# DRAINAGE STRATEGY

for

# MR S FORSHAW AND SONS

## TWO AGRICULTURAL WORKERS DWELLINGS

at

## BOLTON FOLD FARM, ALSTON LANE, ALSTON, LONGRIDGE

**JUNE 2024**


**REFORD**

**Consulting Engineers Limited**

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# 1. INTRODUCTION

1.1 This drainage strategy has been produced on behalf of Mr S Forshaw and Sons in support of a planning application for the erection of two agricultural workers dwellings at Bolton Fold Farm, Alston Lane, Alston, Longridge, PR3 3BN. A location plan is included within Appendix A.

1.2 This drainage strategy describes the existing site conditions and proposed development. It assesses the potential impact of proposals on existing drainage and includes a proposed strategy for the provision of new drainage to serve the proposed development.

## 2. BASE INFORMATION

**Existing site**

2.1 The proposal relates to a piece of land immediately to the west of Bolton Fold Farm, Alston. The area of land allocated for the two dwellings has been measured as 1,191$m^2$. The site comprises green field.

2.2 The site lies to the east of the B6243 Preston Road, from which access is taken via Alston Lane.

**Understanding of existing drainage local to the site**

2.3 United Utilities sewer records identify no sewers local to the area. The sewer records are included within Appendix B.

2.4 A watercourse, a tributary of the Tun Brook, lies along the eastern boundary of the farm holding and drains to the south to ultimately discharge into the River Ribble approx. 3.8km to the south of the site.

2.5 A stone culvert lies to the south of the main farm buildings and runs across the fields to the southeast to discharge into the watercourse. The location of the existing culvert is also included within Appendix B.

**Site geology**

2.6 The online Soilscapes viewer has identified the geology of this parcel of land as slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils.

**Proposed development**

2.7 The proposal is for the erection of two agricultural workers dwellings.

# 3. PROPOSED DRAINAGE STRATEGY

**Surface water drainage**

3.1 In accordance with the National Standards for Sustainable Drainage, the drainage strategy should incorporate the use of Sustainable Drainage (SUDS) where possible. The approach promotes the use infiltration features in the first instance. If drainage cannot be achieved solely through infiltration due to site conditions or contamination risks, the preferred options are (in order of preference):

(i) a controlled discharge to a local waterbody or watercourse, or

(ii) a controlled discharge into the public sewer network (depending on availability and capacity).

3.2 The rate and volume of discharge should strive to provide betterment and be restricted to the pre-development values as far as practicable.

3.3 The online Soilscapes viewer has identified the geology of this parcel of land as slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils. As such infiltration techniques for the discharge of surface water back into the ground are unlikely to be viable.

3.4 A stone culvert lies to the south of the main farm buildings and runs across the fields to the southeast to discharge into the watercourse, a tributary of the Tun Brook, that lies along the eastern boundary of the farm holding and drains to the south to ultimately discharge into the River Ribble approx. 3.8km to the south of the site.

3.5 Surface water from the main farm buildings runs off into the stone culvert.

3.6 The proposal is for the erection of two agricultural workers dwellings.

3.7 It is therefore intended that surface water runoff from the developed site will be controlled to the existing pre-development Greenfield runoff rate, Qbar, or 2.0 l/s whichever is the greater, allowing surface water runoff generated by all rainfall events up to the 100 year critical rain storm plus 50% on stored volumes to discharge into the stone culvert and the watercourse. The additional 50% is to allow for climate change and has been included in the surface water volume.

3.8 To determine the restricted surface water discharge rate from the developed site, the pre-development Greenfield runoff rates have been calculated using the 'Causeway Flow' programme. The calculations are based upon the site area of 0.12ha. The existing pre-development Greenfield runoff rates have been calculated as below:

**Pre-development discharge**

| | |
|---|---|
| **Site Makeup** | Greenfield |
| **Greenfield Method** | IH124 |
| **Positively Drained Area (ha)** | 0.120 |
| **SAAR (mm)** | 1094 |
| **Soil Index** | 4 |
| **SPR** | 0.47 |
| **Region** | 10 |
| **Betterment (%)** | 0 |
| | Calc |
| **QBar (l/s)** | 1.0 |

| Return Period (years) | Growth Factor | Q (l/s) |
|---|---|---|
| 1 | 0.87 | 0.9 |
| 30 | 1.70 | 1.7 |
| 100 | 2.08 | 2.0 |

3.9 A surface water drainage design has been carried out for the site development for all events up to the 100 year critical rain storm plus 50% on stored volumes. The design takes all surface water runoff from the proposed development's buildings roofs and hardstanding areas, and is attenuated to the limiting discharge rate of 2.0 l/s, prior to a controlled discharge made into the stone culvert. Attenuation will be provided utilising underground storage.

