY. Gravel is sub-angular fine to coarse of limestone.
58.36	(1.00) 1.40	MADE GROUND: Stiff orangish brown mottled bluish grey slightly gravelly CLAY. Gravel is sub-angular fine to coarse of mudstone with sand sized gypsum crystals.
57.96	(0.40) 1.80	MADE GROUND: Firm bluish grey and black CLAY with pockets (20-30mm) of fibrous organic material and roots. *Between 1.40-1.80mbgl: Slight organic odour.*
57.26	(0.70) 2.50	MADE GROUND: Stiff grey CLAY.
56.86	(0.40) 2.90	MADE GROUND: Stiff dark grey mottled black CLAY. *Between 2.50-2.90mbgl: Slight organic odour.*
55.76	(1.10) 4.00	Stiff orangish brown mottled bluish grey CLAY. (CHARMOUTH MUDSTONE FORMATION)
		End of Borehole at 4.00m

Groundwater: Water Strike | Backfill / Installation

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter / Casing Diameter

Depth (m)	Dia (mm)	Depth	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.50	PLAIN	50
1.50	3.50	SLOTTED	50

Remarks:
Groundwater not encountered.

Appendix C – Photographs

APPENDIX - SITE PHOTOGRAPHS

PLATE 01 – Profile of naturally derived soil – TP102.

PLATE 02 – Twigs and plastic found within TP102.

PLATE 03 – Profile of soils with buried topsoil within WS101.

PLATE 04 – View of saturated ground and surface water flooding around monitoring well installation.

	
PLATE 05 – View of water level in vicinity of moat.	**PLATE 06 – View of water level at top of standpipe in monitoring installation and ingress of surface water.**

Appendix D – Chemical Results

Unit A2
Windmill Road
Ponswood Industrial Estate
St Leonards on Sea
East Sussex
TN38 9BY
[redacted]

THE ENVIRONMENTAL LABORATORY LTD

Analytical Report Number: 17-15293

Issue: 1

Date of Issue: 11/12/2017

Contact: [redacted]

Customer Details: T & P Regeneration Ltd (Smeaton Road)
Unit 4
Brunel Lock Development
Bristol
BS1 6SE

Quotation No: Q15-00390

Order No: 3390-SNO1877a

Customer Reference: SNO1877a

Date Received: 04/12/2017

Date Approved: 11/12/2017

Details: SNO1877a

Approved by: [redacted]

[redacted], Technical Manager

Sample Summary

Report No.: 17-15293

Elab No.	Client's Ref.	Date Sampled	Date Scheduled	Description	Deviations
120569	TP101 2.00 - 2.20	28/11/2017	07/12/2017	Silty clayey loam	
120570	TP103 3.00 - 3.40	28/11/2017	07/12/2017	Silty clayey loam	
120571	TP105 2.00 - 2.20	28/11/2017	07/12/2017	Silty clayey loam	
120572	TP106 1.50 - 1.60	28/11/2017	07/12/2017	Silty clayey loam	
120573	WS101 1.80 - 2.00	29/11/2017	07/12/2017	Silty clayey loam	
120574	WS101 2.20 - 2.40	29/11/2017	07/12/2017	Silty clayey loam	
120575	WS101 2.50 - 2.60	29/11/2017	07/12/2017	Clayey loam	
120576	WS102 1.40 - 1.60	29/11/2017	07/12/2017	Silty clayey loam	
120577	WS102 2.20 - 2.40	29/11/2017	07/12/2017	Silty clayey loam	
120578	WS102 3.20 - 3.40	29/11/2017	07/12/2017	Clayey loam	
120579	WS103 1.50 - 1.70	29/11/2017	07/12/2017	Clayey loam	
120580	WS103 2.60 - 2.80	29/11/2017	07/12/2017	Silty clayey loam	
120581	WS103 3.80 - 4.00	29/11/2017	07/12/2017	Silty clayey loam	
120582	WS104 1.20 - 1.40	29/11/2017	07/12/2017	Silty clayey loam	
120583	WS104 1.50 - 1.70	29/11/2017	07/12/2017	Silty clayey loam	
120584	WS104 2.00 - 2.20	29/11/2017	07/12/2017	Clayey loam	
120585	WS104 2.60 - 2.80	29/11/2017	07/12/2017	Clayey loam	
120586	WS104 3.00 - 3.20	29/11/2017	07/12/2017	Silty clayey loam	

ELAB

Results Summary

Report No.: 17-15293

			ELAB Reference	120569	120570	120571	120572	120573	120574
			Customer Reference						
			Sample ID						
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sample Location	TP101	TP103	TP105	TP106	WS101	WS101
			Sample Depth (m)	2.00 - 2.20	3.00 - 3.40	2.00 - 2.20	1.50 - 1.60	1.80 - 2.00	2.20 - 2.40
			Sampling Date	28/11/2017	28/11/2017	28/11/2017	28/11/2017	29/11/2017	29/11/2017
Determinand	**Codes**	**Units**	**LOD**						
Miscellaneous									
Total Organic Carbon	N	%	0.01	0.42	0.71	1.1	0.61	0.33	0.91

ELAB

Results Summary

Report No.: 17-15293

			ELAB Reference	120575	120576	120577	120578	120579	120580
			Customer Reference						
			Sample ID						
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sample Location	WS101	WS102	WS102	WS102	WS103	WS103
			Sample Depth (m)	2.50 - 2.60	1.40 - 1.60	2.20 - 2.40	3.20 - 3.40	1.50 - 1.70	2.60 - 2.80
			Sampling Date	29/11/2017	29/11/2017	29/11/2017	29/11/2017	29/11/2017	29/11/2017
Determinand	**Codes**	**Units**	**LOD**						
Miscellaneous									
Total Organic Carbon	N	%	0.01	0.36	0.42	0.48	0.37	0.59	0.30

Results Summary

Report No.: 17-15293

			ELAB Reference	120581	120582	120583	120584	120585	120586
			Customer Reference						
			Sample ID						
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sample Location	WS103	WS104	WS104	WS104	WS104	WS104
			Sample Depth (m)	3.80 - 4.00	1.20 - 1.40	1.50 - 1.70	2.00 - 2.20	2.60 - 2.80	3.00 - 3.20
			Sampling Date	29/11/2017	29/11/2017	29/11/2017	29/11/2017	29/11/2017	29/11/2017
Determinand	**Codes**	**Units**	**LOD**						
Miscellaneous									
Total Organic Carbon	N	%	0.01	0.36	0.41	0.49	0.46	0.53	0.41

Tests marked N are not UKAS accredited.

ELAB

Method Summary

Report No.: 17-15293

Parameter	Codes	Analysis Undertaken On	Date Tested	Method Number	Technique
Soil					
Total organic carbon/Total sulphur	N	Air dried sample	11/12/2017	210	IR

Tests marked N are not UKAS accredited

ELAB

Report Information

Report No.: 17-15293

Key

U	hold UKAS accreditation
M	hold MCERTS and UKAS accreditation
N	do not currently hold UKAS accreditation
^	MCERTS accreditation not applicable for sample matrix
*	UKAS accreditation not applicable for sample matrix
S	Subcontracted to approved laboratory UKAS Accredited for the test
SM	Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test
I/S	Insufficient Sample
U/S	Unsuitable sample
n/t	Not tested
<	means "less than"
>	means "greater than"

Soil sample results are expressed on an air dried basis (dried at < 30°C)
Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
PCB congener results may include any coeluting PCBs
Uncertainty of measurement for the determinands tested are available upon request

Deviation Codes

a	No date of sampling supplied
b	No time of sampling supplied (Waters Only)
c	Sample not received in appropriate containers
d	Sample not received in cooled condition
e	The container has been incorrectly filled
f	Sample age exceeds stability time (sampling to receipt)
g	Sample age exceeds stability time (sampling to analysis)

Where a sample has a deviation code, the applicable test result may be invalid.

Sample Retention and Disposal

All soil samples will be retained for a period of one month
All water samples will be retained for 7 days following the date of the test report
Charges may apply to extended sample storage

Appendix E – Ground Gas Monitoring Records

Gas Monitoring Records

Client: **Edward Ware Homes**
Site: **Land east of Snow Capel Farm, Matson**
Date: **05/12/2017**

Job No: SNO1877a
Visit No: 1 **of** **6**
Operator: LM
Project Manager: SB

Monitoring Point	VOLATILES: PID Peak (ppm)	FLOW DATA: Flow rate (l/hr) Peak	Flow rate (l/hr) Steady	Differential borehole Pressure (Pa)	Time for flow to equalise (sec)	GAS CONCENTRATIONS: Methane (%v/v) Peak	Methane (%v/v) Steady	%LEL Peak	%LEL Steady	Carbon dioxide (%v/v) Peak	Carbon dioxide (%v/v) Steady	Carbon monoxide (ppmv) Peak	Carbon monoxide (ppmv) Steady
WS01	0.3	29.8	11	135	180	33.5	29.5	<0.1	<0.1	16.6	16.5	<0.1	<0.1
WS03	<0.1	-0.1	<0.1	0	30	<0.1	<0.1	<0.1	<0.1	5.3	5.2	<0.1	<0.1
WS05	<0.1	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	2.3	2.3	<0.1	<0.1
WS08	<0.1	-0.1	<0.1	0	10	<0.1	<0.1	<0.1	<0.1	2.2	2.2	<0.1	<0.1
WS101	51	-0.1	-0.1	0	20	<0.1	<0.1	<0.1	<0.1	4.5	4.4	<0.1	<0.1
WS102	5000+	-0.2	0.1	0	30	0.4	0.3	<0.1	<0.1	6.4	6.3	6.1	6.1
WS103	<0.1	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	3.7	3.6	<0.1	<0.1
WS104	13.5	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	4.7	4.6	<0.1	<0.1
Max	**51.0**	**29.8**	**11.0**	**135**		**33.5**	**29.5**	**0.0**	**0.0**	**16.6**	**16.5**	**6.1**	**6.1**
Min	**0.3**	**-0.2**	**-0.1**	**0**		**0.4**	**0.3**	**0.0**	**0.0**	**2.2**	**2.2**	**6.1**	**6.1**

Monitoring Point	Hydrogen sulphide (ppmv) Peak	Hydrogen sulphide (ppmv) Steady	Oxygen (%v/v) Min.	Oxygen (%v/v) Steady	Run time (min)	WELL AND WATER DATA: Product thickness (mm)	Water Level pre-bailing (mbgl)	Bailed water level (mbgl)	Minutes passed	Ground level (mAOD)	Water level (mbgl)	Base of well (mbgl)	Water level (mAOD)	Response zone range (m)	Comments
WS01	19.5	18.01	9.8	10.2	4	ND	-	-	-	58.44	ND	2.58	-	0.5-2.7	
WS03	<0.1	<0.1	16.8	16.8	3	ND	-	-	-	59.96	1.65	2.15	58.31	1-2	
WS05	<0.1	<0.1	19.5	19.5	3	ND	-	-	-	61.9	ND	2.95	-	1-3	
WS08	<0.1	<0.1	19.8	19.8	3	ND	-	-	-	57.54	2.53	3.03	55.01	1-3	
WS101	<0.1	<0.1	17.4	17.5	3	ND	-	-	-	57.86	ND	2.89	-	1-3	
WS102	<0.1	<0.1	15.4	15.4	4	ND	-	-	-	58.56	3.77	3.87	54.79	2-4	
WS103	<0.1	<0.1	17	17.1	3	ND	-	-	-	59.38	3.76	3.93	55.62	1-4	
WS104	<0.1	<0.1	16.5	16.5	3	ND	-	-	-	59.76	ND	3.34	-	1.5-3.5	
Max	**19.5**	**18.01**	**19.8**	**19.8**											
Min	**19.5**	**18.01**	**9.8**	**10.2**											

ND - Not detected
NR - Not recorded

METEOROLOGICAL AND SITE INFORMATION: (Put X in front of selected or enter data as applicable)

State of ground:	Dry	Moist	**Wet**	Snow	Frozen
Wind:	**Calm**	Light	Moderate	Strong	
Cloud cover:	None	Slight	Cloudy	**Overcast**	
Preciptation:	None	Slight	Moderate	Heavy	
Time monitoring performed:	Start **09:00**		End **11:00**		
Barometric pressure (mbar):	Start **1035**		End **1034**		
Pressure trend:	**Falling**	Steady	Rising		
Air temperature (degree C):	Before 8		After 8		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter:	GAS DATA LMS xi				
Gas range:	**CH_4:** 0 - 100%	**CO_2:**	0 - 100%	**O_2:**	0 -25%
Gas flow range:	+30/-10 l/hr				
Differential pressure:	+300/-30 Pa				
Date of last calibration:	09/02/2017				
Date of next calibration:	09/02/2018				

PID:	Micro5
Calibrated range:	0-99 ppm
Calibration gas:	Isobutylene
Response time:	2 seconds
Accuracy:	0.1 ppm
Date of last calibration:	13/07/2017
Date of next calibration:	13/07/2018

Gas Monitoring Records

Client: Edward Ware Homes
Site: Land east of Snow Capel Farm, Matson
Date: 22/12/2017

Job No: SNO1877a
Visit No: 2 **of** 6
Operator: CT
Project Manager: SB

	VOLATILES	FLOW DATA				GAS CONCENTRATIONS													WELL AND WATER DATA									
Monitoring Point	PID Peak (ppm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (sec)	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		Run time (min)	Product thickness (mm)	Water Level pre-bailing (mbgl)	Bailed water level (mbgl)l	Minutes passed	Water level (mbgl)	Base of well (mbgl)	Ground level (mAOD)	Water level (mAOD)	Response zone range (m)	Comments
		Peak	Steady			Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady											
WS01	1.1	-3.7	-3.7	-9	10	54	54	<0.1	<0.1	17	16	<0.1	<0.1	<0.1	<0.1	16.7	16.8	2	ND	-	-	-	2.60	3.30	58.44	55.84	0.5-2.7	Water level recorded above top of bung. Water refilled too quickly to enable monitoring to be completed.
WS03	1.8	-0.1	<0.1	0	10	<0.1	<0.1	<0.1	<0.1	5	4.9	<0.1	<0.1	<0.1	<0.1	17.9	17.9	2	ND	-	-	-	1.56	2.20	59.96	58.40	1-2	
WS05	NR	NR	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	-	ND	-	-	-	-	2.95	61.90	-	1-3	Water level recorded above top of bung.
WS08	NR	NR	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	-	ND	-	-	-	-	3.03	57.54	-	1-3	Water level recorded above top of bung.
WS101	14.9	0.5	0.2	0	30	<0.1	<0.1	<0.1	<0.1	7.9	7.7	<0.1	<0.1	<0.1	<0.1	13.7	13.7	3	ND	-	-	-	0.60	2.95	57.86	57.26	1-3	
WS102	5000+	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	9.1	9	<0.1	<0.1	<0.1	<0.1	14.3	14.3	3	ND	-	-	-	3.10	3.99	58.56	55.46	2-4	
WS103	NR	NR	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	-	ND	-	-	-	-	3.93	59.38	-	1-4	Water level recorded above top of bung.
WS104	4.3	-0.1	-0.1	0	10	<0.1	<0.1	<0.1	<0.1	5	4.7	<0.1	<0.1	<0.1	<0.1	16.7	16.8	2	ND	-	-	-	2.60	3.30	59.76	57.16	1.5-3.5	PID took a long time to stabilise.
Max	**14.9**	**0.5**	**0.2**	**0**		**54.0**	**54.0**	**0.0**	**0.0**	**17.0**	**16.0**	**0**	**0**	**0**	**0**	**17.9**	**17.9**											
Min	**1.1**	**-3.7**	**-3.7**	**-9**		**54.0**	**54.0**	**0.0**	**0.0**	**5.0**	**4.7**	**0**	**0**	**0**	**0**	**13.7**	**13.7**											

ND - Not detected
NR - Not recorded

METEOROLOGICAL AND SITE INFORMATION: (Put X in front of selected or enter data as applicable)

State of ground:	Dry		Moist	**Wet**		Snow	Frozen
Wind:	Calm		**Light**	Moderate		Strong	
Cloud cover:	None		Slight	**Cloudy**		Overcast	
Preciptation:	None		Slight	**Moderate**		Heavy	
Time monitoring performed:	Start	**08:28**		End	**10:05**		
Barometric pressure (mbar):	Start	**1032**		End	**1033**		
Pressure trend:	Falling		Steady	**Rising**			
Air temperature (degree C):	Before	**10**		After	10		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GAS DATA LMS xi
Gas range: **CH_4:** 0 - 100% **CO_2:** 0 - 100% **O_2:** 0 -25%
Gas flow range: +30/-10 l/hr
Differential pressure: +300/-30 Pa
Date of last calibration: 09/02/2017
Date of next calibration: 09/02/2018

PID: Micro5
Calibrated range: 0-99 ppm
Calibration gas: Isobutylene
Response time: 2 seconds
Accuracy: 0.1 ppm
Date of last calibration: 13/07/2017
Date of next calibration: 13/07/2018

Gas Monitoring Records

Client: Edward Ware Homes
Site: Land east of Snow Capel Farm, Matson
Date: 03/01/2018

Job No: SNO1877a
Visit No: 3 **of** 6
Operator: CT
Project Manager: SB

Monitoring Point	VOLATILES PID Peak (ppm)	FLOW DATA Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (sec)	GAS CONCENTRATIONS Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		Run time (min)
		Peak	Steady			Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady	
WS01	<0.1	<0.1	<0.1	0	-	0.1	0.1	1.8	1.8	0.4	0.1	9	3	<0.1	<0.1	21.2	21.1	1.5
WS03	1.6	16.6	2.4	6	30	<0.1	<0.1	<0.1	<0.1	4.2	4.1	<0.1	<0.1	<0.1	<0.1	18.6	18.6	3
WS05	2.6	16	2.2	5	20	<0.1	<0.1	<0.1	<0.1	0.5	0.5	<0.1	<0.1	<0.1	<0.1	20.9	20.9	3
WS08	0.1	25	8.1	22	60	<0.1	<0.1	<0.1	<0.1	0.6	0.6	<0.1	<0.1	<0.1	<0.1	21.4	21.4	3
WS101	0.4	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	21.1	21.1	3
WS102	17.1	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	21.1	21.1	3
WS103	<0.1	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	0.6	0.6	<0.1	<0.1	<0.1	<0.1	21.1	21.1	5
WS104	<0.1	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	21.2	21.2	3
Max	**17.1**	**25.0**	**8.1**	**22**		**0.1**	**0.1**	**1.8**	**1.8**	**4.2**	**4.1**	**9**	**3**	**0**	**0**	**21.4**	**21.4**	
Min	**0.1**	**16.0**	**2.2**	**0**		**0.1**	**0.1**	**1.8**	**1.8**	**0.3**	**0.1**	**9**	**3**	**0**	**0**	**18.6**	**18.6**	

Monitoring Point	WELL AND WATER DATA Product thickness (mm)	Water Level pre-bailing (mbgl)	Bailed water level (mbgl)l	Minutes passed	Water level (mbgl)	Base of well (mbgl)	Ground level (mAOD)	Water level (mAOD)	Response zone range (m)	Comments
WS01	ND	0.70	0.83	44.00	0.78	3.30	58.44	57.66	0.5-2.7	Bailed out. Monitoring time limited by surface water back-fill.
WS03	ND	0.85	-	-	1.00	2.20	59.96	58.96	1-2	
WS05	ND	0.36	2.56	24.00	1.98	3.00	61.90	59.92	1-3	Bailed out.
WS08	ND	0.00	2.58	49.00	1.35	3.00	57.54	56.19	1-3	Bailed out.
WS101	ND	0.48	2.20	30.00	2.10	3.95	57.86	55.76	1-3	Required 20 + bail loads.
WS102	ND	1.50	2.20	31.00	2.14	3.95	58.56	56.42	2-4	Bailed out.
WS103	ND	0.05	2.55	41.00	2.45	3.98	59.38	56.93	1-4	Bailed out.
WS104	ND	0.55	3.00	45.00	2.84	3.35	59.76	56.92	1.5-3.5	Bailed out.
Max										
Min										

ND - Not detected
NR - Not recorded

METEOROLOGICAL AND SITE INFORMATION: (Put X in front of selected or enter data as applicable)

State of ground:	Dry	Moist	**Wet**	Snow	Frozen
Wind:	Calm	Light	Moderate	**Strong**	
Cloud cover:	None	Slight	**Cloudy**	Overcast	
Preciptation:	None	**Slight**	Moderate	Heavy	
Time monitoring performed:	Start **09:43**		End **13:27**		
Barometric pressure (mbar):	Start **994**		End **998**		
Pressure trend:	Falling	Steady	**Rising**		
Air temperature (degree C):	Before **9**		After **10**		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter: GAS DATA LMS xi
Gas range: **CH_4:** 0 - 100% **CO_2:** 0 - 100% **O_2:** 0 -25%
Gas flow range: +30/-10 l/hr
Differential pressure: +300/-30 Pa
Date of last calibration: 09/02/2017
Date of next calibration: 09/02/2018

PID: Micro5
Calibrated range: 0-99 ppm
Calibration gas: Isobutylene
Response time: 2 seconds
Accuracy: 0.1 ppm
Date of last calibration: 13/07/2017
Date of next calibration: 13/07/2018

Gas Monitoring Records

Client: Edward Ware Homes
Site: Land east of Snow Capel Farm, Matson
Date: 16/01/2018

Job No: SNO1877a
Visit No: 4 **of** **6**
Operator: CT
Project Manager: SB

Monitoring Point	VOLATILES PID Peak (ppm)	FLOW DATA Flow rate (l/hr) Peak	Flow rate (l/hr) Steady	Differential borehole Pressure (Pa)	Time for flow to equalise (sec)	GAS CONCENTRATIONS Methane (%v/v) Peak	Methane (%v/v) Steady	%LEL Peak	%LEL Steady	Carbon dioxide (%v/v) Peak	Carbon dioxide (%v/v) Steady	Carbon monoxide (ppmv) Peak	Carbon monoxide (ppmv) Steady	Hydrogen sulphide (ppmv) Peak	Hydrogen sulphide (ppmv) Steady	Oxygen (%v/v) Min.	Oxygen (%v/v) Steady	Run time (min)
WS01	<0.1	<0.1	<0.1	0	-	2.7	2.7	52.5	52.5	1.1	1.1	<0.1	<0.1	<0.1	<0.1	18.9	18.9	2.5
WS03	1.8	16.2	0.5	1	20	0.1	0.1	3.2	3.1	0.6	0.6	<0.1	<0.1	<0.1	<0.1	21	21	3.5
WS05	0.5	1.4	1.1	2	10	<0.1	<0.1	<0.1	<0.1	0.5	0.5	<0.1	<0.1	<0.1	<0.1	20.8	20.8	5
WS08	NR	NR	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	-
WS101	2.8	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	2.1	2.1	<0.1	<0.1	<0.1	<0.1	19.7	19.7	6
WS102	46.5	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	0.4	0.4	<0.1	<0.1	<0.1	<0.1	21	21	3
WS103	<0.1	-0.7	-0.4	0	20	<0.1	<0.1	<0.1	<0.1	0.9	0.9	<0.1	<0.1	<0.1	<0.1	20.8	20.8	3
WS104	0.1	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	0.3	0.2	<0.1	<0.1	<0.1	<0.1	21	21	4
Max	**46.5**	**16.2**	**1.1**	**2**		**2.7**	**2.7**	**52.5**	**52.5**	**2.1**	**2.1**	**0**	**0**	**0**	**0**	**21.0**	**21.0**	
Min	**0.1**	**-0.7**	**-0.4**	**0**		**0.1**	**0.1**	**3.2**	**3.1**	**0.3**	**0.2**	**0**	**0**	**0**	**0**	**18.9**	**18.9**	

Monitoring Point	WELL AND WATER DATA Product thickness (mm)	Water Level pre-bailing (mbgl)	Bailed water level (mbgl)l	Minutes passed	Water level (mbgl)	Base of well (mbgl)	Ground level (mAOD)	Water level (mAOD)	Response zone range (m)	Comments
WS01	ND	0.80	1.95	109	0.88	3.98	58.44	57.56	0.5-2.7	Bailed out. Monitoring time limited by surface water back-fill.
WS03	ND	0.92	1.77	110	1.65	2.20	59.96	58.31	1-2	
WS05	ND	0.45	2.30	111	2.04	3.00	61.90	59.86	1-3	
WS08	ND	-	1.95	90	-	3.00	57.54	-	1-3	Water above top of bung - well flooded. Unable to monitor ground gases.
WS101	ND	0.52	2.33	117	2.20	3.95	57.86	55.66	1-3	
WS102	ND	2.50	2.80	111	2.47	3.98	58.56	56.09	2-4	
WS103	ND	0.05	2.20	102	2.08	4.00	59.38	57.30	1-4	
WS104	ND	0.65	2.20	108	2.05	3.40	59.76	57.71	1.5-3.5	
Max										
Min										

ND - Not detected
NR - Not recorded

METEOROLOGICAL AND SITE INFORMATION: (Put X in front of selected or enter data as applicable)

State of ground:	Dry	Moist	**Wet**	Snow	Frozen
Wind:	Calm	Light	**Moderate**	Strong	
Cloud cover:	None	Slight	**Cloudy**	Overcast	
Preciptation:	None	**Slight**	Moderate	Heavy	
Time monitoring performed:	Start **12:13**		End **14:18**		
Barometric pressure (mbar):	Start **997**		End **994**		
Pressure trend:	**Falling**	Steady	Rising		
Air temperature (degree C):	Before **7**		After **7**		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter:	GAS DATA LMS xi					
Gas range:	**CH_4:**	0 - 100%	**CO_2:**	0 - 100%	**O_2:**	0 -25%
Gas flow range:	+30/-10 l/hr					
Differential pressure:	+300/-30 Pa					
Date of last calibration:	09/02/2017					
Date of next calibration:	09/02/2018					

PID:	Micro5
Calibrated range:	0-99 ppm
Calibration gas:	Isobutylene
Response time:	2 seconds
Accuracy:	0.1 ppm
Date of last calibration:	13/07/2017
Date of next calibration:	13/07/2018

Gas Monitoring Records

Client: Edward Ware Homes
Site: Land east of Snow Capel Farm, Matson
Date: 30/01/2018

Job No: SNO1877a
Visit No: 5 **of** 6
Operator: CT
Project Manager: SB

	VOLATILES	FLOW DATA				GAS CONCENTRATIONS												
Monitoring Point	PID Peak (ppm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (sec)	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		Run time (min)
		Peak	Steady			Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady	
WS01	<0.1	f<<<l/h	f<<<l/h	<<	-	2.4	<0.1	42.8	<0.1	3.8	0.2	<0.1	<0.1	<0.1	<0.1	17.2	17.2	9
WS03	1.8	0.5	<0.1	0	10	<0.1	<0.1	<0.1	<0.1	2.7	<0.1	<0.1	<0.1	<0.1	<0.1	19.7	19.7	15 secs
WS05	<0.1	0.6	<0.1	0	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	19.6	19.6	10 secs
WS08	NR	NR	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	-
WS101	<0.1	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	21	21.1	2
WS102	NR	NR	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	-
WS103	<0.1	2.6	<0.1	0	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	21.3	21.3	3
WS104	<0.1	<0.1	<0.1	0	-	<0.1	<0.1	<0.1	<0.1	1	<0.1	<0.1	<0.1	<0.1	<0.1	21.2	21.2	3
Max	**1.8**	**2.6**	**0.0**	**0**		**2.4**	**0.0**	**42.8**	**0.0**	**3.8**	**0.2**	**0**	**0**	**0**	**0**	**21.3**	**21.3**	
Min	**1.8**	**0.5**	**0.0**	**0**		**2.4**	**0.0**	**42.8**	**0.0**	**0.6**	**0.2**	**0**	**0**	**0**	**0**	**17.2**	**17.2**	

	WELL AND WATER DATA									
Monitoring Point	Product thickness (mm)	Water Level pre-bailing (mbgl)	Bailed water level (mbgl)l	Minutes passed	Water level (mbgl)	Base of well (mbgl)	Ground level (mAOD)	Water level (mAOD)	Response zone range (m)	Comments
WS01	ND	-	-	-	1.08	3.98	58.44	57.36	0.5-2.7	
WS03	ND	-	-	-	0.30	2.18	59.96	59.66	1-2	Surface water overflow into standpipe occurring.
WS05	ND	-	-	-	0.43	3.00	61.90	61.47	1-3	Surface water overflow into standpipe occurring.
WS08	ND	-	-	-	-	3.00	57.54	-	1-3	Water level recorded above top of bung. Water refilled too quickly to enable monitoring to be completed. Oily scum on water.
WS101	ND	-	-	-	0.32	3.94	57.86	57.54	1-3	
WS102	ND	-	-	-	-	3.00	58.56	-	2-4	Water level recorded above top of bung. Water refilled too quickly to enable monitoring to be completed.
WS103	ND	-	-	-	0.18	4.00	59.38	59.20	1-4	
WS104	ND	-	-	-	0.24	3.38	59.76	59.52	1.5-3.5	
Max										
Min										

ND - Not detected
NR - Not recorded

METEOROLOGICAL AND SITE INFORMATION: (Put X in front of selected or enter data as applicable)

State of ground:	Dry	Moist	**Wet**	Snow	Frozen
Wind:	Calm	**Light**	Moderate	Strong	
Cloud cover:	**None**	Slight	Cloudy	Overcast	
Preciptation:	None	**Slight**	Moderate	Heavy	
Time monitoring performed:	Start **11:05**		End **12:13**		
Barometric pressure (mbar):	Start **1022**		End **1024**		
Pressure trend:	Falling	Steady	**Rising**		
Air temperature (degree C):	Before **3**		After **6**		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter:	GAS DATA LMS xi				
Gas range:	**CH_4:** 0 - 100%	**CO_2:**	0 - 100%	**O_2:**	0 -25%
Gas flow range:	+30/-10 l/hr				
Differential pressure:	+300/-30 Pa				
Date of last calibration:	09/02/2017				
Date of next calibration:	09/02/2018				

PID:	Micro5
Calibrated range:	0-99 ppm
Calibration gas:	Isobutylene
Response time:	2 seconds
Accuracy:	0.1 ppm
Date of last calibration:	13/07/2017
Date of next calibration:	13/07/2018

Gas Monitoring Records

Client: Edward Ware Homes
Site: Land east of Snow Capel Farm, Matson
Date: 13/02/2018

Job No: SNO1877a
Visit No: 6 **of** 6
Operator: CT
Project Manager: SB

	VOLATILES	FLOW DATA				GAS CONCENTRATIONS												
Monitoring Point	PID Peak (ppm)	Flow rate (l/hr)		Differential borehole Pressure (Pa)	Time for flow to equalise (sec)	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppmv)		Hydrogen sulphide (ppmv)		Oxygen (%v/v)		Run time (min)
		Peak	Steady			Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Min.	Steady	
WS01	NR	NR	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	-
WS03	2.4	2.4	-2.8	-17	10	<0.1	<0.1	<0.1	<0.1	2.8	<0.1	<0.1	<0.1	<0.1	<0.1	17.8	18.6	3
WS05	1.1	4.8	-2	-11	-	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	19.7	19.7	3.5
WS08	NR	NR	NR	NR	-	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	-
WS101	NR	-2.7	-2.5	-16	10	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	20	20	2
WS102	NR	-2.6	-2.7	-17	10	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	20	20	2
WS103	NR	-2.5	-2.8	-17	10	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	20	20	2
WS104	1.2	-2.5	-2.7	-16	10	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	20	20.1	2.5
Max	**2.4**	**4.8**	**-2.0**	**-11**		**0.0**	**0.0**	**0.0**	**0.0**	**2.8**	**0.1**	**0**	**0**	**0**	**0**	**20.0**	**20.1**	
Min	**1.1**	**-2.7**	**-2.8**	**-17**		**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0**	**0**	**0**	**0**	**17.8**	**18.6**	

	WELL AND WATER DATA									
Monitoring Point	Product thickness (mm)	Water Level pre-bailing (mbgl)	Bailed water level (mbgl)l	Minutes passed	Water level (mbgl)	Base of well (mbgl)	Ground level (mAOD)	Water level (mAOD)	Response zone range (m)	Comments
WS01	ND	-	-	-	-	3.98	58.44	-	0.5-2.7	Surface water prevented monitoring.
WS03	ND	-	-	-	0.24	2.18	59.96	59.72	1-2	
WS05	ND	-	-	-	0.15	3.00	61.90	61.75	1-3	
WS08	NR	-	-	-	-	3.00	57.54	-	1-3	Water level recorded above top of bung. Water refilled too quickly to enable monitoring to be completed. Oily scum on water.
WS101	ND	-	-	-	0.10	3.94	57.86	57.76	1-3	
WS102	ND	-	-	-	0.11	3.00	58.56	58.45	2-4	
WS103	ND	-	-	-	0.11	4.00	59.38	59.27	1-4	
WS104	ND	-	-	-	0.16	3.38	59.76	59.60	1.5-3.5	
Max										
Min										

ND - Not detected
NR - Not recorded

METEOROLOGICAL AND SITE INFORMATION: (Put X in front of selected or enter data as applicable)

State of ground:	Dry	Moist	**Wet**	Snow	Frozen
Wind:	Calm	Light	**Moderate**	Strong	
Cloud cover:	None	Slight	**Cloudy**	Overcast	
Preciptation:	None	Slight	**Moderate**	Heavy	
Time monitoring performed:	Start **10:02**		End **11:20**		
Barometric pressure (mbar):	Start **984**		End **984**		
Pressure trend:	Falling	**Steady**	Rising		
Air temperature (degree C):	Before **3**		After **6**		

INSTRUMENTATION TECHNICAL SPECIFICATIONS:

Ground gas meter:	GAS DATA LMS xi						
Gas range:	**CH_4:**	0 - 100%	**CO_2:**	0 - 100%	**O_2:**	0 -25%	
Gas flow range:	+30/-10 l/hr						
Differential pressure:	+300/-30 Pa						
Date of last calibration:	13/02/2017						
Date of next calibration:	Mar-19						

PID:	Micro5
Calibrated range:	0-99 ppm
Calibration gas:	Isobutylene
Response time:	2 seconds
Accuracy:	0.1 ppm
Date of last calibration:	Feb-18
Date of next calibration:	Feb-19

Snow Capel, Matson Water Environment Assessment: Tier 2

Final Report

May 2021

www.jbaconsulting.com

edwardwareHomes

JBA Project Manager

[redacted]
Salts Mill
Victoria Road
Shipley BD18 3LF

Revision History

Revision Ref/Date	Amendments	Issued to
15/03/2021	Draft Interim Report	[redacted]
14/05/2021	Final Report	

Contract/

This report describes work commissioned by Finlay Jenkins, on behalf of Edward Ware Homes Limited, by an email dated November 12th, 2020. Eleanor Williams and Michael McDonald of JBA Consulting carried out this work.

Prepared by .... [redacted]

Senior Chartered Hydrogeologist

.... [redacted]

Hydrogeologist

Reviewed by .... [redacted]

Technical Director

Purpose

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[redacted]

[redacted]

[redacted]

Executive Summary

[redacted] prepared by JBA Consulting, on behalf of Edward Ware Homes [redacted]opments Ltd and is a Tier 2 water environment assessment of the moat associated with the scheduled monument, Moated site at Sneedham's Green, 220 m north east of Green Farm (Historic England ref. 1019399) located at Land at Snow Capel Farm, Matson, Gloucester in support of a planning application for residential development.

The potential for impacts upon the significance of the scheduled monument have been considered in accordance with Historic England guidance: Preserving Archaeological Remains – Decision-taking for Sites under Development (HE, 2016) and, in particular, adopting the tiered assessment approach set out in Appendix 3 of t[redacted] regarding the moat's water environment.

In summary, the assessment concludes that the proposed residential development could result in a fall in the water level in the moat, potentially resulting in the drying out of the moat and a negative impact upon the significance of the scheduled monument.

The desk-based review, alongside an evaluation of site-specific data, indicates that the moat is supported by a combination of surface water inputs, comprising direct rainfall and rainfall-runoff, and shallow groundwater inputs, most likely comprising near-surface seepage.

The potential for a reduction in water in[redacted] development includes decreased surface water runoff, due to the installation of site drainage such that runoff may no longer reach the moat, and reduced groundwater seepage, due to the excavation of ground surface material, depending on the engineering approach to foundation des[redacted] drying of the moat water body unless a supplementary water supply is incorporated into the development design which can permit maintenance of current moat water levels.

Nonetheless, given the lack of clear evidence for the current supply of the moat by a groundwater spring source beneath its [redacted] hydrochemical signature of the water that might be used in future to maintain moat water levels and, therefore, whether the top up source is derived from surface water or groundwater.

In conclusion, the assessment has not identified any reason why potential effects on the moat water level from the proposed development could not be appropriately mitigated to safeguard the continued existence of the moat water body.

![JBA consulting]

Contents

1 Introduction

1.1 Background

[redacted] comprises a site for a proposed residential development which incorporates a Scheduled Monument, "Moated Site at Sneedham's Green". The monument consists of the extant remains of a medieval moated site which is water filled and may potentially represent a source of waterlogged archaeological deposits. It is a designated heritage asset in planning terms and, therefore, any impacts should be considered in the context of the relevant statutory provisions and as set out in the National Planning Policy Framework (NPPF). This report forms part of the assessment of any potential impacts on the Scheduled Monument and will inform the development proposals for the surrounding area in the future. It should be read alongside the Archaeologic[redacted]ent (Environmental Dimension Partnership (EDP), 2021[1]).

1.2 Aims

Historic England's (HE's) guidance document for sites under development[2] includes a specific evaluation methodology in relation to water environment assessment techniques in Appendix 3[3]. This adopts a tiered approach to assessment, the need for which depends on the likely scale and significance of the potential risks involved.

This report constitutes a Tier 2 water environment assessment in accordance with the HE assessment guidance which provides:

"a basic qualitative assessment [redacted] system".

The report first presents the details of the Moated Site (Section 2) and the approach adopted for the HE Tier 2 assessment (Section 3). Baseline data for the Moated Site in terms of the hydrological and [redacted]ta to consider the inputs to and outputs from the groundwater system, and the likely water supply mechanism to the Moated Site. A conceptual understanding of the Moated Site is presented in Section 5 based upon the findings of this investigation, which provides an evaluation in the context of the tiered assessment approac[redacted]ction 6.

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[1] EDP, 2021. Lane at Snow Capel Farm, Matson Gloucester. Archaeological and Heritage Assessment. April 2021.

[2] https://historicengland.org.uk/images-books/publications/preserving-archaeological-remains/

[3] https://historicengland.org.uk/images-books/publications/preserving-archaeological-remains/heag100d-appendix3-water-environment-assessment-techniques/

2 Site Information

2.1 Moat Details

[redacted] Site at Sneedham's Green consists of the known extent of a medieval moated site; a sub-rectangular or trapezoidal moat enclosing an island. The northern side and parts of the western and eastern sides of the moat are extant, enclosing an area c. 66 m by 42 m which is open on the south side. The extant moat is c. 14 m at its widest point, c. 8 m at its narrowest (EDP, 2021) and c. 1 m deep. It is water-filled and may contain waterlogged archaeological deposits, potential related to its medieval history and usage.

As a scheduled monument the moated site is of the 'highest significance' in terms of NPPF. A detailed description of the moat and its history is set out in the accompanying Archaeological and Heritage Assessment (EDP, 2021). In [redacted] the EDP assessment states that:

'The scheduled monument derives its significance primarily [redacted] interest as defined by the extant moat, the deposits within it and any buried archaeological remains within the scheduled area that are related to the moated site. The monument also has a degree of historic interest as it illustrates the nature and appearance of the medieval landscape in the locality and is associated with the history of the De Sneedham family, the history of settlement at Sneedham and with the general history of the medieval aristocracy of Gloucester.'

Details of the historic and current archaeological mapping for the site are set out in the EDP (2021) report.

Figure 1 - Moated Site at Sneedham[redacted]

The moat remains lie within a 'bowl' in the landscape formed by placement of material from the construction of the adjacent M5 motorway, and its edges are overgrown with vegetation. Fluctuating water levels have, at times, flooded the surrounding area, and have resulted in a recent drainage ditch being cut west towards the lane-side ditch to alleviate this.

The scheduled area extends beyond the extant part of the monument to the south, encompassing the former entirety of the moat and a 2 metre buffer around it.

The southern extent of the former moated enclosure is located underneath a layer of overburden deposited during the construction of the M5 motorway, although it is understood that this section of the moat had already been incorporated into a later post-medieval field system that crossed the site and which was infilled when the site was cleared prior to the construction of the M5 (EDP, 2021; Figure 4).

Within this area, the archaeological and heritage assessme[redacted]s only a low potential for any well-preserved archaeological remain[redacted]r southern arm of the moat (EDP, 2021), and it is apparent from aerial photography that the monument was disturbed during the motorway's construction. The ground surface was clearly scoured, both within the moated enclosure and around it, which is likely to have impacted upon buried remains. Further detail on the treatment of the moat during the 20th century is given in the Archaeological and Heritage Assessment (EDP, 2021).

This report will form part of a tranche of assessments which will help to inform and enable consideration of the potential for development to impact on the significance of the Scheduled Monument. It will be considered alongside other specific heritage assessments, including archaeological trial tr[redacted]ent of the setting of the heritage asset (EDP, 2021).

2.2 Proposed Development

The proposal is for a residentia[redacted]d access road, landscaping and infrastructure. The proposed site plan is not yet fixed although is being influenced by both this study and the archaeological assessment (EDP, 2021).

[redacted]

3 Historic England Assessment Tiered Approach

3.1 Introduction

[redacted] sets out the main requirements of the HE tiered approach and the responses to the key questions posed by each tier of assessment.

3.2 Tier 1 Assessment

Where the future preservation of the Moated Site is being considered for the long-term sustainability of the retention of the features, the HE Tier 1 Assessment aims to address the following questions:

- *"Are the deposits, in which significant waterlogged archaeological remains are located, hydraulically connected to the wider groundwa*[redacted]
- *"Are these remains likely to be located under the wate*[redacted] *the past?"*

The information which supports this evaluation comprises:

- A review of published maps (geology, heritage boundaries/elevations, watercourse elevations, drainage features) and borehole logs; and
- On-site observations and measurements about channel depths and vegetation growth.

This review enables the completion of an initial conceptual model of the water environment at the Moated Site, including [redacted] The conceptual model is presented in Section 5 and addresses the questions above.

With regards to the first question above, it is not currently known if there are significant waterlogged archaeological remains in the base of the moat, since no intrusive surveys have been carried out in this [redacted]e moat itself that is of significance, but the risk cannot be taken that significant waterlogged remains do not exist and, therefore, it is important that the current hydrological conditions of the Moated Site are not derogated by the proposed development. Nonetheless, the moat is likely to have been a waterlogged feature for some or most of its history, assuming that a natural water supply mechanism was readily[redacted]ecent anecdotal information also indicates that it has been inundated in recent years.

The HE guidance also states:

"To appreciate whether such levels are likely to be sustained, an assessment of annual rainfall versus annual evaporation for the area is needed (data that are available on the Meteorological Office website). This indicates whether an area has a net positive effective rainfall that can infiltrate and feed into the local water system, or is an area of negative effective rainfall, where there is little water available to infiltrate into the local groundwater system"

An assessment of net effective rainfall is made in Section 4.4.

The outcomes of the Tier 1 assessment within this document, below, identified that more, site-specific, data are required, as part of a Tier 2 assessment.

3.3 Tier 2 Assessment

The aim of a Tier 2 assessment is to refine the first conceptual model with site-specific data, and to ask some more detailed assessment questions at minimal cost. The Tier 2 assessment aims to address the following questions:

- *"Will the deposits in which significant waterlogged archaeological remains are located be underwater all year?"*; and

- *"If not, what variation can be expected and what is influencing the variation (anthropogenic or natural)? And are these variations short-term or long-term / permanent?"*.

[redacted] only anecdotal information exists with regards to the first question, because site-specific monitoring data are only available for the Moated Site between December 2020 and April 2021. It is understood from anecdotal evidence that the remains are waterlogged year-round. A full annual cycle of monitoring data would be required to fully satisfy this question.

The monitoring data obtained to date are evaluated in Section 4 to review potential controls on groundwater levels and their variations, although these are limited to short-term data.

In addition, the available data are used to allow estimation of a qualitative review of water inputs for the Moated Site. This evaluation has helped to [redacted] ferent mechanisms for water supply to the moat, outlined in Sect [redacted]

[redacted]

[redacted]

[redacted]

4 Water Environment Baseline

4.1 Introduction

[redacted] sets out information about the baseline hydrological and hydrogeological conditions at the Moated Site.

4.2 Site Location, Topography and Land Use

The site is located on the southern edge of Gloucester, between Sneedham's Green to the west and the M5 to the south east (Map 1; Appendix A) and is centred on National Grid Reference (NGR) 385116 214169.

The current land use of the site is a pasture field which has also historically been the case according to historic mapping (back to 1888-1913). The [redacted] locally was the construction of the M5 motorway in this area in [redacted] layout was created following the amalgamation of several [redacted] the motorway.

A topographic survey was carried out in January 2021 (Appendix B) by K.J. Hall Surveyors. Spot heights indicate that the moat edge itself lies close to 56.1-56.3 mAOD (above ordnance datum) and the land in the centre of the moat rises to ~56.7 mAOD.

The land is raised around the moat on the north, and southern sides to ~57.7 mAOD and is highest on the eastern side ~61.8 mAOD such that the moat is in a slight hollow. Overall, the site slopes down from the east to ~55.3 mAOD in the northwest, and the land falls away slightly to the northeast in the direction of surface water drainage. To the north west of the site, the land rises up to [redacted]

An estimate of moat depth of 1.5 m has previously been made from the archaeological interpretation, which indicates that the base of the moat lies at ~54.7 mAOD. In April 2021 a bathymetric survey of the moat was carried out by JBA Consulting (Appendix B), using a dipper approach to su[redacted]s across the water body without any disturbance to the moat bed, so as to avoid potential impacts to any unknown archaeological features which may preside at the base of the moat. In summary, the deepest part of the moat occurred in the southwestern arm, at 55.34 mAOD, somewhat shallower than previously spe[redacted]where across the moat. Heavy silting and vegetation may disguise the likely original depths.

4.3 Site Catchment and Hydrology

The site lies within the headwaters of the Sud Brook, a lower catchment tributary of the River Severn, which emerges close to the road at Snow Capel Farm, immediately southwest of the moat (Figure 1). This ditch flows northeast around the north (downgradient) side of the moat to join another tributary of the Sud Brook (NGR 385550 215300) before flowing north through Gloucester to join the Severn close to the intersection of the Severn with the Gloucester and Sharpness Canal.

There are numerous other mapped surface water features to the west of the Moated Site, at Sneedham's Green (Figure 1). The Ordnance Survey (OS) 25 Inch (1892-1914) mapping indicates these ponds have existed for many years. However, these lie outwith the surface water catchment for the moat as drainage from these areas is from the north/west of the drainage ditch to the Sud Brook. In addition, catchment delineation data from the Flood Estimation Handbook (FEH) suggests that these Sneedham's Green ponds drain to the west.

The site inspection, undertaken by JBA on February 17th, 2021, followed several weeks of wet winter conditions. The Sneedham's Green ponds contained water close to ground level. Water in the Sud Brook close to the Moated Site was flowing to the north east. In addition, the whole field containing the Moated Site was very wet underfoot, and there was a flow in the small drainage 'channel' exiting the moat on its west side, which flows to join the roadside drainage ditch of the Sud Brook. This flow was estimated by eye at ~4 l/s.

In the Sud Brook, water levels were noted at 54.85 mAOD in February 2017 [redacted] 2017). Recent topographic survey mapping (T&P, 2020) indicates that Sud Brook water levels are similar, at ~55 mAOD, whilst water levels in the moat at the time were ~56.2 mAOD.

The water level within the moat has also been recorded at 56.166 mAOD (T&P, January 2021) and 55.97 mAOD (JBA, April 2021). From GIS analysis, the surface area of the water body is estimated to be ~1,946 m^2, and the surface water catchment area around the moat is ~25,400 m^2.

Catchment information has been accessed from the Flood Estimation Handbook (FEH) and, using the most applicable catchment outline for the site, t[redacted] here is estimated to be 0.356, which indicates that groundwater r[redacted]nt of surface water flow.

River levels near the site are monitored at Bondend Road on the River Twyver, 1.9 km north east of the site[4] (Figure 1) and at Cheyney Close Level on the Sud Brook[5] and indicate a rapid, flashy response to rainfall events.

There is no surface water flood risk indicated for the site by the EA flood mapping[6].

4.4 Climate

The Flood Estimation Handbook (FEH) CD-ROM includes long-term average rainfall data for catchments in the UK. For the[redacted]dard Annual Average Rainfall (SAAR) is 697 mm/yr [redacted].

Average annual rainfall (1961-1990) from a nearby gauging station (Chelt at Slate Mill) is 685 mm[7]. Other climatic data are available online e.g. rainfall data from Gloucester Weather[8]. In 2019, annual rai[redacted]hilst for 2020 was 1126.4 mm. Precipitation levels in January [redacted]ection, were particularly wet, at 134.7 mm (roughly 20% of average annual total rainfall).

Values for potential evapotranspiration (PE) for 2009 are given for certain MORECS[9] squares across the UK. For the [redacted]), PE was 610-649 mm whilst actual evapotranspiratio[redacted].

Comparing an approximate long-term average annual rainfall value of ~690 mm and an annual AE rate of ~550 mm, the net effective annual rainfall is ~140 mm. A net positive effective rainfall is therefore indicated, although it should be considered that this balance may not be positive in prolonged dry weather, or drought years.

4.5 Site Geology

The bedrock geology[11] underlying the Moated Site comprises strata of the Jurassic age Lias Group (Charmouth Formation), which consists of dark grey laminated shales, and dark,

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[4] https://riverlevels.uk/gloucestershire-upton-st-leonards-bond-end-road-lvl#.X6pfzGc3bcc

[5] https://www.gaugemap.co.uk/#!Map/Summary/16545/12273

[6] https://flood-map-for-planning.service.gov.uk/confirm-location?easting=383697&northing=218521&placeOrPostcode=gloucester

[7] https://nrfa.ceh.ac.uk/data/station/spatial/54026

[8] https://www.glosweather.com/climate

[9] https://www.metoffice.gov.uk/services/industry/data/specialist-datasets

[10] http://nora.nerc.ac.uk/id/eprint/6357/1/Hydrological_Review_2006.pdf

[11] http://mapapps2.bgs.ac.uk/geoindex/home.html

pale and bluish grey mudstones. There are no mapped geological faults close to the Moated Site. There are also no mapped superficial geological deposits at the Moated Site. Geology mapped for the Moated Site is illustrated in the Groundsure report (Intégrale, 2017). [redacted]

To the north west of the site, on Robins Wood Hill, the conical-shaped hill comprises strata of the Whitby Mudstone Formation, Marlstone Rock Formation and the Dyrham Formation. To the south of the site, and east of the M5, lies limestone, argillaceous rocks and subordinate sandstones of the Lias Group and Inferior Oolite Group.

Soils at the Moated Site are mapped as slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils with impeded drainage and are of the Martock Association (GSB Prospection Ltd, 2017).

The nearest online borehole record (SO81SE20) is east of [redacted] with the M5 motorway[12] and indicates 0.3 m of Made Ground ([redacted]mestone gravel), overlying a silty clay, above the bedrock mudston[redacted] level (mbgl). Further along the M5 to the south west, another borehole log[13] indicates a much thicker extent of Made Ground, up to 10 m deep, comprising concrete clasts and limestone gravel.

An aerial photograph taken in 1970 (during the motorway construction works) shows the extent of disturbance, illustrating that the entire site area, including the area of the scheduled monument, was disturbed (EPD, 2017). The M5 works resulted in the infilling of part of the former moat (that had been incorporated into a post-medieval field boundary) and also associated earthworks. Some of the remains are likely to be capped by this modern overburden. It is ther[redacted]re referred to as Made Ground, they are largely re-worked overburden of predominantly natural clay materials.

Other boreholes from previous ground investigations on the site (Appendix C) indicate the presence of 1-3.5 m thick grav[redacted]lised soft clayey Alluvium, and a continuous stratum of variably weathered soft through to stiff to very stiff Lower Lias clay (Intégrale, 2017[14]). The Made Ground appears to thicken to the south of the Moated Site, in line with the understanding that additional material was placed here during the construction of the M5.

[redacted]

Additional boreholes were installed in 2018 (T&P, 2018) (Figure 2). WS101 south of the moat indicates that Made Ground exists to 2.4 mbgl (55.46 mAOD), and WS102 shows 3.1 m thickness of Made Ground (also to 55.46 mAOD). To the northeast of the moat, WS8 indicates 1.6 m thickness of Made Ground, down to 55.90 mAOD.

A more recent site ground investigation (December, 2020) (T&P) indicates similar thickness and composition of Made Ground, with the Mudstone Bedrock encountered below clay-dominated Made Ground, with rock head occurring in some boreholes, typically 56 mAOD south of the moat (WS203, WS206 and WS207), 54.6 mAOD north of the moat and 55 mAOD west of the moat. The boreholes are completed with a cap within the piezometer and a cap flush to the ground surface.

Two further boreholes have more recently been drilled on the south and east sides of the moat (March, 2021; T&P), where Made Ground deposits are at their thickest. They indicate that, here, rock head is at ~57.5 mAOD.

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[12] http://scans.bgs.ac.uk/sobi_scans/boreholes/19329370/images/19328817.html

[13] https://webservices.bgs.ac.uk/GWBV/viewborehole?loca_id=20200204094745385 49

[14] Intégrale, 2017. Geotechnical and Phase II Contamination Report. Proposed Development Snow Capel.

Overall, although unmapped, the presence of Made Ground (associated with the motorway construction and typically comprising re-worked cohesive soils) at and surrounding the Moated Site is persistent.

[redacted]ological trial trenching report (Headland Archaeology, 2021[15]) identifies in more detail evidence for buried topsoil, which was possibly removed in some areas prior to deposition of the Made Ground. Nonetheless, due to the reworking and similarity in lithology between natural deposits and redeposited material as Made Ground, it is difficult to discern between the two across the Moated Site and, indeed between the superficial deposits and the top of the weathered upper part of the bedrock.

4.6 Hydrogeology

4.6.1 Aquifer Classification

The geological strata have been assessed for their hydroge[redacted] Lias Group bedrock strata underlying the site are classified as a [redacted] aquifer. As rocks with essentially no groundwater, the BGS mapping describes the Lias group as comprising a largely mudstone sequence with limestone and marlstone Rock forming local aquifers, yielding small supplies. The Dyrham Formation to the north west is classified as a Secondary A aquifer, whilst the oolite strata to the south of the site is a Principal Aquifer.

4.6.2 Groundwater Levels and Flows

Given the clayey nature of both the superficial and bedrock strata underlying the Moated Site, it is unlikely that there is [redacted]water and the local surface water drainage features.

Topographical control on the groundwater flow direction is likely and is, therefore, anticipated to be in the direction SE to NW locally within the Moated Site, and more broadly towards the north, following t[redacted] drainage from the site.

This is supported by spot observations of groundwater levels on the Moated Site. From previous ground investigations, groundwater stands at 1.5-2.5 mbgl locally where old drainage ditches or the Moat occur (Intégrale, 2017). It is likely that this groundwater comprises a perched groundwa[redacted]bedrock groundwater table may occur at some depth (e.g. 5-10 mbgl).

Groundwater was not encountered during drilling by T&P in 2018. Groundwater dip levels were subsequently recorded during gas monitoring visits between 54.8 and 61.9 mAOD. Saturated ground was encountered during several monitoring visits, with surface water also observed within the moat area. This included some of the monitoring wells being flooded from surface water.

Similarly, groundwater was not encountered during drilling the T&P in December 2020-January 2021. Interim spot water levels are given in Table 1.

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[15] Headland, 2021. Snow Capel, Matson, Gloucestershire: Archaeological Trial Trenching.

Table 1 - Groundwater Level Monitoring

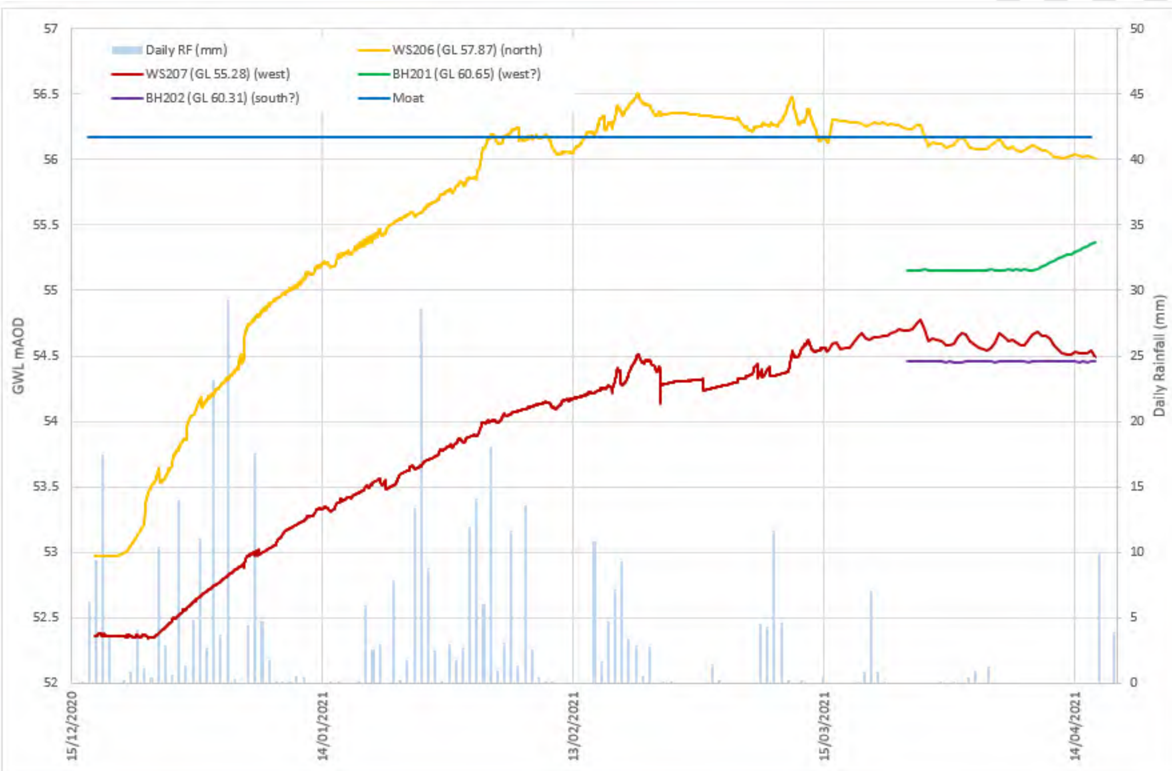
BH ID	GL mAOD	Depth m	Monitoring	GWL mAOD 21/01/21	GWL mAOD 17/02/21
WS201	58.03	3	MG	55.59	56.03
WS202	58.22	3	MG	57.44	58.02
WS203	58.78	3	MG/bedrock	58.74	58.76
WS204	59.05	3	MG	58.05	58.25
WS205	58.57	3	MG	57.69	57.59
WS206	57.87	5	MG/bedrock	55.32	56.04
WS207	55.28	3	bedrock	54.45	54.48

Boreholes WS201-WS205 are all close together on the sou[redacted]ndicate a water level range of 2.73 m even in such close proximity, with a gradient falling from east to west. The highest water level occurs in the borehole which has been completed into the top of bedrock. Water levels fall to the north and west and are lowest in the area to the west of the moat, in the area of lowest elevations. In some cases, the groundwater level is extremely close to the ground surface and there is potential, given the boreholes did not encounter groundwater at the time of drilling, that the water within the boreholes is rainwater fill. In the latest boreholes, BH201 and BH202, groundwater was also not encountered during drilling.

Continuous data are available [redacted]d BH202, and for the moat. For the moat, WS206 and WS207, data extend from December 17th 2020 to April 16th 2021. For BH201 and BH202, data extend from March 25th to April 16th. The data provided by T&P are provided in Appendix D and are summarised for comparison in Figure 2.

[redacted]

Figure 2 - Groundwater Level Continuous Monitoring Data



Data from the Gloucester rain gauge record[16] are also included. All borehole records show an initially steady water level. However, in the shallow boreholes (WS206/WS207), levels rise over time following wet winter weather. Although the dataset for the newer boreholes [redacted], there is less evidence for water level rise of the same order of magnitude, and less variability in the steady water levels observed compared to those in WS206/WS207.

It is possible that the water level variability in boreholes WS206 and WS207 reflect ingress of rainfall/runoff directly into the piezometer tubing, given that the boreholes are completed flush to ground level, while the long-term trend is likely indicative of the water table within the clay.

There are no nearby regional groundwater monitoring boreholes available[17][18]. A licenced groundwater abstraction well is noted within the southern corner of the Moated Site (18/54/20/0193, issued 1966 for general farming and do[redacted]7). It is not known whether this abstraction is currently operationa[redacted]not evident during the site inspection.

4.7 Moat Water Quality

To explore the source of water to the moat, seven water samples were collected from a range of locations across the moat, and a further sample from the nearest other pond at Sneedham's Green for comparison on April 26th 2021 by JBA Consulting. The aim of the analysis was to investigate whether there was evidence for a groundwater signature within the water chemistry. Given that the M5 lies upgradient of the site, the selected determinands also aimed to detect whether runoff from the M5 motorway makes its way along any potential groundwat[redacted]e Made Ground and/or within the top weathered surface of the mudstone bedrock.

The presence of elements such as metals and polycyclic aromatic hydrocarbons (PAH) would help to determine whether a groundwater pathway exists between the adjacent motorway runoff, through the [redacted] the moat. The samples were analysed at an accredited environmental laboratory for a range of parameters, including major ions (Na, Ca, Mg, HCO3, Cl, SO4, NO3, heavy metals (Cd, Cu, Zn and Pb) and PAH compounds). Given the 2021 winter conditions and likelihood of salts within the motorway runoff, it is considered that evidence of such parameters should be likely to be observed if indeed a pathway exists. [redacted]

By spreading the samples across the moat, any spatial variability may provide an indication into the location where a spring source may be entering.

The results are presented in Appendix E. Overall, the composition of the moat appears fairly consistent with no obvious spatial variability indicating a spring source location which would have been evidenced by being strongly mineralised e.g. strongly sulphate signal. The most notable features are elevated chromium in the south-east sample, and presence of naphthalene in the north west sample, both of which could be associated with motorway run-off, although are not persistent across all samples. Zinc in all samples could also be linked to motorway run-off, although the low values are well below environmental quality standards (EQS)[19], and do not provide clear cut evidence in themselves.

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[16] https://www.glosweather.com/climate

[17] https://www.gaugemap.co.uk/#!Map

[18] https://eip.ceh.ac.uk/hydrology/water-resources/

[19] https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit

Overall, a similar chemical signature to the moat is seen at Sneedham's Pond. As such, in light of the above observations, a definitive groundwater signal is not observed in the moat from the water quality sampling.

[redacted]

4.8 Moat Water Balance

In order to provide further evaluation of the source of water to the moat, a preliminary water balance can be used to determine the likelihood of the ability of the surface water catchment to support moat water volumes through direct rainfall and rainfall-runoff. By estimating the volume of water in the moat and comparing this to an estimate of the volume of rainfall-runoff generated within the surface water catchment to the moat, an assessment can be made as to whether the moat can likely be supported by surface water inputs alone.

The annual volume of water required to support the moat [redacted] can be estimated from the approximate surface area (1,946 m^2) a[redacted]s, which are estimated at 0.55 m (determined in the earlier review of climate data). On this basis, the water volume required is ~1,070 m^3/year.

From the earlier review of climate data, the effective annual rainfall is 140 mm. From a review of the site topographic data, the surface water catchment to the moat is ~25,400 m^2 extending to the east of the moat. On this basis, the available water volume from rainfall and surface runoff which could support the moat is ~3,560 m^3/y. This is likely to be a conservative figure as it does not account for rapid runoff to the moat during heavy rainfall/flood events that would bypass some evapotranspiration accounted for in the effective rainfall calculation ac[redacted]he surface water catchment area is sufficient to top up the moat and overcome evaporative losses of ~1,070 m^3/y. A proportion of the rainfall within this catchment will likely reach the moat as groundwater flow/baseflow where water can infiltrate to the water table. The groundwater flow is likely to mimic surface flow routes due to the topography. There may be some leakage from the moat to the [redacted]oat. This is likely to be minimal due to the low permeability nature of the surrounding clay soils but would require hydraulic testing of the surrounding clay to ascertain groundwater flow rates from the moat.

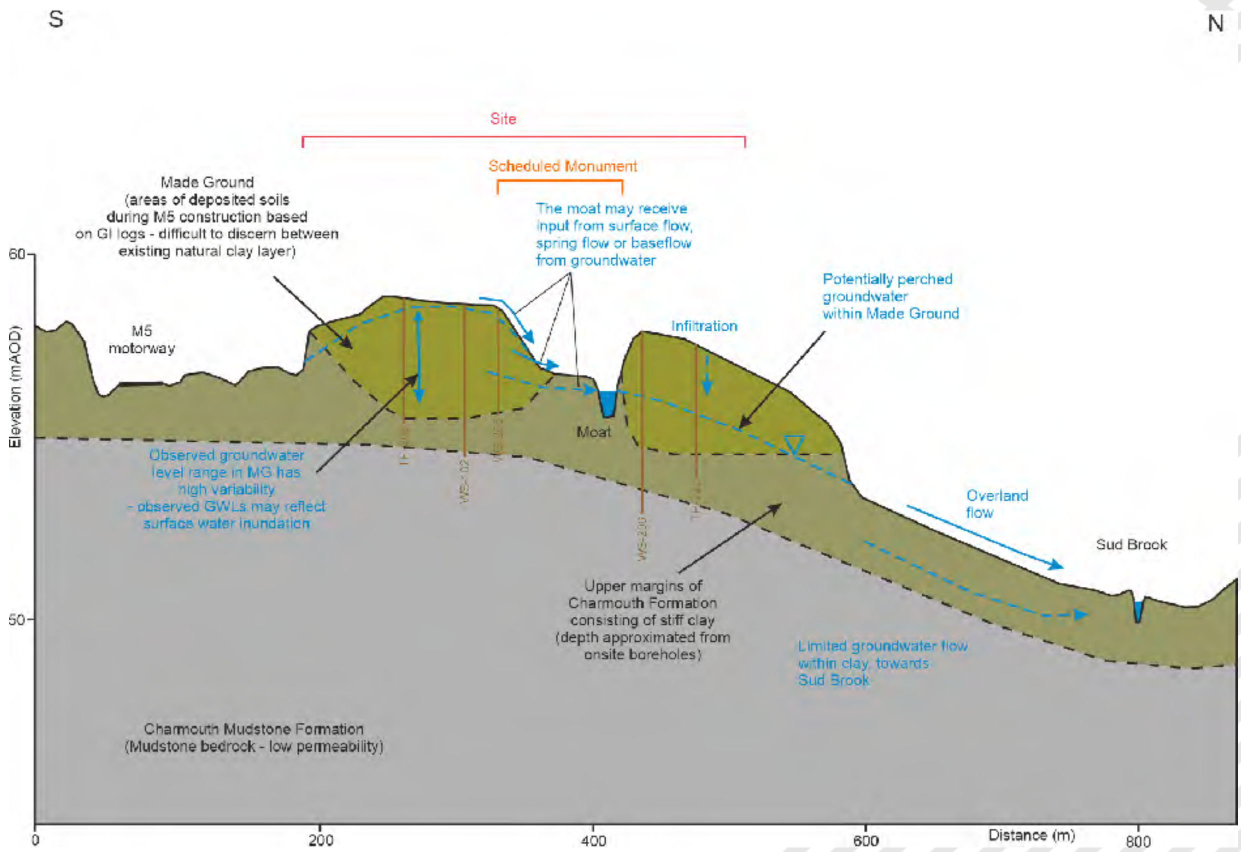
The above estimates have made several assumptions, including that the only water losses of the moat are through evapo[redacted]moat bed to ground. In addition, some of the rainfall on the surface water catchment area may also be lost to ground. In addition, the effective rainfall may be higher for open water than the estimate value, and so more water than indicated may be required to support the current moat water levels.

5 Hydrogeological Conceptual Model

The EA defines a conceptual model as "a description of how a hydrogeological system is believed to behave" and its development as "an iterative or cyclical process of development [redacted] in which new observations are used to evaluate and improve the model."

A preliminary conceptual model for the Moated Site and surrounding environment has been developed based on the information available, and is outlined in Figure 3, which has been constructed based upon the topography for the Moated Site and the site-specific data regarding depth of Made Ground and water levels.

Figure 3 - Conceptual Cross Section



The conceptual understanding is described as follows:

- The Lias Group mudstone bedrock, a low permeability formation, is largely unconfined at and near the Moated Site, with the outcrop recharge area occurring at the highest elevations of Robins Wood Hill to the north west of the site (up to ~198 mAOD). The upper surface of the bedrock illustrates evidence for weathering;
- Across part of the Moated Site are Made Ground deposits, located as a result of the construction of the adjacent M5 motorway. The deposits comprise slightly gravelly, slightly silty clays, and are relocated natural deposits. It is therefore difficult to differentiate between existing site material and that artificially placed here, such that the available site investigation data may overestimate the depth of the reworked soils. Nonetheless, it is anticipated that the natural material is likely to comprise the lower part of the subsoil profile;
- Observed groundwater levels at the Moated Site are between ~54 and ~59 mAOD within Made Ground deposits, and are locally variable although

largely emulating topography. Groundwater levels are likely to be perched within the generally low permeability deposits, targeting zones of higher permeability material lenses. However, there is potential that the observed [redacted] water levels in fact reflect rainwater ingress and not a true groundwater level. Water level in the underlying bedrock are limited, but it does not appear that the moat is intrinsically hydraulically connected to the wider groundwater system. Furthermore, these remains are not likely to be located under a regional water table, or have been so in the past;

- Water levels in the closest surface watercourse, the Sud Brook to the west of the Moated Site, may not be in hydraulic connectivity with those in the moat. Those in the moat are ~1 m higher, although precise contemporaneous survey data for the ditch, nearest borehole (WS207) and the moat are not yet available;
- At this site, it does not seem likely that groundwater le[redacted] by abstractions due to their absence locally;
- There are several options considered with regards to the likely water supply mechanism for the moat. The first is that groundwater is perched within the gravelly clay deposits and seeps laterally into the sides of the hollow in which the moat sits. Nonetheless, given that the boreholes were dry when drilled and only subsequently have an observed water level, it is possible that water supply to the moat is instead largely from direct rainfall input and surface runoff;
- The water supply mechanism to the moat may to be different now to when it was constructed, and different again since the construction of the motorway. A further water supply mech[redacted]orway, and any associated drainage measures, has increased surface runoff rates locally, and that this water finds its way through the Made Ground, or at rockhead, towards the moat. However, water quality analysis has not indicated that this is the primary source of wate[redacted]
- One further consideration is that anecdotal information from the local farmer indicates that the moat is thought to be fed by a spring. Evidence for this is that the moat never truly dries out during prolonged dry weather, in contrast to dry conditions observed at the [redacted] the moat (Medieval), all the historic mapping available illustrates the existence of the moat and does not, therefore, afford the opportunity to observe if a spring was previously mapped, although it is possible that the existence of a spring prompted the selection of the site for the moat. There is no surface evidence of a spring emerging at the site. If a spring supply is the primary mechanism for maintaining water within the moat then it is more likely that the spring is sourced within the underlying low permeability bedrock. However, water quality analysis has not indicated that this is the case. It is likely that any spring that may have previously existed could have been since silted up and no longer functioning as it once did; and
- If local hydrological conditions have altered since the moat was constructed, it is useful to consider the likely conditions under which the moat was installed. With the exception of the deposition of Made Ground at the Moated Site during construction of the M5 the inherent geological conditions at the Moated Site are unlikely to have changed. As such, a lack of mapped permeable superficial deposits overlying a low permeability bedrock would suggest that water in the moat is sustained by runoff, perhaps from the historic southern ditch, unless a shallow groundwater source within weathered bedrock happened to persist at this location. It is possible that, prior to development of the area, that some runoff could have been derived from Robin's Wood Hill area, but this would seem unlikely at the present day meaning that the moat would be more vulnerable to

drying out in drier periods. This study has indicated that there is potential for some water to be supplied by near-surface seepage of shallow groundwater.

In summary, following an evaluation of the available information, it is concluded that the [redacted] water supply mechanism to the moat is a combination of direct rainfall, surface runoff, and shallow groundwater seepage/interflow.

[redacted]

[redacted]

[redacted]

[redacted]

6 Conclusions

An initial understanding of the water environment at the site has been developed with respect to the moat, in determining the likely water supply mechanisms to the site. [redacted]te-specific datasets have been analysed to address the questions posed by the HE Tier 2 water environment assessment requirements. In summary, the most likely water supply mechanism to the site appears to be a combination of surface water run-off and shallow groundwater inputs.

In summary, the assessment concludes that the proposed residential development could result in a fall in the water level in the moat, potentially resulting in the drying out of archaeological deposits and a negative impact upon the significance of the scheduled monument, for the reasons below.

The potential for a reduction in water inputs to the moat fr[redacted]pment includes decreased surface water runoff, due to installatio[redacted]night no longer reach the moat, and reduced groundwater seepage[redacted]ound surface material depending on the engineering approach to foundation design. This could result in the drying of the moat water body unless a supplementary water supply is incorporated into the development design which can permit maintenance of current moat water levels.

Nonetheless, given the lack of clear or indirect evidence for the current supply of the moat from a deeper groundwater spring source beneath its base, there are no concerns regarding the hydrochemical signature of the water used in future to maintain moat water levels and, therefore, whether the top up source is derived from surface water or groundwater. [redacted]

As such, ongoing monitoring of the moat water levels prior to, during and post construction would be recommended alongside development of an appropriate drainage strategy to support the long-term preservation of the moat water body. Further monitoring would be not be considered to impact th[redacted]cation submission.

In conclusion, the assessment has not identified any reason why potential effects on the moat water level from the proposed development could not be appropriately mitigated to safeguard the continued existence of the moat water body.

[redacted]

Appendices

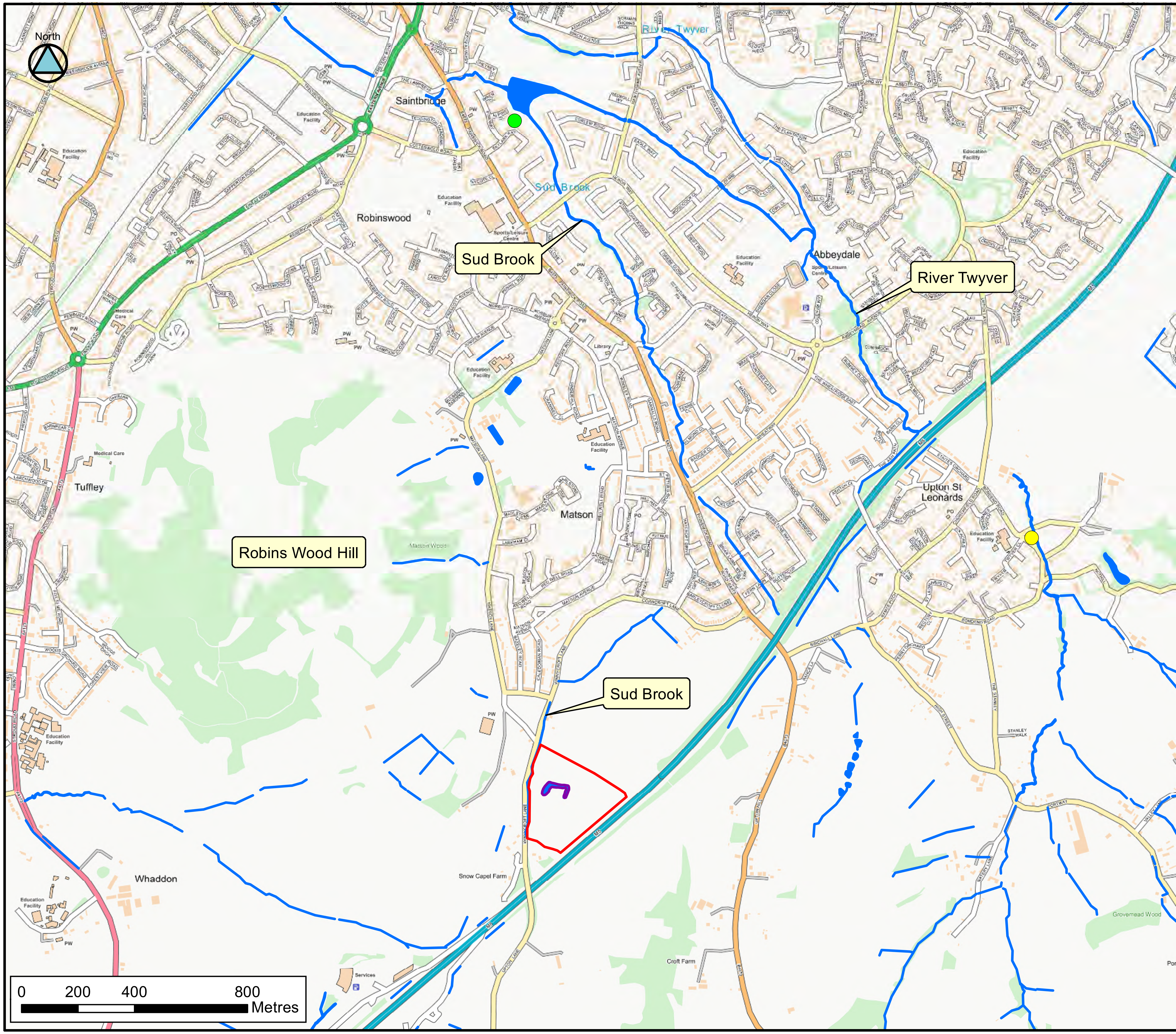
A Maps [redacted]

[redacted]

[redacted]

[redacted]

[redacted]



LEGEND

Site boundary

Moat

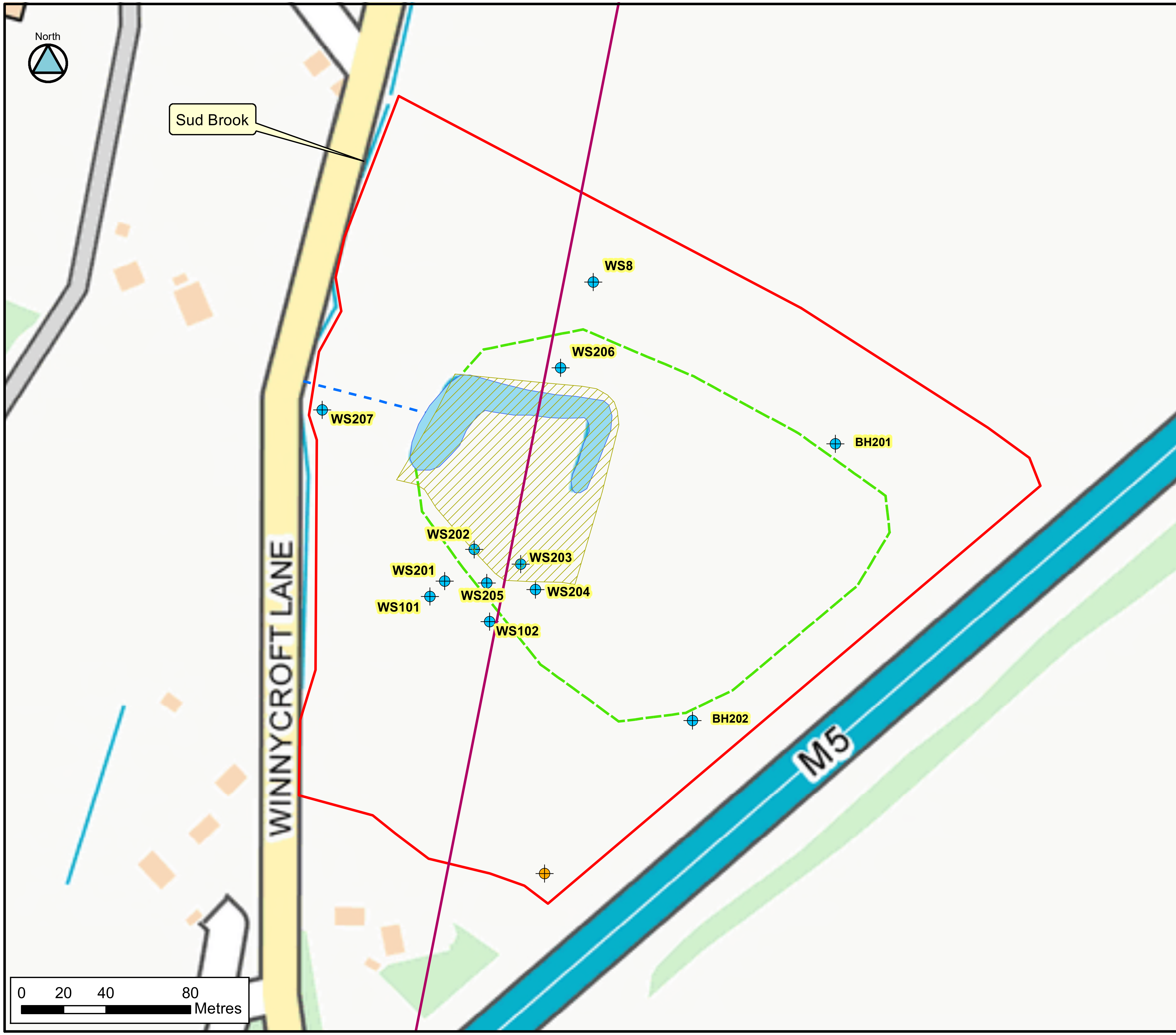
Cheyney Close Gauge (Sud Brook)

Bondend Road Gauge (River Twyver)

Surface water

JBA consulting

MAP 1: Surface Water Features



LEGEND

- Cross-section line
- Site boundary
- Scheduled Monument
- Moat
- Surface water runoff catchment to moat (approx.)
- Shallow ditch
- Abstraction BH
- GW Monitoring Locations

JBA consulting

MAP 2: Site Hydrogeological Features

B Site Topography and Moat Depths

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]


CLIENT:–
EDWARD WARE HOMES
DRAWING:–
170105/1
SNOW CAPEL
GLOUCESTER
FEBRUARY 2017
ABBREVIATIONS:–
BOL BOLLARD
BT BT SERVICE COVER
C/B CLOSE BOARDED FENCE
CL COVER LEVEL
C/L CHAIN LINK FENCE
CPS CONCRETE PAVING SLABS
EP ELECTRICITY POLE
FL FLOOR LEVEL
FH FIRE HYDRANT
IC INSPECTION CHAMBER
IL INVERT LEVEL
KO KERB OUTLET
LP LAMP POST
MH MANHOLE
MKR MARKER
OHW OVERHEAD WIRE
P/R POST & RAIL FENCE
P/W POST & WIRE FENCE
RE RODDING EYE
RG ROAD GULLY
RS ROAD SIGN
R/W RETAINING WALL
ST STOP TAP
TCB TELEPHONE CALL BOX
TL THRESHOLD LEVEL
TP TELEGRAPH POLE
LEGEND:–
BUILDING
KERB LINE
EDGE OF ROAD
PATH/CHANGE OF SURFACE
ROAD MARKINGS
WALL
VEGETATION
FENCE
BANK
OHW (ELEC)
OHW (BT)
N
LEVELS RELATIVE TO
ORDNANCE DATUM
VIA GPS OBSERVATION
HEIGHTS ARE IN METRES
GRID IS UKNG BASED
K.J. HALL SURVEYORS LTD
22 Bower Hinton MARTOCK Somerset TA12 6JY
Tel 01935 823423 Email admin@kjhsurvey.com
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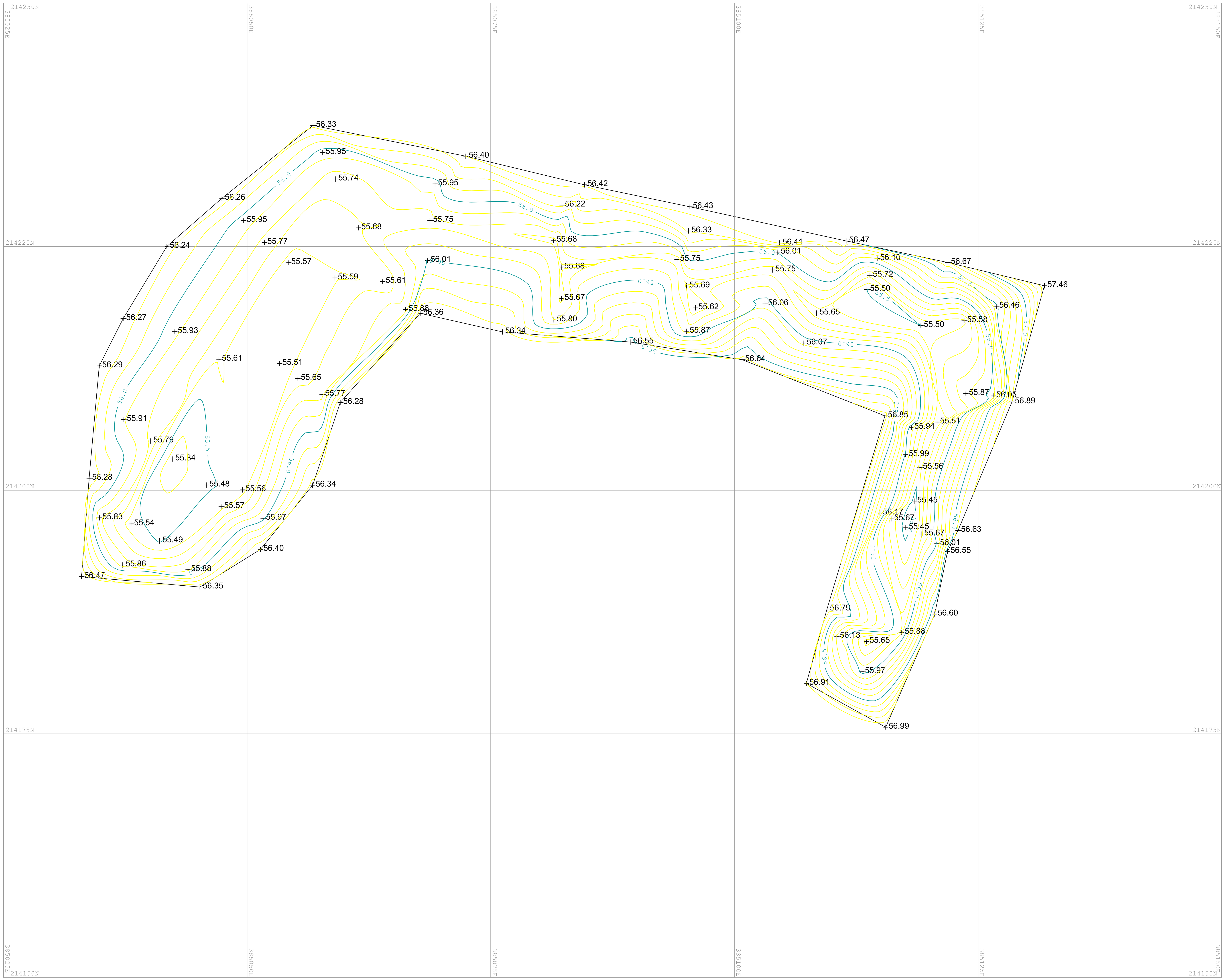


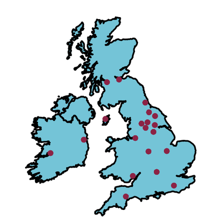
General Notes

1. All dimensions shown are in (metres) unless otherwise stated and levels in metres to Ordnance Datum.
2. Do not scale from this drawing. All dimensions must be checked/verified on site.
3. Any discrepancies noted on site are to be reported to the Engineer immediately.
4. All works in watercourses will be carried out with care to minimise the risk of pollution adhering to Pollution Prevention Guidelines.
5. The electronic model of this drawing is not to be used for setting out.

