

 T J Booth Associates. Consulting Engineers 20A Eastgate St, Rochdale OL16 1DH	Project 2 War Office Road, Bamford				Job Ref. rep-tjba-rostron-2 war office rd-DSR-270622	
	Section DRAINAGE STRATEGY REPORT				Sheet no./rev. 1 / 0	
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History.

Revision	Date	Reason
0	July 2022	Original to support planning application.
1	Sept 2024	Updated following LLFA consultation, dwg & calcs rev1.

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Introduction.

Reference:

As part of a planning application for residential development, a Drainage Strategy Report is required to address issues regarding sustainable drainage principles for the proposed development.

The original Drainage Strategy Report was undertaken in July 2022.

The detailed drainage design was completed in March 2024.

In August 2024, the LLFA published a drainage consultation for the Site which recommended the following:

DRAINAGE OFFICER & FLOOD OFFICER SUMMARY:

- I. Further investigation of infiltration feasibility is required.
- II. Further investigation of more sustainable outfall options are required.
- III. More robust flow controls should be assessed.
- IV. Hydraulic design should be provided
- V. Surface based SuDS components should be incorporated within the design.
- VI. The above points should be reviewed / addressed before the condition can be discharged.

Purpose of Report:

The primary purpose of this report is to identify specific drainage proposals for parts of the proposed site in accordance with the national drainage hierarchy for surface water disposal & exceedance characteristics, also considering the proposed end adopters and their requirements.

Regarding site assessment, this report will appraise the existing site and local drainage infrastructure, assess the suitability of the proposed development, giving recommendations for drainage design & management, specifically for approval of the LLFA/EA/sewerage undertakers, as applicable.

General principles:

Drainage from new developments is to be designed to follow the national drainage hierarchy for surface water discharge to the following networks in order of preference:

- *infiltration*
- *watercourse*
- *public sewer*

Flow rates (existing & proposed) are to be estimated for approval using the following methodology:

- *Development should aim to deliver greenfield runoff on greenfield sites up to a 100yr rainfall event, considering climate change.*
- *Development should aim for a minimum reduction in surface water runoff rates of 50% for brownfield sites on a 1yr rainfall event.*
- *Development should be designed so that there is no flooding to the development in a 30yr event and so that there is no property flooding in a 100yr event considering climate change.*

Plans.

Location Plan.

Refer to the appended Location Plan.

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The Site is within a residential area with some immediate local amenities, such as shops, public houses, and sports facilities.

The closest open watercourse is the River Roch approximately 350m southeast.

Site Plan.

The overall pre-development Site comprised a residential bungalow, nominally central to the plot. The Site entrance is off War Office Road.

The external areas were made up of pcc pavements to surrounding pathways/patios, all drained to surface water gullies, and the remainder of the Site comprising a predominantly gravel finish with some turf/vegetated verges.

The predevelopment areas are:

- *Total area* 780 sqm.
- *Roof area (impermeable)* 100 sqm.
- *Hardstanding area (impermeable)* 220 sqm.
- *Soft landscaped area (permeable)* 460 sqm.

The proposal is for 3No. detached 3 storey (room in the roof) masonry residential dwellings. The existing access to the Site from War office Road will be closed and new access points made from the adjacent Arnside Drive to driveways within the property boundary.

The proposed areas are:

- *Total area* 780 sqm.
- *Roof area (impermeable)* 230 sqm.
- *Hardstanding area (permeable)* 220 sqm.
- *Soft landscaped area (permeable)* 330 sqm.

Desk Surveys & Investigations.

Existing and proposed topography.

A topographic survey has been undertaken and indicated the following levels:

Northwest Site corner/Arnside Rd: 140.65maOD.

Northeast Site corner/Arnside Rd: 141.18maOD.

Southwest Site corner: 140.55maOD.

Southeast Site corner: 140.80maOD.

The land surrounding the Site is higher held by retaining walls.

Bury Road to the south is approximately: 141.20maOD.

No.2 Arnside Road to the east side is approximately: 142.20maOD.

The overall natural fall of the area is to the southwest.

BGS Geology.

Geological maps of the local area suggest the Site is underlain by glacial till/boulder clay.

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Borehole Records.

There were no relevant boreholes within close proximity to the Site.

Trial Hole Site Investigations 29.02.2024.

A subsequent site investigation was undertaken on 29.02.2024 and comprised 4No. machine excavated trial holes (THs 1-4).

On-site geology comprised mixed ground, generally with an upper silty occasionally sandy MADE GROUND (including brick, stone, occasional ash etc) to between 500mm to 1m depth. Below the MADE GROUND was varying depths of CLAY to the rear of the Site, and clayey SAND/SAND & GRAVEL to a depth of 2.4m at the front of the Site adjacent Arnside Road.

CLAY generally had mixed strength, with soft, soft to firm, and stiff noted at varying depths over the Site. In trial holes 3 & 4, CLAY was soft-soft to firm, and in trial hole 4 a soft peaty CLAY was noted at between 1500-1700 deep).

Trial Hole Logs & the Site Investigation Plan are in the Appendix.

Soakaway Site Investigations 29.02.2024.

Following comments from the RMBC LLFA, two further trial holes were excavated to the Site front adjacent Arnside Road (Infiltration Test Hole 1), and to the Site rear adjacent Bury Road (Infiltration Test Hole 2). Refer to Site Investigation Plan & Photos in the Appendix.

The infiltration test holes were excavated to nominally to 1.5m deep, which would give a general depth assessment for the potential soakaway construction.

Infiltration Test Hole 1 was excavated to 1.5m bGL without groundwater being noted. Infiltration tests were undertaken in accordance with BRE365, and comprised 3 separate tests, and an infiltration test rate obtained. Pit and summary data including the design infiltration coefficient is tabulated below:

soakaway test		as per BRE Digest 365	
client	Rosbuild		
project	2 War Office Rd		
locn	Site front/Arnside Rd Infiltration Test Hole 2		
date	15-18 Sept 2024		
provide a clean vertical sided pit or trench			
pit length	0.9	m	
pit width	0.7	m	
pit depth b GL	1.5	m	
pit equiv dia	0.2	m	
pit base area	0.585	sqm	
TEST	DATE	INFILTRATION RATE	
		m/s	m/hr
TEST 1	15th Sept 2024	2.4E-06	8.8E-03
TEST 2	17th Sept 2024	8.4E-05	3.0E-01
TEST 3	18th Sept 2024	7.0E-06	2.5E-02
Design infiltration rate		3.1E-05	1.1E-01

Infiltration Test Hole 2 was excavated, and groundwater was noted seeping into the hole from around 1400 deep. The hole was filled but it didn't drain and so was abandoned. The rear of the Site is not considered suitable for infiltration due to CLAY geology, as noted in the original trial hole investigation.

The rear of the Site is generally considered unsuitable for soakaways.

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United Utilities Records.

United Utilities (UU) records indicated only combined sewers locally. There is a non UU surface water MH/sewer in the verge of War Office Road which is shown to flow into Bury Road as per the UU plan below.



The LLFA Officer requested that the sewer be assessed to see if it flows closer to the Site.

The manhole at the head of the system (labelled H/S circled above) was accessed in order to be surveyed by a 3rd party drainage surveyor. The MH cover was lifted and after attempts to be jetted were unsuccessful, the surveyor indicated that the sewer was unable to be surveyed (ref email below).

From: Jon Bradshaw <Jon@fp-drains.co.uk>
Sent: Monday, September 30, 2024 6:00:47 pm
To: steverostron@outlook.com <steverostron@outlook.com>
Subject: War office Road/bury road

We have been instructed to carry out a cctv survey on a surface water drain on the corner of war office road/Bury road to determine its suitability for the development opposite. Due to a significant amount of silt, we were unable to carry out a survey.

