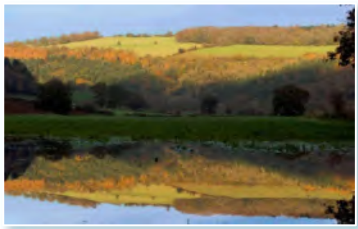

Drainage Statement

Newbridge Road Industrial Estate, Pontllanfraith

On behalf of

Formaction Limited

Quality Management

Prepared by:	Tom Paltridge BSc MSc FGs	
Reviewed and authorised by:	Chris Betts MSc FGS CGeol	CGeol
Calculations Approved by:	Chris Betts MSc FGS CGeol	CGeol
Date:	March 2024	
Revision:	Version 1	
Project Number:	HYG1246	
Document Reference:	HYG1246 R 240306 TP Frontier Site Drainage Statement	
Document File Path:	https://hydrogeoltd-my.sharepoint.com/personal/mike_hydrogeo_co_uk/Documents/Projects/HYG1246 - Frontier Site Newbridge Road/Reports/Drainage Statement/Final/HYG1246 R 240306 TP Frontier Site Drainage Statement.docx	

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bsi. ISO 9001 Quality Management

Contents

Tables

Figures

Drawings and Appendices

1 Introduction

1.1 Background

Hydrogeo Limited (Hydrogeo) have been commissioned by Formaction Limited (the Client) to produce a Drainage Statement to support a planning application for a proposed commercial development on land at the former Frontier Medical Site, Newbridge Road Industrial Estate, Pontllanfraith (the Site).

This drainage statement provides details of the method that will be used to discharge the surface water runoff at the Site. The drainage statement will form the basis of a forthcoming drainage design report, in accordance with the six standards requiring evaluation as part of a SAB full-application enquiry.

Flood risk at the development site is discussed in the report.

1.2 Standards

This drainage statement references the principles of SuDS presented in the 'Statutory Standards for Sustainable Drainage Systems – Designing, constructing, operating and maintaining surface water drainage systems'.

The six standards that need to be met are as follows:

- S1 – Surface water runoff destination
- S2 – Surface water runoff hydraulic control
- S3 – Water Quality
- S4 – Amenity
- S5 – Biodiversity
- S6 – Designing drainage for construction, operation, maintenance and structural integrity

1.3 Climate Change

Projections of future climate change in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. The recommended national precautionary sensitivity range for peak rainfall intensity is 40%.

2 Location & Development Description

2.1 Site Location

The Site is located at the Newbridge Road Industrial Estate, Pontllanfraith, NP12 2YL. The grid reference for the centre of the Site is 318649, 196061.

The location of the Site has been shown in Figure 2-1 and the boundary of the Site has been shown in Figure 2-2.

Figure 2-1 Site location

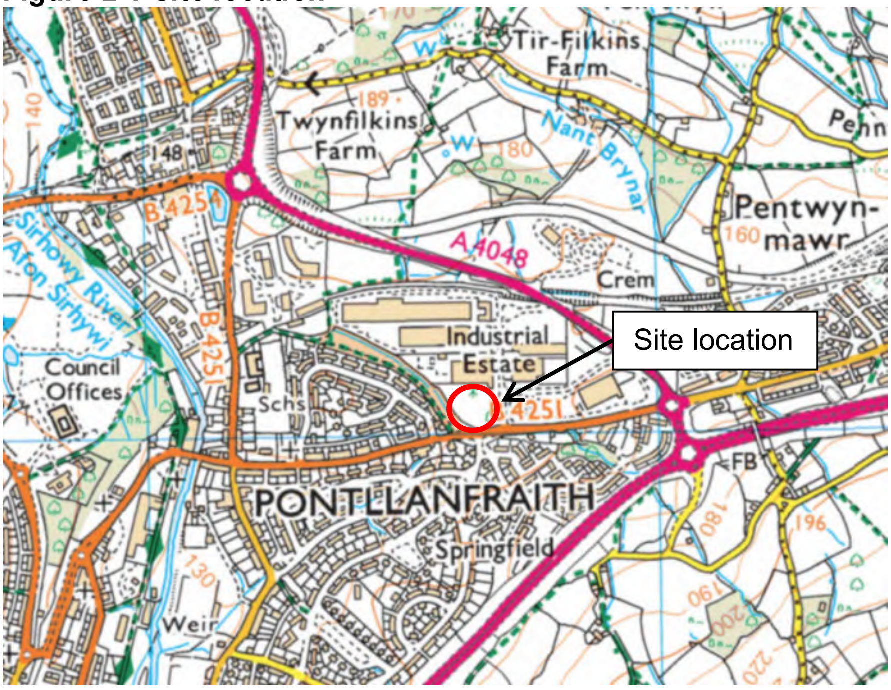
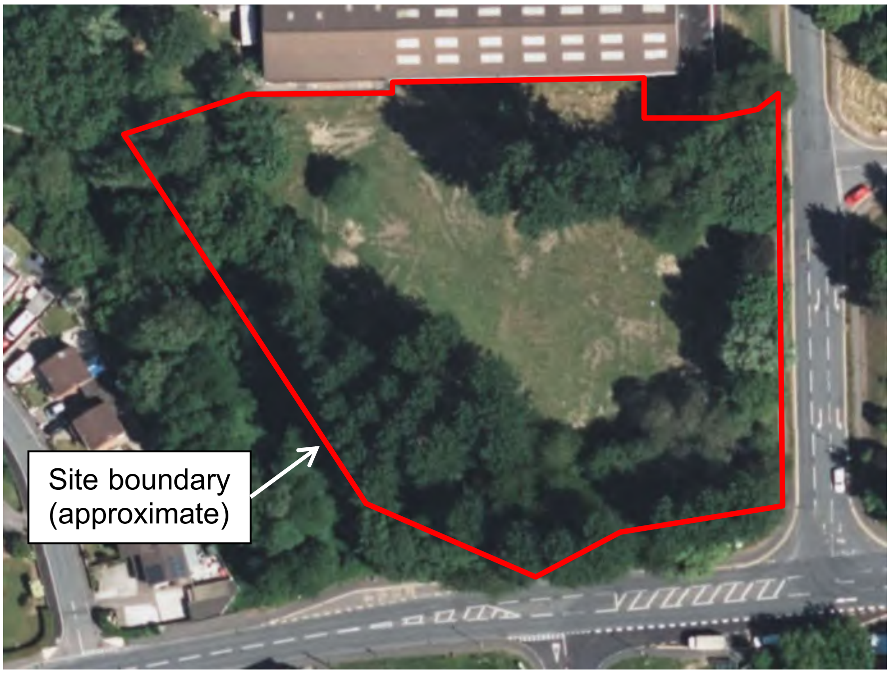


