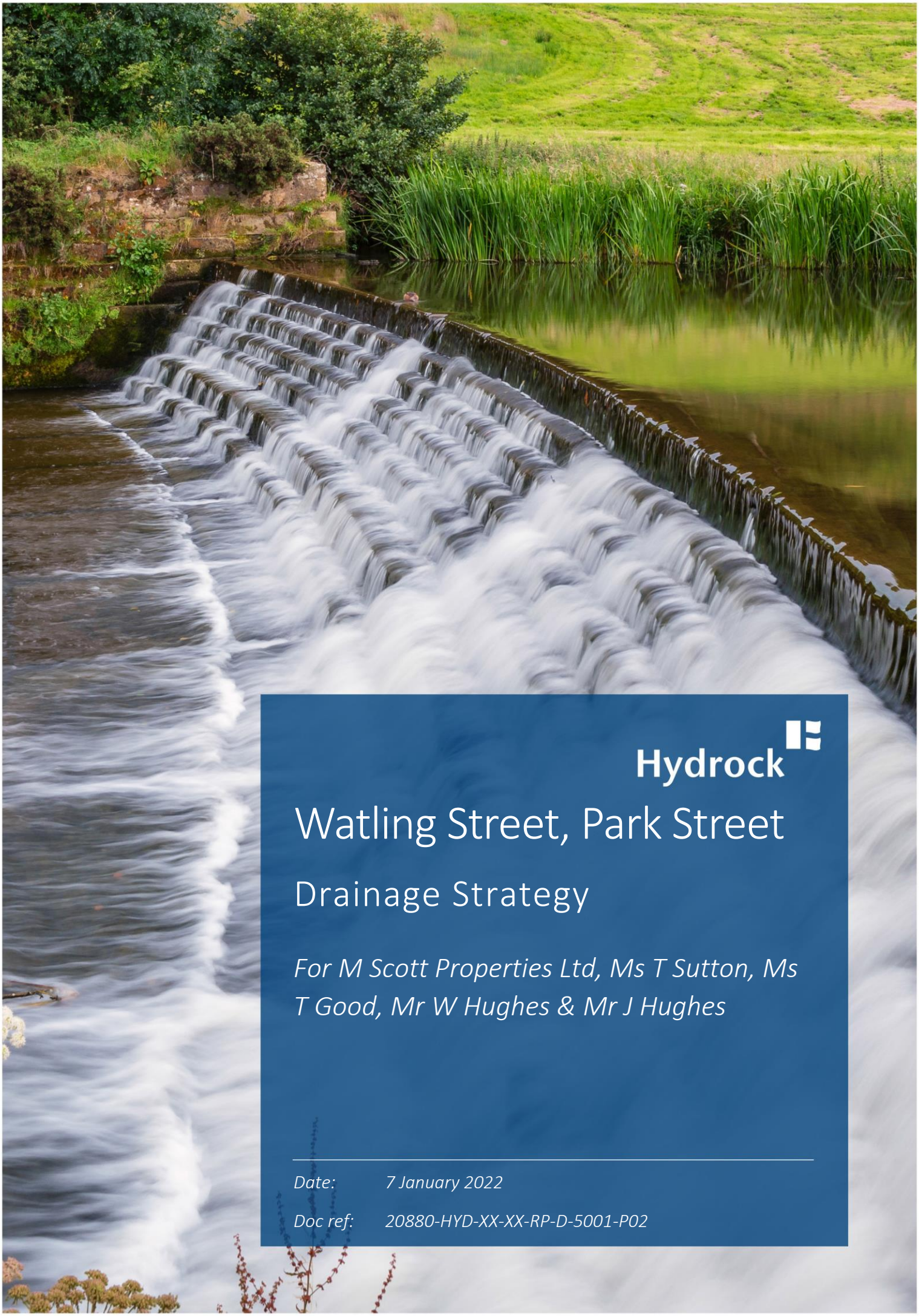


Hydrock

Watling Street, Park Street

Drainage Strategy

For M Scott Properties Ltd, Ms T Sutton, Ms T Good, Mr W Hughes & Mr J Hughes

Date: *7 January 2022*

Doc ref: *20880-HYD-XX-XX-RP-D-5001-P02*

DOCUMENT CONTROL SHEET

Issued by	Hydrock Consultants Limited Over Court Barns Over Lane Almondsbury Bristol BS32 4DF United Kingdom	T +44 (0)1454 619533 F +44 (0)1454 614125 E bristol@hydrock.com www.hydrock.com
Client	M Scott Properties Ltd, Ms T Sutton, Ms T Good, Mr W Hughes & Mr J Hughes	
Project name	Watling Street, Park Street	
Title	Drainage Strategy	
Doc ref	20880-HYD-XX-XX-RP-D-5001-P02	
Project no.	C-20880	
Status	S2	
Date	07/01/2022	

Document Production Record		
Issue Number	P02	Name
Prepared by		Sayed Hashemi, MSc, BEng, GMICE
Checked by		Richard Hughes Eng Tech, TMICE
Approved by		Richard Hughes Eng Tech, TMICE

Document Revision Record			
Issue Number	Status	Date	Revision Details
P01	S2	14/09/2021	Issued for application.
P02	S2	07/01/2022	Updated to Client comments.

CONTENTS

Tables

Figures

Appendices

1. INTRODUCTION

This report has been prepared by Hydrock on behalf of M Scott Properties Limited, Ms T Sutton, Ms T Good, Mr W Hughes and Mr J Hughes in support of an outline planning application for a proposed residential development with associated access roads and public open space on a parcel of land located on the southern outskirts of St Albans.

This Drainage Strategy has been prepared to address the requirements of the NPPF, through:

- Assessing whether the proposed development is appropriate in the suggested location.
- Investigate existing drainage and ground infiltration potential.
- Identify the main constraints and opportunities to facilitate a sustainable strategy for managing surface water.
- Identify further work required to support a planning application.
- A separate Flood Risk Assessment for this site has been prepared by Hydrock.

2. SITE INFORMATION

Location and Setting

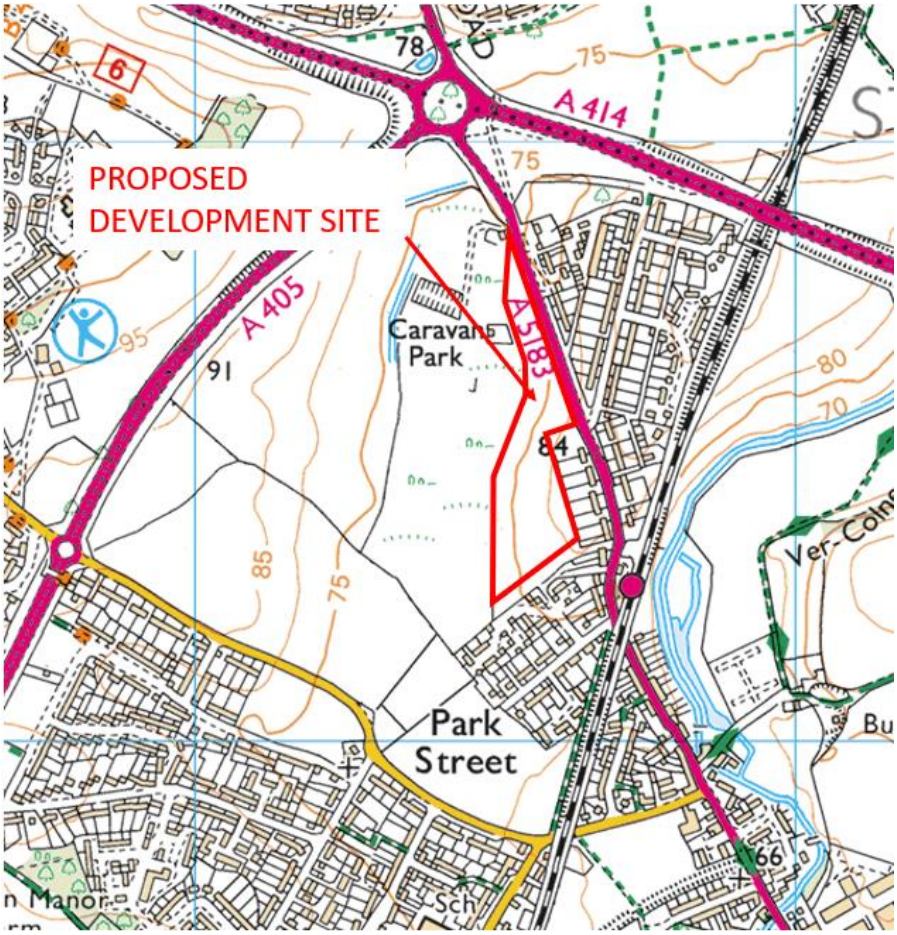
2.1 The site is a vacant parcel of land, approximately 4.3ha in extent and greenfield in nature. The M25 and M1 is located to the south and east of the site respectively and St Albans is located approximately 3km to the north of site.

2.2 The proposed development is bounded by Watling Street (A5183) to the east and north, by Watling Street Caravan Park to the northwest, by open greenfield to the west and a strip of greenfield land to the south with residential dwellings beyond.

2.3 The site address and location are shown below in Table 1: Site Address

Table 1: Site Address

Address	Land west of Watling Street, Park Street, St Albans
Post Code	AL2 2NN
OS Grid Reference	TL145044 / TL1456104496



Contains OS data © Crown copyright (2019) and Environment Agency data under OGLv3

Figure 1: Site Location

Topography

2.4 A topographical survey of the site has been provided by the client and indicates that the site generally falls in westerly direction. The highest ground levels of the site are located along the south-eastern boundary of the site at approximately 81.8m AOD. The lowest ground levels of the site are located towards the south-western portion of the site at 73.8m AOD.

