COUCH Consulting Engineers
Civil & Structural

Drainage Statement

For: Southway Housing Trust

Site: Minden Close, Burnage, Manchester M20 6JY

Couch Consulting Engineers (Midlands) Ltd
St George's House, Unit 2, Priory, London Road, Canwell, Sutton Coldfield B75 5SH
Tel: 0121 308 7557

This report has been issued and amended as follows:

Reference	Issue	Revision	Description	Date	Signed	Checked
8395-DS	First	P0	First Issue	March 2023	RM	ME

Table of Contents

1	Brief	3
2	The Site	
2.1	Location	4
2.2	Topography	5
3	Development Proposals	6
4	Flood Risk	
4.1	Flood Risk from Rivers of the Sea	7
4.2	Flood Risk from Surface Water	8
4.3	EA Flood Map for Planning	9
5	Potential SuDS Features	10-12
6	Proposed SuDS Features	13
7	Surface Water Drainage Strategy	14
8	Water Supply	15
9	Landscaping & Biodiversity	16
10	Minimising Surface Water Pollution During Construction	17
11	Conclusion	18

APPENDIX

1 Brief

Couch Consulting Engineers have been commissioned by Triangle Architects Ltd to provide a Drainage Statement to support a planning application for a proposed residential redevelopment for Minden Close, Burnage, Manchester. For clarity, the description of the proposed development works is as follows:

"Re-development of existing brownfield site to provide 2 new single storey dwellings with private courtyards and associated car parking spaces".

2 The Site

2.1 Location

The proposed development site is located off Paris Wood Road, Burnage, Manchester, M20 6JY.

The proposed site comprises 2 single storey houses with associated private gardens and parking spaces. The area was previously a brownfield site (warehouse) with hardstanding external surfacing. It is proposed that the existing area be redeveloped into housing.

The proposed development site has an area of approximately 0.032ha, with 0.023ha being impermeable.

A location plan for the proposed development site is show in Figure 2-1.

A copy of the site plan is contained within the Appendix (Triangle Architects, ref. MIN – TRI – Z1 – 00 – DR – A – SK012).



Source: Google Earth (North ^)

Figure 2-1 Site Location Plan

2.2 Topography

The site is regular in shape and currently comprises an existing warehouse building, hardstanding areas and various containers.

The site is generally flat in which levels range from 37.72mAOD to 37.88mAOD.

A copy of the topographical survey is contained within the Appendix (Survey & Engineering Projects. ref. S21439-T).

3 Development Proposals

The proposed development comprises 2 new single storey home homes with associated car parking spaces and private garden areas.

A copy of the development proposals plan is contained within the Appendix (Triangle Architects, ref. MIN – TRI – Z1 – 00 – DR – A – SK012).

4 Flood Risk

4.1 Flood Risk from Rivers or the Sea

The site resides within Flood Zone 1 – within the zone assessed as having a less than 1 in 1000 annual probability of flooding in any year as identified on the Environment Agency's flood mapping. An extract from the Environment Agency's flood risk mapping (rivers or the sea) is shown below.

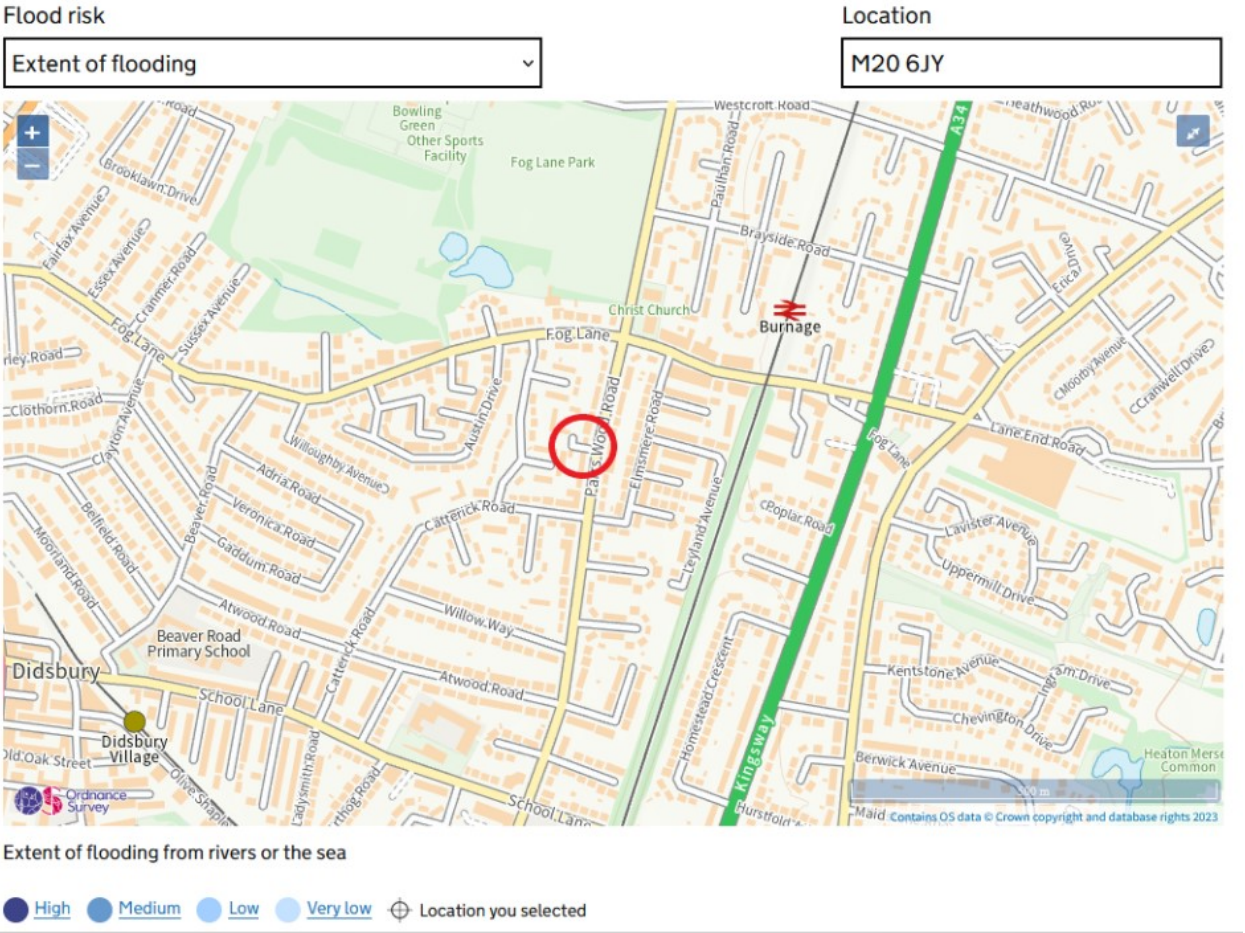


Figure 4-1 Extract from EA Flood Risk mapping (Rivers or the Sea)

