HOLDGATE CONSULTING

**Drainage Design Calculations**

# Project:
Former Combs Hostel
Hall lane

# Job No.:
21-105

| DRAFT | FINAL |
|---|---|
| Author: NM | Author: NM |
| Date: 22.09.21 | Date:22.09.21 |
| Checked: RJP | Checked: RJP |
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## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 1 | Maximum Rainfall (mm/hr) | 50.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | England and Wales | Connection Type | Level Soffits |
| M5-60 (mm) | 19.000 | Minimum Backdrop Height (m) | 0.000 |
| Ratio-R | 0.350 | Preferred Cover Depth (m) | 1.200 |
| CV | 0.750 | Include Intermediate Ground | ✓ |
| Time of Entry (mins) | 5.00 | Enforce best practice design rules | ✓ |

## Nodes

| Name | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Depth (m) |
|---|---|---|---|---|---|
| IC S38 | 0.034 | 5.00 | 76.960 | 1200 | 2.100 |
| IC S39 | 0.048 | 5.00 | 76.960 | 1200 | 2.177 |
| IC S40 | 0.000 | | 75.100 | 1200 | 1.425 |
| IC S41 | 0.040 | 5.00 | 71.600 | 1200 | 1.425 |
| IC S42 | 0.018 | 5.00 | 68.850 | 1200 | 1.425 |
| IC S43 | 0.145 | 5.00 | 68.800 | 1200 | 2.467 |
| IC S44 | 0.074 | 5.00 | 67.894 | 1200 | 2.100 |
| IC S45 | 0.189 | 5.00 | 67.843 | 1200 | 2.168 |
| IC S46 | 0.000 | | 67.804 | 1200 | 2.188 |
| IC C1 | 0.000 | | 67.804 | 1200 | 2.203 |

## Links

| Name | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | IC S38 | IC S39 | 6.170 | 0.600 | 74.860 | 74.783 | 0.077 | 80.0 | 900 | 5.03 | 48.5 |
| 1.001 | IC S39 | IC S40 | 22.200 | 0.600 | 74.783 | 73.675 | 1.108 | 20.0 | 225 | 5.16 | 48.0 |
| 1.002 | IC S40 | IC S41 | 37.800 | 0.600 | 73.675 | 70.175 | 3.500 | 10.8 | 225 | 5.31 | 47.4 |
| 1.003 | IC S41 | IC S42 | 23.000 | 0.600 | 70.175 | 67.425 | 2.750 | 8.4 | 225 | 5.40 | 47.1 |
| 1.004 | IC S42 | IC S43 | 33.350 | 0.600 | 67.425 | 67.008 | 0.417 | 80.0 | 225 | 5.78 | 45.7 |
| 1.005 | IC S43 | IC S44 | 12.800 | 0.600 | 66.333 | 65.794 | 0.539 | 23.7 | 900 | 5.81 | 45.6 |
| 1.006 | IC S44 | IC S45 | 17.800 | 0.600 | 65.794 | 65.675 | 0.119 | 150.0 | 900 | 5.93 | 45.2 |
| 1.007 | IC S45 | IC S46 | 8.920 | 0.600 | 65.675 | 65.616 | 0.059 | 150.0 | 900 | 5.98 | 45.0 |
| 1.008 | IC S46 | IC C1 | 2.200 | 0.600 | 65.616 | 65.601 | 0.015 | 150.0 | 900 | 6.00 | 45.0 |

| Name | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) | Pro Depth (mm) | Pro Velocity (m/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 3.504 | 2229.4 | 4.5 | 1.200 | 1.277 | 0.034 | 0.0 | 29 | 0.725 |
| 1.001 | 2.936 | 116.7 | 10.7 | 1.952 | 1.200 | 0.082 | 0.0 | 45 | 1.835 |
| 1.002 | 4.004 | 159.2 | 10.5 | 1.200 | 1.200 | 0.082 | 0.0 | 39 | 2.297 |
| 1.003 | 4.552 | 181.0 | 15.6 | 1.200 | 1.200 | 0.122 | 0.0 | 44 | 2.815 |
| 1.004 | 1.463 | 58.2 | 17.4 | 1.200 | 1.567 | 0.140 | 0.0 | 84 | 1.280 |
| 1.005 | 6.443 | 4098.8 | 35.2 | 1.567 | 1.200 | 0.285 | 0.0 | 58 | 2.065 |
| 1.006 | 2.556 | 1625.9 | 44.0 | 1.200 | 1.268 | 0.359 | 0.0 | 100 | 1.146 |
| 1.007 | 2.556 | 1625.9 | 66.9 | 1.268 | 1.288 | 0.548 | 0.0 | 122 | 1.292 |
| 1.008 | 2.556 | 1625.9 | 66.8 | 1.288 | 1.303 | 0.548 | 0.0 | 122 | 1.292 |

