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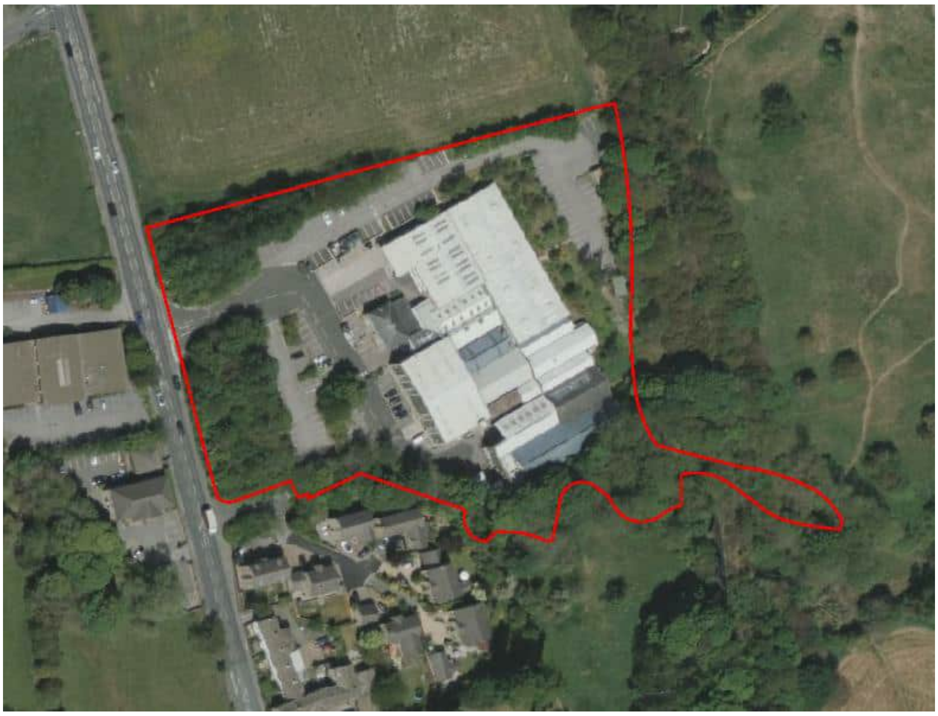
# FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY



| | |
|---|---|
| Client: | **Reliance Precision Limited** |
| Site Address: | **Rowley Mills**<br>**Penistone Road**<br>**Fenay Bridge**<br>**Huddersfield**<br>**HD8 0LE** |
| Project Number: | **23308** |
| Report Reference: | **23308-DCE-XX-XX-T-C-001-P01** |
| Date: | **28/03/2024** |

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CONSULTING ENGINEERS

**CONTENTS**



| Revision | Date | Author | Checked by; | Comments |
|---|---|---|---|---|
| P01 | 28/03/24 | Jonathan Allchin | Peter Dixon | |
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## 1.0 INTRODUCTION

1.1 Dudleys Consulting Engineers have prepared this site-specific Flood Risk Assessment and Drainage Strategy for the extension to an existing mill building and associated parking facilities on Penistone Road, Fenay Bridge, Huddersfield.

1.2 The assessment investigates the potential flood risk impacts of the proposed development in accordance with the National Planning Policy Framework (NPPF) and supporting Planning Practice Guidance. This FRA is considered proportionate to the degree of flood risk and to the scale, nature, and location of the development.

1.3 This Flood Risk Assessment and Drainage Strategy has been carried out generally in accordance with:

- National Planning Policy Framework (December 2023)
- Planning Practice Guidance: Flood Risk and Coastal Change (August 2022)
- Building Regulations Part H
- BS8533:2017 “Assessing and managing flood risk in development, Code of Practice”
- CIRIA Report C753” The SUDS Manual” 2015
- Environment Agency Report SC030219 Rainfall Runoff Management for Developments
- DEFRA Non-Statutory Technical Standards for Sustainable Drainage Systems (March 2015)

## 2.0 CONSULTATION AND EVIDENCE

2.1 The development is situated on Penistone Road, Fenay Bridge, Huddersfield. Kirklees Council are the Local Planning Authority (LPA) and the Lead Local Flood Authority (LLFA) for the site. Yorkshire Water are the Local Sewerage Authority for the site. The site does not fall within an Internal Drainage Board area.

2.2 As parts of the site are within Flood Zones 2 and 3, the Environment Agency have been contacted and the information supplied is discussed in Section 7 and included in Appendix D.

2.3 Planning policy requires that the site be developed in accordance with NPPF requirements in terms of flood risk management, climate change allowances and reduced runoff from the development.

## 3.0 SITE DESCRIPTION

3.1 The proposed works comprise the extension to an existing mill building and associated parking facilities.

3.2 The site is situated immediately north of Beldon Brook and the site straddles Flood Zones 1, 2 and 3.

3.3 The existing site topographic survey is provided to the rear of this document in Appendix A. The site falls from northeast to southwest with levels between 86.0 and 103.0mAOD.

3.4 The approximate grid reference of the site is E418769, N414343.

3.5 The site has a total site area of 1.78ha, with an existing impermeable area of 1.02ha.

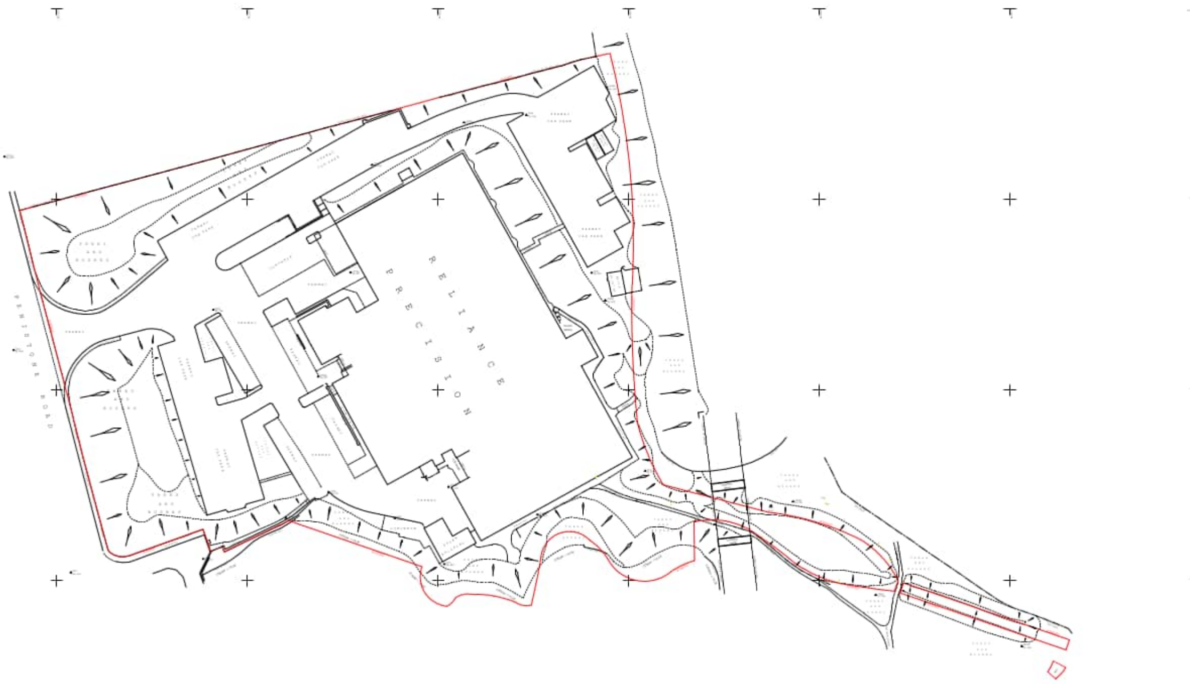


Figure 1: Site Location Plan

3.6 It is understood that there will be works to the existing building on the west side of Penistone Road, however, the impermeable area will not be changing, and hence there is no requirement for works to the existing drainage system. Furthermore, a site-specific Flood Risk Assessment has already been undertaken for that parcel of land by EWE Associates Ltd in May 2022 that confirmed the site was in an area of low flood risk. Furthermore, a Flood Risk Sequential Assessment was undertaken by Robert Halstead Chartered Surveyors and Town Planners in August 2022 that confirmed works on the west side of Penistone Road would pass the sequential test in accordance with national and local planning policy.

3.7 The red line boundary, including the existing building to the west of Penistone Road is shown in Figure 2 below.

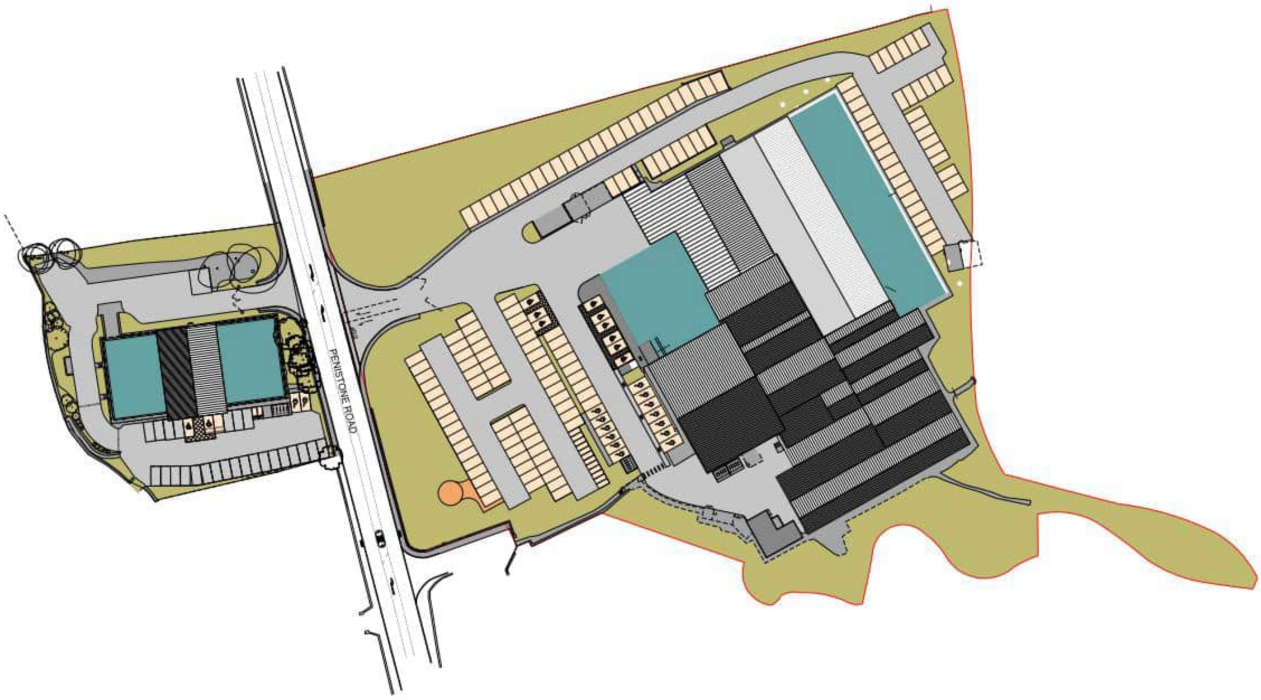


Figure 2: Overall Site Layout

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## 4.0 SITE PROPOSALS

4.1 The proposed development layout is shown in Figure 3 below, but can also be found in Appendix B.

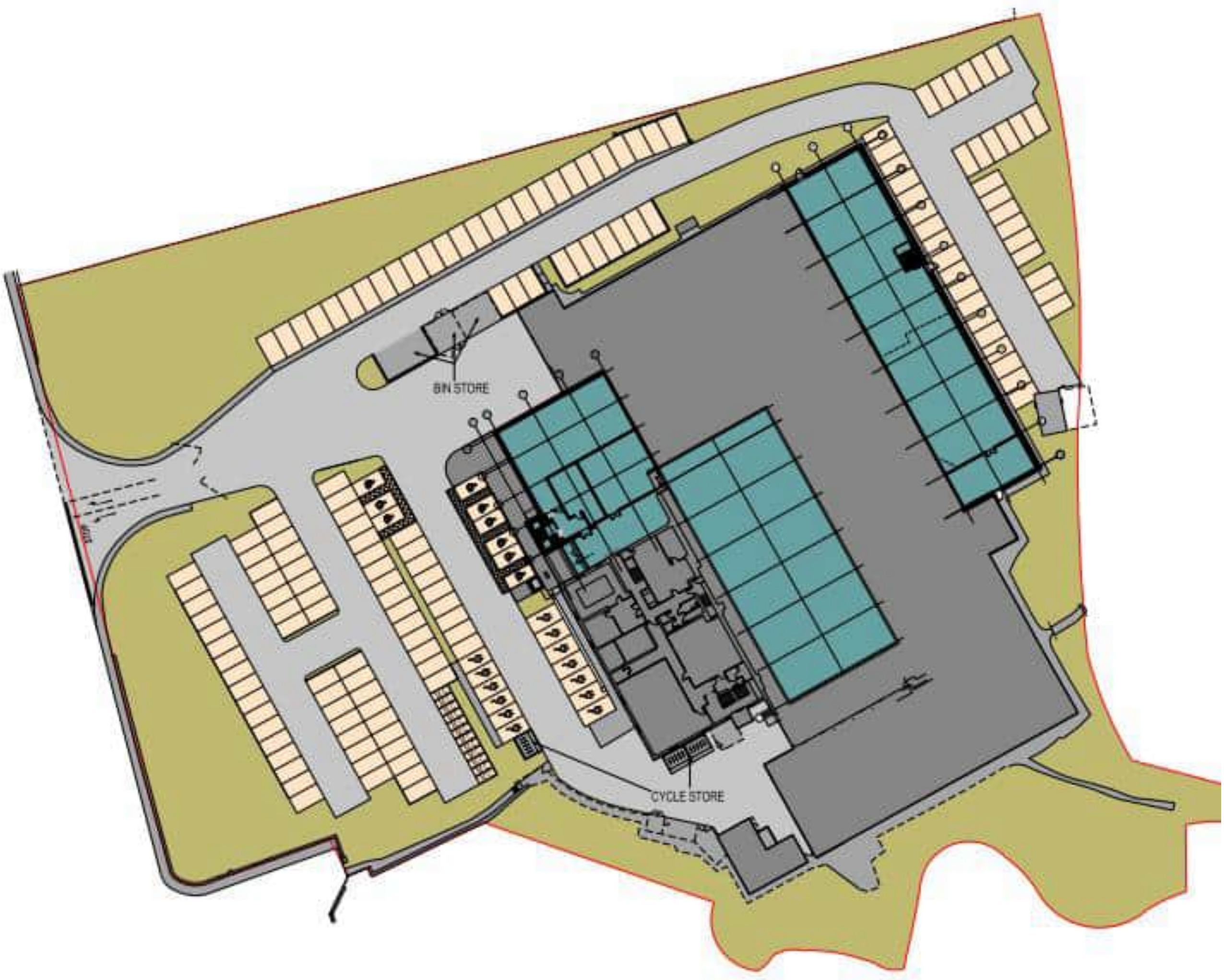



Figure 3: Proposed Development Layout

## 5.0 FLOOD RISK VULNERABILITY

5.1 The Flood Risk Vulnerability Classification has been determined in accordance with Planning Practice Guidance, Flood Risk and Coastal Change.

5.2 The Flood Risk Vulnerability Classification is 'Less Vulnerable'. This classification includes, "Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure." This classification is in accordance with Planning Practice Guidance, Flood Risk and Coastal Change, paragraph 066.

## 6.0 FLOOD ZONE COMPATIBILITY

6.1 The majority of the site is located within Flood Zone 1 as indicated on the Environment Agency Flood Zone map in Section 7. The only areas identified within Flood Zones 2 and 3 are car parking areas. Therefore, we believe the proposed extension works are suitable without the application of the Sequential Test.

6.2 The Flood Zone Compatibility has been reviewed in accordance with Planning Practice Guidance, Flood Risk and Coastal Change, paragraph 067 Table 3. This compatibility is summarised in Table 1 below.

Table 1: Flood Risk Vulnerability Classification

| **Flood Zones** | **Flood Risk Vulnerability Classification** | | | | |
|---|---|---|---|---|---|
| | **Essential infrastructure** | **Highly vulnerable** | **More vulnerable** | **Less vulnerable** | **Water compatible** |
| **Zone 1** | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Zone 2** | ✓ | Exception Test required | ✓ | ✓ | ✓ |
| **Zone 3a †** | Exception Test required † | ✗ | Exception Test required | ✓ | ✓ |
| **Zone 3b *** | Exception Test required * | ✗ | ✗ | ✗ | ✓* |

Where:

✗ Development should not be permitted.

✓ Development is appropriate

6.3 The vulnerability classification is ‘Less Vulnerable’. Therefore, the proposed development is appropriate without an exception test.

## 7.0 FLUVIAL FLOODING (FLOODING FROM RIVERS AND THE SEA)

7.1 Fluvial flooding occurs when high flows exceed the capacity of the river channel and spill out onto the floodplain, usually after a period of prolonged or heavy rainfall.

7.2 The Environment Agency Flood Map (rivers and sea) shows that the majority of the development (including the existing building and proposed extension) is located in a low risk area, having an annual probability of river flooding less than 1 in 1000 (0.1%). This is shown in Figure 4 below. There is a small area towards the southwest of the site that is located in Flood Zone 2 and Flood Zone 3. The proposed extension to the car park will fall within this area.

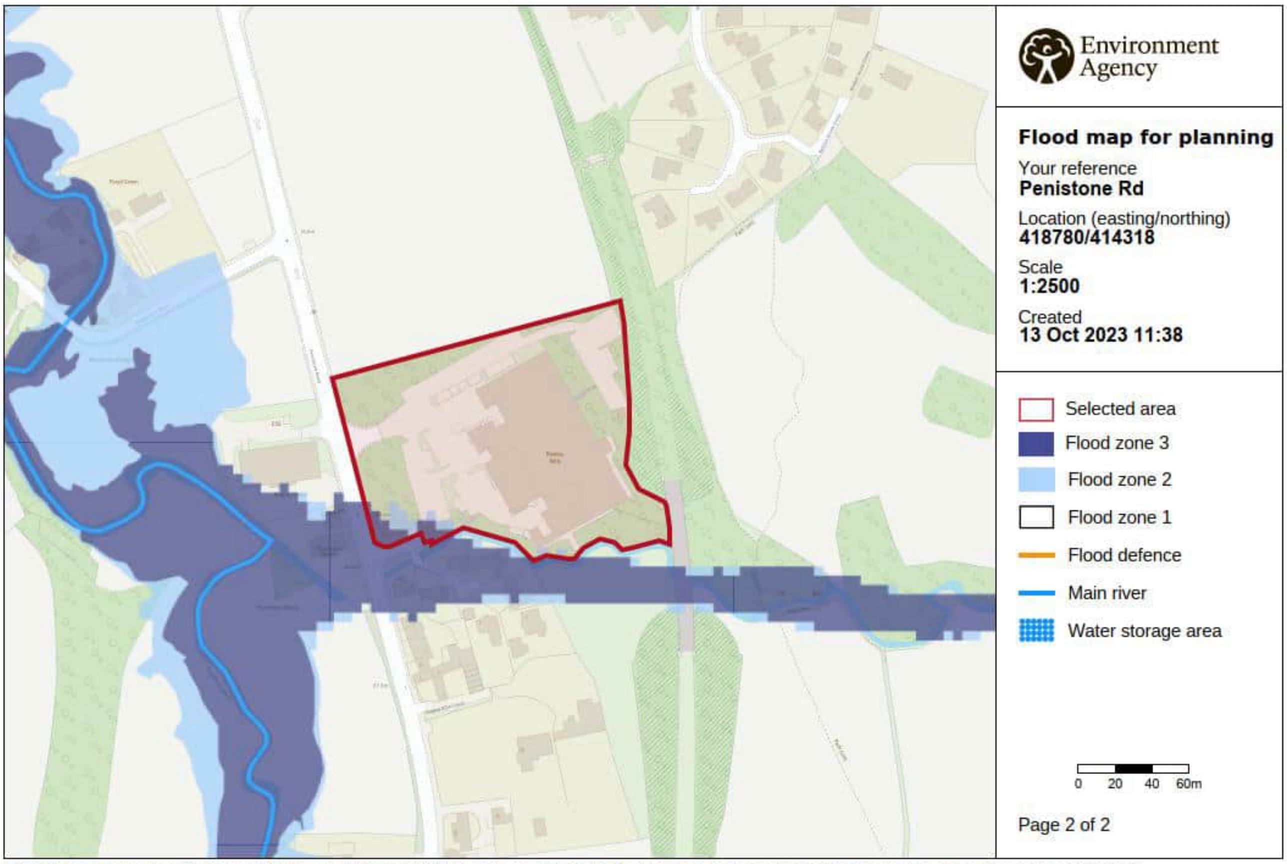





Figure 4: Fluvial Flood Risk Map

7.3 Flood risk assessment data has been provided by the Environment Agency, and is included in Appendix D. The data contains pertinent information from the 2007 Fenay Beck model. Node 9 from this model is closest to the site.

7.4 In accordance with latest guidance, a central climate change peak river flow allowance should be used for less vulnerable developments. The central peak river flow allowance for the Aire and Calder

Management Catchment up to the 2080s epoch is 23%. The data supplied by the EA includes a 1%AEP + 20% climate change estimated flood level, and hence this will be the design flood level for the site. The following table shows the estimated flood levels from this model. The lowest point within the proposed car park is 89.00mAOD.

Table 2: Flood Level Data

| Flood Scenario | Estimated Flood Level (mAOD) | Summary |
|---|---|---|
| 1% AEP | 84.72 | No flooding |
| 1% AEP +20% CC | 84.82 | No flooding |
| 0.1% AEP | 85.12 | No flooding |

7.5 The above table shows that the site is significantly higher than the estimated flood levels in the 1% AEP +20%CC scenario, and the 0.1%AEP. Therefore, the site is not at risk from fluvial flooding.

## 8.0 PLUVIAL FLOODING (FLOODING FROM SURFACE WATER)

8.1 The Environment Agency Flood Map showing Risk of Flooding from Surface Water is shown below. This type of flooding can be difficult to predict, much more so than river or sea flooding as it is hard to forecast exactly where or how much rain will fall in any storm.

8.2 The map below indicates that the site is not at risk from surface water flooding. However, the extension to the building and car parking areas will be designed so that finished floor levels are above surrounding ground levels, and additional drainage features will be constructed to ensure that localised flood risk is managed.

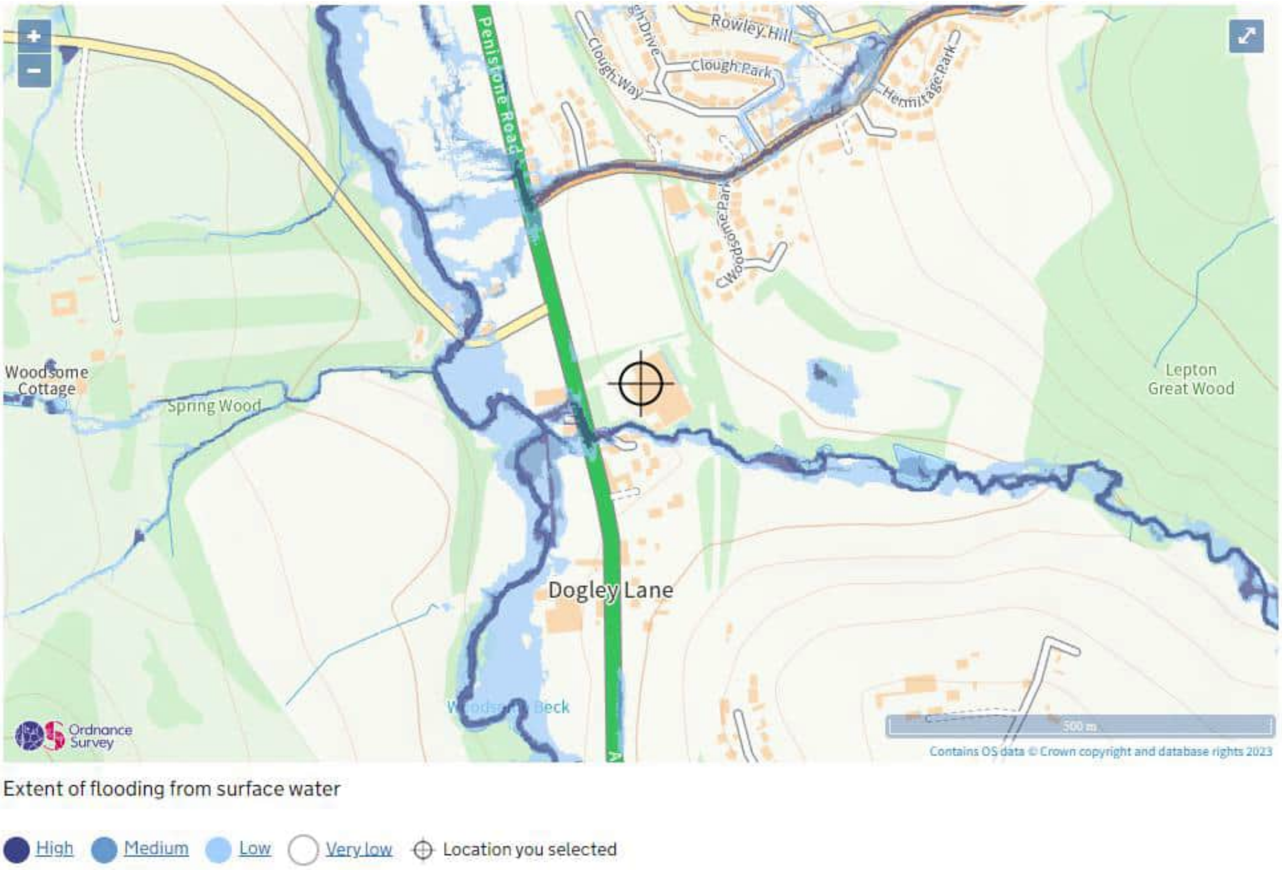



Figure 5: Pluvial Flood Risk Map

9.0 GROUNDWATER FLOODING

9.1 Groundwater flooding occurs when water levels in the ground rise above surface levels, which is more likely to occur in low lying areas.

9.2 Kirklees Council's Local Flood Risk Management Strategy includes a map of the groundwater flood risk across the region. This indicates the site has a moderate risk of groundwater flooding, please see below.

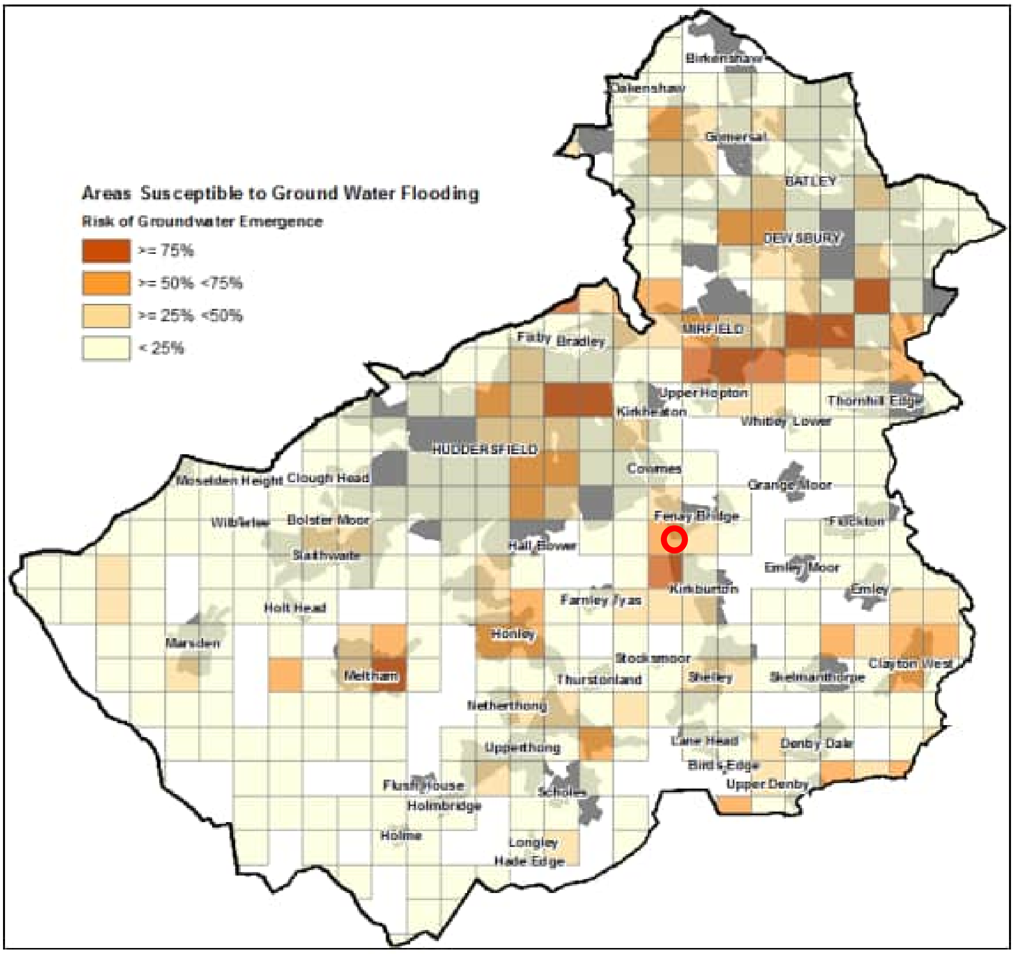



Figure 6: Groundwater Flood Risk Map

9.3 In order to reduce the risk of groundwater flooding, no additional infiltration techniques will be used on the site. As stated in Section 8, the building extension and parking facilities will be designed so that finished floor levels are above surrounding ground levels.