4.2 Flood Risk from Surface Water

The Environment Agency Risk of Flooding from Surface Water map indicates the site is not at risk of surface water flooding. An extract from the Environment Agency's flood risk mapping (surface water) is shown below.

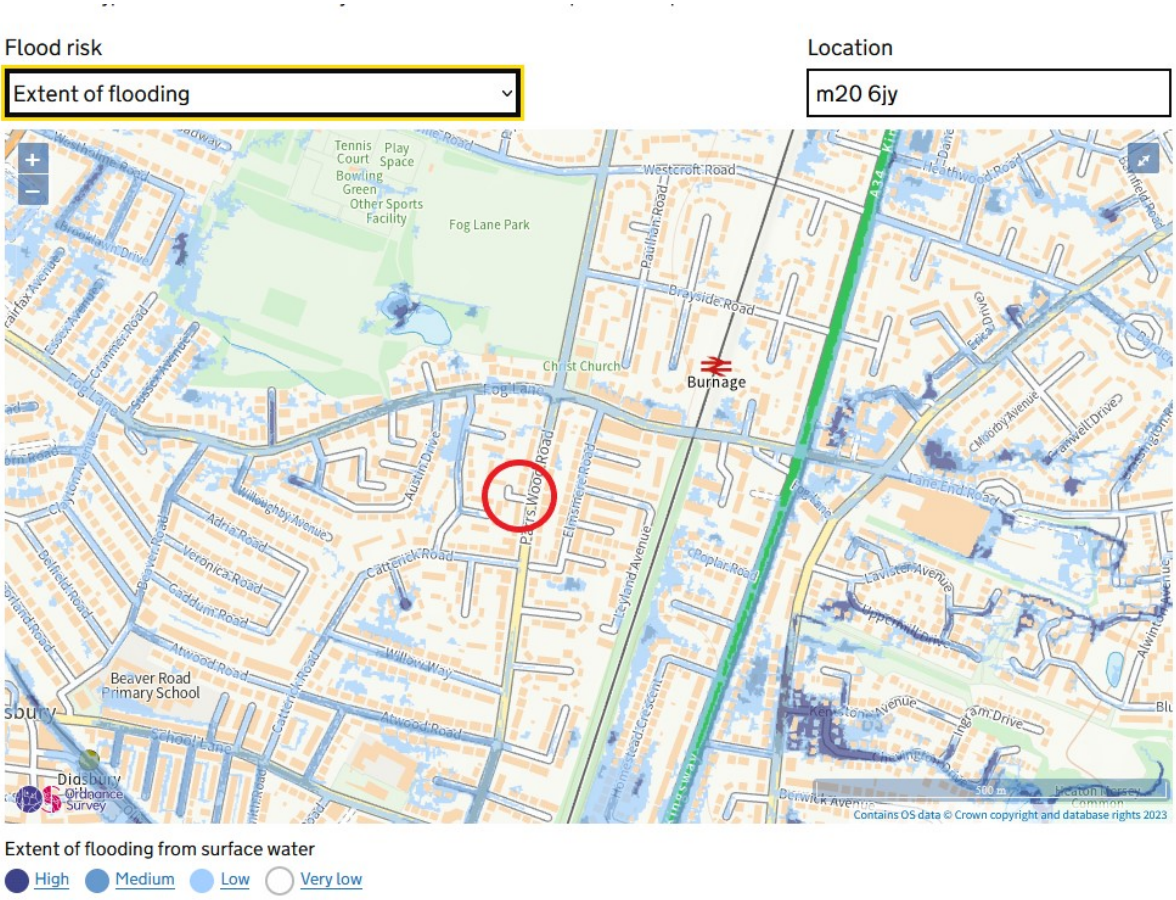
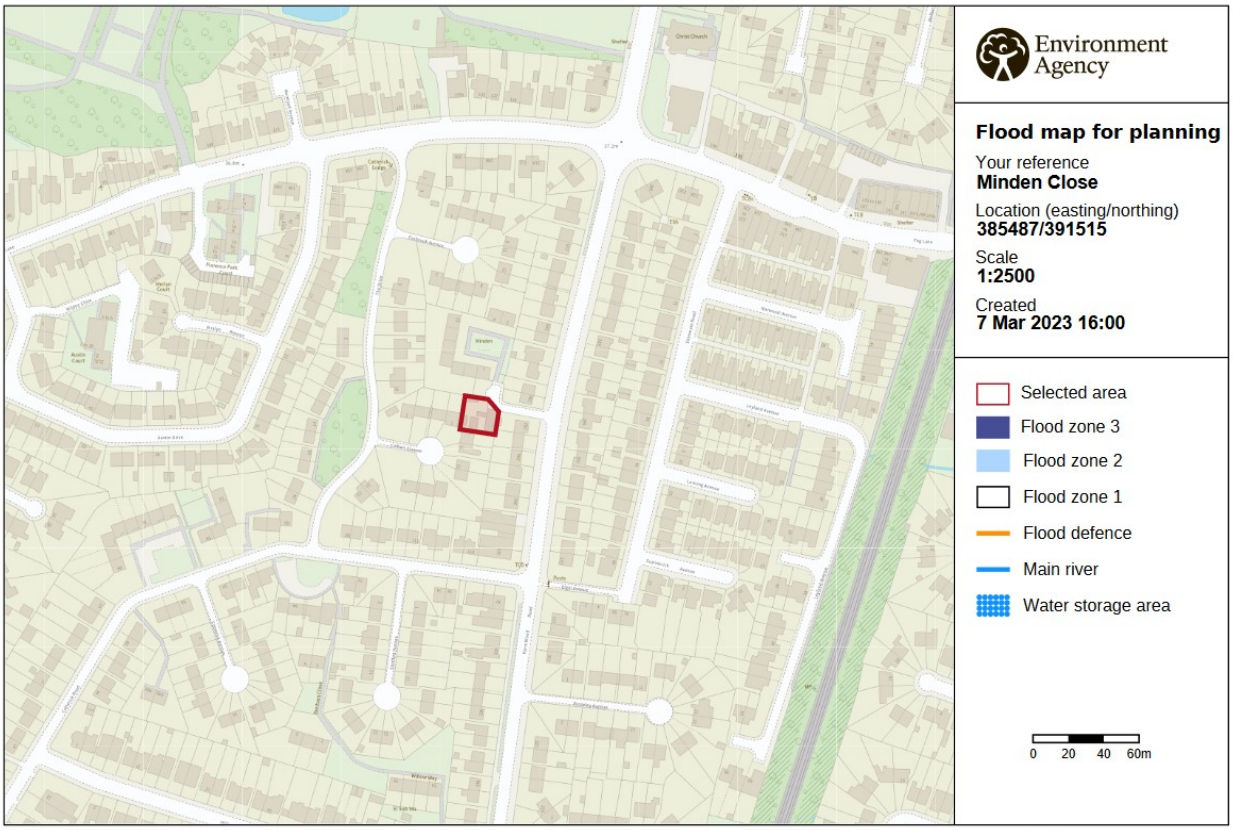


