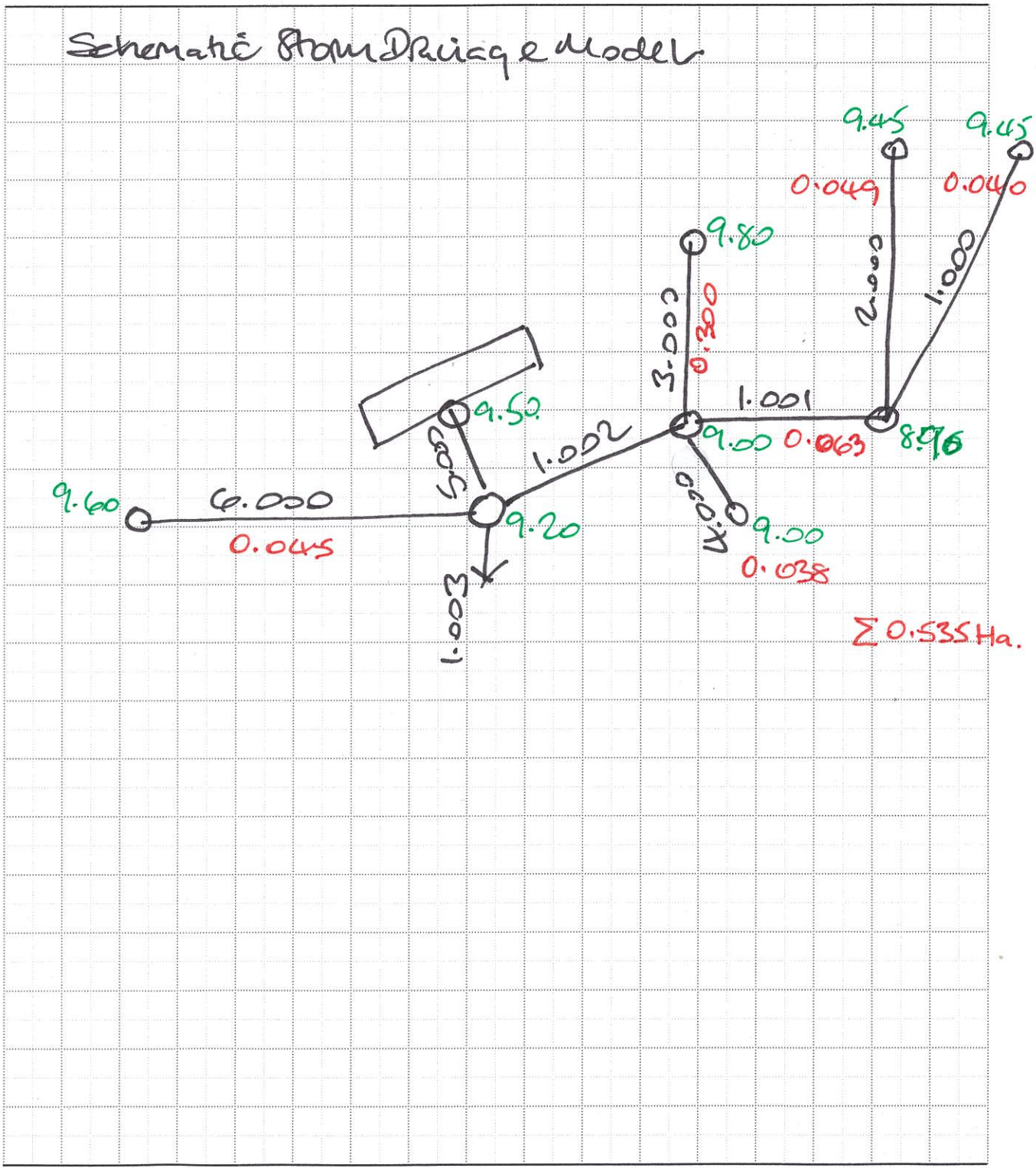
SKETCH SHEET

Client BGC | Made PAA | Job No 2019-249

Project Rilborough | Date 28.7.21. | Sheet No

Subject Car Park + Warehouse | Checked | Revision



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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)	1	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	1	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 Inverts

