



Sustainable Drainage System Strategy

Site Address

Former Fox and Hounds Public House
26-27 London Road
Northfleet
Gravesend, DA11 9JH

Client

Super Asset Management Ltd

Report Reference

SWDS - 2024 - 000026

Prepared By

STM Environmental Consultants Ltd

Date

17/07/2024



**CONSULTING ENVIRONMENTAL
ENGINEERS AND SCIENTISTS**

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1 Document Control

	Sustainable Drainage System Strategy	
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Contents

1	Document Control	2
2	Abbreviations.....	5
3	Disclaimer	6
4	Executive Summary.....	7
5	Introduction.....	9
5.1	Proposed Development.....	9
5.2	Report Aims and Objectives.....	10
5.3	Legislative and Policy Context	12
5.4	Gravesham Borough Council Policy CS18.....	14
6	Site Characteristics	15
6.1	Location and Area	15
6.2	Current Site and Surrounding Uses	15
6.3	Site Topography.....	15
6.4	Flood Risk Summary.....	17
6.5	Existing Surface Water Drainage Features	17
7	Hydrological Run-off Assessment	17
7.1	Existing and Proposed Ground Cover.....	18
7.2	Peak Flow Control.....	18
7.3	Volume Control Requirements	18
7.4	Run-off and Storage Calculations	19
8	SuDS	20
8.1	SuDS Hierarchy	20
8.2	Drainage Hierarchy Discussion	20
8.3	Appraisal of Potential SuDS Options.....	22
8.4	SuDS Strategy	23
8.5	Maintenance and Adoption of SuDS	26
9	Conclusion and Recommendations.....	27
10	References	28
11	Appendices	29
11.1	Appendix 1 – Development Plans & Photos.....	29
11.2	Appendix 2– Site Topography and Drainage Characteristics	32
11.3	Appendix 3 – Flood Risk Mapping.....	43
11.4	Appendix 4 – Runoff Rate and Storage Calculations	47
11.5	Appendix 5 – Drainage Asset Search	51
11.6	Appendix 6 – SuDS Suitability Assessment	52

11.7	Appendix 7 – Details of Proposed Of SuDS	53
11.8	Appendix 8 – SuDS Maintenance Manual.....	57
11.9	Appendix 9 – Drainage Modelling Results and Layout.....	68
11.10	Appendix 10 – Water Quality Assessment	71

List of Tables

Table 1: Asset Information	17
Table 2: Breakdown of Ground Cover in the Proposed Development	18
Table 3: Summary of Permeable and Impermeable Areas.....	18
Table 4: Calculation of post-development run-off rates for the site.	19
Table 5: Trial pits and associated depth and infiltration rate	21
Table 6: SuDS Appraisal; Feasibility of various SuDS and the potential uses on site.	22
Table 7: Proposed SuDS.....	23

2 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
LLFA	Lead Local Flood Authority
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Drainage Systems
GWSPZ	Groundwater Source Protection Zone

3 Disclaimer

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4 Executive Summary

BACKGROUND			
Location	Former Fox and Hounds Public House, 26-27 London Road, Gravesend, DA11 9JH Grid reference: 563245, 174046		
Site Area	883m²		
Proposed Development	The erection of a 4-storey building attached to No.25 London Road to provide 2no. 2-bedroom and 7no. 1-bedroom flats; and, erection of a 2-storey detached block to provide 2no. 2-bedroom and 2no. 1-bedroom flats with associated parking, amenity space and waste storage.		
Current Site and Surrounding Uses	The site is currently a redundant former public house situated in a largely residential and industrial area.		
Topography	The site itself is relatively flat with small fluctuations in elevation. The site ranges from 23.94mAOD in the southwest to 25.70mAOD in the north of the site.		
Hydrology	No watercourses within 250m of the site. The River Thames is situated approximately 500m north of the site. Surface water discharge to a watercourse is not available.		
Geology	BGS information indicates that the site is not situated on superficial deposits while the bedrock is classified as belonging to the Seaford and Newhaven Chalk Formations (Chalk).		
Hydrogeology	BGS information indicates that the site is situated upon a principal bedrock aquifer.		
Source Protection Zone	The site lies within Source Protection Zones 2 and 3.		
Permeability	BGS information indicates that the bedrock is classified as free draining.		
Infiltration Potential	BGS information indicates that there are significant constraints for the installation of infiltration SuDS measures, due to the underlying chalk and potential for contamination. Infiltration testing was undertaken on site and was successful. The infiltration rates, when averaged between TP01 – TP03, equate to 1.0x10⁻⁵ m/s, which is classified as a moderate rate. Soil samples were collected and sent to accredited laboratory for contamination analysis testing. No contamination was identified within the trial pits (TP01 – TP05).		
Fluvial Flood Risk	Low – The site lies within EA Flood Zone 1.		
Surface Water Flood Risk	Low – The site is not impacted during any surface water flood event.		
Groundwater Flood Risk	Low - the EA mapping does not indicate the potential for groundwater to occur on site. Groundwater is likely to be more than 5mbgl for at least part of the year.		
Existing and Proposed Site Layout	Ground Cover	Existing (m²)	Proposed (m²) (Without SuDS)
	Buildings	0	293
	Driveways/Patio	0	455
	Gardens/ Soft landscaping	883	135

	Total Impermeable Area	0	883
Changes in Impermeable	Without SuDS, the proposed development would decrease the impermeable area of the site and therefore is likely to increase the post development runoff rate and volume.		
PROPOSED SUDS			
Run-Off Rates	Greenfield (GF) (l/s)	MRM Pre - Development (l/s)	MRM Post Development Without SuDS (l/s)
Qbar	0.19	0.19	0.38
1 in 1	0.16	0.16	0.33
1 in 30	0.44	0.44	0.88
1 in 100	0.61	0.61	1.22
1 in 100 + CC (40%)	0.91	0.91	1.81
SuDS Target Requirement	As the development is taking place on a previously developed site the non-statutory technical standards for sustainable drainage systems S3 (peak flow) and S5 and S6 (volume controls) apply. The proposal should aim to achieve the greenfield runoff rate of 0.19/s for all storm events when discharging to watercourse or sewer.		
Drainage Hierarchy	The proposed will discharge into the ground via infiltration.		
Storage Required to meet Planning Requirement	The site is estimated to require 26 - 56m³ of storm water attenuation with an infiltration rate of 1.0x10-5 m/s.		
SuDS Strategy	The proposal will introduce combined rainwater butts and SuDS planters, small rain gardens and filter strips, permeable paving forming the car parking and a large geocellular soakaway to discharge all surface waters to ground via infiltration. All excess storm water will be dealt with on site via source control SuDS methods and will discharge to ground. The proposal will provide 78m³ of attenuation storage.		
Water Quality			
Conclusion	With the proposed SuDS mitigation measures which have been outline introduced into the scheme, we believe that the proposed development will reduce local flood risk and therefore be in compliance with the LLFA's current planning policy and the NPPF.		

5 Introduction

STM Environmental Consultants Limited have been appointed by Super Asset Management Ltd to undertake a Sustainable Drainage System (SuDS) Strategy for a proposed development at Former Fox and Hounds Public House, 26-27 London Road, Northfleet, Gravesend, DA11 9JH.

5.1 Proposed Development

The SuDS report is required to support a planning application (Reference: 20220431) for the *'Erection of a 4-storey building attached to No.25 London Road to provide 2no. 2-bedroom and 7no. 1-bedroom flats; and, erection of a 2-storey detached block to provide 2no. 2-bedroom and 2no. 1-bedroom flats with associated parking, amenity space and waste storage at Fox and Hounds, 26-27 London Road, Gravesend DA11 9JH.'*

The planning condition states as follows:

Sustainable surface water drainage

4. No development shall be commenced until a scheme for sustainable surface water drainage has been submitted to and approved, in writing, by the Local Planning Authority.
 - a. The detailed drainage scheme submitted shall demonstrate that both the rate and volume of run-off leaving the site post- development will be restricted to that of the existing site during any rainfall event (up to and including the climate change adjusted 100yr critical storm);
 - b. demonstrate that the existing on-site surface water flow-routes and accumulation points will not be altered in such a way that the development places property at risk from flooding during any rainfall event, up to and including the climate change adjusted critical 100yr storm;
 - c. demonstrate that infiltration features are not located on parts of the site where contamination might be present;
 - d. include a timetable for its implementation, and

- e. include a management and maintenance plan for the lifetime of the development which shall include the arrangements for adoption by any public body or statutory undertaker, or any other arrangements to secure the operation of the sustainable drainage system throughout its lifetime.

The surface water drainage scheme shall thereafter be implemented in full prior to first residential occupation of the development and thereafter maintained and managed in accordance with the approved scheme.

Reason: To ensure that the principles of sustainable drainage are incorporated into this proposal; to ensure that the development does not contribute to, or is not put at risk from, or adversely affected by, unacceptable levels of water pollution caused by mobilised contaminants and to ensure ongoing efficacy of the drainage provisions, in accordance with Policies CS18 and CS19 of the Gravesham Local Plan Core Strategy (September 2014).

Copies of the development plans are presented in [Appendix 1](#).

5.2 Report Aims and Objectives

This report sets out the proposed drainage strategy that will be employed in the designs to meet the requirements of the planning condition and the National Planning Policy Framework.

This report should be read in conjunction with following reports also produced by STM:

- STM Environmental - Phase 1 Report - Former Fox & Hounds Pub – PH1-2018- 017017
- STM Environmental - Phase 2 Report - Former Fox & Hounds Pub – PH2-2024-000024
- PHASE 3 - Remediation and Verification Strat - 26-27 London Rd - REM-2024-000013

5.2.1 Summary of Works Undertaken

Site investigation works were carried out on the 1st May 2024. A total of 3no. windowless sample boreholes (BH01 – BH03) were excavated to a maximum depth of 3mbgl for both geotechnical and environmental purposes.

In addition to the above, 6no. trial pits (TP01-TP06) were excavated to a maximum depth of 1.6mbgl using an excavator for environmental purposes and 1no. cable percussion borehole (CP01) was undertaken to a depth of 15mbgl for geotechnical purposes.

A total of 12no. soil samples were collected from depths ranging between 0.2 – 0.8mbgl and submitted to a UKAS/MCERTS accredited laboratory for analysis of Heavy Metals, TPH, BTEX, PAHs, SVOCs and Asbestos.

5.2.2 Summary of Finding

Made Ground consisting of chalky SILT/SAND with fragments of brick, concrete and tile was encountered to a maximum depth of 1.2mbgl. The Made Ground/SILT was generally underlain by CHALK to 15mbgl, the maximum depth of the boreholes.

Topsoil was encountered to a maximum depth of 0.35mbgl within the trial pits, underlain by Chalk, Sand, Silt and Gravel to 1.6mbgl.

Visual indications of contamination of the Made Ground were observed (i.e. brick, concrete and tile fragments) generally across the site. No significant odours or PID readings were recorded during the investigation.

Results of the soil sample analysis indicate that concentrations of PAHs (Benzo(a)anthracene, Benzo(a)pyrene, Dibenzo(ah)anthracene, Benzo(b)fluoranthene) and Heavy Metals (Arsenic and Lead) exceeded the chosen GAC in 2no. of the 9no. sampling locations (BH01 & BH03).

Asbestos Containing Material (ACM) was identified in a 3no. samples (BH01/1, BH01/2, BH02/2) at depths of 0.3mbgl, 0.8mbgl and 0.2mbgl respectively. The Asbestos was identified as Chrysotile. Quantification reported that the total percentage of Asbestos in the samples were less than 0.001%.

No contamination was identified within any of the trial pit locations. All hotspot locations of indefinable leachable contamination were located below the proposed buildings.