Figure 4-2 Extract from EA Flood Risk mapping (Surface Water)

4.3 EA Flood Map for Planning

The Environment Agency Flood map for planning indicates the site is located in Flood Zone 1 and is in an area of low probability of flooding. An extract from the Environment Agency's flood map for planning is shown below.



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Figure 4-3 Extract from EA Flood Map for Planning

5 Potential SuDS Features

The following represents our considered views on suitable SUDS options appropriate to this site. CIRIA C697 the SUDS Manual was consulted to examine the use of SUDS on this site. Our conclusions are based on the assessment of the site and the evaluation of the relevant design requirements and regulatory consultation. Potential SUDS Techniques Considered for this site are as follows:

Green Roofs

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover, over a drainage layer. They are designed to intercept and retain precipitation, reducing the volume of run-off and attenuating peak flows.

Cost to the structure can be considerable and poor maintenance will leave it looking unsightly. The development proposals include roof constructions that would not be economically viable to upgrade to support green roofs.

Not recommended

Soakaways

Soakaways are square or circular excavations either filled with rubble or lined with brickwork, precast concrete or polyethylene rings/perforated storage structures or modular geocellular units surrounded by granular backfill. They can be grouped and linked together to drain large areas including highways. Soakaways provide storm water attenuation, storm water treatment and groundwater recharge.

The ground conditions under the proposed building are known to consist of cohesive soils (Glacial Till).

In view of the above, infiltration suds are not considered appropriate for this site.

Not recommended

Swales

Swales are linear vegetated drainage features in which surface water can be stored or conveyed. They can be designed to allow infiltration, where appropriate. They should promote low flow velocities to allow much of the suspended particulate load in the storm water runoff to settle out, thus providing effective pollutant removal. Roadside swales can replace conventional gullies and drainage pipes. Swales are easy to incorporate into the landscape design it can reduce the run-off rates and volumes.

Not Recommended

Permeable Surfacing

Permeable surfacing provides a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored between infiltration to the ground, reuse or discharge to a watercourse or other drainage system. Pavements with aggregate sub-bases can provide good water quality treatment. The use of permeable paving for parking bays can be used as a stone sub-base not only stores and slows down the rate of discharge, but also raises the water quality. Due to limited space and clashes with proposed infrastructure, this method of SuDS is not viable.

Not Recommended.

Geo-cellular/Modular Storage Systems

Modular plastic geo-cellular systems with a high void ratio that can be used to create a below ground storage structure. Modular tanks can be used for run-off attenuation but requires silt trap protection and a suitable means of access for cleaning and inspection.

Due to the limited space on the site, we are proposing that part of the surface water attenuation is via geo-cellular storage.

Recommended and Proposed

Ponds

Ponds can provide both storm water attenuation and treatment. They are designed to support emergent and submerged aquatic vegetation along their shoreline. Run off from each rain event is detained and treated in the pool. The retention time promotes removal through sedimentation and the opportunity for biological uptake mechanisms to reduce nutrient concentrations.

There is no adequate space within the proposed development.

Not Recommended

Attenuation Basin

Attenuation basins are surface structures, typically vegetated depressions that provide flow control through temporary storage and attenuation with controlled release of stored runoff. They should be designed as landscape features that act as visual enhancement and habitat creation. When dry, they can be used for social space and habitat creation.

There is no adequate space within the proposed development.

Not Recommended.

Infiltration Basin

Infiltration basins are vegetated depressions in the ground designed to store surface water runoff on the surface. They should be dry most of the time except in periods of heavy rain. Infiltration basins should be designed as landscape features that act as visual enhancement and habitat creation. When dry, they can be used for social space and habitat creation.

There is no adequate space within the proposed development.

Not Recommended

Filter Trench

Filter drains are gravel filled trenches that collect, store, and move water. They also treat pollution. The trench is filled with free draining gravel and often has a perforated pipe in the bottom to collect the water. They are widely used to drain roads and are often seen along the end of main roads. There is frequently a geotextile just below the surface that is used to trap silt and stop it clogging the gravel deeper in the trench.

Not recommended

Rain Garden / Storm water Planter

Rain gardens and storm water planters are shallow, localised, landscaped areas which typically rely on engineered soils, enhanced vegetation, and underdrains. These features are designed to manage and treat runoff from frequent storm events, providing attenuation and treatment of runoff.

There is limited space on site to enable suitable rain garden areas on this site.

Not Recommended

6 Proposed SuDS Features

A review of the site and the ground conditions to be encountered indicates that the underlying cohesive materials will have a low permeability and therefore are not considered suitable for infiltration drainage techniques. As such no infiltration Suds are proposed.