3.10 The surface water drainage design is included within Appendix C.

**Foul water drainage**

3.11 There are no public sewers local to the area.

3.12 A watercourse, a tributary of the Tun Brook, lies along the eastern boundary of the farm holding and drains to the south to ultimately discharge into the River Ribble approx. 3.8km to the south of the site.

3.13 A stone culvert lies to the south of the main farm buildings and runs across the fields to the southeast to discharge into the watercourse.

3.14 It is therefore intended that a sewage treatment plant will be installed to treat foul water from the proposed residential dwellings and the effluent discharged into the stone culvert that lies to the south of the main farm buildings and runs across the fields to the southeast to discharge into the watercourse.

3.15 The sewage treatment plant is to be sited a minimum 7m away from habitable areas and is to be sited under the landscaped area to the south of the properties.

# 4. SUMMARY AND CONCLUSIONS

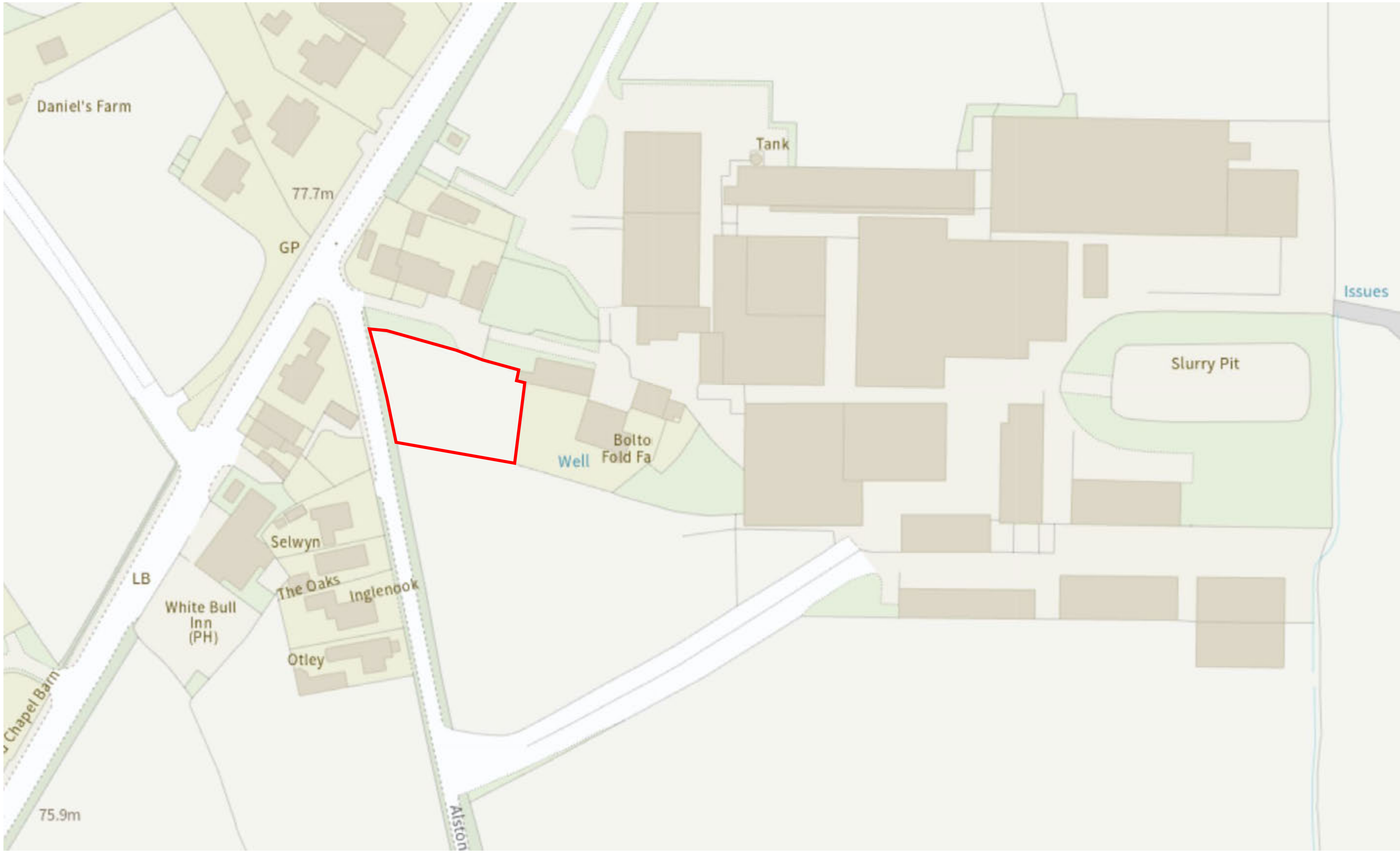
4.1 This drainage strategy has been produced on behalf of Mr S Forshaw and Sons in support of a planning application for the erection of two agricultural workers dwellings at Bolton Fold Farm, Alston Lane, Alston, Longridge, PR3 3BN.

