



- ▶ Assumed heights of the following process stages, from aerial photography and inferred from similar WwTW: Primary Settlement Tank, Storm Tank, Sludge Holding Tank, Inlet Balancing Tank, Filter Beds and Humus Tank
- ▶ The sludge drying beds have been considered to no longer be in use as indicated on the site plan provided by Yorkshire Water
- ▶ The inlet balancing tank is assumed to be non-covered
- ▶ The sludge holding tanks are assumed to be non-covered
- ▶ The sludge and storm P.S. chambers are assumed to be fully enclosed
- ▶ The sludge decant chambers are assumed to be covered
- ▶ There is not a significant history of complaints from the surrounding community associated with odour from the site
- ▶ In the event that there has been previous odour monitoring or H₂S surveys undertaken on the site, this has not been taken into consideration, nor has feedback from technical staff regarding odours produced on the site
- ▶ If further modifications to the sewage treatment works are planned in the future, these have not been taken into consideration

Author


William Smith

Reviewer


Ben Anstee

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APPENDIX G:

Peak Runoff Rate from Existing Site

The peak discharge rates of surface water runoff from the impermeable areas at the site have been calculated based on the Modified Rational Method and an assessment of the pipe capacities. The lower of the two values has determined the existing discharge rates from the impermeable areas at the existing site.

Modified Rational Method

The following parameters have been obtained from the maps in Volume 3 of the Wallingford Procedure:

M5-60 minute rainfall depth:	19 mm
Ratio of M5-60 to M5-2 day rainfall:	0.32
Average Annual Rainfall:	1000 mm
Winter Rain Acceptance Potential/ Soil Type:	2 / 0.30
The Urban Catchment Wetness Index (UCWI) value:	110

A time of concentration of 15 minutes has been used.

A rainfall estimation calculation has been carried out to convert the M5-60 minute rainfall to the 15 minute duration rainfall for the 1 in 1 and 1 in 100 annual probability rainfall events. The calculated rainfall intensities for these events are 27.8 and 87.7 mm/hr respectively.

The flow rate as given by the Modified Rational Method is:

$$Q = 2.78 \times C_v \times C_r \times \text{rainfall intensity} \times \text{impermeable area}$$

where:

C_v is the volumetric runoff coefficient = $P_r/PIMP = 0.78$

where P_r is Percentage Runoff and PIMP is Percentage Impermeable Area

C_r is the routing coefficient = 1.3

Total Impermeable Area = 4.81 ha

The peak discharges of surface runoff from impermeable areas of the existing site are shown in the table below.

Pipe Capacities

Colebrook-White equation with Darcy-Weisbach formula:

$$V = -2 \sqrt{2gDS_f} \log \left(\frac{k_s}{3.7D} + \frac{2.51\nu}{D\sqrt{2gDS_f}} \right)$$

V = Average velocity (ms^{-1})

g = 9.81 (ms^{-2})

D = Pipe Diameter (m)

$S_f = h_f/L$

h_f = Hydraulic gradient (m)

L = Pipe length (m)

k_s = Roughness (mm)

$\nu = 1.13 \times 10^{-6}$ (m^2s^{-1})

Key:

US = Upstream; DS = Downstream; IL = Invert level

Area	Max US level (m AOD)	DS IL (m AOD)	D (m)	L (m)	Ks (mm)	V (ms ⁻¹)	Q (ls ⁻¹)
Outfall 1	94.41	93.19	0.225	71.00	0.6	1.548	57.6
Outfall 2	95.03	92.47	0.3	79.73	0.6	2.654	172.4
Outfall 3	95.31	92.57	0.3	91.51	0.6	2.574	168.9
Outfall 4	95.10	92.65	0.15	85.45	0.6	1.722	29.1
Outfall 5	95.38	93.03	0.225	86.66	0.6	2.053	77.2
Outfall 6	95.31	92.79	0.3	91.80	0.6	2.450	156.3
Outfall 7	95.18	92.52	0.375	40.82	0.6	4.303	332.8
Outfall 8	95.39	92.60	0.225	77.41	0.6	2.389	89.3
Outfall 9	100.33	96.27	0.3	37.00	0.6	5.039	284.1
Outfall 10	100.19	99.38	0.15	26.33	0.6	1.597	27.8
SW32 to SW33	100.04	98.59	0.15	52.32	0.6	1.589	26.8
SW35 to SW36	100.28	98.66	0.15	14.44	0.6	3.232	55.6

Peak Runoff Rate for Impermeable Surfaces at Existing Site – MRM and Pipe Capacity