The surface water run-off from these areas will be collected by gullies in the carpark and into pipes/cellular storage from the roof areas, this will then discharge into the main drainage system.

It is proposed that SuDS in the form of geo-cellular storage will then outfall back into the proposed network when it reaches a certain compacity.

7 Surface Water Drainage Strategy

The proposed surface water drainage strategy and micro-drainage software calculations are indicated in the Appendix.

Existing Greenfield Rates

Existing greenfield rates have been calculated using IH124 determined (see Appendix, HR Wallingford).

Greenfield runoff rates	Default
Q_{BAR} (l/s):	0.6
1 in 1 year (l/s):	0.52
1 in 30 years (l/s):	1.02
1 in 100 year (l/s):	1.25
1 in 200 years (l/s):	1.43

Existing BrownField Rates

Existing rate Q (l/s) = 2.78 x Impermeable Area (ha) x 50

Existing impermeable area 0.032 ha.

2.78 x 0.032ha x 50 = 4.45 l/s

50% betterment as required by LLFA = 2.23 l/s

Due to the very low existing existing greenfield rates, it is recommended by UK SuDS for a site of this size that a discharge rate of **2.0 l/s** is proposed.

Soakaways have been determined not to be feasible for this site, due to the nature of the existing ground conditions encountered (cohesive, Glacial Till). Reports extracts are contained within the Appendix (Phase 2 Geo-Environmental & Geotechnical Report carried out by Curtins, Ref:077873-CUR-00-XX-RP-GE-037-V01, 30th March 2022).

6 Water Supply

6.1 Anticipated Water Consumption

The proposed development comprises 2 dwellings. Anticipated water consumption is not considered to be any more than expected for a residential redevelopment of this size.

6.2 Methods to minimise the use of potable water supplies.

Methods intended to be considered to minimise the use of potable water supplies include (but are not limited to):

- Aerated faucets
- Low-flow toilets
- Installation of low water usage dishwasher and washing machines

7 Landscaping & Biodiversity

Proposed landscaping improvements in the form of trees and shrubbery are to be featured within the site. These small areas of greenery not only improve the existing hardstanding and therefore the surface water drainage but also enhance the biodiversity of the site.

8 Minimising Surface Water Pollution During Construction

It is intended that surface water pollution arising during construction is minimised. The following measures are recommended to be considered during the construction of the proposed development to minimise surface water pollution (please note that this list is not exhaustive):

- Cover piles of building materials like cement, sand and other powders, regularly inspect for spillages and locate them where they will not be washed into waterways or drainage areas.
- Use non-toxic paints, solvents and other hazardous materials wherever possible.
- Cover up and protect all drains on site.
- Collect any wastewater generated from site activities in settlement tanks, screen, and discharge the clean water and dispose of the remaining sludge according to environmental regulations.
- Use low sulphur diesel oil in all vehicle and equipment engines and incorporate the latest specifications of particulate filters and catalytic converters.

9 Conclusion

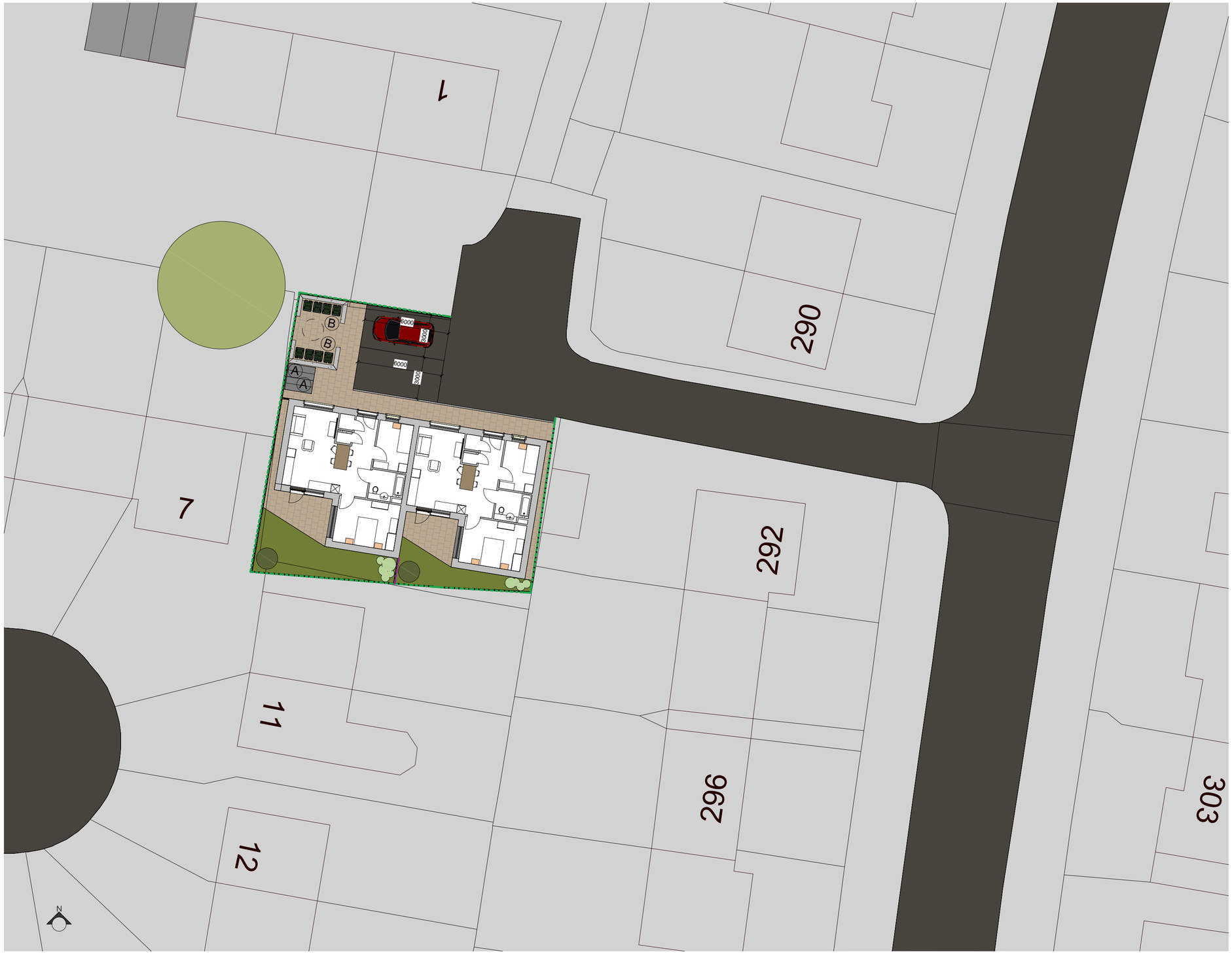
- The site lays within Flood Zone 1 - within the zone assessed as having a less than 1 in 1000 annual probability of flooding in any year as identified on the Environment Agency's flood mapping.
- The Environment Agency Risk of Flooding from Surface Water map indicates the site is not at risk of surface water flooding.
- The Environment Agency Risk of Flooding from rivers or sea indicates the site is not at risk of flooding.
- Due to the size and location of the site, a Flood Risk Assessment is not considered to be required.
- Both storm and foul flows from the proposed development are intended to discharge into the nearest adopted combined sewer.
- Anticipated water consumption is not considered to be any more than expected for a residential development of this size.
- Methods for conserving potable water supplies will be considered including aerated faucets, low-flow toilets and low water usage dishwasher and washing machines.
- Landscaping is proposed to be improved.
- Methods for minimising surface water pollution during construction will be considered including siting materials with potential to spill away from areas where they are likely to be washed into drains/waterways, covering up and protecting all existing drains on site, using low Sulphur diesel oil in all vehicles and equipment engines.