## 10.0 EXISTING SEWERS

10.1 Flooding caused by the existing sewer network occurs when the network is over capacity or there is a blockage in the system.

10.2 There are no sewers within the site; the closest sewers are within Penistone Road. As the site is significantly raised above Penistone Road, the risk of sewer flooding is considered low.

## 11.0 FLOODING FROM RESERVOIRS

11.1 Reservoir flooding is unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925 and even with recent events, measures are in place to monitor and protect reservoirs in event of an unlikely catastrophic event. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the Environment Agency ensure that reservoirs are inspected regularly, and essential safety work is carried out. However, in the unlikely event that a reservoir dam failed, a large volume of water would escape at once and flooding could happen with little or no warning.

11.2 The Environment Agency Map showing Risk of Flooding from Reservoirs is shown below. The site is not within an area at risk from reservoir flooding.

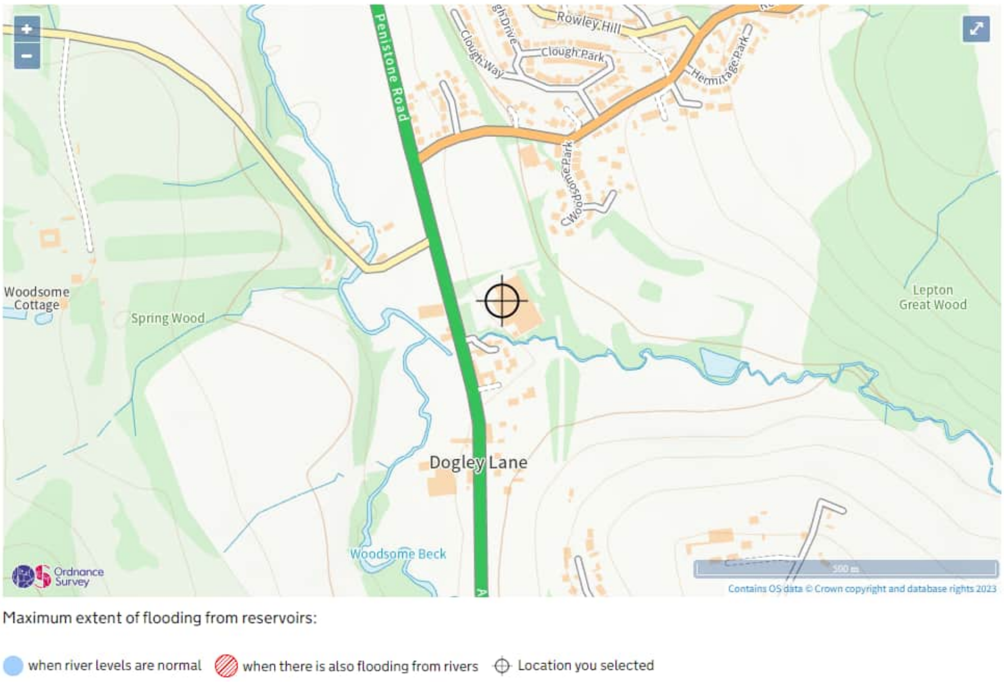



Figure 7: Reservoir Flood Risk Map

## 12.0 DRAINAGE ASSESSMENT

### SURFACE WATER DRAINAGE

12.1 A topographical survey and drainage survey show the existing drainage facilities within the site boundary, please see Appendix A. The surface water from the site has six separate outfalls to Beldon Brook.

12.2 In line with the Building Regulations, planning policy and the SuDS Manual, the hierarchy for surface water disposal has been followed in the design process.

12.3 The use of infiltration techniques was initially considered, however due to the risk of groundwater flooding, and the deep layers of impermeable clay underlying the site, infiltration is considered unviable for the development.

12.4 Discharge to a watercourse was then considered. As the site is immediately north of Beldon Brook, and there are existing discharges to the brook, this is the preferred option for surface water disposal.

12.5 The drainage survey in Appendix A shows that 1.022ha of impermeable area currently discharges to Beldon Brook via six separate outfalls. At 140l/s/ha, the brownfield runoff rate is 143l/s. A 30% reduction of the existing brownfield runoff rate would lead to a proposed discharge rate of 100l/s.

12.6 As part of the works, Outfalls 2-6 will be unaffected, except for some rationalisation of rainwater pipe locations, to be confirmed by the architect at detailed design stage. Hence a restricted discharge rate for Outfall 1 is proposed to deliver the brownfield betterment requirement for the whole site, with a total site discharge of 100l/s, please refer to Table 3 below.

Table 3: Impermeable Areas and Discharge Rates

| Outfall | Existing Impermeable Area (ha) | Existing Discharge Rate @ 140 l/s/ha (l/s) | Proposed Impermeable Area (ha) | Proposed Discharge Rate @ 140 l/s/ha (l/s) |
|---|---|---|---|---|
| 1 | 0.699 | 97.86 | 0.859 | 58.3 (restricted via a flow control device) |
| 2 | 0.086 | 12.04 | 0.058 | 8.12 |
| 3 | 0.008 | 1.12 | 0.008 | 1.12 |
| 4 | 0.132 | 18.48 | 0.144 | 20.16 |
| 5 | 0.050 | 7 | 0.050 | 7 |
| 6 | 0.047 | 6.58 | 0.038 | 5.32 |
| **Total** | **1.022** | **143.08** | **1.157** | **100.02** |

12.7 As the proposed discharge is to a watercourse, a surcharged outfall has been included in the design of the surface water drainage system.

12.8 The proposed impermeable area of the site is 1.157ha. In order to contain the 1 in 100 year + 45% climate change rainfall scenario within the site, with the proposed total site discharge rate of 100l/s, attenuation of 570m³ will be required. The 45% climate change allowance is the Aire and Calder Management Catchment peak rainfall upper end allowance for the 2070s epoch.

12.9 A geocellular attenuation tank will provide the required storage volume of 570m³.

12.10 The hydraulic calculations in Appendix D demonstrate there is no surface water flooding in the 1 in 30 year rainfall scenario, and that there is only minor surface water flooding in the 1 in 100 year + 45% climate change rainfall scenario, which will drain to channel drains and gullies and connect into the system downstream where pipes have sufficient capacity, or drain to landscaped areas.

12.11 The surface water from the car parking areas will pass through a Class 1 bypass separator, in line with pollution prevention for businesses guidance. The size of the separators has been calculated in line with the Building Regulations Appendix H3-A for the contributing impermeable area. A flow control manhole will be installed to restrict the discharge to Outfall 1 to 58.3l/s.

12.12 The bypass separator will also provide the required level of water treatment in line with Chapter 26 of the SuDS Manual. The site would be classified as a medium pollution risk from Table 26.2 of the SuDS

Manual. The following table shows the pollution hazard indices for the site, taken from Table 26.2, and the proposed mitigation indices, provided by the manufacturer of the bypass separator.

Table 4: Water Treatment Calculations

| Pollution Hazard Indices | | | | |
|---|---|---|---|---|
| **Land Use** | **Pollution Hazard Level** | **Total Suspended Solids (TSS)** | **Metals** | **Hydrocarbons** |
| Commercial yard and delivery area, non-residential car parking | Medium | 0.7 | 0.6 | 0.7 |
| **SuDS Mitigation Indices** | | | | |
| **Type of SuDS Component** | | **Total Suspended Solids (TSS)** | **Metals** | **Hydrocarbons** |
| SPEL ESR Stormceptor | | 0.8 | 0.6 | 0.9 |
| Are the Total SuDS Mitigation Indices greater than or equal to the Pollution Hazard Indices? | | Yes | Yes | Yes |

12.13 The existing surface water drainage system will be utilised as far as possible, however some of the existing pipes will need to be upsized in order to contain the 1 in 2 year storm event without surcharging of the pipes, and to contain the 1 in 30 year + 40% climate change storm event within the drainage system.

12.14 A drainage strategy drawing has been produced on the above basis and can be found in Appendix D.

### FOUL WATER DRAINAGE

12.15 The existing private foul water drainage system connects into the combined sewer in Penistone Road. However, the drainage survey identified the pipework is currently blocked and needs clearing, which will need to be done as part of the works. There are no changes proposed to the existing foul water system as part of the works.

## 13.0 FLOOD RISK MITIGATION MEASURES

13.1 As stated in Sections 8 and 9, the site is at risk from fluvial flooding and groundwater flooding. In order to mitigate these risks, the proposed warehouse will be raised above surrounding levels, there will be no additional infiltration techniques used on the site.

## 14.0 MAINTENANCE STRATEGY

14.1 Maintenance and suitable management of all drainage aspects is required to ensure that the systems are operating correctly to ensure water quality and effluent quality and subsequently reducing the risk of flooding on the site. The maintenance of the existing drainage facilities within the site boundary are the responsibility of the owner/occupier and must be undertaken by a competent contractor. The proposed resilience measures will need to be maintained in line with the manufacturer's requirements.

14.2 The maintenance of the drainage network is to be linked with the wider site maintenance. Required maintenance operations are as follows in accordance with the CIRIA SuDS Manual and relevant industry guidance documentation.

**Pipe Network/Flow Control**

| Operation | Frequency |
|---|---|
| Inspect and identify any areas that are not operating correctly, if required, take remedial actions. | Monthly for 3 months as a part of normal post completion monitoring, then biannually |
| Debris removal from manholes (where may cause risk performance) | Monthly |
| Where rainfall into network from above, check surface or filter for blockage or silt, algae or other matter by jetting | As required, but at least twice a year |
| Remove sediment from pipework by jetting. | Annually or as required |
| Repair/check all inlets, outlets and overflow pipes | As required |
| Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed | Annually and after large storms |

**Attenuation Tank**

| Operation | Frequency |
|---|---|
| Inspect and identify any areas that are not operating correctly, if required, take remedial actions | Monthly for 3 months, then six monthly |
| Debris removal from attenuation tank (where may cause risk performance) | Monthly |
| Remove sediment from upstream surface water network by jetting. | Annually or as required |
| Repair/check all inlets, outlets and overflow pipes | As required |
| Inspect/check all inlets, outlets, and overflow pipes to ensure that they are in good condition and operating as designed. | Annually and after large storms |

| | |
|---|---|
| Survey inside of tank for sediment build up and remove if necessary. | Every 5 years. |

14.3 The bypass separator should be maintained in line with the manufacturer's guidance.

14.4 A log of all maintenance activities is to be kept and made available to the LPA and / or the LLFA on request.

## 15.0 CONCLUSION AND RECOMMENDATIONS

15.1 The majority of the site is in Flood Zone 1 and has a low risk of fluvial flooding. The site has a moderate risk of groundwater flooding.

15.2 The flood risk assessment data supplied by the EA shows that the areas of the site within Flood Zones 2 and 3 are not at risk of flooding in the design flood event.

15.3 The extension to the mill building and associated parking facilities will be designed so that finished floor levels are above surrounding ground levels to ensure that localised flood risk is managed. The proposals have been designed to minimise the risk of groundwater flooding.

15.4 The surface water drainage system has been designed in accordance with planning policy, building regulations, and industry guidance and will discharge to Beldon Brook, utilising the existing connections, at a restricted rate of 100l/s, via a flow control device. This offers a 30% reduction on the existing calculated discharge from the site.

15.5 The proposed development is wholly suitable for the proposed site on the basis of national and local planning policy and will not have any implications on neighbouring properties in terms of flood risk.

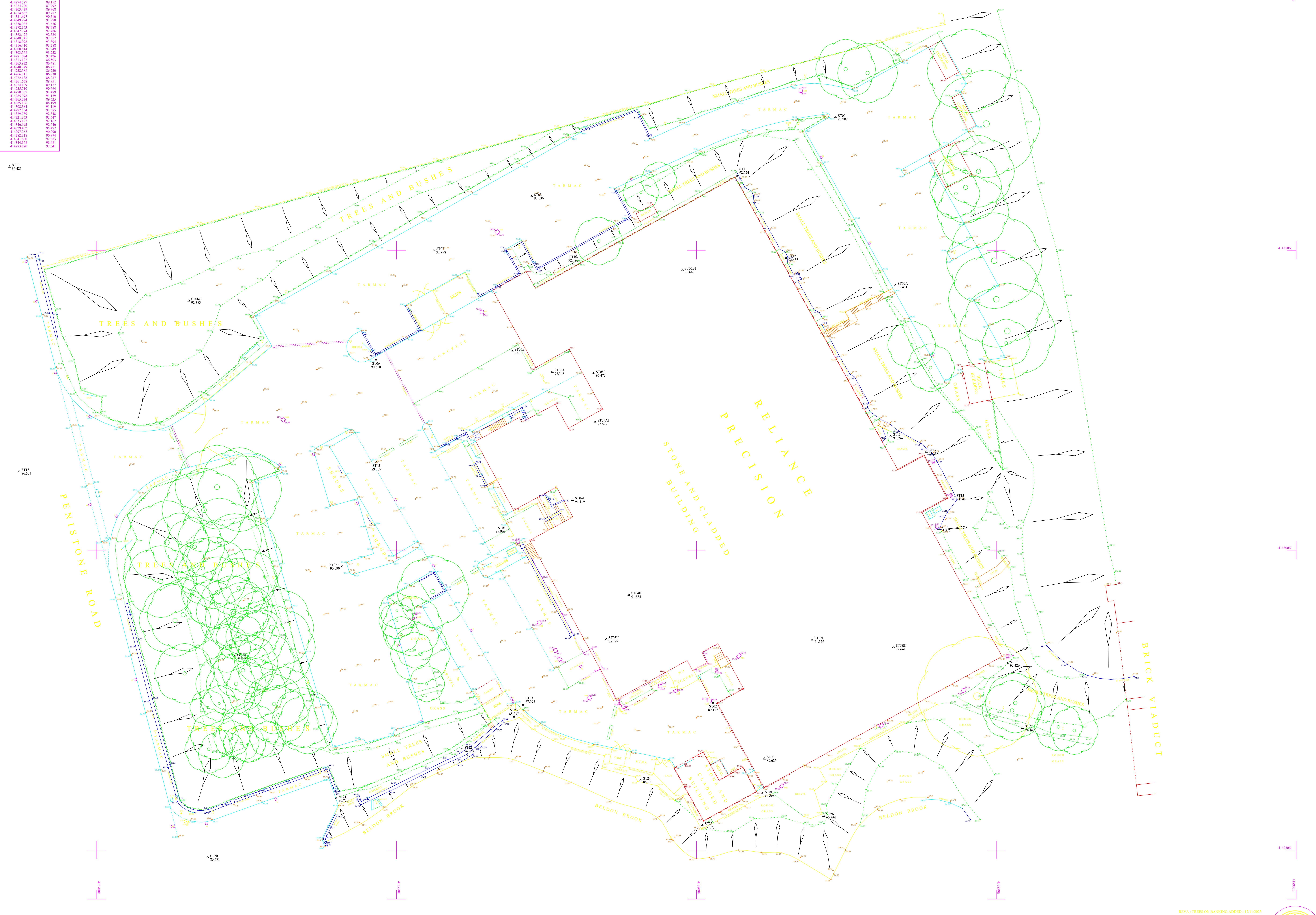
REDACTED

**Jonathan Allchin IEng MICE**

On behalf of Dudleys Consulting Engineers

## APPENDIX A – TOPOGRAPHICAL SURVEY & DRAINAGE SURVEY

| Station | Easting | Northing | Level |
|---|---|---|---|
| ST01 | 418810.998 | 414259.413 | 90.368 |
| ST02 | 418802.760 | 414274.527 | 89.152 |
| ST03 | 418771.081 | 414274.220 | 87.992 |
| ST04 | 418768.565 | 414303.439 | 89.968 |
| ST05 | 418746.622 | 414314.662 | 89.787 |
| ST06 | 418746.569 | 414331.697 | 90.510 |
| ST07 | 418756.223 | 414349.974 | 91.998 |
| ST08 | 418772.520 | 414358.985 | 93.636 |
| ST09 | 418823.179 | 414372.163 | 98.788 |
| ST10 | 418779.454 | 414347.774 | 92.486 |
| ST11 | 418806.746 | 414362.428 | 92.524 |
| ST12 | 418814.923 | 414348.745 | 92.657 |
| ST13 | 418832.389 | 414318.998 | 93.394 |
| ST14 | 418838.321 | 414316.410 | 93.288 |
| ST15 | 418842.950 | 414308.814 | 93.249 |
| ST16 | 418840.344 | 414303.568 | 93.252 |
| ST17 | 418851.879 | 414281.094 | 92.426 |
| ST18 | 418687.071 | 414313.122 | 86.503 |
| ST19 | 418685.463 | 414363.932 | 86.481 |
| ST20 | 418718.518 | 414248.749 | 86.471 |
| ST21 | 418739.951 | 414258.588 | 86.720 |
| ST22 | 418760.902 | 414266.811 | 86.938 |
| ST23 | 418769.574 | 414272.188 | 88.037 |
| ST24 | 418790.712 | 414261.658 | 88.951 |
| ST25 | 418800.992 | 414254.109 | 89.177 |
| ST26 | 418821.219 | 414255.710 | 90.664 |
| ST27 | 418854.371 | 414270.367 | 91.489 |
| ST02I | 418819.263 | 414285.078 | 91.159 |
| ST03I | 418811.319 | 414265.234 | 89.625 |
| ST03II | 418784.967 | 414285.126 | 88.199 |
| ST04I | 418779.363 | 414308.384 | 91.119 |
| ST04II | 418788.737 | 414292.554 | 91.585 |
| ST05A | 418775.949 | 414329.739 | 92.348 |
| ST05AI | 418783.101 | 414321.363 | 92.647 |
| ST05B | 418769.276 | 414333.192 | 92.162 |
| ST05BI | 418797.647 | 414346.693 | 92.646 |
| ST05I | 418782.834 | 414329.452 | 95.472 |
| ST06A | 418740.943 | 414297.267 | 90.090 |
| ST06B | 418722.919 | 414282.318 | 90.894 |
| ST06C | 418715.357 | 414341.600 | 92.383 |
| ST09A | 418833.149 | 414344.168 | 98.481 |
| ST5BII | 418832.840 | 414283.820 | 92.641 |




REVA : TREES ON BANKING ADDED - 17/11/2023

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LOCATION
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THE COORDINATE SYSTEM USED FOR THE PRIMARY CONTROL IS OSGB36(15)
GRID CENTRE POINT : ST06

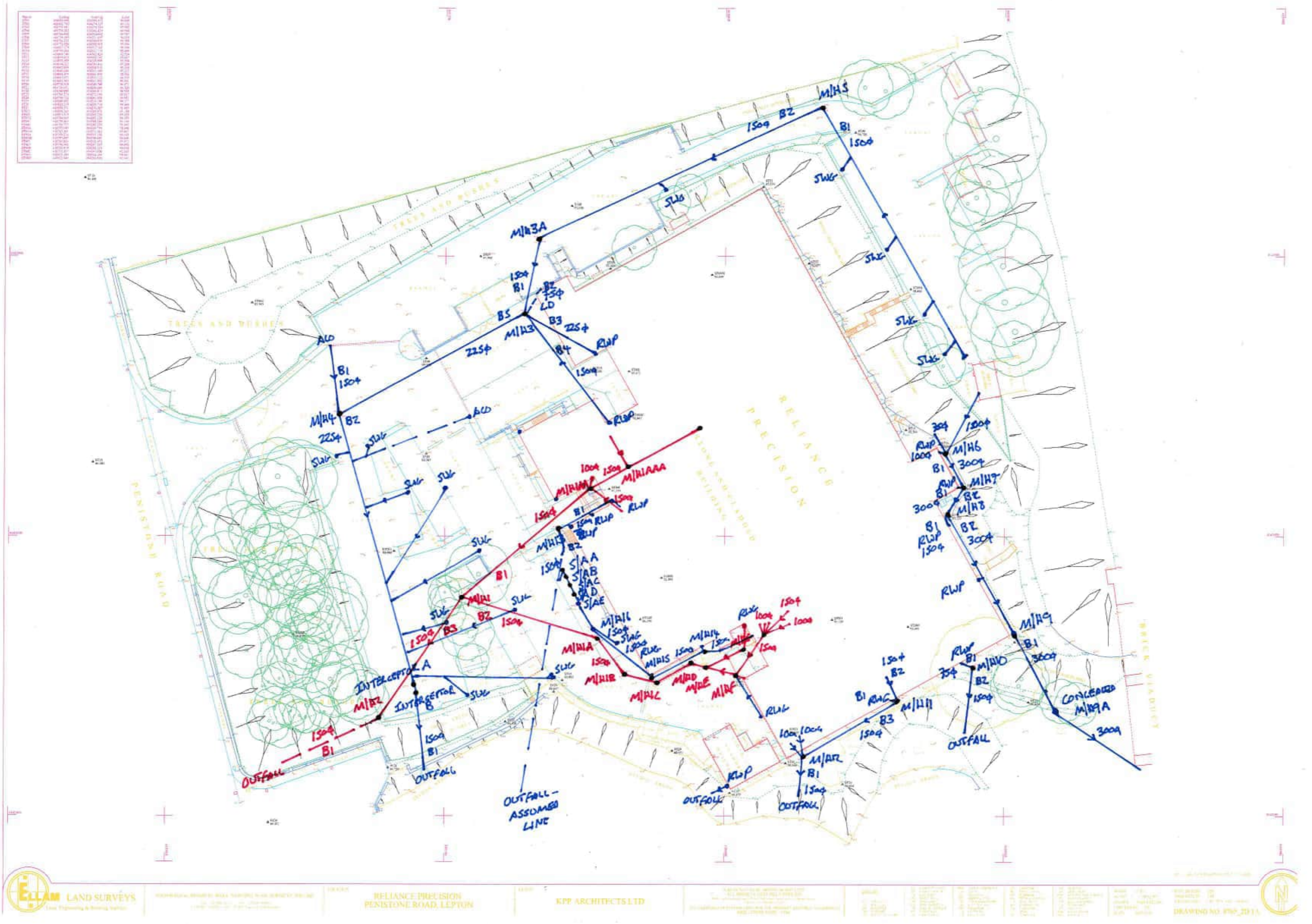
LEGEND

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AV | AIR VALVE | CC | CONCRETE COVER | FWS | FOUL WATER SEWER | LP | LAMP POST | ST | STOP TAP |
| B | BOLLARD | CM | CABLE MARKER | G | GULLY | MC | METAL COVER | SV | STOP VALVE |
| BH | BOREHOLE | CP | CATCH PIT | GV | GAS VALVE | MH | MANHOLE | SWS | SURFACE WATER SEWER |
| BS | BUS STOP | CTV | CABLE TV I.C | HV | HIGH VOLTAGE | MV | MEDIUM VOLTAGE | TL | TRAFFIC LIGHTS |
| BT | BRITISH TELECOM | DP | DOWN PIPE | IC | INSPECTION COVER | P | POST / POLE | TP | TELEGRAPH POLE |
| | | ECP | ELEC. CABLE PIT | JB | JUNCTION BOX | RE | RODDING EYE | TH | THRESHOLD |
| | | EP | ELEC. POLE/PYLON | KW | KERB WEIR | RS | ROAD SIGN | VP | VENT PIPE |
| | | ER | EARTH ROD | LB | LITTER BIN | S | STAY | WM | WATER METER |
| | | FH | FIRE HYDRANT | LH | LAMP HOLE | SC | STOP COCK | WO | WASH OUT |

SHEET 1 OF ?
SCALE 1 : 200 @ A0
DRAWN STEVE ELLAM
CHECKED BY NS
DATE NOV 2023

LEVEL DATUM GPS
GRID DATUM GPS
DATUM USED GPS : ST06 Value : 90.510m.

DRAWING NO. 8765_2D/1A



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RELIANCE PRECISION
PENISTONE ROAD, LEPTON
KPP ARCHITECTS LTD
PENISTONE ROAD
TREES AND BUSHES
RELIANCE PRECISION
M/H5
B2
150ø
B1
SWG
M/H3A
B5
M/H3
B3
225ø
RWP
B4
ACO
M/H4
LD
SWG
M/H1AAA
M/H1AA
M/H1
M/H1A
M/H1B
M/H1C
M/H1D
M/H1E
M/H1F
M/H1Z
M/H2
M/H6
M/H7
M/H8
M/H9
M/H9A
CONCEALED
M/H10
M/H11
M/H12
M/H14
M/H15
M/H16
S/AA
S/AB
S/AC
S/AD
S/AE
300ø
100ø
INTERCEPTOR A
INTERCEPTOR B
OUTFALL
OUTFALL - ASSUMED LINE

## APPENDIX B – PROPOSED ARCHITECT'S LAYOUT

Notes:

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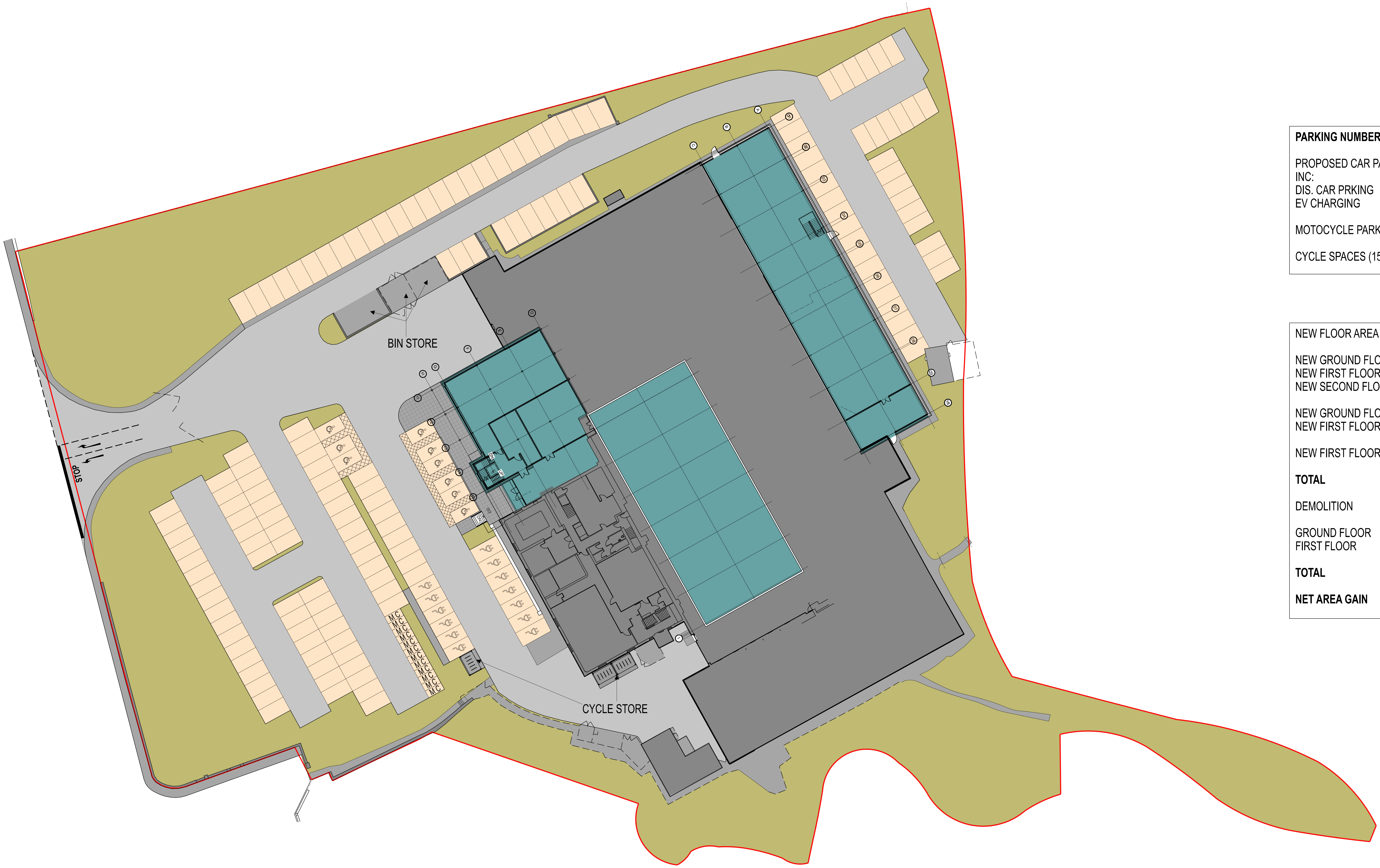
Do not scale from this drawing. Any descrepancies on site should be brought to the attention of KPP Architects Ltd.