Rev.	Modifications	Date	Drawn	Designed	Checked	Approved

8a Castle Street
WALLINGFORD
Oxfordshire
OX10 8DL
United Kingdom

[redacted]



Offices at Coleshill, Doncaster, Dublin, Edinburgh, Exeter, Glasgow, Haywards Heath, Isle of Man, Leeds, Limerick, Newcastle, Newport, Peterborough, Saltaire, Skipton, Tadcaster, Thirsk, Wallingford and Warrington

for

2020s1556

Snow Capel Moat
Topographic Survey

Scale:	
1:200 @ A1	Drawn:J Gaskell
	Designed:J Gaskell
	Checked:J Gaskell
	Approved:J Gaskell

Digital File Name:

Drawing Number:	Rev.:	Sheet No.:	Status:
		1 of 1	

C Borehole Logs

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel		Client: Edward Ware Homes		Borehole ID: WS201 Sheet 1 of 1
	Contract Number: CS-J-0828	Date Started: 14/12/2020	Logged By: SH	Checked By:	Status: DRAFT
Windowless Sample Borehole Log	Easting: 385051.65	Northing: 214139.61	Ground Level: 58.03mOD	Plant Used: Competitor Dart	Scale: 1:25

Weather: Overcast

Termination: Engineer instructed

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Water Strike	Backfill / Installation
		0.00 - 1.00 = 100%		57.93	0.10	MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to medium of mixed lithology. (TOPSOIL)		
0.50 - 0.60	ES1				(2.40)	MADE GROUND: Orangish brown mottled grey slightly gravelly silty CLAY. Gravel is subrounded fine and medium of limestone and rare brick.		
		1.00 - 2.00 = 100%						
1.50 - 1.60	D2							
		2.00 - 3.00 = 100%						
2.50 - 2.60	ES3			55.53	2.50	MADE GROUND: Dark grey silty CLAY.		
				55.38	2.65			
2.80 - 3.00	D4				(0.35)	MADE GROUND: Light grey mottled brown slightly gravelly CLAY with rare oraganic content and wood fragments. Gravel is subrounded fine and medium of limestone.		
				55.03	3.00	End of Borehole at 3.00m		

1 2 3 4 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter / **Casing Diameter**

Depth (m)	Dia (mm)	Depth	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	3.00	SLOTTED	50

Remarks:

Groundwater not encountered.

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel	Client: Edward Ware Homes	Borehole ID: WS202

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CS-J-0828	14/12/2020	SH		DRAFT	

Windowless Sample Borehole Log	Easting: 385065.17	Northing: 214153.38	Ground Level: 58.22mOD	Plant Used: Competitor Dart	Scale: 1:25

Weather: Overcast | Termination: Engineer instructed

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill / Installation
		0.00 - 1.00 = 100%		58.12	0.10		MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to medium of mixed lithology. (TOPSOIL)		
0.50 - 0.60	ES1				(1.40)		MADE GROUND: Orangish brown mottled grey slightly gravelly silty CLAY. Gravel is subrounded fine and medium of limestone and rare brick.		
1.20	D2	1.00 - 2.00 = 100%							
		2.00 - 3.00 = 100%		56.72	1.50 (1.00)		MADE GROUND: Dark grey silty CLAY.		
2.60 - 2.70	ES3			55.72	2.50 (0.50)		MADE GROUND: Light grey mottled brown slightly gravelly CLAY with rare oraganic content and wood fragments. Gravel is subrounded fine and medium of limestone.		
				55.22	3.00		End of Borehole at 3.00m		

Depth scale: 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth	Dia (mm)

Remarks:
Groundwater not encountered.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	3.00	SLOTTED	50

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Windowless Sample Borehole Log

Contract Name:	Client:	Borehole ID:
Snow Capel	Edward Ware Homes	WS203

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CS-J-0828	14/12/2020	SH		DRAFT	

Easting:	Northing:	Ground Level:	Plant Used:	Scale:
385087.81	214146.92	58.78mOD	Competitor Dart	1:25

Weather: Overcast

Termination: Engineer instructed

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill / Installation
		0.00 - 1.00 = 100%		58.68	0.10		MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to medium of mixed lithology. (TOPSOIL)		
		1.00 - 2.00 = 100%			(2.60)		MADE GROUND: Dark grey mottled orangish brown slightly gravelly silty CLAY. Gravel is subrounded fine to medium of limestone and rare brick.		
		2.00 - 3.00 = 100%		56.08	2.70				
				55.98	2.80		MADE GROUND: Dark greyish brown slightly sandy slightly gravelly silty CLAY. Gravel is subrounded fine to medium of limestone and rare brick.		
				55.78	3.00		Stiff orangish brown mottled grey silty CLAY. (CHARMOUTH MUDSTONE FORMATION)		
							End of Borehole at 3.00m		

Depth scale: 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter / **Casing Diameter**

Depth (m)	Dia (mm)	Depth	Dia (mm)

Remarks:

Groundwater not encountered.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	3.00	SLOTTED	50

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Windowless Sample Borehole Log	Contract Name: Snow Capel		Client: Edward Ware Homes		Borehole ID: WS204
	Contract Number: CS-J-0828	Date Started: 14/12/2020	Logged By: SH	Checked By:	Status: DRAFT	Sheet 1 of 1
	Easting: 385094.75	Northing: 214134.12	Ground Level: 59.05mOD	Plant Used: Competitor Dart	Scale: 1:25

Weather: Overcast | Termination: Engineer instructed

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill / Installation
		0.00 - 1.00 = 80%		58.95	0.10		MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to medium of mixed lithology. (TOPSOIL)		
		1.00 - 2.00 = 100%			(2.40)		MADE GROUND: Grey mottled brown slightly gravelly silty CLAY. Gravel is subrounded fine to medium of limestone and rare brick.		
		2.00 - 3.00 = 100%		56.55	2.50		MADE GROUND: Dark brown slightly gravelly silty CLAY with a high organic content including wood fragments. Gravel is subrounded fine to medium of limestone.		
				56.45	2.60 (0.40)		MADE GROUND: Dark grey slightly gravelly silty CLAY with rare wood fragments and rootlets. Gravel is subrounded fine to medium of limestone.		
				56.05	3.00		End of Borehole at 3.00m		

Depth scale: 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth	Dia (mm)

Remarks:
Groundwater not encountered.

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	3.00	SLOTTED	50

Contract Name:	Client:	Borehole ID:
Snow Capel	Edward Ware Homes	WS205

T&P Regen
www.tandpregeneration.co.uk

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CS-J-0828	14/12/2020	SH		DRAFT	

Windowless Sample Borehole Log

Easting:	Northing:	Ground Level:	Plant Used:	Scale:
385071.59	214137.59	58.57mOD	Competitor Dart	1:25

Weather: Overcast

Termination: Engineer instructed

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Water Strike	Backfill / Installation
		0.00 - 1.00 = 100%		58.42	0.15	MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to medium of mixed lithology. (TOPSOIL)		
		1.00 - 2.00 = 100%			(2.05)	MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to medium of mixed lithology and rare brick.		
		2.00 - 3.00 = 100%		56.37	2.20			
					(0.80)	MADE GROUND: Orangish brown mottled grey slightly gravelly silty CLAY with rare wood fragments. Gravel is subrounded and rounded fine to medium of mixed lithology.		
				55.57	3.00	End of Borehole at 3.00m		

Depth scale: 1, 2, 3, 4, 5

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter / **Casing Diameter**

Depth (m)	Dia (mm)	Depth	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	3.00	SLOTTED	50

Remarks:
Groundwater not encountered.

T&P Regen www.tandpregeneration.co.uk	Contract Name: Snow Capel			Client: Edward Ware Homes		Borehole ID: WS206 Sheet 1 of 1
	Contract Number: CS-J-0828	Date Started: 14/12/2020	Logged By: SH	Checked By:	Status: DRAFT	
Windowless Sample Borehole Log	Easting: 385106.17	Northing: 214239.91	Ground Level: 57.87mOD	Plant Used: Competitor Dart		Scale: 1:25

Weather: Overcast | Termination: Engineer instructed

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Legend	Strata Description	Water Strike	Backfill / Installation
0.00 - 0.10	ES1	0.00 - 1.00 = 90%		57.72	0.15		MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to medium of mixed lithology. (TOPSOIL)		
0.40 - 0.50	ES2						MADE GROUND: Greyish brown mottled grey slightly gravelly silty CLAY with rare wood fragments. Gravel is subrounded and rounded fine to medium of mixed lithology.		
		1.00 - 2.00 = 90%							
1.50 - 1.60	D3				(2.85)				
		2.00 - 3.00 = 100%							
		3.00 - 4.00 = 100%		54.87	3.00				
					(0.30)		MADE GROUND: Brown slightly sandy slightly gravelly CLAY. Gravel is subrounded fine to coarse of limestone.		
				54.57	3.30				
3.80 - 4.00	D4				(0.90)		Stiff orangish brown mottled grey silty CLAY. (CHARMOUTH MUDSTONE FORMATION)		
		4.00 - 5.00 = 100%		53.67	4.20				
4.80 - 5.00	D5				(0.80)		Very stiff orangish brown mottled grey silty CLAY. (CHARMOUTH MUDSTONE FORMATION)		
				52.87	5.00		End of Borehole at 5.00m		

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter / **Casing Diameter**

Depth (m)	Dia (mm)	Depth	Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	5.00	SLOTTED	50

Remarks:
Groundwater not encountered.

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Windowless Sample Borehole Log						
Contract Name: Snow Capel		Client: Edward Ware Homes			Borehole ID: WS207	
Contract Number: CS-J-0828	Date Started: 14/12/2020	Logged By: SH	Checked By:	Status: DRAFT	Sheet 1 of 1	
Easting: 384993.13	Northing: 214219.77	Ground Level: 55.28mOD	Plant Used: Competitor Dart		Scale: 1:25	
Weather: Overcast	Termination: Engineer instructed					

Depth	Sample ID	Windowless Sample Recovery	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Water Strike	Backfill / Installation
0.00 - 0.10	ES1	0.00 - 1.00 = 100%		55.08	0.20	Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to medium of mixed lithology. (TOPSOIL)		
0.40 - 0.50	ES2			54.88	0.40	Orangish brown friable slightly gravelly silty CLAY. Gravel is subrounded and rounded fine and medium of mixed lithology.		
0.80 - 1.00	D3	1.00 - 2.00 = 100%		53.68	(1.20) 1.60	Firm orangish brown mottled grey silty CLAY. (CHARMOUTH MUDSTONE FORMATION)		
1.80 - 2.00	D4	2.00 - 3.00 = 100%		52.58	(1.10) 2.70	Stiff dark grey silty CLAY. (CHARMOUTH MUDSTONE FORMATION)		
				52.28	(0.30) 3.00	Very stiff dark grey silty CLAY. (CHARMOUTH MUDSTONE FORMATION)		
						End of Borehole at 3.00m		

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)

Borehole Diameter Depth (m)	Borehole Diameter Dia (mm)	Casing Diameter Depth	Casing Diameter Dia (mm)

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	3.00	SLOTTED	50

Remarks:
Groundwater not encountered.

T&P Regen

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Cable Percussion Borehole Log

Contract Name:	Client:	Borehole ID:
Snow Capel	Edward Ware Homes	BH202

Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CS-J-0828	23/03/2021	SH		DRAFT	

Easting:	Northing:	Ground Level:	Plant Used:	Scale:
			Dando 4000	1:50

Weather: Clear | Termination: Driving refusal | SPT Hammer: N/R, Energy Ratio: N/R

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Water Strike	Backfill / Installation
				0.10	MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to coarse of mixed lithology.		
					MADE GROUND: Brown mottled grey slightly gravelly silty CLAY. Gravel is subrounded fine to medium of mixed lithology.		
1.20	D1	SPT(S) 1.20m, N=7 (1,2/1,2,2,2)					
				(2.90)			
2.00	D2	SPT(S) 2.00m, N=7 (1,1/1,2,2,2)					
3.00	D3	SPT(S) 3.00m, N=10 (1,2/2,2,3,3)		3.00	Stiff orangish brown mottled dark grey friable silty CLAY. (CHARMOUTH MUDSTONE FORMATION)		
4.00	D4	SPT(S) 4.00m, N=11 (1,1/2,2,3,4)					
				(3.00)			
5.00	D5	SPT(S) 5.00m, N=31 (3,4/6,7,8,10)					
6.00	D6			6.00	Extremely weak residual MUDSTONE. (CHARMOUTH MUDSTONE FORMATION)		
		SPT(C) 6.50m, N=38 (5,6/8,9,10,11)					
7.00	D7						
				(3.00)			
8.00	D8	SPT(C) 8.00m, N=51 (5,10/10,12,14,15)					
9.00	D9	SPT(C) 9.00m, 50 (5,10/50 for 225mm)		9.00	End of Borehole at 9.00m		

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
23-03-2021	12:30	0.00		
23-03-2021	16:00	9.00	1.50	

Borehole Diameter / Casing Diameter

Depth (m)	Dia (mm)	Depth	Dia (mm)

Remarks:
Groundwater not encountered.

Chiselling

From (m)	To (m)	Duration	Remarks
8.50	9.00	01:00	

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	6.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Cable Percussion Borehole Log	Contract Name: Snow Capel	Client: Edward Ware Homes	Borehole ID: BH201

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Contract Number:	Date Started:	Logged By:	Checked By:	Status:	Sheet 1 of 1
CS-J-0828	23/03/2021	SH		DRAFT	

Easting:	Northing:	Ground Level:	Plant Used:	Scale:
			Dando 4000	1:50

Weather: Clear | Termination: Driving refusal | SPT Hammer: N/R, Energy Ratio: N/R

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description
				0.10	MADE GROUND: Brown slightly gravelly silty CLAY. Gravel is subrounded and rounded fine to coarse of mixed lithology.
				(2.90)	MADE GROUND: Brown mottled grey slightly gravelly silty CLAY. Gravel is subrounded fine to medium of mixed lithology.
1.20	D1	SPT(S) 1.20m, N=6 (1,1/1,1,2,2)			
2.00	D2	SPT(S) 2.00m, N=7 (1,1/2,1,2,2)			
3.00	D3	SPT(S) 3.00m, N=8 (1,1/2,2,2,2)		3.00	Stiff orangish brown mottled dark grey friable silty CLAY. (CHARMOUTH MUDSTONE FORMATION)
4.00	D4	SPT(S) 4.00m, N=17 (1,2/3,3,4,7)		(2.00)	
5.00	D5	SPT(S) 5.00m, 50 (5,7/50 for 225mm)		5.00	Extremely weak residual MUDSTONE. (CHARMOUTH MUDSTONE FORMATION)
6.00	D6				
		SPT(C) 6.50m, N=50 (5,10/11,12,15,12)		(3.00)	
7.00	D7				
8.00	D8	SPT(C) 8.00m, N=50 (4,9/10,15,20,5)		8.00	End of Borehole at 8.00m

Groundwater: Water Strike / Backfill / Installation

Sample Key: B = Bulk Disturbed D = Small Disturbed U = Undisturbed Open-Drive W = Water G = Gas ES = Environmental Soil EW = Environmental Water

Start & End of Shift Observations

Date	Time	Depth (m)	Casing (m)	Water (m)
23-03-2021	11:30	0.00		
23-03-2021	12:00	8.00	1.50	

Borehole Diameter / **Casing Diameter**

Depth (m)	Dia (mm)	Depth	Dia (mm)

Remarks:
Groundwater not encountered.

Chiselling

From (m)	To (m)	Duration	Remarks
7.50	8.00	01:00	

Installation

Top (m)	Base (m)	Type	Dia (mm)
0.00	1.00	PLAIN	50
1.00	6.00	SLOTTED	50

Water Strikes

Strike (m)	Casing (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

D Site Groundwater Levels

[redacted]

[redacted]

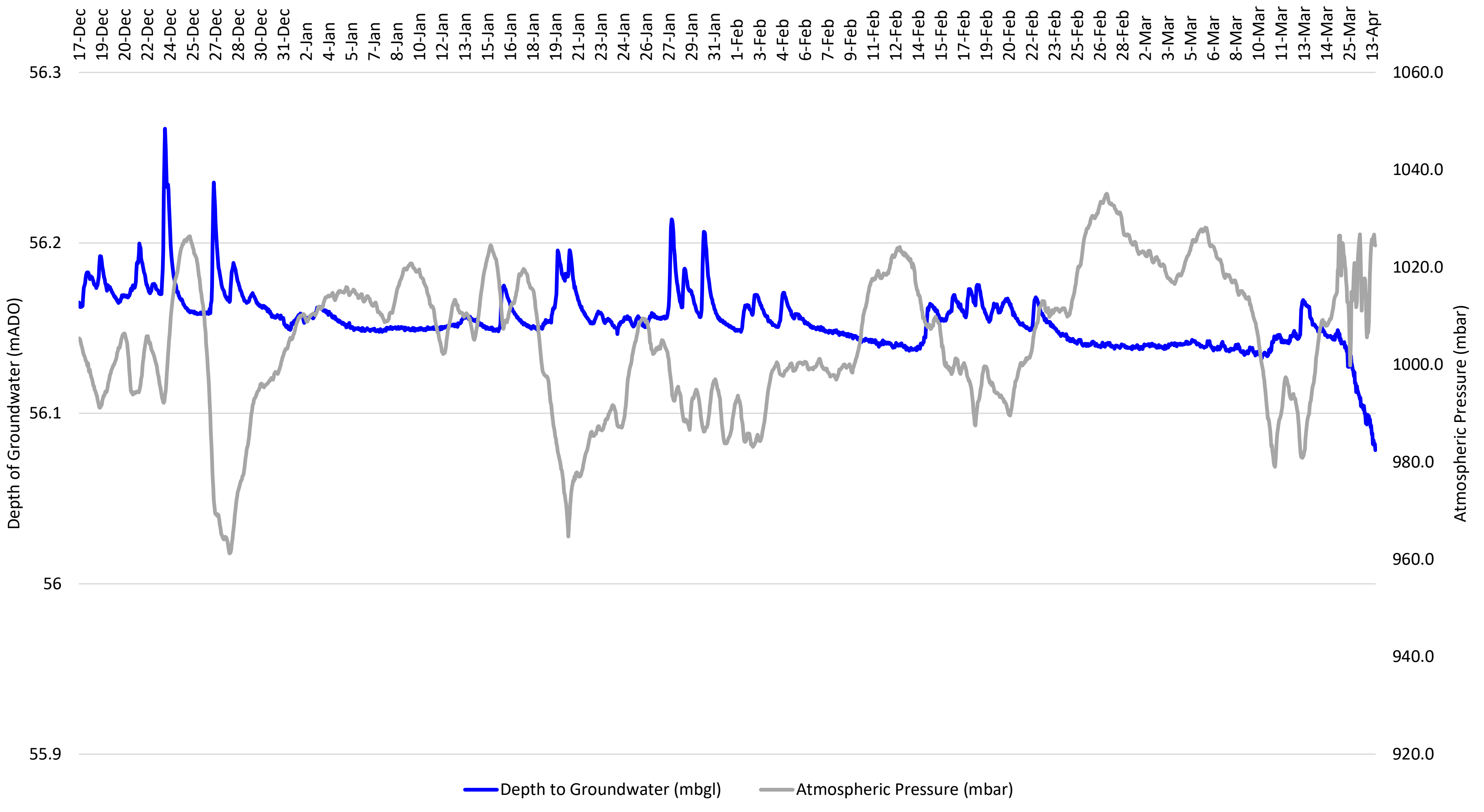
[redacted]

[redacted]

[redacted]

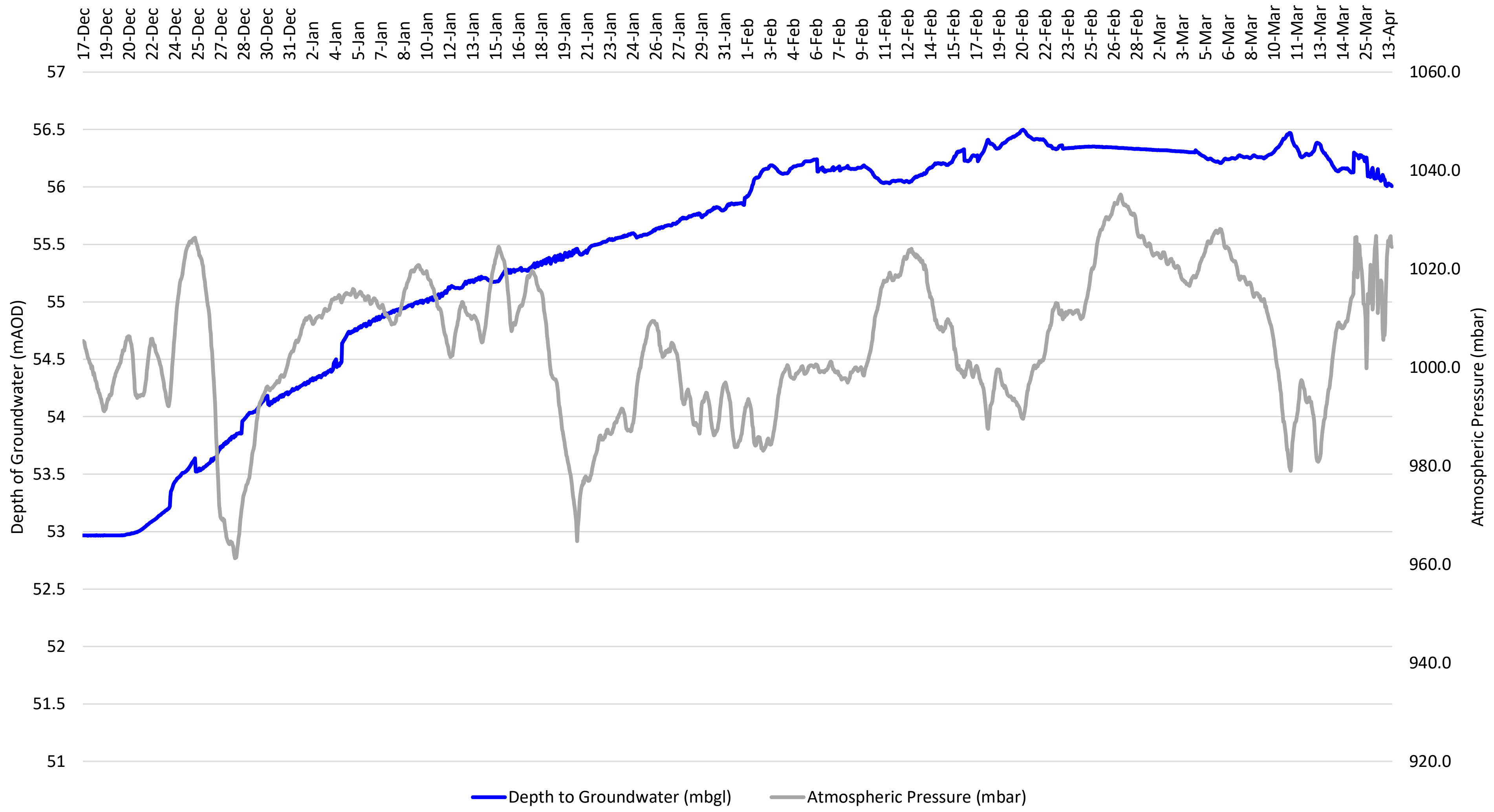
Groundwater Monitoring Results

Site Address:	CS-J-0916	Base of Installation (mbgl)	N/A		Min. GW Level (mbgl)	-0.10
		Ground level (mAOD)	56.17		Min. GW Level (mAOD)	56.08
		Depth of Probe (mbgl)	0.39		Max. GW Level (mbgl)	0.09
					Max. GW Level (mAOD)	56.27
Site ID:	Snow Capel	Run Time (Days)	120		Min. Atm' Pres' (mB)	961.2
Hole ID:	Moat	Run Time Period	17/12/2020	16/04/2021	Max. Atm' Pres' (mB)	1035.1



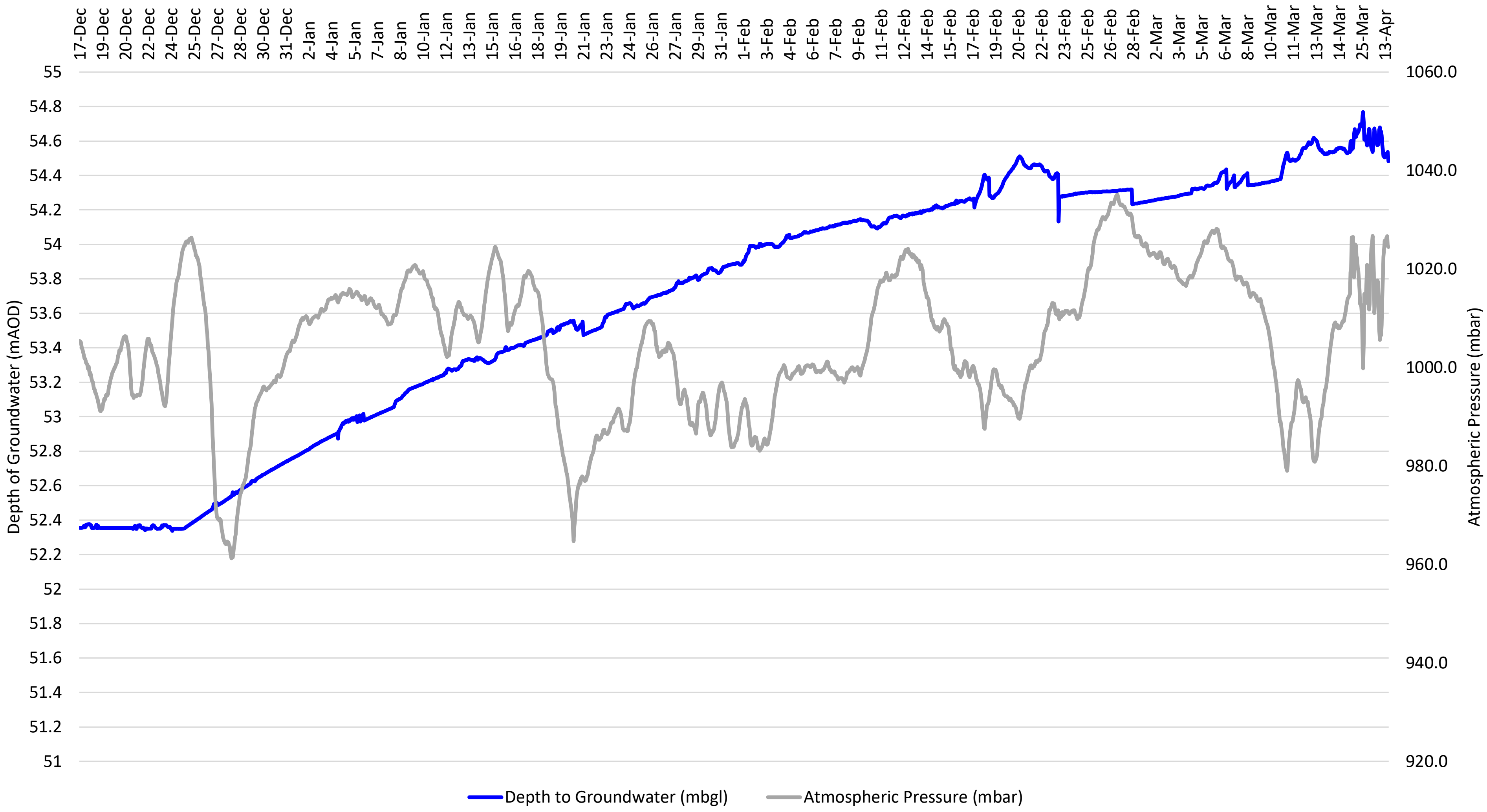
Groundwater Monitoring Results

Site Address:	CS-J-0916	Base of Installation (mbgl)	N/A	Min. GW Level (mbgl)	1.37
		Ground level (mAOD)	57.87	Min. GW Level (mAOD)	52.97
		Depth of Probe (mbgl)	4.90	Max. GW Level (mbgl)	4.90
				Max. GW Level (mAOD)	56.50
Site ID:	Snow Capel	Run Time (Days)	120	Min. Atm' Pres' (mB)	961.2
Hole ID:	WS206	Run Time Period	17/12/2020 16/04/2021	Max. Atm' Pres' (mB)	1035.1



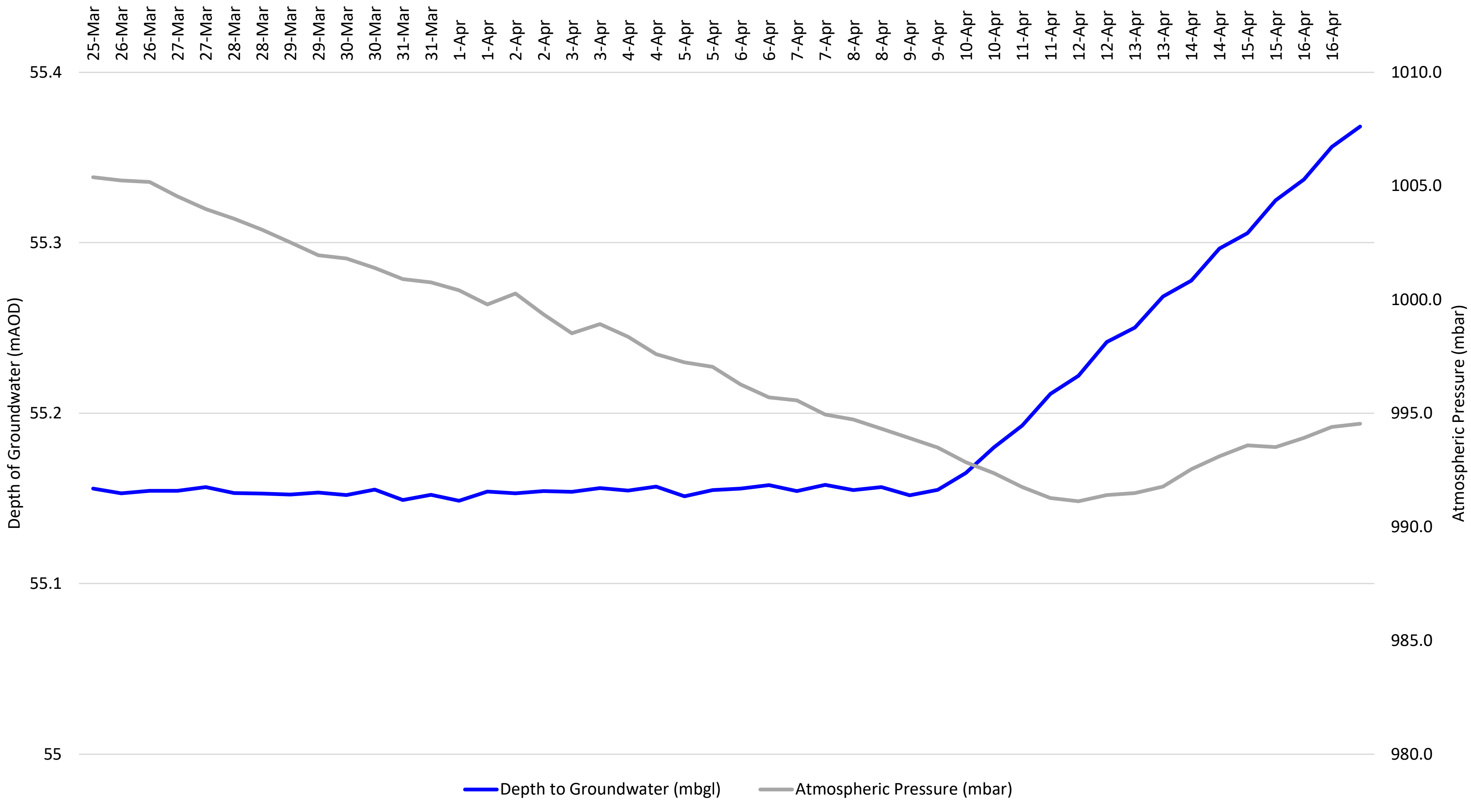
Groundwater Monitoring Results

Site Address:	CS-J-0916	Base of Installation (mbgl)	3.00		Min. GW Level (mbgl)	0.51
		Ground level (mAOD)	55.28		Min. GW Level (mAOD)	52.34
		Depth of Probe (mbgl)	2.93		Max. GW Level (mbgl)	2.94
					Max. GW Level (mAOD)	54.77
Site ID:	Snow Capel	Run Time (Days)	120		Min. Atm' Pres' (mB)	961.2
Hole ID:	WS207	Run Time Period	17/12/2020	16/04/2021	Max. Atm' Pres' (mB)	1035.1



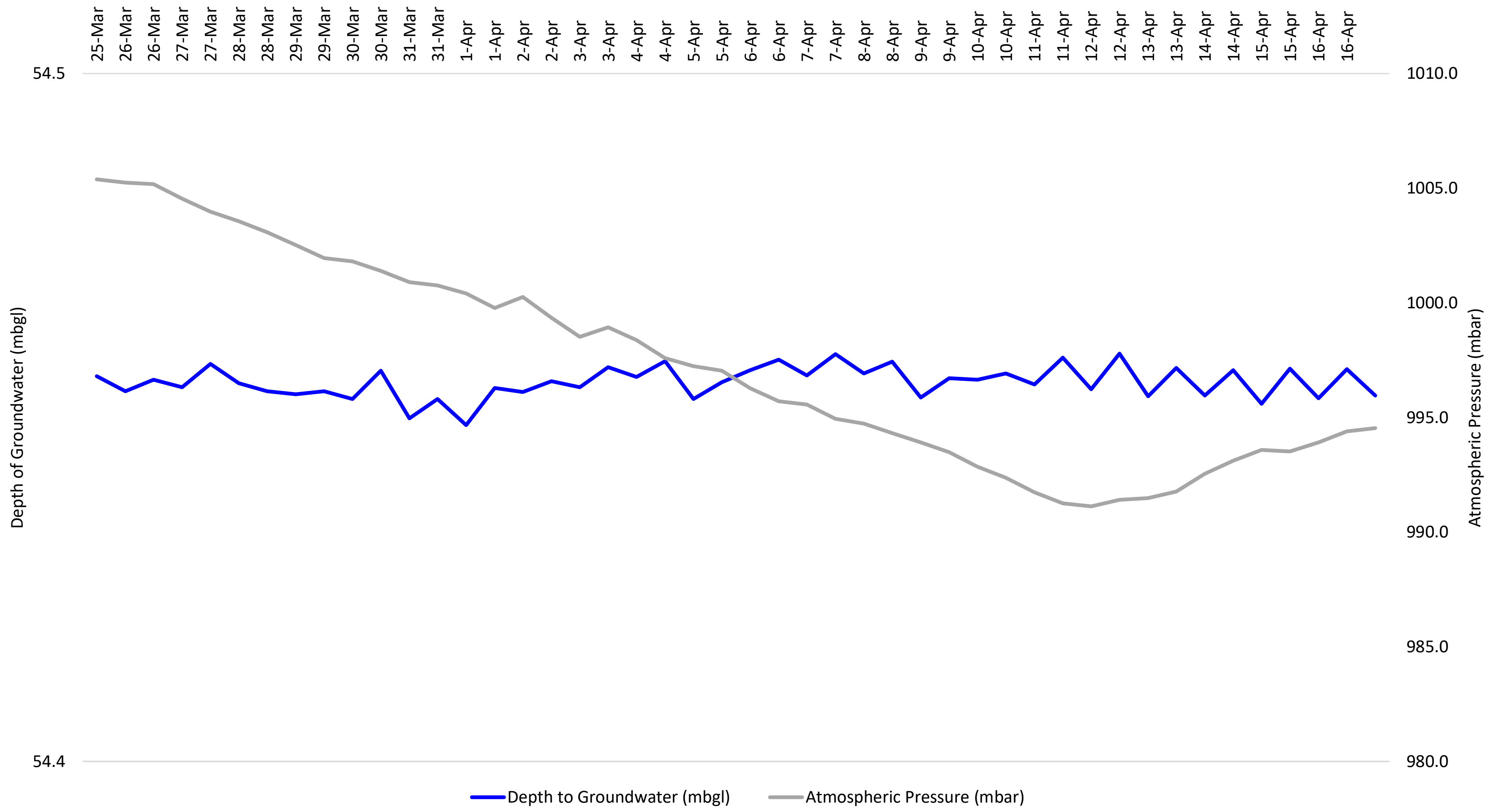
Groundwater Monitoring Results

Site Address:	CS-J-0916	Base of Installation (mbgl)	5.64		Min. GW Level (mbgl)	5.28
		Ground level (mAOD)	60.65		Min. GW Level (mAOD)	55.15
		Depth of Probe (mbgl)	5.50		Max. GW Level (mbgl)	5.50
					Max. GW Level (mAOD)	55.37
Site ID:	Snow Capel	Run Time (Days)	23		Min. Atm' Pres' (mB)	991.1
Hole ID:	BH201	Run Time Period	25/03/2021	16/04/2021	Max. Atm' Pres' (mB)	1005.4



Groundwater Monitoring Results

Site Address:	CS-J-0916	Base of Installation (mbgl)	6.07		Min. GW Level (mbgl)	5.85
		Ground level (mAOD)	60.31		Min. GW Level (mAOD)	54.45
		Depth of Probe (mbgl)	5.85		Max. GW Level (mbgl)	5.86
					Max. GW Level (mAOD)	54.46
Site ID:	Snow Capel	Run Time (Days)	23		Min. Atm' Pres' (mB)	991.1
Hole ID:	BH202	Run Time Period	25/03/2021	16/04/2021	Max. Atm' Pres' (mB)	1005.4



E Moat Water Quality

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

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Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number:	21/04524		
Issue Number:	1	**Date:**	05 May, 2021

Client: JBA Consulting (Saltaire)
Salts mill
Victoria Road
Saltaire
Shipley
BD18 3LF

Project Manager:	[redacted]
Project Name:	Snow Capel
Project Ref:	2020s1556
Order No:	TBC
Date Samples Received:	28/04/21
Date Instructions Received:	28/04/21
Date Analysis Completed:	05/05/21

Prepared by: **Approved by:**

[redacted]

UKAS TESTING 1247

Envirolab Job Number: 21/04524

Client Project Name: Snow Capel

Client Project Ref: 2020s1556

Lab Sample ID	21/04524/1	21/04524/2	21/04524/3	21/04524/4	21/04524/5	21/04524/6	21/04524/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	Moat North	Moat NW	Moat NE	Moat East	Moat SE	Moat SW	Moat West			
Depth to Top										
Depth To Bottom										
Date Sampled	26-Apr-21	26-Apr-21	26-Apr-21	26-Apr-21	26-Apr-21	26-Apr-21	26-Apr-21			
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW			
Sample Matrix Code	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Alkalinity by titration (carbonate) (w)$_A$	<15	<15	<15	<15	<15	<15	<15	mg/l Ca CO3	15	Titration w
Chloride (w)$_A^{\#}$	13	12	14	14	17	11	13	mg/l	1	A-T-026w
Nitrate (w)$_A^{\#}$	<0.1	<0.1	0.8	<0.1	<0.1	<0.1	<0.1	mg/l	0.1	A-T-026w
Sulphate (w)$_A^{\#}$	75	63	107	113	79	47	51	mg/l	1	A-T-026w
Arsenic (dissolved)$_A^{\#}$	-	1	1	-	2	2	-	µg/l	1	A-T-025w
Boron (dissolved)$_A^{\#}$	-	26	63	-	66	50	-	µg/l	10	A-T-025w
Cadmium (dissolved)$_A^{\#}$	-	<0.2	<0.2	-	<0.2	<0.2	-	µg/l	0.2	A-T-025w
Calcium (dissolved)$_A^{\#}$	102	105	99	93	111	98	106	mg/l	1	A-T-049w
Copper (dissolved)$_A^{\#}$	-	<1	<1	-	<1	<1	-	µg/l	1	A-T-025w
Chromium (dissolved)$_A^{\#}$	-	<1	<1	-	24	<1	-	µg/l	1	A-T-025w
Lead (dissolved)$_A^{\#}$	-	<1	<1	-	<1	<1	-	µg/l	1	A-T-025w
Magnesium (dissolved)$_A^{\#}$	14	14	15	16	16	14	14	mg/l	1	A-T-049w
Mercury (dissolved)$_A^{\#}$	-	<0.1	<0.1	-	<0.1	<0.1	-	µg/l	0.1	A-T-025w
Nickel (dissolved)$_A^{\#}$	-	1	3	-	2	2	-	µg/l	1	A-T-025w
Potassium (dissolved)$_A^{\#}$	4	4	3	3	4	3	4	mg/l	1.2	A-T-049w
Selenium (dissolved)$_A^{\#}$	-	<1	<1	-	<1	<1	-	µg/l	1	A-T-025w
Sodium (dissolved)$_A^{\#}$	21	20	22	23	27	20	20	mg/l	1	A-T-049w
Zinc (dissolved)$_A^{\#}$	-	2	1	-	4	2	-	µg/l	1	A-T-025w

Envirolab Job Number: 21/04524

Client Project Name: Snow Capel

Client Project Ref: 2020s1556

Lab Sample ID	21/04524/1	21/04524/2	21/04524/3	21/04524/4	21/04524/5	21/04524/6	21/04524/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	Moat North	Moat NW	Moat NE	Moat East	Moat SE	Moat SW	Moat West			
Depth to Top										
Depth To Bottom										
Date Sampled	26-Apr-21	26-Apr-21	26-Apr-21	26-Apr-21	26-Apr-21	26-Apr-21	26-Apr-21			
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW	Water - EW			
Sample Matrix Code	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
PAH 16MS (w)										
Acenaphthene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Acenaphthylene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Anthracene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Benzo(a)anthracene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Benzo(a)pyrene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Benzo(b)fluoranthene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Benzo(ghi)perylene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Benzo(k)fluoranthene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Chrysene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Dibenzo(ah)anthracene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Fluoranthene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Fluorene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Indeno(123-cd)pyrene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Naphthalene (w)$_{A}^{\#}$	-	0.25	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Phenanthrene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Pyrene (w)$_{A}^{\#}$	-	<0.01	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w
Total PAH 16MS (w)$_{A}^{\#}$	-	0.25	<0.01	-	<0.01	<0.01	-	µg/l	0.01	A-T-019w

Envirolab Job Number: 21/04524

Client Project Name: Snow Capel

Client Project Ref: 2020s1556

Lab Sample ID	21/04524/8							Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	Sneedhams Pond									
Depth to Top										
Depth To Bottom										
Date Sampled	26-Apr-21									
Sample Type	Water - EW									
Sample Matrix Code	N/A									
Alkalinity by titration (carbonate) (w)$_A$	<15							mg/l Ca CO3	15	Titration w
Chloride (w)$_A$#	36							mg/l	1	A-T-026w
Nitrate (w)$_A$#	<0.1							mg/l	0.1	A-T-026w
Sulphate (w)$_A$#	95							mg/l	1	A-T-026w
Calcium (dissolved)$_A$#	122							mg/l	1	A-T-049w
Magnesium (dissolved)$_A$#	19							mg/l	1	A-T-049w
Potassium (dissolved)$_A$#	3							mg/l	1.2	A-T-049w
Sodium (dissolved)$_A$#	37							mg/l	1	A-T-049w

REPORT NOTES

General
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and interpretations expressed are outside the scope of our accreditation.
If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.
A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any “A” subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:
Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:
Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis.
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:
1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.
Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.
Secondary Matrix Codes:
A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal, E = contains roots/twigs.

Key:
IS indicates Insufficient Sample for analysis.
US indicates Unsuitable Sample for analysis.
NDP indicates No Determination Possible.
NAD indicates No Asbestos Detected.
N/A indicates Not Applicable.
Superscript # indicates method accredited to ISO 17025.
Superscript "M" indicates method accredited to MCERTS.
Subscript "A" indicates analysis performed on the sample as received.
Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR

[redacted] [redacted]

Client:	JBA Consulting (Saltaire), Salts mill, Victoria Road, Saltaire, Shipley, BD18 3LF	**Project No:**	21/04524
		Date Received:	28/04/2021 (am)
Project:	Snow Capel	**Cool Box Temperatures (°C):**	11.9
Clients Project No:	2020s1556		

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

JBA consulting

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Wick Road, Bishop Sutton,
Somerset BS39 5XP United Kingdom

[redacted]
www.integrale.uk.com

Intégrale
Understanding Ground Conditions

Proposed Development
Snow Capel
Matson
Gloucester
Gloucestershire
GL4 6EQ

GEOTECHNICAL AND PHASE II CONTAMINATION REPORT

REPORT NO. 1826, August 2017

GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

Intégrale is a trading name of Integrale 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

Proposed Development
Geotechnical and Phase II Contamination Report
Snow Capel
Matson
Gloucester
Gloucestershire
GL4 6EQ

Client: Edward Ware Homes Limited

Intégrale Report No. 1826, August 2017

		Signature/Date
Project Co-ordinator & Report Preparation:	[redacted]	
Report Approved by:		
Final Check by:		

CONFIDENTIALITY STATEMENT

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

Edward Ware Homes Limited
45 Oakfield Road
Clifton
Bristol
BS8 2AX

Integrale Limited has prepared this report solely for the use of the client named above. Should any other parties wish to use or rely upon the contents of this report, written approval must be sought from Integrale Limited. An assignment fee may then be charged.

Intégrale

LIST OF CONTENTS

- EXECUTIVE SUMMARY –

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

[redacted]
www.integrale.uk.com

EXECUTIVE SUMMARY
Geotechnical and Phase II Contamination Report
1826 – Snow Capel, Matson

Edward Ware Homes Limited propose to develop this site with housing. The site contains a scheduled ancient monument, centred around an existing moat, which is excluded from the development area. The site lies adjacent to the M5 motorway. Anecdotally, excavated material from the motorway cutting was deposited across the site.

The geology map reports Lower Lias Clay of Jurassic age. Old maps show open farm land since the 1880s until present date. By the late 1960s/early 1970s, the motorway was constructed adjacent, and it is presumed that the placement of the excavated material must have occurred around these dates. Nearby borehole records available on the BGS website indicate Made Ground comprising firm sandy gravelly Clay from ground level to 0.4/2.5m depth, overlying stiff grey CLAY to 4.2/10.3m depth.

Windowless sampling boreholes and continuous dynamic penetration tests proved a veneer of Topsoil, a variable thickness mantle (1-3.5m) of existing very soft or loosely compact gravelly clay Made Ground, localised soft clayey Alluvium, and a continuous stratum of variably weathered soft through to stiff to very stiff Lower Lias clay. Groundwater stands at 1.5-2.5m depth locally where old drainage ditches or the Moat occur.

The variably weathered Lower Lias Clay is capable of supporting reinforced spread foundations, with design bearing pressures of 100-75kN/m^2 for 1-2m wide foundations at 3-4m depth. Flexible foundation rafts, with continuity of reinforcement and poured monolithically, can even out variations in formation compressibility. A piled foundation is another option. Ground floor slabs should be designed as suspended. Design CBR values of at least 1% onto the clayey Made Ground are feasible. An effective angle of friction (Ø') of 25° is appropriate for the clayey Made Ground and variably weathered Lower Lias Clay. Design Sulphate Class of DS-1 and ACEC Class of AC-1 is recommended for buried concrete, however may require upgrading.

Monitoring to date has encountered significantly raised methane and carbon dioxide within one of the standpipe installations. At these levels (up to approximately 60% and 35% respectively), further borehole installations and monitoring should be completed to provide a robust gas regime classification and/or delineate problem areas.

No specific remedial measures are considered necessary to protect human health or environmental receptors, however, it is anticipated that special gas precautions will be required, pending completion of the recommended supplementary monitoring. Check tests on existing topsoil should be completed to confirm suitability for reuse.

No Radon protection measures are required, however new water supply pipes will require protection.

1.0 INTRODUCTION

Edward Ware Homes Limited *(the client)* are proposing to develop this site with housing.

The site contains a scheduled ancient monument *(SAM)*, which includes a moat. This area is excluded from the development area. The client has commissioned The Environmental Dimension Partnership Limited as project archaeologists.

The site lies adjacent to the M5 motorway. Anecdotally, excavated material from the motorway cutting was deposited across the site. It is not known if the original topsoil was buried, or stripped first.

Integrale Limited *(Intégrale)* are commissioned to undertake a ground investigation and complete a Geotechnical and Phase II Contamination Report. The investigation scope was determined by the client in liaison with Intégrale and the archaeologist.

This interpretative report summarises desk studies, describes the scope of fieldworks, laboratory investigations and monitoring, discusses the ground and groundwater conditions encountered, and gives advice on foundations and other geotechnical aspects. The investigation will also be used to allow the design team to ascertain the need for any archaeological investigation.

The results of contamination analyses and generic quantitative risk assessment are reported and used to establish a conceptual model of pollutant linkages. Potential implications for the development are discussed and recommendations for further investigation and design measures given.

2.0 THE SITE

2.1 Location and Description

As shown in Appendix A, the site is located in agricultural land at Snow Capel, Matson, Gloucester. It has a central Ordnance Survey Grid Reference of SO 851 141 and postcode GL4 6EQ.

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	Open field.
Site Area & Plan Shape	Approximately 7.8 Hectares; Site roughly triangular in shape.
Maximum Dimensions	350m (NW-SE) x 295m (NE-SW).
Ground Slopes & Topography	Site slopes gently from SE (c.61.5mAOD) to NW (50mAOD). The scheduled monument slopes steeply down to form the Moat.
Buildings & Condition	None.
Surfacings & Condition	100% grass/vegetation.
Vegetation & Trees	Site covered in grass and wild flowers. Small copse of trees by Moat.
Water Courses	Small drainage ditch running N-S adjacent to W site boundary. Water level 54.85m AOD Feb 2017. Moat in centre of site.
Site Boundary Features	All four boundaries fence with hedge beyond. Some breaks in hedge on E boundary, framed by fences onto M5 motorway.
Contamination Issues	Thick Made Ground associated with M5 construction anticipated. Potential for anomalous gases and range of contaminants.
Geotechnical Issues	Thick Made Ground may require special foundations.
Other Features	SAM in centre of site, centered around existing Moat.

2.2 Published Geology and Mining

2.2.1 British Geological Survey Mapping

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

Map / Scale	Sheet 234 (Gloucester) at 1:50,000 scale.
BGS On-Line Viewer	Accessed May 2017.
Artificial Ground	None mapped.
Superficial Deposits	None mapped.
Solid Geology	Lower Lias clay of Jurassic age (known as Charmouth Mudstone Formation).

2.2.2 BGS Previous Investigation Records

Previous investigation records available on the BGS website under the Open Government Licence include boreholes sunk 5m to the east (ref: SO81SE20) and 100m to the south west (ref: SO81SW55). These indicate Made Ground comprising firm sandy gravelly Clay from ground level to 0.4/2.5m depth, overlying stiff grey CLAY to 4.2/10.3m depth. Groundwater details were not given.

2.2.3 Past Coal Mining

The Groundsure Report indicates that the site and surrounding 1000m radius area is not affected by active or historic coal mining.

2.2.4 Other Mining

The Groundsure Report indicates that there are no areas of non-coal mining within a 1000m radius of the site.

2.3 Outline History

Historical maps obtained from a Groundsure Report are included in Appendix C. These indicate the following pertinent information:

Map Date	Site Features / Land Use	Adjacent Features (distance from site)
1883	Site composed of 3 fields. Moat in centre. Footpath running SW to NE.	Site set in agricultural land. Snow Caple farm adjacent to SW.
1884-1901	Footpath running parallel to N boundary.	-
1903-1923	As previous.	Track/road runs N-S adjacent to W boundary.
1924 - 1955	As previous.	Rifle Range 200m S.
1966-1971	As previous.	Motorway constructed adjacent to E boundary in cutting.
1974-1975	Footpath running SW to NE no longer marked.	-
1994-2014	Field boundaries removed	-

2.4 Hydrogeology, Hydrology & Groundwater Vulnerability

Based on the published geological strata, topographic maps showing surface water courses and the Groundwater Vulnerability maps, the following can be anticipated at this site:

Soils Permeability	Low permeability.
Anticipated Groundwater Table Depth	Deep (5-10m+ below ground level). The true groundwater table may well be very deep (10m + BEGL), however, shallow perched water may be encountered within Made Ground.
Anticipated Groundwater Flow Direction	From SE to NW (based on topography).
Surface Water Courses and Flow Direction	Unnamed drain/tertiary river forms W boundary flowing N.
Aquifer Type	Secondary (undifferentiated) aquifer on site.
Environment Agency Soils Classification	Low leaching potential, 133m SE. No information provided for on-site.
Hydraulic Continuity of Groundwater and Water Courses	Unlikely given clayey nature of Lower Lias clay.

2.5 Environmental Information

The following pertinent information on activities within 250m of the site has been extracted from the Groundsure report included in Appendix C.

2.5.1 Pollution Information and Licencing

	Number	Distance from Site
Surface Water Abstractions	0	-
Groundwater Abstractions	1	On site in S apex, for general farming and domestic use, (licence: 18/54/20/0193) issued 1966, referenced as Land at Upton St. Leonards – Well.
Contaminated Land Register Entry/ Enforcement / Prohibition	0	-
Known Pollution to Controlled Waters	0	-
Integrated Pollution Control	0	-
Fuel Station Entry	0	-
Registered Radioactive Substances	0	-
Discharge Consent	1	32m S. Sewage discharges, final/treated effluent.
Known Landfills / Waste Management / Transfer Sites within 250m	0	-
Source Protection Zones	0	-

2.5.2 Geological Information

	Hazard Rating.
Natural and Mining Cavities	Low.
Potential for Shrink/Swell Clays	Low.
Potential for Ground Dissolution	Negligible.
Potential for Landslide Ground Stability Hazard	Very Low (Low 43m SE).
Potential for Compressible Deposits	Negligible.
Potential for Collapsible Deposits	Very Low.
Potential for Running Sands	Negligible.

2.5.3 Background Soils Chemistry

The Groundsure report includes BGS estimated background soil chemistry for 5 metals within shallow soils. This indicates that naturally occurring arsenic and chromium are slightly raised in this area. Interpretation suggests that at these levels, such metals would be unlikely to exceed generic assessment criteria for residential use.

2.5.4 Contemporary Trade Directories

Potentially Contaminative Activities on Site	Historic and current agricultural use.
Potentially Contaminative Business Activities within 250-300m of Site	Livestock farming, 88m NW. Waste pump, 171m W. Electricity substation, 211m N.

2.5.5 Groundsure Radon Risk Information

The Groundsure report indicates that the specific site does not lie within a Radon Affected Area, as less than 1% of the properties are above the action level. No radon protective measures are necessary.

Where Groundsure conclude that no radon gas protection methods are needed, the local authority may have more conservative requirements, based on the indicative maps, and this aspect should be confirmed with their Building Control department.

2.6 Conceptual Exposure Model

This section draws together desk study information, outlines an initial conceptual exposure model, and provides a qualitative assessment of potential contamination via a source-pathway-receptor framework for the proposed redevelopment.

2.6.1 Proposed Redevelopment

The proposed redevelopment will be the subject of an outline planning application. Full details of the proposed redevelopment are not available at the time of writing; however it is understood that the redevelopment may consist of circa 75-85 residential dwellings with conventional gardens. The central area around the scheduled monument will be soft landscaping providing a 25m buffer from the buildings. There will be a public open space/noise bund along the southeastern boundary with the motorway. Access will be provided off Winnycroft Lane along the western boundary, via a loop road around the central public open space. Two soft landscaping 'corridors' are shown on the preliminary drawings in Appendix H; these extend from the loop road to the northern and southeastern boundaries.

Preliminary discussions between the design team indicates that an attenuation pond will be required in the northwestern corner, with storm water drainage being directed to this area, allowing flow at green field levels into the adjacent ditch along the western boundary.

2.6.2 Potential Sources of Contamination

The desk study has been used to identify the likely remnant contaminant sources and distribution. The potential current and historical on- and off-site sources and the contaminants associated with these, derived using CLR8 Potential Contaminants for the Assessment of Land, and through experience of industrial land use, are detailed below.

Potential Contaminants Associated with On-Site Sources			
Description	Metals, semi-metals, non-metals, inorganic chemicals and others	Organic chemicals	Ground Gases & Vapours
Agricultural use	Remnant metals possible, although likely low level. Range of other chemicals locally possible due to long history of farming usage, but unlikely.	Hydrocarbons, PAH's and organic compounds possible locally due to long history of farming usage, but overall unlikely.	Methane, carbon dioxide, hydrogen sulphide possible if buried slurry, animal wastes etc. present locally, but no evidence of this,
Motorway spoil – anecdotally natural soil excavation material from adjacent cutting	Range of potential contaminants could be expected (albeit considered low potential from natural spoil).		Unlikely unless degradable materials (e.g buried topsoil) present.

Potential Relevant Contaminants Associated with Off-Site Sources			
Description	Metals, semi-metals, non-metals, inorganic chemicals and others	Organic chemicals	Ground Gases & Vapours
Agricultural use adjacent to N, W & S	Remnant metals possible, although likely low level. Range of other chemicals locally possible due to long history of farming usage, but unlikely.	Hydrocarbons, PAH's and organic compounds possible locally due to long history of farming usage, but overall unlikely.	Methane, carbon dioxide, hydrogen sulphide possible if buried slurry, animal wastes etc. present locally, but no evidence of this.

2.6.3 Potential Pathways

To understand the potential risks posed by the contaminants to human receptors, the possible contaminant pathways need identified. The CLEA model (DEFRA & EA 2002) indicates potential exposure routes for assessing risks to human health for a residential setting (with home-grown produce uptake) as follows:

- Dermal exposure;
- Inhalation of particulates;
- Inhalation of soil vapour (indoor and outdoor);
- Inhalation of groundwater vapour (indoor and outdoor);
- Direct ingestion of soil;
- Ingestion of home-grown produce and soil attached to vegetables.

The potential pathways with respect to Controlled Waters will include:

- Downward migration through Made Ground and to underlying Secondary (undifferentiated) Aquifer;
- Lateral migration through Made Ground to surface water;
- Lateral migration through groundwater to surface water;
- Lateral migration via man-made pathways (e.g. services) to surface water.

2.6.4 Potential Receptors

For a residential end use and the known neighbouring land uses, the potential receptors to contamination (if present on site) are:

- Immediately adjacent residents – critical receptor female child;
- Construction workers – critical receptor female adult;
- Future site users – critical receptor female child.

The likely sensitive Controlled Waters receptors are considered to be:

- Secondary (undifferentiated) Aquifer in Lower Lias clay on-site;
- Unnamed tertiary river/ditch, along the western boundary;
- Moat, on-site.

Due to the topography of the site, and the underlying thick clay soils, the tertiary river is considered the most likely receptor. The Moat (although a receptor) is isolated and considered less sensitive. Although a groundwater abstraction point is referenced in the southern apex of the site; it is unlikely that this will be used as part of the redevelopment, and the abstraction point would be removed.

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 Lined Sampling Boreholes

8 No. Small diameter boreholes were drilled with a tracked, open-drive percussive lined sampler rig on 24th and 25th May 2017. These borehole locations, chosen by the consulting engineer are shown on Figure 1 and were referenced as WS1-8. Boreholes were sunk to between 2.8 and 4m depth. The general procedures adopted during windowless sampling, together with the detailed borehole records are included in Appendix D.

3.2 Groundwater and Soils Gas Standpipe Installations and Monitoring

Standpipes were installed Boreholes WS1, 3, 5 and 8 to 3m depth, and details are given on the borehole records. Monitoring has been undertaken on two occasions and the results are included in Appendix E, together with the general procedures adopted for installing standpipes.

3.3 Preliminary Geotechnical Laboratory Testing

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

Location	Depth (m)	Stratum	Testing	Criteria for test selection
WS1	2.5	Made Ground	Natural Moisture Content	Soil classification.
WS2	1.5	"	"	"
WS3	2.5	"	Natural Moisture Content, Atterberg Limits	"
WS4	3.5	Weathered Lower Lias	"	"
WS5	2.25	Highly Weathered Lower Lias	BRE (reduced) suite	Concrete classification.
WS7	1.25	Made Ground	Natural Moisture Content, Atterberg Limits	Soil classification.
WS8	2.5	Alluvium	Natural Moisture Content	"

3.4 Contamination Analyses

In view of the desk study and fieldwork findings, a schedule of soils and water analyses was prepared in line with CLR 8. 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
WS1	0.5	Made Ground	Generic Suite, Total TPH, Asbestos Screen.	Potential preliminary off site waste classification.
WS5	1.8	"	"	"
WS6	1.4	"	Generic Suite, Total TPH	Check contamination testing
WS8	0.6	"	"	"

3.5 Referencing

Locations of the exploratory positions were set out using taped offsets from existing features, and ground level estimated from spot heights on the topographic survey.

4.0 GROUND & GROUNDWATER CONDITIONS

4.1 Summary of Strata Encountered

The strata encountered across the site are broadly similar, they can be summarised as follows:

Depth (m)	Description
GL to 0.15/0.25	Grass over TOPSOIL.
0.15/0.25 to 1.5/3.5	MADE GROUND: (comprising very loosely and loosely compact grey-brown, brown and dark grey-green, locally black and orange-brown slightly gravelly silty Clay. Rare pockets of buried topsoil).
1.5/3.5 to 2.5/3.9	Soft to firm locally soft brown and grey-brown slightly silty CLAY. (HIGHLY WEATHERED LOWER LIAS)
2.5/3.9 proven to 4.0	Firm becoming firm to stiff and stiff grey-brown and dark grey slightly silty CLAY with occasional lithorelicts. (WEATHERED LOWER LIAS)

Alluvium was encountered in WS1 and WS8 overlying the variably weathered Lower Lias soils. This comprised very soft or soft clay with pieces of wood and organic material.

A buried topsoil pocket was encountered at 1.45-1.55m within WS2, but it is not clear whether this is a wider horizon on layer.

4.2 Strata Properties

4.2.1 Made Ground / Topsoil

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

Made Ground Type/Location	Reworked Clay Site wide.
Min/Max. thickness (m)	1.25/3.15
Main Constituents	Silt, mudstone gravel, **Clay**, pockets of buried topsoil.
Properties	Cohesive Very loosely and loosely compact, N100 = 0-1 typically.
Moisture Content / Atterberg Limits	MC = 42.3-42.9 (and 29.9%) LL = 62-76% PL = 28-40% PI = 34-36% Organic Clay of High to Very High Plasticity *(note: although the atterberg plot line given in Appendix F indicates that the sample at 2.5m is below the A-Line, the lab note independently that this is caused by organic material, and the sample should be treated as Clay).* Medium Volume Change Potential.
Visual Contamination / Odours	None.

Topsoil, typically 150-250mm thick, was proven in all of the exploratory positions.

The Made Ground is thickest at WS2 & 3 in the southern area, followed by WS1 & 4 centrally. The thinner Made Ground to only 1.5m depth occurs in WS7 & 8 on the north eastern boundary.

4.2.2 Alluvium

For the purposes of this report Alluvium has locally been defined where the natural ground is very soft and compressible, with pieces of rotten wood, and organic material. The properties can be summarised as:

Stratum	Alluvium
Min/Max. thickness (m)	0.1/1.2
Soil Strength / Properties	Very soft or soft: N100 = typically 0-1.
Occurrence	WS1 and WS8 only.
Moisture Content	MC = 28.2%
Visual Contamination / Odours	None.

WS1 is anomalous and appears to show Made Ground of excavated Lias clay to 2.3/2.7m overlying a drainage ditch or potentially the Medieval Moat. This may extend to 4m depth before consistently firm Lias Clay is inferred in the CDPT hole. There may have been a system of drainage ditches to maintain water levels in the Moat which are now backfilled at WS1 & WS8.

4.2.3 Variably Weathered Lower Lias Clay

For the purposes of this report, the typical uppermost horizon of natural ground has been defined as Highly Weathered where soft or soft to firm clays with little or no extraneous material were observed. The deeper soils have been defined as Weathered where becoming firm, firm to stiff and locally stiff. The CDPTs identified very stiff soils at depth. The properties can be summarised as:

Stratum	Highly Weathered Lower Lias	Weathered Lower Lias
Min/Max. thickness (m)	0.3/1.8	0.1/1.5
Soil Strength/ Properties	Soft: N100 = 1-2 Soft to firm: N100 = 2-3	Firm: N100 = 2-4 Firm to stiff: N100 = 4-5 Stiff: N100 = 5-10 Very stiff: N100 = 10-19
Occurrence	WSs 2, 3 & 5-8.	Site wide.
Moisture Content / Atterberg Limits	-	MC = 29.1% LL = 66% PL = 27% PI = 39% Clay of High Plasticity Medium Volume Change Potential.
Sulphate /pH	pH = 7.9 Water sol. Sulphate = 0.066g/l Total Sulphur = 0.035% Acid Sol. Sulphate = 0.035%	-

Visual Contamination/ Odours	None.	None.

4.3 Groundwater

Groundwater was only encountered during drilling in WS1 at 2.6m depth. The following groundwater levels were encountered during the subsequent monitoring visits on 7th and 13th July 2017:

	07/07/2017	13/07/2017
	Depth below existing ground level (m)	Depth below existing ground level (m)
WS1	1.55	1.58
WS3	1.34	1.29
WS5	Dry	Dry
WS8	2.64	2.57

Groundwater appears to stand near the base of the Made Ground (presumably perched on the underlying insitu impermeable Lower Lias clay). In WS8, the standing water level appears to be near the base of the localised Alluvium deposits, again overlying the Lias.

It is noted that the reduced elevation of the standing water in WS1 & WS8 at 55-56m AOD, is similar to that recorded in the western drainage ditch at 54.9m AOD (February 2017).

4.4 Ground Gas

The preliminary monitoring indicates (locally) very high levels of carbon dioxide (35.2-35.7%) and methane (61.1-61.6%) within WS1. WS3 encountered lower, but still significant raised levels of the both gases (7.1-8.5% and 2.8-2.9% respectively). WS's 5 and 8 recorded only trace levels of methane (0.1-0.3% volume) and slightly elevated carbon dioxide (3.5-4.2%).

Typically, no gas flow was encountered, except within WS1 and WS8, where a maximum of 0.1l/hr was recorded. No VOCs were present in the standpipes.

WS1 proved organic Alluvium at the base of the borehole, and is considered the likely source of such high methane and carbon dioxide. No obvious source (except for Made Ground) was noted in WS3. At WS8 Alluvium was also proven, but the gas regime appears only slightly abnormal.

Summary results are detailed below with full information provided in Appendix E.

Exploratory Location	WS1	WS3	WS5	WS8
Response Zone (m) / Strata	0.7-2.7m (Made Ground & Alluvium)	1-2m (Made Ground)	1-3m (Made Ground & Lias)	1-3m Made Ground, Alluvium & Lias)
Evidence of Contamination	None	None	None	None
Monitoring Visits (No.)	2	2	2	2
Methane (%)	61.1-61.6%	2.8-2.9%	0.2-0.3%	0.0-0.1%
Carbon Dioxide (%)	35.2-35.7%	7.1-8.5%	3.8-4%	3.5-4.2%
Oxygen (%)	3.8-5%	16.4-17%	18.3-18.6%	18.9-20%
Gas Flow (litres/hr)	0.0-0.1%	0.0	0.0	0.0-0.1
Water levels (m)	1.55-1.58	1.29-1.34	Dry	2.57-2.64
Atmospheric Pressure Range (mb)	1010-1014	1010-1014	1010-1014	1010-1014

5.0 GEOTECHNICAL CONSIDERATIONS

5.1 Scheme Details & Structural Loadings

The proposed development will be constructed at existing grade. According to the recent architects layout the development is to comprise approximately 90 residential properties, assumed to be of either timber framed or load bearing masonry construction.

Foundation line loads could be between 75-200kN/m run. Combined 'dead' and 'live' loading on the ground floor slabs should be less than 10kN/m^2.

The development will also include access and estate roads, car parking, conventional gardens, and managed communal soft landscaping, as shown on preliminary sketch in Appendix H.

5.2 Site Preparation and Earthworks

Topsoil, typically 120-250mm thick, and any localised areas of particularly poor quality Made Ground, should be removed from beneath proposed building and hardstanding areas. Excavations to at least 3.5m depth are should generally be feasible with conventional soils excavating machinery. Pneumatic tools may be required locally to break out existing foundations, or similar buried masonry obstructions.

Much of the spoil resulting from excavations in the existing Made Ground may well be unsuitable for reuse as structural fill.

Whilst some excavations to 2.5m depth may remain dry, other shallow excavations could encounter slight or moderate infiltration and perched groundwater seepages. Such excavations can be kept dry by intermittent pumping from a convenient sump.

Temporary excavations in the existing Made Ground and variably weathered Lower Lias clay will probably stand unsupported in the short term at gradients of about 1 on 2.5. Excavations below approximately 1m depth will require sheeting and shoring, particularly if personnel are to enter.

Formations in the clayey Made Ground and natural ground will be very susceptible to deterioration due to site traffic and weather and should be protected immediately on exposure with 200mm of granular material, or 100mm of lean mix concrete.

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

Attention is drawn to the old field boundary lines shown on historical maps and up until the 1990's. Anomalous ground conditions and/or gas regime could be present along these lines.

5.3 Foundations and Ground Floor Slabs

5.3.1 Typical Ground Conditions

The investigation has proven a veneer of Topsoil, a variable thickness mantle (1-3.5m) of existing very soft or loosely compact gravelly clay Made Ground, localised soft clayey Alluvium, and a continuous stratum of variably weathered soft to firm becoming firm to stiff then stiff to very stiff Lower Lias clay.

A localised perched groundwater table appears to be at typically 1.5-2.5m depth. Consequently the variably weathered Lower Lias clay can provide an adequate bearing stratum for mesh reinforced strip footings.

5.3.2 Design Bearing Pressures for Strip and Pad Footings
The following design bearing pressures are given for guidance:

Depth (m) BEGL	Stratum (SPT 'N')	Design Bearing Pressure kN/m²)	
		1m*	2m*
3-4m	Firm WLL (N = 10-12)	100	75
4.5-5.5	Firm to stiff WLL (N = 15-20)	175	150

Notes: * Indicates width of foundation
(WLL = Weathered Lower Lias clay)

At the intensities of loading given above, total settlements should not exceed 25mm, with angular rotation along a typical 10m long mesh reinforced strip footing of not worse than 1 in 500. There will be variations in formation compressibility and consequently mesh reinforcement should be included in all footings to even out those variations in formation performance.

In view of the poor quality soft compressible and variable thickness of shallow to moderate depth of clayey Made Ground soils at this site, the requirement for 'deep' trench fill or strip footings, may prove to be economically unattractive.

Indeed, deep strip footings may result in large quantities of excavation spoil and unless this surplus material can be relocated safely on-site, consideration may need to be given to an alternative foundation solution such as short piles.

5.3.3 Other Shallow Reinforced Spread Foundations
In view of the above, consideration may need to be given to the adoption of a 'flexible' foundation raft. The term flexible raft can apply to a substructure, where there is continuity of reinforcement, poured monolithically, but where the intensity of loading on the underside varies. This type of raft is relatively inexpensive.

5.3.4 Ground Improvement
Consideration could be given to ground improvement of the clayey Made Ground and uppermost weathered Lower Lias clay by the application of vibro replacement (stone columns) of these relatively cohesive and poor quality shallow depth soils to reduce the anticipated settlement beneath flexible foundation rafts, as recommended by NHBC. Further advice should be sought from special vibro contractors.

5.3.5 Piles
In view of the above, consideration could be given to the adoption of piled foundations and a wide range of both driven and bored piles could be suitable in the ground conditions proven at this site.

Experienced piling contractors should be provided with a copy of this report and asked to demonstrate the suitability of their preferred pile type in the ground conditions proven. Intégrale would welcome the opportunity of reviewing those proposals and commenting on the specialist contractors preferred pile types.

5.3.6 Ground Floor Slabs
Ground floor slabs should be designed as suspended. 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.

Ground bearing floor slabs may be adopted following satisfactory ground improvement by vibro-replacement.

5.3.7 Inspections

All foundation, ground slab and other substructure foundations should be checked and approved by a suitably qualified and experience engineer or geotechnical specialist.

5.4 Pavement Design

The equivalent CBR strength of anticipated pavement formations has been judged on the basis of past experience in similar materials. The following tentative design values are given for guidance:

Stratum	Design CBR	Typical Depth (m) BEGL
Clayey Made Ground	1-2%	0.5-1.5m
Firm WLL	2%	Below 2m

It would be prudent to allow a contingency for treating 'soft-spots' equivalent to 25% of the proposed hardstanding area to a depth of typically 500mm. All soft spots should be excavated and replaced with suitable well compacted granular material.

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. Intégrale can give further guidance on request.

5.5 Earth Pressures and Retaining Walls

Foundations for retaining walls can be based on the allowable design bearing pressures given in section 5.3.2. Earth pressures may be calculated assuming the following effective shear strength parameters:

Stratum	Effective Cohesion C' (kN/m^2)	Effective Angle of Friction Ø' (degrees)	Bulk Density (Mg/m^3)
Clayey Made Ground	Zero	25°	1.85
Firm WLL	Zero	25°	1.85

5.6 Protection of Buried Concrete

In line with BRE Special Digest 1:2005 'Concrete in Aggressive Ground', a single sample of variably weathered Lower Lias clay was tested for water soluble sulphate, total acid soluble sulphate, total sulphur and pH. The results are reported in Appendix F.

The desk study and ground investigation indicate the site can be categorised as being:

- Natural ground likely to contain pyrites;
- Mobile groundwater conditions, as water will flow into excavations or is percolating slowly through the ground.

Strictly in accordance with the guidance, the number of tests completed is insufficient to fully categorise this type of site and the design team should consider whether further analysis should be completed.

The result for water soluble sulphate was 0.066g/l, and pH was 7.9. The results for total acid soluble sulphate (0.035%) and total sulphur (0.035%) indicate pyrite is not present in the tested samples. It is therefore recommended that a Design Sulphate Class of DS-1 and an ACEC Class of AC-1 be adopted for budgeting purposes.

However, based on past experience within similar ground conditions, higher soluble sulphate values / total potential sulphate values could be anticipated. Sugary gypsum crystals are noted on some of the soil descriptions. 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.

6.0 GENERIC QUANTITATIVE CONTAMINATION ASSESSMENT

6.1 Summary of Soils Results with Respect to Human Health

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
Contaminated soils	→	Ingestion of home-grown produce and soil attached to vegetables	→	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 with 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

No contaminants were present in the analysed samples in excess of the relevant assessment criteria.

6.2 Summary of Soils Results with Respect to Phytotoxicity

No substances were present in the analysed samples in excess of the phytotoxic criteria.

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	Arsenic, chromium	Made Ground	0.5-1.8	WSs 1, 5, 6 & 8

This suggests that new water pipes laid through the Made Ground 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 Linkages for Controlled Waters Risk Assessment

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 the unsaturated zone.	→	Groundwater
Contaminated soils	→	Leaching from soils or migration of liquid contaminants through service runs	→	Adjacent tertiary river along western boundary
Perched water contamination	→	Transport in groundwater	→	Adjacent tertiary river along western boundary
Groundwater contamination	→	Transport in groundwater	→	Adjacent tertiary river along W boundary
Groundwater contamination	→	Transport in groundwater	→	Abstraction point in S apex of site

The conceptual site model indicates that the tertiary river along the western boundary is the most sensitive controlled waters receptor.

The soils analyses have identified no elevated substances which would pose a risk to human health receptors, as summarised above; it is tentatively inferred that groundwater or leachate testing is unlikely to be necessary based on these results. No obvious impact to groundwater has been identified.

6.5 Gas Mitigation

Based on the maximum gas flow and methane/carbon dioxide results, a gas screening value would identify a Gas Regime as Characteristic Situation 1. For low-rise residential buildings this suggests a Green protection level is required in line with the NHBC Traffic Light system. However, typical gas concentrations for these classifications would be up to 1% methane and 5% carbon dioxide. For the purposes of this report it is tentatively assumed the redevelopment will consist solely of traditional low rise housing.

The monitoring has recorded significantly elevated methane and carbon dioxide (up to 61% and 38% respectively) at one location. These concentrations would typically be encountered within a Red protection level for low rise housing. These high elevations were only encountered within WS1; the remaining locations recorded methane and carbon dioxide up to about 3% and 9% respectively. These concentrations would place the gas regime as Amber 1.

Clearly, the gas regime across the site varies dramatically depending on the underlying ground conditions. It should be noted that the monitoring has been completed in relatively intermediate to high atmospheric pressures (1010-1014mb), thus less favourable gas flow and volumes could be anticipated during lower pressures i.e. 995-1000mb. In addition, the worst case readings were taken from one location, which could be a localised ‘hotspot’ in comparison with the larger site.

In line with CIRIA C665, standard residential housing would not normally be acceptable without a further gas risk assessment and/or possible remedial mitigation measures to reduce and/or remove the source of gas.

Given the size of the site, the relatively large spacing between investigation locations, and monitoring to date, consideration should be given to installing a system of additional borehole standpipes on a closer spacing beneath the areas for proposed housing. This should allow a robust gas assessment to be completed for the site; it may be possible to define the Red protection area, thus requiring a lesser protection level on other parts of the site.

These standpipes should be monitored on a monthly basis over a 3-6 month period to fully assess the site, ensuring that monitoring is completed within a period of low atmospheric pressure. Intégrale can provide further assistance on request.

Based on these results, it is assumed that both active and passive gas protection measures could be required locally. Where a more normal regime is confirmed, a lesser degree of protection seems likely.

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:

- Methane and carbon dioxide are present which will potentially pose a risk to future occupiers of the buildings.
- Sulphates and acids present could potentially pose a risk to building materials.
- WRAS contaminant threshold concentrations are exceeded in the Made Ground.

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) Install additional borehole standpipes and complete further monitoring to confirm the range of soil gas regimes, allow design and installation of anti-gas measures for houses and garages.
b) Advice and protection to groundworkers during excavations. Based on the monitoring, groundworkers may require suitable respiratory protective equipment (RPE) if entering excavations, depending on the results of further monitoring.

No soil contamination has been identified to date that would pose a risk to human health. Therefore new garden cover systems should not be required, and a minimum of 150mm certified topsoil would only be needed. Validation criteria for any imported topsoil should be agreed with the regulator. It would be prudent to complete further testing of existing topsoil during the installation of additional borehole standpipes to confirm whether the on-site material is suitable for reuse.

6.7.2 For Protection of Groundwater / Surface Water

Controlled Water receptors do not appear to be at risk, as no impact to soils has been identified during the current investigation. Therefore it seems that no further remedial works or measures would be required. During the construction phase, the workers should have adequate precautions in place for minimising chemical spills/leaks.

6.7.3 For Protection of Building Materials & Services

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

a) Specification of appropriate concrete protection for the sulphate/pH environment, as detailed in Section 5.
b) Use of protective pipework for all water supplies.

6.7.4 For Protection of New Vegetation

Based on the analyses to date, no remedial measures are required for new planting.

6.7.5 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.

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.

6.7.6 Recommended Further Investigation and Assessment

Based on the investigation findings to date, it will be necessary to:

- Complete supplementary investigation and standpipe installations on a relatively close spacing beneath areas of proposed housing, followed by
- Further monitoring of the standpipes over a 3-6 month period to allow the gas regime to be finalised.

Depending on the results of further monitoring, a separate gas risk assessment may be required to clarify the appropriate scope of remedial measures and gas protection design.

Once completed, 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.