2.5 A copy of the topographical survey is included in Appendix A.

Proposed Development

2.6 The proposed development is residential in nature and covers an approximate 4.3ha of land on the southern outskirts of St Albans. The development will comprise up to 95 dwellings including associated access roads, driveways and open public space.

2.7 A copy of the proposed architectural layout is included in Appendix A.

3. SURFACE WATER MANAGEMENT

Pre-Development

3.1 Public sewer maps obtained from Thames Water shows that there are no public surface water sewers within the site boundaries. See Appendix A.

3.2 A public surface water sewer is shown in the western verge of Watling Road, flowing northwards. No diameter is shown for the pipe. Public surface water sewers are also shown in the Old Orchard highway to the south of the site.

3.3 As described in Section 2.1, the existing site is a vacant parcel of greenfield land and as such no private drainage systems are anticipated.

3.4 There are no watercourses recorded within the site or in the immediate vicinity, the nearest body of water being the River Ver, approximately 150m to the east of the site.

3.5 As such, rainfall will infiltrate the ground until infiltration capacity is reached at which point flows will travel overland following the topography of the site. The British Geological Survey (BGS) online data indicates that the site underlain by superficial deposits of River Trace which comprises of Sand and Gravel with bedrock geology of Lewes Nodular Chalk Formation and Seaford Chalk Formation.

3.6 At this stage it is assumed that the site is not suitable for infiltration of surface water runoff however, it is recommended that in the next phase of the development, site specific soakaway testing will need to be carried out in order to establish the permeability rate of the geology within the site.

3.7 As such, surface water runoff from the proposed development will be discharged to the public surface water sewers located within the vicinity of the site.

Post-Development

Assessment of Options

3.8 In accordance with the Sustainable Drainage Systems (SUDS) hierarchy, rainfall run-off should be managed in the following preferential order:

1. Infiltrated to ground.
2. Discharged to local watercourse.
3. Discharged to a local surface water sewer network.
4. Discharged to a local combined water sewer network.

3.9 As described above, it is anticipated that the site is not suitable for infiltration of surface water into the ground and there are no watercourses located within the proximity of the site. Therefore, the next option for the discharge of surface water is to the existing public surface water sewer network.

3.10 The site falls away from Watling Road and therefore levels preclude the use of a gravity connection to the sewer recorded in the western verge therefore it is proposed to connect to the sewers in Old Orchard to the south of the site. See Appendix C.

3.11 In line with NPPF requirements, in order to ensure no detrimental effect downstream of the site all post-development flows will need to be restricted to existing greenfield runoff rates. All attenuation structures will be designed to accommodate up to and including the 1 in 100 year storm event plus an allowance of 40% for climate change in accordance with the upper end of the UKCP18 allowance whilst discharging at a Q_{BAR} greenfield runoff rate.

Existing Greenfield Runoff

3.12 Pre-development greenfield runoff has been calculated using the ICP-SUDS Method in accordance with IH124. Results have been obtained for a notional 1 hectare are using the Source Control module within the industry standard Micro Drainage software.

3.13 The results of the calculations are included in Appendix B and it will be noted that the Q_{BAR} value for the site is 1.8 litres/sec/ha.

Discharge

3.14 In accordance with the NPPF to ensure no detrimental downstream effects, all storm events up to and including the 1 in 100 year storm plus an allowance of 40% for climate change shall be limited to a discharge rate not greater than that of Q_{BAR} at 1.8 l/s/ha.

3.15 The post-development impermeable areas have been measured from the Illustrative Layout plan and used to calculate the proposed flow rates. The total measured drained area is 1.752 ha and therefore, on this basis, the allowable discharge rate will be 1.8 l/s/ha x 1.752 ha = 3.1 l/s.

3.16 A surface water Micro Drainage model has been constructed detailing the proposed surface water network including SuDS features. Rainfall simulations have been conducted for storm events up to and including the 1 in 100 year event plus a 40% climate change allowance.

3.17 In accordance with CIRIA non-statutory guidance, an additional allowance has been made within the designed system to cater for a potential impermeable area increase of 10% to accommodate any future 'urban creep' of the private residential areas however, the above discharge rate is based on the actual measured area.

3.18 A full set of modelling results and calculations are included in Appendix B of this report together with the proposed drainage strategy layout plan.

Storage

3.19 In accordance with the NPPF all surplus flows generated onsite for storm events up to and including those of the 1 in 100 year event plus 40% for climate change allowance, must be retained within the site until such time as they are discharged. Further to this, no flooding is to be present in storms up to and including the 1 in 30 year event across the proposed drainage network.

3.20 Storage is to be provided primarily within two storage features comprising an attenuation basin located in the northern part of the site and an underground tank located in the south-west corner of the site. The depth of the drainage system in the south-west part of the site is some 3-4m deep and a basin of such a depth will cause issues with land take and health and safety therefore a tank system has been chosen.

3.21 The northern basin has a flow control in order to maximise the upstream storage potential. Flows are then conveyed downstream to the underground tank via a swale and piped system.

Sustainable Drainage Systems

3.22 In accordance with NPPF requirements, Sustainable Drainage Systems (SuDS) have been applied across the site where practicable.

3.23 These include the provision of an attenuation basin, a swale and permeable paving to significant areas of private hardstanding.

3.24 CIRIA document C753, chapter 26, recommends the use of the 'Simple Index Approach' for assessing the minimum water quality management requirements and this method has been used to check the suitability of the above proposals as follows;

(i) From table 26.2, residential roads and roof runoff is classified as 'low' pollution hazard.

(ii) From Table 26.2, the following hazard indices are applicable

Total suspended solids - 0.5

Metals - 0.4

Hydrocarbons - 0.4

(iii) From Table 26.3, the indicative SuDS mitigation indices for an attenuation basin are as follows

Total suspended solids - 0.5

Metals - 0.5

Hydrocarbons - 0.6

(iv) From Table 26.3, the indicative SuDS mitigation indices for permeable paving is as follows

Total suspended solids - 0.7

Metals - 0.6

Hydrocarbons - 0.6

(v) From Table 26.3, the indicative SuDS mitigation indices for swales are as follows

Total suspended solids - 0.5

Metals - 0.6

Hydrocarbons - 0.6

(vi) Where permeable paving is used on its own, the cumulative SuDS mitigation indices become

Total suspended solids - 0.7 = 0.70

Metals - 0.6 = 0.60

Hydrocarbons - 0.6 = 0.60

(vii) Where swales and permeable paving are used in conjunction with an attenuation basin, the cumulative SuDS mitigation indices become

Total suspended solids - 0.7 + (0.5 x 0.5) + (0.5 x 0.5) = 1.20

Metals - 0.6 + (0.6 x 0.5) + (0.5 x 0.4) = 1.05

Hydrocarbons - 0.6 + (0.6 x 0.5) + (0.5 x 0.4) = 1.05

3.25 From the above it can be seen that the provision of permeable paving only achieves the minimum pollution mitigation requirements whilst the use of permeable paving, swales and an attenuation basin in combination will exceed the required values and therefore provide the required mitigation.

Maintenance

3.26 The relevant drainage structures are to be offered for adoption to the local authorities. As such they will be maintained by the local authority.

3.27 All main sewers and manholes are to be constructed following the Sewer Sector Guidance and offered to Thames Water for adoption under a Section 104 Agreement of the Water Industries Act. As part of the Section 104 Agreement the attenuation basin and discharge swale will also be offered for adoption.

3.28 If the systems are not acceptable under a Section Agreement, then they shall remain private. A management company will be appointed by the developer and prior to this they shall be responsible for the maintenance of all systems.

Overland and Exceedance Flows

3.29 As demonstrated by the overland flows and exceedance drawing located in Appendix B, overland flows are directed towards the attenuation basin, swale, and open space areas.

4. FOUL WATER MANAGEMENT

Pre-Development

4.1 Public sewer maps obtained from Thames Water shows that there are public foul water sewers within the site boundaries and in the immediate vicinity.

4.2 A public 300mm diameter foul water sewer is shown in the eastern verge of Watling Road, flowing southwards. The sewer crosses Watling Road and enters the development area some 190m from the northern end of the site. This sewer crosses the development area in a south-west direction and runs parallel to the western boundary before exiting the site in the extreme south-west corner.

4.3 A secondary 225mm diameter public foul sewer enters the site on the western boundary from Watling Street, opposite the junction with Mount Drive.

4.4 It is anticipated that a 6m overall width easement will be associated with these existing sewers.

4.5 As described in Section 2.1 above, the development area is an existing greenfield site and therefore no foul flows are likely to be generated by the site in the pre-development scenario.

4.6 Therefore, it is concluded that no foul effluence is generated by the existing site.

Post-Development

4.7 In accordance with the Sewerage Sector Guidance as published by Water UK peak foul effluent flows should be calculated based on 4000l/dwelling/day.

4.8 As such peak foul effluent flows have been calculated based on 95 residential units giving a maximum rate of 4.4 l/s.

4.9 An existing public Thames Water foul sewer is located within the site boundaries and it is anticipated that connections will be made at various points along the system, preferably at existing manholes.

4.10 It is anticipated that all connections can be made by gravity.

4.11 Given that is a greenfield site, the site will generate additional flows and a Pre-Development Enquiry will be submitted to Thames Water to confirm capacity availability.

