Royal HaskoningDHV	
Blays House Wick Road Englefield Green Egham Surrey TW20 0HJ	Haverhill Great Willsey Park Area 6 FEH Results
Date 4/7/2019 File HAVERHILL. ALL NETWORKS FOR TENDER.MDX	Designed by RMV Checked by DJ
Innovyze	Network 2018.1.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW 06

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	Foul Sewage (l/s/ha)	0.000	Maximum Backdrop Height (m)	1.500
M5-60 (mm)	21.000	Volumetric Runoff Coeff.	0.750	Min Design Depth for Optimisation (m)	1.200
Ratio R	0.423	PIMP (%)	100	Min Vel for Auto Design only (m/s)	1.00
Maximum Rainfall (mm/hr)	50	Add Flow / Climate Change (%)	0	Min Slope for Optimisation (1:X)	500
Maximum Time of Concentration (mins)	30	Minimum Backdrop Height (m)	0.200		

Designed with Level Soffits

Network Design Table for SW 06

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
2.000	41.426	0.001	41426.3	0.000	4.00	0.0	0.600		-1	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)
2.000	50.00	5.88	90.077	0.000	0.0	0.0	0.0	0.37	3847.0	0.0

Network Design Table for SW 06

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
3.000	4.269	0.019	224.7	0.060	3.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	4.148	0.160	25.9	0.180	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	27.771	0.001	27771.0	0.000	0.00	0.0	0.600		-1	Pipe/Conduit	
4.000	5.753	0.044	130.8	0.280	3.00	0.0	0.600	o	300	Pipe/Conduit	
4.001	4.089	0.087	47.0	0.200	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.002	4.754	0.600	7.9	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)
3.000	50.00	3.08	90.644	0.060	0.0	0.0	0.0	0.87	34.5	8.1
3.001	50.00	3.10	90.550	0.240	0.0	0.0	0.0	3.10	219.1	32.5
2.001	50.00	6.91	90.076	0.240	0.0	0.0	0.0	0.45	4722.1	32.5
4.000	50.00	3.07	90.206	0.280	0.0	0.0	0.0	1.37	97.1	37.9
4.001	50.00	3.10	90.162	0.480	0.0	0.0	0.0	2.30	162.5	65.0
2.002	50.00	6.93	90.075	0.720	0.0	0.0	0.0	5.62	397.2	97.5

Conduit Sections for SW 06

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)
-1		10000	1500			3.922	10.500

Manhole Schedules for SW 06

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S6.01	92.230	2.153	Junction		2.000	90.077	-1				
S6.02	91.835	1.191	Open Manhole	1200	3.000	90.644	225				
S6.03	91.495	0.945	Junction		3.001	90.550	300	3.000	90.625	225	
S6.04	91.600	1.524	Junction		2.001	90.076	-1	2.000	90.076	-1	
								3.001	90.390	300	
S6.05	91.300	1.094	Open Manhole	1200	4.000	90.206	300				
S6.06	91.300	1.138	Junction		4.001	90.162	300	4.000	90.162	300	
S6.07 FC	91.300	1.225	Open Manhole	1800	2.002	90.075	300	2.001	90.075	-1	
								4.001	90.075	300	
S6.O1	89.914	0.439	Open Manhole	0		OUTFALL		2.002	89.475	300	

PIPELINE SCHEDULES for SW 06

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)
2.000		-1	S6.01	92.230	90.077	0.653	Junction	
3.000	o	225	S6.02	91.835	90.644	0.966	Open Manhole	1200
3.001	o	300	S6.03	91.495	90.550	0.645	Junction	
2.001		-1	S6.04	91.600	90.076	0.024	Junction	
4.000	o	300	S6.05	91.300	90.206	0.794	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)
2.000	41.426	41426.3	S6.04	91.600	90.076	0.024	Junction	
3.000	4.269	224.7	S6.03	91.495	90.625	0.645	Junction	
3.001	4.148	25.9	S6.04	91.600	90.390	0.910	Junction	
2.001	27.771	27771.0	S6.07 FC	91.300	90.075	-0.275	Open Manhole	1800
4.000	5.753	130.8	S6.06	91.300	90.162	0.838	Junction	

PIPELINE SCHEDULES for SW 06

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)
4.001	o	300	S6.06	91.300	90.162	0.838	Junction	
2.002	o	300	S6.07 FC	91.300	90.075	0.925	Open Manhole	1800

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)
4.001	4.089	47.0	S6.07 FC	91.300	90.075	0.925	Open Manhole	1800
2.002	4.754	7.9	S6.01	89.914	89.475	0.139	Open Manhole	0

Area Summary for SW 06

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
2.000	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.060	0.060	0.060
3.001	-	-	100	0.180	0.180	0.180
2.001	-	-	100	0.000	0.000	0.000
4.000	-	-	100	0.280	0.280	0.280
4.001	-	-	100	0.200	0.200	0.200
2.002	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.720	0.720	0.720

Free Flowing Outfall Details for SW 06

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
2.002	S6.O1	89.914	89.475	0.000	0	0

Simulation Criteria for SW 06

Volumetric Runoff Coeff	0.840	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	4.000	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	FSR	M5-60 (mm)	21.000	Cv (Summer)	0.750
Return Period (years)	1	Ratio R	0.423	Cv (Winter)	0.840
Region England and Wales	Profile Type	Winter	Storm Duration (mins)		15