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## Manhole Schedule

| Node | CL (m) | Depth (m) | Dia (mm) | Connections | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|
| IC S38 | 76.960 | 2.100 | 1200 | | | | |
| | | | | 0 | 1.000 | 74.860 | 900 |
| IC S39 | 76.960 | 2.177 | 1200 | 1 | 1.000 | 74.783 | 900 |
| | | | | 0 | 1.001 | 74.783 | 225 |
| IC S40 | 75.100 | 1.425 | 1200 | 1 | 1.001 | 73.675 | 225 |
| | | | | 0 | 1.002 | 73.675 | 225 |
| IC S41 | 71.600 | 1.425 | 1200 | 1 | 1.002 | 70.175 | 225 |
| | | | | 0 | 1.003 | 70.175 | 225 |
| IC S42 | 68.850 | 1.425 | 1200 | 1 | 1.003 | 67.425 | 225 |
| | | | | 0 | 1.004 | 67.425 | 225 |
| IC S43 | 68.800 | 2.467 | 1200 | 1 | 1.004 | 67.008 | 225 |
| | | | | 0 | 1.005 | 66.333 | 900 |
| IC S44 | 67.894 | 2.100 | 1200 | 1 | 1.005 | 65.794 | 900 |
| | | | | 0 | 1.006 | 65.794 | 900 |
| IC S45 | 67.843 | 2.168 | 1200 | 1 | 1.006 | 65.675 | 900 |
| | | | | 0 | 1.007 | 65.675 | 900 |
| IC S46 | 67.804 | 2.188 | 1200 | 1 | 1.007 | 65.616 | 900 |
| | | | | 0 | 1.008 | 65.616 | 900 |
| IC C1 | 67.804 | 2.203 | 1200 | 1 | 1.008 | 65.601 | 900 |

## Simulation Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Analysis Speed | Normal |
| FSR Region | England and Wales | Skip Steady State | x |
| M5-60 (mm) | 19.000 | Drain Down Time (mins) | 240 |
| Ratio-R | 0.350 | Additional Storage ($m^3$/ha) | 20.0 |
| Summer CV | 0.750 | Check Discharge Rate(s) | x |
| Winter CV | 0.840 | Check Discharge Volume | x |

### Storm Durations

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 |

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| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 |
| 100 | 30 | 0 | 0 |

**Node IC S46 Online Hydro-Brake® Control**

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 65.616 | Product Number | CTL-SHE-0174-1450-0900-1450 |
| Design Depth (m) | 0.900 | Min Outlet Diameter (m) | 0.225 |
| Design Flow (l/s) | 14.5 | Min Node Diameter (mm) | 1200 |

**Node IC S39 Online Hydro-Brake® Control**

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 74.783 | Product Number | CTL-SHE-0147-1000-0900-1000 |
| Design Depth (m) | 0.900 | Min Outlet Diameter (m) | 0.225 |
| Design Flow (l/s) | 10.0 | Min Node Diameter (mm) | 1200 |

**Node IC S43 Online Hydro-Brake® Control**

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 66.333 | Product Number | CTL-SHE-0154-1100-0900-1100 |
| Design Depth (m) | 0.900 | Min Outlet Diameter (m) | 0.225 |
| Design Flow (l/s) | 11.0 | Min Node Diameter (mm) | 1200 |

**Node IC S44 Depth/Area Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 65.794 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 72.0 | 0.0 | 0.900 | 72.0 | 0.0 | 0.901 | 0.0 | 0.0 |