Figure 2-2 Site boundary



2.2 Existing Development

The Site comprises an undeveloped plot of land, formerly a soft landscaping area of the Frontier Medial site immediately to the north. The Site is approximately 7,900m^2 in size and generally flat, at an elevation of approximately 142m above ordnance datum (mAOD).

The Site is located in an industrial estate, and is bounded to the north by a commercial premises, to the east by a stream, and to the south and east by highways.

2.3 Proposed Development

The proposed development comprises the construction of a new metal framed and clad commercial building with individual units for rent.

The proposed site layout plan has been attached at Appendix A.

2.4 Existing Drainage

The Site comprises undeveloped soft landscaping therefore has no formal drainage. Existing surface water and combined sewer drainage is present below the Site, from adjacent premises at Newbridge Industrial Estate.

A Dŵr Cymru Welsh Water (DCWW) sewer plan has been attached at Appendix B and shows two combined sewers, 225mm and 300mm vitrified clay, cross the Site.

Additionally, a 600mm vitrified clay surface water sewer below the highway to the east is shown to enter an outfall at the eastern boundary of the Site; this outfall is into a concrete box culvert.

The Nant Brynar watercourse catchment extends to the north east of the site, however the watercourse has been culverted beneath road to the Newbridge Road Industrial Estate and crosses the site in a box culvert. This Ordinary Watercourse contained in a box culvert passes below the Site from north east to south west: a survey of this feature has been undertaken (attached at Appendix C), including CCTV, proved the position, depth and construction of the culvert which identified no significant issues. A still from the CCTV survey has been shown in Figure 2-3.

Figure 2-3 CCTV survey of box culvert below Site

It is understood that an existing private surface water drainage connection to the box culvert is present towards the south west of the Site.

The position of the proposed building at the Site has been designed to have a minimum horizontal offset from the outer perimeter of the culvert of 8 meters, measured from the widest part of the culvert to comply with Chapter 1, Section 3 (iii) of the Caerphilly County Borough Council Land Drainage Bye-laws 2018.

2.5 Catchment Hydrology

Available Ordnance Survey (OS) mapping has been used to determine the surface water features in the vicinity of the Site.

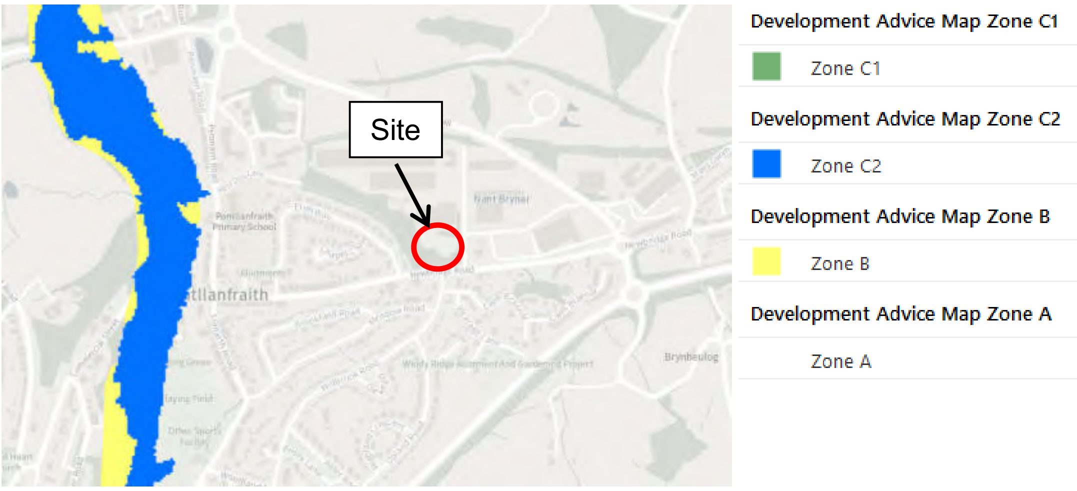
An unnamed stream flows south east along with western boundary of the Site. The stream enters the concrete box culvert near the south west corner of the Site, and flows south west to eventually join the Sirhowy River.

2.6 Flooding Maps

Development Advice Map
The NRW Development Advice Map has been shown in Figure 2-4.

The Site falls within Zone A.