APPENDIX

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- CHECK ALL DIMENSIONS ON SITE.
- DRAWING TO BE READ IN CONJUNCTION WITH THE HEALTH & SAFETY PLAN. AND ALL RELEVANT RISK ASSESSMENTS AND THE FOLLOWING DRAWINGS:



Site Plan Key

2100mm High Concrete Post & Panel Fence (Colour: Grey)

1500mm High Concrete Post & Panel Fence (Colour: Grey)

- Existing Tree
- New Tree
- Medium Height Shrubs
- Buff Paving (450x450 Paving)
- Grass
- Asphalt/ Tarmac
- (A) Timber and Metal Cycle Store (SBD Compliant)
- (B) Brick Bin Enclosure

Proposed Site Plan

1 : 200

Scale 1:200

0m 2m 4m 10m

Rev	Date	By	Remarks
P01	17.01.23	HR	First Issue.

Client: Southway Housing Trust

Project No. / Project Name: 20-041 / Southway Infill - Minden Close

Drawing Name: Proposed Site Plan

Drawing Purpose: **INFORMATION**

Project:	Origin.:	Vol/Sys:	Level:	Type:	Role:	Drg No.:	Revision
MIN - TRI - Z1 - 00 - DR - A - SK012							**P01**

Status	Scale @ A2	Drawn	Check.	Date
S0	1 : 200	HR	HR	01/16/23

TRIANGLE ARCHITECTS

Tel: 0161 272 3500
E-mail: studio@trianglearchitects.co.uk
Web: www.trianglearchitects.co.uk
Twitter: @TriangleArch

Raven House,
113 Fairfield Street,
Manchester,
M12 6EL

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T. (01695) 729835 F. (01695) 725566 W. www.sepsurvey.com E. info@sepsurvey.com

LEGEND

AV	AIR VALVE	LBY	LIFEBUOY
BB	BELISHA BEACON	MH	MANHOLE
BOL	BOLLARD	MKR	MARKER
BH	BORE HOLE	MS	MILE STONE
BIN	BIN	MP	MOORING POINT
BM	BENCH MARK	MW	MONITORING WELL
BS	BUS STOP	OP	OUTFALL PIPE
BT	BT INSPECTION COVER	PB	POST OFFICE BOX
CB	CONTROL BOX	PN	PYLON
CCTV	CCTV CAMERA POST	PP	PETROL PUMP
COL	COLUMN	PT	POST
COM	COMMUNICATIONS COVER	RE	RODDING EYE
CST	CAR CHARGING STATION	RL	RIDGE LEVEL
CTV	CABLE TV COVER	RS	ROAD SIGN
DC	DRAINAGE CHANNEL	RTW	RETAINING WALL
DP	DOWN PIPE	RWP	RAINWATER PIPE
DR	DRAIN	SAP	SAPLING
ELEC	ELEC INSPECTION COVER	SNP	NAME PLATE
EL	EAVES LEVEL	SP	SIGN POST
ELB	ELECTRIC BOX	SOF	SOFFIT LEVEL
ER	EARTH ROD	SV	STOP VALVE
EP	ELECTRICITY POLE	TB	TRAFFIC BOLLARD
FL	FINISHED FLOOR LEVEL	TCB	TELEPHONE CALL BOX
FH	FIRE HYDRANT	TIE	TIE WIRE
FP	FLAG POLE	TL	TRAFFIC LIGHT
G	GULLY	TLB	TRAFFIC LIGHT BOX
GLT	GROUND LIGHT	TM	TICKET MACHINE
GP	GATE POST	TP	TELEGRAPH POLE
GST	GAS TAP	VP	VENT PIPE
GSV	GAS VALVE	WM	WATER METER
IC	INSPECTION COVER	WO	WASH OUT
IL	INVERT LEVEL	WST	WATER STOP TAP
KO	KERB OUTLET	WSV	WATER STOP VALVE
LAD	LADDER	G0.8ø	TREE GIRTH (Dia.)
LD	LAND DRAIN	MG	TREE MULTI-GIRTH
LP	LAMP POST		

PAL	PALISADE		WATER COURSE
W/M	WIRE MESH		KERB
B/W	BARBED WIRE		FENCE
C/P	CONC PANEL		SURFACE CHANGE
P/W	POST AND WIRE		WALL
P/R	POST AND RAIL		TOP BANK
I/R	IRON RAIL		BOTTOM BANK
C/B	CLOSE BOARDED		BUILDING
CH/L	CHAIN LINK		BUILDING CANOPY
(99.99)	TOP OF FEATURE		SURVEY BOUNDARY
	GATE		OVER HEAD ELECTRICAL
	STATION		OVER HEAD TELECOM
	BOREHOLE		
	BATTER		HEDGE



PLAN GRID NORTH

File Name: S21439-T_3D.dwg

NOTES:

All levels relate to O.S (Newlyn) Datum, Established using network RTK.
Survey plotted on a plane local grid, orientated to National Grid.