**Node IC S45 Depth/Area Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 65.675 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 50.0 | 0.0 | 1.200 | 50.0 | 0.0 | 1.201 | 0.0 | 0.0 |

**Node IC S43 Depth/Area Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 66.333 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 1.00 | Time to half empty (mins) | 104 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 65.0 | 0.0 | 1.200 | 65.0 | 0.0 | 1.201 | 0.0 | 0.0 |

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Results for 1 year Critical Storm Duration. Lowest mass balance: 29.73%

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | IC S38 | 11 | 74.940 | 0.080 | 4.3 | 0.1166 | 0.0000 | OK |
| 15 minute winter | IC S39 | 11 | 74.942 | 0.159 | 8.8 | 0.2501 | 0.0000 | OK |
| 15 minute winter | IC S40 | 11 | 73.712 | 0.037 | 9.4 | 0.0418 | 0.0000 | OK |
| 15 minute winter | IC S41 | 11 | 70.217 | 0.042 | 14.1 | 0.0716 | 0.0000 | OK |
| 15 minute winter | IC S42 | 11 | 67.508 | 0.083 | 16.3 | 0.1148 | 0.0000 | OK |
| 1440 minute winter | IC S43 | 1020 | 66.548 | 0.215 | 2.3 | 14.4688 | 0.0000 | OK |
| 1440 minute summer | IC S44 | 1140 | 66.513 | 0.719 | 3.9 | 53.0850 | 0.0000 | OK |
| 1440 minute winter | IC S45 | 1050 | 66.513 | 0.838 | 4.5 | 44.3343 | 0.0000 | OK |
| 1440 minute winter | IC S46 | 1620 | 66.513 | 0.897 | 0.2 | 1.0146 | 0.0000 | OK |
| 15 minute summer | IC C1 | 1 | 65.601 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | IC S38 | 1.000 | IC S39 | 3.4 | 0.144 | 0.002 | 0.3172 | |
| 15 minute winter | IC S39 | Hydro-Brake® | IC S40 | 9.4 | | | | |
| 15 minute winter | IC S40 | 1.002 | IC S41 | 9.3 | 2.026 | 0.059 | 0.1777 | |
| 15 minute winter | IC S41 | 1.003 | IC S42 | 14.1 | 1.566 | 0.078 | 0.2120 | |
| 15 minute winter | IC S42 | 1.004 | IC S43 | 16.1 | 1.240 | 0.277 | 0.4335 | |
| 1440 minute winter | IC S43 | Hydro-Brake® | IC S44 | 2.3 | | | | |
| 1440 minute summer | IC S44 | 1.006 | IC S45 | 3.6 | 0.069 | 0.002 | 10.3054 | |
| 1440 minute winter | IC S45 | 1.007 | IC S46 | 0.2 | 0.036 | 0.000 | 5.5656 | |
| 1440 minute winter | IC S46 | Hydro-Brake® | IC C1 | 0.0 | | | | 0.0 |

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Results for 30 year Critical Storm Duration. Lowest mass balance: 29.73%