A map of the boreholes and trial pits is available in [Appendix 2](#).

5.3 Legislative and Policy Context

5.3.1 Legislative Context

Section H3 of the Building Regulations 2010 requires that adequate provision is made for rainwater to be carried from the building roofs and paved areas, and be preferentially discharged to soakaways or some other adequate infiltration system. Where that is not reasonably practicable, a watercourse; or sewer can be used.

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area, called “local flood risk management strategy”.

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

5.3.2 Policy Context

The National Planning Policy Framework (NPPF) sets out the Government's economic, environmental and social planning policies for England. The policies set out in this framework apply to the preparation of local and neighbourhood plans and to decisions on planning applications.

Paragraph 167 of the National Planning Policy Framework (NPPF) states that:

When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications

should be supported by a site-specific flood-risk assessment (See Note 1) Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location
- the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment;
- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Applications for some minor development and changes of use (See Note.2) should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in (See Note 1).

Paragraph 169 states that:

Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

- take account of advice from the lead local flood authority;
- have appropriate proposed minimum operational standards;
- have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
- where possible, provide multifunctional benefits.

A major development is defined as:

- a residential development: 10 dwellings or more or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known

- a non-residential development: provision of a building or buildings where the total floor space to be created is 1000 square metres or more or where the floor area is not yet known, a site area of 1 hectare or more.

Note. 1 - A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

Note. 2 - This includes householder development, small non-residential extensions (with a footprint of less than 250m²) and changes of use; except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site, where the sequential and exception tests should be applied as appropriate.

5.4 Gravesham Borough Council Policy CS18

Sustainable Drainage and Surface Water Run-Off

The Council will seek to minimise the impact of drainage from new development on waste water systems. In particular, the Council will:

- Require that surface water run-off from all new development has, as a minimum, no greater adverse impact than the existing use; and
- Require the use of Sustainable Drainage Systems on all developments where technically and financially feasible.

6 Site Characteristics

6.1 Location and Area

The site is centred at national grid reference 563245, 174046 and has an area of 833m².

It falls within the jurisdiction of Gravesham Borough Council and Kent County Council in terms of the planning consultation process on flood risk and surface water management.

Figure 1 provides the site location map and aerial imagery.

6.2 Current Site and Surrounding Uses

The site is currently a redundant former public house situated in a largely residential and industrial area. To the north of the site, adjacent to the B2175, lies a large industrial estate which is met by the River Thames, over 500m north of the site. At a larger scale, the site is situated in Gravesend which is a town situated in northwest Kent.

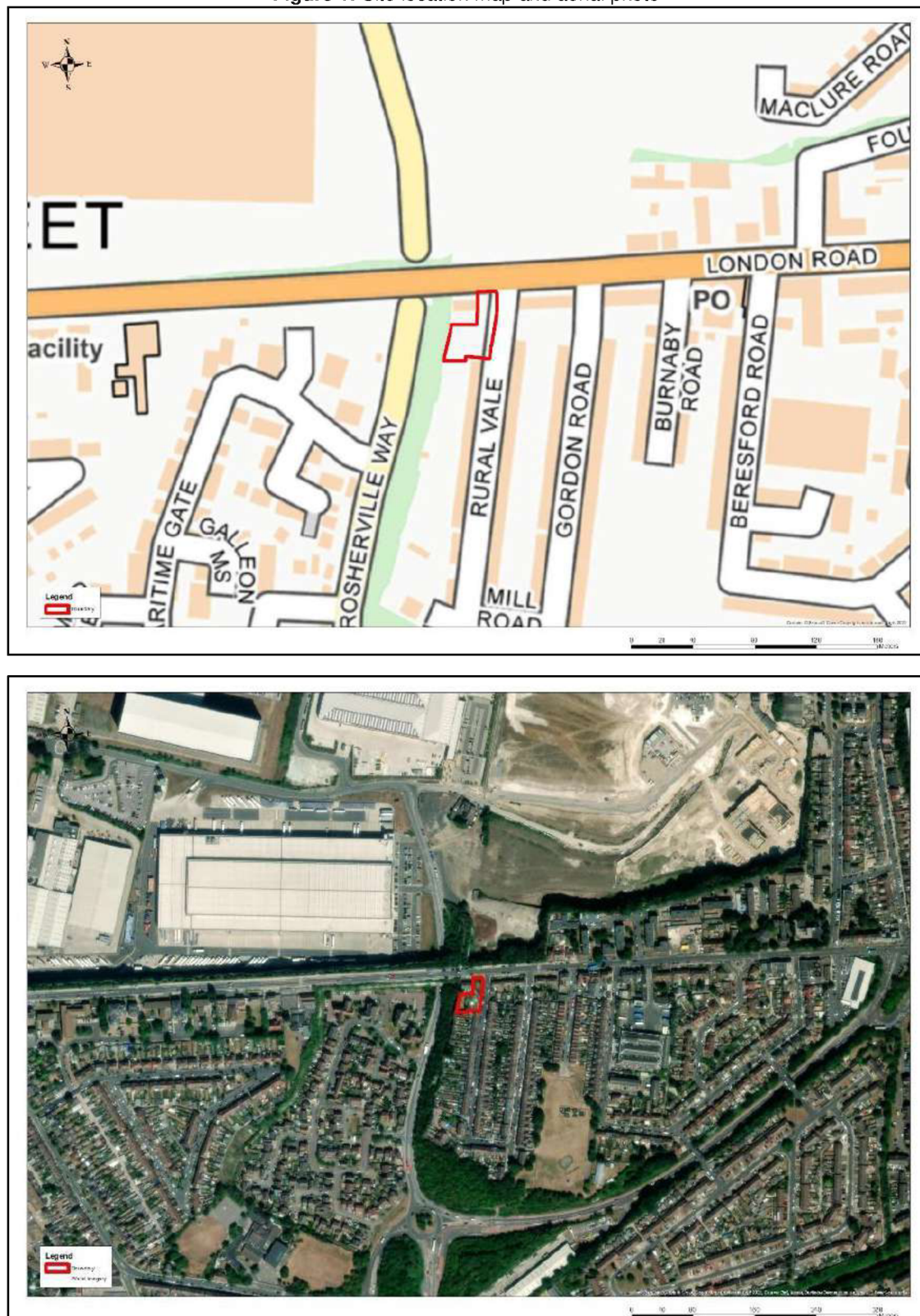
6.3 Site Topography

The mapping provided in [Appendix 2](#) shows the 1m LiDAR DTM (2022) ground elevations within the site. A topographical survey was not available.

The site itself is relatively flat with small fluctuations in elevation. The site ranges from 25.70mAOD in the north (adjacent to the B2175), to 23.94mAOD in the southwest of the site.

At a wider scale, the site is positioned at the top of a small cliff face. To the west of the site, elevations drop dramatically from 25.50mAOD, to 8.87mAOD. There are sheer elevation changes to the north and west of the site.

Figure 1: Site location map and aerial photo



6.4 Flood Risk Summary

The overall flood risk to the site is considered to be very low. No main source of flood risk to the development site was identified. The flood risk maps are available in [Appendix 3](#)

6.5 Existing Surface Water Drainage Features

Drainage plans showing the existing surface water drainage system at the site were not available.

A utility search was undertaken which identified Thames Water as the local sewage undertaker. The sewer and asset information is available in [Appendix 5](#).

Table 1: Asset Information

Asset ID	Asset Type	Location / Distance (m)	Manhole Cover Level (mAOD)	Manhole Invert Level (mAOD)	Depth (m)
2003	Foul	On Site	24.98	24.25	0.73
2002	Foul	2m North	24.96	23.41	1.55
2050	Surface Water	28m West	8.16	6.13	2.03

It should be noted existing on site foul sewer assets are indicated to be located close to the proposed building in the north. Whilst a foul sewer which may service the properties to the north runs below the site from north to south east below the proposed access roadway.

7 Hydrological Run-off Assessment

To minimise the impact of the new development on local flood risk, the NPPF requires that the water drainage arrangements for any development site are that the volumes and peak flow rates leaving the site post-development are improved upon those of the existing conditions. The following run-off assessment predicts the Greenfield, pre- and post-development run-off rates and provides the required SuDS necessary for complying with the relevant planning policies.

7.1 Existing and Proposed Ground Cover

Table 2: Breakdown of Ground Cover in the Proposed Development

Ground Cover	Existing Development Area		Proposed Development Area		Difference (m ²)
	m ²	%	m ²	%	
Buildings	0	0.0	293	33.2	293
Hard Standing	0	0.0	455	51.5	455
Soft landscaping	883	100.0	135	15.3	748
Total	883	100	883	100	

Table 3: Summary of Permeable and Impermeable Areas

	Impermeable Area		Permeable Area		Total Area
	m ²	%	m ²	%	m ²
Existing Site	0	0.0	883	100.0	883
Proposed Site	748	84.7	135	15.3	883
Difference	748	84.7	-748	-84.7	

The proposed development increases the impermeable area of the site by 84.7% to 748m². As such, this is likely to have a negative impact on the runoff rate without the introduction of SuDS.

7.2 Peak Flow Control

With regard to peak flow control, the non-statutory technical standards for sustainable drainage systems state that:

 S3 For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

7.3 Volume Control Requirements

With regard to volume control, the non-statutory technical standards for sustainable drainage systems state that:

 S5 Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway

drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event.

- S6 Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S4 or S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.

7.4 Run-off and Storage Calculations

The IH124 & MRM methods were applied to calculate the Greenfield, pre and post-development run-off rates including allowances for climate change. The full calculations and results are presented in [Appendix 4](#). The table below gives a summary of the results:

Table 4: Calculation of post-development run-off rates for the site.

	Greenfield (l/s)	Pre - Development (l/s)	Post Development (l/s)
Qbar	0.19	0.19	0.38
1 in 1	0.16	0.16	0.33
1 in 30	0.44	0.44	0.88
1 in 100	0.61	0.61	1.22
1 in 100 + CC	0.91	0.91	1.81

As the development is taking place on a previously developed site S3 (peak flow) and S5 and S6 (volume controls) apply.

The greenfield runoff rate should be the aim for the post-development scenario.

When discharging to ground via infiltration, the required storage volume is between 26 - 56m³ when assigning the infiltration rate of 1.0x10⁻⁵ m/s.

Screenshots of the quick storage estimate and variables are available [Appendix 4](#).

8 SuDS

8.1 SuDS Hierarchy

The SuDS Hierarchy sets out the preferred method of selecting which Sustainable Drainage System should be used.

-  rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation);
-  rainwater infiltration to ground at or close to source;
-  rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);
-  rainwater discharge direct to a watercourse (unless not appropriate);
-  controlled rainwater discharge to a surface water sewer or drain;
-  controlled rainwater discharge to a combined sewer;

The table outlined on the page below summarises the available SuDS, their potential suitability and the benefits.

8.2 Drainage Hierarchy Discussion

8.2.1 Rainwater Harvesting

The development has good potential to provide rainwater harvesting. As such, this is recommended in the form of rainwater butts.

8.2.2 Green, Blue or Brown Roofs

Based on the proposed roof design, which include pitched style roofs, the use of alternative roofing is not deemed to be suitable.

8.2.3 Infiltration To Ground

The development site is suitable for infiltration SuDS following the on-site ground investigation that was undertaken.

Site investigation works were carried out on the 1st & 2nd May 2024. Trial pits were excavated to depths of up to 1.3mbgl (TP01 – TP03) for standard infiltration testing in

accordance with BRE DG 365. Trial pits were also excavated to a depth of up to 1.1mbgl (TP04 - TP05) for shallow infiltration testing. The 3no. standard trial pits and 2no. shallow trial pits were rapidly filled with water from a 1.2m³ water bowser.