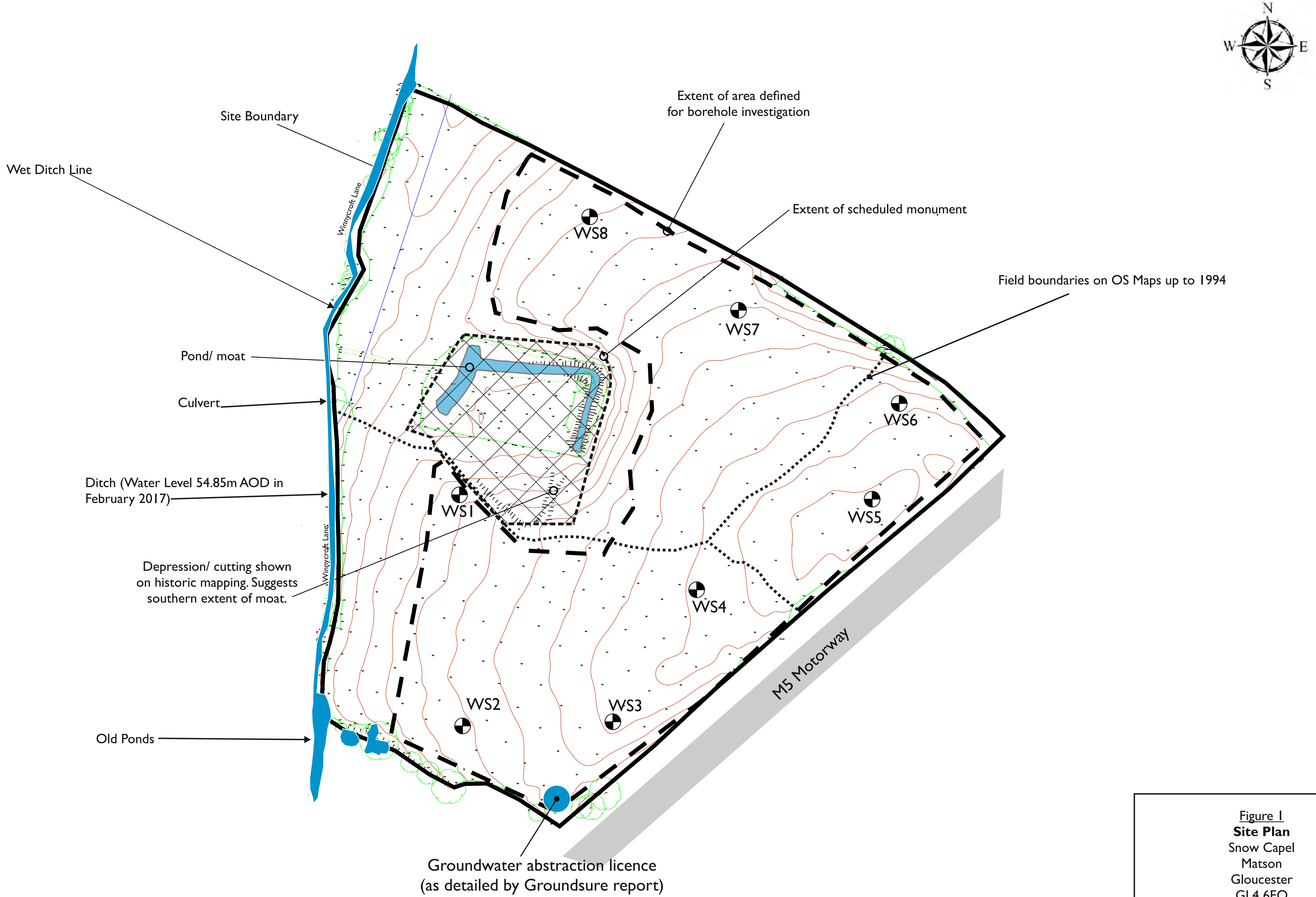


Figure 1
Site Plan
Snow Capel
Matson
Gloucester
GL4 6EQ

Job No: 1826
August 2017

Intégrale

Scale = 1:2000 (approx.) @ A3

Intégrale

Appendix A

Site Location

Integrale Limited, Suite 7, Westway Farm Business Park, Wick Road, Bishop Sutton, Somerset, BS39 5XP United Kingdom
[redacted] www.integrale.uk.com

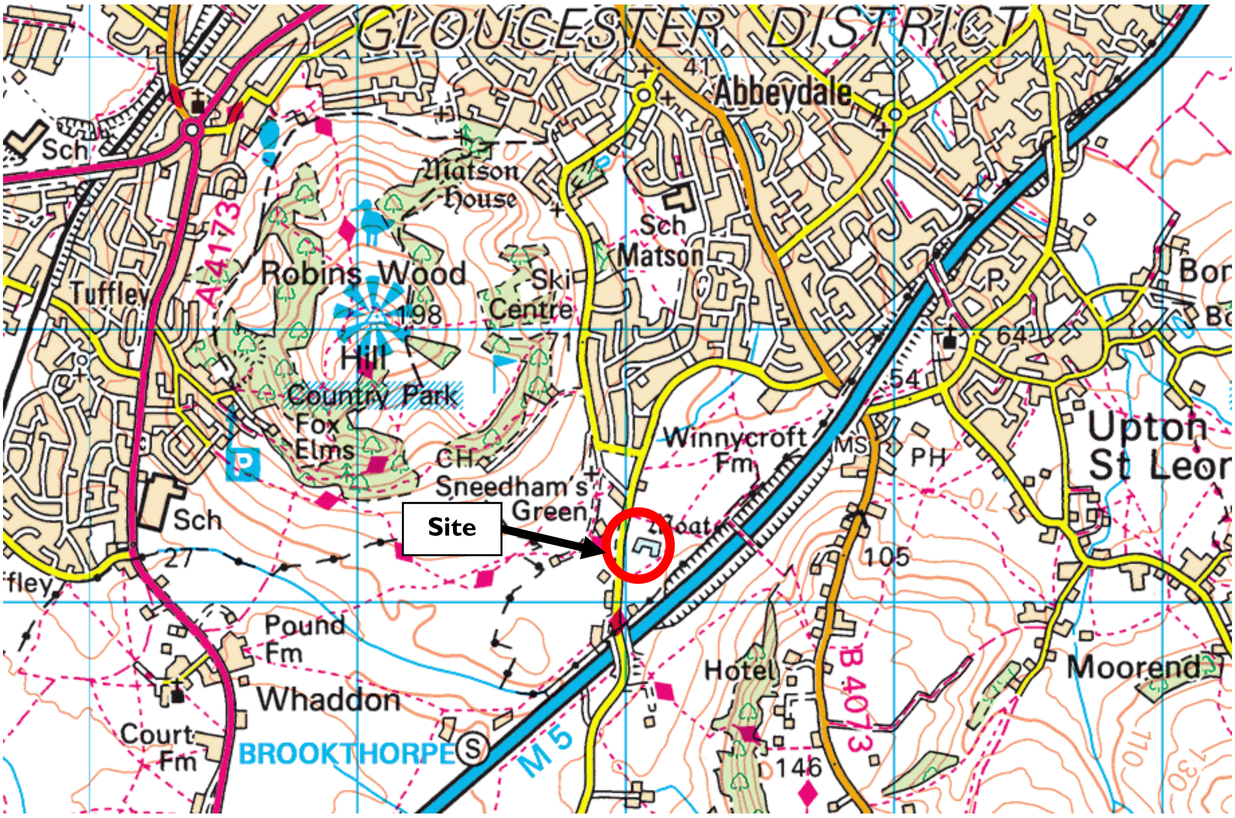
Registered Office: The Granary, Chewton Fields, Ston Easton, Somerset, BA3 4BX United Kingdom VAT Reg. No. 609 7402 37

Suite 7, Westway Farm Business Park
Wick Road, Bishop Sutton, Somerset,
BS39 5XP, United Kingdom
[redacted]
www.integrale.uk.com

Project: **Snow Capel, Matson, Gloucester, GL4 6EQ**

Job No: 1826

Site Location Plan



North

Appendix B

Site Description/Photographs

Integrale Limited, Suite 7, Westway Farm Business Park, Wick Road, Bishop Sutton, Somerset, BS39 5XP United Kingdom
[redacted] www.integrale.uk.com

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

[redacted]
www.integrale.uk.com

REFERENCES	
Project No.	1826
Site Address	Snow Capel, Matson, Gloucester, Gloucestershire, GL4 6EQ.
Grid Reference	SO851141
Date of Visit	24/05/17
Names of site owners/ developers/ engineers met with on site	-
Prepared by	WS
SITE – GENERAL	
Plan of site	See Figure 1.
Site size (area) : % building, % hardstanding, % soft landscaping, % open space, etc.	-
Current use (occupants and operations)	90% field; 10% fenced off moat.
Site Area	Field.
Maximum Dimensions	7.8 Hectares.
Boundaries – e.g. wooden fence/ retaining wall	352m (NW-SE) x 294m (NE-SW).
Any access limitations for JCBs, drilling rigs etc; minimum distances, steps, steep banks, inaccessible areas, need for breaker for SI. Take dimensions of access	All four boundaries fence with hedge beyond. Some breaks in hedge on E boundary.
Any specific working hours for SI; keys required for access	Gate in NW corner unlocked. No issue for window sampling rig access.
Any specific Health and Safety hazards/ considerations	No.
Water supply on site? Fire hydrant nearby? Power supply on site?	No.

SITE – BUILDINGS	
Age of building(s)	No buildings on site.
Building appearance: no. of storeys, basement, roofing type, chimneys / stacks?, car park, service areas;	N/A.
State of buildings, i.e. cracks; structural distress etc.	N/A.
Tanks: location (internal / external : above or below ground), age / condition, size / capacity, type, bunding (condition), refuelling point, evidence of stains / spills	None noted.
Heating : electric/gas/oil	N/A.
Chemical storage : drums, other chemical stores	None noted.
Gas control measures (e.g. vents, cowls, monitoring / alarms)	N/A.
Other evidence of industrial activity	None noted.
Asbestos / deleterious materials – any asbestos surveys?, removal programmes?	None noted.
Electrical equipment / Transformers – check for PCBs? Backup power supplies (generators)	None noted.

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SITE – EXTERNAL	
Hard surfacings : type (asphalt/concrete etc.), staining, weathering, subsidence, repairs. Specific reinstatement required.	No hard surfacing on site.
Landscaped areas/ soft landscaping: vegetation dieback/ growth	No landscaped areas on site.
Invasive species noted (e.g. Japanese Knotweed). Note: absence indicated here by non-specialist does not infer that JKn is not present.	None noted.
Can investigation be in landscaped areas. Specific reinstatement required.	N/A.
Site topography – flat / sloping, Level compared to surroundings & mAOD.	Site slopes gently from 62mAOD in SE to 57mAOD in NW. Small slope down towards moat.
Evidence of filling or raising, earthworks, mounds/ hummocks, soil creep, soil fluction, mass movement, steep/ vertical laces, 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.	Raised bank runs parallel with west boundary. Composed of removed material associated with construction of M5 motorway adjacent to site.
Soil drainage – marshy/ marsh vegetation/ dry/ surfaces cracked/ surface rutting etc.	Site was well draining.
Trees – effects on buildings, condition, species and height; location; maturity; leaning/ upright; rotated trees?	Small cluster of mature trees near moat.
Rock/ soil exposures – height/ extent description etc.	None noted.
Drainage : interceptors, disposal of storm water / waste water, mains water supply.	Small drainage ditch running N to S along E boundary.
Other evidence of Services, e.g. overhead cables, Gas 'yellow headstone'.	Overhead cables in E of site.
Vehicle maintenance : washdown areas, workshops, refuelling points.	None noted.
Waste : skips / compounds, any hazardous waste? Burning grounds or incinerators.	None noted.
Sub-stations : age, condition, transformers, operator, servicing?	None noted.
Ecological features of note – Burrows, bats, nest sites, designated preservation areas.	None noted.
Any seepages on or adjacent to site.	None noted.
Watercourses, water levels, direction and rate of flow.	Small drainage ditch running N to S along E boundary.
Other features of note within site.	Moat in centre of site. Standing water with reeds. Fenced off with small gap for entry in the S. Archaeologically significant so no investigation in the immediate vicinity.

SURROUNDING LAND USES	
General site context – industrial, commercial, urban, agricultural etc.	Agricultural.
Land use – north (give distances)	Agricultural.
Land use – south (give distances)	Property then M5 motorway with agricultural beyond.
Land use – east (give distances)	M5 motorway with agricultural beyond.
Land use – west (give distances)	Agricultural. 200m E Gloucester Golf Club.
Nearby (<500m) sources of pollution – landfills, filling stations, industrial activity.	None noted.
Nearby river / surface water features – culverted, banks, flood plain. If visible, condition of watercourse.	None noted.
Local ground profiles and signs of instability.	None noted.
Evidence of structural distress on nearby buildings.	None noted.
Evidence of mining history (colliery spoil heap, miners cottage).	None noted.
Nearby rock/ soil outcrops.	None noted.
Vegetation – distinctive change in vegetation (e.g. hydrophyllic veg).	None noted.
Adjacent geotechnical features of note – cuttings, quarries, embankments, slopes (particularly if failed), major excavations, deep basements, sources of vibrations (railway or heavy machinery).	None noted.
Other features of note adjacent to site.	None noted.

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View from S boundary looking N at western half of site.

View from SE corner looking W along S boundary.

View from SE on raised area looking NE showing slope down to M5 motorway beyond E boundary.

View from S boundary looking E at eastern half of site.

View from SE corner looking NE along E boundary showing raised bank.

View from SW corner of fenced moat looking E showing standing water.

View from NE corner looking NW along N boundary.

View looking NW showing small slope down to moat.

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Appendix C

Desk Study Information

Integrale Limited, Suite 7, Westway Farm Business Park, Wick Road, Bishop Sutton, Somerset, BS39 5XP United Kingdom
[redacted] www.integrale.uk.com

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CENTREMAPS

Open Space, Upper Interfields,
Worcester, WR14 1UT

Groundsure Reference:	CMAPS-CM-625691-13238-220517EDR
Your Reference:	13238
Report Date	22 May 2017
Report Delivery Method:	Email - pdf

Groundsure Enviro Insight

Address: Snow Capel Matson , GL4 6EQ

Dear Sir/ Madam,

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

If you need any further assistance, please do not hesitate to contact our helpline on [redacted] quoting the above CENTREMAPS reference number.

Yours faithfully,

CENTREMAPS

Enc.
Groundsure Enviroinsight

Groundsure Enviro Insight

Address:	**Snow Capel Matson , GL4 6EQ**
Date:	**22 May 2017**
Reference:	**CMAPS-CM-625691-13238-220517EDR**
Client:	**CENTREMAPS**

NW N NE

W E

SW S SE

Aerial Photograph Capture date:	10-Jul-2014
Grid Reference:	385157,214176
Site Size:	7.95ha

Report Reference: CMAPS-CM-625691-13238-220517EDR
Client Reference: 13238

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Overview of Findings

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

Section 1: Historical Industrial Sites	On-site	0-50	51-250	251-500
1.1 Potentially Contaminative Uses identified from 1:10,000 scale mapping	0	1	7	9
1.2 Additional Information – Historical Tank Database	0	0	1	0
1.3 Additional Information – Historical Energy Features Database	0	0	2	8
1.4 Additional Information – Historical Petrol and Fuel Site Database	0	0	0	0
1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database	0	0	0	0
1.6 Potentially Infilled Land	2	1	9	5

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

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LOCATION INTELLIGENCE

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

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

Section 5: Geology	
5.1 Are there any records of Artificial Ground and Made Ground present beneath the study site?	No
5.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site?	None
5.3 For records of Bedrock and Solid Geology beneath the study site see the detailed findings section.	

Section 6: Hydrogeology and Hydrology	0-500m
6.1 Are there any records of Strata Classification in the Superficial Geology within 500m of the study site?	No
6.2 Are there any records of Strata Classification in the Bedrock Geology within 500m of the study site?	Yes

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

Section 6: Hydrogeology and Hydrology

	On-site	0-50m	51-250	251-500	501-1000	1000-1500
	0-500m					
6.9 Is there any Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site?	No	No	No	No	No	Yes
6.10 Detailed River Network entries within 500m of the site	3	0	6	5	Not searched	Not searched
6.11 Surface water features within 250m of the study site	Yes	Yes	Yes	Not searched	Not searched	Not searched

Section 7: Flooding

7.1 Are there any Enviroment Agency Zone 2 floodplains within 250m of the study site?	No
7.2 Are there any Environment Agency/Natural Resources Wales Zone 3 floodplains within 250m of the study site	No
7.3 What is the Risk of flooding from Rivers and the Sea (RoFRaS) rating for the study site?	Very Low
7.4 Are there any Flood Defences within 250m of the study site?	No
7.5 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
7.6 Are there any areas used for Flood Storage within 250m of the study site?	No
7.7 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	Not Prone
7.8 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	Not Applicable

Section 8: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	1	1
8.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0
8.3 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
8.4 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
8.5 Records of Ramsar sites	0	0	0	0	0	0
8.6 Records of Ancient Woodlands	0	0	0	0	2	0
8.7 Records of Local Nature Reserves (LNR)	0	0	0	0	1	0
8.8 Records of World Heritage Sites	0	0	0	0	0	0
8.9 Records of Environmentally Sensitive Areas	0	0	1	0	0	0

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

Section 9: Natural Hazards

9.1 What is the maximum risk of natural ground subsidence?	Low
9.1.1 What is the maximum Shrink-Swell hazard rating identified on the study site?	Low
9.1.2 What is the maximum Landslides hazard rating identified on the study site?	Low
9.1.3 What is the maximum Soluble Rocks hazard rating identified on the study site?	Negligible
9.1.4 What is the maximum Compressible Ground hazard rating identified on the study site?	Negligible
9.1.5 What is the maximum Collapsible Rocks hazard rating identified on the study site?	Very Low
9.1.6 What is the maximum Running Sand hazard rating identified on the study site?	Negligible
9.2 Radon	
9.2.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.
9.2.2 Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary.

Section 10: Mining

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

Using this report

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

1. Historical Industrial Sites

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

2. Environmental Permits, Incidents and Registers

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

3. Landfills and Other Waste Sites

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

4. Current Land Uses

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

5. Geology

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

6. Hydrogeology and Hydrology

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

7. Flooding

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

8. Designated Environmentally Sensitive Sites

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

9. Natural Hazards

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

10. Mining

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

11. Contacts

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

Note: Maps

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

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

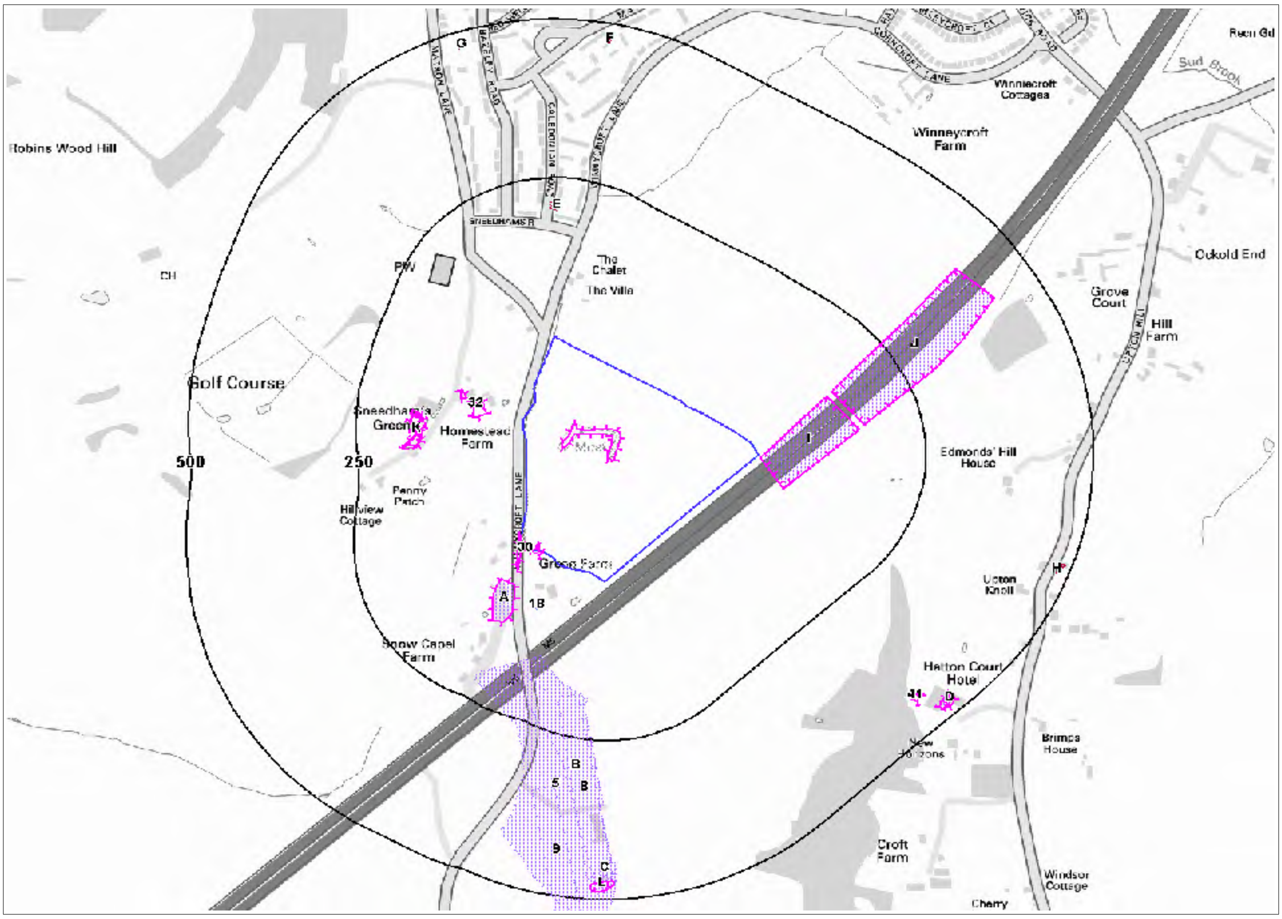
All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

Groundsure

1. Historical Land Use

NW N NE

W E



SW S SE

Site Outline

250
500
Search Buffers (m)

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

Industrial Land Use

Potentially Infilled Land

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

Energy Features

Petrol Stations

Tanks

Garages

1. Historical Industrial Sites

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

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

Records of sites with a potentially contaminative past land use within 500m of the search boundary: 17

ID	Distance [m]	Direction	Use	Date
1I	5	SE	Cuttings	1973
2A	59	SW	Unspecified Ground Workings	1973
3A	59	SW	Unspecified Ground Workings	1986
4J	144	NE	Cuttings	1973
5	145	S	Rifle Ranges	1924
6B	172	SW	Rifle Ranges	1938
7B	172	SW	Rifle Ranges	1924
8	183	S	Rifle Ranges	1954
9	331	S	Disused Rifle Ranges	1973
10C	451	S	Fire Station	1924
11C	455	S	Butts	1973
12C	460	S	Fire Station	1924
13C	467	S	Butts	1924
14D	469	SE	Unspecified Pit	1924
15D	469	SE	Unspecified Pit	1938
16L	471	S	Unspecified Heap	1954
17D	471	SE	Unspecified Pit	1954

1.2 Additional Information – Historical Tank Database

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

Records of historical tanks within 500m of the search boundary: 1

ID	Distance (m)	Direction	Use	Date
18	72	SW	Unspecified Tank	1884

1.3 Additional Information – Historical Energy Features Database

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

Records of historical energy features within 500m of the search boundary: 10

ID	Distance (m)	Direction	Use	Date
19E	198	N	Electricity Substation	1978
20E	199	N	Electricity Substation	1994
21F	468	N	Electricity Substation	1978
22F	468	N	Electricity Substation	1994
23G	474	N	Electricity Substation	1986
24G	474	N	Electricity Substation	1994
25H	481	SE	Electricity Substation	1992
26H	483	E	Electricity Substation	1966
27H	484	E	Electricity Substation	1971
28H	487	E	Electricity Substation	1994

1.4 Additional Information – Historical Petrol and Fuel Site Database

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

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

Database searched and no data found.

1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database

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

Records of historical garage and motor vehicle repair sites within 500m of the search boundary: 0

Database searched and no data found.

1.6 Potentially Infilled Land

Records of Potentially Infilled Features from 1:10,000 scale mapping within 500m of the study site: 17

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

ID	Distance(m)	Direction	Use	Date
29	0	On Site	Pond	1883
30	0	On Site	Ponds	1883

31I	5	SE	Cuttings	1973
32	56	W	Ponds	1883
33A	59	SW	Unspecified Ground Workings	1986
34A	59	SW	Unspecified Ground Workings	1973
35J	144	NE	Cuttings	1973
36K	146	W	Ponds	1883
37K	149	W	Ponds	1924
38K	149	W	Ponds	1938
39K	152	W	Ponds	1973
40K	152	W	Ponds	1986
41	438	SE	Pool	1973
42D	469	SE	Unspecified Pit	1938
43D	469	SE	Unspecified Pit	1924
44L	471	S	Unspecified Heap	1954
45D	471	SE	Unspecified Pit	1954

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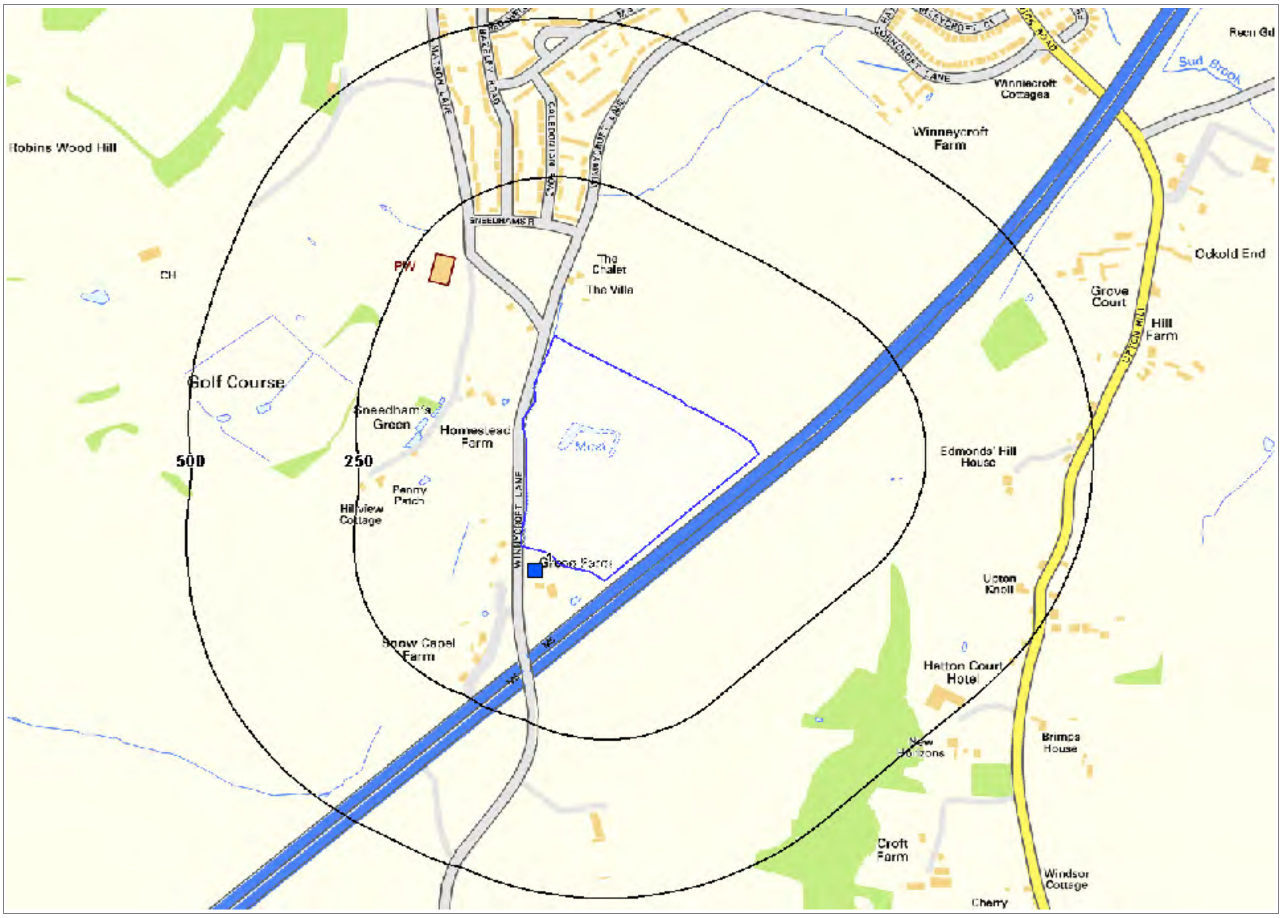
2. Environmental Permits, Incidents and Registers Map



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Site Outline
250 / 500 Search Buffers (m)

Recorded Pollution Incident
Dangerous Substances (List 1)
Dangerous Substances (List 2)
Water Industry Referrals
Licenced Discharge Consents
Red List Discharge Consents

RAS 3 & 4 Authorisations
Part A(1) Authorised Processes and Historic IPC Authorisations
Part A(2) and Part B Authorised Processes
COMAH / NIHHS Sites
Sites Determined as Contaminated Land
Hazardous Substance Consents and Enforcements

2. Environmental Permits, Incidents and Registers

2.1 Industrial Sites Holding Licences and/or Authorisations

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

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations:

0

Database searched and no data found.

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

1

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

ID	Distance (m)	Direction	NGR	Details	
1	32	S	385000 214000	Address: GREEN FARM, SNEEDHAM'S GREEN, NR MATSON, GLOS Effluent Type: SEWAGE DISCHARGES - FINAL/TREATED EFFLUENT - NOT WATER COMPANY Permit Number: WQ/72/1085 Permit Version: 1	Receiving Water: UNDERGROUND STRATA Status: PRE NRA LEGISLATION WHERE ISSUE DATE < 01-SEP-89 (HISTORIC ONLY) Issue date: 23/03/1977 Effective Date: 23-Mar-1977 Revocation Date: -

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

0

Database searched and no data found.

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

0

Database searched and no data found.

2.2 Dangerous or Hazardous Sites

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

Database searched and no data found.

2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents

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

0

Database searched and no data found.

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

0

Database searched and no data found.

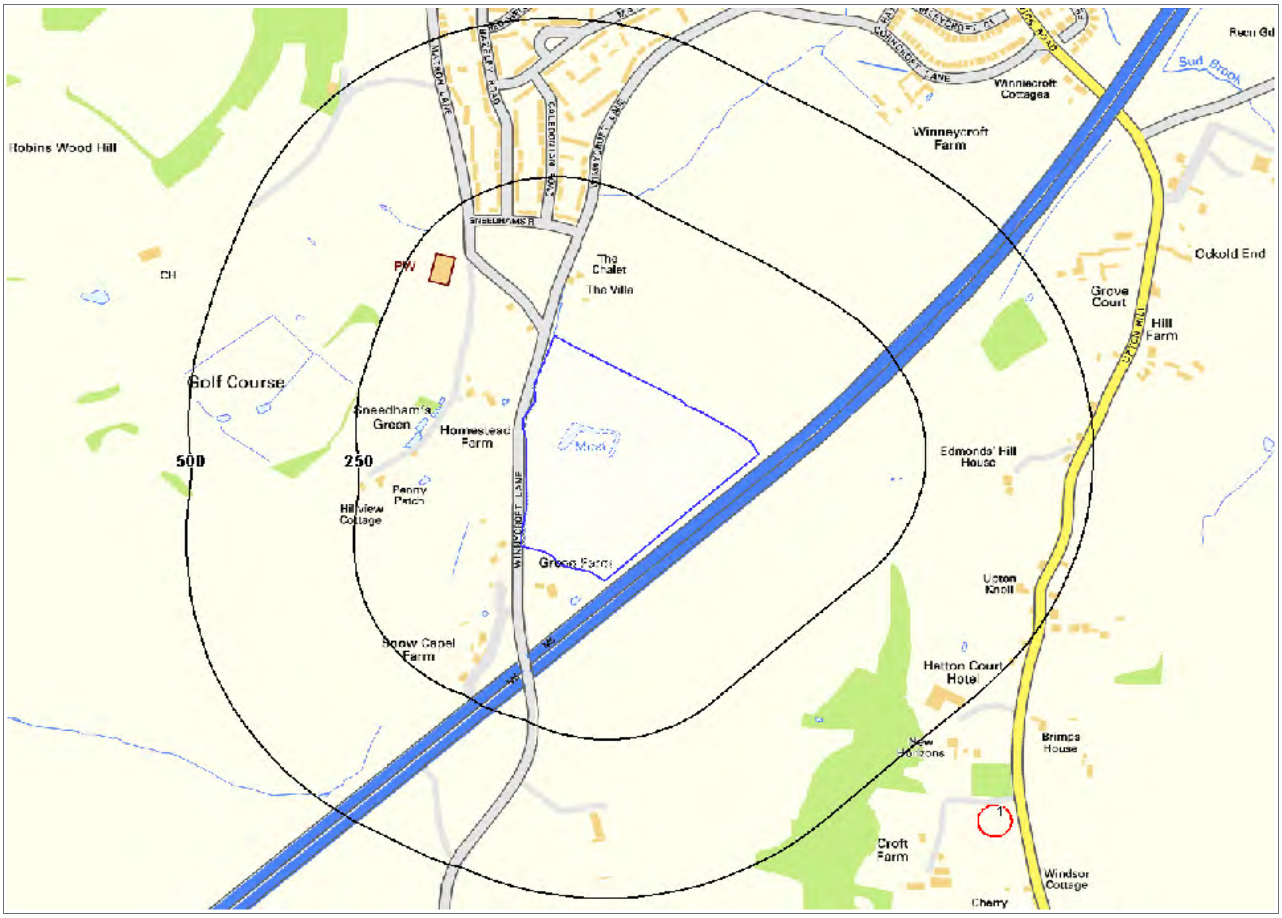
2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990

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

Database searched and no data found.

---

3. Landfill and Other Waste Sites Map



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Site Outline

250
500
Search Buffers (m)

EA/NRW Active Landfill

EA/NRW Historic Landfill

BGS / DoE Survey Landfill

Historic and Planned Waste Sites

EA/NRW Licensed Waste Site

Local Authority/Historical Mapping Landfill Records

3. Landfill and Other Waste Sites

3.1 Landfill Sites

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

0

Database searched and no data found.

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

1

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

ID	Distance (m)	Direction	NGR	Details	
1	644	SE	385600 213600	Site Address: On B4073 Road, Upton-St-Leonards, Gloucestershire Waste Licence: - Site Reference: 282 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: Licence Surrendered: Licence Holder Address: - Operator: - Licence Holder: - First Recorded: - Last Recorded: -

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

0

Database searched and no data found.

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

0

Database searched and no data found.

3.2 Other Waste Sites

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

0

Database searched and no data found.

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

0

Database searched and no data found.

---

4. Current Land Use Map

Site Outline	Current Industrial Sites	Electricity Transmission Cables
250 / 500 Search Buffers (m)	Petrol & Fuel Sites	Gas Transmission Pipelines

4. Current Land Uses

4.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site: 3

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

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1	88	NW	C G Herbert	384904 214279	C G Herbert, Homestead Farm, Sneedhams Green, Matson, Gloucester, GL4 6EF	Livestock Farming	Farming
2	171	W	Pump	384814 214260	Pump, GL4	Water Pumping Stations	Industrial Features
3	211	N	Electricity Sub Station	385029 214580	Electricity Sub Station, GL4	Electrical Features	Infrastructure and Facilities

4.2 Petrol and Fuel Sites

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

Database searched and no data found.

4.3 National Grid High Voltage Underground Electricity Transmission Cables

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

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

Database searched and no data found.

4.4 National Grid High Pressure Gas Transmission Pipelines

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

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

Database searched and no data found.

5. Geology

5.1 Artificial Ground and Made Ground

Database searched and no data found.

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

5.2 Superficial Ground and Drift Geology

Database searched and no data found.

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

5.3 Bedrock and Solid Geology

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

Lex Code	Description	Rock Type
BLCR-MDST	BLUE LIAS FORMATION AND CHARMOUTH MUDSTONE FORMATION (UNDIFFERENTIATED)	MUDSTONE
CHAM-MDST	CHARMOUTH MUDSTONE FORMATION	MUDSTONE

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

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6 Hydrogeology and Hydrology

6a. Aquifer Within Superficial Geology

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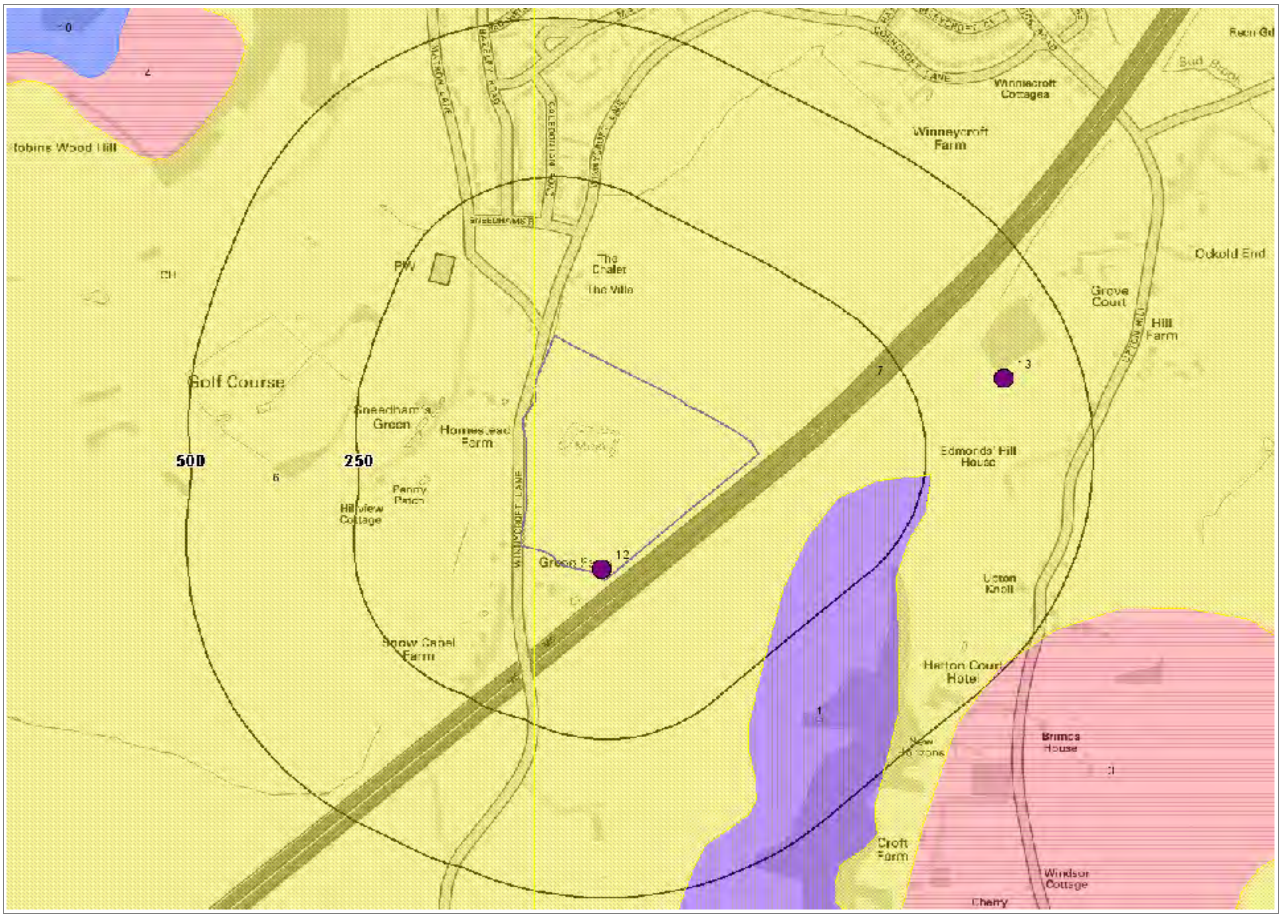
Site Outline	Principal Aquifer	Secondary Aquifer - Undifferentiated Layers
250 / 500 Search Buffers (m)	Secondary (A) Aquifer - Permeable Layers	Unproductive
	Secondary (B) Aquifer - Lower Permeability Layers	Unknown (lakes and landslip)

6b. Aquifer Within Bedrock Geology and Abstraction Licenses

NW N NE

W E

SW S SE



Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

Secondary (B) Aquifer - Lower Permeability Layers

Groundwater Abstraction Licence

Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

Surface Water Abstraction Licence

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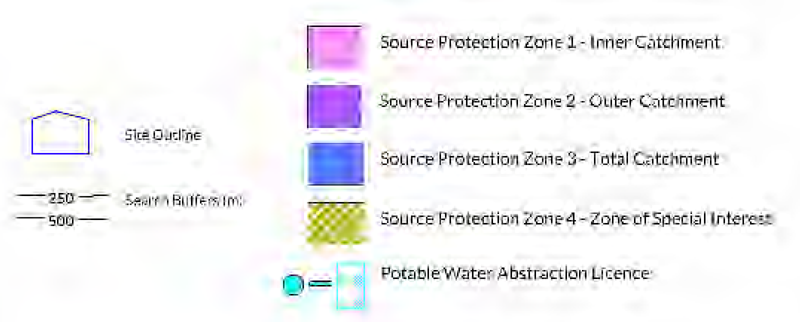
6c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses

NW N NE

W E

SW S SE



6d. Hydrogeology – Source Protection Zones within confined aquifer

NW N NE

W E

SW S SE

Site Outline

250
500
Search Buffers (m)

Source Protection Zone 1 - Inner Catchment

Source Protection Zone 2C - Outer Catchment within Confined Aquifer

Source Protection Zone 3C - Total Catchment within Confined Aquifer

Potable Water Abstraction Licence

6e. Hydrology – Detailed River Network and River Quality

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

6.Hydrogeology and Hydrology

6.1 Aquifer within Superficial Deposits

Are there records of strata classification within the superficial geology at or in proximity to the property? No

Database searched and no data found.

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

6.2 Aquifer within Bedrock Deposits

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

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

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

ID	Distance (m)	Direction	Designation	Description
6	0	On Site	Secondary (undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
7	0	On Site	Secondary (undifferentiated)	Assigned where it is not possible to attribute either category A or B to a rock type. In general these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type
1	137	SE	Principal	Geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale. Generally principal aquifers were previously major aquifers
3	492	SE	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

6.3 Groundwater Abstraction Licences

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

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

ID	Distance (m)	Direction	NGR	Details	
12	0	On Site	385100 214000	Status: Historical Licence No: 18/54/20/0193 Details: General Farming & Domestic Direct Source: Groundwater Midlands Region Point: Land At Upton St Leonards - Well Data Type: Point Name: POLLARD	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 18/11/1966 Expiry Date: - Issue No: 100 Version Start Date: 18/11/1966 Version End Date:
13	384	E	385700 214300	Status: Historical Licence No: 18/54/20/0137 Details: General Farming & Domestic Direct Source: Groundwater Midlands Region Point: Land At Upton St Leonards - Catchpits Data Type: Point Name: HATSON ESTATE	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: - Original Start Date: 18/7/1966 Expiry Date: - Issue No: 100 Version Start Date: 18/7/1966 Version End Date:

6.4 Surface Water Abstraction Licences

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

Database searched and no data found.

6.5 Potable Water Abstraction Licences

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

Database searched and no data found.

6.6 Source Protection Zones

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

Database searched and no data found.

6.7 Source Protection Zones within Confined Aquifer

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

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

Database searched and no data found.

6.8 Groundwater Vulnerability and Soil Leaching Potential

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

Distance (m)	Direction	Classification	Soil Vulnerability Category	Description
133	SE	Minor Aquifer/Low Leaching Potential	L	Soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.
463	SE	Minor Aquifer/Intermediate Leaching Potential	I1	Soils which can possibly transmit a wide range of pollutants.

6.9 River Quality

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

---

6.9.1 Biological Quality:

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

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

ID	Distance (m)	Direction	NGR	River Quality Grade	Biological Quality Grade				
					2005	2006	2007	2008	2009
Not shown	1368	E	386700 214100	River Name: Twyver Reach: A46 Upton St. Leonards To Tredworth End/Start of Stretch: Start of Stretch NGR	D	C	C	C	C

6.9.2 Chemical Quality:

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

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

					Chemical Quality Grade				
ID	Distance (m)	Direction	NGR	River Quality Grade	2005	2006	2007	2008	2009
Not shown	1368	E	386700 214100	River Name: Twyver R Reach: Upton St Leonards To Tredworth End/Start of Stretch: Start of Stretch NGR	C	C	B	B	A

6.10 Detailed River Network

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

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

ID	Distance (m)	Direction	Details	
1	0	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
2	0	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
3	0	W	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
4	52	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Secondary River Main River Status: Currently Undefined
5	54	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
6	83	W	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
7	153	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
8	204	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Culvert Main River Status: Currently Undefined
9	233	N	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
10	252	NW	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined

ID	Distance (m)	Direction	Details	
11	351	SW	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
12	435	NE	River Name: Drain Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
13	481	SW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined
14	482	SW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined

6.11 Surface Water Features

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

The following surface water records are not represented on mapping:

Distance (m)	Direction
0	On Site
0	On Site
2	W
54	N
83	W
88	N
105	N
233	N

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

NW N NE

W E

SW S SE

Zone 2 Floodplain

Area used for Flood Storage

Site Outline

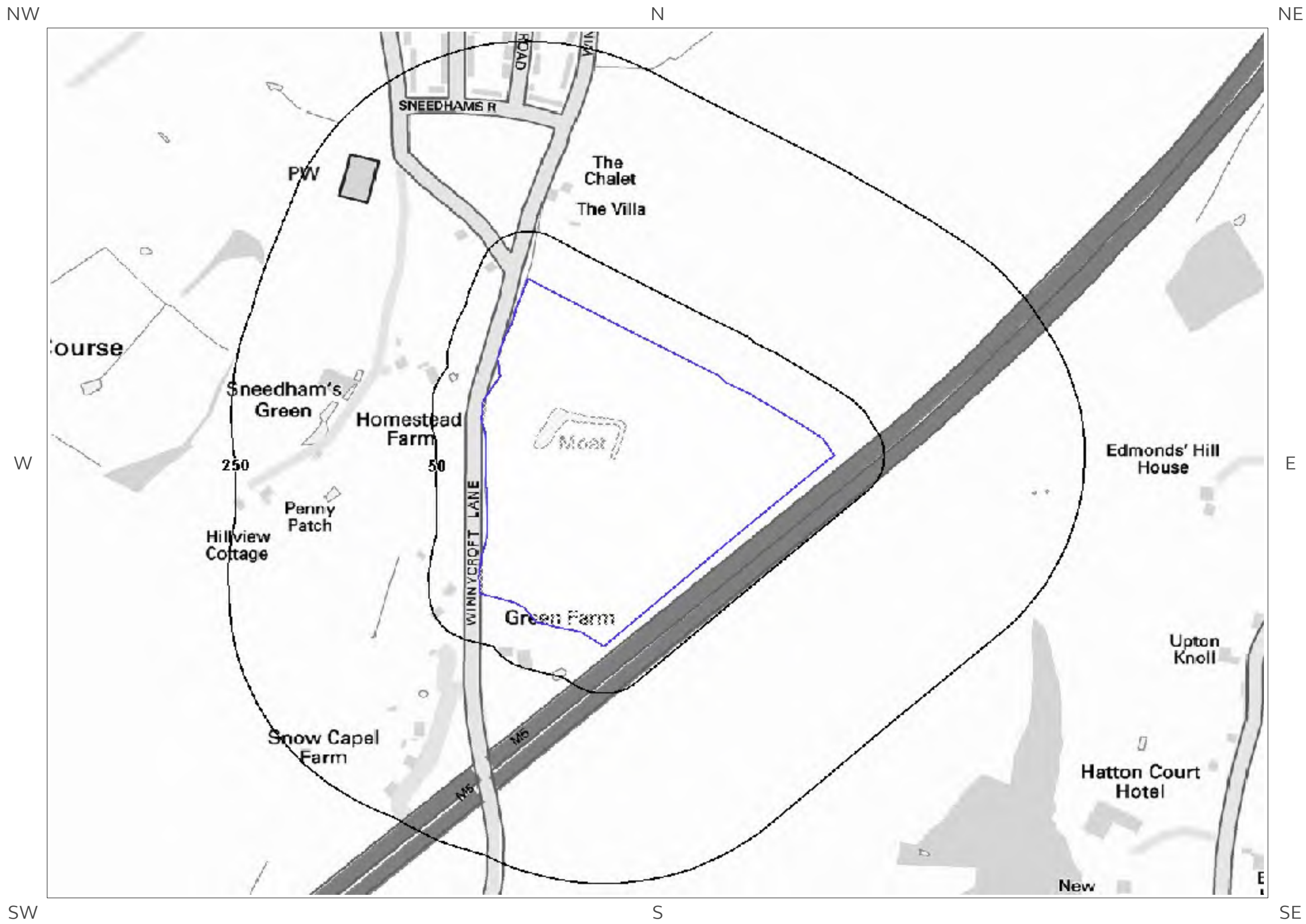
Zone 3 Floodplain

Area Benefiting from Flood Defences

100
250
Search Buffers (m)

Flood Defences

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



Site Outline

100 / 250 Search Buffers (m)

RoFRaS Rating

- Very Low
- Low
- Medium
- High

Groundsure LOCATION INTELLIGENCE

CENTRE MAPS LIVE.

7 Flooding

7.1 River and Coastal Zone 2 Flooding

Is the site within 250m of an Environment Agency/Natural Resources Wales Zone 2 floodplain? No

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

Database searched and no data found.

7.2 River and Coastal Zone 3 Flooding

Is the site within 250m of an Environment Agency/Natural Resources Wales Zone 3 floodplain? No

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

Database searched and no data found.

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

What is the highest risk of flooding onsite? Very Low

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

RoFRaS data for the study site indicates the property is in an area with a Very Low (less than 1 in 1000) chance of flooding in any given year.

7.4 Flood Defences

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

Database searched and no data found.

7.5 Areas benefiting from Flood Defences

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

7.6 Areas benefiting from Flood Storage

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

---

7.7 Groundwater Flooding Susceptibility Areas

7.7.1 Are there any British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site? No

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

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

Not Prone

The area is not considered to be prone to groundwater flooding based on rock type.

7.8 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result? Not Applicable

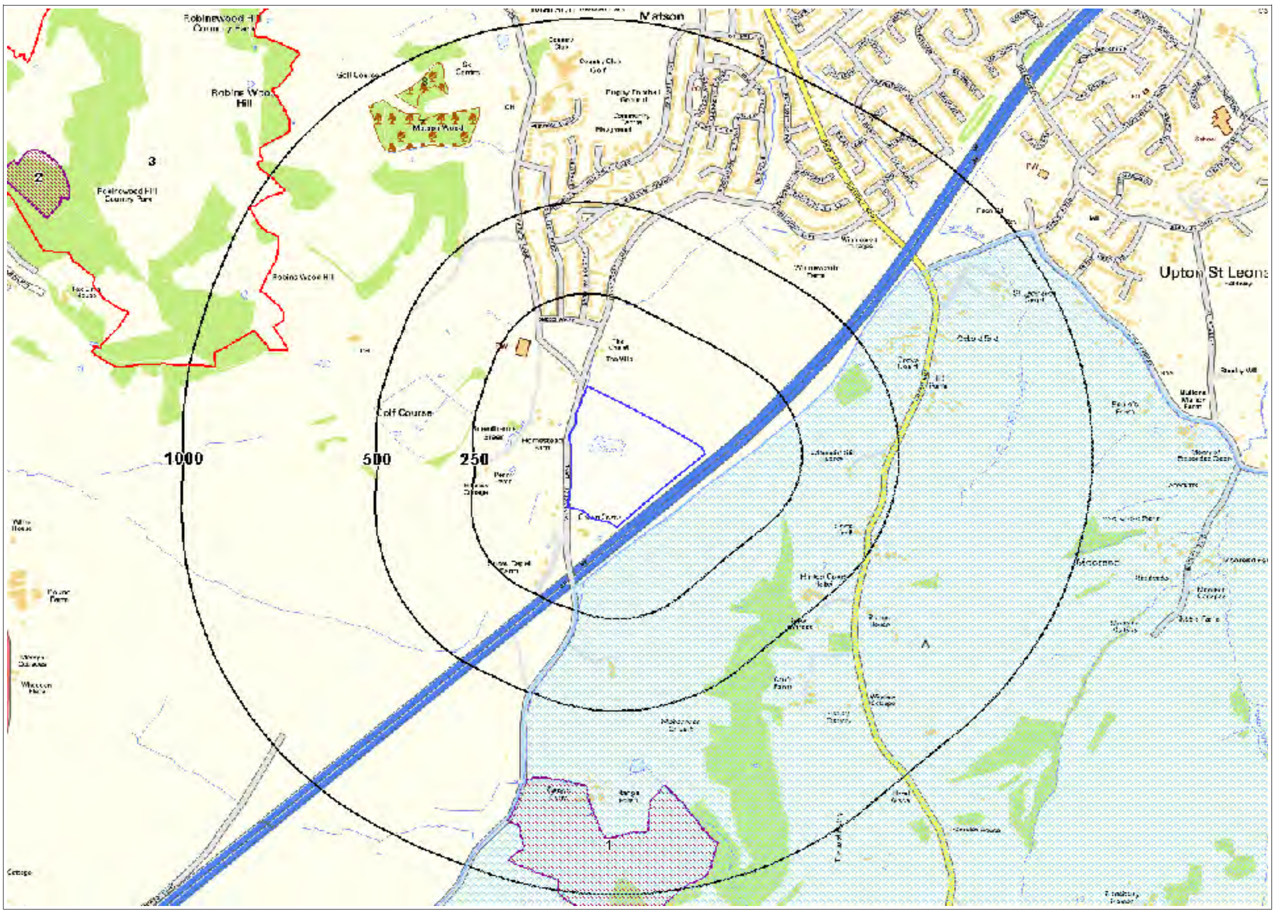
Notes: Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

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

8. Designated Environmentally Sensitive Sites Map

NW N NE

W E



SW S SE

Site Outline

100
250
Search Buffers (m)

AONB

National Park

SSSI

Special Protection Areas

Nitrate Vulnerable Zones

Green Belt

Environmentally Sensitive Areas

Special Areas of Conservation

World Heritage Sites

Nitrate Sensitive Areas

Ancient Woodland

National Nature Reserve

Local Nature Reserves

Ramsar Sites

8. Designated Environmentally Sensitive Sites

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

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

2

The following Site of Special Scientific Interest (SSSI) records provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	SSSI Name	Data Source
1	704	S	Range Farm Fields	Natural England
2	1433	W	Robin's Wood Hill Quarry	Natural England

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

2

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

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
7	732	NW	UNKNOWN	Ancient and Semi-Natural Woodland
8	876	NW	UNKNOWN	Ancient and Semi-Natural Woodland

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

1

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

ID	Distance (m)	Direction	LNR Name	Data Source
3	763	W	Robinswood Hill	Natural England

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

0

Database searched and no data found.

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

1

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

ID	Distance (m)	Direction	ESA Name	Data Source
6A	56	SE	Cotswold Hills	Natural England

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

1

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

ID	Distance (m)	Direction	AONB/NSA Name	Data Source
5A	59	SE	Cotswolds	Natural England

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

0

Database searched and no data found.

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

0

Database searched and no data found.

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

1

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

ID	Distance (m)	Direction	NVZ Name	Data Source
Not shown	1612	S	Existing	DEFRA

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

0

Database searched and no data found.

9. Natural Hazards Findings

9.1 Detailed BGS GeoSure Data

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

9.1.1 Shrink Swell

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

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

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

9.1.2 Landslides

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

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

Hazard
Possibility of slope instability problems after major changes in ground conditions. Consideration should be given to stability if changes to drainage or excavations take place. Possible increase in construction cost to reduce potential slope stability problems. Existing property no significant increase in insurance risk due to natural slope instability problems.

9.1.3 Soluble Rocks

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

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

Hazard
Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

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

9.1.4 Compressible Ground

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

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

Hazard
No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

9.1.5 Collapsible Rocks

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

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

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

9.1.6 Running Sand

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

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

Hazard
No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

9.2 Radon

9.2.1 Radon Affected Areas

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

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

9.2.2 Radon Protection

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

10. Mining

10.1 Coal Mining

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

Database searched and no data found.

10.2 Non-Coal Mining

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

Database searched and no data found.

10.3 Brine Affected Areas

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

Groundsure
LOCATION INTELLIGENCE

Contact Details

CENTREMAPS
[redacted]
Open Space, Upper Interfields, Malvern, Worcester, WR14 1UT

[redacted]

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

Standard Terms and Conditions

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

CENTREMAPS

Open Space, Upper Interfields,
Worcester, WR14 1UT

Report Reference: CMAPS-CM-625691-13238-220517GEO

Your Reference: 13238

Report Date 22 May 2017

Report Delivery Method: Email - pdf

Groundsure Geo Insight

Address: Snow Capel Matson , GL4 6EQ

Dear Sir/ Madam,

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

If you need any further assistance, please do not hesitate to contact our helpline on [redacted] quoting the above CENTREMAPS reference number.

Yours faithfully,

CENTREMAPS

Enc.
Groundsure Geo Insight

Groundsure Geo Insight

Address: Snow Capel Matson , GL4 6EQ

Date: 22 May 2017

Reference: CMAPS-CM-625691-13238-220517GEO

Client: CENTREMAPS

NW N NE

W E

SW S SE

Aerial Photograph Capture date: 10-Jul-2014
Grid Reference: 385157,214176
Site Size: 7.95ha

Contents Page

Groundsure LOCATION INTELLIGENCE

CENTRE MAPS LIVE. FOR A BETTER POINT OF VIEW

Overview of Findings

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

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

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

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

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

Groundsure LOCATION INTELLIGENCE

CENTRE MAPS LIVE. FOR A BETTER POINT OF VIEW

Section 2: Geology 1:50,000 Scale

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

Section 3: Radon

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

Section 4: Ground Workings	On-site	0-50m	51-250	251-500	501-1000
4.1 Historical Surface Ground Working Features from Small Scale Mapping	2	1	9	Not Searched	Not Searched
4.2 Historical Underground Workings from Small Scale Mapping	0	0	0	0	0
4.3 Current Ground Workings	0	0	0	0	0

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

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

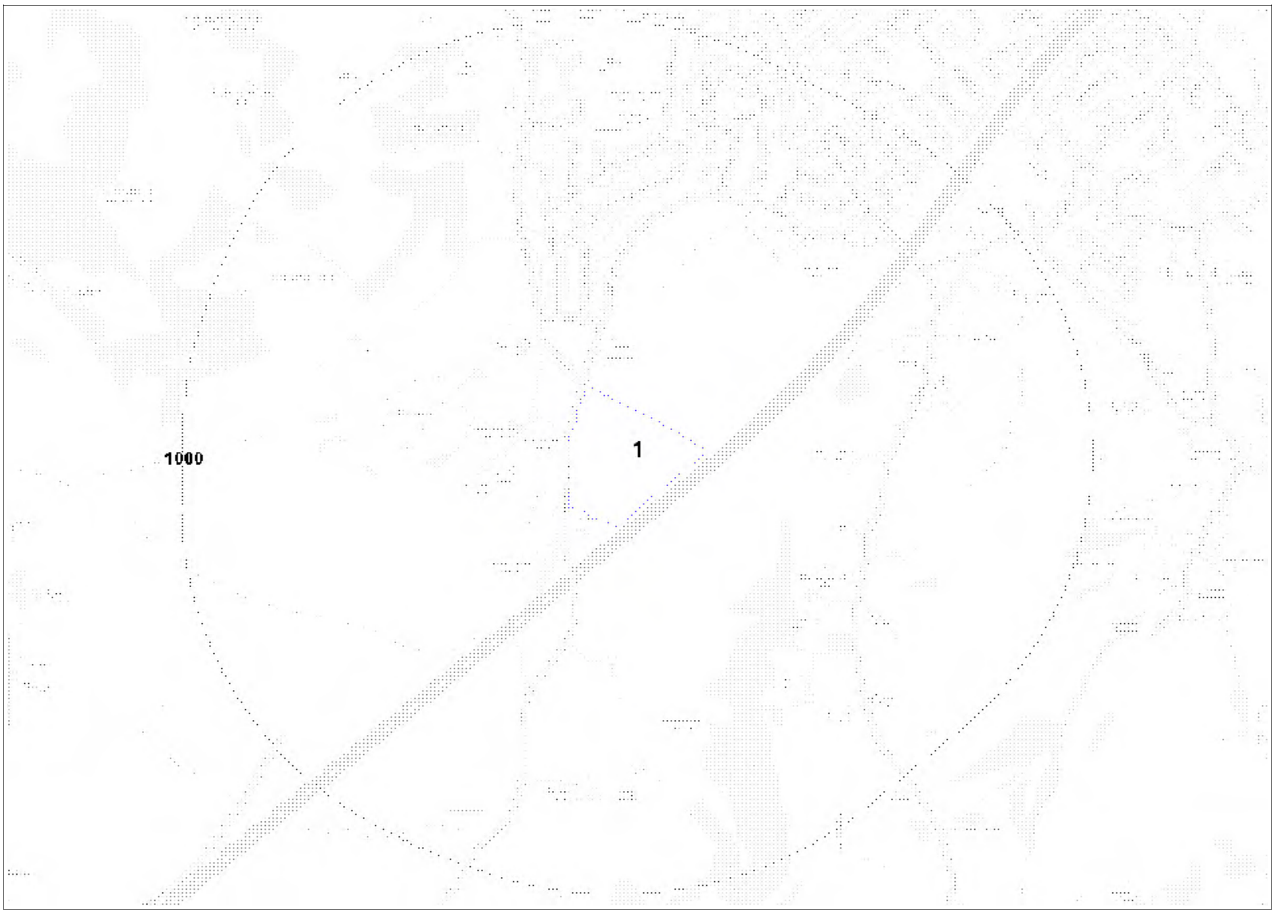
Section 6: Natural Ground Subsidence	On-site
6.1 Shrink-Swell Clay	Low
6.2 Landslides	Low
6.3 Ground Dissolution of Soluble Rocks	Negligible
6.4 Compressible Deposits	Negligible
6.5 Collapsible Deposits	Very Low
6.5 Running Sand	Negligible

Section 7: Borehole Records	On-site	0-50m	51-250
7 BGS Recorded Boreholes	0	1	10

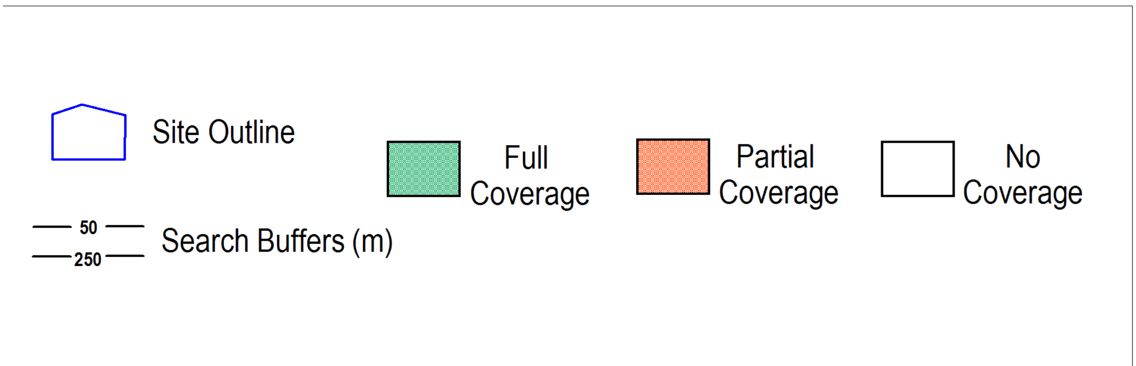
Section 8: Estimated Background Soil Chemistry	On-site	0-50m	51-250
8 Records of Background Soil Chemistry	4	2	0

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

1:10,000 Scale Availability



1_10,000 Availability Legend



Availability of 1:10,000 Scale Geology Mapping

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

ID	Distance	Artificial Coverage	Superficial Coverage	Bedrock Coverage	Mass Movement Coverage
1	0.0	No deposits are mapped	No coverage	No coverage	No coverage

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

The definitions of coverage are as follows:

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

1 Geology (1:10,000 scale).

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

NW N NE

W

E

SW S SE

Artificial Ground Legend

Site Outline

Search Buffers (m) — 500, 1000

Made Ground (undivided)

Disturbed Ground (undivided)

Worked Ground (undivided)

Landscaped Ground (undivided)

Infilled Ground

Reclaimed Ground

1. Geology 1:10,000 scale

1.1 Artificial Ground

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

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

Database searched and no data found.

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

NW N NE

W  E

SW S SE

Artificial Ground Legend

Site Outline

500
1000
Search Buffers (m)

1.2 Superficial Deposits and Landslips

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

1.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary at 1:10,000 scale? No

Database searched and no data found.

1.2.2 Landslip

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

No

Database searched and no data found.

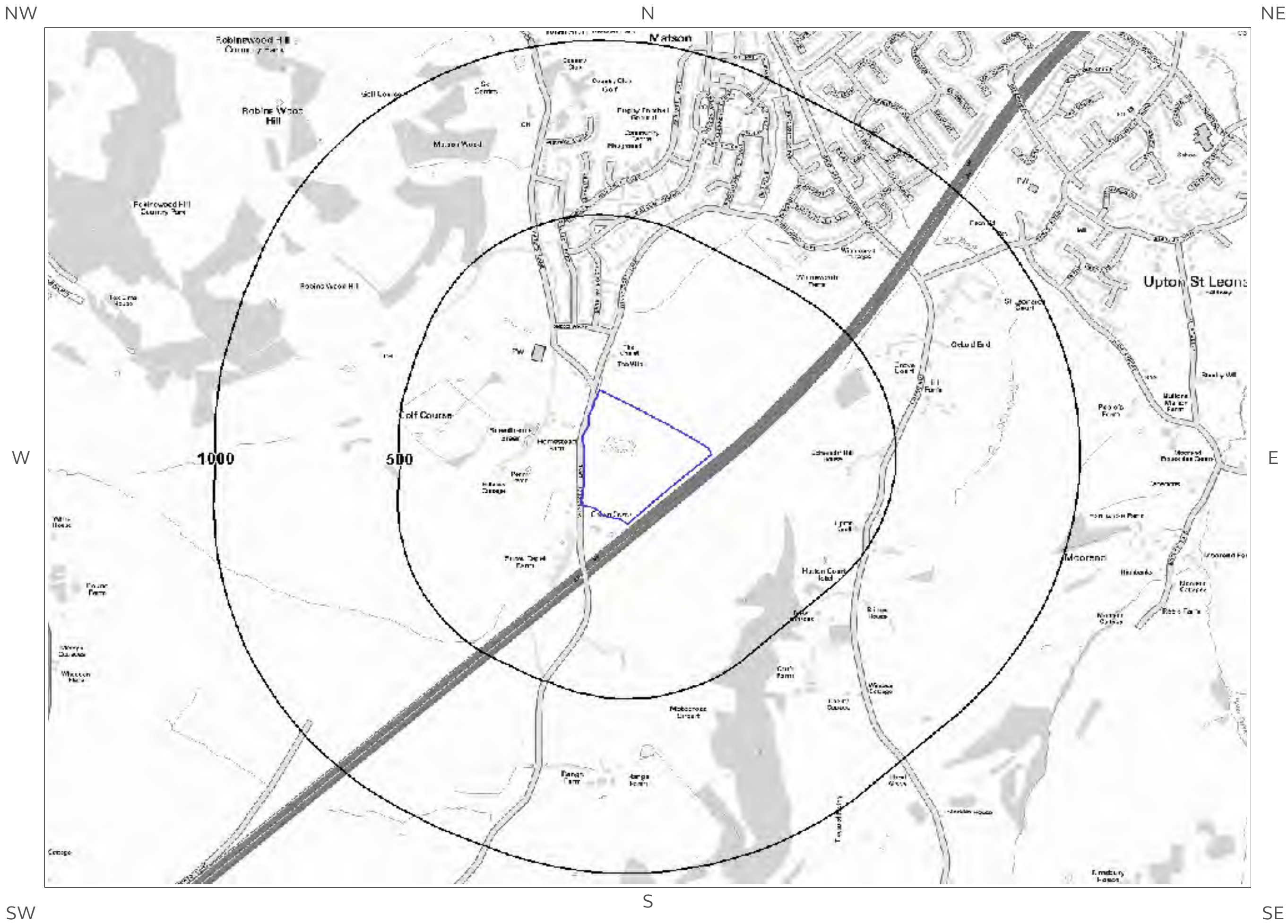
The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:10,000 scale

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

Groundsure LOCATION INTELLIGENCE

CENTRE MAPS LIVE. FOR A BETTER POINT OF VIEW

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



Bedrock and Faults Legend

Site Outline

500 / 1000 Search Buffers (m)

1.3 Bedrock and Faults

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

1.3.1 Bedrock/ Solid Geology

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

Database searched and no data found at this scale.

1.3.2 Faults

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

Database searched and no data found at this scale.

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

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

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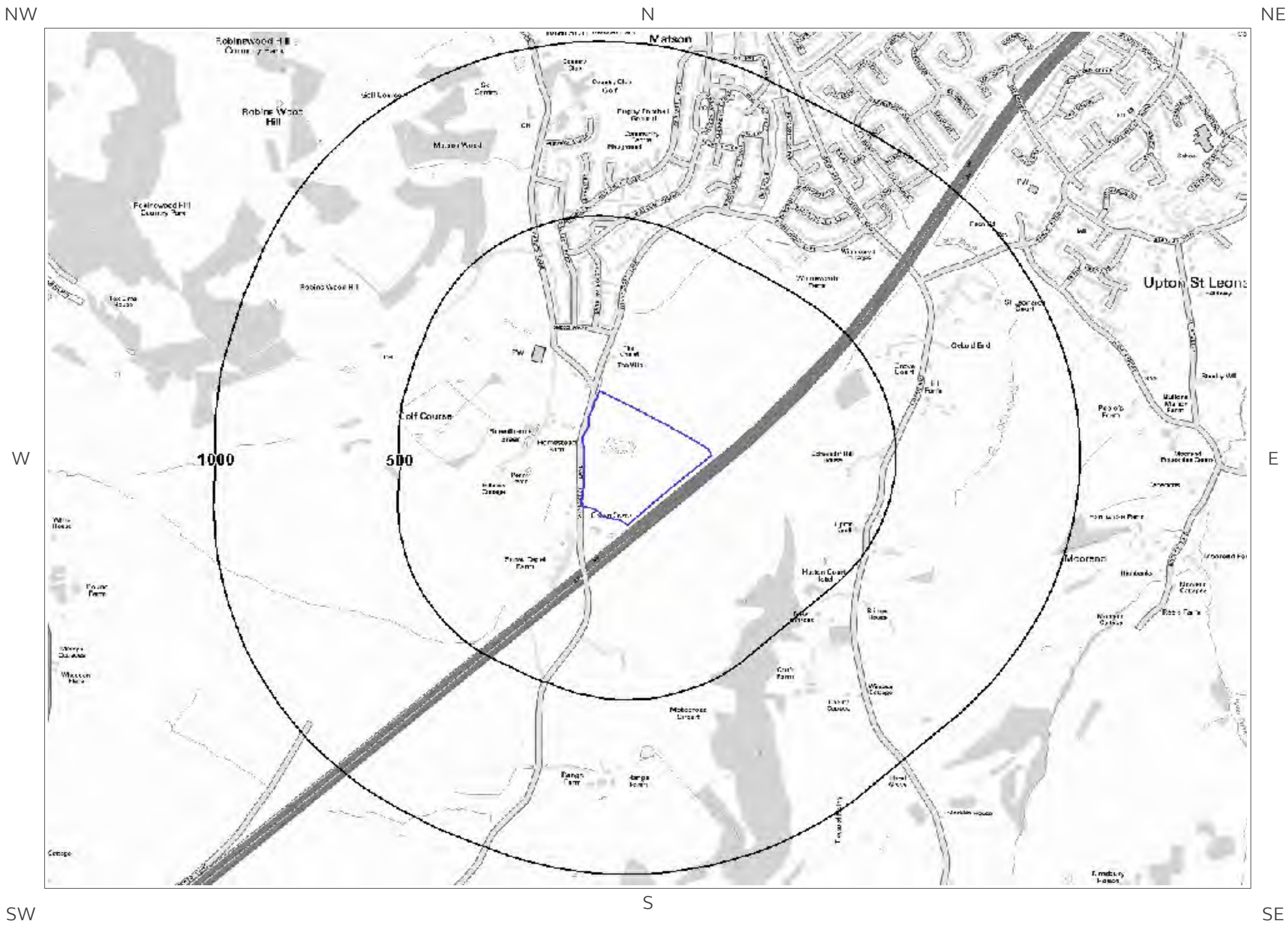
LOCATION INTELLIGENCE

CENTRE MAPS LIVE.
FOR A BETTER POINT OF VIEW

2 Geology 1:50,000 Scale

2.1 Artificial Ground Map



Ground Workings Legend

Site Outline

500
1000
Search Buffers (m)

Made Ground (undivided)

Worked Ground (undivided)

Infilled Ground

Disturbed Ground (undivided)

Landscaped Ground (undivided)

Reclaimed Ground

2. Geology 1:50,000 scale

2.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 234

2.1.1 Artificial/ Made Ground

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

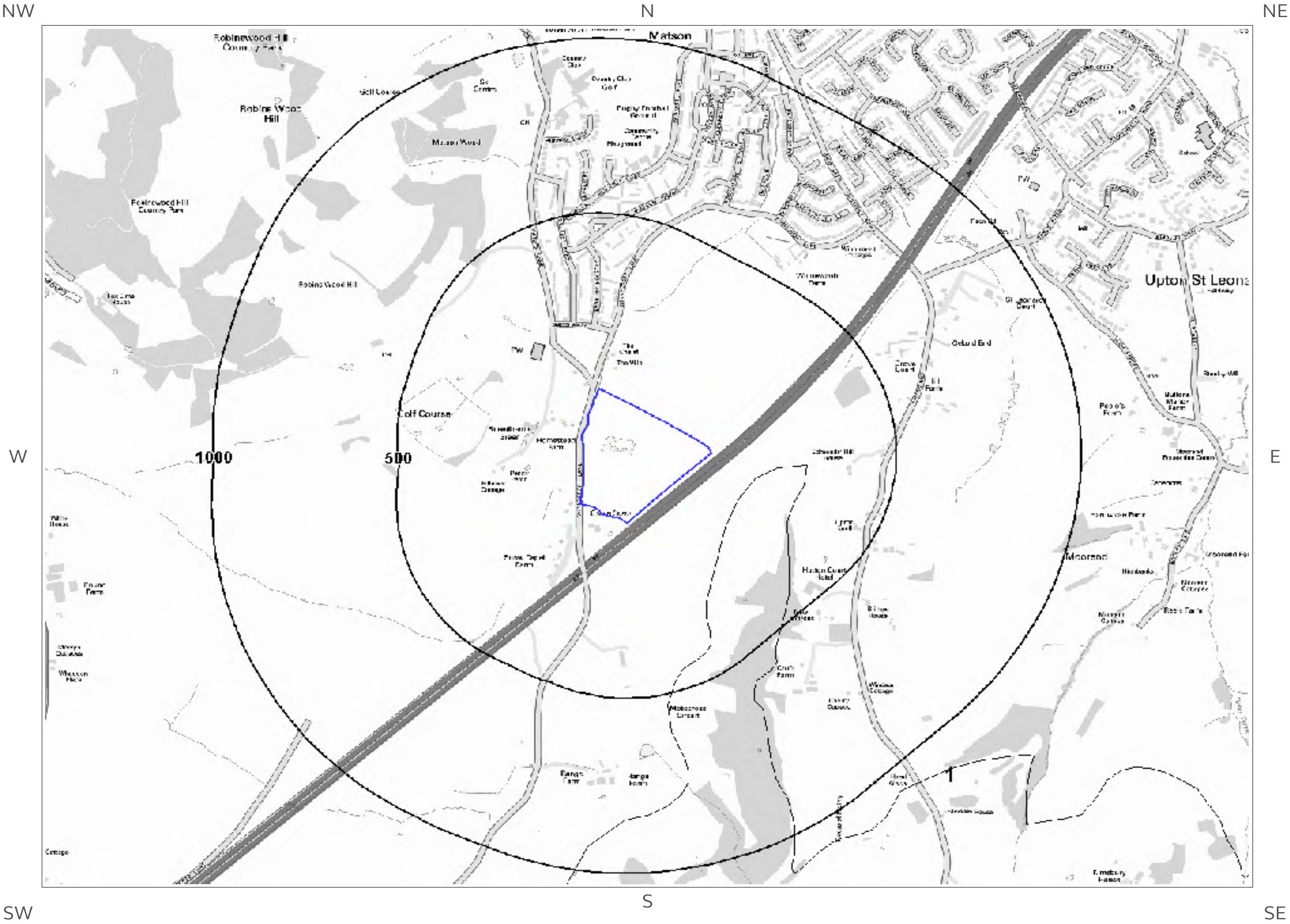
Database searched and no data found.

2.1.2 Permeability of Artificial Ground

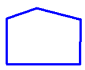
Are there any records relating to permeability of artificial ground within the study site boundary?	No

Database searched and no data found.

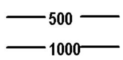
2.2 Superficial Deposits and Landslips Map (1:50,000 scale)



Ground Workings Legend



Site Outline



Search Buffers (m)

2.2 Superficial Deposits and Landslips

2.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary? No

Database searched and no data found.

2.2.2 Permeability of Superficial Ground

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

Database searched and no data found.

2.2.3 Landslip

Are there any records of Landslip within 500m of the study site boundary? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	137.0	SE	SLIP-UKNOWN	LANDSLIDE DEPOSITS	UNKNOWN/UNCLASSIFIED ENTRY

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

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

2.2.4 Landslip Permeability

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

Database searched and no data found.

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LOCATION INTELLIGENCE

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

Ground Workings Legend

Site Outline

500
1000
Search Buffers (m)

2.3 Bedrock, Solid Geology & Faults

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 234

2.3.1 Bedrock/Solid Geology

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

ID	Distance	Direction	LEX Code	Rock Description	Rock Age
1	0.0	On Site	BLCR-MDST	BLUE LIAS FORMATION AND CHARMOUTH MUDSTONE FORMATION (UNDIFFERENTIATED) - MUDSTONE	RHAETIAN
2	0.0	On Site	CHAM-MDST	CHARMOUTH MUDSTONE FORMATION - MUDSTONE	SINEMURIAN
3	137.0	SE	LIIO-LMAS	LIAS GROUP AND INFERIOR OOLITE GROUP (UNDIFFERENTIATED) - LIMESTONE, ARGILLACEOUS ROCKS AND SUBORDINATE SANDSTONE, INTERBEDDED	RHAETIAN
4	259.0	E	DYS-SIMD	DYRHAM FORMATION - SILTSTONE AND MUDSTONE, INTERBEDDED	PLIENSBACHIAN
5A	472.0	NW	DYS-SIMD	DYRHAM FORMATION - SILTSTONE AND MUDSTONE, INTERBEDDED	PLIENSBACHIAN
6	492.0	SE	MRB-FLMST	MARLSTONE ROCK FORMATION - LIMESTONE, FERRUGINOUS	PLIENSBACHIAN

2.3.2 Permeability of Bedrock Ground

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

Distance	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Fracture	Low	Low
0.0	On Site	Fracture	Low	Low

2.3.3 Faults

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

Database searched and no data found.

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

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

3 Radon Data

3.1 Radon Affected Areas

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

3.2 Radon Protection

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

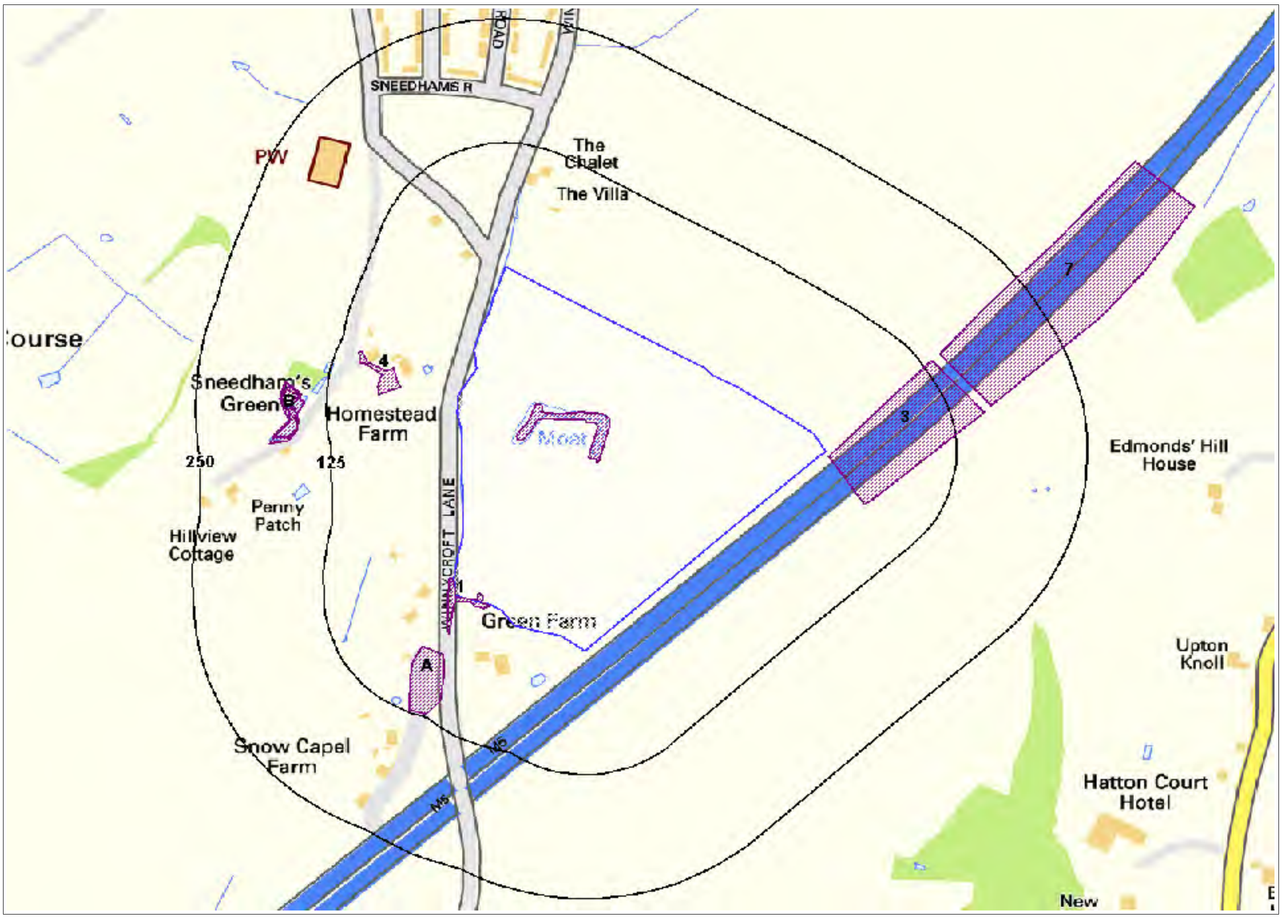
Groundsure
LOCATION INTELLIGENCE

CENTRE MAPS LIVE.
FOR A BETTER POINT OF VIEW

4 Ground Workings Map

NW N NE

W E



SW S SE

Ground Workings Legend

Site Outline

125
250
Search Buffers (m)

Historic Surface Ground Workings

Historic Underground Workings

Current Ground Workings

4 Ground Workings

4.1 Historical Surface Ground Working Features derived from Historical Mapping

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

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

ID	Distance (m)	Direction	NGR	Use	Date
1	0.0	On Site	384977 214028	Ponds	1883
2	0.0	On Site	385046 214202	Pond	1883
3	5.0	SE	385411 214203	Cuttings	1973
4	56.0	W	384909 214263	Ponds	1883
5A	59.0	SW	384954 213954	Unspecified Ground Workings	1986
6A	59.0	SW	384954 213954	Unspecified Ground Workings	1973
7	144.0	NE	385565 214353	Cuttings	1973
8B	146.0	W	384824 214219	Ponds	1883
9B	149.0	W	384825 214223	Ponds	1924
10B	149.0	W	384825 214223	Ponds	1938
11B	152.0	W	384824 214226	Ponds	1986
12B	152.0	W	384824 214226	Ponds	1973

4.2 Historical Underground Working Features derived from Historical Mapping

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

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

Database searched and no data found.

4.3 Current Ground Workings

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

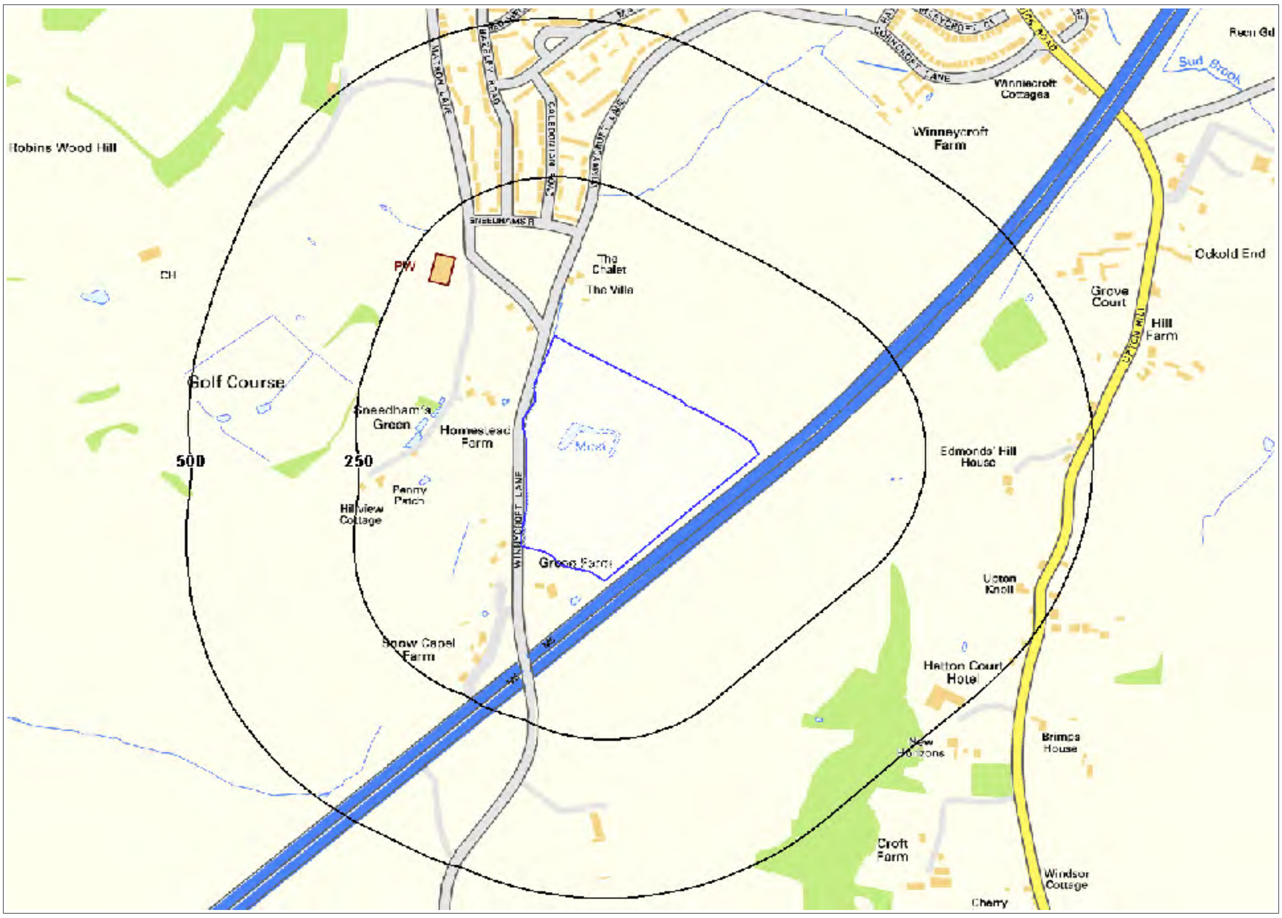
Are there any BGS Current Ground Workings within 1000m of the study site boundary? No

Database searched and no data found.