Jon Bradshaw




Director of Fp Drain-Force Ltd
 Email: Jon@fp-drains.co.uk
 Contact Telephone : 03302990999
 Mobile: 07516024000

The manhole showed an inlet to the north side of the MH, however the direction was towards the Winston Churchill/Foresters Site, and not further towards the Development Site. Historic overlays of the area (above) suggest this is a redundant & historic connection from cottages demolished on the Winston Churchill Site c1960.

Due to the information obtained, it is not considered that this is a suitable connection.

Assessments.

Flood zone category.

Refer to the .gov flood maps appended. The Site is within Food Zone 1, ie a LOW probability of flooding.

Watercourses – No risk from watercourses in the local area.

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Surface water – Current maps show there is some minor flooding of surface water outside of the Site on War Office Road which is the low point in the local area. There is potential for on-site flooding if proposed levels are too low.

Canals/Artificial Water Bodies – No risk.

Reservoirs – Not known to be a risk.

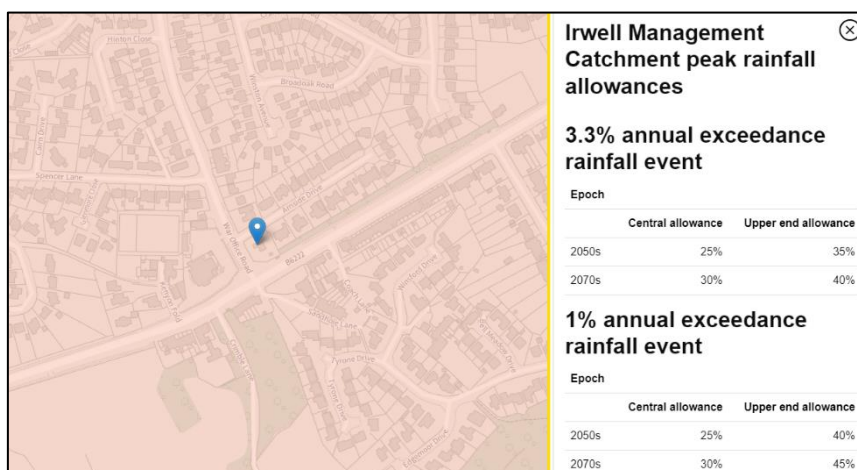
Climate change impacts.

Climate change allowances allow for uncertainty in the climate model, and the resultant change assumed through time. Allowances are thus related to the type of development and the potential lifetime expected of such development as per the Environment Agency table below:

Guidance suggests residential developments should be assessed against the '2070s' lifetime & the upper end 95th percentile exceedance estimates, which result in the following climate change allowances:

30yr rainfalls +40% climate change.

100yr rainfalls +45% climate change.



Existing surface water system.

The Site formerly comprised a nominal 320 sqm of impermeable area with a proven on-site connection to the local UU combined system.

The existing Site has been assessed using the Modified Rational Method in order to estimate pre-existing runoff flow rates.

MODIFIED RATIONAL METHOD					
Client:	Rosbuild				
Site:	2 War Office Road, Rochdale				
Element:	EXISTING RUNOFF ESTIMATE TO UU SEWER.				
PEAK RUNOFF RATE ESTIMATION					
in accordance with CIRIA C753, pgs 519-520, EQ. 24.5					
modified rational method		$Q = 2.78 C i A$	return period (Tr)	rainfall mintensity (mm/hr)	runoff rate (l/s)
site area:	320 sqm		1yr	19.10	1.70
	0.032 Ha		30yr	47.10	4.19
volumetric runoff coefficient Cv:	1		100yr	61.80	5.50
dimensionless routing coefficient Cr:	1		30yr+40%	65.94	5.87
runoff coefficient C (Cv x Cr):	1		100yr+45%	89.61	7.97
rainfall intensity assumptions:					
1yr rainfall	19.1 mm/hr	synthetic 2yr TEDDS calculation			
30yr rainfall	47.1 mm/hr	constant lower intensity estimation, CIRIA C753			
100yr rainfall	61.8 mm/hr	constant upper intensity estimation, CIRIA C753			
development type	residential	enter commercial or residential			
30yr rainfall climate change allowance	40 %		0.4	ratio	
100yr rainfall climate change allowance	45 %		0.45	ratio	

Pass Forward Flow Rates:

The existing 1yr brownfield flow rate is <5l/s. It is normal practice to limit restriction to a max 5l/s to avoid blockages at unnecessarily low flow rates.

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Because of this, the pass forward flow rate from the Site to any discharge point should be restricted to max 5l/s for surface water discharge only.

Proposed Surface Water System.

Following the guidance of hierarchy for disposal of surface water (SUDS):

- **INFILTRATION:**

Building regulations indicate all soakaways must be at least 5m from foundation lines.

To the rear of the Site there is room beyond 5m of the proposed foundation line to easily construct soakaways, however, this area was found to be unsuitable for infiltration with shallow groundwater noted and clay soils, and subsequently an attempt to obtain an infiltration coefficient was abandoned.

Another infiltration test was undertaken at the front of the proposed Site, and although the soakaway test was successful, the coefficient of $3 \times 10^{-5} \text{ms}^{-1}$ obtained for design is at the lower end of soakaway suitability.

While it was attempted to design a soakaway in this area for the roof areas only using this infiltration coefficient, the limited amount of space available and relatively low infiltration rate meant it was impossible to design a soakaway large enough to contain the water volumes required, without undermining the highway; and for these reasons a soakaway isn't suitable for discharge of roof rainwater.

It is however proposed to infiltrate all external areas in direct contact with the ground surface including patios & driveways via a permeable paving system. The permeable paving system will reduce the area and volume of rainfall that would otherwise have to discharge via other methods.

However, the roof areas will have to drain by the next available method.

- **WATERCOURSE:**

There are no suitable watercourses for the discharge and connection of Site surface water. All are distant or redundant.

- **SW SEWER:**

There are no suitable surface water sewers in the local area.

- **COMBINED SEWER:**

The Site has an existing connection to the combined sewer. It is proposed to use this for roof derived rainwater only. Due to the relatively small area of the roofs, attenuation crates and flow control have been designed to ensure the 100yr+cc rainfall event is stored on Site discharging at no more than 5l/s.

To ensure blockages do not occur, the flow control has been designed using a hydrobrake.

Proposed Foul Water System.

Foul water flows from the proposed development will need to be kept separate from surface water flows, and combined in the last manhole on Site and discharging to public combined sewer.

Additional Recommendations.

There is a minor flood risk around the current Site entrance where it meets War Office Road, which is the Low point of the area on the development side of Bury Road.

The proposed FFL of plot 1 submitted with the planning application is considered too low and leaves the external area around the building in a hollow compared to its surrounding levels. The level as currently proposed presents a risk of surface water flooding should the gullies on War Office Road block or fail.

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It is proposed to increase plot 1 to 140.975maOD to ensure external levels are not lower than 140.825maOD. This external level can then tie in to the existing surrounds removing any risk.

