## STORM SEWER DESIGN by the Modified Rational Method

### 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 | 31.600 | 0.080 | 395.0 | 0.071 | 5.00 | 0.0 | 0.600 | o | 900 | Pipe/Conduit | |
| 1.001 | 10.000 | 0.025 | 400.0 | 0.029 | 0.00 | 0.0 | 0.600 | o | 900 | Pipe/Conduit | |
| 1.002 | 10.000 | 0.025 | 400.0 | 0.029 | 0.00 | 0.0 | 0.600 | o | 900 | Pipe/Conduit | |
| 1.003 | 17.787 | 0.920 | 19.3 | 0.053 | 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 | 50.00 | 5.34 | 167.600 | 0.071 | 0.0 | 0.0 | 0.0 | 1.57 | 999.0 | 9.6 |
| 1.001 | 50.00 | 5.44 | 167.520 | 0.100 | 0.0 | 0.0 | 0.0 | 1.56 | 992.7 | 13.5 |
| 1.002 | 50.00 | 5.55 | 167.495 | 0.129 | 0.0 | 0.0 | 0.0 | 1.56 | 992.7 | 17.5 |
| 1.003 | 50.00 | 5.68 | 167.420 | 0.182 | 0.0 | 0.0 | 0.0 | 2.30 | 40.7 | 24.6 |

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## Manhole Schedules for Storm

| 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) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1 | 172.120 | 4.520 | Open Manhole | 3000 | 1.000 | 167.600 | 900 | | | | |
| S1A | 170.620 | 3.100 | Open Manhole | 3000 | 1.001 | 167.520 | 900 | 1.000 | 167.520 | 900 | |
| S1B | 170.120 | 2.625 | Open Manhole | 3000 | 1.002 | 167.495 | 900 | 1.001 | 167.495 | 900 | |
| S2 | 169.480 | 2.060 | Open Manhole | 3000 | 1.003 | 167.420 | 150 | 1.002 | 167.470 | 900 | 800 |
| | 167.050 | 0.550 | Open Manhole | 1200 | | OUTFALL | | 1.003 | 166.500 | 150 | |

No coordinates have been specified, layout information cannot be produced.

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## 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) |
|---|---|---|---|---|---|---|---|---|
| 1.000 | o | 900 | S1 | 172.120 | 167.600 | 3.620 | Open Manhole | 3000 |
| 1.001 | o | 900 | S1A | 170.620 | 167.520 | 2.200 | Open Manhole | 3000 |
| 1.002 | o | 900 | S1B | 170.120 | 167.495 | 1.725 | Open Manhole | 3000 |
| 1.003 | o | 150 | S2 | 169.480 | 167.420 | 1.910 | Open Manhole | 3000 |

### 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) |
|---|---|---|---|---|---|---|---|---|
| 1.000 | 31.600 | 395.0 | S1A | 170.620 | 167.520 | 2.200 | Open Manhole | 3000 |
| 1.001 | 10.000 | 400.0 | S1B | 170.120 | 167.495 | 1.725 | Open Manhole | 3000 |
| 1.002 | 10.000 | 400.0 | S2 | 169.480 | 167.470 | 1.110 | Open Manhole | 3000 |
| 1.003 | 17.787 | 19.3 | | 167.050 | 166.500 | 0.400 | Open Manhole | 1200 |

### Free Flowing Outfall Details for Storm

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| 1.003 | | 167.050 | 166.500 | 0.000 | 1200 | 0 |

### Simulation Criteria for Storm

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

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

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 2 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 19.000 | Storm Duration (mins) | 30 |
| Ratio R | 0.280 | | |

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## Online Controls for Storm

### Hydro-Brake® Optimum Manhole: S2, DS/PN: 1.003, Volume (m³): 19.0

| | |
|---|---|
| Unit Reference | MD-SHE-0075-3500-2100-3500 |
| Design Head (m) | 2.100 |
| Design Flow (l/s) | 3.5 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 75 |
| Invert Level (m) | 167.420 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.100 | 3.5 |
| Flush-Flo™ | 0.332 | 2.6 |
| Kick-Flo® | 0.674 | 2.1 |
| Mean Flow over Head Range | - | 2.7 |

