



TOPPING ENGINEERS

CONSULTING CIVIL &
STRUCTURAL ENGINEERS

DRAINAGE CALCULATIONS

LOCATION:

The Old Garage Site
Dunsop Bridge

CLIENT:

Duchy of Lancaster

DOCUMENT REF:

23120-Calc-C-001

REVISION/DATE:

April 2025

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Innovyze	Network 2019.1	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.600	Add Flow / Climate Change (%)	0
Ratio R	0.229	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	0	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	9.257	0.093	99.5	0.096	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	5.000	0.050	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	47.962	0.119	403.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	3.340	0.085	39.3	0.122	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	12.294	0.082	149.9	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)
1.000	0.00	5.12	111.563	0.096	0.0	0.0	0.0	1.31	52.1	0.0
1.001	0.00	5.18	111.470	0.096	0.0	0.0	0.0	1.31	52.0	0.0
1.002	0.00	6.42	111.269	0.096	0.0	0.0	0.0	0.65	25.7	0.0
2.000	0.00	5.03	111.310	0.122	0.0	0.0	0.0	1.61	28.5	0.0
1.003	0.00	6.67	111.150	0.218	0.0	0.0	0.0	0.82	14.5	0.0

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<u>Simulation Criteria for Storm</u> 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 Coefficient 0.800 Hot Start Level (mm) 0 Flow per Person per Day (l/per/day) 0.000 Manhole Headloss Coeff (Global) 0.500 Run Time (mins) 60 Foul Sewage per hectare (l/s) 0.000 Output Interval (mins) 1 Number of Input Hydrographs 0 Number of Storage Structures 2 Number of Online Controls 1 Number of Time/Area Diagrams 0 Number of Offline Controls 0 Number of Real Time Controls 0 <u>Synthetic Rainfall Details</u> Rainfall Model FSR Profile Type Summer Return Period (years) 1 Cv (Summer) 0.750 Region England and Wales Cv (Winter) 0.840 M5-60 (mm) 20.600 Storm Duration (mins) 30 Ratio R 0.229		
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 5, DS/PN: 1.003, Volume (m³): 3.2

Unit Reference	MD-SHE-0088-3600-1150-3600
Design Head (m)	1.150
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	88
Invert Level (m)	111.150
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.150	3.6
Flush-Flo™	0.343	3.6
Kick-Flo®	0.711	2.9
Mean Flow over Head Range	-	3.2

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	2.7	1.200	3.7	3.000	5.6	7.000	8.4
0.200	3.4	1.400	3.9	3.500	6.0	7.500	8.7
0.300	3.6	1.600	4.2	4.000	6.4	8.000	8.9
0.400	3.6	1.800	4.4	4.500	6.8	8.500	9.2
0.500	3.5	2.000	4.7	5.000	7.1	9.000	9.4
0.600	3.3	2.200	4.9	5.500	7.5	9.500	9.7
0.800	3.0	2.400	5.1	6.000	7.8		
1.000	3.4	2.600	5.3	6.500	8.1		

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.200
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.800	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 50

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	1	+0%	100/15 Summer				111.639
1.001	2	15 Winter	1	+0%	100/15 Summer				111.560
1.002	3	240 Winter	1	+0%	30/120 Winter				111.346
2.000	4	60 Summer	1	+0%	30/15 Summer				111.418
1.003	5	60 Summer	1	+0%	1/15 Summer				111.402

PN	US/MH Name	Depth (m)	Surcharged Volume (m³)	Flooded Flow / Cap. (l/s)	Pipe Flow (l/s)	Status	Level
							Exceeded
1.000	1	-0.149	0.000	0.24	10.4	OK	
1.001	2	-0.135	0.000	0.33	10.5	OK	
1.002	3	-0.148	0.000	0.10	2.3	OK	
2.000	4	-0.042	0.000	0.58	10.6	OK	
1.003	5	0.102	0.000	0.27	3.5	SURCHARGED	

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

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.200
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.800	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 50

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	480 Winter	100	+50%	100/15 Summer				112.087
1.001	2	480 Winter	100	+50%	100/15 Summer				112.085
1.002	3	480 Winter	100	+50%	30/120 Winter				112.084
2.000	4	480 Winter	100	+50%	30/15 Summer				112.081
1.003	5	480 Winter	100	+50%	1/15 Summer				112.080

PN	US/MH Name	Depth (m)	Surcharged Volume (m³)	Flooded Volume (m³)	Flow / Cap. (l/s)	Pipe Flow (l/s)	Status	Level
								Exceeded
1.000	1	0.299	0.000	0.22		9.4	SURCHARGED	
1.001	2	0.390	0.000	0.29		9.2	SURCHARGED	
1.002	3	0.590	0.000	0.31		7.5	SURCHARGED	
2.000	4	0.621	0.000	0.59		10.8	FLOOD RISK	
1.003	5	0.780	0.000	0.27		3.6	FLOOD RISK	

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