5 Mining, Extraction & Natural Cavities Map

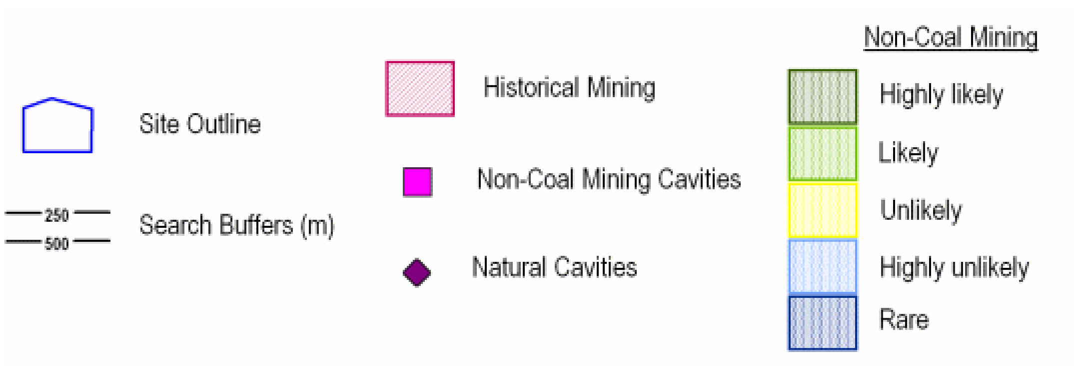
NW N NE

W E



SW S SE

Mining, Extraction and Natural Cavities Legend



5 Mining, Extraction & Natural Cavities

5.1 Historical Mining

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

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

Database searched and no data found.

5.2 Coal Mining

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

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

Database searched and no data found.

5.3 Johnson Poole and Bloomer

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

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

The following information provided by JPB is not represented on mapping: Database searched and no data found.

5.4 Non-Coal Mining

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

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

Database searched and no data found.

5.5 Non-Coal Mining Cavities

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

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.6 Natural Cavities

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

Are there any Natural Cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.7 Brine Extraction

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

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

Database searched and no data found.

5.8 Gypsum Extraction

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

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

Database searched and no data found.

5.9 Tin Mining

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

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

Database searched and no data found.

5.10 Clay Mining

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

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

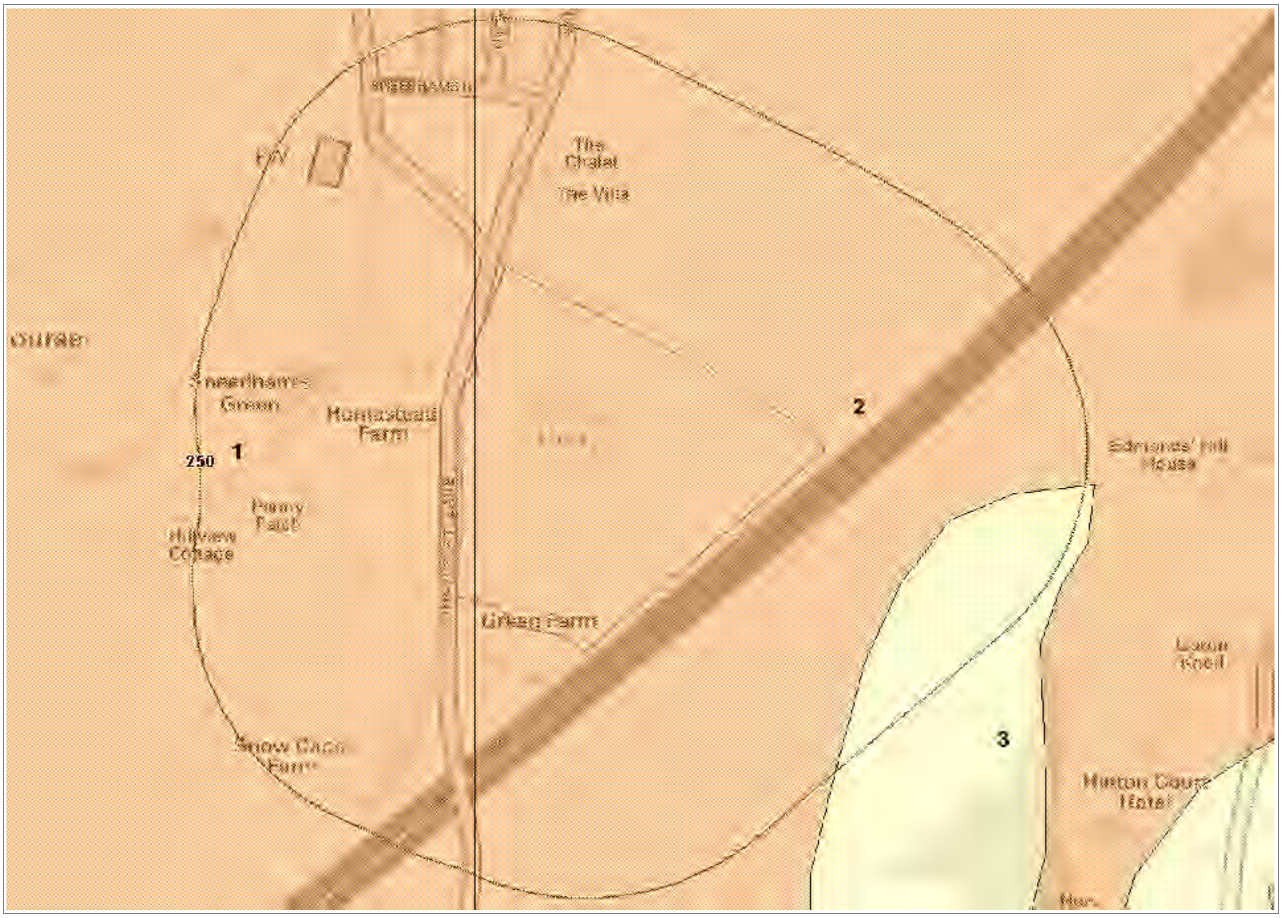
Database searched and no data found.

6 Natural Ground Subsidence

6.1 Shrink-Swell Clay Map

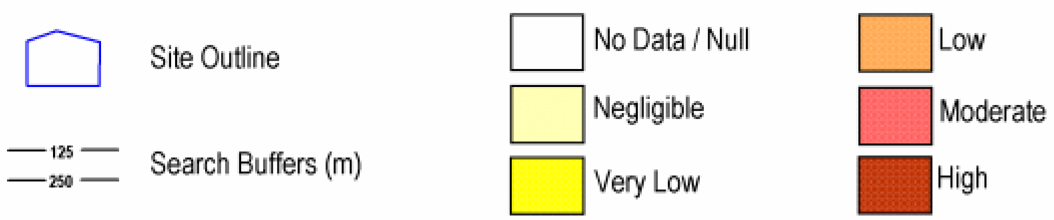
NW N NE

W E

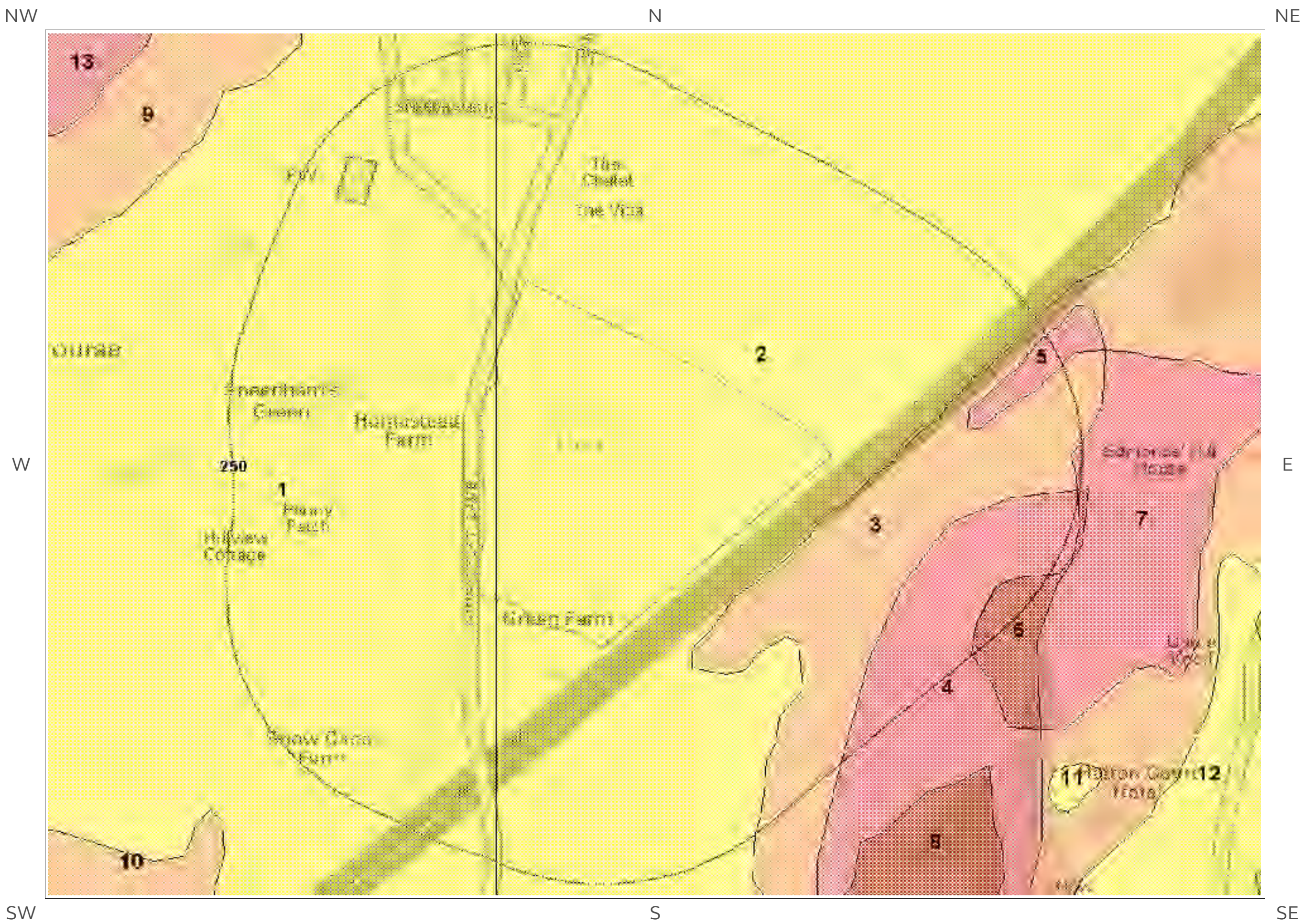


SW S SE

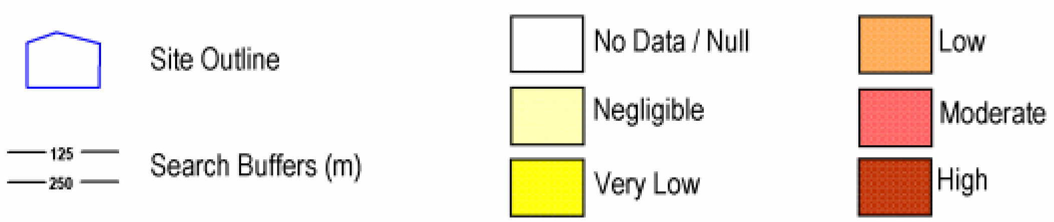
Shrink Swell Clay Legend



6.2 Landslides Map



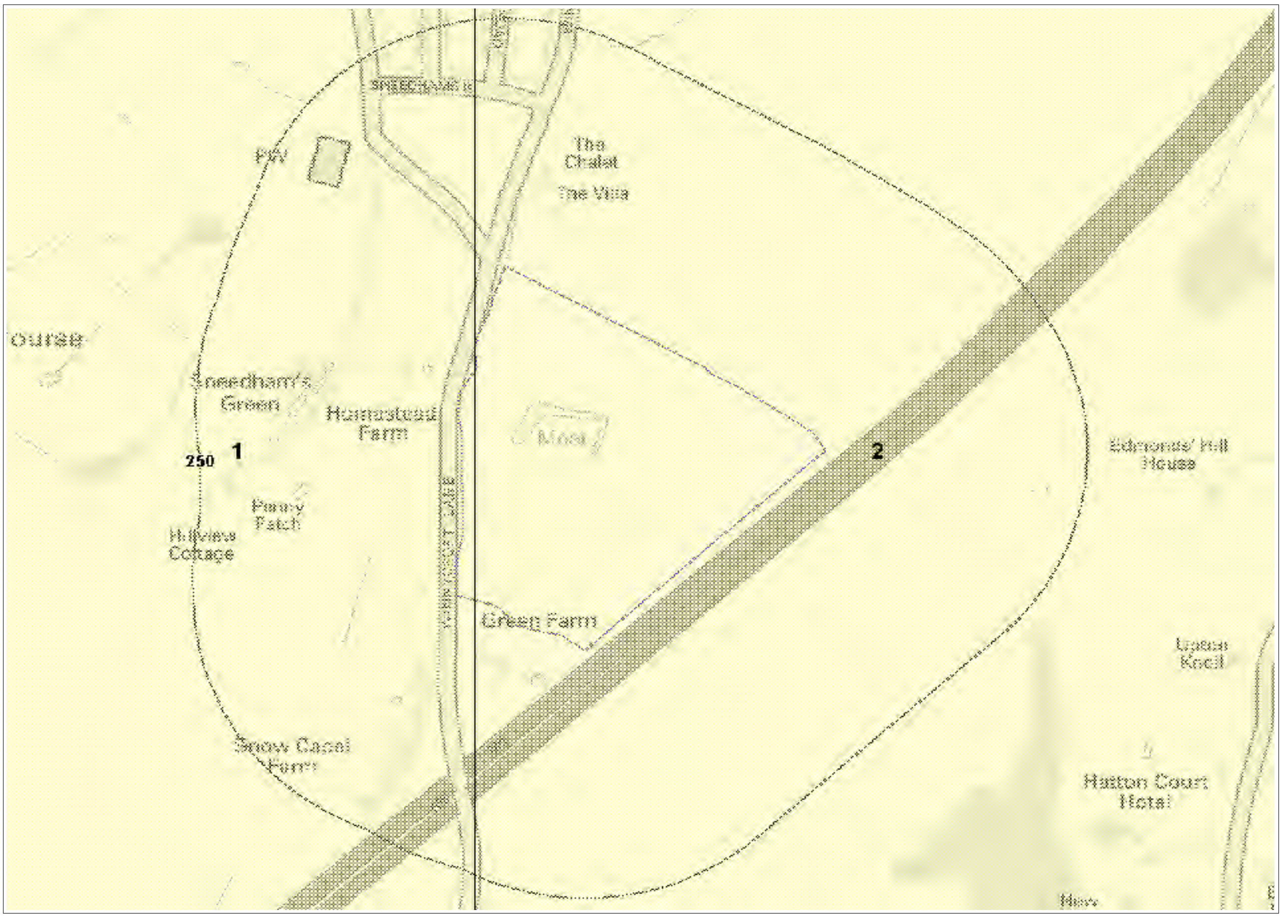
Landslides Legend



6.3 Ground Dissolution of Soluble Rocks Map

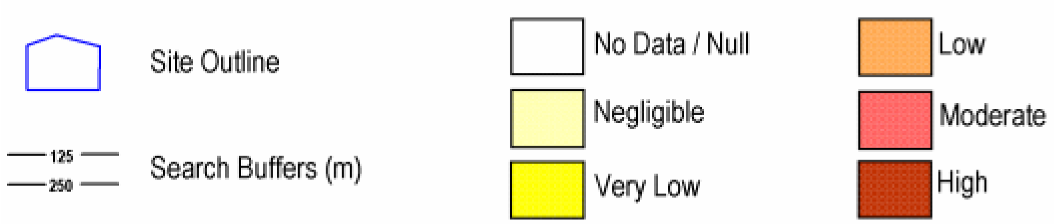
NW N NE

W E

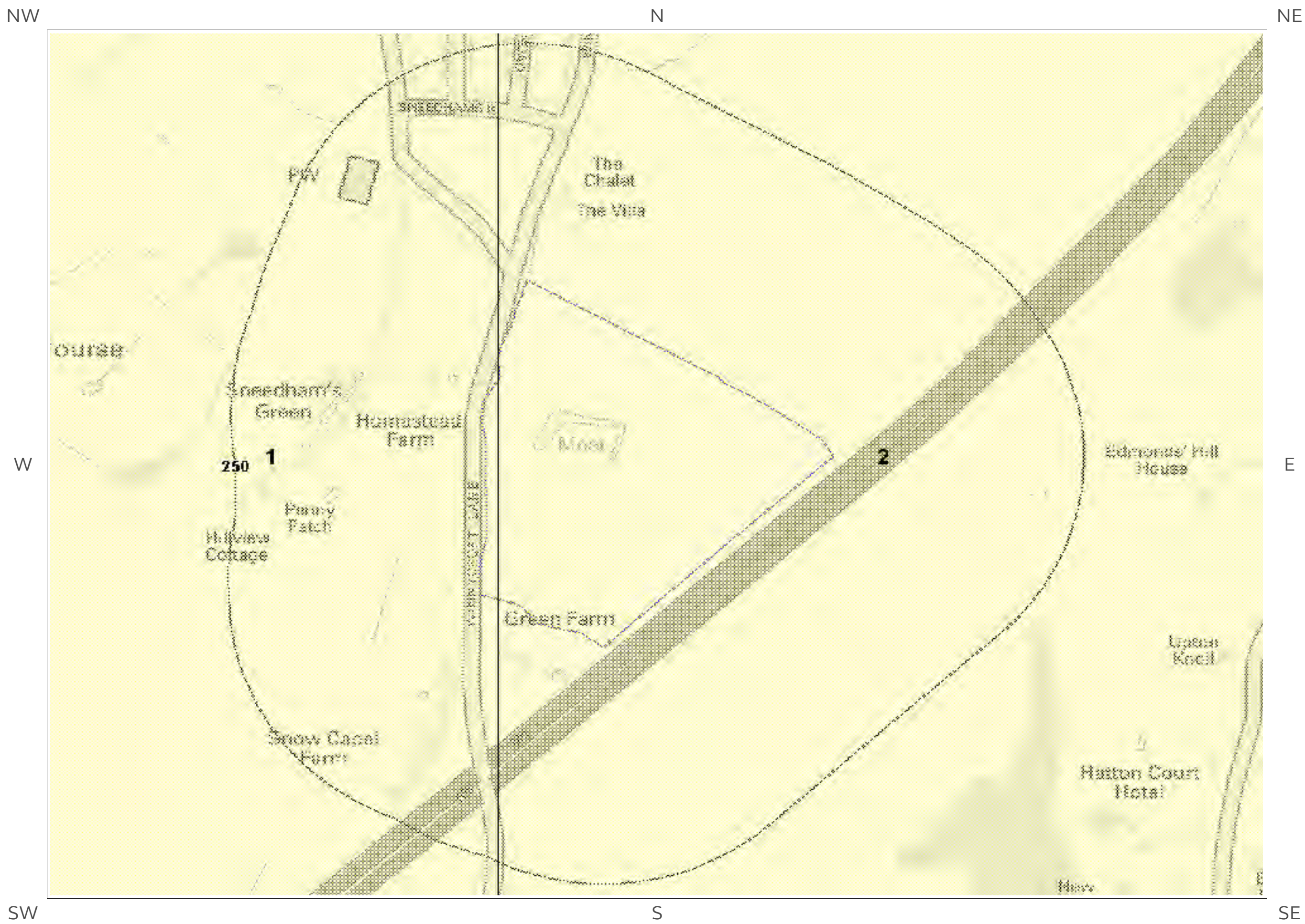


SW S SE

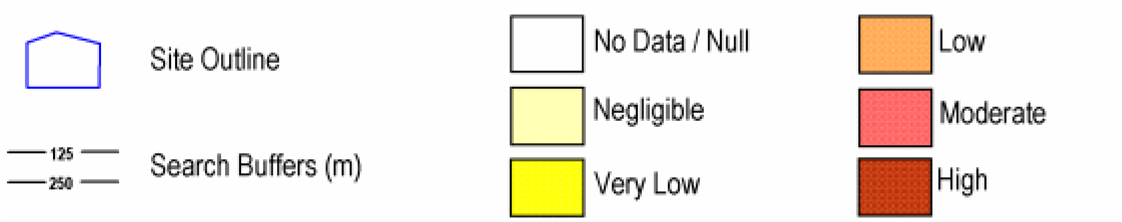
Ground Dissolution Soluble Rocks Legend



6.4 Compressible Deposits Map

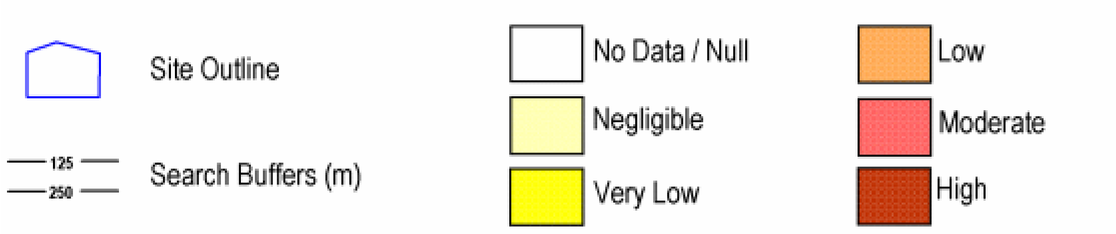


Compressible Deposits Legend



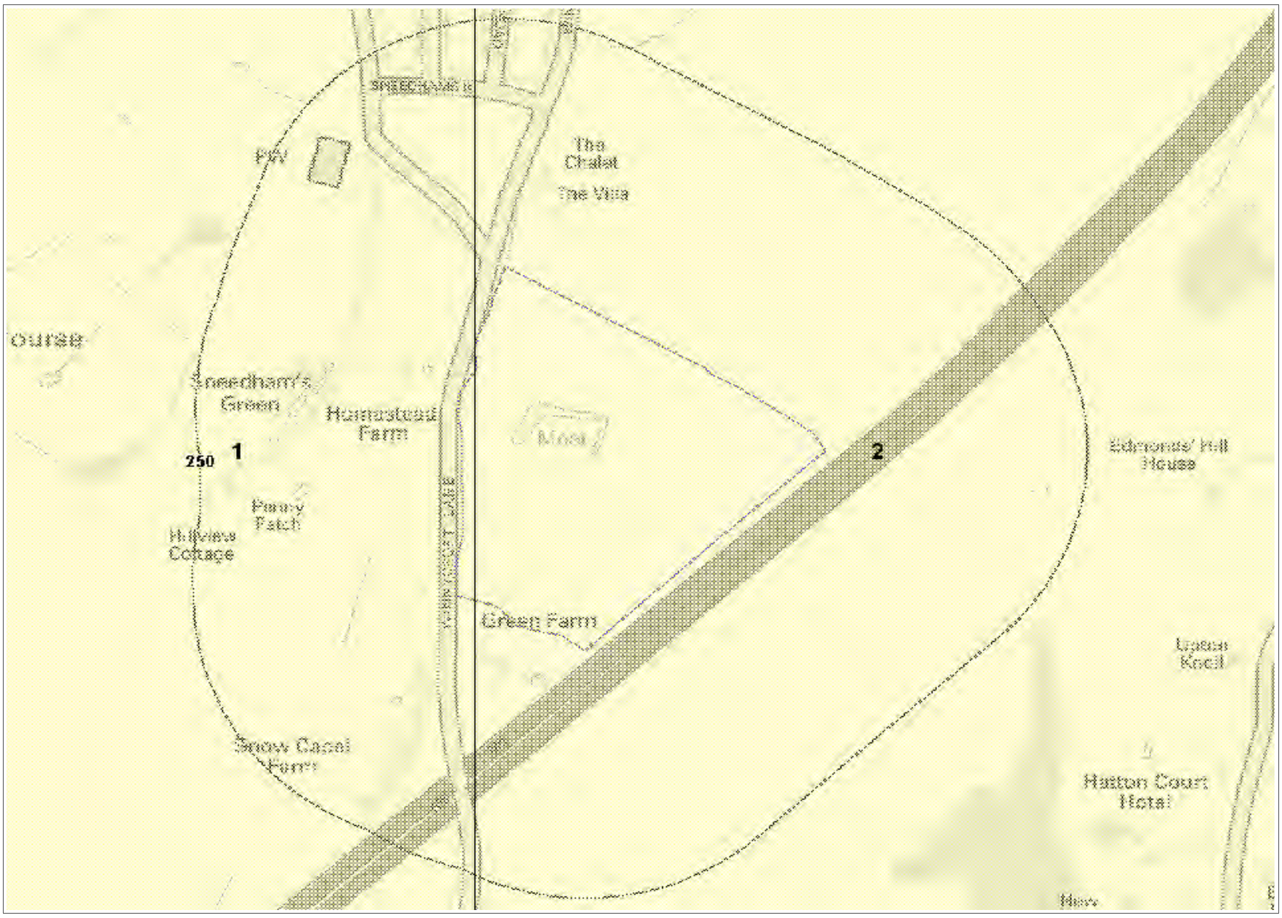
6.5 Collapsible Deposits Map

Collapsible Deposits Legend



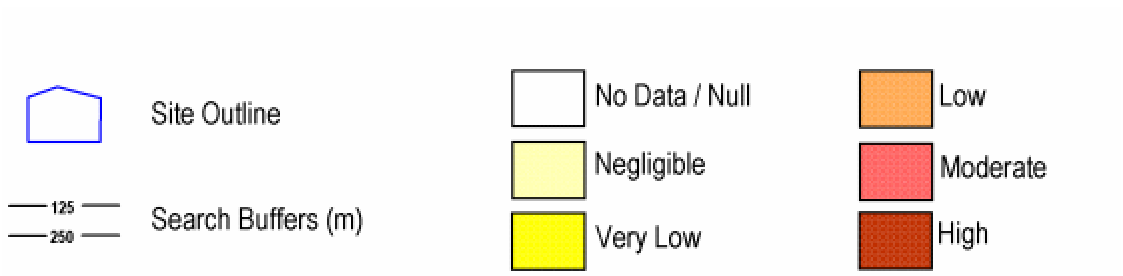
6.6 Running Sand Map

NW N NE

W  E

SW S SE

Running Sand Legend



6 Natural Ground Subsidence

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

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

What is the maximum hazard rating of natural subsidence within the study site** boundary? Low

6.1 Shrink-Swell Clays

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

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Low	Ground conditions predominantly medium plasticity. Do not plant trees with high soil moisture demands near to buildings. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a possible increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a possible increase in insurance risk, especially during droughts or where vegetation with high moisture demands is present.
2	0.0	On Site	Low	Ground conditions predominantly medium plasticity. Do not plant trees with high soil moisture demands near to buildings. For new build, consideration should be given to advice published by the National House Building Council (NHBC) and the Building Research Establishment (BRE). There is a possible increase in construction cost to reduce potential shrink-swell problems. For existing property, there is a possible increase in insurance risk, especially during droughts or where vegetation with high moisture demands is present.

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

6.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.
2	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.
3	43.0	SE	Low	Possibility of slope instability problems after major changes in ground conditions. Consideration should be given to stability if changes to drainage or excavations take place. Possible increase in construction cost to reduce potential slope stability problems. Existing property - no significant increase in insurance risk due to natural slope instability problems.

6.3 Ground Dissolution of Soluble Rocks

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

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.
2	0.0	On Site	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

6.4 Compressible Deposits

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

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

ID	Distance (m)	Direction	Hazard Rating	Details
2	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

6.5 Collapsible Deposits

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

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.
2	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

6.6 Running Sands

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

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.
2	0.0	On Site	Negligible	No indicators for running sand identified. No special actions required to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

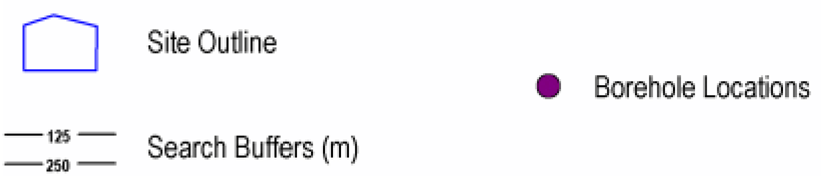
7 Borehole Records Map

NW N NE

W E

SW S SE

Borehole Records Legend



7 Borehole Records

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

Records of boreholes within 250m of the study site boundary: 11

ID	Distance (m)	Direction	NGR	BGS Reference	Drilled Length	Borehole Name
1	18.0	SE	385317 214146	SO81SE20	10.33	AREA 2 M5 MOTORWAY GDIS PHASE 3 11
2A	97.0	S	384953 213945	SO81SW55	4.2	M5 J11-12 & M4 J17-18 WS6
3A	100.0	S	384952 213942	SO81SW54	4.2	M5 J11-12 & M4 J17-18 WS5
4	108.0	NE	385420 214250	SO81SE8	4.87	M5 ROSS SPUR-EASTINGTON 73
5A	110.0	S	384945 213934	SO81SW52	4.2	M5 J11-12 & M4 J17-18 WS3
6A	111.0	S	384944 213934	SO81SW53	4.2	M5 J11-12 & M4 J17-18 WS4
7A	111.0	S	384953 213931	SO81SW51	4.2	M5 J11-12 & M4 J17-18 WS2
8A	111.0	S	384952 213931	SO81SW50	4.2	M5 J11-12 & M4 J17-18 WS1
9	167.0	NE	385479 214266	SO81SE19	10.26	AREA 2 M5 MOTORWAY GDIS PHASE 3 5
10	195.0	SW	384940 213840	SO81SW2	6.4	M5 ROSS SPUR-EASTINGTON 74A
11	236.0	S	384950 213790	SO81SW3	9.14	M5 ROSS SPUR-EASTINGTON 74B

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

#1: scans.bgs.ac.uk/sobi_scans/boreholes/19329370
#2A: scans.bgs.ac.uk/sobi_scans/boreholes/18843960
#3A: scans.bgs.ac.uk/sobi_scans/boreholes/18843959
#4: scans.bgs.ac.uk/sobi_scans/boreholes/271391
#5A: scans.bgs.ac.uk/sobi_scans/boreholes/18843957
#6A: scans.bgs.ac.uk/sobi_scans/boreholes/18843958
#7A: scans.bgs.ac.uk/sobi_scans/boreholes/18843956
#8A: scans.bgs.ac.uk/sobi_scans/boreholes/18843955
#9: scans.bgs.ac.uk/sobi_scans/boreholes/19329369
#10: scans.bgs.ac.uk/sobi_scans/boreholes/271396
#11: scans.bgs.ac.uk/sobi_scans/boreholes/271397

8 Estimated Background Soil Chemistry

Records of background estimated soil chemistry within 250m of the study site boundary: 6

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

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	Sediment	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	Sediment	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	Sediment	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
0.0	On Site	Sediment	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
32.0	S	Sediment	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg
32.0	S	Sediment	15 - 25 mg/kg	<1.8 mg/kg	90 - 120 mg/kg	30 - 45 mg/kg	<100 mg/kg

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

Groundsure
LOCATION INTELLIGENCE

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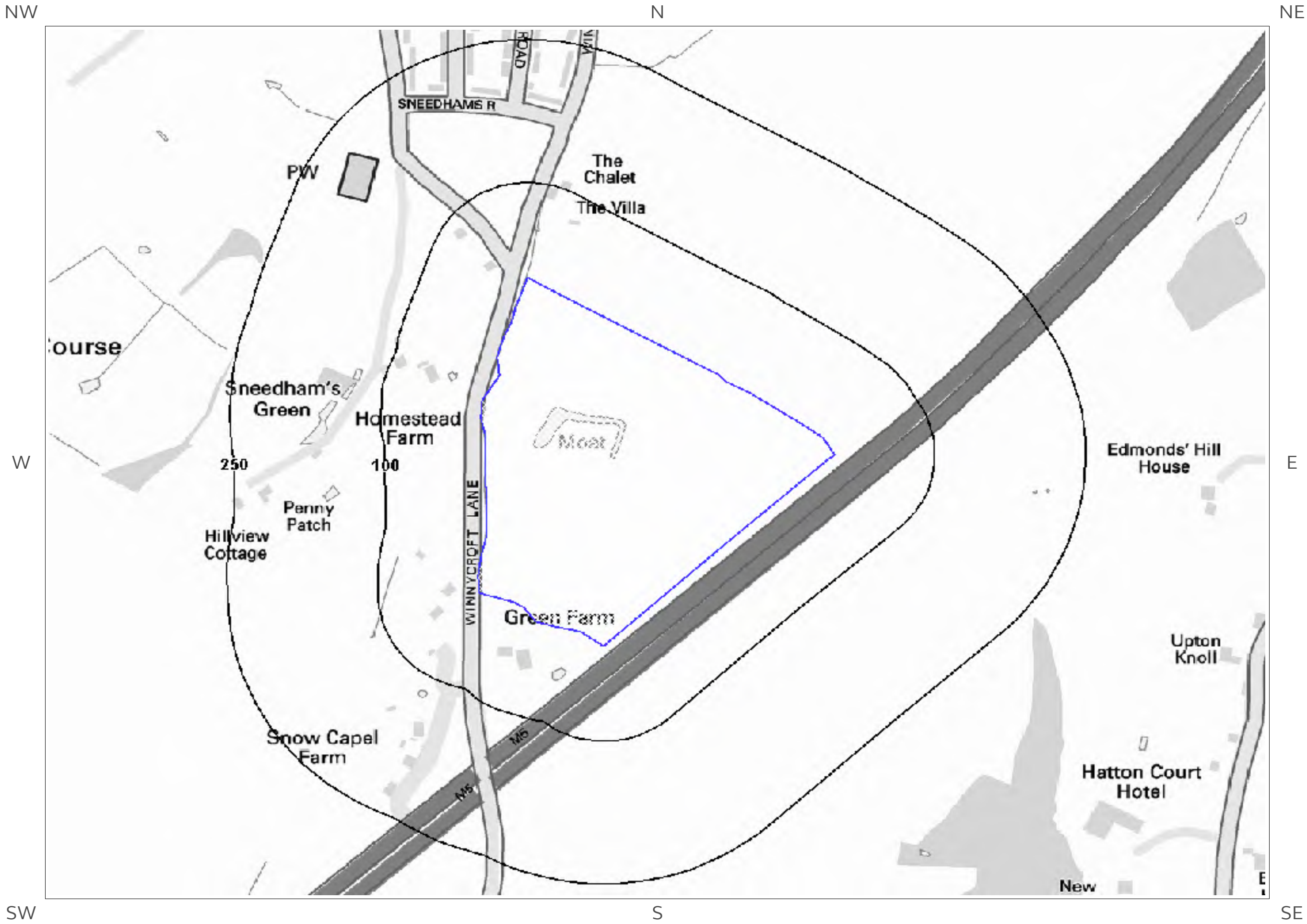
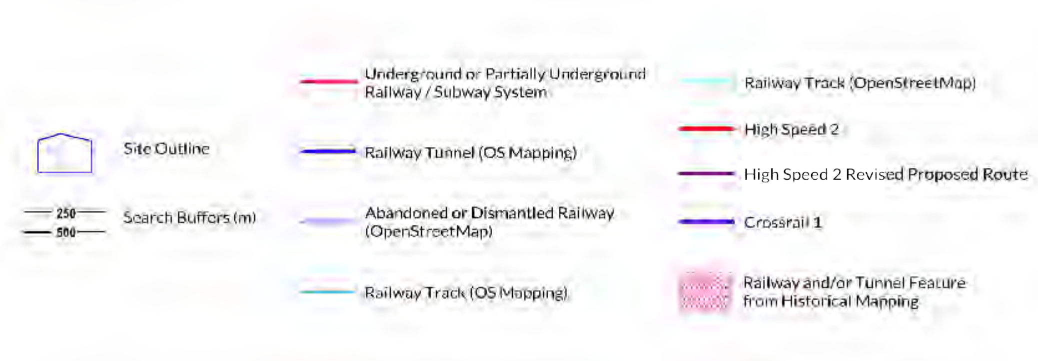
FOR A BETTER POINT OF VIEW

9 Railways and Tunnels Map



Railways and Tunnels Legend



9 Railways and Tunnels

9.1 Tunnels

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

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

Database searched and no data found.

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

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

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

Database searched and no data found.

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

9.2 Historical Railway and Tunnel Features

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

Have any historical railway or tunnel features been identified within the study site boundary?	No
Have any historical railway or tunnel features been identified within 250m of the study site boundary?	No

Database searched and no data found.

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

9.3 Historical Railways

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

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

Database searched and no data found.

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

9.4 Active Railways

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

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

Database searched and no data found.

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

9.5 Railway Projects

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

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

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

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

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

Contact Details

CENTREMAPS

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Groundsure@centremaps.co.uk
Open Space, Upper Interfields, Malvern, Worcester, WR14 1UT

[redacted]

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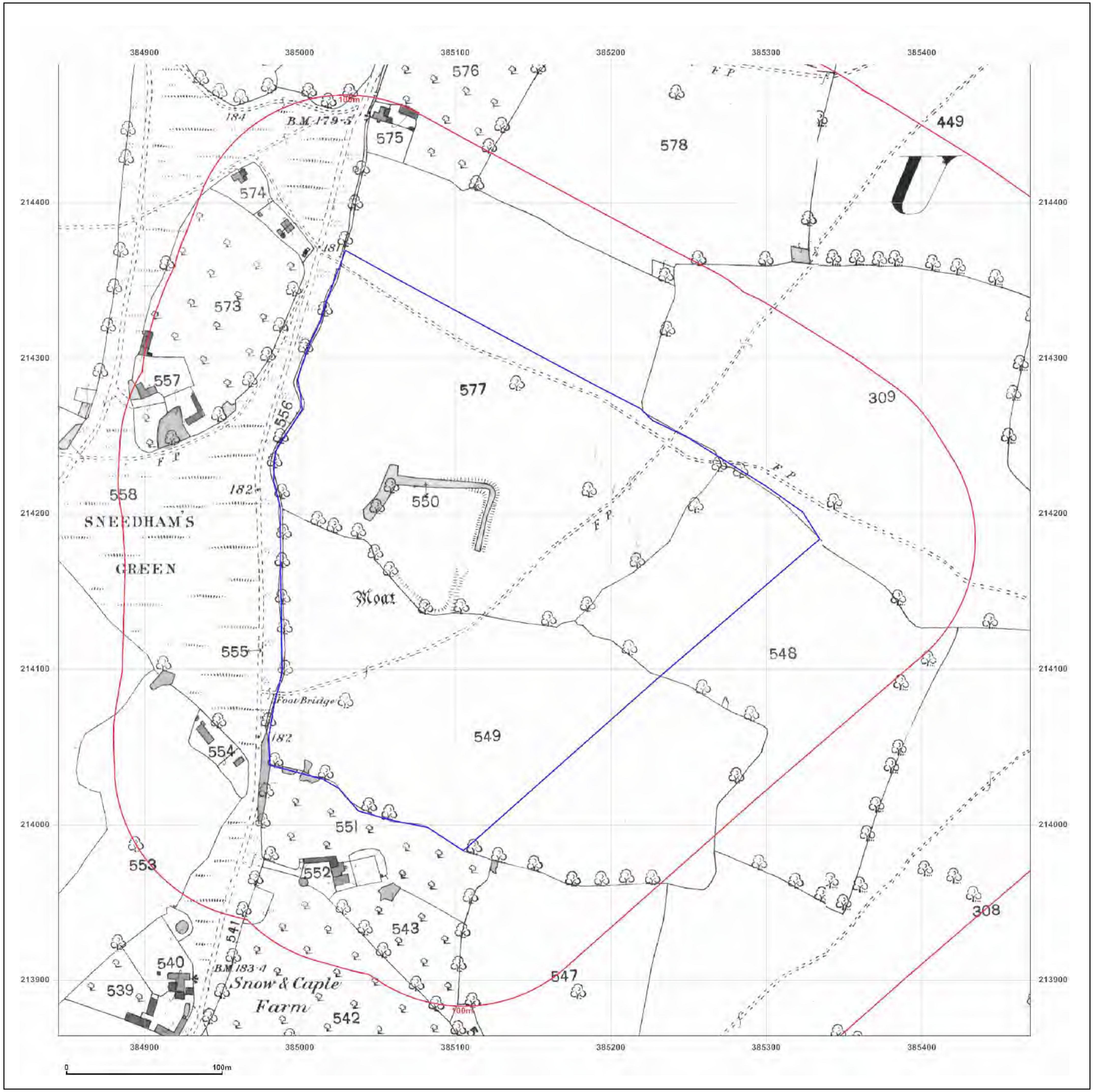
[redacted]

Standard Terms and Conditions

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



CENTRE MAPS LIVE.

FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: County Series

Map date: **1884**

Scale: 1:2,500

Printed at: 1:2,500

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Groundsure INSIGHTS

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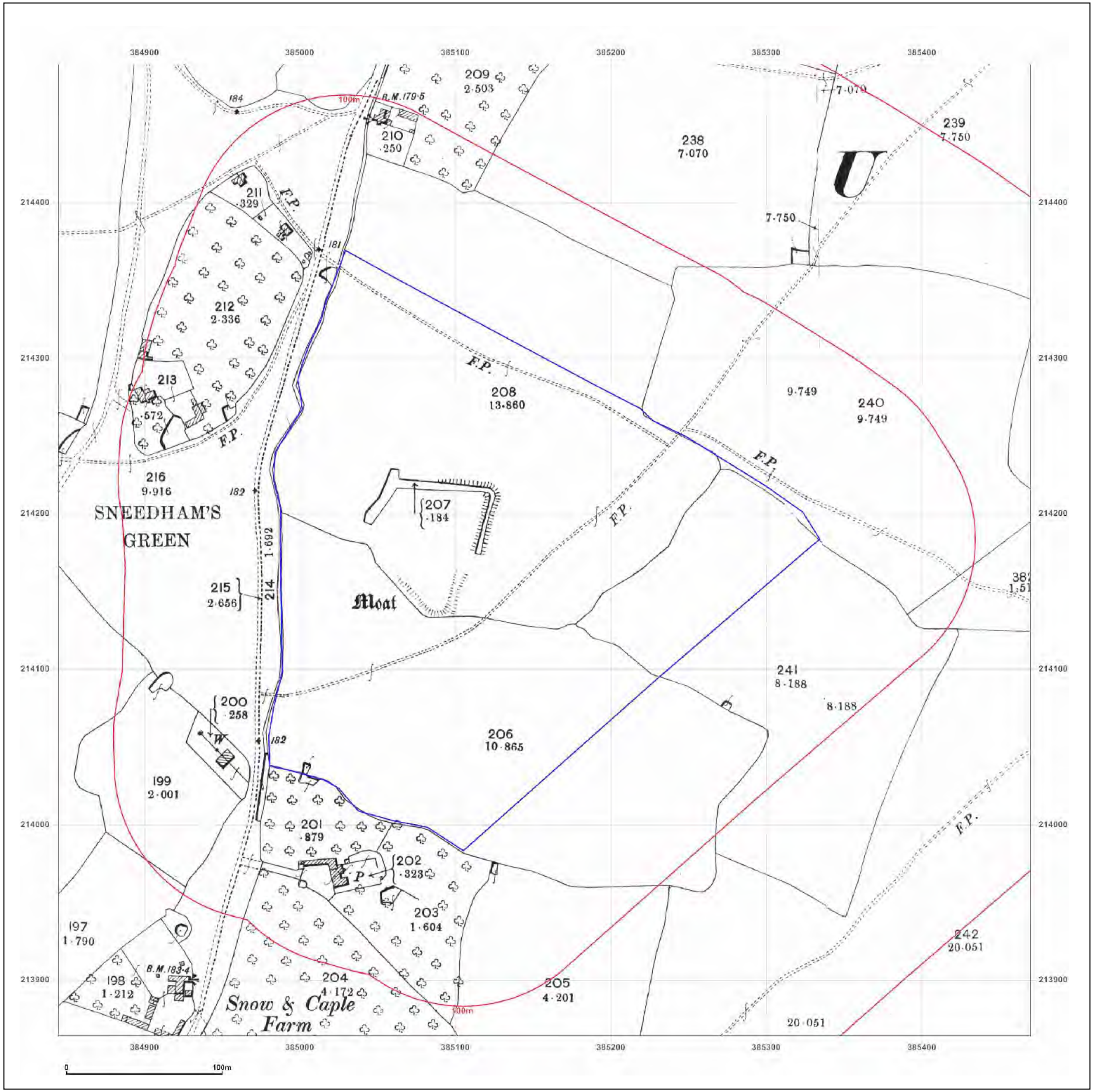
Powered by OS

Supplied by:
www.centremapslive.com
[redacted]

Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: County Series

Map date: 1903

Scale: 1:2,500

Printed at: 1:2,500

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Groundsure Insights
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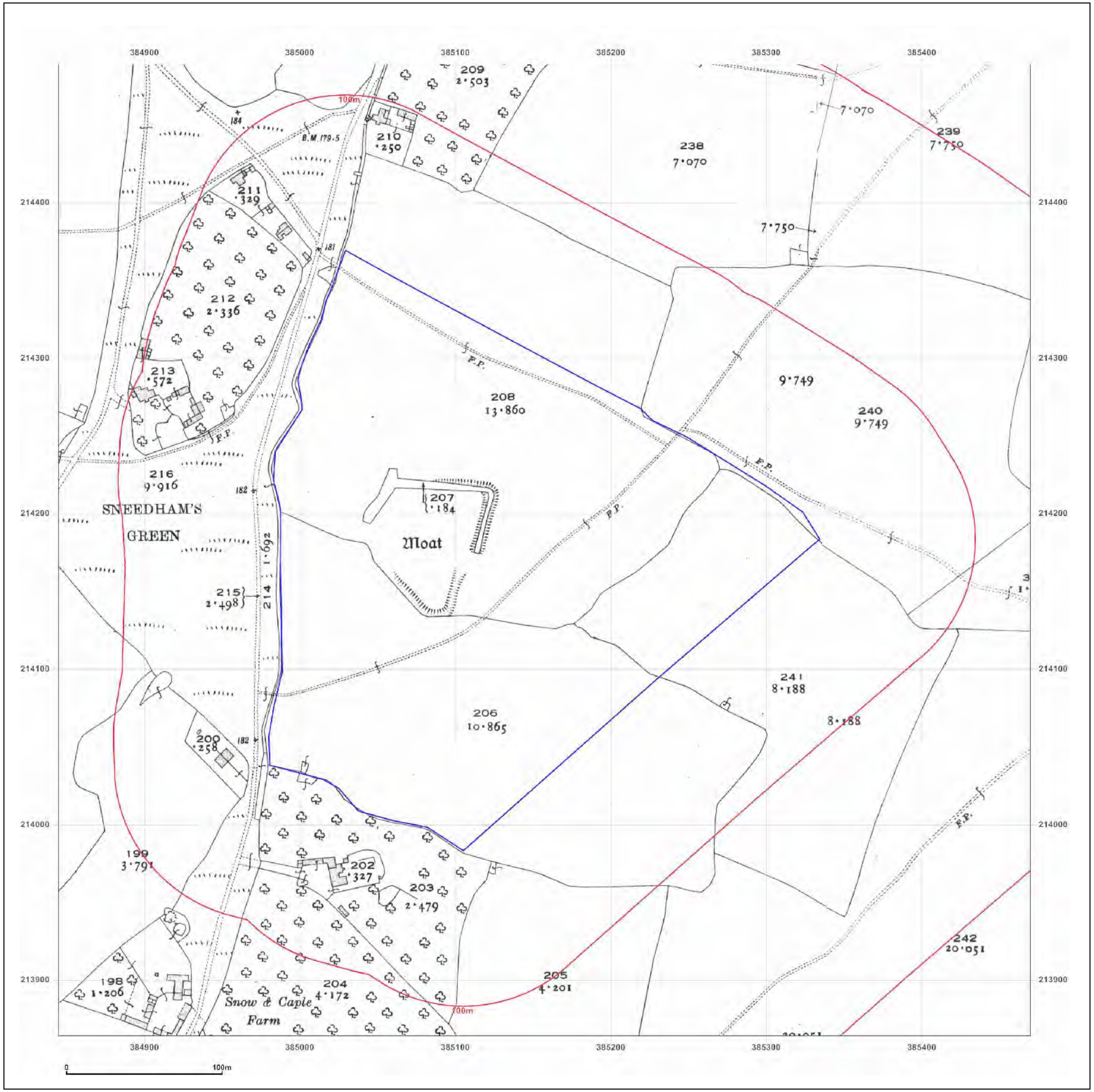
[redacted]

Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: County Series

Map date: **1923**

Scale: 1:2,500

Printed at: 1:2,500

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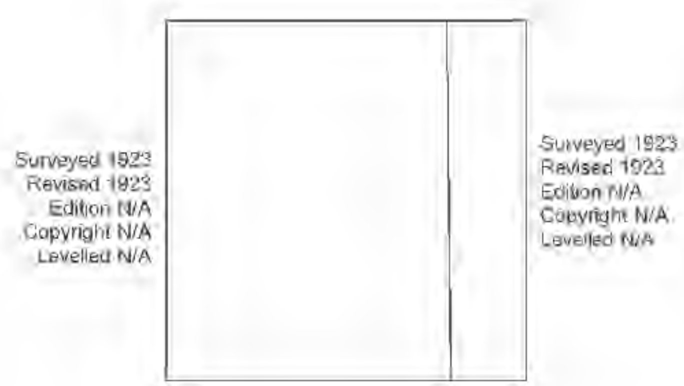
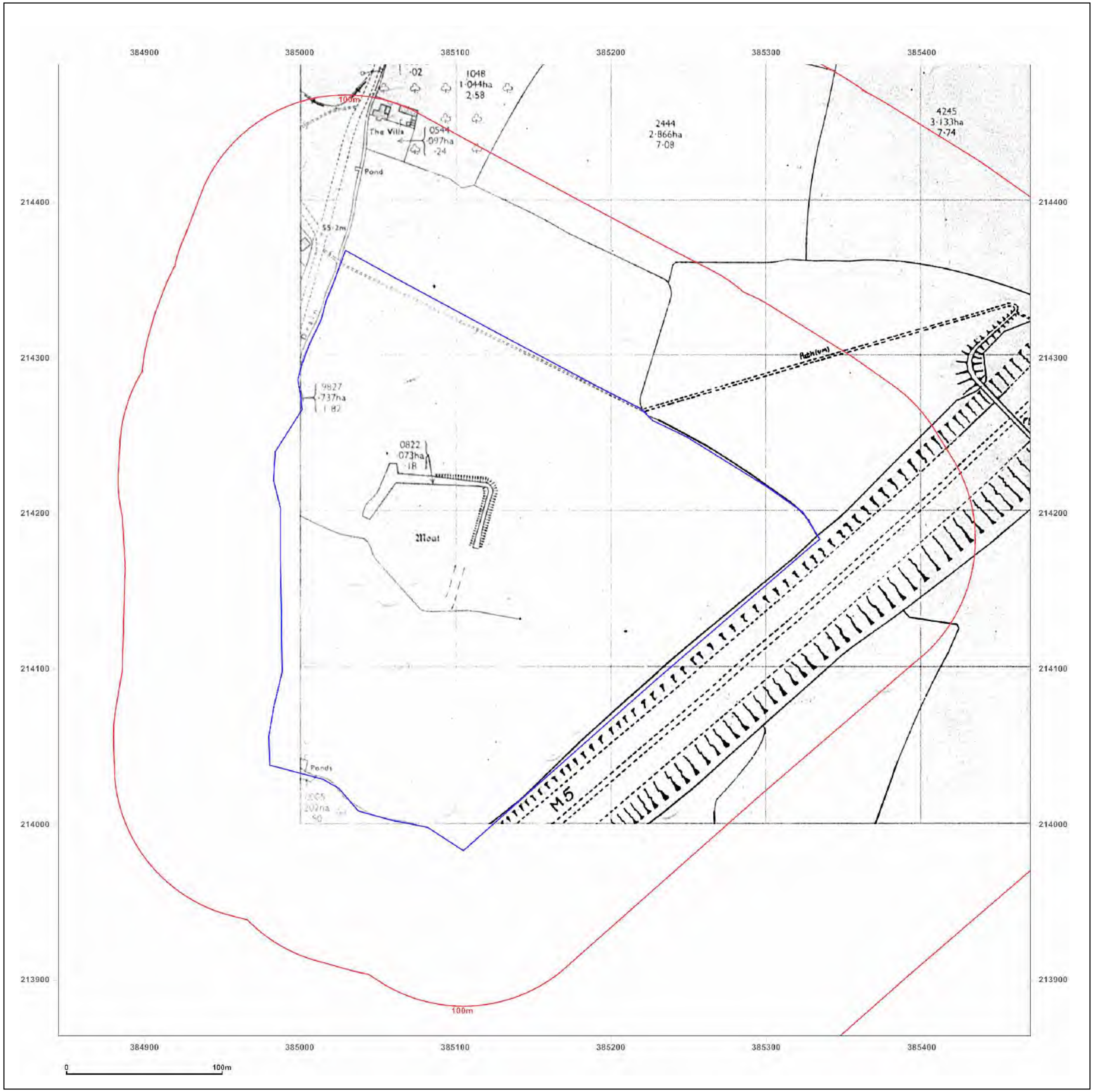


Produced by
Groundsure Insights
www.groundsure.com

Supplied by:
www.centremapslive.com
[redacted]

Production date: 22 May 2017

To view map legend click here Legend



CENTRE MAPS LIVE.
FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: National Grid

Map date: **1966**

Scale: 1:2,500

Printed at: 1:2,500

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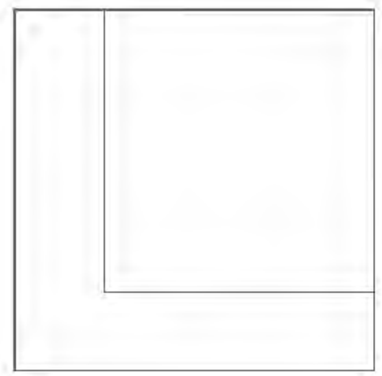
Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled 1966



Groundsure INSIGHTS

Produced by
Groundsure Insights
www.groundsure.com

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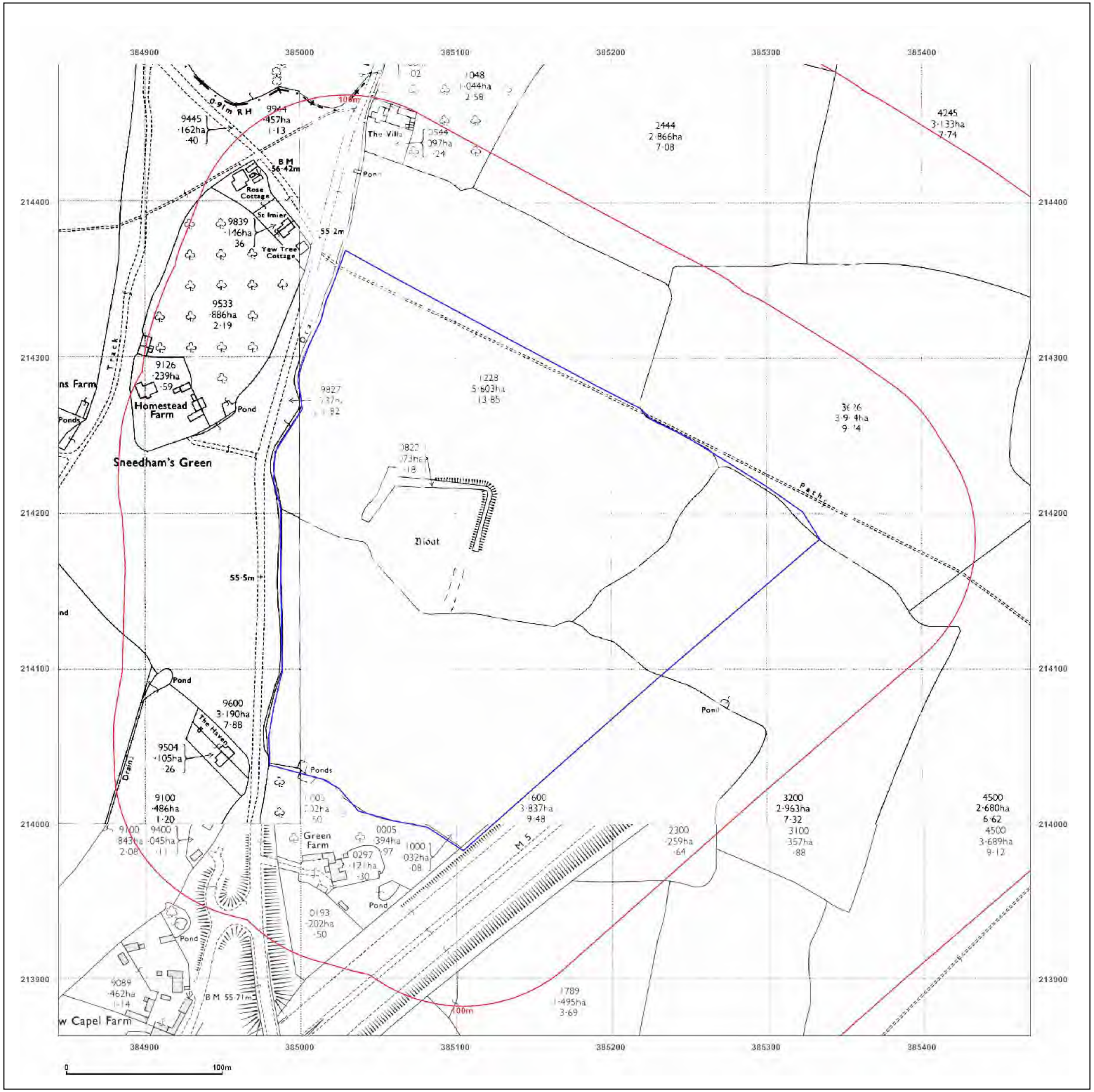
Supplied by:
www.centremapslive.com
[redacted]

Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: National Grid

Map date: **1970-1971**

Scale: 1:2,500

Printed at: 1:2,500

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

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

Surveyed 1971
Revised 1971
Edition N/A
Copyright 1972
Levelled 1966

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Supplied by:
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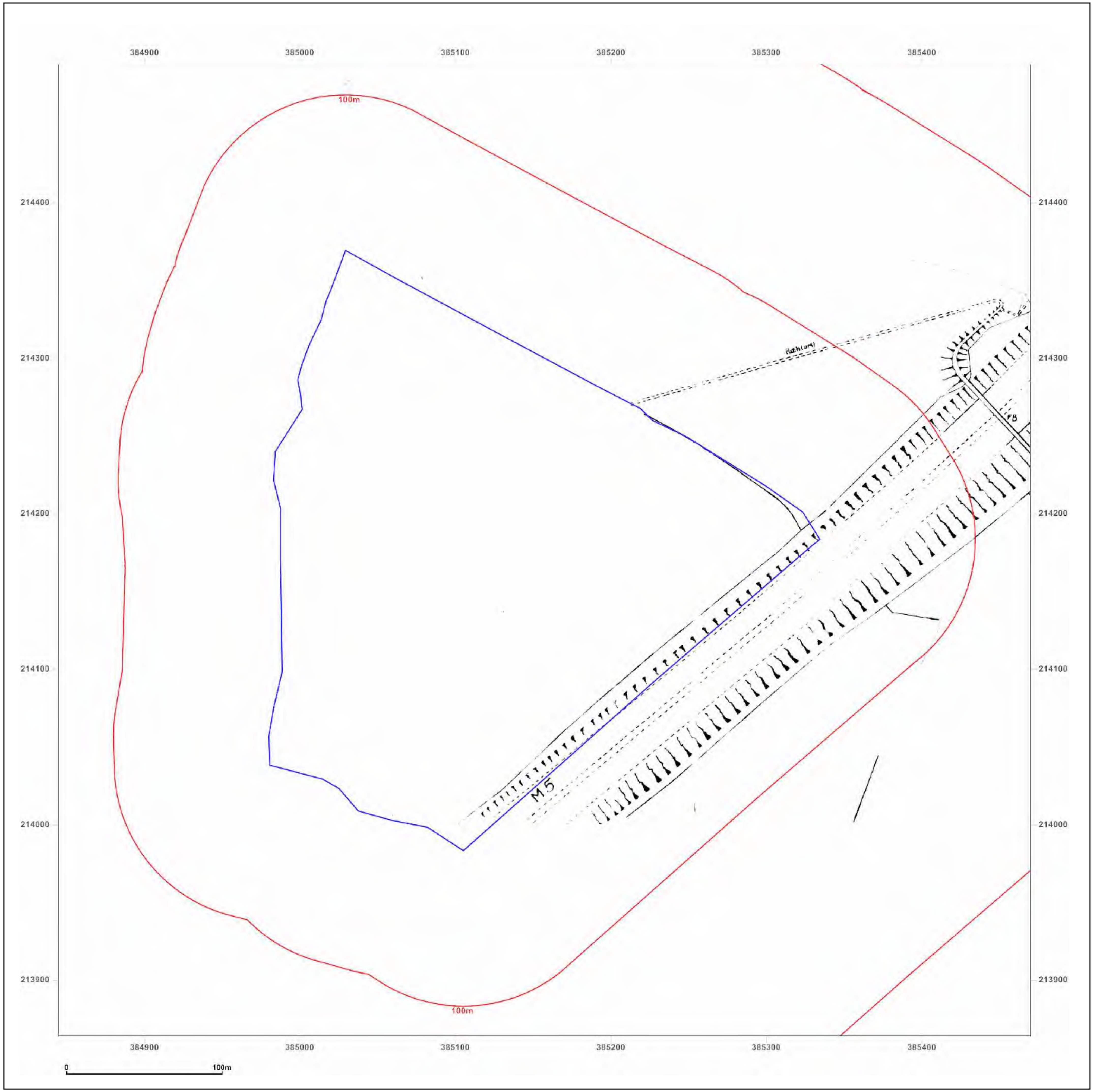
Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: National Grid

Map date: **1978**

Scale: 1:2,500

Printed at: 1:2,500

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

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Production date: 22 May 2017

To view map legend click here *Legend*

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: National Grid

Map date: 1994

Scale: 1:1,250

Printed at: 1:2,000

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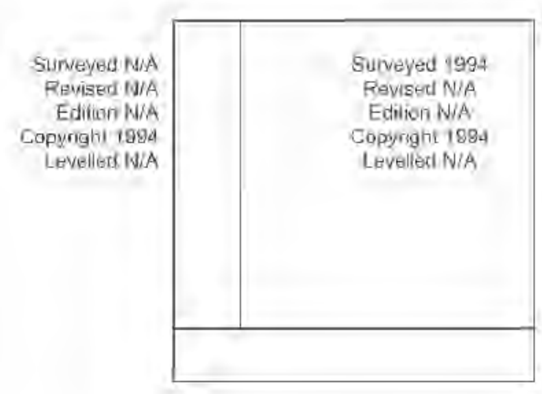

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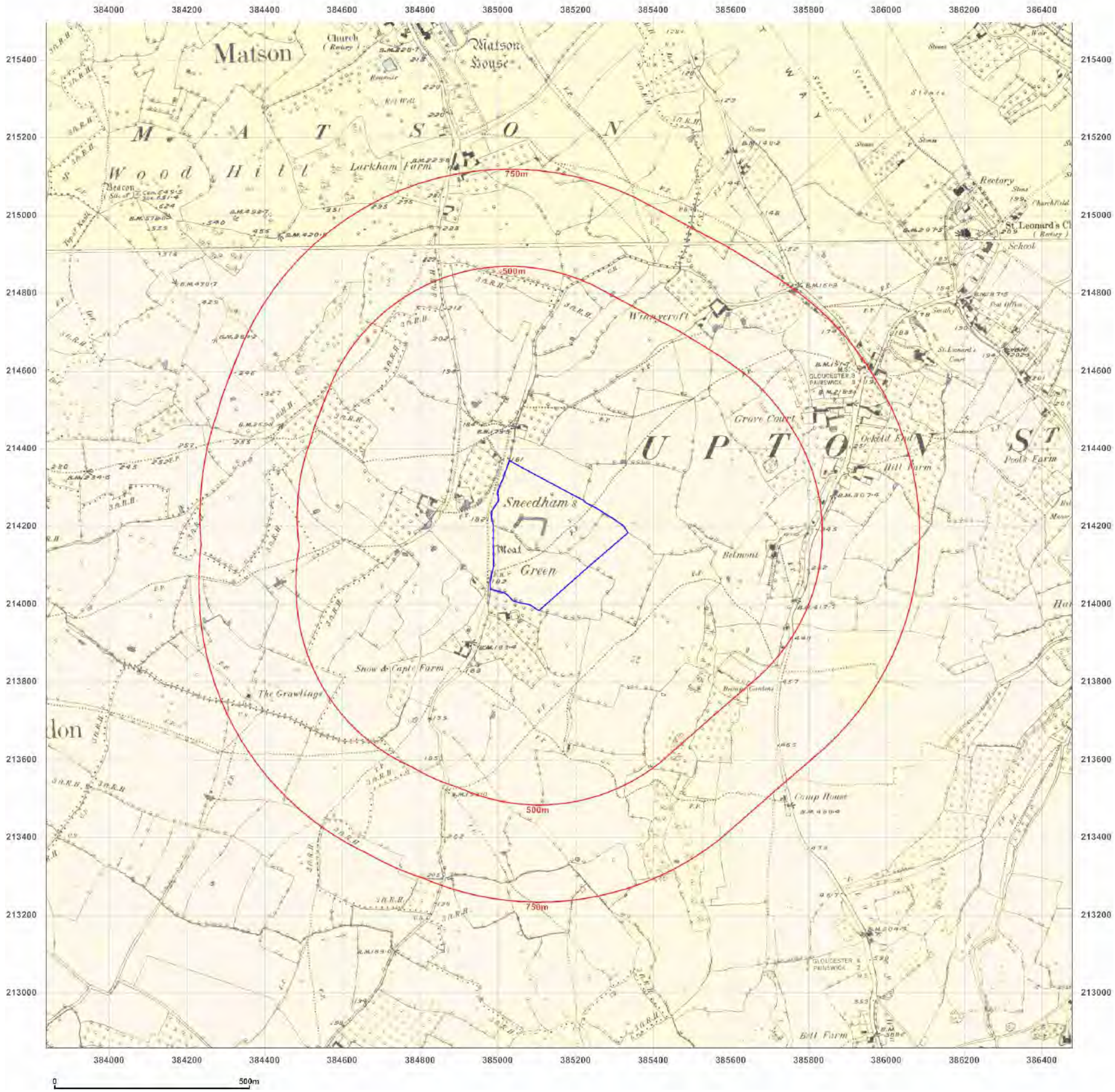
Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: County Series

Map date: **1883**

Scale: 1:10,560

Printed at: 1:10,560

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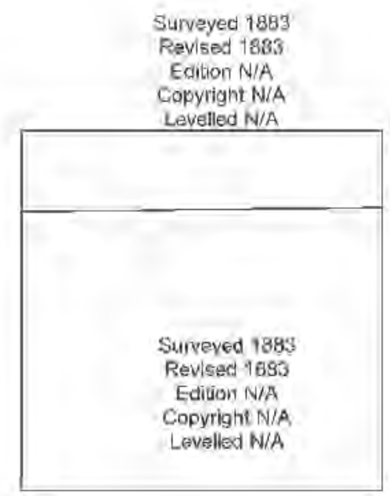

Produced by
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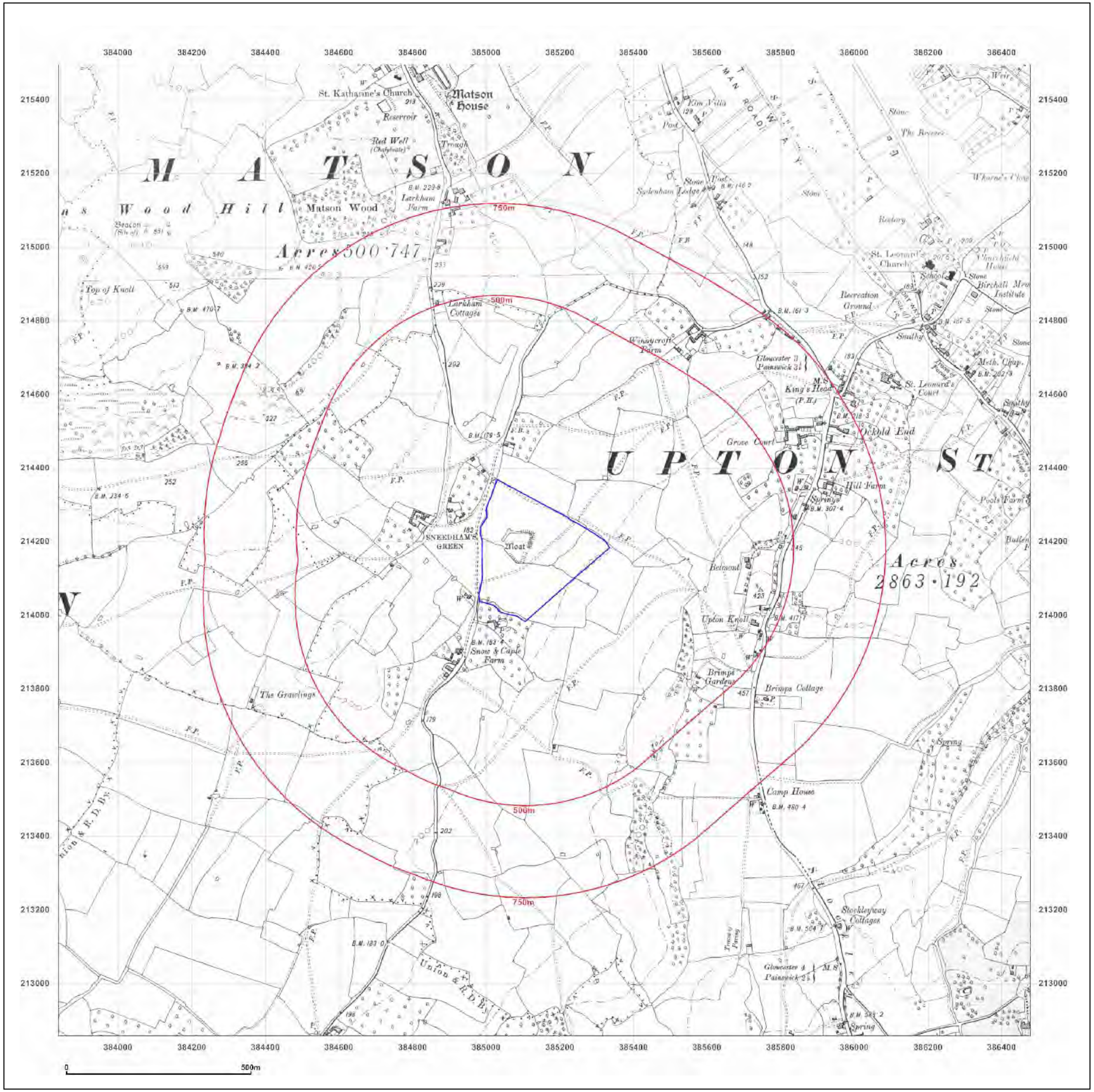
www.groundsure.com

Supplied by:
www.centremapslive.com
[redacted]

Production date: 22 May 2017

To view map legend click here *Legend*



CENTRE MAPS LIVE. FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: County Series

Map date: **1901**

Scale: 1:10,560

Printed at: 1:10,560

N W E S

Surveyed 1882
Revised 1901
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1882
Revised 1901
Edition N/A
Copyright N/A
Levelled N/A

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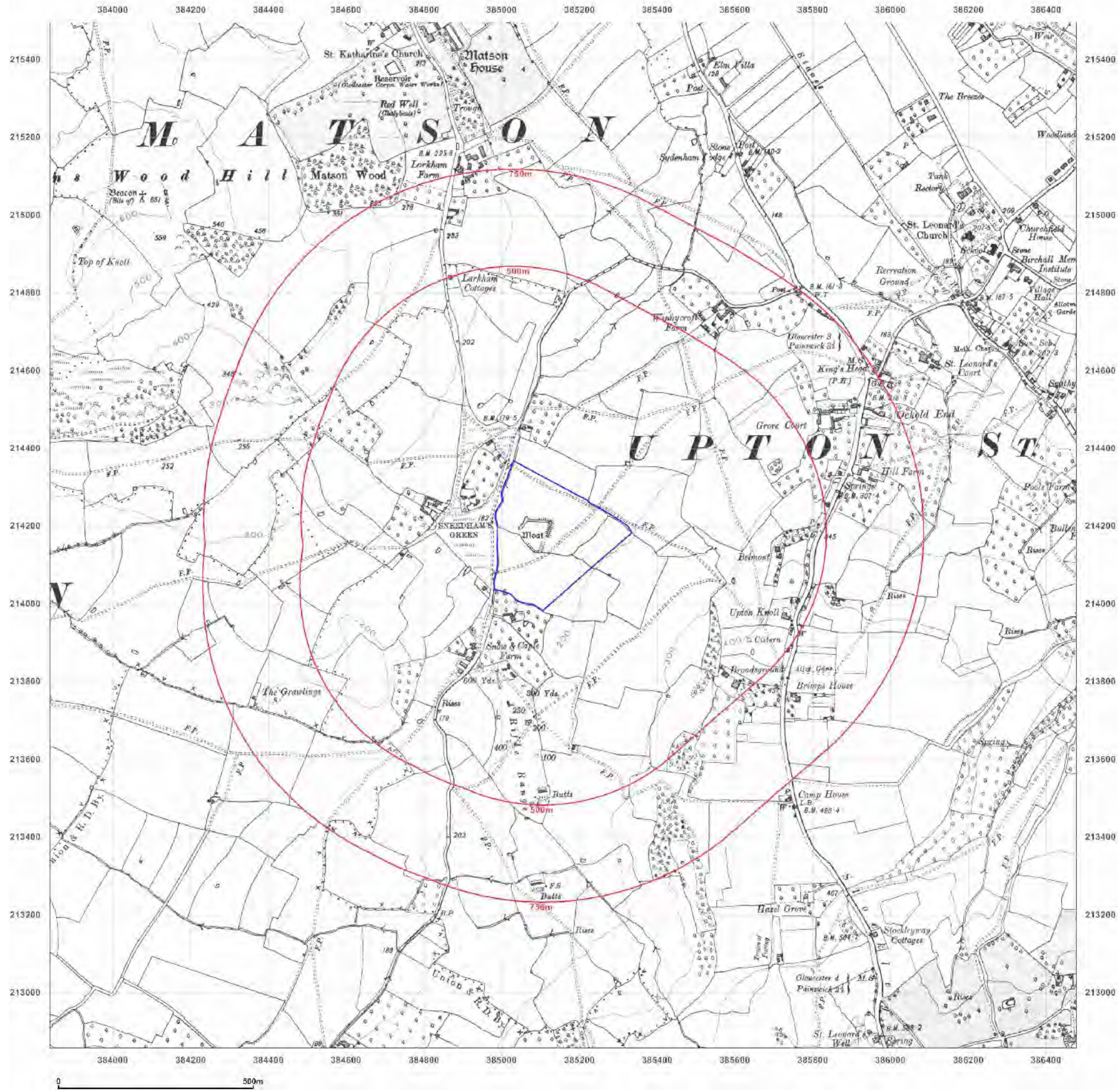
Supplied by:
www.centremapslive.com
[redacted]

Production date: 22 May 2017

To view map legend click here *Legend*



CENTRE MAPS LIVE.
FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: County Series

Map date: **1924**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1882
Revised 1924
Edition N/A
Copyright N/A
Levelled N/A

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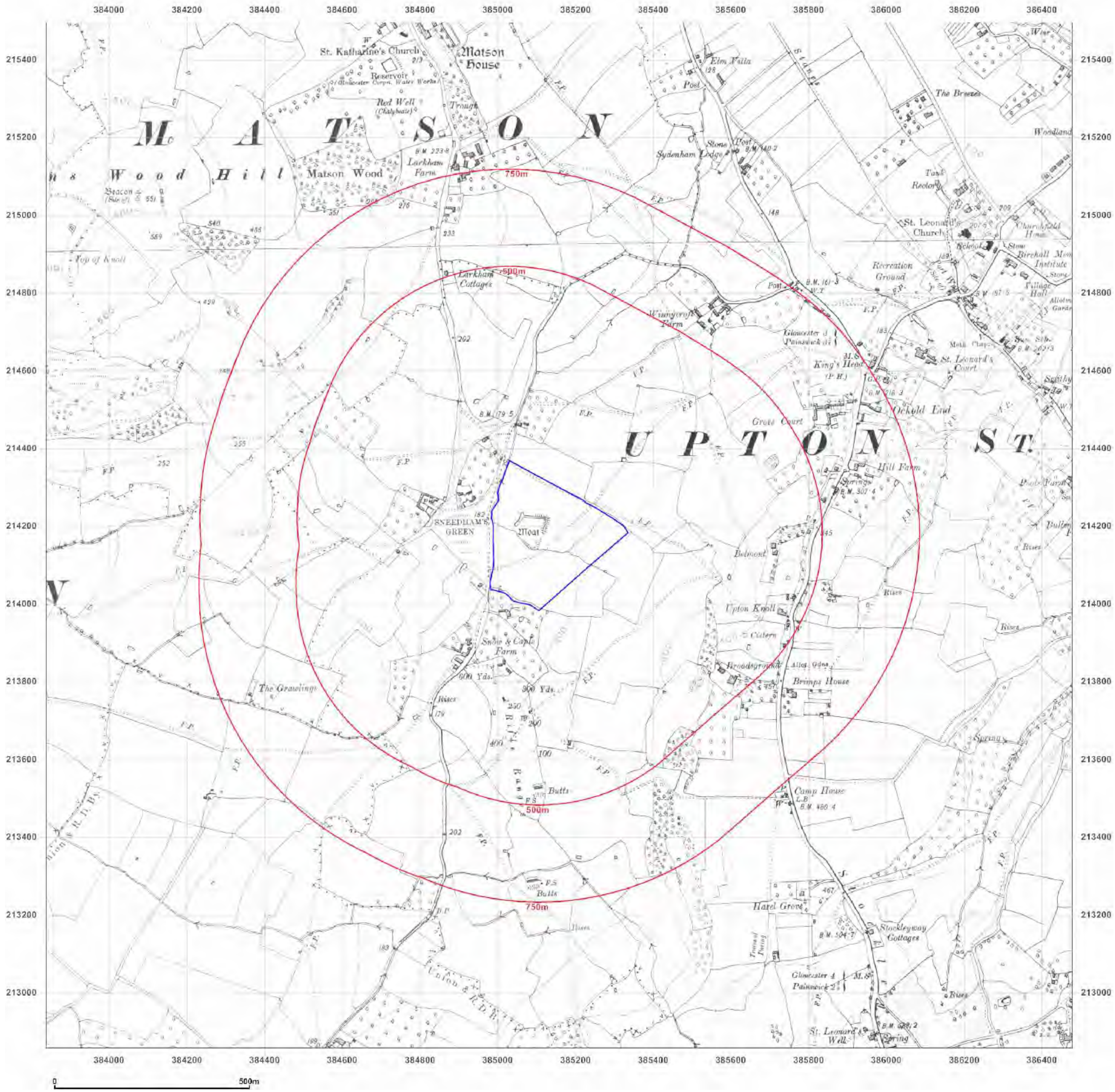
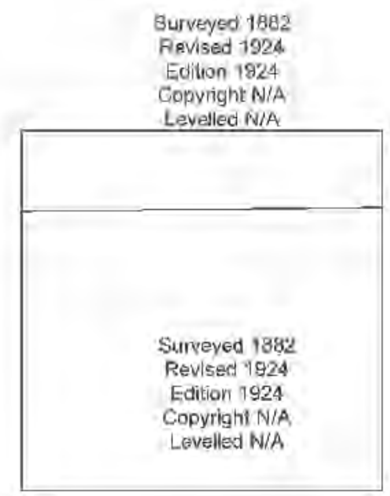
Production date: 22 May 2017

To view map legend click here *Legend*





CENTRE MAPS LIVE.
FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: County Series

Map date: **1924**

Scale: 1:10,560

Printed at: 1:10,560

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Groundsure INSIGHTS

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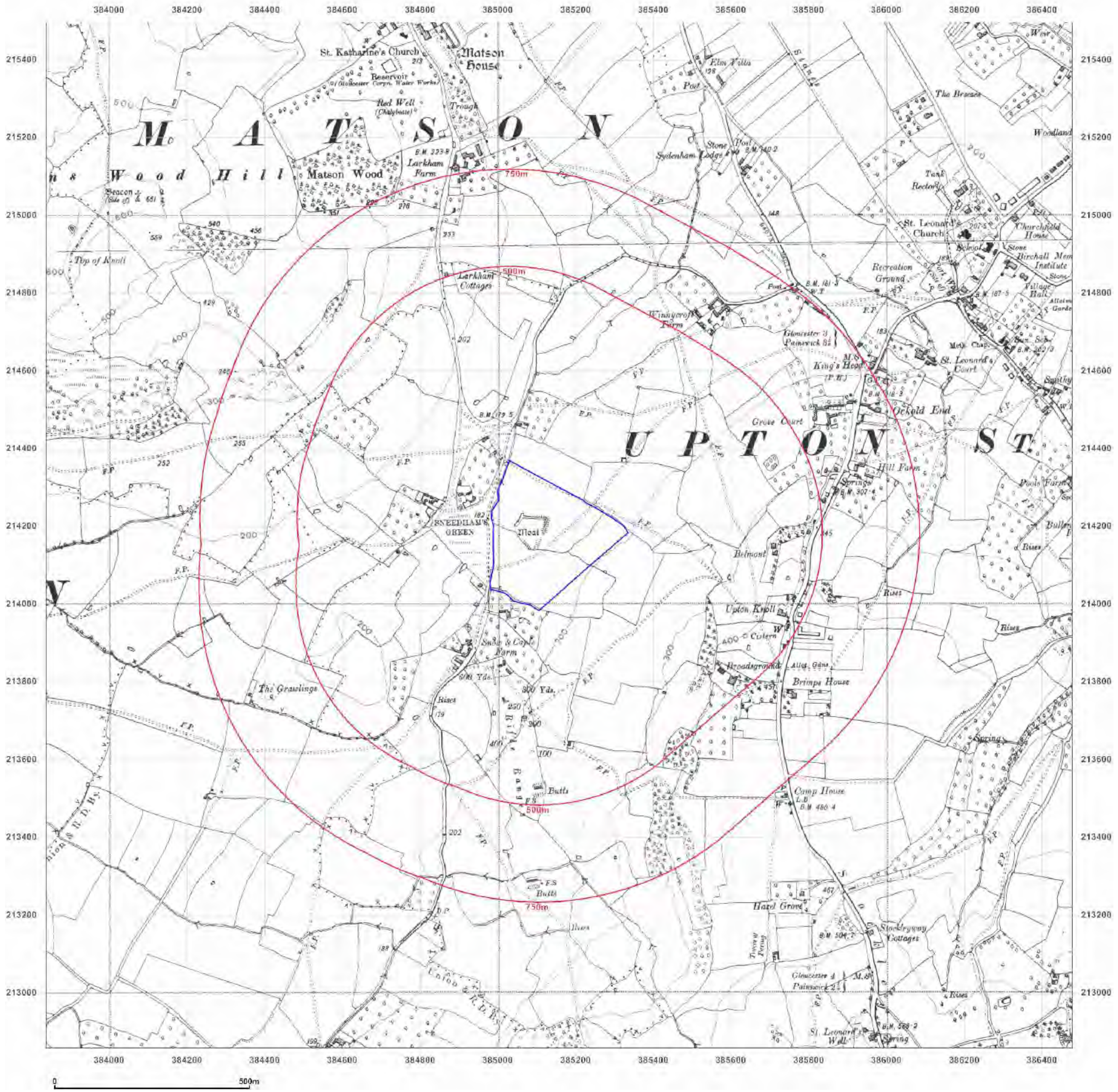
www.groundsure.com

Powered by

Supplied by:
www.centremapslive.com
[redacted]

Production date: 22 May 2017

To view map legend click here *Legend*



CENTRE MAPS LIVE.

FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: County Series

Map date: **1938**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1882
Revised 1938
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1882
Revised 1938
Edition N/A
Copyright N/A
Levelled N/A

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Powered by OS

Supplied by:
www.centremapslive.com
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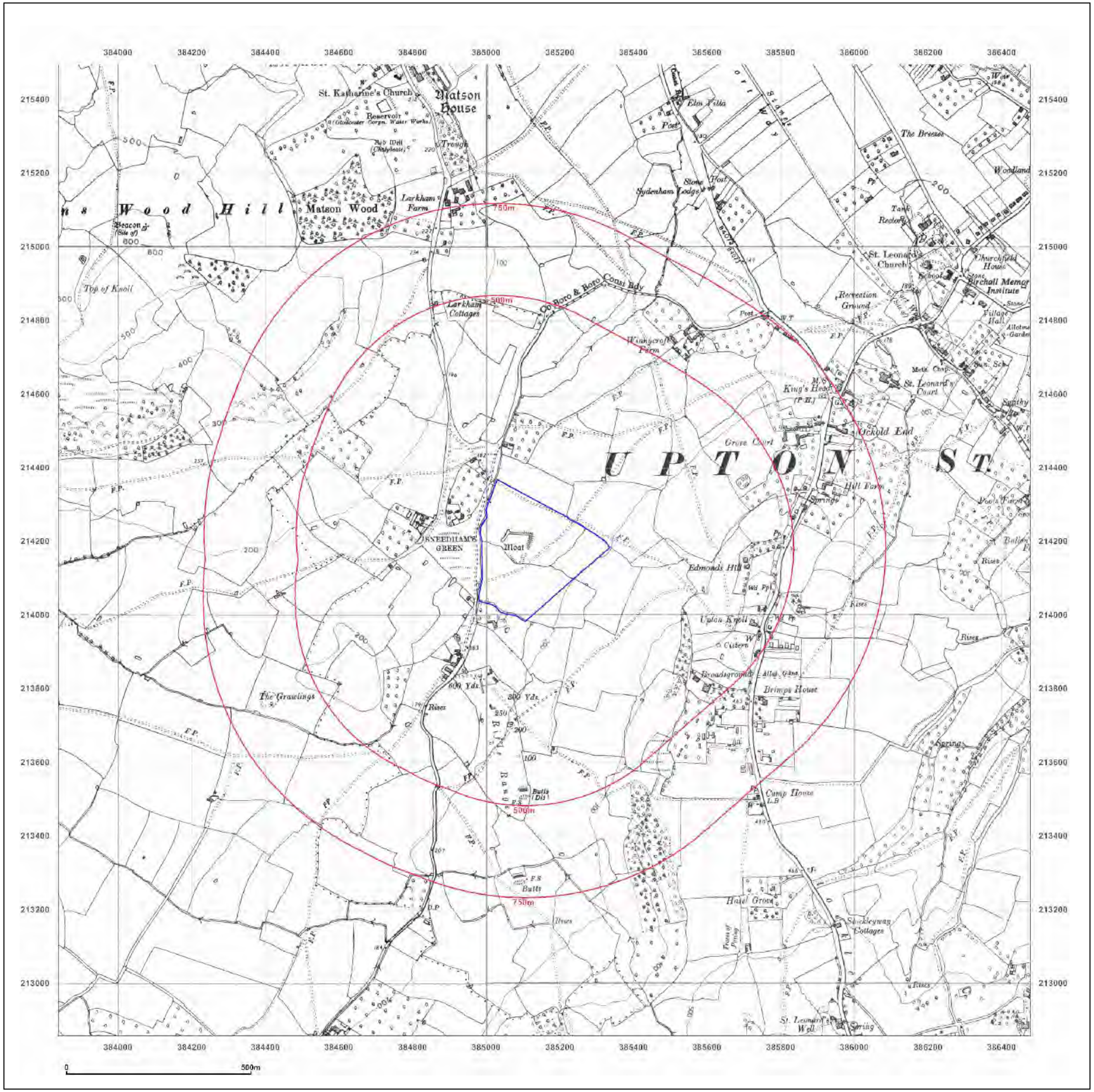
Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: Provisional

Map date: **1954-1955**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1949
Revised 1954
Edition N/A
Copyright N/A
Levelled N/A

Surveyed N/A
Revised 1954
Edition 1955
Copyright N/A
Levelled N/A

Surveyed N/A
Revised 1954
Edition 1954
Copyright N/A
Levelled N/A

Surveyed N/A
Revised 1954
Edition N/A
Copyright 1955
Levelled N/A

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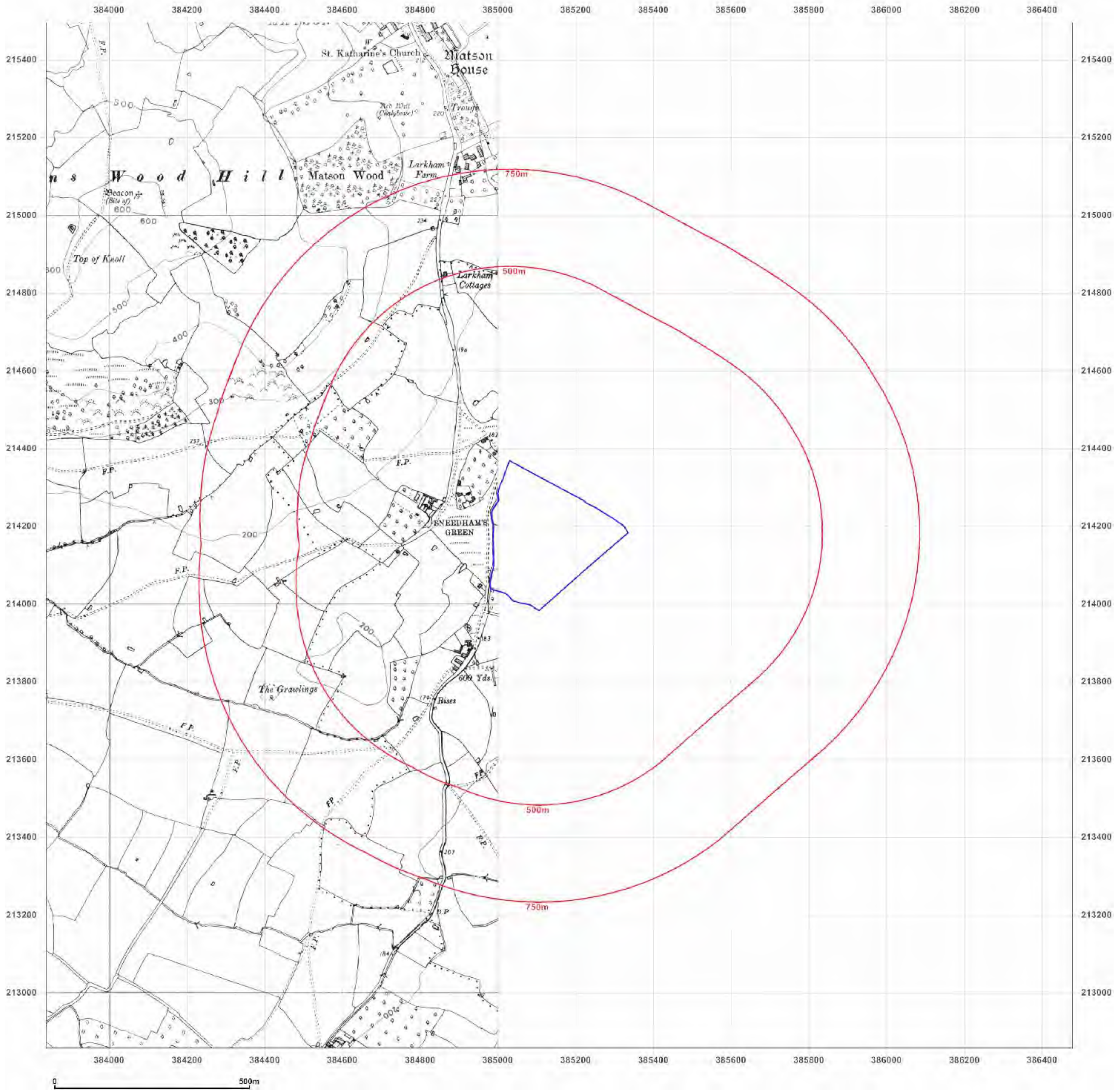
Production date: 22 May 2017

To view map legend click here *Legend*



CENTRE MAPS LIVE.

FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: Provisional

Map date: **1960-1961**

Scale: 1:10,560

Printed at: 1:10,560

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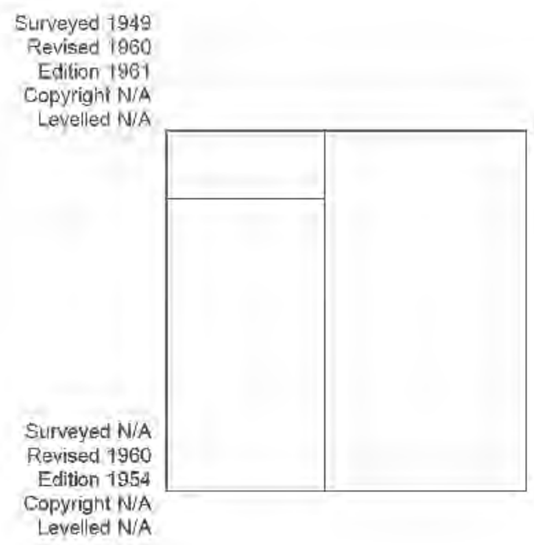

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Powered by

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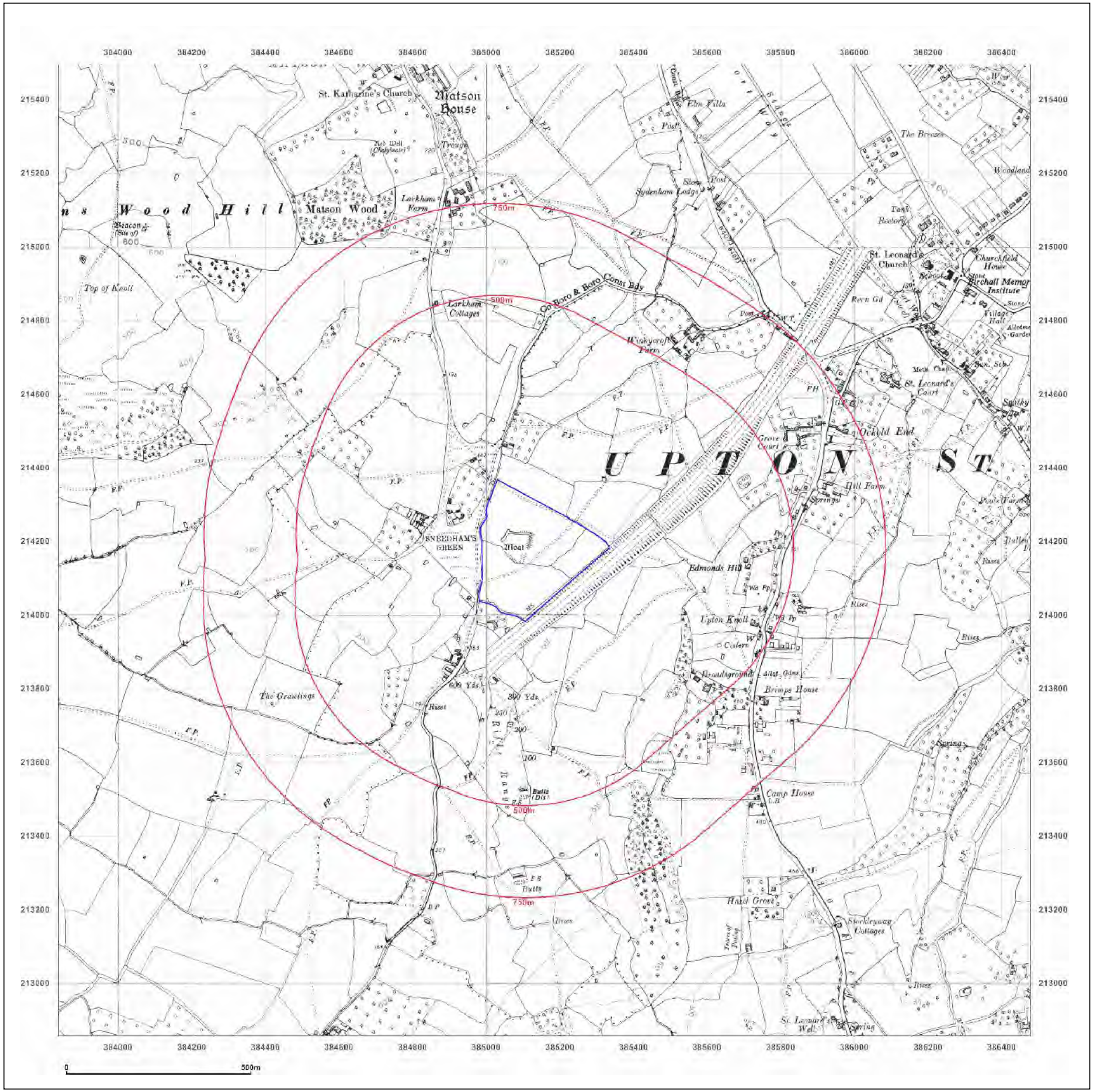
Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: Provisional

Map date: **1966-1971**

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed N/A	Surveyed N/A
Revised 1971	Revised 1968
Edition N/A	Edition 1955
Copyright N/A	Copyright N/A
Levelled N/A	Levelled N/A

Surveyed N/A	Surveyed N/A
Revised 1968	Revised 1971
Edition 1954	Edition N/A
Copyright N/A	Copyright 1955
Levelled N/A	Levelled N/A

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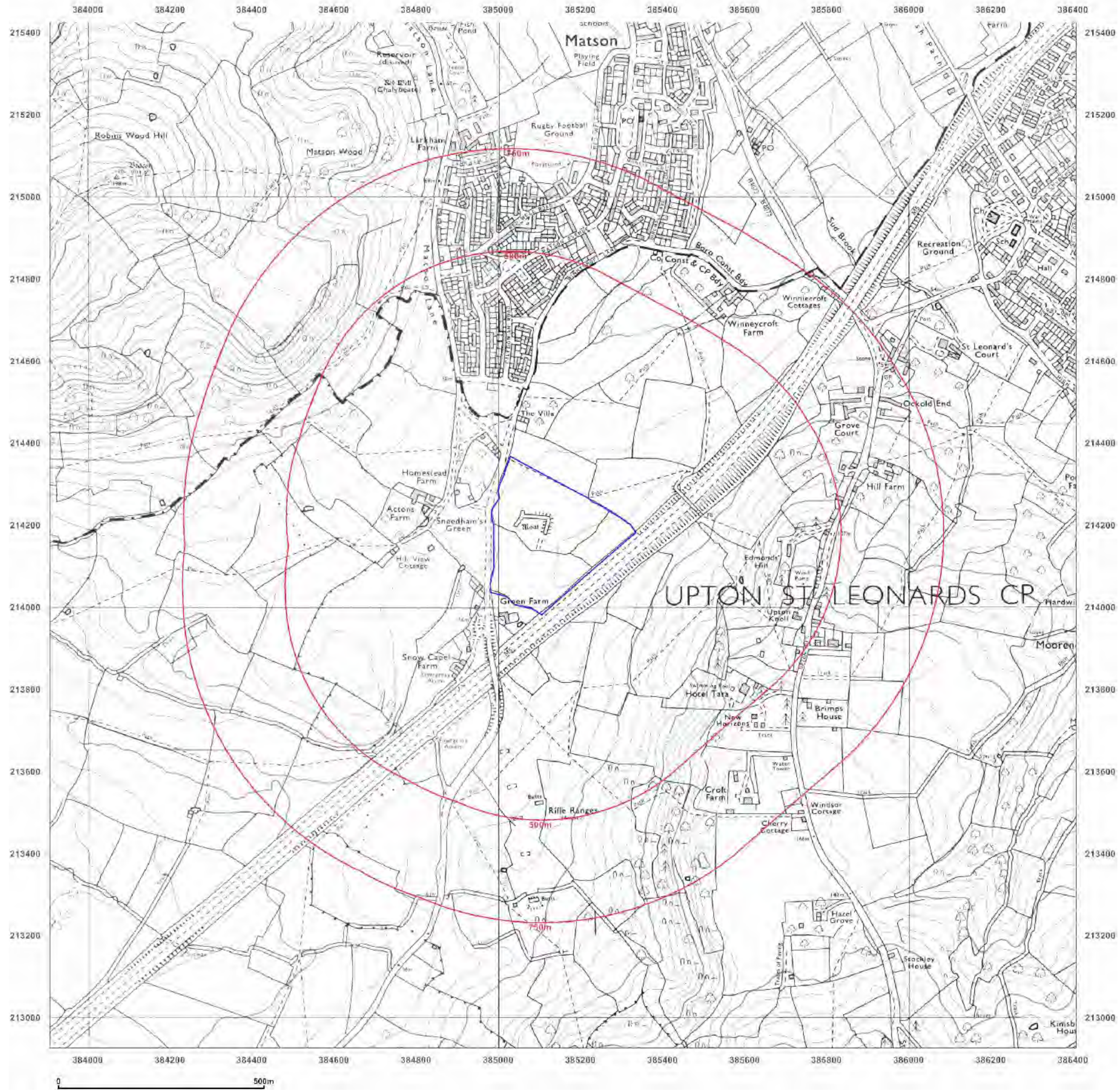
www.groundsure.com

Supplied by:
www.centremapslive.com
[redacted]

Production date: 22 May 2017

To view map legend click here Legend



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: National Grid

Map date: **1974-1975**

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1973
Revised 1975
Edition N/A
Copyright 1975
Levelled 1972

Surveyed 1973
Revised 1975
Edition N/A
Copyright 1975
Levelled 1972

Surveyed 1972
Revised 1974
Edition N/A
Copyright 1974
Levelled 1972

Surveyed 1971
Revised 1973
Edition N/A
Copyright 1975
Levelled 1972

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Supplied by:
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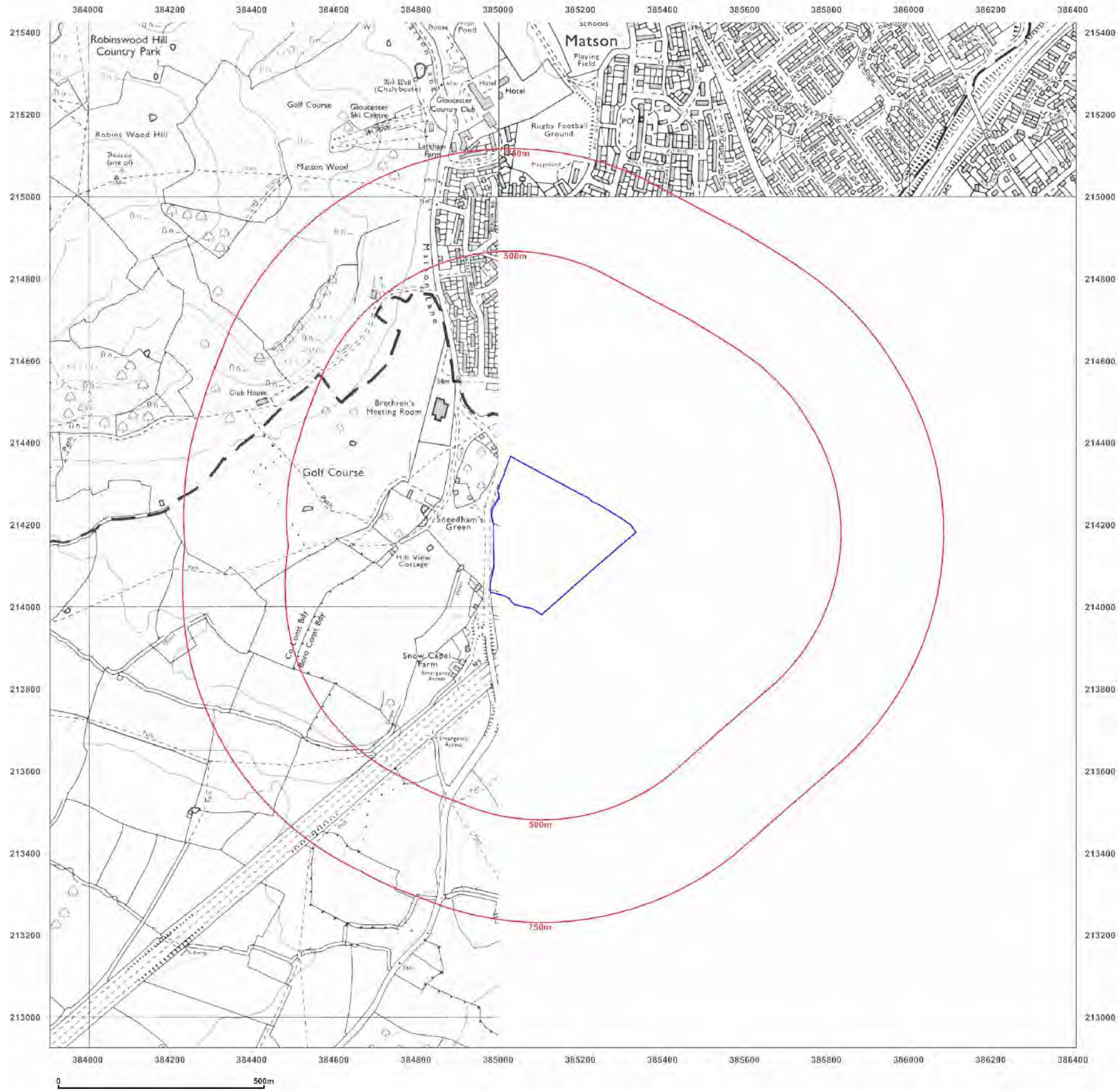
Production date: 22 May 2017

To view map legend click here Legend



CENTRE MAPS LIVE.
FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: National Grid

Map date: **1986-1989**

Scale: 1:10,000

Printed at: 1:10,000

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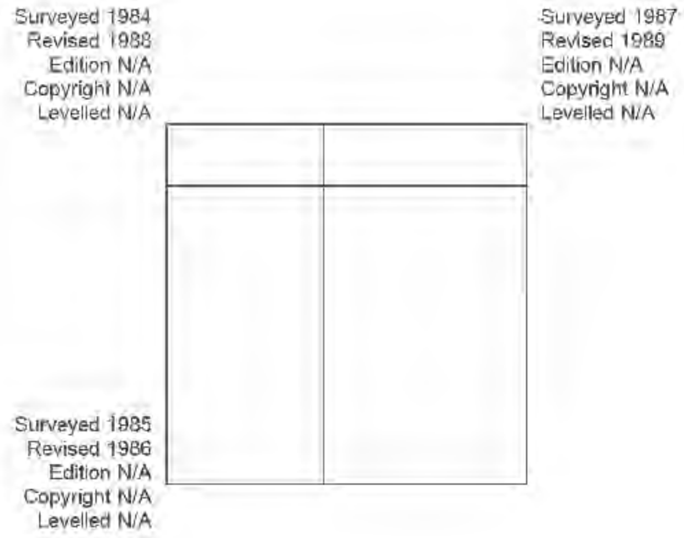


Groundsure INSIGHTS

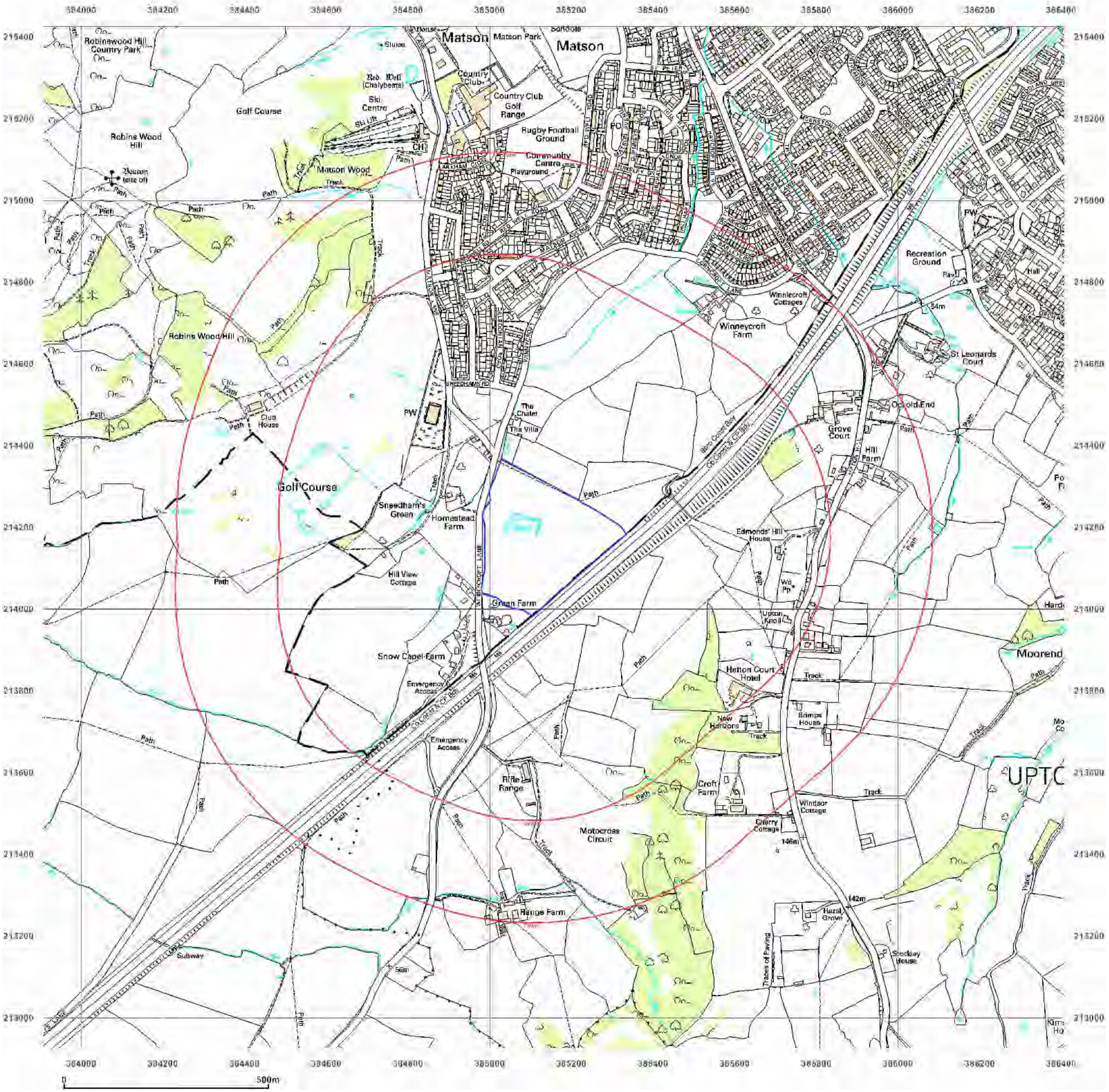
Produced by
Groundsure Insights
www.groundsure.com

Powered by OS

Supplied by:
www.centremapslive.com
[redacted]

Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: 1:10,000 Raster

Map date: **2002**

Scale: 1:10,000

Printed at: 1:10,000

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Powered by

Supplied by:
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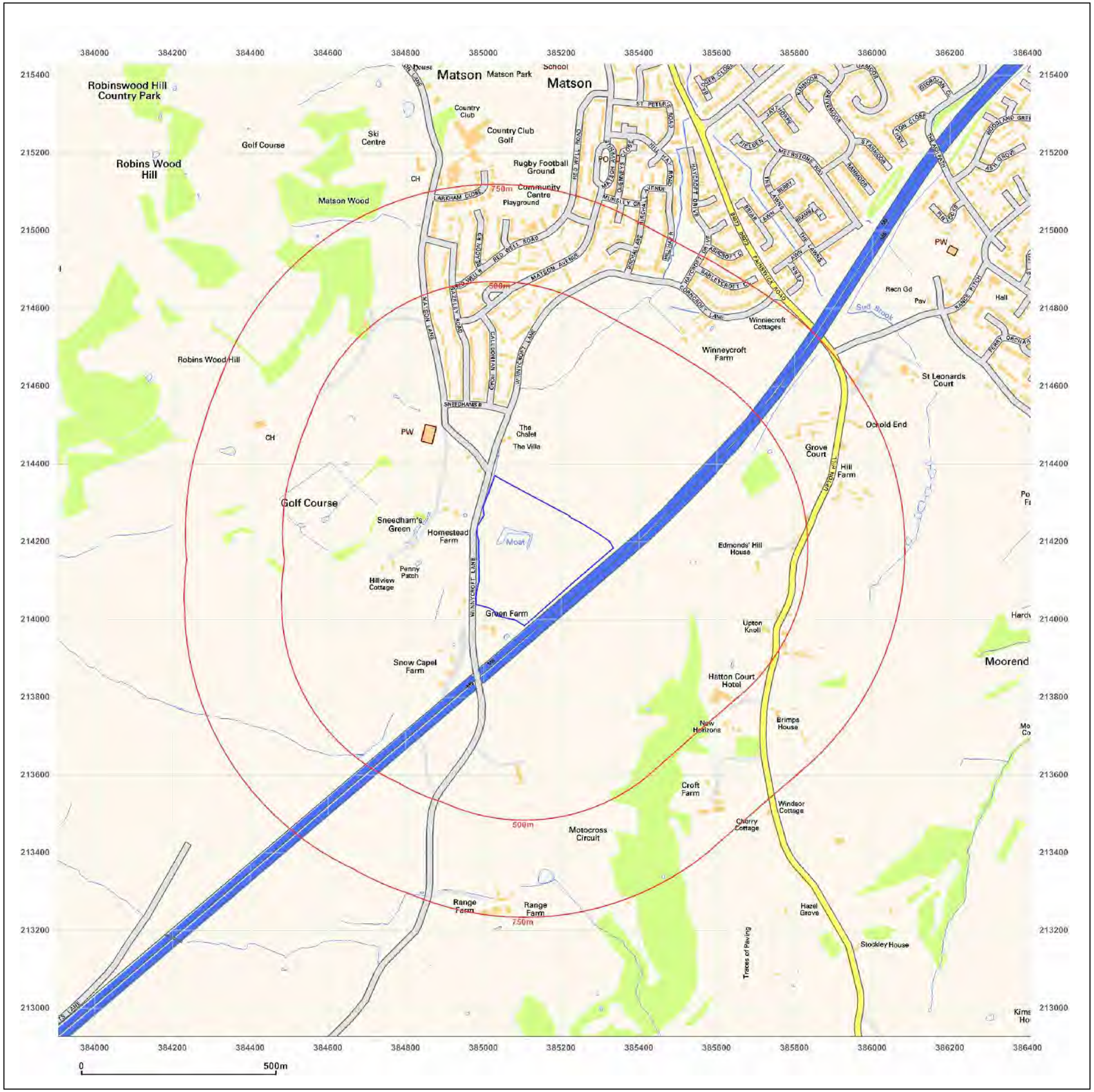
Production date: 22 May 2017

To view map legend click here *Legend*



Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: National Grid

Map date: 2010

Scale: 1:10,000

Printed at: 1:10,000

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Groundsure Insights
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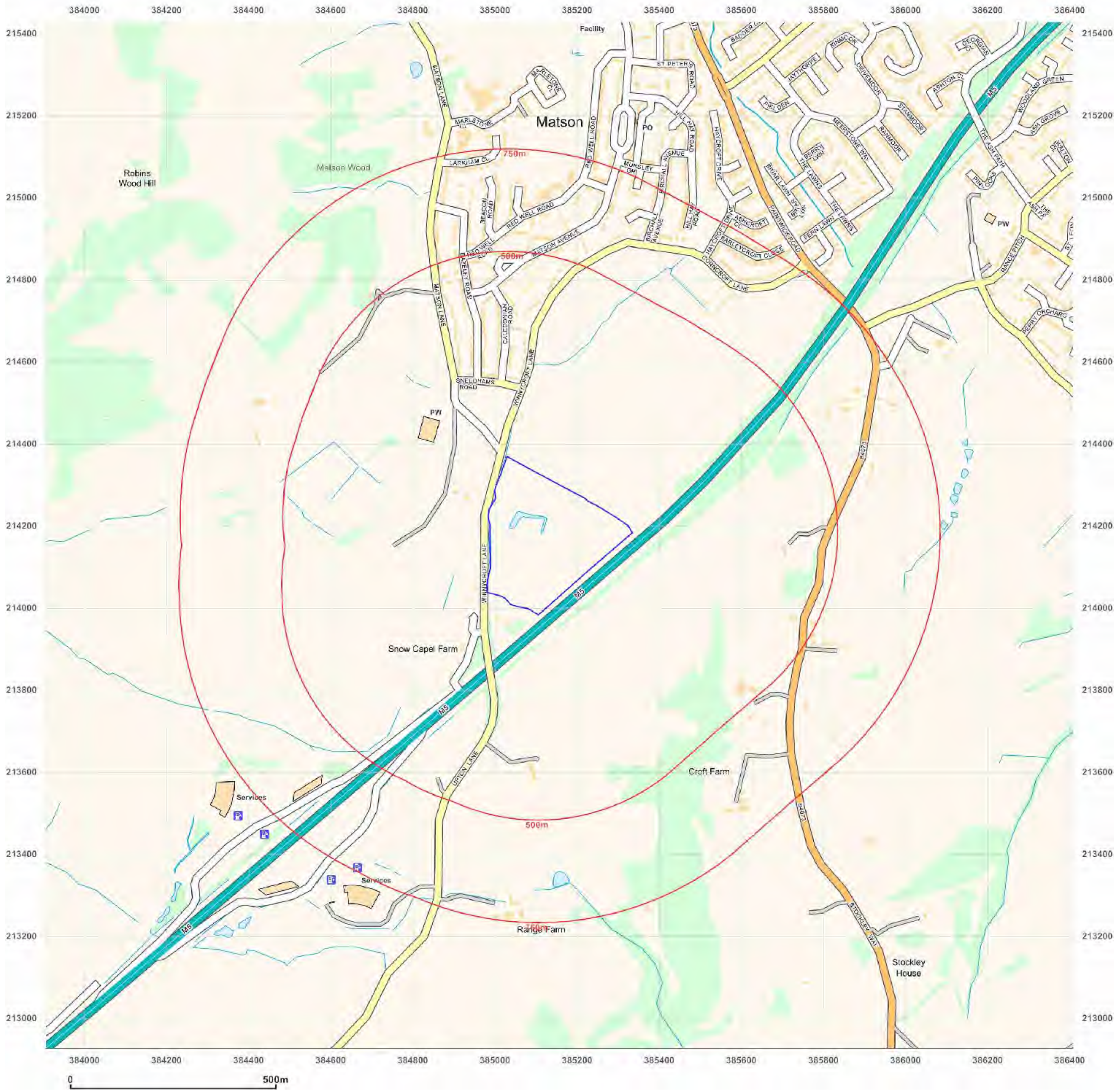
Production date: 22 May 2017

To view map legend click here [Legend]



CENTRE MAPS LIVE. FOR A BETTER POINT OF VIEW

Site Details:

Snow Capel Matson , GL4 6EQ

Client Ref: 13238
Report Ref: CMAPS-CM-625691-13238-220517HIS
Grid Ref: 385157, 214176

Map Name: National Grid

Map date: **2014**

Scale: 1:10,000

Printed at: 1:10,000

2014

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Supplied by: www.centremapslive.com

Production date: 22 May 2017

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Appendix D

Boreholes

Integrale Limited, Suite 7, Westway Farm Business Park, Wick Road, Bishop Sutton, Somerset, BS39 5XP United Kingdom
[redacted] www.integrale.uk.com

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

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

[redacted]
www.integrale.uk.com

STANDARD METHODOLOGY FOR WINDOWLESS SAMPLING BOREHOLES & CONTINUOUS DYNAMIC PENETRATION TESTING (CDPT)

Windowless sampling boreholes and heavy or super heavy continuous dynamic penetration tests were sunk using a small tracked drilling and probing rig. The types of drilling are identified on each of the borehole records included as a separate appendix. The locations are given in Figure 1 and selected using information on the proposed redevelopment, existing buried services and structures, ongoing site use, reinstatement requirements and time constraints.

The windowless sampling technique consists of driving a hollow tube sampler with a plastic liner into the ground by repeated blows using the dynamic probing apparatus. This sampler is extracted from the ground by a pneumatically operated jack and the sample extracted from the plastic liner for logging. Deeper sections of the strata are sampled by driving successively smaller diameter samplers into the ground. If the material is suitable, the soil strength is examined using a pocket penetrometer.

Continuous dynamic probing is a simple test consisting of driving a rod, with an oversized cone point, into the ground with a uniform hammer blow. The blow count is recorded for every 100mm penetration (N100). The equipment is a machine driven unit using a 63.5kg hammer dropping through 0.75m onto 32mm diameter rods with a 1500mm^2 cone. The equipment confirms to the DPSH probing apparatus in Clause 3.2 of Part 9 of BS 1377 (199)). The equivalent SPT 'N' value can be estimated by multiplying the blow count by 3-5, dependant on soil characteristics. This method has been used to interpret soil strengths given on the CDPT plots.

Drilling was directed and supervised full-time by an experienced geologist who kept a record of the strata encountered, recorded the groundwater ingress and also recovered representative disturbed samples.

On completion the boreholes were either backfilled with their spoil, and if requested the surface reinstated, or a standpipe installation fitted.

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

Borehole Log

Intégrale — Understanding Ground Conditions

Project Name: Snow Capel	Project No. 1826	Co-ords: -	Hole Type WS
Location: Snow Capel, Matson, Gloucester GL4 6EQ		Level: 57.92	Scale 1:25
Client: Edward Ware Homes		Dates: 24/05/2017 -	Logged By S.J.

Borehole No. **WS1** — Sheet 1 of 1

Sample Depth (m)	Type	Results
0.10	ES	
0.50	ES	
0.75	D	
1.50	D	
1.50	D	
1.75	D	
2.50	D	

Depth (m)	Level (m)	Stratum Description
0.15	57.77	Grass over TOPSOIL: (comprising soft to firm brown slightly sandy Silt, with occasional small rootlets [Ø 2-3mm]).
1.00	56.92	MADE GROUND: (comprising loosely compact grey-brown to grey slightly silty Clay, with extraneous fine angular mudstone/clay gravel and randomly oriented laminations).
2.30	55.62	MADE GROUND: (comprising loosely compact grey-brown to grey-green slightly gravelly silty Clay, with localised horizontal laminations and pockets of sugary gypsum).
2.70	55.22	MADE GROUND: (comprising loosely compact dark grey-green slightly gravelly Clay. Gravel is fine angular mudstone lithorelicts with localised peat specks).
2.80	55.12	Soft brownish-grey slightly gravelly CLAY with pieces of wood. (ALLUVIUM)

End of borehole at 2.80 m

Remarks
Recovery: 0-1m (100%); 1-2m (100%); 2-2.8m (70%).
CDPT to 9m.

Intégrale
Understanding Ground Conditions

Borehole Log

Borehole No. **WS2**
Sheet 1 of 1

Project Name: Snow Capel	Project No. 1826	Co-ords: -	Hole Type WS
Location: Snow Capel, Matson, Gloucester GL4 6EQ		Level: 58.29	Scale 1:25
Client: Edward Ware Homes		Dates: 24/05/2017 -	Logged By S.J.

Well	Water Strikes	Samples Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	ES		0.20	58.09		Grass over TOPSOIL: (comprising soft light slightly sandy Silt, with abundant small brown to white rootlets [Ø 2-3mm]).
		0.40	ES					MADE GROUND: (comprising loosely compact grey-brown to green-brown Clay with rare fine angular mudstone gravel).
		0.50	D					
		0.75	D					
					1.45	56.84		BURIED TOPSOIL.
		1.50	D		1.55	56.74		MADE GROUND: (comprising loosely compact brown to grey-brown locally grey-green Clay).
		1.50	ES					
		2.50	D					
					3.20	55.09		Soft brown to grey-brown slightly silty CLAY. (HIGHLY WEATHERED LOWER LIAS)
		3.50	D					
					3.90	54.39		Firm grey-brown slightly silty CLAY. (WEATHERED LOWER LIAS)
					4.00	54.29		End of borehole at 4.00 m

1
2
3
4
5

Remarks
Dry.
Recovery: 0-1m (100%); 1-2m (100%); 2-3m (100%); 3-4 (100%).
CDPT to 8.8m.

Borehole Log

Intégrale — Understanding Ground Conditions	Borehole Log	Borehole No. **WS3** Sheet 1 of 1

Project Name: Snow Capel	Project No. 1826	Co-ords: -	Hole Type WS
Location: Snow Capel, Matson, Gloucester GL4 6EQ		Level: 60.10	Scale 1:25
Client: Edward Ware Homes		Dates: 24/05/2017 -	Logged By S.J.

Well	Water Strikes	Samples Depth (m)	Samples Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.20	ES		0.25	59.85		Grass over TOPSOIL: (comprising brown slightly sandy Silt, with occasional small brown rootlets [Ø 2mm]. Gravel is extraneous sandstone and mudstone).
		0.50	ES					MADE GROUND: (comprising loosely compact brown slightly gravelly Clay with occasional roots [Ø 1-3cm]).
		0.75	D					
		1.25	D		1.60	58.50		
								MADE GROUND: (comprising loosely compact, locally very loosely compact grey-green Clay with pockets of brown silt).
		2.50	D		2.70	57.40		
								MADE GROUND: (comprising loosely compact black to grey-brown Clay with occasional sugary gypsum crystals).
		3.25	D		3.40	56.70		
								Soft to firm grey to grey-brown slightly silty CLAY. (HIGHLY WEATHERED LOWER LIAS)
		3.75	D		3.80	56.30		
								Firm grey-brown slightly silty CLAY. (WEATHERED LOWER LIAS)
					4.00	56.10		End of borehole at 4.00 m

Depth scale: 1, 2, 3, 4, 5

Remarks
Dry.
Recovery: 0-1m (100%); 1-2m (100%); 2-3m (100%); 3-4 (100%).
CDPT to 9m.

Intégrale — Understanding Ground Conditions	Borehole Log		Borehole No. **WS4** Sheet 1 of 1
Project Name: Snow Capel	Project No. 1826	Co-ords: -	Hole Type WS
Location: Snow Capel, Matson, Gloucester GL4 6EQ		Level: 60.60	Scale 1:25
Client: Edward Ware Homes		Dates: 24/05/2017 -	Logged By S.J.

Well	Water Strikes	Samples and In Situ Testing: Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	ES		0.15	60.45		Grass over TOPSOIL: (comprising soft brown slightly sandy Silt, with abundant rootlets [Ø 2-3mm]).
		0.50	ES					MADE GROUND: (comprising loosely compact grey-brown to brown slightly silty Clay, with occasional fine angular extraneous gravel and localised brown to black speckling).
		0.80	D					
		1.25	D		1.60	59.00		
		1.85	D					MADE GROUND: (comprising loosely compact grey to dark grey-brown Clay, with occasional black mottling/speckling).
								Below 2.2m, becoming loosely to moderately compact.
		2.40	D		2.70	57.90		
		2.80	D					Firm grey to dark grey locally brown slightly silty CLAY. (WEATHERED LOWER LIAS)
		3.50	D		3.70	56.90		
					4.00	56.60		Firm to stiff rapidly becoming stiff dark grey slightly silty CLAY. (WEATHERED LOWER LIAS)
								End of borehole at 4.00 m

Remarks
Dry.
Recovery: 0-1m (100%); 1-2m (100%); 2-3m (100%); 3-4 (100%).
CDPT to 7.9m.

Intégrale
Understanding Ground Conditions

Borehole Log

Borehole No.	WS5
Sheet	1 of 1
Project Name:	Snow Capel
Project No.	1826
Co-ords:	-
Hole Type	WS
Location:	Snow Capel, Matson, Gloucester GL4 6EQ
Level:	61.60
Scale	1:25
Client:	Edward Ware Homes
Dates:	25/05/2017 -
Logged By	S.J.

Samples Depth (m)	Type	Results
0.10	ES	
0.60	ES	
1.00	D	
1.25	D	
1.80	ES	
2.50	D	
3.60	D	

Depth (m)	Level (m)	Stratum Description
0.20	61.40	Grass over TOPSOIL: (comprising soft brown slightly sandy Silt, with abundant rootlets [Ø 2-3mm]).
0.55	61.05	MADE GROUND: (comprising moderately compact orange-brown to grey-brown silty Clay, with orange and black speckles).
2.10	59.50	MADE GROUND: (comprising loosely compact, becoming moderately compact brown to grey-brown slightly gravely Clay, with horizons of black mottling and rare rootlet traces [Ø 2-3mm]. Gravel is fine angular mudstone.
2.50	59.10	Soft to firm grey to dark grey slightly silty CLAY. (HIGHLY WEATHERED LOWER LIAS)
3.40	58.20	Firm grey to dark grey slightly silty CLAY. (WEATHERED LOWER LIAS)
4.00	57.60	Firm to stiff becoming stiff grey to dark grey slightly silty CLAY, with rare fine angular mudstone gravel. (WEATHERED LOWER LIAS)

End of borehole at 4.00 m

Remarks
Dry.
Recovery: 0-1m (100%); 1-2m (100%); 2-3m (100%); 3-4 (100%).
CDPT to 6.9m.

Borehole Log

Intégrale — Understanding Ground Conditions

Project Name: Snow Capel	Project No. 1826	Co-ords: -	Borehole No. **WS6** Sheet 1 of 1
Location: Snow Capel, Matson, Gloucester GL4 6EQ		Level: 60.81	Hole Type WS
Client: Edward Ware Homes		Dates: 25/05/2017 -	Scale 1:25
			Logged By S.J.

Well	Water Strikes	Samples Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.10	ES					Grass over TOPSOIL: (comprising soft brown very sandy Silt, with occasional rootlets [Ø 2-3mm]).
					0.25	60.56		MADE GROUND: (comprising loosely compact to grey-brown slightly silty Clay, with occasional black speckles).
		0.70	ES					
		1.10	D		1.10	59.71		MADE GROUND: (comprising loosely compact to dark grey to brown locally gravelly Clay with localised black to brown mottling/speckles).
		1.40	ES					
		1.80	D					
		2.25	D					
					2.50	58.31		Soft to firm locally soft grey to dark grey slightly silty CLAY. (HIGHLY WEATHERED LOWER LIAS)
					3.20	57.61		Firm grey to dark grey slightly silty CLAY with localised fine angular mudstone lithorelicts. (WEATHERED LOWER LIAS)
		3.25	D					
					3.50	57.31		Firm to stiff dark grey slightly gravelly silty CLAY with localised fine angular lithorelicts. (WEATHERED LOWER LIAS)
		3.85	D					*Between 3.8-4.0m, abundant angular fine mudstone lithorelicts and horizontal laminations.*
					4.00	56.81		End of borehole at 4.00 m

Depth scale: 1, 2, 3, 4, 5

Remarks
Dry.
Recovery: 0-1m (100%); 1-2m (100%); 2-3m (100%); 3-4 (100%).
CDPT to 5.8m.

Intégrale
Understanding Ground Conditions

Borehole Log

Project Name: Snow Capel	Project No. 1826	Co-ords: -	Borehole No. **WS7** Sheet 1 of 1
Location: Snow Capel, Matson, Gloucester GL4 6EQ		Level: 59.00	Hole Type WS
Client: Edward Ware Homes		Dates: 25/05/2017 -	Scale 1:25
			Logged By S.J.

Well	Water Strikes	Samples and In Situ Testing Depth (m)	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
		0.15	ES		0.25	58.75		Grass over TOPSOIL: (comprising soft brown slightly sandy Silt, with abundant rootlets [Ø 203mm] and roots [Ø 0.5-1.0cm]).
		1.25	D		1.50	57.50		MADE GROUND: (comprising loosely compact brown to orange-brown slightly silty gravelly Clay. Gravel is fine to angular mudstone lithorelicts).
		2.00	D		2.20	56.80		Soft grey locally grey-brown silty CLAY. (HIGHLY WEATHERED LOWER LIAS)
		2.25 2.75 3.25	D D D		3.30	55.70		Soft to firm locally soft grey to grey-brown silty CLAY. (HIGHLY WEATHERED LOWER LIAS)
		3.75	D		3.80	55.20		Firm grey-brown silty CLAY. (WEATHERED LOWER LIAS)
					4.00	55.00		Firm to stiff grey to grey-brown CLAY, with occasional fine angular mudstone lithorelicts. (WEATHERED LOWER LIAS)

End of borehole at 4.00 m

1
2
3
4
5

Remarks
Dry.
Recovery: 0-1m (100%); 1-2m (100%); 2-3m (100%); 3-4 (100%).
CDPT to 7.5m.

Intégrale
Understanding Ground Conditions

Borehole Log

Project Name: Snow Capel	Project No. 1826	Co-ords: -
Location: Snow Capel, Matson, Gloucester GL4 6EQ		Level: 57.50
Client: Edward Ware Homes		Dates: 25/05/2017 -

Borehole No. **WS8**
Sheet 1 of 1
Hole Type: WS
Scale: 1:25
Logged By: S.J.

Sample Depth (m)	Type	Results	Depth (m)	Level (m)	Stratum Description
					Grass over TOPSOIL: (comprising soft brown sandy Silt).
			0.25	57.25	MADE GROUND: (comprising loosely compact grey to blue-grey Clay, with wood fragments, abundant roots and rootlets [Ø 2-15mm]).
0.60	ES				
0.90	D				
1.40	D				
			1.60	55.90	Very soft blue-grey to grey CLAY with occasional black organic fragments. (ALLUVIUM)
2.50	D				
			2.80	54.70	Soft to firm brown slightly gravelly CLAY. (HIGHLY WEATHERED LOWER LIAS)
			3.10	54.40	Firm grey-brown slightly gravelly slightly silty CLAY. (WEATHERED LOWER LIAS)
					Between 3.5-4.0m, mudstone lithorelicts.
			4.00	53.50	End of borehole at 4.00 m

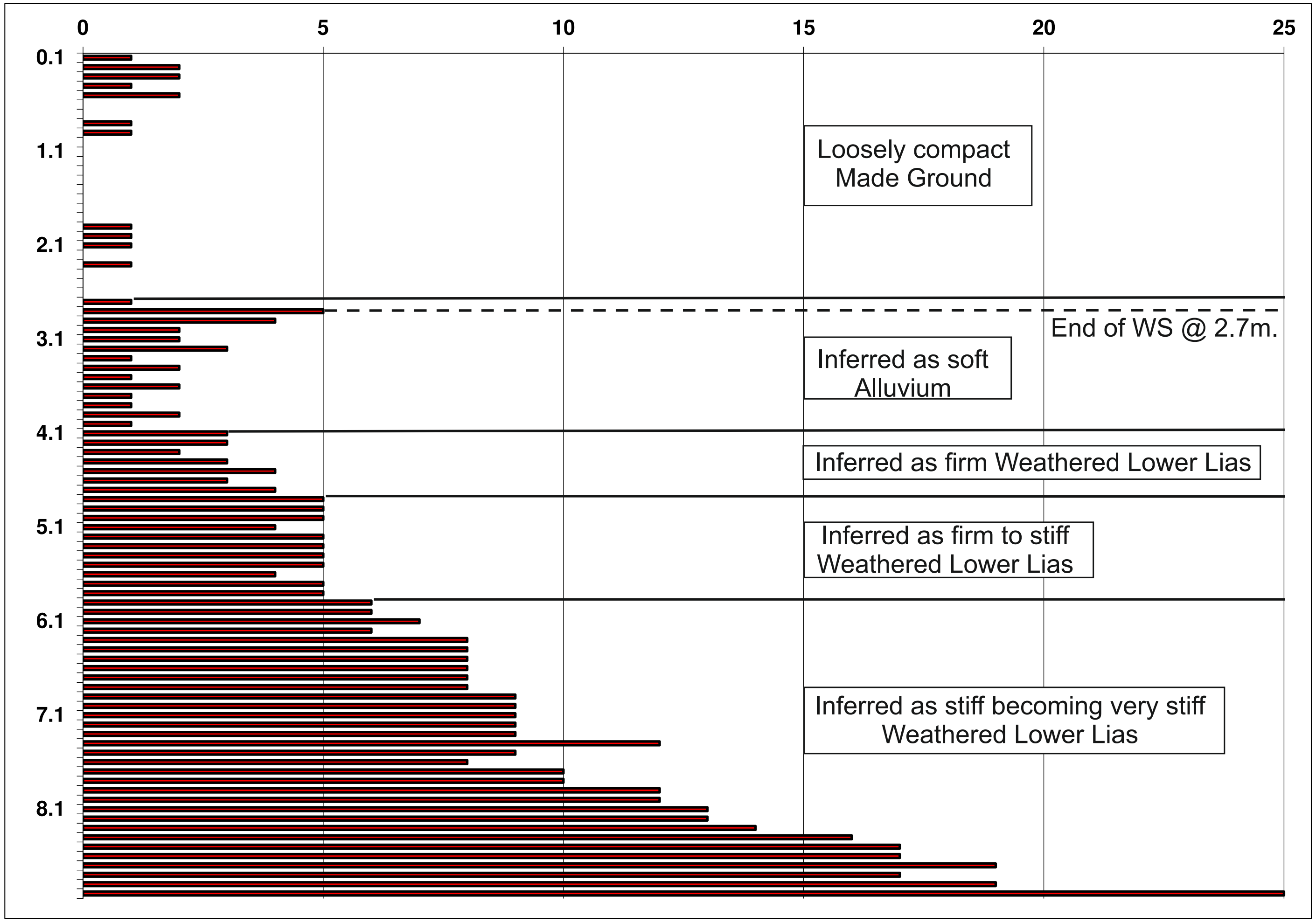
Remarks
Dry.
Recovery: 0-1m (100%); 1-2m (100%); 2-3m (100%); 3-4 (100%).
CDPT to 5.7m.

Super Heavy Dynamic Probe Records

Intégrale — Understanding Ground Conditions

Job Ref: 1826
Job Name: Snow Capel, Gloucester
Hole: WS1 CDPT 1

Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count
0.1	1	2.6	0	5.1	4	7.6	8
0.2	2	2.7	1	5.2	5	7.7	10
0.3	2	2.8	5	5.3	5	7.8	10
0.4	1	2.9	4	5.4	5	7.9	12
0.5	2	3	2	5.5	5	8	12
0.6	0	3.1	2	5.6	4	8.1	13
0.7	0	3.2	3	5.7	5	8.2	13
0.8	1	3.3	1	5.8	5	8.3	14
0.9	1	3.4	2	5.9	6	8.4	16
1	0	3.5	1	6	6	8.5	17
1.1	0	3.6	2	6.1	7	8.6	17
1.2	0	3.7	1	6.2	6	8.7	19
1.3	0	3.8	1	6.3	8	8.8	17
1.4	0	3.9	2	6.4	8	8.9	19
1.5	0	4	1	6.5	8	9	25
1.6	0	4.1	3	6.6	8	9.1	
1.7	0	4.2	3	6.7	8	9.2	
1.8	0	4.3	2	6.8	8	9.3	
1.9	1	4.4	3	6.9	9	9.4	
2	1	4.5	4	7	9	9.5	
2.1	1	4.6	3	7.1	9	9.6	
2.2	0	4.7	4	7.2	9	9.7	
2.3	1	4.8	5	7.3	9	9.8	
2.4	0	4.9	5	7.4	12	9.9	
2.5	0	5	5	7.5	9	10	

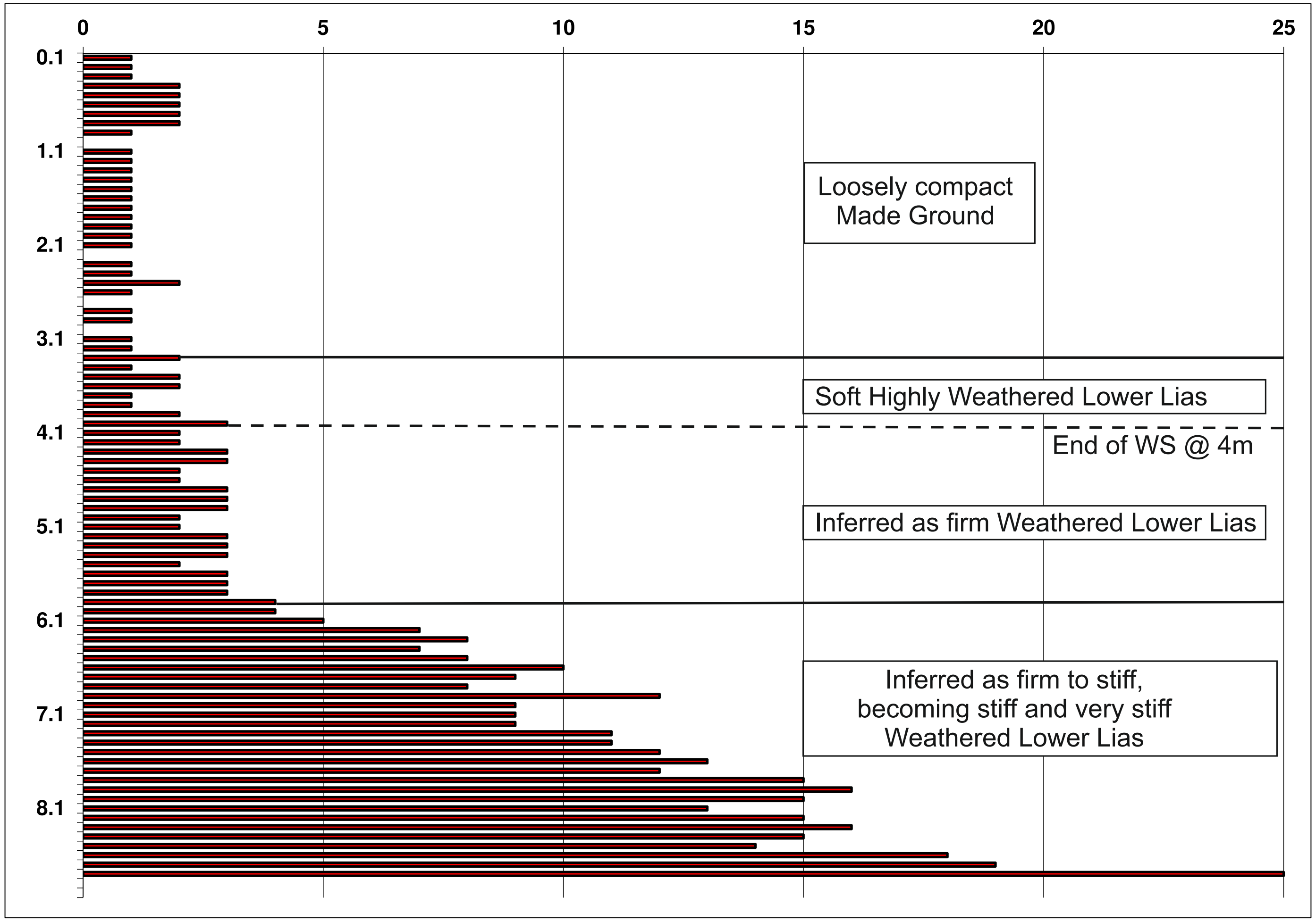


Intégrale
Understanding Ground Conditions

Super Heavy Dynamic Probe Records

Job Ref: 1826
Job Name: Snow Capel, Gloucester
Hole: WS2 **CDPT 2**

Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count
0.1	1	2.6	1	5.1	2	7.6	13
0.2	1	2.7	0	5.2	3	7.7	12
0.3	1	2.8	1	5.3	3	7.8	15
0.4	2	2.9	1	5.4	3	7.9	16
0.5	2	3	0	5.5	2	8	15
0.6	2	3.1	1	5.6	3	8.1	13
0.7	2	3.2	1	5.7	3	8.2	15
0.8	2	3.3	2	5.8	3	8.3	16
0.9	1	3.4	1	5.9	4	8.4	15
1	0	3.5	2	6	4	8.5	14
1.1	1	3.6	2	6.1	5	8.6	18
1.2	1	3.7	1	6.2	7	8.7	19
1.3	1	3.8	1	6.3	8	8.8	25
1.4	1	3.9	2	6.4	7	8.9	
1.5	1	4	3	6.5	8	9	
1.6	1	4.1	2	6.6	10	9.1	
1.7	1	4.2	2	6.7	9	9.2	
1.8	1	4.3	3	6.8	8	9.3	
1.9	1	4.4	3	6.9	12	9.4	
2	1	4.5	2	7	9	9.5	
2.1	1	4.6	2	7.1	9	9.6	
2.2	0	4.7	3	7.2	9	9.7	
2.3	1	4.8	3	7.3	11	9.8	
2.4	1	4.9	3	7.4	11	9.9	
2.5	2	5	2	7.5	12	10	

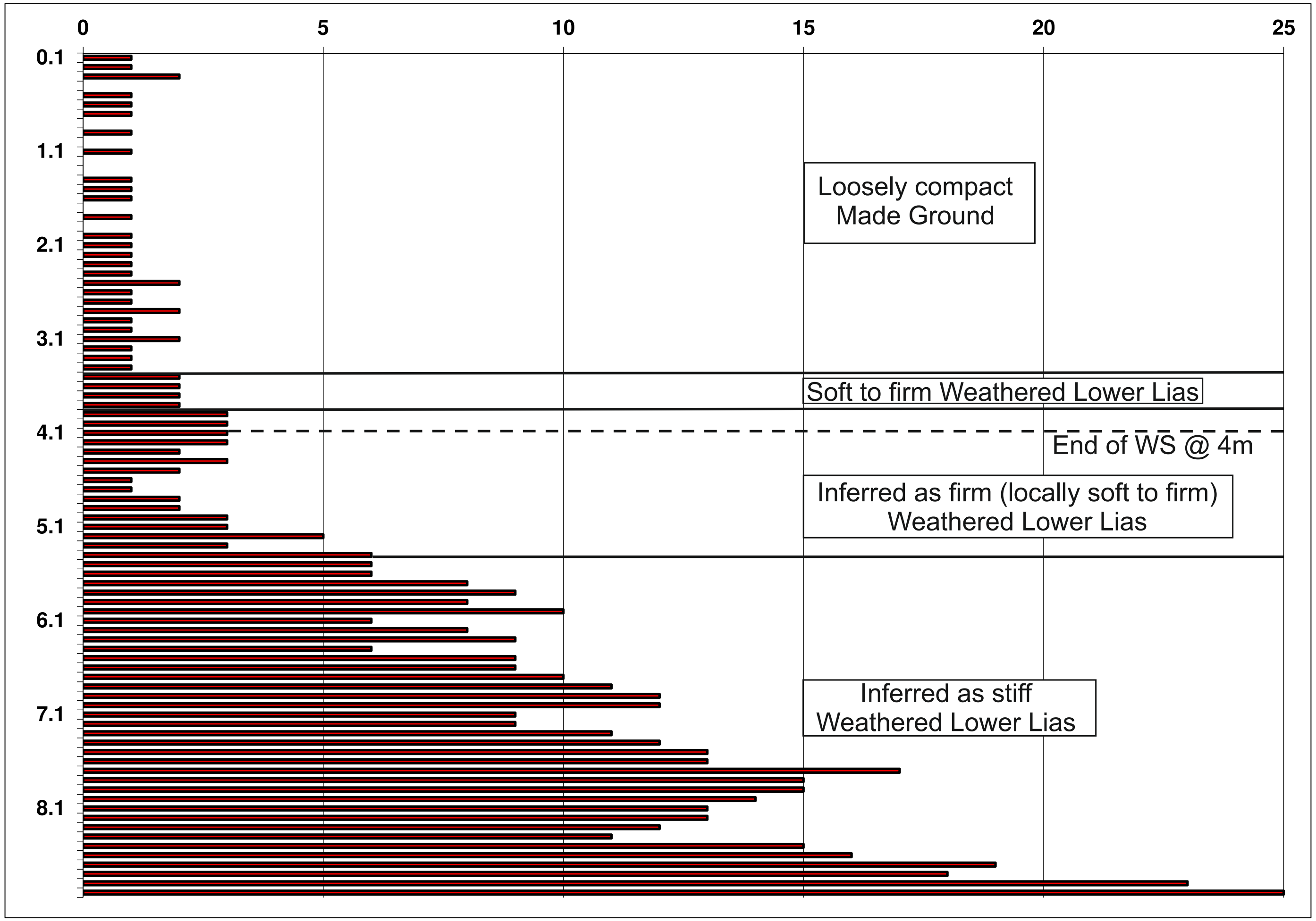


Intégrale
Understanding Ground Conditions

Super Heavy Dynamic Probe Records

Job Ref: 1826
Job Name: Snow Capel, Gloucester
Hole: WS3 CDPT 3

Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count
0.1	1	2.6	1	5.1	3	7.6	13
0.2	1	2.7	1	5.2	5	7.7	17
0.3	2	2.8	2	5.3	3	7.8	15
0.4	0	2.9	1	5.4	6	7.9	15
0.5	1	3	1	5.5	6	8	14
0.6	1	3.1	2	5.6	6	8.1	13
0.7	1	3.2	1	5.7	8	8.2	13
0.8	0	3.3	1	5.8	9	8.3	12
0.9	1	3.4	1	5.9	8	8.4	11
1	0	3.5	2	6	10	8.5	15
1.1	1	3.6	2	6.1	6	8.6	16
1.2	0	3.7	2	6.2	8	8.7	19
1.3	0	3.8	2	6.3	9	8.8	18
1.4	1	3.9	3	6.4	6	8.9	23
1.5	1	4	3	6.5	9	9	25
1.6	1	4.1	3	6.6	9	9.1	
1.7	0	4.2	3	6.7	10	9.2	
1.8	1	4.3	2	6.8	11	9.3	
1.9	0	4.4	3	6.9	12	9.4	
2	1	4.5	2	7	12	9.5	
2.1	1	4.6	1	7.1	9	9.6	
2.2	1	4.7	1	7.2	9	9.7	
2.3	1	4.8	2	7.3	11	9.8	
2.4	1	4.9	2	7.4	12	9.9	
2.5	2	5	3	7.5	13	10	

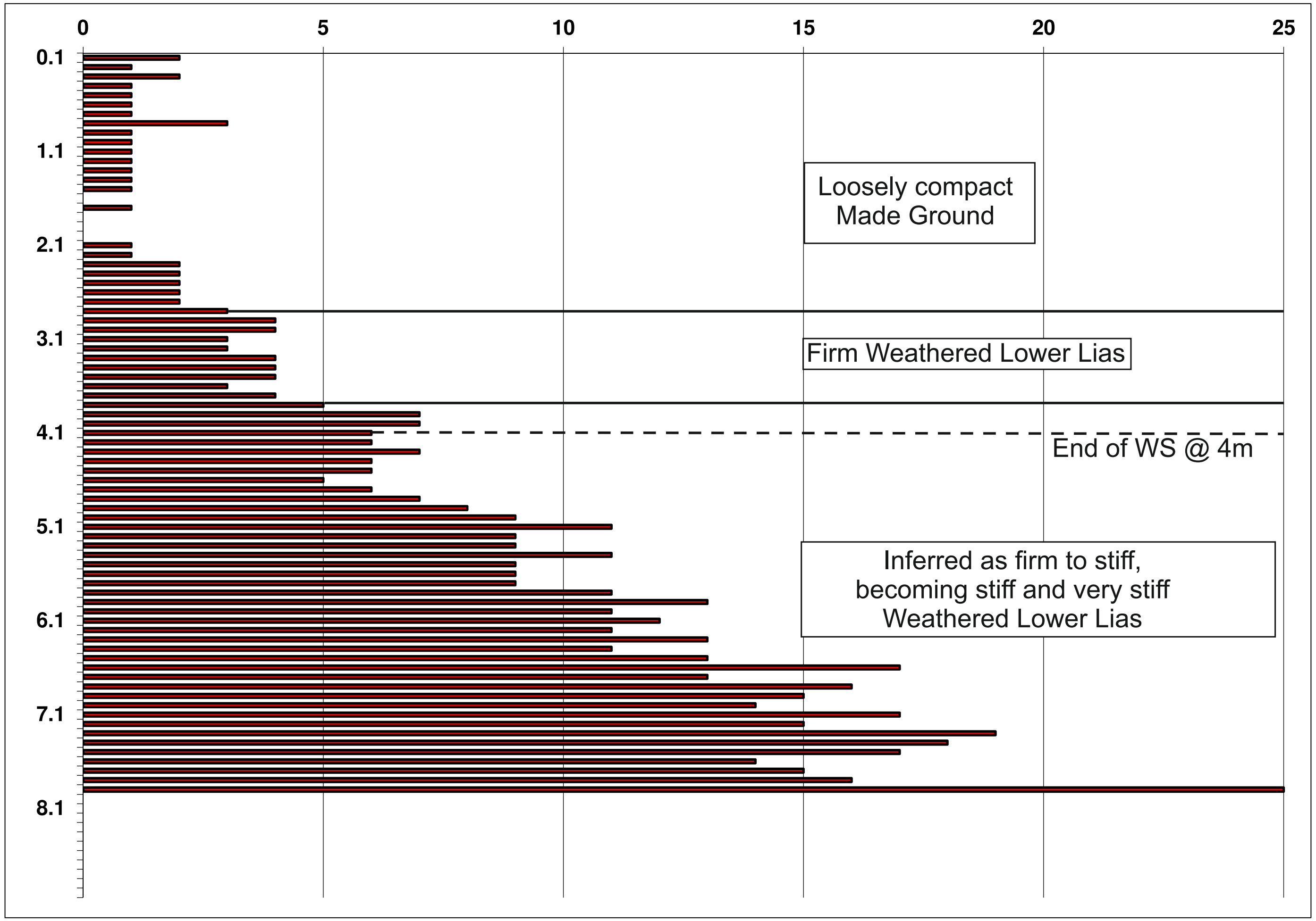


Super Heavy Dynamic Probe Records

Intégrale
Understanding Ground Conditions

Job Ref: 1826
Job Name: Snow Capel, Gloucester
Hole: WS4 CDPT 4

Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count
0.1	2	2.6	2	5.1	11	7.6	14
0.2	1	2.7	2	5.2	9	7.7	15
0.3	2	2.8	3	5.3	9	7.8	16
0.4	1	2.9	4	5.4	11	7.9	25
0.5	1	3	4	5.5	9	8	
0.6	1	3.1	3	5.6	9	8.1	
0.7	1	3.2	3	5.7	9	8.2	
0.8	3	3.3	4	5.8	11	8.3	
0.9	1	3.4	4	5.9	13	8.4	
1	1	3.5	4	6	11	8.5	
1.1	1	3.6	3	6.1	12	8.6	
1.2	1	3.7	4	6.2	11	8.7	
1.3	1	3.8	5	6.3	13	8.8	
1.4	1	3.9	7	6.4	11	8.9	
1.5	1	4	7	6.5	13	9	
1.6	0	4.1	6	6.6	17	9.1	
1.7	1	4.2	6	6.7	13	9.2	
1.8	0	4.3	7	6.8	16	9.3	
1.9	0	4.4	6	6.9	15	9.4	
2	0	4.5	6	7	14	9.5	
2.1	1	4.6	5	7.1	17	9.6	
2.2	1	4.7	6	7.2	15	9.7	
2.3	2	4.8	7	7.3	19	9.8	
2.4	2	4.9	8	7.4	18	9.9	
2.5	2	5	9	7.5	17	10	

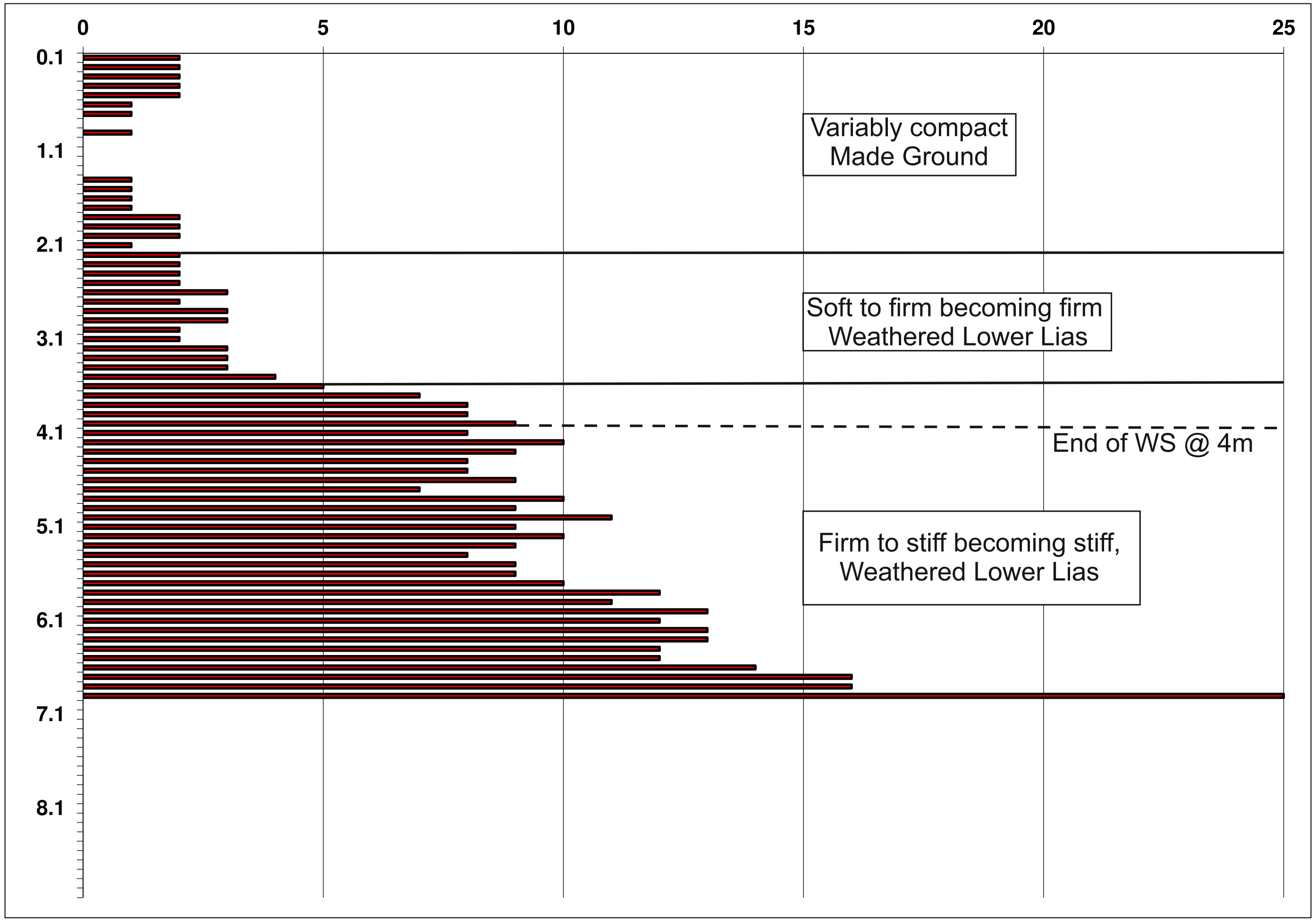


Intégrale
Understanding Ground Conditions

Super Heavy Dynamic Probe Records

Job Ref: 1826
Job Name: Snow Capel, Gloucester
Hole: WS5 CDPT 5

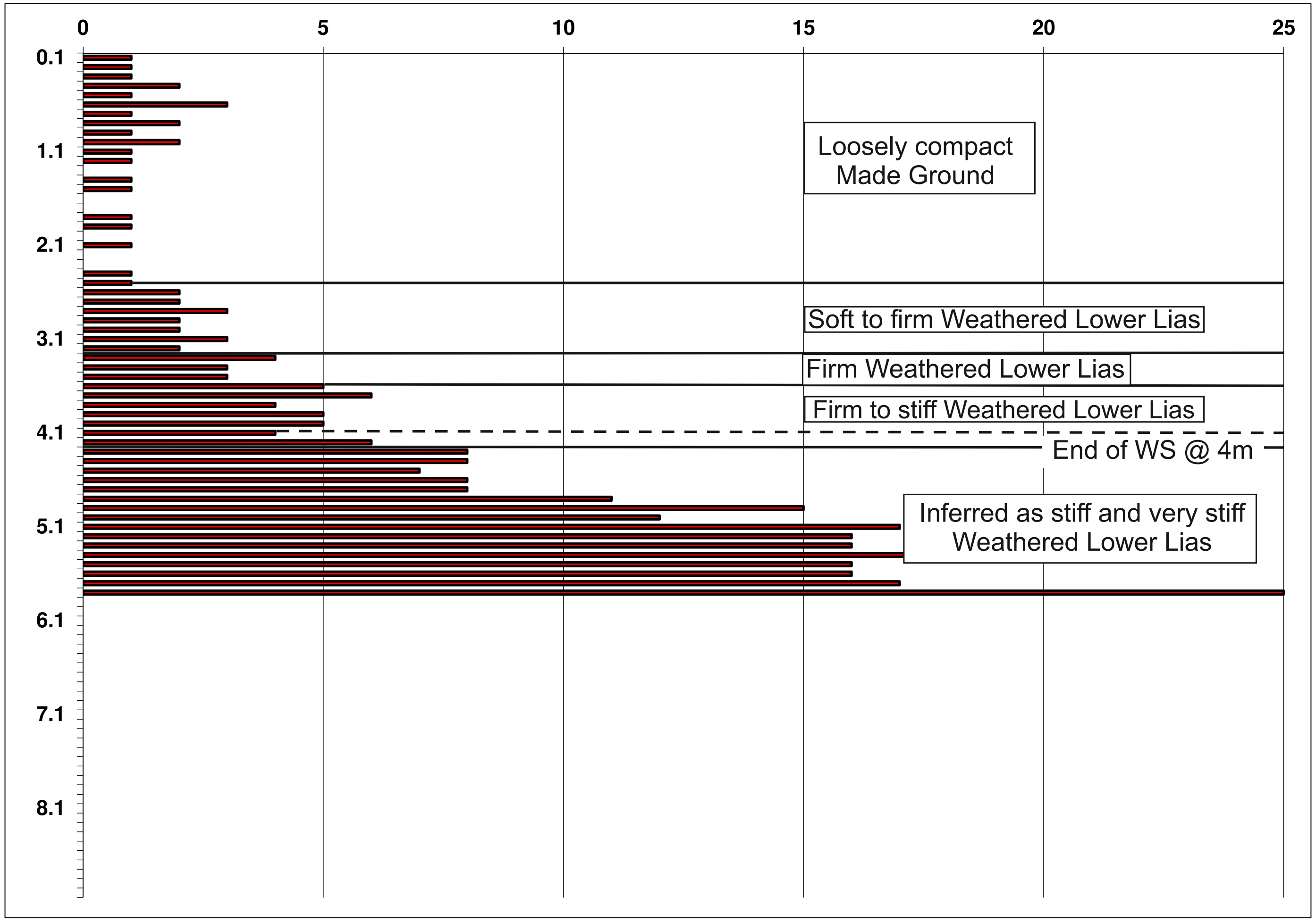
Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count
0.1	2	2.6	3	5.1	9	7.6	
0.2	2	2.7	2	5.2	10	7.7	
0.3	2	2.8	3	5.3	9	7.8	
0.4	2	2.9	3	5.4	8	7.9	
0.5	2	3	2	5.5	9	8	
0.6	1	3.1	2	5.6	9	8.1	
0.7	1	3.2	3	5.7	10	8.2	
0.8	0	3.3	3	5.8	12	8.3	
0.9	1	3.4	3	5.9	11	8.4	
1	0	3.5	4	6	13	8.5	
1.1	0	3.6	5	6.1	12	8.6	
1.2	0	3.7	7	6.2	13	8.7	
1.3	0	3.8	8	6.3	13	8.8	
1.4	1	3.9	8	6.4	12	8.9	
1.5	1	4	9	6.5	12	9	
1.6	1	4.1	8	6.6	14	9.1	
1.7	1	4.2	10	6.7	16	9.2	
1.8	2	4.3	9	6.8	16	9.3	
1.9	2	4.4	8	6.9	25	9.4	
2	2	4.5	8	7		9.5	
2.1	1	4.6	9	7.1		9.6	
2.2	2	4.7	7	7.2		9.7	
2.3	2	4.8	10	7.3		9.8	
2.4	2	4.9	9	7.4		9.9	
2.5	2	5	11	7.5		10	



Super Heavy Dynamic Probe Records

Job Ref: 1826
Job Name: Snow Capel, Gloucester
Hole: WS6 CDPT 6

Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count
0.1	1	2.6	2	5.1	17	7.6	
0.2	1	2.7	2	5.2	16	7.7	
0.3	1	2.8	3	5.3	16	7.8	
0.4	2	2.9	2	5.4	18	7.9	
0.5	1	3	2	5.5	16	8	
0.6	3	3.1	3	5.6	16	8.1	
0.7	1	3.2	2	5.7	17	8.2	
0.8	2	3.3	4	5.8	25	8.3	
0.9	1	3.4	3	5.9		8.4	
1	2	3.5	3	6		8.5	
1.1	1	3.6	5	6.1		8.6	
1.2	1	3.7	6	6.2		8.7	
1.3	0	3.8	4	6.3		8.8	
1.4	1	3.9	5	6.4		8.9	
1.5	1	4	5	6.5		9	
1.6	0	4.1	4	6.6		9.1	
1.7	0	4.2	6	6.7		9.2	
1.8	1	4.3	8	6.8		9.3	
1.9	1	4.4	8	6.9		9.4	
2	0	4.5	7	7		9.5	
2.1	1	4.6	8	7.1		9.6	
2.2	0	4.7	8	7.2		9.7	
2.3	0	4.8	11	7.3		9.8	
2.4	1	4.9	15	7.4		9.9	
2.5	1	5	12	7.5		10	

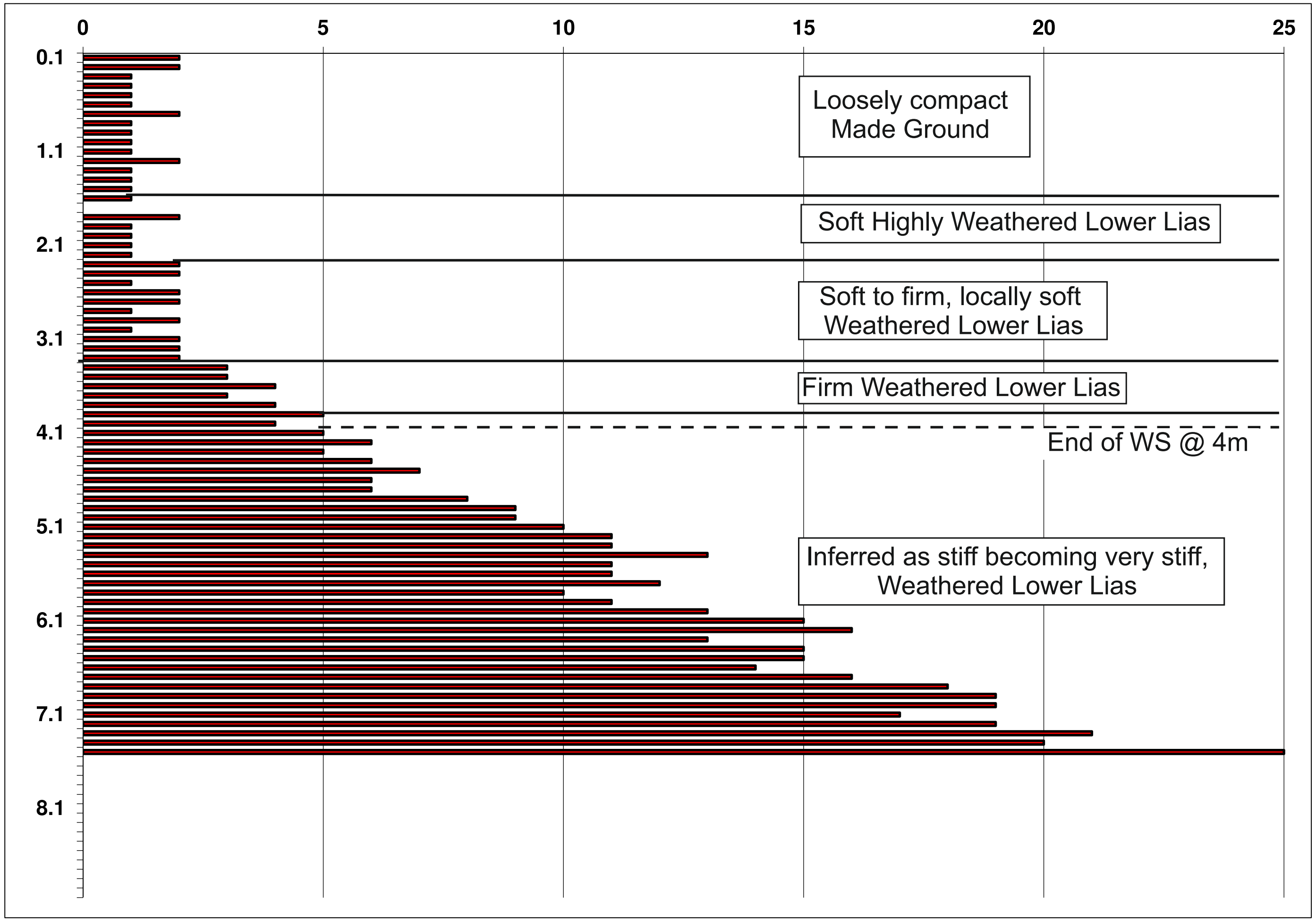


Intégrale
Understanding Ground Conditions

Super Heavy Dynamic Probe Records

Job Ref: 1826
Job Name: Snow Capel, Gloucester
Hole: WS7 **CDPT 7**

Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count
0.1	2	2.6	2	5.1	10	7.6	
0.2	2	2.7	2	5.2	11	7.7	
0.3	1	2.8	1	5.3	11	7.8	
0.4	1	2.9	2	5.4	13	7.9	
0.5	1	3	1	5.5	11	8	
0.6	1	3.1	2	5.6	11	8.1	
0.7	2	3.2	2	5.7	12	8.2	
0.8	1	3.3	2	5.8	10	8.3	
0.9	1	3.4	3	5.9	11	8.4	
1	1	3.5	3	6	13	8.5	
1.1	1	3.6	4	6.1	15	8.6	
1.2	2	3.7	3	6.2	16	8.7	
1.3	1	3.8	4	6.3	13	8.8	
1.4	1	3.9	5	6.4	15	8.9	
1.5	1	4	4	6.5	15	9	
1.6	1	4.1	5	6.6	14	9.1	
1.7	0	4.2	6	6.7	16	9.2	
1.8	2	4.3	5	6.8	18	9.3	
1.9	1	4.4	6	6.9	19	9.4	
2	1	4.5	7	7	19	9.5	
2.1	1	4.6	6	7.1	17	9.6	
2.2	1	4.7	6	7.2	19	9.7	
2.3	2	4.8	8	7.3	21	9.8	
2.4	2	4.9	9	7.4	20	9.9	
2.5	1	5	9	7.5	25	10	

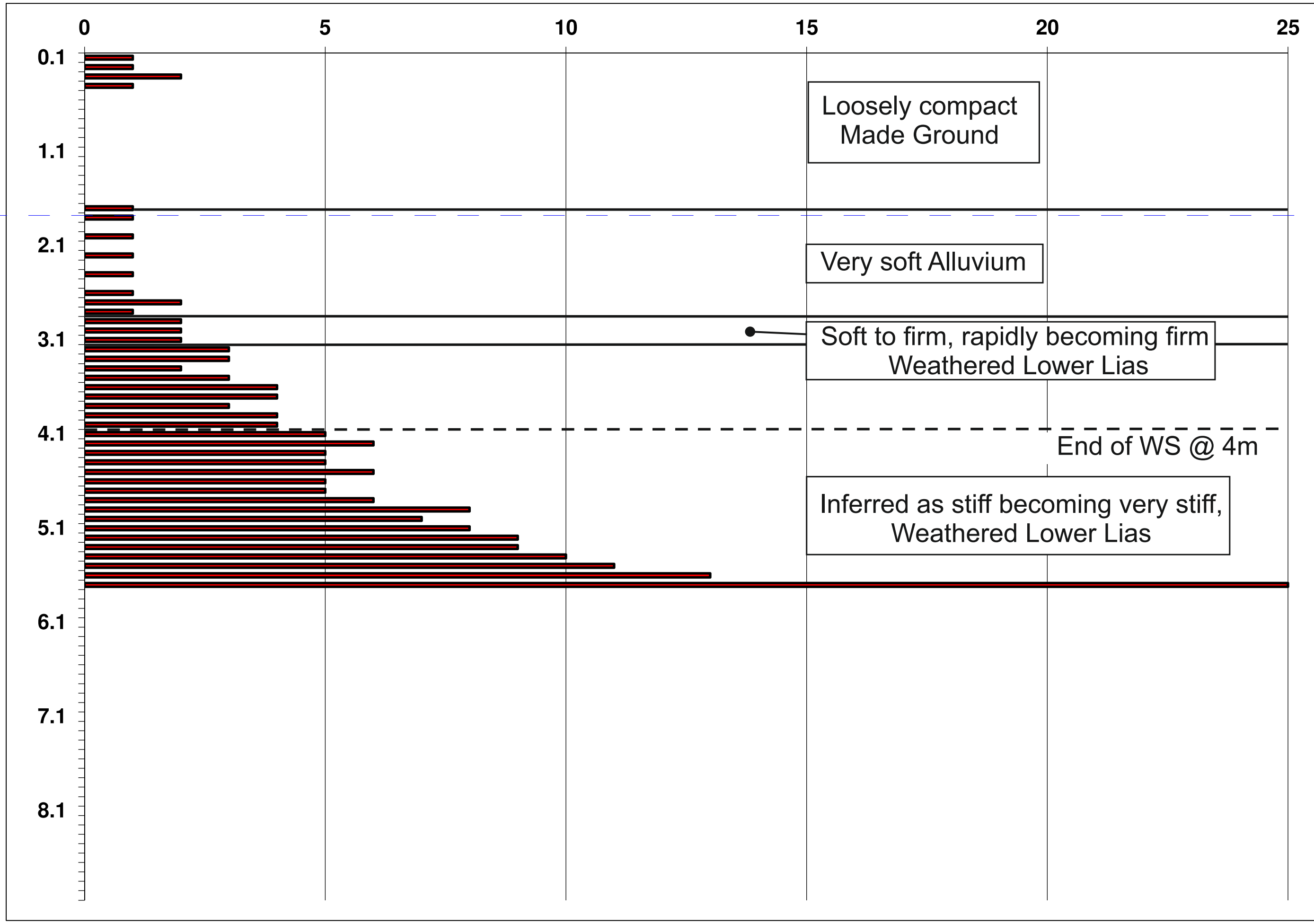


Intégrale
Understanding Ground Conditions

Super Heavy Dynamic Probe Records

Job Ref: 1826
Job Name: Snow Capel, Gloucester
Hole: WS8 CDPT 8

Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count	Depth (m)	Blow Count
0.1	1	2.6	1	5.1	8	7.6	
0.2	1	2.7	2	5.2	9	7.7	
0.3	2	2.8	1	5.3	9	7.8	
0.4	1	2.9	2	5.4	10	7.9	
0.5	0	3	2	5.5	11	8	
0.6	0	3.1	2	5.6	13	8.1	
0.7	0	3.2	3	5.7	25	8.2	
0.8	0	3.3	3	5.8		8.3	
0.9	0	3.4	2	5.9		8.4	
1	0	3.5	3	6		8.5	
1.1	0	3.6	4	6.1		8.6	
1.2	0	3.7	4	6.2		8.7	
1.3	0	3.8	3	6.3		8.8	
1.4	0	3.9	4	6.4		8.9	
1.5	0	4	4	6.5		9	
1.6	0	4.1	5	6.6		9.1	
1.7	1	4.2	6	6.7		9.2	
1.8	1	4.3	5	6.8		9.3	
1.9	0	4.4	5	6.9		9.4	
2	1	4.5	6	7		9.5	
2.1	0	4.6	5	7.1		9.6	
2.2	1	4.7	5	7.2		9.7	
2.3	0	4.8	6	7.3		9.8	
2.4	1	4.9	8	7.4		9.9	
2.5	0	5	7	7.5		10	



Appendix E

Gas and Groundwater Monitoring

Integrale Limited, Suite 7, Westway Farm Business Park, Wick Road, Bishop Sutton, Somerset, BS39 5XP United Kingdom
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Intégrale
Understanding Ground Conditions

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[redacted]
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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

[redacted]
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Results of Gas & Groundwater Monitoring Visit No. 1

Site	Snow Capel, Gloucester
Client	Edward Ware Homes Limited
Date	07/07/17

Job No.	1826
Monitored By	WS

Weather	Sunny
Air Temperature	21°C
Atmospheric Pressure (mbar)	1010
Ground Conditions	Dry

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)
WS1	0	0.0	1232	61.6	35.2	3.8	0.0	-	1.55	-	2.75
	30	0.0									
	60	0.0									
Comments:											
WS3	0	0.0	58	2.9	8.5	16.4	0.0	-	1.34	-	2.17
	30	0.0									
	60	0.0									
Comments:											
WS5	0	0.0	6	0.3	4	18.6	0.0	-	DRY	-	2.92
	30	0.0									
	60	0.0									
Comments:											
WS8	0	0.0	2	0.1	3.5	20	0.0	-	2.64	-	3.02
	30	0.0									
	60	0.0									
Comments:											

Equipment:

Type:	*Serial No:*	*Used:*
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

Intégrale
Understanding Ground Conditions

Suite 7, Westway Farm Business Park
Wick Road, Bishop Sutton, Somerset,
BS39 5XP, United Kingdom
[redacted]
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Results of Gas & Groundwater Monitoring Visit No. 2

Site	Snow Capel, Gloucester
Client	Edward Ware Homes Limited
Date	13/07/17

Job No.	1826
Monitored By	WS

Weather	Cloudy
Air Temperature	19°C
Atmospheric Pressure (mbar)	1014
Ground Conditions	Dry

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)
WS1	0	0.0	1222	61.1	35.7	5	0.0	-	1.58	-	2.78
	30	0.1									
	60	0.1									
Comments:											
WS3	0	0.0	56	2.8	7.1	17	0.0	-	1.29	-	2.15
	30	0.0									
	60	0.0									
Comments:											
WS5	0	0.0	4	0.2	3.8	18.3	0.0	-	DRY	-	2.83
	30	0.0									
	60	0.0									
Comments:											
WS8	0	0.1	0	0.0	4.2	18.9	0.0	-	2.57	-	3.02
	30	0.1									
	60	0.1									
Comments:											

Equipment:

Type:	*Serial No:*	*Used:*
GA5000	G501893	✓
Tiger PID Gas Detector	T-108427	✓
Solinst Mini Interface Meter	122 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

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

[redacted]
www.integrale.uk.com

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.