The trial pits were left to drain for a 24 - hour period or until nearly empty. The water level was continuously monitored using a water level logger. The water level achieved within the trial pits was used as the effective storage depth.

The infiltration rates obtained on site are available in Table 5 below. The average of TP01 – TP03 (1.0×10^{-5} m/s, 0.024m/hr) will be used throughout the report to allow for a conservative assessment of storage values.

Table 5: Trial pits and associated depth and infiltration rate

Trial Pit	Depth	Infiltration Rate		Rate
		m/s	m/hr	
TP01	1.30	1.0×10^{-5}	0.028	Moderate
TP02	1.30	1.0×10^{-5}	0.026	Moderate
TP03	1.30	5.0×10^{-6}	0.018	Moderate
TP04	1.00	1.0×10^{-5}	0.029	Moderate
TP05	1.10	2.08×10^{-4}	7.5	Rapid

8.2.4 Permeable Surfaces and Filter Drains

Approximately 51.5% of the development will consist of outdoor space, and patios which could be designed to be permeable and infiltration has been proven to be suitable on site.

8.3 Appraisal of Potential SuDS Options

8.3.1 SuDS Options

Table 6: SuDS Appraisal; Feasibility of various SuDS and the potential uses on site.

Key	H	M	L	Y	?	N	N/A
Details	High Impact	Medium	Low Impact	Yes	Maybe	No	Not Applicable

Main Category	SuDS Features	Total Suspended Solids Removal	Heavy Metals Removal	Nutrient Removal	Bacteria Removal	Dissolved Pollutants	Runoff Volume Reduction	Flow Rate Control / Events			Site Potential	Included	Discussion / Details	Potential Storage Provided	Potential Storage Provided
								1-2 Years	10 - 30 Years	100 Years					
Source Control Measure	Green / Brown Roof	NA	NA	NA	NA	H	H	H	H	L	N	N	Poorly compatible with proposed; Combined Rainwater Butt and SuDS Planters	0	0
	Rain Water harvesting	M	L	L	L	NA	M	M	H	L	Y	Y		2	1
Infiltration Methods	Infiltration trench	H	H	H	M	H	H	H	H	L	Y	N	Conveyance route to rear;	0	0
	Permeable Pavement	H	H	H	H	H	H	H	H	H	Y	Y	Good potential to be included where car parking spaces are located	40.9	17.3
	Infiltration basin	H	H	H	M	H	H	H	H	H	N	N	Limited Space	0	0
	Soakaway	H	H	H	M	H	H	H	H	L	Y	Y	Good Potential - Moderate Rate	100	57.1
Filtration	Filtration Surface sand	H	H	H	M	H	L	H	H	L	Y	N	Limited Space	0	0
	Sub-surface sand filter	H	H	H	M	H	L	H	H	L	Y	N	Limited Space	0	0
	Perimeter sand filter	H	H	H	M	H	L	H	H	L	Y	N	Limited Space	0	0
	Bioretention/filter strips	H	H	H	M	H	L	H	H	L	Y	Y	Small raised rain gardens by the side of impermeable area	20	2.4
	Filter trench	H	H	H	M	H	L	H	H	L	Y	N	Limited Space	0	0
Channels Features (Open)	Open channels Conveyance	H	M	M	M	H	M	H	H	H	N	N	Topography Not Suitable	0	0
	Enhanced dry swale	H	H	H	M	H	M	H	H	H	N	N	Topography Not Suitable	0	0
	Enhanced wet swale	H	H	M	H	H	L	H	H	H	N	N	Topography Not Suitable	0	0
Wet SuDS	Wetland Shallow wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space	0	0
	Extended detention wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space	0	0
	Pond / wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space	0	0
	Pocket wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space	0	0
	Submerged gravel wetland	H	M	H	M	H	L	H	M	L	N	N	Limited Space	0	0
	Wetland channel	H	M	H	M	H	L	H	M	L	N	N	Limited Space	0	0
Retention	Retention pond	H	M	M	M	H	L	H	H	H	N	N	Limited Space	0	0
Detention	Detention basin	M	M	L	L	L	L	H	H	H	N	N	Limited Space	0	0
Tank Storage	Sub-surface storage (Tank)	L	L	L	L	L	L	H	H	H	Y	N	Good potential, least sustainable.	0	0
Total														78	

8.4 SuDS Strategy

8.4.1 SuDS Options

The proposal will introduce combined SuDS planters and rainwater butts which will allow for a minimal amount of water re-use. Small rain gardens will accept all rooftop runoff before discharging to a large geocellular soakaway to the rear.

All other hard standing will convey flows onto strategically placed filter strips and permeable paving to ensure suitable filtration and water quality measures are implemented around the site. These filtration mediums will also provide additional attenuation and natural reduce the runoff velocity as excess flows migrate through the structures.

The combination of the SuDS measures introduce will provide 78m³ of attenuation the details are outline in the table below.

Table 7: Proposed SuDS

ID	Proposed Area (m ²)	SuDS Option	Estimated Storage Provided (m ³)
N/A	4.8	Combined Rainwater Butt and SuDS Planters	1.0
RG1	20	Rain Garden (0.5 - 0.6m thick)	2.4
P1a	60	Permeable Paving – 350mm Sub-base	6.3
P2a	105	Permeable Paving – 350mm Sub-base	11
G1	150	Geocellular Storage (0.4 thick)	57.1
Total			77.8

The drainage layout, model sections and model results are is available in [Appendix 9](#).

The descriptions of the proposed SuDS and how they interact with the different features is outlined below.

8.4.2 Combined Rainwater Butts and SuDS Planters

Combined rainwater butts and SuDS planters are suited to this development. 5no. planters fitted to the downpipes of the proposed rooftops, as to act as a filtration medium while attenuating flow and removing sediment. These will also allow for 1.8m³ of rainwater re-use. These will provide a total of 1.0m³ of attenuation storage. Once at capacity the planters will discharge into the SuDS management train described below.

8.4.3 Rain Gardens

A Rain garden will be formed within the north site, south of the proposed building.

The rain garden will cover a total of 20m², they will be formed from a minimum of 400mm of well-draining topsoil and covered in suitable planting (grasses and flora). The based of the raingardens will be formed from permeable MOT type 3 (no fines) aggregate. The sub-base will increase the attenuation and filtration potential and where suitable will allow for infiltration into the ground. An overflow connection allow for excess flows to discharge further along the proposed system and to prevent flooding occurring during extreme events.

These will provide a total of 1.2m³ attenuation within the sub-base based on an average porosity of 0.3. The well-draining substrate will have a porosity of 0.15 providing a further 1.2m³ of attenuation.

8.4.4 Filter Strips

A filter strip will be formed beside the proposed driveway, which will accept excess storm water from the entrance way, and will help direct discharge into the Geocellular soakaway.

The filter strip will be formed from well-draining topsoil and supported with a permeable sub-base to ensure conveyance along the system. The sub-base of the filter strip will work in combination with the permeable paving that is forms the bin store, just north of building No.2.

All excess flows will discharge via a catchpit before discharging into the large geocellular soakaway located to the rear of the site.

8.4.5 Permeable Block Paving – Car Parking

Permeable Paving (Marshalls Prior or similar) combines hardstanding with SuDS and works in a very different way to traditional pavement. It is designed to allow rainfall to

percolate immediately through the surface near to where the raindrop lands – so surface ponding is completely eradicated without the need for an additional channel drainage system.

The construction will consist of 80mm interlocking concrete blocks with jointing, with a 50mm underlying bedding layer with a 350mm sub-base consisting of a graded aggregate (Marshall's Priora Aggregates or similar) with a porosity of 0.30. This construction depth will provide CBR value of <5% which will be designed for cars and light vans. This construction over 165m² will provide approximately 17.3m³ of interception, attenuation, and treatment storage, and it will allow for direct infiltration. This has been designed using the average infiltration rate from TP01 / TP02 / TP03 (0.024m/hr).

8.4.6 Geocellular soakaway

The geocellular storage structures will be placed below the main car parking area to the front of the dwelling. The structure will cover a total area of 150m² with a thickness of 0.4m. The geocellular storage crates ([AquaCell Drainage Crates](#) or similar) will have a porosity of 95% and will be stacked together to create the desired storage volume of 57.1m³.

8.4.7 Surface Water Discharge Points

The surface water will discharge into the ground via infiltration.

8.4.8 Treatment of Run-off

Treatment of roof water runoff will be provided through the provision of the permeable paving and small rain gardens, to intercept gross solids and sediment. Guidance will be provided to the developer on appropriate maintenance requirements including regular cleaning of gullies.

A water quality assessment, available in [Appendix 10](#), indicates that the groundwater protection measures are adequate for the development.

8.4.9 Exceedance Flows

The ground levels within the redline boundary range from 23.94mAOD in the southwest to 25.70mAOD in the north. Upon completion these falls will largely remain the same.

The elevation review of the LIDAR 1m DTM Mapping indicates that in the event of exceedance on the site upon completion, overland flows will flow away from the car parking and discharging onto Rosherville Way, away from the building ensuring safe access and egress can be maintained during such an event. A raised bund could be placed within the southwest of the site, to allow for excess surface water flows to remain within the car parking area.

8.5 Maintenance and Adoption of SuDS

All SuDS features will be properly installed by competent persons. They will be maintained regularly to ensure that their design capacity and attenuation characteristics provide the required storage volume.

Landscaping and adjacent areas will be designed such that they do not cause soil, mulch and other materials to be washed onto the permeable surfaces and into drains causing clogging.

Owners of the properties/persons responsible for maintenance of SuDS components will be provided with operation and maintenance manuals which will include information such as:

-  the location of SuDS components;
-  an explanation of design intent and objective of the SuDS;
-  the requirements for regular and occasional inspection and maintenance;
-  visual indicators that may trigger maintenance.

Regular maintenance of SuDS components is relatively straightforward with the main tasks consisting of:

- Regular visual inspections – checking inlets are not blocked and verifying that clogging has not occurred;
- Litter and debris removal;
- Grass cutting;
- Preventive sweeping;
- Weeding and invasive plant control;
- Oil and stain removal.

Occasional maintenance activities to ensure the long-term performance of the SuDS features include:

- Sediment removal
- Vegetation and plant replacement

These simple measures will ensure that the storage capacity of the system is maintained and that the need for reconstruction and replacement of components is minimised.

Further details on SuDS maintenance measures that will be employed at the site can be found in [Appendix 8](#).

9 Conclusion and Recommendations

With the proposed SuDS mitigation measures in place, it is considered that the proposed development will reduce local flood risk and enhance the local environment and will therefore be in compliance with the LLFA's current planning policy and the NPPF.