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | IC S38 | 14 | 75.504 | 0.644 | 10.6 | 0.9368 | 0.0000 | OK |
| 15 minute winter | IC S39 | 14 | 75.501 | 0.718 | 22.6 | 1.1293 | 0.0000 | SURCHARGED |
| 15 minute winter | IC S40 | 23 | 73.714 | 0.039 | 10.0 | 0.0442 | 0.0000 | OK |
| 15 minute winter | IC S41 | 10 | 70.228 | 0.053 | 22.3 | 0.0898 | 0.0000 | OK |
| 15 minute winter | IC S42 | 10 | 67.538 | 0.113 | 27.8 | 0.1559 | 0.0000 | OK |
| 60 minute winter | IC S43 | 52 | 66.989 | 0.656 | 44.0 | 44.1661 | 0.0000 | OK |
| 720 minute winter | IC S44 | 450 | 66.862 | 1.068 | 9.6 | 66.7967 | 0.0000 | SURCHARGED |
| 720 minute winter | IC S45 | 450 | 66.859 | 1.184 | 237.2 | 62.5993 | 0.0000 | SURCHARGED |
| 960 minute summer | IC S46 | 555 | 67.337 | 1.721 | 23.2 | 1.9467 | 0.0000 | SURCHARGED |
| 15 minute summer | IC C1 | 1 | 65.601 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | IC S38 | 1.000 | IC S39 | 8.0 | 0.185 | 0.004 | 3.1713 | |
| 15 minute winter | IC S39 | Hydro-Brake® | IC S40 | 10.0 | | | | |
| 15 minute winter | IC S40 | 1.002 | IC S41 | 10.0 | 2.310 | 0.063 | 0.2173 | |
| 15 minute winter | IC S41 | 1.003 | IC S42 | 22.2 | 1.697 | 0.123 | 0.3104 | |
| 15 minute winter | IC S42 | 1.004 | IC S43 | 27.4 | 1.422 | 0.471 | 0.6441 | |
| 60 minute winter | IC S43 | Hydro-Brake® | IC S44 | 11.0 | | | | |
| 720 minute winter | IC S44 | 1.006 | IC S45 | 7.1 | 0.114 | 0.004 | 11.2812 | |
| 720 minute winter | IC S45 | 1.007 | IC S46 | -187.9 | -0.296 | -0.116 | 5.6533 | |
| 960 minute summer | IC S46 | Hydro-Brake® | IC C1 | 0.0 | | | | 0.0 |

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Results for 100 year +30% CC Critical Storm Duration. Lowest mass balance: 29.73%

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | IC S38 | 13 | 75.817 | 0.957 | 578.2 | 1.3929 | 0.0000 | SURCHARGED |
| 30 minute summer | IC S39 | 21 | 76.067 | 1.284 | 1122.6 | 2.0181 | 0.0000 | SURCHARGED |
| 15 minute winter | IC S40 | 12 | 73.715 | 0.040 | 10.8 | 0.0450 | 0.0000 | OK |
| 15 minute winter | IC S41 | 10 | 70.237 | 0.062 | 30.7 | 0.1051 | 0.0000 | OK |
| 120 minute winter | IC S42 | 100 | 68.510 | 1.085 | 20.1 | 1.5023 | 0.0000 | SURCHARGED |
| 120 minute winter | IC S43 | 100 | 68.498 | 2.165 | 46.2 | 83.0245 | 0.0000 | SURCHARGED |
| 180 minute winter | IC S44 | 116 | 66.864 | 1.070 | 28.3 | 66.8001 | 0.0000 | SURCHARGED |
| 180 minute winter | IC S45 | 116 | 66.867 | 1.192 | 118.9 | 63.0492 | 0.0000 | SURCHARGED |
| 60 minute summer | IC S46 | 126 | 67.702 | 2.086 | 504.7 | 2.3595 | 0.0000 | FLOOD RISK |
| 15 minute summer | IC C1 | 1 | 65.601 | 0.000 | 0.0 | 0.0000 | 0.0000 | OK |

| Link Event (Upstream Depth) | US Node | Link | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | IC S38 | 1.000 | IC S39 | -520.0 | -0.841 | -0.233 | 3.8733 | |
| 30 minute summer | IC S39 | Hydro-Brake® | IC S40 | 10.9 | | | | |
| 15 minute winter | IC S40 | 1.002 | IC S41 | 10.9 | 2.309 | 0.068 | 0.2532 | |
| 15 minute winter | IC S41 | 1.003 | IC S42 | 30.3 | 1.760 | 0.168 | 0.4062 | |
| 120 minute winter | IC S42 | 1.004 | IC S43 | 20.1 | 1.315 | 0.346 | 1.3264 | |
| 120 minute winter | IC S43 | Hydro-Brake® | IC S44 | 14.7 | | | | |
| 180 minute winter | IC S44 | 1.006 | IC S45 | 67.6 | 0.178 | 0.042 | 11.2812 | |
| 180 minute winter | IC S45 | 1.007 | IC S46 | 171.0 | 0.270 | 0.105 | 5.6533 | |
| 60 minute summer | IC S46 | Hydro-Brake® | IC C1 | 0.0 | | | | 0.0 |

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