STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Warrenby 3B

« - Indicates pipe capacity < flow

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	Auto Design
3B-1.000	57.813	0.586	98.7	0.493	1.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-1.001	46.089	0.092	501.0	0.408	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-1.002	39.750	0.080	496.9	0.458	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-1.003	38.640	0.800	48.3	0.222	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.000	63.166	0.126	501.3	0.467	1.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.001	57.017	0.284	200.8	0.000	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.002	65.987	0.663	99.5	0.000	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.003	66.658	0.133	501.2	0.388	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.004	55.047	0.402	136.9	0.332	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.005	43.696	0.087	502.2	0.000	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.006	53.440	0.107	499.4	0.000	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.007	45.348	0.091	498.3	0.324	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.008	61.057	0.122	500.5	0.470	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.009	64.800	0.130	498.5	0.478	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.010	77.082	0.154	500.5	0.461	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.011	98.327	0.114	862.5	0.336	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-2.012	31.535	0.091	346.5	0.161	0.00	0.0		0.018	1.5 _/	500	1:1.5 Ditch	
3B-1.004	56.698	2.971	19.1	0.295	0.00	0.0	0.600		o	450	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)
3B-1.000	250.00	1.54	5.980	0.493	0.0	0.0	0.0	1.78	508.5	334.1
3B-1.001	244.90	2.51	5.394	0.901	0.0	0.0	0.0	0.79	225.7«	597.8
3B-1.002	200.89	3.34	5.302	1.360	0.0	0.0	0.0	0.80	226.6«	739.7
3B-1.003	191.03	3.60	5.222	1.582	0.0	0.0	0.0	2.55	726.8«	818.4
3B-2.000	250.00	2.33	5.980	0.467	0.0	0.0	0.0	0.79	225.6«	315.9
3B-2.001	212.15	3.09	5.854	0.467	0.0	0.0	0.0	1.25	356.5	315.9
3B-2.002	186.99	3.71	5.570	0.467	0.0	0.0	0.0	1.78	506.3	315.9
3B-2.003	149.80	5.11	4.907	0.854	0.0	0.0	0.0	0.79	225.6«	346.5
3B-2.004	138.64	5.72	4.702	1.186	0.0	0.0	0.0	1.51	431.7«	445.2
3B-2.005	125.05	6.64	4.300	1.186	0.0	0.0	0.0	0.79	225.4«	445.2
3B-2.006	112.25	7.76	4.213	1.186	0.0	0.0	0.0	0.79	226.0«	445.2
3B-2.007	103.62	8.71	4.106	1.510	0.0	0.0	0.0	0.79	226.3«	445.2
3B-2.008	94.23	10.00	4.015	1.980	0.0	0.0	0.0	0.79	225.8«	505.2
3B-2.009	86.28	11.36	3.893	2.457	0.0	0.0	0.0	0.79	226.2«	574.2
3B-2.010	78.68	12.98	3.763	2.918	0.0	0.0	0.0	0.79	225.8«	621.8
3B-2.011	69.00	15.70	3.609	3.254	0.0	0.0	0.0	0.60	172.0«	621.8
3B-2.012	67.37	16.25	3.495	3.415	0.0	0.0	0.0	0.95	271.3«	623.1
3B-1.004	66.79	16.45	3.404	5.292	0.0	0.0	0.0	4.67	742.9«	957.3

Area Summary for Warrenby 3B

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.493	0.493	0.493
1.001	User	-	100	0.408	0.408	0.408
1.002	User	-	100	0.458	0.458	0.458
1.003	User	-	100	0.222	0.222	0.222
2.000	User	-	100	0.467	0.467	0.467
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.000	0.000	0.000
2.003	User	-	100	0.388	0.388	0.388
2.004	User	-	100	0.332	0.332	0.332
2.005	-	-	100	0.000	0.000	0.000
2.006	-	-	100	0.000	0.000	0.000
2.007	User	-	100	0.324	0.324	0.324
2.008	User	-	100	0.470	0.470	0.470
2.009	User	-	100	0.478	0.478	0.478
2.010	User	-	100	0.461	0.461	0.461
2.011	User	-	100	0.336	0.336	0.336
2.012	User	-	100	0.161	0.161	0.161
1.004	User	-	100	0.295	0.295	0.295
				Total	Total	Total
				5.292	5.292	5.292