2718

Intégrale Limited
Unit 7
Westway Farm Business Park
Wick Road
Bishop Sutton
BS39 5XP

For the attention of [redacted]

Version No. 1

Date of Issue 13/06/2017

TEST REPORT

PROJECT/SITE	Snow Capel, Gloucester	Samples received	30/05/2017
GEL REPORT NUMBER	33145	Schedule received	30/05/2017
Your ref/PO:	1826	Testing commenced	02/06/2017
Test report refers to	Schedule 1	Status	Final

SUMMARY OF RESULTS ATTACHED

TEST METHOD & DESCRIPTION	QUANTITY	ACCREDITED TEST
BS EN ISO 17892-1: 2014:5. Water Content	6	YES
BS1377: Part 2: 1990:4.2-4.4&5.2-5.4, Liquid & Plastic Limits	3	YES
BRE SD1 Reduced Suite: pH, Sulphate - water and acid soluble, sulphur (Subcontracted)	1	YES

Remarks
This report may not be partially reproduced without written permission from this laboratory.

Approved Signatories:
S Robinson (Client Manager) W Jones (Technical Support)
J Hanson (Director) N Parry (Director)

[redacted]

Geotechnical Engineering Ltd
Centurion House
Olympus Park, Quedgeley
Gloucester GL2 4NF

www.geoeng.co.uk

[redacted]

Registered number: 00700739
VAT Number: 682 5857 89

Payments: Geotechnical Engineering Limited
Sort code: 30-15-99 **Bank account**: 00072116

Geotechnical Engineering Limited

LIQUID AND PLASTIC LIMITS

BS.1377 : PART 2 : 1990 : 4 and 5

CLIENT INTEGRALE LIMITED

SITE SNOW CAPEL, GLOUCESTER

borehole /trial pit no.	sample no./type	sample depth (m)	specimen depth (m)	natural water content (%)	specimen preparation and test method	fraction >0.425 mm (%)	liquid limit (%)	plastic limit (%)	plasticity index (%)	description and remarks
WS1	D	2.50	2.50	42.3	E					Grey slightly sandy CLAY with rare organic material
WS2	D	1.50	1.50	42.9	E					Brown mottled grey slightly sandy CLAY with rare organic material
WS3	D	2.50	2.50	45.7	BXE	5	76	40	36	Greyish brown slightly sandy slightly gravelly CLAY with rare rootlets
WS4	D	3.50	3.50	29.1	BXE	2	66	27	39	Greenish brown mottled grey slightly sandy CLAY with rare organic material
WS7	D	1.25	1.25	29.9	BXE	3	62	28	34	Greenish brown slightly sandy slightly gravelly CLAY
WS8	D	2.50	2.50	28.2	E					Greenish brown slightly sandy CLAY

general remarks

natural water content determined in accordance with BS EN ISO 17892 - 1 : 2014 (unless specified)

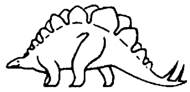
NP denotes non plastic

# denotes sample tested is smaller than that which is recommended in accordance with BS1377 or BS EN ISO 17892

specimen preparation		test method	CONTRACT	CHECKED
A - as received	D - oven dried (60oC)	X - cone penetrometer (test 4.3)	**33145**	**SR**
B - washed on 0.425mm sieve	E - oven dried (105oC)	Y - cone penetrometer (test 4.4)		
C - air dried	F - not known	Z - casagrande apparatus (test 4.5)		

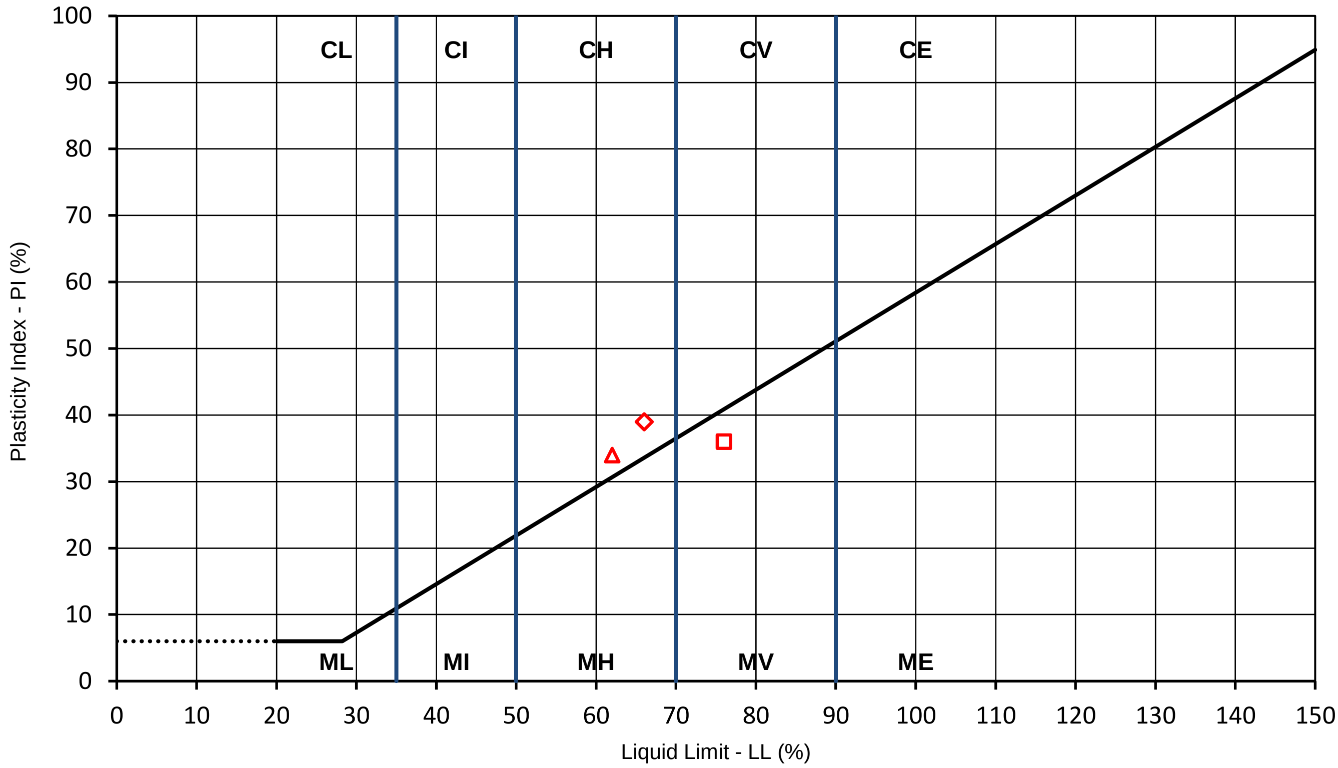
Geotechnical Engineering Limited

ATTERBERG LINE PLOT



CLIENT INTEGRALE LIMITED

SITE SNOW CAPEL, GLOUCESTER



	BH/TP No.	depth (m)	LL	PL	PI	remarks
□	WS3	2.50	76	40	36	
◇	WS4	3.50	66	27	39	
△	WS7	1.25	62	28	34	

CONTRACT	CHECKED
33145	**SR**

Chemtest
The right chemistry to deliver results
Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
[redacted]

UKAS TESTING 2183

Final Report

Report No.:	17-13762-1
Initial Date of Issue:	07-Jun-2017
Client	Geotechnical Engineering Ltd
Client Address:	Centurion House Olympus Park Quedgeley Gloucester Gloucestershire GL2 4NF
Contact(s):	[redacted]
Project	33145 Snow Capel, Gloucester

Quotation No.:		**Date Received:**	01-Jun-2017
Order No.:	33145	**Date Instructed:**	01-Jun-2017
No. of Samples:	1		
Turnaround (Wkdays):	5	**Results Due:**	07-Jun-2017
Date Approved:	07-Jun-2017		

Approved By:

[redacted]

Details: [redacted] Technical Manager

Results - Soil

Project: 33145 Snow Capel, Gloucester

Client: Geotechnical Engineering Ltd	**Chemtest Job No.:**				17-13762
Quotation No.:	**Chemtest Sample ID.:**				461482
Order No.: 33145	Client Sample Ref.:				WS5
	Client Sample ID.:				D
	Sample Type:				SOIL
	Top Depth (m):				2.25
	Date Sampled:				31-May-2017
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Moisture	N	2030	%	0.020	18
pH	U	2010		N/A	7.9
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.066
Total Sulphur	U	2175	%	0.010	0.035
Sulphate (Acid Soluble)	U	2430	%	0.010	0.035

Test Methods

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
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.

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

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 G

Results of Contamination Analyses

Intégrale
Understanding Ground Conditions

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

[redacted]
www.integrale.uk.com

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.

Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
[redacted]

UKAS TESTING 2183

Final Report

Report No.:	17-13349-1
Initial Date of Issue:	05-Jun-2017
Client	Integrale Limited
Client Address:	Fieldworks Office Unit 7 Westway Farm Business P Wick Road Bishops Sutton BS39 5XP
Contact(s):	[redacted]
Project	1826 Snow Capel, Gloucester

Quotation No.:		**Date Received:**	30-May-2017
Order No.:		**Date Instructed:**	30-May-2017
No. of Samples:	4		
Turnaround (Wkdays):	5	**Results Due:**	05-Jun-2017
Date Approved:	05-Jun-2017		

Approved By:

[redacted]

Details: [redacted] Laboratory Manager

Chemtest
The right chemistry to deliver results

Results - Soil

Project: 1826 Snow Capel, Gloucester

Client: Integrale Limited				**Chemtest Job No.:**	17-13349	17-13349	17-13349	17-13349
Quotation No.:				**Chemtest Sample ID.:**	459417	459418	459419	459420
Order No.:				Client Sample Ref.:	WS1	WS5	WS6	WS8
				Client Sample ID.:	INT 1826	INT 1826	INT 1826	INT 1826
				Sample Type:	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.50	1.80	1.40	0.60
				Date Sampled:	25-May-2017	25-May-2017	25-May-2017	25-May-2017
				Asbestos Lab:	COVENTRY	COVENTRY		
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
ACM Type	U	2192		N/A	-	-		
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected		
Moisture	N	2030	%	0.020	14	20	16	16
pH	U	2010		N/A	8.0	7.3	7.4	8.0
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	1.0	1.1	< 0.40	0.80
Sulphur (Elemental)	U	2180	mg/kg	1.0	< 1.0	63	23	5.3
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Sulphide (Easily Liberatable)	U	2325	mg/kg	0.50	7.0	11	7.7	6.8
Sulphate (Total)	U	2430	%	0.010	1.3	0.72	0.075	0.28
Arsenic	U	2450	mg/kg	1.0	8.1	14	6.7	14
Barium	U	2450	mg/kg	10	87	73	36	49
Beryllium	U	2450	mg/kg	1.0	< 1.0	1.0	< 1.0	< 1.0
Cadmium	U	2450	mg/kg	0.10	0.19	< 0.10	< 0.10	< 0.10
Chromium	U	2450	mg/kg	1.0	29	44	50	47
Copper	U	2450	mg/kg	0.50	17	21	24	27
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	33	36	50	50
Lead	U	2450	mg/kg	0.50	19	29	23	25
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vanadium	U	2450	mg/kg	5.0	27	52	54	48
Zinc	U	2450	mg/kg	0.50	82	100	93	98
Chromium (Trivalent)	N	2490	mg/kg	5.0	29	44	50	47
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	1.0	2.2	0.71	1.4
Total TPH >C6-C40	U	2670	mg/kg	10	< 10	< 10	< 10	< 10
Naphthalene	U	2700	mg/kg	0.10	0.14	< 0.10	< 0.10	0.13
Acenaphthylene	U	2700	mg/kg	0.10	0.11	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	0.17	0.22	< 0.10	0.13
Fluorene	U	2700	mg/kg	0.10	< 0.10	0.13	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	0.41	0.60	< 0.10	0.13
Anthracene	U	2700	mg/kg	0.10	< 0.10	0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	0.33	0.42	0.16	0.15
Pyrene	U	2700	mg/kg	0.10	0.38	0.45	0.16	0.12
Benzo[a]anthracene	U	2700	mg/kg	0.10	0.13	< 0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	0.22	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10

WRAS = Exceeds WRAS thresholds

Results - Soil

Project: 1826 Snow Capel, Gloucester

Client: Integrale Limited				**Chemtest Job No.:**	17-13349	17-13349	17-13349	17-13349
Quotation No.:				**Chemtest Sample ID.:**	459417	459418	459419	459420
Order No.:				Client Sample Ref.:	WS1	WS5	WS6	WS8
				Client Sample ID.:	INT 1826	INT 1826	INT 1826	INT 1826
				Sample Type:	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.50	1.80	1.40	0.60
				Date Sampled:	25-May-2017	25-May-2017	25-May-2017	25-May-2017
				Asbestos Lab:	COVENTRY	COVENTRY		
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Benzo[a]pyrene	U	2700	mg/kg	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	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	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	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	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

Chemtest
The right chemistry to deliver results

Test Methods

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	Allkaline 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
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.

Chemtest
The right chemistry to deliver results

Report Information

Key

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

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

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


GCN DISPERSAL.
MAINTAIN FOOTPATH
FOOTPATH LINKS ACROSS BARWOOD SCHEME.
POTENTIAL CONNECTION TO BARWOOD P.O.S.
GCN DISPERSAL
SM DESIGNATION
25m BUFFER
DIVERTED PROW
50m BUFFER
GCN DISPERSAL.
OPTION FOR LOOP ROAD? OTHERWISE, LOOP INTERNALLY.
35m BUFFER TO M5
POTENTIAL NOISE BUND & FENCE (3m + 2m).
A.O.N.B.

Appendix H

Gloucestershire County Council Local Flood Risk Management Strategy Main Document (Summer 2014)

Gloucestershire County Council

Local Flood Risk Management Strategy

Main Document

Summer 2014

Gloucestershire
COUNTY COUNCIL

Document Status

This Local Strategy has been prepared by Gloucestershire County Council in partnership with the relevant Risk Management Authorities in Gloucestershire. The Local Strategy sets the direction for local flood risk management in Gloucestershire. It is a 'living document' and will be updated as and when necessary to support future local flood risk management.

Amendment Record:

Revision	Description	Date	Signed
1	First full draft for FRM Partnership Group review	November 2012	[redacted]
2	Revised draft following partner consultation	April 2013	
3	Draft for public consultation	June 2013	
4	Final version for Scrutiny	December 2013	
5	Final version for publication from Cabinet review	April 2014	
6	Final version for publication	Summer 2014	

Foreword

We are all aware of the devastating effects of flooding on people and communities following the unprecedented flooding in Gloucestershire in 2007, and the more recent, but less severe, flooding in November and December 2012. Flooding causes damage to property and infrastructure, and results in significant stress and disruption to people.

After the summer 2007 flooding Government commissioned Sir Michael Pitt to undertake a review of the flood events and to make recommendations about how we should manage flooding in the future. On the back of the Pitt Review Government brought in new legislation in 2010 called the Flood and Water Management Act. The Act gave new responsibilities to Gloucestershire County Council to take a leadership role in managing and co-ordinating flood risk, in partnership with other organisations that have a key role to play in managing flood risk.

A key component of the Act was the requirement for GCC to produce and maintain a Local Flood Risk Management Strategy which sets out the vision and framework for managing flood risk, identifies the most vulnerable communities across Gloucestershire, and identifies the range of measures we will take in partnership with others to manage flood risk. This document, alongside the appendices and action plan forms the Local Flood Risk Management Strategy for Gloucestershire.

Local communities in Gloucestershire face flood risk from many sources including rivers, surface runoff, groundwater, exceedance from highway and drainage networks, and no one organisation has sole responsibility to manage flood risk from all these sources. Therefore we recognise the value and importance of working with others to manage flood risk and to fulfil our roles and responsibilities.

This Strategy has been produced through a working group comprising of officers from across GCC, the district and borough councils, the Environment Agency, the water and sewerage companies, and the Lower Severn Internal Drainage Board. We will need to continue to develop our close working relationship with these organisations to improve the management of flood risk in Gloucestershire. In addition, we will need to establish stronger relationships with local communities to make them aware of the risks they face and to take actions to reduce their exposure and vulnerability to flood risk.

We cannot wholly prevent flooding, though its impacts can be reduced. Indeed, since 2007 GCC has invested over £2 million every year in flood risk management and it is estimated that in November and December 2012 over 500 properties would have flooded had various schemes implemented by local authorities and the Environment Agency not been in place. We will continue to reduce flood risk in Gloucestershire through investment, good planning and management, and by working together with our partners, other organisations and local communities.

This Strategy is the first step in ensuring we have a sound framework for managing flood risk in Gloucestershire over the next 5-10 years, and further work and funding will be required to ensure successful delivery of the measures outlined in the Strategy.

[redacted]

Contents

1. Introduction

1.1. Why flood risk is important in Gloucestershire

1. Flooding is a natural process which shapes the environment, providing benefits including the recharge of groundwater, improvement of soil fertility, maintenance of ecosystems in river corridors, and floodplain biodiversity. However, floods can also threaten life and cause substantial negative social and economic effects. This was demonstrated during the summer 2007 flooding in Gloucestershire where approximately 5,000 residential properties and 500 non-residential properties were flooded, 135,000 people were left without water for 2 weeks due to flooding at Mythe Water Treatment Works, and flooding was experienced along major transport routes such as the M5. Furthermore, the more recent flooding in November and December 2012 in Gloucestershire served as a reminder of the impact of flooding on people and communities, although the consequences were significantly reduced in nature as a result of the investment in flood risk management across the county since 2007.

2. A future increase in precipitation and sea level rise due to climate change is likely to cause an increase in flood risk in Gloucestershire, although the nature and extent of this increase remains uncertain.

3. Given the scale of existing risk and the predicted increase in future flood risk, it is vital that organisations and local communities work together to better understand flood risk and seek to reduce flood risk to people and property where it is economically, technically, socially and environmentally feasible. It is important to recognise that flooding cannot be wholly prevented, though its impacts can be reduced through investment to mitigate flood risk and good planning and management.

1.2. Why are we producing a Strategy?

4. In 2010 Gloucestershire County Council (GCC), became a Lead Local Flood Authority (LLFA) under the Flood and Water Management Act[1]. The requirements of the Act and the duties it hands to LLFAs means that GCC, like other Local Authorities across the Country, is now responsible for the management of flood risk related to **groundwater, surface runoff and ordinary watercourse flooding**. This is referred to as ‘local flood risk’ in the Flood and Water Management Act.

5. A key component of the Flood and Water Management Act is that GCC, must ‘develop, maintain, apply and monitor a strategy for local flood risk management in its area’. The Local Flood Risk Management Strategy (herein referred to as the ‘Local Strategy’) provides the vision and direction to enable flood risk management in Gloucestershire, and must be consistent with the National Flood and Coastal Erosion Risk Management Strategy published by Defra and the Environment Agency[2]. This Strategy is the means by which the Council will discharge its duty to provide leadership and coordinate flood risk management in Gloucestershire.

6. The Local Strategy is therefore an important new tool to help individuals, communities, businesses and authorities understand and manage flood risk within the county. The Local Strategy will be used by GCC and Risk Management Authorities to help plan and co-ordinate investment in flooding. In addition,

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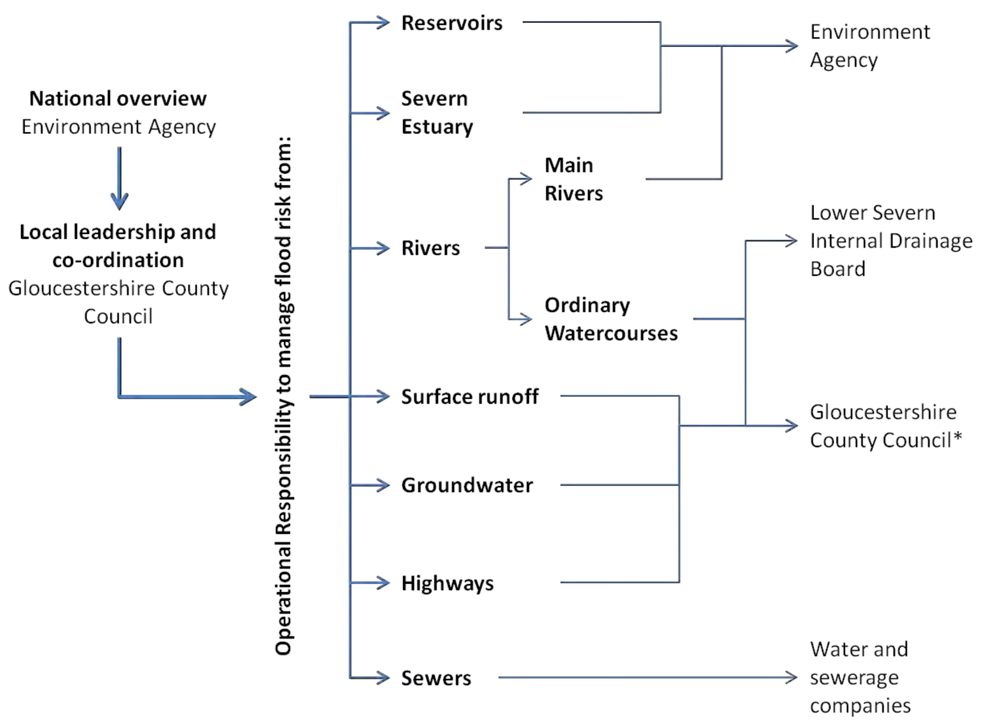
[1] http://www.legislation.gov.uk/ukpga/2010/29/contents

[2] http://www.environment-agency.gov.uk/research/policy/130073.aspx

members of the public can use the Local Strategy to better understand how flood risk will be managed over the next 10 years. Its **primary focus** is flooding from surface runoff, groundwater or ordinary watercourses such as streams and ditches, which we are now directly responsible for managing under the Act. Flooding from surface runoff, groundwater or ordinary watercourses is becoming increasingly common, and is becoming increasingly important, but until recently there has been little understanding of the risks or actions to address the risk.

7. It is important to note that different organisations are responsible for managing drainage and flood risk from different sources. These are summarised in Figure 1-1, which outlines which organisations have operational responsibility for different parts of flood risk management. The roles and responsibilities are explained further in Section 3.1 and Appendix C of the Local Strategy. The Environment Agency still retains responsibility for tidal/coastal and Main River flooding, and water and sewerage companies are responsible for managing flooding from the sewer network. Furthermore, the Lower Severn Internal Drainage Board remains responsible for drainage and ordinary watercourses in some of the low lying areas in Gloucestershire. Given the significant flood risk from Main Rivers, the Severn Estuary, and the sewer network in Gloucestershire the Local Strategy does not ignore risk management issues arising from these sources.



NB: in partnership with the 6 lower tier authorities in Gloucestershire who have powers to undertake works on ordinary watercourses, and have some delegated responsibility under the Flood and Water Management Act. In addition the lower tier authorities are category 1 responders for emergencies and are the planning authority.

Figure 1-1 Responsibility of different organisations for flood risk management

8. We recognise that for those who suffer flooding it matters little what type of flooding is causing the problem. Therefore, GCC will seek to take a leadership and co-ordinating role in managing flood risk irrespective of the cause of flooding. This does not mean that GCC will act as the lead organisation on all types of flooding. Rather, we will work within the legislative framework to identify the appropriate

organisation to take a lead in any given location, working in partnership with other organisations as necessary. This will increase accountability and transparency to the public.

1.3. What does the Local Strategy cover?

9. Building on other plans and policies (see Section 1.5) the Local Strategy identifies the extent of flooding in Gloucestershire, establishes priorities for managing flooding from surface runoff, groundwater and ordinary watercourses, and identifies how GCC will work together with Risk Management Authorities[3], other stakeholders, and local communities to manage flood risk. It is important to note, that in keeping with our statutory duties, the Local Strategy focuses on flooding from surface runoff, groundwater and ordinary watercourses, whilst considering the linkages with other sources of flooding. However, as part of our leadership role we have identified flood risk which is the operational responsibility of other organisations and will continue to work closely in partnership to support reduction in flood risk across the county irrespective of source. The Local Strategy is made up of several documents, which are outlined in Table 1-1 below.

Name of Document	Purpose of document and summary of contents
Main Document	This is the main strategy document which details the objectives of the Local Strategy and our approach to working in partnership. It also sets out our understanding of flood risk and how we'll prioritise investment in specific locations. It considers broad actions we will take with our partners across the county to manage flood risk. This is supported by a series of Annexes which deal with some of the key issues in detail
Summary Document	This provides an overview of the Local Strategy, including the background, key roles and responsibilities, and actions to manage flood risk
Annual progress and implementation plan	Because there will inevitably be legislative, regulatory and financial changes over this period GCC will need to maintain some flexibility over the delivery period of the Local Strategy. To reflect future uncertainty and maintain flexibility, GCC will develop and maintain an 'annual progress and implementation plan'. The annual progress and implementation plan will provide more specific details on: progress against the Local Strategy objectives; changes which impact the delivery of the Local Strategy (e.g. funding opportunities or legislative changes), and; the priorities for investment for the forthcoming year.
Strategic Environmental Assessment (SEA) Environmental Report	The SEA is a process for considering the potential environmental impacts of addressing flood risk.

Table 1-1 Documents generated as part of Local Strategy

10. It is helpful to describe flood risk management in Gloucestershire in three phases, which are illustrated in Figure 1-2. The Local Strategy is principally concerned with the 'before' phase of flood risk management, by identifying areas at risk of flooding, and taking actions to reduce risk where possible. The 'during' and 'after' phases of flood incidents are led by the Local Resilience Forum partners; the Local Strategy provides an overview of these activities in Section 9.1.18.

[3] Risk Management Authorities are defined in the Flood and Water Management Act as the LLFA, district/borough councils, the Environment Agency, water and sewerage companies, the highways authority and Internal Drainage Boards. Their roles are discussed in Section 2 of the Local Strategy

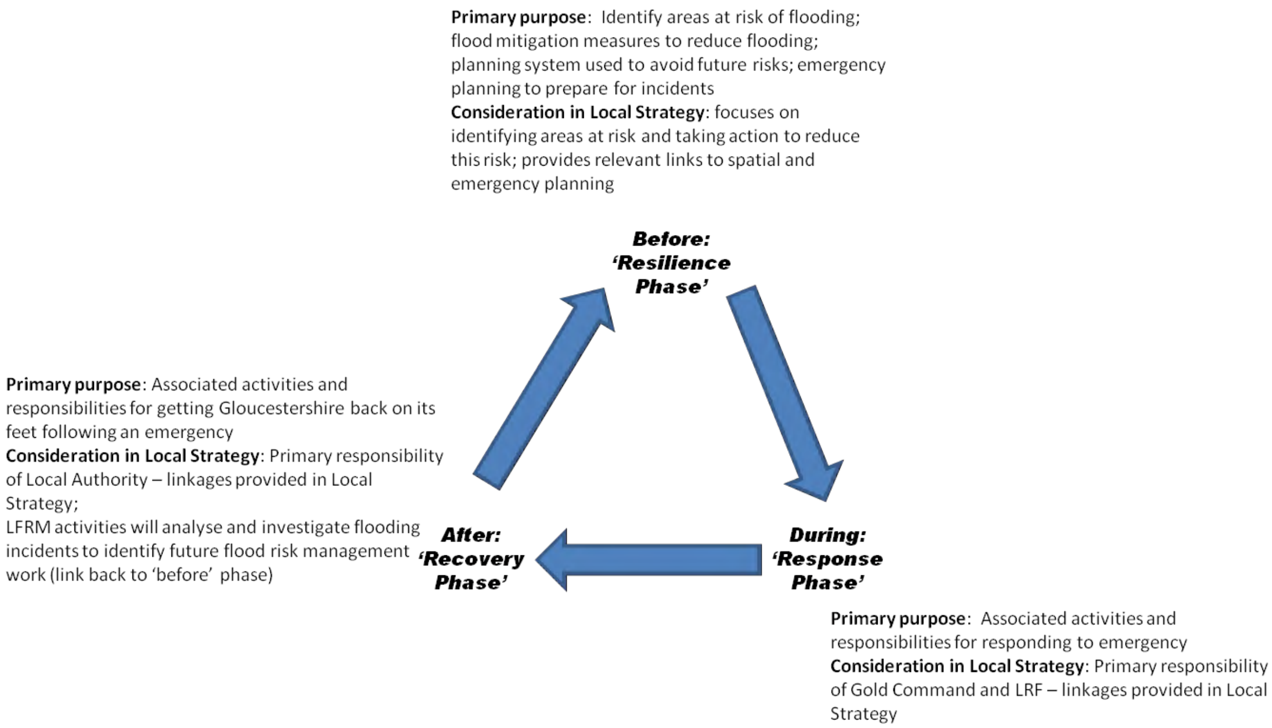


Figure 1-2 Role of Local Strategy before, during and after a flood

1.4. Key principles of the Local Flood Risk Management Strategy

1.4.1. Working with others

11. Due to the integrated nature of flooding in Gloucestershire, successful local flood risk management can only be achieved if Risk Management Authorities, other stakeholders and local communities work together to better understand and manage flood risk. Furthermore, it is imperative that all organisations work together to help communities understand the risks they face and the actions they can take to reduce flood risk to themselves and their properties.

12. The Local Strategy has been developed in partnership with Risk Management Authorities and other stakeholders, and ongoing partnership working will be essential to successfully deliver local flood risk management. Section 2 of this Strategy provides further details on how we will work with others to manage local flood risk. We will also continue to work with neighbouring local authorities to ensure cross-boundary flooding issues are tackled in an integrated way.

1.4.2. Prioritising investment in areas at greatest risk of flooding

13. A key principle of the Local Strategy is that investment will be prioritised, where possible, in areas at greatest risk from local flooding. However, financial resources are limited and considering that solutions may not always be cost beneficial, it may not always be viable to invest in the areas at greatest risk. Funding may sometimes be invested in less vulnerable areas where economically viable 'quick wins' can be delivered. Furthermore, Defra's introduction in 2011 of the partnership funding approach means that the ability of LLFAs to leverage contributions (both financial and in kind) from local partners could

make the difference between locally important projects going ahead or not. The principle of partnership funding is further explained in Section 7.1.

14. Decision-making will be based on the best available information and will ensure that the limited financial resources are directed to highest demonstrable areas of risk within the County. As GCC gains a more complete understanding of local flood risk, the Strategy implementation will be adjusted accordingly.

15. Given the geographical size of Gloucestershire and the scale of flood risk within the county, it is not feasible or desirable for the Local Strategy to provide a detailed breakdown of all future investment needs to manage local flood risk. Rather, the Local Strategy should set out the vision, strategic priorities and direction for investment over the next 10 years. To complement the Local Strategy, GCC and all partners will work together on an annual basis to plan and co-ordinate an 'annual progress and implementation plan'. This plan will identify proposed flood mitigation schemes by Risk Management Authorities for the forthcoming year and will be linked back to the strategic priorities set out in the Local Strategy. The annual progress and implementation plan will enable GCC and other risk management authorities to co-ordinate delivery of flood mitigation measures and monitor progress against investment on an annual basis. It will be accessible as a stand-alone document, published as a supplement to the main Local Strategy document.

1.4.3. Personal responsibility

16. We all have a role to play in managing flood risk. Risk Management Authorities have legal duties and powers to manage watercourses and drainage under a range of different legislation[4] and collectively have undertaken significant investment prior to, and following, the summer 2007 floods to manage flood risk in Gloucestershire. Individuals, communities and businesses can play a key role in reducing their own exposure to flood risk (e.g. property-level resilience and resistance measures[5]) by bagging and binning leaves rather than allowing them to block drains, disposing of cooking fat, oil and grease more responsibly, or getting involved in local flood risk management activities (e.g. through the role of flood wardens). Riparian owners are responsible for maintaining a proper flow of water in any watercourse which drains through their property and there is a community expectation that landowners with such responsibility will, in future, play a greater role in maintaining those stretches of watercourse for which they have legal responsibility[6].

17. To deliver successful local flood risk management will require local communities, businesses and riparian owners to work in partnership with Risk Management Authorities and to take personal actions to help manage flood risk. Furthermore, under new Government funding arrangements, local contributions will be required to secure flood defence funding and we will need to work with individuals, communities and businesses to identify potential sources of local contributions for flood alleviation schemes. This is further explored in Section 3.3 of the Local Strategy.

[4] e.g. Flood and Water Management Act (2010), Environment Act (1995), Land Drainage Act (1991), Water Industry Act (1991), Highways Act (1981)

[5] Advice on how to prepare your property for flooding is available here: http://www.bluepages.org.uk/LinkClick.aspx?fileticket=Facm4b6kASw%3d&tabid=1664

[6] Further advice available here: http://www.gloucestershire.gov.uk/CHttpHandler.ashx?id=26530&p=0

1.4.4. Sustainability and achieving multiple benefits

18. Local Flood Risk Management must be sustainable[7] and should seek to ensure that investment achieves multiple benefits to communities and the environment. For example, more sustainable approaches to local flood risk management tend to work with natural processes that are more adaptive than traditional, hard engineered solutions. A Strategic Environmental Assessment (SEA) Environmental Report has been produced alongside the Local Strategy to ensure that the Local Strategy (and future actions arising from it) are sustainable and take due consideration of environmental requirements.

19. When identifying investment in local flood risk management, Risk Management Authorities should ensure that:

- the investment is sustainable, promotes measures which retain natural river processes, and promotes sustainable drainage and upstream storage over heavily engineered measures where they would be technically, economically and environmentally viable and advantageous;
- the investment seeks to achieve multiple benefits such as water quality, amenity or biodiversity, wherever possible, and;
- the investment is compliant with relevant environmental legislation, including the Water Framework Directive, the SEA Directive and the Habitats Directive.

1.5. Links to other plans, policies, legislation and regulation

20. The Local Strategy is influenced by, and influences, a wide range of other plans, policies and legislation. It is important that the linkages between other plans, policies and legislation are considered to ensure that the Local Strategy is consistent with them, but does not duplicate information already contained elsewhere.

21. Figure 1-3 highlights the linkages between the Local Strategy and other plans, policies and legislation. A more detailed description is provided in Appendix A. There are particularly strong linkages between the Local Strategy and the spatial planning and emergency planning systems, which are discussed below.

1.5.1. Links to spatial planning

22. The spatial planning system aims to provide residential and non-residential development in a timely, affordable and sustainable manner. With respect to flood risk, the spatial planning system seeks to ensure that development is safe from flooding and does not increase flood risk elsewhere. The Local Strategy does not duplicate the existing work completed by local planning authorities in preparation of their Core Strategies (most notably Strategic Flood Risk Assessments). Rather, it focuses on where we can provide additional evidence to support effective spatial planning, ensures local flood risk is adequately considered in planning policy and determines planning applications. This is further discussed in Section 9.1.13 of the Local Strategy.

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[7] Guidance on Sustainable Development indicates that sustainability ‘means making the necessary decisions now to realise our vision of stimulating economic growth, maximising wellbeing and protecting our environment, without negatively impacting on the ability of future generations to do the same’ (available at http://www.defra.gov.uk/publications/files/pb13640-sdg-guidance.pdf

1.5.2. Links to emergency planning

23. Emergency planning focuses on the response to, and recovery from, emergency incidents (including flooding). The Local Resilience Forum (including emergency services, Local Authorities, Environment Agency and Health Authorities), is responsible for working in partnership to plan for and respond to flooding emergencies. Local Authorities are responsible for leading the recovery from flooding incidents. GCC Civil Protection Team has worked with other agencies (including district/borough councils) to coordinate the preparation of Multi-Agency Flood Plans[8] and a Local Authorities Recovery Plan[9] to identify the response to, and recovery from, flooding incidents. As with spatial planning, the Local Strategy does not duplicate existing work of the LRF and local authorities on responding to and recovering from a flood emergency. Rather, it focuses on establishing mechanisms for ensuring that emergency planners have access to, and make use of, the best available data and information on local flood risk. This is further discussed in Section 9.1.18 of the Local Strategy.

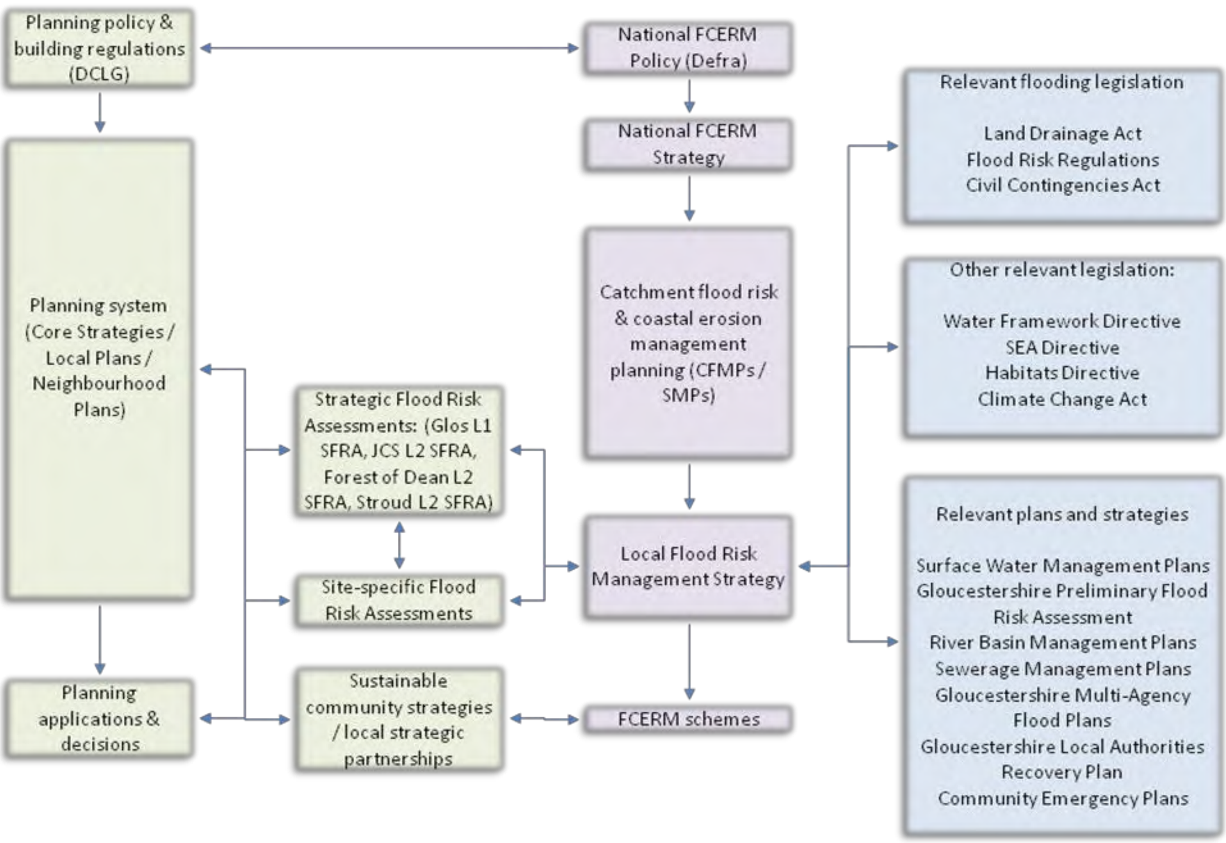

Figure 1-3 **Links between Local Strategy and other plans and policies**

2. Aims and Objectives

24. The aim of this Local Strategy is to work in partnership with local communities, and organisations responsible for managing flood risk, in order to better understand and reduce local flood risk in Gloucestershire where it is economically, technically, socially, and environmentally feasible to do so.

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[8] http://www.gloucestershireprepared.co.uk/plans-and-planning.html

[9] http://www.gloucestershire.gov.uk/CHttpHandler.ashx?id=32794&p=0

25. To achieve this aim there are a number of key strategic objectives. The six key strategic objectives for the Local Strategy are:

1. improve our understanding of local flood risk;
2. put in place plans to manage these risks;
3. avoid inappropriate development and ensure new development does not increase flooding elsewhere;
4. increase public awareness of flooding and encourage local communities to take action;
5. ensure close partnership working and co-ordination with other risk management authorities in Gloucestershire, and;
6. support response to, and recovery from, flooding incidents.

26. Table 2-1 provides a more detailed breakdown of the strategic objectives, alongside the outcomes which should be realised by achieving the objectives. We will review these objectives on an annual basis, to assess performance against the objectives and to assess whether objectives should be added or modified. Section 9.1 of the Local Strategy considers the measures we will take to achieve our objectives.

Breakdown of objectives	Outcome
Strategic objective 1: Improve our understanding of local flood risk	
Identify hotspots of flooding across Gloucestershire using historic and predicted flood risk data	Highest priority locations will be identified which will inform prioritisation and resource allocation
Undertake further studies in areas of greatest flood risk (e.g. GCC or district/borough-led studies)	An improved understanding of flooding and an assessment of potential mitigation measures
Establish and maintain a register of assets and designate assets which have a significant effect on flood risk	An improved understanding of assets and their impact on flood risk. Assets which have a significant effect on flood risk will be protected
Map flood incidents and investigate incidents which are 'locally significant'	Better capture of historic flood incident data will improve decision-making due to better understanding of flooding
Strategic objective 2: Put in place plans to manage these risks	
Identify and plan local investment needs in flood risk management in Gloucestershire on an annual basis, in partnership with other RMAs	Investment will be co-ordinated, targeted and planned on an annual basis, which will be used to identify funding requirements annually
Ensure local flood risk management achieves wider benefits for local communities & the environment, works with natural processes, and contributes to achieving environmental objectives (e.g. Water Framework Directive)	Flood risk management measures will consider wider potential benefits to local communities and work with natural processes to achieve multiple benefits, leading to social, economic and environmental benefits. Flood risk management activities will seek to improve the natural and built environment
Ensure new capital schemes have appropriate maintenance regimes in place which are adhered to	Flood risks schemes will be adequately maintained, ensuring the function as designed
Strategic objective 3: Avoid inappropriate development and ensure that new development does not increase flooding elsewhere	

Ensure local planning authorities use the 'Locally Agreed Surface Water Information[10]' to support spatial planning	Local planning authorities will use the best available information on local flood risk to inform spatial planning
Work closely with County and District planners (including other organisations where relevant) to avoid inappropriate development in areas of flood risk and ensure development does not increase risk elsewhere	Local planning policy will take account of local flood risk in allocating development. Development will be safe and not increase the risk of flooding elsewhere
Ensure the design, construction, operation and maintenance of Sustainable Drainage Systems in new developments and redevelopments meet national standards	New developments will have surface water drainage which meets national standards, ensuring adequate drainage provision is in place
Seek earlier consultation with developers to ensure they are cognisant of drainage requirements at an early stage of site master planning	Drainage will be considered at an earlier stage of the development process, helping to ensure a more optimal drainage strategy for development sites
Strategic objective 4: Increase public awareness of flooding and encourage communities to take action	
Work in partnership with communities to build awareness of local flood risks	Communities will be better informed of their vulnerability to flooding
Work with communities to develop an understanding of how they can adapt to change and better protect their properties	Communities will know what action they can take to reduce their vulnerability to flooding
Work with communities to be actively involved in local flood risk management, e.g. through the role of flood wardens	Communities will play an active role in local flood risk management
Strategic objective 5: Ensure close partnership working and co-ordination with other risk management authorities and the public	
Ensure that all risk management authorities' roles and responsibilities are clarified and that there is ongoing partnership working to realise these roles and responsibilities and to maximise joint working and funding opportunities	Risk management activities will be well co-ordinated, with all partners having clarity about their responsibility, whilst ensuring close working relationships between risk management authorities
Establish and develop mechanisms to facilitate effective sharing of information between risk management authorities	Relevant information will be shared between risk management authorities to assist in local flood risk management, wherever possible
Improve co-ordination and partnership working with local communities, through parish/town councils and local flood action groups	Local communities will be more involved in flood risk management, making best use of local knowledge and expertise
Strategic objective 6: Support response to, and recovery from, flooding incidents	
Encourage the formation of local flood action groups and volunteer community flood warden schemes to assist in planning local responses to flooding	Local communities will be better prepared for flooding, which will enable a quicker response should a flooding incident occur
Encourage local communities to sign up to flood warnings where available	Local communities will have advance warning of likely flooding, which will help them to respond and recover more quickly
Support communities and individuals in the event of floods and recovery thereafter	Local communities will recover more quickly in the event of a flooding incident

Table 2-1 Objectives for the Local Strategy

[10] Includes ordinary watercourses

3. Working with others

27. No one organisation can deliver the aims and objectives of the Local Strategy in isolation and therefore we will need to work together with other stakeholders. This section of the Local Strategy outlines who we will work with, their roles and responsibilities, and how we will work with them. Broadly, there are three categories of organisations and people who we will need to work with, each of which is discussed in the subsequent chapters. As part of the development of the Local Strategy, consultation has been undertaken with Risk Management Authorities, other FRM stakeholders and the public and local community groups.

- Risk Management Authorities, as defined by the Flood and Water Management Act (2010), which includes GCC as a LLFA, district councils, the Environment Agency, internal drainage boards, water companies and highway authorities [NB: this includes relevant departments and service areas within GCC and districts/boroughs including Gloucestershire Highways, property services, strategic planning, development co-ordination, legal services, environmental health, neighbourhood management teams, and Civil Protection Team];

- other flood risk management stakeholders, which are defined as organisations who have a responsibility for drainage and flood risk management, or who may be affected by the Local Strategy (e.g. Network Rail, Natural England, English Heritage), and;

- public and local community groups, which includes parish/town councils, flood action groups, businesses, and individuals.

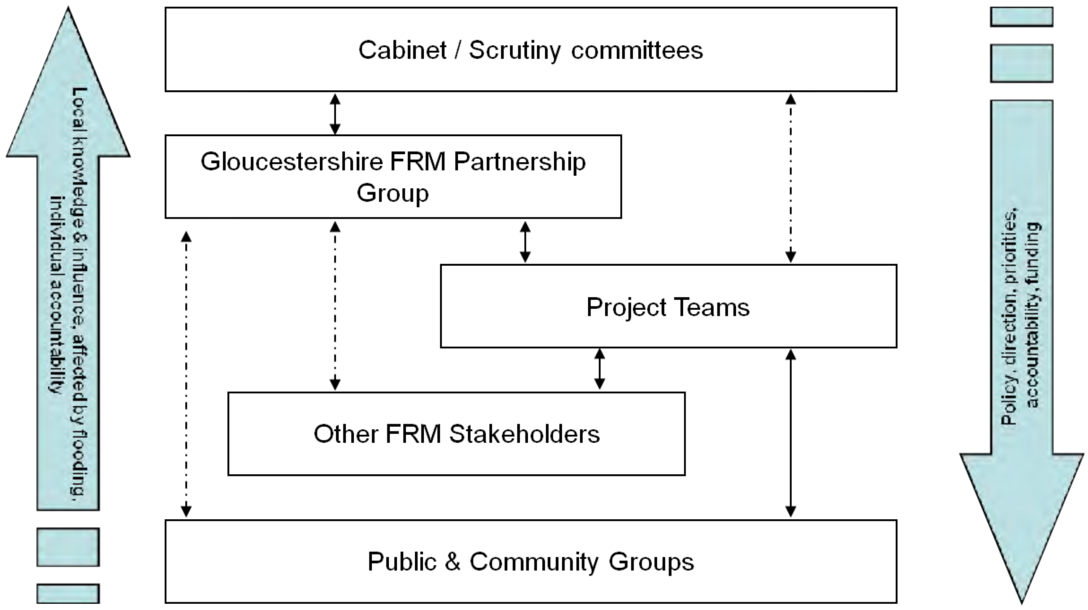

Figure 3-1 Partnership model for local flood risk management

28. Figure 3-1 outlines the partnership model to be adopted in Gloucestershire. GCC Cabinet and Scrutiny Committees will monitor and provide feedback on the Local Strategy and progress on managing flood risk. The Gloucestershire FRM partnership group consists of representatives from the Risk Management Authorities, and its main purpose is to help co-ordinate and implement flood risk management in Gloucestershire, and to develop and deliver the Local Strategy.

29. Project teams will be formed to deliver specific work or projects (e.g. deliver a flood alleviation

scheme or flood study). Whilst they will primarily be formed of Risk Management Authorities they will need to establish strong links and work in partnership with other flood risk management stakeholders, and the public to ensure effective delivery. The Gloucestershire FRM partnership group will also establish linkages with other flood risk management stakeholders and the public, but this will be less direct and frequent than engagement through Project Teams.

3.1. Working with Risk Management Authorities

30. Risk Management Authorities are defined in the Flood and Water Management Act as the lead local flood authorities, district councils for areas where there is no unitary authority, the Environment Agency, internal drainage boards, water companies and highway authorities. The geographical coverage of these authorities, in the context of Gloucestershire's county boundary, is illustrated in Appendix B. Relevant authorities must co-operate with each other in exercising functions under the Act and can delegate functions to each other by local agreement (except for the Local Strategy which GCC cannot delegate).

3.1.1. Functions of Risk Management Authorities

31. A detailed breakdown of the roles and responsibilities of the Risk Management Authorities is provided in Appendix C, and a brief overview is provided below.

32. **Gloucestershire County Council** is the Lead Local Flood Authority and is responsible for taking the lead in managing flood risk from local sources. This includes surface water, groundwater and ordinary watercourses and also where there is an interaction between these sources and main rivers or the sea. The county council also has other related roles in emergency planning and highway drainage.

33. The **Environment Agency** is responsible for managing flood risk from main rivers, reservoirs and the sea, and also has a strategic overview role over all flood and coastal erosion risk management. It also has a key role in providing flood warnings to the public, supporting emergency responders when flooding occurs, protecting and improving the environment and promoting sustainable development.

34. **Severn Trent Water, Thames Water, Welsh Water and Wessex Water** are the water and sewerage companies responsible for the provision and disposal of foul and surface water sewerage.

35. The **Highways Agency** and **Gloucestershire Highways** are responsible for managing flood risk and drainage on highways within the county.

36. Within Gloucestershire there are **six City, District or Borough Councils** who have powers to undertake flood risk management work on ordinary watercourses. The City, District or Borough Councils are also category 1 responders to emergencies and are responsible for assisting in the preparation of Multi-Agency Flood plans. They are also the Local Planning Authorities with responsibility for preparing Local Plans and determining planning applications.

3.1.2. Partnership approach with Risk Management Authorities

37. After the 2007 floods, GCC acted quickly to establish the Gloucestershire Flood Risk Management (FRM) Partnership Group; a multi-agency group that included representatives from GCC (including Civil Protection Team, Planning, Development Co-ordination and Gloucestershire Highways representatives), the Environment Agency, Severn Trent Water, Thames Water, Welsh Water, Wessex Water, Lower Severn Internal Drainage Board and all the local Districts/Borough Councils.

38. The group was active countywide, providing a forum for discussing strategic and legislative issues, collaborative working and identifying where multi-agency action could be effective. The relationships that were built early on have helped the progression of joint-funded schemes on a District by District basis, and have included work such as de-silting, culvert improvement and watercourse modelling. The Partnership group was re-formed in 2012 and the Local Strategy has been developed collectively by the representatives on this new partnership group.

39. In addition to the Gloucestershire FRM Partnership Group, project teams will also need to be formed to deliver specific work or projects. These teams will be project focussed and will comprise of different Risk Management Authorities and stakeholders, depending on the nature of the flood risk in a given location. At the outset of a project the lead organisation should pro-actively engage with other Risk Management Authorities, especially where flooding is the responsibility of multiple organisations (e.g. sewer and surface water flooding), which may offer opportunities for joint investment to alleviate flooding. It is also worth noting that project teams from different Risk Management Authorities may need to work together to help deliver the requirements of the Water Framework Directive.

40. Project teams have been or will be formed across Gloucestershire to: deliver specific studies where partnership working is required (e.g. Surface Water Management Plans or Water Framework Directive schemes); deliver flood alleviation schemes (e.g. Bourton on the Water), or; support implementation of the FWMA (e.g. implementing, consenting and enforcement).

41. Within the Risk Management Authorities there are other internal departments and service areas outside the core flood risk management team, who may have a role in local flood risk management. Within GCC, the relevant internal service areas are identified in Figure 3-2 (other Risk Management Authorities will have their own internal departments and service areas). Risk Management Authorities will need to be cognisant of other internal departments and service areas, and will need to engage with them where relevant, during the delivery of further studies or flood alleviation projects.

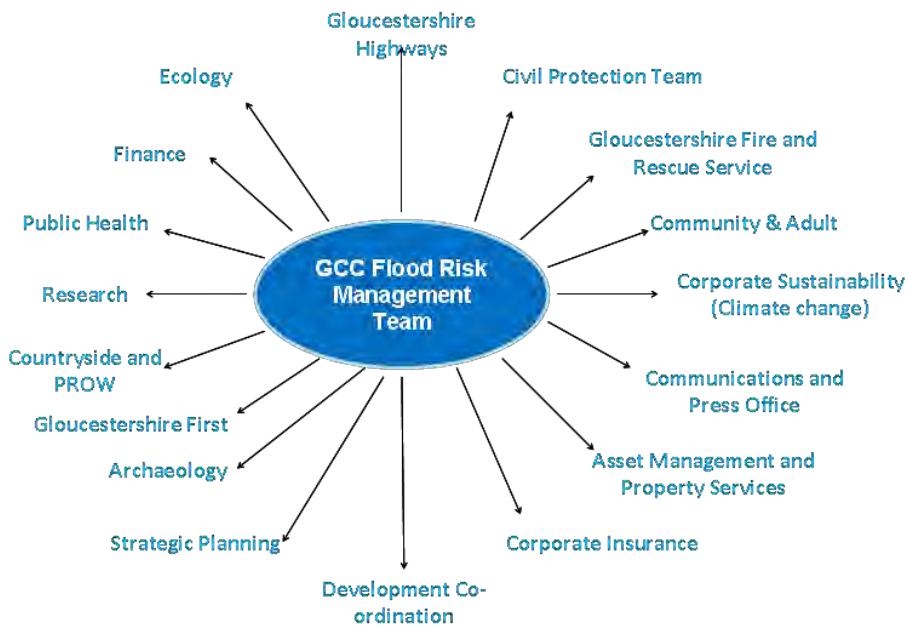

Figure 3-2 **Relevant internal service areas in GCC**

3.2. Working with other relevant Flood Risk Management stakeholders

42. There are a range of other relevant organisations that have a key role to play in local flood risk management, have a responsibility for drainage and flood risk management, or may be affected by the Local Strategy. Table 3-1 identifies these stakeholders and considers their role in local flood risk management and how Risk Management Authorities should engage with them. These stakeholders will primarily be engaged when needed to support flood alleviation projects, or to provide information, support and input on a project-by-project basis.

Stakeholders	Role in LFRM	Method of engagement
Association of British Insurers	Represent the UK insurance industry and to government, regulators and policy makers (including flooding)	Providing advice and comments where necessary
Canal & Rivers Trust	Ownership and maintenance of 2,000 miles of waterways and associated assets in England and Wales	Through project teams where required
Department for food and rural affairs (Defra)	Government department responsible for setting policy for flood risk management in England	Responding to consultations and inquiries
Developers and house builders	Ensuring new developments are designed to avoid flood risks on-site and no increase in downstream risk	As the SUDS Approval Body role is developed to ensure they know the required standards
Emergency Services	Respond to emergency situations Gloucestershire Fire & Rescue Service keep records of flood incidents responded to	Through MAFP working group and Strategic Coordinating Group (multi-agency Gold)
English Heritage	Government adviser on historic places and heritage	Through project teams where required
Highways Agency	Responsible for operating, maintaining and improving strategic road network (motorways and trunk roads) in England, including drainage	Through project teams where required
Housing Associations	Provide social housing for local communities	Sharing information on areas vulnerable to flooding & providing advice on property protection
Land owners & land/estate managers	Responsible for maintaining proper flow of watercourses (as riparian owner). Access and acquisition of land may be required for flood alleviation schemes	Through project teams where required
Local Government Association (LGA) & Local Government Information Unit (LGIU)	Voluntary lobbying organisation which advocates the local government sector	Sharing best practice and responding to queries
Met Office & Flood Forecasting Centre	Provide extreme rainfall alerts and daily flood guidance statements	Officer communication on local authority needs
National Farmers Union	Champions British farming and provides professional representation and services to its Farmer and Grower members	Through project teams where required
Natural England	Government's advisor on the natural environment, and provide practical advice, grounded in science, on how best to safeguard England's natural wealth. Issues licences and consents to carry out work involving protected species	Through project teams where required
National Flood Forum	Provides support and advice to communities and individuals that have been	Encourage local communities to take advice from NFF where they

Stakeholders	Role in LFRM	Method of engagement
	flooded and stimulates the formation of community groups in areas at risk of flooding	are seeking to establish action groups
Neighbouring local authorities	Responsibilities for LFRM within their area and to understand impacts of work/opportunities elsewhere within river catchments	Sharing information to assist with responsibilities and seek consistency, where possible
Network Rail	Authority responsible for UK's railway network, including drainage of railways and ownership of rail assets (e.g. culverts, bridges)	Through project teams where required
Regional Flood and Coastal Committee (RFCC)	The RFCC is a committee established by the Environment Agency under the Flood and Water Management Act 2010 that brings together members appointed by Lead Local Flood Authorities (LLFAs) and independent members with relevant experience. Amongst other roles they administer the local levy	Through local RFCC member
Town and Parish Councils	Source of local knowledge, funding and are consultees in the planning process	Through project teams where required
Universities (e.g. Gloucester and Oxford)	Develop flood science and officer knowledge	Through ongoing dialogue to continue learning opportunities
Utility companies (other than water companies)	Hold network plans for various utilities Undertake flood alleviation management work to protect their own assets as necessary.	Through project teams where required
Voluntary Sector Groups	Provide local support before and during a flood	Principally through involvement in projects and with Civil Protection Team
Sky Watch Civil Air Patrol (SWCAP)	Liaise with the local units to understand the role they can play before, during and after flood incidents	Principally through involvement in projects and with Civil Protection Team

Table 3-1 Other relevant flood risk management stakeholders

3.3. Working with the public and local community groups

43. It is particularly important that we effectively work with the public and local community groups[11] to make sure the county's residents, businesses, and services are better prepared to cope with future floods and to ensure the public are fully informed about the work GCC is doing to reduce the likelihood of future flooding.

44. Our vision is that the public and local community groups are made aware of the flood risks they may face, take action to reduce their vulnerability to flooding, be actively involved in flood risk management, and work with Risk Management Authorities to assist in delivery of flood mitigation work, taking safe precautions in the event of a flooding incident[12]. To achieve this vision, engagement and partnership working will need to take place at different stages, which are discussed below.

[11] When referring to the public and local community groups the Local Strategy is considering: individual members of the public; parish/town councils and residents associations; local flood action groups; resident/community groups; businesses and chambers of commerce, and; riparian owners

[12] Details of which can be found at http://www.gloucestershire.gov.uk/flooding

3.3.2. Stage 1 – raising awareness

45. The **purpose** of this stage is for GCC, in partnership with other Risk Management Authorities, to raise awareness of local flood risk across Gloucestershire, and to encourage local communities to take action to reduce their vulnerability to flooding. The involvement of local communities, primarily through town and parish councils, will be critical in raising awareness of flooding and promoting action. We are working with the Civil Protection Team to develop key messages and approaches as part of this process.

46. The **key messages** which should be communicated are: how different organisations are working together to deliver local flood risk management and the importance of public involvement; the need for a greater level of individual and community responsibility to reduce vulnerability to flooding, and; flood risk can never be eliminated, but working together we can seek to manage this risk to mitigate the probability and consequences of flooding.

47. We will use multiple approaches to raise awareness of local flood risk and to encourage local communities to take action. These are described in Table 3-2.

Method of engagement	Details of Local Strategy approach
Website	• Publish the 'annual implementation and progress plan' so that local communities are aware of planned and completed flood risk management works • Provide clarity on roles and responsibilities in flood risk management, and relevant contact details (e.g. who to contact in the event of a flood) • Provide details of actions local communities can take to reduce their vulnerability to flooding (see Appendix D for more information)
TV / Newspaper articles / Radio	• Targeted campaigns to encourage local communities to take action (e.g. fats, oil and greases campaign prior to Christmas or preparation of flood plan) • Information on planned and completed flood risk management works to assure the public of ongoing commitment and action
SkillZONE	• This facility, which opened in 2012, allows visitors to experience 'risks' and management of those risks within a safe learning environment. It includes flood prevention, resilience and advice in its scenarios. The centre has classroom and cinema facilities also available, which with agreement, could be used to offer targeted awareness training for residents and businesses.
Community events	• Where community events are happening in an area of known flood risk, Risk Management Authorities should investigate whether they can attend to engage with local residents about flood risk (e.g. community resilience work / community emergency planning promoted by the districts or fire station open days)
Parish/Town Councils and Chambers of Commerce	• Provide information on planned and completed flood risk management works, and promote personal resilience through monthly briefing • Undertake specific engagement activities (e.g. attendance at parish council meetings) to outline actions local communities can take to reduce their vulnerability to flooding

Table 3-2 Typical engagement activities for stage 1 engagement

3.3.3. Stage 2 – targeting at-risk communities

48. The **purpose** of this engagement will be to engage with specific local communities as part of a flood study (e.g. Surface Water Management Plan) or flood alleviation scheme.

49. The Local Strategy confirms that as part of a flood study or flood alleviation scheme, the lead organisation should prepare an engagement plan which sets out:

- the stakeholders who need to be engaged (including other Risk Management Authorities, other FRM stakeholders, local community groups and the public);

- how the stakeholders will be engaged (e.g. drop-in sessions) and how will the input of stakeholders affect the decision-making process;
- when the stakeholders will be engaged, and;
- key messages for engagement activities.

50. Engagement at this level is critical to ensure that relevant stakeholders are involved in the decision-making process, which will help to ensure that proposed works have the support of, and are acceptable to, relevant stakeholders and are suitably funded. It will be for the project team to determine the appropriate stage of the project to engage with local communities.

51. Engagement will include embracing the principles of 'Partnership Funding' to maximise the potential of securing funding of any proposed works. Furthermore the project team should ensure that the criteria for securing funding are well understood by local communities.

52. As the nature and consequences of flooding varies, and each local community is different, the nature of engagement activities will vary from place to place. However, it is recommended that a diverse range of methods are used to engage with local communities and the public. This could include: radio or TV interviews, newspaper articles, use of social media, leaflet drops, advertising in local community shops or centres (e.g. libraries / supermarkets), or drop-in sessions, for example. Local councillors (county, district/borough and/or parish councillors) should be engaged to provide advice on suitable engagement approaches, embracing local knowledge of their communities.

4. Our understanding of flooding in Gloucestershire

4.1. Characteristics of Gloucestershire

53. Gloucestershire commands a predominantly rural setting, with population centred around the main urban areas of Gloucester, Cheltenham, Stroud and Cirencester, though numerous towns and villages exist. The County is drained predominantly by the lower reaches of the River Severn, which flows through the centre of Gloucestershire from the north east to the south west. The Cotswold Hills to the east of the County and the upland areas of the Forest of Dean to the west form the Severn's catchment boundary; areas which are in sharp contrast to the lowland river valley. To the south east of the Cotswold Hills lie the headwaters of the River Thames catchment, draining the majority of the Cotswold District. The western side of the Forest of Dean is drained by the River Wye, which forms most of the county boundary in this area and meets the Severn Estuary between Sedbury and Chepstow.

54. A comprehensive review of the rivers, hydrology, geology and topography within Gloucestershire was undertaken as part of the Level 1 Strategic Flood Risk Assessments which were completed in 2008, which is available at. http://www.gloucestershire.gov.uk/extra/index.aspx?articleid=17247.

55. A map of the location of Gloucestershire's main rivers / ordinary watercourses is shown in Appendix B

4.1. Our understanding of historic flooding in Gloucestershire

56. Gloucestershire has a long history of flooding. There have been the following major flood incidents in Gloucestershire:

- Cheltenham Borough – July 1968 and Summer 2007;
- Cotswold District – March 1947, July 1968, August 1977, September 1992, October 1993, April 1998, December 2000, Summer 2007 and January 2008;
- Forest of Dean District - March 1947, July 1968, December 1981, December 2000, Summer 2007;
- Gloucester City – January 1939, March 1947, July 1968, December 1981, January 1990, December 2000, Summer 2007;
- Stroud District – January 1939, March 1947, December 1965, July 1968, December 1981, January 1990, December 2000, Summer 2007, and;
- Tewkesbury Borough - January 1939, March 1947, July 1968, December 1981, 1985, January 1990, April 1998, December 2000, Summer 2007.

57. In the summer 2007 Gloucestershire experienced one of the most significant flood incidents seen in the UK. Following a relatively dry spring the summer was one of the wettest on record. Heavy rainfall at the end of June led to flooding in some areas in Gloucestershire, both from surface water overloading the drainage systems and very high water levels in rivers and brooks. Heavier rain fell in July and on the 20th July the equivalent of two months' rain fell in 14 hours. A summary of the impact of flooding across Gloucestershire is provided below:

- **5,000** homes and businesses were flooded (**80%** of properties were affected were overwhelmed by flash flooding), and **500** businesses were affected;

- **48,000** homes were without electricity for two days;
- Mythe water treatment works was flooded on 22nd July, resulting in **135,000** homes (over half the homes in Gloucestershire) being without drinking water for up to 17 days;
- **825** homes were evacuated resulting in approximately **1,950** people (including **490** children) seeking temporary accommodation;
- **10,000** motorists were stranded on county roads, including the M5 where many people remained overnight, and **500** commuters were stranded at Gloucester train station;
- over **2,500** people were accommodated in local authority rest centres, many of them commuters from the motorway and rail network, and;
- the estimated cost to repair the county's roads was **£25 million**.

58. Due to the scale and impact of the summer 2007 floods, the majority of detailed flood incident records in Gloucestershire are associated with the summer 2007 floods. Figure 4-1 below shows a breakdown of numbers of flooded properties in 2007 by each of the district councils. Further details on the impacts of the summer 2007 flooding by district are provided in Appendix E.

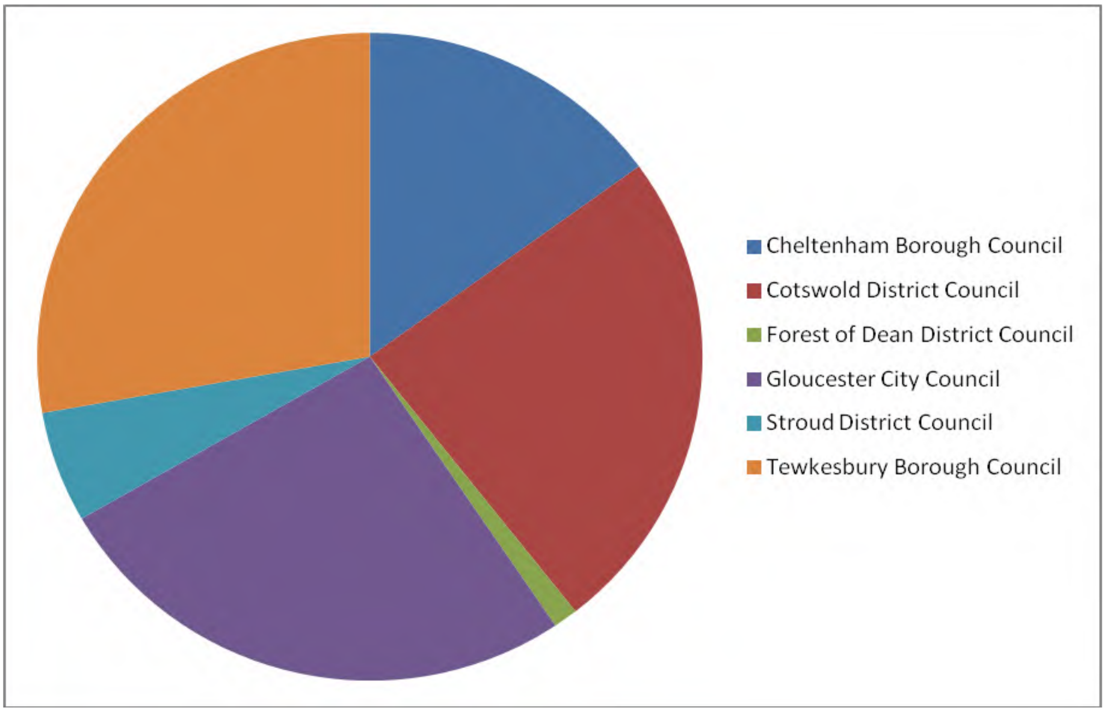

Figure 4-1 Summary of flooded properties during summer 2007 floods

59. Gloucestershire has also suffered significant flooding in both November and December 2012. It is estimated that 125-150 properties suffered flooding during November 2012, although GCC and Environment Agency estimated that over 500 properties would have flooded had various schemes implemented by local authorities and the Environment Agency not been in place. Nevertheless the flooding in November and December 2012 served as a reminder of the impact of flooding on people and communities, and that flood risk remains a big issue in the county.

4.2. Our understanding of current flood risk in Gloucestershire

60. In addition to collating anecdotal evidence of historic flooding there are tools and methods available to assess the risk of future potential flooding from a range of sources (where risk equates to the **likelihood** of flooding occurring multiplied by the **consequence** of flooding to people, property and the environment). The nature of flood risk is highly variable across Gloucestershire, both in terms of the scale and sources of flood risk. The following sources of flood risk are considered in the Local Strategy[13]:

- flooding from surface runoff (part of local flood risk);
- flooding from ordinary watercourses (part of local flood risk);
- flooding from groundwater (part of local flood risk);
- flooding from highways;
- flooding from Main Rivers (responsibility of the Environment Agency), and;
- flooding from sewerage systems (responsibility of water and sewerage companies).

61. Mapping of flood risk from Main Rivers (and some ordinary watercourses[14]) has been undertaken by the Environment Agency for over 10 years, and as such understanding of flood risk from Main Rivers is well advanced. However, the assessment of flood risk from other sources of flooding (most notably surface runoff, the majority of ordinary watercourses and groundwater) is rather more in its infancy, although knowledge is rapidly improving as new studies and assessments are undertaken. GCC is currently increasing its knowledge of surface water flood risk through a number of Surface Water Management Plans (SWMPs) and groundwater knowledge through a groundwater management plan (GWMP) for the county.

4.2.1. Assessment of flood risk from surface runoff and ordinary watercourses

62. Much work has been undertaken in the past 5 years to better understand flood risk from surface runoff and ordinary watercourses both nationally and locally though surface water modelling and mapping.

63. In December 2013 the Environment Agency released its most comprehensive and up to date surface water mapping. This has been adopted across Gloucestershire as the 'Locally Agreed Surface Water Information'

64. As the 'locally agreed surface water information' represents the best available information on areas which are most likely to flood, all Risk Management Authorities should principally use this when assessing whether an area is vulnerable to surface water flooding. A GIS layer of flood extents of the 'locally agreed surface water information' has been distributed to the Risk Management Authorities. In some locations GCC and the districts/boroughs have access to more detailed mapping outputs (e.g. from SWMP), which are used to plan and design flood mitigation schemes. However, for spatial and emergency planning, and

[13] It should be noted that whilst the Local Strategy considers flood risk from all sources, future investment resulting from the Local Strategy will be focussed on areas at greatest risk from local sources of flooding (surface runoff, ordinary watercourses and groundwater).

[14] The Environment Agency's Flood Map only consider watercourses where the upstream catchment is >3 km2, therefore many ordinary watercourses will not be included

to broadly understand surface water flood risk across Gloucestershire, the 'Locally Agreed Surface Water Information' should be used. Based on the 'Locally Agreed Surface Water Information' over 9,000 residential and non-residential properties, and 115 critical services (e.g. schools) are vulnerable to surface water flooding to a depth of >0.3m during an extreme rainfall event similar to that experienced in Cheltenham in July 2007.

4.2.2. Assessment of vulnerability to groundwater flooding

65. Current understanding of groundwater flooding is very limited due to the complexities of representing the flow and emergence of groundwater. Existing approaches have tended to focus on the **susceptibility** of areas to groundwater flooding.

66. The Environment Agency has produced a groundwater susceptibility map, known as the 'Areas Susceptible to Groundwater Flooding map', which identifies vulnerability to groundwater flooding on a 1km square grid. This map has been used to identify vulnerability to groundwater flooding within Gloucestershire by calculating the number of 1km squares within a parish/ward which fall within the different percentage classifications outlined above. It must be noted that due to the level of confidence in the dataset this map should only be used to identify broad areas (rather than individual properties) which are vulnerable to groundwater flooding and hence may need further investigation. Based on the analysis of this map, the locations most vulnerable to groundwater flooding are shown in Appendix B and outlined below:

- in the south of the Cotswolds, including the parishes of Somerford Keynes, South Cerney, Down Ampney, Kempsford, Fairford and Lechlade;
- in the east of the Cotswolds, including the parishes of Adlestrop, Donnington, Longborough and Moreton-in-Marsh, and;
- the Severn Vale, including parts of the parishes of Tewkesbury, Forthampton, Deerhurst, Tirley and Twyning.

67. GCC is currently undertaking a scoping study to assess what further work can be done on a local scale to improve understanding of groundwater flooding across Gloucestershire. The outputs from the scoping study will help to inform future investigations required to enhance our understanding of groundwater flood risk.

4.2.1. Assessment of flooding from highways

68. Gloucestershire Highways (GH), which is part of Gloucestershire County Council, is responsible for the provision and management of highway drainage and highway ditches under the Highways Act (1980)[15]. GH have developed a priority list of potential highway improvement schemes, which is used to plan and deliver a prioritised programme of highways maintenance and improvement schemes to help reduce the risk of flooding from highways. This list is based on known flooding issues associated with highways.

69. Furthermore, GH receives phone calls from residents about flooding and drainage problems associated with highway drainage. These are captured on a Public Enquiry Manager (PEM) form, which is then used as the basis for follow up contact and works. GCC's FRM team have access to the PEM forms,

[15] With the exception of trunk roads (e.g. A40, A417) and motorways which are managed by the Highways Agency

and capture the relevant PEM records into the GCC GIS[16]; this enables the FRM team to build up a complete picture of highway flooding. Highway flooding issues captured in GH's priority list and PEM forms will be cross-referenced with information on local flood risk to ensure that potential overlaps (and hence funding opportunities) are identified.

4.2.2. Assessment of flood risk from Main Rivers

70. The Environment Agency has permissive powers to manage flood risk from Main Rivers on a priority basis. However, in Gloucestershire flood mechanisms are complex, and flooding sources are intertwined. Furthermore, in parts of Gloucestershire the performance of urban drainage systems can be heavily influenced by levels in Main Rivers. Therefore, whilst the Local Strategy focuses on investment needs to manage local flood risk, an understanding of flood risk from Main Rivers and how this interacts with local flood risk is critical. Flooding from Main Rivers has been incorporated into our prioritisation methodology. With respect to Main Rivers the locations below are most at risk of flooding. In all cases there is likely to be more than one source and close partnership working will be needed.

71. The parishes and wards with more than 100 residential and non-residential properties at 'significant'[17] risk of fluvial flooding are outlined below:

- Awre;
- Barton and Tredworth Ward;
- Cirencester;
- Kingsholm and Wotton Ward, Gloucester;
- Lansdown Ward, Cheltenham;
- Longford;
- Lydbrook
- Moreland Ward, Gloucester;
- Nailsworth;
- Newland;
- Rodborough;
- Stroud;
- Tewkesbury, and;
- Westgate Ward, Gloucester.

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[16] This is further described in Chapter **Error! Reference source not found.** on how we will investigate flooding incidents

[17] 'Significant' flood risk is defined as flood risk of greater than 1 in 75 chance of occurring in any given year

4.2.3. Assessment of flood risk from the Severn Estuary

72. With respect to flooding from the Severn Estuary, the Environment Agency's draft Severn Estuary Flood Risk Management Strategy[18] provides an overview of the current and future investment needs and proposals for the Severn Estuary. The Strategy proposes continuation of current maintenance in some locations, but also managed realignment and ceasing of maintenance in other locations. There is evidently a link between surface water and fluvial discharge with levels and flood protection from the Severn Estuary. GCC continues to work with the Environment Agency on its proposals for the Severn Estuary, and will ensure work we undertake fully considers the future capital and maintenance proposals for the Estuary.

4.2.4. Assessment of flooding from sewerage systems

73. Flooding from sewerage systems occurs when the capacity of the drainage network is exceeded. This can be due to blockage, failure of equipment or overloading of sewers due to rainfall. Water and sewerage companies are responsible for managing sewerage networks under the Water Industry Act 1991. All water and sewerage companies maintain a register of properties/areas which have experienced flooding from the sewerage system due to hydraulic incapacity in their network; this is known as the DG5 Register. This includes flooding from foul sewers, combined sewers and surface water sewers.

74. For the Local Strategy the four water and sewerage companies in Gloucestershire have made their DG5 Registers available at a four-digit postcode level. This information was overlaid onto the Local Strategy strategic hotspot areas to identify areas which were at risk from local sources of flooding and were also on the DG5 Register. This analysis will ensure that we have an early understanding of areas which are at risk from multiple sources of flooding. As a result we can identify the potential for joint working (and joint funding) to mitigate flooding issues.

4.3. Our understanding of how flood risk may change over time

75. Flood risk is not static and there are many factors which could influence how flood risk changes over time including: climate change; new residential and commercial development; 'urban creep'[19], and; a lack of maintenance and deterioration of assets which perform a flood risk management function. These are further discussed in 4.3.1 to 4.3.4 below, alongside proposed mitigation approaches.

4.3.1. Climate change

76. Over the past century around the UK we have seen sea level rise and more of our winter rain falling in intense wet spells. Seasonal rainfall is highly variable. It seems to have decreased in summer and increased in winter, although winter amounts changed little in the last 50 years. Greenhouse gas (GHG) levels in the atmosphere are likely to cause higher winter rainfall in future. Past GHG emissions mean some climate change is inevitable in the next 20-30 years. Lower emissions could reduce the amount of climate change further into the future, but changes are still projected at least as far ahead as the 2080s.