4.2 A stone culvert lies to the south of the main farm buildings and runs across the fields to the southeast to also discharge into the watercourse. Surface water from the main farm buildings runs off into the stone culvert.

4.3 Surface water runoff from the developed site will be controlled to the limiting discharge rate of 2.0 l/s, prior to a controlled discharge made into the stone culvert. Attenuation will be provided utilising underground storage.

4.4 Foul water from the proposed residential dwellings will be treated by a sewage treatment plant and the effluent discharged into the stone culvert.

# APPENDIX A

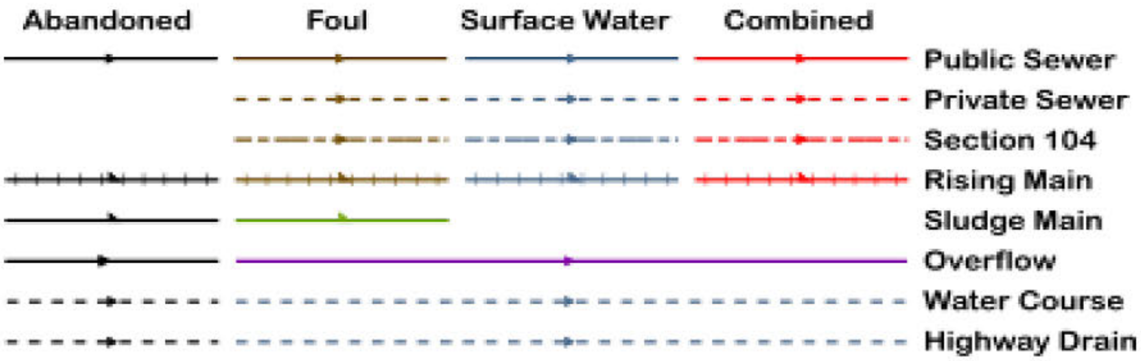



**LOCATION PLAN**

# APPENDIX B

United Utilities
Water for the North West

# Wastewater Symbology

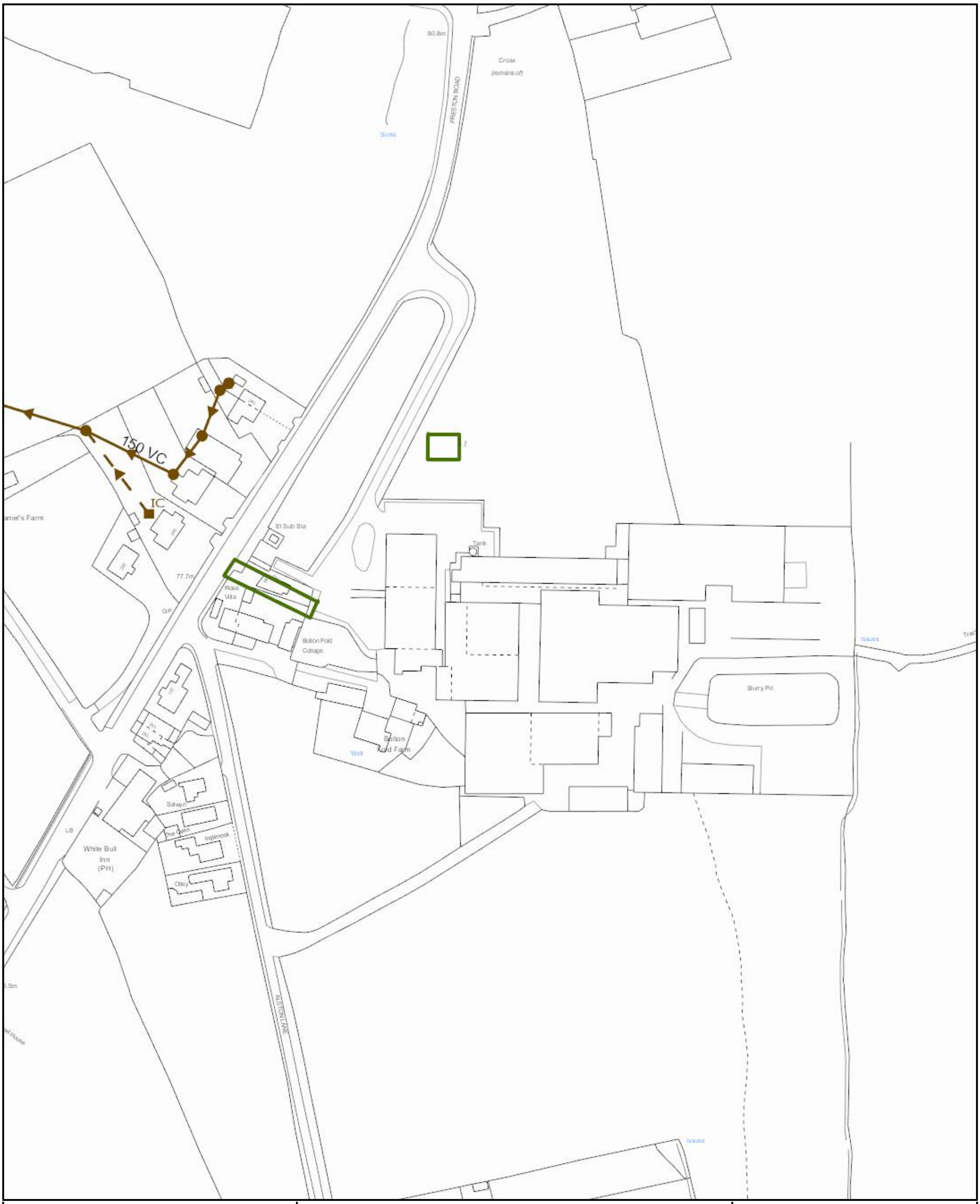



