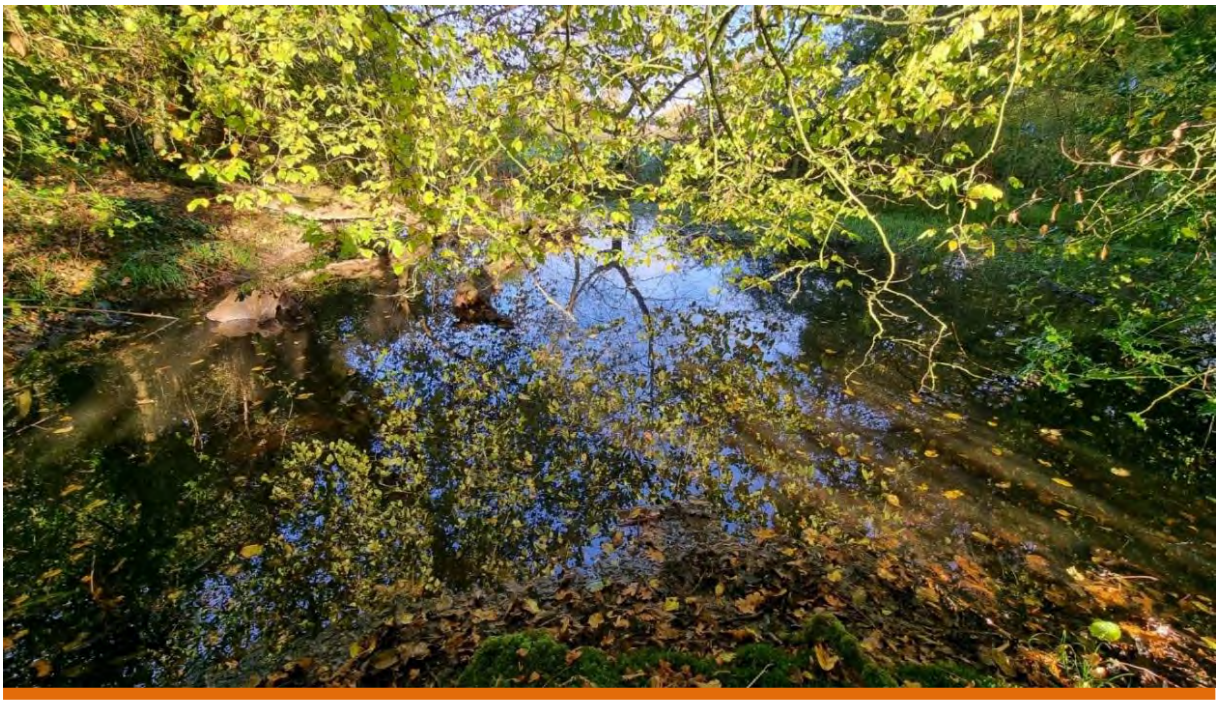

Flood Risk Assessment

Crescent Place, Storrington Road, Thakeham RH20 3ED

Client

Michael & Rosslyn Lowdell

Crescent Place

Storrington Road

Thakeham, RH20 3ED

Ref: 12303

Date: April 2023

Consulting Engineers

GTA Civils & Transport Ltd

Maple House

192 – 198 London Road

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West Sussex, RH15 9RD

Tel: 01444 871444

Index

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2	Existing Site and Current Flood Conditions	3
3	Proposed Development & Flood Mitigation	5
4	Sustainable Surface Water Drainage Design	6

Schedule of Appendices

A	Site Location Map & Aerial Photo
B	Environment Agency Flood Data, SCALGO Live Maps & Groundwater Maps
C	Topographic Survey, Sewer Records & Architect's Scheme Drawings
D	Drainage Drawings
E	BRE Digest 365 Soil Soakage Test Report
F	Drainage Calculations
G	Drainage Maintenance and Management Plan

Issue	Issue date	Compiled	Checked
Preliminary Issue	15 February 2023	JP	MR
First Issue	02 March 2023	JP	MR
Updated to LLFA comments	24 April 2024	FVV	MR

1 Introduction

1.1 GTA Civils & Transport Limited was appointed by the client to provide a Flood Risk Assessment (FRA) as requested by the Environment Agency (EA) and Horsham District Council (HDC) in order to achieve Planning Approval at said property.

1.2 This FRA report has been prepared for Michael & Rosslyn Lowdell in relation to the proposed development at Crescent Place, Storrington Road, Thakeham RH20 3ED. No responsibility is accepted to any third party for all or part of this study in connection with this or any other development.

1.3 This report has been prepared in accordance with the 2023 National Planning Policy Framework (NPPF) and the relevant latest planning practice guidance (PPG).

1.4 This third issue has been prepared in response to the request for more information received from HDC's drainage officer dated 01st of April 2024. Further information has been provided on the following:

- Surface water flooding in the existing and proposed scenario.
- Existing watercourses.
- Drainage strategy layout and details.
- Drainage maintenance plan.
- Groundwater considerations.

2 Existing Site and Current Flood Conditions

2.1 The application site lies in Thakeham, in the area administered by HDC. The site comprises two adjoining private properties, Little Snapes to the north and Crescent Place to the south, both with their respective private gardens. There is a swimming pool near the southern boundary. An existing site location map and aerial view are shown in Appendix A.

2.2 Two unnamed watercourses bisect the site, flowing in from the east – northeast. They join close to the centre of the site, where they flow into a 450-diameter culvert going west, crossing underneath Storrington Road. The unnamed watercourse then continues southwest, eventually discharging into the River Stor (Main River) 2km away. A watercourse plan is included in Appendix D. Lakes are located within the Sandgate Quarry approximately 1km to the south.

2.3 A topographic survey is shown in Appendix C. The site slopes from northeast to southwest with external levels ranging between 43.17mAOD and 41.51mAOD. Note the survey levels have been provided relative to an arbitrary site datum. This has been converted to Ordnance Datum based on publicly available information.

2.4 Geology: according to the BGS's online map, the site's solid geology is Fittleworth Member (sandstone and mudstone) with a superficial deposit of Head (clay, silt, sand and gravel) overlying.

2.5 Soil soakage testing was undertaken in accordance with BRE Digest 365 within the site. Testing of the sub soil, which was noted as Clay, did not produce a useable rate - as the water failed to drain more than **10mm** during the **3-hour** long test. The test was therefore declared a 'fail' (nil result). Refer to Appendix E for the full report.

2.6 The site is located within an area with Medium-High groundwater vulnerability; it is removed from any Source Protection Zones. Groundwater seepage was observed during the infiltration testing at approximately 0.9m depth.

2.7 Public Sewers: Southern Water's sewer records are shown in Appendix C. A 150mmØ foul sewer flows north-south under Storrington Road to the west of the site. There are no public surface water sewers in this vicinity.

2.8 Fluvial flooding: the Environment Agency's Flood Map in Appendix B shows the site is situated in Flood Zone 1 (FZ1) – Low Risk. Sites in FZ1 are susceptible to an annual exceedance probability of less than 1 in 1000 years (<0.1% AEP).

2.9 Surface water flooding occurs when excess rainwater does not infiltrate into the ground, or is not intercepted by urban drainage systems, and instead flows across the surface. The EA's surface water

flood map indicates that the site is bisected by an overland flow route, flowing from northeast to southwest, associated with the existing ditches. The flooding is mostly contained to the ditch itself in both the 'High Risk' (1 in 30 years storm event) and 'Medium Risk' (1 in 100 years storm event).

2.10 In a 'Low Risk Scenario' ('1 in 1000 years' storm event), the overland flow spills out from the ditch across the grassed area in front of Crescent Place, and onto Storrington Road. The depths of flooding range between 300mm and 900mm closest to the ditch line and is below 300mm across the rest of the site. A flood map illustrating this is included in Appendix B; this includes mapping generated with SCALGO Live, demonstrating the flood routes. The velocity of this is – predominantly – greater than 0.25 m/s.

2.11 Artificial sources: flooding from reservoirs, canals and docks. The EA's reservoir flooding map (in Appendix B) shows the site is clear from the risk of flooding from this source. There are no docks or canals in this area.

2.12 Historical records: the EA's historical flood map in Appendix B does not include any records of flooding at the site.

2.13 In conclusion, the flood risk profile of this site is High – limited to areas in the Surface Water floodplain. In the rest of the site the flood risk is Low.

3 Proposed Development & Flood Mitigation

3.1 The proposal is to build one infill detached dwelling house – located to the north of the stream network. A new vehicular access and garage is also included to the southwest. The proposed scheme drawings are shown in Appendix C.

3.2 As summarised in section 2.12 above, the flood risk of the site is High – limited to the surface water floodplain close to the northern stream.

3.3 The dwelling house will be located to the north of the floodplain. Its lowest floor level will be set at **42.77mAOD**, which is greater than 1m above the stream's north bank's levels at this point. The depth of flooding in the 1 in 1000 years scenario has been estimated at **42.15mAOD** closest to the proposed dwelling using SCALGO Live (based on 225mm flood depth over ground level 41.83mAOD). This means >0.6m of freeboard will be provided; this complies fully with the NPPF.

3.4 The proposed garage and associated drive will be encroaching slightly within the overland flow path as mapped by the EA. However, as outlined in Section 2.10, the main flow path is associated with the northeast-southeast ditch, spilling out at the location of the existing 450 diameter culvert. The garage and drive will not encroach onto this main flow mechanism and will therefore have limited impact on the overall flood risk.