To recap the objections by the LLFA and to show that we have complied with requests, a summary is provided below:

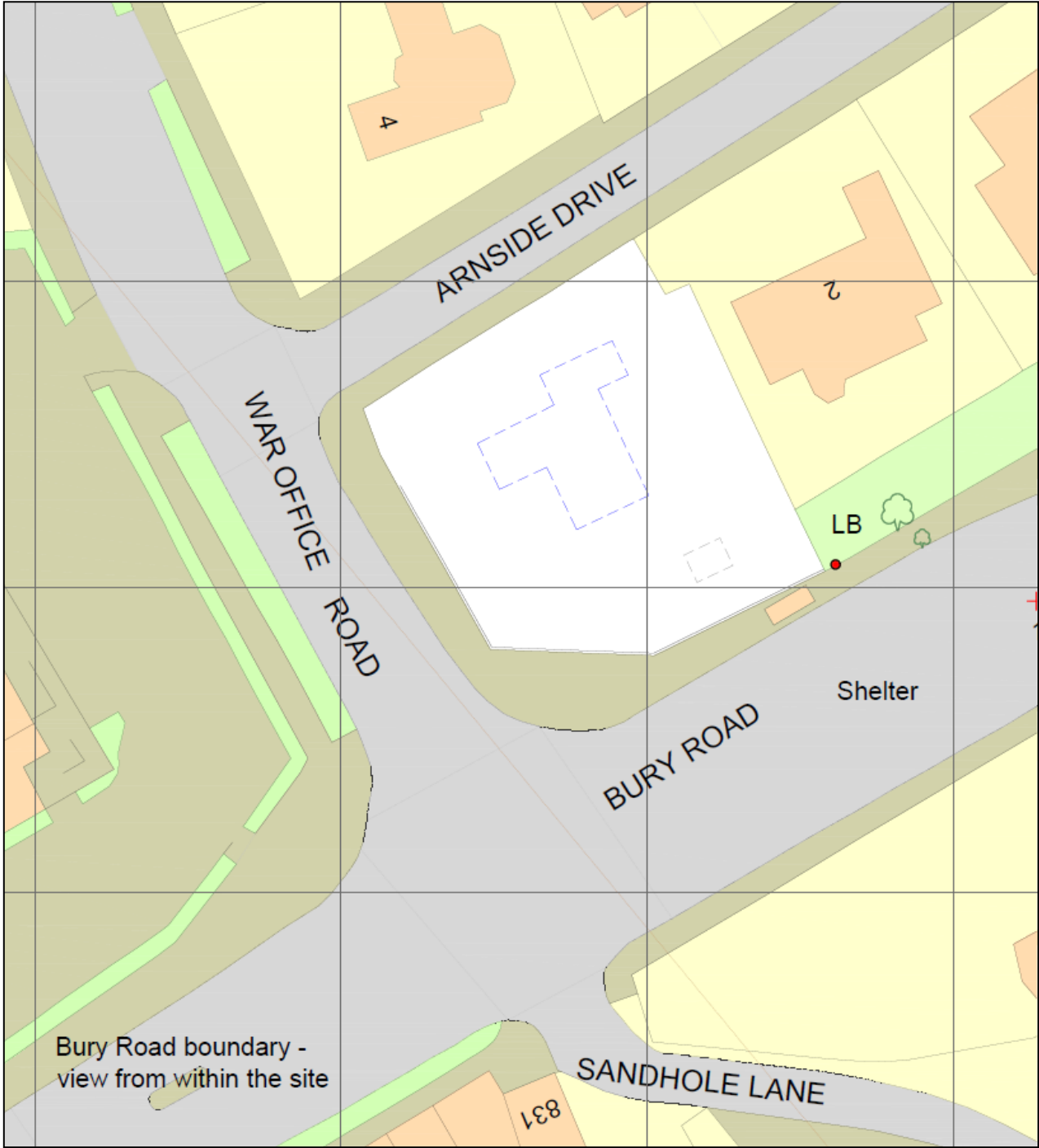
- I. Further investigation of infiltration feasibility is required.
Infiltration tests have been undertaken and found not to be suitable for the Site.
- II. Further investigation of more sustainable outfall options are required.
The surface water sewer has been assessed and found to flow no closer to the Site. It appears to be a redundant historic connection.
- III. More robust flow controls should be assessed.
A hydrobrake has been included as a flow control as requested.
- IV. Hydraulic design should be provided.
Hydraulic design in the Appendix.
- V. Surface based SuDS components should be incorporated within the design.
Permeable paving has been incorporated for all areas in direct contact with the ground surface.
- VI. The above points should be reviewed / addressed before the condition can be discharged.

This report should be submitted to the LLFA as part of planning condition discharge.

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Appendix.

Location Plan.



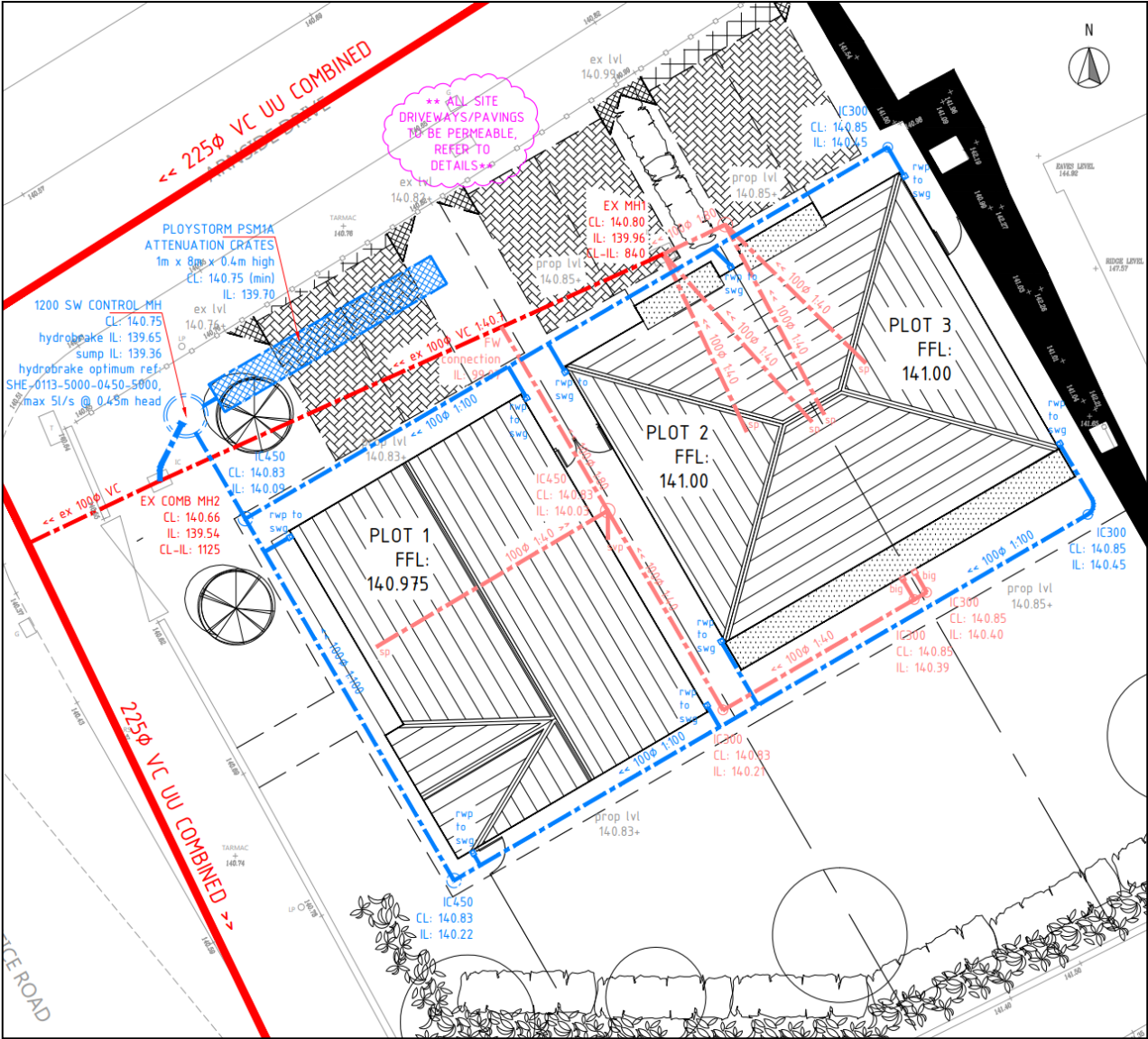
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Proposed Site Plans



