7 APPENDIX 2 – DRAINAGE CALCULATIONS

- Surface Water System 1 – Residential
- Surface Water System 2 – Stadium
- Surface Water System 3 – Stadium Carpark
- Surface Water System 4 – Southern Access Road

7.1 – Micro Drainage Calculations - Surface Water System 1 - Residential

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	1
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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
S2.000	86.000	0.215	400.0	0.258	4.00	0.0	0.600	[]	-10	Pipe/Conduit	
S2.001	10.000	0.985	10.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.002	37.069	0.153	242.3	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.003	37.069	0.478	77.6	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)	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)
S2.000	50.00	6.33	27.560	0.258	0.0	0.0	0.0	0.62	743.3	34.9
S2.001	50.00	6.36	27.150	0.258	0.0	0.0	0.0	4.96	350.8	34.9
S2.002	50.00	6.98	26.165	0.258	0.0	0.0	0.0	1.01	71.1	34.9
S2.003	50.00	7.32	26.012	0.258	0.0	0.0	0.0	1.79	126.3	34.9

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
S3.000	72.500	0.180	402.8	0.200	4.00	0.0	0.600	[]	-11	Pipe/Conduit	
S3.001	10.000	1.711	5.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.004	35.794	0.119	300.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.005	35.794	0.089	402.2	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S4.000	68.000	0.170	400.0	0.110	4.00	0.0	0.600	[]	-12	Pipe/Conduit	
S4.001	10.000	1.469	6.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	142.000	0.355	400.0	0.328	4.00	0.0	0.600	[]	-13	Pipe/Conduit	
S5.001	10.000	2.549	3.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.006	12.975	0.032	401.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.007	27.500	0.069	401.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.008	27.500	0.063	436.5	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.009	5.376	0.012	448.0	0.000	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)
S3.000	50.00	5.97	27.620	0.200	0.0	0.0	0.0	0.61	870.8	27.1
S3.001	50.00	5.99	27.245	0.200	0.0	0.0	0.0	6.54	462.6	27.1
S2.004	49.70	7.98	25.534	0.458	0.0	0.0	0.0	0.90	63.7	61.6
S2.005	46.97	8.65	25.340	0.458	0.0	0.0	0.0	0.90	99.1	61.6
S4.000	50.00	5.84	27.160	0.110	0.0	0.0	0.0	0.62	613.8	14.9
S4.001	50.00	5.87	26.795	0.110	0.0	0.0	0.0	6.06	428.5	14.9
S5.000	50.00	7.85	28.080	0.328	0.0	0.0	0.0	0.61	600.8	44.4
S5.001	50.00	7.86	27.725	0.328	0.0	0.0	0.0	10.32	1640.9	44.4
S2.006	46.17	8.86	25.176	0.896	0.0	0.0	0.0	1.01	160.4	112.0
S2.007	44.57	9.32	25.144	0.896	0.0	0.0	0.0	1.01	160.4	112.0
S2.008	43.04	9.79	25.075	0.896	0.0	0.0	0.0	0.97	153.7	112.0
S2.009	42.75	9.89	25.012	0.896	0.0	0.0	0.0	0.95	151.7	112.0

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)
S9	28.010	0.450	Open Manhole	1800	S2.000	27.560	-10				
SHB1	28.335	1.185	Open Manhole	1800	S2.001	27.150	300	S2.000	27.345	-10	
S2	28.530	2.365	Open Manhole	1350	S2.002	26.165	300	S2.001	26.165	300	
S3	28.465	2.453	Open Manhole	1350	S2.003	26.012	300	S2.002	26.012	300	
S11	28.070	0.450	Open Manhole	1800	S3.000	27.620	-11				
SHB2	28.200	0.955	Open Manhole	1800	S3.001	27.245	300	S3.000	27.440	-11	
S4	28.400	2.866	Open Manhole	1350	S2.004	25.534	300	S2.003	25.534	300	
								S3.001	25.534	300	
S5	28.335	2.995	Open Manhole	1800	S2.005	25.340	375	S2.004	25.415	300	
S13	27.610	0.450	Open Manhole	1200	S4.000	27.160	-12				
SHB3	27.800	1.005	Open Manhole	1200	S4.001	26.795	300	S4.000	26.990	-12	
S100	28.530	0.450	Open Manhole	1800	S5.000	28.080	-13				
SHB4	28.265	0.540	Open Manhole	1800	S5.001	27.725	450	S5.000	27.725	-13	
S6	28.265	3.089	Open Manhole	1350	S2.006	25.176	450	S2.005	25.251	375	
								S4.001	25.326	300	
								S5.001	25.176	450	
S7	28.000	2.856	Open Manhole	1350	S2.007	25.144	450	S2.006	25.144	450	
SAT	28.000	2.925	Open Manhole	1350	S2.008	25.075	450	S2.007	25.075	450	
S8	25.900	0.888	Open Manhole	1200	S2.009	25.012	450	S2.008	25.012	450	
S	25.800	0.800	Open Manhole	0		OUTFALL		S2.009	25.000	450	

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)
S2.000	[]	-10	S9	28.010	27.560	0.345	Open Manhole	1800
S2.001	o	300	SHB1	28.335	27.150	0.885	Open Manhole	1800
S2.002	o	300	S2	28.530	26.165	2.065	Open Manhole	1350
S2.003	o	300	S3	28.465	26.012	2.153	Open Manhole	1350
S3.000	[]	-11	S11	28.070	27.620	0.345	Open Manhole	1800
S3.001	o	300	SHB2	28.200	27.245	0.655	Open Manhole	1800
S2.004	o	300	S4	28.400	25.534	2.566	Open Manhole	1350
S2.005	o	375	S5	28.335	25.340	2.620	Open Manhole	1800
S4.000	[]	-12	S13	27.610	27.160	0.345	Open Manhole	1200
S4.001	o	300	SHB3	27.800	26.795	0.705	Open Manhole	1200
S5.000	[]	-13	S100	28.530	28.080	0.345	Open Manhole	1800
S5.001	o	450	SHB4	28.265	27.725	0.090	Open Manhole	1800
S2.006	o	450	S6	28.265	25.176	2.639	Open Manhole	1350

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)
S2.000	86.000	400.0	SHB1	28.335	27.345	0.885	Open Manhole	1800
S2.001	10.000	10.2	S2	28.530	26.165	2.065	Open Manhole	1350
S2.002	37.069	242.3	S3	28.465	26.012	2.153	Open Manhole	1350
S2.003	37.069	77.6	S4	28.400	25.534	2.566	Open Manhole	1350
S3.000	72.500	402.8	SHB2	28.200	27.440	0.655	Open Manhole	1800
S3.001	10.000	5.8	S4	28.400	25.534	2.566	Open Manhole	1350
S2.004	35.794	300.8	S5	28.335	25.415	2.620	Open Manhole	1800
S2.005	35.794	402.2	S6	28.265	25.251	2.639	Open Manhole	1350
S4.000	68.000	400.0	SHB3	27.800	26.990	0.705	Open Manhole	1200
S4.001	10.000	6.8	S6	28.265	25.326	2.639	Open Manhole	1350
S5.000	142.000	400.0	SHB4	28.265	27.725	0.435	Open Manhole	1800
S5.001	10.000	3.9	S6	28.265	25.176	2.639	Open Manhole	1350
S2.006	12.975	401.4	S7	28.000	25.144	2.406	Open Manhole	1350

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)
S2.007	o	450	S7	28.000	25.144	2.406	Open Manhole	1350
S2.008	o	450	SAT	28.000	25.075	2.475	Open Manhole	1350
S2.009	o	450	S8	25.900	25.012	0.438	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)
S2.007	27.500	401.4	SAT	28.000	25.075	2.475	Open Manhole	1350
S2.008	27.500	436.5	S8	25.900	25.012	0.438	Open Manhole	1200
S2.009	5.376	448.0	S	25.800	25.000	0.350	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
2.000	-	-	100	0.258	0.258	0.258
2.001	-	-	100	0.000	0.000	0.000
2.002	-	-	100	0.000	0.000	0.000
2.003	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.200	0.200	0.200
3.001	-	-	100	0.000	0.000	0.000
2.004	-	-	100	0.000	0.000	0.000
2.005	-	-	100	0.000	0.000	0.000
4.000	-	-	100	0.110	0.110	0.110
4.001	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.328	0.328	0.328
5.001	-	-	100	0.000	0.000	0.000
2.006	-	-	100	0.000	0.000	0.000
2.007	-	-	100	0.000	0.000	0.000
2.008	-	-	100	0.000	0.000	0.000
2.009	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.896	0.896	0.896

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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	5	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	1
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Summer Storms	Yes

Synthetic Rainfall Details

Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Orifice Manhole: SHB1, DS/PN: S2.001, Volume (m^3): 104.7

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 27.150

Orifice Manhole: SHB2, DS/PN: S3.001, Volume (m^3): 102.7

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 27.245

Orifice Manhole: SHB3, DS/PN: S4.001, Volume (m^3): 67.8

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 26.795

Orifice Manhole: SHB4, DS/PN: S5.001, Volume (m^3): 138.3

Diameter (m) 0.200 Discharge Coefficient 0.600 Invert Level (m) 27.725

Hydro-Brake® Optimum Manhole: SAT, DS/PN: S2.008, Volume (m^3): 8.3

Unit Reference	MD-SHE-0073-3500-2400-3500
Design Head (m)	2.400
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	73
Invert Level (m)	25.075
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)	2.400	3.5	Kick-Flo®	0.651	1.9
Flush-Flo™	0.316	2.4	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	2.0	0.500	2.3	1.200	2.5	2.000	3.2
0.200	2.3	0.600	2.1	1.400	2.7	2.200	3.4
0.300	2.4	0.800	2.1	1.600	2.9	2.400	3.5
0.400	2.4	1.000	2.3	1.800	3.1	2.600	3.6

Hydro-Brake® Optimum Manhole: SAT, DS/PN: S2.008, Volume (m³): 8.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
3.000	3.9	5.000	4.9	7.000	5.8	9.000	6.5
3.500	4.2	5.500	5.2	7.500	6.0	9.500	6.7
4.000	4.4	6.000	5.4	8.000	6.1		
4.500	4.7	6.500	5.6	8.500	6.3		

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 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 5 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

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, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S9	15 Winter	1	+0%					27.574
S2.001	SHB1	15 Winter	1	+0%	30/15 Summer				27.374
S2.002	S2	15 Winter	1	+0%	100/180 Winter				26.272
S2.003	S3	15 Winter	1	+0%	100/120 Winter				26.090
S3.000	S11	15 Winter	1	+0%					27.631

1 year Return Period 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)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S9	-0.091	0.000	0.05		37.3	OK	
S2.001	SHB1	-0.076	0.000	0.07		18.1	OK	
S2.002	S2	-0.193	0.000	0.28		18.1	OK	
S2.003	S3	-0.222	0.000	0.16		18.1	OK	
S3.000	S11	-0.094	0.000	0.04		29.7	OK	

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.	Water Level (m)
S3.001	SHB2	15 Winter	1	+0%	100/15 Summer				27.459
S2.004	S4	15 Winter	1	+0%	30/180 Winter				25.702
S2.005	S5	15 Winter	1	+0%	30/120 Winter				25.504
S4.000	S13	15 Winter	1	+0%	100/480 Winter				27.169
S4.001	SHB3	15 Summer	1	+0%	100/15 Summer				26.997
S5.000	S100	15 Winter	1	+0%					28.098
S5.001	SHB4	60 Winter	1	+0%					27.836
S2.006	S6	15 Winter	1	+0%	30/60 Summer				25.399
S2.007	S7	480 Winter	1	+0%	30/60 Summer				25.387
S2.008	SAT	480 Winter	1	+0%	30/15 Winter				25.385
S2.009	S8	240 Winter	1	+0%					25.059

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S3.001	SHB2	-0.086	0.000	0.05		17.5	OK	
S2.004	S4	-0.132	0.000	0.60		35.4	OK	
S2.005	S5	-0.211	0.000	0.40		35.4	OK	
S4.000	S13	-0.096	0.000	0.03		16.9	OK	
S4.001	SHB3	-0.098	0.000	0.05		16.1	OK	
S5.000	S100	-0.087	0.000	0.06		38.5	OK	
S5.001	SHB4	-0.339	0.000	0.01		8.4	OK	
S2.006	S6	-0.227	0.000	0.49		50.0	OK	
S2.007	S7	-0.207	0.000	0.10		13.5	OK	
S2.008	SAT	-0.140	0.000	0.02		2.4	OK	
S2.009	S8	-0.403	0.000	0.02		2.4	OK	

