

PROPOSED RESIDENTIAL DEVELOPMENT
LAND AT SOUTHLEIGH PARK HOUSE
EASTLEIGH ROAD
HAVANT
HAMPSHIRE
PO9 2PE

ADDENDUM TO FLOOD RISK ASSESSMENT & DEVELOPMENT DRAINAGE STRATEGY

BARGATE HOMES

REVISION B
JANUARY 2023
REF: SS/23/0752/6281



DOCUMENT CONTROL RECORD

Document Issue:

Rev	Date	Issue Status	Prepared by	Checked by
-	19.09.23	First Issue for comment	S. Smith	C. Pendle
A	06.12.23	Updated to new layout	S. Smith	C. Pendle
B	18.01.23	Updated to new layout	S. Smith	C. Pendle



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References

Environment Agency Flood Map Information © and database right www.environment_agency.gov.uk

National Planning Policy Framework (Department for Communities and Local Government, March 2012)

PPG Flood risk and coastal change (Department for Communities and Local Government, March 2014)

1 Introduction

Scope

- 1.1 Bargate Homes is seeking alterations to planning permission [APP/17/00863] for change of use, alterations to and extension of existing buildings to 20 Residential units, (13 dwellings in the main house and 7 in other Listed Buildings) with associated landscaping parking and amenity space. Outline Application (All Matters Reserved except means of access) for the demolition of 1983 office building and associated brick and glass corridor link and development of up to 70 residential units, associated landscaping, parking and infrastructure works. The present scheme reduces the number of proposed residential units to 41.
- 1.2 A flood risk assessment for the site was carried out by Ardent Consulting Engineers in July 2017. MJA Consulting has been appointed to provide an Addendum to the Flood Risk Assessment & Drainage Strategy to reflect the alterations to the planning application.
- 1.3 The 3.2 ha site is located 0.9km east of the town Havant in Hampshire. at land at land to the south-east of Crawley Down in West Sussex. The current parcel of land comprises of gardens and parkland with various buildings and a Grade 2 listed house. The land slopes from the north east to the south east with a fall of approximately 1:25 across the site.
- 1.4 The original Flood Risk Assessment found that the site was not at risk of flooding from all sources. A review of flood risk for the site, as of 2023, is set out in the next section.

2 Flood Risk

- 2.1 The assessment of flood risk to the site requires that all potential forms of flooding are considered. In accordance with the Environment Agency's Flood Risk Assessment Guidance, NPPF, PPG and CIRIA Report 624, sources of flooding to be assessed include tidal, fluvial (rivers, streams and watercourses), pluvial (overland rainfall runoff), groundwater, artificial sources (canals and reservoirs) and existing / proposed sewerage and water mains infrastructure.

History of Flooding

- 2.2 With reference to the above, and in the context of the proposed development, there are no historic issues of flooding from the following potential sources including:
- Fluvial (Rivers and Sea).
 - Tidal.
 - Groundwater.
 - Pluvial (Surface water runoff).
 - Existing foul, storm and combined sewers or potable water main infrastructure.
 - Artificial infrastructure.

Fluvial

- 2.3 The Environment Agency (EA) is the principal flood risk management operating authority in England. The EA have carried out a national flood risk assessment (NaFRA) which assesses the probability of flooding to land from all main rivers in England.
- 2.4 The latest Environment Agency 'Flood Zone Map' (September 2023) indicates the site is located within the lowest risk category - Flood Zone 1. 'Flood Zone 1' is land assessed as having a less than 1 in 1000 (<0.1%) annual probability of flooding from a main river in each year and is not within an area of recorded river flooding.
- 2.5 It is demonstrated that safe and dry access and egress at the site is achievable to a publicly accessible location outside the 1:100 year (plus climate change) flood event extent, in accordance with DEFRA Report FD2320/TR2 - 'Flood Risk Assessment Guidance for New Developments'. All site entrances provide a safe egress.

Tidal

- 2.6 The site does not encounter a risk from tidal flooding as confirmed by the SFRA, PFRA and the Environment Agency.

Surface Water

- 2.7 The latest Environment Agency 'Flood Zone Map' (September 2023) indicates that the existing site has a 'very low' (less than a 1:1000 or 0.1%) risk of flooding from surface water runoff.
- 2.8 The implementation of a robust drainage scheme to collect, attenuate and convey the surface water runoff from the proposed development will mitigate any residual risk of surface water flooding to the site in its developed state.

2.9 **Groundwater**

The original FRA, the PFRA, SFRA and the Environment Agency confirm that no recorded events of groundwater flooding have been identified at or within the vicinity of the site. The risk from groundwater flooding therefore is low.

2.10 The site is not within a source protection zone.

2.11 **Artificial Sources**

With reference to the SFRA/PRFA there have been no recorded incidents of flooding to the site or surrounding areas from artificial sources. There is an existing pond onsite which poses little risk to the development.