Work and materials must comply with the current building regulations and codes of practice and be read in conjunction with building specifications and other sub-contractors information. All materials are to be installed in strict accordance with the recommendations of the manufacturers.




| PARKING NUMBERS | |
|---|---|
| PROPOSED CAR PARKING INC: | 170No. |
| DIS. CAR PRKING | 9No. |
| EV CHARGING | 13No. |
| MOTOCYCLE PARKING | 12No. |
| CYCLE SPACES (15 HOOPS) | 30 (SPACES) |

| NEW FLOOR AREA | |
|---|---|
| NEW GROUND FLOOR EXTENSION | 4,300 SQ.FT. |
| NEW FIRST FLOOR EXTENSION | 4,300 SQ.FT. |
| NEW SECOND FLOOR EXTENSION | 3,500 SQ.FT. |
| NEW GROUND FLOOR REAR EXTENSION | 7,000 SQ.FT. |
| NEW FIRST FLOOR REAR EXTENSION | 7,000 SQ.FT. |
| NEW FIRST FLOOR CENTRAL EXPANSION | 8,200 SQ.FT. |
| **TOTAL** | **34,200 SQ.FT.** |
| DEMOLITION | |
| GROUND FLOOR | 2,400 SQ.FT. |
| FIRST FLOOR | 1,000 SQ.FT. |
| **TOTAL** | **3,400 SQ.FT.** |
| **NET AREA GAIN** | **30,900 SQ.FT.** |

| Rev | Description | By | Chkd | Date |
|---|---|---|---|---|
| . | . | . | . | . |

Client

**RELIANCE PRECISION LIMITED**

Project Title

**ROWLEY MILLS**

Drawing Title

**PROPOSED PARKING LAYOUT**

KPP ARCHITECTS

Lodge House
12 Town Street
Horsforth, Leeds LS184RJ
T : +44 (0) 113 2390460
E : architects@kpp-leeds.co.uk
W : www.kpp-leeds.co.uk

| Scale | Size | Date | Drawn | Checked |
|---|---|---|---|---|
| 1:500 | A2 | JUNE '23 | AB | . |

Status

**SCHEME**

| KPP Job No | Rev |
|---|---|
| **2421** | . |

Number

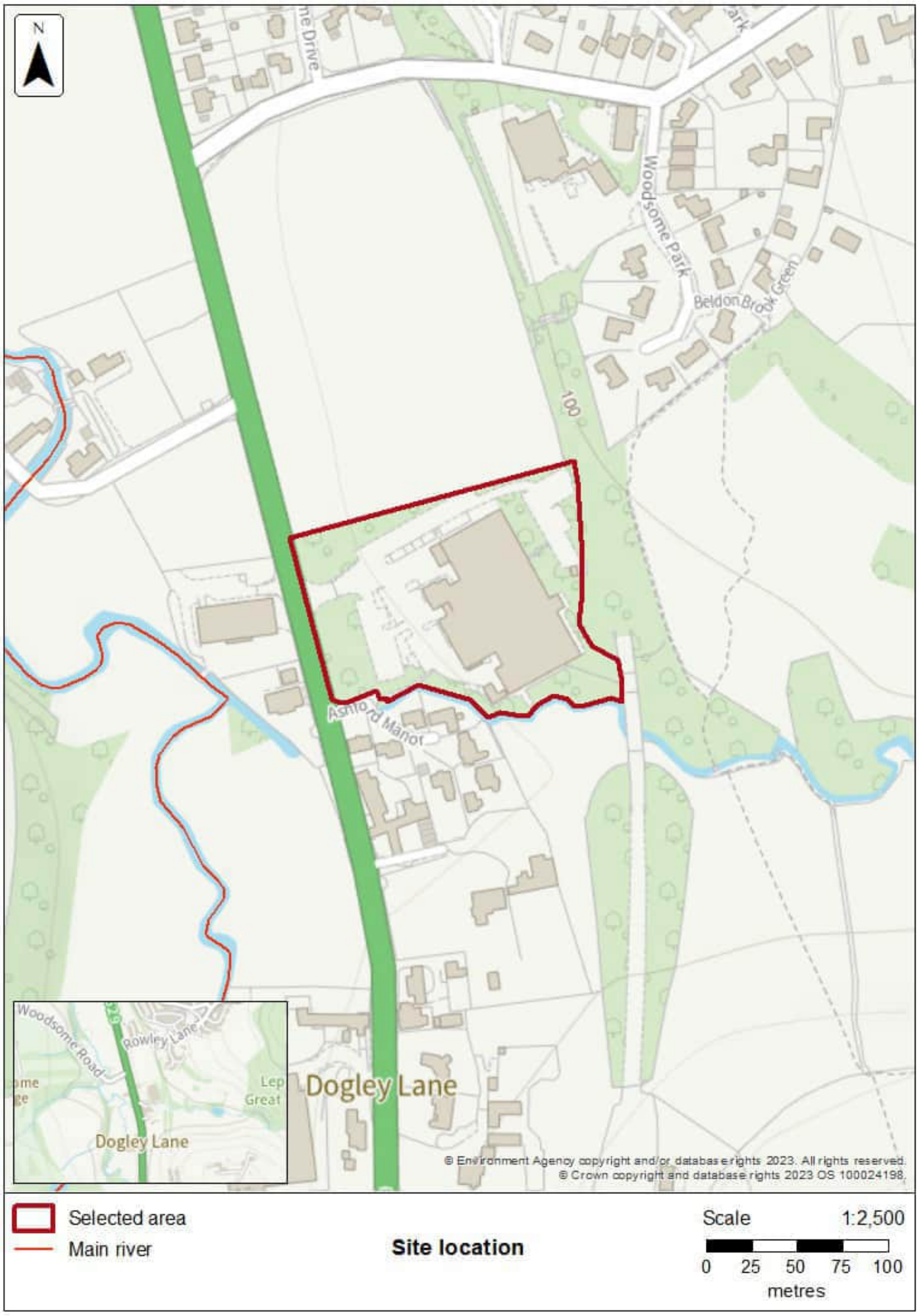
**2004**

## APPENDIX C – ENVIRONMENT AGENCY FLOOD RISK ASSESSMENT DATA

# Flood risk assessment data

**Location of site:** 418782 / 414313 (shown as easting and northing coordinates)
**Document created on:** 13 October 2023
**This information was previously known as a product 4.**
**Customer reference number:** KC7411X4VAGK

Map showing the location that flood risk assessment data has been requested for.



## How to use this information

You can use this information as part of a flood risk assessment for a planning application. To do this, you should include it in the appendix of your flood risk assessment.

**We recommend that you work with a flood risk consultant to get your flood risk assessment.**

## Included in this document

In this document you'll find:

- how to find information about surface water and other sources of flooding
- information on the models used
- definitions for the terminology used throughout
- flood map for planning (rivers and the sea)
- modelled data
- climate change modelled data
- information about strategic flood risk assessments
- information about this data
- information about flood risk activity permits
- help and advice

## Not included in this document

This document does not include a Flood Defence Breach Hazard Map.

If your location has a reduced flood risk from rivers and sea because of defences, you need to request a Flood Defence Breach Hazard Map and information about the level of flood protection offered at your location from the Yorkshire Environment Agency team at neyorkshire@environment-agency.gov.uk. This information will only be available if modelling has been carried out for breach scenarios.

Include a site location map in your request.

## Information that's unavailable

This document **does not** contain:

- historic flooding
- flood defences and attributes

We do not have historic flooding data for this location.

Please note that:

- flooding may have occurred that we do not have records for
- flooding can come from a range of different sources
- we can only supply flood risk data relating to floodng from rivers or the sea

You can contact your Lead Local Flood Authority or Internal Drainage Board to see if they have other relevant local flood information. Please note that some areas do not have an Internal Drainage Board.

We aren't able to display flood defence locations and attributes as there are no formal flood defences in the area of interest.

## Surface water and other sources of flooding

Use the long term flood risk service to find out about the risk of flooding from:

- surface water
- ordinary watercourses
- reservoirs

For information about sewer flooding, contact the relevant water company for the area.

## About the models used

Model name: 2007 Fenay Beck
Scenario(s): Defences removed fluvial, defences removed climate change fluvial
Date: 1 August 2007

This model contains the most relevant data for your area of interest.

## Terminology used

### Annual exceedance probability (AEP)

This refers to the probability of a flood event occurring in any year. The probability is expressed as a percentage. For example, a large flood which is calculated to have a 1% chance of occuring in any one year, is described as 1% AEP.

### Metres above ordnance datum (mAOD)

All flood levels are given in metres above ordnance datum which is defined as the mean sea level at Newlyn, Cornwall.

## Flood map for planning (rivers and the sea)

Your selected location is in flood zone 3.

Flood zone 3 shows the area at risk of flooding for an undefended flood event with a:

- 0.5% or greater probability of occurring in any year for flooding from the sea
- 1% or greater probability of occurring in any year for fluvial (river) flooding

Flood zone 2 shows the area at risk of flooding for an undefended flood event with:

- between a 0.1% and 0.5% probability of occurring in any year for flooding from the sea
- between a 0.1% and 1% probability of occurring in any year for fluvial (river) flooding

It's important to remember that the flood zones on this map:

- refer to the land at risk of flooding and do not refer to individual properties
- refer to the probability of river and sea flooding, ignoring the presence of defences
- do not take into account potential impacts of climate change

This data is updated on a quarterly basis as better data becomes available.

Environment Agency

**Flood map for planning**

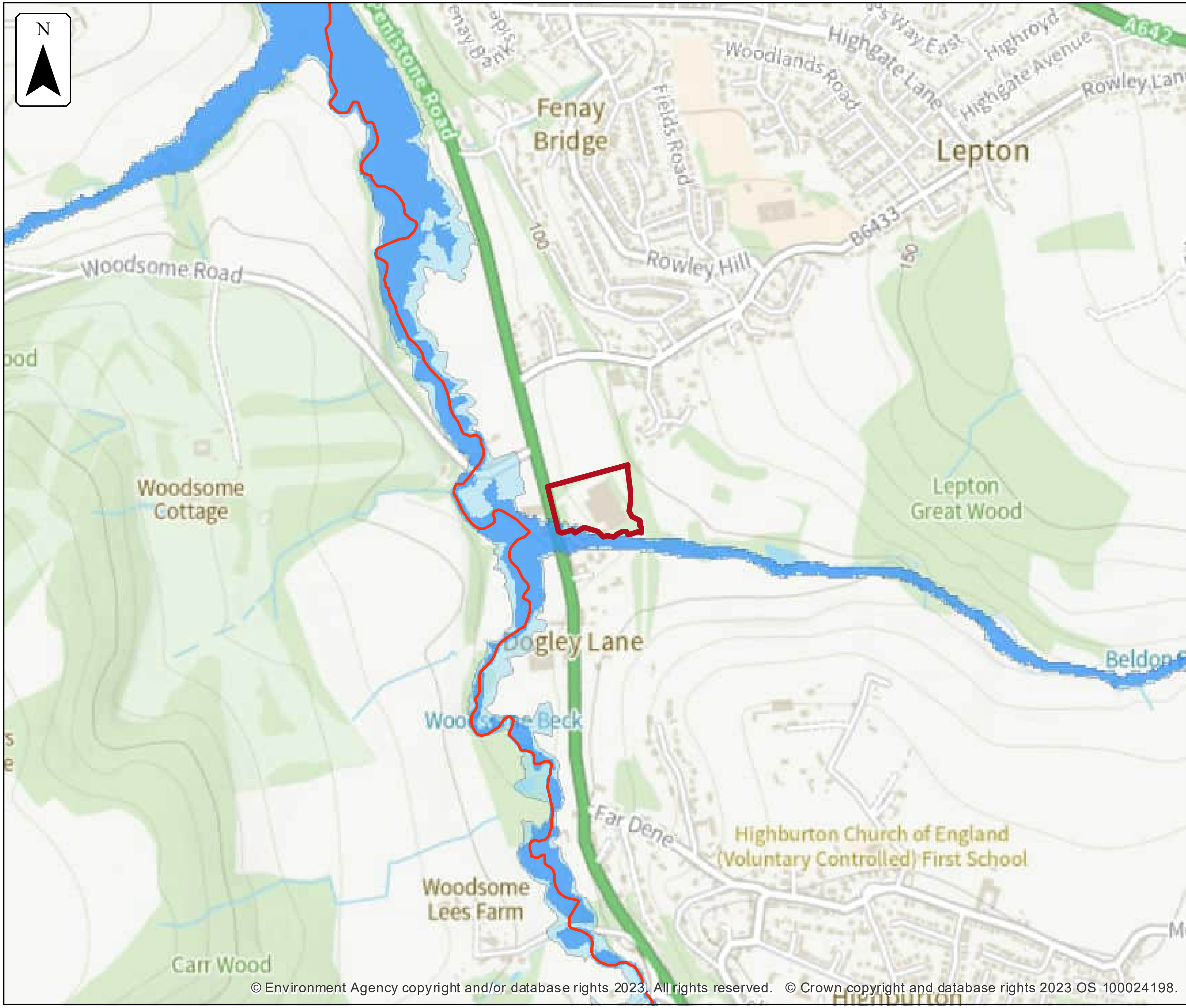
Location (easting/northing)
**418782/414313**

Scale
**1:10,000**

Created
**13 Oct 2023**

- Selected area
- Main river
- Flood zone 3
- Flood zone 2

0 100 200 300 400 500
metres



# Modelled data

This section provides details of different scenarios we have modelled and includes the following (where available):

- outline maps showing the area at risk from flooding in different modelled scenarios
- modelled node point map(s) showing the points used to get the data to model the scenarios and table(s) providing details of the flood risk for different return periods

## Climate change

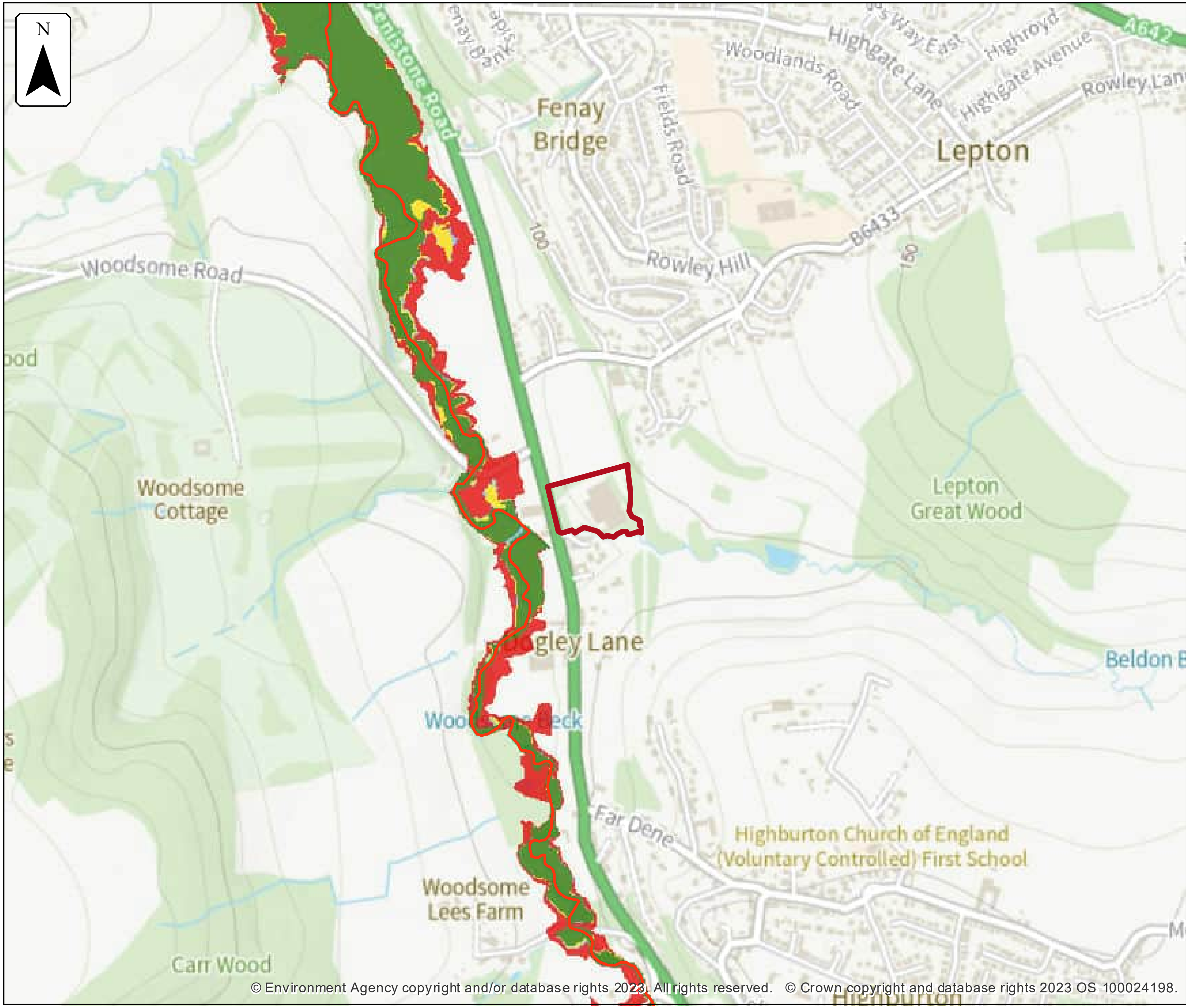
The climate change data included in the models may not include the latest flood risk assessment climate change allowances. Where the new allowances are not available you will need to consider this data and factor in the new allowances to demonstrate the development will be safe from flooding.

The Environment Agency will incorporate the new allowances into future modelling studies. For now, it's your responsibility to demonstrate that new developments will be safe in flood risk terms for their lifetime.

## Modelled scenarios

The following scenarios are included:

- Defences removed modelled fluvial: risk of flooding from rivers where flood defences have been removed
- Defences removed climate change modelled fluvial: risk of flooding from rivers where flood defences have been removed, including estimated impact of climate change





Environment Agency

## Defences removed modelled fluvial extent

Location (easting/northing)
**418782/414313**

Scale **1:10,000**

Created **13 Oct 2023**

Model name
**2007 Fenay Beck**

Selected area

Main river

Modelled flood extent

2% AEP

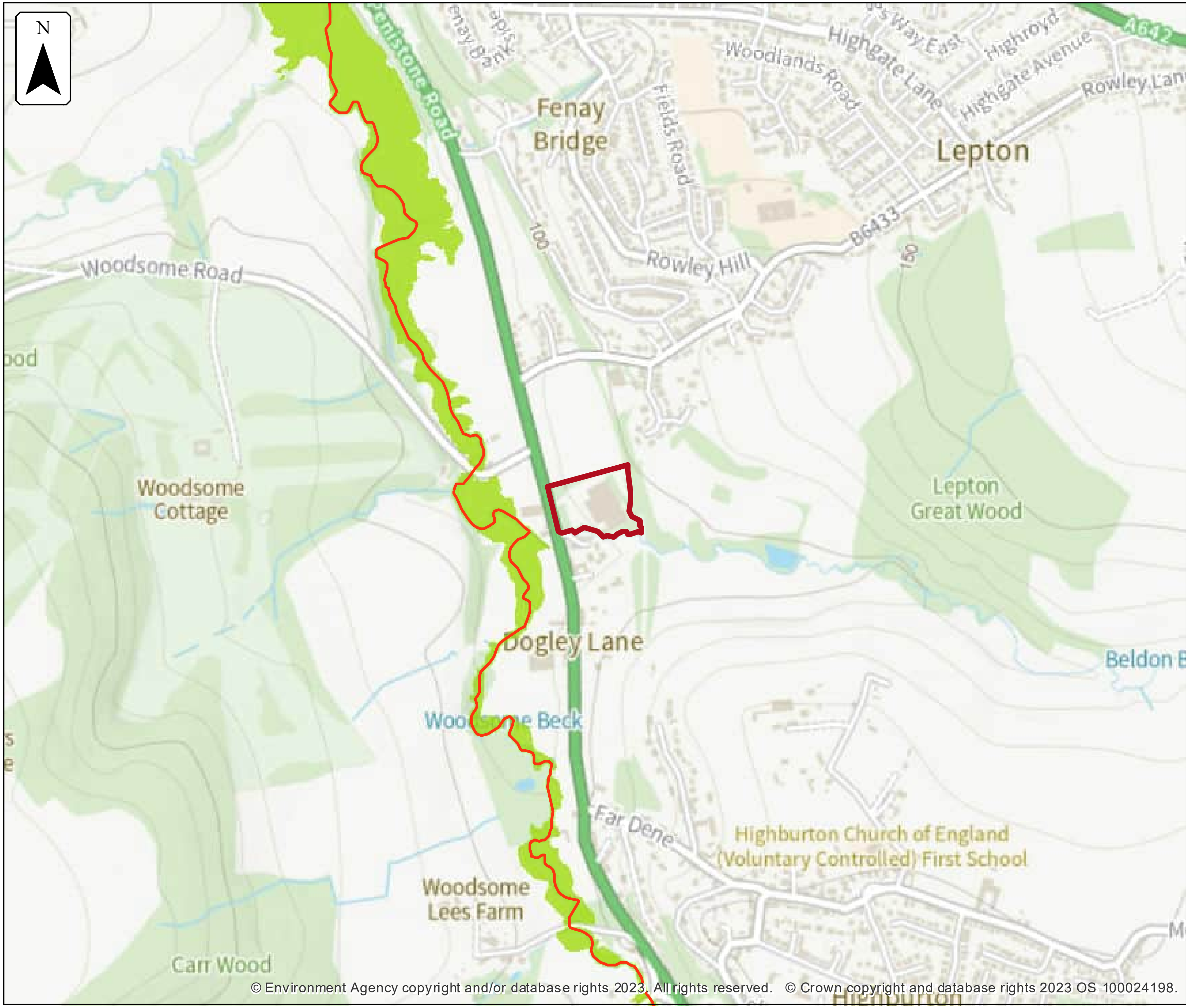
1.33% AEP

1% AEP

0.1% AEP

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500
metres




Environment Agency

## Defences removed climate change modelled fluvial extent

Location (easting/northing)
**418782/414313**

Scale **1:10,000**

Created **13 Oct 2023**

Model name
**2007 Fenay Beck**

Selected area

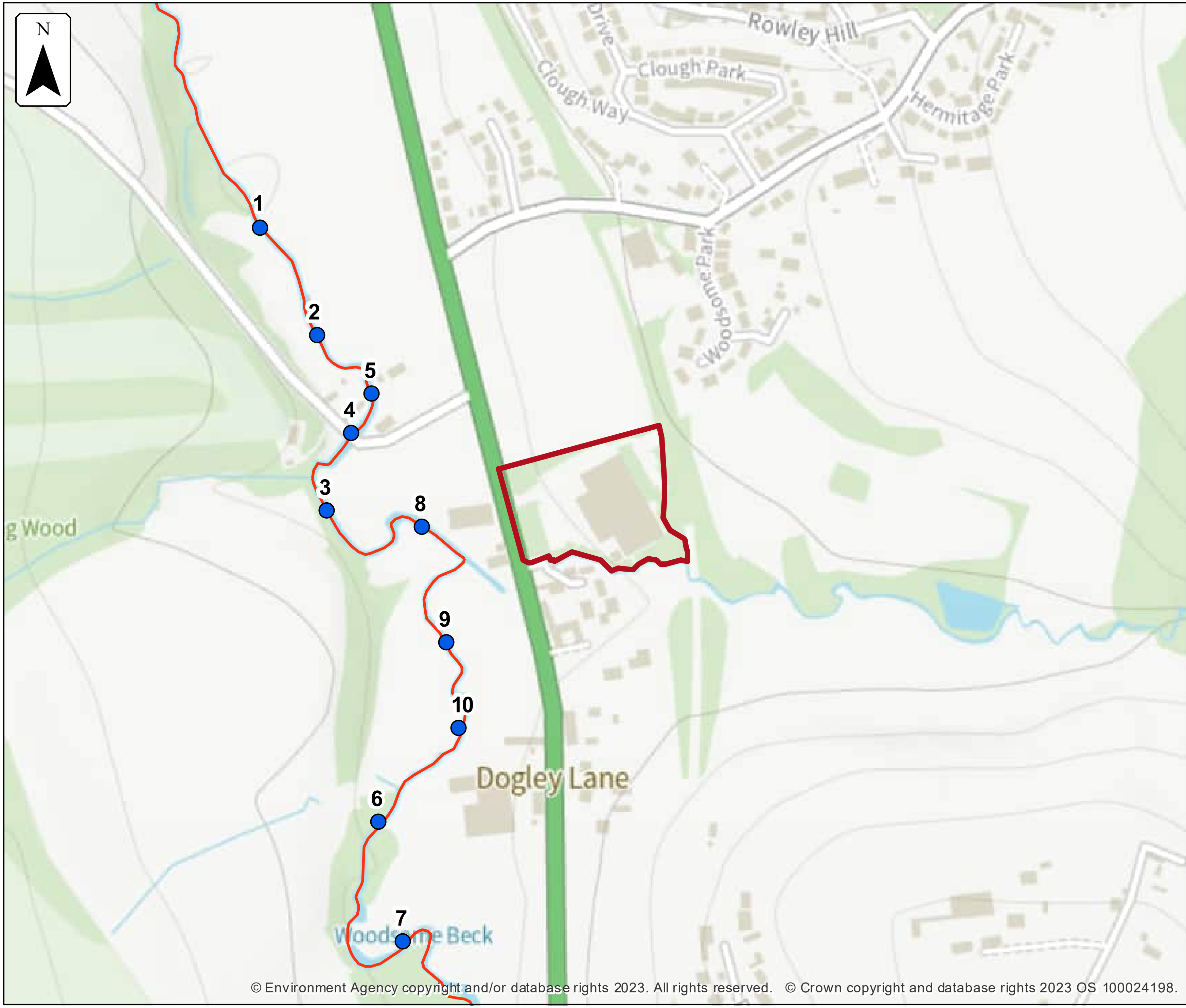
Main river

Modelled flood extent

1.0% AEP (+20%)