5. CONCLUSIONS

5.1 This report therefore demonstrates that provided a suitable, sustainable drainage system is employed, as described in this document, the proposed scheme:

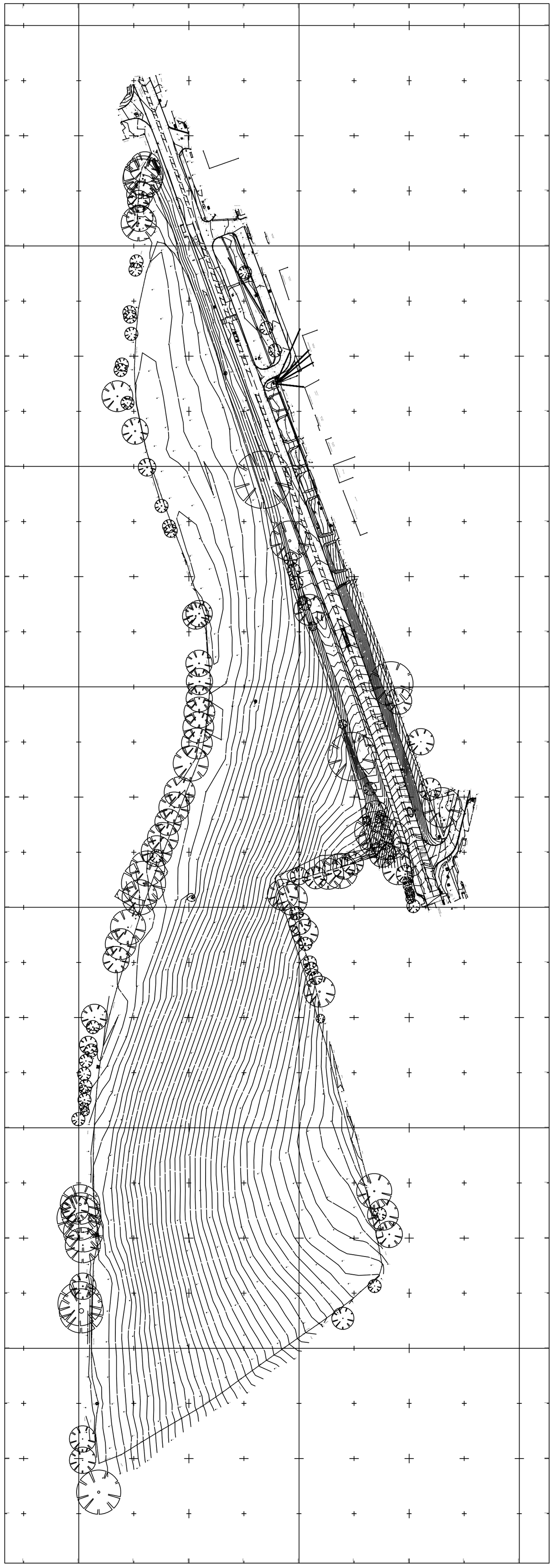
- Is suitable in the location proposed.
- Will be adequately flood resistant and resilient from surface water sources.
- Will not place additional persons at risk of flooding, and will offer a safe means of access and egress.
- Will not increase flood risk elsewhere as a result of the proposed development through the loss of floodplain storage or impedance of flood flows.
- Will put in place measures to ensure surface water is appropriately managed.

5.2 As such, the proposals are concluded to meet the surface water flood risk and management requirements of the NPPF.

Appendix A

Site Information

Reference	Title	Type	Originator
No Reference	Topographic Survey	Drawing	BB Surveys
SCT210806-IL-01-P3	Illustrative Layout - 01	Drawing	Thrive Architects
TL1404SE	Asset Location Sewer Map	Plan	Thames Water
TL1404NE	Asset Location Sewer Map	Plan	Thames Water



2219-2436 – Land West of Watling Street, St Albans 2D
All survey data to Ordnance Survey National Grid (OSTN15)

(Surveyed by BB Surveys 19th September 2020 using Trimble S8 & Trimble R10 GPS with VRS)

STATION TABLE

Station Name	Easting	Northing	Height (m)	Station Identifier
STNBBS1	514527.666	204876.337	75.953	Mag Nail & Washer
STNBBS2	514545.740	204817.140	75.505	Mag Nail & Washer
STNBBS3	514571.792	204758.928	75.635	Mag Nail & Washer
STNBBS4	514598.289	204697.352	75.573	Mag Nail & Washer
STNBBS5	514621.654	204622.358	77.420	Mag Nail & Washer
STNBBS6	514642.015	204549.346	81.187	Mag Nail & Washer
STNBBS7	514669.379	204499.325	83.964	Mag Nail & Washer

Control Stations have been forced to a Scale Factor of 1.

A0

PRIVATE

House Type	No of Bedrooms	SqFt	No	Total SqFt
2B.1	2	850	11	9350
2B BUNG	2	753	3	2259
3B.1	3	1001	22	22022
3B.3	3	1040	1	1040
3B.4	3	1180	2	2360
3B BUNG	3	1119	4	4476
4B.1	4	1375	11	15125
4B.2	4	1240	3	3720
TOTALS			57	60352

AFFORDABLE RENT

House Type	No of Bedrooms	SqFt	No	Total SqFt
1B FLAT	1	538	6	3228
1B BUNG	1	540	2	1080
2B FLAT	2	656	2	1312
2B FOG	2	656	1	656
2B FLAT	2	753	6	4518
2B BUNG	2	755	2	1510
3B5P	3	1001	7	7007
4B6P	4	1140	3	3420
TOTALS			29	22731

AFFORDABLE OWNERSHIP

House Type	No of Bedrooms	SqFt	No	Total SqFt
1B MAS	1	624	2	1248
2B4P	2	850	4	3400
3B5P	3	1001	3	3003
TOTALS			9	7651

SITE TOTALS	95	105814

- Site Boundary
- 26 Plot Number
- 2B House Type
- Affordable Rent
- Affordable Ownership
- Self Build
- Bus Stop
- 30 & 40mph Speed Zones
- Root Protection Area
- RW Retaining Wall
- POS Public Open Space
- VIS Visitor Parking
- BC Bin Collection
- SUDS Sustainable Drainage Systems

Romsey
T: 01794 367703
F: 01794 367276

Portishead
T: 01275 407000
F: 01794 367276

Camberley
T: 01276 749050
F: 01794 367276

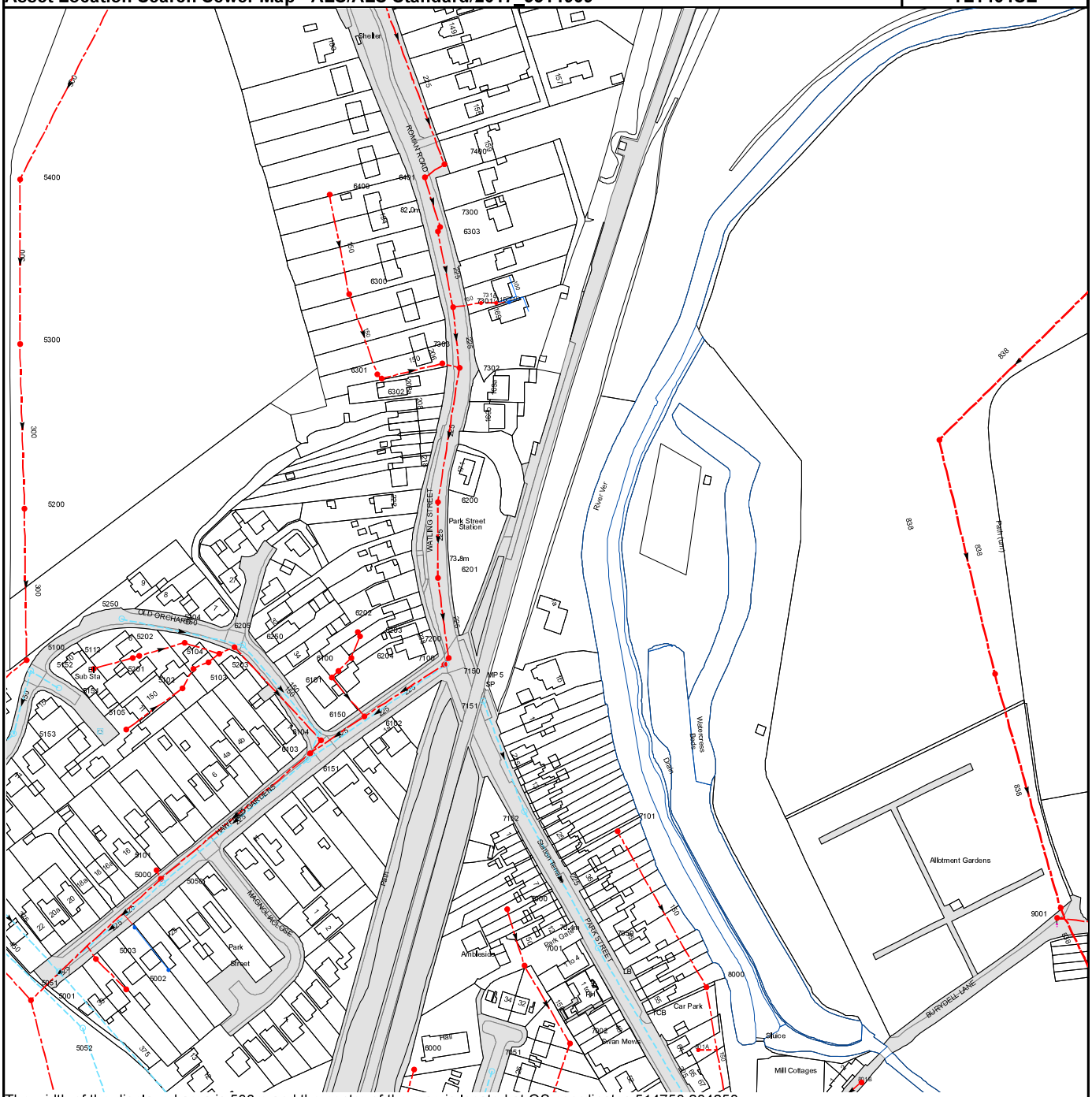
www.thrivearchitects.co.uk

Rev	Description	Date	Au	Ch
P1	Preliminary Issue	25.11.21	PR/AA	PR/--
P2	Added dormers to apartments, sub-station and moved signalised pedestrian crossing	08.12.21	PR/--	--/--
P3	Amendments to SuDS	13.12.21	PR/AA	PR/--