Figure 2-4 NRW Development Advice Map



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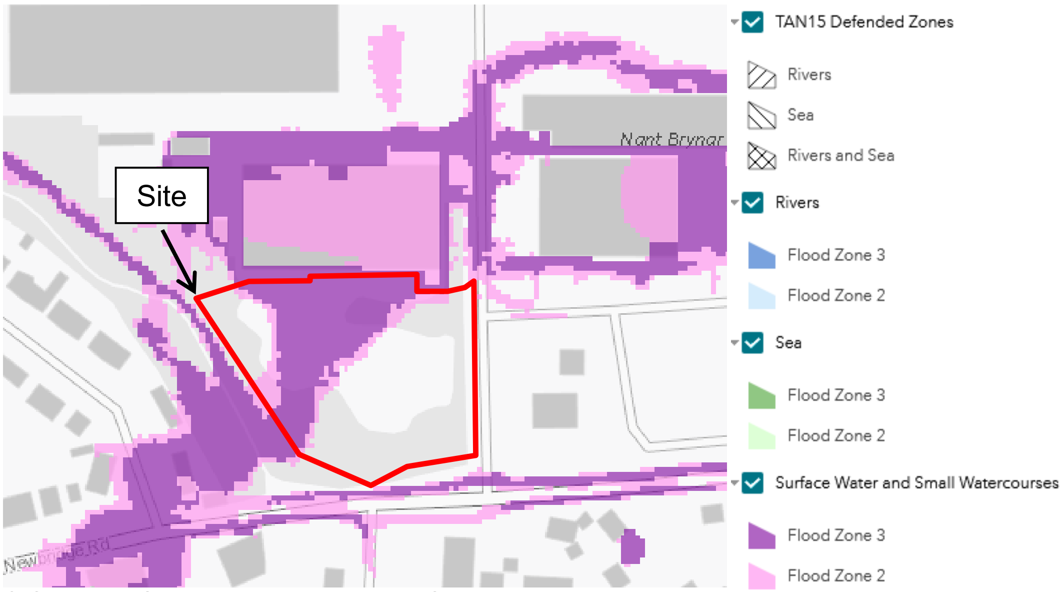
Flood Map for Planning

The NRW Flood Map for Planning has been shown in Figure 2-5.

Parts of the Site falls within Flood Zones 2 and 3 for surface water and small watercourse flooding. The Site lies within Flood Zone 1 for rivers and sea flooding.

Figure 2-5 NRW Flood Map for Planning



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Flood Risk Assessment Map

The NRW Flood Risk Assessment Map has been shown in Figure 2-6.

The Site lies within high, medium and low risk areas for surface water and small watercourse flooding. The Site lies outside of all risk areas for rivers and sea flooding.

Figure 2-6 NRW Flood Risk Assessment Map

2.7 Flood Risk Summary

Applying the Flood Risk Vulnerability Classification in TAN15, the proposed development is classified as being 'less vulnerable'. The proposed development is appropriate at this location, as per TAN15.

The Site is not at risk of flooding from a major source (e.g. fluvial and/or tidal). The Site has a 'low probability' of fluvial/tidal flooding as the Site is located within Zone A and Flood Zone 1 with less than a 1 in 1000 annual probability of river/tidal flooding in any year (<0.1%).

Flooding from surface water and small watercourses is indicated to pose a risk to the Site. However it should be noted that the NRW data indicating surface water or small watercourse flooding in Figure 2-5 and Figure 2-6 is based only on topography and does not take into account the surface water drainage network of gullies and pipes at the Newbridge Road Industrial Estate, and also the concrete box culvert conveying the water course below the Site.

It is considered that the full extent of surface water flooding implied by the NRW Flood Map for Planning and the Flood Risk Assessment Map is unlikely to occur. The proposed development at the Site would collect surface water runoff and divert to the SuDS where attenuation will be provided for the 1 in 100 year design event. In addition, the box culvert has significant capacity to drain Newbridge Road Industrial Estate and has been shown to be in good condition from the drainage and CCTV survey.

The risk of flooding from all sources is considered to be low or not significant. The flooding sources will only inundate the Site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the Site.

The proposed development is classified as being 'less vulnerable'. The proposed development is appropriate at this location, as per TAN15. The proposed development will have no impact on flood risk and the overall direction of the movement of water will be maintained within the Site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed. The proposals have been shown to be in accordance with A1.12 of TAN15.

In conclusion, the flood risk to the Site can be considered to be limited; the Site is situated in Zone A, and Flood Zone 1 for rivers and sea flooding with a low or very lows annual probability of flooding.

The Site is unlikely to flood except in very extreme conditions.

2.8 Published Geology

British Geological Survey (BGS) resources have been used to identify the geology below the Site.

Superficial Geology
The BGS indicate that superficial deposits are present at the south east half of the Site only. The superficial deposits are marked as Till: diamicton deposited in a glacial environment between 116,000 and 11,800 years ago during the Quaternary period.

Bedrock Geology
The BGS indicate that the bedrock is different at the north west half of the Site to the south east part of the Site; the formations are separated by a normal fault with the downthrow side to the north west. Bedrock below the Site dips to the north west at approximately 4 to 5˚.

The bedrock underlying the north west half of the Site comprises the Grovesend Formation: mudstone, siltstone and sandstone deposited in a fluvial environment between 309.5 and 308 million years ago during the Carboniferous period.

The bedrock underlying the south east half of the Site comprises the Grovesend Formation – Sandstone: a sandstone deposited in a fluvial environment between 309.5 and 308 million years ago during the Carboniferous period.

2.9 Coal Mining

The bedrock geology forms part of the South Wales Coalfield and a Coal Mining Risk Assessment has been undertaken by Hydrogeo for the Site. The report has been provided under separate cover and the findings have been summarised below.

A total of 3 no. boreholes were advanced as part of works supervised by Hydrogeo between the 22nd and 23rd February 2024, to maximum depths of between 30.5m and 35mBGL in order to identify any coal seams or voids. A plan showing the borehole locations has been shown on Drawing 1.

An intact coal seam was identified in BH1 on the south eastern side of the fault at approximately 23mBGL. An intact coal seam was identified in BH2 on the north western side of the fault at approximately 33.3mBGL.

A third borehole, BH3, advanced near the north west corner of the Site did not identify any coal seams within 30.5mBGL. This is considered to be due to the dip direction and angle of the bedrock at the Site.