10 References

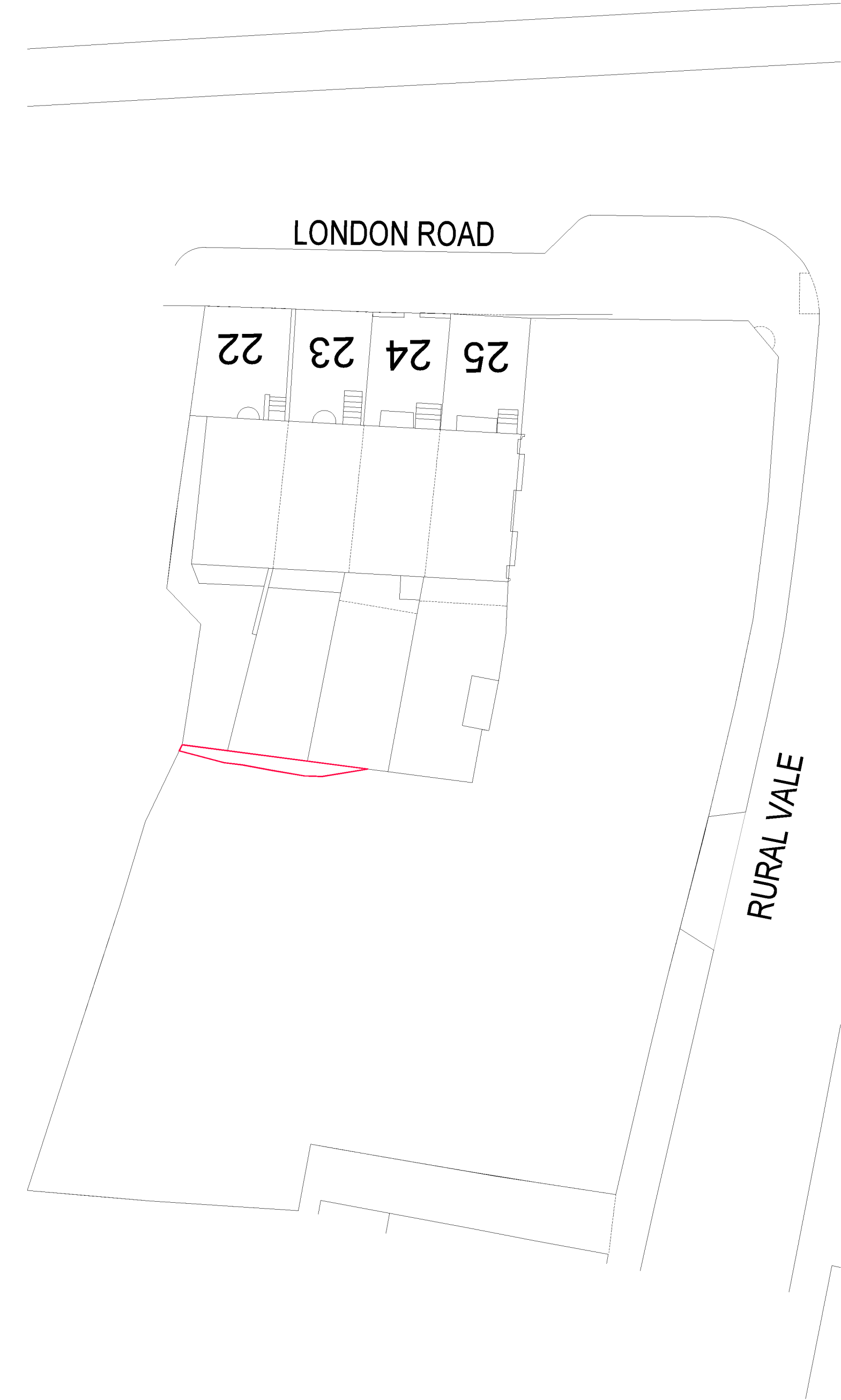
1. Communities and Local Government - National Planning Policy Framework NPPF, 2019.
2. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
3. Gravesham Borough Council – Gravesham Local Plan, Adopted September 2015

11 Appendices

11.1 Appendix 1 – Development Plans & Photos

11.1.1 Development Plans

PDF to follow this page.



Existing Block Plan 1:200



Proposed Block Plan 1:200

Scale 1:200

Scale 1:1250



Notes:

- Do not scale from this drawing.
- All dimensions to be verified on site and is in mm.
- Builder to verify all dimensions, heights and levels prior to commencement of work.
- All documents shall be checked to ensure that they are compatible by the contractor before construction commences. In the event of apparent ambiguity or contradiction the engineer and/ or architect shall be notified immediately.
- The contractor in preparing his estimate shall visit the site and acquaint himself with the problems involved.
- The contractor shall issue all statutory notices to the local Authority during progress and completion of works.



Site Location Plan 1:1250



A	-	-	-/-/-
REV:	DESCRIPTION:	BY:	DATE:

STATUS: PLANNING
BARRON
EDWARDS
STERLING

Whitehall Place
47 The Terrace,
Gravesend, Kent
DA12 2DL
01474 247 787
info@barronedwards.co.uk
www.barronedwards.co.uk

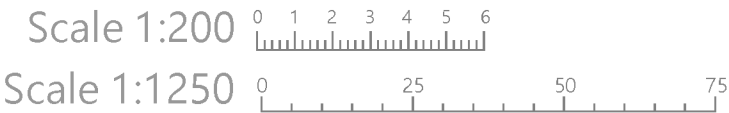
SITE:
London Road
Rural Vale
Gravesend, Kent
DA11 9JH

TITLE:
Site Location Plan
Existing Block Plan
Proposed Block Plan

SCALE AT A2: 1:1250, 1:200	DATE: 20.09.22	DRAWN: SA
PROJECT NO: 220803	DRAWING NO: 001	REVISION: A



Proposed Block Plan 1:200



Notes:

- Do not scale from this drawing.
- All dimensions to be verified on site and is in mm.
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A	-	-	-/-/-
REV:	DESCRIPTION:	BY:	DATE:

STATUS:

PLANNING
BARRON
EDWARDS
STERLING

Whitehall Place
47 The Terrace,
Gravesend, Kent

DA12 2DL
01474 247 787

info@barronedwards.co.uk
www.barronedwards.co.uk

SITE:
London Road
Rural Vale
Gravesend, Kent
DA11 9JH

TITLE:

Proposed Block Plan

SCALE AT A2:	DATE:	DRAWN:
1:1250, 1:200	20.09.22	SA
PROJECT NO:	DRAWING NO:	REVISION:
220803	003	A



KEY:

Standard Concrete Block Paving (or similar)
Charcoal - 353sqm
Marshalls

Urbex® Textured Paving (or similar)
Buff - 13.1sqm
Marshalls

Marshalls Indian Sandstone (or similar)
Brown Multi - 1.2sqm
Marshalls

Proposed Planting Band (or similar)

Lawn or Artificial Lawn
114sqm

Planting density 7.5 / linear metre (triple staggered). Planted rows should be no further than 450mm apart. Hedging stock to be planted with perforated spirals and bamboo canes. Spirals and supports shall be removed within year 3 when planting has established. Hedge to be maintained to a height of no less than 1.7m and no greater than 2.0m; and of a width no less than 1.0m.

PLANTING BAND 1 (or similar)
Area: 0.7sqm
Species to include:

1 x Euonymus fortune
"Emerald Gaiety": Size: 2L CG;
Density: 4m²

PLANTING BAND 2 (or similar)
Area: 0.8sqm
Species to include:

1 x Euonymus fortune
"Emerald Gaiety": Size: 2L CG;
Density: 4m²

PLANTING BAND 3 (or similar)
Area: 0.8sqm
Species to include:

1 x Euonymus fortune
"Emerald Gaiety": Size: 2L CG;
Density: 4m²

PLANTING BAND 4 (or similar)
Area: 1.8sqm
Species to include:

2 x Euonymus fortune
"Emerald Gaiety": Size: 2L CG;
Density: 4m²

PLANTING BAND 5 (or similar)
Area: 3 sqm
Species to include:

3 x Euonymus fortune
"Emerald Gaiety": Size: 2L CG;
Density: 4m²

PLANTING BAND 6 (or similar)
Area: 1.3sqm
Species to include:

1 x Euonymus fortune
"Emerald Gaiety": Size: 2L CG;
Density: 4m²

SOIL DEPTH:
- Min. depths to BS 3882:2015 (topsoil) and BS 8601:2013 (subsoil)
- Trees – 300mm topsoil / 600mm subsoil
- Hedges & Shrub Planting Areas – 300mm topsoil / 300mm subsoil
- Lawns – 150mm topsoil / 300mm subsoil
- Tree Pit width: Minimum 200mm greater than the radius of the rootball.
- Tree Pit depth: Soil depth no greater than 150mm below the base of the rootball.
- Main contractor to excavate to required depth & thoroughly break up sub-soil. Landscape contractor to supply and install the following:
- Premium grade topsoil throughout all planting areas with 75mm layer of organic material thoroughly mixed in. Ameliorate soil areas with Terracotem polymer/fertiliser at manufacturers rate or similar and approved.

PLANTING NOTES:
1. All planting to comply with the requirements specified in BS3936 (1980) 'Specification of Nursery Stock Part 1 Trees and Shrubs' and in BS4428 (1969) 'Recommendations for General Landscape Operations.
2. All hedging plants to be bushy and trimmed back to design heights.
3. Any trees or shrubs which, within a period of 5 years from the first planting and seeding season, die, are removed or become seriously damaged or diseased, shall be replaced in the next planting season with others of similar size and species.
4. All shrubs are to be container grown in 3 litre pots in accordance with BS 3936 part 1 (1980) and part 2 (1990) and to have 3-5 branching shoots with minimum stem diameters of 7mm.

Notes:

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- All dimensions to be verified on site and is in mm.
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- All documents shall be checked to ensure that they are compatible by the contractor before construction commences. In the event of apparent ambiguity or contradiction the engineer and/ or architect shall be notified immediately.
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Site Location Plan 1:1250

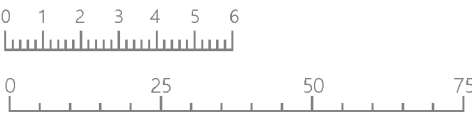
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STATUS:		PLANNING	

GILL STERLING

Whitehall Place
47 The Terrace,
Gravesend, Kent
DA12 2DL
01474 247 787
info@barronedwards.co.uk
www.barronedwards.co.uk

SITE:	London Road Rural Vale Gravesend, Kent DA11 9JH		
TITLE:	Condition No. 8 Condition No. 9		

Scale 1:200
Scale 1:1250



SCALE AT A2:	DATE:	DRAWN:
1:1250, 1:200, 1:50	20.03.24	SR
PROJECT NO:	DRAWING NO:	REVISION:
240320	001	A

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PROPOSED ELEVATIONS BLOCK A (I-100)