Project	Land West of Watling Street, Park Street
Drawing	Illustrative Layout - 01
Client	M SCOTT PROPERTIES LTD
Job no.	SCOT210806
Dwg no.	IL-01
Date	25.11.21
Rev.	P3
Author	PR/AA
Checked	PR/-
Scale	1:500@A0
Status	PRELIMINARY
Office	Romsey
Client ref.	-

thrive. architects

Asset Location Search Sewer Map - ALS/ALS Standard/2017_3514909	TL1404SE

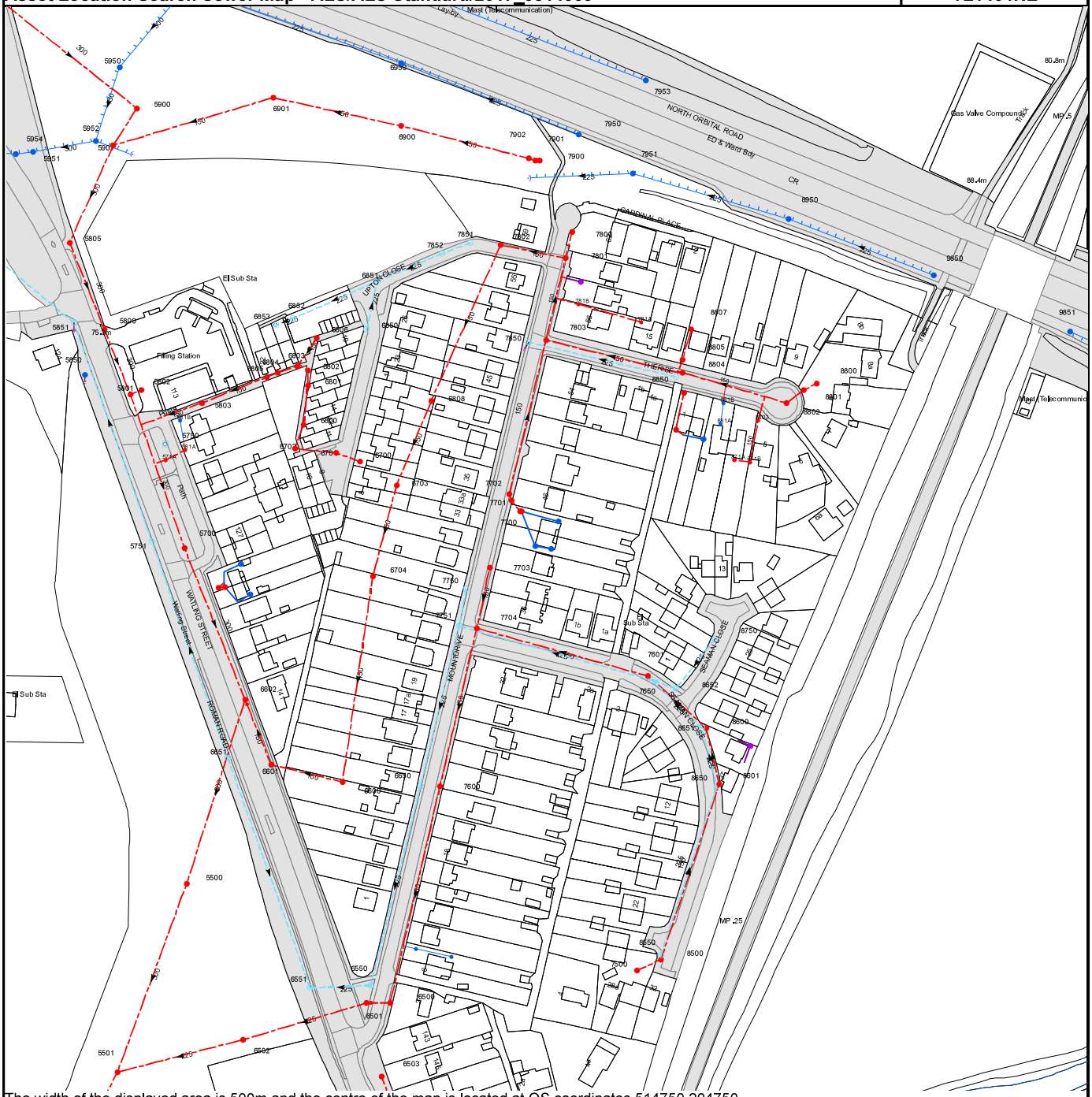


The width of the displayed area is 500m and the centre of the map is located at OS coordinates 514750,204250

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Asset Location Search Sewer Map - ALS/ALS Standard/2017_3514909

TL1404NE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 514750,204750

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

Appendix B

Surface Water Calculations

Reference	Title	Type	Originator
No Reference	Existing Greenfield Runoff	Calculation	Hydrock
20880.mdx	Proposed Surface Water Network	Calculation	Hydrock

ICP SUDS Mean Annual Flood

Input

Return Period (years) 100 SAAR (mm) 700 Urban 0.000
Area (ha) 1.000 Soil 0.300 Region Number Region 6

Results l/s

QBAR Rural 1.8
QBAR Urban 1.8

Q100 years 5.8

Q1 year 1.5
Q30 years 4.1
Q100 years 5.8

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.337	4-8	1.170	8-12	0.353

Total Area Contributing (ha) = 1.859

Total Pipe Volume (m³) = 884.513

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type
1.000	17.600	0.073	241.1	0.029	4.00	0.0	0.600		o	300	Pipe/Conduit
1.001	26.700	0.112	238.4	0.066	0.00	0.0	0.600		o	300	Pipe/Conduit
1.002	14.800	0.061	242.6	0.031	0.00	0.0	0.600		o	300	Pipe/Conduit
1.003	38.300	0.160	239.4	0.082	0.00	0.0	0.600		o	300	Pipe/Conduit
1.004	31.800	0.132	240.9	0.054	0.00	0.0	0.600		o	300	Pipe/Conduit
1.005	24.000	0.100	240.0	0.032	0.00	0.0	0.600		o	300	Pipe/Conduit
2.000	24.300	2.100	11.6	0.055	5.00	0.0	0.600		o	300	Pipe/Conduit
2.001	14.300	0.638	22.4	0.024	0.00	0.0	0.600		o	300	Pipe/Conduit
1.006	7.700	0.032	240.6	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit
1.007	8.500	0.035	242.9	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit
1.008	55.700	0.223	249.8	0.000	0.00	0.0		0.045	2 _/	300	1:2 Ditch
3.000	15.800	1.100	14.4	0.062	5.00	0.0	0.600		o	300	Pipe/Conduit
3.001	21.400	2.093	10.2	0.008	0.00	0.0	0.600		o	300	Pipe/Conduit
4.000	46.300	0.193	239.9	0.134	5.00	0.0	0.600		o	300	Pipe/Conduit
3.002	9.800	0.835	11.7	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit
1.009	65.500	0.872	75.1	0.000	0.00	0.0		0.045	2 _/	300	1:2 Ditch
1.010	23.400	0.097	241.2	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit
5.000	13.400	0.056	239.3	0.064	5.00	0.0	0.600		o	300	Pipe/Conduit
5.001	12.200	0.051	239.2	0.049	0.00	0.0	0.600		o	300	Pipe/Conduit
5.002	38.800	1.643	23.6	0.132	0.00	0.0	0.600		o	300	Pipe/Conduit
5.003	18.600	1.150	16.2	0.067	0.00	0.0	0.600		o	300	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
1.000	73.200	0.029	0.0	1.01	71.3
1.001	73.127	0.095	0.0	1.01	71.7
1.002	73.015	0.126	0.0	1.00	71.0
1.003	72.954	0.208	0.0	1.01	71.5
1.004	72.794	0.262	0.0	1.01	71.3
1.005	72.662	0.294	0.0	1.01	71.4
2.000	75.300	0.055	0.0	4.65	328.5
2.001	73.200	0.079	0.0	3.34	235.8
1.006	72.562	0.373	0.0	1.01	71.3
1.007	72.530	0.373	0.0	1.00	71.0
1.008	72.495	0.373	0.0	1.12	5567.1
3.000	76.300	0.062	0.0	4.17	294.7
3.001	75.200	0.070	0.0	4.94	349.5
4.000	73.300	0.134	0.0	1.01	71.4
3.002	73.107	0.204	0.0	4.61	326.2
1.009	72.272	0.577	0.0	2.39	19124.0
1.010	71.400	0.577	0.0	1.01	71.2
5.000	78.500	0.064	0.0	1.01	71.5
5.001	78.444	0.113	0.0	1.01	71.5
5.002	78.393	0.245	0.0	3.25	229.7
5.003	76.750	0.312	0.0	3.93	277.7