3.5 To demonstrate this, the proposed levels have been imported into SCALGO Live to review the potential impacts on the overland flow route. This confirmed that the main flow pathways through the site remain unchanged. This is included in Appendix B.

3.6 Additionally, the footpath from the proposed drive to the proposed dwelling crosses over the western branch of the ditch. As shown on the Watercourse Plan, this is a minor branch of the ditch issuing within the site itself. It is not expected that the footpath crossing will create any undue restrictions to flow. It is proposed that a minimum opening size of 450mm is kept matching the existing downstream culvert.

3.7 Placing a new dwelling unit in FZ1 is 'appropriate development', according to Tables 1, 2 and 3 of the NPPF. There is no need to pass the Sequential / Exception Tests.

3.8 The dwelling house will be placed 4m north of the stream's north bank. This, together with the new outfall headwall, will be subject to Ordinary Watercourse Consent (OWC) from the LLFA (as within 8m of the existing bank). The watercourse plan in Appendix D demonstrates that maintenance access to the ditch will be maintained from the south. On this basis, there is no reason to suppose OWC would not be forthcoming, subject to details to be submitted during the OWC process.

4 Sustainable Surface Water Drainage Design

4.1 The SuDS hierarchy has been applied, this being:-

- Infiltration to ground, namely features such as soakaways, infiltration trenches and the like;
- Discharging to a watercourse;
- Discharging to a public sewer.

4.2 As set out in section 2.5 and Appendix E, the soil possesses insufficient permeability for infiltration structures (eg soakaways, permeable pavings).

4.3 The development's surface water will be drained to the stream within the site. The offsite flow rate will be restricted to 1.0l/s, which is the practical minimum limit of screened orifices / vortex devices.

4.4 A cellular attenuation tank is proposed to store the volume in the critical 1 in 100 years storm event + 45% allowance for climate change. The tank will be lined to protect groundwater from any contaminants. Drainage drawings and details of the tank are included in Appendix D. Hydraulic calculations are included in Appendix F.

4.5 Preliminary buoyancy calculations have been carried out to assess the risk of flotation from the shallow groundwater. These have been conducted for two scenarios: groundwater at 0.9m below ground, as observed during testing; and peaking groundwater at 0.5m below ground. In both cases, no ballast or additional reinforcement is required. The calculations are included in Appendix F.

4.6 Exceedance flows: an exceedance flow plan is included in Appendix D demonstrating that the water will be able to flow safely away from the dwellings and into the existing stream in the event of a system failure or extreme storm in excess of the design event.

4.7 Maintenance of the SuDS network will remain the responsibility of the Applicant. A preliminary Maintenance and Management Plan is included in Appendix G.

Conclusion:

This development will not increase the flood risk, either on this site or to neighbouring properties, and so complies fully with the NPPF and PPG.

- End of Report -

Appendix A

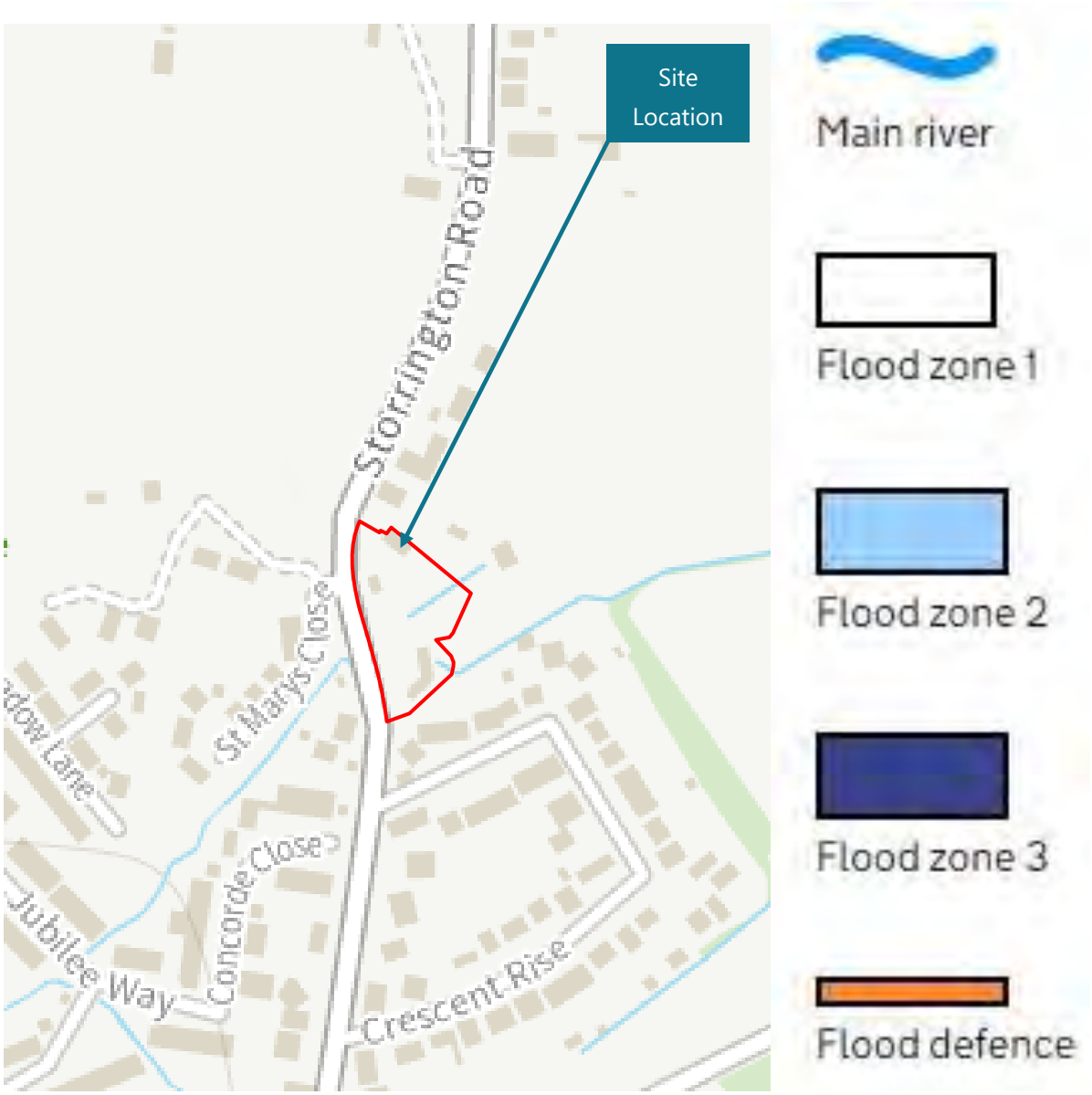
Site Location Map & Aerial Photo




Site
Location

Appendix B

Environment Agency Flood Data, SCALGO Live Maps & Groundwater Maps



EA's Online Flood Map for Planning (Rivers and Seas)

The site is located in Flood Zone 1 (FZ1)



Surface water flood risk: water depth in a low risk scenario

Flood depth (millimetres)

Over 900mm | 300 to 900mm | Below 300mm

EA's Online Surface Water Flood Depth Map in a 'Low Risk Scenario'
(1 in 1000 years storm event)

An overland flow route bisects the site from northeast-southwest causing potential flooding in the centre of the site between 300mm and 900mm and spilling into the site to a depth of below 300mm



EA's Online Surface Water Flood Velocity Map in a 'Low Risk Scenario'
(1 in 1000 years storm event)

An overland flow route bisects the site from northeast-southwest predominantly over 0.25 m/s

EA Surface Water Flood Risk Mapping for Low Risk Scenario (1 in 1000) - shown in blue.
Overland Flow Plan for 200mm rainfall based on existing levels, as generated by SCALGO Live - ahown in purple.
Spill routes shown by SCALGO live.

Legend

Flooded Areas
Terrain/Buildings, , depth, Rain: 20.0 cm.
0.0m 0.2m 0.4m 0.6m 0.8m