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 | 2.1 | 1.200 | 2.7 | 3.000 | 4.1 | 7.000 | 6.1 |
| 0.200 | 2.5 | 1.400 | 2.9 | 3.500 | 4.4 | 7.500 | 6.3 |
| 0.300 | 2.6 | 1.600 | 3.1 | 4.000 | 4.7 | 8.000 | 6.5 |
| 0.400 | 2.6 | 1.800 | 3.3 | 4.500 | 5.0 | 8.500 | 6.7 |
| 0.500 | 2.5 | 2.000 | 3.4 | 5.000 | 5.2 | 9.000 | 6.9 |
| 0.600 | 2.3 | 2.200 | 3.6 | 5.500 | 5.5 | 9.500 | 7.1 |
| 0.800 | 2.2 | 2.400 | 3.7 | 6.000 | 5.7 | | |
| 1.000 | 2.5 | 2.600 | 3.9 | 6.500 | 5.9 | | |

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

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| 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 | 0.280 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 19.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | ON |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | OFF | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 1, 30, 100 |
| Climate Change (%) | 0, 0, 30 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S1 | 120 Winter | 1 | +0% | 100/60 Summer | | | | 167.777 |
| 1.001 | S1A | 120 Winter | 1 | +0% | 100/30 Winter | | | | 167.777 |
| 1.002 | S1B | 120 Winter | 1 | +0% | 100/30 Winter | | | | 167.777 |
| 1.003 | S2 | 120 Winter | 1 | +0% | 1/15 Summer | | | | 167.777 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S1 | -0.723 | 0.000 | 0.00 | | | 2.4 | OK | |
| 1.001 | S1A | -0.643 | 0.000 | 0.00 | | | 2.0 | OK | |
| 1.002 | S1B | -0.618 | 0.000 | 0.00 | | | 2.0 | OK | |
| 1.003 | S2 | 0.207 | 0.000 | 0.07 | | | 2.6 | SURCHARGED | |

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## 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 Storage Structures | 0 |
| 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 | 0.280 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 19.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | ON |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | OFF | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 1, 30, 100 |
| Climate Change (%) | 0, 0, 30 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S1 | 180 Winter | 30 | +0% | 100/60 Summer | | | | 168.252 |
| 1.001 | S1A | 180 Winter | 30 | +0% | 100/30 Winter | | | | 168.252 |
| 1.002 | S1B | 180 Winter | 30 | +0% | 100/30 Winter | | | | 168.252 |
| 1.003 | S2 | 180 Winter | 30 | +0% | 1/15 Summer | | | | 168.252 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S1 | -0.248 | 0.000 | 0.01 | | | 4.5 | OK | |
| 1.001 | S1A | -0.168 | 0.000 | 0.00 | | | 1.7 | OK | |
| 1.002 | S1B | -0.143 | 0.000 | 0.00 | | | 2.0 | OK | |
| 1.003 | S2 | 0.682 | 0.000 | 0.07 | | | 2.6 | 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 Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| 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 | 0.280 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 19.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | ON |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | OFF | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 1, 30, 100 |
| Climate Change (%) | 0, 0, 30 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S1 | 240 Winter | 100 | +30% | 100/60 Summer | | | | 169.412 |
| 1.001 | S1A | 240 Winter | 100 | +30% | 100/30 Winter | | | | 169.412 |
| 1.002 | S1B | 240 Winter | 100 | +30% | 100/30 Winter | | | | 169.412 |
| 1.003 | S2 | 240 Winter | 100 | +30% | 1/15 Summer | | | | 169.412 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S1 | 0.912 | 0.000 | 0.01 | | | 6.0 | SURCHARGED | |
| 1.001 | S1A | 0.992 | 0.000 | 0.01 | | | 2.4 | SURCHARGED | |
| 1.002 | S1B | 1.017 | 0.000 | 0.01 | | | 2.5 | SURCHARGED | |
| 1.003 | S2 | 1.842 | 0.000 | 0.09 | | | 3.4 | FLOOD RISK | |

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