

Paul Waite Associates Ltd		Page 1
Summit House, Riparian Way The Crossings, Cross Hills Keighley, BD20 7BW	22228-PWA-00-XX-DR-C-3000-P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK	
Date 02/03/2023 File 22228-PWA-00-XX-CA-C-30...	Designed by IB Checked by LS	
Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales					
Return Period (years)	10	PIMP (%)	100		
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0		
Ratio R	0.300	Minimum Backdrop Height (m)	0.200		
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500		
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200		
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00		
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.257	4-8	0.107

Total Area Contributing (ha) = 0.364

Total Pipe Volume (m³) = 11.685

Network Design Table 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	Auto Design
1.000	70.000	0.700	100.0	0.070	4.00	0.0	0.600	o	225	Pipe/Conduit	🔴
1.001	23.000	0.230	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🔴
1.002	45.000	0.200	225.0	0.144	0.00	0.0	0.600	o	300	Pipe/Conduit	🔴
2.000	24.000	1.200	20.0	0.080	4.00	0.0	0.600	o	150	Pipe/Conduit	🔴
1.003	6.500	0.065	100.0	0.070	0.00	0.0	0.600	o	300	Pipe/Conduit	🔴
1.004	12.000	0.080	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🔴
1.005	43.500	1.299	33.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	🟢

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.89	166.700	0.070	0.0	0.0	0.0	1.31	52.0	9.5
1.001	50.00	5.19	166.000	0.070	0.0	0.0	0.0	1.31	52.0	9.5
1.002	50.00	5.90	165.695	0.214	0.0	0.0	0.0	1.04	73.8	29.0
2.000	50.00	4.18	166.695	0.080	0.0	0.0	0.0	2.26	40.0	10.8
1.003	50.00	5.97	165.495	0.364	0.0	0.0	0.0	1.57	111.1	49.3
1.004	50.00	6.13	165.030	0.364	0.0	0.0	0.0	1.28	90.6	49.3
1.005	50.00	6.39	164.950	0.364	0.0	0.0	0.0	2.73	192.7	49.3

Paul Waite Associates Ltd		Page 2
Summit House, Riparian Way The Crossings, Cross Hills Keighley, BD20 7BW		22228-PWA-00-XX-DR-C-3000-P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK
Date 02/03/2023 File 22228-PWA-00-XX-CA-C-30...		Designed by IB Checked by LS
Innovyze		Network 2020.1.3



Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
RE01	167.250	0.550	Open Manhole	450	1.000	166.700	225				
SW01	167.250	1.250	Open Manhole	450	1.001	166.000	225	1.000	166.000	225	
SW02	167.250	1.555	Open Manhole	1200	1.002	165.695	300	1.001	165.770	225	
SW03	167.250	0.555	Open Manhole	1200	2.000	166.695	150				
SW04	167.250	1.755	Open Manhole	450	1.003	165.495	300	1.002	165.495	300	
TANK	167.500	2.470	Junction		1.004	165.030	300	2.000	165.495	150	
SW FC	167.000	2.050	Open Manhole	1500	1.005	164.950	300	1.003	165.430	300	400
	166.370	2.719	Open Manhole	0		OUTFALL		1.004	164.950	300	
								1.005	163.651	300	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
RE01	388731.617	410783.807	388731.617	410783.807	Required	
SW01	388727.490	410713.929	388727.490	410713.929	Required	
SW02	388750.450	410712.573	388750.450	410712.573	Required	
SW03	388754.518	410781.453	388754.518	410781.453	Required	
SW04	388753.103	410757.494	388753.103	410757.494	Required	
TANK	388759.592	410757.111			No Entry	
SW FC	388760.471	410769.079	388760.471	410769.079	Required	
	388803.956	410770.239			No Entry	

Paul Waite Associates Ltd		Page 3
Summit House, Riparian Way The Crossings, Cross Hills Keighley, BD20 7BW	22228-PWA-00-XX-DR-C-3000-P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK	
Date 02/03/2023 File 22228-PWA-00-XX-CA-C-30...	Designed by IB Checked by LS	
Innovyze	Network 2020.1.3	