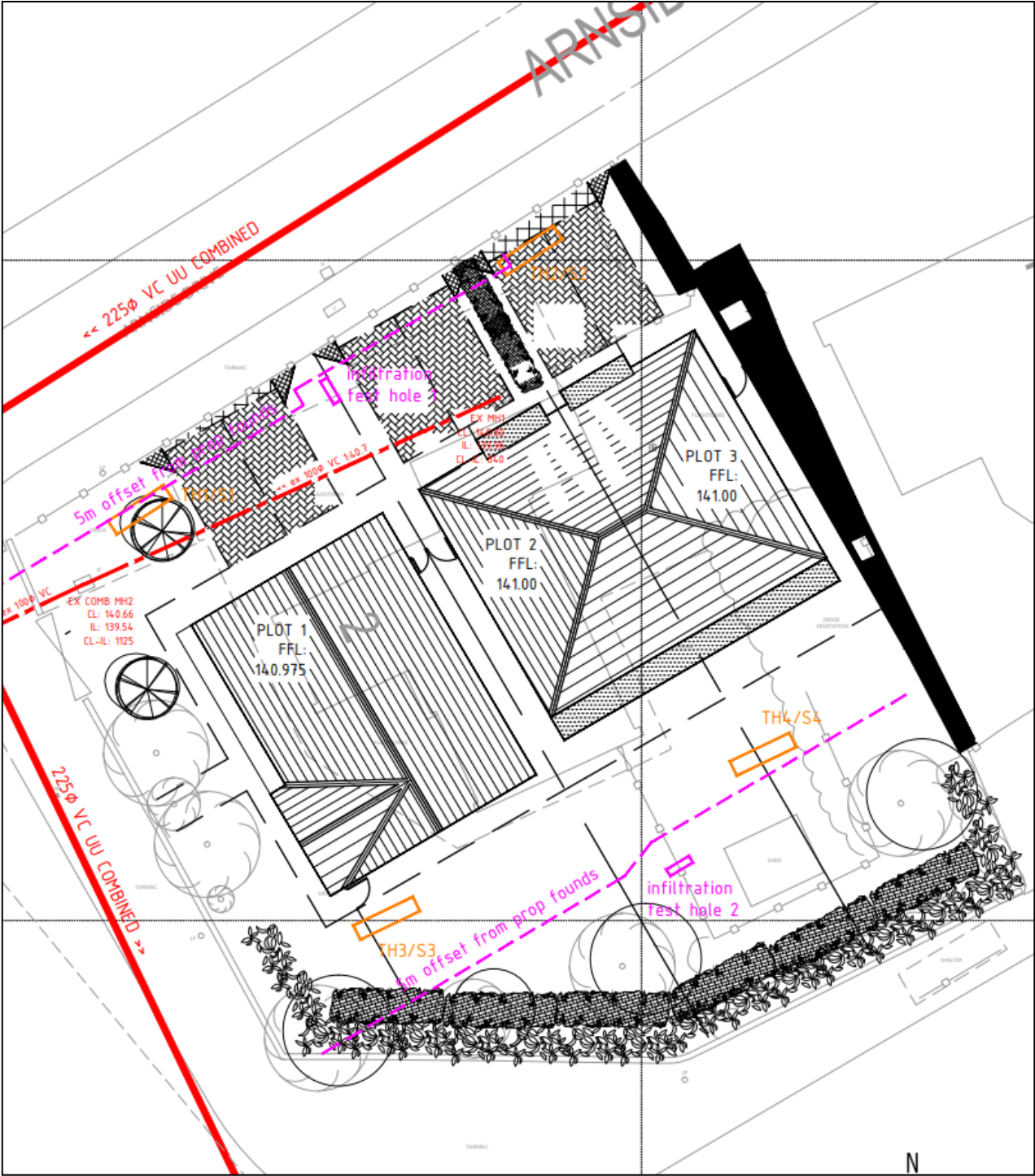
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Proposed Drainage Plan (Excerpt)



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Site Investigation Plan, Trial Hole Logs & Photos.



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Trial pit reference TH1					Sheet 1 of 1
Water	Reduced Level (m)	Legend	Depth (m)	Description	
	100.00				
	99.95	X X	0.05	Dark brown silty topsoil MADE GROUND	
	99.55	X X X X	(0.40) 0.45	Dark brown-blue/grey fine sand & gravel MADE GROUND. Sand & gravel is brick, stone, ash, mortar. (S1)	
	99.05	- - - - - - - - - - - - - - -	(0.50) 0.95	Soft to firm brown-dark brown slightly sandy CLAY (suspect MADE GROUND with occasional fine gravel of brick)	
<u>v</u>	97.90 97.85	X - X - - X - X - X - X - - X - X - X - X - - X - X -	(1.20) 2.15	Medium dense to dense orange-brown/grey mottled very clayey SAND & GRAVEL. Gravel is sandstone & shale.	
	97.70	- - - - -	2.30	Firm brown very sandy CLAY	
				Trial pit ends	
Not shown to scale					
Additional notes: GW noted at 2150.					



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Trial pit reference TH2					Sheet 1 of 1
Water	Reduced Level (m)	Legend	Depth (m)	Description	
	100.00				
	99.95	X X	0.05	Dark brown silty topsoil MADE GROUND	
	99.50	X X X X X X	(0.45) 0.50	Dark brown/black sandy, very gravelly MADE GROUND. Gravel is brick, stone, ash, slate etc. Occasional cobbles of brick & stone. (S2)	
	99.05	- - - - - - - - - - - - - - -	(0.45) 0.95	Stiff orange-brown/grey mottled sandy CLAY	
<u>v</u>	98.60 98.55	- - - - - - - - -	(0.50) 1.45	Medium dense orange/brown fine to medium SAND (occasionally clayey).	
	98.15	- - - - - -	(0.40) 1.85	Stiff orange-brown CLAY	
	97.60	- o - o - o - o - o - o - o -	(0.55) 2.40	Medium dense to dense orange-brown SAND AND GRAVEL (sand & gravel is sandstone & shale).	
				Trial pit ends	
Not shown to scale					
Additional notes: GW noted at 1450.					



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Trial pit reference TH3					Sheet 1 of 1
Water	Reduced Level (m)	Legend	Depth (m)	Description	
	100.00				
	99.50	X X X X X X	(0.50) 0.50	Dark brown occasionally clayey gravel & cobbles MADE GROUND. Gravel is quartz with rare sandstone. Abundant rootlets. (S3)	
<u>v</u>	99.35 99.05	X X X X X X	(0.45) 0.95	Loose occasionally clayey coarse gravel & cobbles MADE GROUND. Gravel/cobbles are stone, brick & ash. NOTE DEPTH IS ONLY AN ESTIMATE DUE TO GROUND WATER IN TRIAL HOLE.	
	98.40	X o X o o X o X X o X o o X o X	(0.65) 1.60	Soft-soft to firm black slightly gravelly CLAY. NOTE DEPTH IS JUST AN ESTIMATE DUE TO GROUNDWATER IN TRIAL HOLE.	
	98.20	X o X o o X o X	(0.20) 1.80	Very soft-soft orange-brown/grey mottled gravelly CLAY. NOTE DEPTH IS JUST AN ESTIMATE DUE TO GROUNDWATER IN TRIAL HOLE.	
				Trial pit ends	
Not shown to scale					
Additional notes: Heavy influx of GW at 650 deep. Hole was filled with water throughout excavation.					