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 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 5 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

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, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S9	15 Winter	30	+0%					27.589
S2.001	SHB1	15 Winter	30	+0%	30/15 Summer				27.484
S2.002	S2	15 Winter	30	+0%	100/180 Winter				26.290
S2.003	S3	15 Winter	30	+0%	100/120 Winter				26.104
S3.000	S11	15 Winter	30	+0%					27.642

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S9	-0.076	0.000	0.16		118.0	OK	
S2.001	SHB1	0.034	0.000	0.10		23.9	SURCHARGED	
S2.002	S2	-0.175	0.000	0.36		23.9	OK	
S2.003	S3	-0.208	0.000	0.20		23.9	OK	
S3.000	S11	-0.083	0.000	0.11		94.3	OK	

30 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.	Water Level (m)
S3.001	SHB2	15 Winter	30	+0%	100/15 Summer				27.545
S2.004	S4	720 Winter	30	+0%	30/180 Winter				25.977
S2.005	S5	720 Winter	30	+0%	30/120 Winter				25.976
S4.000	S13	15 Winter	30	+0%	100/480 Winter				27.179
S4.001	SHB3	15 Winter	30	+0%	100/15 Summer				27.052
S5.000	S100	15 Winter	30	+0%					28.118
S5.001	SHB4	30 Winter	30	+0%					27.946
S2.006	S6	720 Winter	30	+0%	30/60 Summer				25.975
S2.007	S7	720 Winter	30	+0%	30/60 Summer				25.974
S2.008	SAT	720 Winter	30	+0%	30/15 Winter				25.973
S2.009	S8	10080 Summer	30	+0%					25.059

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S3.001	SHB2	0.000	0.000	0.07		22.3	OK	
S2.004	S4	0.143	0.000	0.24		13.9	SURCHARGED	
S2.005	S5	0.261	0.000	0.15		13.5	SURCHARGED	
S4.000	S13	-0.086	0.000	0.09		53.1	OK	
S4.001	SHB3	-0.043	0.000	0.07		20.0	OK	
S5.000	S100	-0.067	0.000	0.22		129.8	OK	
S5.001	SHB4	-0.229	0.000	0.03		24.7	OK	
S2.006	S6	0.349	0.000	0.25		25.7	SURCHARGED	
S2.007	S7	0.381	0.000	0.19		25.7	SURCHARGED	
S2.008	SAT	0.448	0.000	0.02		2.4	SURCHARGED	
S2.009	S8	-0.403	0.000	0.02		2.4	OK	

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	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	5	Number of Storage Structures	1	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

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, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.000	S9	15 Winter	100	+20%					27.602
S2.001	SHB1	15 Winter	100	+20%	30/15 Summer				27.598
S2.002	S2	720 Winter	100	+20%	100/180 Winter				27.459
S2.003	S3	720 Winter	100	+20%	100/120 Winter				27.459
S3.000	S11	15 Winter	100	+20%					27.653

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S9	-0.063	0.000	0.30		219.7	OK	
S2.001	SHB1	0.148	0.000	0.12		28.7	SURCHARGED	
S2.002	S2	0.994	0.000	0.20		13.0	SURCHARGED	
S2.003	S3	1.147	0.000	0.11		13.0	SURCHARGED	
S3.000	S11	-0.072	0.000	0.21		175.6	OK	

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	Overflow Act.	Water Level (m)
S3.001	SHB2	15 Winter	100	+20%	100/15 Summer				27.613
S2.004	S4	720 Winter	100	+20%	30/180 Winter				27.459
S2.005	S5	720 Winter	100	+20%	30/120 Winter				27.460
S4.000	S13	720 Winter	100	+20%	100/480 Winter				27.463
S4.001	SHB3	720 Winter	100	+20%	100/15 Summer				27.464
S5.000	S100	15 Winter	100	+20%					28.135
S5.001	SHB4	30 Winter	100	+20%					28.087
S2.006	S6	720 Winter	100	+20%	30/60 Summer				27.460
S2.007	S7	720 Winter	100	+20%	30/60 Summer				27.458
S2.008	SAT	720 Winter	100	+20%	30/15 Winter				27.457
S2.009	S8	720 Winter	100	+20%					25.064

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S3.001	SHB2	0.068	0.000	0.08		25.4	SURCHARGED	
S2.004	S4	1.625	0.000	0.38		22.5	SURCHARGED	
S2.005	S5	1.745	0.000	0.25		22.2	SURCHARGED	
S4.000	S13	0.198	0.000	0.01		5.6	FLOOD RISK	
S4.001	SHB3	0.369	0.000	0.02		5.6	SURCHARGED	
S5.000	S100	-0.050	0.000	0.41		241.8	OK	
S5.001	SHB4	-0.088	0.000	0.05		42.7	OK	
S2.006	S6	1.834	0.000	0.40		41.5	SURCHARGED	
S2.007	S7	1.865	0.000	0.30		41.4	SURCHARGED	
S2.008	SAT	1.932	0.000	0.03		3.5	SURCHARGED	
S2.009	S8	-0.399	0.000	0.03		3.5	OK	

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 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 5 Number of Storage Structures 1 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

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)	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)
S2.000	S9	30 Winter	100	+40%					27.665
S2.001	SHB1	15 Winter	100	+40%	100/15 Summer				27.656
S2.002	S2	960 Winter	100	+40%	100/120 Summer				27.613
S2.003	S3	960 Winter	100	+40%	100/60 Winter				27.612
S3.000	S11	15 Winter	100	+40%					27.656

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	S9	0.000	0.000	0.24		177.9	OK	
S2.001	SHB1	0.206	0.000	0.12		30.8	SURCHARGED	
S2.002	S2	1.148	0.000	0.18		11.9	SURCHARGED	
S2.003	S3	1.300	0.000	0.10		11.9	SURCHARGED	
S3.000	S11	-0.069	0.000	0.24		204.8	OK	

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	Overflow Act.
S3.001	SHB2	15 Winter	100	+40%	100/15 Summer			
S2.004	S4	960 Winter	100	+40%	100/15 Summer			
S2.005	S5	960 Winter	100	+40%	100/15 Summer			
S4.000	S13	960 Winter	100	+40%	100/180 Winter	100/480 Winter		
S4.001	SHB3	960 Winter	100	+40%	100/15 Summer			
S5.000	S100	30 Winter	100	+40%	100/30 Winter			
S5.001	SHB4	30 Winter	100	+40%	100/30 Winter			
S2.006	S6	960 Winter	100	+40%	100/15 Summer			
S2.007	S7	960 Winter	100	+40%	100/15 Summer			
S2.008	SAT	960 Winter	100	+40%	100/15 Summer			
S2.009	S8	960 Winter	100	+40%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S3.001	SHB2	27.638	0.093	0.000	0.08		26.5	SURCHARGED	
S2.004	S4	27.611	1.777	0.000	0.35		20.5	SURCHARGED	
S2.005	S5	27.611	1.896	0.000	0.23		20.3	SURCHARGED	
S4.000	S13	27.612	0.347	2.052	0.01		5.1	FLOOD	2
S4.001	SHB3	27.657	0.562	0.000	0.02		5.1	FLOOD RISK	
S5.000	S100	28.190	0.005	0.000	0.35		208.4	SURCHARGED	
S5.001	SHB4	28.182	0.007	0.000	0.06		49.9	FLOOD RISK	
S2.006	S6	27.611	1.985	0.000	0.37		38.5	SURCHARGED	
S2.007	S7	27.609	2.016	0.000	0.28		38.4	SURCHARGED	
S2.008	SAT	27.607	2.082	0.000	0.03		3.6	SURCHARGED	
S2.009	S8	25.064	-0.398	0.000	0.03		3.6	OK	

7.2 – Micro Drainage Calculations - Surface Water System 2 - Stadium

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	1
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

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
S1.000	29.689	0.150	197.9	0.037	4.00	0.0	0.600	[]	-9	Pipe/Conduit	
S2.000	23.500	0.120	195.8	0.079	4.00	0.0	0.600	o	450	Pipe/Conduit	
S2.001	23.500	0.120	195.8	0.079	0.00	0.0	0.600	o	450	Pipe/Conduit	
S3.000	18.936	0.095	199.3	0.037	4.00	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)
S1.000	50.00	4.26	27.620	0.037	0.0	0.0	0.0	1.88	931.0	5.0
S2.000	50.00	4.27	27.710	0.079	0.0	0.0	0.0	1.45	230.5	10.7
S2.001	50.00	4.54	27.590	0.158	0.0	0.0	0.0	1.45	230.5	21.4
S3.000	50.00	4.22	27.565	0.037	0.0	0.0	0.0	1.44	228.4	5.0

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
S1.001	34.587	0.175	197.6	0.089	0.00	0.0	0.600	[]	-9	Pipe/Conduit	
S1.002	34.674	0.315	110.1	0.089	0.00	0.0	0.600	[]	-9	Pipe/Conduit	
S4.000	23.500	0.120	195.8	0.073	4.00	0.0	0.600	o	450	Pipe/Conduit	
S4.001	23.500	0.305	77.0	0.073	0.00	0.0	0.600	o	450	Pipe/Conduit	
S5.000	19.169	0.100	191.7	0.037	4.00	0.0	0.600	o	300	Pipe/Conduit	
S1.003	31.295	0.160	195.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.004	45.407	0.240	189.2	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	75.000	0.115	652.2	0.000	0.00	0.0	0.600	4o	-10	Pipe/Conduit	
S6.000	27.332	0.140	195.2	0.083	4.00	0.0	0.600	[]	-9	Pipe/Conduit	
S7.000	23.500	0.120	195.8	0.079	4.00	0.0	0.600	o	450	Pipe/Conduit	
S7.001	23.500	0.120	195.8	0.079	0.00	0.0	0.600	o	450	Pipe/Conduit	
S6.001	34.506	0.175	197.2	0.083	0.00	0.0	0.600	[]	-9	Pipe/Conduit	
S6.002	34.755	0.425	81.8	0.083	0.00	0.0	0.600	[]	-9	Pipe/Conduit	
S8.000	23.500	0.120	195.8	0.073	4.00	0.0	0.600	o	450	Pipe/Conduit	
S8.001	23.500	0.420	56.0	0.073	0.00	0.0	0.600	o	450	Pipe/Conduit	
S6.003	30.009	0.150	200.1	0.083	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)
S1.001	50.00	4.85	27.420	0.321	0.0	0.0	0.0	1.88	931.6	43.5
S1.002	50.00	5.08	27.245	0.410	0.0	0.0	0.0	2.52	1250.5	55.5
S4.000	50.00	4.27	27.355	0.073	0.0	0.0	0.0	1.45	230.5	9.9
S4.001	50.00	4.44	27.235	0.146	0.0	0.0	0.0	2.32	368.7	19.8
S5.000	50.00	4.28	27.180	0.037	0.0	0.0	0.0	1.13	80.0	5.0
S1.003	50.00	5.44	26.930	0.593	0.0	0.0	0.0	1.45	230.6	80.3
S1.004	50.00	5.95	26.770	0.593	0.0	0.0	0.0	1.47	234.5	80.3
S1.005	50.00	6.56	24.880	0.593	0.0	0.0	0.0	2.05	28459.5	80.3
S6.000	50.00	4.24	27.390	0.083	0.0	0.0	0.0	1.89	937.4	11.2
S7.000	50.00	4.27	27.490	0.079	0.0	0.0	0.0	1.45	230.5	10.7
S7.001	50.00	4.54	27.370	0.158	0.0	0.0	0.0	1.45	230.5	21.4
S6.001	50.00	4.85	27.200	0.324	0.0	0.0	0.0	1.88	932.7	43.9
S6.002	50.00	5.04	27.025	0.407	0.0	0.0	0.0	2.93	1451.9	55.1
S8.000	50.00	4.27	27.140	0.073	0.0	0.0	0.0	1.45	230.5	9.9
S8.001	50.00	4.41	27.020	0.146	0.0	0.0	0.0	2.72	433.0	19.8
S6.003	50.00	5.39	26.600	0.636	0.0	0.0	0.0	1.43	228.0	86.1