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	225	RE01	167.250	166.700	0.325	Open Manhole	450
1.001	o	225	SW01	167.250	166.000	1.025	Open Manhole	450
1.002	o	300	SW02	167.250	165.695	1.255	Open Manhole	1200
2.000	o	150	SW03	167.250	166.695	0.405	Open Manhole	1200
1.003	o	300	SW04	167.250	165.495	1.455	Open Manhole	450
1.004	o	300	TANK	167.500	165.030	2.170	Junction	
1.005	o	300	SW FC	167.000	164.950	1.750	Open Manhole	1500

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	70.000	100.0	SW01	167.250	166.000	1.025	Open Manhole	450
1.001	23.000	100.0	SW02	167.250	165.770	1.255	Open Manhole	1200
1.002	45.000	225.0	SW04	167.250	165.495	1.455	Open Manhole	450
2.000	24.000	20.0	SW04	167.250	165.495	1.605	Open Manhole	450
1.003	6.500	100.0	TANK	167.500	165.430	1.770	Junction	
1.004	12.000	150.0	SW FC	167.000	164.950	1.750	Open Manhole	1500
1.005	43.500	33.5		166.370	163.651	2.419	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)
------------------------	-----------------	-----------------	-----------------	------------------------	-------------	-----------

1.005		166.370	163.651	163.650	0	0
-------	--	---------	---------	---------	---	---

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.000	Cv (Summer)	0.750
Return Period (years)	10	Ratio R	0.300	Cv (Winter)	0.840
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

Paul Waite Associates Ltd		Page 4
Summit House, Riparian Way The Crossings, Cross Hills Keighley, BD20 7BW	22228-PWA-00-XX-DR-C-3000-P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK	
Date 02/03/2023	Designed by IB	
File 22228-PWA-00-XX-CA-C-30...	Checked by LS	
Innovyze	Network 2020.1.3	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: SW FC, DS/PN: 1.005, Volume (m³): 4.4

Unit Reference	MD-SHE-0092-5000-2000-5000	Sump Available	Yes
Design Head (m)	2.000	Diameter (mm)	92
Design Flow (l/s)	5.0	Invert Level (m)	164.950
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.0	Kick-Flo®	0.816	3.3
Flush-Flo™	0.398	4.1	Mean Flow over Head Range	-	3.9

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	2.9	0.800	3.4	2.000	5.0	4.000	6.9	7.000	9.0
0.200	3.8	1.000	3.6	2.200	5.2	4.500	7.3	7.500	9.3
0.300	4.1	1.200	3.9	2.400	5.4	5.000	7.7	8.000	9.6
0.400	4.1	1.400	4.2	2.600	5.6	5.500	8.0	8.500	9.9
0.500	4.1	1.600	4.5	3.000	6.0	6.000	8.4	9.000	10.2
0.600	4.0	1.800	4.8	3.500	6.5	6.500	8.7	9.500	10.4

Paul Waite Associates Ltd		Page 5
Summit House, Riparian Way The Crossings, Cross Hills Keighley, BD20 7BW	22228-PWA-00-XX-DR-C-3000-P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK	
Date 02/03/2023	Designed by IB	
File 22228-PWA-00-XX-CA-C-30...	Checked by LS	
Innovyze	Network 2020.1.3	

Storage Structures for Storm

Cellular Storage Manhole: TANK, DS/PN: 1.004

Invert Level (m) 165.030 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	160.0	160.0	1.200	160.0	227.2	1.201	0.0	227.2

Paul Waite Associates Ltd		Page 6
Summit House, Riparian Way The Crossings, Cross Hills Keighley, BD20 7BW	22228-PWA-00-XX-DR-C-3000-P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK	
Date 02/03/2023 File 22228-PWA-00-XX-CA-C-30...	Designed by IB Checked by LS	
Innovyze	Network 2020.1.3	

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 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 Offline Controls	0
Number of Online Controls	1	Number of Storage Structures	1
		Number of Time/Area Diagrams	0
		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	0.300	Cv (Winter)	0.840

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

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

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)	Flooded Volume (m³)	Flow / Cap.
1.000	RE01	15 Winter	1	+0%	100/15 Summer				166.766	-0.159	0.000	0.18
1.001	SW01	15 Winter	1	+0%	100/15 Summer				166.067	-0.158	0.000	0.19
1.002	SW02	15 Winter	1	+0%	30/15 Summer				165.819	-0.176	0.000	0.34
2.000	SW03	15 Winter	1	+0%	100/15 Summer				166.749	-0.096	0.000	0.29
1.003	SW04	15 Winter	1	+0%	30/15 Summer				165.670	-0.125	0.000	0.64
1.004	TANK	240 Winter	1	+0%	30/15 Winter				165.237	-0.093	0.000	0.06
1.005	SW FC	240 Winter	1	+0%	30/15 Summer				165.234	-0.016	0.000	0.02