All point assets follow the standard colour convention: red – combined; brown - foul; blue – surface water; purple - overflow

- Manhole
- Head of System
- Extent of Survey
- Rodding Eye
- Inlet
- Discharge Point
- Vortex
- Penstock
- Washout Chamber
- Valve
- Air Valve
- Non Return Valve
- Soakaway
- Gully
- Cascade
- Flow Meter
- Hatch Box
- Oil Interceptor
- Summit
- Drop Shaft
- Orifice Plate

- Side Entry Manhole
- Outfall
- Screen Chamber
- Inspection Chamber
- Bifurcation Chamber
- Lamp Hole
- T Junction / Saddle
- Catchpit
- Valve Chamber
- Vent Column
- Vortex Chamber
- Penstock Chamber
- Network Storage Tank
- Sewer Overflow
- Ww Treatment Works
- Ww Pumping Station
- Septic Tank
- Control Kiosk

- Change of Characteristic




**Scale:** 1:2472
**Date:** 13/07/2023

# SEWER RECORDS

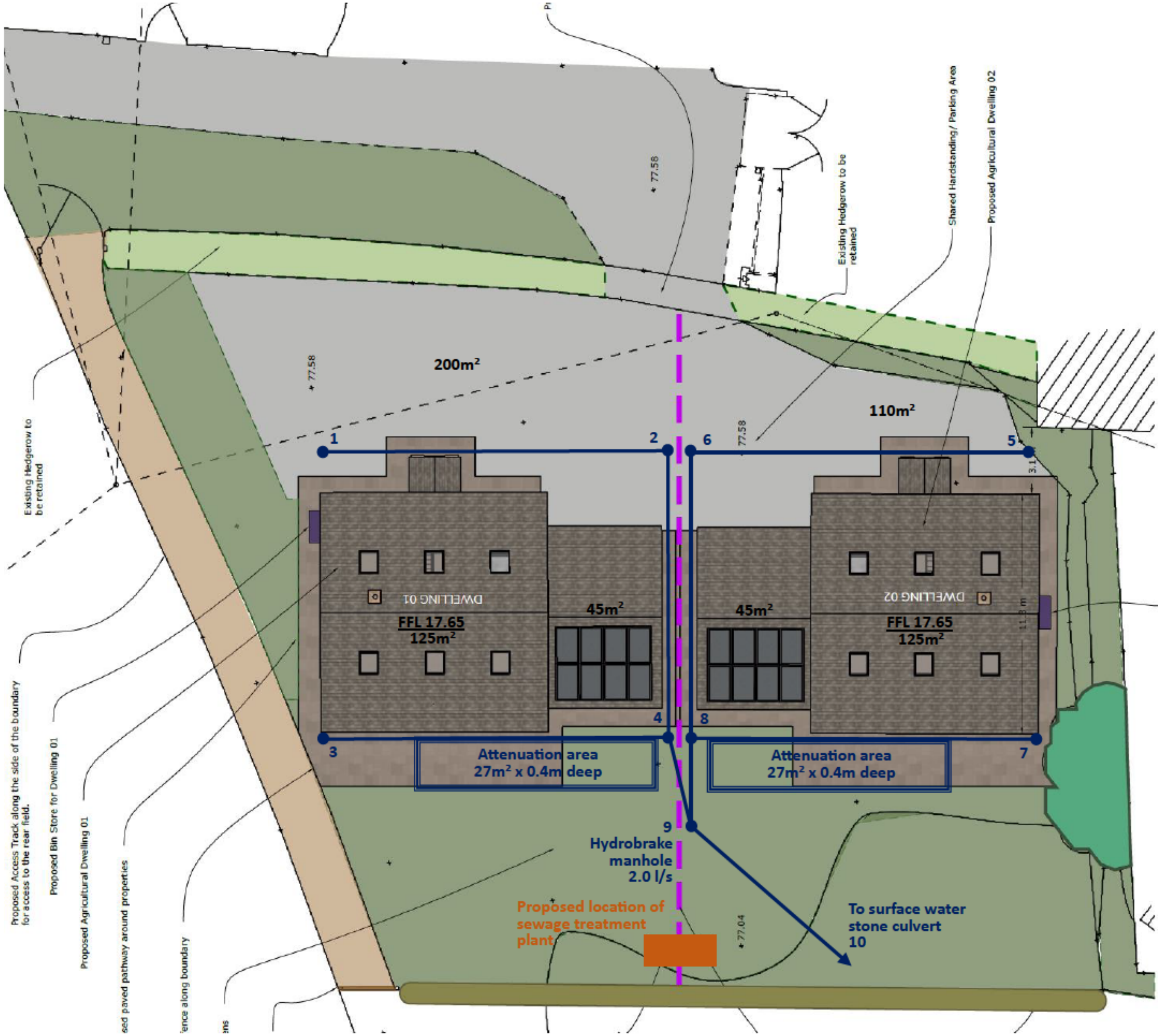
United Utilities
Water for the North West