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
S6.004	33.500	0.155	216.1	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	26.961	0.135	199.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.007	18.632	0.095	196.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.008	9.099	0.050	182.0	0.000	0.00	0.0	0.600	o	225	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)
S6.004	50.00	5.80	26.450	0.636	0.0	0.0	0.0	1.38	219.3	86.1
S1.006	50.00	7.05	26.280	1.229	0.0	0.0	0.0	0.92	36.6«	166.4
S1.007	50.00	7.38	26.145	1.229	0.0	0.0	0.0	0.93	37.0«	166.4
S1.008	50.00	7.54	26.050	1.229	0.0	0.0	0.0	0.97	38.4«	166.4

Conduit Sections for Storm

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m^2)
-9	[]	1000	500	90.0	45	0.685	0.496
-10	4o	8400	2100			2.100	13.854

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)
S1	28.620	1.000	Open Manhole	3000	S1.000	27.620	-9				
S11	29.100	1.390	Open Manhole	1350	S2.000	27.710	450				
S11a	29.100	1.510	Open Manhole	1350	S2.001	27.590	450	S2.000	27.590	450	
S12	28.775	1.210	Open Manhole	1350	S3.000	27.565	450				
S2	29.100	1.680	Open Manhole	3000	S1.001	27.420	-9	S1.000	27.470	-9	50
								S2.001	27.470	450	
								S3.000	27.470	450	
S3	29.200	1.955	Open Manhole	3000	S1.002	27.245	-9	S1.001	27.245	-9	
S14	29.300	1.945	Open Manhole	1350	S4.000	27.355	450				
S14a	29.300	2.065	Open Manhole	1350	S4.001	27.235	450	S4.000	27.235	450	
S15	29.235	2.055	Open Manhole	1200	S5.000	27.180	300				
S4	29.300	2.370	Open Manhole	3000	S1.003	26.930	450	S1.002	26.930	-9	
								S4.001	26.930	450	
								S5.000	27.080	300	
S6	28.900	2.130	Open Manhole	1350	S1.004	26.770	450	S1.003	26.770	450	
S7	29.340	4.460	Open Manhole	3000	S1.005	24.880	-10	S1.004	26.530	450	
S16	28.635	1.245	Open Manhole	3000	S6.000	27.390	-9				
S21	29.100	1.610	Open Manhole	1350	S7.000	27.490	450				
S21a	29.100	1.730	Open Manhole	1350	S7.001	27.370	450	S7.000	27.370	450	
S17	29.100	1.900	Open Manhole	3000	S6.001	27.200	-9	S6.000	27.250	-9	50
								S7.001	27.250	450	
S18	29.200	2.175	Open Manhole	3000	S6.002	27.025	-9	S6.001	27.025	-9	
S22	29.300	2.160	Open Manhole	1350	S8.000	27.140	450				
S22a	29.300	2.280	Open Manhole	1350	S8.001	27.020	450	S8.000	27.020	450	
S19	29.300	2.700	Open Manhole	3000	S6.003	26.600	450	S6.002	26.600	-9	
								S8.001	26.600	450	
S20	28.900	2.450	Open Manhole	1350	S6.004	26.450	450	S6.003	26.450	450	
SAT	29.215	4.450	Open Manhole	3000	S1.006	26.280	225	S1.005	24.765	-10	
								S6.004	26.295	450	240
S9	28.125	1.980	Open Manhole	1200	S1.007	26.145	225	S1.006	26.145	225	
S10	28.125	2.075	Open Manhole	1200	S1.008	26.050	225	S1.007	26.050	225	
S	27.000	1.000	Open Manhole	0		OUTFALL		S1.008	26.000	225	

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	[]	-9	S1	28.620	27.620	0.500	Open Manhole	3000
S2.000	o	450	S11	29.100	27.710	0.940	Open Manhole	1350
S2.001	o	450	S11a	29.100	27.590	1.060	Open Manhole	1350
S3.000	o	450	S12	28.775	27.565	0.760	Open Manhole	1350
S1.001	[]	-9	S2	29.100	27.420	1.180	Open Manhole	3000
S1.002	[]	-9	S3	29.200	27.245	1.455	Open Manhole	3000
S4.000	o	450	S14	29.300	27.355	1.495	Open Manhole	1350
S4.001	o	450	S14a	29.300	27.235	1.615	Open Manhole	1350
S5.000	o	300	S15	29.235	27.180	1.755	Open Manhole	1200
S1.003	o	450	S4	29.300	26.930	1.920	Open Manhole	3000
S1.004	o	450	S6	28.900	26.770	1.680	Open Manhole	1350
S1.005	4o	-10	S7	29.340	24.880	2.360	Open Manhole	3000
S6.000	[]	-9	S16	28.635	27.390	0.745	Open Manhole	3000
S7.000	o	450	S21	29.100	27.490	1.160	Open Manhole	1350
S7.001	o	450	S21a	29.100	27.370	1.280	Open Manhole	1350

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	29.689	197.9	S2	29.100	27.470	1.130	Open Manhole	3000
S2.000	23.500	195.8	S11a	29.100	27.590	1.060	Open Manhole	1350
S2.001	23.500	195.8	S2	29.100	27.470	1.180	Open Manhole	3000
S3.000	18.936	199.3	S2	29.100	27.470	1.180	Open Manhole	3000
S1.001	34.587	197.6	S3	29.200	27.245	1.455	Open Manhole	3000
S1.002	34.674	110.1	S4	29.300	26.930	1.870	Open Manhole	3000
S4.000	23.500	195.8	S14a	29.300	27.235	1.615	Open Manhole	1350
S4.001	23.500	77.0	S4	29.300	26.930	1.920	Open Manhole	3000
S5.000	19.169	191.7	S4	29.300	27.080	1.920	Open Manhole	3000
S1.003	31.295	195.6	S6	28.900	26.770	1.680	Open Manhole	1350
S1.004	45.407	189.2	S7	29.340	26.530	2.360	Open Manhole	3000
S1.005	75.000	652.2	SAT	29.215	24.765	2.350	Open Manhole	3000
S6.000	27.332	195.2	S17	29.100	27.250	1.350	Open Manhole	3000
S7.000	23.500	195.8	S21a	29.100	27.370	1.280	Open Manhole	1350
S7.001	23.500	195.8	S17	29.100	27.250	1.400	Open Manhole	3000

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)
S6.001	[]	-9	S17	29.100	27.200	1.400	Open Manhole	3000
S6.002	[]	-9	S18	29.200	27.025	1.675	Open Manhole	3000
S8.000	o	450	S22	29.300	27.140	1.710	Open Manhole	1350
S8.001	o	450	S22a	29.300	27.020	1.830	Open Manhole	1350
S6.003	o	450	S19	29.300	26.600	2.250	Open Manhole	3000
S6.004	o	450	S20	28.900	26.450	2.000	Open Manhole	1350
S1.006	o	225	SAT	29.215	26.280	2.710	Open Manhole	3000
S1.007	o	225	S9	28.125	26.145	1.755	Open Manhole	1200
S1.008	o	225	S10	28.125	26.050	1.850	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)
S6.001	34.506	197.2	S18	29.200	27.025	1.675	Open Manhole	3000
S6.002	34.755	81.8	S19	29.300	26.600	2.200	Open Manhole	3000
S8.000	23.500	195.8	S22a	29.300	27.020	1.830	Open Manhole	1350
S8.001	23.500	56.0	S19	29.300	26.600	2.250	Open Manhole	3000
S6.003	30.009	200.1	S20	28.900	26.450	2.000	Open Manhole	1350
S6.004	33.500	216.1	SAT	29.215	26.295	2.470	Open Manhole	3000
S1.006	26.961	199.7	S9	28.125	26.145	1.755	Open Manhole	1200
S1.007	18.632	196.1	S10	28.125	26.050	1.850	Open Manhole	1200
S1.008	9.099	182.0	S	27.000	26.000	0.775	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.037	0.037	0.037
2.000	-	-	100	0.079	0.079	0.079
2.001	-	-	100	0.079	0.079	0.079
3.000	-	-	100	0.037	0.037	0.037
1.001	-	-	100	0.089	0.089	0.089
1.002	-	-	100	0.089	0.089	0.089
4.000	-	-	100	0.073	0.073	0.073
4.001	-	-	100	0.073	0.073	0.073
5.000	-	-	100	0.037	0.037	0.037
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
6.000	-	-	100	0.083	0.083	0.083
7.000	-	-	100	0.079	0.079	0.079
7.001	-	-	100	0.079	0.079	0.079
6.001	-	-	100	0.083	0.083	0.083
6.002	-	-	100	0.083	0.083	0.083
8.000	-	-	100	0.073	0.073	0.073
8.001	-	-	100	0.073	0.073	0.073
6.003	-	-	100	0.083	0.083	0.083
6.004	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.229	1.229	1.229

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)
S1.008	S	27.000	26.000	26.000	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 Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	1
Site Location	GB 535350 201250 TL 35350 01250

Synthetic Rainfall Details

C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Pump Manhole: SAT, DS/PN: S1.006, Volume (m³): 1023.2

Invert Level (m) 26.280

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.200	4.8000	1.800	4.8000	3.400	4.8000	5.000	4.8000
0.400	4.8000	2.000	4.8000	3.600	4.8000	5.200	4.8000
0.600	4.8000	2.200	4.8000	3.800	4.8000	5.400	4.8000
0.800	4.8000	2.400	4.8000	4.000	4.8000	5.600	4.8000
1.000	4.8000	2.600	4.8000	4.200	4.8000	5.800	4.8000
1.200	4.8000	2.800	4.8000	4.400	4.8000	6.000	4.8000
1.400	4.8000	3.000	4.8000	4.600	4.8000		
1.600	4.8000	3.200	4.8000	4.800	4.8000		

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 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	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.265
Site Location	GB 535350 201250 TL 35350 01250	E (1km)	0.330
C (1km)	-0.025	F (1km)	2.484
D1 (1km)	0.295	Cv (Summer)	0.750
D2 (1km)	0.262	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

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, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+0%	100/15 Summer				27.628
S2.000	S11	15 Winter	1	+0%	100/15 Summer				27.783
S2.001	S11a	15 Winter	1	+0%	100/15 Summer				27.691
S3.000	S12	15 Winter	1	+0%	100/15 Summer				27.618
S1.001	S2	15 Winter	1	+0%	100/15 Summer				27.476
S1.002	S3	15 Winter	1	+0%	100/15 Summer				27.298
S4.000	S14	15 Winter	1	+0%	100/15 Summer				27.425
S4.001	S14a	15 Winter	1	+0%	100/15 Summer				27.310
S5.000	S15	15 Winter	1	+0%	100/15 Summer				27.237
S1.003	S4	15 Winter	1	+0%	30/15 Summer				27.124
S1.004	S6	15 Winter	1	+0%	30/15 Summer				26.956
S1.005	S7	10080 Winter	1	+0%	100/360 Winter				26.026
S6.000	S16	15 Winter	1	+0%	100/15 Summer				27.407
S7.000	S21	15 Winter	1	+0%	100/15 Summer				27.563
S7.001	S21a	15 Winter	1	+0%	100/15 Summer				27.471
S6.001	S17	15 Winter	1	+0%	100/15 Summer				27.256
S6.002	S18	15 Winter	1	+0%	100/15 Summer				27.072
S8.000	S22	15 Winter	1	+0%	100/15 Summer				27.210
S8.001	S22a	15 Winter	1	+0%	100/15 Summer				27.088
S6.003	S19	15 Winter	1	+0%	30/15 Summer				26.803
S6.004	S20	15 Winter	1	+0%	30/15 Summer				26.654

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.492	0.000	0.01		5.7	OK	
S2.000	S11	-0.377	0.000	0.06		12.1	OK	
S2.001	S11a	-0.349	0.000	0.11		21.4	OK	
S3.000	S12	-0.397	0.000	0.03		5.7	OK	
S1.001	S2	-0.444	0.000	0.06		43.4	OK	
S1.002	S3	-0.447	0.000	0.05		54.0	OK	
S4.000	S14	-0.380	0.000	0.06		11.2	OK	
S4.001	S14a	-0.375	0.000	0.07		20.0	OK	
S5.000	S15	-0.243	0.000	0.08		5.7	OK	
S1.003	S4	-0.256	0.000	0.38		76.3	OK	
S1.004	S6	-0.264	0.000	0.36		75.8	OK	
S1.005	S7	-0.954	0.000	0.00		1.3	OK	
S6.000	S16	-0.483	0.000	0.02		12.7	OK	
S7.000	S21	-0.377	0.000	0.06		12.1	OK	
S7.001	S21a	-0.349	0.000	0.11		21.4	OK	
S6.001	S17	-0.444	0.000	0.06		44.4	OK	
S6.002	S18	-0.453	0.000	0.05		54.3	OK	
S8.000	S22	-0.380	0.000	0.06		11.2	OK	
S8.001	S22a	-0.382	0.000	0.06		20.0	OK	
S6.003	S19	-0.247	0.000	0.42		81.6	OK	
S6.004	S20	-0.246	0.000	0.42		80.6	OK	