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.378	4-8	0.157

Total Area Contributing (ha) = 0.535

Total Pipe Volume (m³) = 14.513

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	68.000	0.500	136.0	0.040	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	57.000	0.500	114.0	0.049	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	25.000	0.250	100.0	0.063	0.00	0.0	0.600	o	300	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	1.00	6.01	8.300	0.040	0.0	0.0	0.0	1.12	44.5	0.1
2.000	1.00	5.78	8.300	0.049	0.0	0.0	0.0	1.22	48.7	0.1
1.001	1.00	6.28	7.800	0.152	0.0	0.0	0.0	1.57	111.1	0.4

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
3.000	22.000	1.150	19.1	0.300	5.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	7.000	0.400	17.5	0.038	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	10.000	0.100	100.0	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.000	15.000	0.100	150.0	0.000	5.00	0.0	0.600	o	450	Pipe/Conduit	
6.000	45.000	0.450	100.0	0.045	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	10.000	0.100	100.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
3.000	1.00	5.10	8.800	0.300	0.0	0.0	0.0	3.61	255.3	0.8
4.000	1.00	5.04	8.000	0.038	0.0	0.0	0.0	3.14	125.0	0.1
1.002	1.00	6.36	7.550	0.490	0.0	0.0	0.0	2.03	323.4	1.3
5.000	1.00	5.15	7.550	0.000	0.0	0.0	0.0	1.66	263.6	0.0
6.000	1.00	5.57	7.900	0.045	0.0	0.0	0.0	1.31	52.0	0.1
1.003	1.00	6.53	7.450	0.535	0.0	0.0	0.0	1.00	17.8	1.4

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)
1.003		9.000	7.350	0.000	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	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Storm Duration (mins)	30
Ratio R	0.350		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 9, DS/PN: 1.003, Volume (m³): 7.8

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	7.450
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)	1.000	3.0	Kick-Flo®	0.623	2.4
Flush-Flo™	0.297	3.0	Mean Flow over Head Range	-	2.6

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	2.4	1.200	3.3	3.000	5.0	7.000	7.4
0.200	2.9	1.400	3.5	3.500	5.4	7.500	7.7
0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9
0.400	2.9	1.800	3.9	4.500	6.0	8.500	8.2
0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.5	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.7	6.500	7.2		

Storage Structures for Storm

Tank or Pond Manhole: 7, DS/PN: 5.000

Invert Level (m) 7.550

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	472.5	0.800	472.5	0.801	0.0

Volume Summary (Static)

Length Calculations based on Centre-Centre

Pipe Number	USMH Name	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	2.704	0.000	2.704
2.000	2	2.266	0.000	2.266
1.001	3	1.767	0.000	1.767
3.000	4	1.555	0.000	1.555
4.000	5	0.278	0.000	0.278
1.002	6	1.590	0.000	1.590
5.000	7	2.386	378.158	380.543
6.000	8	1.789	0.000	1.789
1.003	9	0.177	0.000	0.177
Total		14.513	378.158	392.670

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 Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

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

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.345
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600
Return Period(s) (years)	100
Climate Change (%)	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				8.739
2.000	2	15 Winter	100	+40%	100/15 Summer				8.774
1.001	3	15 Winter	100	+40%	100/15 Summer				8.612
3.000	4	15 Winter	100	+40%					9.093
4.000	5	15 Winter	100	+40%	100/15 Summer				8.472
1.002	6	15 Winter	100	+40%	100/15 Summer				8.452
5.000	7	600 Winter	100	+40%	100/60 Winter				8.304
6.000	8	15 Winter	100	+40%	100/15 Summer				8.343
1.003	9	480 Winter	100	+40%	100/15 Summer				8.352

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.214	0.000	0.48			20.9	SURCHARGED	
2.000	2	0.249	0.000	0.56			26.1	SURCHARGED	
1.001	3	0.512	0.000	0.78			77.3	FLOOD RISK	
3.000	4	-0.007	0.000	0.75			167.9	OK	

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)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
4.000	5	0.247	0.000	0.24			21.0	SURCHARGED	
1.002	6	0.452	0.000	1.49			264.9	SURCHARGED	
5.000	7	0.304	0.000	0.02			3.3	SURCHARGED	
6.000	8	0.218	0.000	0.51			25.2	SURCHARGED	
1.003	9	0.752	0.000	0.19			3.0	SURCHARGED	