Flood extents may not be visible where they overlap other return periods

0 100 200 300 400 500 metres





Environment Agency

**Defences removed modelled fluvial node locations**

Location (easting/northing)
**418782/414313**

Scale
**1:5,000**

Created
**13 Oct 2023**

Model name
**2007 Fenay Beck**

Selected area
Modelled location
Main river

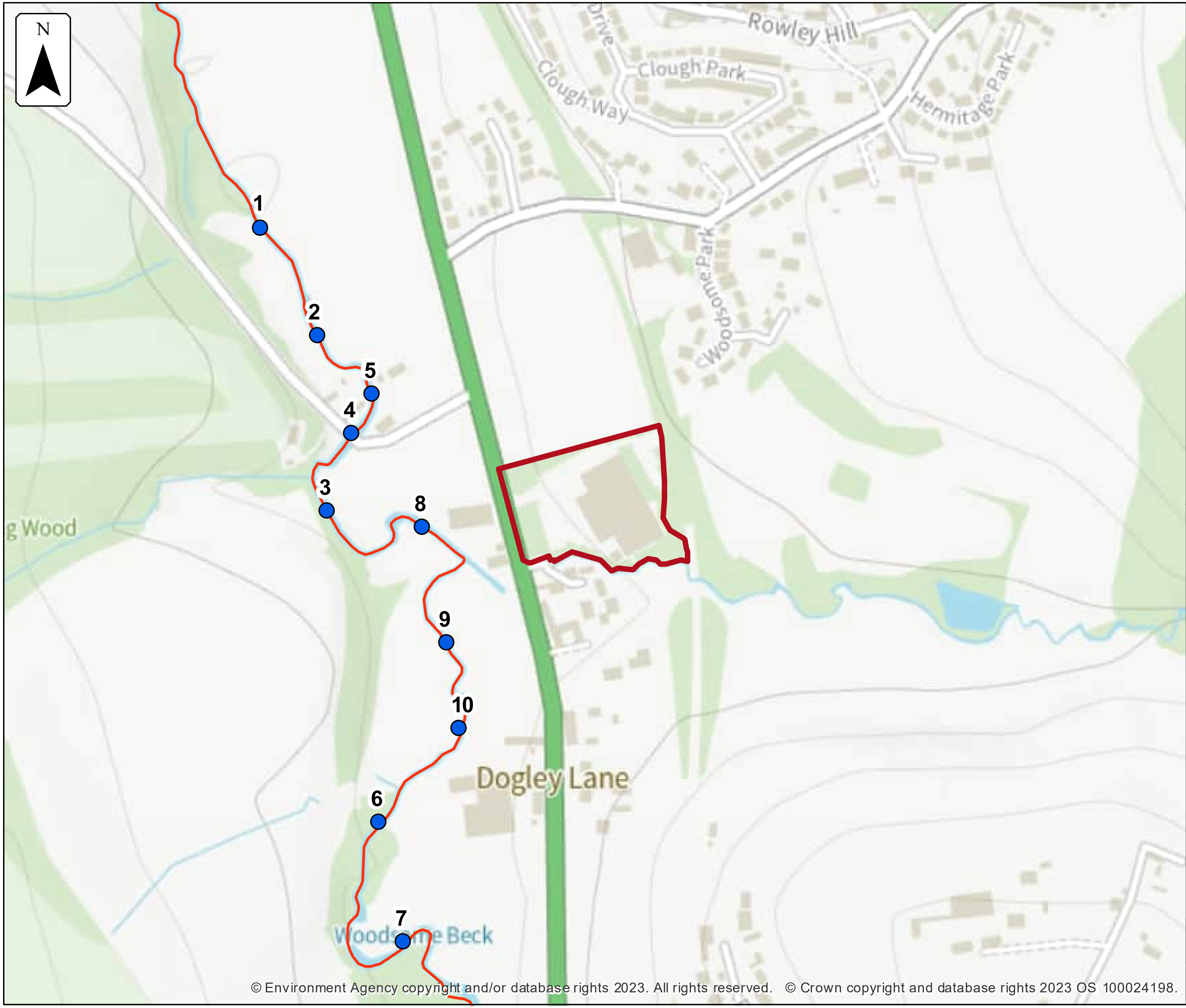
0 50 100 150 200 250
metres

# Modelled node locations data

## Defences removed

| Label | Modelled location ID | Easting | Northing | 4% AEP | | 2% AEP | | 1.33% AEP | | 1% AEP | | 0.5% AEP | | 0.1% AEP | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Level | Flow | Level | Flow | Level | Flow | Level | Flow | Level | Flow | Level | Flow |
| 1 | 969336 | 418457 | 414581 | 80.20 | 31.86 | 80.34 | 38.49 | 80.44 | 43.78 | 80.48 | 46.47 | | | 81.01 | 88.75 |
| 2 | 969359 | 418511 | 414476 | 80.88 | 31.86 | 81.04 | 38.49 | 81.14 | 43.76 | 81.19 | 46.47 | | | 81.67 | 88.78 |
| 3 | 969325 | 418522 | 414306 | 82.56 | 31.87 | 82.78 | 38.50 | 82.98 | 44.73 | 83.02 | 46.48 | | | 84.08 | 88.82 |
| 4 | 969362 | 418545 | 414382 | 81.86 | 31.87 | 82.07 | 38.50 | 82.24 | 44.35 | 82.31 | 46.47 | | | 83.69 | 88.79 |
| 5 | 969316 | 418564 | 414419 | 81.49 | 31.87 | 81.64 | 38.49 | 81.74 | 44.19 | 81.78 | 46.47 | | | 82.35 | 88.79 |
| 6 | 969364 | 418572 | 414002 | 85.93 | 19.38 | 86.08 | 23.35 | 86.17 | 26.01 | 86.23 | 28.08 | | | 86.72 | 53.62 |
| 7 | 969358 | 418596 | 413886 | 87.46 | 19.38 | 87.67 | 23.96 | 87.77 | 26.01 | 87.84 | 28.08 | | | 88.27 | 53.64 |
| 8 | 969363 | 418615 | 414290 | 83.56 | 31.87 | 83.71 | 38.51 | 83.78 | 43.04 | 83.82 | 46.49 | | | 84.35 | 89.06 |
| 9 | 969379 | 418638 | 414178 | 84.54 | 31.88 | 84.63 | 38.52 | 84.68 | 42.99 | 84.72 | 46.50 | | | 85.12 | 89.17 |
| 10 | 969315 | 418649 | 414094 | 84.93 | 19.38 | 85.03 | 23.34 | 85.09 | 26.02 | 85.14 | 28.08 | | | 85.52 | 53.62 |

Data in this table comes from the 2007 Fenay Beck model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.





Environment Agency

**Defences removed climate change modelled fluvial node locations**

Location (easting/northing)
**418782/414313**

Scale
**1:5,000**

Created
**13 Oct 2023**

Model name
**2007 Fenay Beck**

Selected area
Modelled location
Main river

0 50 100 150 200 250
metres

# Modelled node locations data

## Defences removed climate change

| Label | Modelled location ID | Easting | Northing | 1.0% AEP (+20%) | |
|---|---|---|---|---|---|
| | | | | Level | Flow |
| 1 | 969336 | 418457 | 414581 | 80.63 | 55.78 |
| 2 | 969359 | 418511 | 414476 | 81.33 | 55.79 |
| 3 | 969325 | 418522 | 414306 | 83.19 | 55.80 |
| 4 | 969362 | 418545 | 414382 | 82.57 | 55.80 |
| 5 | 969316 | 418564 | 414419 | 81.92 | 55.80 |
| 6 | 969364 | 418572 | 414002 | 86.36 | 33.73 |
| 7 | 969358 | 418596 | 413886 | 88.0 | 33.73 |
| 8 | 969363 | 418615 | 414290 | 83.92 | 55.84 |
| 9 | 969379 | 418638 | 414178 | 84.82 | 55.84 |
| 10 | 969315 | 418649 | 414094 | 85.24 | 33.73 |

Data in this table comes from the 2007 Fenay Beck model.
Level values are shown in mAOD, and flow values are shown in cubic metres per second.
Any blank cells show where a particular scenario has not been modelled for this location.

## Strategic flood risk assessments

We recommend that you check the relevant local authority's strategic flood risk assessment (SFRA) as part of your work to prepare a site specific flood risk assessment.

This should give you information about:

- the potential impacts of climate change in this catchment
- areas defined as functional floodplain
- flooding from other sources, such as surface water, ground water and reservoirs

## About this data

This data has been generated by strategic scale flood models and is not intended for use at the individual property scale. If you're intending to use this data as part of a flood risk assessment, please include an appropriate modelling tolerance as part of your assessment. The Environment Agency regularly updates its modelling. We recommend that you check the data provided is the most recent, before submitting your flood risk assessment.

## Flood risk activity permits

Under the Environmental Permitting (England and Wales) Regulations 2016 some developments may require an environmental permit for flood risk activities from the Environment Agency. This includes any permanent or temporary works that are in, over, under, or nearby a designated main river or flood defence structure.

Find out more about flood risk activity permits

## Help and advice

Contact the Yorkshire Environment Agency team at neyorkshire@environment-agency.gov.uk for:

- more information about getting a product 5, 6, 7 or 8
- general help and advice about the site you're requesting data for

## APPENDIX D – DRAINAGE STRATEGY AND CALCULATIONS


DO NOT SCALE

DESIGNERS HAZARD IDENTIFICATION

IT IS ASSUMED THAT ALL WORKS WILL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. IN ADDITION TO THE HAZARDS TYPICALLY ASSOCIATED WITH THE TYPES OF CONSTRUCTION DETAILED ON THIS DRAWING, ANY KNOWN ABNORMAL HAZARDS SPECIFIC TO THIS SCHEME HAVE BEEN IDENTIFIED.

ABNORMAL HAZARD REFERENCE

NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. THIS DRAWING IS TO BE REPRODUCED IN COLOUR.
3. IF ANY DISCREPANCIES ARE FOUND IN THIS DRAWING, PLEASE REPORT TO DUDLEYS CONSULTING ENGINEERS.
4. THIS DRAWING HAS BEEN ORIENTATED TO OS BRITISH NATIONAL GRID (EPSG:27700 OSGB36). EXISTING SURVEY STATIONS ARE SHOWN ON THE TOPOGRAPHICAL SURVEY.
5. THIS DRAWING IS BASED ON THE FOLLOWING INFORMATION:
   - 5.1. 8765_2D/1A - TOPOGRAPHICAL SURVEY BY ELLAM LAND SURVEYS DATED NOVEMBER 2023
   - 5.2. 2421-2004 - PROPOSED SITE PLAN BY KPP ARCHITECTS DATED JUNE 2023
   - 5.3. GMP/LHG/3148 CCTV DRAINAGE SURVEY BY GP DRAIN SURVEYS DATED NOVEMBER 2023
6. FLOOD ZONE EXTENTS TAKEN FROM DEFRA DATA SERVICES PLATFORM.
7. REFERENCES FOR EXISTING MANHOLES TAKEN FROM THE CCTV DRAINAGE SURVEY REPORT.
8. ALL WORK TO BE UNDERTAKEN IN ACCORDANCE WITH THE CURRENT EDITION OF THE BUILDING REGULATIONS, SEWERAGE SECTOR CODES OF PRACTICE, AND THE RELEVANT LOCAL AUTHORITY STANDARDS.
9. REFER TO REPORT 23308-DCE-XX-XX-T-C-001-P01 FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY FOR HYDRAULIC CALCULATIONS.

KEY

- PROPOSED PRIVATE SURFACE WATER DRAIN
- PROPOSED PRIVATE SURFACE WATER MANHOLE
- PROPOSED PRIVATE SURFACE WATER PPIC
- PROPOSED PRIVATE SURFACE WATER RODDING EYE
- PROPOSED PRIVATE SURFACE WATER ATTENUATION TANK
- PROPOSED PRIVATE SURFACE WATER SEPARATOR
- EXISTING PRIVATE SURFACE WATER DRAIN
- EXISTING PRIVATE FOUL WATER DRAIN
- EXISTING PRIVATE SURFACE FOUL/ WATER MANHOLE
- EXISTING PRIVATE GULLY
- EXISTING PRIVATE SURFACE WATER SEPARATOR
- EXISTING PRIVATE SURFACE WATER DRAIN TO BE ABANDONED
- FLOOD ZONE 2
- FLOOD ZONE 3

| DATE | REVISION DESCRIPTION | BY | CHK. | REV. |
|---|---|---|---|---|
| 04.03.24 | PRELIMINARY ISSUE | JA | PD | P01 |

DUDLEYS CONSULTING ENGINEERS
Tithe House
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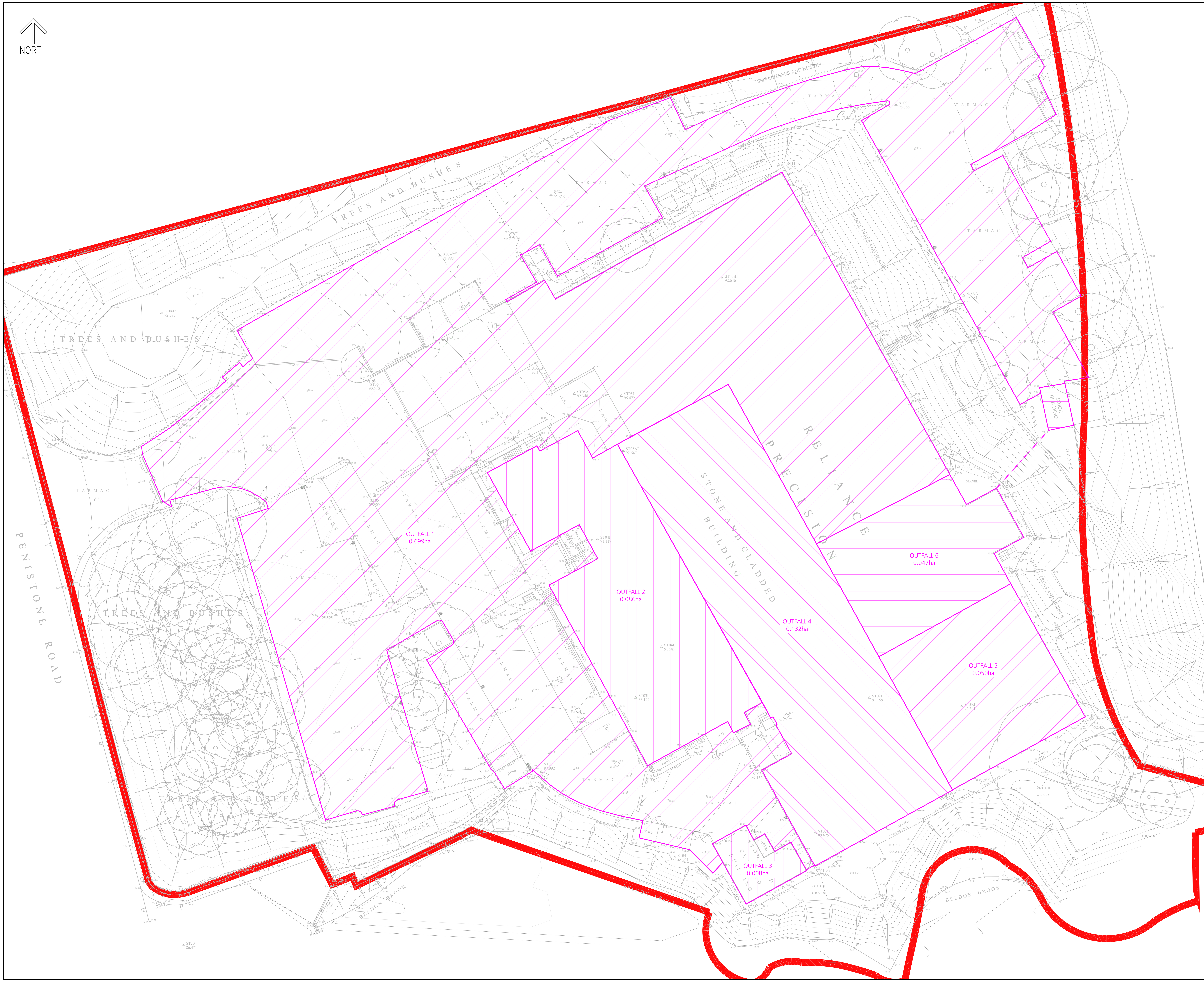
0113 258 3611
info@dudleys.co.uk

PROJECT
ROWLEY MILLS
PENISTONE ROAD, FENAY BRIDGE
HUDDERSFIELD, HD8 0LE

TITLE
DRAINAGE STRATEGY

| SCALE | PAPER | STATUS |
|---|---|---|
| 1:250 | A1 | PRELIMINARY |

| DRAWING NO. | REV. |
|---|---|
| 23308-DCE-XX-XX-D-C-100 | P01 |




DO NOT SCALE

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   5.3. GMP/LHG/3148 CCTV DRAINAGE SURVEY BY GP DRAIN SURVEYS DATED NOVEMBER 2023

KEY

EXISTING IMPERMEABLE AREA: 1.022ha

| DATE | REVISION DESCRIPTION | BY | CHK. | REV. |
|---|---|---|---|---|
| 04.03.24 | PRELIMINARY ISSUE | JA | PD | P01 |

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PROJECT
ROWLEY MILLS
PENISTONE ROAD, FENAY BRIDGE
HUDDERSFIELD, HD8 0LE

TITLE
EXISTING IMPERMEABLE AREAS

| SCALE | PAPER | STATUS |
|---|---|---|
| 1:250 | A1 | PRELIMINARY |

| DRAWING NO. | REV. |
|---|---|
| 23308-DCE-XX-XX-D-C-102 | P01 |


DO NOT SCALE

## DESIGNERS HAZARD IDENTIFICATION

IT IS ASSUMED THAT ALL WORKS WILL BE UNDERTAKEN BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT. IN ADDITION TO THE HAZARDS TYPICALLY ASSOCIATED WITH THE TYPES OF CONSTRUCTION DETAILED ON THIS DRAWING, ANY KNOWN ABNORMAL HAZARDS SPECIFIC TO THIS SCHEME HAVE BEEN IDENTIFIED.

ABNORMAL HAZARD REFERENCE

NOTES

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   5.2. 2421-2004 - PROPOSED SITE PLAN BY KPP ARCHITECTS DATED JUNE 2023
   5.3. GMP/LHG/3148 CCTV DRAINAGE SURVEY BY GP DRAIN SURVEYS DATED NOVEMBER 2023

KEY

PROPOSED IMPERMEABLE AREA: 1.157ha

| DATE | REVISION DESCRIPTION | BY | CHK. | REV. |
|---|---|---|---|---|
| 04.03.24 | PRELIMINARY ISSUE | JA | PD | P01 |


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PROJECT
ROWLEY MILLS
PENISTONE ROAD, FENAY BRIDGE
HUDDERSFIELD, HD8 0LE

TITLE
PROPOSED IMPERMEABLE AREAS

| SCALE | PAPER | STATUS |
|---|---|---|
| 1:250 | A1 | PRELIMINARY |

| DRAWING NO. | REV. |
|---|---|
| 23308-DCE-XX-XX-D-C-103 | P01 |

## Design Settings

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Methodology | FEH-22 | Maximum Time of Concentration (mins) | 30.00 | Preferred Cover Depth (m) | 1.200 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 | Include Intermediate Ground | ✓ |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 | Enforce best practice design rules | x |
| CV | 1.000 | Connection Type | Level Soffits | | |
| Time of Entry (mins) | 4.00 | Minimum Backdrop Height (m) | 0.600 | | |

## Nodes

| Name | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|---|---|---|---|---|---|---|---|
| J1 | 0.088 | 4.00 | 98.400 | | 418842.864 | 414332.224 | 1.350 |
| MH5 | 0.036 | 4.00 | 98.350 | 1200 | 418817.434 | 414376.624 | 1.650 |
| MH3A | | | 92.960 | 1200 | 418766.719 | 414353.040 | 1.300 |
| SW1-1 | 0.032 | 4.00 | 92.525 | 450 | 418841.195 | 414327.838 | 0.575 |
| SW1-2 | | | 92.525 | 450 | 418832.125 | 414344.091 | 0.710 |
| SW1-3 | 0.046 | 4.00 | 92.525 | 450 | 418818.144 | 414369.115 | 0.880 |
| SW1-4 | | | 92.525 | 450 | 418776.259 | 414345.864 | 1.165 |
| SW1-5 | | | 92.300 | 450 | 418765.745 | 414347.827 | 1.020 |
| MH3 | 0.198 | 4.00 | 92.080 | 1500 | 418764.269 | 414339.701 | 1.500 |
| MH4 | 0.460 | 4.00 | 89.240 | 1500 | 418731.083 | 414321.721 | 1.620 |
| TANK | | 4.00 | 90.000 | | 418739.141 | 414276.932 | 3.490 |
| FLOW CONTROL | | | 89.700 | 2100 | 418742.681 | 414278.875 | 3.845 |
| INTERCEPTOR | | | 89.600 | 1200 | 418744.158 | 414273.422 | 3.250 |
| OUTFALL 1 | | | 86.190 | | 418746.377 | 414258.337 | 0.500 |

**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 | J1 | MH5 | 51.167 | 0.600 | 97.050 | 96.700 | 0.350 | 146.2 | 150 | 5.03 | 49.6 |
| 1.001 | MH5 | MH3A | 55.930 | 0.600 | 96.700 | 91.660 | 5.040 | 11.1 | 150 | 5.34 | 48.5 |
| 1.002 | MH3A | SW1-5 | 5.303 | 0.600 | 91.660 | 91.355 | 0.305 | 17.4 | 150 | 5.37 | 48.4 |
| 2.000 | SW1-1 | SW1-2 | 18.612 | 0.600 | 91.950 | 91.815 | 0.135 | 137.9 | 225 | 4.28 | 49.7 |
| 2.001 | SW1-2 | SW1-3 | 28.665 | 0.600 | 91.815 | 91.645 | 0.170 | 169.0 | 225 | 4.76 | 49.7 |
| 2.002 | SW1-3 | SW1-4 | 47.906 | 0.600 | 91.645 | 91.360 | 0.285 | 168.1 | 225 | 5.55 | 47.7 |
| 2.003 | SW1-4 | SW1-5 | 10.696 | 0.600 | 91.360 | 91.280 | 0.080 | 133.7 | 225 | 5.71 | 47.2 |
| 1.004 | MH3 | MH4 | 37.744 | 0.600 | 90.580 | 87.770 | 2.810 | 13.4 | 450 | 5.86 | 46.6 |
| 1.005 | MH4 | FLOW CONTROL | 44.388 | 0.600 | 87.620 | 86.500 | 1.120 | 39.6 | 600 | 6.06 | 46.0 |
| 3.000 | TANK | FLOW CONTROL | 3.039 | 0.600 | 86.510 | 86.500 | 0.010 | 303.9 | 600 | 4.04 | 49.7 |
| 1.006 | FLOW CONTROL | INTERCEPTOR | 5.649 | 0.600 | 86.500 | 86.450 | 0.050 | 113.0 | 375 | 6.11 | 45.8 |
| 1.007 | INTERCEPTOR | OUTFALL 1 | 15.247 | 0.600 | 86.350 | 85.690 | 0.660 | 23.1 | 150 | 6.23 | 45.4 |
| 1.003 | SW1-5 | MH3 | 8.259 | 0.600 | 91.280 | 90.805 | 0.475 | 17.4 | 225 | 5.75 | 47.0 |

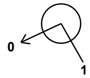
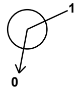
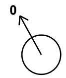
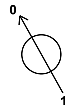
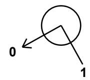
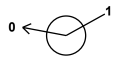
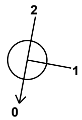
| Name | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) | Pro Depth (mm) | Pro Velocity (m/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 0.829 | 14.6 | 15.8 | 1.200 | 1.500 | 0.088 | 0.0 | 150 | 0.844 |
| 1.001 | 3.041 | 53.7 | 21.7 | 1.500 | 1.150 | 0.124 | 0.0 | 67 | 2.886 |
| 1.002 | 2.427 | 42.9 | 21.7 | 1.150 | 0.795 | 0.124 | 0.0 | 75 | 2.431 |
| 2.000 | 1.111 | 44.2 | 5.7 | 0.350 | 0.485 | 0.032 | 0.0 | 55 | 0.774 |
| 2.001 | 1.003 | 39.9 | 5.7 | 0.485 | 0.655 | 0.032 | 0.0 | 58 | 0.717 |
| 2.002 | 1.005 | 40.0 | 13.5 | 0.655 | 0.940 | 0.078 | 0.0 | 90 | 0.910 |
| 2.003 | 1.129 | 44.9 | 13.3 | 0.940 | 0.795 | 0.078 | 0.0 | 84 | 0.987 |
| 1.004 | 5.569 | 885.7 | 67.4 | 1.050 | 1.020 | 0.400 | 0.0 | 83 | 3.349 |
| 1.005 | 3.875 | 1095.7 | 142.9 | 1.020 | 2.600 | 0.860 | 0.0 | 145 | 2.721 |
| 3.000 | 1.391 | 393.4 | 0.0 | 2.890 | 2.600 | 0.000 | 0.0 | 0 | 0.000 |
| 1.006 | 1.703 | 188.1 | 142.3 | 2.825 | 2.775 | 0.860 | 0.0 | 244 | 1.865 |
| 1.007 | 2.104 | 37.2 | 141.1 | 3.100 | 0.350 | 0.860 | 0.0 | 150 | 2.143 |
| 1.003 | 3.153 | 125.4 | 34.3 | 0.795 | 1.050 | 0.202 | 0.0 | 80 | 2.702 |

**Pipeline Schedule**

| Link | Length (m) | Slope (1:X) | Dia (mm) | Link Type | US CL (m) | US IL (m) | US Depth (m) | DS CL (m) | DS IL (m) | DS Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 51.167 | 146.2 | 150 | Circular | 98.400 | 97.050 | 1.200 | 98.350 | 96.700 | 1.500 |
| 1.001 | 55.930 | 11.1 | 150 | Circular | 98.350 | 96.700 | 1.500 | 92.960 | 91.660 | 1.150 |
| 1.002 | 5.303 | 17.4 | 150 | Circular | 92.960 | 91.660 | 1.150 | 92.300 | 91.355 | 0.795 |
| 2.000 | 18.612 | 137.9 | 225 | Circular | 92.525 | 91.950 | 0.350 | 92.525 | 91.815 | 0.485 |
| 2.001 | 28.665 | 169.0 | 225 | Circular | 92.525 | 91.815 | 0.485 | 92.525 | 91.645 | 0.655 |
| 2.002 | 47.906 | 168.1 | 225 | Circular | 92.525 | 91.645 | 0.655 | 92.525 | 91.360 | 0.940 |
| 2.003 | 10.696 | 133.7 | 225 | Circular | 92.525 | 91.360 | 0.940 | 92.300 | 91.280 | 0.795 |
| 1.004 | 37.744 | 13.4 | 450 | Circular | 92.080 | 90.580 | 1.050 | 89.240 | 87.770 | 1.020 |
| 1.005 | 44.388 | 39.6 | 600 | Circular | 89.240 | 87.620 | 1.020 | 89.700 | 86.500 | 2.600 |
| 3.000 | 3.039 | 303.9 | 600 | Circular | 90.000 | 86.510 | 2.890 | 89.700 | 86.500 | 2.600 |
| 1.006 | 5.649 | 113.0 | 375 | Circular | 89.700 | 86.500 | 2.825 | 89.600 | 86.450 | 2.775 |
| 1.007 | 15.247 | 23.1 | 150 | Circular | 89.600 | 86.350 | 3.100 | 86.190 | 85.690 | 0.350 |
| 1.003 | 8.259 | 17.4 | 225 | Circular | 92.300 | 91.280 | 0.795 | 92.080 | 90.805 | 1.050 |

| Link | US Node | Dia (mm) | Node Type | MH Type | DS Node | Dia (mm) | Node Type | MH Type |
|---|---|---|---|---|---|---|---|---|
| 1.000 | J1 | | Junction | | MH5 | 1200 | Manhole | Adoptable |
| 1.001 | MH5 | 1200 | Manhole | Adoptable | MH3A | 1200 | Manhole | Adoptable |
| 1.002 | MH3A | 1200 | Manhole | Adoptable | SW1-5 | 450 | Manhole | Adoptable |
| 2.000 | SW1-1 | 450 | Manhole | Adoptable | SW1-2 | 450 | Manhole | Adoptable |
| 2.001 | SW1-2 | 450 | Manhole | Adoptable | SW1-3 | 450 | Manhole | Adoptable |
| 2.002 | SW1-3 | 450 | Manhole | Adoptable | SW1-4 | 450 | Manhole | Adoptable |
| 2.003 | SW1-4 | 450 | Manhole | Adoptable | SW1-5 | 450 | Manhole | Adoptable |
| 1.004 | MH3 | 1500 | Manhole | Adoptable | MH4 | 1500 | Manhole | Adoptable |
| 1.005 | MH4 | 1500 | Manhole | Adoptable | FLOW CONTROL | 2100 | Manhole | Adoptable |
| 3.000 | TANK | | Junction | | FLOW CONTROL | 2100 | Manhole | Adoptable |
| 1.006 | FLOW CONTROL | 2100 | Manhole | Adoptable | INTERCEPTOR | 1200 | Manhole | Adoptable |
| 1.007 | INTERCEPTOR | 1200 | Manhole | Adoptable | OUTFALL 1 | | Junction | |
| 1.003 | SW1-5 | 450 | Manhole | Adoptable | MH3 | 1500 | Manhole | Adoptable |