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.	Water Level (m)
S1.006	SAT	10080 Winter	1	+0%	100/120 Winter				26.026
S1.007	S9	60 Summer	1	+0%					26.145
S1.008	S10	30 Winter	1	+0%					26.050

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	SAT	-0.479	0.000	0.00		0.0	OK	
S1.007	S9	-0.225	0.000	0.00		0.0	OK	
S1.008	S10	-0.225	0.000	0.00		0.0	OK	

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 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	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.265
Site Location	GB 535350 201250 TL 35350 01250	E (1km)	0.330
C (1km)	-0.025	F (1km)	2.484
D1 (1km)	0.295	Cv (Summer)	0.750
D2 (1km)	0.262	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

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, 40

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)
S1.000	S1	15 Winter	30	+0%	100/15 Summer				27.647	-0.473
S2.000	S11	15 Winter	30	+0%	100/15 Summer				27.860	-0.300
S2.001	S11a	15 Winter	30	+0%	100/15 Summer				27.797	-0.243
S3.000	S12	15 Winter	30	+0%	100/15 Summer				27.665	-0.350
S1.001	S2	15 Winter	30	+0%	100/15 Summer				27.556	-0.364
S1.002	S3	15 Winter	30	+0%	100/15 Summer				27.463	-0.282
S4.000	S14	15 Winter	30	+0%	100/15 Summer				27.500	-0.305
S4.001	S14a	15 Winter	30	+0%	100/15 Summer				27.463	-0.222
S5.000	S15	15 Winter	30	+0%	100/15 Summer				27.456	-0.024
S1.003	S4	15 Winter	30	+0%	30/15 Summer				27.443	0.063
S1.004	S6	15 Winter	30	+0%	30/15 Summer				27.240	0.020
S1.005	S7	5760 Winter	30	+0%	100/360 Winter				26.388	-0.592
S6.000	S16	15 Winter	30	+0%	100/15 Summer				27.446	-0.444
S7.000	S21	15 Winter	30	+0%	100/15 Summer				27.640	-0.300
S7.001	S21a	15 Winter	30	+0%	100/15 Summer				27.577	-0.243
S6.001	S17	15 Winter	30	+0%	100/15 Summer				27.337	-0.363
S6.002	S18	15 Winter	30	+0%	100/15 Summer				27.236	-0.289
S8.000	S22	15 Winter	30	+0%	100/15 Summer				27.282	-0.308
S8.001	S22a	15 Winter	30	+0%	100/15 Summer				27.236	-0.234
S6.003	S19	15 Winter	30	+0%	30/15 Summer				27.216	0.166
S6.004	S20	15 Winter	30	+0%	30/15 Summer				26.980	0.080

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.03		19.3	OK	
S2.000	S11	0.000	0.22		41.5	OK	
S2.001	S11a	0.000	0.43		81.8	OK	
S3.000	S12	0.000	0.11		19.5	OK	
S1.001	S2	0.000	0.22		162.8	OK	
S1.002	S3	0.000	0.19		185.6	OK	
S4.000	S14	0.000	0.20		38.4	OK	
S4.001	S14a	0.000	0.23		71.6	OK	
S5.000	S15	0.000	0.25		17.6	OK	
S1.003	S4	0.000	1.17		233.6	SURCHARGED	
S1.004	S6	0.000	1.08		228.4	SURCHARGED	
S1.005	S7	0.000	0.00		3.4	OK	
S6.000	S16	0.000	0.07		43.6	OK	
S7.000	S21	0.000	0.22		41.5	OK	
S7.001	S21a	0.000	0.43		81.9	OK	
S6.001	S17	0.000	0.22		164.9	OK	
S6.002	S18	0.000	0.16		178.2	OK	
S8.000	S22	0.000	0.20		38.4	OK	
S8.001	S22a	0.000	0.20		73.0	OK	
S6.003	S19	0.000	1.26		246.2	SURCHARGED	
S6.004	S20	0.000	1.29		246.1	SURCHARGED	

30 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.	Water Level (m)	Surcharged Depth (m)
S1.006	SAT	5760 Winter	30	+0%	100/120 Winter				26.388	-0.117
S1.007	S9	5760 Winter	30	+0%					26.186	-0.184
S1.008	S10	5760 Winter	30	+0%					26.093	-0.182

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	SAT	0.000	0.08		2.6	OK	
S1.007	S9	0.000	0.08		2.6	OK	
S1.008	S10	0.000	0.08		2.6	OK	

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 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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D3 (1km) 0.265
Site Location GB 535350 201250 TL 35350 01250 E (1km) 0.330
C (1km) -0.025 F (1km) 2.484
D1 (1km) 0.295 Cv (Summer) 0.750
D2 (1km) 0.262 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 150.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status OFF
Inertia Status OFF

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, 40

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)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				28.357	0.237
S2.000	S11	15 Winter	100	+40%	100/15 Summer				28.420	0.260
S2.001	S11a	15 Winter	100	+40%	100/15 Summer				28.398	0.358
S3.000	S12	15 Winter	100	+40%	100/15 Summer				28.364	0.349
S1.001	S2	15 Winter	100	+40%	100/15 Summer				28.354	0.434
S1.002	S3	15 Winter	100	+40%	100/15 Summer				28.329	0.584
S4.000	S14	15 Winter	100	+40%	100/15 Summer				28.357	0.552
S4.001	S14a	15 Winter	100	+40%	100/15 Summer				28.337	0.652
S5.000	S15	15 Winter	100	+40%	100/15 Summer				28.322	0.842
S1.003	S4	15 Winter	100	+40%	30/15 Summer				28.296	0.916
S1.004	S6	15 Winter	100	+40%	30/15 Summer				27.717	0.497
S1.005	S7	1440 Winter	100	+40%	100/360 Winter				27.636	0.656
S6.000	S16	15 Winter	100	+40%	100/15 Summer				28.313	0.423
S7.000	S21	15 Winter	100	+40%	100/15 Summer				28.374	0.434
S7.001	S21a	15 Winter	100	+40%	100/15 Summer				28.352	0.532
S6.001	S17	15 Winter	100	+40%	100/15 Summer				28.307	0.607
S6.002	S18	15 Winter	100	+40%	100/15 Summer				28.280	0.755
S8.000	S22	15 Winter	100	+40%	100/15 Summer				28.308	0.718
S8.001	S22a	15 Winter	100	+40%	100/15 Summer				28.287	0.817
S6.003	S19	15 Winter	100	+40%	30/15 Summer				28.246	1.196
S6.004	S20	1440 Winter	100	+40%	30/15 Summer				27.636	0.736

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.05		33.7	SURCHARGED	
S2.000	S11	0.000	0.45		87.0	SURCHARGED	
S2.001	S11a	0.000	0.85		162.8	SURCHARGED	
S3.000	S12	0.000	0.22		39.1	SURCHARGED	
S1.001	S2	0.000	0.32		233.0	SURCHARGED	
S1.002	S3	0.000	0.26		255.6	SURCHARGED	
S4.000	S14	0.000	0.39		73.9	SURCHARGED	
S4.001	S14a	0.000	0.48		146.9	SURCHARGED	
S5.000	S15	0.000	0.52		36.3	SURCHARGED	
S1.003	S4	0.000	1.88		374.1	SURCHARGED	
S1.004	S6	0.000	1.78		374.9	SURCHARGED	
S1.005	S7	0.000	0.00		18.9	SURCHARGED	
S6.000	S16	0.000	0.12		78.1	SURCHARGED	
S7.000	S21	0.000	0.44		84.9	SURCHARGED	
S7.001	S21a	0.000	0.83		158.1	SURCHARGED	
S6.001	S17	0.000	0.30		220.8	SURCHARGED	
S6.002	S18	0.000	0.24		275.8	SURCHARGED	
S8.000	S22	0.000	0.38		72.2	SURCHARGED	
S8.001	S22a	0.000	0.40		144.4	SURCHARGED	
S6.003	S19	0.000	2.19		428.5	SURCHARGED	
S6.004	S20	0.000	0.11		20.7	SURCHARGED	

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	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.006	SAT	1440 Winter	100	+40%	100/120 Winter				27.636	1.131
S1.007	S9	240 Summer	100	+40%					26.202	-0.168
S1.008	S10	240 Summer	100	+40%					26.108	-0.167

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.006	SAT	0.000	0.14		4.8	SURCHARGED	
S1.007	S9	0.000	0.14		4.8	OK	
S1.008	S10	0.000	0.15		4.8	OK	

7.3 – Micro Drainage Calculations - Surface Water System 3 – Stadium Car Park

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	1
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.000	4-8	0.493	8-12	0.285	12-16	0.074

Total Area Contributing (ha) = 0.852

Total Pipe Volume (m³) = 855.039

Network Design Table for Storm

« - Indicates pipe capacity < flow

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
S1.000	119.000	0.160	743.8	0.204	4.00	0.0	0.600	[]	-11	Pipe/Conduit	
S1.001	43.884	0.060	731.4	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.002	157.000	0.210	747.6	0.648	0.00	0.0	0.600	[]	-12	Pipe/Conduit	
S1.003	18.301	1.405	13.0	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)
S1.000	50.00	7.51	27.880	0.204	0.0	0.0	0.0	0.57	1229.2	27.6
S1.001	47.58	8.49	27.720	0.204	0.0	0.0	0.0	0.74	118.3	27.6
S1.002	35.01	13.12	27.660	0.852	0.0	0.0	0.0	0.57	2119.5	80.8
S1.003	34.81	13.23	27.450	0.852	0.0	0.0	0.0	2.81	49.6«	80.8

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
S1.004	9.099	0.045	202.2	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)
S1.004	34.41	13.45	26.045	0.852	0.0	0.0	0.0	0.70	12.4«	80.8

Conduit Sections for Storm

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \/ open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m²)
-11	[]	14500	150	90.0		0.297	2.175
-12	[]	25000	150	90.0		0.298	3.750

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)
S1	28.430	0.550	Open Manhole	3000	S1.000	27.880	-11				
S2	28.270	0.550	Open Manhole	3000	S1.001	27.720	450	S1.000	27.720	-11	
S3	28.210	0.550	Open Manhole	3000	S1.002	27.660	-12	S1.001	27.660	450	
S6	28.000	0.550	Open Manhole	3000	S1.003	27.450	150	S1.002	27.450	-12	
S7	28.125	2.080	Open Manhole	1200	S1.004	26.045	150	S1.003	26.045	150	
S	27.000	1.000	Open Manhole	0		OUTFALL		S1.004	26.000	150	

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	[]	-11	S1	28.430	27.880	0.400	Open Manhole	3000
S1.001	o	450	S2	28.270	27.720	0.100	Open Manhole	3000
S1.002	[]	-12	S3	28.210	27.660	0.400	Open Manhole	3000
S1.003	o	150	S6	28.000	27.450	0.400	Open Manhole	3000
S1.004	o	150	S7	28.125	26.045	1.930	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	119.000	743.8	S2	28.270	27.720	0.400	Open Manhole	3000
S1.001	43.884	731.4	S3	28.210	27.660	0.100	Open Manhole	3000
S1.002	157.000	747.6	S6	28.000	27.450	0.400	Open Manhole	3000
S1.003	18.301	13.0	S7	28.125	26.045	1.930	Open Manhole	1200
S1.004	9.099	202.2	S	27.000	26.000	0.850	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.204	0.204	0.204
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.648	0.648	0.648
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.852	0.852	0.852

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)
S1.004	S	27.000	26.000	26.000	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 Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	1	Number of Storage Structures	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	1
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake Optimum® Manhole: S6, DS/PN: S1.003, Volume (m^3): 581.4

Unit Reference	MD-SHE-0083-2500-0430-2500
Design Head (m)	0.430
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	27.450
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)	0.430	2.5	Kick-Flo®	0.310	2.2
Flush-Flo™	0.137	2.5	Mean Flow over Head Range	-	2.1