NORTH ELEVATION



SOUTH ELEVATION

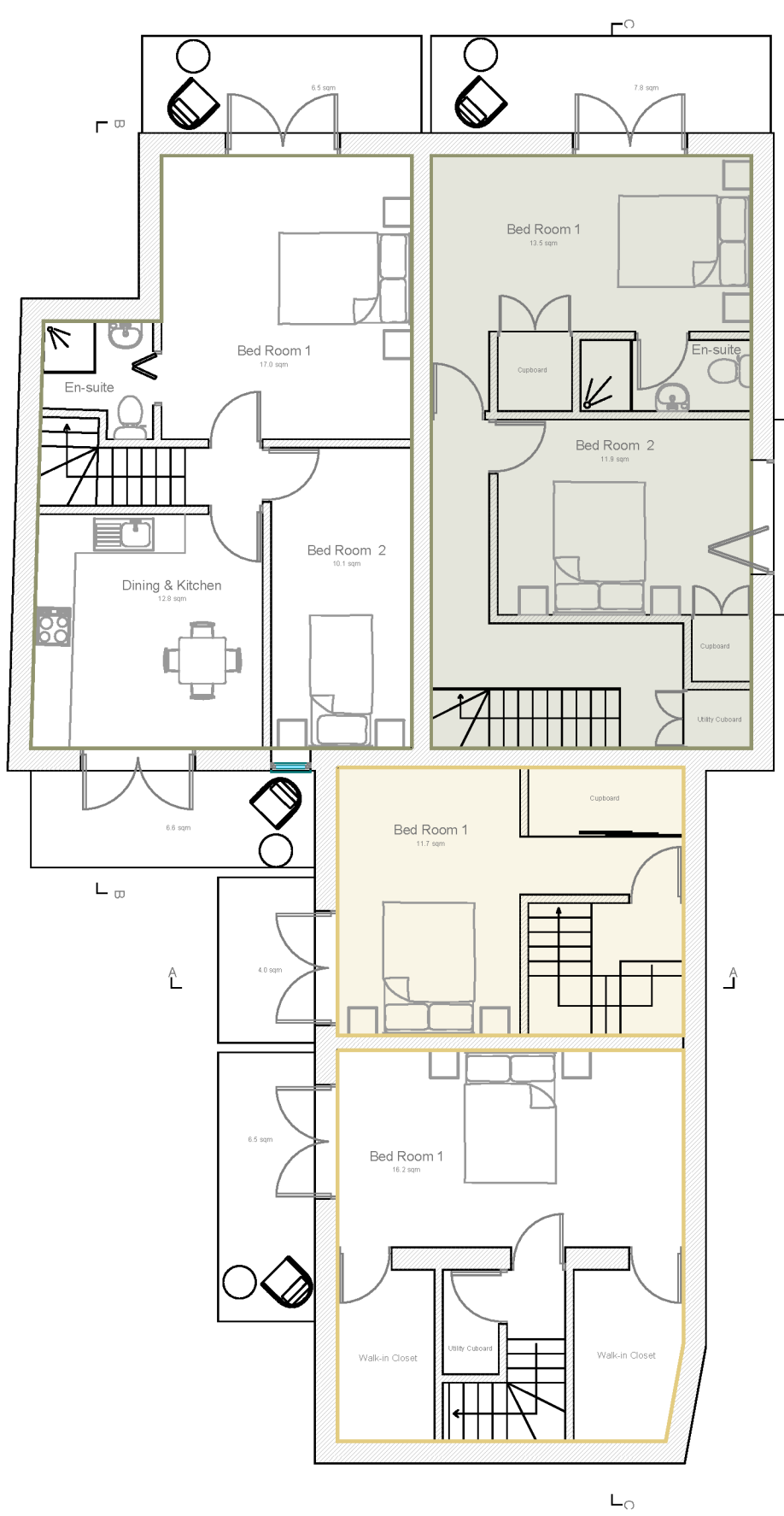


EAST ELEVATION

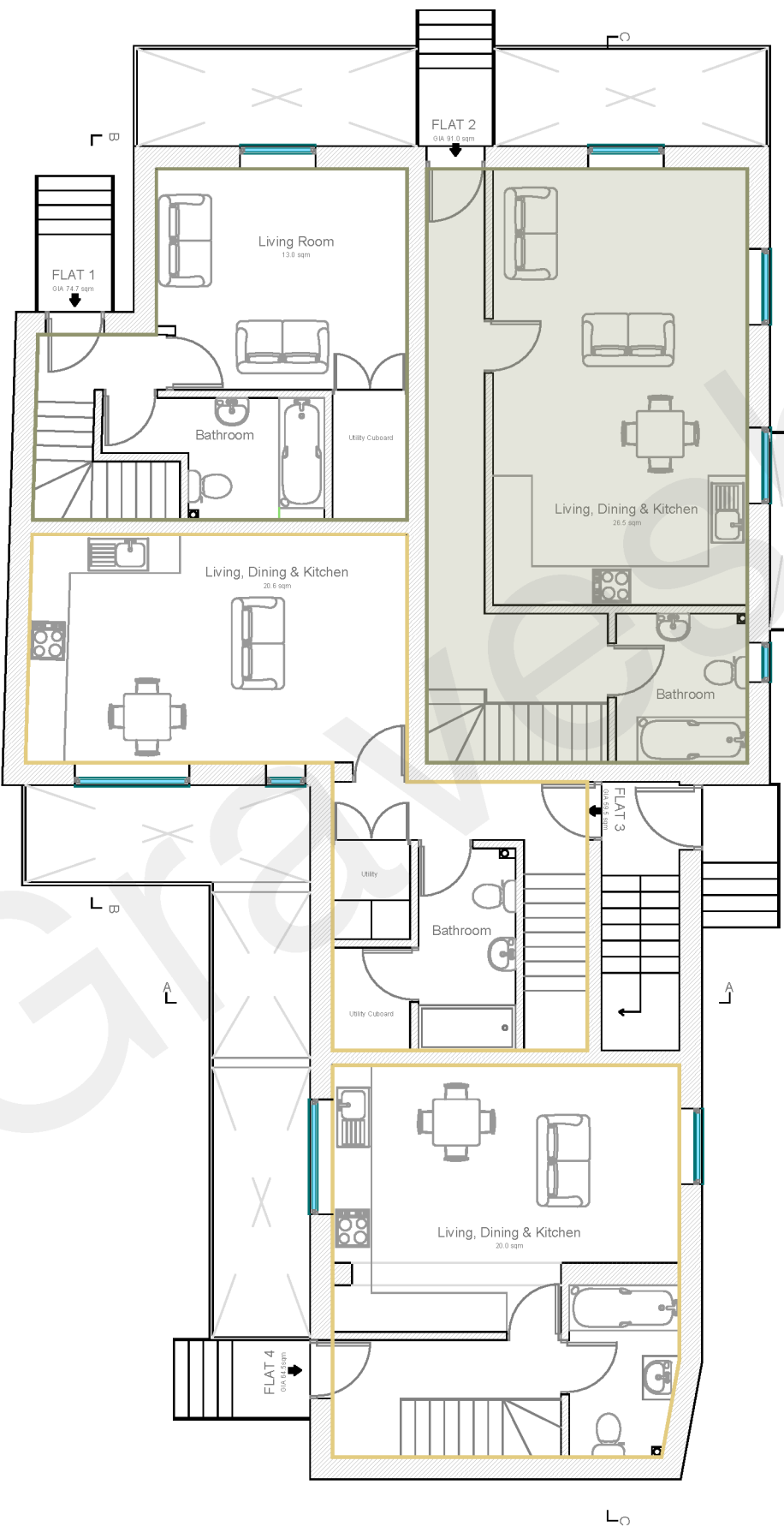


WEST ELEVATION

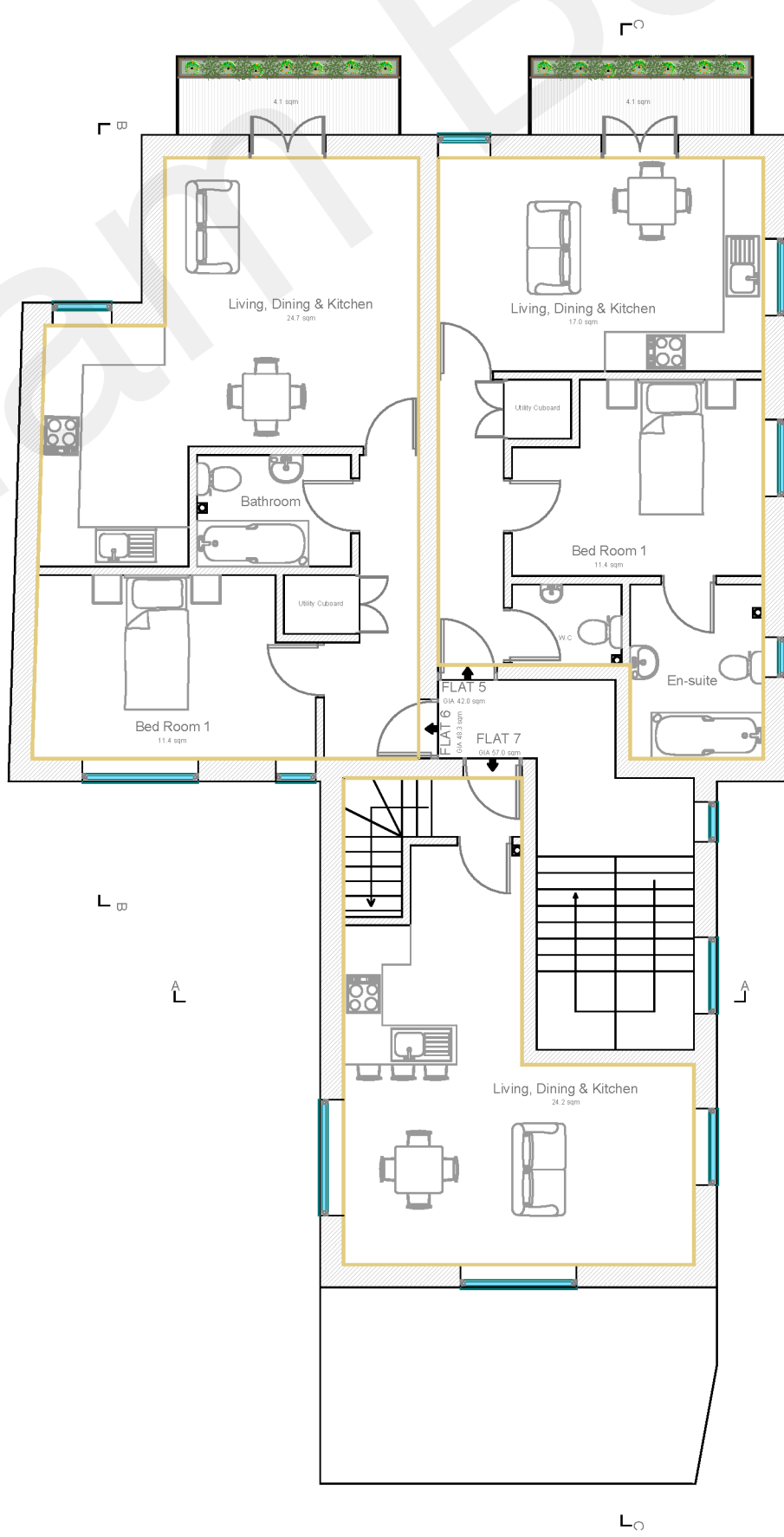
PROPOSED FLOOR PLANS BLOCK A (I-100)