Annual probability of rainfall event	Peak Runoff Rate from MRM (l/s)	Pipe Capacity (l/s)	Actual Peak Runoff Rate (l/s)
Outfall 1			
1 in 1	18.1	57.6	18.1
1 in 30	44.3		44.3
1 in 100	57.0		57.0
Outfall 2			
1 in 1	66.9	172.4	66.9
1 in 30	163.9		163.9
1 in 100	210.8		172.4
Outfall 3			
1 in 1	38.6	168.9	38.6
1 in 30	94.5		94.5
1 in 100	121.5		121.5
Outfall 4			
1 in 1	16.5	29.1	16.5
1 in 30	40.5		29.1
1 in 100	52.1		29.1
Outfall 5			
1 in 1	12.6	77.2	12.6

1 in 30	30.8		30.8
1 in 100	39.7		39.7
Outfall 6			
1 in 1	43.3		43.3
1 in 30	106.0	156.3	106.0
1 in 100	136.4		136.4
Outfall 7			
1 in 1	78.8		78.8
1 in 30	192.8	332.8	192.8
1 in 100	248.0		248.0
Outfall 8			
1 in 1	44.1		44.1
1 in 30	107.9	89.3	89.3
1 in 100	138.9		89.3
Outfall 9			
1 in 1	13.4		13.4
1 in 30	32.8	284.1	32.8
1 in 100	42.2		42.2
Outfall 10			
1 in 1	8.7		8.7
1 in 30	21.2	27.8	21.2
1 in 100	27.3		27.3
SW32 to SW33			
1 in 1	7.9		7.9
1 in 30	19.3	26.8	19.3
1 in 100	24.8		24.8
SW35 to SW36			
1 in 1	15.8		15.8
1 in 30	38.6	55.6	38.6
1 in 100	49.6		49.6
South of Site			
1 in 1	14.2		14.2
1 in 30	34.7	No data	34.7
1 in 100	44.6		44.6

APPENDIX H:

Greenfield Runoff Calculations

Weetwood		Page 1																								
No 2 Smithy Farm Bruera Chester CH3 6EW																										
Date 05/02/2016 15:16 File	Designed By MichaelDarby Checked By																									
Micro Drainage		Source Control W.12.1																								
<u>ICP SUDS Mean Annual Flood</u> Input <table> <tr> <td>Return Period (years)</td> <td>100</td> <td>Soil</td> <td>0.300</td> </tr> <tr> <td>Area (ha)</td> <td>1.000</td> <td>Urban</td> <td>0.000</td> </tr> <tr> <td>SAAR (mm)</td> <td>1000</td> <td>Region Number</td> <td>Region 3</td> </tr> </table> Results l/s <table> <tr> <td>QBAR Rural</td> <td>2.8</td> </tr> <tr> <td>QBAR Urban</td> <td>2.8</td> </tr> <tr> <td>Q100 years</td> <td>5.8</td> </tr> <tr> <td>Q1 year</td> <td>2.4</td> </tr> <tr> <td>Q30 years</td> <td>4.9</td> </tr> <tr> <td>Q100 years</td> <td>5.8</td> </tr> </table>			Return Period (years)	100	Soil	0.300	Area (ha)	1.000	Urban	0.000	SAAR (mm)	1000	Region Number	Region 3	QBAR Rural	2.8	QBAR Urban	2.8	Q100 years	5.8	Q1 year	2.4	Q30 years	4.9	Q100 years	5.8
Return Period (years)	100	Soil	0.300																							
Area (ha)	1.000	Urban	0.000																							
SAAR (mm)	1000	Region Number	Region 3																							
QBAR Rural	2.8																									
QBAR Urban	2.8																									
Q100 years	5.8																									
Q1 year	2.4																									
Q30 years	4.9																									
Q100 years	5.8																									
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APPENDIX I:

Surface Water Attenuation - Storage Volume Calculation

Weetwood				Page 1	
41 St Paul's Stee Leeds LS1 2JG					
Date 22/02/2016 11:44					
File 2992 160222 Parcel A 10...					
XP Solutions		Designed by KeelyBonser Checked by			
		Source Control 2015.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.052	0.852	127.1	81.0	O K
30 min Summer	1.135	0.935	133.3	88.9	O K
60 min Summer	1.066	0.866	128.2	82.3	O K
120 min Summer	0.866	0.666	112.1	63.3	O K
180 min Summer	0.713	0.513	98.1	48.8	O K
240 min Summer	0.606	0.406	86.9	38.6	O K
360 min Summer	0.482	0.282	71.8	26.8	O K
480 min Summer	0.426	0.226	60.8	21.5	O K
600 min Summer	0.393	0.193	52.3	18.3	O K
720 min Summer	0.368	0.168	46.0	15.9	O K
960 min Summer	0.333	0.133	37.4	12.7	O K
1440 min Summer	0.293	0.093	27.6	8.8	O K
2160 min Summer	0.252	0.052	20.3	5.0	O K
2880 min Summer	0.232	0.032	16.4	3.0	O K
4320 min Summer	0.213	0.013	11.9	1.2	O K
5760 min Summer	0.201	0.001	9.6	0.1	O K
7200 min Summer	0.200	0.000	8.0	0.0	O K
8640 min Summer	0.200	0.000	7.0	0.0	O K
10080 min Summer	0.200	0.000	6.2	0.0	O K
15 min Winter	1.153	0.953	134.5	90.6	O K
30 min Winter	1.207	1.007	138.4	95.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	112.155	0.0	143.0	13	
30 min Summer	76.559	0.0	195.4	21	
60 min Summer	49.937	0.0	254.5	38	
120 min Summer	31.422	0.0	321.0	68	
180 min Summer	23.571	0.0	360.2	98	
240 min Summer	19.061	0.0	388.8	128	
360 min Summer	14.142	0.0	432.7	188	
480 min Summer	11.424	0.0	466.0	246	
600 min Summer	9.672	0.0	493.2	308	
720 min Summer	8.436	0.0	516.2	368	
960 min Summer	6.792	0.0	554.2	490	
1440 min Summer	4.993	0.0	611.1	734	
2160 min Summer	3.662	0.0	672.3	1100	
2880 min Summer	2.934	0.0	718.1	1456	
4320 min Summer	2.142	0.0	786.6	2152	
5760 min Summer	1.713	0.0	838.6	2936	
7200 min Summer	1.442	0.0	882.4	0	
8640 min Summer	1.252	0.0	919.8	0	
10080 min Summer	1.112	0.0	952.8	0	
15 min Winter	112.155	0.0	159.9	13	
30 min Winter	76.559	0.0	218.2	22	
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Weetwood				Page 2	
41 St Paul's Stee Leeds LS1 2JG					
Date 22/02/2016 11:44					
File 2992 160222 Parcel A 10...					
XP Solutions		Designed by KeelyBonser Checked by Source Control 2015.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.059	0.859	127.6	81.7	O K
120 min Winter	0.772	0.572	103.7	54.4	O K
180 min Winter	0.596	0.396	85.8	37.7	O K
240 min Winter	0.490	0.290	72.9	27.6	O K
360 min Winter	0.407	0.207	56.0	19.7	O K
480 min Winter	0.365	0.165	45.4	15.7	O K
600 min Winter	0.338	0.138	38.6	13.1	O K
720 min Winter	0.318	0.118	33.8	11.2	O K
960 min Winter	0.291	0.091	27.1	8.6	O K
1440 min Winter	0.251	0.051	20.1	4.8	O K
2160 min Winter	0.225	0.025	14.7	2.3	O K
2880 min Winter	0.212	0.012	11.8	1.2	O K
4320 min Winter	0.200	0.000	8.6	0.0	O K
5760 min Winter	0.200	0.000	6.9	0.0	O K
7200 min Winter	0.200	0.000	5.8	0.0	O K
8640 min Winter	0.200	0.000	5.0	0.0	O K
10080 min Winter	0.200	0.000	4.5	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	49.937	0.0	285.6	40	
120 min Winter	31.422	0.0	358.6	70	
180 min Winter	23.571	0.0	403.7	100	
240 min Winter	19.061	0.0	435.4	130	
360 min Winter	14.142	0.0	484.6	188	
480 min Winter	11.424	0.0	522.0	248	
600 min Winter	9.672	0.0	552.4	308	
720 min Winter	8.436	0.0	578.2	368	
960 min Winter	6.792	0.0	620.8	490	
1440 min Winter	4.993	0.0	684.4	732	
2160 min Winter	3.662	0.0	752.9	1092	
2880 min Winter	2.934	0.0	804.3	1428	
4320 min Winter	2.142	0.0	880.9	0	
5760 min Winter	1.713	0.0	939.3	0	
7200 min Winter	1.442	0.0	988.2	0	
8640 min Winter	1.252	0.0	1030.2	0	
10080 min Winter	1.112	0.0	1067.1	0	
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Weetwood		Page 3
41 St Paul's Stee Leeds LS1 2JG		
Date 22/02/2016 11:44	Designed by KeelyBonser	
File 2992 160222 Parcel A 10...	Checked by	
XP Solutions		Source Control 2015.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.320	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.680