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	2.5	1.200	4.0	3.000	6.1	7.000	9.3
0.200	2.4	1.400	4.3	3.500	6.6	7.500	9.6
0.300	2.2	1.600	4.6	4.000	7.0	8.000	9.9
0.400	2.4	1.800	4.8	4.500	7.4	8.500	10.2
0.500	2.7	2.000	5.1	5.000	7.8	9.000	10.5
0.600	2.9	2.200	5.3	5.500	8.2	9.500	10.8
0.800	3.3	2.400	5.5	6.000	8.6		
1.000	3.7	2.600	5.7	6.500	8.9		

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 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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.265
Site Location	GB 535350 201250 TL 35350 01250	E (1km)	0.330
C (1km)	-0.025	F (1km)	2.484
D1 (1km)	0.295	Cv (Summer)	0.750
D2 (1km)	0.262	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
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, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+0%					27.891
S1.001	S2	180 Winter	1	+0%					27.760
S1.002	S3	15 Winter	1	+0%	100/180 Winter				27.675
S1.003	S6	960 Winter	1	+0%	30/60 Winter				27.563
S1.004	S7	480 Winter	1	+0%					26.093

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.139	0.000	0.02		28.2	OK	
S1.001	S2	-0.410	0.000	0.02		2.0	OK	
S1.002	S3	-0.135	0.000	0.03		70.6	OK	
S1.003	S6	-0.037	0.000	0.05		2.5	OK	
S1.004	S7	-0.102	0.000	0.23		2.5	OK	

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 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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.265
Site Location	GB 535350 201250 TL 35350 01250	E (1km)	0.330
C (1km)	-0.025	F (1km)	2.484
D1 (1km)	0.295	Cv (Summer)	0.750
D2 (1km)	0.262	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
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, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%					27.906
S1.001	S2	60 Winter	30	+0%					27.813
S1.002	S3	15 Winter	30	+0%	100/180 Winter				27.693
S1.003	S6	960 Winter	30	+0%	30/60 Winter				27.659
S1.004	S7	2160 Winter	30	+0%					26.093

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.124	0.000	0.08		90.6	OK	
S1.001	S2	-0.357	0.000	0.10		10.1	OK	
S1.002	S3	-0.117	0.000	0.11		223.7	OK	
S1.003	S6	0.059	0.000	0.05		2.5	SURCHARGED	
S1.004	S7	-0.102	0.000	0.23		2.5	OK	

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 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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH	D3 (1km)	0.265
Site Location	GB 535350 201250 TL 35350 01250	E (1km)	0.330
C (1km)	-0.025	F (1km)	2.484
D1 (1km)	0.295	Cv (Summer)	0.750
D2 (1km)	0.262	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
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, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	100	+40%					27.922
S1.001	S2	960 Winter	100	+40%					27.921
S1.002	S3	960 Winter	100	+40%	100/180 Winter				27.921
S1.003	S6	960 Winter	100	+40%	30/60 Winter				27.921
S1.004	S7	960 Winter	100	+40%					26.094

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.108	0.000	0.16		189.5	OK	
S1.001	S2	-0.249	0.000	-0.13		-13.3	OK	
S1.002	S3	0.111	0.000	0.02		37.7	SURCHARGED	
S1.003	S6	0.321	0.000	0.06		2.6	FLOOD RISK	
S1.004	S7	-0.101	0.000	0.24		2.6	OK	

7.3 – Micro Drainage Calculations - Surface Water System 4 – Southern Access Road

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	1
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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
S1.000	110.000	0.275	400.0	0.130	4.00	0.0	0.600	[]	-11	Pipe/Conduit	
S1.001	23.494	0.117	200.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	9.099	0.045	202.2	0.000	0.00	0.0	0.600	o	225	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)
S1.000	50.00	6.98	28.190	0.130	0.0	0.0	0.0	0.62	626.8	17.6
S1.001	50.00	7.41	27.795	0.130	0.0	0.0	0.0	0.92	36.5	17.6
S1.002	50.00	7.57	26.045	0.130	0.0	0.0	0.0	0.92	36.4	17.6

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)
S1	28.640	0.450	Open Manhole	3000	S1.000	28.190	-11				
S3	28.640	0.845	Open Manhole	3000	S1.001	27.795	225	S1.000	27.915	-11	
S4	28.125	2.080	Open Manhole	1200	S1.002	26.045	225	S1.001	27.678	225	1633
S	27.000	1.000	Open Manhole	0		OUTFALL		S1.002	26.000	225	

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	[]	-11	S1	28.640	28.190	0.345	Open Manhole	3000
S1.001	o	225	S3	28.640	27.795	0.620	Open Manhole	3000
S1.002	o	225	S4	28.125	26.045	1.855	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	110.000	400.0	S3	28.640	27.915	0.620	Open Manhole	3000
S1.001	23.494	200.8	S4	28.125	27.678	0.222	Open Manhole	1200
S1.002	9.099	202.2	S	27.000	26.000	0.775	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.130	0.130	0.130
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.130	0.130	0.130

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

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	1
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Storm Duration (mins)	30

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S3, DS/PN: S1.001, Volume (m³): 115.0

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	27.795
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	1.0	Kick-Flo®	0.398	0.6
Flush-Flo™	0.196	0.7	Mean Flow over Head Range	-	0.8

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)**
0.100	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

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 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	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	OFF

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, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+0%					28.200
S1.001	S3	120 Winter	1	+0%	30/15 Summer				27.983
S1.002	S4	240 Winter	1	+0%					26.069

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.095	0.000	0.03		18.5	OK	
S1.001	S3	-0.037	0.000	0.02		0.7	OK	
S1.002	S4	-0.201	0.000	0.02		0.7	OK	

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 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	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	OFF

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, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%					28.211
S1.001	S3	360 Winter	30	+0%	30/15 Summer				28.078
S1.002	S4	1440 Winter	30	+0%					26.069

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.084	0.000	0.10		59.3	OK	
S1.001	S3	0.058	0.000	0.02		0.7	SURCHARGED	
S1.002	S4	-0.201	0.000	0.02		0.7	OK	

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	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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	1999
Site Location	GB 535350 201250 TL 35350 01250
C (1km)	-0.025
D1 (1km)	0.295
D2 (1km)	0.262
D3 (1km)	0.265
E (1km)	0.330
F (1km)	2.484
Cv (Summer)	0.750
Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	150.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	OFF

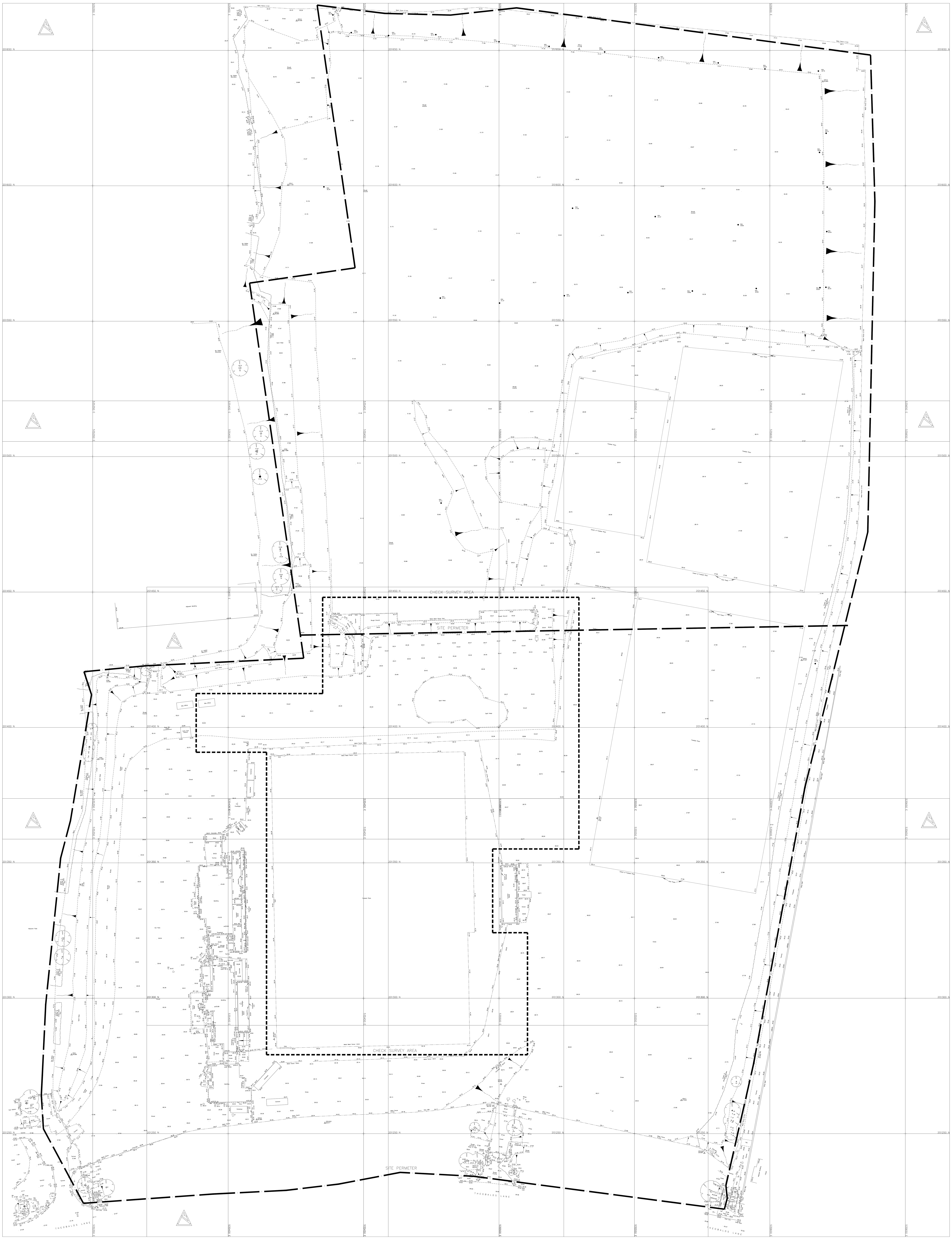
Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	600 Winter	100	+40%					28.248
S1.001	S3	600 Winter	100	+40%	30/15 Summer				28.248
S1.002	S4	4320 Summer	100	+40%					26.069

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.047	0.000	0.01		8.9	OK	
S1.001	S3	0.228	0.000	0.02		0.7	SURCHARGED	
S1.002	S4	-0.201	0.000	0.02		0.7	OK	