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Trial pit reference TH4					Sheet 1 of 1
Water	Reduced Level (m)	Legend	Depth (m)	Description	
	100.00				
		X X X X X X	(0.60) 0.60	Firm orange-brown gravelly clay MADE GROUND. (S4)	
v	99.15 99.10	: o : o : o : o : o	(0.30) 0.90	Loose to medium dense light brown slightly clayey SAND AND GRAVEL Gravel is sandstone & shale.	
		- o - o - o - o - o - o - o -	(0.60) 1.50	Soft black/grey slightly gravelly CLAY	
	98.30	- - -	1.70	Soft brown peaty CLAY	
		- : - : - : : - : - : - - : - : - :	(0.60) 2.30	Soft to firm grey very sandy CLAY becoming firm at approx 2000.	
	97.70	- : - : - : : - : - : - - : - : - :			
				Trial pit ends	
Not shown to scale					
Additional notes: GW noted seeping at 900.					



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Infiltration Test Hole 1/Front of Site/Arnside Rd.



Infiltration Test Hole 2/Rear of Site/Bury Rd.



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Infiltration Test Calculations.

soakaway test

as per BRE Digest 365

client

Rosbuild

project

2 War Office Rd

locn

Site front/Armside Rd Infiltration Test Hole 2

date

15-18 Sept 2024

provide a clean vertical sided pit or trench

pit length

0.9

m

pit width

0.7

m

pit depth b GL

1.5

m

pit equiv dia

0.2

m

pit base area

0.585

sqm

TEST

DATE

INFILTRATION RATE

m/s

m/hr

TEST 1

15th Sept 2024

2.4E-06

8.8E-03

TEST 2

17th Sept 2024

8.4E-05

3.0E-01

TEST 3

18th Sept 2024

7.0E-06

2.5E-02

Design infiltration rate

3.1E-05

1.1E-01

test 1

15th Sept 2024

time

duration

depth from GL

depth from base

depth from wt

% depth

wetted area

volume cum

hr

min

mins

m

m

m

sqm

cu m

13

40

0

0.5

1

100

3.7

0.6

13

50

10

0.55

0.95

95

3.5

0.6

14

0

20

0.59

0.91

91

3.4

0.5

14

10

30

0.625

0.875

88

3.3

0.5

14

30

50

0.65

0.85

85

3.2

0.5

14

50

70

0.66

0.84

84

3.2

0.5

15

10

90

0.68

0.82

82

3.1

0.5

15

30

110

0.69

0.81

81

3.1

0.5

15

50

130

0.7

0.8

80

3.1

0.5

16

20

160

0.71

0.79

79

3.0

0.5

40

20

1600

1.5

0

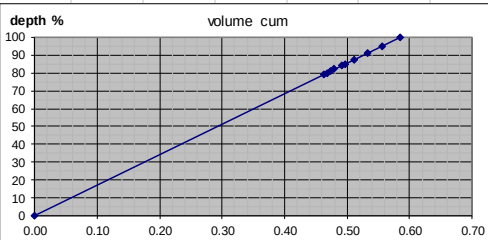
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0.6

0.0

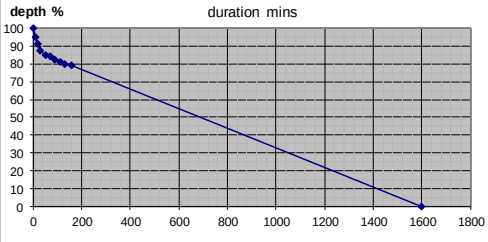
depth %

volume cum



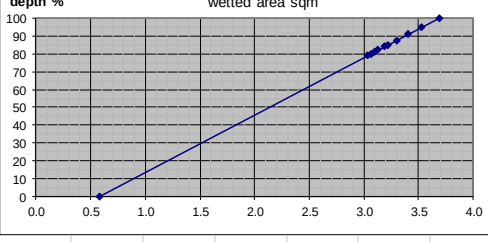
depth %

duration mins



depth %

wetted area sqm



from charts

V75

0.44

cu m

volume @ 75% depth

V25

0.15

cu m

time @ 75% depth

t75

220

mins

time @ 25% depth

t25

1140

mins

pit surface area @ 50% depth

Ap50

2.15

sq m

infiltration rate

f

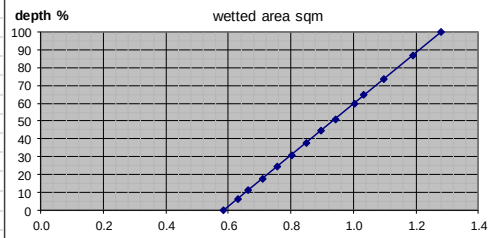
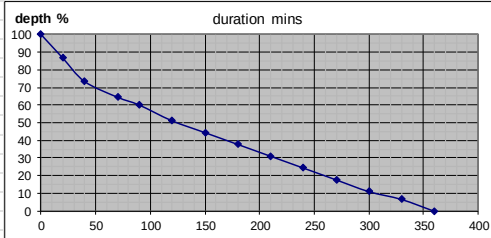
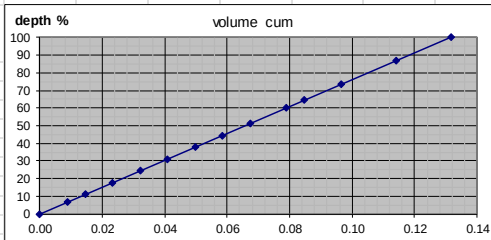
2.4E-06

m/s

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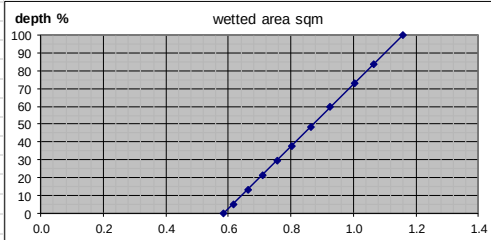
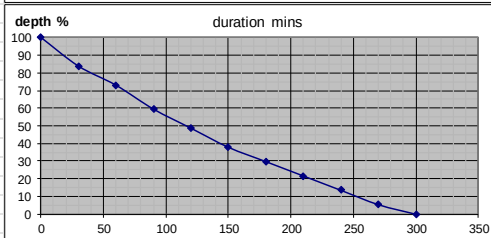
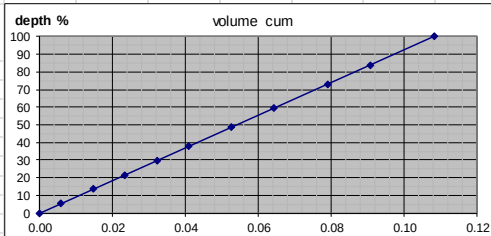
test 2		17th Sept 2024									
hr	min	duration mins	depth from GL m	depth from base m	depth from wt m	% depth	wetted area sqm	volume cum			
9	0	0	0.48	1.02	0.225	100	1.3	0.1			
9	20	20	0.51	0.99	0.195	87	1.2	0.1			
9	40	40	0.54	0.96	0.165	73	1.1	0.1			
10	10	70	0.56	0.94	0.145	64	1.0	0.1			
10	30	90	0.57	0.93	0.135	60	1.0	0.1			
11	0	120	0.59	0.91	0.115	51	0.9	0.1			
11	30	150	0.605	0.895	0.1	44	0.9	0.1			
12	0	180	0.62	0.88	0.085	38	0.8	0.0			
12	30	210	0.635	0.865	0.07	31	0.8	0.0			
13	0	240	0.65	0.85	0.055	24	0.8	0.0			
13	30	270	0.665	0.835	0.04	18	0.7	0.0			
14	0	300	0.68	0.82	0.025	11	0.7	0.0			
14	30	330	0.69	0.81	0.015	7	0.6	0.0			
15	0	360	0.705	0.795	0	0	0.6	0.0			

volume @ 75% depth	V75	0.98	cu m
volume @ 25% depth	V25	0.034	cu m
time @ 75% depth	t75	35	mins
time @ 25% depth	t25	235	mins
pit surface area @ 50% depth	Ap50	0.94	sq m
infiltration rate	f	8.4E-05	m/s



test 3		18th Sept 2024									
hr	min	duration mins	depth from GL m	depth from base m	depth from wt m	% depth	wetted area sqm	volume cum			
8	45	0	0.5	1	0.185	100	1.2	0.1			
9	15	30	0.53	0.97	0.155	84	1.1	0.1			
9	45	60	0.55	0.95	0.135	73	1.0	0.1			
10	15	90	0.575	0.925	0.11	59	0.9	0.1			
10	45	120	0.595	0.905	0.09	49	0.9	0.1			
11	15	150	0.615	0.885	0.07	38	0.8	0.0			
11	45	180	0.63	0.87	0.055	30	0.8	0.0			
12	15	210	0.645	0.855	0.04	22	0.7	0.0			
12	45	240	0.66	0.84	0.025	14	0.7	0.0			
13	15	270	0.675	0.825	0.01	5	0.6	0.0			
13	45	300	0.685	0.815	0	0	0.6	0.0			

volume @ 75% depth	V75	0.08	cu m
volume @ 25% depth	V25	0.028	cu m
time @ 75% depth	t75	55	mins
time @ 25% depth	t25	195	mins
pit surface area @ 50% depth	Ap50	0.88	sq m
infiltration rate	f	7.0E-06	m/s