**Address or Site Reference:** bolton fold farm
**Printed by:** Property Searches

The position of the underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available. United Utilities Water will not accept liability for any loss or damage caused by the actual position being different from those shown.


**LOCATION OF EXISTING STONE CULVERT**

# APPENDIX C




**PROPOSED DRAINAGE LAYOUT**

## Design Settings

| | | | |
|---|---|---|---|
| Rainfall Methodology | FSR | Maximum Time of Concentration (mins) | 30.00 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 75.0 |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 |
| FSR Region | England and Wales | Connection Type | Level Soffits |
| M5-60 (mm) | 18.800 | Minimum Backdrop Height (m) | 3.000 |
| Ratio-R | 0.300 | Preferred Cover Depth (m) | 0.450 |
| 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) |
|---|---|---|---|---|---|
| 1 | 0.007 | 5.00 | 77.500 | 100 | 0.550 |
| 2 | 0.022 | 5.00 | 77.500 | 600 | 0.819 |
| 3 | 0.006 | 5.00 | 77.500 | 100 | 0.550 |
| 4 | 0.002 | 5.00 | 77.500 | 600 | 1.021 |
| 5 | 0.007 | 5.00 | 77.500 | 100 | 0.550 |
| 6 | 0.013 | 5.00 | 77.500 | 600 | 0.819 |
| 7 | 0.006 | 5.00 | 77.500 | 100 | 0.550 |
| 8 | 0.002 | 5.00 | 77.500 | 600 | 1.021 |
| 9 | | | 77.500 | 1200 | 1.139 |
| 10 | | | 77.000 | 1200 | 0.937 |

## 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 | 1 | 2 | 16.000 | 0.600 | 76.950 | 76.681 | 0.269 | 59.5 | 100 | 5.27 | 55.8 |
| 1.001 | 2 | 4 | 12.000 | 0.600 | 76.681 | 76.479 | 0.202 | 59.4 | 100 | 5.47 | 55.0 |
| 2.000 | 3 | 4 | 16.000 | 0.600 | 76.950 | 76.479 | 0.471 | 34.0 | 100 | 5.20 | 56.1 |
| 1.002 | 4 | 9 | 4.000 | 0.600 | 76.479 | 76.411 | 0.068 | 58.8 | 100 | 5.53 | 54.7 |
| 3.000 | 5 | 6 | 16.000 | 0.600 | 76.950 | 76.681 | 0.269 | 59.5 | 100 | 5.27 | 55.8 |
| 3.001 | 6 | 8 | 12.000 | 0.600 | 76.681 | 76.479 | 0.202 | 59.4 | 100 | 5.47 | 55.0 |
| 4.000 | 7 | 8 | 16.000 | 0.600 | 76.950 | 76.479 | 0.471 | 34.0 | 100 | 5.20 | 56.1 |
| 3.002 | 8 | 9 | 4.000 | 0.600 | 76.479 | 76.411 | 0.068 | 58.8 | 100 | 5.53 | 54.7 |
| 1.003 | 9 | 10 | 30.000 | 0.600 | 76.361 | 76.063 | 0.298 | 100.7 | 150 | 6.03 | 52.9 |