Existing Network Details for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type
5.004	23.700	2.050	11.6	0.044	0.00	0.0	0.600		o	300	Pipe/Conduit
5.005	13.100	0.750	17.5	0.101	0.00	0.0	0.600		o	300	Pipe/Conduit
5.006	28.300	0.118	239.8	0.064	0.00	0.0	0.600		o	450	Pipe/Conduit
5.007	30.600	1.379	22.2	0.045	0.00	0.0	0.600		o	450	Pipe/Conduit
1.011	26.100	0.216	120.8	0.052	0.00	0.0	0.600		o	450	Pipe/Conduit
1.012	20.700	0.051	405.9	0.042	0.00	0.0	0.600		o	450	Pipe/Conduit
1.013	23.700	0.060	395.0	0.043	0.00	0.0	0.600		o	450	Pipe/Conduit
1.014	27.800	0.069	402.9	0.032	0.00	0.0	0.600		o	450	Pipe/Conduit
6.000	22.000	0.092	239.1	0.041	5.00	0.0	0.600		o	300	Pipe/Conduit
6.001	35.200	0.308	114.3	0.108	0.00	0.0	0.600		o	300	Pipe/Conduit
6.002	15.900	2.000	8.0	0.151	0.00	0.0	0.600		o	300	Pipe/Conduit
6.003	25.400	2.000	12.7	0.006	0.00	0.0	0.600		o	300	Pipe/Conduit
6.004	6.800	3.293	2.1	0.021	0.00	0.0	0.600		o	300	Pipe/Conduit
1.015	29.300	0.073	401.4	0.056	0.00	0.0	0.600		o	450	Pipe/Conduit
1.016	16.900	0.043	393.0	0.039	0.00	0.0	0.600		o	450	Pipe/Conduit
1.017	8.200	0.021	390.5	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit
7.000	22.000	2.050	10.7	0.000	5.00	0.0	0.600		o	300	Pipe/Conduit
7.001	13.400	0.600	22.3	0.105	0.00	0.0	0.600		o	300	Pipe/Conduit
7.002	16.600	0.850	19.5	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit
7.003	15.500	3.580	4.3	0.020	0.00	0.0	0.600		o	300	Pipe/Conduit
1.018	6.600	0.016	412.5	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit
1.019	54.700	-0.186	-294.1	0.000	0.00	0.0	0.600		o	300	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
5.004	75.600	0.356	0.0	4.65	328.6
5.005	73.550	0.457	0.0	3.78	267.2
5.006	72.800	0.521	0.0	1.31	208.1
5.007	72.682	0.566	0.0	4.33	688.8
1.011	71.303	1.195	0.0	1.85	294.0
1.012	71.087	1.237	0.0	1.00	159.5
1.013	71.036	1.280	0.0	1.02	161.7
1.014	70.976	1.312	0.0	1.01	160.1
6.000	78.600	0.041	0.0	1.01	71.6
6.001	78.508	0.149	0.0	1.47	103.9
6.002	78.200	0.300	0.0	5.61	396.5
6.003	76.200	0.306	0.0	4.44	313.5
6.004	74.200	0.327	0.0	11.02	778.9
1.015	70.907	1.695	0.0	1.01	160.4
1.016	70.834	1.734	0.0	1.02	162.1
1.017	70.791	1.734	0.0	1.02	162.7
7.000	77.850	0.000	0.0	4.83	341.1
7.001	75.800	0.105	0.0	3.34	236.2
7.002	75.200	0.105	0.0	3.57	252.6
7.003	74.350	0.125	0.0	7.61	537.6
1.018	70.770	1.859	0.0	0.99	158.2
1.019	70.754	1.859	0.0	0.00	0.0

PIPELINE SCHEDULES for Storm

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)
1.000	o	300	1	74.700	73.200	1.200	Open Manhole	1200
1.001	o	300	2	74.600	73.127	1.173	Open Manhole	1200
1.002	o	300	3	74.400	73.015	1.085	Open Manhole	1200
1.003	o	300	4	74.300	72.954	1.046	Open Manhole	1200
1.004	o	300	5	74.300	72.794	1.206	Open Manhole	1200
1.005	o	300	6	75.000	72.662	2.038	Open Manhole	1200
2.000	o	300	7	76.800	75.300	1.200	Open Manhole	1200
2.001	o	300	8	75.150	73.200	1.650	Open Manhole	1200
1.006	o	300	9	74.000	72.562	1.138	Open Manhole	1200
1.007	o	300	10	74.000	72.530	1.170	Open Manhole	1200
1.008	2 _/	300	11	74.000	72.495	1.205	Open Manhole	1200
3.000	o	300	12	77.800	76.300	1.200	Open Manhole	1200
3.001	o	300	13	76.700	75.200	1.200	Open Manhole	1200
4.000	o	300	14	74.800	73.300	1.200	Open Manhole	1200
3.002	o	300	15	74.800	73.107	1.393	Open Manhole	1200
1.009	2 _/	300	16	74.200	72.272	1.628	Open Manhole	2653
1.010	o	300	17	73.700	71.400	2.000	Junction	
5.000	o	300	18	80.100	78.500	1.300	Open Manhole	1200
5.001	o	300	19	80.100	78.444	1.356	Open Manhole	1200
5.002	o	300	20	79.900	78.393	1.207	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)
1.000	17.600	241.1	2	74.600	73.127	1.173	Open Manhole	1200
1.001	26.700	238.4	3	74.400	73.015	1.085	Open Manhole	1200
1.002	14.800	242.6	4	74.300	72.954	1.046	Open Manhole	1200
1.003	38.300	239.4	5	74.300	72.794	1.206	Open Manhole	1200
1.004	31.800	240.9	6	75.000	72.662	2.038	Open Manhole	1200
1.005	24.000	240.0	9	74.000	72.562	1.138	Open Manhole	1200
2.000	24.300	11.6	8	75.150	73.200	1.650	Open Manhole	1200
2.001	14.300	22.4	9	74.000	72.562	1.138	Open Manhole	1200
1.006	7.700	240.6	10	74.000	72.530	1.170	Open Manhole	1200
1.007	8.500	242.9	11	74.000	72.495	1.205	Open Manhole	1200
1.008	55.700	249.8	16	74.200	72.272	1.628	Open Manhole	2653
3.000	15.800	14.4	13	76.700	75.200	1.200	Open Manhole	1200
3.001	21.400	10.2	15	74.800	73.107	1.393	Open Manhole	1200
4.000	46.300	239.9	15	74.800	73.107	1.393	Open Manhole	1200
3.002	9.800	11.7	16	74.200	72.272	1.628	Open Manhole	2653
1.009	65.500	75.1	17	73.700	71.400	2.000	Junction	
1.010	23.400	241.2	26	74.000	71.303	2.397	Open Manhole	1200
5.000	13.400	239.3	19	80.100	78.444	1.356	Open Manhole	1200
5.001	12.200	239.2	20	79.900	78.393	1.207	Open Manhole	1200
5.002	38.800	23.6	21	78.250	76.750	1.200	Open Manhole	1200

PIPELINE SCHEDULES for Storm

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)
5.003	o	300	21	78.250	76.750	1.200	Open Manhole	1200
5.004	o	300	22	77.700	75.600	1.800	Open Manhole	1200
5.005	o	300	23	75.050	73.550	1.200	Open Manhole	1200
5.006	o	450	24	74.300	72.800	1.050	Open Manhole	1200
5.007	o	450	25	74.100	72.682	0.968	Open Manhole	1200
1.011	o	450	26	74.000	71.303	2.247	Open Manhole	1200
1.012	o	450	27	74.500	71.087	2.963	Open Manhole	1200
1.013	o	450	28	74.500	71.036	3.014	Open Manhole	1200
1.014	o	450	29	74.400	70.976	2.974	Open Manhole	4175
6.000	o	300	30	80.100	78.600	1.200	Open Manhole	1200
6.001	o	300	31	80.150	78.508	1.342	Open Manhole	1200
6.002	o	300	32	79.700	78.200	1.200	Open Manhole	1200
6.003	o	300	33	77.700	76.200	1.200	Open Manhole	1200
6.004	o	300	34	75.700	74.200	1.200	Open Manhole	1200
1.015	o	450	35	75.100	70.907	3.743	Open Manhole	1200
1.016	o	450	36	75.500	70.834	4.216	Open Manhole	1200
1.017	o	450	37	74.900	70.791	3.659	Open Manhole	1200
7.000	o	300	38	79.350	77.850	1.200	Open Manhole	1200
7.001	o	300	39	77.300	75.800	1.200	Open Manhole	1200
7.002	o	300	40	76.700	75.200	1.200	Open Manhole	1200
7.003	o	300	41	75.850	74.350	1.200	Open Manhole	1200
1.018	o	450	42	74.000	70.770	2.780	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)
5.003	18.600	16.2	22	77.700	75.600	1.800	Open Manhole	1200
5.004	23.700	11.6	23	75.050	73.550	1.200	Open Manhole	1200
5.005	13.100	17.5	24	74.300	72.800	1.200	Open Manhole	1200
5.006	28.300	239.8	25	74.100	72.682	0.968	Open Manhole	1200
5.007	30.600	22.2	26	74.000	71.303	2.247	Open Manhole	1200
1.011	26.100	120.8	27	74.500	71.087	2.963	Open Manhole	1200
1.012	20.700	405.9	28	74.500	71.036	3.014	Open Manhole	1200
1.013	23.700	395.0	29	74.400	70.976	2.974	Open Manhole	4175
1.014	27.800	402.9	35	75.100	70.907	3.743	Open Manhole	1200
6.000	22.000	239.1	31	80.150	78.508	1.342	Open Manhole	1200
6.001	35.200	114.3	32	79.700	78.200	1.200	Open Manhole	1200
6.002	15.900	8.0	33	77.700	76.200	1.200	Open Manhole	1200
6.003	25.400	12.7	34	75.700	74.200	1.200	Open Manhole	1200
6.004	6.800	2.1	35	75.100	70.907	3.893	Open Manhole	1200
1.015	29.300	401.4	36	75.500	70.834	4.216	Open Manhole	1200
1.016	16.900	393.0	37	74.900	70.791	3.659	Open Manhole	1200
1.017	8.200	390.5	42	74.000	70.770	2.780	Open Manhole	1200
7.000	22.000	10.7	39	77.300	75.800	1.200	Open Manhole	1200
7.001	13.400	22.3	40	76.700	75.200	1.200	Open Manhole	1200
7.002	16.600	19.5	41	75.850	74.350	1.200	Open Manhole	1200
7.003	15.500	4.3	42	74.000	70.770	2.930	Open Manhole	1200
1.018	6.600	412.5	43	74.300	70.754	3.096	Open Manhole	1200