2.12 There are no additional artificial sources of flooding, such as that from canals, reservoirs and sewage treatment works within a 500 m radius of the site.

3 Update to the Surface Water Drainage Strategy

- 3.1 The National Planning Policy Framework (NPPF) requires that developments do not exacerbate flood risks both to the development site and to offsite parties and land, which means there is a need to control surface water drainage and overland runoff to ensure there are no increases in peak rates and volumes of runoff as a result of the development.
- 3.2 The original approved drainage strategy utilised an outfall to the existing ditch along the southern boundary of the site. The approved allowable total discharge rate from the site was 11.0 l/s (QBAR). This is a reduction of approximately 158 l/s (a betterment of 94%) on existing uncontrolled brownfield rates.
- 3.3 The original drainage strategy was designed to a climate change factor of +40%. The updated drainage strategy is also designed to +40% which is in line with current guidance for the region.
- 3.4 The original strategy utilised a tank as well as extending the existing pond to provide additional storage. The updated strategy has removed the extended pond design and utilises a tank only to preserve the local ecology.
- 3.5 The required storage onsite will be 830m³ and will in the form of a tank 26m x 28m x 1.2m deep (870m³).
- 3.6 All flows leaving the site will be controlled to 11.0 l/s for all storm events up to the 1:100 year +40% before outfalling to the ditch along the southern boundary.
- 3.7 As confirmed by the geotechnical report, the soil permeability rates for the stiff clay are insufficient to use infiltration as a method of disposing the surface water runoff generated from the proposed development.
- 3.8 The strategy for drainage from houses and garage roofs, driveways and parking courts, carriageways and footways remain unchanged will drain via a conventional system of road gullies and downpipes, as well as permeable paving, to the surface water pipe network and tank.
- 3.9 All drains and manholes/inspection chambers will be designed and constructed in accordance with the Building Regulations Part H and BS EN 752, ensuring adequate capacity and robust structural integrity for the lifetime of the development. This will ensure that no polluted discharge from the drainage system to ground will take place.

4 Water Quality and Pollution Prevention

- 4.1 The CIRIA SuDS Manual 2015 details an approach for establishing the hazard posed by the intended land use activates and the extent to which the proposed SuDS components can reduce and mitigate the contamination risk to the receiving waterbody.
- 4.2 Referring to Table 26.2 – ‘Pollution hazard indices for different land use classifications’ the proposed development and land use results in a low pollution hazard , therefore a ‘Simple Index’ method can be used to make a qualitative assessment of the proposed SuDS management.

Table 1 - Table 26.2 – ‘Pollution hazard indices for different land use classifications’ CIRIA C753, 2015

TABLE 26.2 Pollution hazard indices for different land use classifications				
Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4

- 4.3 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for each contaminant type):

Roof Runoff:

Total SuDS mitigation index ≥ pollution hazard index (for each contaminant type)
For the development site: TSS = 0.2, Metals = 0.2, Hydrocarbons = 0.05

Driveway / Parking / Road Runoff:

Total SuDS mitigation index ≥ pollution hazard index (for each contaminant type)
For the development site: TSS = 0.5, Metals = 0.4, Hydrocarbons = 0.4

Table 2 - Table 26.3 – 'Indicative SuDS mitigation indices' CIRIA C753, 2015

TABLE 26.3	Indicative SuDS mitigation indices for discharges to surface waters			
		Mitigation indices ¹		
	Type of SuDS component	TSS	Metals	Hydrocarbons
	Filter strip	0.4	0.4	0.5
	Filter drain	0.4 ²	0.4	0.4
	Swale	0.5	0.6	0.6
	Bioretention system	0.8	0.8	0.8
	Permeable pavement	0.7	0.6	0.7
	Detention basin	0.5	0.5	0.6
	Pond ⁴	0.7 ³	0.7	0.5
	Wetland	0.8 ³	0.8	0.8
	Proprietary treatment systems ^{5,6}	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

- 4.4 The proposed development surface water drainage system consists of the following SuDS component:

Roof Runoff:

Primary Treatment – Pond

Using table 26.3 – Mitigation Indices

TSS = 0.7 which is > 0.2 therefore ok.

Metals = 0.7 which is > 0.2 therefore ok.

Hydrocarbons = 0.5 which is > 0.05 therefore ok.

Driveway / Parking / Road Runoff:

Primary Treatment – Permeable Stone Sub-base and/or pond

Using table 26.3 – Mitigation Indices:

TSS = 0.7 which is > 0.5 therefore ok.

Metals = 0.7 which is > 0.4 therefore ok.

Hydrocarbons = 0.5 which is > 0.4 therefore ok.