| 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 | 1.000 | 7.9 | 1.1 | 0.450 | 0.719 | 0.007 | 0.0 | 25 | 0.692 |
| 1.001 | 1.001 | 7.9 | 4.3 | 0.719 | 0.921 | 0.029 | 0.0 | 53 | 1.023 |
| 2.000 | 1.328 | 10.4 | 0.9 | 0.450 | 0.921 | 0.006 | 0.0 | 20 | 0.811 |
| 1.002 | 1.006 | 7.9 | 5.5 | 0.921 | 0.989 | 0.037 | 0.0 | 61 | 1.086 |
| 3.000 | 1.000 | 7.9 | 1.1 | 0.450 | 0.719 | 0.007 | 0.0 | 25 | 0.692 |
| 3.001 | 1.001 | 7.9 | 3.0 | 0.719 | 0.921 | 0.020 | 0.0 | 43 | 0.931 |
| 4.000 | 1.328 | 10.4 | 0.9 | 0.450 | 0.921 | 0.006 | 0.0 | 20 | 0.811 |
| 3.002 | 1.006 | 7.9 | 4.2 | 0.921 | 0.989 | 0.028 | 0.0 | 51 | 1.016 |
| 1.003 | 1.001 | 17.7 | 9.3 | 0.989 | 0.787 | 0.065 | 0.0 | 77 | 1.012 |

## Manhole Schedule

| Node | CL (m) | Depth (m) | Dia (mm) | Connections | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|
| 1 | 77.500 | 0.550 | 100 | 0 | 1.000 | 76.950 | 100 |

**Manhole Schedule**

| Node | CL (m) | Depth (m) | Dia (mm) | Connections | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|
| 2 | 77.500 | 0.819 | 600 | 1 | 1.000 | 76.681 | 100 |
| | | | | 0 | 1.001 | 76.681 | 100 |
| 3 | 77.500 | 0.550 | 100 | | | | |
| | | | | 0 | 2.000 | 76.950 | 100 |
| 4 | 77.500 | 1.021 | 600 | 1 | 2.000 | 76.479 | 100 |
| | | | | 2 | 1.001 | 76.479 | 100 |
| | | | | 0 | 1.002 | 76.479 | 100 |
| 5 | 77.500 | 0.550 | 100 | | | | |
| | | | | 0 | 3.000 | 76.950 | 100 |
| 6 | 77.500 | 0.819 | 600 | 1 | 3.000 | 76.681 | 100 |
| | | | | 0 | 3.001 | 76.681 | 100 |
| 7 | 77.500 | 0.550 | 100 | | | | |
| | | | | 0 | 4.000 | 76.950 | 100 |
| 8 | 77.500 | 1.021 | 600 | 1 | 4.000 | 76.479 | 100 |
| | | | | 2 | 3.001 | 76.479 | 100 |
| | | | | 0 | 3.002 | 76.479 | 100 |
| 9 | 77.500 | 1.139 | 1200 | 1 | 3.002 | 76.411 | 100 |
| | | | | 2 | 1.002 | 76.411 | 100 |
| | | | | 0 | 1.003 | 76.361 | 150 |

## Manhole Schedule

| Node | CL (m) | Depth (m) | Dia (mm) | Connections | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|
| 10 | 77.000 | 0.937 | 1200 | 1 | 1.003 | 76.063 | 150 |

## Simulation Settings

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Methodology | FSR | Summer CV | 0.750 | Drain Down Time (mins) | 240 |
| FSR Region | England and Wales | Winter CV | 0.840 | Additional Storage (m³/ha) | 20.0 |
| M5-60 (mm) | 18.800 | Analysis Speed | Normal | Check Discharge Rate(s) | x |
| Ratio-R | 0.300 | Skip Steady State | x | Check Discharge Volume | x |

**Storm Durations**

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

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) | Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| 30 | 0 | 0 | 0 | 100 | 50 | 0 | 0 |

## Node 9 Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | x | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 76.361 | Product Number | CTL-SHE-0066-2000-1100-2000 |
| Design Depth (m) | 1.100 | Min Outlet Diameter (m) | 0.100 |
| Design Flow (l/s) | 2.0 | Min Node Diameter (mm) | 1200 |

## Node 4 Depth/Area Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 76.479 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 0.95 | Time to half empty (mins) | 228 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 27.0 | 0.0 | 0.400 | 27.0 | 0.0 | 0.401 | 0.0 | 0.0 |

**Node 8 Depth/Area Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 76.479 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 0.95 | Time to half empty (mins) | 228 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 27.0 | 0.0 | 0.400 | 27.0 | 0.0 | 0.401 | 0.0 | 0.0 |