3 S1: Surface Water Runoff Destination

3.1 Surface Water Runoff Destination

As part of the SuDS Standards the management of runoff from developments should be prioritised as to the choice of discharge destination. The priority hierarchy is listed below:

1) Collect for re-use;

2) Infiltrate to ground;

3) Discharge to a surface water body;

4) Discharge to a surface water sewer/highway drain; and

5) Discharge to a combined sewer.

3.2 Collect for re-use

The reuse of water from roofed areas to provide grey (non-potable) water for flushing WCs within buildings can reduce storm runoff without the need for treatment or oil separators since the risk of spillage or contamination is low.

Such a system would require one or more tanks at roof level and under optimum conditions these would be kept as near as full as possible to ensure a reliable water supply. For the purposes of a worst-case design scenario it is assumed that the tanks would be full at the start of an extreme rainfall event and hence all storm rainfall would enter the surface water drainage system rather than grey water storage.

Whilst the first priority is to collect rainwater for re-use, rainwater harvesting was considered and deemed not suitable. From a cost/benefit approach, a rainwater harvesting system is considered to be unsuitable considering the commercial nature of the site and the relatively low population density.

There are no industrial water-intensive processes proposed at site and it is highly unlikely that there ever will be, as the units are not designed for it and only have light electrical supplies.

In accordance with G1.4 of the SuDS standards is, rainwater harvesting is not proposed for the development as:

1. There is no foreseeable need to harvest water at the site as the relevant water undertaker's water resources and drought management plans do not identify potential stresses on mains water supplies.

2. The use of rainwater harvesting is not a viable / cost-effective part of the solution for managing surface water runoff at the site, taking account of the potential water supply benefits of such a system.

3. Considering the surface area of the roofs and the low population density of the commercial units, the rainfall yield is likely to exceed the demand.

With regards to the second point above, the costs of rainwater harvesting systems (unit costs, installation costs, running costs and maintenance costs) outweigh the water saving costs. Furthermore, section G1.6 of the SuDS Standards states that; '*in most cases,* *rainwater harvesting alone will not be adequate to deal with the site drainage and provision will be required for an overflow to a Level 2 or lower priority runoff destination.'*

It is considered that the use of rainwater harvesting is not a viable / cost effective approach for the management of surface water runoff at the development, taking into account the potential water supply benefits of such systems.

3.3 Infiltrate to ground

Due to the presence of Till superficial deposits at the south eastern half of the Site infiltration is expected to be poor. In addition, coal is known to have been mined in the local area, and intact seams have been identified by Hydrogeo following site works for a Coal Mining Risk Assessment Report.

It is proposed that infiltration testing is undertaken at the southern part of the Site where SuDS features may be located in order to assess the viability of an infiltration SuDS feature, and the potential for interception of the first 5mm of rainfall.

3.4 Discharge to a surface water body

A concrete box culvert passes below the Site, with a chamber in the south west allowing connection from an existing private surface water drain. The box culvert is understood to convey Nant Brynar and also receives water from the stream which forms the western boundary of the Site.

Discharge into this culverted stream is considered to be the most viable option, with a component of infiltration possible following site testing.

3.5 Discharge to sewers

Two DCWW combined sewers are present below the Site, therefore discharge to either of these features may be possible however higher priority discharge destinations exist and will be explored first.

4 S2: Surface water runoff hydraulic control

4.1 Site Areas

The total area of the Site has been calculated at 7,900m^2.

For the purposes of this report it is proposed that surface water runoff from all positively drained developed areas of the Site is to be discharged to the box culvert. Following site testing a limited component may infiltrate to ground but this is not expected to be viable for all runoff.

The remainder of the Site will comprise soft landscaping and will not be provided with drainage. It is expected that rain falling onto these areas will infiltrate the topsoil and will not contribute to the formal drainage system.

The calculated areas at the Site have been summarised in Table 4-1.

Table 4-1 Site surface areas

Surface	Area (m^2)	Drainage required	Drainage type	Rationale
Building	2,095	Formal drainage	SuDS	New development
Vehicular yard	3,815	Formal drainage	SuDS	New development
Soft landscaping	1,990	Informal drainage	Non-SuDS	Not required

4.2 SuDS Strategy

The objective of this drainage statement is to ensure that a sustainable drainage solution can be achieved which reduces the peak discharge rate to manage and reduce the flood risk posed by the surface water runoff from the Site.

At this stage a detailed surface water drainage design has not been undertaken, however it is necessary to demonstrate that the surface water from the proposed development can be discharged safely and sustainably. The drainage statement takes into account the following principles:

- No increase in the volume or runoff rate of surface water runoff from the Site.
- No increase in flooding to people or property off-site as a result of the development.
- No surface water flooding of the Site.
- The proposals take into account a 40% increase in rainfall intensity due to climate change.
- The proposals take into account a 10% increase of impermeable surface area due to surface creep.

The proposed drainage layout has been shown on Drawing 2.

It is proposed that surface water runoff is collected from the building roof by guttering and downpipes, and conveyed to the southern part of the Site in a piped network.

The concrete yard will be constructed with a gentle cross fall towards the perimeter. Runoff from the yard will pass over a grassy filter strip and into a filter drain around the perimeter, and will be conveyed to the southern part of the Site.

A grassy detention basin will be installed at the southern part of the Site, and will receive surface water runoff from all developed surfaces. The basin will drain via short pipe network into the existing inspection chamber at the south west corner through a new connection; this chamber allows water into the box culvert.

A flow control chamber will be installed between the basin and the inspection chamber, restricting the flow to the greenfield 1 in 1 year runoff rate. Sufficient attenuation will be provided in the basin for the 1 in 100 year design rainfall event, including +40% for climate change and +10% for urban creep.

Drainage features such as inspection chambers will be installed to allow inspection and maintenance of the system.

The runoff and attenuation calculations have been attached at Appendix D.

4.3 Interception

It is proposed that the flat unlined base of the grassy detention basin will provide interception for the Site. The inlet to the pipe draining the basin will be set at a higher elevation than the base to allow some water to always remain and infiltrate the soil.