- 4.5 The total mitigation level exceeds the development pollution risk and would be suitable for both medium and high-risk developments. The proposed drainage strategy incorporates measures to far exceed the water quality target requirements within the SuDS Manual and therefore complies with the Water Framework Directives for discharge of runoff into controlled waters.

5 Foul Water Drainage Strategy

- 5.1 It is proposed that the foul drainage strategy for the development will be a gravity system that connects to the existing outfall to the Southern Water foul sewer at the south of the site.
- 5.2 Consultation with Southern Water has resulted in confirmation of spare capacity within their foul sewer network to accommodate the proposed development, provided the point of connection is foul manhole ref. MHSU73077801 which is located approximately 4.0m south of the southern site boundary.
- 5.3 Foul drainage from the conversion/refurbishment units will be connected into the wider development scheme.



APPENDIX A

Site Layout



Romsey T: 01794 367703
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London T: 01794 367703
www.thrivearchitects.co.uk

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Rev	Description	Date	Au	Ch
P1	Preliminary Issue	---	---	---

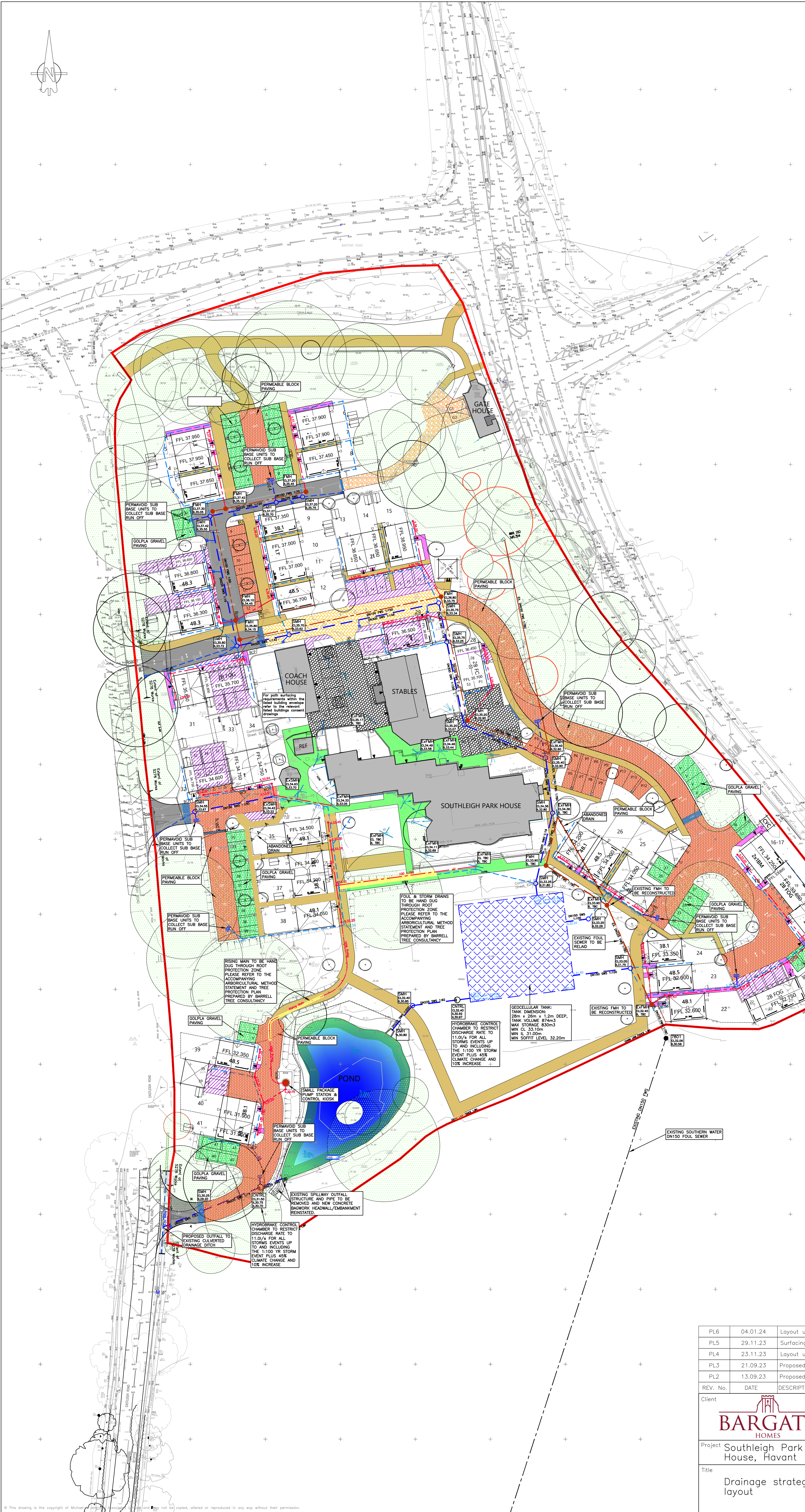
Project	Name, Location
Drawing	-
Client	-
Job no.	-
Dwg no.	-
Author	-/-
Status	PRELIMINARY
Client ref.	-
Date	---
Rev.	P1
Scale	1:-@A1
Office	Romsey