**Manhole Schedule**

| Node | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections | | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| J1 | 418842.864 | 414332.224 | 98.400 | 1.350 | |  | 0 | 1.000 | 97.050 | 150 |
| MH5 | 418817.434 | 414376.624 | 98.350 | 1.650 | 1200 |  | 1 | 1.000 | 96.700 | 150 |
| | | | | | | | 0 | 1.001 | 96.700 | 150 |
| MH3A | 418766.719 | 414353.040 | 92.960 | 1.300 | 1200 |  | 1 | 1.001 | 91.660 | 150 |
| | | | | | | | 0 | 1.002 | 91.660 | 150 |
| SW1-1 | 418841.195 | 414327.838 | 92.525 | 0.575 | 450 |  | 0 | 2.000 | 91.950 | 225 |
| SW1-2 | 418832.125 | 414344.091 | 92.525 | 0.710 | 450 |  | 1 | 2.000 | 91.815 | 225 |
| | | | | | | | 0 | 2.001 | 91.815 | 225 |
| SW1-3 | 418818.144 | 414369.115 | 92.525 | 0.880 | 450 |  | 1 | 2.001 | 91.645 | 225 |
| | | | | | | | 0 | 2.002 | 91.645 | 225 |
| SW1-4 | 418776.259 | 414345.864 | 92.525 | 1.165 | 450 |  | 1 | 2.002 | 91.360 | 225 |
| | | | | | | | 0 | 2.003 | 91.360 | 225 |
| SW1-5 | 418765.745 | 414347.827 | 92.300 | 1.020 | 450 |  | 1 | 2.003 | 91.280 | 225 |
| | | | | | | | 2 | 1.002 | 91.355 | 150 |
| | | | | | | | 0 | 1.003 | 91.280 | 225 |

## Manhole Schedule

| Node | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|---|---|
| MH3 | 418764.269 | 414339.701 | 92.080 | 1.500 | 1500 | 1 | 1.003 | 90.805 | 225 |
| | | | | | | 0 | 1.004 | 90.580 | 450 |
| MH4 | 418731.083 | 414321.721 | 89.240 | 1.620 | 1500 | 1 | 1.004 | 87.770 | 450 |
| | | | | | | 0 | 1.005 | 87.620 | 600 |
| TANK | 418739.141 | 414276.932 | 90.000 | 3.490 | | 0 | 3.000 | 86.510 | 600 |
| FLOW CONTROL | 418742.681 | 414278.875 | 89.700 | 3.845 | 2100 | 1 | 3.000 | 86.500 | 600 |
| | | | | | | 2 | 1.005 | 86.500 | 600 |
| | | | | | | 0 | 1.006 | 86.500 | 375 |
| INTERCEPTOR | 418744.158 | 414273.422 | 89.600 | 3.250 | 1200 | 1 | 1.006 | 86.450 | 375 |
| | | | | | | 0 | 1.007 | 86.350 | 150 |
| OUTFALL 1 | 418746.377 | 414258.337 | 86.190 | 0.500 | | 1 | 1.007 | 85.690 | 150 |

## Simulation Settings

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Rainfall Methodology | FEH-22 | Skip Steady State | ✓ | 2 year (l/s) | 0.0 | 100 year 360 minute (m³) | 716 |
| Summer CV | 1.000 | Drain Down Time (mins) | 240 | 30 year (l/s) | 0.0 | | |
| Winter CV | 1.000 | Additional Storage (m³/ha) | 0.0 | 100 year (l/s) | 0.0 | | |
| Analysis Speed | Detailed | Check Discharge Rate(s) | ✓ | Check Discharge Volume | ✓ | | |

**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 %) |
|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 100 | 45 | 0 | 0 |
| 30 | 40 | 0 | 0 | | | | |

**Pre-development Discharge Rate**

| | | | | | | |
|---|---|---|---|---|---|---|
| Site Makeup | Brownfield | PIMP (%) | 100 | Betterment (%) | 0 | Q 100 year (l/s) |
| Brownfield Method | MRM | CV | 1.000 | Q 1 year (l/s) | | |
| Contributing Area (ha) | 1.080 | Time of Concentration (mins) | 4.00 | Q 30 year (l/s) | | |

**Pre-development Discharge Volume**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Site Makeup | Brownfield | PIMP (%) | 100 | Climate Change (%) | 0 | PR | 1.000 |
| Brownfield Method | MRM | CV | 1.000 | Storm Duration (mins) | 360 | Runoff Volume (m³) | 716 |
| Contributing Area (ha) | 1.080 | Return Period (years) | 100 | Betterment (%) | 0 | | |

**Node FLOW CONTROL Online Hydro-Brake® Control**

| | | | |
|---|---|---|---|
| Flap Valve | ✓ | Objective | (HE) Minimise upstream storage |
| Downstream Link | 1.006 | Sump Available | ✓ |
| Replaces Downstream Link | ✓ | Product Number | CTL-SHE-0304-5830-1800-5830 |
| Invert Level (m) | 86.500 | Min Outlet Diameter (m) | 0.375 |
| Design Depth (m) | 1.800 | Min Node Diameter (mm) | 2100 |
| Design Flow (l/s) | 58.3 | | |

**Node TANK Depth/Area Storage Structure**

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 86.510 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 0.95 | Time to half empty (mins) | 26 |

| Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) | Depth (m) | Area (m²) | Inf Area (m²) |
|---|---|---|---|---|---|---|---|---|
| 0.000 | 250.0 | 0.0 | 2.400 | 250.0 | 0.0 | 2.401 | 0.0 | 0.0 |

## Rainfall

| Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) | Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) |
|---|---|---|---|---|---|
| 2 year 15 minute summer | 101.472 | 28.713 | 30 year +40% CC 60 minute summer | 170.008 | 44.928 |
| 2 year 15 minute winter | 71.209 | 28.713 | 30 year +40% CC 60 minute winter | 112.949 | 44.928 |
| 2 year 30 minute summer | 66.286 | 18.757 | 30 year +40% CC 120 minute summer | 103.314 | 27.303 |
| 2 year 30 minute winter | 46.516 | 18.757 | 30 year +40% CC 120 minute winter | 68.639 | 27.303 |
| 2 year 60 minute summer | 44.888 | 11.863 | 30 year +40% CC 180 minute summer | 79.010 | 20.332 |
| 2 year 60 minute winter | 29.823 | 11.863 | 30 year +40% CC 180 minute winter | 51.359 | 20.332 |
| 2 year 120 minute summer | 31.404 | 8.299 | 30 year +40% CC 240 minute summer | 62.409 | 16.493 |
| 2 year 120 minute winter | 20.864 | 8.299 | 30 year +40% CC 240 minute winter | 41.463 | 16.493 |
| 2 year 180 minute summer | 25.720 | 6.619 | 30 year +40% CC 360 minute summer | 47.813 | 12.304 |
| 2 year 180 minute winter | 16.719 | 6.619 | 30 year +40% CC 360 minute winter | 31.080 | 12.304 |
| 2 year 240 minute summer | 21.167 | 5.594 | 30 year +40% CC 480 minute summer | 37.815 | 9.993 |
| 2 year 240 minute winter | 14.063 | 5.594 | 30 year +40% CC 480 minute winter | 25.123 | 9.993 |
| 2 year 360 minute summer | 16.938 | 4.359 | 30 year +40% CC 600 minute summer | 31.092 | 8.504 |
| 2 year 360 minute winter | 11.010 | 4.359 | 30 year +40% CC 600 minute winter | 21.244 | 8.504 |
| 2 year 480 minute summer | 13.726 | 3.627 | 30 year +40% CC 720 minute summer | 27.813 | 7.454 |
| 2 year 480 minute winter | 9.119 | 3.627 | 30 year +40% CC 720 minute winter | 18.692 | 7.454 |
| 2 year 600 minute summer | 11.456 | 3.134 | 30 year +40% CC 960 minute summer | 22.996 | 6.055 |
| 2 year 600 minute winter | 7.828 | 3.134 | 30 year +40% CC 960 minute winter | 15.233 | 6.055 |
| 2 year 720 minute summer | 10.350 | 2.774 | 30 year +40% CC 1440 minute summer | 16.873 | 4.522 |
| 2 year 720 minute winter | 6.956 | 2.774 | 30 year +40% CC 1440 minute winter | 11.340 | 4.522 |
| 2 year 960 minute summer | 8.649 | 2.277 | 100 year +45% CC 15 minute summer | 494.364 | 139.888 |
| 2 year 960 minute winter | 5.729 | 2.277 | 100 year +45% CC 15 minute winter | 346.922 | 139.888 |
| 2 year 1440 minute summer | 6.390 | 1.713 | 100 year +45% CC 30 minute summer | 332.227 | 94.009 |
| 2 year 1440 minute winter | 4.295 | 1.713 | 100 year +45% CC 30 minute winter | 233.142 | 94.009 |
| 30 year +40% CC 15 minute summer | 373.763 | 105.762 | 100 year +45% CC 60 minute summer | 228.476 | 60.379 |
| 30 year +40% CC 15 minute winter | 262.290 | 105.762 | 100 year +45% CC 60 minute winter | 151.794 | 60.379 |
| 30 year +40% CC 30 minute summer | 249.256 | 70.531 | 100 year +45% CC 120 minute summer | 136.342 | 36.031 |
| 30 year +40% CC 30 minute winter | 174.916 | 70.531 | 100 year +45% CC 120 minute winter | 90.582 | 36.031 |

**Rainfall**

| Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) | Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) |
|---|---|---|---|---|---|
| 100 year +45% CC 180 minute summer | 103.540 | 26.644 | 100 year +45% CC 600 minute summer | 40.628 | 11.113 |
| 100 year +45% CC 180 minute winter | 67.303 | 26.644 | 100 year +45% CC 600 minute winter | 27.760 | 11.113 |
| 100 year +45% CC 240 minute summer | 81.496 | 21.537 | 100 year +45% CC 720 minute summer | 36.457 | 9.771 |
| 100 year +45% CC 240 minute winter | 54.144 | 21.537 | 100 year +45% CC 720 minute winter | 24.502 | 9.771 |
| 100 year +45% CC 360 minute summer | 62.252 | 16.020 | 100 year +45% CC 960 minute summer | 30.353 | 7.993 |
| 100 year +45% CC 360 minute winter | 40.465 | 16.020 | 100 year +45% CC 960 minute winter | 20.106 | 7.993 |
| 100 year +45% CC 480 minute summer | 49.289 | 13.026 | 100 year +45% CC 1440 minute summer | 22.439 | 6.014 |
| 100 year +45% CC 480 minute winter | 32.747 | 13.026 | 100 year +45% CC 1440 minute winter | 15.081 | 6.014 |

**Results for 2 year Critical Storm Duration. Lowest mass balance: 99.49%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | J1 | 11 | 97.227 | 0.177 | 16.2 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute summer | MH5 | 10 | 96.765 | 0.065 | 20.9 | 0.0735 | 0.0000 | OK |
| 15 minute summer | MH3A | 10 | 91.746 | 0.086 | 20.9 | 0.0971 | 0.0000 | OK |
| 15 minute summer | SW1-1 | 10 | 92.007 | 0.057 | 5.9 | 0.0090 | 0.0000 | OK |
| 15 minute summer | SW1-2 | 10 | 91.873 | 0.057 | 5.9 | 0.0091 | 0.0000 | OK |
| 15 minute summer | SW1-3 | 10 | 91.738 | 0.093 | 14.3 | 0.0149 | 0.0000 | OK |
| 15 minute summer | SW1-4 | 11 | 91.452 | 0.092 | 13.8 | 0.0146 | 0.0000 | OK |
| 15 minute summer | SW1-5 | 11 | 91.370 | 0.090 | 34.4 | 0.0143 | 0.0000 | OK |
| 15 minute summer | MH3 | 10 | 90.667 | 0.087 | 69.9 | 0.1534 | 0.0000 | OK |
| 15 minute summer | MH4 | 10 | 87.769 | 0.149 | 154.0 | 0.2633 | 0.0000 | OK |
| 120 minute summer | TANK | 74 | 86.737 | 0.227 | 41.9 | 53.9784 | 0.0000 | OK |
| 120 minute summer | FLOW CONTROL | 74 | 86.737 | 0.237 | 73.5 | 0.8210 | 0.0000 | OK |
| 120 minute summer | INTERCEPTOR | 74 | 86.521 | 0.171 | 37.9 | 0.1930 | 0.0000 | SURCHARGED |
| 120 minute summer | OUTFALL 1 | 82 | 85.842 | 0.152 | 37.6 | 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 summer | J1 | 1.000 | MH5 | 14.5 | 1.233 | 0.988 | 0.6374 | |
| 15 minute summer | MH5 | 1.001 | MH3A | 20.9 | 2.405 | 0.389 | 0.4958 | |
| 15 minute summer | MH3A | 1.002 | SW1-5 | 20.9 | 2.193 | 0.487 | 0.0505 | |
| 15 minute summer | SW1-1 | 2.000 | SW1-2 | 5.9 | 0.760 | 0.134 | 0.1472 | |
| 15 minute summer | SW1-2 | 2.001 | SW1-3 | 5.8 | 0.497 | 0.145 | 0.3375 | |
| 15 minute summer | SW1-3 | 2.002 | SW1-4 | 13.8 | 0.917 | 0.346 | 0.7235 | |
| 15 minute summer | SW1-4 | 2.003 | SW1-5 | 13.9 | 0.923 | 0.309 | 0.1609 | |
| 15 minute summer | SW1-5 | 1.003 | MH3 | 34.5 | 2.510 | 0.275 | 0.1137 | |
| 15 minute summer | MH3 | 1.004 | MH4 | 69.3 | 3.319 | 0.078 | 0.7885 | |
| 15 minute summer | MH4 | 1.005 | FLOW CONTROL | 153.4 | 2.266 | 0.140 | 3.0183 | |
| 120 minute summer | TANK | 3.000 | FLOW CONTROL | -41.9 | -0.745 | -0.106 | 0.3057 | |
| 120 minute summer | FLOW CONTROL | Hydro-Brake® | INTERCEPTOR | 37.9 | | | | |
| 120 minute summer | INTERCEPTOR | 1.007 | OUTFALL 1 | 37.6 | 2.326 | 1.012 | 0.2677 | 140.3 |

**Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 99.49%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | J1 | 9 | 98.400 | 1.350 | 59.7 | 0.0000 | 0.0000 | FLOOD RISK |
| 15 minute summer | MH5 | 12 | 97.953 | 1.253 | 63.1 | 1.4174 | 0.0000 | SURCHARGED |
| 15 minute summer | MH3A | 12 | 92.236 | 0.576 | 53.6 | 0.6510 | 0.0000 | SURCHARGED |
| 15 minute summer | SW1-1 | 10 | 92.067 | 0.117 | 21.7 | 0.0186 | 0.0000 | OK |
| 15 minute summer | SW1-2 | 11 | 92.021 | 0.206 | 22.2 | 0.0327 | 0.0000 | OK |
| 15 minute summer | SW1-3 | 11 | 91.974 | 0.329 | 50.8 | 0.0524 | 0.0000 | SURCHARGED |
| 15 minute summer | SW1-4 | 11 | 91.584 | 0.224 | 45.1 | 0.0355 | 0.0000 | OK |
| 15 minute summer | SW1-5 | 11 | 91.468 | 0.188 | 96.9 | 0.0299 | 0.0000 | OK |
| 15 minute summer | MH3 | 10 | 90.742 | 0.162 | 227.5 | 0.2858 | 0.0000 | OK |
| 15 minute summer | MH4 | 10 | 87.930 | 0.310 | 539.3 | 0.5479 | 0.0000 | OK |
| 120 minute summer | TANK | 84 | 87.555 | 1.045 | 187.2 | 248.0976 | 0.0000 | SURCHARGED |
| 120 minute summer | FLOW CONTROL | 84 | 87.555 | 1.055 | 239.9 | 3.6536 | 0.0000 | SURCHARGED |
| 120 minute summer | INTERCEPTOR | 84 | 87.264 | 0.914 | 51.8 | 1.0339 | 0.0000 | SURCHARGED |
| 60 minute winter | OUTFALL 1 | 131 | 85.842 | 0.152 | 51.6 | 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 summer | J1 | 1.000 | MH5 | 40.9 | 2.326 | 2.796 | 0.9008 | |
| 15 minute summer | MH5 | 1.001 | MH3A | 53.6 | 3.062 | 0.998 | 0.9846 | |
| 15 minute summer | MH3A | 1.002 | SW1-5 | 53.3 | 3.031 | 1.244 | 0.0933 | |
| 15 minute summer | SW1-1 | 2.000 | SW1-2 | 22.2 | 1.048 | 0.503 | 0.5139 | |
| 15 minute summer | SW1-2 | 2.001 | SW1-3 | 22.4 | 0.617 | 0.561 | 1.1157 | |
| 15 minute summer | SW1-3 | 2.002 | SW1-4 | 45.1 | 1.134 | 1.128 | 1.9040 | |
| 15 minute summer | SW1-4 | 2.003 | SW1-5 | 45.1 | 1.195 | 1.004 | 0.4021 | |
| 15 minute summer | SW1-5 | 1.003 | MH3 | 96.8 | 3.051 | 0.772 | 0.2602 | |
| 15 minute summer | MH3 | 1.004 | MH4 | 227.3 | 4.494 | 0.257 | 1.9202 | |
| 15 minute summer | MH4 | 1.005 | FLOW CONTROL | 539.9 | 2.993 | 0.493 | 8.8805 | |
| 120 minute summer | TANK | 3.000 | FLOW CONTROL | -187.2 | -1.260 | -0.476 | 0.8560 | |
| 120 minute summer | FLOW CONTROL | Hydro-Brake® | INTERCEPTOR | 51.8 | | | | |
| 120 minute summer | INTERCEPTOR | 1.007 | OUTFALL 1 | 51.7 | 2.937 | 1.391 | 0.2684 | 466.0 |

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.49%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | J1 | 8 | 98.400 | 1.350 | 79.0 | 0.0000 | 0.0000 | FLOOD RISK |
| 15 minute summer | MH5 | 10 | 98.350 | 1.650 | 81.3 | 1.8662 | 4.1090 | FLOOD |
| 15 minute summer | MH3A | 12 | 92.377 | 0.716 | 55.4 | 0.8104 | 0.0000 | SURCHARGED |
| 15 minute summer | SW1-1 | 11 | 92.525 | 0.575 | 28.7 | 0.0914 | 0.1304 | FLOOD |
| 15 minute summer | SW1-2 | 11 | 92.483 | 0.668 | 29.4 | 0.1063 | 0.0000 | FLOOD RISK |
| 15 minute summer | SW1-3 | 11 | 92.423 | 0.778 | 60.6 | 0.1237 | 0.0000 | FLOOD RISK |
| 15 minute summer | SW1-4 | 11 | 91.774 | 0.414 | 57.0 | 0.0658 | 0.0000 | SURCHARGED |
| 15 minute summer | SW1-5 | 11 | 91.590 | 0.310 | 110.2 | 0.0493 | 0.0000 | SURCHARGED |
| 15 minute summer | MH3 | 10 | 90.755 | 0.175 | 282.8 | 0.3085 | 0.0000 | OK |
| 15 minute summer | MH4 | 10 | 87.997 | 0.377 | 695.5 | 0.6669 | 0.0000 | OK |
| 60 minute winter | TANK | 57 | 87.984 | 1.474 | 288.8 | 350.0942 | 0.0000 | SURCHARGED |
| 60 minute winter | FLOW CONTROL | 57 | 87.984 | 1.484 | 349.1 | 5.1407 | 0.0000 | SURCHARGED |
| 60 minute winter | INTERCEPTOR | 59 | 87.577 | 1.227 | 57.1 | 1.3880 | 0.0000 | SURCHARGED |
| 480 minute winter | OUTFALL 1 | 200 | 85.842 | 0.152 | 49.0 | 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 summer | J1 | 1.000 | MH5 | 54.6 | 3.103 | 3.729 | 0.9008 | |
| 15 minute summer | MH5 | 1.001 | MH3A | 55.4 | 3.147 | 1.031 | 0.9846 | |
| 15 minute summer | MH3A | 1.002 | SW1-5 | 56.8 | 3.226 | 1.324 | 0.0934 | |
| 15 minute summer | SW1-1 | 2.000 | SW1-2 | 29.4 | 1.085 | 0.665 | 0.7402 | |
| 15 minute summer | SW1-2 | 2.001 | SW1-3 | 26.0 | 0.655 | 0.653 | 1.1400 | |
| 15 minute summer | SW1-3 | 2.002 | SW1-4 | 57.0 | 1.434 | 1.427 | 1.9053 | |
| 15 minute summer | SW1-4 | 2.003 | SW1-5 | 56.6 | 1.422 | 1.260 | 0.4254 | |
| 15 minute summer | SW1-5 | 1.003 | MH3 | 109.2 | 3.053 | 0.871 | 0.2898 | |
| 15 minute summer | MH3 | 1.004 | MH4 | 282.7 | 4.490 | 0.319 | 2.5876 | |
| 15 minute summer | MH4 | 1.005 | FLOW CONTROL | 689.0 | 3.110 | 0.629 | 10.3941 | |
| 60 minute winter | TANK | 3.000 | FLOW CONTROL | -288.8 | -1.886 | -0.734 | 0.8560 | |
| 60 minute winter | FLOW CONTROL | Hydro-Brake® | INTERCEPTOR | 57.1 | | | | |
| 60 minute winter | INTERCEPTOR | 1.007 | OUTFALL 1 | 57.1 | 3.243 | 1.535 | 0.2684 | 514.6 |

## Design Settings

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Methodology | FEH-22 | Maximum Time of Concentration (mins) | 30.00 | Preferred Cover Depth (m) | 1.200 |
| Return Period (years) | 2 | Maximum Rainfall (mm/hr) | 50.0 | Include Intermediate Ground | ✓ |
| Additional Flow (%) | 0 | Minimum Velocity (m/s) | 1.00 | Enforce best practice design rules | x |
| CV | 1.000 | Connection Type | Level Soffits | | |
| Time of Entry (mins) | 4.00 | Minimum Backdrop Height (m) | 0.600 | | |

## Nodes

| Name | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|---|---|---|---|---|---|---|---|
| J1 | 0.088 | 4.00 | 98.400 | | 418842.864 | 414332.224 | 1.350 |
| MH5 | 0.036 | 4.00 | 98.350 | 1200 | 418817.434 | 414376.624 | 1.650 |
| MH3A | | | 92.960 | 1200 | 418766.719 | 414353.040 | 1.300 |
| SW1-1 | 0.032 | 4.00 | 92.525 | 450 | 418841.195 | 414327.838 | 0.575 |
| SW1-2 | | | 92.525 | 450 | 418832.125 | 414344.091 | 0.710 |
| SW1-3 | 0.046 | 4.00 | 92.525 | 450 | 418818.144 | 414369.115 | 0.880 |
| SW1-4 | | | 92.525 | 450 | 418776.259 | 414345.864 | 1.165 |
| SW1-5 | | | 92.300 | 450 | 418765.745 | 414347.827 | 1.020 |
| MH3 | 0.198 | 4.00 | 92.080 | 1500 | 418764.269 | 414339.701 | 1.500 |
| MH4 | 0.460 | 4.00 | 89.240 | 1500 | 418731.083 | 414321.721 | 1.620 |
| TANK | | 4.00 | 90.000 | | 418739.141 | 414276.932 | 3.490 |
| FLOW CONTROL | | | 89.700 | 2100 | 418742.681 | 414278.875 | 3.845 |
| INTERCEPTOR | | | 89.600 | 1200 | 418744.158 | 414273.422 | 3.250 |
| OUTFALL 1 | | | 86.190 | | 418746.377 | 414258.337 | 0.500 |

**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 | J1 | MH5 | 51.167 | 0.600 | 97.050 | 96.700 | 0.350 | 146.2 | 150 | 5.03 | 49.6 |
| 1.001 | MH5 | MH3A | 55.930 | 0.600 | 96.700 | 91.660 | 5.040 | 11.1 | 150 | 5.34 | 48.5 |
| 1.002 | MH3A | SW1-5 | 5.303 | 0.600 | 91.660 | 91.355 | 0.305 | 17.4 | 150 | 5.37 | 48.4 |
| 2.000 | SW1-1 | SW1-2 | 18.612 | 0.600 | 91.950 | 91.815 | 0.135 | 137.9 | 225 | 4.28 | 49.7 |
| 2.001 | SW1-2 | SW1-3 | 28.665 | 0.600 | 91.815 | 91.645 | 0.170 | 169.0 | 225 | 4.76 | 49.7 |
| 2.002 | SW1-3 | SW1-4 | 47.906 | 0.600 | 91.645 | 91.360 | 0.285 | 168.1 | 225 | 5.55 | 47.7 |
| 2.003 | SW1-4 | SW1-5 | 10.696 | 0.600 | 91.360 | 91.280 | 0.080 | 133.7 | 225 | 5.71 | 47.2 |
| 1.004 | MH3 | MH4 | 37.744 | 0.600 | 90.580 | 87.770 | 2.810 | 13.4 | 450 | 5.86 | 46.6 |
| 1.005 | MH4 | FLOW CONTROL | 44.388 | 0.600 | 87.620 | 86.500 | 1.120 | 39.6 | 600 | 6.06 | 46.0 |
| 3.000 | TANK | FLOW CONTROL | 3.039 | 0.600 | 86.510 | 86.500 | 0.010 | 303.9 | 600 | 4.04 | 49.7 |
| 1.006 | FLOW CONTROL | INTERCEPTOR | 5.649 | 0.600 | 86.500 | 86.450 | 0.050 | 113.0 | 375 | 6.11 | 45.8 |
| 1.007 | INTERCEPTOR | OUTFALL 1 | 15.247 | 0.600 | 86.350 | 85.690 | 0.660 | 23.1 | 150 | 6.23 | 45.4 |
| 1.003 | SW1-5 | MH3 | 8.259 | 0.600 | 91.280 | 90.805 | 0.475 | 17.4 | 225 | 5.75 | 47.0 |

| 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 | 0.829 | 14.6 | 15.8 | 1.200 | 1.500 | 0.088 | 0.0 | 150 | 0.844 |
| 1.001 | 3.041 | 53.7 | 21.7 | 1.500 | 1.150 | 0.124 | 0.0 | 67 | 2.886 |
| 1.002 | 2.427 | 42.9 | 21.7 | 1.150 | 0.795 | 0.124 | 0.0 | 75 | 2.431 |
| 2.000 | 1.111 | 44.2 | 5.7 | 0.350 | 0.485 | 0.032 | 0.0 | 55 | 0.774 |
| 2.001 | 1.003 | 39.9 | 5.7 | 0.485 | 0.655 | 0.032 | 0.0 | 58 | 0.717 |
| 2.002 | 1.005 | 40.0 | 13.5 | 0.655 | 0.940 | 0.078 | 0.0 | 90 | 0.910 |
| 2.003 | 1.129 | 44.9 | 13.3 | 0.940 | 0.795 | 0.078 | 0.0 | 84 | 0.987 |
| 1.004 | 5.569 | 885.7 | 67.4 | 1.050 | 1.020 | 0.400 | 0.0 | 83 | 3.349 |
| 1.005 | 3.875 | 1095.7 | 142.9 | 1.020 | 2.600 | 0.860 | 0.0 | 145 | 2.721 |
| 3.000 | 1.391 | 393.4 | 0.0 | 2.890 | 2.600 | 0.000 | 0.0 | 0 | 0.000 |
| 1.006 | 1.703 | 188.1 | 142.3 | 2.825 | 2.775 | 0.860 | 0.0 | 244 | 1.865 |
| 1.007 | 2.104 | 37.2 | 141.1 | 3.100 | 0.350 | 0.860 | 0.0 | 150 | 2.143 |
| 1.003 | 3.153 | 125.4 | 34.3 | 0.795 | 1.050 | 0.202 | 0.0 | 80 | 2.702 |