SURVEY STATIONS			
Name	Easting	Northing	Height
SEP1	385536.601	391517.351	37.727
SEP2	385497.999	391517.531	37.829
SEP3	385489.427	391519.151	37.761

SHEET LAYOUT

0 2m 4m 8m 12m 16m

SCALE BAR

REV	DATE	DESCRIPTION

SURVEY & ENGINEERING PROJECTS

Client
Curtins Consulting Limited
Rose Wharf
78-80 East Street
Leeds
LS9 8EE

Project Title
Topographical Survey of Land at:
Minden Close
Manchester
M20 6HB

Surveyed	Drawn	Checked
R.Pleavin	M.Charlton	R.Critchley

Scale	Date	Drawing Ref.	No.	Size	Rev
1:200	Apr' 21	S21439-T	01	A2	--

ALL DIMENSIONS TO BE CHECKED BY CONTRACTOR

All existing sewers on / nearby the site to be CCTV surveyed to check for third party connections to determine potential diversion / abandonment / removal. Invert levels to be determined prior to detailed design / site works commencing.

Works undertaken prior to receipt of planning approval and legal agreements approvals are done so at contractors own risk.

Approval required from the Sewerage Undertaker for any new connection under S106 of the Water Industry Act 1991, prior to commencing works to public sewer.

For internal SVP/RWP locations/setting out refer to Architects Details

All existing drainage and associated infrastructure based on:

- Topographical Survey by Survey & Engineeing Projects (drawing ref S21439-T, April 2021)
- United Utilities Sewer Records (dated 08/02/203)

NOTE:
THIS DWG IS PRELIMINARY DESIGN STATUS. PENDING PLANNING AUTHORITY APPROVAL. THEREFORE FINAL DESIGN MAY BE SUBJECT TO ALTERATION / CHANGE AT DETAILED DESIGN.

Key

- Existing adopted combined water sewer
- Proposed surface water sewer
- Proposed foul water sewer
- Proposed combined water sewer
- YG — Proposed Surface Water gully
- YG — Proposed foul gully (bin store)
- Proposed cellular attenuation
- Proposed surface water flow control chamber
- Proposed foul water inspection chamber (nom 450Ø)
- FFL XXX.XXX — Finished floor level
- Ⓛ — Part M Level access
- + 61.35 — Finished external level
- + ex. 61.32 — Existing external level



Assumptions & design principles

Finished floor levels

- Finished floor levels +/- 450mm at detailed design.

Retaining features

- Retaining less than 450mm not shown.

Combined water drainage

- Combined water drainage connection into existing United Utilities network be agreed by United Utilities under a Section 106 Agreement.

Surface Water drainage

- Surface water drainage systems designed to accommodate 100 year + 40% climate change storm events.
- As per the Phase 2 Geo-Environmental & Geotechnical Report carried out by Curtins (Ref:077873-CUR-00-XX-RP-GE-037-V01, 30th March 2022), discharge of surface water is highly unlikley by means of soakaway due to the nature of the existing ground conditions encountered (cohesive, Glacial Till).
- Surface Water Sewer will be at a restricted rate of 2.0 l/s.
- Attenuation to be provided by cellular storage.

Foul water drainage

- Foul water drainage connection to connect into combined water sewer.

General Drainage

- All proposed surface/foul/combined water drainage levels are indicative until the location, size & levels of the existing United Utilities sewer has been confirmed by detailed survey.

Existing brownfield discharge rate using the Modified Rationale Method:

Existing rate Q (l/s) = 2.78 x Impermeable Area (ha) x 50

Existing impermeable area 0.032 ha.

2.78 x 0.032ha x 50 = 4.45 l/s

50% betterment as required by LLFA = 2.23 l/s

Proposed discharge rate = 2.0 l/s

REV	AMENDMENT	BY	DATE
P0	First Issue	RM	10.03.2023

PROJECT EXECUTION CLASS: N/A

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PURPOSE OF ISSUE

PRELIMINARY

COUCH
Consulting Engineers
Civil & Structural

SUTTON COLDFIELD ☒
St George's House, Priory, Unit 2, London Road, Canwell, Sutton Coldfield, B75 5SH
Tel: 0121 308 7557
info@cceng.co.uk

AYLESBURY ☐
Midshires House, Midshires Business Park, Smeaton Close, Aylesbury, HP16 8HL
Tel: 01296 761 719

STOKE-ON-TRENT ☐
Genesis Centre, 18 Innovation Way, Stoke-on-Trent, ST6 4BF
Tel: 01782 366 160
www.cceng.co.uk

CLIENT: SOUTHWAY HOUSING TRUST

PROJECT: MINDEN CLOSE

DRAWING TITLE: DRAINAGE STRATEGY

SHEET SIZE	SCALE	DATE	DRAWN	CHECKED	STATUS
A1	1:100	MAR' 2023	RM	ME	-

CCE PROJECT No.	DRAWING No.	REV
8395	100	P0

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THEREFORE FINAL DESIGN MAY BE SUBJECT TO ALTERATION / CHANGE AT DETAILED DESIGN.



KEY

Overland water flow route in the event of exceedance or blockage of the drainage system.