APPENDIX B

Drainage Strategy



SURFACING KEY

Macadam Highway Construction:

Macadam Footway & Parking Construction

Permeable block paved carriageway construction:

Golpla permeable crate parking areas:

Tegula Impermeable paving parking areas

"Silver" Granite sett rumble strip

Gravel surfacing to Gate House

Hoggin footpath with timber edging

Impermeable concrete block paving driveway

Impermeable concrete block access road

Silver/Grey paving slabs

Existing Tarmac

DRAINAGE KEYProposed highway gully and connectionProposed surface water manholeProposed foul water manholeProposed storm drainProposed foul drainProposed private storm drainProposed private foul drainProposed foul rising mainHand dug trench through root protection zonePermavoid collectors within sub baseStorm drains from refurbishmentFoul drains from refurbishmentLined cellular attenuation tankHydrobrake control structureBrick headwall

PL6	04.01.24	Layout updated to SL01_H	AK	KTG
PL5	29.11.23	Surfacing colouring amended	KTG	KTG
PL4	23.11.23	Layout updated to SL01_D	KTG	KTG
PL3	21.09.23	Proposed drainage updated to suit revised layout	JRV	KTG
PL2	13.09.23	Proposed levels updated to suit revised layout	JRV	KTG
REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED

Client

BARGATE
HOMES

Project Southleigh Park House, Havant

Title Drainage strategy layout

MJA CONSULTING
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Scale: 1:500@A1

Status: PLANNING

Drawn: KTG

Project Engineer: KTG

MJA Project No: 6281

Date: 30/08/2023

Drawing Number: 6281-MJA-SW-XX-DR-C-003

Rev: PL6

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APPENDIX C

Surface Water Calculations

MJA Consulting		Page 1								
Monarch House Barton Lane OX14 3NB	Southleigh Park House Bargate Homes Surface Water Calculations									
Date 15/09/2023 File SURFACE WATER	Designed by S.Smith Checked by CP									
Innovyze	Network 2020.1									
<u>Time Area Diagram for Storm</u> <table><thead><tr><th>Time (mins)</th><th>Area (ha)</th><th>Time (mins)</th><th>Area (ha)</th></tr></thead><tbody><tr><td>0-4</td><td>0.434</td><td>4-8</td><td>0.555</td></tr></tbody></table> Total Area Contributing (ha) = 0.989 Total Pipe Volume (m³) = 66.355			Time (mins)	Area (ha)	Time (mins)	Area (ha)	0-4	0.434	4-8	0.555
Time (mins)	Area (ha)	Time (mins)	Area (ha)							
0-4	0.434	4-8	0.555							
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Date 15/09/2023 File SURFACE WATER	Designed by S.Smith Checked by CP	
Innovyze	Network 2020.1	

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)	HYD SECT	DIA (mm)	Section Type
S1.000	7.182	0.050	143.6	0.040	4.00	0.0	0.600	o	225	Pipe/Conduit
S1.001	18.013	0.150	120.1	0.025	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.002	35.375	1.830	19.3	0.041	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.003	14.240	0.100	142.4	0.095	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.004	40.793	0.280	145.7	0.080	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.005	10.645	0.090	118.3	0.095	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.006	22.511	0.180	125.1	0.064	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.007	23.496	0.170	138.2	0.074	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.008	14.838	0.100	148.4	0.095	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.009	19.331	1.000	19.3	0.050	0.00	0.0	0.600	o	300	Pipe/Conduit
S1.010	17.659	0.800	22.1	0.065	0.00	0.0	0.600	o	300	Pipe/Conduit
S2.000	19.860	1.260	15.8	0.087	4.00	0.0	0.600	o	225	Pipe/Conduit
S3.000	30.007	0.750	40.0	0.074	4.00	0.0	0.600	o	225	Pipe/Conduit
S1.011	22.534	0.080	281.7	0.000	0.00	0.0	0.600	[]	1	Pipe/Conduit
S1.012	11.022	0.120	91.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.013	10.220	0.050	204.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.014	47.429	0.050	948.6	0.000	0.00	0.0	0.600	[]	1	Pipe/Conduit
S1.015	2.494	0.050	49.9	0.060	0.00	0.0	0.600	o	225	Pipe/Conduit
S1.016	20.944	1.500	14.0	0.044	0.00	0.0	0.600	o	225	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S1.000	35.750	0.040	0.0	1.09	43.3
S1.001	35.700	0.065	0.0	1.19	47.4
S1.002	35.550	0.106	0.0	2.99	118.9
S1.003	33.720	0.201	0.0	1.32	93.0
S1.004	33.620	0.281	0.0	1.30	91.9
S1.005	33.340	0.376	0.0	1.44	102.1
S1.006	33.250	0.440	0.0	1.40	99.3
S1.007	33.070	0.514	0.0	1.34	94.4
S1.008	32.900	0.609	0.0	1.29	91.1
S1.009	32.800	0.659	0.0	3.59	253.9
S1.010	31.800	0.724	0.0	3.36	237.6
S2.000	32.260	0.087	0.0	3.31	131.7
S3.000	31.750	0.074	0.0	2.07	82.5
S1.011	31.000	0.885	0.0	1.78	1223.1
S1.012	30.970	0.885	0.0	1.36	54.3
S1.013	30.850	0.885	0.0	0.91	36.2
S1.014	30.800	0.885	0.0	0.96	662.6
S1.015	30.750	0.945	0.0	1.86	73.8
S1.016	30.700	0.989	0.0	3.52	140.0