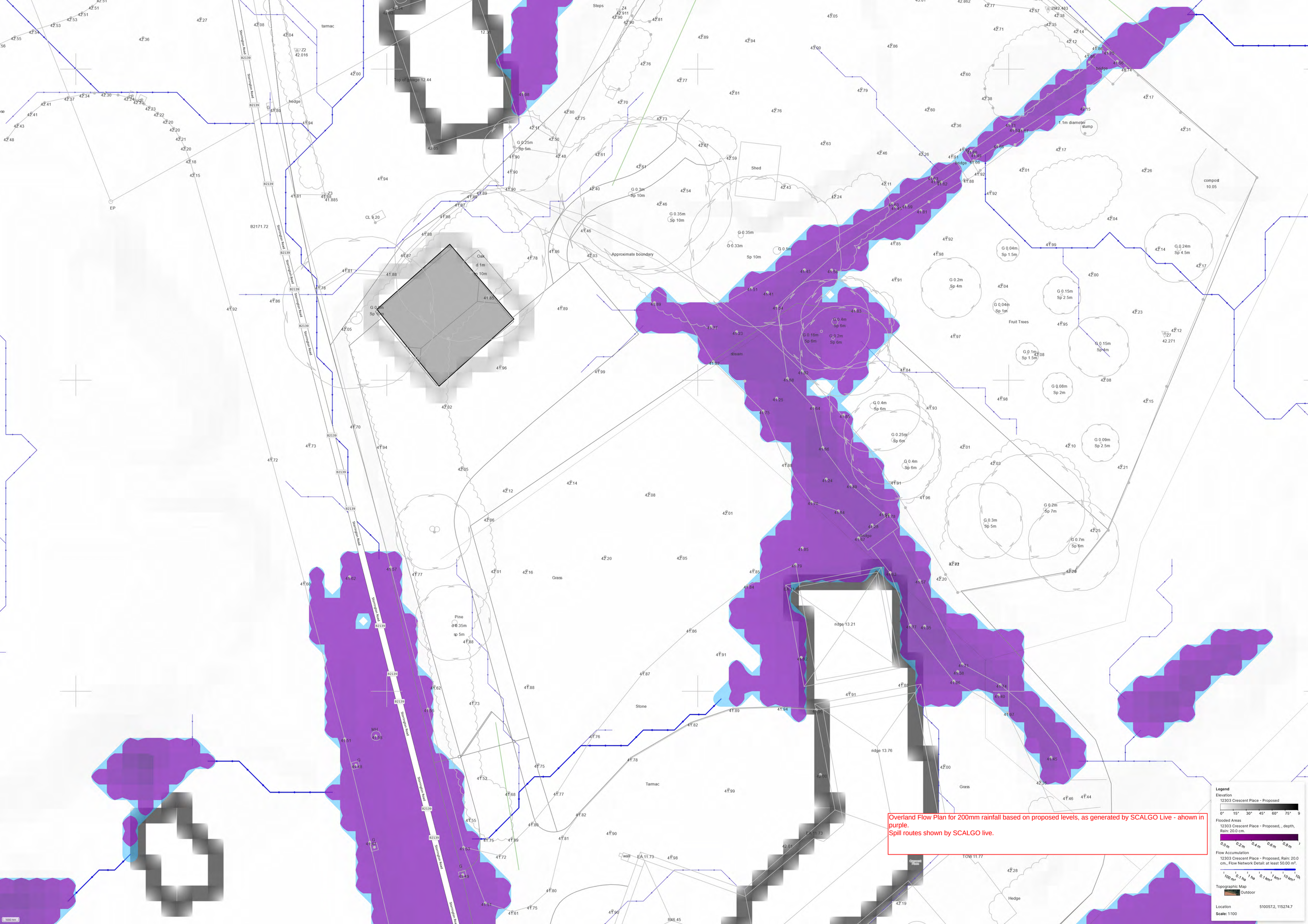
Flow Accumulation
Terrain/Buildings, Rain: 20.0 cm., Flow Network Detail: at least 50.00 m².

Topographic Map
Outdoor

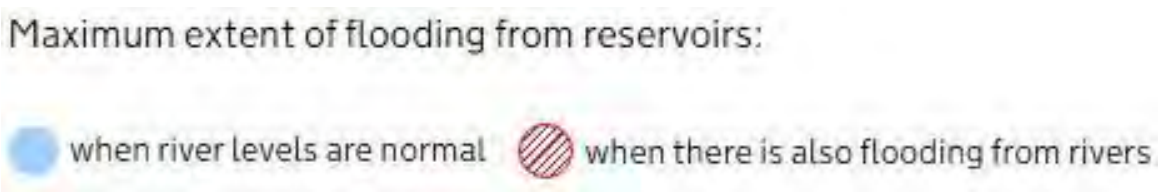
Water Depth
Surface Water T1000 Depth
0.0m 0.2m 0.4m 0.6m 0.8m

Location 510056.3, 115275.3

Scale: 1:100

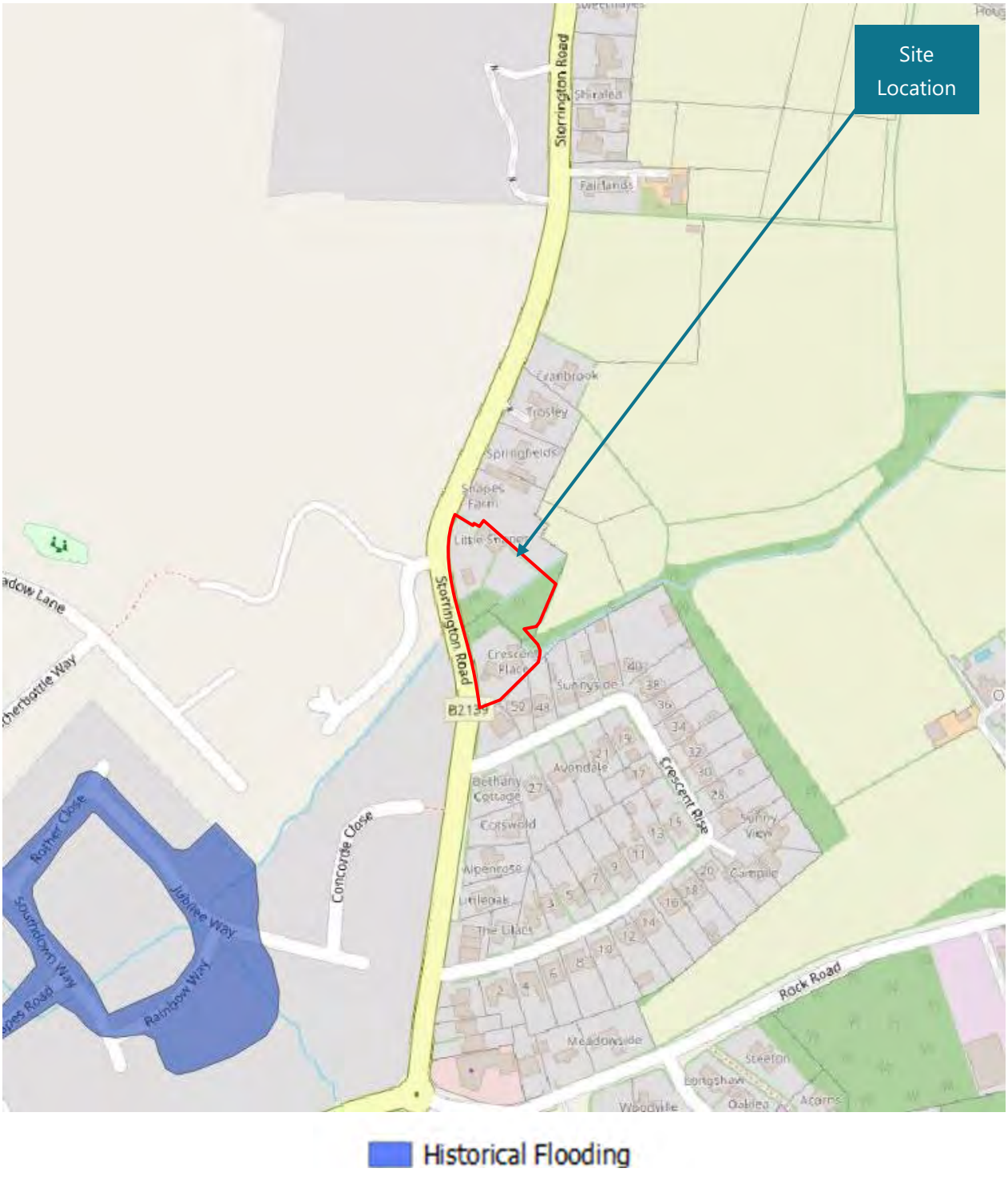

Overland Flow Plan for 200mm rainfall based on proposed levels, as generated by SCALGO Live - ahown in purple.
Spill routes shown by SCALGO live.
Legend
Elevation
12303 Crescent Place - Proposed
0° 15° 30° 45° 60° 75° 9
Flooded Areas
12303 Crescent Place - Proposed, , depth, Rain: 20.0 cm.
0.0 m 0.2 m 0.4 m 0.6 m 0.8 m
Flow Accumulation
12303 Crescent Place - Proposed, Rain: 20.0 cm., Flow Network Detail: at least 50.00 m².
100 m² 0.1 ha 1 ha 0.1 km² 1 km² 10 km²
Topographic Map
Outdoor
Location 510057.2, 115274.7
Scale: 1:100
Approximate boundary
Fruit Trees
Grass
Stone
Tarmac
Hedge
Shed
Steps
Pine
Oak
stream
Storrington Road
B2139
B2171.72
EP
CL 9.20
TOW 11.77
EA 11.73
R46.45
ridge 13.21
ridge 13.76
compost 10.05
1.1m diameter stump
Top of garage 12.44
tarmac
hedge
Crescent Place