PIPELINE SCHEDULES for Storm

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)
1.019	o	300	43	74.300	70.754	3.246	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)
1.019	54.700	-294.1		72.160	70.940	0.920	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.029	0.029	0.029
1.001	-	-	100	0.066	0.066	0.066
1.002	-	-	100	0.031	0.031	0.031
1.003	-	-	100	0.082	0.082	0.082
1.004	-	-	100	0.054	0.054	0.054
1.005	-	-	100	0.032	0.032	0.032
2.000	-	-	100	0.055	0.055	0.055
2.001	-	-	100	0.024	0.024	0.024
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.062	0.062	0.062
3.001	-	-	100	0.008	0.008	0.008
4.000	-	-	100	0.134	0.134	0.134
3.002	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.064	0.064	0.064
5.001	-	-	100	0.049	0.049	0.049
5.002	-	-	100	0.132	0.132	0.132
5.003	-	-	100	0.067	0.067	0.067
5.004	-	-	100	0.044	0.044	0.044
5.005	-	-	100	0.101	0.101	0.101
5.006	-	-	100	0.064	0.064	0.064
5.007	-	-	100	0.045	0.045	0.045
1.011	-	-	100	0.052	0.052	0.052
1.012	-	-	100	0.042	0.042	0.042
1.013	-	-	100	0.043	0.043	0.043
1.014	-	-	100	0.032	0.032	0.032
6.000	-	-	100	0.041	0.041	0.041
6.001	-	-	100	0.108	0.108	0.108
6.002	-	-	100	0.151	0.151	0.151
6.003	-	-	100	0.006	0.006	0.006
6.004	-	-	100	0.021	0.021	0.021
1.015	-	-	100	0.056	0.056	0.056
1.016	-	-	100	0.039	0.039	0.039
1.017	-	-	100	0.000	0.000	0.000
7.000	-	-	100	0.000	0.000	0.000
7.001	-	-	100	0.105	0.105	0.105
7.002	-	-	100	0.000	0.000	0.000
7.003	-	-	100	0.020	0.020	0.020
1.018	-	-	100	0.000	0.000	0.000
1.019	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.859	1.859	1.859

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 2

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840
Ratio R	0.423	Storm Duration (mins)	30
Profile Type	Summer		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 10, DS/PN: 1.007, Volume (m³): 2.1

Unit Reference	MD-SHE-0047-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	72.530
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.0	Kick-Flo®	0.415	0.7
Flush-Flo™	0.205	0.8	Mean Flow over Head Range	-	0.8

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)	Depth (m)	Flow (l/s)
0.100	0.8	0.800	0.9	2.000	1.4	4.000	1.9	7.000	2.4
0.200	0.8	1.000	1.0	2.200	1.4	4.500	2.0	7.500	2.5
0.300	0.8	1.200	1.1	2.400	1.5	5.000	2.1	8.000	2.6
0.400	0.7	1.400	1.2	2.600	1.5	5.500	2.2	8.500	2.7
0.500	0.7	1.600	1.2	3.000	1.6	6.000	2.3	9.000	2.7
0.600	0.8	1.800	1.3	3.500	1.8	6.500	2.3	9.500	2.8

Hydro-Brake® Optimum Manhole: 43, DS/PN: 1.019, Volume (m³): 4.9

Unit Reference	MD-SHE-0066-3100-2700-3100
Design Head (m)	2.700
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	66
Invert Level (m)	70.754
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.700	3.1	Kick-Flo®	0.593	1.6
Flush-Flo™	0.290	1.9	Mean Flow over Head Range	-	2.3

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)	Depth (m)	Flow (l/s)
0.100	1.6	0.800	1.8	2.000	2.7	4.000	3.7	7.000	4.8
0.200	1.9	1.000	2.0	2.200	2.8	4.500	3.9	7.500	5.0
0.300	1.9	1.200	2.1	2.400	2.9	5.000	4.1	8.000	5.1
0.400	1.9	1.400	2.3	2.600	3.0	5.500	4.3	8.500	5.3
0.500	1.8	1.600	2.4	3.000	3.2	6.000	4.5	9.000	5.4
0.600	1.6	1.800	2.6	3.500	3.5	6.500	4.7	9.500	5.6

Storage Structures for Storm

Tank or Pond Manhole: 9, DS/PN: 1.006

Invert Level (m) 72.562

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	199.0	1.200	442.0	2.400	442.0	3.600	442.0	4.800	442.0
0.200	254.0	1.400	442.0	2.600	442.0	3.800	442.0	5.000	442.0
0.400	312.0	1.600	442.0	2.800	442.0	4.000	442.0		
0.600	375.0	1.800	442.0	3.000	442.0	4.200	442.0		
0.800	442.0	2.000	442.0	3.200	442.0	4.400	442.0		
1.000	442.0	2.200	442.0	3.400	442.0	4.600	442.0		

Tank or Pond Manhole: 42, DS/PN: 1.018

Invert Level (m) 70.770

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	300.0	1.200	300.0	2.400	0.0	3.600	0.0	4.800	0.0
0.200	300.0	1.400	300.0	2.600	0.0	3.800	0.0	5.000	0.0
0.400	300.0	1.600	300.0	2.800	0.0	4.000	0.0		
0.600	300.0	1.800	300.0	3.000	0.0	4.200	0.0		
0.800	300.0	2.000	300.0	3.200	0.0	4.400	0.0		
1.000	300.0	2.001	0.0	3.400	0.0	4.600	0.0		

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm) 20.000 Cv (Summer)	0.750
Region England and Wales		Ratio R 0.423 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	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)
1.000	1	15 Winter	1	+0%	100/15 Summer				73.258
1.001	2	15 Winter	1	+0%	100/15 Summer				73.216
1.002	3	15 Winter	1	+0%	30/15 Summer				73.124
1.003	4	15 Winter	1	+0%	30/15 Summer	100/15 Summer			73.082
1.004	5	15 Winter	1	+0%	30/15 Summer				72.938
1.005	6	15 Winter	1	+0%	30/15 Summer				72.817
2.000	7	15 Winter	1	+0%					75.333
2.001	8	15 Winter	1	+0%	100/2160 Winter				73.245
1.006	9	480 Winter	1	+0%	30/30 Winter				72.788
1.007	10	480 Winter	1	+0%	30/30 Summer				72.787
1.008	11	960 Summer	1	+0%					72.511
3.000	12	15 Winter	1	+0%					76.337
3.001	13	15 Winter	1	+0%					75.235
4.000	14	15 Winter	1	+0%	100/15 Summer				73.409
3.002	15	15 Winter	1	+0%	100/960 Winter				73.177
1.009	16	15 Winter	1	+0%					72.386
1.010	17	2880 Winter	1	+0%	1/1440 Winter				71.754
5.000	18	15 Winter	1	+0%	100/15 Winter				78.584
5.001	19	15 Winter	1	+0%	100/15 Summer				78.548
5.002	20	15 Winter	1	+0%					78.469
5.003	21	15 Winter	1	+0%					76.831
5.004	22	15 Winter	1	+0%	100/15 Summer				75.678
5.005	23	15 Winter	1	+0%	100/15 Summer	100/15 Winter			73.654
5.006	24	15 Winter	1	+0%	100/15 Summer				72.986
5.007	25	15 Winter	1	+0%	100/15 Summer				72.783
1.011	26	2880 Winter	1	+0%	1/2880 Winter				71.754
1.012	27	2880 Winter	1	+0%	1/480 Winter				71.754
1.013	28	2880 Winter	1	+0%	1/360 Winter				71.753
1.014	29	2880 Winter	1	+0%	1/240 Winter				71.752
6.000	30	15 Winter	1	+0%					78.661
6.001	31	15 Winter	1	+0%					78.598
6.002	32	15 Winter	1	+0%					78.266

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.242	0.000	0.07		4.4	OK	
1.001	2	-0.211	0.000	0.19		12.2	OK	
1.002	3	-0.191	0.000	0.26		15.7	OK	
1.003	4	-0.172	0.000	0.37		24.8	OK	2
1.004	5	-0.156	0.000	0.46		30.1	OK	
1.005	6	-0.145	0.000	0.52		33.2	OK	
2.000	7	-0.267	0.000	0.03		7.8	OK	
2.001	8	-0.255	0.000	0.05		10.6	OK	
1.006	9	-0.074	0.000	0.02		0.9	OK	
1.007	10	-0.043	0.000	0.02		0.8	OK	
1.008	11	-1.489	0.000	0.00		0.8	OK	
3.000	12	-0.263	0.000	0.04		8.8	OK	
3.001	13	-0.265	0.000	0.03		9.7	OK	
4.000	14	-0.191	0.000	0.27		18.4	OK	
3.002	15	-0.230	0.000	0.12		28.1	OK	
1.009	16	-1.814	0.000	0.00		28.1	OK	
1.010	17	0.054	0.000	0.02		1.6	SURCHARGED*	
5.000	18	-0.216	0.000	0.15		9.1	OK	
5.001	19	-0.196	0.000	0.26		14.9	OK	
5.002	20	-0.224	0.000	0.14		30.6	OK	
5.003	21	-0.219	0.000	0.16		38.7	OK	
5.004	22	-0.222	0.000	0.15		44.0	OK	
5.005	23	-0.196	0.000	0.26		56.1	OK	1
5.006	24	-0.264	0.000	0.36		63.4	OK	
5.007	25	-0.349	0.000	0.12		68.3	OK	
1.011	26	0.001	0.000	0.02		4.4	SURCHARGED	
1.012	27	0.217	0.000	0.03		4.5	SURCHARGED	
1.013	28	0.267	0.000	0.03		4.6	SURCHARGED	
1.014	29	0.326	0.000	0.03		4.5	SURCHARGED	
6.000	30	-0.239	0.000	0.09		5.7	OK	
6.001	31	-0.210	0.000	0.20		18.6	OK	
6.002	32	-0.234	0.000	0.11		36.6	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
6.003	33	15 Winter	1	+0%					76.273	-0.227
6.004	34	15 Winter	1	+0%					74.260	-0.240
1.015	35	2880 Winter	1	+0%	1/180 Winter				71.753	0.396
1.016	36	2880 Winter	1	+0%	1/120 Winter				71.752	0.468
1.017	37	2880 Winter	1	+0%	1/120 Summer				71.752	0.511
7.000	38	180 Winter	1	+0%					77.850	-0.300
7.001	39	15 Winter	1	+0%					75.850	-0.250
7.002	40	15 Winter	1	+0%					75.247	-0.253
7.003	41	15 Winter	1	+0%					74.386	-0.264
1.018	42	2880 Winter	1	+0%	1/60 Winter				71.752	0.532
1.019	43	2880 Winter	1	+0%	1/15 Summer				72.030	0.976