4.4 Designing for Local Drainage System Failure/Design Exceedance

When considering residual risk, it is necessary to make predictions as to the impacts of a storm event that exceeds the design event, or the impact of a failure of the local drainage system.

The drainage statement applies a safe and sustainable approach to discharging rainfall runoff from the Site and this reduces the risk of flooding however, it is not possible to completely remove the risk. This section is therefore associated with the way the residual risk is managed.

As part of the drainage statement, it must be demonstrated that the flooding of property would not occur in the event of local drainage system failure and/or design exceedance. It is not economically viable or sustainable to build a drainage system that can accommodate the most extreme events. Consequently, the capacity of the drainage system may be exceeded on rare occasions, with excess water flowing above ground[1].

The drainage statement has been designed to accommodate the 1 in 100 year critical rainfall event. The layout of the Site provides an opportunity to manage this local drainage system failure/exceedance flow and ensure that indiscriminate flooding of property does not occur.

A freeboard will be included at the basin, however eventually an exceedance event would lead to water overtopping the basin and flowing down-gradient south west into the stream on the western site boundary. A blockage of the surface water drainage system is expected to lead to the same flow path into the stream.

[1] CIRIA (2006) Designing for exceedance in urban drainage – good practice.

5 S3: Water Quality

The pollution hazard level of different surfacing types has been shown in Table 5-1, based on Table 26.2 of the SuDS Manual. Based on the construction type and surface area it is considered that the proposed development at the Site is represented by the 'other roofs' and 'commercial yard' categories.

A non-residential roof has a 'low' pollution hazard level and a commercial yard has a 'medium' pollution hazard.

Table 5-1 Level of hazard

Hazard	Source of hazard
Very low	Residential roofs
Low	Other roofs (commercial/industrial) Private driveways, residential car parks, low traffic roads, non-residential parking with infrequent change
Medium	Commercial yard, delivery area, non-residential parking with frequent change, all roads except low-traffic and trunk roads/motorways
High	Haulage yards, lorry parks, chemical sites, waste sites, fuel sites, trunk roads/motorways

The pollution hazard indices for the proposed development have been shown in Table 5-2, as described in Table 26.2 of the SuDS Manual.

Table 5-2 Pollution hazard indices

Land use	Pollution hazard level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Commercial roof – low metals leaching	Low	0.3	0.4	0.05
Commercial yard	Medium	0.7	0.6	0.7

Indices values range from 0-1.

Table 5-3 demonstrates that the filter strip, filter drain and grassy detention basin will provide sufficient treatment for the expected runoff.

Table 5-3 SuDS mitigation indices

Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.2*	0.2*	0.2*
Detention basin	0.25*	0.25*	0.3*
Total	**0.85**	**0.85**	**>0.95**

A factor of 0.5 has been applied to the mitigation indices for all SuDS components following the first.

6 S4 and S5: Amenity and Biodiversity

The filter strip and the detention basin will provide amenity and biodiversity benefits for the Site.

It is proposed that the detention basin is seeded with a native wetland and pond edge 80/20 wild grass and wild flower mix.

7 S6: Designing drainage for construction, operation, maintenance and structural integrity

7.1 Introduction

The SuDS components have been designed for easy maintenance to comprise:

- Regular day to day care – regular gardening to control excessive vegetation growth and checking inlets where water enters the SuDS features.
- Occasional tasks – checking the SuDS features and removing any silt that builds up.
- Remedial work – repairing damage where necessary.

7.2 SuDS Maintenance and Management

A management and maintenance plan will be developed as part of the SAB full design application. A construction and phasing plan to mitigate impacts of surface water runoff during construction and provided details of development phases will be developed with the full design application.

It is proposed that SuDS devices are constructed toward the very end of the build to prevent damage or silting-up of the components.

7.3 Design Life

The design life of the development is likely to exceed the design life of each of the SUDS components listed above. During the routine inspections of any SuDS components it may become apparent that they have reached the end of their functional lifetime. In the interest of sustainability repairs should be the first choice solution where practicable. If this is not the case, then it will be necessary to undertake complete replacement of the component in question.

When undertaking maintenance, repairs or replacement, all engineering drawings used in the design, construction and installation of the SuDS components should be referred to for construction and specification details; this will help to ensure satisfactory performance of each of the SuDS components.

Drawings

Drawing 1

Borehole location plan

HYDROGEO

HYG1246 Frontier Site

Drawing 1

Borehole location plan

KEY

Site boundary (approximate)