Free Flowing Outfall Details for Warrenby 3B

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
3B-1.004	E	2.783	0.433	2.000	0	0

Simulation Criteria for Warrenby 3B

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 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	FEH	E (1km)	0.282
Return Period (years)	30	F (1km)	2.353
FEH Rainfall Version	1999	Summer Storms	Yes
Site Location GB 457250 524500 NZ 57250 24500		Winter Storms	Yes
C (1km)	-0.021	Cv (Summer)	0.750
D1 (1km)	0.380	Cv (Winter)	0.840
D2 (1km)	0.382	Storm Duration (mins)	30
D3 (1km)	0.245		

Online Controls for Warrenby 3B

Hydro-Brake® Optimum Manhole: E18, DS/PN: 3B-1.004, Volume (m³): 178.7

Unit Reference	MD-SHE-0409-1085-0994-1085
Design Head (m)	0.994
Design Flow (l/s)	108.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	409
Invert Level (m)	3.404
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.994	108.5	Kick-Flo®	0.852	100.7
Flush-Flo™	0.564	108.5	Mean Flow over Head Range	-	81.8

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	11.2	0.800	103.4	2.000	152.5	4.000	214.0	7.000	281.6
0.200	40.0	1.000	108.8	2.200	159.7	4.500	226.7	7.500	291.4
0.300	77.7	1.200	118.9	2.400	166.7	5.000	238.7	8.000	300.7
0.400	105.3	1.400	128.1	2.600	173.3	5.500	250.2	8.500	309.8
0.500	108.1	1.600	136.8	3.000	185.9	6.000	261.1	9.000	318.7
0.600	108.4	1.800	144.8	3.500	200.5	6.500	271.6	9.500	327.3

Storage Structures for Warrenby 3B

Infiltration Basin Manhole: E18, DS/PN: 3B-1.004

Invert Level (m) 3.304 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1073.1	1.000	1073.1

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Warrenby 3B

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 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	FEH	D3 (1km)	0.245
FEH Rainfall Version	1999	E (1km)	0.282
Site Location	GB 457250 524500 NZ 57250 24500	F (1km)	2.353
C (1km)	-0.021	Cv (Summer)	0.600
D1 (1km)	0.380	Cv (Winter)	0.600
D2 (1km)	0.382		

Margin for Flood Risk Warning (mm)	0.0
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, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3B-1.000	E1	15 Summer	1	+0%					6.082
3B-1.001	E2	15 Summer	1	+0%	100/15 Summer	100/15 Summer			5.568
3B-1.002	E3	15 Summer	1	+0%					5.493
3B-1.003	E4	15 Summer	1	+0%					5.328
3B-2.000	E5	15 Summer	1	+0%					6.128
3B-2.001	E6	15 Summer	1	+0%					5.952
3B-2.002	E7	15 Summer	1	+0%					5.649
3B-2.003	E8	15 Summer	1	+0%					5.062
3B-2.004	E9	15 Summer	1	+0%					4.823
3B-2.005	E10	15 Summer	1	+0%	100/15 Summer	100/15 Summer			4.474
3B-2.006	E11	15 Summer	1	+0%					4.401
3B-2.007	E12	30 Summer	1	+0%					4.308
3B-2.008	E13	30 Summer	1	+0%					4.229
3B-2.009	E14	30 Summer	1	+0%					4.119
3B-2.010	E15	30 Summer	1	+0%					4.001
3B-2.011	E16	30 Summer	1	+0%	100/120 Summer	100/60 Winter			3.874
3B-2.012	E17	30 Summer	1	+0%					3.696
3B-1.004	E18	480 Summer	1	+0%	30/60 Summer				3.643