REV	AMENDMENT	BY	DATE
P0	First Issue	RM	10.03.2023

PROJECT EXECUTION CLASS: N/A

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PURPOSE OF ISSUE

PRELIMINARY

COUCH
Consulting Engineers
Civil & Structural

SUTTON COLDFIELD ☒
St George's House, Priory, Unit 2, London Road, Canwell, Sutton Coldfield, B75 5SH
Tel: 0121 308 7557
info@cceng.co.uk

AYLESBURY ☐
Midshires House, Midshires Business Park, Smeaton Close, Aylesbury, HP19 8HL
Tel: 01296 761 719

STOKE-ON-TRENT ☐
Genesis Centre, 18 Innovation Way, Stoke-on-Trent, ST6 4BF
Tel: 01782 366 160
www.cceng.co.uk

CLIENT

SOUTHWAY HOUSING TRUST

PROJECT

MINDEN CLOSE

DRAWING TITLE

FLOOD EXCEEDANCE PLAN

SHEET SIZE	SCALE	DATE	DRAWN	CHECKED	STATUS
A1	1:100	MAR' 2023	RM	ME	-

CCE PROJECT No.	DRAWING No.	REV
8395	101	P0

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Site name:	Minden Close
Site location:	Manchester

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	53.42027° N
Longitude:	2.21968° W
Reference:	2162878778
Date:	Mar 06 2023 11:08

Runoff estimation approach IH124

Site characteristics

Total site area (ha):	0.032

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	845	845
Hydrological region:	10	10
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	1.7	1.7
Growth curve factor 100 years:	2.08	2.08
Growth curve factor 200 years:	2.37	2.37

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited
Q_{BAR} (l/s):	0.6	0.6
1 in 1 year (l/s):	0.52	0.52
1 in 30 years (l/s):	1.02	1.02
1 in 100 year (l/s):	1.25	1.25
1 in 200 years (l/s):	1.43	1.43

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Table 3.2 - *Summary of encountered ground conditions:*

Stratum	Depth to Top of Strata m bgl (m AOD)	Thickness (m)		Description
		Min	Max	
MADE GROUND	0.00 (37.68 – 37.80)	0.90	1.00	**Surface cover of** Grass over brown slightly gravelly silty clay with rare rootlets, or Grey concrete. **Overlying in all locations** MADE GROUND: Black or dark brown clayey gravel with occasional to frequent cobbles. Gravel is medium to coarse and angular to sub-angular of concrete, asphalt, brick and siltstone. Cobbles of angular brick and concrete. **Overlying in WS102 and WS103** MADE GROUND: Grey slightly gravelly silty sandy clay. Gravel is fine to medium and angular of brick, sandstone and siltstone.
GLACIAL TILL (Cohesive)	0.90 – 1.00 (36.76 – 36.90)	1.90	2.10	Firm to stiff brown with occasional grey mottling gravelly, occasionally sandy, CLAY. Gravel is medium and sub-rounded to rounded of mudstone, siltstone and sandstone.
GLACIAL TILL (Granular)	1.90 – 3.10 (34.80 – 35.90)	0.10	1.05[1]	**0.10m to 0.20m thick, interbedded bands of** Medium dense slightly clayey fine to coarse SAND. **From 2.80m – 3.10m bgl,** Very dense reddish brown or brown, locally clayey, brown fine to coarse SAND.

1 - Base of strata not encountered.

3.3 Groundwater

A water seepage was recorded in WS103 at 1.00m bgl, however the borehole was recorded as dry upon completion. WS101 and WS102 were recorded as dry throughout their progression.

Groundwater levels were recorded during post investigation gas monitoring visits. The monitoring well response zones and depth to the groundwater levels in each monitoring well during the visit are detailed in *Table 3.3*.

Table 3.3 – *Monitoring Well Response Zones*

Borehole Ref.	Installation Strata	Response Zone m bgl (m AOD)	Depth to water level m bgl (m AOD)					
			24/11/21	10/12/21	20/12/21	07/01/22	20/01/22	04/02/22
WS101	Cohesive and granular Glacial Till	1.00 – 3.70 (36.80 – 34.10)	Dry	1.30	1.72	1.44	2.03	2.21
WS102	Made Ground	0.50 – 1.00 (37.26 – 36.76)	Dry	0.62	0.98	0.41	0.41	0.77
WS103	Made Ground	0.50 – 1.00 (37.18 – 36.68)	0.77	0.58	0.74	0.44	0.44	0.74

3.4 Obstructions

SPT refusals were recorded within all three borehole locations terminating boreholes at 3.29 to 4.05m bgl (33.75 - 34.39m AOD) on possible bedrock.

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 8395-SWS NETWORK.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.000
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for 8395-SWS NETWORK.SWS

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.017	4-8	0.006

Total Area Contributing (ha) = 0.023

Total Pipe Volume (m³) = 0.981

Network Design Table for 8395-SWS NETWORK.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	17.479	0.300	58.3	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	10.936	0.200	54.7	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	7.469	0.100	74.7	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	3.048	0.050	61.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	16.591	0.150	110.6	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.22	37.300	0.016	0.0	0.0	0.0	1.32	23.3	2.2
S1.001	50.00	5.35	37.000	0.016	0.0	0.0	0.0	1.36	24.1	2.2
S1.002	50.00	5.46	36.800	0.023	0.0	0.0	0.0	1.16	20.6	3.1
S1.003	50.00	5.50	36.700	0.023	0.0	0.0	0.0	1.29	22.8	3.1
S1.004	50.00	5.79	36.650	0.023	0.0	0.0	0.0	0.95	16.9	3.1

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Manhole Schedules for 8395-SWS NETWORK.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	37.800	0.500	Open Manhole	300	S1.000	37.300	150				
S2	37.800	0.800	Open Manhole	450	S1.001	37.000	150	S1.000	37.000	150	
S3	37.800	1.000	Open Manhole	450	S1.002	36.800	150	S1.001	36.800	150	
S6	37.750	1.050	Open Manhole	1200	S1.003	36.700	150	S1.002	36.700	150	
S7	37.800	1.150	Open Manhole	1200	S1.004	36.650	150	S1.003	36.650	150	
S8	37.800	1.300	Open Manhole	1200		OUTFALL		S1.004	36.500	150	

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PIPELINE SCHEDULES for 8395-SWS NETWORK.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1	37.800	37.300	0.350	Open Manhole	300
S1.001	o	150	S2	37.800	37.000	0.650	Open Manhole	450
S1.002	o	150	S3	37.800	36.800	0.850	Open Manhole	450
S1.003	o	150	S6	37.750	36.700	0.900	Open Manhole	1200
S1.004	o	150	S7	37.800	36.650	1.000	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	17.479	58.3	S2	37.800	37.000	0.650	Open Manhole	450
S1.001	10.936	54.7	S3	37.800	36.800	0.850	Open Manhole	450
S1.002	7.469	74.7	S6	37.750	36.700	0.900	Open Manhole	1200
S1.003	3.048	61.0	S7	37.800	36.650	1.000	Open Manhole	1200
S1.004	16.591	110.6	S8	37.800	36.500	1.150	Open Manhole	1200