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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)
S1.000	o	225	S1	37.200	35.750	1.225	Open Manhole	1200
S1.001	o	225	S2	37.270	35.700	1.345	Open Manhole	1200
S1.002	o	225	S3	37.420	35.550	1.645	Open Manhole	1200
S1.003	o	300	S5	35.800	33.720	1.780	Open Manhole	1200
S1.004	o	300	S6	35.700	33.620	1.780	Open Manhole	1200
S1.005	o	300	S7	36.800	33.340	3.160	Open Manhole	1200
S1.006	o	300	S8	35.750	33.250	2.200	Open Manhole	1200
S1.007	o	300	S9	35.200	33.070	1.830	Open Manhole	1200
S1.008	o	300	S10	35.400	32.900	2.200	Open Manhole	1200
S1.009	o	300	S11	34.360	32.800	1.260	Open Manhole	1200
S1.010	o	300	S12	33.250	31.800	1.150	Open Manhole	1200
S2.000	o	225	S13	33.250	32.260	0.765	Open Manhole	1200
S3.000	o	225	S14	33.050	31.750	1.075	Open Manhole	1200
S1.011	[]	1	STank	33.000	31.000	1.400	Open Manhole	1200
S1.012	o	225	S15 CTRL	32.400	30.970	1.205	Open Manhole	1200
S1.013	o	225	S16	32.400	30.850	1.325	Open Manhole	1200
S1.014	[]	1	SHW	32.800	30.800	1.400	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	7.182	143.6	S2	37.270	35.700	1.345	Open Manhole	1200
S1.001	18.013	120.1	S3	37.420	35.550	1.645	Open Manhole	1200
S1.002	35.375	19.3	S5	35.800	33.720	1.855	Open Manhole	1200
S1.003	14.240	142.4	S6	35.700	33.620	1.780	Open Manhole	1200
S1.004	40.793	145.7	S7	36.800	33.340	3.160	Open Manhole	1200
S1.005	10.645	118.3	S8	35.750	33.250	2.200	Open Manhole	1200
S1.006	22.511	125.1	S9	35.200	33.070	1.830	Open Manhole	1200
S1.007	23.496	138.2	S10	35.400	32.900	2.200	Open Manhole	1200
S1.008	14.838	148.4	S11	34.360	32.800	1.260	Open Manhole	1200
S1.009	19.331	19.3	S12	33.250	31.800	1.150	Open Manhole	1200
S1.010	17.659	22.1	STank	33.000	31.000	1.700	Open Manhole	1200
S2.000	19.860	15.8	STank	33.000	31.000	1.775	Open Manhole	1200
S3.000	30.007	40.0	STank	33.000	31.000	1.775	Open Manhole	1200
S1.011	22.534	281.7	S15 CTRL	32.400	30.920	0.880	Open Manhole	1200
S1.012	11.022	91.9	S16	32.400	30.850	1.325	Open Manhole	1200
S1.013	10.220	204.4	SHW	32.800	30.800	1.775	Open Manhole	1200
S1.014	47.429	948.6	SPond HW	31.500	30.750	0.150	Open Manhole	1200

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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)
S1.015	o	225	SPond HW	31.500	30.750	0.525	Open Manhole	1200
S1.016	o	225	S17 CTRL	31.500	30.700	0.575	Open Manhole	1200
S1.017	o	225	S18	30.250	29.200	0.825	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)
S1.015	2.494	49.9	S17 CTRL	31.500	30.700	0.575	Open Manhole	1200
S1.016	20.944	14.0	S18	30.250	29.200	0.825	Open Manhole	1200
S1.017	10.688	53.4	SDitch	35.500	29.000	6.275	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
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S1.017	SDitch	35.500	29.000	0.000	0	0
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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	2	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.600	Storm Duration (mins)	30
Ratio R	0.349		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: STank, DS/PN: S1.011, Volume (m³): 5.3