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3B-1.000	E1	-0.298	0.000	0.06		59.2	OK	
3B-1.001	E2	-0.226	0.000	0.17		70.2	OK	3
3B-1.002	E3	-0.357	0.000	0.12		91.6	OK	
3B-1.003	E4	-0.872	0.000	0.02		104.0	OK	
3B-2.000	E5	-0.252	0.000	0.11		44.4	OK	
3B-2.001	E6	-0.303	0.000	0.06		41.8	OK	
3B-2.002	E7	-0.321	0.000	0.05		41.3	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Warrenby 3B

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3B-2.003	E8	-0.245	0.000	0.15		61.4	OK	
3B-2.004	E9	-0.279	0.000	0.10		76.6	OK	
3B-2.005	E10	-0.226	0.000	0.18		73.8	OK	3
3B-2.006	E11	-0.550	0.000	0.05		70.6	OK	
3B-2.007	E12	-0.992	0.000	0.02		79.0	OK	
3B-2.008	E13	-1.571	0.000	0.01		92.5	OK	
3B-2.009	E14	-1.417	0.000	0.01		107.3	OK	
3B-2.010	E15	-1.719	0.000	0.01		123.5	OK	
3B-2.011	E16	-0.405	0.000	0.14		129.6	OK	7
3B-2.012	E17	-1.124	0.000	0.02		132.4	OK	
3B-1.004	E18	-0.211	0.000	0.08		54.4	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Warrenby 3B

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 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	FEH	D3 (1km)	0.245
FEH Rainfall Version	1999	E (1km)	0.282
Site Location	GB 457250 524500 NZ 57250 24500	F (1km)	2.353
C (1km)	-0.021	Cv (Summer)	0.600
D1 (1km)	0.380	Cv (Winter)	0.600
D2 (1km)	0.382		

Margin for Flood Risk Warning (mm)	0.0
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, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3B-1.000	E1	15 Summer	30	+0%					6.167
3B-1.001	E2	15 Summer	30	+0%	100/15 Summer	100/15 Summer			5.725
3B-1.002	E3	15 Summer	30	+0%					5.668
3B-1.003	E4	15 Summer	30	+0%					5.434
3B-2.000	E5	15 Summer	30	+0%					6.254
3B-2.001	E6	15 Summer	30	+0%					6.033
3B-2.002	E7	15 Summer	30	+0%					5.714
3B-2.003	E8	15 Summer	30	+0%					5.194
3B-2.004	E9	15 Summer	30	+0%					4.925
3B-2.005	E10	15 Summer	30	+0%	100/15 Summer	100/15 Summer			4.618
3B-2.006	E11	15 Summer	30	+0%					4.551
3B-2.007	E12	15 Summer	30	+0%					4.461
3B-2.008	E13	30 Summer	30	+0%					4.388
3B-2.009	E14	15 Summer	30	+0%					4.293
3B-2.010	E15	15 Summer	30	+0%					4.183
3B-2.011	E16	15 Summer	30	+0%	100/120 Summer	100/60 Winter			4.058
3B-2.012	E17	240 Summer	30	+0%					3.959
3B-1.004	E18	240 Summer	30	+0%	30/60 Summer				3.934

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3B-1.000	E1	-0.213	0.000	0.19		172.1	OK	
3B-1.001	E2	-0.069	0.000	0.58		235.9	OK	3
3B-1.002	E3	-0.182	0.000	0.40		321.8	OK	
3B-1.003	E4	-0.766	0.000	0.06		367.3	OK	
3B-2.000	E5	-0.126	0.000	0.35		140.4	OK	
3B-2.001	E6	-0.222	0.000	0.19		121.7	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Warrenby 3B