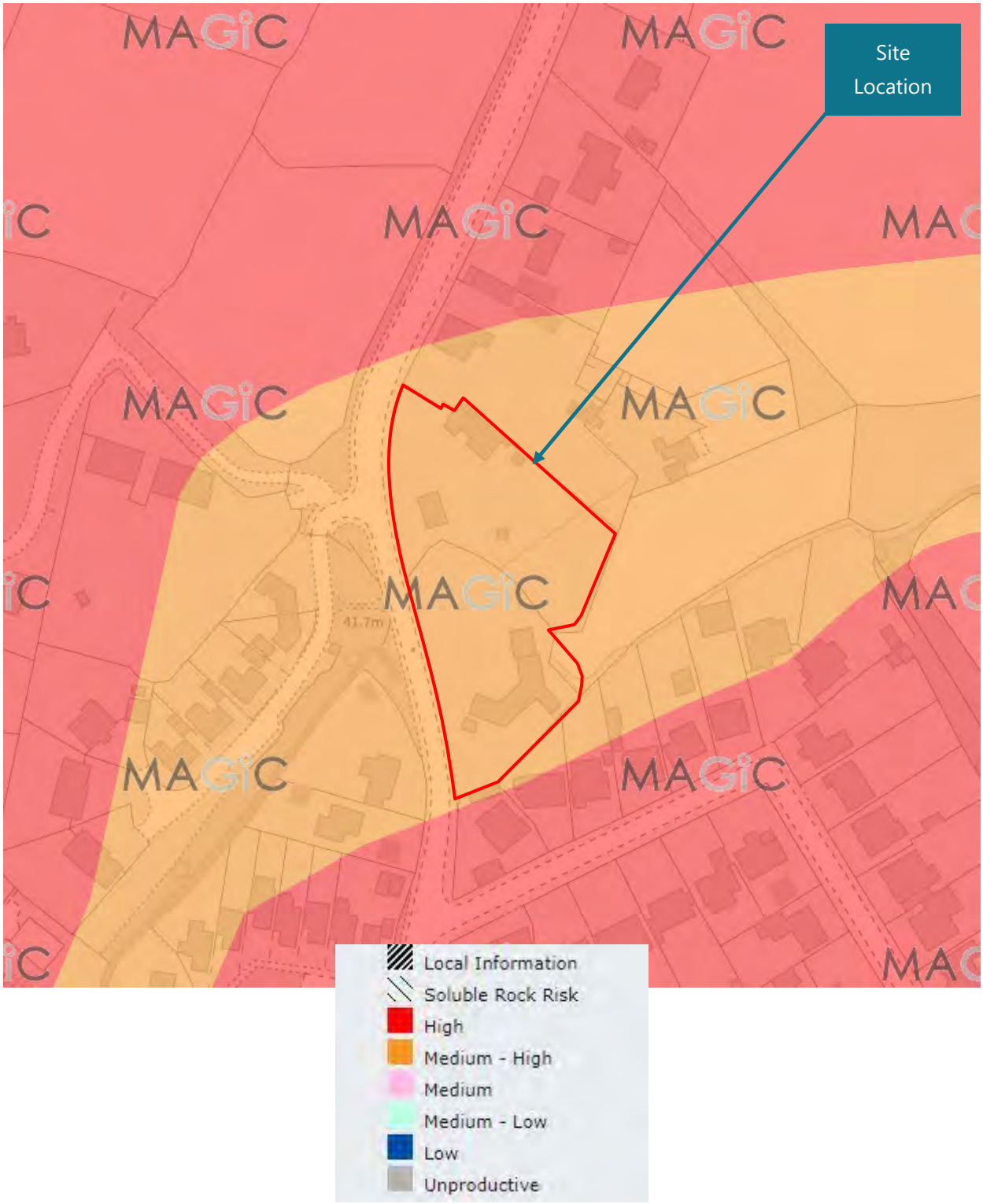
EA's Online Flood Risk from Reservoirs – Flood Depth - Map

The site is clear from the risk of flooding from this source



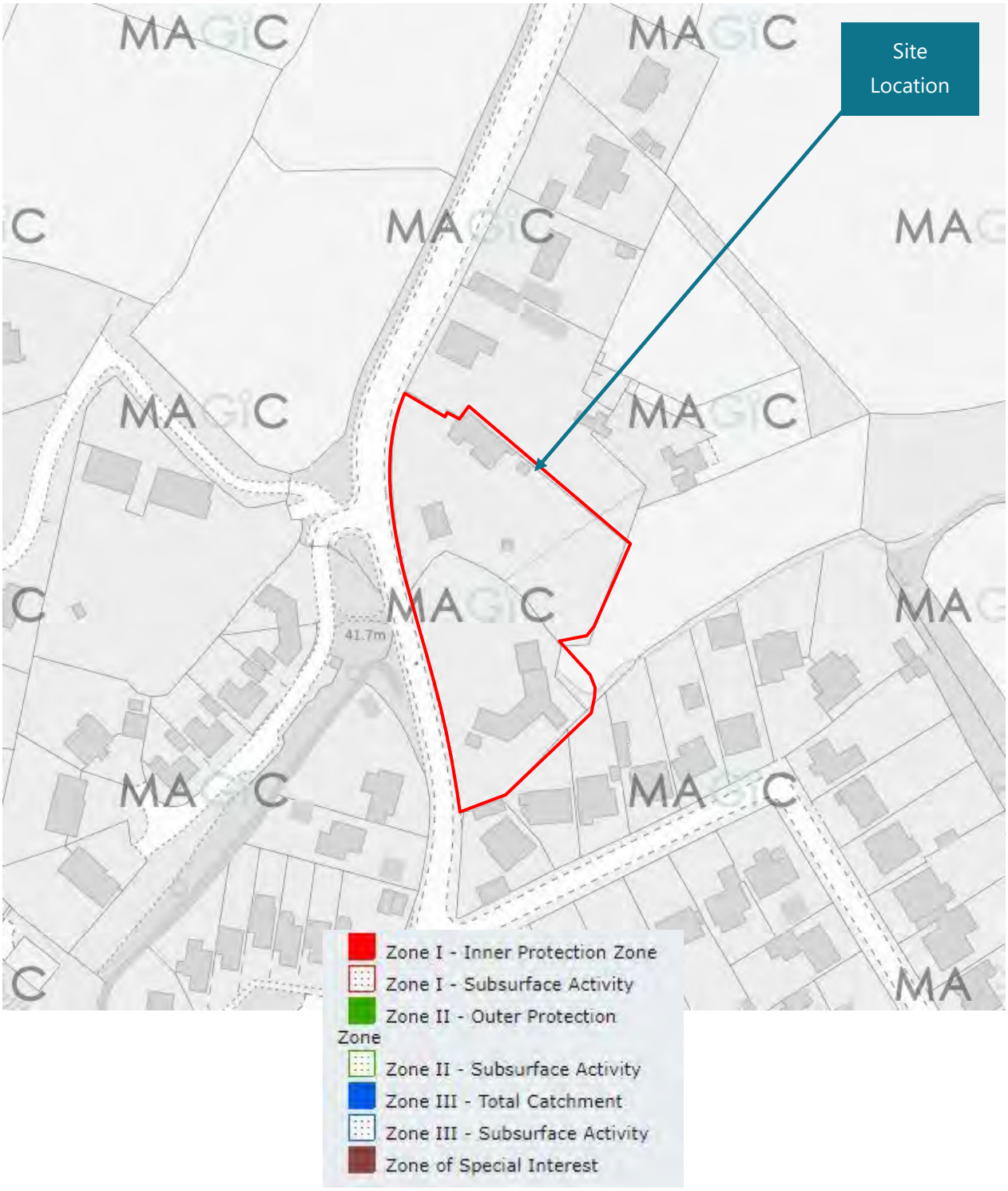
DEFRA's Online 'Historical Flooding' Map