Time (mins)	Area
From:	To: (ha)
0	4 0.680

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Weetwood		Page 4
41 St Paul's Stee Leeds LS1 2JG		
Date 22/02/2016 11:44 File 2992 160222 Parcel A 10...	Designed by KeelyBonser Checked by	
XP Solutions Source Control 2015.1		

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.200

Depth (m)	Area (m ²)
0.000	95.1

Orifice Outflow Control

Diameter (m) 0.258 Discharge Coefficient 0.600 Invert Level (m) 0.086

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41 St Paul's Stee Leeds LS1 2JG					
Date 22/02/2016 12:01					
File 2992 160222 Parcel B 10...					
XP Solutions		Source Control 2015.1			
Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.051	0.851	82.1	54.0	O K
30 min Summer	1.136	0.936	86.4	59.4	O K
60 min Summer	1.070	0.870	83.1	55.2	O K
120 min Summer	0.877	0.677	72.6	43.0	O K
180 min Summer	0.730	0.530	63.4	33.6	O K
240 min Summer	0.627	0.427	56.1	27.1	O K
360 min Summer	0.505	0.305	46.0	19.4	O K
480 min Summer	0.445	0.245	39.7	15.5	O K
600 min Summer	0.414	0.214	34.0	13.6	O K
720 min Summer	0.392	0.192	29.9	12.2	O K
960 min Summer	0.362	0.162	24.3	10.3	O K
1440 min Summer	0.326	0.126	17.9	8.0	O K
2160 min Summer	0.293	0.093	13.2	5.9	O K
2880 min Summer	0.273	0.073	10.6	4.6	O K
4320 min Summer	0.257	0.057	7.7	3.6	O K
5760 min Summer	0.248	0.048	6.2	3.0	O K
7200 min Summer	0.238	0.038	5.2	2.4	O K
8640 min Summer	0.232	0.032	4.5	2.0	O K
10080 min Summer	0.227	0.027	4.0	1.7	O K
15 min Winter	1.147	0.947	87.0	60.1	O K
30 min Winter	1.204	1.004	89.7	63.7	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	112.155	0.0	92.5	13	
30 min Summer	76.559	0.0	126.3	21	
60 min Summer	49.937	0.0	164.8	38	
120 min Summer	31.422	0.0	207.5	68	
180 min Summer	23.571	0.0	233.1	98	
240 min Summer	19.061	0.0	251.6	128	
360 min Summer	14.142	0.0	279.9	188	
480 min Summer	11.424	0.0	301.6	246	
600 min Summer	9.672	0.0	319.1	308	
720 min Summer	8.436	0.0	334.0	368	
960 min Summer	6.792	0.0	358.5	490	
1440 min Summer	4.993	0.0	395.5	734	
2160 min Summer	3.662	0.0	435.0	1100	
2880 min Summer	2.934	0.0	464.7	1448	
4320 min Summer	2.142	0.0	508.9	2192	
5760 min Summer	1.713	0.0	542.7	2856	
7200 min Summer	1.442	0.0	570.9	3640	