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Proposed Drainage Design/Attenuation Calculations.

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Micro Drainage	Source Control W.10.4	

Summary of Results for 1 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
360 Winter	0.6	0.6	139.7000	0.0000	0.0	O K
480 Winter	0.5	0.5	139.7000	0.0000	0.0	O K
600 Winter	0.4	0.4	139.7000	0.0000	0.0	O K
720 Winter	0.4	0.4	139.7000	0.0000	0.0	O K
960 Winter	0.3	0.3	139.7000	0.0000	0.0	O K
1440 Winter	0.2	0.2	139.7000	0.0000	0.0	O K
2160 Winter	0.2	0.2	139.7000	0.0000	0.0	O K
2880 Winter	0.2	0.2	139.7000	0.0000	0.0	O K
4320 Winter	0.1	0.1	139.7000	0.0000	0.0	O K
5760 Winter	0.1	0.1	139.7000	0.0000	0.0	O K
7200 Winter	0.1	0.1	139.7000	0.0000	0.0	O K
8640 Winter	0.1	0.1	139.7000	0.0000	0.0	O K
10080 Winter	0.1	0.1	139.7000	0.0000	0.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
360 Winter	4.21	0
480 Winter	3.50	0
600 Winter	3.03	0
720 Winter	2.70	0
960 Winter	2.25	0
1440 Winter	1.73	0
2160 Winter	1.33	0
2880 Winter	1.11	0
4320 Winter	0.85	0
5760 Winter	0.71	0
7200 Winter	0.61	0
8640 Winter	0.54	0
10080 Winter	0.49	0

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Micro Drainage		
Source Control W.10.4		

Rainfall Details

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	1	Longest Storm (mins)	10080
M5-60 (mm)	20.000	Summer Storms	Yes
Ratio-R	0.300	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+0
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.024

Time	(mins)	Area
from:	to:	(ha)
0	4	0.024

 T J Booth Associates. Consulting Engineers 20A Eastgate St, Rochdale OL16 1DH	Project 2 War Office Road, Bamford				Job Ref. rep-tjba-rostron-2 war office rd-DSR-270622	
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Micro Drainage	Source Control W.10.4	

Tank/Pond Details

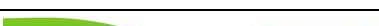
Invert Level (m) 139.700 Ground Level (m) 140.750

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.00	9.0	0.50	9.0	1.00	9.0	1.50	9.0	2.00	9.0	2.50	9.0
0.10	9.0	0.60	9.0	1.10	9.0	1.60	9.0	2.10	9.0		
0.20	9.0	0.70	9.0	1.20	9.0	1.70	9.0	2.20	9.0		
0.30	9.0	0.80	9.0	1.30	9.0	1.80	9.0	2.30	9.0		
0.40	9.0	0.90	9.0	1.40	9.0	1.90	9.0	2.40	9.0		

Depth / Flow Outflow Control

Invert Level of Control 139.650

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	3.9	0.80	5.6	2.00	8.0	4.00	11.3	7.00	15.0
0.20	5.0	1.00	5.7	2.20	8.4	4.50	12.0	7.50	15.5
0.30	4.7	1.20	6.2	2.40	8.8	5.00	12.6	8.00	16.0
0.40	4.7	1.40	6.7	2.60	9.1	5.50	13.3	8.50	16.5
0.50	5.2	1.60	7.1	3.00	9.8	6.00	13.8	9.00	17.0
0.60	5.4	1.80	7.6	3.50	10.6	6.50	14.4	9.50	17.4

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104 Yorkshire St

Rochdale

Lancashire OL16 1JY

SW attenuation

2 war office rd

bamford

Date mar 2024 revision1

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Micro Drainage

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Micro Drainage®

Summary of Results for 30 year Return Period (+40%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	5.0	5.0	139.8837	0.1837	1.7	O K
30 Summer	5.0	5.0	139.8867	0.1867	1.7	O K
60 Summer	4.9	4.9	139.8447	0.1447	1.3	O K
120 Summer	4.2	4.2	139.7777	0.0778	0.7	O K
180 Summer	3.7	3.7	139.7442	0.0443	0.4	O K
240 Summer	3.1	3.1	139.7292	0.0292	0.3	O K
360 Summer	2.4	2.4	139.7117	0.0118	0.1	O K
480 Summer	2.0	2.0	139.7012	0.0013	0.0	O K
600 Summer	1.7	1.7	139.7000	0.0000	0.0	O K
720 Summer	1.5	1.5	139.7000	0.0000	0.0	O K
960 Summer	1.2	1.2	139.7000	0.0000	0.0	O K
1440 Summer	0.9	0.9	139.7000	0.0000	0.0	O K
2160 Summer	0.7	0.7	139.7000	0.0000	0.0	O K
2880 Summer	0.6	0.6	139.7000	0.0000	0.0	O K
4320 Summer	0.4	0.4	139.7000	0.0000	0.0	O K
5760 Summer	0.3	0.3	139.7000	0.0000	0.0	O K
7200 Summer	0.3	0.3	139.7000	0.0000	0.0	O K
8640 Summer	0.2	0.2	139.7000	0.0000	0.0	O K
10080 Summer	0.2	0.2	139.7000	0.0000	0.0	O K
15 Winter	5.0	5.0	139.9132	0.2132	1.9	O K
30 Winter	5.0	5.0	139.8962	0.1962	1.8	O K
60 Winter	4.7	4.7	139.8217	0.1218	1.1	O K
120 Winter	3.7	3.7	139.7453	0.0453	0.4	O K
180 Winter	2.9	2.9	139.7233	0.0232	0.2	O K
240 Winter	2.4	2.4	139.7108	0.0108	0.1	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	68.99	12
30 Summer	47.08	20
60 Summer	30.81	36
120 Summer	19.53	66
180 Summer	14.75	94
240 Summer	12.05	124
360 Summer	9.05	186
480 Summer	7.38	244
600 Summer	6.29	0
720 Summer	5.52	0
960 Summer	4.49	0
1440 Summer	3.35	0
2160 Summer	2.49	0
2880 Summer	2.02	0
4320 Summer	1.50	0
5760 Summer	1.21	0
7200 Summer	1.03	0
8640 Summer	0.90	0
10080 Summer	0.81	0
15 Winter	68.99	13
30 Winter	47.08	22
60 Winter	30.81	38
120 Winter	19.53	66
180 Winter	14.75	96
240 Winter	12.05	126