Borehole

Microsoft 2024

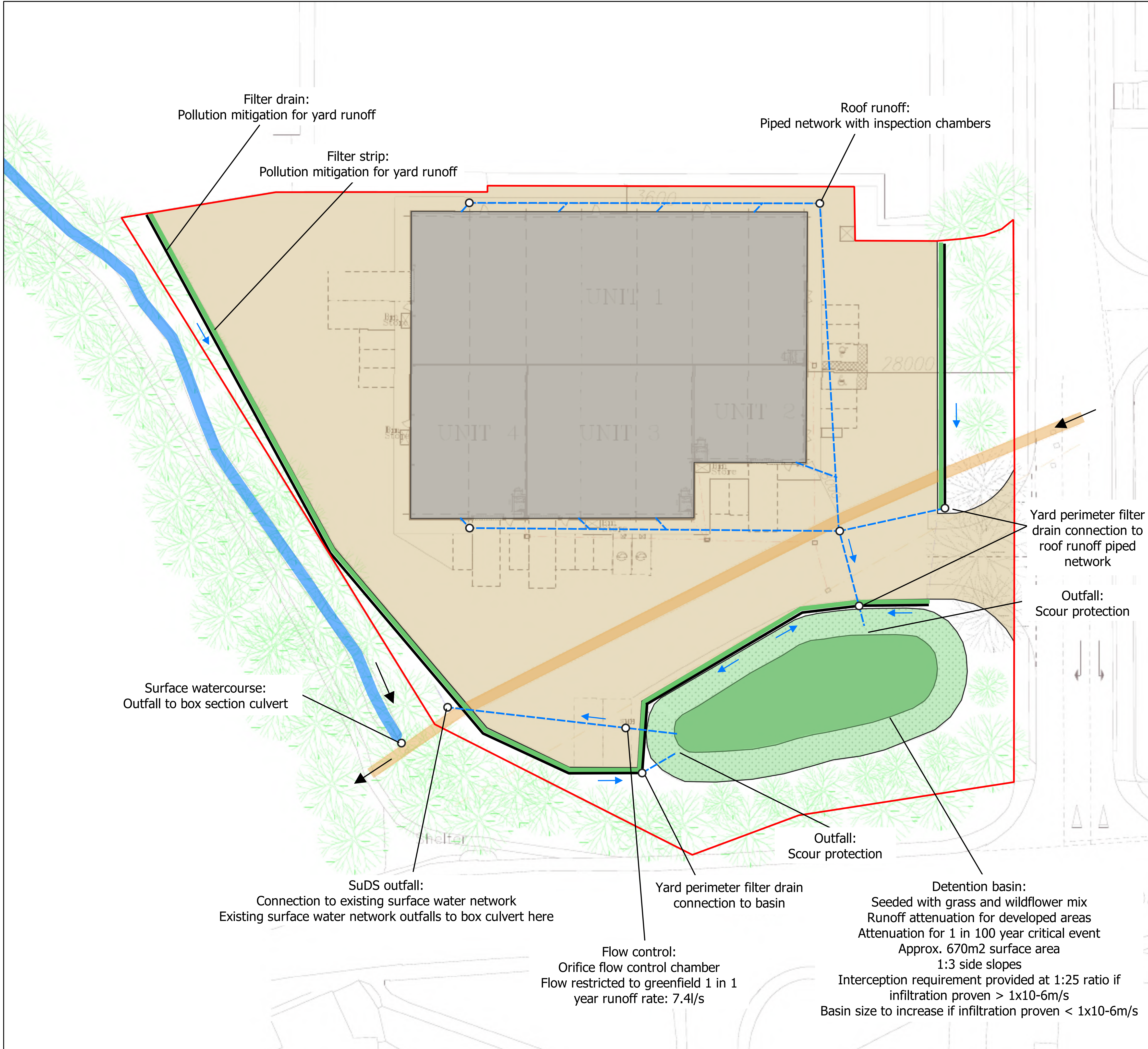
10 0 10 20 m

N

Date	By	Paper	Scale	Rev
03 2024	TP	A3	1:500	1

Drawing 2

Drainage layout plan



HYDROGEO

HYG1246 Frontier Site

Drawing 2

Drainage layout

KEY

Site boundary (approximate)

Existing drainage features

Watercourse

Box culvert

Proposed development

Building

Yard

Proposed SuDS features

Detention basin

Filter strip

Filter drain

Pipe

Inspection chamber (including flow control chamber)

Drawing edited from 'Proposed Industrial Unit', Drawing No. 328051/1, Revision J.

10 0 10 20 m

N

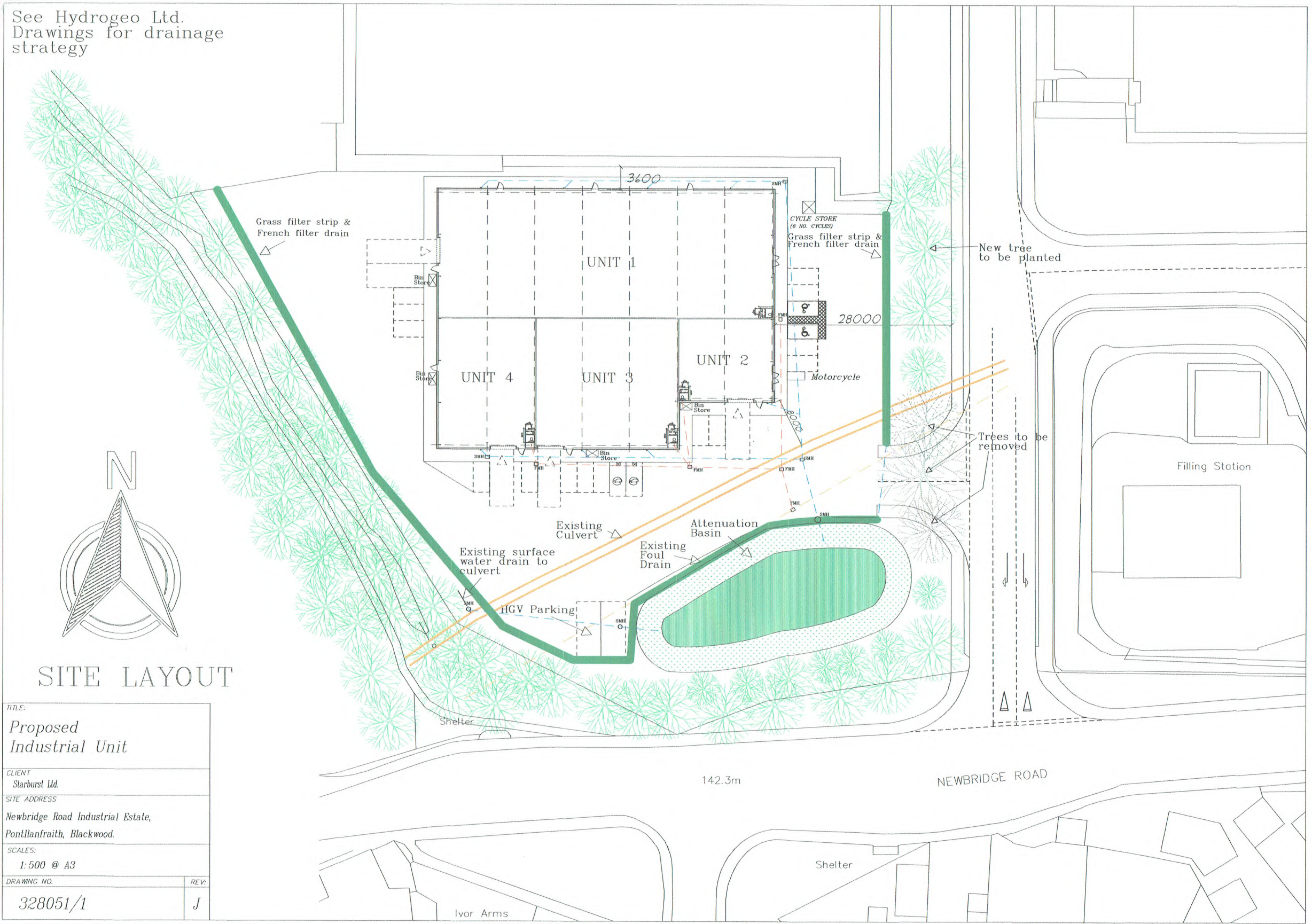
Date	By	Paper	Scale	Rev
03 2024	TP	A3	1:500	1