The site has not been affected by flooding in the past



Environment Agency's Online Groundwater Vulnerability Zones Map

The site overlies a 'Medium - High' Groundwater Vulnerability Zone

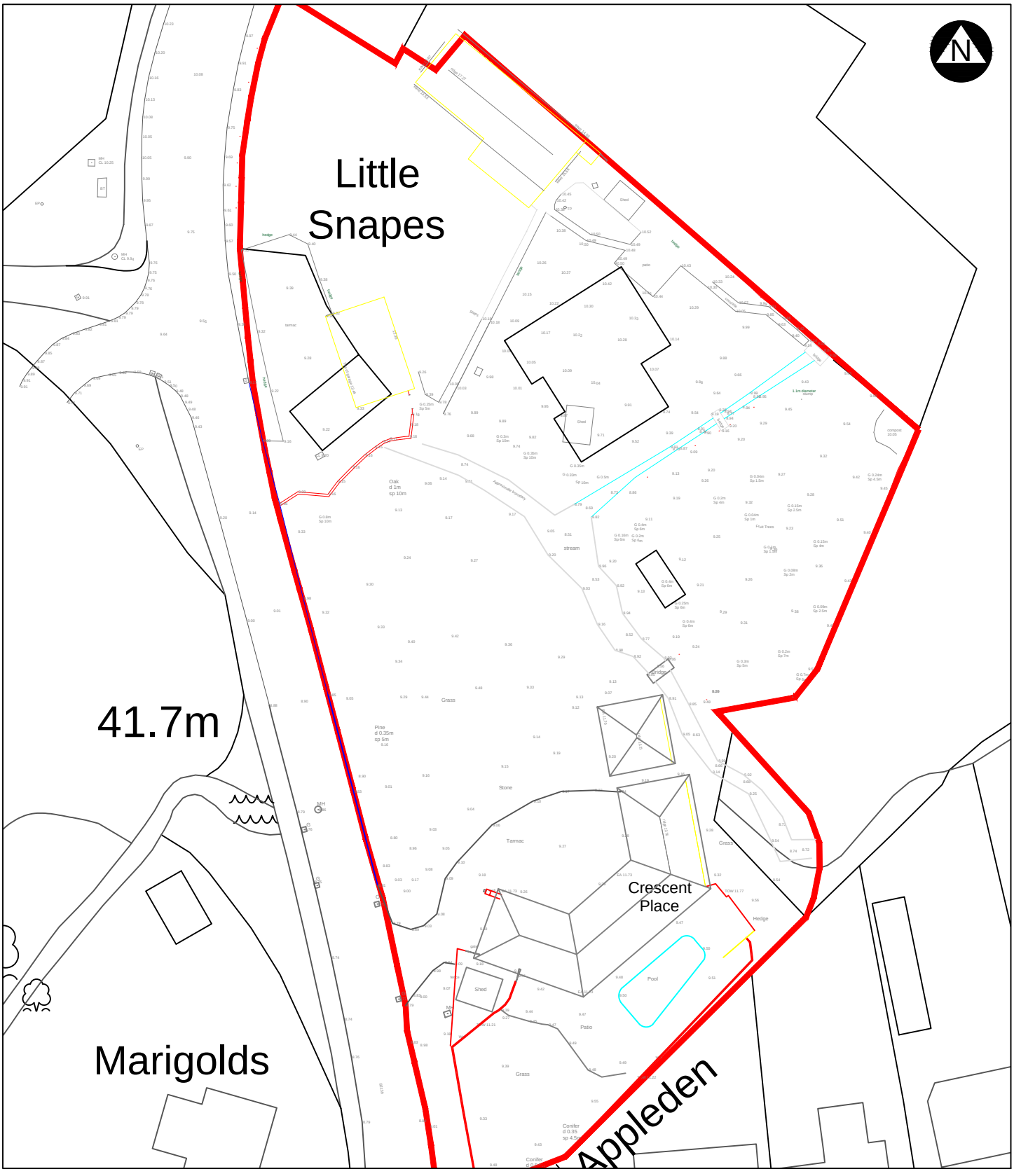


Environment Agency's Online Groundwater Source Protection Zones Map

The site is removed from the nearest Source Protection Zone

Appendix C

Topographic Survey, Sewer Records & Architect's Scheme Drawings



revision

address
Crescent Place, Storrington Road, Thakeham, RH20 3ED

project
Proposed development of rear agarden

title
Topo

scale	date	dwg no.	revision
1@500 @A4	July 2022	2022.351.01	

DOWNSVIEW
ASSOCIATES
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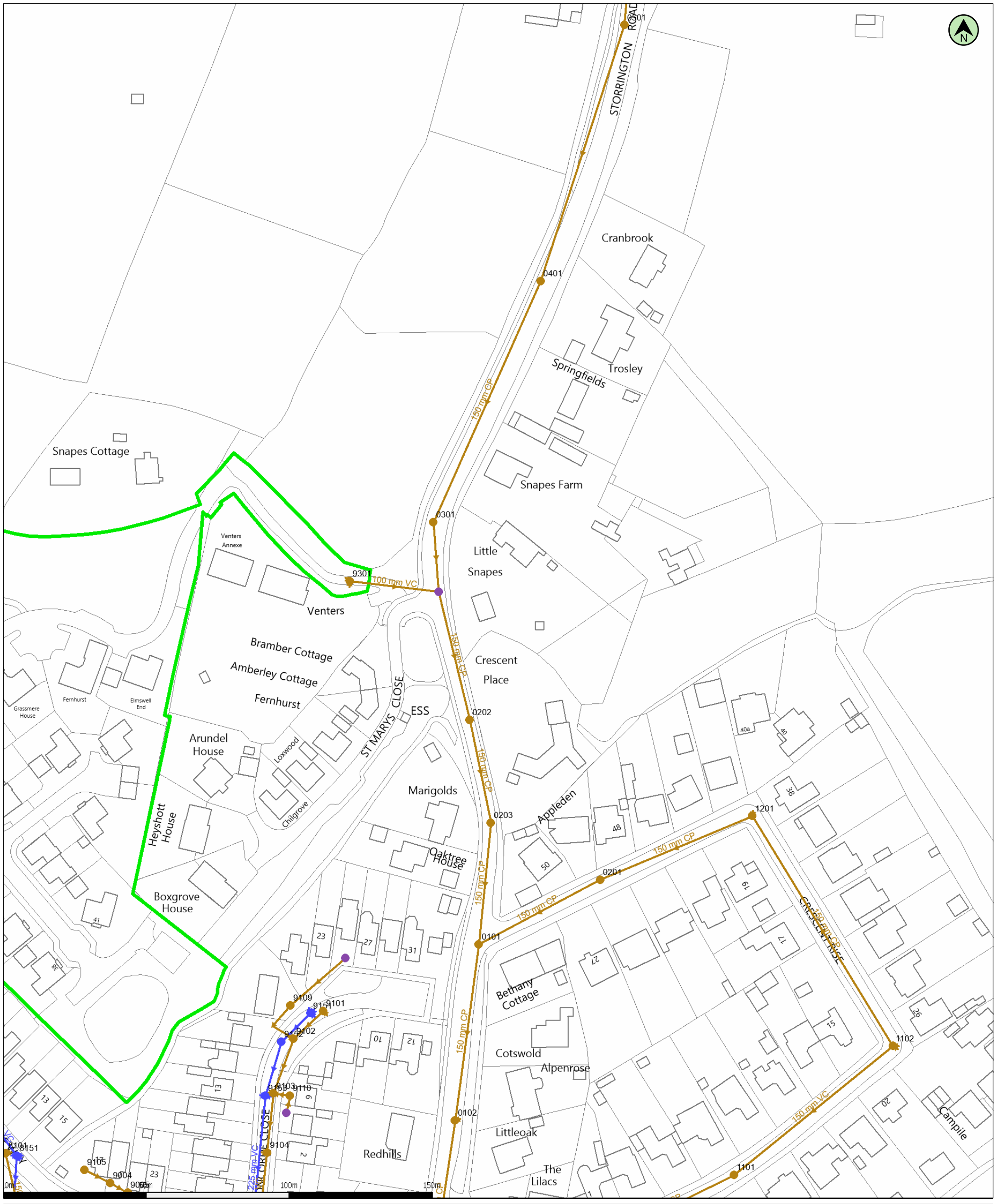
RICS



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Data updated: 06/01/23	Map Centre: 510050,115302	Our Ref: 1055854 - 1	Powered by digdat

Foul Gravity Sewer
Combined Gravity Sewer
Culverted Water Course or Treated Effluent
Surface Water Gravity Sewer
Rising Main, Vacuum or Syphon
Combined Outfall
Surface Water Outfall
Foul Outfall
Surface Water Inlet
Combined Pumping Station
Surface Water Pumping Station
Foul Pumping Station
WWTW Water Treatment Works
Section 104 Area
Building Over Agreement Area
Foul Manhole
Combined Manhole
Surface Water Manhole
Side Entry Manhole, Decarcation Chamber, Dummy Manhole or Surface Water Soakaway

cfagan@gtacivils.co.uk

12303 Crescent Place

WATER for LIFE from Southern Water.

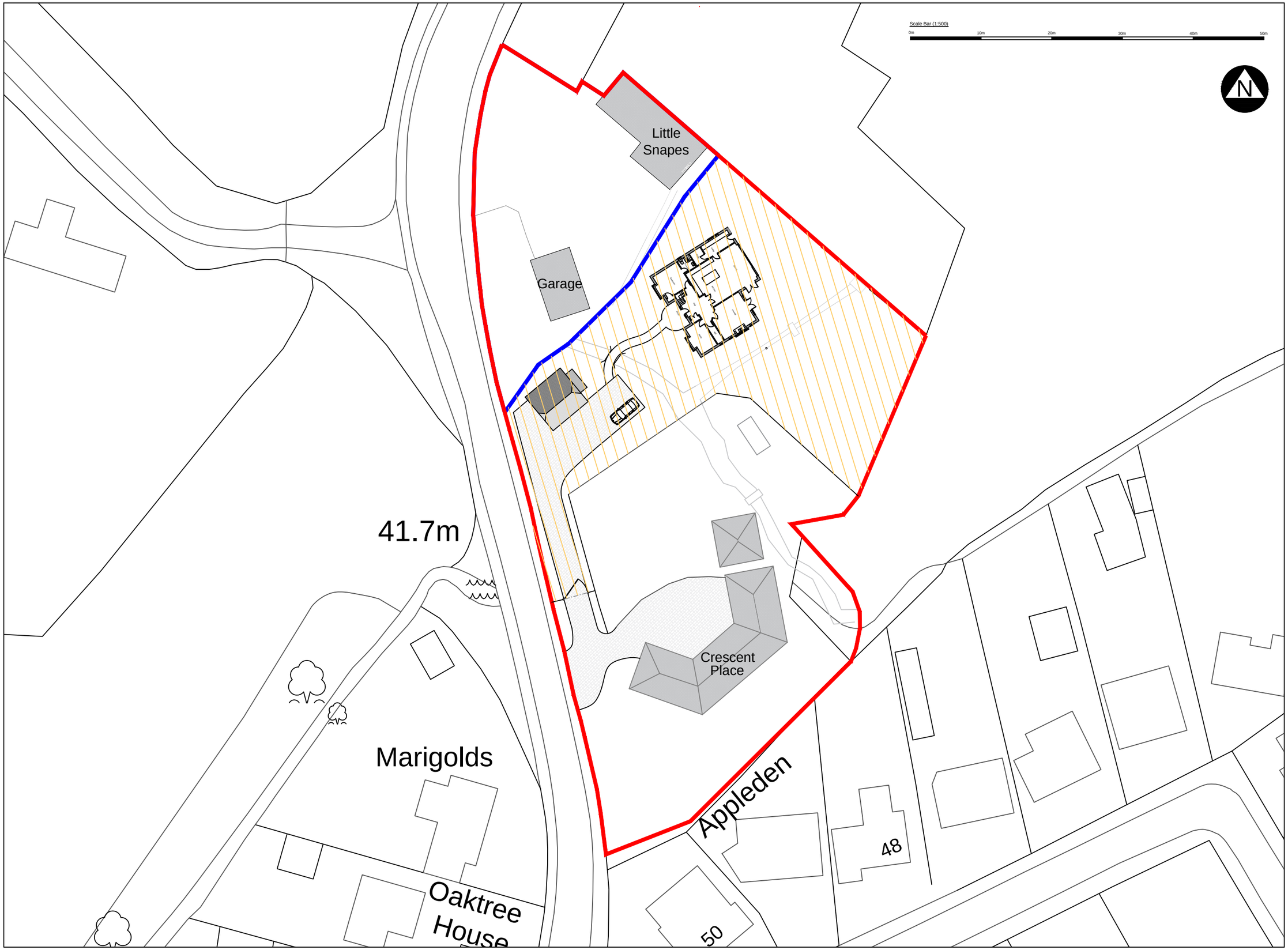
The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2023 Ordnance Survey 100031673 .This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0101	F	41.96	39.70	
0102	F	42.46	39.35	
0201	F	42.88	41.21	
0202	F	41.55	40.13	
0203	F	41.56	39.95	
0301	F	0.00	0.00	
0401	F	44.82	43.15	
0501	F	0.00	0.00	
1101	F	45.83	43.58	
1102	F	45.71	44.01	
1201	F	43.93	42.19	
8101	F	47.18	44.72	
9004	F	0.00	0.00	
9005	F	0.00	0.00	
9101	F	48.50	46.59	
9102	F	0.00	0.00	
9103	F	48.28	46.15	
9104	F	48.15	45.96	
9105	F	0.00	0.00	
9109	F	0.00	0.00	
9110	F	0.00	0.00	
9301	F	42.88	42.22	
8151	S	47.16	45.48	
9151	S	48.46	47.09	
9152	S	48.36	46.96	
9153	S	48.27	46.87	