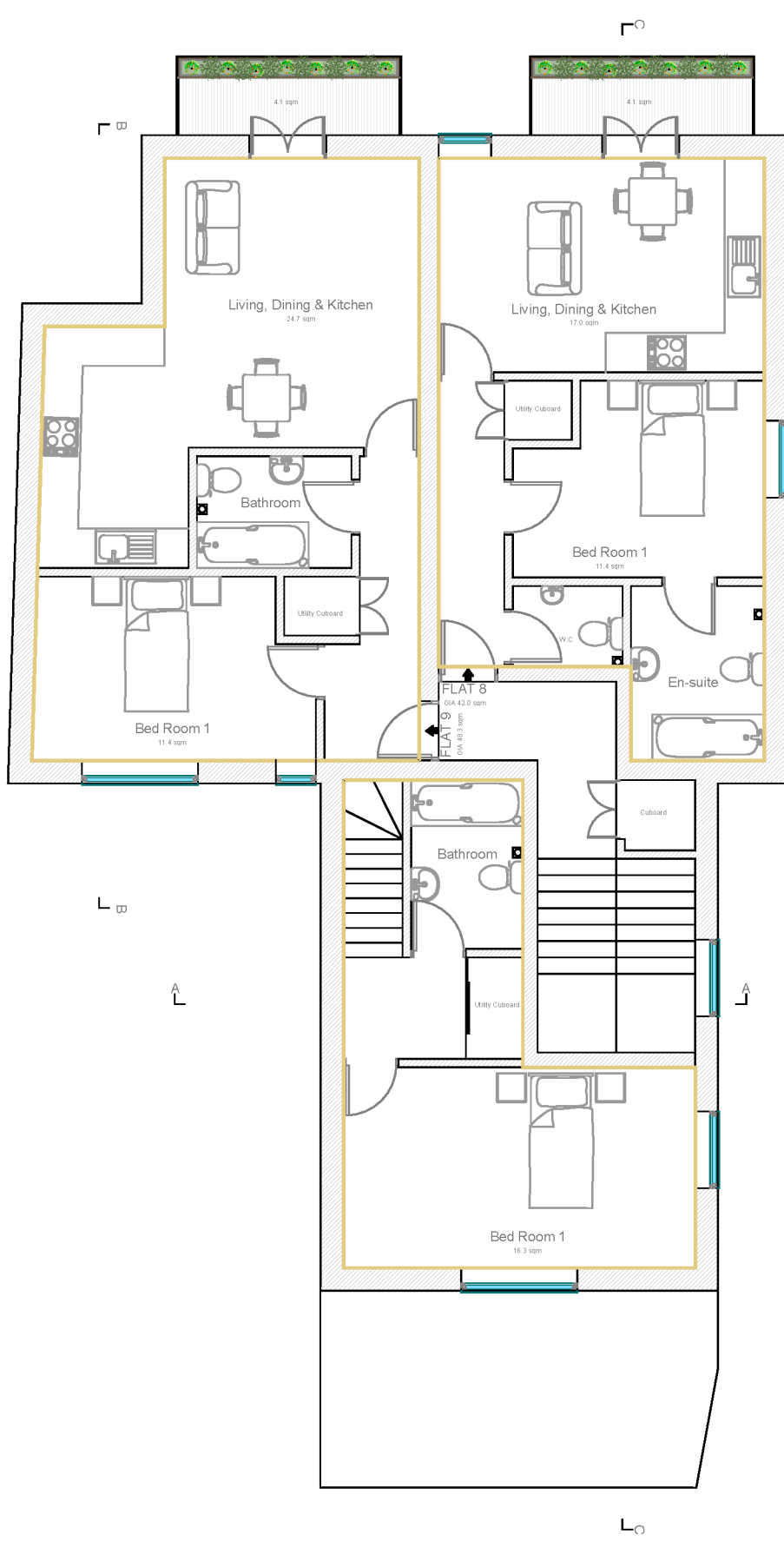
LOWER GROUND FLOOR PLAN



GROUND FLOOR PLAN



FIRST FLOOR PLAN



SECOND FLOOR PLAN

- KEY:
- 1 X Bed Room Flat
 - 2 X Bed Room Flat

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REVISIONS			
Issued for PLANNING			
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CLIENT LONDON ROAD RURAL VALE GRAVESEND KENT DA11 9JH			
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DRAWING NUMBER LR1-19-P2		REVISION 1	



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PROPOSED STREET VIEWS (I-I00)



LONDON ROAD



RURAL VALE

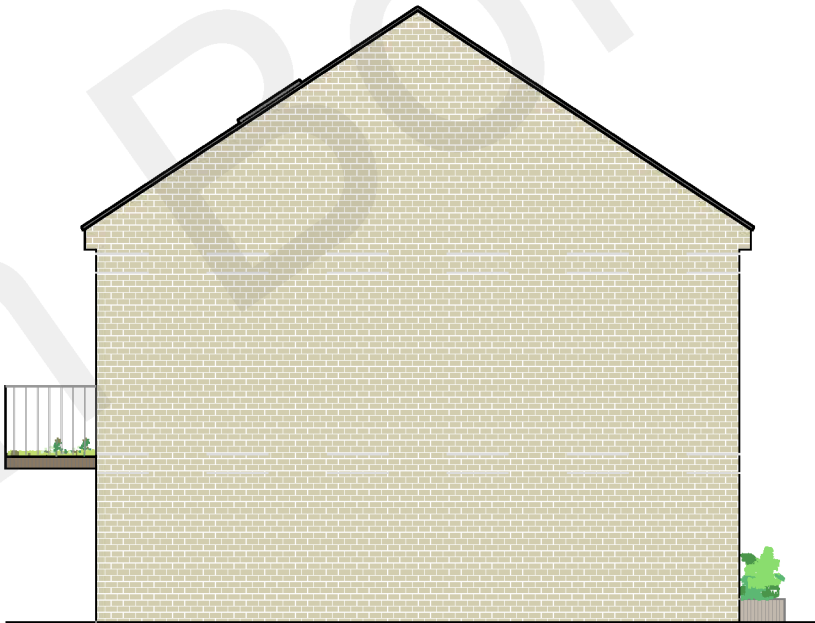
PROPOSED ELEVATIONS BLOCK B (I-I00)