Online Controls for SW 06

Complex Manhole: S6.07 FC, DS/PN: 2.002, Volume (m³): 285.5

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0061-1200-0300-1200	Sump Available	Yes
Design Head (m)	0.300	Diameter (mm)	61
Design Flow (l/s)	1.2	Invert Level (m)	90.075
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	75
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.300	1.2	Kick-Flo®	0.218	1.0
Flush-Flo™	0.094	1.2	Mean Flow over Head Range	-	1.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	0.500	1.5	1.200	2.2	2.000	2.8	3.000	3.4	5.000	4.4
0.200	1.1	0.600	1.6	1.400	2.4	2.200	3.0	3.500	3.7	5.500	4.6
0.300	1.2	0.800	1.9	1.600	2.6	2.400	3.1	4.000	3.9	6.000	4.8
0.400	1.4	1.000	2.1	1.800	2.7	2.600	3.2	4.500	4.2	6.500	5.0

Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.000	5.2	7.500	5.4	8.000	5.6	8.500	5.8	9.000	5.9	9.500	6.1

Orifice

Diameter (m) 0.055 Discharge Coefficient 0.600 Invert Level (m) 90.875

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 06

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	4.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 568800 245850 TL 68800 45850	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 06

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
2.000	S6.01	480 Winter	2	+0%					90.622	-0.955	0.000	0.00		0.0
3.000	S6.02	15 Summer	2	+0%	30/240 Winter				90.752	-0.117	0.000	0.43		10.7
3.001	S6.03	15 Winter	2	+0%					90.670	-0.180	0.000	0.33		33.5
2.001	S6.04	480 Winter	2	+0%					90.622	-0.954	0.000	0.00		0.9
4.000	S6.05	480 Winter	2	+0%	2/120 Winter	100/15 Summer			90.622	0.116	0.000	0.10		6.1
4.001	S6.06	120 Winter	2	+0%					90.462	0.000	0.000	0.32		23.7
2.002	S6.07 FC	480 Winter	2	+0%	2/30 Summer				90.622	0.247	0.000	0.01		1.6

PN	US/MH Name	Status	Level Exceeded
2.000	S6.01	OK	
3.000	S6.02	OK	
3.001	S6.03	OK*	
2.001	S6.04	OK	
4.000	S6.05	SURCHARGED	4
4.001	S6.06	SURCHARGED*	
2.002	S6.07 FC	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 06

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	4.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 568800 245850 TL 68800 45850	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 06

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
2.000	S6.01	480 Winter	30	+0%					90.927	-0.650	0.000	0.00		0.0
3.000	S6.02	480 Winter	30	+0%	30/240 Winter				90.928	0.059	0.000	0.10		2.4
3.001	S6.03	240 Winter	30	+0%					90.850	0.000	0.000	0.17		16.8
2.001	S6.04	480 Winter	30	+0%					90.927	-0.649	0.000	0.00		1.6
4.000	S6.05	480 Winter	30	+0%	2/120 Winter	100/15 Summer			90.928	0.422	0.000	0.17		10.5
4.001	S6.06	60 Winter	30	+0%					90.462	0.000	0.000	1.06		78.0
2.002	S6.07 FC	480 Winter	30	+0%	2/30 Summer				90.927	0.552	0.000	0.01		2.7

PN	US/MH Name	Status	Level Exceeded
2.000	S6.01	OK	
3.000	S6.02	SURCHARGED	
3.001	S6.03	SURCHARGED*	
2.001	S6.04	OK	
4.000	S6.05	SURCHARGED	4
4.001	S6.06	SURCHARGED*	
2.002	S6.07 FC	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 06

Simulation Criteria

Areal Reduction Factor	1.000	Manhole Headloss Coeff (Global)	0.500	MADD Factor * 10m³/ha Storage	4.000
Hot Start (mins)	0	Foul Sewage per hectare (l/s)	0.000	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Additional Flow - % of Total Flow	0.000	Flow per Person per Day (l/per/day)	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	Data Type	Catchment
FEH Rainfall Version	2013	Cv (Summer)	0.750
Site Location	GB 568800 245850 TL 68800 45850	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	2, 30, 100
Climate Change (%)	0, 0, 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for SW 06

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
2.000	S6.01	480 Winter	100	+30%					91.253	-0.324	0.000	0.00		0.0
3.000	S6.02	480 Winter	100	+30%	30/240 Winter				91.254	0.385	0.000	0.16		4.0
3.001	S6.03	60 Winter	100	+30%					90.850	0.000	0.000	0.72		71.7
2.001	S6.04	480 Winter	100	+30%					91.253	-0.323	0.000	0.00		3.5
4.000	S6.05	15 Winter	100	+30%	2/120 Winter	100/15 Summer			91.310	0.804	9.700	1.82		111.9
4.001	S6.06	60 Winter	100	+30%					90.462	0.000	0.000	1.75		129.6
2.002	S6.07 FC	480 Winter	100	+30%	2/30 Summer				91.253	0.878	0.000	0.03		6.0

PN	US/MH Name	Status	Level Exceeded
2.000	S6.01	OK	
3.000	S6.02	SURCHARGED	
3.001	S6.03	SURCHARGED*	
2.001	S6.04	OK	
4.000	S6.05	FLOOD	4
4.001	S6.06	SURCHARGED*	
2.002	S6.07 FC	FLOOD RISK	