8640 min Summer	1.252	0.0	595.1	4328	
10080 min Summer	1.112	0.0	616.5	5096	
15 min Winter	112.155	0.0	103.6	13	
30 min Winter	76.559	0.0	141.4	22	
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Weetwood				Page 2		
41 St Paul's Stee Leeds LS1 2JG						
Date 22/02/2016 12:01					Designed by KeelyBonser	
File 2992 160222 Parcel B 10...					Checked by	
XP Solutions		Source Control 2015.1				
<u>Summary of Results for 100 year Return Period (+30%)</u>						
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status	
60 min Winter	1.063	0.863	82.8	54.8	O K	
120 min Winter	0.787	0.587	67.2	37.3	O K	
180 min Winter	0.618	0.418	55.4	26.5	O K	
240 min Winter	0.515	0.315	47.0	20.0	O K	
360 min Winter	0.426	0.226	36.2	14.4	O K	
480 min Winter	0.390	0.190	29.4	12.1	O K	
600 min Winter	0.366	0.166	25.0	10.5	O K	
720 min Winter	0.348	0.148	21.8	9.4	O K	
960 min Winter	0.325	0.125	17.6	7.9	O K	
1440 min Winter	0.292	0.092	13.0	5.8	O K	
2160 min Winter	0.267	0.067	9.6	4.3	O K	
2880 min Winter	0.256	0.056	7.7	3.6	O K	
4320 min Winter	0.242	0.042	5.6	2.7	O K	
5760 min Winter	0.231	0.031	4.5	2.0	O K	
7200 min Winter	0.224	0.024	3.8	1.5	O K	
8640 min Winter	0.219	0.019	3.3	1.2	O K	
10080 min Winter	0.216	0.016	2.9	1.0	O K	
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)		
60 min Winter	49.937	0.0	184.5	40		
120 min Winter	31.422	0.0	232.2	70		
180 min Winter	23.571	0.0	261.2	100		
240 min Winter	19.061	0.0	281.7	130		
360 min Winter	14.142	0.0	313.6	188		
480 min Winter	11.424	0.0	337.8	248		
600 min Winter	9.672	0.0	357.3	308		
720 min Winter	8.436	0.0	374.1	368		
960 min Winter	6.792	0.0	401.6	486		
1440 min Winter	4.993	0.0	442.9	736		
2160 min Winter	3.662	0.0	487.2	1104		
2880 min Winter	2.934	0.0	520.4	1472		
4320 min Winter	2.142	0.0	570.0	2192		
5760 min Winter	1.713	0.0	607.8	2896		
7200 min Winter	1.442	0.0	639.5	3608		
8640 min Winter	1.252	0.0	666.5	4384		
10080 min Winter	1.112	0.0	690.5	5096		
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Weetwood		Page 3
41 St Paul's Stee Leeds LS1 2JG		
Date 22/02/2016 12:01	Designed by KeelyBonser	
File 2992 160222 Parcel B 10...	Checked by	
XP Solutions		Source Control 2015.1