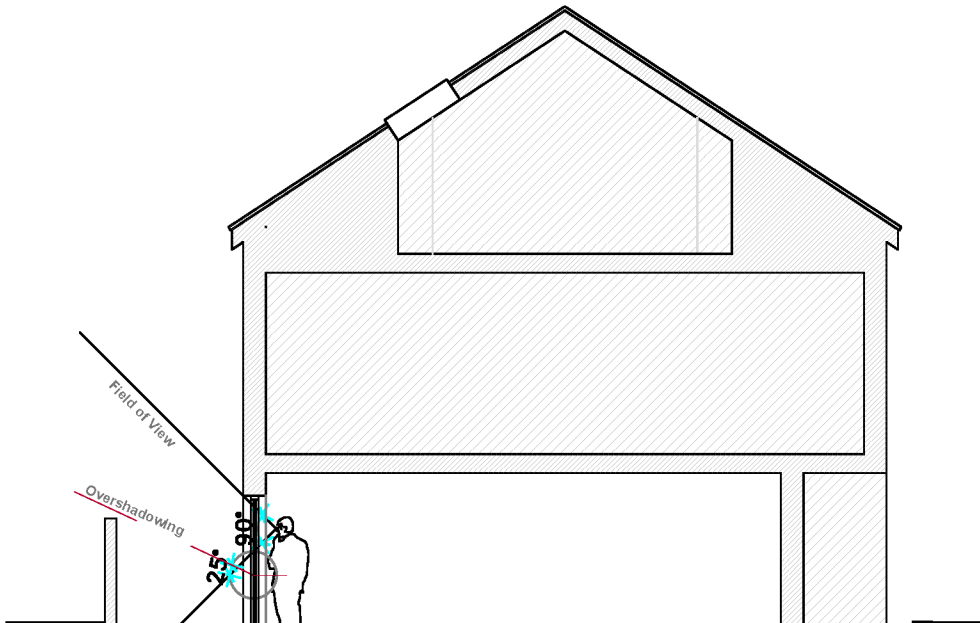
EAST ELEVATION



WEST ELEVATION

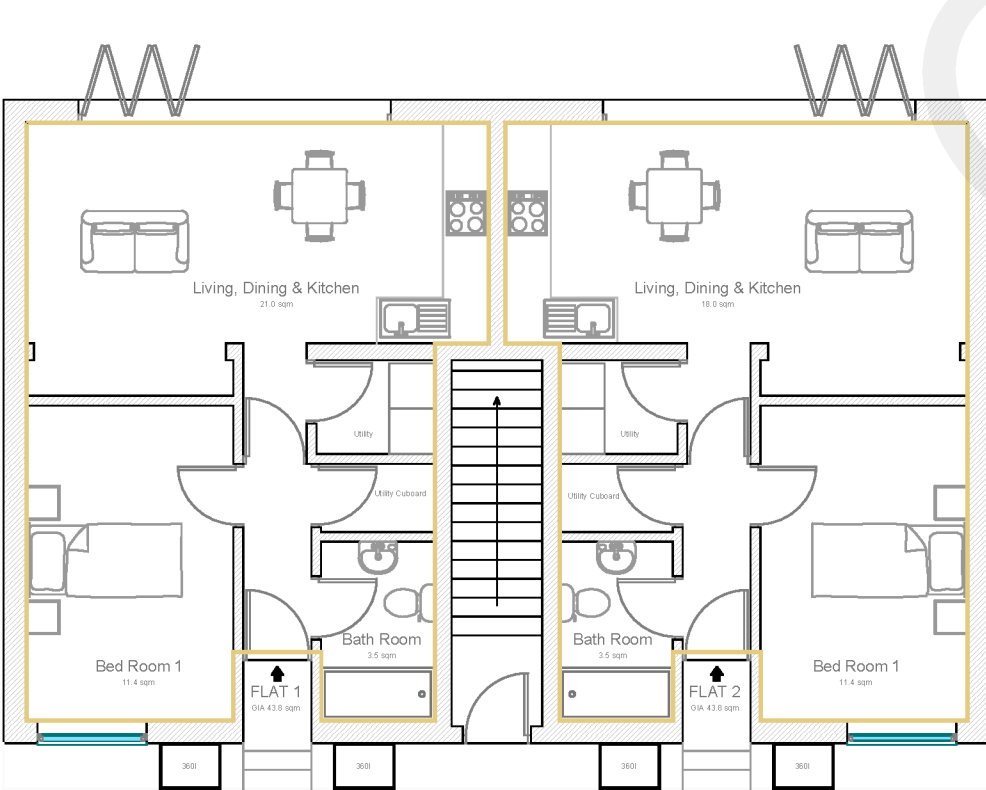


NORTH ELEVATION

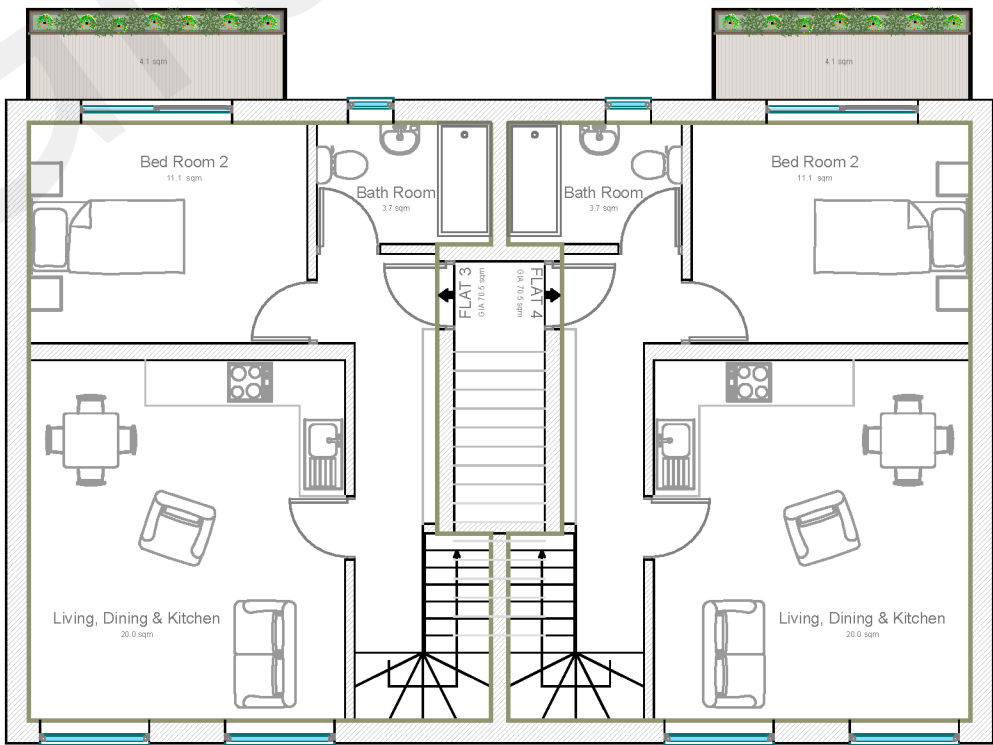


SECTION

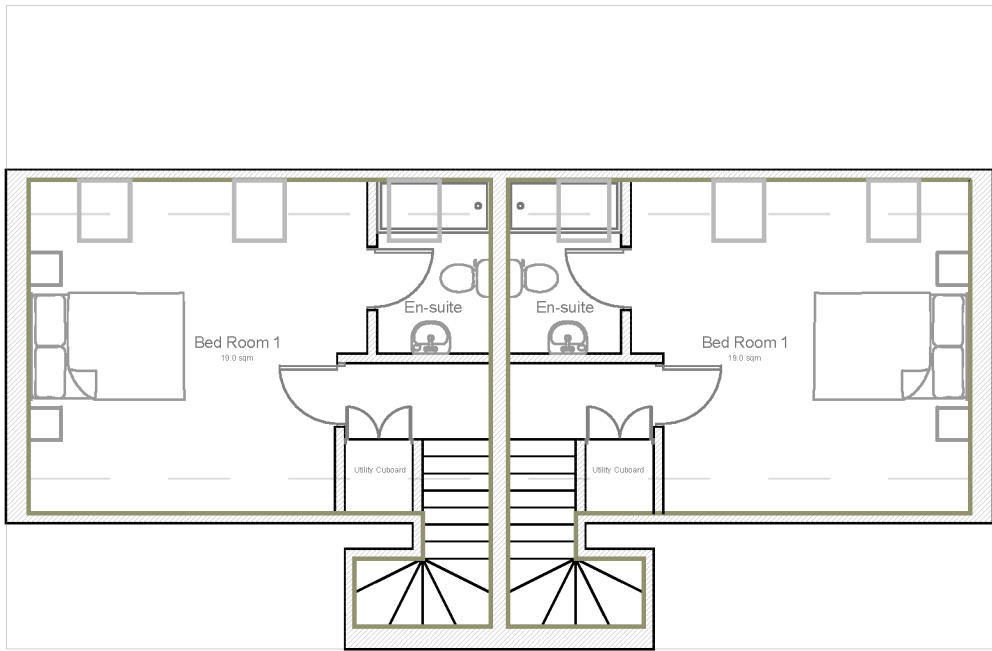
PROPOSED FLOOR PLANS BLOCK B (I-I00)



GROUND FLOOR PLAN

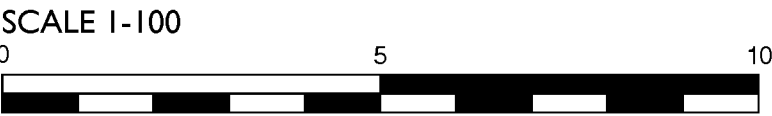


FIRST FLOOR PLAN



LOFT FLOOR PLAN

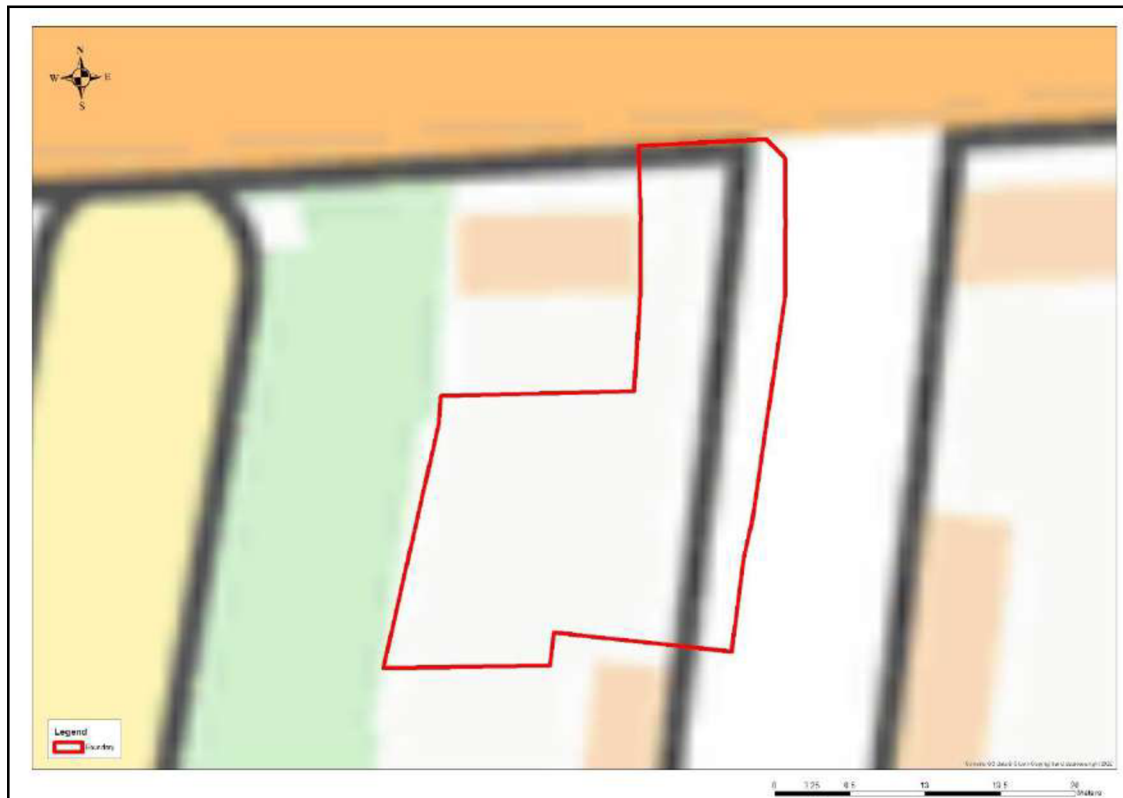
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 - 2 X Bed Room Flat



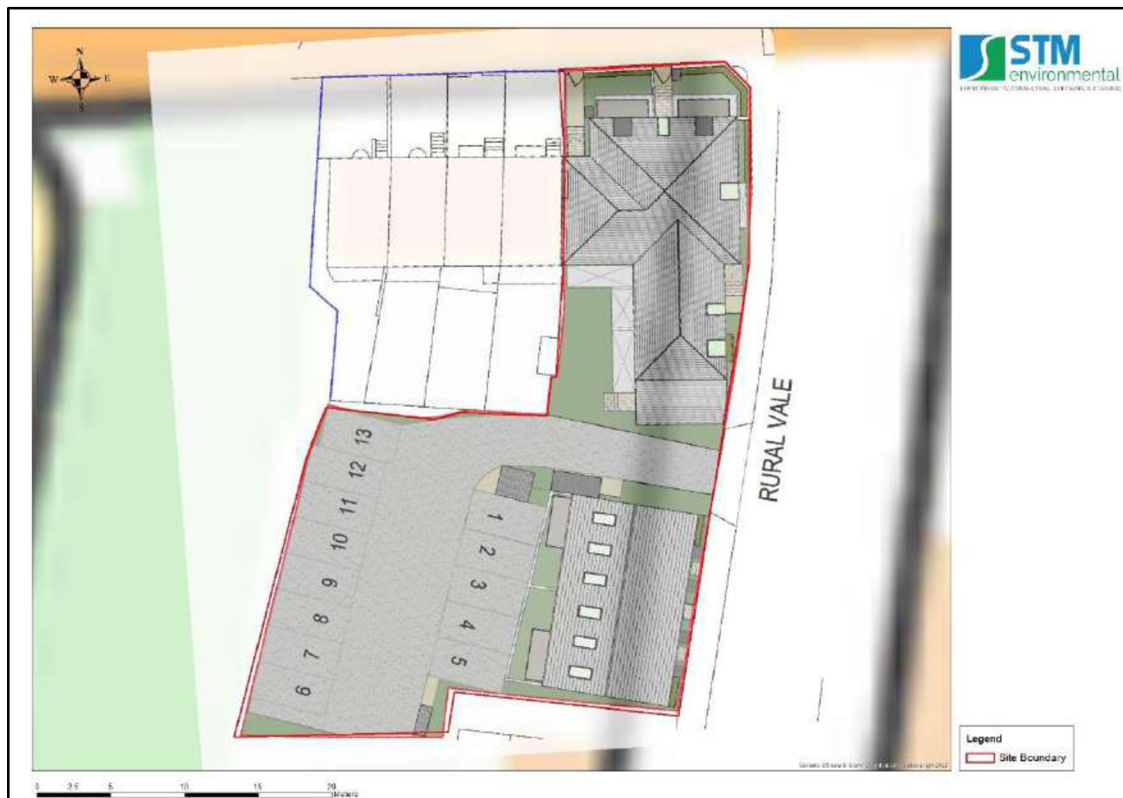
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11.1.2 Existing Development