**Results for 1 year Critical Storm Duration. Lowest mass balance: 99.52%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 1 | 11 | 76.972 | 0.022 | 0.8 | 0.0057 | 0.0000 | OK |
| 15 minute winter | 2 | 10 | 76.732 | 0.051 | 3.4 | 0.0422 | 0.0000 | OK |
| 15 minute winter | 3 | 11 | 76.968 | 0.018 | 0.7 | 0.0040 | 0.0000 | OK |
| 60 minute winter | 4 | 45 | 76.534 | 0.055 | 2.5 | 1.4370 | 0.0000 | OK |
| 15 minute winter | 5 | 11 | 76.972 | 0.022 | 0.8 | 0.0057 | 0.0000 | OK |
| 15 minute winter | 6 | 10 | 76.724 | 0.043 | 2.4 | 0.0256 | 0.0000 | OK |
| 15 minute winter | 7 | 9 | 76.968 | 0.018 | 0.7 | 0.0041 | 0.0000 | OK |
| 60 minute winter | 8 | 45 | 76.534 | 0.055 | 1.9 | 1.4310 | 0.0000 | OK |
| 60 minute winter | 9 | 45 | 76.534 | 0.173 | 2.3 | 0.1953 | 0.0000 | SURCHARGED |
| 15 minute summer | 10 | 1 | 76.063 | 0.000 | 1.7 | 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 | 1 | 1.000 | 2 | 0.8 | 0.328 | 0.102 | 0.0423 | |
| 15 minute winter | 2 | 1.001 | 4 | 3.4 | 1.245 | 0.435 | 0.0375 | |
| 15 minute winter | 3 | 2.000 | 4 | 0.7 | 0.773 | 0.067 | 0.0299 | |
| 60 minute winter | 4 | 1.002 | 9 | 1.9 | 0.636 | 0.238 | 0.0245 | |
| 15 minute winter | 5 | 3.000 | 6 | 0.8 | 0.393 | 0.102 | 0.0353 | |
| 15 minute winter | 6 | 3.001 | 8 | 2.4 | 1.169 | 0.305 | 0.0294 | |
| 15 minute winter | 7 | 4.000 | 8 | 0.7 | 0.866 | 0.068 | 0.0310 | |
| 60 minute winter | 8 | 3.002 | 9 | 1.3 | 0.555 | 0.169 | 0.0245 | |
| 60 minute winter | 9 | Hydro-Brake® | 10 | 1.8 | | | | 6.4 |

**Results for 30 year Critical Storm Duration. Lowest mass balance: 99.52%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 1 | 10 | 76.985 | 0.035 | 2.1 | 0.0091 | 0.0000 | OK |
| 15 minute winter | 2 | 11 | 76.811 | 0.130 | 8.5 | 0.1066 | 0.0000 | SURCHARGED |
| 15 minute winter | 3 | 10 | 76.978 | 0.028 | 1.8 | 0.0063 | 0.0000 | OK |
| 60 minute winter | 4 | 58 | 76.672 | 0.193 | 6.1 | 5.0145 | 0.0000 | SURCHARGED |
| 15 minute winter | 5 | 10 | 76.985 | 0.035 | 2.1 | 0.0091 | 0.0000 | OK |
| 15 minute winter | 6 | 10 | 76.750 | 0.069 | 5.8 | 0.0412 | 0.0000 | OK |
| 15 minute winter | 7 | 10 | 76.978 | 0.028 | 1.8 | 0.0063 | 0.0000 | OK |
| 60 minute winter | 8 | 58 | 76.671 | 0.192 | 4.7 | 4.9969 | 0.0000 | SURCHARGED |
| 60 minute winter | 9 | 58 | 76.670 | 0.309 | 2.4 | 0.3499 | 0.0000 | SURCHARGED |
| 15 minute summer | 10 | 1 | 76.063 | 0.000 | 1.8 | 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 | 1 | 1.000 | 2 | 2.0 | 0.370 | 0.261 | 0.0820 | |
| 15 minute winter | 2 | 1.001 | 4 | 8.1 | 1.353 | 1.036 | 0.0938 | |
| 15 minute winter | 3 | 2.000 | 4 | 1.8 | 0.870 | 0.170 | 0.0749 | |
| 60 minute winter | 4 | 1.002 | 9 | 1.9 | 0.626 | 0.238 | 0.0313 | |
| 15 minute winter | 5 | 3.000 | 6 | 2.0 | 0.500 | 0.261 | 0.0653 | |
| 15 minute winter | 6 | 3.001 | 8 | 5.8 | 1.286 | 0.739 | 0.0736 | |
| 15 minute winter | 7 | 4.000 | 8 | 1.8 | 0.948 | 0.170 | 0.0730 | |
| 60 minute winter | 8 | 3.002 | 9 | 1.0 | 0.550 | 0.122 | 0.0313 | |
| 60 minute winter | 9 | Hydro-Brake® | 10 | 1.9 | | | | 15.8 |