77. We have enough confidence in large scale climate models to say that we must plan for change. There is more uncertainty at a local scale but model results can still help us plan to adapt. For example we

[18] http://www.severnestuary.net/frms/2013gloucestershire.html

[19] Urban creep includes extensions to existing properties and the paving over of gardens. As urban creep often falls outside the development control process, its impacts on peak flows and volumes are less likely to be mitigated than development which is subject to planning applications.

understand rain storms may become more intense, even if we can't be sure about exactly where or when. By the 2080s, the latest UK climate projections (UKCP09) are that there could be around three times as many days in winter with heavy rainfall (defined as more than 25mm in a day). It is plausible that the amount of rain in extreme storms (with a 1 in 5 annual chance or rarer) could increase locally by 40%. The climate change predictions for the 2050s for a medium emission scenario, based on UKCP09 projections are shown in Table 4-1 for the Severn and Thames River Basin Districts.

Severn RBD	Thames RBD
Winter precipitation increases of around 12% (very likely to be between 2 and 26%)	Winter precipitation increases of around 15% (very likely to be between 2 and 32%)
Precipitation on the wettest day in winter up by around 9% (very unlikely to be more than 22%)	Precipitation on the wettest day in winter up by around 15% (very unlikely to be more than 31%)
Relative sea level at Bristol very likely to be up between 10 and 40cm from 1990 levels (not including extra potential rises from polar ice sheet loss	Relative sea level at Sheerness very likely to be up between 10 and 40cm from 1990 levels (not including extra potential rises from polar ice sheet loss)
Peak river flows in a typical catchment likely to increase between 9 and 18%	Peak river flows in a typical catchment likely to increase between 8 and 18%
Increases in rain are projected to be greater at the coast and in the south of the district.	

Table 4-1 Climate change implications for the Severn and Thames RBD

78. Climate changes can affect local flood risk in several ways. Impacts will depend on local conditions and vulnerability. Wetter winters and more of this rain falling in intense wet spells may increase river flooding along the Severn and its tributaries. More intense rainfall causes more surface runoff, increasing localised flooding and erosion. In turn, this may increase pressure on drains, sewers and water quality. Summer storm intensity could increase even in drier summers, so we need to be prepared for the unexpected. Drainage systems have been modified to manage water levels and could help in adapting locally to some impacts of future climate on flooding, but different management may also be needed. Rising sea or river levels may also increase local flood risk inland or away from major rivers because of interactions with drains, sewers and smaller watercourses.

79. The adaptation sub-committee's progress report[20] identified four key adaptation measures to manage long-term flood risk in a changing climate: location and design of new development; actions to protect existing properties from flooding; measures for managing surface water flows in urban areas [NB: surface water flows will also need to be effectively managed in rural areas to protect properties in rural areas and in downstream urban areas], and; emergency planning and response.

80. Table 4-2 identifies the appropriate mitigation measures which will be taken for each of the four categories. Example mitigation and adaptation measures have been identified in part using evidence from Gloucestershire County Council's and the districts climate change strategies. These measures are all further considered in Section 9.1 of the Local Strategy.

Category	Example mitigation/adaptation measures
Location and design of new development	• Ensure all sources of flood risk are considered when assessing development sites • Ensure downstream properties are protected from an increase (and preferably seek a decrease) in flood risk due to development, including an allowance for

[20] http://hmccc.s3.amazonaws.com/ASC/2012%20report/CCC_ASC_2012_Spreads.pdf

Category	Example mitigation/adaptation measures
	climate change • Consider using climate change maps when applying the sequential test • Ensure sustainable drainage systems are implemented in new development using a SuDS treatment train (thus ensuring source control measures are implemented) • Implement development control policies to help mitigate flood risk (e.g. set back buildings and extensions from watercourses) • Allocate land for future water attenuation schemes
Actions to protect existing properties from flooding Measures for managing surface water flows in urban [and rural] areas	• Identify areas which could be flooded without high risk of damages to properties or injury. Consider using these areas for conveyance and storage of storm water • Promote mitigation measures which retain/enhance natural processes and allow for future adaptation • Maintain and seek to enhance existing watercourse and overland flow corridors • Minimise future culverting of watercourses and seek to 'daylight' existing culverts wherever possible • Encourage uptake of retrofit SuDS (e.g. rainwater harvesting) to better manage surface water runoff
Emergency planning and response	• Locating emergency services in areas at low risk of flooding • Ensuring local communities have flood plans in place

Table 4-2 Mitigation measures for adapting to future changes in flood risk

4.3.2. New residential and commercial development

81. Under the Localism Act (2012) each district is now individually responsible for setting their own local housing numbers based on objectively assessed need. This will be reflective of economic circumstance, environmental capacity and an understanding of the existing unmet housing need of local communities. Based on the last set of household projections it is estimated that Gloucestershire as a county is likely to experience 55,000 to 65,000 new residential homes from 2010 to 2026. Alongside the development of residential properties will be the delivery of critical services (e.g. schools). It is important that surface runoff from these sites and potential flood risk to these sites are fully considered.

82. Without effective planning policy there is a risk that the increase in hard standing and impermeable surfaces associated with such development will increase surface water runoff and hence the risk of flooding. It is imperative that surface runoff and flood risk are fully assessed as part of the development of Local Plans and in determining planning applications to mitigate this risk. This is discussed more fully in Section 9.1.13.

4.3.3. Urban creep

83. Urban creep is the change of permeable areas within the urban environment to impermeable areas. A typical example is the paving over of front gardens to create hard standing parking areas. This creates increased runoff and contributes to surface water flooding. Owing to the scale of urban creep it is inherently challenging to monitor and effectively manage the issue. Planning permission is required to pave over a front garden if the surface to be covered is more than five square metres and will not provide a permeable area for water to run off into. Effective enforcement is critical to ensure that planning permission is being sought and the use of permeable materials when paving over front gardens should be used wherever practically possible.

84. A key part of the mitigation approach is the need to improve public understanding and knowledge of the impact of increasing impermeable area on flood risk. This can be achieved through targeted media

and web campaigns to raise awareness of planning law and the benefits of implementing permeable surfaces when paving over front gardens.

4.3.4. Lack of maintenance and deterioration of assets

85. Assets (e.g. culverts, trash screens, gullies) which are not adequately maintained may not function appropriately during rainfall, which could exacerbate the consequences of flooding. Furthermore, asset condition may deteriorate over time, thus resulting in a reduced performance of the asset.

86. Flood risk management assets on Main Rivers are the responsibility of riparian owners, but the Environment Agency has permissive powers to carry out maintenance on such assets using a risk-based approach and subject to available funding. The Environment Agency use a system (Asset Information Management System [AIMS]) to manage the maintenance and condition of assets. In addition, water and sewerage companies manage assets associated with the public sewer system. With respect to highways, Gloucestershire Highways clear and jet up to 135,000 highway gullies across the county up to three times a year depending on the level of risk. They also deliver an annual prioritised programme of maintenance and improvement schemes to help reduce the risk of flooding from highway systems.

87. We know significantly less about the condition and performance of assets associated with local flood risk. Under Section 21 of the Flood and Water Management Act GCC has a duty to create and maintain a register of assets which records the location, ownership and condition of assets with a significant effect on a flood risk. Chapter 9.1.3 provides a detailed overview of how GCC and other Risk Management Authorities are improving understanding of assets associated with local flood risk.

5. Developing an understanding of the most vulnerable locations in the county

88. For the Local Strategy we have undertaken a process which allows us to develop an initial list of priority locations. This will help us to inform future investigations and investment on the basis on the priority locations across the county, help target limited financial resources to the areas of greatest risk and seek transparency in decision-making.

89. The methodology, described in greater detail in Appendix F, uses the best available evidence to develop a priority list and builds upon the assessment undertaken for the PFRA.

90. The priority list has been developed at the parish scale and considers all sources of flood risk[21], using the following datasets:

- number of properties (residential, non-residential and critical services predicted to be vulnerable to flooding using the 'Locally Agreed Surface Water Information' for the 1 in 30 year and 1 in 100 year rainfall events;
- number of properties (residential, non-residential and critical services predicted to be vulnerable to flooding using the 'defended' fluvial outlines for the 1 in 20 year and 1 in 100 year rainfall events;
- areas predicted to be vulnerable to groundwater flooding, using the Environment Agency's 'Areas Susceptible to Groundwater Flooding' map;
- number of significant flooding incidents per parish/ward in the past 30 years[22], and;
- total number of flooded properties per parish/ward in the past 30 years.

91. Further to consultation with parish, district and county councillors in October 2012 we have given higher weightings to flooding based on the scale (number of properties) and frequency of flooding. The methodology does not take into account 'risk to life' because of the lack of available information to support a robust assessment.

92. We recognise that flooding does not respect administrative boundaries such as parishes and wards, so when we look at managing this risk or investigating the flood risk in more detail we will examine it more closely and will consider the issue both at a parish/ward and a river catchment scale.

93. The output from this analysis provides an initial list of the parishes and wards most vulnerable to flooding in the county from all sources. The parishes and wards identified as being the most vulnerable to flood risk will be the priority for GCC and its partners. Where an area is identified as being at risk and GCC does not have legislative responsibility (e.g. Main Rivers or sewerage flooding) we will take a leadership and co-ordinating role. Where we have direct operational responsibility we will lead on the development of mitigation measures.

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[21] In Cheltenham and Gloucester administrative areas ward boundaries have been used

[22] This is based on the 'significance' criteria outlined in Chapter **Error! Reference source not found.**.

94. However it must be stressed that this does not preclude less vulnerable locations from securing funding to deliver flood risk management works should sufficient funding be available (including contributions from local communities) and the works are cost-beneficial, are environmentally acceptable, and have support of stakeholders.

95. The list of most vulnerable parishes and wards will be updated on an annual basis and will form part of the Gloucestershire 'annual progress and implementation plan'. The annual progress and implementation plan will set out:

- a summary of progress since the previous annual progress and implementation plan was published;
- an up to date prioritisation list based on the most vulnerable locations[23] for the forthcoming year, and;
- planned capital or maintenance works for the forthcoming year, including likely costs and benefits of any works.

96. The annual progress and implementation plan will enable GCC and other Risk Management Authorities to co-ordinate and monitor progress against investment on an annual basis. It will be accessible as a stand-alone document, published as a supplement to the main Local Strategy document.

[23] This could be based on new information being available due to better modelling and mapping, or a flood incident within a parish or ward.

6. Measures to manage local flood risk

97. There are a range of measures which can be taken to manage local flood risk. The purpose of this section is to provide an overview of the measures we will take to manage local flood risk. The measures are broadly split into three core themes:

- capital investment measures to better understand and manage local flood risk;
- operational measures to mitigate local flood risk including investigating flooding incidents, building and maintaining a register of assets (and ensuring effective maintenance regimes of key assets), designating features and structures, and consenting works and enforcement action on ordinary watercourses, and;
- policy measures including spatial planning, emergency planning and engagement with public and local community groups to raise awareness of local flood risks and to encourage people to take action.

98. Table 6-1 illustrates the measures which have been developed and are already in place as a result of the Local Strategy. Furthermore Table 6-2 indicates the county-wide actions which will be taken to manage local flood risk in the future. It is important to note that it is not possible to deliver all of the potential flood risk management measures immediately, and a phased approach will be required.

99. In addition, Section 6.4 summarises the types of measures which can be taken in communities most vulnerable to flooding to reduce flood risk.

100. It is vital to note that the delivery of proposed measures will be dependent on the availability of funding and will need to be implemented over the long term. Therefore a phased approach will be necessary, particularly in communities most vulnerable to local flood risk. This is explained further in section 9.

6.2. Measures already in place to manage local flood risk

Strategic objectives	Measures in place through Local Strategy
Strategic objective 1: Improve our understanding of flood risk	We have undertaken a risk assessment that provides an evidence base for prioritising future activities and identifies the parishes and wards most vulnerable to local flood risk across the county.
	We have established an asset register to identify the location, ownership and condition of key assets.
	We have developed a reporting and investigation procedure to ensure we appropriately investigate future flooding incidents.
Strategic objective 2: Put in place plans to manage these risks	We have developed action plans for the most vulnerable parishes and wards alongside the Local Strategy.
	We have developed a funding strategy and funding guidance that identifies the primary sources of local flood risk management funding. The strategy also identifies how to maximise other non-flood related outputs to secure contributions from other secondary sources of funding.
	We have developed a consistent and robust approach to consenting of works on ordinary watercourses and taking enforcement action when this is required. We have also developed a policy on culverting of watercourses.
	We have prepared a Strategic Environmental Assessment as part of the development of the Local Strategy. This has assessed the proposed measures and will provide the framework to ensure flood risk management measures deliver environmental enhancements. It also identifies assessment criteria to ensure future measures protect and enhance the environment.
Strategic objective 3: Avoid inappropriate development and ensure that new development does not increase flooding elsewhere	We have provided 'Locally Agreed SW Information' to local planning authorities and have established a procedure for flood and drainage teams in the districts (and GCC) to comment on planning applications, where necessary.
	We have recommended some planning policies which could be adopted into Local Plans to mitigate local flood risk.
Strategic objective 4: Increase public awareness of flooding and encourage communities to take action	We have developed a proposed approach for engaging with local communities to raise their awareness of local flood risk and to take action to protect themselves.
Strategic objective 5: Ensure close partnership working and co-ordination with other Risk Management Authorities	All RMAs are part of the FRM Partnership Group. The Local Strategy has been developed through a series of workshops with the RMAs.
	We have clarified the roles and responsibilities for flood risk management in Gloucestershire.
	We have established a procedure to facilitate effective sharing of information.
Strategic objective 6: Support response to, and recovery from, flooding incidents	We have established a protocol with the Civil Protection Team to better share information on flooded locations following a flood incident. This will help us to target where S.19 Investigations should be carried out.
	We have distributed the Locally Agreed SW Information to the Civil Protection Team to ensure that surface water flooding is incorporated into the emergency planning process.

Table 6-1 Measures developed and already in place through the Local Strategy

6.3. Measures we will take to manage local flood risk across Gloucestershire

Strategic objectives	What we will do	Consideration in Local Strategy
Strategic objective 1: Improve our understanding of flood risk	We will undertake further studies where required to improve our understanding of local flood risk. Where resources permit we will endeavour to undertake studies in response to flooding incidents during the year.	Section 9.1.1
	We will ensure that S.19 Investigations are undertaken where the 'significance' criteria is met.	Section 9.1.2
	We will review consent applications to ensure works on ordinary watercourses do not increase flood risks and we will undertake enforcement actions where required.	Section 9.1.3
	We will develop a consistent approach to the recording and designation of structures.	Section 9.1.4
	We will seek to collate further historic flood incident data from parish/town councils.	Section 9.1.5
Strategic objective 2: Put in place plans to manage these risks	We will develop an annual progress and implementation plan and co-ordinate investigations and investment on an annual basis.	Section 9.1.6
	We will seek to secure increased funding from external sources to support delivery of capital schemes to alleviate flood risk.	Section 7.1.1
	We will ensure that the S.21 asset register is populated with information about key local flood risk assets and is available for public inspection.	Section 9.1.7
	We will develop a risk-based asset management programme to maintain key local flood risk assets owned and operated by GCC and district councils.	Section 9.1.8
	We will work with parish councils to identify the location and ownership of drainage ditches and ordinary watercourses. We will support parish councils to work with local landowners to clear drainage ditches/ordinary watercourses and will use our land drainage enforcement role where necessary.	Section 9.1.9
	We will investigate the opportunity to undertake a pilot study to assess the effectiveness of green infrastructure in urban areas to manage surface water runoff in a more sustainable manner.	Section 9.1.10
Strategic objective 3: Avoid inappropriate development and ensure that new development	We will develop a SUDS Approval Body delivery model and procedures to be ready for the implementation date (date to be confirmed) to ensure that new development will not increase runoff entering watercourses.	Section 9.1.11

does not increase flooding elsewhere	We will issue updated surface water mapping to local planning authorities as and when it is available.	Section 9.1.12
	We will improve linkages with local planning authorities to ensure that flood risk is appropriately addressed in 'plan making' and 'decision taking'.	Section 9.1.13
Strategic objective 4: Increase public awareness of flooding and encourage communities to take action	We will publish surface water mapping to make local communities more aware of the surface water flood risks they face.	Section 9.1.14
	We will work with local media to help raise awareness of flood risk in Gloucestershire and the work being done across the county to manage flood risk.	Section 9.1.15
	We will empower local communities to be aware of the flood risks they face and take action to address these risks.	Section 9.1.16
Strategic objective 5: Ensure close partnership working and co-ordination with other Risk Management Authorities and local communities	We will continue to meet regularly with the Flood Risk Management Partnership Group to deliver the objectives of the Local Strategy.	Section 9.1.17
Strategic objective 6: Support response to, and recovery from, flooding incidents	We will work with the Civil Protection Team to ensure that communities are more aware of the flood risks they face and are better prepared to take action.	Section 9.1.18
	We will track improvements in flood warning for surface water flooding..	Section 9.1.19

Table 6-2 Measures we will take to manage local flood risk across Gloucestershire

6.4. Measures we will take to mitigate flood risk in specific locations

101. Appendix H summarises the types of measures that can be taken to mitigate flood risk in local areas. The measures are broken down into broad themes:

- **Investigations** aim to better understand the cause of flooding to improve the confidence in decision-making.

- **Source control measures** for surface water flooding normally aim to reduce flooding by increasing storage of flood water, reducing the rate of runoff or increasing the volume of water which soaks into the ground. Sustainable Drainage Systems (SUDS) are often an effective means to implement source control. SUDS encompass a variety of measures such as permeable paving which allows more water to soak into the ground than traditional impermeable road and path surfaces. Other SUDS measures may include introducing ponds and wetlands that can hold flood water, or swales and detention basins which slow the movement of water and reduce the volume of runoff.

- **Pathway measures** aim to manage the movement of flood water through both natural and manmade drainage systems. Measures may be structural, for example involving the development of new drainage systems or separating foul and surface water sewers, or may be non-structural for example encouraging land management practices which reduce runoff. We recognise that maintenance of our existing drainage infrastructure will be an important aspect to managing flooding; it can reduce flood risk with minimal capital investment, freeing up funds for measures elsewhere.

- **Receptor-level measures** aim to reduce the likelihood but more often the impact of flooding on people, property and environment. We will work with our partners to increase awareness of flood risk so that individuals and communities understand the flood risks they face and the ways in which they can help to manage that risk. We will help people to understand how they can become more resilient to flooding. This will better equip people to take measures to prevent flooding entering their properties and to recover if they are affected by flooding.

7. Funding Strategy

102. Successful delivery of LFRM measures will require innovative ways of working and funding, based on teamwork and trust. Defra's introduction in 2011 of the partnership funding approach means that the ability of LLFAs to leverage contributions (both financial and in kind) from local partners could make the difference between locally important projects going ahead or not. The qualifying benefits for dedicated flood risk funding sources are typically well understood but it may also be possible, with slight modifications or additions to a flood risk project (or even just a different way of 'selling' the benefits), to meet the requirements of funders outside the flood risk industry and access additional funding in this way. Whilst it may be possible to fully fund some projects using only the mainstream dedicated flood risk funding sources such as Flood Defence Grant in Aid (FDGiA), there will be others that require a range of funding sources to make up the total sum needed.

103. The suitability of potential funding sources depends on a number of factors, including: total sum required; total fund available; effort / investment required (number of applications, match funding, etc); qualifying benefits required; frequency of availability and; level of competition.

104. For the Local Strategy it is anticipated that the majority of funding will come from dedicated flood risk management sources, supplemented by contributions from alternative sources wherever sufficient qualifying outputs/outcomes are identified to ensure that the benefit-cost ratio of pursuing these is supportable.

7.1. Funding sources and key principles

105. A detailed summary of relevant funding sources for LFRM is provided in Appendix J. Further information is also available in Defra guidance, which can be accessed at: http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=17085

106. A matrix of funding sources and benefits is illustrated in Figure 7-1 and is designed to help with the initial identification of those funding sources most likely to be suitable based on the anticipated outcomes and outputs of a measure. The top section focuses on the primary benefit of flood risk management measures, i.e. to reduce the risk of flooding to various types of receptor. To use the matrix, select the receptor(s) that will benefit from a reduction in flood risk as a result of the measure under consideration and read along the row to identify the funding sources with the highest potential. Next, read down the funding source column to identify other outputs and outcomes which could increase the likelihood of accessing this funding source.

107. The matrix is intended as an initial guide to help direct fundraising efforts. If project or area specific knowledge suggests a funding source may have greater or lesser potential than is suggested by this matrix then such evidence should take precedence.

7.1.1. Proposed funding approach

108. It is considered that the best funding mix will take in a cross section of the funding sources outlined in Appendix I. GCC and district funding will be targeted towards the most vulnerable locations in the county, with some funding allocated towards lower vulnerability areas. However, it should be noted that any scheme can be promoted irrespective of the scale of flood risk in the

parish or ward subject to sufficient funding be available (including contributions from local communities) and the works are cost-beneficial, are environmentally acceptable, and have support of stakeholders.

109. Once a flood risk scheme has been identified (including an understanding of the whole life costs and benefits of the scheme) the dedicated flood risk funding should be secured first, at least in outline. Dedicated flood risk funding sources include GCC, district funding, parish precepts, FDGiA and RFCC Local Levy. It is worth noting that the amount of FDGiA a project may qualify for can be estimated in advance using Defra's Partnership Funding Calculator, which will enable the likely size of the funding gap to be determined. One of the factors affecting FDGiA eligibility is the amount of other contributions obtained, so it helps to have some understanding of the likely availability of local contributions as early as possible to feed in to the iterative process. Local communities, for example, could agree to help with maintenance of schemes, which could be included as a contribution to the whole life costs of the scheme.

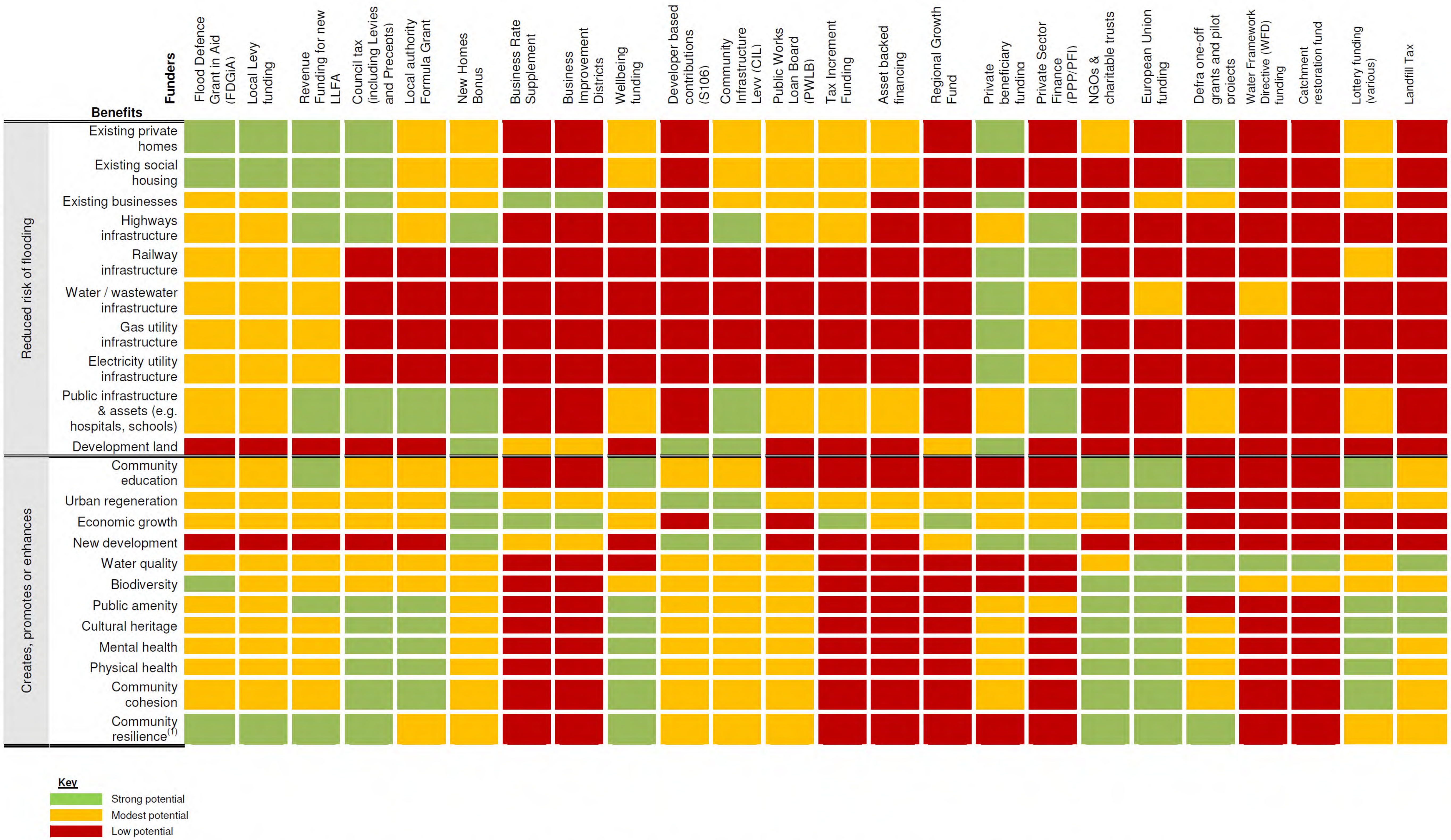
110. Once the funding gap left by the main dedicated flood risk funding sources has been established, schemes will be individually assessed according to how they meet a range of other funders' requirements.

111. There are many things that will lead to the delivery of successful fundraising but at this strategic stage the three main areas are: partnership working; early planning to ensure that deadlines are not missed and that projects are designed with the funder's requirements in mind; and, the development of a good case for support, including benefits to local businesses and communities that go beyond basic flood management. The next stage will be to develop specific planned interventions, working with Risk Management Authorities, relevant stakeholders, local elected members, and the public to explore these and to see how they can best be packaged up to attract financial support. This will then feed into the annual progress and implementation plan which will layout which applications are recommended, when, for what and for how much. The proposed approach for planning investment on an annual basis is described in detail in the subsequent chapter.

Community Infrastructure Levy

Community Infrastructure Levy (CIL) is a new 'tariff' style charge which local authorities in England and Wales are empowered, but not required, to charge on all new houses (and other buildings / extensions to buildings of more than $100m^2$), to be spent on local and sub-regional infrastructure to support the development of the area

GCC is currently working in partnership with the six districts to prepare an **Infrastructure Delivery Plan** (IDP) which will help to identify the required infrastructure in Gloucestershire to help deliver growth. GCC's FRM team is providing input to the IDP to ensure that flood risk needs are considered during the development of the Plan. The IDP will continue to be developed during 2013 and as it progresses we will seek to ensure that flood risk issues are considered and included in any future CIL tariffs.



Note: This matrix is intended as an initial guide to help direct fundraising efforts. If project- or area- specific knowledge suggests a funding source may have greater or lesser potential than is suggested by this matrix then such evidence should take precedence.

(1) *Refers to 'soft' measures which improve a community's ability to respond and recover effectively; for example community flood plans, flood wardens, etc. Structural resilience measures such as individual property protection are included in reduced flood risk to existing homes

Figure 7-1 Potential funding sources and benefits

7.2. Annual investment planning process

112. Investment to better understand and mitigate local flood risk will be planned and co-ordinated with all other Risk Management Authorities across the county by GCC on an annual basis using the approach illustrated in Figure 7-2 and described in detail below.

113. We envisage that GCC/district councils/IDB will identify capital schemes or studies required in January each year. For capital schemes GCC/district councils/IDB should populate Defra's Partnership Funding calculator. It is recognised that not all capital schemes will be put forward for FDGiA, but ensuring all partners populate Defra's Partnership Funding calculator will facilitate comparison between capital schemes and will help to ensure transparency in decision-making

114. All identified capital schemes and studies will be submitted to GCC's Flood Risk Management (FRM) team, alongside an indication of funding secured to date and whether additional funding is required for the scheme to progress. This is to enable co-ordination of activities (and reporting) across the county.

115. GCC's FRM team will subsequently undertake a review of the proposed schemes or studies in April and will identify the level of GCC contribution that can be committed. Funding from GCC will be prioritised using the priority locations identified in the Local Strategy with a higher proportion of funding allocated to the most vulnerable locations[24]. However, we recognise that there is also a need to allocate funds to medium and low vulnerable locations, where it may be feasible to reduce flood risk through relatively low cost mitigation measures.

116. Once schemes have been identified and assessed by GCC a partnership meeting will be held with the FRM Partnership Group to discuss all identified schemes and studies, the level of existing contributions[25], and the optimal funding route.

117. Where a scheme or study can be progressed without FDGiA funding this will be taken forward by the lead Risk Management Authority. Equally, where a scheme or study will not be put forward for FDGiA (e.g. insufficient Partnership Funding score) and there is a shortage of required funding, the lead Risk Management Authority will need to seek further funding prior to progression of the scheme or study.

118. In many cases FDGiA funding will be required to enable schemes to progress. Where FDGiA funding is required **and** the Partnership Funding score is >100% a FDGiA application form should be submitted to the Environment Agency by the required deadline. Where FDGiA funding is required **but** the Partnership Funding score is <100% the scheme may need to be delayed until further external funding can be secured, or the costs of the scheme are reduced[26].

119. Initial determination of the FDGiA applications is made by the Environment Agency in August, who administer FDGiA on behalf of Defra. Once the initial determination is made a draft version of the annual progress and implementation plan will be produced by GCC and circulated to members of the FRM Partnership Group. RFCCs consider the initial determination of FDGiA applications in October and identify

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[24] Districts and the IDB should also be mindful of the priority locations when identifying and promoting schemes, and target investment proportional to the level of vulnerability

[25] and whether further contributions are likely to be needed for successful implementation

[26] It is possible that the promoting the scheme could result in it being added to the Environment Agency's Medium Term Plan, but the scheme would not be able to go ahead until the PF Score was >=100%. Local Levy from the RFCC can be used to 'top up' FDGiA funding to enable a scheme to score >=100% so there may be merit in submitting an FDGiA application form.

the Local Levy which can be contributed to schemes. Following this the FDGiA allocations are finalised by the Environment Agency in November/December. At this time a final version of the annual progress and implementation plan will be produced by GCC and published on the GCC website.

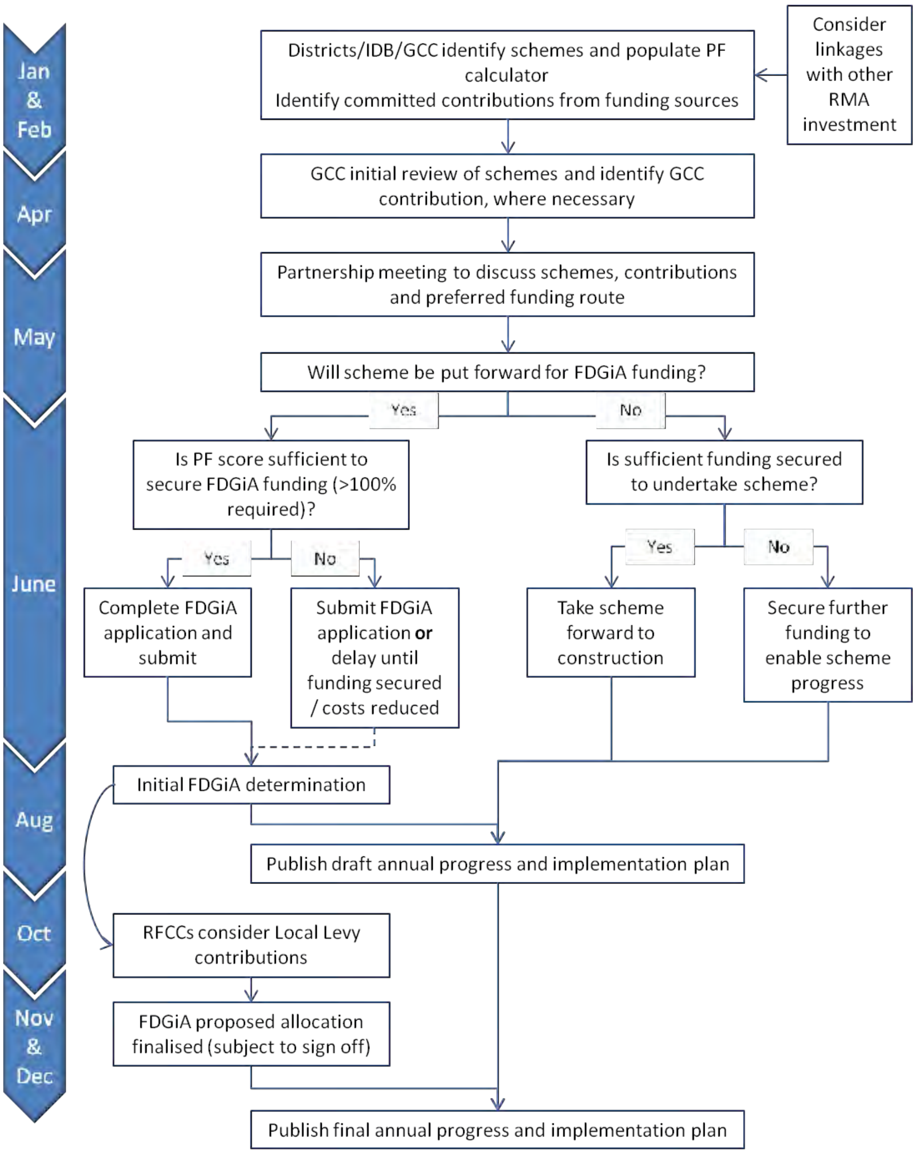


Figure 7-2 **Approach to plan and co-ordinate investment in LFRM**

8. Achieving environmental objectives

120. In developing the Local Strategy, GCC has carried out a range of environmental work to identify the potential impacts of the Local Strategy on the natural and man-made environment. Three specific assessments have been carried out to support the development of the Local Strategy, which are discussed in turn below.

8.1. Environmental Assessments

8.1.1. Strategic Environmental Assessment

121. SEA is the systematic appraisal of the potential environmental impacts of policies, plans, strategies and programmes, before they are approved. It ensures that any implications for the environment are fully and transparently considered before final decisions are taken and is required by an EC Directive (2001/42/EC) *'on the assessment of the effects of certain plans and programmes on the environment'*, known as the 'SEA Directive', which came into force in 2004. The Directive is implemented in England and Wales through the *Environmental Assessment of Plans and Programmes Regulations* (SI 1633 2004) and the *Environmental Assessment of Plans and Programmes (Wales) Regulations* (SI 1656 2004).

122. Local strategies are statutory plans and are subject to the requirements of SEA. LLFAs need to take a proportionate approach to applying SEA to local strategies, particularly when environmental effects are not evident in the early stages of plan development. For the Local Strategy the SEA has considered the environmental baseline for the county, focusing on issues that are specifically relevant to flood risk and surface water management, and has assessed the range of measures included in the main Local Strategy document and action plans against the SEA objectives

8.1.2. Habitats Regulations Assessment

123. Due to the potential for the Local Strategy to have significant effects on sites of international nature conservation importance (Natura 2000 sites – Special Areas of Conservation (SACs), Special Protection Areas (SPAs) and Ramsar sites) in the Gloucestershire area, a Habitats Regulations Assessment (HRA) was carried out in parallel with the SEA. The HRA is required under the EU Habitats Directive (EU Council Directive 92/43/EEC on the Conservation of Natural Habitats and Wild Fauna and Flora) and the transposing U.K. Regulations (The Conservation of Habitats and Species (Amendment) Regulations 2012 (the 'Conservation Regulations').

8.1.3. Water Framework Directive (WFD) assessment

124. The Local Strategy needs to be assessed for WFD compliance to ensure that local measures to reduce flood risk comply with the WFD, and should contribute to achieving WFD objectives. The Local Strategy does not require a detailed WFD assessment and the Environment Agency has advised that 'WFD assessment can be incorporated into the SEA'. Therefore, the SEA Objectives covering water quality, resource availability and hydromorphology and their underlying assessment criteria are designed in order to fulfil the requirements of the WFD.

8.2. Assessment of Local Strategy measures

125. The SEA Environmental Report provides a detailed assessment of the environmental baseline in the county, the SEA objectives and an assessment of the range of measures contained within the Local

Strategy. The SEA Environmental Report is available as a separate document. A summary of the findings from the SEA assessment is provided in the sections below.

8.2.2. Assessment of Local Strategy objectives with SEA objectives

126. All of the Local Strategy objectives were assessed to have neutral or positive impacts on the natural and built environment and hence all the receptors that fall under the different SEA topic areas are likely to benefit or not be affected by the Local Strategy objectives at this strategic level. Some positive impacts on receptors are likely to be indirect; for example positive effects on human health and water quality are given as a result of expected better flood risk management in the county generally. Local Strategy objectives 4 and 6 may help to reduce fear of flooding and may even reduce the risk of direct physical impacts of flooding by improving local community understanding of flooding and empowering them to respond to it. These Local Strategy objectives have therefore been assessed to be a major positive influence on population and human health.

8.2.3. Assessment of Local Strategy measures with SEA objectives

127. The Local Strategy measures were assessed to have neutral or positive effects for all SEA objectives. Major positive scores are predicted for all Local Strategy measures for the SEA objectives covering climate change adaptation (i.e. by adapting to flood risk) and the protection of material assets. There are also likely to be indirect positive effects on human health and neutral or positive effects on water quality as a result of the Local Strategy measures. The positive effects on human health are predicted as a result of reduced flood risk, improved public understanding of flood risk and improved ability of the public to respond to flooding. The positive effects on water quality are expected due to expected improved FRM (including using natural drainage systems where possible) and reduced risk of the spread of contaminants, for example through the reduced risk of flash flooding of contaminated land. It was not possible to discern potential positive or negative effects on many SEA objectives as the measures are 'high level' at this stage, hence there are many neutral scores in the matrix. The headline results for each Local Strategy Strategic Objective (SO) are shown below;

SO1 Local Strategy measures

128. For SO1, through providing a consistent approach to designating structures, additional safeguards are being put in place to prevent the alteration, replacement or removal of features or structures used in FRM. In some cases this could help protect FRM features that are also cultural heritage assets; therefore a positive score has been given for this Local Strategy measure under the cultural heritage SEA objective.

SO2 Local Strategy measures

129. All measures under SO2 have been given minor or major positive scores under climate change adaptation, material assets and the human health SEA Objectives. The recommendations under the sixth measure to undertake a pilot to assess green infrastructure is likely to be beneficial to a range of SEA receptors, as green infrastructure can provide significant opportunities for biodiversity, landscape, water quality, climate change, material assets, recreation and amenity, and human health. GI networks can provide dedicated flood water storage areas thereby providing water for nature conservation or other purposes, opportunities to aid a more natural and slower response to heavy rainfall, helping manage surface water, by reducing flood risk from streams, rivers and sewers and the use of Sustainable drainage systems (SuDS).

SO3 Local Strategy measures

130. The first measure under SO3 should have tangible benefits for biodiversity, water quality, hydromorphology, soils and amenity as more SuDS schemes are implemented in the future. This will happen when GCC becomes the SUDS Approval Body for new sites and the re-development of existing sites.

The second and third measures under SO3 provides recommendations to issue surface water mapping and improve linkages with local planning authorities to inform decision-making. These recommendations are likely to have a positive impact on water quality, hydromorphology and soils due to the sharing of information (e.g. between planning authorities and commenting on planning applications). This should help to protect natural drainage patterns and protect land, which currently forms part of the natural drainage (e.g. floodplains, watercourses and surface water flow routes).

SO4 Local Strategy measures

131. By engaging with local communities to raise flood-risk awareness and improve their ability of people to take action on flood-risk, the LFRMS measures for SO4 should have major positive impacts on human health by helping to reduce fear of flooding and potentially the risk of the direct physical impacts of flooding.

SO5 Local Strategy measures

132. By continuing to meet with Flood Risk Management Partnership, information can be shared and actions agreed that are expected to have major positive effects, either directly or indirectly on climate change adaptation, material assets and human health.

SO6 Local Strategy measures

133. These measures are likely to have neutral effects for all SEA objectives except the objectives for climate change adaptation, material assets and human health, which have major positive scores predicted. This is due to a predicted reduction in the fear of flooding through raising awareness of flooding and potentially a reduced risk to people of the direct physical impacts of flooding by tracking improvements in flood warning .

9. Action Plan

134. We will be taking actions to reduce flood risk in partnership with others. There are actions we will take across Gloucestershire and there are location-specific actions which will be prioritised by the level of risk.

135. The purpose of the action plan is to set the timescales and responsibility for the measures we propose to take to manage local flood risk in Gloucestershire over the next 10 years. Whilst the action plan set the framework for the next 10 years there will inevitably be legislative, regulatory and financial changes over this period which will affect how we manage local flood risk. Therefore, we need to maintain flexibility during the delivery period of the Local Strategy, and we will develop an annual progress and implementation plan which will provide:

- a summary of progress since the previous annual progress and implementation plan was published;
- an up to date prioritisation list based on most vulnerable locations[27] for the forthcoming year, and;
- planned capital or maintenance works for the forthcoming year, including likely costs and benefits of any works.

9.1. Action plan for measures across Gloucestershire

136. Table 9-1 highlights the measures we will take across Gloucestershire over the next 10 years to co-ordinate and manage flood risk. More detail is presented in Sections 9.1.1 to 9.1.19.

[27] This could be based on new information being available due to better modelling and mapping, or a flood incident within a parish or ward.

Table 9-1 Overview of measures

Section ID	Measures	Responsibility	How will we measure success	Timescale for action
9.1.1	Undertake further studies to improve our understanding of local flood risk, and in response to flooding incidents	GCC in partnership with Risk Management Authorities	Completion of studies which identify potential mitigation measures to alleviate flooding. Further hydraulic modelling to understand future risks due to climate change	Ongoing with annual progress updates to assess whether objective is being delivered. Future modelling work to better understand potential climate change impacts will be completed by April 2016
9.1.2	Undertake S.19 Investigations where criteria is met	GCC in partnership with Risk Management Authorities	Completion and publication of S.19 Investigations	Ongoing with annual progress updates to assess whether objective is being delivered
9.1.3	Deliver consenting and enforcement role	GCC in partnership with Risk Management Authorities	Consent applications will be subject to rigorous scrutiny prior to approval / rejection Enforcement action will be undertaken when necessary	Ongoing with annual progress updates to assess whether objective is being delivered
9.1.4	Develop consistent approach for designating structures	GCC in partnership with Risk Management Authorities	Agreed protocol between designating authorities	Spring 2014
9.1.5	Collate additional information from parish councils	GCC in partnership with Risk Management Authorities	Establishment of process to collate additional data. Collection of additional flood data	Spring 2015 to commence the process
9.1.6	Develop an annual progress and implementation plan and co-ordinate investigations and investment on an annual basis.	GCC in partnership with Risk Management Authorities	Agreed implementation plan on an annual basis by Risk Management Authorities	First implementation plan will be developed for 2014/15 Then ongoing annually
7.1.1	Increase funding from external sources	GCC in partnership with Risk Management Authorities	Increase in external contributions towards funding applications over the next 5 years	Ongoing annually
9.1.7	Populate S.21 Asset Register	GCC in partnership with Risk Management Authorities	S.21 Asset Register populated and available for public inspection	Asset register populated and available for public inspection by autumn 2013
9.1.8	Develop risk-based approach for maintaining assets	GCC in partnership with Risk Management Authorities	Asset management programme in place with sufficient funding for delivery	Programme in place by autumn 2014

9.1.9	Undertake ditch mapping and clearance with parish councils	GCC in partnership with district and parish councils	More comprehensive mapping of location and condition of drainage ditches More drainage ditches across the county being cleared by riparian owners	Pilot to be run in 2013/2014 with full implementation 2014/2015 subject to success of pilot Ongoing with annual progress updates to assess whether objective is being delivered
9.1.10	Undertake pilot to assess green infrastructure	GCC in partnership with district councils and water companies	Successful implementation of a pilot study	Pilot study to be established during 2014/15
9.1.11	Develop SUDS Approval Body role	GCC in partnership with district councils	SUDS Approval Body delivery model in place for commencement of Schedule 3 of FWMA	To be confirmed (dependant on commencement date from Government)
9.1.12	Issue surface water mapping to local planning authorities	GCC	LPAs have access to and utilise the latest SW mapping to inform decision-making	Ongoing as and when new information is available
9.1.13	Improve linkages with local planning authorities	GCC in partnership with local planning authorities		
9.1.14	Publish surface water mapping	GCC in partnership with the Environment Agency	Publication of surface water mapping online	Summer 2014 subject to legal review about publishing mapping
9.1.15	Raise awareness of flood risk through media	GCC in partnership with district councils	Increase in amount of media activity related to flood risk management	Ongoing with annual progress updates to assess whether objective is being delivered
9.1.16	Empower local communities to be aware and take action on flood risk	GCC in partnership with district councils	Increased number of flood wardens over next 3 years. Evidence of communities being more aware and involved in flood risk management. More people installing property level protection	Ongoing with annual progress updates to assess whether objective is being delivered
9.1.17	Continue meeting with Flood Risk Management Partnership Group	GCC in partnership with Risk Management Authorities	FRM Partnership Group meets up to 3 times per year	Ongoing with annual progress updates to assess whether objective is being delivered
9.1.18	Work with Civil protection Team to raise awareness of flooding and ensure joined up approach	GCC	Evidence of local communities becoming more prepared for flooding (e.g. preparation of community flood plans). Civil Protection Team have access to latest mapping to inform planning	Ongoing with annual progress updates to assess whether objective is being delivered
9.1.19	Track improvements in flood warning	GCC	GCC flood team up to date with latest research	Ongoing with annual progress updates to assess whether objective is being delivered

9.1.1. Undertake further studies to improve understanding of local flood risk

137. At a strategic scale there are a number of studies which are ongoing and will improve understanding of local flood risk; these are highlighted in Table 9-2.

Name of study	Description
Groundwater Flood Risk scoping study	GCC is currently undertaking a groundwater study across the county to better understand the risks of groundwater flooding and considers potential options for mitigating the risk. Further work may be required in high risk locations, but this will be identified during the scoping study.
Critical Infrastructure flood risk assessment	The aim of this project is to prepare a comprehensive plan identifying critical infrastructure at risk of flooding from a range of flooding sources to help inform the Local Strategy and emergency response.
Preliminary Flood Risk Assessment (PFRA)	The PFRA provides a summary of historic and predicted flood risk across Gloucestershire and identifies areas which are at nationally significant risk of flooding. GCC published the first PFRA in December 2011 and, in accordance with the Flood Risk Regulations, will publish an updated PFRA every six years.
Environment Agency updated Flood Map for Surface Water	The Environment Agency has prepared its updated Flood Map for Surface Water, which supercedes existing Flood Map for Surface Water and Areas Susceptible to Surface Water Flooding. It provides an improved representation of surface water flooding in areas within Gloucestershire where no other localised mapping has been undertaken.

Table 9-2 Strategic studies ongoing or programmed in Gloucestershire

138. At a more local scale GCC recognises the value of Surface Water Management Plans (SWMPs) as a tool to identify flood risk from surface water and ordinary watercourses, assess options to mitigate the risk and prepare a costed action plan to manage the risk. GCC has completed, or is in the process of completing, a series of SWMPs in the following locations across the county including: Bishop's Cleeve, Cheltenham, Gloucester (including Churchdown and Innsworth) and Tewkesbury.

139. It is also recognised that the six district and borough councils have programmes in place to improve understanding of flooding in local areas and to identify mitigation measures (e.g. Cotswold top 21 priority areas or Tewkesbury's Flood Risk Action Plan). GCC will continue to support and have input to these where necessary. We will continue to pro-actively undertake studies in areas of high flood risk, and in response to flooding incidents which occur. The studies will be used to identify and appraise suitable mitigation measures, as well as identifying funding sources. Undertaking further investigations is important to properly understand flooding mechanisms and suitable mitigation measures, which in turn will give confidence that proposed schemes are appropriate.

140. Furthermore, by April 2016 we will have undertaken further hydraulic modelling to better understand the future flood risks due to more extreme rainfall events which are predicted to occur as a result of climate change.

9.1.2. Undertake S.19 Investigations where criteria is met

141. Section 19 of the Flood and Water Management Act introduces a new responsibility for LLFAs with respect to investigating flooding incidents. The Act states that the LLFA is required to investigate flood incidents that it becomes aware of to the extent that it considers is necessary or appropriate. Where the LLFA investigates such a matter, it will determine: which authority has relevant flood risk management functions, and; whether that authority has exercised, or is proposing to exercise, those functions in

response to the flood. Where an authority carries out an investigation it must publish the results of its investigation and notify relevant Risk Management Authorities.

142. Capturing information on locations where flood incidents have occurred is critical to confirm locations that are at greatest risk from local sources of flooding, and to better understand flooding mechanisms. A Geographical Information System (GIS) has been established as the principal mechanism for capturing flood incidents and identifying whether an investigation under S.19 of the Act will be required. The GIS provides a single platform for all relevant local flood risk management partners to capture, store and view flood incident records. We are continuing to work with partners to improve the mechanism and quality of data capture.

143. Figure 9-1 illustrates the protocol for investigating flooding incidents in Gloucestershire. In determining whether an incident requires a S.19 Investigation Risk Management Authorities will be mindful of the criteria for locally significant floods, which is: five or more properties flooded internally; two or more non-residential properties flooded; one or more critical service (e.g. hospital) flooded; there are health and safety concerns (e.g. environmental health or risk to life), and/or; a transport link is totally impassable for a significant period.

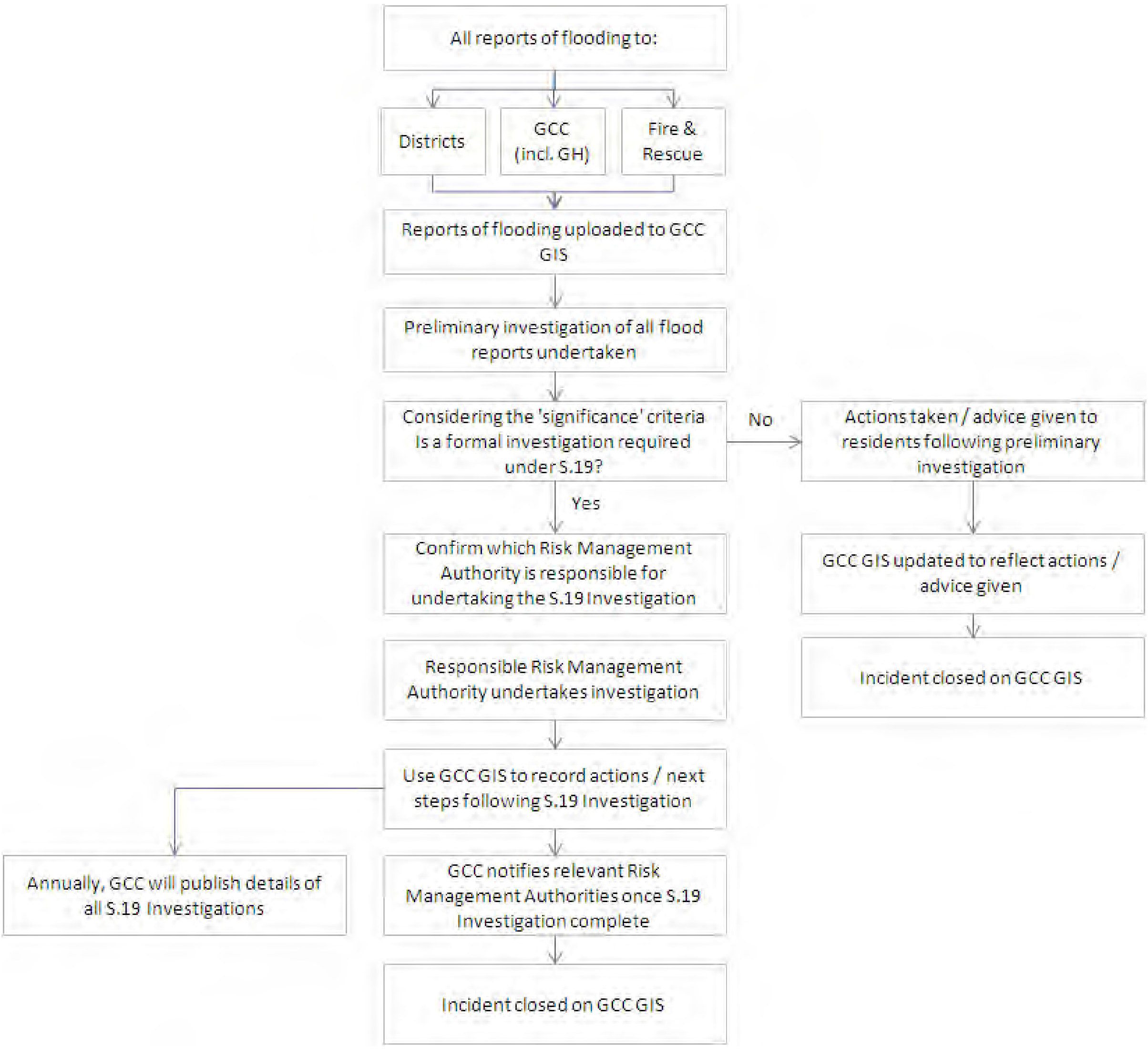


Figure 9-1 S.19 Investigation protocol

9.1.3. Consenting and Enforcement

144. Part of the Flood and Water Management Act transfers the Environment Agency's responsibility for flood defence consents and enforcement powers under sections 23, 24 and 25 of the Land Drainage Act (LDA) to the LLFA and removes the powers to require works for maintaining flow of watercourses from District councils to LLFAs (section 25 LDA). In addition they amend the prohibition on obstructions to ordinary watercourses to preclude the erection of any culvert without prior consent, and allow the relevant authority to attach reasonable conditions to a consent issued under section 23 of the LDA. As part of the development of the Local Strategy GCC has drafted a policy on culverting of ordinary watercourses, which has been shared with Risk Management Authorities and will be accessible on GCC's website.

145. In Gloucestershire the delivery of the consenting and enforcement role is being delivered through a partnership between GCC and the districts and it will be reviewed annually. A key part of this role is engaging with landowners to ensure that ditches and watercourses are appropriately maintained, which links into the action outlined in Section 9.1.9.

9.1.4. Designation of features or structures

146. Under Schedule 1 of the Flood and Water Management Act a designating authority (LLFA, Environment Agency, district councils and the Internal Drainage Board) can designate a feature (natural or man-made) or a structure to prevent the owner of the feature or structure from altering or removing it. This can only be done if a number of conditions are satisfied, which are outlined in the legislation. Once a structure or feature is designated, a person may not <u>alter, remove or replace</u> the structure or feature without the consent of the organisation that designated it.

147. 'Designation' is a legal process with an appeals procedure and GCC is currently developing the appropriate procedures in partnership with the districts to ensure a consistent and lawful approach is adopted throughout Gloucestershire.

9.1.5. Collate additional historic flood incident data

148. We already hold significant amounts of data on historic flooding incidents across Gloucestershire. However, we recognise that local communities may hold additional information we are not yet aware of and which would help to better understand flood risks within different locations. We will seek to establish a process by which town and parish councils can provide additional information on historic flooding to support flood risk management.

9.1.6. Develop annual progress and implementation plan

149. The Local Strategy sets the framework for managing local flood risk. However, we recognise the need to maintain flexibility in the delivery of local flood risk management to respond to legislative, regulatory or financial changes. Therefore, we will develop an annual progress and implementation plan with Risk Management Authorities which will review progress and set the priorities and actions for the forthcoming year.

9.1.7. Populate S.21 Asset Register

150. Section 21 of the Act states that a 'lead local flood authority must establish and maintain: a register of structures or features which, in the opinion of the authority, are likely to have a significant effect on a

flood risk in its area, and; a record of the information about each of those structures or features, including information about ownership and state of repair'. Section 21 also states that this register (called an asset register) must be available for inspection at all reasonable times.

151. Knowing the location, ownership and condition of assets will help GCC and other Risk Management Authorities to better understand how the performance of these assets affects local flood risk. It is our intention locally to build up the asset register using a risk-based approach. Therefore we will initially prioritise our efforts in capturing asset information for the assets which are known to have a significant effect on local flood risk. Over time, and subject to available resources, we will work collaboratively with Risk Management Authorities to capture more information on a larger number of assets. It is anticipated that the initial capture of assets will be completed by summer 2013. Subject to available resources there will be an ongoing programme to capture information on other assets which have a less significant effect on local flood risk.

152. It is not our intention to capture and store information for assets associated with Main Rivers, the sea, reservoirs, and public sewers. Both the Environment Agency (for Main Rivers, the sea and reservoirs) and water companies (for public sewers) already hold asset information and we do not wish to duplicate information held, wherever possible.

9.1.8. Develop risk-based approach for maintaining assets

153. Subject to available resources and funding, we need to ensure that we understand the maintenance requirements and condition of assets, and take action to ensure key flood risk assets are performing effectively. It should be noted that Gloucestershire Highways already have a gully clearance programme in place. Therefore we will focus our efforts on existing assets which do not have a defined maintenance regime.

154. Once we have captured sufficient data on the location, ownership and condition of assets with a significant effect on local flood risk, it is intended that GCC will work with the districts to plan a programme of maintenance works.

9.1.9. Undertake ditch mapping and clearance with parish councils

155. We are also proposing to work in close partnership with parish councils to better understand the location, ownership and condition of local drainage ditches across the county, which would help to pro-actively plan the maintenance of these assets. Parish councils will have access to much local knowledge which will be invaluable in working with riparian owners to maintain drainage ditches. It is also important to note that many assets are on private land and the maintenance responsibility lies with the riparian owner. This will need to be further considered when developing a programme of maintenance to ensure that public money is invested in the most cost-effective manner.

9.1.10. Undertake pilot to assess green infrastructure

156. Historically, drainage and flood risk management infrastructure have been constructed with little focus on wider benefits that can be achieved, such as amenity, biodiversity or water quality benefits. Working with our highways teams, district councils and the water companies we will seek to start a pilot study to implement green infrastructure in urban areas. This will capture surface runoff at source thereby reducing flood risk, but also providing opportunities to improve amenity and create habitat and biodiversity within urban environments. The pilot study will be used to inform future investment

opportunities in using green infrastructure to manage surface water in urban areas in new and innovative ways.

9.1.11. Develop SUDS Approval Body Role

157. The Act requires the drainage system for each new development or re-development (subject to exemptions) to be approved, adopted and maintained by the unitary or county council for the area before construction starts. The drainage system must take account of National Standards for the design and construction of sustainable drainage systems. These will set out the criteria on which the forms of drainage appropriate to any particular site or development can be determined.

158. GCC and the districts have commenced preliminary discussions with respect to the delivery model and procedures for implementing the SuDS Approval Body (SAB). However, the National Standards and commencement order for the implementation of SuDS have yet to be released. Until this is done the resources and actions, or operational timetable needed cannot be confirmed.

9.1.12. Issue surface water mapping to local planning authorities

159. The 'Locally Agreed Surface Water Information' has been produced by GCC and the district councils to create a single source of data on modelled surface water flooding across Gloucestershire. The Locally Agreed Surface Water Information (and historic flooding information) should be used by local planning authorities in 'plan-making' and 'decision-taking'. The Locally Agreed Surface Water Information enables planners to identify natural overland flow pathways and areas where surface water will pond (i.e. in depressions and low spots). The information has been provided to the six local planning authorities for use in plan-making and decision-taking. Updates to the Locally Agreed Surface Water Information will be distributed to the local planning authorities, as and when necessary.

160. In plan-making the information should be used by local planning authorities as part of Strategic Flood Risk Assessments, to help steer development away from areas of highest flood risk.

161. The Locally Agreed Surface Water Information should not be used as the sole source of information for decision-taking (i.e. determining a planning application), but it does provide a useful starting point (alongside the Environment Agency's fluvial flood maps) for:

- identifying whether a development site lies within a natural overland flow pathway or an area where surface water is likely to pond, and;
- identifying whether there are existing surface water flooding issues downstream of a development site.

9.1.13. Improve linkages with local planning authorities

162. The Local Strategy is not primarily a strategic spatial planning document, nor does it seek to duplicate the extensive work undertaken by the Local Planning Authorities in Gloucestershire in preparation of their 'Local Plans'. Nevertheless there are strong linkages between flood risk management and spatial planning and the Local Strategy seeks to identify these interactions.

163. Under the Localism Act (2012) each district is now individually responsible for setting their own local housing numbers based on objectively assessed need, which is reflective of economic circumstance, environmental capacity and an understanding of the existing unmet housing need of local communities.

Each council's website contains up to date information on the status of planning documents. As part of our leadership role we are, and will continue, to work with the district councils to ensure that:

- appropriate development control policies are embedded in development plan documents, many of which are considered in SFRAs;
- we engage with the local planning authority on 'major' planning applications as early as possible where there are potential local flood risk implications. This will enable us to provide advice on the development site early in the planning process;
- local planning authorities have access to, and make use of, the 'Locally Agreed Surface Water Information' (Section 9.1.12), and;
- investment opportunities through Section 106, Community Infrastructure Levy and New Homes Bonus are explored, whilst recognising that developer contributions should not be considered the 'magic bullet' to fill the funding gap.

164. Part of this action will be to engage with parishes and neighbourhoods who are preparing Neighbourhood Development Plans, to ensure that flood risk information within these plans are consistent with the Local Strategy and actions arising from it[28].

9.1.14. Publish surface water mapping

165. We will publish the most up to date surface water mapping to allow local residents to identify whether they are at risk from surface water flooding. This will be published alongside appropriate guidance on how to interpret and use this information. The Environment Agency published their updated national surface water mapping in December 2013 and the risk assessment has been updated using this information. This is available here: http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=ufmfsw#x=393531&y=222237&scale=10.

9.1.15. Raise awareness of flood risk through media

166. GCC's media approach relies heavily on media liaison and the use of 'free' advertising channels such as the GCC website. In doing so, we have and will continue to create a general awareness of GCC's extensive commitment to the management of flood risk in the county, particularly amongst affected communities. An open and transparent media approach exists to keep the local and trade press informed of ongoing engineering schemes and works and in order to assure the public of our ongoing commitment to flood risk management. In addition, we will use the media to raise awareness and education of flood risk issues such as disposing of fats, oils and greases, ditch clearance, or paving over of gardens, for examples.

9.1.16. Empower local communities to be aware of flood risk and take action

167. A key aspect of GCC's communication is the need to increase public awareness and understanding of flood risk and provide 'at risk' groups with the knowledge to contribute to their own resistance and resilience to flooding.

[28] More information is available here: www.grcc.org.uk/neighbourhood-development-plans/neighbourhood-development-plans

168. Change of this kind is likely to be long term, gradual, and measurable only through qualitative research methods. Figure 9-2 outlines a range of actions the public and local community groups can take to reduce their vulnerability to flooding. Further information on these is provided in Appendix D. GCC and the district/borough councils will need to provide technical advice and funding to empower local communities, although this will need to be subject to available funding and resource.

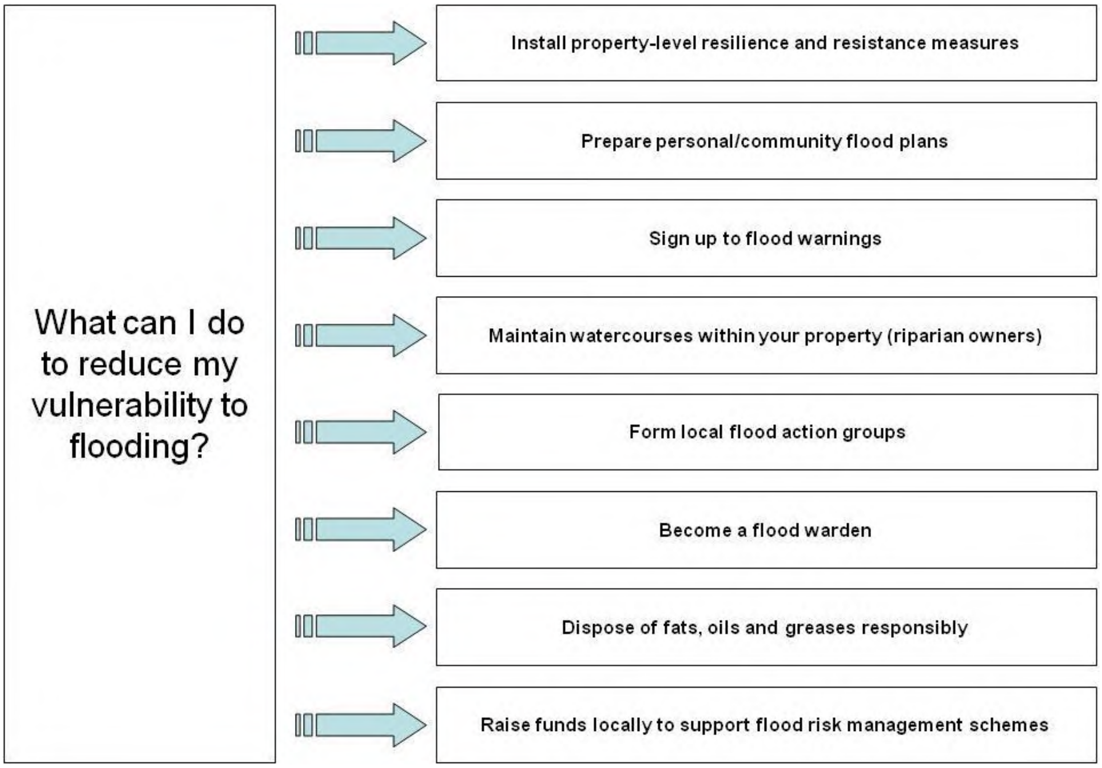


Figure 9-2 Measures that can be taken by the public and community groups to reduce their vulnerability to flooding (see Appendix D for further information)

9.1.17. Continue meeting with FRM Partnership Group

169. We have formed a Flood Risk Management Partnership Group following the 2007 flooding to discuss strategic flooding issues in Gloucestershire, and to develop the Local Strategy. We will continue to work with Risk Management Authorities through the Partnership Group to ensure a co-ordinated approach to flood risk management in Gloucestershire and as a forum to discuss technical issues.

9.1.18. Work with Civil Protection Team

170. Emergency planning focuses on the response to, and recovery from, emergency incidents (including flooding). The Local Resilience Forum (including emergency services, Local Authorities, Environment Agency and Health Authorities), is responsible for working in partnership to plan for and respond to flooding emergencies. Local Authorities are responsible for leading the recovery from flooding incidents. GCC Civil Protection Team has worked with other agencies (including district/borough councils) to coordinate the preparation of Multi-Agency Flood Plans (MAFP) and a Local Authorities Recovery Plan[29] to identify the response to, and recovery from, flooding incidents.

[29] http://www.gloucestershire.gov.uk/CHttpHandler.ashx?id=32794&p=0

171. The MAFP comprises a county-wide generic 'tactical' level plan and annexes detailing 'operational' level flood plans for each district/borough within Gloucestershire. The tactical plan is maintained on behalf of the LRF by GCC's Civil Protection Team. The District Council Flood Plans are owned and maintained by each District Council, with support from GCC's Civil Protection Team. The MAFP can be accessed at the following link: http://gloucestershireprepared.co.uk/files/Glos%20LRF%20MAFP%20-%20Public%20Version%201.2%20November%202011.pdf. A specific plan has also been developed to address the particular risk of flash flooding in Lydney. Local Authorities have also been encouraging local communities (e.g. via Parish Councils) to develop their own 'Community Emergency Plan' to increase the resilience at a community level to emergencies including flooding.

172. It is vital that through the Local Strategy there is full engagement with the Gloucestershire Local Resilience Forum to ensure that emergency planning is aligned with the day-to-day arrangements for management of flood risk, and to maximise opportunities to share data and communications. GCC's Civil Protection Team is represented on the FRM Partnership Group which will ensure there are strong linkages between local flood risk management and emergency planning. Specific measures which will be taken through the Local Strategy are outlined in Table 9-3.

Measure	Description
Locally Agreed SW Information	Ensure that the Locally Agreed Surface Water Information is distributed to Gloucestershire LRF to be used in future updates of the MAFP
SWMP mapping	SWMPs include more detailed mapping of flood depth, velocities and hazards which will be distributed to Gloucestershire LRF to be used in future updates of the MAFP
Groundwater flooding scoping study	Distribute outputs from groundwater flooding scoping study (and any further work) to Gloucestershire LRF for future updates of the MAFP
Critical infrastructure flood risk assessment	Distribute outputs from critical infrastructure flood risk assessment to Gloucestershire LRF to be used in future updates of the MAFP
Flood incident data	Ensure that any flood incident data collated by the districts/boroughs and the fire and rescue service (or other organisations) in the event of a flood are provided to GCC's FRM team to enable S.19 Investigations to be undertaken.
Working with communities	GCC's FRM team is working with the Civil Protection Team to identify approaches for empowering local communities to take action to reduce their vulnerability to flooding

Table 9-3 Measures in the Local Strategy which link to emergency planning

9.1.19. Track improvements in flood warning

173. The ability of property owners to effectively undertake resistance and resilience measures is reliant upon a suitable flood warning system which enables people to activate/install appropriate measures in advance of a flood. The Environment Agency provides a flood warning service[30] for certain watercourses in the county and they actively promote sign-up to the warning service for properties at risk of fluvial flooding. The Local Strategy actively encourages people in at risk areas to sign up to flood warnings.

174. It is recognised that a flood warning system does not yet exist for other sources of flooding, such as surface water. GCC will continue to monitor progress of the research and development of such a system and, in the meantime, encourage owners of at risk properties to pay attention to extreme weather warnings and Environment Agency flood warnings in order for their own appropriate action to be taken.

[30] http://www.environment-agency.gov.uk/homeandleisure/floods/31618.aspx

9.2. Action Plan for location-specific actions

175. A methodology for identifying the parishes and wards most vulnerable to flooding was provided in Section 5. Based on this methodology a prioritised list of parishes and wards has been identified, which are summarised in Appendix G. The top 20 parishes and wards identified as being most vulnerable to flooding from all sources will remain the priority for GCC and its partners.

176. We recognise there are many parishes and wards outside of the top 20 which are at risk of flooding and we will continue to implement mitigation measures in these locations. We will allocate funds on an annual basis for parishes and wards identified as being at lower risk. However, the parishes and wards within the top 20 will remain the highest priority for GCC as a LLFA. The top 20 list will remain 'live' and as mitigation measures are implemented the list will be updated. Equally, future flooding incidents will cause us to re-evaluate the priority parishes and wards.

177. Details of proposed mitigation measures in parishes and wards will be provided as part of the annual progress and implementation plan. It will focus on the top 20 parishes and wards, but will also outline proposed mitigation measures in other parishes and wards.

10. Monitoring and Review

178. It is important that the new duties and responsibilities the Act brings to GCC are seen to be administered and conducted in an open, honest and accountable way. Transparent and open governance is a policy of the County Council (GCC Code of Corporate Governance) and it is intended that the administration of this Strategy will be in accord with the fundamental principles of the Code. In doing this, GCC will exercise its role as lead authority providing its Strategy for local flood risk management in the County, striving to seek the best use of resources and value for money.

179. The FRM team sits within the Strategic Planning Unit and meets regularly with the relevant Lead Cabinet Members to scrutinise and approve the FRM and Drainage Team's proposed programme of works, to receive updates on progress with delivering the programme of works and agree funding allocations. Ultimately, all flood risk management activity in the county is scrutinised by the Environment Overview and Scrutiny Committee. The Local Strategy will be subject to review by the Environment Overview and Scrutiny Committee and was passed by Cabinet prior to final adoption. Going forward both GCC and the district authorities have scrutiny procedures in place to ensure the accountability of the decision making processes and that sufficient progress is being made to manage flood risk across Gloucestershire.

180. The Act ensures that GCC consults with the public and its partner organisations on the content of the Local Strategy that it produces. The process for continued accountability is already in place, with the Act providing for close working co-operation with our partners and a continuing exchange of information.

10.1. Monitoring and reviewing the Local Strategy

181. GCC will review the Local Strategy on an annual basis when producing the annual progress and implementation plan. This strategy and the supporting action plan will remain a live document over the strategy period. The strategy is valid until 2023, at which point an update of the Local Strategy will be produced. However, the strategy may need to be updated within this period if:

- there are significant flood events that challenge the conclusions of the prioritisation process;
- there are important changes to any of the datasets that underpin the prioritisation methodology;
- there are relevant policy changes that amend the roles and responsibilities of the Risk Management Authorities, and;
- the annual monitoring identifies that the Local Strategy is not achieving its objectives.

10.2. Resources to deliver Local Strategy

182. It is important that the Local Strategy sets out how the proposed objectives and measures will be resourced. Effective practical implementation of objectives and measures requires adequate resources (financial and people) for both the management and response activities of Risk Management Authorities as well as to deliver capital projects. This section considers the existing people resources to deliver the objectives and measures within the Local Strategy and identifies the resources gap within Risk Management Authorities.

10.2.1. Existing resource capacity in Risk Management Authorities

183. It is difficult to ascertain the resource capacity required to deliver Local Flood Risk Management, particularly because some of the requirements of the Flood and Water Management Act are dependent on external factors (e.g. flooding incidents). Nevertheless an estimate has been made of the required resources required to successfully deliver the objectives of the Local Strategy. This estimate is shown in Table 10-1, which indicates that between 11 and 16 full time equivalent staff will be required (in GCC and the districts) to successfully deliver the objectives of the Local Strategy.

184. These resources may be located within GCC or the districts and a skills audit has been undertaken in GCC and the districts to identify the existing resource capacity. Based on this audit it is estimated that there are approximately 8 FTEs (full time employees)[31] involved in local flood risk management activities in GCC and the districts. In light of this evidence it is clear that between **three to eight** additional FTEs will be required across the county (depending on implementation of the SUDS approval bodies)[32].

Activity	Resources required
Develop, delivery, apply and monitor a Local Strategy (including developing the annual progress and implementation plan)	1.5-2.0 FTE
General management and ongoing partnership working	1.0-1.5 FTE
Interface with spatial and emergency planners and commenting on planning applications	0.5-1.0 FTE
Undertake studies to better understand local flood risk and deliver schemes to reduce local flood risk (this work is frequently done by third party consultants, but there is still a requirement to manage this process)	1.0-2.0 FTE
Community awareness and public engagement activities	0.5-1.0 FTE
Investigating flooding incidents	0.5-1.0 FTE
Developing and maintaining an asset register	0.5 FTE
Developing a maintenance approach for key assets and implement (maintenance work will be undertaken by third party contractors and is not included here)	0.5 FTE
Designating features or structures	0.2 FTE (from Defra Impact Assessment)
Consenting and enforcing works on ordinary watercourses	1.0-2.0 FTE
SUDS Approval bodies	4.0 FTE (estimate)
Total resource required	**11-16 FTE**

Table 10-1 Resources required to deliver objectives of the Local Strategy

[31] This is made up of: GCC FRM Team: 2.5 FTE, Cheltenham Borough Council: 1 FTE, Cotswold District Council: 1 FTE, Forest of Dean District Council: 0.5 FTE, Gloucester City Council: 1 FTE, Stroud District Council: 1 FTE, Tewkesbury Borough Council: 1 FTE

[32] A framework paper prepared for Defra by Local Government Centre (Warwick Business School) and Atkins assessed the additional staff costs associated with meeting the new roles and responsibilities under the Act. This paper has estimated that Gloucestershire, which has been determined as being the 23rd most at risk from flooding authority area in the country, would require between 5 to 6.3 additional full time employees to meet the new burdens under the Act. The analysis within the Local Strategy is consistent with the evidence from the Defra paper.

10.2.2. Addressing the skills gap

185. As outlined above it is evident that GCC and RMAs will need to increase capacity to successfully deliver the objectives set out in this Local Strategy and the requirements of the Flood and Water Management Act.

186. A Government 'strategy for skills and capacity building in local authorities for local flood risk management' was produced in July 2010 to increase local authority capacity and skills to assist in the delivery of the new LLFA role and other actions recommended in the Pitt Review. In its response to the Pitt recommendations, the Government committed £1 million to support the development of local authority capacity building. The strategy sets out short term actions and also looks at which elements of capacity should continue to be developed in the medium to long term. Three key themes are identified which provide the structure for the development of the strategy. These are:

- Developing knowledge and skills for existing staff;
- Building capacity through provision of educational courses for new staff;
- Providing information and tools primarily to support LAs and other stakeholders to develop skills.

187. GCC recognises that to deliver some elements of the Local Strategy and the Flood and Water Management Act additional resources may be required, particularly to deliver the SUDS Approval Body role once commenced. GCC is currently exploring options for recruiting new staff and/or sharing resources across Risk Management Authorities wherever possible. GCC has also taken advantage of the Defra part-funded foundation degree student placement programme, and will have a mature student as a member of the FRM Team during years 2012-2014.

188. GCC is committed to the training and development of staff skills in line with the local capacity building programme and has attended many of the meetings and workshops as part of the programme.

Appendix A Relevant Plans and Policies

Appendix B Maps

Appendix B1 – District council boundaries

Appendix B2 – Water companies boundaries

Appendix B3 – Internal Drainage Board boundary

Appendix B4 – Areas Susceptible to Groundwater Flooding

Appendix B5 – Main Rivers and Ordinary Watercourses

NB: The Environment Agency has published maps of flood risk from rivers and surface water. Mapping can be viewed at: http://watermaps.environment-agency.gov.uk/wiyby/wiyby.aspx?topic=ufmfsw#x=393531&y=222237&scale=10

Appendix C Roles and Responsibilities of RMAs

Appendix D Empowering local communities

Appendix E Summary of summer 2007 floods

Appendix F Methodology for identifying priority locations

Appendix G Summary of flood risk to parishes and wards

Appendix H Types of flood risk measures

Appendix I Potential sources of funding for LFRM

Appendix J Draft culvert policy

Glossary

ABI – Association of British Insurers.

Breach – Flooding caused by the constructional failure of a flood defences or other structure that is acting as a flood defence.

CFMP – Catchment Flood Management Plan. A CFMP is a high-level strategic plan through which the Environment Agency seeks to work with other key-decision makers within a river catchment to identify and agree long-term policies for sustainable flood risk management.

Civil Contingencies Act (2004) - Legislation that aims to deliver a single framework for civil protection in the UK and sets out the actions that need to be taken in the event of a flood.

Climate Change – A long-term change in the statistical distribution of weather patterns over periods of time that range from decades to millions of years. It may be a change in the average weather conditions or a change in the distribution of weather events with respect to an average, for example, greater or fewer extreme weather events. Climate change may be limited to a specific region, or may occur across the whole Earth.

Climate Change Act (2008) – An Act that requires a UK-wide climate change risk assessment every five years, accompanied by a national adaptation programme that is also reviewed every five years. It also requires public bodies and statutory organisations such as water companies to report on how they are adapting to climate change.

Coastal Erosion - The wearing away of land or the removal of beach or dune sediments by wave action, tidal currents, wave currents, or drainage. Waves, generated by storms, wind, or fast moving motor craft, cause coastal erosion, which may take the form of long-term losses of sediment and rocks, or merely the temporary redistribution of coastal sediments; erosion in one location may result in accretion nearby.

Commencement Order – An instruction that brings a defined aspect of legislation into force.

Conservation of Habitats and Species Regulations (2010) - An Act which transposed the Habitats Directive into UK law. The regulations aim to help maintain and enhance biodiversity throughout the EU, by conserving natural habitats, flora and fauna. The main way it does this is by establishing a coherent network of protected areas and strict protection measures for particularly rare and threatened species.

Critical Infrastructure - a term used to describe the assets that are essential for the functioning of a society and economy. Most commonly associated with the term are facilities for: electricity generation, transmission and distribution; gas production, transport and distribution; oil and oil products production, transport and distribution; telecommunication; water supply (drinking water, waste water/sewage, stemming of surface water (e.g. dikes and sluices)); agriculture, food production and distribution; heating (e.g. natural gas, fuel oil, district heating); public health (hospitals, ambulances); transportation systems (fuel supply, railway network, airports, harbours, inland shipping); financial services (banking, clearing); and security services (police, military).

Culvert - A closed conduit used for the conveyance of surface drainage water under a roadway, railroad, canal, or other impediment

Defence (Flood Defence) – A structure that alters the natural flow of water or flood water for the purposes of flood defence, thereby reducing the risk of flooding. A defence may be formal' (a structure built and maintained specifically for flood defence purposes) or 'informal'/'defacto' (a structure that provides a flood defence function but has not been built and/or maintained for this purpose).

Defra - Department of Environment, Food and Rural Affairs

EC Floods Directive – A European Directive that has been transposed to UK law through the Flood Risk Regulations (2009).

EMS - Emergency Management Service.

Environment Agency – An Executive Non-departmental Public Body responsible to the Secretary of State for environment, Food and Rural Affairs and an Assembly Sponsored Public Body responsible to the National Assembly for Wales. The Environment Agency's principal aims are to protect and improve the environment, and to promote sustainable development. They play a central role in delivering the environmental priorities of central government and the Welsh Assembly Government through our functions and roles.

Flood - A flood is an overflow of an expanse of water that submerges land. Both the Flood and Water Management Act (2010) and the Flood Risk Regulations (2009) state that it doesn't matter whether a flood is caused by: heavy rainfall; a river overflowing its banks of being breached; a dam overflowing or being breached; tidal waters; groundwater; or anything else including a combination of factors. However, both state that a 'flood' does not include: a flood caused from any part of a sewerage system, unless wholly or partly caused by an increase in the volume of rainwater (including snow and other precipitation) entering or otherwise affecting the system; or a flood caused by a burst water main.

Flood and Water Management Act (2010) - The Act brings together the recommendations of the Pitt report and previous policies, to improve the management of water resources and create a more comprehensive and risk based regime for managing the risk of flooding from all sources. The Act states that its purpose is to "make provision about water, including provision about the management of risks in connection with flooding and coastal erosion."

Flood Hazard Map – A map that defines flood risk areas and shows: the likely extent (including water level or depth) of possible floods; the likely direction and speed of flow of possible floods; and whether the probability of each possible flood occurring is low, medium or high (in the opinion of the person preparing the map).

Flood Resistance – Actions taken to prevent to ingress of flood water to a property. Flood Resistance measures may include flood barriers placed over doorways.

Flood Resilience – Actions taken which allow the ingress of flood water through a property, but enable swift recovery after the flood event. Flood resilience measures may include (among others) flood-resistant construction materials, raised electricity sockets and water-resistant flooring.

Flood Risk – Flood risk is a combination of two components: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would cause if it occurred

Flood Risk Area – a term defined for the Flood Risk Regulations, and represents an area of significant flood risk. It is calculated by identifying a cluster where at least 30,000 people are at risk from surface water flooding. There are 10 'Flood Risk Areas' in England.

Flood Risk Map – A map showing: the number of people living in the area who are likely to be affected in the event of flooding; the type of economic activity likely to be affected in the event of flooding; any industrial activities in the area that may increase the risk of pollution in the event of flooding; any relevant protected areas that may be affected in the event of flooding; any areas of water subject to specified measures or protection for the purpose of maintaining the water quality that may be affected in the event of flooding; and any other effect on human health, economic activity or the environment (including cultural heritage).

Flood Risk Management Plan – A plan for the management of a significant flood risk. The plan must include details of: objectives set by the person preparing the plan for the purpose of managing the flood risk; and the proposed measures for achieving those objectives (including measures required by any provision of an Act or subordinate legislation).

Fluvial - The processes associated with rivers and streams and the deposits and landforms created by them.

FRM - Flood Risk Management. A process to reduce the probability of occurrence through the management of land, river systems and flood defences and reduce the impact through influencing development on flood risk areas, flood warning and emergency response.

FRPB – Future Resilience Programme Board.

Flood Risk – The probability or chance of a flood event occurring and the consequence of that event, if it did take place.

Flood Risk Regulations (2009) - Transposes the EC Floods Directive (Directive 2007/60/EC on the assessment and management of flood risks) into domestic law and implements its provisions. The regulations outline the roles and responsibilities of the various authorities consistent with the Flood and Water Management Act 2010 and provide for the delivery of the outputs required by the directive. The Directive requires Member States to develop and update a series of tools for managing all sources of flood risk.

Flood Zones - Nationally consistent delineation of ‘high’ and ‘medium’ flood risk, published on a quarterly basis by the Environment Agency.

Functional Floodplain Zone 3b - Defined as areas at risk of flooding in the 5% AEP (1 in 20 year) design event. In any one year the chance of a 5% AEP (1 in 20 year) event occurring is 5%.

GCC – Gloucestershire County Council

GH – Gloucestershire Highways

GIS – Geographic Information System. GIS is any system which stores geographical data, such as elevations, location of buildings and extent of flood outlines.

Gloucestershire Flood Risk Management Group – A multi-agency group that includes representatives from the Environment Agency, Severn Trent Water, Thames Water, Lower Severn Internal Drainage Board and all the local Districts, set up to provide a co-ordinated response to flood risk management in Gloucestershire at a strategic level.

Groundwater - Water located beneath the ground surface, either in soil pore spaces or fractures in rock.

High probability Zone 3a - Defined as areas at risk of flooding in the 1% AEP (1 in 100 year) design event. In any one year the chance of a 1% AEP (1 in 100 year) event occurring is 1%.

IDB – Internal Drainage Board

LDF - Local Development Framework. The LDF consists of a number of documents which together form the spatial strategy for development and the use of land.

LGA – Local Government Association

LGIU – Local Government Information Unit

LLFA – Lead Local Flood Authority

LRF – Local Resilience Forum

Local Flood Risk – defined in the Flood and Water Management Act as flooding from surface runoff, ordinary watercourses and groundwater

Low Probability Zone 1 – The area outside Zone 2. Defined as an area with less that 0.1% AEP (1 in 1000 year) chance of flooding. In any one year the chance of a 1% AEP (1 in 100 year) event occurring is less than 0.1%.