Unit Reference	MD-SHE-0149-1100-1200-1100
Design Head (m)	1.200
Design Flow (l/s)	11.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	149
Invert Level (m)	31.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	11.0	Kick-Flo®	0.782	9.0
Flush-Flo™	0.357	11.0	Mean Flow over Head Range	-	9.5

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	5.4	1.200	11.0	3.000	17.0	7.000	25.5
0.200	10.4	1.400	11.8	3.500	18.3	7.500	26.4
0.300	10.9	1.600	12.6	4.000	19.5	8.000	27.2
0.400	11.0	1.800	13.3	4.500	20.6	8.500	28.0
0.500	10.8	2.000	14.0	5.000	21.7	9.000	28.8
0.600	10.5	2.200	14.7	5.500	22.7	9.500	29.5
0.800	9.1	2.400	15.3	6.000	23.7		
1.000	10.1	2.600	15.9	6.500	24.6		

Hydro-Brake® Optimum Manhole: S17 CTRL, DS/PN: S1.016, Volume (m³): 1.0

Unit Reference	MD-SHE-0160-1100-0400-1100
Design Head (m)	0.400
Design Flow (l/s)	11.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	160
Invert Level (m)	30.700
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

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<u>Hydro-Brake® Optimum Manhole: S17 CTRL, DS/PN: S1.016, Volume (m³): 1.0</u>							
Control Points		Head (m)	Flow (l/s)	Control Points	Head (m) Flow (l/s)		
Design Point (Calculated)		0.400	11.0	Kick-Flo®	0.341 10.2		
Flush-Flo™		0.223	11.0	Mean Flow over Head Range	- 8.2		
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	5.7	1.200	18.5	3.000	28.7	7.000	43.4
0.200	11.0	1.400	19.9	3.500	31.0	7.500	45.0
0.300	10.7	1.600	21.2	4.000	33.0	8.000	46.5
0.400	11.0	1.800	22.5	4.500	34.7	8.500	47.9
0.500	12.2	2.000	23.6	5.000	36.6	9.000	49.3
0.600	13.3	2.200	24.7	5.500	38.4	9.500	50.7
0.800	15.3	2.400	25.8	6.000	40.2		
1.000	17.0	2.600	26.8	6.500	41.8		
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<u>Storage Structures for Storm</u> <u>Cellular Storage Manhole: STank, DS/PN: S1.011</u> Invert Level (m) 31.000 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>728.0</td><td>728.0</td><td>1.201</td><td>0.0</td><td>857.6</td></tr><tr><td>1.200</td><td>728.0</td><td>857.6</td><td></td><td></td><td></td></tr></table> <u>Tank or Pond Manhole: SPond HW, DS/PN: S1.015</u> Invert Level (m) 30.750 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>823.0</td><td>0.100</td><td>860.0</td><td>0.200</td><td>898.0</td></tr></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	728.0	728.0	1.201	0.0	857.6	1.200	728.0	857.6				Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	823.0	0.100	860.0	0.200	898.0
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																											
0.000	728.0	728.0	1.201	0.0	857.6																											
1.200	728.0	857.6																														
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)																											
0.000	823.0	0.100	860.0	0.200	898.0																											
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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	2.000
Hot Start Level (mm)	0	Inlet Coefficient	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	2	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.349
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Summer	1	+0%				
S1.001	S2	15 Winter	1	+0%				
S1.002	S3	15 Winter	1	+0%	100/15 Winter			
S1.003	S5	15 Winter	1	+0%	30/15 Winter			
S1.004	S6	15 Winter	1	+0%	30/15 Winter			
S1.005	S7	15 Winter	1	+0%	30/15 Summer			
S1.006	S8	15 Winter	1	+0%	30/15 Summer			
S1.007	S9	15 Winter	1	+0%	30/15 Summer			
S1.008	S10	15 Winter	1	+0%	30/15 Summer			
S1.009	S11	15 Winter	1	+0%	100/15 Summer			
S1.010	S12	15 Winter	1	+0%	100/15 Summer			
S2.000	S13	15 Winter	1	+0%				
S3.000	S14	15 Winter	1	+0%				
S1.011	STank	480 Winter	1	+0%	100/120 Summer			
S1.012	S15 CTRL	480 Winter	1	+0%				
S1.013	S16	480 Winter	1	+0%	100/1440 Summer			
S1.014	SHW	720 Winter	1	+0%				
S1.015	SPond HW	960 Winter	1	+0%	100/1440 Summer			