**Pipeline Schedule**

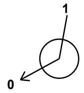
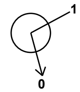
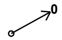
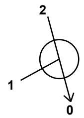
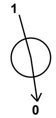
| Link | Length (m) | Slope (1:X) | Dia (mm) | Link Type | US CL (m) | US IL (m) | US Depth (m) | DS CL (m) | DS IL (m) | DS Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 51.167 | 146.2 | 150 | Circular | 98.400 | 97.050 | 1.200 | 98.350 | 96.700 | 1.500 |
| 1.001 | 55.930 | 11.1 | 150 | Circular | 98.350 | 96.700 | 1.500 | 92.960 | 91.660 | 1.150 |
| 1.002 | 5.303 | 17.4 | 150 | Circular | 92.960 | 91.660 | 1.150 | 92.300 | 91.355 | 0.795 |
| 2.000 | 18.612 | 137.9 | 225 | Circular | 92.525 | 91.950 | 0.350 | 92.525 | 91.815 | 0.485 |
| 2.001 | 28.665 | 169.0 | 225 | Circular | 92.525 | 91.815 | 0.485 | 92.525 | 91.645 | 0.655 |
| 2.002 | 47.906 | 168.1 | 225 | Circular | 92.525 | 91.645 | 0.655 | 92.525 | 91.360 | 0.940 |
| 2.003 | 10.696 | 133.7 | 225 | Circular | 92.525 | 91.360 | 0.940 | 92.300 | 91.280 | 0.795 |
| 1.004 | 37.744 | 13.4 | 450 | Circular | 92.080 | 90.580 | 1.050 | 89.240 | 87.770 | 1.020 |
| 1.005 | 44.388 | 39.6 | 600 | Circular | 89.240 | 87.620 | 1.020 | 89.700 | 86.500 | 2.600 |
| 3.000 | 3.039 | 303.9 | 600 | Circular | 90.000 | 86.510 | 2.890 | 89.700 | 86.500 | 2.600 |
| 1.006 | 5.649 | 113.0 | 375 | Circular | 89.700 | 86.500 | 2.825 | 89.600 | 86.450 | 2.775 |
| 1.007 | 15.247 | 23.1 | 150 | Circular | 89.600 | 86.350 | 3.100 | 86.190 | 85.690 | 0.350 |
| 1.003 | 8.259 | 17.4 | 225 | Circular | 92.300 | 91.280 | 0.795 | 92.080 | 90.805 | 1.050 |

| Link | US Node | Dia (mm) | Node Type | MH Type | DS Node | Dia (mm) | Node Type | MH Type |
|---|---|---|---|---|---|---|---|---|
| 1.000 | J1 | | Junction | | MH5 | 1200 | Manhole | Adoptable |
| 1.001 | MH5 | 1200 | Manhole | Adoptable | MH3A | 1200 | Manhole | Adoptable |
| 1.002 | MH3A | 1200 | Manhole | Adoptable | SW1-5 | 450 | Manhole | Adoptable |
| 2.000 | SW1-1 | 450 | Manhole | Adoptable | SW1-2 | 450 | Manhole | Adoptable |
| 2.001 | SW1-2 | 450 | Manhole | Adoptable | SW1-3 | 450 | Manhole | Adoptable |
| 2.002 | SW1-3 | 450 | Manhole | Adoptable | SW1-4 | 450 | Manhole | Adoptable |
| 2.003 | SW1-4 | 450 | Manhole | Adoptable | SW1-5 | 450 | Manhole | Adoptable |
| 1.004 | MH3 | 1500 | Manhole | Adoptable | MH4 | 1500 | Manhole | Adoptable |
| 1.005 | MH4 | 1500 | Manhole | Adoptable | FLOW CONTROL | 2100 | Manhole | Adoptable |
| 3.000 | TANK | | Junction | | FLOW CONTROL | 2100 | Manhole | Adoptable |
| 1.006 | FLOW CONTROL | 2100 | Manhole | Adoptable | INTERCEPTOR | 1200 | Manhole | Adoptable |
| 1.007 | INTERCEPTOR | 1200 | Manhole | Adoptable | OUTFALL 1 | | Junction | |
| 1.003 | SW1-5 | 450 | Manhole | Adoptable | MH3 | 1500 | Manhole | Adoptable |

## Manhole Schedule

| Node | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|---|---|
| J1 | 418842.864 | 414332.224 | 98.400 | 1.350 | | 0 | 1.000 | 97.050 | 150 |
| MH5 | 418817.434 | 414376.624 | 98.350 | 1.650 | 1200 | 1 | 1.000 | 96.700 | 150 |
| | | | | | | 0 | 1.001 | 96.700 | 150 |
| MH3A | 418766.719 | 414353.040 | 92.960 | 1.300 | 1200 | 1 | 1.001 | 91.660 | 150 |
| | | | | | | 0 | 1.002 | 91.660 | 150 |
| SW1-1 | 418841.195 | 414327.838 | 92.525 | 0.575 | 450 | 0 | 2.000 | 91.950 | 225 |
| SW1-2 | 418832.125 | 414344.091 | 92.525 | 0.710 | 450 | 1 | 2.000 | 91.815 | 225 |
| | | | | | | 0 | 2.001 | 91.815 | 225 |
| SW1-3 | 418818.144 | 414369.115 | 92.525 | 0.880 | 450 | 1 | 2.001 | 91.645 | 225 |
| | | | | | | 0 | 2.002 | 91.645 | 225 |
| SW1-4 | 418776.259 | 414345.864 | 92.525 | 1.165 | 450 | 1 | 2.002 | 91.360 | 225 |
| | | | | | | 0 | 2.003 | 91.360 | 225 |
| SW1-5 | 418765.745 | 414347.827 | 92.300 | 1.020 | 450 | 1 | 2.003 | 91.280 | 225 |
| | | | | | | 2 | 1.002 | 91.355 | 150 |
| | | | | | | 0 | 1.003 | 91.280 | 225 |

## Manhole Schedule

| Node | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections | | Link | IL (m) | Dia (mm) |
|---|---|---|---|---|---|---|---|---|---|---|
| MH3 | 418764.269 | 414339.701 | 92.080 | 1.500 | 1500 |  | 1 | 1.003 | 90.805 | 225 |
| | | | | | | | 0 | 1.004 | 90.580 | 450 |
| MH4 | 418731.083 | 414321.721 | 89.240 | 1.620 | 1500 |  | 1 | 1.004 | 87.770 | 450 |
| | | | | | | | 0 | 1.005 | 87.620 | 600 |
| TANK | 418739.141 | 414276.932 | 90.000 | 3.490 | |  | 0 | 3.000 | 86.510 | 600 |
| FLOW CONTROL | 418742.681 | 414278.875 | 89.700 | 3.845 | 2100 |  | 1 | 3.000 | 86.500 | 600 |
| | | | | | | | 2 | 1.005 | 86.500 | 600 |
| | | | | | | | 0 | 1.006 | 86.500 | 375 |
| INTERCEPTOR | 418744.158 | 414273.422 | 89.600 | 3.250 | 1200 |  | 1 | 1.006 | 86.450 | 375 |
| | | | | | | | 0 | 1.007 | 86.350 | 150 |
| OUTFALL 1 | 418746.377 | 414258.337 | 86.190 | 0.500 | |  | 1 | 1.007 | 85.690 | 150 |

## Simulation Settings

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Rainfall Methodology | FEH-22 | Skip Steady State | ✓ | 2 year (l/s) | 0.0 | 100 year 360 minute (m³) | 716 |
| Summer CV | 1.000 | Drain Down Time (mins) | 240 | 30 year (l/s) | 0.0 | | |
| Winter CV | 1.000 | Additional Storage (m³/ha) | 0.0 | 100 year (l/s) | 0.0 | | |
| Analysis Speed | Detailed | Check Discharge Rate(s) | ✓ | Check Discharge Volume | ✓ | | |

**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 %) |
|---|---|---|---|---|---|---|---|
| 2 | 0 | 0 | 0 | 100 | 45 | 0 | 0 |
| 30 | 40 | 0 | 0 | | | | |

## Pre-development Discharge Rate

| | | | | | | |
|---|---|---|---|---|---|---|
| Site Makeup | Brownfield | PIMP (%) | 100 | Betterment (%) | 0 | Q 100 year (l/s) |
| Brownfield Method | MRM | CV | 1.000 | Q 1 year (l/s) | | |
| Contributing Area (ha) | 1.080 | Time of Concentration (mins) | 4.00 | Q 30 year (l/s) | | |

## Pre-development Discharge Volume

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Site Makeup | Brownfield | PIMP (%) | 100 | Climate Change (%) | 0 | PR | 1.000 |
| Brownfield Method | MRM | CV | 1.000 | Storm Duration (mins) | 360 | Runoff Volume (m³) | 716 |
| Contributing Area (ha) | 1.080 | Return Period (years) | 100 | Betterment (%) | 0 | | |

## Node OUTFALL 1 Surcharged Outfall

| | | | | | |
|---|---|---|---|---|---|
| Overrides Design Area | x | Depression Storage Area (m²) | 0 | Evapo-transpiration (mm/day) | 0 |
| Overrides Design Additional Inflow | x | Depression Storage Depth (mm) | 0 | | |

Applies to All storms

| Time (mins) | Depth (m) | Time (mins) | Depth (m) |
|---|---|---|---|
| 0 | 2.310 | 1440 | 2.310 |

## Node FLOW CONTROL Online Hydro-Brake® Control

| | | | |
|---|---|---|---|
| Flap Valve | ✓ | Design Flow (l/s) | 58.3 |
| Downstream Link | 1.006 | Objective | (HE) Minimise upstream storage |
| Replaces Downstream Link | ✓ | Sump Available | ✓ |
| Invert Level (m) | 86.500 | Product Number | CTL-SHE-0304-5830-1800-5830 |
| Design Depth (m) | 1.800 | Min Outlet Diameter (m) | 0.375 |

## Node FLOW CONTROL Online Hydro-Brake® Control

Min Node Diameter (mm) 2100

## Node TANK Depth/Area Storage Structure

| | | | | | |
|---|---|---|---|---|---|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0 | Invert Level (m) | 86.510 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity | 0.95 | 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 | 250.0 | 0.0 | 2.400 | 250.0 | 0.0 | 2.401 | 0.0 | 0.0 |

## Rainfall

| Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) | Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) |
|---|---|---|---|---|---|
| 2 year 15 minute summer | 101.472 | 28.713 | 2 year 720 minute winter | 6.956 | 2.774 |
| 2 year 15 minute winter | 71.209 | 28.713 | 2 year 960 minute summer | 8.649 | 2.277 |
| 2 year 30 minute summer | 66.286 | 18.757 | 2 year 960 minute winter | 5.729 | 2.277 |
| 2 year 30 minute winter | 46.516 | 18.757 | 2 year 1440 minute summer | 6.390 | 1.713 |
| 2 year 60 minute summer | 44.888 | 11.863 | 2 year 1440 minute winter | 4.295 | 1.713 |
| 2 year 60 minute winter | 29.823 | 11.863 | 30 year +40% CC 15 minute summer | 373.763 | 105.762 |
| 2 year 120 minute summer | 31.404 | 8.299 | 30 year +40% CC 15 minute winter | 262.290 | 105.762 |
| 2 year 120 minute winter | 20.864 | 8.299 | 30 year +40% CC 30 minute summer | 249.256 | 70.531 |
| 2 year 180 minute summer | 25.720 | 6.619 | 30 year +40% CC 30 minute winter | 174.916 | 70.531 |
| 2 year 180 minute winter | 16.719 | 6.619 | 30 year +40% CC 60 minute summer | 170.008 | 44.928 |
| 2 year 240 minute summer | 21.167 | 5.594 | 30 year +40% CC 60 minute winter | 112.949 | 44.928 |
| 2 year 240 minute winter | 14.063 | 5.594 | 30 year +40% CC 120 minute summer | 103.314 | 27.303 |
| 2 year 360 minute summer | 16.938 | 4.359 | 30 year +40% CC 120 minute winter | 68.639 | 27.303 |
| 2 year 360 minute winter | 11.010 | 4.359 | 30 year +40% CC 180 minute summer | 79.010 | 20.332 |
| 2 year 480 minute summer | 13.726 | 3.627 | 30 year +40% CC 180 minute winter | 51.359 | 20.332 |
| 2 year 480 minute winter | 9.119 | 3.627 | 30 year +40% CC 240 minute summer | 62.409 | 16.493 |
| 2 year 600 minute summer | 11.456 | 3.134 | 30 year +40% CC 240 minute winter | 41.463 | 16.493 |
| 2 year 600 minute winter | 7.828 | 3.134 | 30 year +40% CC 360 minute summer | 47.813 | 12.304 |
| 2 year 720 minute summer | 10.350 | 2.774 | 30 year +40% CC 360 minute winter | 31.080 | 12.304 |

**Rainfall**

| Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) | Event | Peak Intensity (mm/hr) | Average Intensity (mm/hr) |
|---|---|---|---|---|---|
| 30 year +40% CC 480 minute summer | 37.815 | 9.993 | 100 year +45% CC 120 minute winter | 90.582 | 36.031 |
| 30 year +40% CC 480 minute winter | 25.123 | 9.993 | 100 year +45% CC 180 minute summer | 103.540 | 26.644 |
| 30 year +40% CC 600 minute summer | 31.092 | 8.504 | 100 year +45% CC 180 minute winter | 67.303 | 26.644 |
| 30 year +40% CC 600 minute winter | 21.244 | 8.504 | 100 year +45% CC 240 minute summer | 81.496 | 21.537 |
| 30 year +40% CC 720 minute summer | 27.813 | 7.454 | 100 year +45% CC 240 minute winter | 54.144 | 21.537 |
| 30 year +40% CC 720 minute winter | 18.692 | 7.454 | 100 year +45% CC 360 minute summer | 62.252 | 16.020 |
| 30 year +40% CC 960 minute summer | 22.996 | 6.055 | 100 year +45% CC 360 minute winter | 40.465 | 16.020 |
| 30 year +40% CC 960 minute winter | 15.233 | 6.055 | 100 year +45% CC 480 minute summer | 49.289 | 13.026 |
| 30 year +40% CC 1440 minute summer | 16.873 | 4.522 | 100 year +45% CC 480 minute winter | 32.747 | 13.026 |
| 30 year +40% CC 1440 minute winter | 11.340 | 4.522 | 100 year +45% CC 600 minute summer | 40.628 | 11.113 |
| 100 year +45% CC 15 minute summer | 494.364 | 139.888 | 100 year +45% CC 600 minute winter | 27.760 | 11.113 |
| 100 year +45% CC 15 minute winter | 346.922 | 139.888 | 100 year +45% CC 720 minute summer | 36.457 | 9.771 |
| 100 year +45% CC 30 minute summer | 332.227 | 94.009 | 100 year +45% CC 720 minute winter | 24.502 | 9.771 |
| 100 year +45% CC 30 minute winter | 233.142 | 94.009 | 100 year +45% CC 960 minute summer | 30.353 | 7.993 |
| 100 year +45% CC 60 minute summer | 228.476 | 60.379 | 100 year +45% CC 960 minute winter | 20.106 | 7.993 |
| 100 year +45% CC 60 minute winter | 151.794 | 60.379 | 100 year +45% CC 1440 minute summer | 22.439 | 6.014 |
| 100 year +45% CC 120 minute summer | 136.342 | 36.031 | 100 year +45% CC 1440 minute winter | 15.081 | 6.014 |

**Results for 2 year Critical Storm Duration. Lowest mass balance: 98.48%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | J1 | 11 | 97.227 | 0.177 | 16.2 | 0.0000 | 0.0000 | SURCHARGED |
| 15 minute summer | MH5 | 10 | 96.765 | 0.065 | 20.9 | 0.0735 | 0.0000 | OK |
| 15 minute summer | MH3A | 10 | 91.746 | 0.086 | 20.9 | 0.0971 | 0.0000 | OK |
| 15 minute summer | SW1-1 | 10 | 92.007 | 0.057 | 5.9 | 0.0090 | 0.0000 | OK |
| 15 minute summer | SW1-2 | 10 | 91.873 | 0.057 | 5.9 | 0.0091 | 0.0000 | OK |
| 15 minute summer | SW1-3 | 10 | 91.738 | 0.093 | 14.3 | 0.0149 | 0.0000 | OK |
| 15 minute summer | SW1-4 | 11 | 91.452 | 0.092 | 13.8 | 0.0146 | 0.0000 | OK |
| 15 minute summer | SW1-5 | 11 | 91.370 | 0.090 | 34.4 | 0.0143 | 0.0000 | OK |
| 15 minute summer | MH3 | 10 | 90.667 | 0.087 | 69.9 | 0.1534 | 0.0000 | OK |
| 1440 minute summer | MH4 | 1470 | 87.909 | 0.289 | 15.3 | 0.5114 | 0.0000 | OK |
| 1440 minute summer | TANK | 1470 | 87.909 | 1.399 | 14.6 | 332.3695 | 0.0000 | SURCHARGED |
| 1440 minute summer | FLOW CONTROL | 1470 | 87.909 | 1.409 | 15.3 | 4.8823 | 0.0000 | SURCHARGED |
| 1440 minute summer | INTERCEPTOR | 1470 | 87.909 | 1.559 | 0.1 | 1.7637 | 0.0000 | SURCHARGED |
| 15 minute summer | OUTFALL 1 | 1 | 86.190 | 0.500 | 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 summer | J1 | 1.000 | MH5 | 14.5 | 1.232 | 0.988 | 0.6374 | |
| 15 minute summer | MH5 | 1.001 | MH3A | 20.9 | 2.405 | 0.389 | 0.4958 | |
| 15 minute summer | MH3A | 1.002 | SW1-5 | 20.9 | 2.193 | 0.487 | 0.0505 | |
| 15 minute summer | SW1-1 | 2.000 | SW1-2 | 5.9 | 0.760 | 0.134 | 0.1472 | |
| 15 minute summer | SW1-2 | 2.001 | SW1-3 | 5.8 | 0.497 | 0.145 | 0.3375 | |
| 15 minute summer | SW1-3 | 2.002 | SW1-4 | 13.8 | 0.917 | 0.346 | 0.7234 | |
| 15 minute summer | SW1-4 | 2.003 | SW1-5 | 13.9 | 0.923 | 0.309 | 0.1609 | |
| 15 minute summer | SW1-5 | 1.003 | MH3 | 34.5 | 2.510 | 0.275 | 0.1137 | |
| 15 minute summer | MH3 | 1.004 | MH4 | 69.3 | 3.319 | 0.078 | 0.7885 | |
| 1440 minute summer | MH4 | 1.005 | FLOW CONTROL | 15.3 | 0.313 | 0.014 | 9.2373 | |
| 1440 minute summer | TANK | 3.000 | FLOW CONTROL | -14.6 | -0.432 | -0.037 | 0.8560 | |
| 1440 minute summer | FLOW CONTROL | Hydro-Brake® | INTERCEPTOR | 0.1 | | | | |
| 1440 minute summer | INTERCEPTOR | 1.007 | OUTFALL 1 | 0.0 | 0.000 | 0.000 | 0.2684 | 0.0 |

**Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 98.48%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | J1 | 9 | 98.400 | 1.350 | 59.7 | 0.0000 | 0.0000 | FLOOD RISK |
| 15 minute summer | MH5 | 12 | 97.953 | 1.253 | 63.1 | 1.4176 | 0.0000 | SURCHARGED |
| 15 minute summer | MH3A | 12 | 92.236 | 0.576 | 53.6 | 0.6510 | 0.0000 | SURCHARGED |
| 15 minute summer | SW1-1 | 10 | 92.067 | 0.117 | 21.7 | 0.0186 | 0.0000 | OK |
| 15 minute summer | SW1-2 | 11 | 92.021 | 0.206 | 22.2 | 0.0327 | 0.0000 | OK |
| 15 minute summer | SW1-3 | 11 | 91.975 | 0.330 | 50.8 | 0.0524 | 0.0000 | SURCHARGED |
| 15 minute summer | SW1-4 | 11 | 91.584 | 0.224 | 45.1 | 0.0355 | 0.0000 | OK |
| 15 minute summer | SW1-5 | 11 | 91.468 | 0.188 | 96.9 | 0.0299 | 0.0000 | OK |
| 15 minute summer | MH3 | 10 | 90.742 | 0.162 | 227.5 | 0.2863 | 0.0000 | OK |
| 960 minute summer | MH4 | 570 | 88.531 | 0.911 | 54.8 | 1.6095 | 0.0000 | SURCHARGED |
| 960 minute summer | TANK | 570 | 88.530 | 2.020 | 48.2 | 479.7535 | 0.0000 | SURCHARGED |
| 960 minute summer | FLOW CONTROL | 570 | 88.530 | 2.030 | 53.0 | 7.0320 | 0.0000 | SURCHARGED |
| 960 minute summer | INTERCEPTOR | 570 | 88.355 | 2.005 | 25.2 | 2.2677 | 0.0000 | SURCHARGED |
| 15 minute summer | OUTFALL 1 | 1 | 86.190 | 0.500 | 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 summer | J1 | 1.000 | MH5 | 40.9 | 2.326 | 2.796 | 0.9008 | |
| 15 minute summer | MH5 | 1.001 | MH3A | 53.6 | 3.062 | 0.998 | 0.9846 | |
| 15 minute summer | MH3A | 1.002 | SW1-5 | 53.4 | 3.031 | 1.244 | 0.0933 | |
| 15 minute summer | SW1-1 | 2.000 | SW1-2 | 22.2 | 1.048 | 0.503 | 0.5139 | |
| 15 minute summer | SW1-2 | 2.001 | SW1-3 | 22.4 | 0.617 | 0.561 | 1.1157 | |
| 15 minute summer | SW1-3 | 2.002 | SW1-4 | 45.1 | 1.134 | 1.128 | 1.9040 | |
| 15 minute summer | SW1-4 | 2.003 | SW1-5 | 45.1 | 1.195 | 1.004 | 0.4021 | |
| 15 minute summer | SW1-5 | 1.003 | MH3 | 96.8 | 3.051 | 0.772 | 0.2602 | |
| 15 minute summer | MH3 | 1.004 | MH4 | 227.3 | 4.494 | 0.257 | 1.9134 | |
| 960 minute summer | MH4 | 1.005 | FLOW CONTROL | 53.0 | 0.560 | 0.048 | 12.5031 | |
| 960 minute summer | TANK | 3.000 | FLOW CONTROL | -48.2 | -0.749 | -0.122 | 0.8560 | |
| 960 minute summer | FLOW CONTROL | Hydro-Brake® | INTERCEPTOR | 25.2 | | | | |
| 960 minute summer | INTERCEPTOR | 1.007 | OUTFALL 1 | 25.2 | 1.429 | 0.677 | 0.2684 | 445.3 |

**Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 98.48%**

| Node Event | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status |
|---|---|---|---|---|---|---|---|---|
| 15 minute summer | J1 | 8 | 98.400 | 1.350 | 79.0 | 0.0000 | 0.0000 | FLOOD RISK |
| 15 minute summer | MH5 | 10 | 98.350 | 1.650 | 81.3 | 1.8662 | 4.1003 | FLOOD |
| 15 minute summer | MH3A | 12 | 92.376 | 0.716 | 55.4 | 0.8103 | 0.0000 | SURCHARGED |
| 15 minute summer | SW1-1 | 11 | 92.525 | 0.575 | 28.7 | 0.0914 | 0.1270 | FLOOD |
| 15 minute summer | SW1-2 | 11 | 92.483 | 0.668 | 29.4 | 0.1063 | 0.0000 | FLOOD RISK |
| 15 minute summer | SW1-3 | 11 | 92.423 | 0.778 | 60.6 | 0.1237 | 0.0000 | FLOOD RISK |
| 15 minute summer | SW1-4 | 11 | 91.774 | 0.414 | 57.0 | 0.0658 | 0.0000 | SURCHARGED |
| 15 minute summer | SW1-5 | 11 | 91.590 | 0.310 | 110.2 | 0.0492 | 0.0000 | SURCHARGED |
| 15 minute summer | MH3 | 10 | 90.753 | 0.173 | 282.8 | 0.3061 | 0.0000 | OK |
| 720 minute summer | MH4 | 435 | 89.225 | 1.605 | 87.1 | 2.8365 | 0.0000 | FLOOD RISK |
| 720 minute summer | TANK | 435 | 89.223 | 2.713 | 68.0 | 570.1188 | 0.0000 | SURCHARGED |
| 720 minute summer | FLOW CONTROL | 435 | 89.223 | 2.723 | 85.6 | 9.4325 | 0.0000 | SURCHARGED |
| 720 minute summer | INTERCEPTOR | 435 | 88.979 | 2.629 | 42.0 | 2.9737 | 0.0000 | SURCHARGED |
| 15 minute summer | OUTFALL 1 | 1 | 86.190 | 0.500 | 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 summer | J1 | 1.000 | MH5 | 54.6 | 3.103 | 3.729 | 0.9008 | |
| 15 minute summer | MH5 | 1.001 | MH3A | 55.4 | 3.147 | 1.031 | 0.9846 | |
| 15 minute summer | MH3A | 1.002 | SW1-5 | 56.8 | 3.226 | 1.324 | 0.0934 | |
| 15 minute summer | SW1-1 | 2.000 | SW1-2 | 29.4 | 1.085 | 0.665 | 0.7402 | |
| 15 minute summer | SW1-2 | 2.001 | SW1-3 | 26.0 | 0.655 | 0.653 | 1.1400 | |
| 15 minute summer | SW1-3 | 2.002 | SW1-4 | 57.0 | 1.434 | 1.427 | 1.9053 | |
| 15 minute summer | SW1-4 | 2.003 | SW1-5 | 56.6 | 1.422 | 1.260 | 0.4254 | |
| 15 minute summer | SW1-5 | 1.003 | MH3 | 109.2 | 3.053 | 0.871 | 0.2898 | |
| 15 minute summer | MH3 | 1.004 | MH4 | 283.3 | 4.486 | 0.320 | 2.6563 | |
| 720 minute summer | MH4 | 1.005 | FLOW CONTROL | 85.6 | 0.670 | 0.078 | 12.5031 | |
| 720 minute summer | TANK | 3.000 | FLOW CONTROL | -68.0 | -0.843 | -0.173 | 0.8560 | |
| 720 minute summer | FLOW CONTROL | Hydro-Brake® | INTERCEPTOR | 42.0 | | | | |
| 720 minute summer | INTERCEPTOR | 1.007 | OUTFALL 1 | 41.8 | 2.374 | 1.124 | 0.2684 | 617.1 |

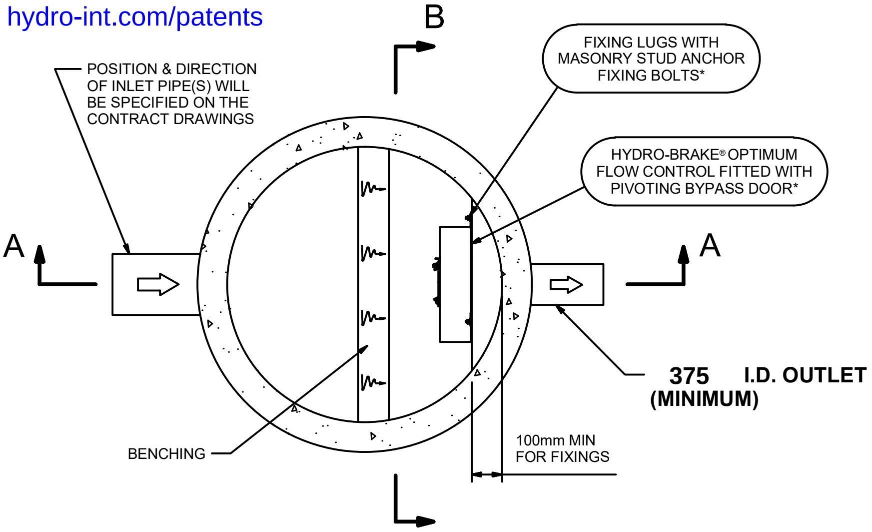
## Technical Specification

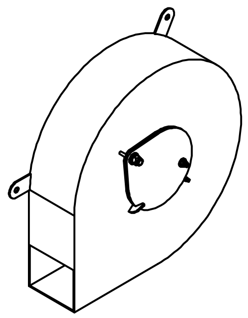
| Control Point | Head (m) | Flow (l/s) |
|---|---|---|
| Primary Design | 1.800 | 58.300 |
| Flush-Flo™ | 0.572 | 58.219 |
| Kick-Flo® | 1.241 | 48.739 |
| Mean Flow | | 49.653 |