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.320	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.440

Time (mins)		Area
From:	To:	(ha)
0	4	0.440

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Weetwood		Page 4
41 St Paul's Stee Leeds LS1 2JG		
Date 22/02/2016 12:01 File 2992 160222 Parcel B 10...	Designed by KeelyBonser Checked by	
XP Solutions Source Control 2015.1		

Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.200

Depth (m) Area (m²)	
0.000	63.5

Orifice Outflow Control

Diameter (m) 0.210 Discharge Coefficient 0.600 Invert Level (m) 0.150

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Weetwood				Page 1	
41 St Paul's Stee Leeds LS1 2JG					
Date 22/02/2016 12:28					
File 2992 160222 Parcel C1 1...					
XP Solutions		Designed by KeelyBonser Checked by			
		Source Control 2015.1			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.046	0.846	130.9	83.2	O K
30 min Summer	1.128	0.928	137.2	91.2	O K
60 min Summer	1.059	0.859	131.9	84.4	O K
120 min Summer	0.860	0.660	115.4	64.9	O K
180 min Summer	0.708	0.508	101.0	49.9	O K
240 min Summer	0.601	0.401	89.5	39.5	O K
360 min Summer	0.478	0.278	74.1	27.3	O K
480 min Summer	0.423	0.223	62.6	21.9	O K
600 min Summer	0.389	0.189	53.8	18.6	O K
720 min Summer	0.364	0.164	47.3	16.1	O K
960 min Summer	0.330	0.130	38.5	12.7	O K
1440 min Summer	0.289	0.089	28.4	8.7	O K
2160 min Summer	0.248	0.048	20.9	4.7	O K
2880 min Summer	0.227	0.027	16.8	2.7	O K
4320 min Summer	0.208	0.008	12.3	0.8	O K
5760 min Summer	0.200	0.000	9.8	0.0	O K
7200 min Summer	0.200	0.000	8.2	0.0	O K
8640 min Summer	0.200	0.000	7.2	0.0	O K
10080 min Summer	0.200	0.000	6.4	0.0	O K
15 min Winter	1.146	0.946	138.6	93.0	O K
30 min Winter	1.200	1.000	142.5	98.3	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	112.155	0.0	147.0	13	
30 min Summer	76.559	0.0	200.9	21	
60 min Summer	49.937	0.0	262.4	38	
120 min Summer	31.422	0.0	329.7	68	
180 min Summer	23.571	0.0	371.2	98	
240 min Summer	19.061	0.0	400.2	128	
360 min Summer	14.142	0.0	445.4	188	
480 min Summer	11.424	0.0	479.8	246	
600 min Summer	9.672	0.0	507.7	308	
720 min Summer	8.436	0.0	531.4	368	
960 min Summer	6.792	0.0	570.5	490	
1440 min Summer	4.993	0.0	629.1	734	
2160 min Summer	3.662	0.0	692.0	1100	
2880 min Summer	2.934	0.0	739.2	1464	
4320 min Summer	2.142	0.0	809.6	2148	
5760 min Summer	1.713	0.0	863.4	0	
7200 min Summer	1.442	0.0	908.3	0	
8640 min Summer	1.252	0.0	946.8	0	
10080 min Summer	1.112	0.0	980.8	0	
15 min Winter	112.155	0.0	165.0	13	
30 min Winter	76.559	0.0	225.1	22	
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41 St Paul's Stee Leeds LS1 2JG						
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XP Solutions		Source Control 2015.1				
<u>Summary of Results for 100 year Return Period (+30%)</u>						
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status	
60 min Winter	1.052	0.852	131.4	83.8	O K	
120 min Winter	0.766	0.566	106.8	55.7	O K	
180 min Winter	0.591	0.391	88.3	38.4	O K	
240 min Winter	0.486	0.286	75.1	28.1	O K	
360 min Winter	0.404	0.204	57.6	20.0	O K	
480 min Winter	0.362	0.162	46.8	15.9	O K	
600 min Winter	0.335	0.135	39.8	13.2	O K	
720 min Winter	0.314	0.114	34.7	11.2	O K	
960 min Winter	0.287	0.087	28.0	8.5	O K	
1440 min Winter	0.246	0.046	20.7	4.5	O K	
2160 min Winter	0.220	0.020	15.2	2.0	O K	
2880 min Winter	0.208	0.008	12.2	0.7	O K	
4320 min Winter	0.200	0.000	8.8	0.0	O K	
5760 min Winter	0.200	0.000	7.1	0.0	O K	
7200 min Winter	0.200	0.000	6.0	0.0	O K	
8640 min Winter	0.200	0.000	5.2	0.0	O K	
10080 min Winter	0.200	0.000	4.6	0.0	O K	
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)		
60 min Winter	49.937	0.0	293.2	40		
120 min Winter	31.422	0.0	369.4	70		
180 min Winter	23.571	0.0	416.0	100		
240 min Winter	19.061	0.0	448.2	130		
360 min Winter	14.142	0.0	498.9	188		
480 min Winter	11.424	0.0	537.4	248		
600 min Winter	9.672	0.0	568.7	308		
720 min Winter	8.436	0.0	595.2	368		
960 min Winter	6.792	0.0	639.0	490		
1440 min Winter	4.993	0.0	704.6	734		
2160 min Winter	3.662	0.0	775.0	1100		
2880 min Winter	2.934	0.0	827.9	1444		
4320 min Winter	2.142	0.0	906.8	0		
5760 min Winter	1.713	0.0	967.0	0		
7200 min Winter	1.442	0.0	1017.3	0		
8640 min Winter	1.252	0.0	1060.5	0		
10080 min Winter	1.112	0.0	1098.5	0		
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.320	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.700

Time (mins)	Area
From:	To: (ha)
0	4 0.700

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Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.200