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	35.814	-0.161	0.000	0.18			5.6	OK	
S1.001	S2	35.768	-0.157	0.000	0.20			8.3	OK	
S1.002	S3	35.601	-0.174	0.000	0.11			12.8	OK	
S1.003	S5	33.821	-0.199	0.000	0.25			19.6	OK	
S1.004	S6	33.733	-0.187	0.000	0.30			25.9	OK	
S1.005	S7	33.479	-0.161	0.000	0.44			32.9	OK	
S1.006	S8	33.391	-0.159	0.000	0.44			38.9	OK	
S1.007	S9	33.229	-0.141	0.000	0.55			45.7	OK	
S1.008	S10	33.085	-0.115	0.000	0.70			53.1	OK	
S1.009	S11	32.904	-0.196	0.000	0.26			57.3	OK	
S1.010	S12	31.915	-0.185	0.000	0.31			62.9	OK	
S2.000	S13	32.308	-0.177	0.000	0.10			12.1	OK	
S3.000	S14	31.804	-0.171	0.000	0.13			10.3	OK	
S1.011	STank	31.163	-0.437	0.000	0.01		320	6.3	OK	
S1.012	S15 CTRL	31.025	-0.170	0.000	0.14			6.3	OK	
S1.013	S16	30.919	-0.156	0.000	0.21			6.3	OK	
S1.014	SHW	30.835	-0.565	0.000	0.01			6.1	OK	
S1.015	SPond HW	30.812	-0.163	0.000	0.17			5.4	OK	

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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.
S1.016	S17 CTRL	960 Winter	1	+0%	100/15 Summer	100/1440 Winter		
S1.017	S18	960 Winter	1	+0%				

PN	US/MH Name	Water Surcharged Flooded			Flow / Overflow		Half Drain Time	Pipe Flow	Level	
		Level (m)	Depth (m)	Volume (m ³)	Cap.	(l/s)	(mins)	(l/s)	Status	Exceeded
S1.016	S17 CTRL	30.798	-0.127	0.000	0.04			5.5	OK	
S1.017	S18	29.246	-0.179	0.000	0.09			5.5	OK	

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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	2.000
Hot Start Level (mm)	0	Inlet Coefficient	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	2	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.349
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	450.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	ON
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.000	S1	15 Summer	30	+0%				
S1.001	S2	15 Summer	30	+0%				
S1.002	S3	15 Summer	30	+0%	100/15	Winter		
S1.003	S5	15 Winter	30	+0%	30/15	Winter		
S1.004	S6	15 Winter	30	+0%	30/15	Winter		
S1.005	S7	15 Winter	30	+0%	30/15	Summer		
S1.006	S8	15 Winter	30	+0%	30/15	Summer		
S1.007	S9	15 Winter	30	+0%	30/15	Summer		
S1.008	S10	15 Winter	30	+0%	30/15	Summer		
S1.009	S11	15 Winter	30	+0%	100/15	Summer		
S1.010	S12	15 Winter	30	+0%	100/15	Summer		
S2.000	S13	15 Winter	30	+0%				
S3.000	S14	15 Winter	30	+0%				
S1.011	STank	360 Winter	30	+0%	100/120	Summer		
S1.012	S15 CTRL	360 Winter	30	+0%				
S1.013	S16	360 Winter	30	+0%	100/1440	Summer		
S1.014	SHW	960 Winter	30	+0%				
S1.015	SPond HW	960 Winter	30	+0%	100/1440	Summer		

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	35.853	-0.122	0.000	0.43		13.7	OK
S1.001	S2	35.816	-0.109	0.000	0.52		22.3	OK
S1.002	S3	35.638	-0.137	0.000	0.32		36.3	OK
S1.003	S5	34.040	0.020	0.000	0.66		51.2	SURCHARGED
S1.004	S6	33.938	0.018	0.000	0.71		60.5	SURCHARGED
S1.005	S7	33.827	0.187	0.000	1.01		76.0	SURCHARGED
S1.006	S8	33.728	0.178	0.000	0.96		84.6	SURCHARGED
S1.007	S9	33.559	0.189	0.000	1.16		97.5	SURCHARGED
S1.008	S10	33.316	0.116	0.000	1.52		115.9	SURCHARGED
S1.009	S11	32.963	-0.137	0.000	0.56		124.1	OK
S1.010	S12	31.986	-0.114	0.000	0.68		138.7	OK
S2.000	S13	32.336	-0.149	0.000	0.25		29.8	OK
S3.000	S14	31.839	-0.136	0.000	0.33		25.3	OK
S1.011	STank	31.355	-0.245	0.000	0.01	276	10.9	OK
S1.012	S15 CTRL	31.044	-0.151	0.000	0.24		10.9	OK
S1.013	S16	30.943	-0.132	0.000	0.36		10.9	OK
S1.014	SHW	30.884	-0.516	0.000	0.02		10.7	OK
S1.015	SPond HW	30.877	-0.098	0.000	0.32		10.1	OK