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Summary of Results for 30 year Return Period (+40%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
360 Winter	1.8	1.8	139.7000	0.0000	0.0	O K
480 Winter	1.5	1.5	139.7000	0.0000	0.0	O K
600 Winter	1.2	1.2	139.7000	0.0000	0.0	O K
720 Winter	1.1	1.1	139.7000	0.0000	0.0	O K
960 Winter	0.9	0.9	139.7000	0.0000	0.0	O K
1440 Winter	0.7	0.7	139.7000	0.0000	0.0	O K
2160 Winter	0.5	0.5	139.7000	0.0000	0.0	O K
2880 Winter	0.4	0.4	139.7000	0.0000	0.0	O K
4320 Winter	0.3	0.3	139.7000	0.0000	0.0	O K
5760 Winter	0.2	0.2	139.7000	0.0000	0.0	O K
7200 Winter	0.2	0.2	139.7000	0.0000	0.0	O K
8640 Winter	0.2	0.2	139.7000	0.0000	0.0	O K
10080 Winter	0.2	0.2	139.7000	0.0000	0.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
360 Winter	9.05	0
480 Winter	7.38	0
600 Winter	6.29	0
720 Winter	5.52	0
960 Winter	4.49	0
1440 Winter	3.35	0
2160 Winter	2.49	0
2880 Winter	2.02	0
4320 Winter	1.50	0
5760 Winter	1.21	0
7200 Winter	1.03	0
8640 Winter	0.90	0
10080 Winter	0.81	0

 T J Booth Associates. Consulting Engineers 20A Eastgate St, Rochdale OL16 1DH	Project				Job Ref.	
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Micro Drainage	Source Control W.10.4	

Rainfall Details

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	30	Longest Storm (mins)	10080
M5-60 (mm)	20.000	Summer Storms	Yes
Ratio-R	0.300	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+40
Cv (Winter)	0.840		

Time / Area Diagram

Total Area (ha) = 0.024

Time	(mins)	Area
from:	to:	(ha)
0	4	0.024

 T J Booth Associates. Consulting Engineers 20A Eastgate St, Rochdale OL16 1DH	Project 2 War Office Road, Bamford				Job Ref. rep-tjba-rostron-2 war office rd-DSR-270622	
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Micro Drainage Source Control W.10.4		

Tank/Pond Details

Invert Level (m) 139.700 Ground Level (m) 140.750

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.00	9.0	0.50	9.0	1.00	9.0	1.50	9.0	2.00	9.0	2.50	9.0
0.10	9.0	0.60	9.0	1.10	9.0	1.60	9.0	2.10	9.0		
0.20	9.0	0.70	9.0	1.20	9.0	1.70	9.0	2.20	9.0		
0.30	9.0	0.80	9.0	1.30	9.0	1.80	9.0	2.30	9.0		
0.40	9.0	0.90	9.0	1.40	9.0	1.90	9.0	2.40	9.0		

Depth / Flow Outflow Control

Invert Level of Control 139.650

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	3.9	0.80	5.6	2.00	8.0	4.00	11.3	7.00	15.0
0.20	5.0	1.00	5.7	2.20	8.4	4.50	12.0	7.50	15.5
0.30	4.7	1.20	6.2	2.40	8.8	5.00	12.6	8.00	16.0
0.40	4.7	1.40	6.7	2.60	9.1	5.50	13.3	8.50	16.5
0.50	5.2	1.60	7.1	3.00	9.8	6.00	13.8	9.00	17.0
0.60	5.4	1.80	7.6	3.50	10.6	6.50	14.4	9.50	17.4

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

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m³)	Status
15 Summer	5.0	5.0	140.0072	0.3072	2.8	O K
30 Summer	5.0	5.0	140.0347	0.3347	3.0	O K
60 Summer	4.9	4.9	139.9948	0.2947	2.7	O K
120 Summer	5.0	5.0	139.8672	0.1672	1.5	O K
180 Summer	4.4	4.4	139.7992	0.0993	0.9	O K
240 Summer	4.0	4.0	139.7607	0.0608	0.5	O K
360 Summer	3.2	3.2	139.7323	0.0322	0.3	O K
480 Summer	2.6	2.6	139.7177	0.0178	0.2	O K
600 Summer	2.3	2.3	139.7077	0.0078	0.1	O K
720 Summer	2.0	2.0	139.7007	0.0008	0.0	O K
960 Summer	1.6	1.6	139.7000	0.0000	0.0	O K
1440 Summer	1.2	1.2	139.7000	0.0000	0.0	O K
2160 Summer	0.9	0.9	139.7000	0.0000	0.0	O K
2880 Summer	0.7	0.7	139.7000	0.0000	0.0	O K
4320 Summer	0.5	0.5	139.7000	0.0000	0.0	O K
5760 Summer	0.4	0.4	139.7000	0.0000	0.0	O K
7200 Summer	0.3	0.3	139.7000	0.0000	0.0	O K
8640 Summer	0.3	0.3	139.7000	0.0000	0.0	O K
10080 Summer	0.3	0.3	139.7000	0.0000	0.0	O K
15 Winter	5.0	5.0	140.0582	0.3582	3.2	O K
30 Winter	5.0	5.0	140.0742	0.3742	3.4	O K
60 Winter	5.0	5.0	139.9842	0.2842	2.6	O K
120 Winter	4.6	4.6	139.8138	0.1138	1.0	O K
180 Winter	3.9	3.9	139.7493	0.0493	0.4	O K
240 Winter	3.2	3.2	139.7312	0.0312	0.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	89.23	13
30 Summer	61.54	22
60 Summer	40.51	38
120 Summer	25.63	68
180 Summer	19.23	98
240 Summer	15.63	126
360 Summer	11.65	186
480 Summer	9.44	246
600 Summer	8.01	306
720 Summer	7.00	366
960 Summer	5.65	0
1440 Summer	4.17	0
2160 Summer	3.07	0
2880 Summer	2.46	0
4320 Summer	1.81	0
5760 Summer	1.45	0
7200 Summer	1.23	0
8640 Summer	1.07	0
10080 Summer	0.95	0
15 Winter	89.23	14
30 Winter	61.54	23
60 Winter	40.51	40
120 Winter	25.63	68
180 Winter	19.23	96
240 Winter	15.63	126

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

Storm Duration (mins)	Maximum Control (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Maximum Volume (m ³)	Status
360 Winter	2.4	2.4	139.7108	0.0108	0.1	O K
480 Winter	1.9	1.9	139.7000	0.0000	0.0	O K
600 Winter	1.6	1.6	139.7000	0.0000	0.0	O K
720 Winter	1.4	1.4	139.7000	0.0000	0.0	O K
960 Winter	1.2	1.2	139.7000	0.0000	0.0	O K
1440 Winter	0.9	0.9	139.7000	0.0000	0.0	O K
2160 Winter	0.6	0.6	139.7000	0.0000	0.0	O K
2880 Winter	0.5	0.5	139.7000	0.0000	0.0	O K
4320 Winter	0.4	0.4	139.7000	0.0000	0.0	O K
5760 Winter	0.3	0.3	139.7000	0.0000	0.0	O K
7200 Winter	0.3	0.3	139.7000	0.0000	0.0	O K
8640 Winter	0.2	0.2	139.7000	0.0000	0.0	O K
10080 Winter	0.2	0.2	139.7000	0.0000	0.0	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
360 Winter	11.65	186
480 Winter	9.44	0
600 Winter	8.01	0
720 Winter	7.00	0
960 Winter	5.65	0
1440 Winter	4.17	0
2160 Winter	3.07	0
2880 Winter	2.46	0
4320 Winter	1.81	0
5760 Winter	1.45	0
7200 Winter	1.23	0
8640 Winter	1.07	0
10080 Winter	0.95	0

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Rainfall Details

Region	ENG+WAL	Shortest Storm (mins)	15
Return Period (years)	100	Longest Storm (mins)	10080
M5-60 (mm)	20.000	Summer Storms	Yes
Ratio-R	0.300	Winter Storms	Yes
Cv (Summer)	0.750	Climate Change %	+45
Cv (Winter)	0.840		