Depth (m) Area (m²)	
0.000	98.3

Orifice Outflow Control

Diameter (m) 0.262 Discharge Coefficient 0.600 Invert Level (m) 0.080

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41 St Paul's Stee Leeds LS1 2JG					
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Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.056	0.856	144.4	91.1	O K
30 min Summer	1.139	0.939	151.3	99.9	O K
60 min Summer	1.068	0.868	145.4	92.3	O K
120 min Summer	0.865	0.665	127.1	70.8	O K
180 min Summer	0.711	0.511	111.3	54.4	O K
240 min Summer	0.603	0.403	98.6	42.9	O K
360 min Summer	0.479	0.279	81.8	29.7	O K
480 min Summer	0.424	0.224	68.7	23.9	O K
600 min Summer	0.390	0.190	59.1	20.2	O K
720 min Summer	0.364	0.164	52.0	17.5	O K
960 min Summer	0.328	0.128	42.3	13.6	O K
1440 min Summer	0.286	0.086	31.2	9.1	O K
2160 min Summer	0.243	0.043	23.0	4.6	O K
2880 min Summer	0.223	0.023	18.5	2.4	O K
4320 min Summer	0.203	0.003	13.5	0.3	O K
5760 min Summer	0.200	0.000	10.8	0.0	O K
7200 min Summer	0.200	0.000	9.1	0.0	O K
8640 min Summer	0.200	0.000	7.9	0.0	O K
10080 min Summer	0.200	0.000	7.0	0.0	O K
15 min Winter	1.158	0.958	152.8	102.0	O K
30 min Winter	1.211	1.011	157.0	107.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	112.155	0.0	161.5	13	
30 min Summer	76.559	0.0	220.7	21	
60 min Summer	49.937	0.0	287.8	38	
120 min Summer	31.422	0.0	363.0	68	
180 min Summer	23.571	0.0	408.2	98	
240 min Summer	19.061	0.0	440.3	128	
360 min Summer	14.142	0.0	490.0	188	
480 min Summer	11.424	0.0	527.7	246	
600 min Summer	9.672	0.0	558.5	308	
720 min Summer	8.436	0.0	584.6	368	
960 min Summer	6.792	0.0	627.6	490	
1440 min Summer	4.993	0.0	692.0	734	
2160 min Summer	3.662	0.0	761.2	1100	
2880 min Summer	2.934	0.0	813.1	1444	
4320 min Summer	2.142	0.0	890.7	2188	
5760 min Summer	1.713	0.0	949.7	0	
7200 min Summer	1.442	0.0	999.1	0	
8640 min Summer	1.252	0.0	1041.5	0	
10080 min Summer	1.112	0.0	1078.9	0	
15 min Winter	112.155	0.0	181.3	13	
30 min Winter	76.559	0.0	247.4	22	
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<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.061	0.861	144.8	91.6	O K
120 min Winter	0.770	0.570	117.6	60.7	O K
180 min Winter	0.592	0.392	97.3	41.8	O K
240 min Winter	0.486	0.286	82.8	30.4	O K
360 min Winter	0.405	0.205	63.3	21.8	O K
480 min Winter	0.362	0.162	51.4	17.2	O K
600 min Winter	0.333	0.133	43.6	14.2	O K
720 min Winter	0.313	0.113	38.2	12.0	O K
960 min Winter	0.283	0.083	30.7	8.9	O K
1440 min Winter	0.242	0.042	22.7	4.4	O K
2160 min Winter	0.216	0.016	16.7	1.7	O K
2880 min Winter	0.203	0.003	13.4	0.3	O K
4320 min Winter	0.200	0.000	9.7	0.0	O K
5760 min Winter	0.200	0.000	7.8	0.0	O K
7200 min Winter	0.200	0.000	6.6	0.0	O K
8640 min Winter	0.200	0.000	5.7	0.0	O K
10080 min Winter	0.200	0.000	5.1	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	49.937	0.0	323.0	40	
120 min Winter	31.422	0.0	406.9	70	
180 min Winter	23.571	0.0	457.1	100	
240 min Winter	19.061	0.0	493.1	130	
360 min Winter	14.142	0.0	548.8	188	
480 min Winter	11.424	0.0	591.0	248	
600 min Winter	9.672	0.0	625.6	308	
720 min Winter	8.436	0.0	654.7	368	
960 min Winter	6.792	0.0	702.9	490	
1440 min Winter	4.993	0.0	775.1	730	
2160 min Winter	3.662	0.0	852.5	1100	
2880 min Winter	2.934	0.0	910.8	1436	
4320 min Winter	2.142	0.0	997.5	0	
5760 min Winter	1.713	0.0	1063.7	0	
7200 min Winter	1.442	0.0	1119.0	0	
8640 min Winter	1.252	0.0	1166.5	0	
10080 min Winter	1.112	0.0	1208.4	0	
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.320	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.770

Time (mins)		Area
From:	To:	(ha)
0	4	0.770

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Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.200