Appendices

Appendix A

Proposed site layout plan

See Hydrogeo Ltd.
Drawings for drainage
strategy



SITE LAYOUT

TITLE:
Proposed Industrial Unit

CLIENT:
Starburst Ltd.

SITE ADDRESS:
Newbridge Road Industrial Estate,
Pontllanfraith, Blackwood.

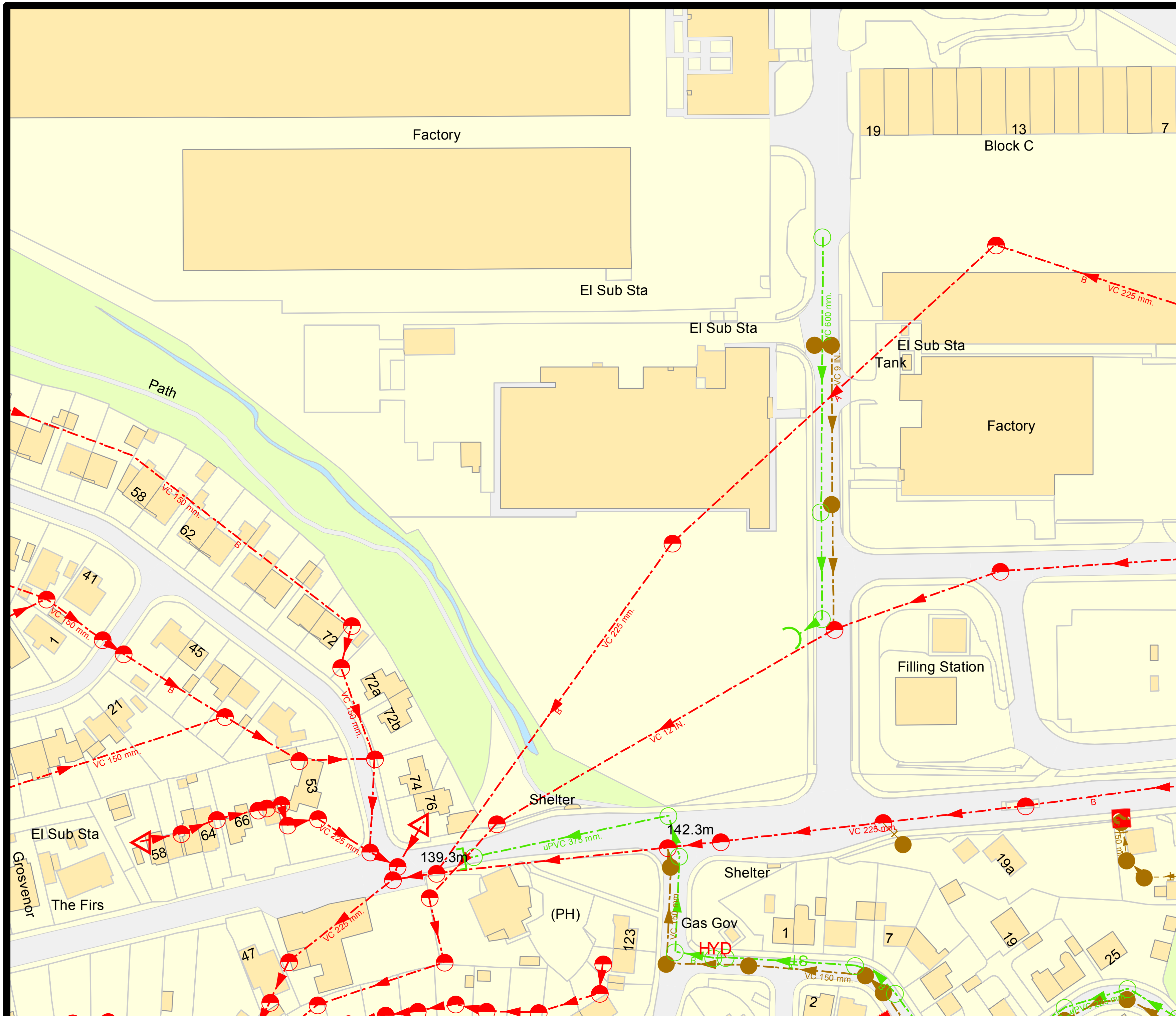
SCALES:
1:500 @ A3

DRAWING NO.: 328051/1

REV: J

Appendix B

DCWW sewer plan



Dŵr Cymru
Welsh Water

PLA0049440

N
W E
S

LEGEND(Representative of most common features)

Waste network:

- Foul chamber
- Surface water chamber
- Combined chamber
- Combined sewer overflow
- Special purpose chamber
- Treatment works
- Pumping station
- Outfall
- Lamphole
- Storm Overflow
- Rising main
- Gravity sewer
- Private sewer
- Private sewer subject to Sect. 104 adoption agreement
- Private Sewer Transfer
- Lateral Drain
- Inspection Chamber

NB: Sewer symbol colour indicates the type.

RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Whilst every reasonable effort has been taken to correctly record the pipe material of DCWW assets, there is a possibility that in some cases pipe material (other than Asbestos Cement or Pitch Fibre) may be found to be asbestos cement (AC) or Pitch Fibre (PF) . It is therefore advisable that the possible presence of AC or PF pipes be anticipated and considered as part of any risk assessment prior to excavation

Dŵr Cymru Cyfyngedig ('the Company') gives this information as to the position of its underground apparatus by way of general guidance only and on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the company's apparatus. The onus of locating apparatus before carrying out any excavations rests entirely on you. The information which is supplied by the Company, is done so in accordance with statutory requirements of sections 198 and 199 of the Water Industry Act 1991 which is based upon the best Information available and, in particular, but without prejudice to the generality of the foregoing, it should be noted that the records that are available to the Company may not disclose the existence of a water main, service pipe, sewer, lateral drain or disposal main and any associated apparatus laid before 1 September 1989, or, if they do, the particulars thereof including their position underground may not be accurate. It must be understood that the furnishing of this information is entirely without prejudice to the provision of the New Roads and Street Works Act 1991 and the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

Map Ref:	318628,196102
Map scale:	1:1550
Printed by:	Gough Jasmin
Printed on:	09 Jun 2020

Appendix C

Drainage survey

Notes:

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2. Due to unavoidable inaccuracies during the reproduction process these drawings should not be scaled. Where dimensions are critical PM Consultants (UK) Ltd should be requested to confirm dimensions based on survey information. Scales appearing at the base of this plan are for indicative purposes only.
3. This plan has been prepared in accordance with B.S. 1192, Part 1 in relation to scale and dimension. Tolerances permitted within the British Standard should be observed.
4. All dimensions and particulars should be checked on site. Any discrepancies should be reported to PM Consultants (UK) Ltd before any work commences.

N

NOTES:

LEVELS AND CO-ORDINATE GRID ARE RELATED TO GPS SURVEY DATUM DERIVED FROM ORDNANCE SURVEY DATUM VIA OSTN15

ALTHOUGH O.S. CO-ORDINATES ARE SHOWN ON THIS PLAN THE GRID IS TO BE TREATED AS ARBITRARY.

NO SCALE FACTOR HAS BEEN APPLIED TO THE SURVEY THEREFORE THE CO-ORDINATES SHOWN ARE NOT TRUE O.S. CO-ORDINATES.

MANHOLE COVERS IN ROAD NOT LIFTED DUE TO HEAVY VOLUME OF TRAFFIC DURING TIME OF SURVEY.

ISSUE	REVISION	DATE

Job: DRAINAGE SURVEY (1 of 2)
NEWBRIDGE ROAD IND EST
NEWBRIDGE

Scale:	Date:	Drawn By:	Checked By:	Job Ref.
1/200	28/11/23	KR	NM	HG/NRIE/001

Client: Hydrogeo Ltd
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E-Mail: surveys@pmconsultants.co.uk

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Constructionline
A UK GOVERNMENT CERTIFICATION SCHEME
Achilles
BUILDER'S PROFILE
chartered ices

Appendix D

Runoff and attenuation calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)
Detention basin	0.591	5.00	142.000	318667.000	196034.000	1.500

Simulation Settings

Rainfall Methodology	FEH-22	Drain Down Time (mins)	240	100 year (l/s)	21.7
Summer CV	1.000	Additional Storage (m^3/ha)	0.0	Check Discharge Volume	✓
Winter CV	1.000	Check Discharge Rate(s)	✓	100 year 360 minute (m^3)	186
Analysis Speed	Normal	1 year (l/s)	7.4		
Skip Steady State	x	30 year (l/s)	17.1		

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 %)
2	40	10	0
30	40	10	0
100	40	10	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.95
Greenfield Method	FEH	Growth Factor 100 year	2.48
Positively Drained Area (ha)	0.591	Betterment (%)	0
SAAR (mm)	1362	QMed	8.1
Host	17	QBar	8.7
BFIHost	0.413	Q 1 year (l/s)	7.4
Region	9	Q 30 year (l/s)	17.1
QBar/QMed conversion factor	1.075	Q 100 year (l/s)	21.7
Growth Factor 1 year	0.85		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	0
Positively Drained Area (ha)	0.591	Storm Duration (mins)	360
Soil Index	3	Betterment (%)	0
SPR	0.37	PR	0.425
CWI	125.905	Runoff Volume (m^3)	186

Node Detention basin Online Orifice Control

Flap Valve	x	Design Depth (m)	1.200	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	7.4		
Invert Level (m)	140.500	Diameter (m)	0.057		

Node Detention basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	5.0	Invert Level (m)	140.500
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m^2)	Inf Area (m^2)	Depth (m)	Area (m^2)	Inf Area (m^2)
0.000	320.0	0.0	1.500	669.0	0.0

Results for 2 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	Detention basin	960	141.209	0.709	22.6	285.2082	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
1440 minute summer	Detention basin	Orifice	5.6	370.7

Results for 30 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	Detention basin	1020	141.658	1.158	37.7	526.7142	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
1440 minute summer	Detention basin	Orifice	7.2	501.7

Results for 100 year +40% CC +10% A Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
1440 minute summer	Detention basin	1020	141.856	1.356	44.9	647.6957	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m^3)
1440 minute summer	Detention basin	Orifice	7.8	550.1