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert



Proposed Site Plan (Scale 1:500)

revisions

DOWNSVIEW ASSOCIATES
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Little Acorns, Hampers Lane, Storrington, West Sussex, RH20 3HZ
Tel 01903 746367 Mob 7525 844985
Email mail@downsview-surveyors.co.uk

RICS

client
Crescent Place
Storrington Road
Storrington
West Sussex

project
Proposed construction of 4 bedroom detached dwelling with detached oak framed garage

title
Proposed site plan

scale:	date:	revision:
As noted @ A3	Nov 2022	

drawing number
2022.351.02

Appendix D

Drainage Drawings

GENERAL NOTES

1. The location, size, depth and identification of existing services that may be shown or referred to on this drawing have been assessed from non intrusive observations , record drawings or the like. The contractor shall safely carry out intrusive investigations, trial holes or soundings prior to commencing work to satisfy himself that it is safe to proceed and that the assessments are accurate. any discrepancies shall be notified to gta prior to works commencing.

2. Tender or billing drawings shall not be used for construction or the ordering of materials.

3. Do not scale. All dimensions and levels to be site confirmed.

4. This drawing shall be read in conjunction with all relevant architects, consultants drawings and specifications, together with H&S plan requirements.

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LEGEND

- 8m Watercourse buffer
- Site Boundary
- Existing Flow Direction
- Existing 450mm Culvert

START OF DITCH

DITCH ENTERS SITE FROM NORTH-EAST

DITCH ENTERS SITE FROM EAST

MAINTENANCE ACCESS TO DITCH FROM CRESCENT PLACE ACCESS

P1	INITIAL ISSUE	24/04/24	NG	FVV
Rev	Amendments	Date	Dsn	Chk

Status: PRELIMINARY

Client: MICHAEL & ROSSLYN LOWDELL

Architect:

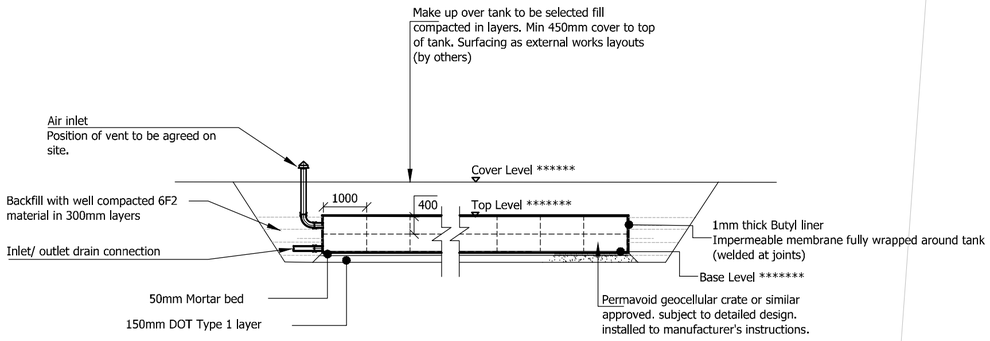
Project: CRESCENT PLACE
THAKEHAM, RH20 3ED

Title: WATERCOURSE PLAN

Date	Scale @ A1
APRIL 2024	1:200
Clients Ref.	Project Ref. 12303

gta Civils & Transport
Maple House, 192-198 London Road,
Burgess Hill, West Sussex, RH15 9RD
Tel.01444 871444 Web: www.gtacivils.co.uk

Drawing Number	Rev.
12303-1000	P1



SECTION THROUGH ATTENUATION TANK
Scale 1 :100

GENERAL NOTES

1. The location, size, depth and identification of existing services that may be shown or referred to on this drawing have been assessed from non intrusive observations , record drawings or the like. The contractor shall safely carry out intrusive investigations, trial holes or soundings prior to commencing work to satisfy himself that it is safe to proceed and that the assessments are accurate. any discrepancies shall be notified to gta prior to works commencing.

2. Tender or billing drawings shall not be used for construction or the ordering of materials.

3. Do not scale. All dimensions and levels to be site confirmed.

4. This drawing shall be read in conjunction with all relevant architects, consultants drawings and specifications, together with H&S plan requirements.

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CELLULAR ATTENUATION TANK
Designed for 1 in 100years storm event
+45% CC allowance
13.0m x 4m x 0.225m DEEP
CL 42.000
IL 41.300
Top of tank: 41.525
MAX VOLUME REQUIRED 9.9m3

OUTFALL TO DITCH
AND ALL WORK WITHIN 8M OF DITCH BANK SUBJECT TO OWC CONSENT

OUTFALL
IL: 41.25

CONTROL
CL 41.905
IL 41.280
ORIFICE OUTFLOW
CONTROL DIA: 26mm

Snapes Farm
Little Snapes
Garage
Crescent Place
Appleden
Marigolds
Saint Marys Close
B2171.72
Oak d 1m sp 10m
Pine d 0.35m sp 5m
Conifer d 0.35 sp 4.5m
Bridge
Pool
Patio
Shed
Grass
Tarmac
Stone
stream
Hedge
Fruit Trees
compost 10.05
41.7m
48

Rev	Amendments	Date	Dsn	Chk
P1	INITIAL ISSUE	24/04/24	NG	FVV

Status: PRELIMINARY

Client: MICHAEL & ROSSLYN LOWDELL

Architect:

Project: CRESCENT PLACE
THAKEHAM, RH20 3ED

Title: DRAINAGE STRATEGY

Date	Scale @ A1
APRIL 2024	1:200
Clients Ref.	Project Ref. 12303

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Burgess Hill, West Sussex, RH15 9RD
Tel.01444 871444 Web: www.gtacivils.co.uk

Drawing Number	Rev.
12303-1600	P1

IMPORTANT NOTE:
TOPOGRAPHICAL SURVEY PROVIDED TO ARBITRARY DATUM. APPROXIMATE CONVERSION TO ORDNANCE SURVEY DATA HAS BEEN CARRIED OUT BY GTA BASED ON PUBLICLY AVAILABLE INFORMATION. ALL LEVELS TO BE CONFIRMED ON SITE PRIOR TO WORKS, AND REPORTED BACK TO ENGINEER

GENERAL NOTES

1. The location, size, depth and identification of existing services that may be shown or referred to on this drawing have been assessed from non intrusive observations , record drawings or the like. The contractor shall safely carry out intrusive investigations, trial holes or soundings prior to commencing work to satisfy himself that it is safe to proceed and that the assessments are accurate. any discrepancies shall be notified to gta prior to works commencing.

2. Tender or billing drawings shall not be used for construction or the ordering of materials.

3. Do not scale. All dimensions and levels to be site confirmed.

4. This drawing shall be read in conjunction with all relevant architects, consultants drawings and specifications, together with H&S plan requirements.

5. Copyright : This drawing must not be copied, amended nor reproduced without the prior written agreement of gta.

6. All drawings specifications and recommendations made by gta are subject to Local Authority and other relevant Statutory Authorities approval. Any works or services made abortive due to the client proceeding prior to these approvals is considered wholly at the Clients risk. gta hold no responsibility for resulting abortive works or costs.

7. If viewing this drawing as an Autocad file (.dwg) in digital format then it is done so with this Disclaimer due to the fact that it can be altered and manipulated following its issue by GTA Civils & Transport and therefore, any alteration or modification of DWG data files provided by GTA Civils & Transport, by you or a third party, without GTA Civils and Transport's express written approval, is done so entirely at your own risk. Modification includes (but is not limited to) turning layers on and off, unfreezing layers and reloading, turning on and off print functions and unloading x-refs.

8. Your attention is also drawn to the fact that the information contained within this file may be subject to alteration at any time, pending technical approval from an approving authority or at the client's instruction. It is therefore strongly recommended that multiple and regular cross checks are made against the current contract drawings.
It is your responsibility to ensure that the correct issue or revision of the DWG data file is being used and requests for updated information made accordingly.