Depth (m)	Area (m ²)
0.000	106.4

Orifice Outflow Control

Diameter (m) 0.274 Discharge Coefficient 0.600 Invert Level (m) 0.070

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Summary of Results for 100 year Return Period (+30%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	1.051	0.851	99.0	64.1	O K
30 min Summer	1.134	0.934	103.9	70.3	O K
60 min Summer	1.066	0.866	99.9	65.2	O K
120 min Summer	0.870	0.670	87.3	50.5	O K
180 min Summer	0.720	0.520	76.4	39.2	O K
240 min Summer	0.615	0.415	67.6	31.2	O K
360 min Summer	0.492	0.292	55.6	22.0	O K
480 min Summer	0.433	0.233	47.7	17.5	O K
600 min Summer	0.401	0.201	40.8	15.1	O K
720 min Summer	0.378	0.178	36.0	13.4	O K
960 min Summer	0.345	0.145	29.1	11.0	O K
1440 min Summer	0.308	0.108	21.5	8.1	O K
2160 min Summer	0.272	0.072	15.9	5.4	O K
2880 min Summer	0.251	0.051	12.7	3.9	O K
4320 min Summer	0.234	0.034	9.3	2.5	O K
5760 min Summer	0.224	0.024	7.4	1.8	O K
7200 min Summer	0.214	0.014	6.3	1.0	O K
8640 min Summer	0.206	0.006	5.4	0.5	O K
10080 min Summer	0.201	0.001	4.8	0.1	O K
15 min Winter	1.148	0.948	104.7	71.4	O K
30 min Winter	1.204	1.004	107.8	75.6	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer	112.155	0.0	111.5	13	
30 min Summer	76.559	0.0	152.1	21	
60 min Summer	49.937	0.0	198.2	38	
120 min Summer	31.422	0.0	249.9	68	
180 min Summer	23.571	0.0	281.3	98	
240 min Summer	19.061	0.0	303.2	128	
360 min Summer	14.142	0.0	337.2	188	
480 min Summer	11.424	0.0	363.2	246	
600 min Summer	9.672	0.0	384.4	308	
720 min Summer	8.436	0.0	402.4	368	
960 min Summer	6.792	0.0	432.0	490	
1440 min Summer	4.993	0.0	476.3	734	
2160 min Summer	3.662	0.0	523.9	1096	
2880 min Summer	2.934	0.0	559.8	1468	
4320 min Summer	2.142	0.0	613.0	2184	
5760 min Summer	1.713	0.0	653.6	2880	
7200 min Summer	1.442	0.0	687.7	3656	
8640 min Summer	1.252	0.0	716.9	4400	
10080 min Summer	1.112	0.0	742.6	5096	
15 min Winter	112.155	0.0	124.6	13	
30 min Winter	76.559	0.0	170.6	22	
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XP Solutions		Source Control 2015.1			
<u>Summary of Results for 100 year Return Period (+30%)</u>					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	1.060	0.860	99.5	64.8	O K
120 min Winter	0.778	0.578	80.8	43.6	O K
180 min Winter	0.605	0.405	66.7	30.5	O K
240 min Winter	0.501	0.301	56.6	22.7	O K
360 min Winter	0.414	0.214	43.7	16.1	O K
480 min Winter	0.375	0.175	35.5	13.2	O K
600 min Winter	0.350	0.150	30.1	11.3	O K
720 min Winter	0.331	0.131	26.3	9.9	O K
960 min Winter	0.306	0.106	21.2	8.0	O K
1440 min Winter	0.270	0.070	15.6	5.3	O K
2160 min Winter	0.245	0.045	11.4	3.4	O K
2880 min Winter	0.233	0.033	9.2	2.5	O K
4320 min Winter	0.218	0.018	6.7	1.3	O K
5760 min Winter	0.206	0.006	5.4	0.4	O K
7200 min Winter	0.200	0.000	4.5	0.0	O K
8640 min Winter	0.200	0.000	3.9	0.0	O K
10080 min Winter	0.200	0.000	3.5	0.0	O K
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
60 min Winter	49.937	0.0	222.5	40	
120 min Winter	31.422	0.0	280.0	70	
180 min Winter	23.571	0.0	315.0	100	
240 min Winter	19.061	0.0	339.3	130	
360 min Winter	14.142	0.0	377.7	188	
480 min Winter	11.424	0.0	406.8	248	
600 min Winter	9.672	0.0	430.5	308	
720 min Winter	8.436	0.0	450.7	368	
960 min Winter	6.792	0.0	483.8	488	
1440 min Winter	4.993	0.0	533.5	732	
2160 min Winter	3.662	0.0	586.8	1100	
2880 min Winter	2.934	0.0	626.9	1432	
4320 min Winter	2.142	0.0	686.5	2184	
5760 min Winter	1.713	0.0	732.1	2872	
7200 min Winter	1.442	0.0	770.3	0	
8640 min Winter	1.252	0.0	802.9	0	
10080 min Winter	1.112	0.0	831.7	0	
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Shortest Storm (mins)	15
Ratio R	0.320	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.530

Time (mins)	Area
From:	To: (ha)
0	4 0.530

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Model Details

Storage is Online Cover Level (m) 1.500

Tank or Pond Structure

Invert Level (m) 0.200

Depth (m) Area (m²)	
0.000	75.3

Orifice Outflow Control

Diameter (m) 0.229 Discharge Coefficient 0.600 Invert Level (m) 0.119

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