**Results for 100 year Critical Storm Duration. Lowest mass balance: 99.52%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute winter | 1 | 10 | 76.990 | 0.040 | 2.7 | 0.0105 | 0.0000 | OK |
| 15 minute winter | 2 | 11 | 76.954 | 0.273 | 10.9 | 0.2236 | 0.0000 | SURCHARGED |
| 15 minute winter | 3 | 10 | 76.982 | 0.032 | 2.3 | 0.0072 | 0.0000 | OK |
| 120 minute winter | 4 | 108 | 76.764 | 0.285 | 5.2 | 7.3909 | 0.0000 | SURCHARGED |
| 15 minute winter | 5 | 10 | 76.990 | 0.040 | 2.7 | 0.0105 | 0.0000 | OK |
| 15 minute winter | 6 | 10 | 76.765 | 0.084 | 7.5 | 0.0505 | 0.0000 | OK |
| 15 minute winter | 7 | 10 | 76.982 | 0.032 | 2.3 | 0.0072 | 0.0000 | OK |
| 120 minute winter | 8 | 108 | 76.763 | 0.284 | 3.9 | 7.3682 | 0.0000 | SURCHARGED |
| 120 minute winter | 9 | 108 | 76.762 | 0.401 | 2.4 | 0.4533 | 0.0000 | SURCHARGED |
| 15 minute summer | 10 | 1 | 76.063 | 0.000 | 1.9 | 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 | 1 | 1.000 | 2 | 2.7 | 0.421 | 0.338 | 0.0860 | |
| 15 minute winter | 2 | 1.001 | 4 | 9.8 | 1.368 | 1.242 | 0.0939 | |
| 15 minute winter | 3 | 2.000 | 4 | 2.3 | 0.898 | 0.216 | 0.0789 | |
| 120 minute winter | 4 | 1.002 | 9 | 1.6 | 0.624 | 0.208 | 0.0313 | |
| 15 minute winter | 5 | 3.000 | 6 | 2.7 | 0.521 | 0.337 | 0.0797 | |
| 15 minute winter | 6 | 3.001 | 8 | 7.4 | 1.306 | 0.940 | 0.0881 | |
| 15 minute winter | 7 | 4.000 | 8 | 2.3 | 0.967 | 0.216 | 0.0787 | |
| 120 minute winter | 8 | 3.002 | 9 | 1.0 | 0.534 | 0.122 | 0.0313 | |
| 120 minute winter | 9 | Hydro-Brake® | 10 | 1.9 | | | | 26.3 |

**Results for 100 year +50% CC Critical Storm Duration. Lowest mass balance: 99.52%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 180 minute winter | 1 | 152 | 77.470 | 0.520 | 1.1 | 0.1362 | 0.0000 | FLOOD RISK |
| 180 minute winter | 2 | 152 | 77.469 | 0.788 | 4.6 | 0.6465 | 0.0000 | FLOOD RISK |
| 180 minute winter | 3 | 152 | 77.467 | 0.517 | 1.0 | 0.1169 | 0.0000 | FLOOD RISK |
| 180 minute winter | 4 | 152 | 77.467 | 0.988 | 5.7 | 10.5909 | 0.0000 | FLOOD RISK |
| 180 minute winter | 5 | 152 | 77.468 | 0.518 | 1.1 | 0.1357 | 0.0000 | FLOOD RISK |
| 180 minute winter | 6 | 152 | 77.468 | 0.787 | 3.2 | 0.4720 | 0.0000 | FLOOD RISK |
| 180 minute winter | 7 | 152 | 77.467 | 0.517 | 1.0 | 0.1167 | 0.0000 | FLOOD RISK |
| 180 minute winter | 8 | 152 | 77.466 | 0.987 | 4.3 | 10.5907 | 0.0000 | FLOOD RISK |
| 180 minute winter | 9 | 152 | 77.465 | 1.104 | 3.7 | 1.2486 | 0.0000 | FLOOD RISK |
| 15 minute summer | 10 | 1 | 76.063 | 0.000 | 1.9 | 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) |
|---|---|---|---|---|---|---|---|---|
| 180 minute winter | 1 | 1.000 | 2 | 1.1 | 0.369 | 0.140 | 0.1252 | |
| 180 minute winter | 2 | 1.001 | 4 | 4.4 | 0.860 | 0.559 | 0.0939 | |
| 180 minute winter | 3 | 2.000 | 4 | 1.0 | 0.626 | 0.096 | 0.1252 | |
| 180 minute winter | 4 | 1.002 | 9 | 2.3 | 0.600 | 0.296 | 0.0313 | |
| 180 minute winter | 5 | 3.000 | 6 | 1.1 | 0.459 | 0.140 | 0.1252 | |
| 180 minute winter | 6 | 3.001 | 8 | 3.1 | 0.830 | 0.391 | 0.0939 | |
| 180 minute winter | 7 | 4.000 | 8 | 1.0 | 0.685 | 0.096 | 0.1252 | |
| 180 minute winter | 8 | 3.002 | 9 | 1.5 | 0.542 | 0.196 | 0.0313 | |
| 180 minute winter | 9 | Hydro-Brake® | 10 | 2.0 | | | | 43.1 |