Free Flowing Outfall Details for 8395-SWS NETWORK.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.004	S8	37.800	36.500	0.000	1200	0

Simulation Criteria for 8395-SWS NETWORK.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.370		

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Online Controls for 8395-SWS NETWORK.SWS

Hydro-Brake® Optimum Manhole: S6, DS/PN: S1.003, Volume (m³): 1.3

Unit Reference	MD-SHE-0067-2000-1000-2000
Design Head (m)	1.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	67
Invert Level (m)	36.700
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	2.0
Flush-Flo™	0.296	1.9
Kick-Flo®	0.599	1.6
Mean Flow over Head Range	-	1.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.6	1.200	2.2	3.000	3.3	7.000	4.9
0.200	1.9	1.400	2.3	3.500	3.5	7.500	5.1
0.300	1.9	1.600	2.5	4.000	3.8	8.000	5.2
0.400	1.9	1.800	2.6	4.500	4.0	8.500	5.4
0.500	1.8	2.000	2.7	5.000	4.2	9.000	5.5
0.600	1.6	2.200	2.9	5.500	4.4	9.500	5.7
0.800	1.8	2.400	3.0	6.000	4.6		
1.000	2.0	2.600	3.1	6.500	4.7		

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Storage Structures for 8395-SWS NETWORK.SWS

Cellular Storage Manhole: S2, DS/PN: S1.001

Invert Level (m) 37.000 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	4.5	0.0	5.200	0.0	0.0
0.400	4.5	0.0	5.600	0.0	0.0
0.401	0.0	0.0	6.000	0.0	0.0
1.200	0.0	0.0	6.400	0.0	0.0
1.600	0.0	0.0	6.800	0.0	0.0
2.000	0.0	0.0	7.200	0.0	0.0
2.400	0.0	0.0	7.600	0.0	0.0
2.800	0.0	0.0	8.000	0.0	0.0
3.200	0.0	0.0	8.400	0.0	0.0
3.600	0.0	0.0	8.800	0.0	0.0
4.000	0.0	0.0	9.200	0.0	0.0
4.400	0.0	0.0	9.600	0.0	0.0
4.800	0.0	0.0	10.000	0.0	0.0

Cellular Storage Manhole: S6, DS/PN: S1.003

Invert Level (m) 36.700 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	2.3	0.0	5.200	0.0	0.0
0.400	2.3	0.0	5.600	0.0	0.0
0.401	0.0	0.0	6.000	0.0	0.0
1.200	0.0	0.0	6.400	0.0	0.0
1.600	0.0	0.0	6.800	0.0	0.0
2.000	0.0	0.0	7.200	0.0	0.0
2.400	0.0	0.0	7.600	0.0	0.0
2.800	0.0	0.0	8.000	0.0	0.0
3.200	0.0	0.0	8.400	0.0	0.0
3.600	0.0	0.0	8.800	0.0	0.0
4.000	0.0	0.0	9.200	0.0	0.0
4.400	0.0	0.0	9.600	0.0	0.0
4.800	0.0	0.0	10.000	0.0	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 8395-SWS NETWORK.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.362
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+0%	100/30 Winter				37.330
S1.001	S2	15 Winter	1	+0%	100/15 Summer				37.030
S1.002	S3	15 Winter	1	+0%	30/15 Summer				36.838
S1.003	S6	15 Winter	1	+0%	2/15 Summer				36.821
S1.004	S7	15 Winter	1	+0%					36.683

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.120	0.000	0.09		1.9	OK	
S1.001	S2	-0.120	0.000	0.09		1.9	OK	
S1.002	S3	-0.112	0.000	0.15		2.6	OK	
S1.003	S6	-0.029	0.000	0.12		1.7	OK	
S1.004	S7	-0.117	0.000	0.11		1.7	OK	

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 8395-SWS NETWORK.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.362
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	2	+0%	100/30 Winter				37.334
S1.001	S2	15 Winter	2	+0%	100/15 Summer				37.034
S1.002	S3	15 Winter	2	+0%	30/15 Summer				36.874
S1.003	S6	15 Winter	2	+0%	2/15 Summer				36.868
S1.004	S7	15 Winter	2	+0%					36.684

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.116	0.000	0.11		2.5	OK	
S1.001	S2	-0.116	0.000	0.11		2.5	OK	
S1.002	S3	-0.076	0.000	0.19		3.4	OK	
S1.003	S6	0.018	0.000	0.13		1.8	SURCHARGED	
S1.004	S7	-0.116	0.000	0.12		1.8	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 8395-SWS NETWORK.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.362
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%	100/30 Winter				37.347
S1.001	S2	30 Winter	30	+0%	100/15 Summer				37.087
S1.002	S3	30 Winter	30	+0%	30/15 Summer				37.083
S1.003	S6	30 Winter	30	+0%	2/15 Summer				37.077
S1.004	S7	60 Winter	30	+0%					36.685

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.103	0.000	0.22		4.7	OK	
S1.001	S2	-0.063	0.000	0.17		3.7	OK	
S1.002	S3	0.133	0.000	0.25		4.5	SURCHARGED	
S1.003	S6	0.227	0.000	0.14		1.9	SURCHARGED	
S1.004	S7	-0.115	0.000	0.12		1.9	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 8395-SWS NETWORK.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.362
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 2, 30, 100
Climate Change (%)	0, 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	30 Winter	100	+40%	100/30 Winter				37.677
S1.001	S2	30 Winter	100	+40%	100/15 Summer				37.670
S1.002	S3	30 Winter	100	+40%	30/15 Summer				37.665
S1.003	S6	30 Winter	100	+40%	2/15 Summer				37.660
S1.004	S7	30 Winter	100	+40%					36.685

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.227	0.000	0.31		6.8	FLOOD RISK	
S1.001	S2	0.520	0.000	0.23		5.0	FLOOD RISK	
S1.002	S3	0.715	0.000	0.35		6.2	FLOOD RISK	
S1.003	S6	0.810	0.000	0.14		2.0	FLOOD RISK	
S1.004	S7	-0.115	0.000	0.12		2.0	OK	

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