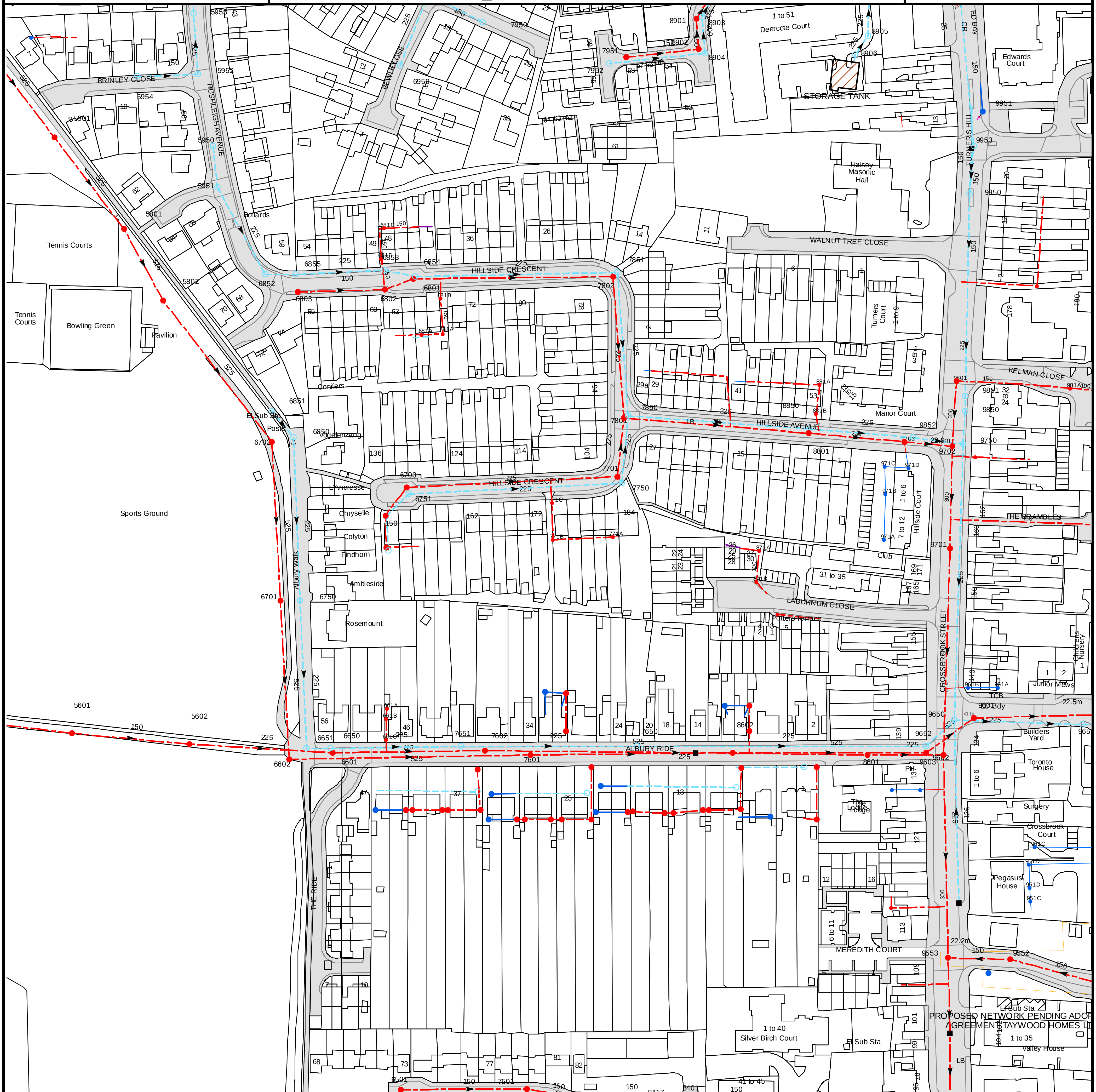
8 APPENDIX 3 – TOPOGRAPHIC SURVEY



CHECK SURVEY AREA
SITE PERIMETER
SITE PERIMETER
CHECK SURVEY AREA
SITE PERIMETER
THEOBALDS LANE

9 APPENDIX 4 – THAMES WATER UTILITY PLAN

Asset Location Search Sewer Map - ALS/ALS Standard/2016_3343289 | TL3501NE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 535750,201750

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

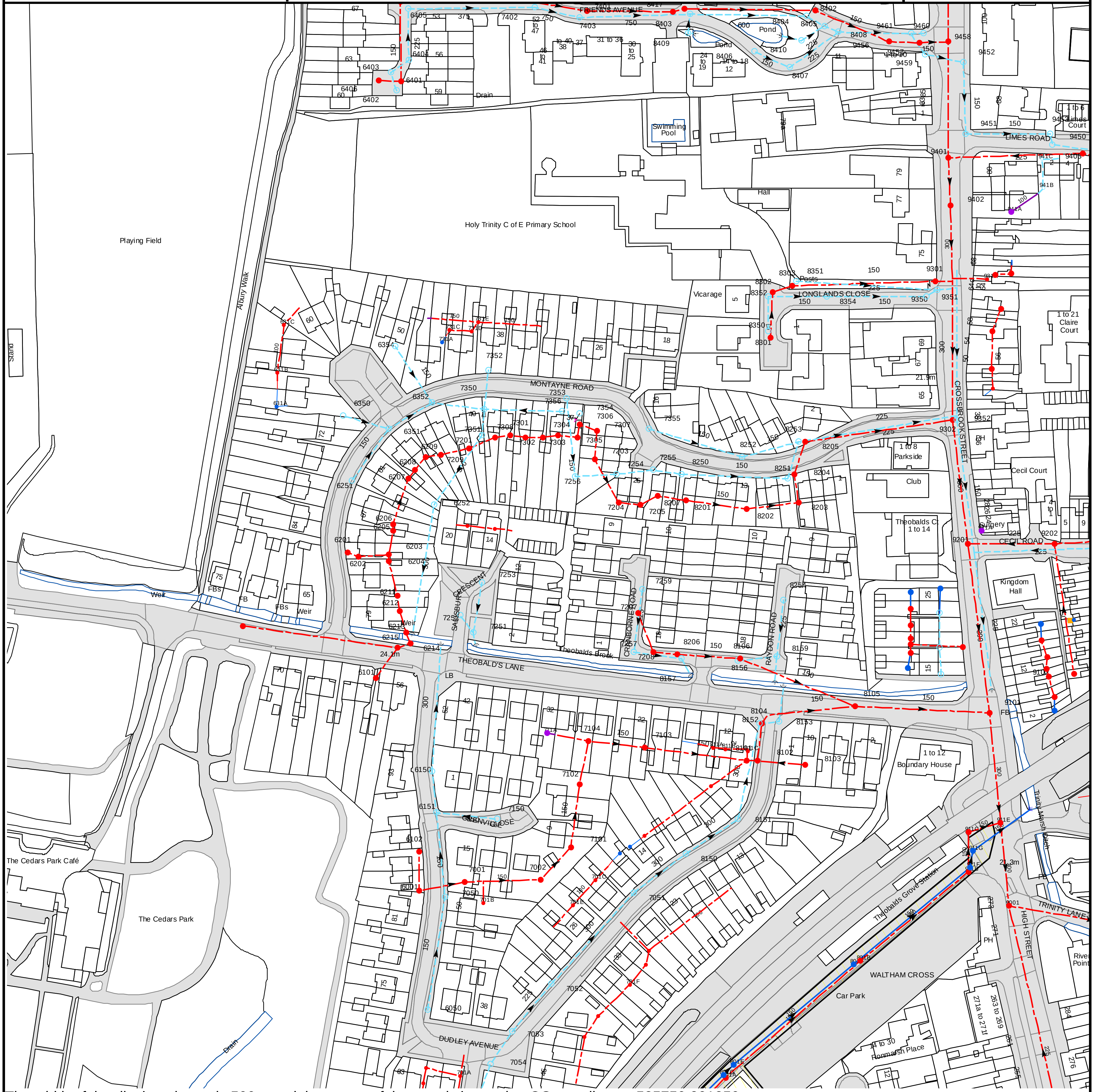
NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
9553	22.23	19.58
951F	22.6	21.25
9552	22.35	19.93
961D	n/a	n/a
951D	n/a	n/a
951C	n/a	n/a
961C	n/a	n/a
961E	n/a	n/a
961F	n/a	n/a
86CF	n/a	n/a
8601	22.68	20.52
9602	22.53	19.88
9603	22.54	21.15
9652	22.54	21.41
9651	22.74	20.74
9650	22.52	21.17
9601	22.5	20.54
961B	n/a	n/a
961A	n/a	n/a
9701	22.68	20.25
971A	n/a	n/a
971B	n/a	n/a
971D	n/a	n/a
971C	n/a	n/a
971E	n/a	n/a
9702	22.82	20.46
9750	22.72	21.64
9703	n/a	n/a
9852	22.9	21.75
8850	22.83	21.96
881B	n/a	n/a
9850	22.82	21.72
9851	22.85	21.79
76CI	n/a	n/a
86DI	n/a	n/a
86DJ	n/a	n/a
86EA	n/a	n/a
76EE	n/a	n/a
86EB	n/a	n/a
76CG	n/a	n/a
86EC	n/a	n/a
76ED	n/a	n/a
86CJ	n/a	n/a
8602	22.93	21.28
7650	23.07	21.83
86AI	n/a	n/a
76BB	n/a	n/a
86AG	n/a	n/a
86AH	n/a	n/a
76AJ	n/a	n/a
871C	n/a	n/a
871B	n/a	n/a
871A	n/a	n/a
771B	n/a	n/a
771A	n/a	n/a
771C	n/a	n/a
7750	23.17	22.25
7701	23.09	21.57
8801	22.84	21.11
7801	23.04	21.49
7850	23.03	22.19
681A	n/a	n/a
781A	n/a	n/a
7952	25.42	23.99
7802	23.21	21.79
7851	23.35	22.37
7951	25.45	24.06
8901	25.57	23.17
8902	25.59	23.29
8903	25.52	23.62
8904	25.57	23.68
881A	n/a	n/a
8906	n/a	23.65
8905	n/a	23.54
9801	22.96	20.61
9950	23.74	22.5
9953	24.04	22.61
9951	24.2	23.25
981B	n/a	n/a
981A	n/a	n/a
6501	24.35	21.96
7501	23.79	21.6
951E	n/a	n/a
86CE	n/a	n/a
76EC	n/a	n/a
76EB	n/a	n/a
76EA	n/a	n/a
76DJ	n/a	n/a
76DI	n/a	n/a
76DG	n/a	n/a
86CG	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
86DG	n/a	n/a
86DH	n/a	n/a
76CF	n/a	n/a
76CH	n/a	n/a
5953	25.9	24.25
6754	n/a	n/a
6755	n/a	n/a
6753	n/a	n/a
6751	24.72	23.86
6703	24.74	23.23
6702	26.05	24.44
6850	25.79	25.16
6851	25.6	25.15
5802	26.24	24.65
681B	n/a	n/a
6803	24.83	23.55
6802	24.46	23.02
6801	24.37	22.86
6854	24.34	23.26
6855	24.86	23.85
6852	24.85	24.03
6853	24.5	23.57
681D	n/a	n/a
5801	26.58	24.78
681C	n/a	n/a
5951	25.26	24.48
5950	25.41	24.69
5901	26.7	24.91
5954	26.07	24.83
5952	25.64	24.57
66BF	n/a	n/a
66BG	n/a	n/a
66BE	n/a	n/a
76FE	n/a	n/a
76FD	n/a	n/a
76FC	n/a	n/a
76DH	n/a	n/a
76FG	n/a	n/a
76FF	n/a	n/a
6602	n/a	n/a
7601	23.61	21.9
6601	25.54	23.65
7602	23.84	21.84
6650	25.5	23.85
6651	26.23	24.64
7651	23.95	22.75
5602	27.75	26.13
661C	n/a	n/a
5601	28.76	26.6
661B	n/a	n/a
661A	n/a	n/a
76AI	n/a	n/a
6701	26.59	24.18
6750	26.43	24.99
6756	n/a	n/a
6950	25.75	24.96
7950	25.75	25.01
591A	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

Asset Location Search Sewer Map - ALS/ALS Standard/2016_3343289	TL3501SE



The width of the displayed area is 500m and the centre of the map is located at OS coordinates 535750,201250

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
8409	23.37	21.53
9460	22.52	21.55
8408	23.06	21.42
8405	23.02	21.42
7403	23.51	21.7
8404	23.02	21.47
8403	23.37	21.53
8417	23.37	21.12
7401	23.5	21.39
8402	23.01	20.67
6405	24.27	22.34
8401	23.38	21
7402	23.7	21.72
9401	22.32	19.17
9458	22.63	20.2
9402	22.13	19.05
9452	22.19	21.09
9451	22.17	20.88
931A	n/a	n/a
93BF	n/a	n/a
941A	n/a	n/a
93AI	n/a	n/a
941C	n/a	n/a
941B	n/a	n/a
9453	22.06	20.79
9450	22.08	20.74
9403	22.1	19.4
731D	n/a	n/a
731E	n/a	n/a
7351	23.37	22.23
7253	23.3	22.57
7350	23.25	22.4
7352	23.28	22.47
7308	23.22	21.61
721A	n/a	n/a
7301	23.2	21.55
7302	n/a	n/a
7303	23.07	21.32
7304	n/a	n/a
7356	n/a	n/a
7353	22.86	21.91
7256	22.92	21.51
7305	23.05	21.1
7306	23	20.98
7354	22.94	n/a
7203	22.69	20.64
7307	22.8	20.95
7254	22.57	21.44
7204	22.56	20.58
7205	22.59	20.46
7259	22.66	21.73
7355	22.53	21.19
7255	22.7	n/a
8207	22.51	20.5
92CA	n/a	n/a
9201	21.84	18.59
9202	21.44	19.24
921A	n/a	n/a
9302	21.96	18.79
9352	22	20.74
93CJ	n/a	n/a
93CI	n/a	n/a
93CH	n/a	n/a
93CG	n/a	n/a
9351	22.12	21.18
9301	22.13	20.27
92BE	n/a	n/a
8254	22.03	21.17
92BD	n/a	n/a
8202	22.15	20.15
8203	22.11	19.99
8201	22.41	20.32
8251	22.22	20.99
8204	22.29	19.75
8250	22.39	21.29
8252	22.44	n/a
8253	22.33	20.89
8205	22.29	19.53
8301	22.5	21.28
8350	22.48	21.95
8352	22.54	21.77
9350	22.01	21.25
8354	22.3	21.58
8302	22.51	21.06
8303	22.43	20.91
8351	22.43	21.6
8407	22.8	21.7
9459	22.71	21.39
8406	23.09	21.87
9457	22.65	20.34