9. Should any apparent discrepancies between the data contained within the DWG file and the current contract drawings become evident, it must be reported back to GTA Civils & Transport as soon as reasonably practicable. Precedence should be given to the current contract drawings (PDF) unless advised otherwise.

LEGEND

Overland Flow Route

BM 44.73m

N

Snapes Farm

Little Snapes

Garage

Saint Marys Close

B2171.72

Oak d 1m sp 10m

stream

Pine d 0.35m sp 5m

Grass

Stone

Tarmac

Crescent Place

Pool

Patio

Bridge

Hedge

Fruit Trees

Shed

Conifer d 0.35 sp 4.5m

41.7m

Marigolds

Oaktree House

Appleden

48

50

Rev	Amendments	Date	Dsn	Chk
P1	INITIAL ISSUE	24/04/24	NG	FVV

Status: PRELIMINARY

Client: MICHAEL & ROSSLYN LOWDELL

Architect:

Project: CRESCENT PLACE
THAKEHAM, RH20 3ED

Title: EXCEEDANCE FLOW PLAN

Date	Scale @ A1
APRIL 2024	1:200
Clients Ref.	Project Ref. 12303

gta Civils & Transport
Maple House, 192-198 London Road,
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Drawing Number	Rev.
12303-1001	P1

Appendix E

BRE Digest 365 Soil Soakage Test Report

cgs civils

Consulting Civil Engineers

Ref: C2531

John Pakenham
GTA Civils

24th January 2023

Re: Crescent Place, Thakeham – Soakaway Testing – Infiltration Test Result Summary

Dear John

The following investigation was carried out at the above location in accordance with our quotation.

1. Site Works

The purpose of the investigation was to supply soakaway test data in general accordance with BRE document 365 (Soakaway Design) at one location which would be the approximate intended location for a possible infiltration device to serve a new development site.

The appended drawing illustrates the position of the test pit. The BRE365 pit was excavated to a depth of 1.2m in line with the approximate depth of the proposed soakaway.

The testing commenced on 20th January 2023 with three tests being undertaken in accordance with BRE 365.

2. BRE 365 Soakaway Test Findings

Testing of the sub soils which was noted as clay failed to produce a useable rate as the water failed to drain more than 10mm during 3 hours. The test was therefore declared a **FAIL**.

During the testing it was noted that there was groundwater seepage at approximately 0.9m deep and this should be taken into consideration during the design.

3. BRE 365 Soakaway Test Results

Test Pit No	Infiltration Rate (1-3 Tests)			Depth of Test	Soil Type
SAT1	N/A	N/A	N/A	1.2m	Clay

Richard Cobden House, Lion Street, Chichester, West Sussex, PO19 1LW
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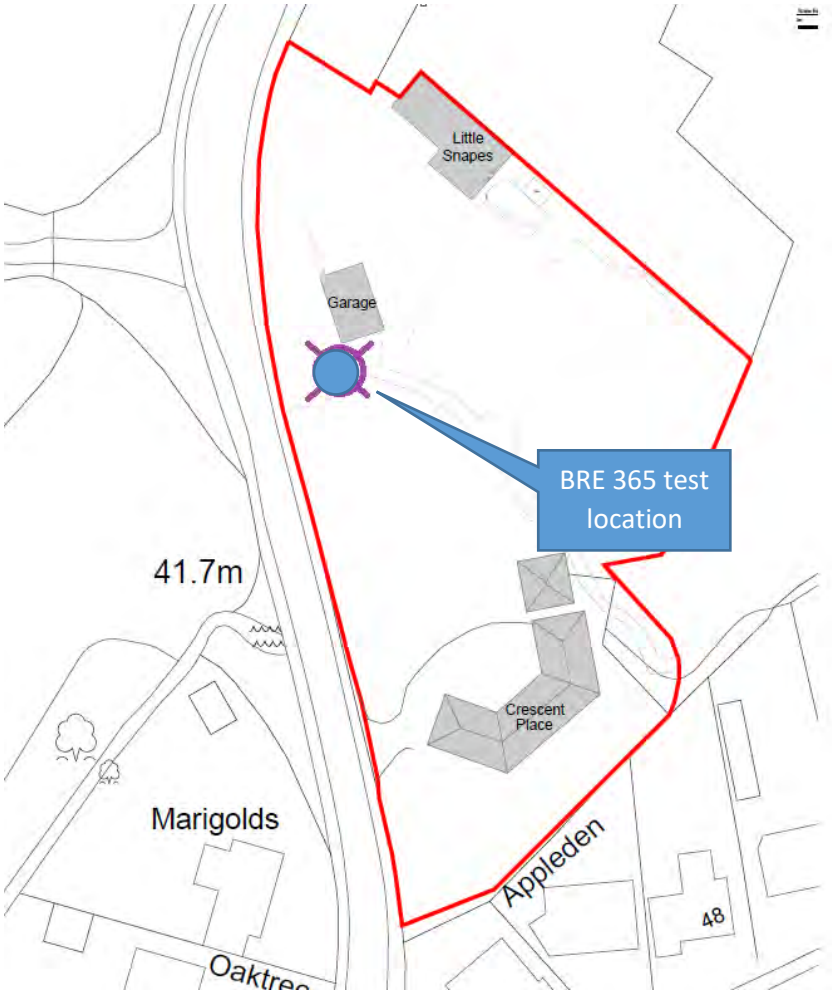
Appendix A – Soakaway Test Location Plan



Appendix B – Site Photographs





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Appendix F

Drainage Calculations

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 137 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	8.215	0.115	0.0	0.6	0.6	5.7	O K
30 min Summer	8.249	0.149	0.0	0.6	0.6	7.3	O K
60 min Summer	8.275	0.175	0.0	0.7	0.7	8.7	O K
120 min Summer	8.286	0.186	0.0	0.7	0.7	9.2	O K
180 min Summer	8.283	0.183	0.0	0.7	0.7	9.1	O K
240 min Summer	8.278	0.178	0.0	0.7	0.7	8.8	O K
360 min Summer	8.268	0.168	0.0	0.7	0.7	8.3	O K
480 min Summer	8.258	0.158	0.0	0.7	0.7	7.8	O K
600 min Summer	8.249	0.149	0.0	0.6	0.6	7.3	O K
720 min Summer	8.240	0.140	0.0	0.6	0.6	6.9	O K
960 min Summer	8.223	0.123	0.0	0.6	0.6	6.1	O K
1440 min Summer	8.195	0.095	0.0	0.5	0.5	4.7	O K
2160 min Summer	8.164	0.064	0.0	0.5	0.5	3.1	O K
2880 min Summer	8.142	0.042	0.0	0.4	0.4	2.1	O K
4320 min Summer	8.115	0.015	0.0	0.4	0.4	0.7	O K
5760 min Summer	8.102	0.002	0.0	0.3	0.3	0.1	O K
7200 min Summer	8.100	0.000	0.0	0.3	0.3	0.0	O K
8640 min Summer	8.100	0.000	0.0	0.3	0.3	0.0	O K
10080 min Summer	8.100	0.000	0.0	0.2	0.2	0.0	O K
15 min Winter	8.230	0.130	0.0	0.6	0.6	6.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	144.024	0.0	6.2	18
30 min Summer	96.415	0.0	8.3	32
60 min Summer	61.440	0.0	10.6	62
120 min Summer	37.674	0.0	13.0	106
180 min Summer	27.822	0.0	14.4	138
240 min Summer	22.363	0.0	15.4	172
360 min Summer	16.430	0.0	17.0	240
480 min Summer	13.179	0.0	18.1	310
600 min Summer	11.098	0.0	19.1	378
720 min Summer	9.638	0.0	19.9	446
960 min Summer	7.709	0.0	21.2	578
1440 min Summer	5.616	0.0	23.2	836
2160 min Summer	4.082	0.0	25.3	1192
2880 min Summer	3.251	0.0	26.9	1556
4320 min Summer	2.355	0.0	29.2	2252
5760 min Summer	1.871	0.0	31.0	2936
7200 min Summer	1.568	0.0	32.5	0
8640 min Summer	1.357	0.0	33.7	0
10080 min Summer	1.200	0.0	34.8	0
15 min Winter	144.024	0.0	6.9	18