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.003	33	0.000	0.13		37.4	OK	
6.004	34	0.000	0.09		39.9	OK	
1.015	35	0.000	0.04		6.2	SURCHARGED	
1.016	36	0.000	0.05		6.3	SURCHARGED	
1.017	37	0.000	0.07		6.3	SURCHARGED	
7.000	38	0.000	0.00		0.0	OK	
7.001	39	0.000	0.07		12.7	OK	
7.002	40	0.000	0.06		12.5	OK	
7.003	41	0.000	0.03		15.0	OK	
1.018	42	0.000	0.18		18.8	SURCHARGED	
1.019	43	0.000	0.06		1.9	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm) 20.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.423	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	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)
1.000	1	15 Winter	30	+0%	100/15 Summer				73.382
1.001	2	15 Winter	30	+0%	100/15 Summer				73.374
1.002	3	15 Winter	30	+0%	30/15 Summer				73.343
1.003	4	15 Winter	30	+0%	30/15 Summer	100/15 Summer			73.311
1.004	5	15 Winter	30	+0%	30/15 Summer				73.181
1.005	6	960 Winter	30	+0%	30/15 Summer				73.065
2.000	7	15 Winter	30	+0%					75.350
2.001	8	15 Winter	30	+0%	100/2160 Winter				73.275
1.006	9	960 Winter	30	+0%	30/30 Winter				73.064
1.007	10	960 Winter	30	+0%	30/30 Summer				73.149
1.008	11	2880 Winter	30	+0%					72.618
3.000	12	15 Winter	30	+0%					76.360
3.001	13	15 Winter	30	+0%					75.257
4.000	14	15 Winter	30	+0%	100/15 Summer				73.486
3.002	15	15 Winter	30	+0%	100/960 Winter				73.221
1.009	16	2880 Winter	30	+0%					72.618
1.010	17	2880 Winter	30	+0%	1/1440 Winter				72.618
5.000	18	15 Winter	30	+0%	100/15 Winter				78.654
5.001	19	15 Winter	30	+0%	100/15 Summer				78.630
5.002	20	15 Winter	30	+0%					78.529
5.003	21	15 Winter	30	+0%					76.896
5.004	22	15 Winter	30	+0%	100/15 Summer				75.741
5.005	23	15 Winter	30	+0%	100/15 Summer	100/15 Winter			73.749
5.006	24	15 Winter	30	+0%	100/15 Summer				73.250
5.007	25	15 Winter	30	+0%	100/15 Summer				72.865
1.011	26	2880 Winter	30	+0%	1/2880 Winter				72.618
1.012	27	2880 Winter	30	+0%	1/480 Winter				72.618
1.013	28	2880 Winter	30	+0%	1/360 Winter				72.617
1.014	29	2880 Winter	30	+0%	1/240 Winter				72.616
6.000	30	15 Winter	30	+0%					78.710
6.001	31	15 Winter	30	+0%					78.670
6.002	32	15 Winter	30	+0%					78.318

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.118	0.000	0.17		10.3	OK	
1.001	2	-0.053	0.000	0.49		31.7	OK	
1.002	3	0.028	0.000	0.62		37.1	SURCHARGED	
1.003	4	0.057	0.000	0.91		60.1	SURCHARGED	2
1.004	5	0.087	0.000	1.12		72.8	SURCHARGED	
1.005	6	0.103	0.000	0.09		6.0	SURCHARGED	
2.000	7	-0.250	0.000	0.07		19.2	OK	
2.001	8	-0.225	0.000	0.14		27.9	OK	
1.006	9	0.202	0.000	0.06		3.0	SURCHARGED	
1.007	10	0.319	0.000	0.02		0.8	SURCHARGED	
1.008	11	-1.382	0.000	0.00		0.8	OK	
3.000	12	-0.240	0.000	0.09		21.6	OK	
3.001	13	-0.243	0.000	0.08		24.4	OK	
4.000	14	-0.114	0.000	0.67		45.2	OK	
3.002	15	-0.186	0.000	0.30		69.4	OK	
1.009	16	-1.582	0.000	0.00		2.6	OK	
1.010	17	0.918	0.000	0.03		2.2	SURCHARGED*	
5.000	18	-0.146	0.000	0.38		22.3	OK	
5.001	19	-0.114	0.000	0.69		40.0	OK	
5.002	20	-0.164	0.000	0.42		88.8	OK	
5.003	21	-0.154	0.000	0.47		113.4	OK	
5.004	22	-0.159	0.000	0.44		129.2	OK	
5.005	23	-0.101	0.000	0.77		166.0	OK	1
5.006	24	0.000	0.000	1.04		184.9	OK	
5.007	25	-0.267	0.000	0.34		201.7	OK	
1.011	26	0.865	0.000	0.03		6.9	SURCHARGED	
1.012	27	1.081	0.000	0.05		7.1	SURCHARGED	
1.013	28	1.131	0.000	0.06		7.4	SURCHARGED	
1.014	29	1.190	0.000	0.05		7.3	SURCHARGED	
6.000	30	-0.190	0.000	0.22		14.0	OK	
6.001	31	-0.138	0.000	0.55		53.0	OK	
6.002	32	-0.182	0.000	0.32		108.7	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
6.003	33	15 Winter	30	+0%					76.332	-0.168
6.004	34	15 Winter	30	+0%					74.304	-0.196
1.015	35	2880 Winter	30	+0%	1/180 Winter				72.617	1.260
1.016	36	2880 Winter	30	+0%	1/120 Winter				72.616	1.332
1.017	37	2880 Winter	30	+0%	1/120 Summer				72.615	1.374
7.000	38	180 Winter	30	+0%					77.850	-0.300
7.001	39	15 Winter	30	+0%					75.891	-0.209
7.002	40	15 Winter	30	+0%					75.286	-0.214
7.003	41	15 Summer	30	+0%					74.414	-0.236
1.018	42	2880 Winter	30	+0%	1/60 Winter				72.614	1.394
1.019	43	2880 Winter	30	+0%	1/15 Summer				72.892	1.838

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.003	33	0.000	0.39		110.2	OK	
6.004	34	0.000	0.26		117.2	OK	
1.015	35	0.000	0.08		10.5	SURCHARGED	
1.016	36	0.000	0.09		10.8	SURCHARGED	
1.017	37	0.000	0.11		10.7	SURCHARGED	
7.000	38	0.000	0.00		0.0	OK	
7.001	39	0.000	0.20		39.2	OK	
7.002	40	0.000	0.18		39.2	OK	
7.003	41	0.000	0.10		46.6	OK	
1.018	42	0.000	0.09		9.4	SURCHARGED	
1.019	43	0.000	0.07		2.4	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.000
Region	England and Wales	Ratio R	0.423
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	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)
1.000	1	15 Winter	100	+40%	100/15 Summer				74.483
1.001	2	15 Winter	100	+40%	100/15 Summer				74.466
1.002	3	15 Winter	100	+40%	30/15 Summer				74.387
1.003	4	15 Winter	100	+40%	30/15 Summer	100/15 Summer			74.301
1.004	5	15 Winter	100	+40%	30/15 Summer				73.943
1.005	6	2880 Winter	100	+40%	30/15 Summer				73.542
2.000	7	15 Winter	100	+40%					75.369
2.001	8	2880 Winter	100	+40%	100/2160 Winter				73.542
1.006	9	2880 Winter	100	+40%	30/30 Winter				73.542
1.007	10	2160 Winter	100	+40%	30/30 Summer				73.681
1.008	11	2160 Winter	100	+40%					73.575
3.000	12	15 Winter	100	+40%					76.380
3.001	13	15 Winter	100	+40%					75.276
4.000	14	15 Winter	100	+40%	100/15 Summer				73.709
3.002	15	2160 Winter	100	+40%	100/960 Winter				73.576
1.009	16	2160 Winter	100	+40%					73.575
1.010	17	2160 Winter	100	+40%	1/1440 Winter				73.575
5.000	18	15 Winter	100	+40%	100/15 Winter				78.801
5.001	19	15 Winter	100	+40%	100/15 Summer				78.766
5.002	20	15 Winter	100	+40%					78.591
5.003	21	15 Winter	100	+40%					76.996
5.004	22	15 Winter	100	+40%	100/15 Summer				76.188
5.005	23	15 Winter	100	+40%	100/15 Summer	100/15 Winter			75.051
5.006	24	15 Winter	100	+40%	100/15 Summer				73.962
5.007	25	15 Winter	100	+40%	100/15 Summer				73.625
1.011	26	2160 Winter	100	+40%	1/2880 Winter				73.575
1.012	27	2160 Winter	100	+40%	1/480 Winter				73.576
1.013	28	2160 Winter	100	+40%	1/360 Winter				73.575
1.014	29	2160 Winter	100	+40%	1/240 Winter				73.574
6.000	30	15 Winter	100	+40%					78.802
6.001	31	15 Winter	100	+40%					78.775
6.002	32	15 Winter	100	+40%					78.366