Manhole Reference	Manhole Cover Level	Manhole Invert Level
9456	22.89	20.44
8410	23.23	21.9
9461	22.64	21.41
8102	22.66	19.61
811C	n/a	n/a
8104	22.76	19.48
8152	22.79	21.1
8153	22.81	20.98
9101	21.84	18.36
91AD	n/a	n/a
8105	22.42	19.06
91AE	n/a	n/a
91AF	n/a	n/a
91CA	n/a	n/a
9102	n/a	n/a
91AG	n/a	n/a
91BJ	n/a	n/a
91AH	n/a	n/a
8159	22.42	20.95
91BI	n/a	n/a
92CC	n/a	n/a
92BI	n/a	n/a
92BH	n/a	n/a
92AD	n/a	n/a
92BG	n/a	n/a
92BF	n/a	n/a
92AE	n/a	n/a
921B	n/a	n/a
92CB	n/a	n/a
6101	24.56	23.46
6215	23.99	23.24
6213	23.82	23.11
6214	24	23.22
6150	23.71	22.18
6151	23.8	22.21
7252	23.43	22.46
7251	23.72	22.26
7150	23.61	22.44
711A	n/a	n/a
7101	23.51	20.81
7102	23.48	20.49
7104	n/a	n/a
711B	n/a	n/a
7257	22.03	21.55
7207	22.76	21.41
7103	22.88	20.94
711D	n/a	n/a
7208	22.9	21.11
8206	22.79	20.97
8157	22.82	21.36
811D	n/a	n/a
811A	n/a	n/a
811B	n/a	n/a
8151	22.84	21.31
8156	22.58	21.63
8106	22.56	20.62
601A	n/a	n/a
801A	22.58	20.82
701A	n/a	n/a
801G	22.9	20.97
601B	n/a	n/a
801E	n/a	n/a
7054	23.52	22
701G	n/a	n/a
7053	23.44	21.93
701H	n/a	n/a
6050	23.62	22.85
701F	n/a	n/a
7052	23.54	21.85
701I	n/a	n/a
701J	n/a	n/a
701E	n/a	n/a
701B	n/a	n/a
7050	23.83	22.46
7051	23.36	21.65
6001	24.07	21.58
7001	23.68	21.43
701C	n/a	n/a
7002	23.43	21.05
8150	23.09	21.47
711C	n/a	n/a
6102	24.06	21.82
801F	22.79	20.72
801B	22.77	20.02
9001	21.33	17.95
911B	21.54	19.66
911F	n/a	n/a
911G	n/a	n/a
911C	21.51	19.11
911E	21.54	17.76
8103	22.46	20.01
8101	22.69	19.66
6350	24.39	23.09

Manhole Reference	Manhole Cover Level	Manhole Invert Level
6201	24.41	22.94
6251	23.99	22.99
6202	24.31	22.84
6406	n/a	n/a
6203	24.13	22.66
6351	23.81	22.61
6204	24.13	22.76
6403	24.22	22.9
6205	23.95	22.55
6206	23.94	22.5
6354	24.22	22.78
6402	24.32	23.01
6211	23.94	22.88
6212	23.92	23.03
6401	24.17	22.21
6207	24.06	22.25
6404	24.1	22.75
6208	23.84	22.24
6209	23.82	22.1
6352	23.53	22.51
6252	23.75	22.26
7209	23.68	21.99
731A	n/a	n/a
731C	n/a	n/a
721B	n/a	n/a
7201	23.5	21.84
621A	n/a	n/a
631A	n/a	n/a
631B	n/a	n/a
631C	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

- Trunk Surface Water
- Trunk Foul
- Storm Relief
- Trunk Combined
- Vent Pipe
- Bio-solids (Sludge)
- Proposed Thames Surface Water Sewer
- Proposed Thames Water Foul Sewer
- Gallery
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Sludge Rising Main
- Proposed Thames Water Rising Main
- Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

- Air Valve
- Dam Chase
- Fitting
- Meter
- Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

- Control Valve
- Drop Pipe
- Ancillary
- Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

- Outfall
- Undefined End
- Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

- Public/Private Pumping Station
- Change of characteristic indicator (C.O.C.I.)
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Operational Site
- Chamber
- Tunnel
- Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

- Foul Sewer
- Surface Water Sewer
- Combined Sewer
- Gulley
- Culverted Watercourse
- Proposed
- Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

10 APPENDIX 5 – ENVIRONMENT AGENCY CORRESPONDENCE

Lucy Newell

From: John Bowstead <j.bowstead@peterdann.com>
Sent: 13 September 2016 02:18 PM
To: Ian Sargent
Cc: Mark Dockerill; Jonathan Hubert
Subject: FW: surface water

Ian,

Please see below for your information. Note we will still need to make an application to the EA for the proposed works on the river.

Kind regards,

John

John Bowstead
Associate Director
j.bowstead@peterdann.com

01223 264688 | 07738 958 633

newton house | cambridge road | barton | cambridge | CB23 7WJ

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From: Hughes, Katherine [mailto:Katherine.Hughes@environment-agency.gov.uk]
Sent: 13 September 2016 12:49
To: John Bowstead
Subject: surface water

Good afternoon John,

Regarding our earlier conversation.

A permit or exemption is not required for the discharge of clean surface run off water, for example from a roof, path or clean hardstanding area.

If surface water was contaminated the customer may need to apply for an environmental permit.

https://www.gov.uk/guidance/check-if-you-need-an-environmental-permit

Kind Regards

Katherine Hughes

National Customer Contact Centre
Part of National Operations
Tel: 03708 506 506
Web Site: www.gov.uk/environment-agency
☎ Tel: 03708 506 506
Web Site: www.gov.uk/environment-agency

Click an icon to keep in touch with us:-

So how did we do...?

Our National Customer Contact Centre relies on customer feedback, so we really value your thoughts on how we are doing. We will always make changes where we can to improve our service. This will only take three minutes to complete:

http://www.smartsurvey.co.uk/s/NCCCcustomer/

11 APPENDIX 6 – RESPONSE TO HERTFORDSHIRE COUNTY COUNCIL LETTER DATED 30 DEC 2016

Environment Director & Chief Executive:
John Wood

Post Point CHN 215
Hertfordshire County Council
County Hall, Pegs Lane
HERTFORD SG13 8DN

Peter Quaile
Borough of Broxbourne
Borough Offices
Bishops College
Churchgate
Cheshunt
Herts
EN8 9XB

Contact Sana Ahmed
Tel 01992 556279
Email FRMConsultations@hertfordshire.gov.uk

Date 30 December 2016

RE: **07/16/1369/F - Cheshunt Football Club, Theobald Lane, EN8 8RU**

Dear Peter,

Thank you for consulting us on the above application for Area 1 - New stadium with up to 5,192 seats, 66 no. 1 bedroom apartments, 70 no. 2 bedroom apartments, 22 no. 3 bedroom houses and 28 no. 4 bedroom houses, highway access works, internal roads and supporting infrastructure. Area 2 - Northern block - New facilities for Cheshunt Football Club in use classes D1, D2 and sui generis - matters relating to internal layout and appearance reserved. Area 3 - Western block - New sports, community, leisure and commercial uses in use classes A1, A3, A4, A5, B1, D1 and D2 - matters relating to internal layout reserved.

In the absence of an acceptable FRA we object to the grant of planning permission and recommend refusal on this basis for the following reasons:

The FRA carried out by Hydrologic Serrvices reference K0753/1 dated September 2016 and the Drainage Strategy carried out by Peter Dann Consulting reference 106561 submitted with this application does not comply with the requirements set out in the Planning Practice Guide (as revised 6 April 2015) to the National Planning Policy Framework. The submitted FRA does not therefore provide a suitable basis for assessment to be made of the flood risks arising from the proposed development.

In order for the Lead Local Flood Authority to advise the relevant local planning authority that the site will not increase flood risk to the site and elsewhere and can provide appropriate sustainable drainage techniques, the following information is required as part of the flood risk assessment;

1. Drainage plan demonstrating a SuDS management treatment train and above ground features for residential development.
2. Update climate change allowance for surface water calculations for the residential development

3. Details of any Informal flooding for the full application.

Overcoming our objection

To address the above points, please see the below comments;

The drainage strategy for the whole site is based upon attenuation and discharge into Theobalds Brook at Greenfield rates. We note two connections are proposed and the Environment Agency has been consulted.

1. As this is a Greenfield site, for the residential development we would expect all features to be above ground. An attenuation tank has been provided to provide some underground storage, however this should be technically justified within the FRA/surface water strategy.

   Above ground measures such as permeable paving, swales etc. could be used on impermeable sites and utilised within green space and areas of landscaping. Prioritising above ground methods and providing source control measures can ensure that surface water run-off can be treated in a sustainable manner and reduce the requirement for maintenance of underground features.

2. The national climate change allowances have been updated for all applications validated on/or after 19 February 2016 and we now require all SuDS component to cater for all rainfall events upto and including the 1 in 100 plus 40% for climate change event. The drainage strategy for the residential development and calculations should be updated accordingly.

3. We note that the micro drainage calculations currently show flooded volumes for 1:100 plus 20% climate change in the residential area and it is proposed it to retain the 1:100 plus 40% event within the kerb lines. If there will be informal flooding within the site, these areas need to be identified on a development layout plan, showing the extent and depth of the flooding and under what rainfall event the flooding will occur. No flooding should occur at and below the 1 in 30 year rainfall event. It should be demonstrated that any flooding above this can be managed within the site without increasing flood risk to the proposed properties and the surrounding area. the 1 in 100 year + 40% climate change extents, depths and volumes should be established.

For further guidance on HCC's policies on SuDS, HCC Developers Guide and Checklist and links to national policy and industry best practice guidance please refer to our surface water drainage webpage

http://www.hertsdirect.org/services/envplan/water/floods/surfacewaterdrainage/

Informative to the LPA

The LPA will need to be satisfied that the proposed drainage strategy will be maintained and managed for the lifetime of the development.

The applicant can overcome our objection by submitting an FRA which covers the deficiencies highlighted above and demonstrates that the development will not increase risk elsewhere and where possible reduces flood risk overall. If this cannot be achieved we are likely to maintain our objection to the application. Production of an FRA will not in itself result in the removal of an objection.

We ask to be re-consulted with the results of the FRA. We will provide you with bespoke comments within 21 days of receiving formal re-consultation. Our objection will be maintained until an adequate FRA has been submitted.

Yours sincerely,

Sana Ahmed

Hertfordshire County Council

01992 556279
FRMConsultations@hertfordshire.gov.uk

Further to your letter dated 30 December 2016 we write in response to the objections contained therein regarding the surface water drainage strategy provided as part of the planning application for the development at Cheshunt Football Club. Planning application number 07/16/1369/F refers.

We would address the points raised in your letter as follows:

The drainage strategy for the whole site is based upon attenuation and discharge into Theobalds Brook at Greenfield rates. We note two connections are proposed and the Environment Agency has been consulted.

1. *As this is a Greenfield site, for the residential development we would expect all features to be above ground. An attenuation tank has been provided to provide some underground storage, however this should be technically justified within the FRA/surface water strategy.*

   Above ground measures such as permeable paving, swales etc. could be used on impermeable sites and utilised within green space and areas of landscaping. Prioritising above ground methods and providing source control measures can ensure that surface water run-off can be treated in a sustainable manner and reduce the requirement for maintenance of underground features.

The infiltration testing undertaken as part of the site geo-environmental investigation confirmed that prevailing ground conditions are not suitable for the use of shallow infiltration methods due the historic site use as a landfill, hence voided sub-base incorporated as part of the attenuation systems is to be tanked with an impermeable membrane. Section 3, paragraphs 4 and 5 of the submitted Drainage Strategy address this point as follows;

> *"Infiltration testing undertaken as part of the EPS Phase I & II Geo-Environmental Assessment proved infiltration rates that would be feasible for the use of infiltration methods for surface water disposal.*
>
> *The historic site use as a landfill will however inhibit the use of shallow infiltration methods due to the potential for concentration of water in the fill materials. As the fill material is not natural and is unlikely to have been subject to any form of compaction and / or treatment this could potentially lead to further settlement and / or deterioration of this material possibly leading to consolidation."*

The FRA prepared by Hydrologic ref Report K0753/1 dated September, 2016 and also part of the planning application submission further supports the recommendations of the geo-environmental assessment. Section 3.2 paragraph 4 states as follows;

> *"A geotechnical investigation has been carried out by Environmental Protection Strategies Ltd. (EPS 2016). The findings were as follows. Typically, the granular fill extended down to the clay at around 7m although, in places dense sands and gravels were found below the fill materials. Groundwater levels were between 2.150m and 3.796m below ground. Although infiltration testing indicated that the soils may be suitable for the use of soakaways, given*

the nature and extent of the fill material, the use of shallow infiltration methods is not recommended."