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	S2	
S1.002	S3	
S1.003	S5	
S1.004	S6	
S1.005	S7	
S1.006	S8	
S1.007	S9	
S1.008	S10	
S1.009	S11	
S1.010	S12	
S2.000	S13	
S3.000	S14	
S1.011	STank	
S1.012	S15 CTRL	
S1.013	S16	
S1.014	SHW	
S1.015	SPond HW	

Simulation Criteria

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	4
Number of Offline Controls	0	Number of Real Time Controls	0

Rainfall Model	FSR	Ratio R	0.349
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.600	Cv (Winter)	0.840

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Time Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

WARNING: Half Drain Time has not been calculated as the structure is too full.

US/MH			Return	Climate	First (X)	First (Y)	First (Z)	Overflow
PN	Name	Storm	Period	Change	Surcharge	Flood	Overflow	Act.
S1.000	S1	15 Summer	100	+45%				
S1.001	S2	30 Winter	100	+45%				
S1.002	S3	30 Winter	100	+45%	100/15	Winter		
S1.003	S5	30 Winter	100	+45%	30/15	Winter		
S1.004	S6	30 Winter	100	+45%	30/15	Winter		
S1.005	S7	30 Winter	100	+45%	30/15	Summer		
S1.006	S8	30 Winter	100	+45%	30/15	Summer		
S1.007	S9	30 Winter	100	+45%	30/15	Summer		
S1.008	S10	30 Winter	100	+45%	30/15	Summer		
S1.009	S11	15 Winter	100	+45%	100/15	Summer		
S1.010	S12	15 Winter	100	+45%	100/15	Summer		
S2.000	S13	15 Winter	100	+45%				
S3.000	S14	15 Winter	100	+45%				
S1.011	STank	360 Winter	100	+45%	100/120	Summer		
S1.012	S15 CTRL	1440 Winter	100	+45%				

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

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	35.907	-0.068	0.000	0.82		25.7	OK
S1.001	S2	35.893	-0.032	0.000	0.75		31.9	OK
S1.002	S3	35.861	0.086	0.000	0.46		52.0	SURCHARGED
S1.003	S5	35.759	1.739	0.000	0.88		68.3	FLOOD RISK
S1.004	S6	35.657	1.737	0.000	1.11		95.3	FLOOD RISK
S1.005	S7	35.344	1.704	0.000	1.74		130.6	SURCHARGED
S1.006	S8	35.097	1.547	0.000	1.65		144.3	SURCHARGED
S1.007	S9	34.619	1.249	0.000	1.95		163.6	SURCHARGED
S1.008	S10	33.962	0.762	0.000	2.62		199.8	SURCHARGED
S1.009	S11	33.285	0.185	0.000	0.96		211.9	SURCHARGED
S1.010	S12	32.352	0.252	0.000	1.15		233.4	SURCHARGED
S2.000	S13	32.368	-0.117	0.000	0.47		55.9	OK
S3.000	S14	31.878	-0.097	0.000	0.62		47.5	OK
S1.011	STank	31.773	0.173	0.000	0.01		10.9	SURCHARGED
S1.012	S15 CTRL	31.147	-0.048	0.000	0.24		10.9	OK

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	S2	
S1.002	S3	
S1.003	S5	
S1.004	S6	
S1.005	S7	
S1.006	S8	
S1.007	S9	
S1.008	S10	
S1.009	S11	
S1.010	S12	
S2.000	S13	
S3.000	S14	
S1.011	STank	
S1.012	S15 CTRL	

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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
S1.013	S16	1440 Winter	100	+45%	100/1440 Summer		
S1.014	SHW	1440 Winter	100	+45%			
S1.015	SPond HW	1440 Winter	100	+45%	100/1440 Summer		
S1.016	S17 CTRL	4320 Summer	100	+45%	100/15 Summer	100/1440 Winter	
S1.017	S18	2160 Winter	100	+45%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.013	S16		31.134	0.059	0.000	0.36			10.9
S1.014	SHW		31.122	-0.278	0.000	0.02			10.9
S1.015	SPond HW		31.117	0.142	0.000	0.31			9.8
S1.016	S17 CTRL		31.131	0.206	0.000	0.08			9.7
S1.017	S18		29.271	-0.154	0.000	0.16			9.9

PN	US/MH Name	Status	Level Exceeded
S1.013	S16	SURCHARGED	
S1.014	SHW	OK	
S1.015	SPond HW	FLOOD RISK	
S1.016	S17 CTRL	FLOOD RISK	
S1.017	S18	OK	



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