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.983	0.000	0.25		15.2	FLOOD RISK	
1.001	2	1.039	0.000	0.79		50.6	FLOOD RISK	
1.002	3	1.072	0.000	1.11		66.0	FLOOD RISK	
1.003	4	1.047	0.725	1.57		104.0	FLOOD	2
1.004	5	0.849	0.000	1.99		129.7	SURCHARGED	
1.005	6	0.580	0.000	0.07		4.3	SURCHARGED	
2.000	7	-0.231	0.000	0.12		34.9	OK	
2.001	8	0.042	0.000	0.01		1.2	SURCHARGED	
1.006	9	0.680	0.000	0.12		6.1	SURCHARGED	
1.007	10	0.851	0.000	0.02		0.8	SURCHARGED	
1.008	11	-0.425	0.000	0.00		0.8	OK	
3.000	12	-0.220	0.000	0.16		39.3	OK	
3.001	13	-0.224	0.000	0.14		44.4	OK	
4.000	14	0.109	0.000	1.23		82.2	SURCHARGED	
3.002	15	0.169	0.000	0.02		4.0	SURCHARGED	
1.009	16	-0.625	0.000	0.00		4.4	OK	
1.010	17	1.875	0.000	0.11		7.6	FLOOD RISK*	
5.000	18	0.001	0.000	0.69		40.5	SURCHARGED	
5.001	19	0.022	0.000	1.26		73.3	SURCHARGED	
5.002	20	-0.102	0.000	0.76		162.0	OK	
5.003	21	-0.054	0.000	0.86		205.4	OK	
5.004	22	0.288	0.000	0.76		222.6	SURCHARGED	
5.005	23	1.201	0.526	1.30		282.0	FLOOD	1
5.006	24	0.712	0.000	1.75		310.6	SURCHARGED	
5.007	25	0.493	0.000	0.55		328.9	SURCHARGED	
1.011	26	1.822	0.000	0.04		10.0	SURCHARGED	
1.012	27	2.039	0.000	0.08		10.5	SURCHARGED	
1.013	28	2.089	0.000	0.08		11.1	SURCHARGED	
1.014	29	2.148	0.000	0.08		10.8	SURCHARGED	
6.000	30	-0.098	0.000	0.41		25.7	OK	
6.001	31	-0.033	0.000	0.99		94.8	OK	
6.002	32	-0.134	0.000	0.59		196.5	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
6.003	33	15 Winter	100	+40%					76.389	-0.111
6.004	34	15 Winter	100	+40%					74.345	-0.155
1.015	35	2160 Winter	100	+40%	1/180 Winter				73.574	2.217
1.016	36	2160 Winter	100	+40%	1/120 Winter				73.573	2.289
1.017	37	2160 Winter	100	+40%	1/120 Summer				73.572	2.331
7.000	38	180 Winter	100	+40%					77.850	-0.300
7.001	39	15 Winter	100	+40%					75.925	-0.175
7.002	40	15 Winter	100	+40%					75.319	-0.181
7.003	41	15 Summer	100	+40%					74.437	-0.213
1.018	42	2160 Winter	100	+40%	1/60 Winter				73.571	2.351
1.019	43	2160 Winter	100	+40%	1/15 Summer				73.570	2.516

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.003	33	0.000	0.71		199.7	OK	
6.004	34	0.000	0.47		212.7	OK	
1.015	35	0.000	0.12		16.7	SURCHARGED	
1.016	36	0.000	0.15		17.3	SURCHARGED	
1.017	37	0.000	0.18		17.3	SURCHARGED	
7.000	38	0.000	0.00		0.0	OK	
7.001	39	0.000	0.37		71.2	OK	
7.002	40	0.000	0.33		71.2	OK	
7.003	41	0.000	0.19		84.8	OK	
1.018	42	0.000	0.18		19.2	SURCHARGED	
1.019	43	0.000	0.09		3.0	SURCHARGED	

Appendix C

Drainage Strategy

Reference	Title	Type	Originator
20880-HYD-XX-XX-DR-D-2200-P02	Foul & Surface Water Drainage Strategy	Drawing	Hydrock
20880-HYD-XX-XX-DR-D-2201-P01	Exceedance Flow Routes	Drawing	Hydrock

Key

- Existing public foul sewer
- Existing public surface water sewer
- Proposed surface water sewer
- Proposed foul water sewer
- Proposed permeable paving
- Proposed underground attenuation tank
- Proposed attenuation basin

REVISIONS

Rev	Date	Description	By	Ckd	App
P02	07/12/21	Redrawn.	RJH		
P01	14/09/21	First Issue.	SBH	RJH	RJH

Hydrock
OVER COURT BARNS
OVER LANE
ALMONDSBURY
BRISTOL
BS32 4DF
t: +44 (0) 1454 619533
e: bristol@hydrock.com

CLIENT
M Scott Properties Ltd
Ms T Sutton
Ms T Good
Mr W Hughes
Mr J Hughes.

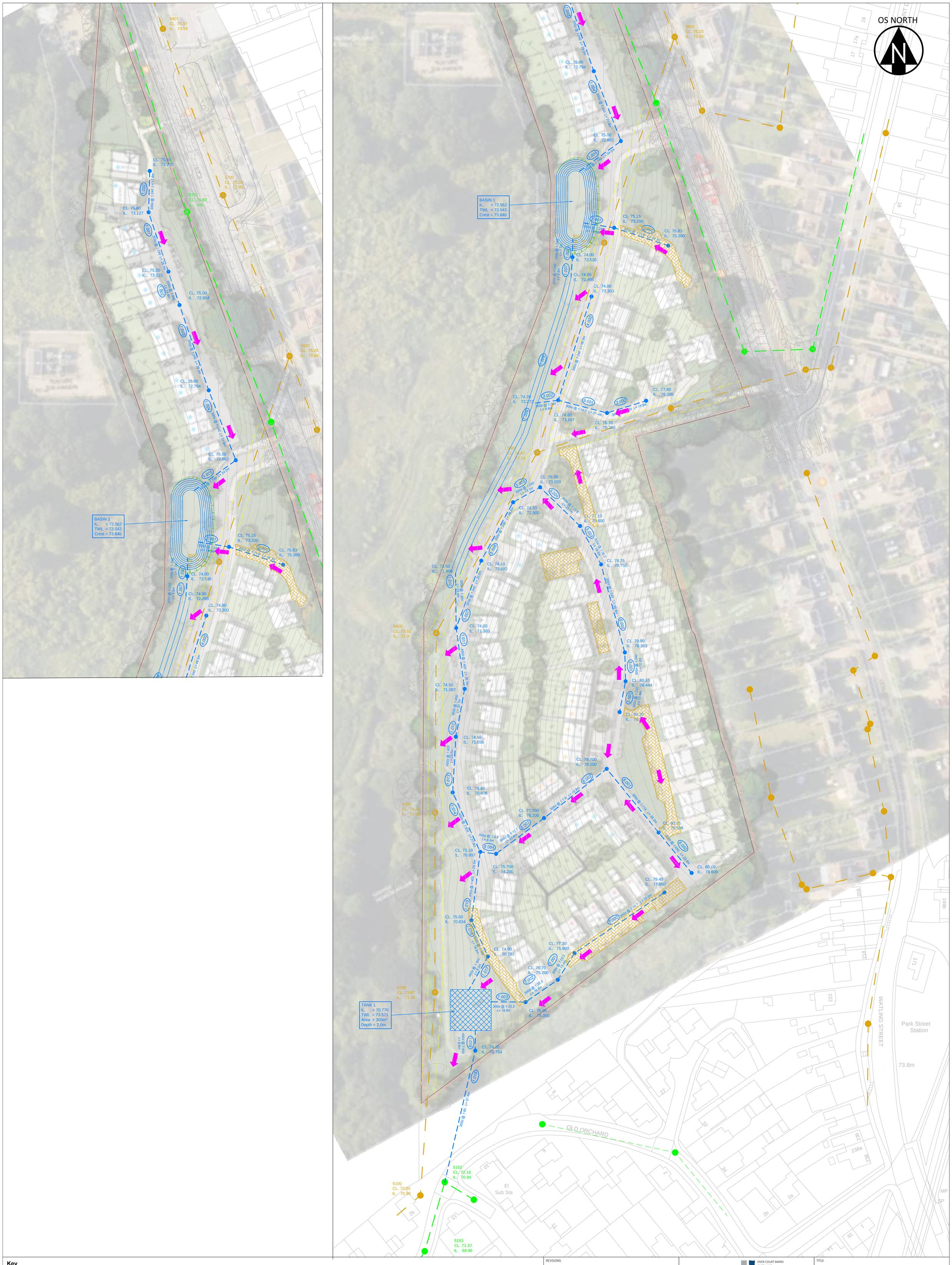
PROJECT
WATLING STREET, ST ALBANS

TITLE
PROPOSED FOUL & SURFACE WATER DRAINAGE STRATEGY

HYDROCK PROJECT NO.	SCALE @ A0
20880-IOCB	1 : 500

STATUS DESCRIPTION	STATUS
INFORMATION	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
20880-HYD-XX-XX-DR-D-2200	P02



Key

- Existing public foul sewer
- Proposed surface water sewer
- Surface water exceedance flow route
- Proposed permeable paving
- Proposed underground attenuation tank
- Proposed attenuation basin

REVISIONS					
P01	12/12/21	First Issue.	SBH	RJH	RJH
Rev	Date	Description	By	Ckd	App

Hydrock
OVER COURT BARNS
OVER LANE
ALMONDSBURY
BRISTOL
BS32 4DF
t: +44 (0) 1454 619533
e: bristol@hydrock.com

CLIENT
M Scott Properties Ltd
Ms T Sutton
Ms T Good
Mr W Hughes
Mr J Hughes.

PROJECT
WATLING STREET, ST ALBANS

TITLE
SURFACE WATER EXCEEDANCE FLOW ROUTES

HYDROCK PROJECT NO.	SCALE @ A0
20880-IOCB	1 : 500
STATUS DESCRIPTION: INFORMATION	STATUS: S2
DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER): 20880-HYD-XX-XX-DR-D-2201	REVISION: P01