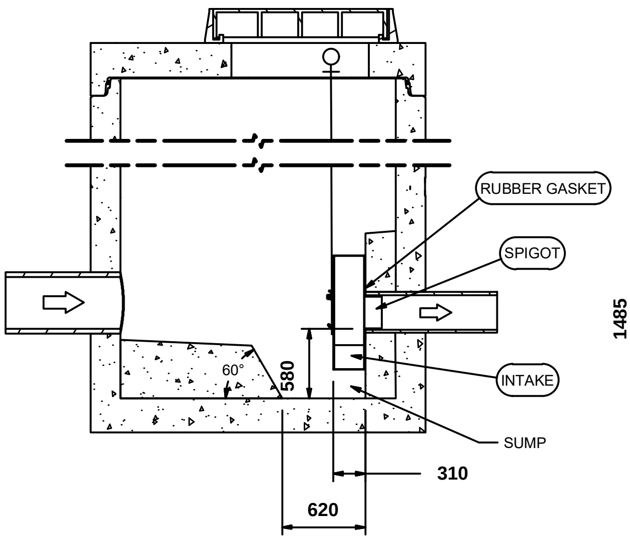
Hydro-Brake® Optimum Flow Control including:

- 5 mm grade 304L stainless steel
- Integral stainless steel pivoting by-pass door allowing clear line of sight through to outlet, c/w stainless steel operating rope
- Beed blasted finish to maximise corrosion resistance
- Stainless steel fixings
- Rubber gasket to seal outlet
- Indicative Weight: 130 kg

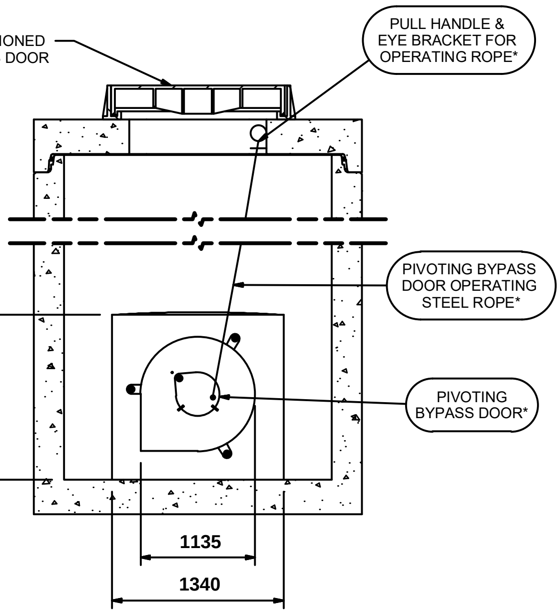
hydro-int.com/patents






SECTION A-A




SECTION B-B

**IMPORTANT:** ⬭ LIMIT OF HYDRO INTERNATIONAL SUPPLY
THE DEVICE WILL BE HANDED TO SUIT SITE CONDITIONS
FOR SITE SPECIFIC DETAILS AND MINIMUM CHAMBER SIZE REFER TO HYDRO INTERNATIONAL
ALL CIVIL AND INSTALLATION WORK BY OTHERS
* WHERE SUPPLIED
HYDRO-BRAKE® FLOW CONTROL & HYDRO-BRAKE® OPTIMUM FLOW CONTROL ARE REGISTERED TRADEMARKS FOR FLOW CONTROLS DESIGNED AND MANUFACTURED EXCLUSIVELY BY HYDRO INTERNATIONAL

**THIS DESIGN LAYOUT IS FOR ILLUSTRATIVE PURPOSES ONLY. NOT TO SCALE.**

DESIGN ADVICE !

The head/flow characteristics of this SHE-0304-5830-1800-5830 Hydro-Brake® Optimum Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.
**The use of any other flow control will invalidate any design based on this data and could constitute a flood risk**.

Hydro International — A CRH COMPANY

| | |
|---|---|
| DATE | 11/12/2023 11:40 |
| SITE | Reliance Precision |
| DESIGNER | Jonathan Allchin |
| REF | 23308 |

SHE-0304-5830-1800-5830
Hydro-Brake® Optimum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jonathan.allchin@dudleys.co.uk

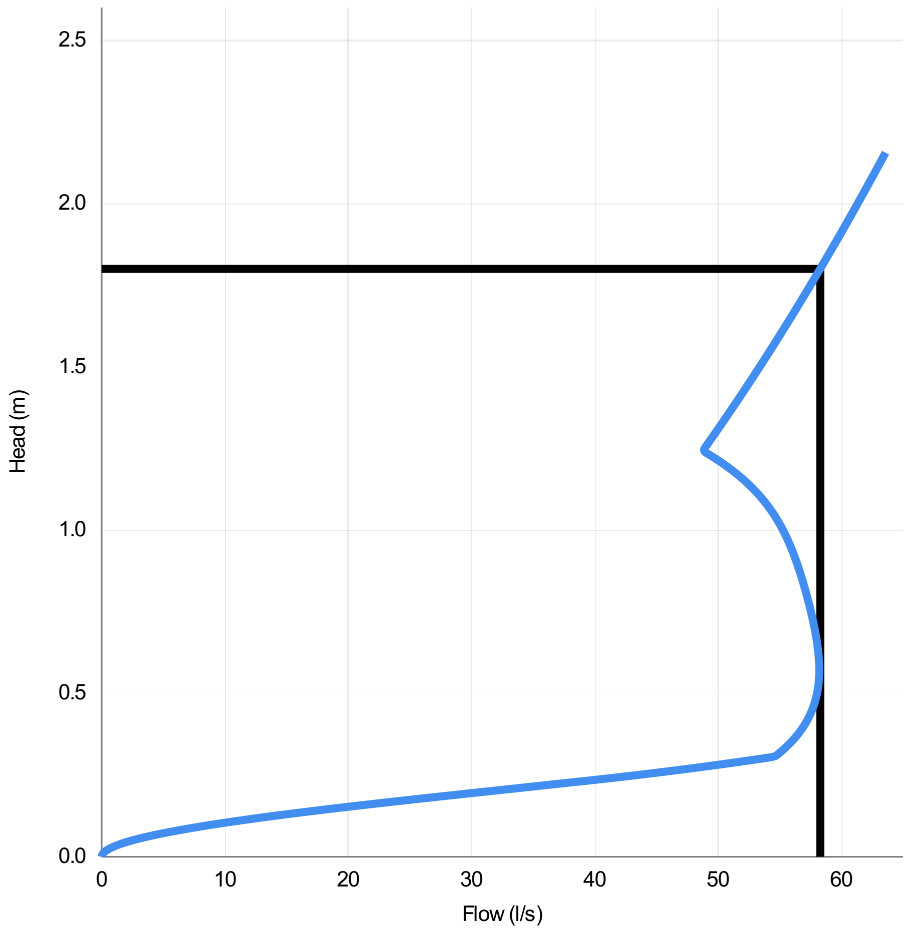
## Technical Specification

| Control Point | Head (m) | Flow (l/s) |
|---|---|---|
| Primary Design | 1.800 | 58.300 |
| Flush-Flo | 0.572 | 58.219 |
| Kick-Flo® | 1.241 | 48.739 |
| Mean Flow | | 49.653 |

hydro-int.com/patents

BBA APPROVAL INSPECTION TESTING CERTIFICATION CERTIFICATE No 08/4596

wrc approved PT/503/0422 Valid: 01/04/2022 - 31/03/2027




| Head (m) | Flow (l/s) |
|---|---|
| 0.000 | 0.000 |
| 0.062 | 3.751 |
| 0.124 | 13.791 |
| 0.186 | 27.888 |
| 0.248 | 43.038 |
| 0.310 | 54.745 |
| 0.372 | 56.432 |
| 0.434 | 57.468 |
| 0.497 | 58.020 |
| 0.559 | 58.214 |
| 0.621 | 58.153 |
| 0.683 | 57.921 |
| 0.745 | 57.578 |
| 0.807 | 57.159 |
| 0.869 | 56.673 |
| 0.931 | 56.096 |
| 0.993 | 55.371 |
| 1.055 | 54.409 |
| 1.117 | 53.094 |
| 1.179 | 51.287 |
| 1.241 | 48.905 |
| 1.303 | 49.896 |
| 1.366 | 51.026 |
| 1.428 | 52.130 |
| 1.490 | 53.209 |
| 1.552 | 54.267 |
| 1.614 | 55.302 |
| 1.676 | 56.318 |
| 1.738 | 57.315 |
| 1.800 | 58.294 |

DESIGN ADVICE

!

The head/flow characteristics of this SHE-0304-5830-1800-5830 Hydro-Brake Optimum® Flow Control are unique. Dynamic hydraulic modelling evaluates the full head/flow characteristic curve.

**The use of any other flow control will invalidate any design based on this data and could constitute a flood risk.**

Hydro International A CRH COMPANY

| | |
|---|---|
| DATE | 11/12/2023 11:40 |
| Site | Reliance Precision |
| DESIGNER | Jonathan Allchin |
| Ref | 23308 |

SHE-0304-5830-1800-5830

Hydro-Brake Optimum®

# Polystorm-R Modular Cell

Data Sheet



Product code: PSM1A

The Polystorm-R modular cell is ideally suited for loaded applications at greater depths, such as housing, commercial and infrastructure projects and has a compressive strength of up to 61 tonnes/m². It offers all the proven performance of the Polystorm cell, with the added benefits of being manufactured from over 90% recycled material content.

Exact colour may vary due to recycled materials.

Wherever performance criteria and standards allow, we will always maximise the sustainability of our products by using post consumer plastics in their manufacture. By sourcing and carefully controlling the quality of the recycled material we use our precision injection moulding. Therefore we are able to guarantee consistent quality in our recycled plastic, giving you the confidence and the performance levels you expect from the market leader.

## Applications

The Polystorm-R modular cells are combined to form a structure that receives rainwater collected from roofs of surface drains. The rainwater is then either attenuated by the structure, when wrapped in an impermeable membrane, or infiltrated by the structure, when wrapped in a permeable geotextile.

## Key Benefits

- Made from specially selected and controlled recycled materials
- Environmentally friendly, sustainable solution
- Has undergone stringent testing to ensure product performance
- Compressive strength of 61 tonnes/m²
- Ideal for retention, attenuation and infiltration applications with a suitable geomembrane or geotextile
- Designed for trafficked and loaded applications
- BBA approved
- Visual and maintenance access an be achieved when used in conjunction with Polystorm Access & Inspect
- Allow flexibility of shape – ideal for shallow excavation systems, narrow strips or use in restricted areas
- Can be used as part of a value engineered hybrid system with Polystorm, Polystorm Lite and Polystorm Xtra
- Integrated inlet and outlet
- 3D flow throughout the structure
- 95% void ratio
- Light in weight yet robust – excellent Health & Safety and installation benefits
- 100% recyclable
- 60 years creep limited life expectancy

| ELEMENT | VALUE |
|---|---|
| **PHYSICAL PROPERTIES** | |
| Length | 1m |
| Width | 0.5m |
| Depth | 0.4m |
| Total volume | 0.2m³ |
| Unit weight | 9kg |
| Unit storage volume | 0.19m³ (190 litres) |
| Void ratio | 95% |
| **SHORT TERM COMPRESSIVE STRENGTH** | |
| Vertical | Maximum 610 kN/m² * |
| Lateral | Maximum 63 kN/m² * |
| **SHORT TERM DEFLECTION** | |
| Vertical | 60 kN/m² per mm |
| Lateral | 4.4 kN/m² per mm |

Note: Polystorm-R is ideal for use in trafficked and pedestrian applications subject to a structural design check and suitable installation conditions

Each unit includes 4 Clips and 2 Shear Connectors.

* Compressive strength at yield, maximum recommended value for design purposes.

BBA BRITISH BOARD OF AGREMENT CERTIFICATE No. 06/4297

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www.polypipe.com/wms

Polypipe

**RECOMMENDED MAXIMUM DEPTH OF INSTALLATION (to cell invert) [m]**

| TYPICAL SOIL TYPE | TYPICAL ANGLE OF SHEAR RESISTANCE | SOIL WEIGHT kN/m³ | WITHOUT GROUNDWATER (below base of cells) NORMAL CASE | | WITH GROUNDWATER AT 1M BELOW GROUND LEVEL AND UNITS WRAPPED IN GEOMEMBRANE | |
|---|---|---|---|---|---|---|
| | | | Pedestrian | Trafficked (cars) <3000kg GVW | Pedestrian | Trafficked (cars) <3000kg GVW |
| Stiff over consolidated clay e.g. London clay | 24 | 20.0 | 2.2 | 1.9 | 1.8 | 1.6 |
| Normally consolidated silty sandy clay e.g. alluvium, made ground | 26 | 19.0 | 2.4 | 2.2 | 1.9 | 1.7 |
| Loose sand and gravel | 30 | 18.0 | 3.0 | 2.7 | 2.0 | 1.9 |
| Medium dense sand and gravel | 33 | 19.0 | 3.2 | 2.9 | 2.0 | 1.9 |
| Dense sand and gravel | 38 | 20.0 | 3.7 | 3.5 | 2.1 | 2.0 |

Note:
1) Stated depths based on the calculation methodology detailed within CIRIA C680 (2008)
2) Assuming water density = 10.0kN/m³
3) Assumed ultimate limit state (ULS) partial factor of safety applied to: Material = 2.75 Lateral pressure = 1.35

## Durability

Wherever allowable we maximise the sustainability of our product by using post-consumer plastics in their manufacture. By carefully sourcing and controlling the quality of the recycled material we are able to guarantee the consistency of our recycled products. The polymer material used in the manufacture of the Polystorm-R unit has an adequate resistance to attack from the type and quantities of chemicals that may be expected to naturally occur in uncontaminated soils and rainwater run-off. When installed in accordance with our recommendations, it is expected that the Polystorm-R unit will have a design life in excess of 60 years*. The installer of a proposed geocellular structure should ensure that an appropriate design check has been undertaken, in accordance with the recommended methodology and factors of safety given in CIRIA C680 (2008), Structural Design of Modular Geocellular Drainage Tanks, prior to the commencement of construction activities.

* Derived from long term extrapolated creep testing

## Notes

1. Unless stated, all values are nominal and may vary within normal production tolerances.
2. The characteristic unit parameters stated have been based on Polypipe BBA certificate Nº 06/4297, sheet 3.
3. Polypipe reserve the right to change product specifications without prior notice.
4. This document is uncontrolled and updates will not be issued automatically.

**RECOMMENDED MINIMUM COVER LEVELS [m]**

| LIVE LOAD CONDITIONS | PEDESTRIAN | LIGHT TRAFFICKED | |
|---|---|---|---|
| | | Car park with vehicle mass <GVW | |
| Minimum cover depth required (m) | 0.50 | <3000kg 0.50 | <9000kg 0.65 |

Note
1) Stated depths based on the calculation methodology detailed within CIRIA C680 (2008)
2) Assumed serviceability limit state (SLS) partial factor of safety applied to: Material = 1.5 Live load = 1.0 Dead load = 1.0
3) Shallower minimum burial depths may be applicable subject to an assessment of the specific site conditions. For further details please consult our Technical Team on 01509 615100.

## Technical Support

Detailed guidance and assistance is available.
For further information, please contact our Technical Team on **+44 (0) 1509 615100** or email **civils@polypipe.com** or visit **www.polypipe.com/civils-technical-hub**

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www.polypipe.com/wms

## Polystorm-R Modular Cell can be utilised in these SuDS techniques

| TECHNIQUES | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blue-Green roofs | Podium Decks | Trees | Sports Pitches | Cycle Paths | Permeable Paving (sub base & podium) | Bioretention & Rain Gardens | Attenuation Storage Tanks | Infiltration | Swales | Filter Drains | Detention Basins | Ponds & Wetlands | Filter Strips |
| | | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

Visit **www.polypipe.com/greeninfrastructure**

# SECTION 4

## SPEL Stormceptor® Class 1
### By-Pass Separators



SPEL

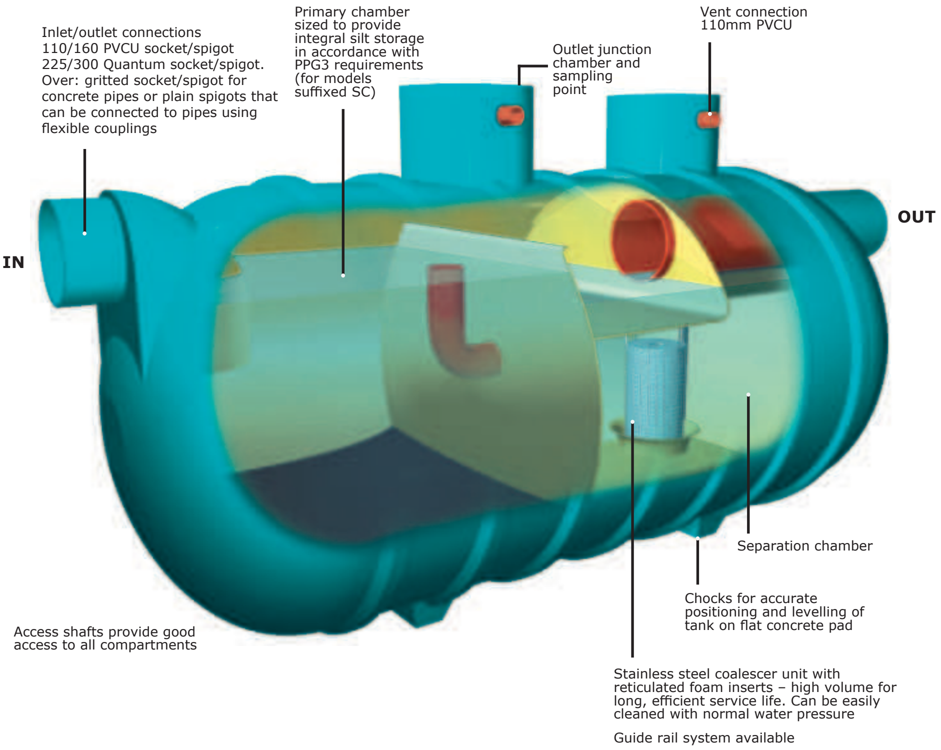
## Compliant to the European Standard BS EN 858-1 and the construction

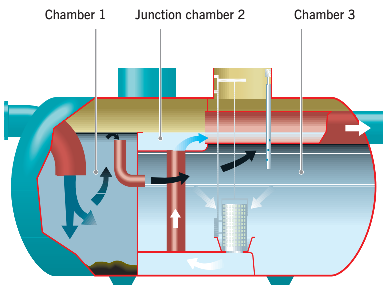
The ‘heart’ of the SPEL Stormceptor® is the unique long life, low maintenance coalescer unit which ‘polishes’ the final effluent AFTER 90% hydrocarbons of silt have been separated out.

The SPEL Stormceptor® is a well proven high quality factory-made unit specially designed and fabricated to provide a very effective means of separating oil and other light liquids from stormwater drainage systems.

The SPEL Stormceptor® was the first Environment Agency listed class 1 by-pass separator to BS EN 858-1:2002.

The SPEL Stormceptor® has been used effectively throughout the UK and abroad since 1985. All sizes and types of development have been catered for, including industrial development sites, hypermarkets and airports. Areas of up to 30 hectares can be covered with a single unit.

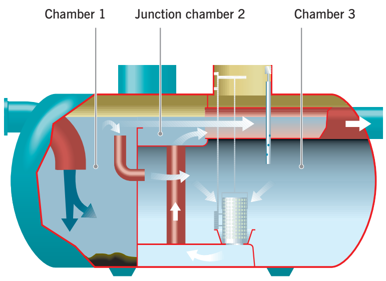



### Flows according to nominal size (NSB)

The polluted surface water first enters the primary chamber where silt settles out and is retained. The fuel, oil and other pollutants lighter than water, rise to the surface and are efficiently skimmed off and transferred to the separation chamber.

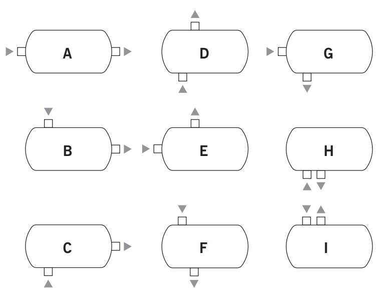
In normal conditions all the flow is through the separation chamber, where the quiescent conditions allow the pollutants to separate out efficiently. Water from the cleanest zone in the separation chamber flows through a coalescer unit, to remove smaller globules of oil, up to the junction chamber and thence to the outlet.




### Storm flows above NSB

During a storm the level in the primary chamber rises and the stormwater passes over the weir into the junction chamber and to the outlet.

The design keeps the turbulence within the separation chamber to a minimum which avoids disturbing the contaminants retained.




### Choice of pipe connections orientations

The orientation of inlet/outlet connections indicated depends on the pipe diameter (see under A–I and D–I 4.2). Any special requirements contact Technical Sales.

Both inlet and outlet connections are spigots (GRP or PVCU) and can be connected to the site pipework using Flex-Seal, Band-Seal or similar flexible couplings.

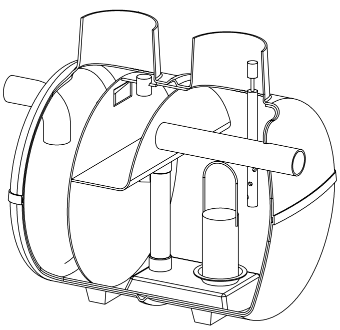

 T. +44 (0)1743 445200 F. +44 (0)1743 465442 E. info@spelproducts.co.uk

## 100 and 200 Series, Class 1

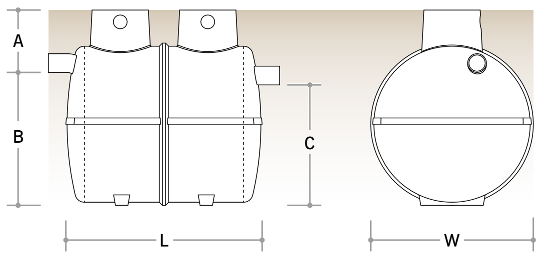
### Compliant to the European Standard BS EN 858-1 and the Construction Products Regulations

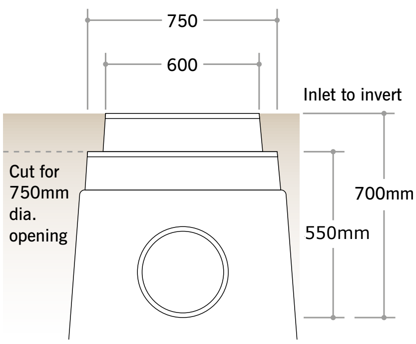
| | Nominal size (NSB) | | Catchment area ($m^2$) | Oil storage (litres) | Silt storage (litres) | Length (mm) | Diameter (mm) | Inlet Invert (mm) | Base to inlet (mm) | Base to outlet | Max in/out pipe diameter (mm) for orientation | | | Number of access shafts Diameter (mm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | Flow (l/s) | Peak Flow (l/s) | | NSB x 15 | NSB x 100 | L | W | A | B | C | A-C | D-I | 450 | 600/750* | 900 |
| 103 C1/SC | 3 | 30 | 1667 | 45 | 300 | 1550 | 1300 | 500 | 1015 | 965 | 160 | 160 | 2 | - | - |
| 204 C1/SC | 4 | 40 | 2222 | 60 | 400 | 1860 | 1225 | 550/700* | 1350 | 1300 | 300 | 300 | - | 1 | - |
| 206 C1/SC | 6 | 60 | 3333 | 90 | 600 | 2120 | 1225 | 550/700* | 1350 | 1300 | 300 | 300 | - | 1 | - |
| 208 C1/SC | 8 | 80 | 4444 | 120 | 800 | 2270 | 1225 | 550/700* | 1350 | 1300 | 300 | 300 | - | 1 | - |
| 210 C1/SC | 10 | 100 | 5556 | 150 | 1000 | 2920 | 1225 | 550/700* | 1350 | 1300 | 300 | 300 | - | 1 | - |
| 212 C1/SC | 12 | 120 | 6667 | 180 | 1200 | 3570 | 1225 | 550/700* | 1350 | 1300 | 300 | 300 | - | 1 | - |
| 215 C1/SC | 15 | 150 | 8333 | 225 | 1500 | 4237 | 1225 | 550/700* | 1350 | 1300 | 300 | 300 | - | 1 | - |

* 200 Series Stormceptors® have a dual size access shaft. For units that will collect silt we recommend using the 750mm diameter access which provides enough room for the silt removal hose to be lowered into the tank during maintenance. The value of 'A' here is 550mm for the 750mm diameter access and 700mm for the 600mm diameter access.

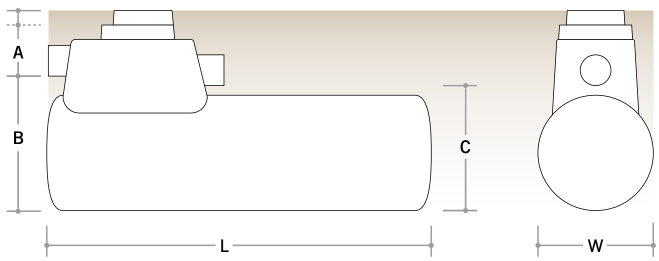


#### 100 Series




#### 200 Series




### Dual access shaft openings

For access to desludge primary chamber, cut to 750mm dia. access shaft opening. Where a silt trap is incorporated upstream or silt build up will not occur 600mm diameter access shaft may be adequate.

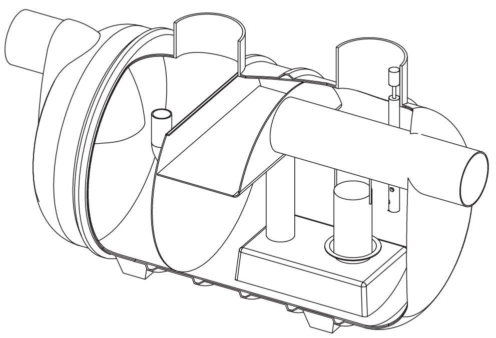
Refer to 4.5 for more comprehensive data including installation.