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3B-2.002	E7	-0.256	0.000	0.13		119.9	OK	
3B-2.003	E8	-0.113	0.000	0.46		186.1	OK	
3B-2.004	E9	-0.177	0.000	0.30		235.1	OK	
3B-2.005	E10	-0.082	0.000	0.55		221.6	OK	3
3B-2.006	E11	-0.400	0.000	0.14		213.2	OK	
3B-2.007	E12	-0.839	0.000	0.05		229.9	OK	
3B-2.008	E13	-1.412	0.000	0.02		252.3	OK	
3B-2.009	E14	-1.243	0.000	0.03		305.8	OK	
3B-2.010	E15	-1.537	0.000	0.02		368.3	OK	
3B-2.011	E16	-0.221	0.000	0.39		364.0	OK	7
3B-2.012	E17	-0.861	0.000	0.03		184.8	OK	
3B-1.004	E18	0.080	0.000	0.16		108.4	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Warrenby 3B

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 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	FEH	D3 (1km)	0.245
FEH Rainfall Version	1999	E (1km)	0.282
Site Location	GB 457250 524500 NZ 57250 24500	F (1km)	2.353
C (1km)	-0.021	Cv (Summer)	0.600
D1 (1km)	0.380	Cv (Winter)	0.600
D2 (1km)	0.382		

Margin for Flood Risk Warning (mm)	0.0
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, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
3B-1.000	E1	15 Summer	100	+20%					6.232
3B-1.001	E2	15 Summer	100	+20%	100/15 Summer	100/15 Summer			5.809
3B-1.002	E3	15 Summer	100	+20%					5.759
3B-1.003	E4	15 Summer	100	+20%					5.499
3B-2.000	E5	15 Summer	100	+20%					6.347
3B-2.001	E6	15 Summer	100	+20%					6.099
3B-2.002	E7	15 Summer	100	+20%					5.769
3B-2.003	E8	15 Summer	100	+20%					5.290
3B-2.004	E9	15 Summer	100	+20%					5.005
3B-2.005	E10	15 Summer	100	+20%	100/15 Summer	100/15 Summer			4.711
3B-2.006	E11	15 Winter	100	+20%					4.649
3B-2.007	E12	15 Winter	100	+20%					4.575
3B-2.008	E13	15 Summer	100	+20%					4.512
3B-2.009	E14	15 Summer	100	+20%					4.424
3B-2.010	E15	240 Summer	100	+20%					4.332
3B-2.011	E16	240 Summer	100	+20%	100/120 Summer	100/60 Winter			4.306
3B-2.012	E17	240 Summer	100	+20%					4.300
3B-1.004	E18	240 Summer	100	+20%	30/60 Summer				4.261

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3B-1.000	E1	-0.148	0.000	0.33		299.4	OK	
3B-1.001	E2	0.015	15.075	0.83		338.1	FLOOD	3
3B-1.002	E3	-0.091	0.000	0.65		514.4	OK	
3B-1.003	E4	-0.701	0.000	0.10		611.9	OK	
3B-2.000	E5	-0.033	0.000	0.62		253.4	OK	
3B-2.001	E6	-0.156	0.000	0.34		221.6	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Warrenby 3B

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
3B-2.002	E7	-0.201	0.000	0.24		217.7	OK	
3B-2.003	E8	-0.017	0.000	0.83		335.6	OK	
3B-2.004	E9	-0.097	0.000	0.55		426.7	OK	
3B-2.005	E10	0.011	11.087	0.85		344.1	FLOOD	3
3B-2.006	E11	-0.302	0.000	0.22		339.5	OK	
3B-2.007	E12	-0.725	0.000	0.08		375.2	OK	
3B-2.008	E13	-1.288	0.000	0.04		434.0	OK	
3B-2.009	E14	-1.112	0.000	0.05		540.9	OK	
3B-2.010	E15	-1.388	0.000	0.02		282.8	OK	
3B-2.011	E16	0.027	26.505	0.31		289.1	FLOOD	7
3B-2.012	E17	-0.520	0.000	0.04		252.8	OK	
3B-1.004	E18	0.407	0.000	0.16		108.5	SURCHARGED	