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Level Exceeded Status
1.000	RE01			9.0	OK
1.001	SW01			9.0	OK
1.002	SW02			23.8	OK
2.000	SW03			10.8	OK
1.003	SW04			41.0	OK
1.004	TANK		109	4.2	OK*
1.005	SW FC			4.1	OK

Paul Waite Associates Ltd		Page 7
Summit House, Riparian Way The Crossings, Cross Hills Keighley, BD20 7BW	22228-PWA-00-XX-DR-C-3000-P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK	
Date 02/03/2023 File 22228-PWA-00-XX-CA-C-30...	Designed by IB Checked by LS	
Innovyze	Network 2020.1.3	

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 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 Offline Controls	0
Number of Online Controls	1	Number of Time/Area Diagrams	0
		Number of Storage Structures	1
		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	0.300	Cv (Winter)	0.840

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

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

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)	Flooded Volume (m³)	Flow / Cap.
1.000	RE01	15 Winter	30	+0%	100/15 Summer				166.807	-0.118	0.000	0.44
1.001	SW01	15 Winter	30	+0%	100/15 Summer				166.141	-0.084	0.000	0.47
1.002	SW02	15 Winter	30	+0%	30/15 Summer				166.095	0.100	0.000	0.92
2.000	SW03	15 Winter	30	+0%	100/15 Summer				166.788	-0.057	0.000	0.70
1.003	SW04	15 Winter	30	+0%	30/15 Summer				165.918	0.123	0.000	1.71
1.004	TANK	240 Winter	30	+0%	30/15 Winter				165.670	0.340	0.000	0.07
1.005	SW FC	240 Winter	30	+0%	30/15 Summer				165.672	0.422	0.000	0.02

PN	US/MH Name	Half Drain Overflow (l/s)	Pipe Flow Time (mins)	Status	Level Exceeded
1.000	RE01		22.1	OK	
1.001	SW01		22.2	OK	
1.002	SW02		63.6	SURCHARGED	
2.000	SW03		26.6	OK	
1.003	SW04		109.0	SURCHARGED	
1.004	TANK		219	SURCHARGED*	
1.005	SW FC		4.1	SURCHARGED	

Paul Waite Associates Ltd		Page 8
Summit House, Riparian Way The Crossings, Cross Hills Keighley, BD20 7BW	22228-PWA-00-XX-DR-C-3000-P01 SURFACE WATER CALCULATIONS GENESIS BUSINESS PARK	
Date 02/03/2023 File 22228-PWA-00-XX-CA-C-30...	Designed by IB Checked by LS	
Innovyze	Network 2020.1.3	

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 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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 1 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 0.300 Cv (Winter) 0.840

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

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.
1.000	RE01	15 Winter	100	+30%	100/15 Summer				167.105	0.180	0.000	0.71
1.001	SW01	360 Winter	100	+30%	100/15 Summer				166.979	0.754	0.000	0.13
1.002	SW02	360 Winter	100	+30%	30/15 Summer				166.977	0.982	0.000	0.28
2.000	SW03	15 Winter	100	+30%	100/15 Summer				167.246	0.401	0.000	0.96
1.003	SW04	360 Winter	100	+30%	30/15 Summer				166.973	1.178	0.000	0.50
1.004	TANK	480 Winter	100	+30%	30/15 Winter				166.231	0.901	0.000	0.08
1.005	SW FC	360 Winter	100	+30%	30/15 Summer				166.967	1.717	0.000	0.03

PN	US/MH Name	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	RE01			35.7	FLOOD RISK	
1.001	SW01			6.3	FLOOD RISK	
1.002	SW02			19.1	FLOOD RISK	
2.000	SW03			36.5	FLOOD RISK	
1.003	SW04			31.7	FLOOD RISK	
1.004	TANK		539	6.0	SURCHARGED*	
1.005	SW FC			5.0	FLOOD RISK	