# 4.3 SPEL Stormceptor® By-Pass Separators

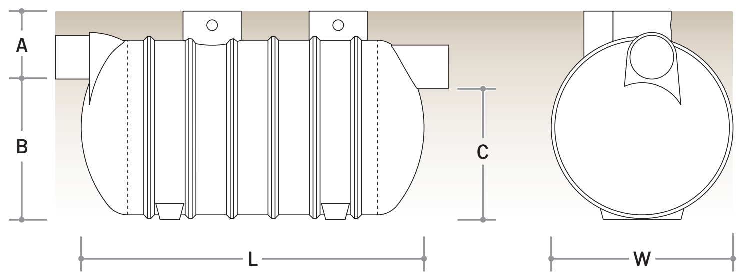
## 300 and 400 Series, class 1

**Compliant to the European Standard BS EN 858-1 and the Construction Products Regulations**

| | Nominal size (NSB) | | Catchment area ($m^2$) | Oil storage (litres) | Silt storage (litres) | Length (mm) | Diameter (mm) | Inlet Invert (mm) | Base to inlet (mm) | Base to outlet | Max in/out pipe diameter (mm) for orientation | | Number of access shafts Diameter (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | Flow (l/s) | Peak Flow (l/s) | | NSB x 15 | NSB x 100 | L | W | A | B | C | A-C | D-I | 450 | 600 | 750 | 900 |
| 320 C1/SC | 20 | 200 | 11111 | 300 | 2000 | 3200 | 1875 | 700 | 1450 | 1350 | 450 | 600 | - | 2 | - | - |
| 325 C1/SC | 25 | 250 | 13889 | 375 | 2500 | 3540 | 1875 | 700 | 1450 | 1350 | 450 | 600 | - | 2 | - | - |
| 330 C1/SC | 30 | 300 | 16667 | 450 | 3000 | 4420 | 1875 | 700 | 1450 | 1350 | 450 | 600 | | - | 1 | 1 |
| 340 C1/SC | 40 | 400 | 22222 | 600 | 4000 | 5760 | 1875 | 740 | 1410 | 1310 | 450 | 600 | - | 1 | 1 | - |
| 345 C1/SC | 45 | 450 | 25000 | 675 | 4500 | 6570 | 1875 | 740 | 1410 | 1310 | 450 | 600 | - | 1 | 1 | - |
| 350 C1/SC | 50 | 500 | 27778 | 750 | 5000 | 7060 | 1875 | 740 | 1410 | 1310 | 450 | 600 | - | 1 | 1 | - |

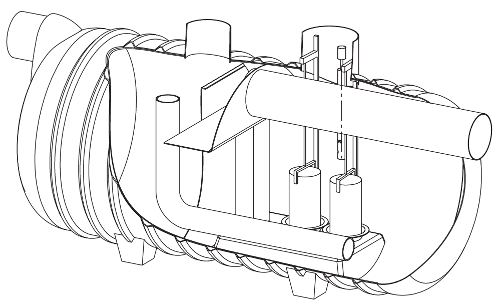


### 300 Series

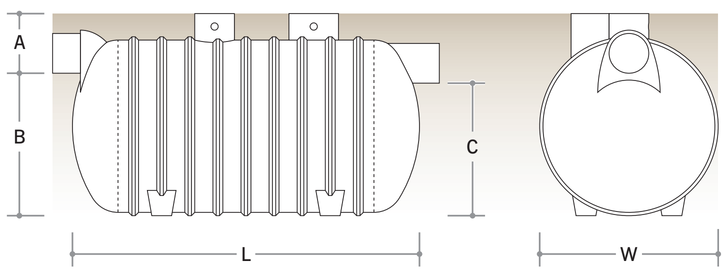



| | Nominal size (NSB) | | Catchment area ($m^2$) | Oil storage (litres) | Silt storage (litres) | Length (mm) | Diameter (mm) | Inlet Invert (mm) | Base to inlet (mm) | Base to outlet | Max in/out pipe diameter (mm) for orientation | | Number of access shafts Diameter (mm) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | Flow (l/s) | Peak Flow (l/s) | | NSB x 15 | NSB x 100 | L | W | A | B | C | A-C | D-I | 450 | 600 | 750 | 900 |
| 460 C1/SC | 60 | 600 | 33333 | 900 | 6000 | 4400 | 2700 | 950 | 2100 | 2000 | 600 | 750 | - | 1 | - | 1 |
| 470 C1/SC | 70 | 700 | 38889 | 1050 | 7000 | 5250 | 2700 | 950 | 2100 | 2000 | 600 | 750 | - | 1 | - | 1 |
| 480 C1/SC | 80 | 800 | 44444 | 1200 | 8000 | 6170 | 2700 | 950 | 2100 | 2000 | 600 | 750 | - | 1 | - | 1 |
| 4100 C1/SC | 100 | 1000 | 55556 | 1500 | 10000 | 7400 | 2700 | 1100 | 1950 | 1850 | 750 | 900 | - | 1 | - | 1 |
| 4125 C1/SC | 125 | 1250 | 69444 | 1875 | 12500 | 9050 | 2700 | 1100 | 1950 | 1850 | 750 | 900 | - | 1 | - | 1 |
| 4150 C1/SC | 150 | 1500 | 83333 | 2250 | 15000 | 9950 | 2700 | 1100 | 1950 | 1850 | 750 | 900 | - | - | - | 2 |
| 4160 C1/SC | 160 | 1600 | 88889 | 2400 | 16000 | 11830 | 2700 | 1250 | 1800 | 1700 | 750 | 900 | | 1 | 1 | 1 |

400 Series – models without silt capacity are available if required – details on application.



### 400 Series



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## 500 and 600 Series, class 1

### Compliant to the European Standard BS EN 858-1 and the Construction Products Regulations

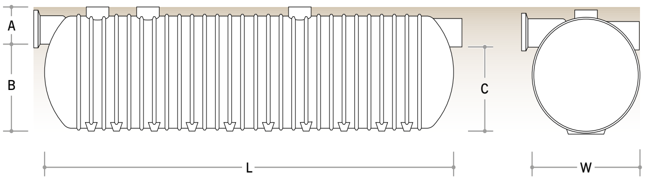
These Stormceptors® are individually designed in accordance with specific site requirements according to catchment area, class, silt capacity, inlet/outlet connection size and orientation. The following is an approximate guide to the range of models available. Please contact our technical department for your specific requirements.

| | Nominal size (NSB) | | Catchment area | Oil storage (litres) | Silt storage (litres) | Length (mm) | Diameter (mm) | Inlet Invert (mm) | Base to inlet (mm) | Base to outlet | Max in/out pipe diameter (mm) for orientation | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Model | Flow (l/s) | Peak Flow (l/s) | hectares | NSB x 15 | NSB x 100 | L | W | A | B | C | A-C | D-I |
| 5180 C1/SC | 180 | 1800 | 10 | 2700 | 18000 | 7470 | 3650 | 1185 | 2690 | 2550 | 900 | 900 |
| 5200 C1/SC | 200 | 2000 | 11.1 | 3000 | 20000 | 8530 | 3650 | 1185 | 2690 | 2355 | 1200 | 1200 |
| 5250 C1/SC | 250 | 2500 | 13.9 | 3750 | 25000 | 10040 | 3650 | 1185 | 2690 | 2355 | 1200 | 1200 |
| 6300 C1/SC | 300 | 3000 | 16.7 | 4500 | 30000 | 10310 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6350 C1/SC | 350 | 3500 | 19.4 | 5250 | 35000 | 11470 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6400 C1/SC | 400 | 4000 | 22.2 | 6000 | 40000 | 12690 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6500 C1/SC | 500 | 5000 | 27.8 | 7500 | 50000 | 15870 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6600 C1/SC | 600 | 6000 | 33.3 | 9000 | 60000 | 18260 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6700 C1/SC | 700 | 7000 | 38.9 | 10500 | 70000 | 22250 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6500 C1 | 500 | 5000 | 27.8 | 7500 | Nil | 11910 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6600 C1 | 600 | 6000 | 33.3 | 9000 | Nil | 13510 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6700 C1 | 700 | 7000 | 38.9 | 10500 | Nil | 16650 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6750 C1 | 750 | 7500 | 41.7 | 11250 | Nil | 18260 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |
| 6800 C1 | 800 | 8000 | 44.4 | 12000 | Nil | 19890 | 4150 | 1325 | 2850 | 2675 | 1200 | 1200 |

Pipe size and orientation designed to suit site pipework and class 1.

**Series 500**
Inside diameter 3500mm, outside diameter 3650mm.

**Series 600**
Inside diameter 4000mm, outside diameter 4150mm.




### Features

Filament wound shells are lightweight but have great strength and durability.

Life expectancy in excess of fifty years.

Smooth, high gloss, corrosion resistant, resin-rich internal surface.

External 'flow coat' water penetration barrier.

25 year warranty.

Stainless steel coalescer units (class 1 separators) with durable high volume reticulated foam inserts for long life and long term efficiency.

**SPEL automatic alarm/monitoring system**

This is to indicate when separator requires emptying or SPEL Tankstor® with Econoskim®. See section 3.

### Optional extras

SPEL coalescer unit guide rail system. See 3.7.

SPEL coalescer unit lifting/locating/ locking system with lifting chains. See 3.7.

SPEL Econoskim® light liquid skimming and separator containment system. Manual or automatic systems which save conventional emptying costs by 90%. Section 7.

SPEL pollution monitoring and containment systems. Section 8.

SPEL mechanical anchoring systems. See 13.11/13.12.

GRP non slip ladder/s with stainless steel fixings.

### Regulation/specification compliance as appropriate

**European Standard**

Compliant to BS EN 858-1 and the Construction Products Regulations.

Underground tanks of glass reinforced plastics (GRP) BS EN 976-1 : 1997.

**British Standard**

Specification for design and construction of vessels and tanks in reinforced plastics BS EN 13121.

Materials to BS 3532, BS 3691 and or BS 2782 or equivalent standards.

## Brief installation instructions – for details refer to Section 13: SPEL Underground Tanks

### Handling

Tanks should be lifted using slings not chains or wire ropes. DO NOT drag tanks along the ground for any distance and avoid jarring or bumps. DO NOT lift with water in the tank. See 13.2.

### Installation guidance notes

Installation should be carried out by a competent contractor in accordance with the following procedures, Health & Safety at Work legislation and good building practice. For detailed instructions see section 13 or installation instructions supplied with every tank.

### Tank dimensions

Dimensions given on the drawings and literature are subject to manufacturing tolerances and should be checked physically prior to installation. This applies to overall length, connection positions, their size and invert dimensions. Also check the correct way the tank shall be installed and alignment with site drainage.

**1.** Determine the size of the excavation allowing for the drain invert depth and a concrete surround. Allowance should be made for consolidating concrete under the unit when backfilling.

**2.** Pour concrete base to correct depth and level off.

**3.** When the concrete has set sufficiently, place the tank in position, check for levels (including inlet/outlet inverts) and fill with water to a maximum depth of: 200 series – 200mm, 300 series – 300mm, 400 series – 400mm. Ensure concrete slab is clean ready for placing concrete surround. Surround should preferably be placed within 48 hours of casting the base slab.

**4.** Place backfill concrete (ST4 mix) up to the depth of the water in the tank ensuring the concrete is properly consolidated under the tank to prevent voids. Consolidate by hand – do not use vibrating pokers. Connect up pipework.

**5.** Continue backfilling with concrete and at the same time filling the tank with water to equalise pressure and resist floatation. Where the tank is divided into chambers ensure all chambers are filled equally.

**6.** Extension access shafts are available in 500mm increments with socket joints or if required, flanged joints with neoprene gaskets.
Prior to surrounding in concrete if required, ensure rectangular access shafts are shuttered internally to support the sides and prevent distortion. This is especially important when guide rails are installed for pumps or coalescer units.
With a high water table ensure all joints are double sealed to prevent ingress of water.

**7.** Top up the tank with water to inlet/outlet invert level and place remainder of concrete to a depth of approximately 200-250mm above the top of the tank. Where extension access shaft is fitted, this can be surrounded in concrete once the main tank concrete surround has set. (See Extension access shafts 13.1).

**8.** Where the concrete slab over the tank is to take vehicle loading it should be reinforced in accordance with good practice to take the maximum load and should be extended onto unexcavated ground. It is important that vehicle loading is not transferred to the tank shell or its concrete surround.

**9.** Incorporate inspection cover and frame.

### Venting

SPEL Separators are governed by the requirements of petroleum regulations: Petrol filling stations: Construction and Operation HS(G)41, ISBN 0-11885449-6. These state in paragraph 45, that each chamber of a petrol interceptor should be vented and vent pipes should extend to not less than 2.4m above ground level, should not be less than 75mm diameter and of a robust construction, and should be manifolded above ground.

### SPEL automatic alarm/monitoring system

The SPEL automatic alarm/monitoring system shall be fitted for continuous monitoring of the separator contents by sensing when the light liquid within the separator has filled to a predetermined level (with design safety margins), and provides a simple audio-visual warning to alert the operator that the separator needs to be emptied. The system is very easy to install and comprises two parts: a compact control unit and a probe unit. It is self-contained and requires only a normal 240v AC electrical supply. The control incorporates a ATEX approved intrinsically safe circuit, which enables the probe unit to be used in Zone Zero Environments. See section 3.

### Maintenance

The SPEL Separators have good access for periodic emptying of retained light liquids and sludge which is essential to maintain the units optimum performance. Periods between emptying will have to be determined depending on site conditions but normally at least twice a year. For further details see Section 3.

*Note: The above must be read in conjunction with the Installation Instructions in Section 13.*

# RAF Brize Norton

CASE STUDY

**Project: RAF Brize Norton**

**Contractor: Tamdown Group Ltd**

**Products:**
**SPEL Stormceptor® Class 1 By-pass Separators:**
**1 No. 460C1/SC**
**1 No. 325C1/SC**
**1 No. 6400C1/SC**

**Puraceptor® Class 1 Full Retention Separator:**
**1 No. P050/1CSC**

A C17 aircraft taxies past one of the new Voyager aircraft with its hangars under construction.

RAF Brize Norton in Oxfordshire is the largest station in the RAF and is home to the Strategic and Tactical Air Transport Force as well as the Air to Air Refuelling Squadron.

This Air Base is extremely busy, being the air hub for all British troops and equipment moving to and from the various areas of conflict and training around the globe. It has undergone a major expansion program in recent years to accommodate the consolidation of this vital role from a number of other bases, with a number of new facilities being built to house the introduction of 3 new aircraft types. The Boeing C17 Globemaster is the RAFs big lifter being able to swallow a Chinook helicopter but it can also be configured for troop transport or Medivac. The Airbus A300 Voyager has two key roles, firstly as a liner style troop transport and also as a tanker providing in flight fuel to other aircraft. The newest is the Airbus A400 Atlas, the first of which arrived in November 2014, this aircraft will progressively replace the Lockeed C130 Hercules by 2022 in the equipment, paratrooper and humanitarian support role.

New hangars and service facilities for these aircraft have been built at RAF Brize Norton with SPEL Products Separators being installed to ensure the best quality pollution control is an integral part of the drainage network for the huge structures and surrounding parking areas.

# RAF Marham

CASE STUDY

**Project:** **Taxiway drainage**

**Contractor:** **GallifordTry/Lagan**

**Products:**
**SPEL Stormceptor® Class 1 By-pass Separators:**
**8no 215's C1/SC**
**1no 206 C1/SC**
**1no 204 C1/SC**
**1no 208. C1/SC**

**SPEL Puraceptor® Class 1 Full Retention Separator:**
**P400 1CSC (treating 400l/sec)**

**RAF Marham is a Royal Air Force station and military airbase near the village of Marham in the county of Norfolk, East Anglia. It is home to No. 138 Expeditionary Air Wing and, as such, is one of the RAF's Main Operating Bases. It was home to the frontline squadrons of the RAF's Tornado Force, ready for operations across the globe. Tornados from RAF Marham have been involved in operations in the Middle East for over 25 years and are supporting the fight against Daesh in the skies over Iraq and Syria.**

Extensive infrastructure changes are being completed across the base with the arrival of the F-35 Lightning last year. The F-35 Lightning is a 5th Generation, multi-role, stealth fighter. The squadron is the famous No. 617.

**617 Squadron**
This squadron is undoubtedly the most famous RAF squadron of the Second World War, earning that fame on its first operational sortie, the famous dams raid of 16/17 May 1943. The squadron was formed on 21 March 1943 as an 'elite within a elite' with selected crews. Its original purpose was to use Barnes Wallis's 'bouncing bomb' in a raid on several Ruhr dams. The hope was that the destruction of these dams and the resulting loss of water would have a devastating impact on German industrial potential.

Barnes Wallis, a British engineer, began working on plans for a bomb that could skip across water. He developed the idea by experimenting with bouncing marbles across a water tub in his back garden. Wallis thought the new weapon could be used to attack moored battleships, but research soon focused on using it against the dams that were vital to German industry. This research and development steadily progressed, albeit with failures and successes, to be proven sufficiently to be considered viable.

617 Squadron was formed on 21 March 1943 and Wing Command Guy Gibson, already a very experienced bomber pilot, was chosen to lead it. The crews were amongst the best in Bomber Command. The operation required then to train in low level flight and navigation and to perfect the demanding run-ins, different for each dam.

From 9.28pm on 16 May, 133 aircrew in 19 Lancasters took off in three waves to bomb the dams. Gibson was flying in the first wave and his aircraft was first to attack the Möhne (pictured here) at 12.28am, but five aircraft had to drop their bombs before it was breached.
The remaining aircraft still to drop their bombs then attacked the Eder, which finally collapsed at 1.52am.
Meanwhile, aircraft from the two other waves bombed the Sorpe but it remained intact.
The mission proved a costly success. Eight of the nineteen aircraft were lost, and only three of their crew survived.

*Continued overleaf*

# The SPEL SuDS Handbook

With SPEL Products

# The Product Range
## Mitigation Index

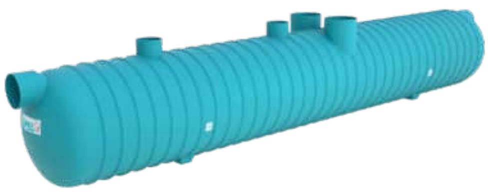
## SPEL ESR Stormceptor

| | Product Certified Mitigation Index | **Covers Low Risk** Pollution Index | **Covers Medium Risk** Pollution Index | **Covers High Risk** Pollution Index |
|---|---|---|---|---|
| TSS | 0.8 | 0.5 ✓ | 0.7 ✓ | 0.8 ✓ |
| Metals | 0.6 | 0.4 ✓ | 0.6 ✓ | 0.8 ✗ |
| Hydrocarbon | 0.9 | 0.4 ✓ | 0.7 ✓ | 0.9 ✓ |

## SPEL ESR Puraceptor

*Awaiting certification*

| | Product Certified Mitigation Index | **Covers Low Risk** Pollution Index | **Covers Medium Risk** Pollution Index | **Covers High Risk** Pollution Index |
|---|---|---|---|---|
| TSS | 0.8 | 0.5 ✓ | 0.7 ✓ | 0.8 ✓ |
| Metals | 0.6 | 0.4 ✓ | 0.6 ✓ | 0.8 ✗ |
| Hydrocarbon | 0.9 | 0.4 ✓ | 0.7 ✓ | 0.9 ✓ |



## SPEL Smartceptor

| | Product Certified Mitigation Index | **Covers Low Risk** Pollution Index | **Covers Medium Risk** Pollution Index |
|---|---|---|---|
| TSS | 0.5 | 0.5 ✓ | 0.7 ✗ |
| Metals | 0.4 | 0.4 ✓ | 0.6 ✗ |
| Hydrocarbon | 0.5 | 0.4 ✓ | 0.7 ✗ |

# The Product Range
## Mitigation Index

## SPELFilter

*This product is not a primary hydrocarbon treatment system*

| | Product Certified Mitigation Index | Covers Low Risk Pollution Index | Covers Medium Risk Pollution Index | Covers High Risk Pollution Index |
|---|---|---|---|---|
| TSS | 0.9 | 0.5 ✓ | 0.7 ✓ | 0.8 ✓ |
| Metals* | 0.8 | 0.4 ✓ | 0.6 ✓ | 0.8 ✓ |
| Hydrocarbon | n/a | 0.4 ✗ | 0.7 ✗ | 0.9 ✗ |

**Includes dissolved metals*

## Floating Treatment Wetlands

| | Product Certified Mitigation Index | Covers Low Risk Pollution Index | Covers Medium Risk Pollution Index | Covers High Risk Pollution Index |
|---|---|---|---|---|
| TSS | 0.7 | 0.5 ✓ | 0.7 ✓ | 0.8 ✓ |
| Metals | 0.7 | 0.4 ✓ | 0.6 ✓ | 0.8 ✓ |
| Hydrocarbon | 0.5 | 0.4 ✓ | 0.7 ✗ | 0.9 ✗ |

## From the Ciria SuDs Manual (C753):

*For reference notes, please see the full manual: https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx*

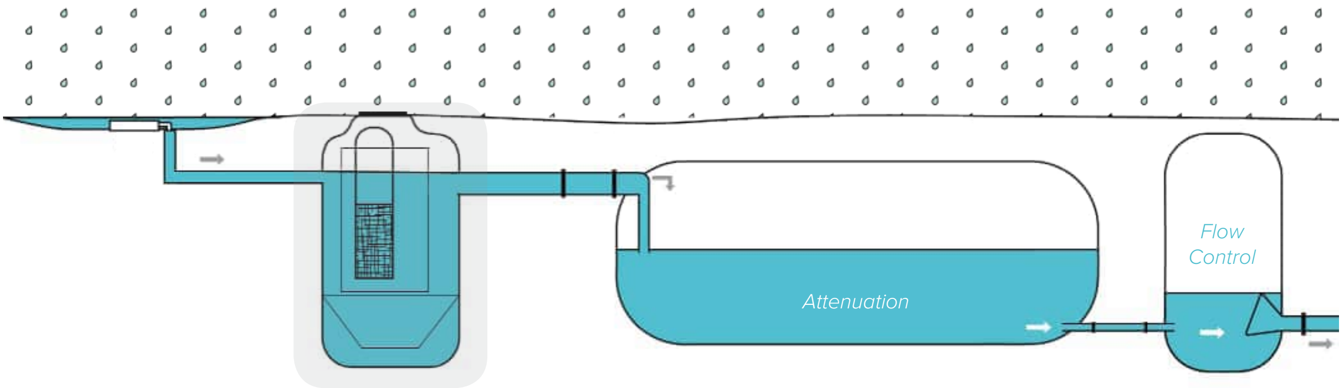
**26.2** Pollution hazard indices for different land use classifications

| Land use | Pollution hazard level | Total suspended solids (TSS) | Metals | Hydrocarbons |
|---|---|---|---|---|
| Residential roofs | Very low | 0.2 | 0.2 | 0.05 |
| Other roofs (typically commercial/industrial roofs) | Low | 0.3 | 0.2 (up to 0.8 where there is potential for metals to leach from the roof) | 0.05 |
| Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day | Low | 0.5 | 0.4 | 0.4 |
| Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads and trunk roads/motorways[1] | Medium | 0.7 | 0.6 | 0.7 |
| Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1] | High | 0.8[2] | 0.8[2] | 0.9[2] |

# Simplifying the Simple Index Approach

Your SuDS Treatment Train with SPEL Products

## Low Mitigation Index = TSS 0.5 | Metal 0.4 | Oil 0.4




**SPEL Smartceptor**

TSS 0.5 | Metal 0.4 | Oil 0.5

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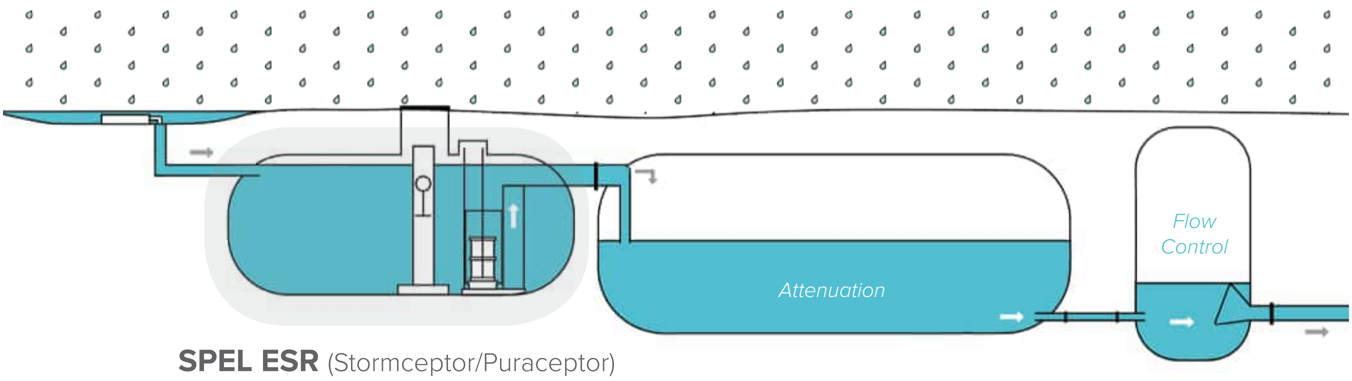
## Medium Mitigation Index = TSS 0.7 | Metal 0.6 | Oil 0.7



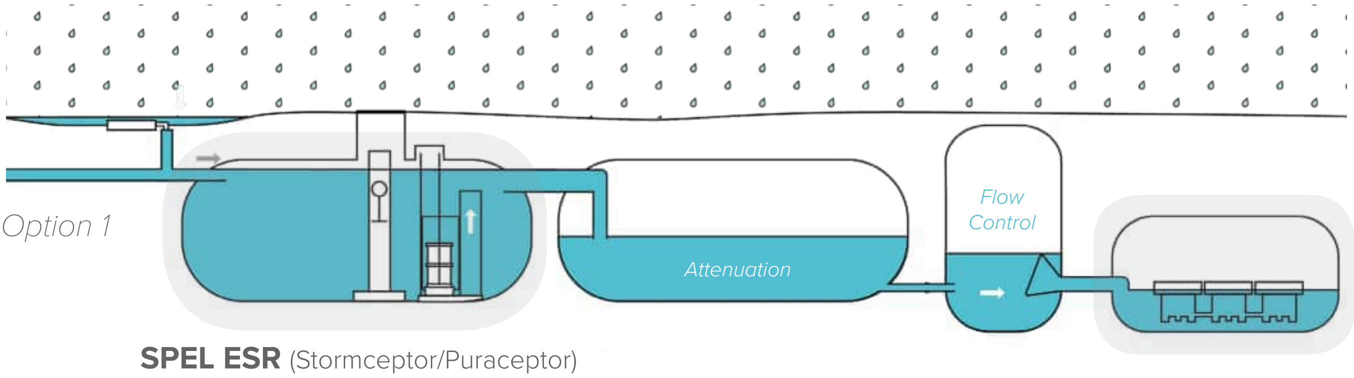

**SPEL ESR** (Stormceptor/Puraceptor)

TSS 0.8 | Metal 0.6 | Oil 0.9

# Simplifying the Simple Index Approach
## Your SuDS Treatment Train with SPEL Products

### High Mitigation Index = TSS 0.8 | Metal 0.8 | Oil 0.9

*Option 1*




**SPEL ESR** (Stormceptor/Puraceptor)
TSS 0.8 | Metal 0.6 | Oil 0.9

**SPELFilter**
TSS 0.8 | Metal 0.6

SPEL ESR + 50% of SPELFilter = **TSS 1.0** | **Metal 1.0** | **Oil 0.9**

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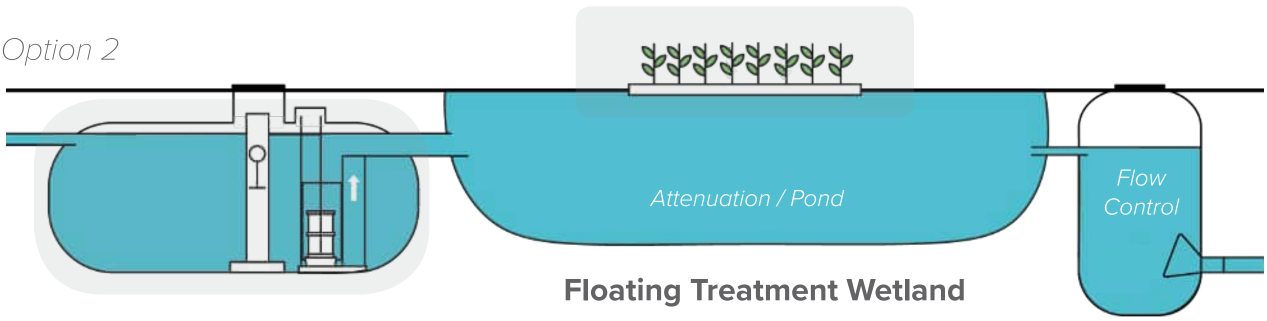
### High Mitigation Index = TSS 0.8 | Metal 0.8 | Oil 0.9

*Option 2*




**SPEL ESR** (Stormceptor/Puraceptor)
TSS 0.8 | Metal 0.6 | Oil 0.9

**Floating Treatment Wetland**
TSS 0.7 | Metal 0.7 | Oil 0.5

SPEL ESR + 50% of FTW = **TSS 1.0** | **Metal 0.9** | **Oil 1.0**

Quality that protects the environment the **safest way**

## Contact us

Our technical team are here to help

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SPEL is an environmentally accredited company to ISO 14001.

Certificate No: FM 35174 UVDB/Achilles accredited – Supplier No. 88611.

Scan code with a QR reader to launch our website: spelproducts.co.uk

#ZeroPollutionAmbassadors

SPEL 02/22



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