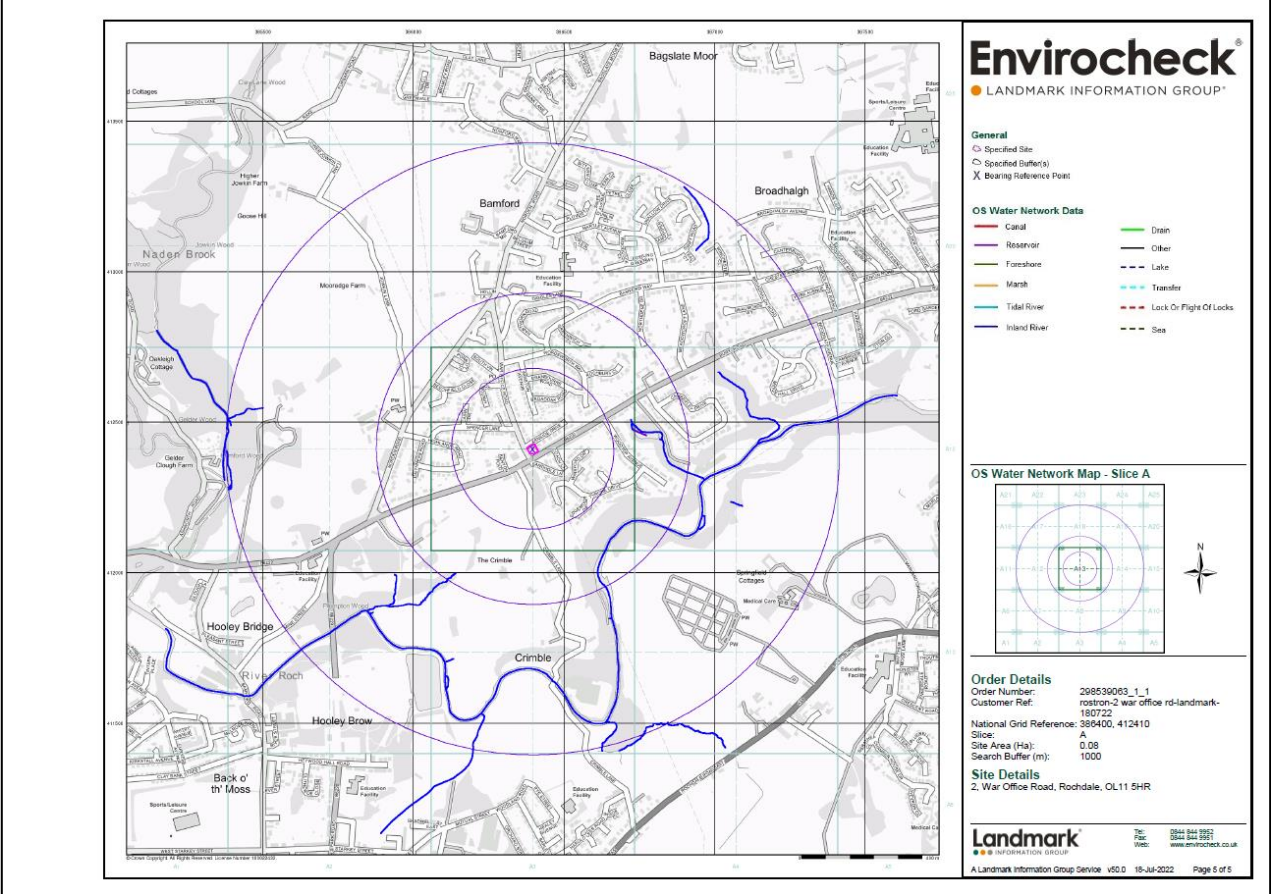
Time / Area Diagram

Total Area (ha) = 0.024

Time	(mins)	Area
from:	to:	(ha)
0	4	0.024

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Landmark Watercourse Map

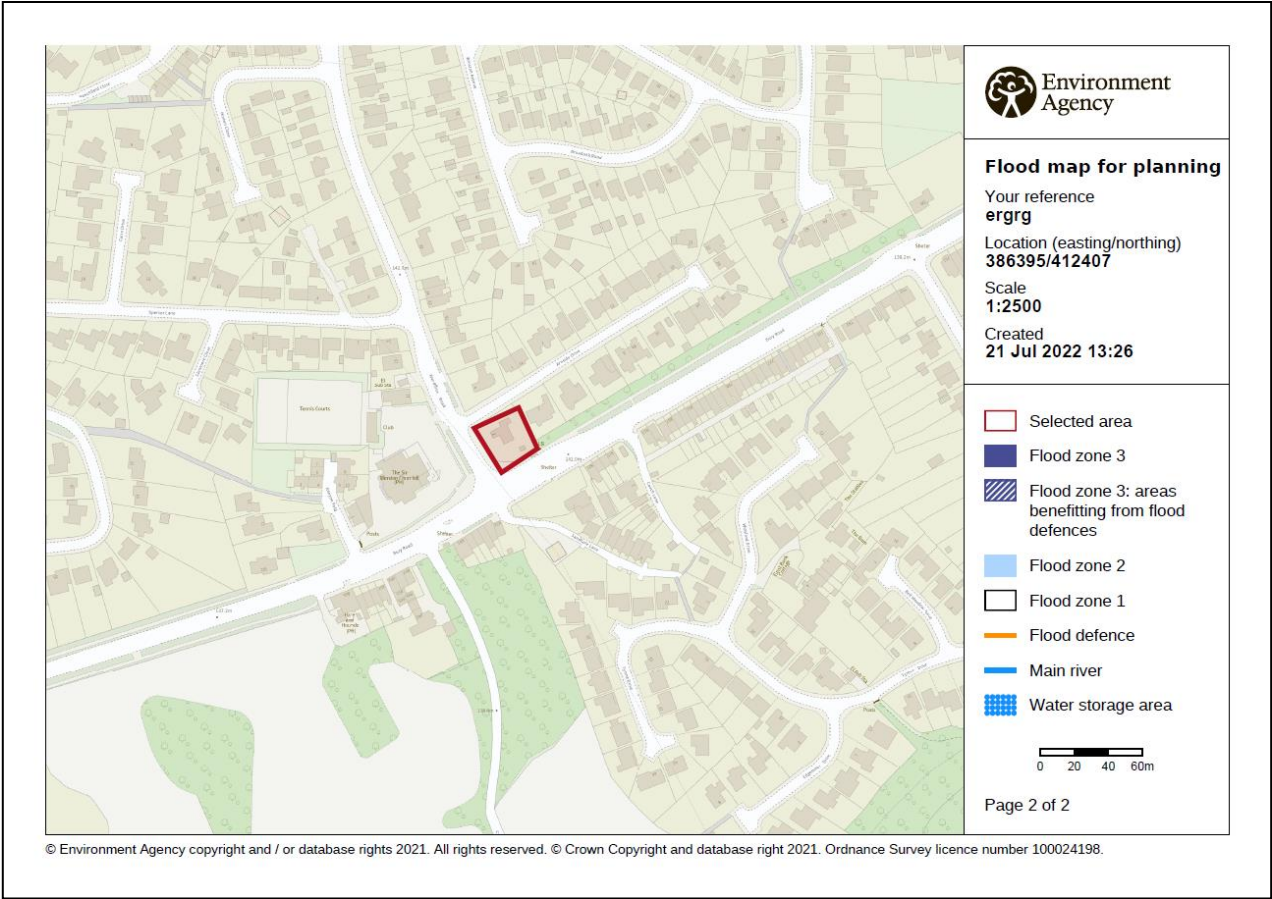


BGS Superficial Geology Maps



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Gov River Flood Map (Flood Zones).



Gov Surface Water Flood Map.



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Drainage Calculations

N/A.

Drainage Utilities Maps.