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Summary of Results for 100 year Return Period (+45%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	8.269	0.169	0.0	0.7	0.7	8.3	O K
60 min Winter	8.301	0.201	0.0	0.7	0.7	9.9	O K
120 min Winter	8.316	0.216	0.0	0.7	0.7	10.7	O K
180 min Winter	8.313	0.213	0.0	0.7	0.7	10.5	O K
240 min Winter	8.307	0.207	0.0	0.7	0.7	10.2	O K
360 min Winter	8.292	0.192	0.0	0.7	0.7	9.5	O K
480 min Winter	8.276	0.176	0.0	0.7	0.7	8.7	O K
600 min Winter	8.262	0.162	0.0	0.7	0.7	8.0	O K
720 min Winter	8.249	0.149	0.0	0.6	0.6	7.4	O K
960 min Winter	8.225	0.125	0.0	0.6	0.6	6.2	O K
1440 min Winter	8.186	0.086	0.0	0.5	0.5	4.2	O K
2160 min Winter	8.146	0.046	0.0	0.5	0.5	2.3	O K
2880 min Winter	8.121	0.021	0.0	0.4	0.4	1.0	O K
4320 min Winter	8.100	0.000	0.0	0.3	0.3	0.0	O K
5760 min Winter	8.100	0.000	0.0	0.3	0.3	0.0	O K
7200 min Winter	8.100	0.000	0.0	0.2	0.2	0.0	O K
8640 min Winter	8.100	0.000	0.0	0.2	0.2	0.0	O K
10080 min Winter	8.100	0.000	0.0	0.2	0.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	96.415	0.0	9.3	32
60 min Winter	61.440	0.0	11.9	60
120 min Winter	37.674	0.0	14.5	116
180 min Winter	27.822	0.0	16.1	146
240 min Winter	22.363	0.0	17.3	184
360 min Winter	16.430	0.0	19.0	260
480 min Winter	13.179	0.0	20.4	336
600 min Winter	11.098	0.0	21.4	408
720 min Winter	9.638	0.0	22.3	478
960 min Winter	7.709	0.0	23.8	616
1440 min Winter	5.616	0.0	26.0	878
2160 min Winter	4.082	0.0	28.4	1236
2880 min Winter	3.251	0.0	30.1	1588
4320 min Winter	2.355	0.0	32.8	0
5760 min Winter	1.871	0.0	34.7	0
7200 min Winter	1.568	0.0	36.3	0
8640 min Winter	1.357	0.0	37.7	0
10080 min Winter	1.200	0.0	39.0	0

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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.900	Shortest Storm (mins)	15
Ratio R	0.355	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.023

Time (mins) From:	To:	Area (ha)
0	4	0.023

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Model Details

Storage is Online Cover Level (m) 9.200

Cellular Storage Structure

Invert Level (m) 8.100 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	52.0	52.0	0.400	0.0	62.2
0.300	52.0	62.2			

Orifice Outflow Control

Diameter (m) 0.026 Discharge Coefficient 0.600 Invert Level (m) 8.030

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Project **Crescent Place, Storrington Road**

Project ref **12303**

Revision **A**
Date **24.04.24**

Tank - Anti-Flotation Calculation

Tank	**Calc 1**	**Calc 2**	
Tank Area at base (m2)	52.400	52.400	
Ground Level (mAOD)	42.000	42.000	
Top GW level(m AOD)	41.100	41.500	*Obtain groundwater level from soil report*
Top of Tank Level (mAOD)	41.525	41.525	
Base of Tank level(m AOD)	41.300	41.300	
Depth of water table above tank (m)	0.000	0.000	
Depth of Tank within Water table (m)	-0.200	0.200	
Depth of Tank (m)	0.225	0.225	
Ballast thickness below tank(m)	0.000	0.000	*Start with an assumed ballast depth, then adjust if FoS is less than 1.1*
Depth of cover over tank (m)	0.475	0.475	
Displacement depth below water table(m)	-0.200	0.200	
Volume for buoyancy (m^3)	-10.480	10.480	
Tank Buoyancy force (kN)	**-102.809**	**102.809**	*9.81kN/m^3 for water. Positive figure denotes uplift force, negative figure denotes downward force*
			Note: If a negative figure is shown above for tank buoyancy then no ballast is required
Ballast construction depth (m)	0.000	0.000	
Ballast downward force (kN)	0.000	0.000	*Unsaturated Clay = 1900Kg/m3 or 18.64kN/m3 (Engineering Toolbox.com) - Adjust if different ballast used*
Total depth over tank (m)	0.475	0.475	
Topsoil downward force (kN)	123.402	123.402	*Density of Dry Topsoil = 1600 Kg/m3 = 15.7kn/m3. Nominal 150mm depth (Adjust if different surfacing)*
Fill soil downward force (kN)	267.371	267.371	*Density of Dry soil = 1600 Kg/m3 = 15.7kn/m3 (Adjust if different backfill)*
Downward anchor forces (kN)	390.773	390.773	
Net Buoyancy Force	493.582	287.964	*Negative figure denotes uplift force, positive figure denotes downward force*
Factor of safety	N/A	3.8	*minimum acceptable value: 1.1*
	N/A	OK	

Assumed dry (liner below ballast)

Indicates field to be completed

V5 - 08.4.24

Appendix G

Drainage Maintenance and Management Plan

Maintenance Responsibilities

It is the overarching responsibility of the **site owner** to ensure the Drainage Infrastructure is maintained in accordance with this Maintenance Plan.

The responsibility of maintenance, repair, renewal and replacement of the surface water drainage system will be the property owner's. These arrangements will be administered in the Transfer Document TP1 at the point of sale with the responsibilities transferring to the successors in title.

Contamination or Dilution of Spillage

The Environment Agency would prefer all spillages to be contained to prevent any downstream contamination. However, this cannot always be achieved, depending on the nature of the spillage. In all circumstances involving the spillage of substances it is important that the Environment Agency are notified as soon as possible so that they can provide advice and take appropriate action.

Prompt action following a spillage can prevent or reduce its effects, whilst inappropriate action may cause or worsen the pollution effects.

In the event of a spillage on site it is the responsibility of the freeholders to clear up any spillage before it enters the drainage system. The primary method of dealing with any spillage of Hydrocarbons should be to use sand to soak up the leak and prevent any Hydrocarbons entering the drainage system. Once sand has been contaminated it should not be washed into the drainage system but disposed of by a Licensed Contractor.

Environment Agency – Emergency Contact Number
In the event of a spillage the Environment Agency should be contacted to notify the event and seek advice. The Environment Agency's Incident Hotline is **0800 80 70 60** (Freephone 24hrs).

Health and Safety

All those responsible for and involved in the maintenance of the site drainage systems should be safety-conscious and comply with the relevant health and safety legislation. This includes:

- The Health and Safety at Work etc Act 1974
- The Management of Health and Safety at Work Regulations 1999
- The Workplace (Health, Safety and Welfare) Regulations 1992

The freeholder is responsible for suitable risk assessment and management to ensure safe working conditions and practices. Measures to protect potential visitors also need to be considered.

Specialist contractors used should work to industry guidelines and be able to demonstrate safe working practices.

Employers have a duty to employees to inform them about the risks of their work environment and to decrease the risk as far as reasonably practicable. Appropriate personal protective equipment (PPE) should be provided and policies implemented based on risk assessment.

Operatives should be trained for working near water. Risks of contaminated water should be considered. Checking for open cuts and using nitrile gloves, waterproof plasters etc is advised.

Entry of pipes, chambers, tanks and culverts should be avoided wherever possible. Work should be carried out from the surface using appropriate equipment. In the event that entry cannot be avoided to perform a critical task, the required safety training, protection measures and precautions must be implemented prior to entry. Lone working should never be attempted.

For further information refer to Section 36 of The SuDS Manual (CIRIA C753).

Riparian Responsibilities – Maintenance of the Ordinary Watercourse

There are legal duties regarding Ordinary Watercourses that should be reviewed and understood.

Inspection Frequency and Maintenance Requirements: as per table below.

Schedule	**Action**	**Frequency**
Regular Maintenance	Litter and debris removal	Monthly
	Cut back vegetation, remove cuttings	Annually between September and March; trim alternate banks each year
Occasional Maintenance	Silt removal from ditch bed including culverts	Rolling programme over 3 years
Remedial Actions	Repair erosion damage, re-seed bare patches on banks	As required
	Clear blockages	As required
	Repair culverts and headwall structures	As required

Monitoring	Inspect culverts for blockages and any damage CCTV survey of long or multi-directional culverts	Monthly 5 years

Safety: The dynamic nature of open and culverted watercourses means that risk should be assessed on a case-by-case basis. Appropriate clothing and protective wear should be worn by all involved in the maintenance. High visibility jackets are recommended when carrying out maintenance near a road.

Works that affect the highway require a temporary Traffic Regulation Order (TRO) from the local Highway Authority Council and adequate notice to be given to the travelling public. The increased risk of working near a road will need to be considered.

Culvert entry should be avoided. Works should be carried out from the surface using appropriate equipment.

Environmental laws may also apply depending on the habitat at each location.

The riparian ownership boundaries of this watercourse should also be understood so that work does not take place on 3rd party land without prior agreement.

Drains, Manholes, Gullies, Silt Catchpits

Regular inspection/maintenance is required to ensure the effective long-term operation of private drains, manholes, gullies & silt pits.

Check hydrobrake orifice is clear and retention tank door is closed. Check function of retention tank door and oil if necessary.

Operation and maintenance requirements for drains, gullies and silt pits are described in the following table:

Schedule	Action	Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action. Debris removal from gullies & silt pits, channel drains (where may cause risks to performance). Lift and inspect receiving manholes to check for any blockages. **Particular attention should be given to the control manhole containing the flow control device**	6 Monthly intervals Weekly Six-monthly

Remedial Actions	Repair any damaged gully gratings or manhole covers Replace / fix any loose channel drain covers	As required As required
Monitoring	Carry out full CCTV survey to confirm ongoing integrity of all drains. Inspect all gullies and silt pits & drainage channels during the survey	10-yearly intervals

Inspection of manholes and removal of silt from silt catchpits should be undertaken by a specialist contractor.

Attenuation Cellular Storage Tanks

Make: Modular tanks – manufacturer to be determined

Inspection Frequency: Annually

Product Function: Rainwater storage.

Maintenance Requirements: Carry out periodic removal of particulate material from connecting catchpit and channel outlet sumps in accordance with manufacturer's Technical Data to ensure the crates do not become blocked and ineffective.






Civil Engineering - Transport Planning - Flood Risk

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