Main River – All watercourses shown on the statutory main river maps held by the Environment Agency and the Department for Environment, Food and Rural Affairs. This can include any structure or appliance for controlling or regulating the flow of water into, in or out of the channel. The Environment Agency has permissive power to carry out works of maintenance and improvement on these rivers.

MSfW - Making Space for Water (Defra 2004). The Government's new evolving strategy to manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches, so as: a) to reduce the threat to people and their property; b) to deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles, c) to secure efficient and reliable funding mechanisms that deliver the levels of investment required.

Medium probability Zone 2 - Defined as an area at risk of flooding from flood events that are greater than the 1% AEP(1 in 100 year), and less than the 0.1% AEP (1 in 1000 year) design event. The probability of flooding occurring in this area in any one year is between 1% and 0.1%.

MWDF – Minerals and Waste Development Framework

National Flood Risk Management Strategy -

NRD – National Receptor Dataset

Ordinary Watercourse – Any section of watercourse not designated as a Main River.

PFRA – Preliminary Flood Risk Assessment

Pluvial – Direct runoff.

Precipitation – Describes rain, sleet, hail, snow and other forms of water falling from the sky.

PPS 25 - Planning Policy Statement 25: Development and Flood Risk. Government policy on development and flood risk. Its aims are to ensure that flood risk is taken into account at all stages in the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk. Where new development is, exceptionally, necessary in such areas, policy aims to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.

RBD – River Basin District.

RFDC – Regional Flood Defence Committee

RFRA – Regional Flood Risk Appraisal

Reservoir - artificial lake used to store water. Reservoirs may be created in river valleys by the construction of a dam or may be built by excavation in the ground or by conventional construction techniques such a brickwork or cast concrete. Reservoirs greater than 10,000m3 are governed by the Reservoirs Act.

Residual Risk - The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.

Return Period – The probability of a flood of a given magnitude occurring within any one year e.g. a 1% AEP (1 in 100 year) event has a probability of occurring once in 100 years, or a 1% chance in any one year. However, a 1% AEP (1 in 100 year) event could occur twice or more within 100 years, or not at all.

Riparian Owner - All landowners whose property is adjoining to a body of water have the right to make reasonable use of it and suitably maintain it.

Risk Management Authority – defined in the Flood and Water Management Act, they all have some responsibility for managing flood risk

RFRA – Regional Flood Risk Assessment

Sequential Test - Informed by a SFRA, a planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed.

Sewer flooding – The consequence of sewer systems exceeding their capacity during a rainfall event.

SFRA - Strategic Flood Risk Assessment. An SFRA is used as a tool by a planning authority to assess flood risk for spatial planning, producing development briefs, setting constraints, informing sustainability appraisals and identifying locations of emergency planning measures and requirements for flood risk assessments.

SuDS – Sustainable Urban Drainage Systems. SuDS are drainage systems which are designed to reduce the impact of urbanisation on the hydrology of a river system.

SWMP – Surface Water Management Plan

Surface Runoff – Rainwater (including snow and other precipitation) which: is on the surface of the ground (whether or not it is moving); and has not entered a watercourse, draining system or public sewer.

Sustainable Development – “Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (The World Commission on Environment and Development, 1987)

Tidal Flood Risk – The flood risk that arises as a consequence of high tides or tidal surges.

Unitary Authority – A type of local authority that has a single tier and is responsible for all local government functions within its area or performs additional functions which elsewhere in the relevant country are usually performed by national government or a higher level of sub-national government.

WaSC – Water and Sewerage Company

WFD - Water Framework Directive

Appendix I

Greenfield Run Off Calculation Sheet

IH 124 Mean Annual Flood

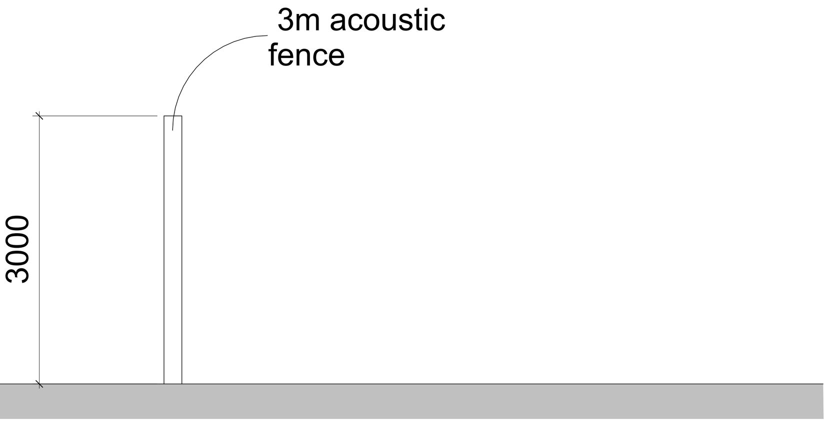
Input

Return Period (years)	100	Soil	0.400
Area (ha)	50.000	Urban	0.000
SAAR (mm)	702	Region Number	Region 4

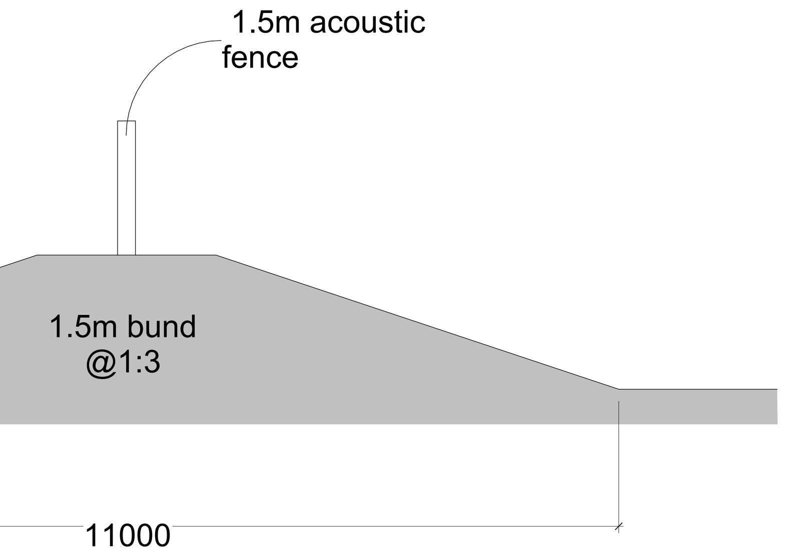
Results	**l/s**
QBAR Rural	170.7
QBAR Urban	170.7
Q100 years	438.7
Q1 year	141.7
Q2 years	153.0
Q5 years	209.9
Q10 years	254.3
Q20 years	303.4
Q25 years	320.5
Q30 years	334.4
Q50 years	375.8
Q100 years	438.7
Q200 years	515.5
Q250 years	541.1
Q1000 years	710.0

Appendix J

Drawing ‘3250-O3S-ZZ-XX-GA-A-0030-ProposedSitePlan-S0-P16’



Acoustic Barrier - Section B-B



Acoustic Barrier - Section A-A

THIS DRAWING IS NOT TO BE SCALED. Except for the purposes of planning applications and for legal plans where the scale bar **must** be used. Always refer to figured dimensions. Verify site dimensions prior to construction and report discrepancies immediately. This drawing is to be read in conjuction with all relevent documents and drawings.

Rev	Revision Details	Dr	Date
P16	Layout amendments following client meeting on 9.03.22	NG	10.03.22
P15	Layout updated following client review	NG	17.01.22
P14	Layout amended following client review and DTM	NG	20.12.21
P13	Net Area's updated. Minor layout chnages following DTM	NG	19.11.21
P12	Layout revised following design meeting and comments with client	NG	26.07.21
P11	Tier 1 housing added. Southern block structure amended for masterplan	NG	02.06.21
P10	Numbers reduced in preparation for proposed Block Plan	NG	06.05.21
P09	Block structure revised to accomodate additional units as per clients instructions	NG	23.04.21
P08	PROW alignment and internal pedestrian/cycle network amended following consultant meeting	NG	30.03.21
P07	Proposed attenuation basins replaced with swales to western boundary. Extent of existing shrubbery indicate on western edge	NG	25.03.21
P06	Layout amended to test single access option from Northern junction	NG	24.03.21
P05	Unit numbers increased and layout changes following review	NG	17.03.21
P04	Layout amendments, net area and schedule updated.	NG	15.03.21
P03	Layout revised following client comments	NG	12.03.21
P02	Site area schedule added	DR	10.02.21
P01	Initial Draft	CH	18.06.20

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RIBA

Client's Name
Edward Ware Homes Ltd & Bromford

Job Title
Snow Capel Farm

Drawing Title
Proposed Site Plan

Scale
As indicated @ A0

Drawn	Checked	Date
CH	DR	09.06.20

Job No	Drawing No	Rev
3250	0030	P16

Status
PRELIMINARY

Sheet ID
3250-O3S-ZZ-XX-GA-A-0030-S0-P16

14/03/2022 15:21:46

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Appendix K

SUB33 Land at Snow Capel Farm Site Historic Environment Assessments for Strategic Assessment of Land Availability (SALA)’

SUB33 Land at Snow Capel Farm

Site Historic Environment Assessments for Strategic Assessment of Land Availability (SALA)

March 2015

Gloucester City Council

Contents

Site Historic Environment Assessment for Strategic Assessment of Land Availability (SALA)

Shona Robson-Glyde

SUB33 Land at Snow Capel Farm

1. Background

1.1 Location

This site historic environment assessment consists of SUB33 Land at Snow Capel Farm located within the parish of Matson, in the Ward of Matson and Robinswood within the wider boundary of Gloucester City (Fig 1). It consists of open fields and the buildings of Snow Capel Farm on the southern edge of Matson. To the north of the site is the open land at the south of Robinswood Hill. The site is bounded by Winneycroft Lane in the east and the M5 in the south east. The M5 Gloucestershire Gateway Motorway Services (North bound) lies to the immediate south of the site with open fields to the west.

1.2 Site Visits

Site visits were undertaken in March 2016. Photographs of the site have been reproduced in this document as Plates 1-5. Archaeological information, historic maps and plans have also been reproduced as Figs 2-4.

1.3 Topography, Geology and Land Use

The site encompasses an area of 14.64 hectares (Fig 1), is centred on NGR SO 8472 1389 and is located on a gentle slope running northwest to the south west and south east. It lies at a height of between 51.1m and 59.2m AOD.

The underlying bedrock is 'Blue Lias Formation And Charmouth Mudstone Formation (Undifferentiated)' (BGS 2015) This is a sedimentary bedrock formed approximately 183 to 204 million years ago in the Jurassic and Triassic Periods. These rocks were formed in warm shallow seas with carbonate deposited on platform, shelf and slope areas. The soils overlying the area are a 'Stagnasol' type of slowly permeable seasonally wet loamy and clayey soils (UKSO 2015).

The last use of the site was as agricultural land of pasture and arable fields. Within the site are the farm buildings of Snow Capel Farm consisting of the farmhouse, L-shaped barn and hay barn.

1.4 Site Constraints

A table detailing all the designated and undesignated assets within and in the area of the site is included in Appendix 1.

There are no scheduled monuments or listed buildings contained within the SUB33 site. The closest scheduled monument is Sneedham's Moat (NHLE1019399) situated around 400m to the north east. The site is not part of a registered park or garden or a battlefield. The entire area of the SUB33 site is included within the Robinswood Hill Landscape Conservation Area.

Planning files show that the area of the SUB33 site has a planning history beginning with an application in 1964 for the 'erection of a building for sawing of wood and storage of coal and wood'

(44/101272/HIST) which was refused. In 1981 another application was received for the 'erection of 27 dwellings' (44/101273/HIST) which was also refused. Following this there are no applications within the site boundary until 2003 when the 'conversion of a timber barn into a self-contained office building' (03/01076/COU) was refused and dismissed on appeal. Four applications relating to an L-shaped structure at Snow Capel Farm followed this starting with 05/00922/COU, 'conversion of barns into two bedroom live-work unit', which was approved. This was then renewed in 2009 (09/01030/COU), 2012 (12/00391/COU) and 2015 (15/00479/FUL). Also in 2015 an application was made for 'change of use from agricultural to residential of an historic oak barn' (15/01458/QPA) which was also approved. In the north part of the site an application for the 'erection of a stable building with tack room' (09/01283/FUL) to the rear of Hill View Cottage (now Wave Hill) was approved but not carried out. Other planning applications have made and approved which are bounded by the SUB33 site but did not have any effect on the site.

2. Assessment

2.1 Archaeology, Built Heritage and Settings

A search of the Gloucester City Council Historic Environment Record (HER; GUAD numbers) for the site and its surrounding area revealed a number of records relating to the buried archaeology of the SUB33 site. Given the sites location on the border of the City, a search was also made of the Gloucester County Council HER (GHER numbers). This was enhanced by a search of records included in the National Heritage List for England (NHLE) and the National Monuments Record (NMR). The relevant records are shown on Figure 2 and discussed below.

2.1.1 Previous Assessments

Within the SUB33 site, no previous assessments have taken place but assessments have been carried out in the close vicinity of the site. To the north of the SUB33 site a desk-based assessment was carried out on Robinswood Hill (GUAD1992) to collect and analyse the historical and archaeological information relating to the Hill. To the north west of the site a desk-based assessment was produced (GUAD1710) which revealed surviving ridge and furrow earthworks and an undated circular cropmark both of which had been subject to impact from the construction of a golf course. A geophysical survey (GUAD1685) was also carried out in the same area and revealed two possible features close to the location of a former field boundary.

To the south and south west of the SUB33 site two desk-based assessments were carried out on the land that became the Gloucestershire Gateways M5 Service Stations. The first of these was carried out in 1994 (GHER20091) which concluded that archaeological potential was low. The planning application was refused at this stage. In 2009 a further desk-based assessment of the same area – (GHER34284) was produced prior to planning permission being granted. This assessment concluded that was potential for unrecorded prehistoric and Roman remains within the area along with ridge and furrow and remains from buildings shown on historic mapping. A geophysical survey of the same area (GHER33928) revealed evidence of ridge and furrow and ditches of a former field system, possible sites of charcoal burning, buildings and ponds shown on historic maps and a foot and mouth burial pit from 2001.

To the north east of the SUB33 site, on land at Winneycroft Farm, a desk-based assessment was produced (GUAD2268) but consisted only of map regression. Geophysics in the same area (GUAD2248) revealed archaeological anomalies in the south with ridge and furrow over the whole site. Geophysics in the adjacent area to the north (GUAD2251) revealed pit-like anomalies possibly related tree removal.

2.1.2 Prehistoric, Roman and Saxon

Prehistoric activity has been recorded to the north of the SUB40 site around the summit of Robinswood Hill with two Neolithic axes, other flint items and Iron Age pottery sherds found in the area. At Winneycroft Farm an evaluation (GUAD2255) revealed a concentration of Late Iron Age or early Roman ditches within the southern part of the site. These features suggest a focus of mid to late 1st to 2nd century occupation (GHER752). A single, residual prehistoric worked flint was also recovered.

Along with the activity on Robinswood Hill, Roman evidence has been recorded close to the SUB33 site. To the south east of the site a scatter of 3rd century pottery and a whetstone (GHER3853) were recovered. A number of sherds of abraded Romano-British 2nd-3rd century pottery (GHER3822) were uncovered during investigation work for the M5 motorway. The number of sherds indicated that a Romano-British occupation site was located close to the site, however it was not located.

2.1.3 Medieval

Archaeology

The medieval evidence around the SUB33 site consists only of archaeological features. The most significant is the Sneedham's Green moated site (GUAD1198, GHER425) located to the north east of the SUB33 site. The moat is a scheduled monument (NHLE1019399) and dates from the 13th to 14th century. Three sides of the moat survive as earthwork ditches with further earthworks showing that buildings on the interior still survive as buried features. To the north east of the site an evaluation (GUAD2255) of land at Winneycroft Farm revealed surviving evidence of medieval ridge and furrow in the trenches closest to the SUB33 site. A further evaluation on more land at Winneycroft Farm (GUAD2273) revealed a concentration of medieval features related to agricultural activity and an area of more intensive activity possibly related to medieval occupation.

Another evaluation, to the south of the SUB33 site on the land to be used for the M5 Service Stations (GHER35145) revealed evidence of field boundaries and ridge and furrow. 2012 aerial photographs of the SUB33 site show cropmarks of ridge and furrow in the southern part of the site. These follow the boundaries of a field system that has not been mapped.

Built Heritage

There are no historic buildings of medieval date within the area surrounding the SUB33 site.

2.1.4 Post-medieval

Archaeology

Post-medieval archaeology is scarce within the area of the SUB33 site with the exception of two small watching briefs that uncovered post-medieval evidence. The first, at The Villa, Winneycroft Lane (GUAD1516), revealed worked soils that contained late post-medieval pottery. The other watching brief was at Hill View Cottage (now called Wave Hill; GUAD1382) and revealed evidence of a 19th century pond.

Built Heritage

Although there are no listed buildings within the locality of the SUB33 site, there are a number of buildings of post-medieval date. Within the SUB33 site itself are the buildings of Snow Capel Farm. The farmhouse, with its multi-gabled eaves and steep pitched roof, looks to be hiding an earlier building than it originally appears to be. Close to the farmhouse is an L-shaped brick building that appears to be a late 18th or early 19th century shelter shed and stable and to the south of this is a small timber built hay barn. Post-medieval buildings in the surrounding area include the surviving structures of Green Farm to the east, two small cottages to the immediate north, Homestead Farm north of these and Wave Hill to the north east.

2.1.5 Modern or Undated

Archaeology

Modern archaeology within the vicinity of the SUB33 site consists mainly of military records however there has also been some evidence found during archaeological investigations. An evaluation (GUAD1701) following a desk-based assessment (GUAD1710) and geophysics (GUAD1685) uncovered a back-filled ditch and an area of burning. The burning was shown to be modern and included a fragment of barbed wire and the back-filled ditch included burnt material. Both features relate to the removal of a field boundary at some point after the Second World War.

The military features within the area of the SUB33 site included a World War II Searchlight Battery (GHER27069) that was located to the immediate west of Snow Capel Farm. This searchlight battery has been identified as General Defence Area site CL08 B2 and earthworks from it could be seen in 1940s aerial photographs although not in more modern photographs. To the east of the SUB33 site is an area that has been used as a rifle range (GHER46617) from at least the 1920s when it is shown on historic maps. To the north of the SUB33 site, around Homestead Farm, was a World War II military depot (GHER48391). It was divided into two parts, to the north and south of the farm, and could be seen on historic aerial photographs. It is believed to have been used as a dispersal or overflow site for the nearby RAF Quedgeley or the British Army's camp on the north side of Robinswood Hill.

Built Heritage

Very few modern buildings have been constructed within the area of the SUB33 site. To the north of Snow Capel Farm, just outside the site, 'The Bungalow' was constructed in the late 20th century and to the north, also just outside the site, Penny Patch was also constructed although these neither of these are distinctive.

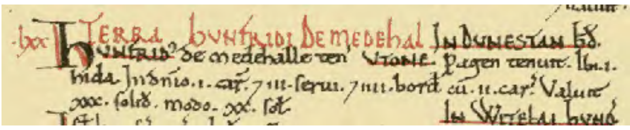
2.1.6 Settings and Key Views

'*The NPPF makes it clear that the setting of a heritage asset is the surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve'* (HE 2015d, p2). Whilst setting is itself not a heritage asset, its importance lies in what it contributes to the significance of the heritage asset.

The SUB33 site is set within an extremely rural area on the south side of Gloucester right on the boundary with the Cotswolds AONB. It also falls within the Robinswood Hill Landscape Conservation Area with views from the north into the site and from the south, from the motorway, showing a very rural setting. The only modern development within the wider area of the site has been the construction of the motorway service stations which themselves back onto open fields.

2.2 History and Map Regression Analysis

The area of the SUB33 site lies within the hamlet of Sneedham's Green. The place-name 'Sneedham' means 'cut-off or intrusive piece of land' (Baddeley 1913, p142) and has as its origin the Anglo-Saxon word '*snæd'*. Sneedham's Green has historically been part of both Matson and Upton St Leonard's. Neither of these places is included by name as a complete settlement within the Domesday Survey



because they were part of King's Barton, the ancient demesne lands of Mercia. The King's Barton, of nine hides of land, had a medium sized population of 14 villagers with 18 smallholders, seven slaves and seven men (Moore 1982, [1],2). At the end of the entry for King's Barton it mentions that 'Humphrey of Maidenhill' held one hide of land at Upton St Leonard's which was included within the King's Barton (ibid). Further on in the Survey a separate section details the Land of Humphrey of Maidenhill. This entry states that the one hide of land had four smallholders and three slaves and that its value in 1066 was 30s which had reduced to 20s in 1086 (Moore 1982, 70,1). It is not possible, however, to work out which of these plots of land included the SUB33 site. The moat at Sneedham's Green may be one of the manors of Matson, of which there were three, or one of Upton St Leonard's properties.

The earliest historic maps of the area of the SUB33 site are not very detailed. The Saxton map (Fig 3) of the later 16th century shows only settlements with churches and the River Severn. It does show Robinswood Hill, to the south of which the SUB33 site lies. The hamlet of Sneedham's Green is not shown on this map, but Matson and Upton St Leonard's are, nor is it shown on the 1646 Blaeu map (Fig 3) which is very similar. The 1794 Cary map (Fig 3) includes roads and also shows Sneedham's Green (spelled 'Sneedum'). The first map showing any detail is the 1811 Dawson map (Fig 3) on which can be seen the green of Sneedham's Green, with its unusual enclosure in the middle, the fields of the SUB33 site and the buildings of Snow Capel Farm. The buildings of Snow Capel Farm are more distinct on the 1828 Ordnance Survey (Fig 3) and the rest of the SUB33 site can be seen as open land. The 1840s tithe map (Fig 3) shows the individual fields and their names with the SUB33 site covering Home Ground, Blacklands, Grawlings, The Acres, Oak Piece and Horn Meadow. The name 'Blacklands' is interesting because it derives from the colour of the soil and can be indicative of an archaeological site.

The 1883 Ordnance Survey (Fig 3) shows the SUB33 site and Snow Capel Farm. On this map however the farm is labelled as 'Snow and Caple Farm'. Interestingly the word 'caple' is an obsolete word meaning 'horse' but it can also mean 'chapel' from the Old North French word *'capele'*. The buildings of the farm are clear and show a rectangular house with an L-shaped range of buildings to its south and two smaller structures to the west of this. This layout has been classified by English Heritage as a Regular Courtyard L-plan (Lake and Edwards 2008) and 'can be strongly concentrated in landscapes enclosed or re-planned in the 18th and 19th centuries' (ibid, p13). The 1883 map also shows a small number of ponds within the SUB33 site, including one close to the farmstead itself, two areas of orchard and a number of individual field boundary trees. The next map, the 1901 Ordnance Survey (Fig 3), shows little change within the area surrounding the SUB33 site. As with the 1883 map the Sneedham's Green moat is shown as is the Green itself with the unusual enclosure in the centre. Within the site, the only changes shown are the construction of two buildings to the south of the L-shaped structure at 'Snow and Caple Farm'.

The 1923 Ordnance Survey (Fig 3) also shows no change with the exception of the loss of a field boundary within the middle of the SUB33 site. The only change shown on the 1938 Ordnance Survey (Fig 3) is the reduction in size of the farm to the immediate west of Sneedham's Green. The Land Utilisation map of 1942 (Fig 3) has the majority of the SUB33 site marked with horizontal green lines indicating 'meadowland and permanent grass'. A couple of small patches, particularly around Snow Capel Farm, are marked with purple horizontal lines indication land that used for orchards. The area of Sneedham's Green itself is shown as yellow meaning that it was 'heath, moorland, common or rough pasture'. The 1955-6 Ordnance Survey (Fig 3) shows that the M5 motorway has been constructed by this time having a significant on Snow Capel Farm. Within the rest of the SUB33 site, the majority of the field boundaries have been removed by this time leaving one large field with a small number of much smaller fields in the east of the site.

2.3 Potential for Further Assets

With the evidence of Roman and medieval archaeology in the vicinity of the SUB33 site, there is potential for archaeological evidence of this date to exist as unknown archaeological features on the site. In the southern part of the site, despite the construction of the M5 motorway, cropmarks show that medieval ridge and furrow probably survives as archaeological features. It is possible that further ridge and furrow could exist elsewhere on the site. The SUB33 site is known to have contained a World War II General Defence Area site to the immediate west of Snow Capel Farm. Archaeological evidence for this, which included a searchlight battery, is likely to have survived.

3. Significance

3.1 Intrinsic interest of the sites

The SUB33 site holds interest because it contains the historic buildings now known as Snow Capel Farm which are at least earlier 19th century in date.

The SUB33 site also holds interest for the potential archaeological features of Roman and medieval date that may exist on the site.

It also holds interest for the surviving evidence of the World War II General Defence Area site that probably remains buried to the immediate west of the farm.

3.2 Relative importance of the sites

There are no designated heritage assets within the SUB33 site and it therefore holds little national importance. Although there is a designated asset within the area of the site, it is not believed to be associated with the site itself.

The whole of the SUB33 site is within the Robinswood Hill LCA and therefore it holds importance in relation to the setting of this LCA.

The SUB33 site also holds importance as the landscape associated with the historic Snow Capel Farm. The character of the farm is associated with the very rural setting of its buildings.

3.3 Physical extent of important elements

The physical extent of the important elements of this site can be viewed in different ways. The historic buildings of Snow Capel Farm are of importance due to their age and because they are surviving historic farm buildings, which are an integral part of our landscape. The southern area of the site holds importance due to the surviving ridge and furrow, although this is of lesser importance as it only survives as cropmarks and not earthworks. The whole area of the SUB33 site could be seen as important because it falls within the Robinswood Hill LCA and any development within the site would not only be of detriment to the LCA but would also be visible from the M5 motorway which passes right by the site.

4. Impact of Development of Site

4.1 Assessment Criteria

The NPPF (DCLG 2012) policy on harm to heritage assets is set out in paragraphs 132 to 134. This is further discussed in the NPPG (NPPG 2014) in paragraph: 017 (Reference ID: 18a-017-20140306) and paragraph: 018 (Reference ID: 18a-018-20140306) of the section on 'Conserving and Enhancing the Historic Environment'. The impact assessment table below has been produced with reference to these policies and guidance.

The site historic environment assessments will consider the impact of development for the allocation sites and will use the criteria cited in the following table.

Major Enhancement	Demonstrable improvement to a designated heritage asset of the highest order (or its setting), or non-designated asset (or its setting) of interest of demonstrable significance equal to that of a scheduled monument. Designated assets will include scheduled monuments, grade I/II* listed buildings, grade I/II* registered parks and gardens, registered battlefields, protected wrecks or World Heritage Sites. Improvement may be in the asset's management, its amenity value, setting, or documentation (for instance enhancing its research value). It may also be in better revealing a World Heritage Site or Conservation Area
Enhancement	Demonstrable improvement to a designated heritage asset (or its setting), or non-designated asset (or its setting) of interest such that the level of improvement will demonstrably have a minor affect on the area and its heritage resource, either at a local or regional level. For instance grade II listed buildings, Conservation Areas and undesignated heritage assets important at a sub-national level. Improvement may be in the asset's management, its amenity value, setting, or documentation (for instance enhancing its research value).
Neutral	Impacts that have no long-term effect on any heritage asset.
Minor Harm	Minor harm to a designated heritage asset (or its setting), or non- designated asset (or its setting) of interest such that the level of harm will demonstrably have a minor affect on the area and its heritage resource, either at a local or regional level. For instance grade II listed buildings, Conservation Areas and undesignated heritage assets important at a sub-national level.
Moderate Harm	Minor harm to a designated heritage asset (or its setting) of the highest significance or non-designated asset (or its setting) of interest of demonstrable significance equal to that of a scheduled monument. For instance scheduled monuments, grade I/II* listed buildings, grade I/II* registered parks and gardens, registered battlefields, protected wrecks or World Heritage Sites. Harm to a designated heritage asset (or its setting), or non-designated asset (or its setting) of interest such that the level of harm will demonstrably affect the area and its heritage resource, either at a local or regional level. For instance grade II listed buildings, Conservation Areas and undesignated heritage assets important at a sub-national level.
Major Harm	Harm to a designated heritage asset (or its setting) of the highest significance, or non-designated asset (or its setting) of interest of demonstrable significance equal to that of a scheduled monument. For instance scheduled monuments, grade I/II* listed buildings, grade I/II* registered parks and gardens, registered battlefields, protected wrecks, World Heritage Sites or harm to a building or other element that makes a positive contribution to the significance of a Conservation Area as a whole. Substantial harm to, or loss of, a designated heritage asset (or its setting), or non-designated asset (or its setting) of interest such that the level of harm or loss will demonstrably affect the area and its heritage resource, either at a local or regional level. For instance grade II listed buildings, Conservation Areas and undesignated heritage assets important at a sub-national level.
Substantial Harm	Substantial harm to, or loss of, a designated heritage asset (or its setting) of the highest significance, or non-designated asset (or its setting) of interest of demonstrable significance equal to that of a scheduled monument. For instance scheduled monuments, grade I/II* listed buildings, grade I/II* registered parks and gardens, registered battlefields, protected

	wrecks, World Heritage Sites or the loss of a building or other element that makes a positive contribution to the significance of a Conservation Area as a whole
Unknown	Where there is insufficient information to determine either significance or impact for any heritage asset, or where a heritage asset is likely to exist but this has not been established, or where there is insufficient evidence for the absence of a heritage asset. For instance where further information will enable the planning authority to make an informed decision.

4.2 Assessment of Harm

4.2.1 Archaeology

The impact upon the unknown archaeological remains suspected to survive within the SUB33 site cannot be quantified in detail as there are no proposals for comparison. However, given the nature of modern development, the depth of foundations and drainage, it is likely that any archaeology would be removed as a result of the development. This would cause **Major Harm** to the heritage assets.

4.2.2 Built Heritage

Development of the whole of the SUB33 site may include the demolition of the historic buildings of Snow Capel Farm. This would cause **Major Harm** to the heritage assets. This would be of detriment to the landscape of the area and to the Robinswood Hill LCA and as such would of **Major Harm** to the heritage asset.

4.2.3 Settings

Any development within the SUB33 site would have a negative impact upon the setting of the area and upon the setting of the Robinswood LCA. This site is very visible from the M5 motorway and therefore development on the site would also be visible unless screened. This would cause **Minor Harm** to the heritage asset.

4.3 Improvements and Enhancements

The farmhouse and barns of Snow Capel Farm should be removed from the developable area to ensure they are protected from demolition. This would be an **enhancement** of the heritage assets.

To add future protection and recognition of its historic and architectural interest, Snow Capel Farmhouse and barns should be locally listed. This would be an **enhancement** to the heritage assets.

The hedgerows and planting within the site should be retained as much as possible to reduce the setting impact of development and retain historic landscape features. This would be an **enhancement** of a development.

The existing hedgerows and planting should be extended to provide screening for Snow Capel Farm. It should also be extended along any access into the site to provide further screening. This would be an **enhancement** to the heritage assets and an **improvement** to the existing planting.

A green buffer should be included around the historic Snow Capel Farm to ensure that it retains some of its rural setting. This would be an **enhancement** to the heritage assets.

5. Planning Requirements

Any application for this site should be supported by a description of the significance of heritage assets likely to be affected by the proposed development. In the first instance applicants should provide a desk-based assessment describing the archaeological potential of the site.

Should the assessment indicate that the proposed development has the potential to conflict with buried archaeological remains, then there will be a need to undertake an archaeological evaluation (trial trenching supported by geophysical survey) to investigate in detail the presence/absence, character, significance and depth of archaeological remains within the site.

Should the assessment indicate that the proposed development has the potential to conflict with built heritage elements, then there will be a need to undertake built heritage assessment (proportionate to the significance of the heritage asset) to investigate in detail the character, history, dating, form and archaeological development of the specified structure on the site.

An assessment of the setting of Snow Capel Farm should be undertaken in relation to a known scheme of development and should include a Zone of Visual Influence (ZVI) or Zone of Theoretical Visibility (ZTV) assessment in accordance with Historic England guidance *The Setting of Heritage Assets* (HE 2015d). These could be included within a built heritage assessment.

Reports outlining the results of each stage of work will need to be submitted in support of the application. This is in accordance with paragraph 128 of the NPPF (DCLG 2012) and policies BE.32 and BE.33 of the Second Stage Deposit Draft of the Gloucester Local Plan 2002 (GCC 2002).

A design and character assessment would need to be produced in order to provide information on heights, massing and scale of the proposed development. This is in accordance with paragraphs 61, 64 and 131 of the NPPF (DCLG 2012) and policies BE.7 and BE.22 of the Second Stage Deposit Draft of the Gloucester Local Plan 2002 (GCC 2002).

6. Minimising Harm

Should any development be proposed, then a number of actions are recommended to mitigate the impacts identified above.

- Requirement to retain the original structures of Snow Capel Farm.
- Desk-based assessment of the site, in line with relevant guidance produced by the CIfA (CIfA 2014f) and Historic England (EH 2010).
- Building recording of the historic buildings of Snow Capel Farm, to assess the impact of the development upon the structures. This should be in line with relevant guidance produced by Historic England (EH 2006) and the CIfA (CIfA 2014e).
- A 10m wide no-development buffer around the farm to be incorporated into any development (as shown in red on Fig 5).
- Setting of Snow Capel Farm to be appraised and a green buffer incorporated into any development to protect this setting and the character of the farmstead.
- Put forward Snow Capel farmhouse and barns for local listing.
- Key views should be retained within any development.
- Geophysical survey of the site, in line with relevant guidance produced by the CIfA (CIfA 2014d).

- Evaluation trenches to identify any possible buried archaeological remains followed by, if necessary, excavation in advance of development or watching brief during construction, in line with relevant guidance produced by the CIfA (CIfA 2014a; CIfA 2014b; CIfA 2014c).
- The design of any development should take into account the setting of Snow Capel Farm and the Landscape Character Area and should reflect the nature and character of both assets.
- Retention of the existing trees, hedges and screening currently in place. Additional screening where needed to reduce the visual impact of development.
- Full reporting, publication and dissemination of all results.

The scope and specification of any works would be agreed with the Gloucester City Archaeologist and the Principal Conservation and Design Officer.

7. Recommendations

The criteria used for the recommendations are detailed in the table below.

Development allowed	Development can go ahead with no mitigation subject to planning approval of proposals and designs.
Development Allowed –mitigation programme	Development can go ahead but following a stage or number of stages of mitigation designed to alleviate the impacts of any proposal. Also subject to planning approval of proposals and designs.
No development	No development within this area.

The recommendations are mapped on Figure 5.

The January 2015 SALA report (GCC 2015a) includes the SUB33 site and describes it as *'not suitable'* and *'part of site unsuitable for development on landscape grounds'* (ibid, Appendix 2). Should the site be approved for development for residential, business or industrial use then certain areas of the site would need to be left free of development and some would involve mitigation from the impacts identified above.

8. Conclusion

This assessment has looked at the heritage assets within and in the area of the SUB33 and discussed the past and present uses of the site. It has looked at the potential for unknown heritage assets to exist with the site and whether they would be at risk of harm from a development. It is considered that development on the SUB33 site could be delivered without significant impact on the heritage assets of the site provided that the actions proposed to minimise the impacts of development, as detailed above, are followed.

Taking into account the impacts discussed and the recommendations to avoid harm to the heritage assets, of the 14.64 hectares of the site, a total area of 0.44 hectares would be unavailable leaving an area of **14.20 hectares available for development**. This figure is indicative only – the final extent of mitigation will need to be agreed in consultation with the City Archaeologist and Principal Conservation and Design Officer.

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CIfA 2014c *Standard and Guidance for Archaeological Field Evaluation,* Chartered Institute for Archaeologists

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10. Appendix 1: Table of designated and undesignated assets

Those marked in **bold** are within the site.

HER	Name	Period	Type	Details
GUAD1198	Sneedham's Green	Medieval	Field Observation	Medieval moated site
GUAD1382	Hill View Cottage	Post-medieval	Watching Brief	Evidence of as 19th C pond
GUAD1516	The Villa, Winneycroft Lane	Post-medieval	Watching Brief	Revealed worked soils and post-medieval to modern pottery
GUAD1685	Jarvis Hotels Site 5, Robinswood Hill	-	Geophysical Survey	Two possible features close to field boundary location
GUAD1701	Jarvis Hotels Site 5, Robinswood Hill	Modern	Evaluation	Back-filled ditch and burning associated with removed field boundary
GUAD1710	Jarvis Hotels Site 5, Robinswood Hill	-	Desk-Based Assessment	Revealed surviving ridge and furrow and undated circular cropmark
GUAD1992	Robinswood Hill	All periods	Desk-Based Assessment	Synthesis of information of Robinswood Hill
GUAD2248	Land at Winneycroft Farm	-	Geophysical Survey	Archaeological anomalies in south with ridge and furrow all over
GUAD2255	Land at Winneycroft Farm	Prehistoric Romano-British Medieval	Evaluation	Concentration of late Iron age or early Roman ditches correlating with geophysics. Medieval ridge and furrow
GUAD2268	Land at Winneycroft Farm	-	Desk-Based Assessment	Map regression only
GHER425	Sneedham's Green	Medieval	Moat	Moated site of 13th to 14th C date with internal features
GHER3822	M5 Motorway	Romano-British	Excavation	Concentration of Romano-British pottery sherds indicating occupation site in area
GHER20091	Land at Ongers Farm	-	Desk-Based Assessment	Low archaeological potential
GHER27069	**Snow Capel Farm**	**Modern**	**Searchlight Battery**	**WWII searchlight battery identified as General Defence Area site CL08 B2**
GHER33928	Land at Proposed Motorway Services	-	Geophysical Survey	Ditches of former field system and area of burning
GHER34284	Land at Proposed Motorway Services	-	Desk-Based Assessment	Potential for prehistoric and Roman remains. Also ridge and furrow and building remains
GHER35145	Land at Proposed Motorway Services	Medieval Undated	Evaluation	Medieval field boundaries and ridge and furrow along with undated archaeological features
NHLE1019399	Sneedham's Green	Medieval	Moat	Scheduled Monument. 13 to 14 century well surviving moat. Earthworks show buildings on interior surviving as buried features.
GHER46617	Gloucester City Rifle Range	Modern	Rifle Range	Area used as rifle range from at 1920s. Shown on historic maps
GHER48391	Homestead Farm	Modern	Depot	WWII military depot in two parts, north and south of farm. Shown on historic photographs

12. Plates

Images taken from Google Streetview

Plate 1: View of site from the south east

Plate 2: View of site from the east

Plate 3: Snow Capel farmhouse from the north east

Plate 4: Snow Capel farmhouse from the south

Plate 5: View of site from the north west, over garden of Penny Patch

13. Figures

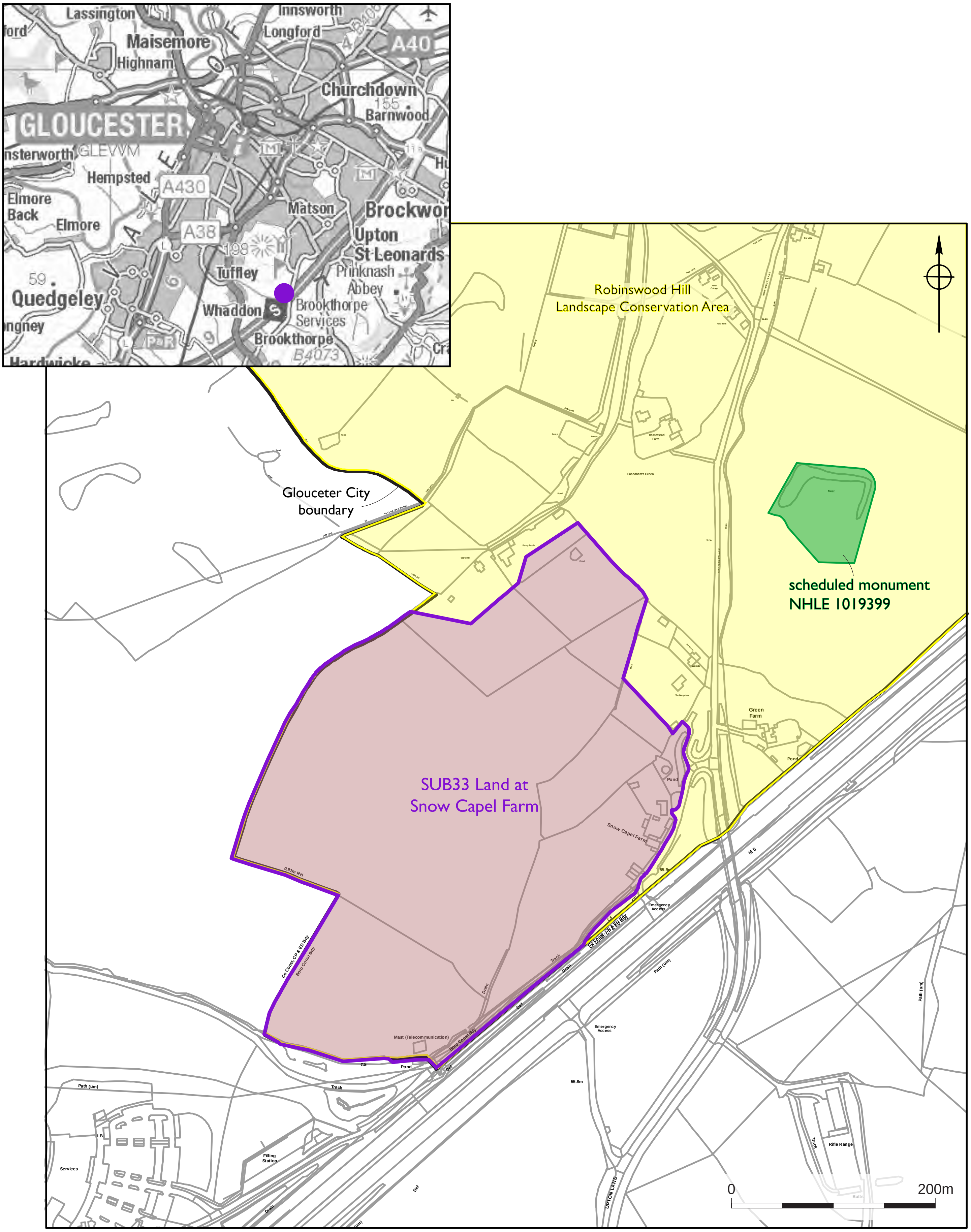


Figure 1 - Site Location

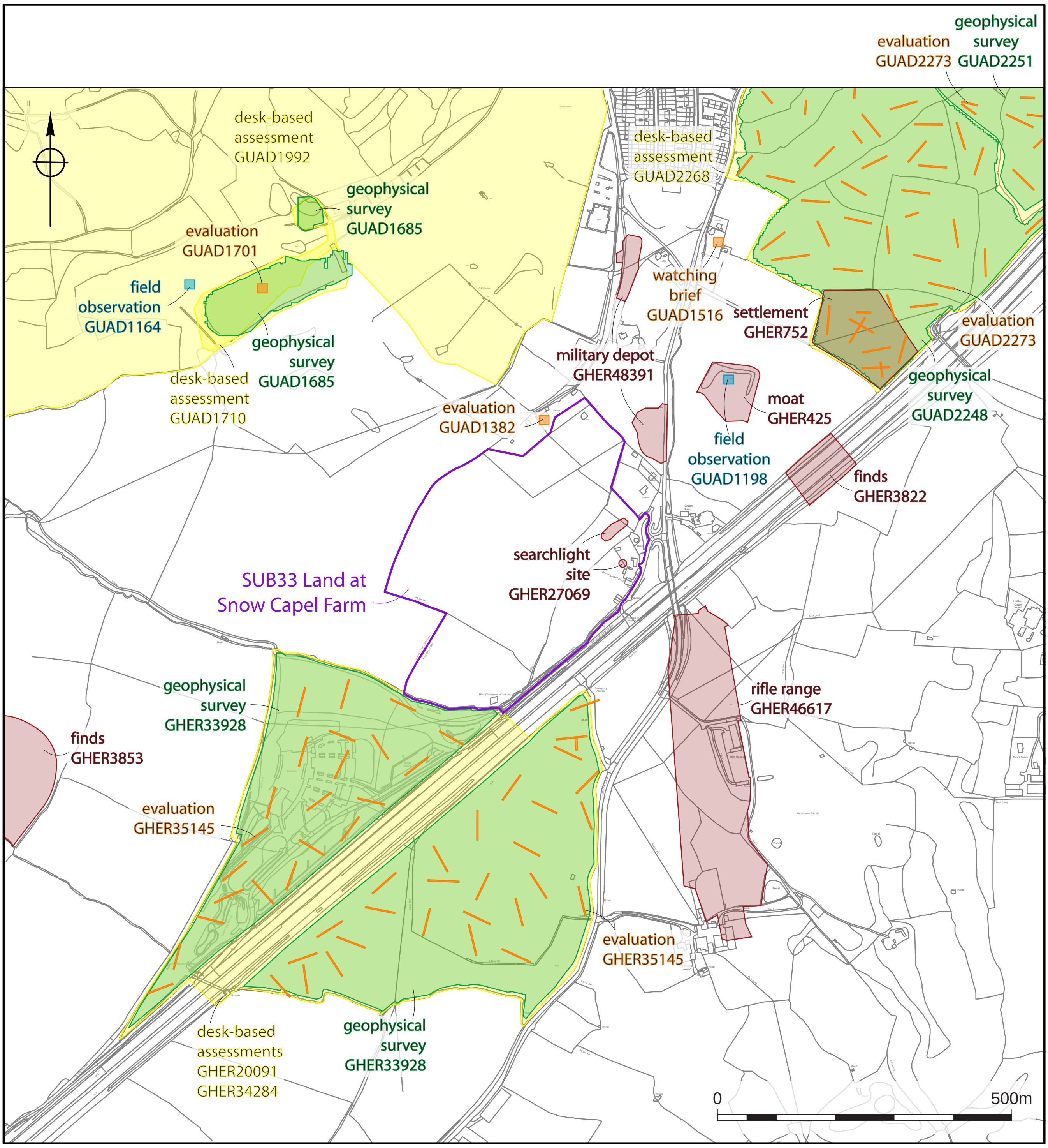
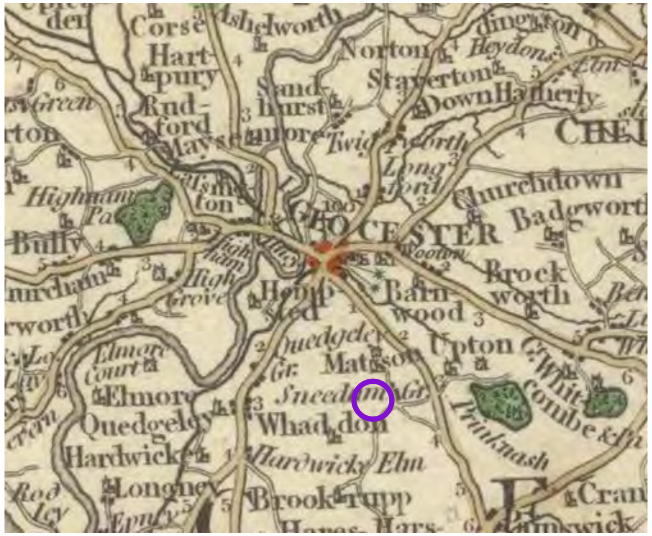


Figure 2 - Archaeological Information

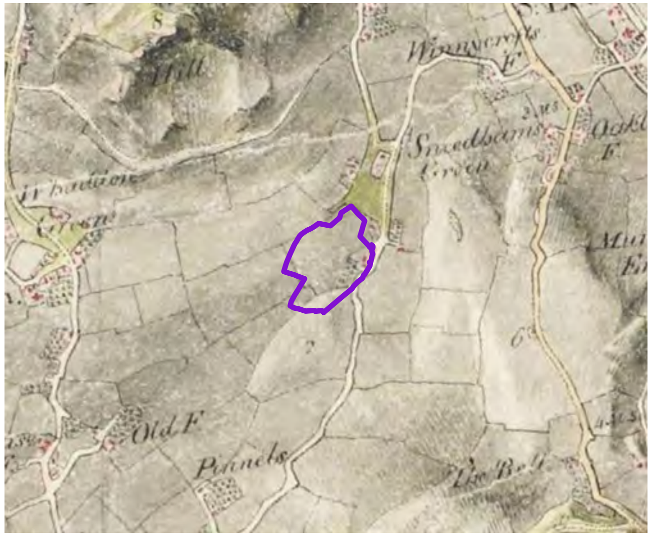
1583 Saxton map



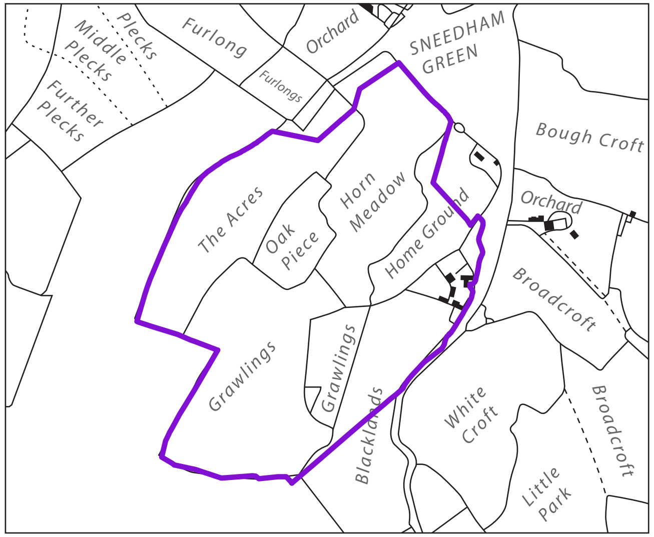
1794 Cary map

1828 Ordnance Survey

1646 Blaeu map

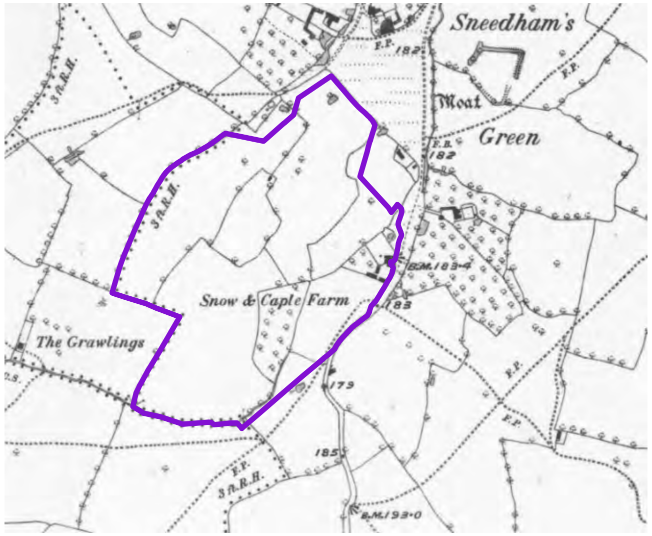


1811 Dawson map

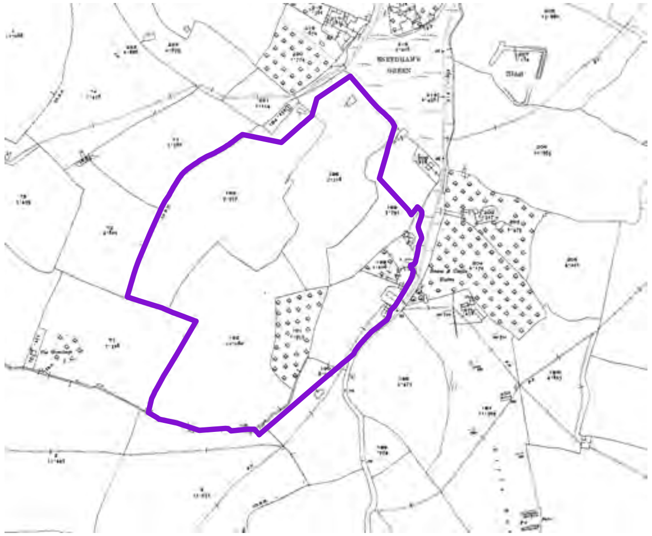


1840 tithe map (transcription)

Figure 3 - Historical mapping

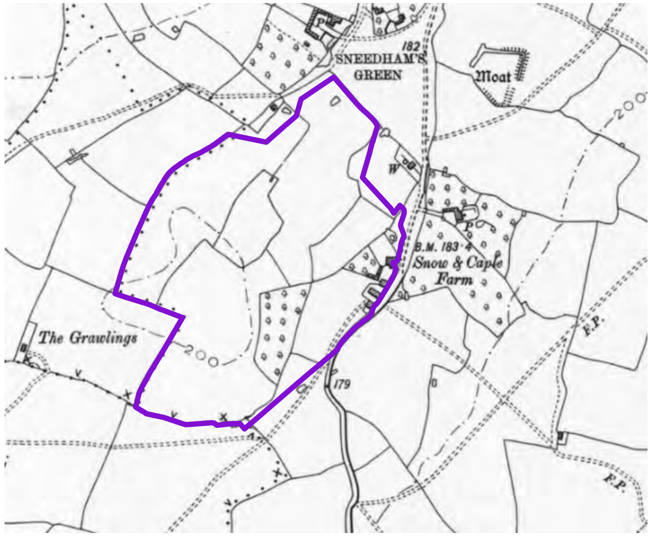


1883 Ordnance Survey

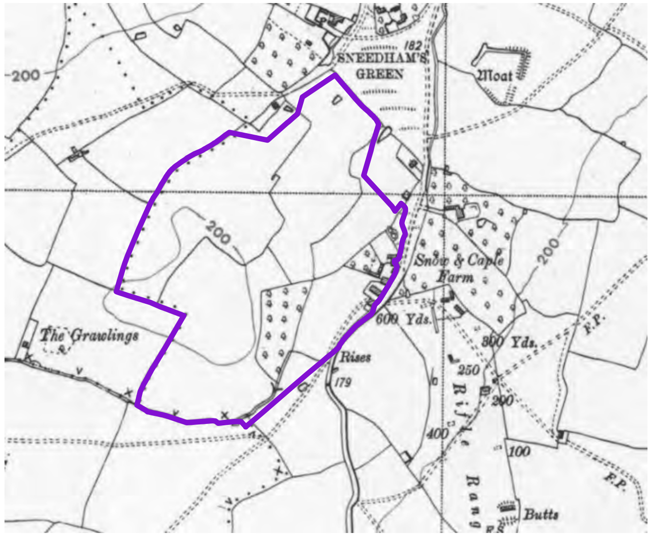


1923 Ordnance Survey

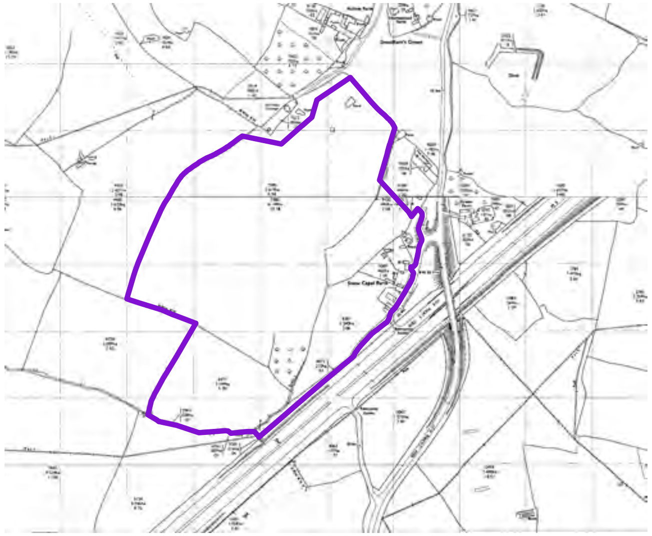
1942 Land Utilisation plan



1901 Ordnance Survey



1938 Ordnance Survey



1955-56 Ordnance Survey

Figure 4 - Historical mapping

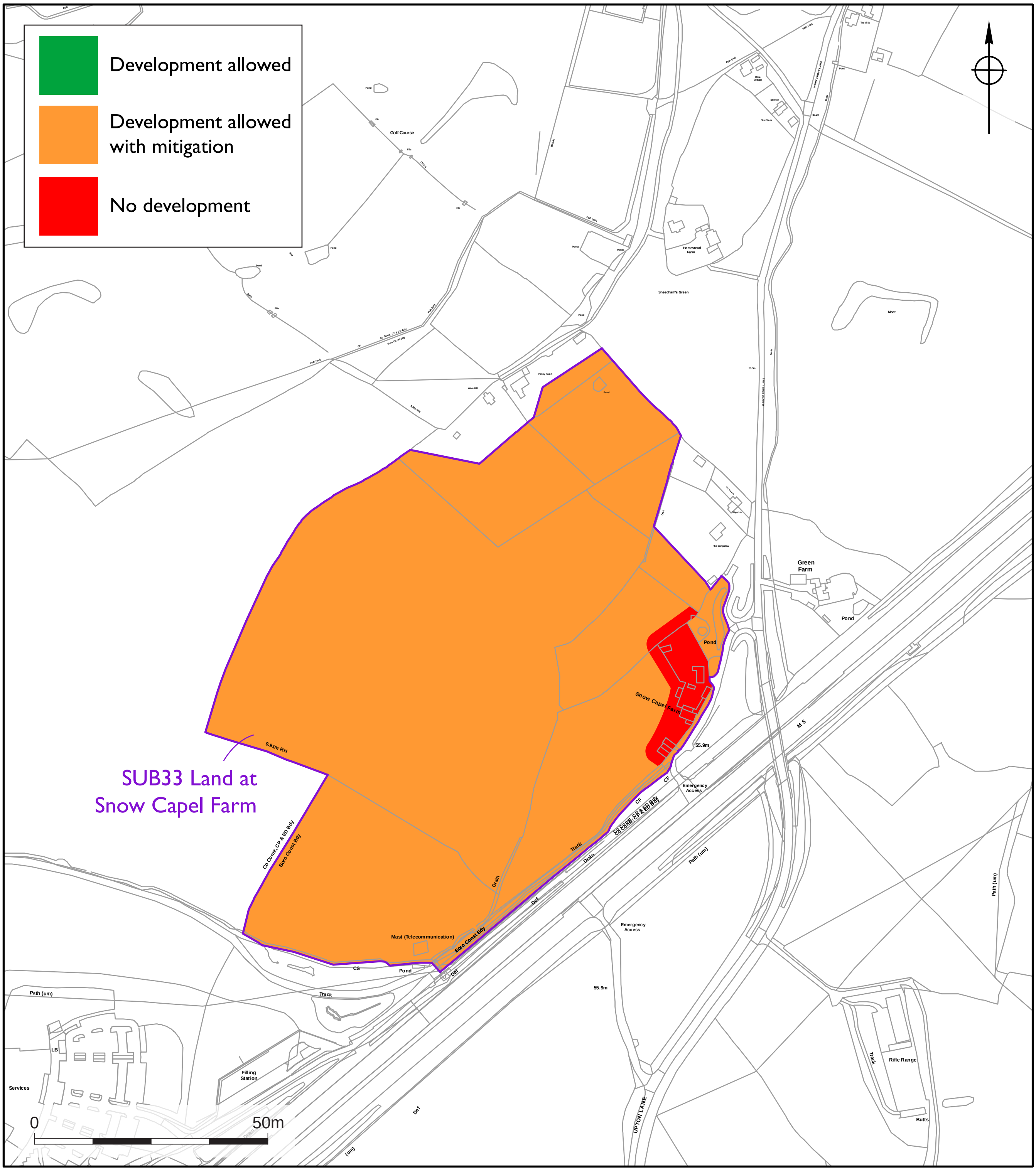
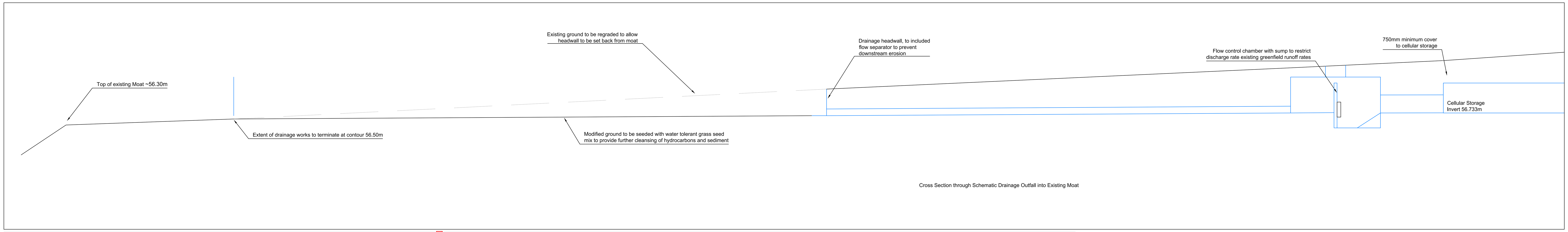


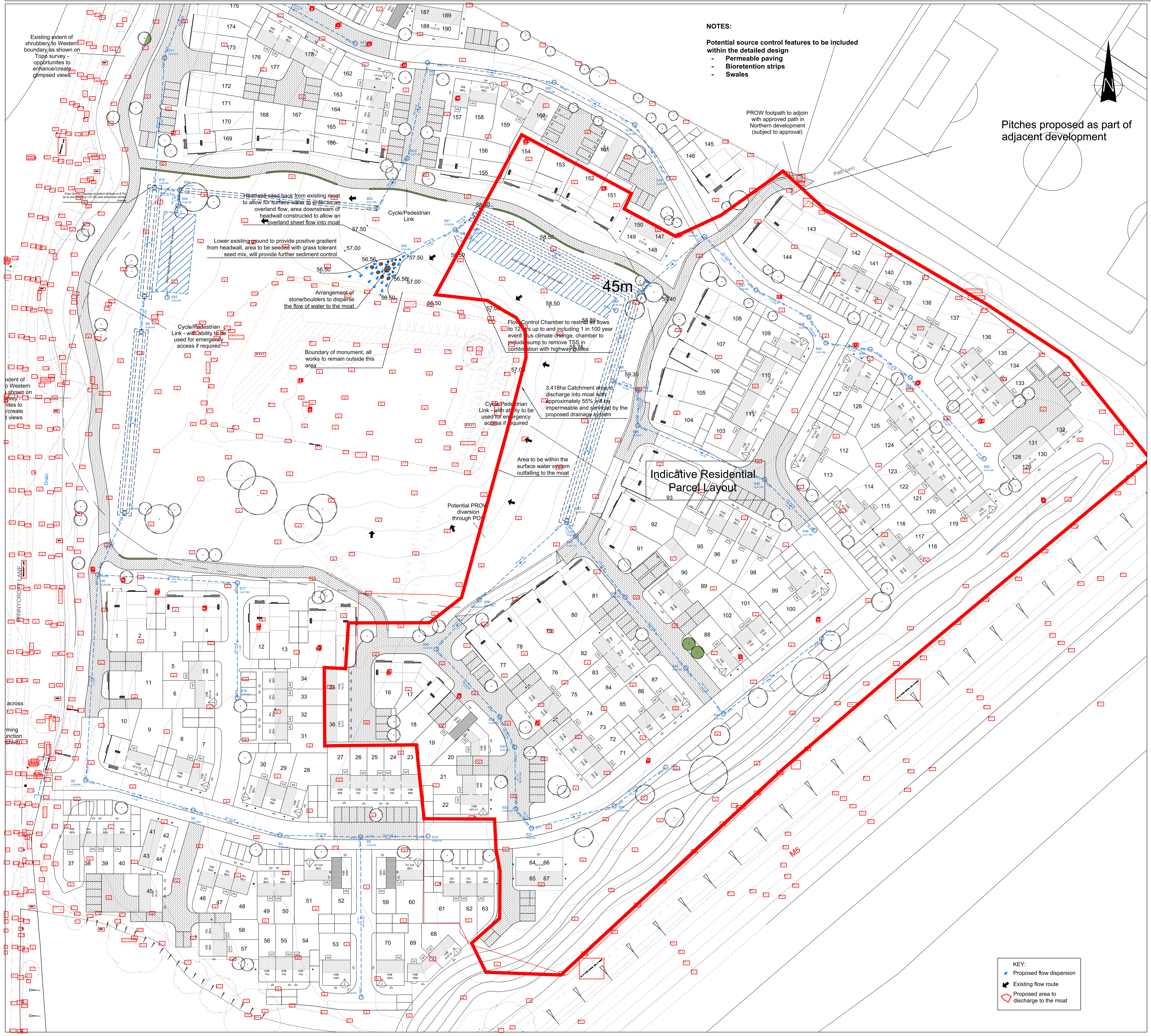
Figure 5 - Recommendations

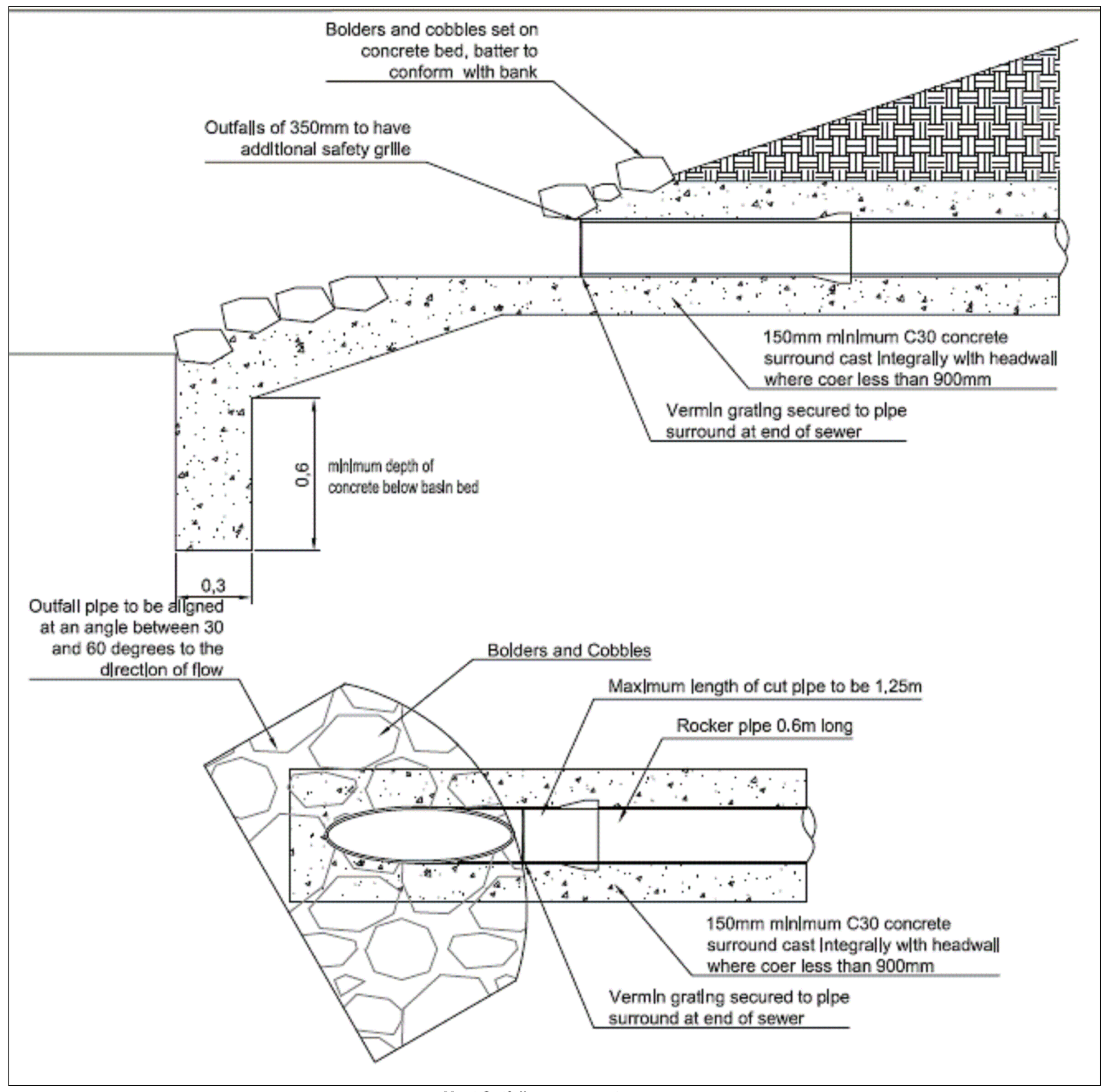
Appendix L

Drainage Strategy

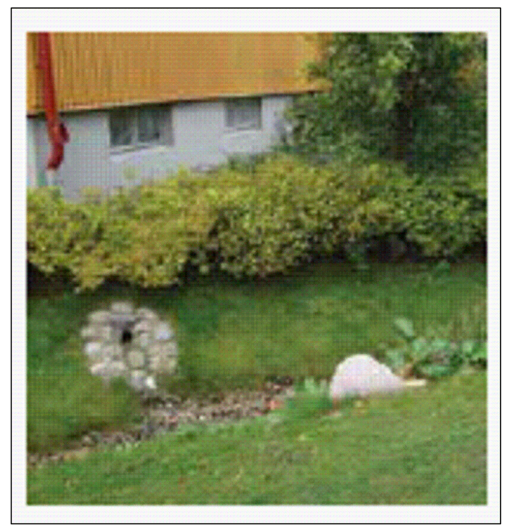


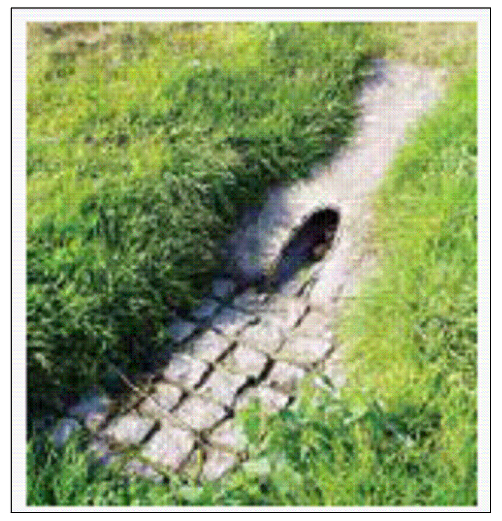
Cross Section through Schematic Drainage Outfall into Existing Moat





Moat Outfall arrangement
(NTS)





REV	BY	CHK	DESCRIPTION	DATE
B	EP	EP	Latest engineering proposals indicated	11.05.22
A	EP	EP	Indicative Development layout included	22.09.21

CLIENT **Bromford Homes**

PROJECT
Proposed Residential Development at Snow Capel Farm, Gloucester

STATUS **Preliminary**

TITLE
Schematic Drainage into Moat

DRG No. **3880-125** Rev: **B**

SCALE: **1:500** DESIGNED BY: **EP**
SIZE: **A0** DRAWN BY: **EP**
DATE: **August 2021** CHECKED BY: **CRW**

DEVELOPMENT DESIGN PARTNERSHIP
PLANNING ARCHITECTURE ENGINEERING

ISSUING OFFICE:
BRIDGEND OFFICE
8 OLD FIELD ROAD
BOCAM PARK
PENCOED
BRIDGEND
CF35 5LJ

ALSO AT:
BRISTOL OFFICE
STUDIO 23
KESTREL COURT
HARBOUR ROAD
PORTISHED
BS20 7AN

TEL: [redacted]
EMAIL:
WEBSITE:

GENERAL NOTES:-

The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work starts. Any discrepancy is to be reported to DDP before work commences.

The Contractor is to comply in all respects with current building legislation - Building Standard Specifications, Building Regulations etc., whether or not specifically stated on this drawing.
The drawing must be read with and checked against any structural, geotechnical or other specialist documentation provided.

All sewers which are to be the subject of a Section 104 Agreement are to be constructed in accordance with the Design and COnstruction Guidance, and to the satisfaction of the adopting sewerage undertaker.

All sewers with less than 1.2m of cover beneath roads or 0.9m elsewhere area to have a protective cover slab.

All outfall levels and existing sewer levels are to be confirmed by the Contractor before works commence.

All construction methods and materials employed are to be in accordance with the current road and bridgework's specification. All construction thicknesses are to be confirmed by C.B.R. test.

No responsibility will be taken for any construction work undertaken prior to receipt of technical approvals for the intended construction, or when work is not executed strictly in accordance with the drawings.

A section 106 application to connect must be made to the water authority, the developer shall give 21 days notice prior to connection, and the works may only be undertaken by a SSIP accredited contractor.

REV	BY	CHK	DESCRIPTION	DATE

CLIENT **Bromford Homes**

PROJECT
Proposed Residential Development at Snow Capel Farm, Gloucester

STATUS

TITLE
Preliminary Drainage Strategy

DRG No. **3880-200**	Rev: **-**
SCALE: **1:500**	DESIGNED BY: **EP**
SIZE: **A0**	DRAWN BY: **EP**
DATE: **February 2022**	CHECKED BY: **EP**

DEVELOPMENT DESIGN PARTNERSHIP
PLANNING ARCHITECTURE ENGINEERING

ISSUING OFFICE:
BRIDGEND OFFICE
8 OLD FIELD ROAD
BOCAM PARK
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ALSO AT:
BRISTOL OFFICE
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PORTISHED
BS20 7AN

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8 Oldfield Road, Bocam Park
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[redacted]

Drainage Strategy Report

Residential Development at Snow Capel Farm, Winnycroft Lane, Gloucester

On behalf of Bromford Homes

March 2022

Issue/Revision	First Issue	Second Issue	Third Issue	Fourth Issue	Fifth Issue	Sixth Issue
Date	29th March 2022	11th May 2022				
Prepared	[redacted]					
Checked						
Authorised						
Project Number	3880	3880				
File Reference	DSR	DSR				

Contents

1.0 Site Information

DDP Limited have been commissioned by Bromford Homes to produce a drainage strategy for a proposed residential development at Snow Capel Farm with an area of 7.7ha.

The development is located to the Southeast of Gloucester, England, Grid reference 385076E, 214223N. The site is currently greenfield and bounded by Winnycroft Lane to the West, M5 to the east. The parcel of land does include a schedule monument in the form of an ancient moat which is being retained.

The site falls from a high point of around 60.8m on the western boundary to 54.70m in the north wester corner at a grade of around 1 in 51.

The residential development at Snow Capel Farm consists of 190 residential dwellings and associated infrastructure.

2.0 Proposed Surface Water Drainage

A new surface water drainage network will be required to service the new development.

Requirement H3 Part 3 of the Building Regulations Approved Document H (2010 Edition) states:

(3) Rainwater from a system provided pursuant to sub-paragraphs (1) and (2) should discharge to one of the following listed in order of priority:

(a) An adequate soakaway or some adequate infiltration system; or, where this is not reasonably practicable,

(b) A watercourse; or where this is not reasonably practicable,

(c) A sewer.

T&P Regen have undertaken a ground investigation which demonstrated the development is underlain by clay soils which are unlikely to prove favourable for utilising infiltration techniques as a method of discharging development runoff.

The site investigation also provides evidence of ground water levels recorded during gas monitoring undertaken between December 2017 and February 2018. Table 3 within the T&P Regen Supplementary Ground Gas Risk Assessment dated 21st March 2018 confirms ground water between 54.8m and 61.9m AOD, this translates to being as shallow as 100mm below existing ground level.

In accordance with best practice design any soakaway features is required to be a minimum of 1m above the existing water table. Based on the high ground water and the nature of the soils experienced on site it therefore unfeasible to discharge the surface water via infiltration.

Due to infiltration features being unfeasible for the proposed development it is therefore proposed to convey surface water runoff to the ditch network sited along the western boundary in combination with an outfall into the onsite moat where levels allow.

The development is intended to be split into two catchments with the Eastern parcel draining to the existing onsite moat, with all remining areas unable to drain to the moat by gravity to drain to an existing ditch alongside Winnycroft Lane at the development low point in the north-western corner of the development.

It is intended to restrict all future runoff from the development to existing greenfield runoff rates. The runoff has been calculated utilising IH 124 methods with the development to be restricted to a Qbar rate of 3.414l/s/ha.

The network discharging into the moat will be limited to 11.6l/s whilst the western catchment to the ditch being restricted to 9.6l/s.

The surface water drainage network is to be designed to accommodate the required attenuation volumes generated by the restricted rates up to and including the 1 in 100 year event. The 1 in 100 year event will also include a factor of 40% for climate change.

All surface water apparatus beyond the curtilage of a single dwelling is intended to be offered for adoption by Severn Trent Water under a Section 104 agreement. It is the designs intention to offer storage up to the 1 in 30 year event for adoption by STW with the additional volume required to accommodate the 1 in 100 year event will be maintained by a management company.

3.0 Proposed Foul Water Drainage

A new foul water drainage network will be required to service the new development. The new network will collect and convey foul water discharge from the development to a connection point on the existing Severn Trent Water network. The proposed drainage strategy is included in the appendix.

Current proposals are for a point of connection into STW manhole SO85140505 which is located within the junction of Winnycroft Lane and Sneedhams Road to the north of the development.

Based on a development of 190 units SSG's Design and Construction Guidance recommends a peak flow rate of 4,000l/day/unit dwelling for residential uses. On this basis an anticipated peak flow rate of 8.79l/s will be generated by the development.

A Developer enquiry response from Severn Trent Water is included in the appendices which provides confirmation of the location of the point of connection along with the existing network having sufficient capacity to cater for the development.

All foul water apparatus beyond the curtilage of a single dwelling is intended to be offered for adoption by Severn Trent Water under a Section 104 agreement.

4.0 Appendices

Rural Runoff Rate

3880-200A – Preliminary Drainage Strategy

Developer Enquiry Response for foul

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	50.000	Urban	0.000
SAAR (mm)	702	Region Number	Region 4

Results	**l/s**
QBAR Rural	170.7
QBAR Urban	170.7
Q100 years	438.7
Q1 year	141.7
Q2 years	153.0
Q5 years	209.9
Q10 years	254.3
Q20 years	303.4
Q25 years	320.5
Q30 years	334.4
Q50 years	375.8
Q100 years	438.7
Q200 years	515.5
Q250 years	541.1
Q1000 years	710.0

GENERAL NOTES:-

The Contractor is to check and verify all building and site dimensions, levels and sewer invert levels at connection points before work starts. Any discrepancy is to be reported to DDP before work commences.

The Contractor is to comply in all respects with current building legislation - Building Standard Specifications, Building Regulations etc., whether or not specifically stated on this drawing.
The drawing must be read with and checked against any structural, geotechnical or other specialist documentation provided.

This drawing is copyright, its use or reproduction without written permission of DDP is prohibited.

All sewers which are to be the subject of a Section 104 Agreement are to be constructed in accordance with the Design and COnstruction Guidance, and to the satisfaction of the adopting sewerage undertaker.

All sewers with less than 1.2m of cover beneath roads or 0.9m elsewhere area to have a protective cover slab.

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All construction methods and materials employed are to be in accordance with the current road and bridgework's specification. All construction thicknesses are to be confirmed by C.B.R. test.

No responsibility will be taken for any construction work undertaken prior to receipt of technical approvals for the intended construction, or when work is not executed strictly in accordance with the drawings.

A section 106 application to connect must be made to the water authority, the developer shall give 21 days notice prior to connection, and the works may only be undertaken by a SSIP accredited contractor.

Key

- Proposed Surface Water Sewer Route
- Proposed Foul Water Sewer Route
- Proposed Surface Water Attenuation to be adopted by STW (Weholite pipe or similar approved)
- Proposed Surface Water Cellular Storage to be maintained by Management company (SDS or similar approved)
- Catchment A Boundary discharging to existing moat
- Catchment B Boundary discharging to existing ditch
- Existing Ditch alongside Winnycroft Lane
- Existing Water surface area
- Existing ditch conveying water from moat to roadside ditch
- Area of existing scheduled monument

REV	BY	CHK	DESCRIPTION	DATE
A	EP	EP	Surface water outfall to the ditch realigned	12.05.2022

CLIENT **Bromford Homes**

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WONDERFUL ON TAP

Severn Trent Water Ltd
Leicester Water Centre
Gorse Hill
Anstey
Leicester
LE7 7GU

[redacted]

www.stwater.co.uk

Email:
[redacted]

Our ref: 1015982

Bromford Developments
Ltd,
Venture Court,
Broadlands,
Wolverhampton,
WC10 6TB.

FAO: [redacted]

1st September 2021

Dear [redacted],

Proposed Residential Development (190 Houses) at: Snow Capel Farm Site, Winnycroft Lane, Gloucester, GL4 8EG.

X: 385097 / Y: 214180

I refer to your Development Enquiry Request submitted in respect of the above site. Please find enclosed the sewer records that are included in the fee together with the Supplementary Guidance Notes (SGN) referred to below.

Public Sewers in Site – Required Protection

There are no public sewers crossing the propose development area.

Please Note:
On 1st October 2011 many private sewers were transferred into the ownership of Severn Trent Water as public sewers, where two or more properties in separate ownership are served by those sewers. Most of these former private sewers will not be shown on the public sewer records, therefore a full site survey should be carried out prior to any layout design or construction works to identify where these sewers may be and to avoid later delays and possible added costs.

Foul Water Drainage

Sewer records show the closest point of connection for gravity foul flows of the proposed 190 houses is at the existing 225mm foul water north of the site (MH0505) in Winnycroft Lane. Our records show that there is a reported flooding location from the foul network further downstream along Birchall Avenue.

WONDERFUL ON TAP

From the information you have provided and our desktop assessment, we feel that sewer modelling will be required. This will enable us to ensure that we fully understand the impact of your proposals on the receiving network and downstream assets – Abbeydale – Birchall Avenue CSO.

In a change to our previous process, we no longer charge developers for the hydraulic modelling service. As a result, while we can provide a brief summary of our findings if you need us to, we will no longer provide the full external capacity assessment report.

Note: Please allow up to 4-6 weeks for completion of the modelling assessment (SCA).

Surface Water Drainage

Under the terms of Section H of the Building Regulations 2000, the disposal of surface water by means of soakaways should be considered as the primary method. If this is
not practical and no watercourse is available as an alternative, the use of sewerage should be considered. In addition, other sustainable drainage methods should also be explored before a discharge to the public sewerage system is considered.

If these are found to be unsuitable, satisfactory evidence will need to be submitted. The evidence should be either percolation test results or by the submission of a statement from the SI consultant (extract or a supplementary letter).

Subject to the above, the site drainage should be discussed with the Local Lead Flood Authority with a view to implement suitable SUDs techniques to land soakaways or other land drainage systems prior to any consideration of discharges to public sewers being accepted. Any discharge rate to a watercourse or drainage ditch will be determined by the LLFA.

It is proposed to attenuate surface water flows on site and discharging flows at a restricted rate to the watercourse north west of the site. Please refer to the attached guidance notes. Soakaways would be the preferred method of surface water disposal but if these are proved unsuitable, a connection to this watercourse would be acceptable. You would need to agree flow rates and all SUDS details with the Lead Local Flood Authority and statutory consultee in the planning process for this area who I believe is Stroud District Council.

WONDERFUL ON TAP

SEVERN TRENT

New Connections

For any new connections including the use, reuse and indirect to the public sewerage system, the developer will need to submit Section 106 application. Our Developer Services department are responsible for handling all such enquiries and applications. To contact them for an application form and associated guidance notes please call 0800 707 6600, email new.connections@severntrent.co.uk or download from www.stwater.co.uk

Please quote the above reference number in any future correspondence (including e-mails) with STW Limited. Please send **all correspondence** to the network.solutions@severntrent.co.uk email inbox address, a response will be made within 15 days.

If you require a VAT receipt for the application fee please email MISCINCOME.NC@SEVERNTRENT.CO.UK quoting the above Reference Number.

Please note that Developer Enquiry responses are only valid for 6 months from the date of this letter.

Yours sincerely,

[redacted]

Senior Evaluation Technician
Network Solutions
Developer Services

Appendix M

Suds Maintenance Requirements

DDP Limited

Proposed Residential Development at Snow Capel Farm, Gloucester

on behalf of Bromford Homes

September 2021

Typical Maintenance requirements for potential Suds Features within the development

Proposed features within development will be determined during detailed design of the development.

The below maintenance requirements are suggested with the extent to be tailored to specific designs during detailed design

1. Cellular Storage attenuation

TABLE 21.3 Operation and maintenance requirements for attenuation storage tanks

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial actions	Repair/rehabilitate inlets, outlet, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

2. Filter Strips

TABLE 15.1 Operation and maintenance requirements for filter strips

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (eg oils)	Monthly (at start, then half yearly)
	Check flow spreader and filter strip surface for even gradients	Monthly (at start, then half yearly)
	Inspect gravel flow spreader upstream of filter strip for clogging	Monthly (at start, then half yearly)
	Inspect silt accumulation rates and establish appropriate removal frequencies	Monthly (at start, then half yearly)
Occasional maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required	As required or if bare soil is exposed over > 10% of the filter strip area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

3. Filter Drain

TABLE 16.1 Operation and maintenance requirements for filter drains

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (eg NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

4. Swales

TABLE 17.1 Operation and maintenance requirements for swales

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

5. Bioretention Features

TABLE 18.3 Operation and maintenance requirements for bioretention systems

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

6. Permeable Paving

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

7. Inlets, Outlets and Flow Control Chambers

Schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris	Monthly (as required)
	Grass cutting - for landscaped areas, spillways and access routes	Monthly (during growing season)
	Tidy all dead growth before start of growing season	Annually
	Remove Sediment from inlets, outlets, forebay	Annually (or as Required)
Remedial Actions	Repair of erosion or other damage	As required
Monitoring	Inspect inlets, outlets and flow control chambers for blockages and clear if required	Monthly
	Check mechanical devices	Half Yearly