Therefore the SW drainage strategy has to be based around attenuated systems discharging at greenfield run-off rates to Theobalds Brook to the south of the development site. The development provides extensive attenuation of surface water using a variety of techniques selected to compliment the site layout whilst maintaining viability of the development. The forms of attenuation and supporting calculations are provided in full within the Drainage Strategy Report already submitted. Please refer to Appendix 1, Drawings and Appendix 2, Drainage Calculations for details.

Whilst we would ideally like to provide more above ground features for the sustainable treatment of surface water, run-off geo-environmental concerns and the nature and layout of this development reduce the opportunity for above ground features to be utilised. This is a matter we have discussed with Broxbourne Council, both in pre-application discussions and following your representation. The site is highly constrained, due to the need to make the most efficient possible use of the land available. As the land is used as playing pitches, Sport England (who are also a statutory consultee with the power to issue a holding objection on the application) require the maximum possible provision of pitch space in the new development. Additionally, as the land is within the Green Belt, it is necessary to demonstrate that the smallest possible area would be used for development, to minimise the effect on the openness of the Green Belt. These are matters which are required by planning policy, and they are key principles in relation to the acceptability of the proposed development. In discussion with Broxbourne Council, we were also referred to a recent planning application at Broxbourne School (ref. 07/14/1119/F), for which space was also highly limited, and underground tanked attenuation was accepted. However, notwithstanding the necessity to use underground attenuation, opportunity for source control of surface water has been adopted wherever reasonably possible to do so.

The football stadium leg of the system utilises permeable paving in its entirety to filter and attenuate surface water run-off. Approximately 7,900m^2 of permeable paving and tanked voided sub-base are provided. Treatment of surface water will be through the capture of surface water run-off and filtration through the permeable pavement with sub surface microbial action providing further treatment.

The football pitch itself will be provided with a specialist land drainage system which will capture and filter surface water run-off prior to discharge to attenuation tanks. The stadium roofs will be attenuated in tanks beneath the permeable paved car parking but unfortunately the significant volumes of water to be attenuated cannot be accommodated with surface features due to space constraints around the existing football club footprint.

New roads serving the development will be adoptable and as such need to be drained via a traditional piped network. Housing similarly has to discharge through a piped network. Infiltration techniques as previously mentioned are not available and whilst this development is not of high density, green space has been utilised in the provision of private gardens to enhance the local environment and provide high quality living space.

Consideration was given to providing above ground drainage features along the eastern and southern boundaries. However, these areas are precluded as options due to a combination of the significant volumes to be attenuated and the need to either establish a semi mature landscaped boundary to the east adjacent to the existing housing estate and to protect the mature landscaped boundary to the south against Theobalds Brook.

It should be noted that in addressing the upstream catchment the land to be used for training pitches will be levelled to direct overland flows to an open swale on the eastern boundary where conditions are conducive to the feature. Again, this is demonstrated in the submitted strategy documents.

2. *The national climate change allowances have been updated for all applications validated on/or after 19 February 2016 and we now require all SuDS component to cater for all rainfall events upto and including the 1 in 100 plus 40% for climate change event. The drainage strategy for the residential development and calculations should be updated accordingly.*

No branch of the developments SW drainage system will flood during a 1:30 year rainfall event.

System 1 providing surface water drainage for the residential development to the east of the football stadium has been designed not to flood for all rainfall events up to the 1 in 100 year return period plus 20% allowance for climate change. Surface flood volumes for rainfall events for the 1 in 100 year return period plus 40% allowance for climate change are to be contained within the kerb lines of the estate roads. The extent and depth of the flooding is annotated on the attached plans.

System 2 providing surface water drainage for the football stadium and pitch has been designed to ensure no flooding for all rainfall events up to and including the 1 in 100 plus 40% for climate change event.

System 3 providing surface water drainage for the car park area serving the football stadium and commercial buildings has been designed to ensure no flooding for all rainfall events up to and including the 1 in 100 plus 40% for climate change event.

System 4 providing surface water drainage for the car parking and estate road to the south of the football stadium has been designed to ensure no flooding for all rainfall events up to and including the 1 in 100 plus 40% for climate change event.

3. *We note that the micro drainage calculations currently show flooded volumes for 1:100 plus 20% climate change in the residential area and it is proposed it to retain the 1:100 plus 40% event within the kerb lines. If there will be informal flooding within the site, these areas need to be identified on a development layout plan, showing the extent and depth of the flooding and under what rainfall event the flooding will occur. No flooding should occur at and below the 1 in 30 year rainfall event. It should be demonstrated that any flooding above this can be managed within the site without increasing flood risk to the proposed properties and the surrounding area. the 1 in 100 year + 40% climate change extents, depths and volumes should be established.*

Please refer to item 2 above and the following;

The Proposed Site Drainage Strategy drawing number 10-6561_XX-DR-D201 rev (PL4) contained within Appendix 1 herein has been updated to show the areas allocated for informal flooding in the relevant 1:100 year + 40% climate change events and to note the anticipated flood volumes and depths.

Following are the Summary of Critical Results by Maximum level (Rank 1, 2 and 3) for System 1 (the residential leg of the drainage system) in support of the aforementioned drawing updates to show anticipated informal flooding information.

peter dann consulting engineers

12 APPENDIX 7 – RESPONSE TO HERTFORDSHIRE COUNTY COUNCIL LETTER DATED 25 APR 2017

Environment Director & Chief Executive:
John Wood

Hertfordshire

Post Point CHN 215
Hertfordshire County Council
County Hall, Pegs Lane
HERTFORD SG13 8DN

Contact Sana Ahmed
Tel 01992 556279
Email FRMConsultations@hertfordshire.gov.uk

Peter Quaile
Borough of Broxbourne
Borough Offices
Bishops College
Churchgate
Cheshunt
Herts
EN8 9XB

Date 25 April 2017

RE: **07/16/1369/F - Cheshunt Football Club, Theobald Lane, EN8 8RU – Add info**

Dear Peter,

Thank you for re-consulting us on the above application for Area 1 - New stadium with up to 5,192 seats, 66 no. 1 bedroom apartments, 70 no. 2 bedroom apartments, 22 no. 3 bedroom houses and 28 no. 4 bedroom houses, highway access works, internal roads and supporting infrastructure. Area 2 - Northern block - New facilities for Cheshunt Football Club in use classes D1, D2 and sui generis - matters relating to internal layout and appearance reserved. Area 3 - Western block - New sports, community, leisure and commercial uses in use classes A1, A3, A4, A5, B1, D1 and D2 - matters relating to internal layout reserved.

In response to the additional information submitted by Peter Dann Consulting reference 10-6561 dated Feburary 2017, we can confirm that there is still point that has not been adequately addressed. We therefore maintain our objection to the grant of planning permission until our concerns have been satisfied. The evidence we require to satisfy our remaining concerns are detailed below;

1. Drainage plan demonstrating a SuDS management train and above ground features for residential development.

Overcoming our objection

The drainage strategy for the whole site is based upon attenuation and discharge into Theobalds Brook at Greenfield rates. We note two surface water systems have been proposed with separate outfalls to Theobalds Brook. The first system caters for residential area and the sports pitch and the second catering for the new stadium and supporting infrastructure. However as this is a Greenfield site and discharging into Main River, for the residential development we would expect all features to be above ground. This is to ensure that a suitable level of management train is provided. An attenuation tank has been provided to provide underground storage however this lies at the bottom of the SuDS hierarchy and does not provide any level of treatment. The selection of SuDS should be justified with technical evidence.

Above ground measures such as permeable paving could be used on impermeable sites and utilised within access roads and driveways. Prioritising above ground methods and providing source control measures can ensure that surface water run-off can be treated in a sustainable manner and reduce the requirement for maintenance of underground features.

For further guidance on HCC's policies on SuDS, HCC Developers Guide and Checklist and links to national policy and industry best practice guidance please refer to our surface water drainage webpage

http://www.hertfordshire.gov.uk/services/envplan/water/floods/surfacewaterdrainage/

Informative to the LPA

Please note it is proposed to discharge to Main River and we would recommend SuDS treatment stages should be provided to manage any potential contaminants from surface water run-off from car parking areas and access roads. The LPA needs to be satisfied that the proposed development will not have a detrimental impact to the water quality with regards to the Water Framework Directive. The LPA will need to be satisfied that the proposed drainage strategy will be maintained and managed for the lifetime of the development.

The applicant can overcome our objection by submitting an FRA which covers the deficiencies highlighted above and demonstrates that the development will not increase risk elsewhere and where possible reduces flood risk overall. If this cannot be achieved we are likely to maintain our objection to the application. Production of an FRA will not in itself result in the removal of an objection.

We ask to be re-consulted with the results of the FRA. We will provide you with bespoke comments within 21 days of receiving formal re-consultation. Our objection will be maintained until an adequate FRA has been submitted.

Yours sincerely,

Sana Ahmed

Hertfordshire County Council
FRMConsultations@hertfordshire.gov.uk

Further to your letter dated 25 April 2017 we write in response to the objection contained therein regarding the surface water drainage strategy provided as part of the planning application for the development at Cheshunt Football Club. Planning application number 07/16/1369/F refers.

We would address the points raised in your letter as follows:

1. *Drainage plan demonstrating a SuDS management train and above ground features for residential development.*

Overcoming our objection

The drainage strategy for the whole site is based upon attenuation and discharge into Theobalds Brook at Greenfield rates. We note two surface water systems have been proposed with separate outfalls to Theobalds Brook. The first system caters for residential area and the sports pitch and the second catering for the new stadium and supporting infrastructure. However as this is a Greenfield site and discharging into Main River, for the residential development we would expect all features to be above ground. This is to ensure that a suitable level of management train is provided. An attenuation tank has been provided to provide underground storage however this lies at the bottom of the SuDS hierarchy and does not provide any level of treatment. The selection of SuDS should be justified with technical evidence.

Above ground measures such as permeable paving could be used on impermeable sites and utilised within access roads and driveways. Prioritising above ground methods and providing source control measures can ensure that surface water run-off can be treated in a sustainable manner and reduce the requirement for maintenance of underground features.

As detailed in our response to your queries dated 30 December 2016 space remains a constraint when looking to provide particularly open above ground features for this development. However, we note your comments regarding permeable paving a significant area of which, is proposed by the original strategy as part of the drainage system for the Stadium car parking. We have therefore looked to expand the use of permeable paving.

Permeable paving is a SuDS technique that is appropriate for use at most developments including the proposed development and provides both a flood reduction benefit due to the attenuation provided in the sub-base and also a pollution reduction benefit due to the filtration of water as is passes through the permeable surfacing.

We have contacted HCC Highways Department regarding the use of permeable paving for the estate roads to the development. They advise that the internal access roads for this development would not be adopted by The Council and as such permeable paved roads are an acceptable solution to provide attenuation of surface water run-off. We have therefore amended our strategy to incorporate permeable paved roads with tanked sub-base of 30% void ratio to all access roads within the development site. This will provide 4,864m^2 of permeable paved area in addition to the 7,900m^2 already proposed to the west and north car parking for the stadium.

In addition to the filtration and attenuation of run-off provided by the use of permeable paving, its use has also all but removed the need for informal flooding in the 1:100 year plus 40% climate change event for the 3 residential access roads to the east of the development. The nominal amount remaining in the current design would hopefully be removed during the final construction stage design work.

In expanding the provision of permeable surfacing to the 3 eastern residential access roads we will also drain the roofs of the buildings themselves through the sub-base of the permeable paving. Again, this will provide filtration prior to attenuation and controlled discharge to the main drainage network.

The Proposed Site Drainage Strategy drawing number 10-6561_XX-DR-D201 rev (PL5) contained within Appendix 1 herein is updated to show the additional areas of permeable paved access roads. The informal flooding previously required by the 1:100 year plus 40% climate change condition is now all but removed and again the drawing is updated to reflect this. Micro Drainage calculations for System 1 and System 4 which benefit from the provision of the additional permeable paving have been updated in Appendix 2. The body of the main report text is also updated where relevant to be consistent with the revised proposals.