11.1.3 Proposed (No Additional SuDS)

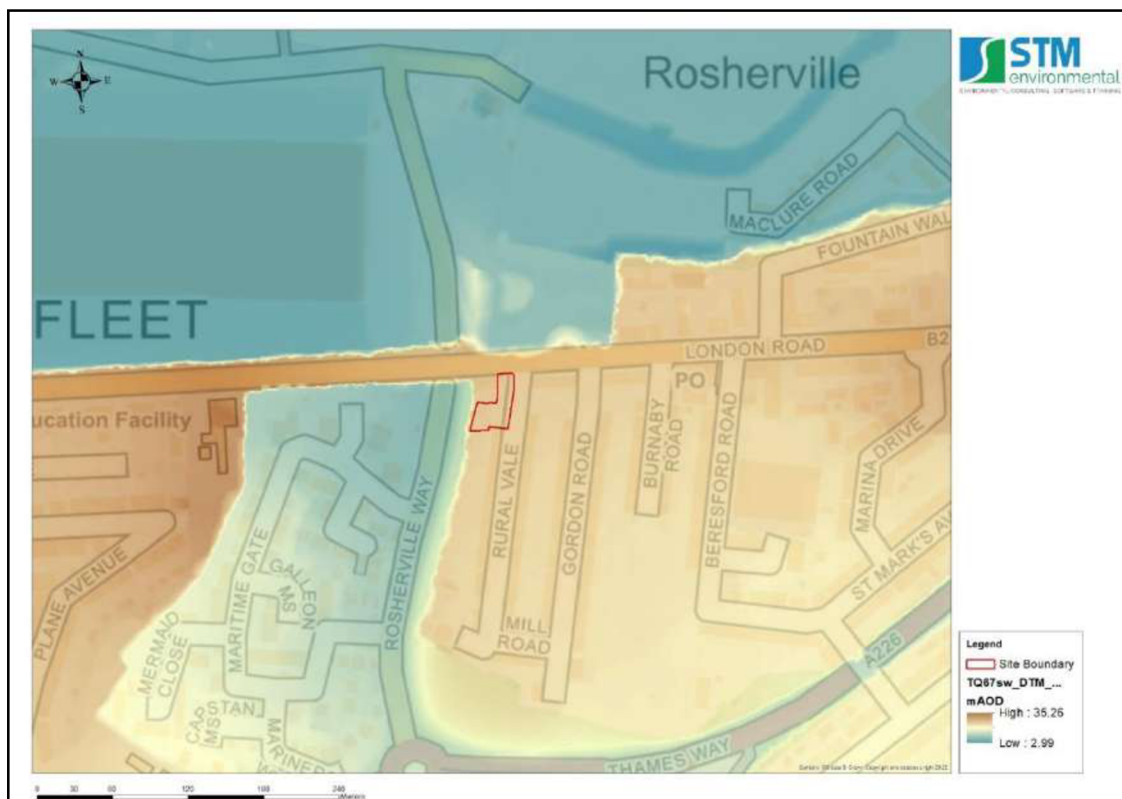


11.1.4 Site Photos

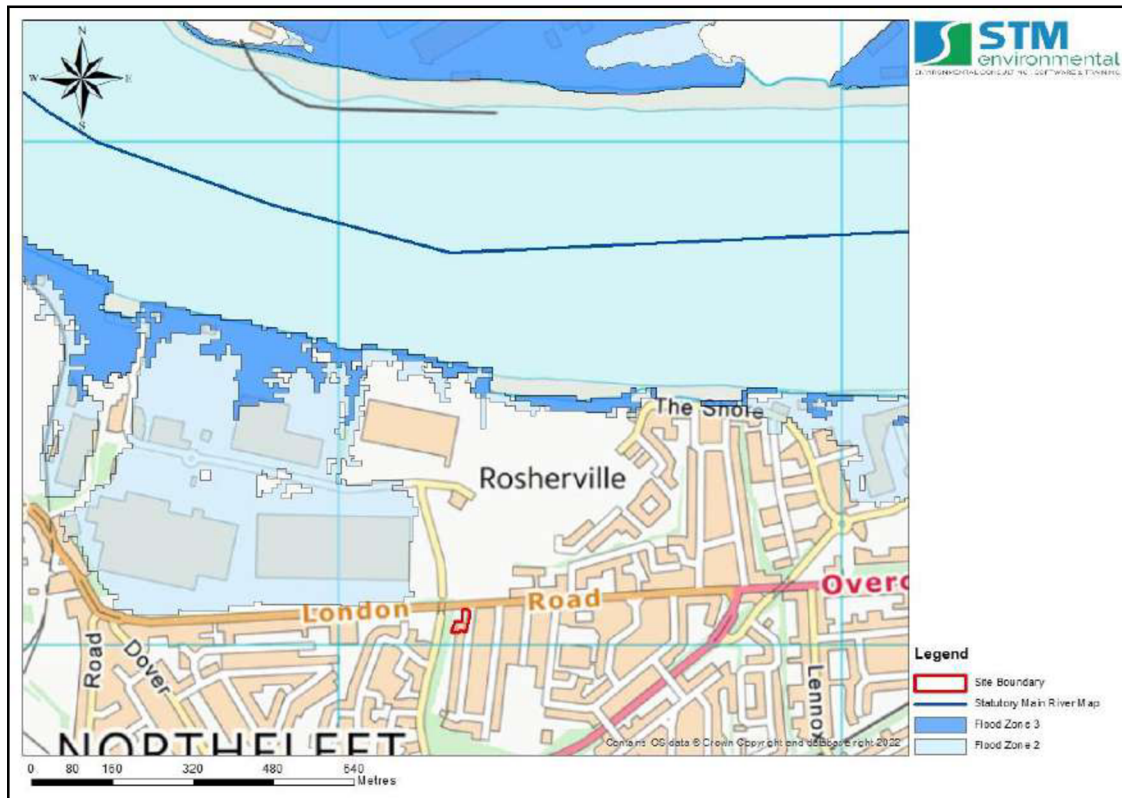


11.2 Appendix 2– Site Topography and Drainage Characteristics

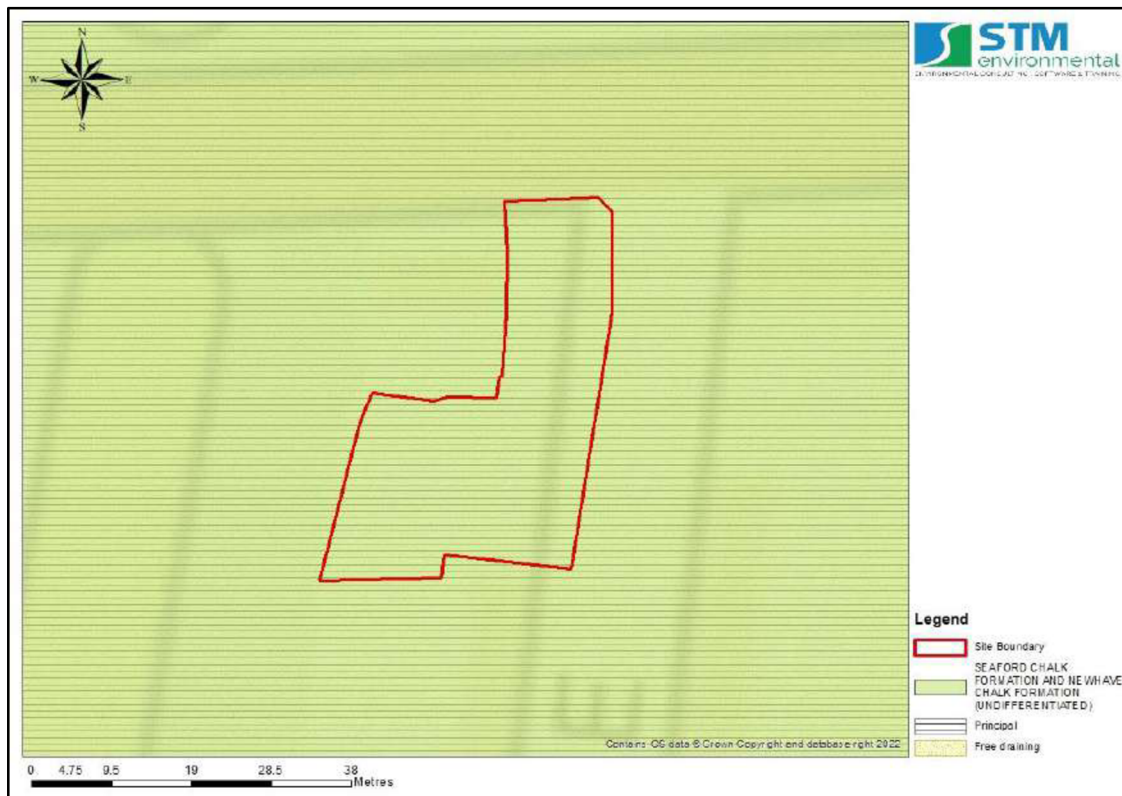
11.2.1 LIDAR Mapping showing Site Topography - (Source: LiDAR DTM 2022)



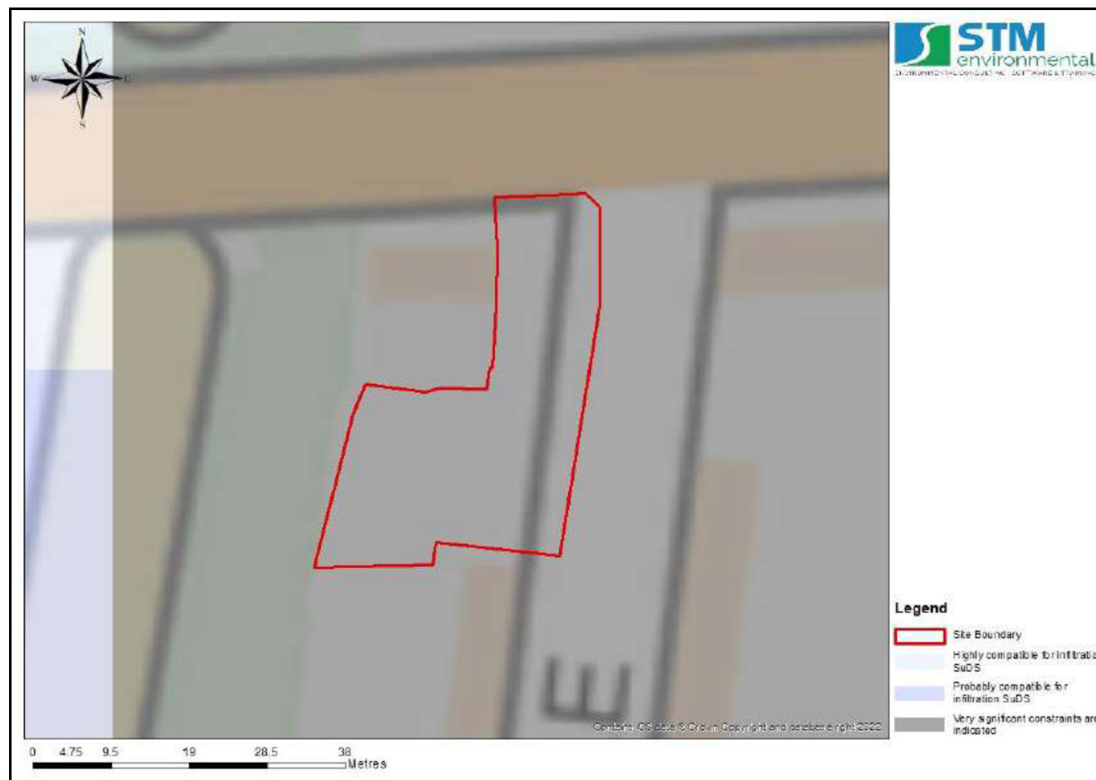
11.2.2 Hydrology Map



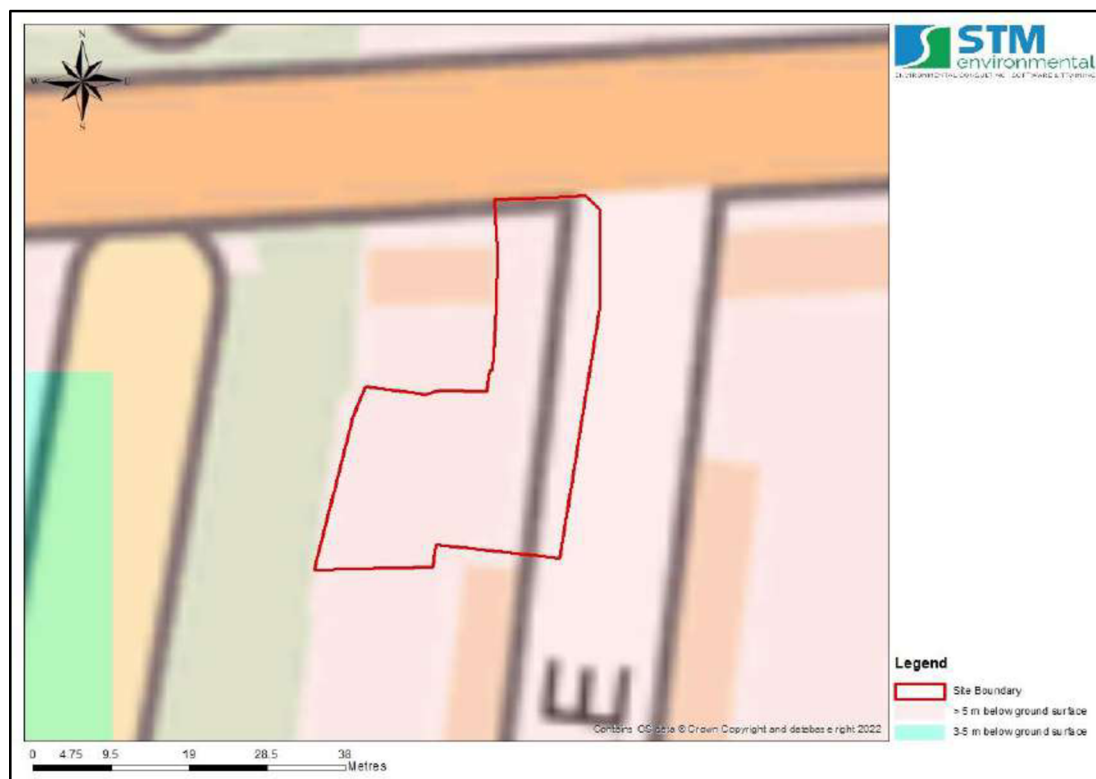
11.2.3 Bedrock Geology, Hydrogeology & Permeability (Source: BGS, 2016)



11.2.4 Infiltration Drainage Potential (Source: BGS, 2016)



11.2.5 Groundwater Table Depth (Source: BGS 2016)

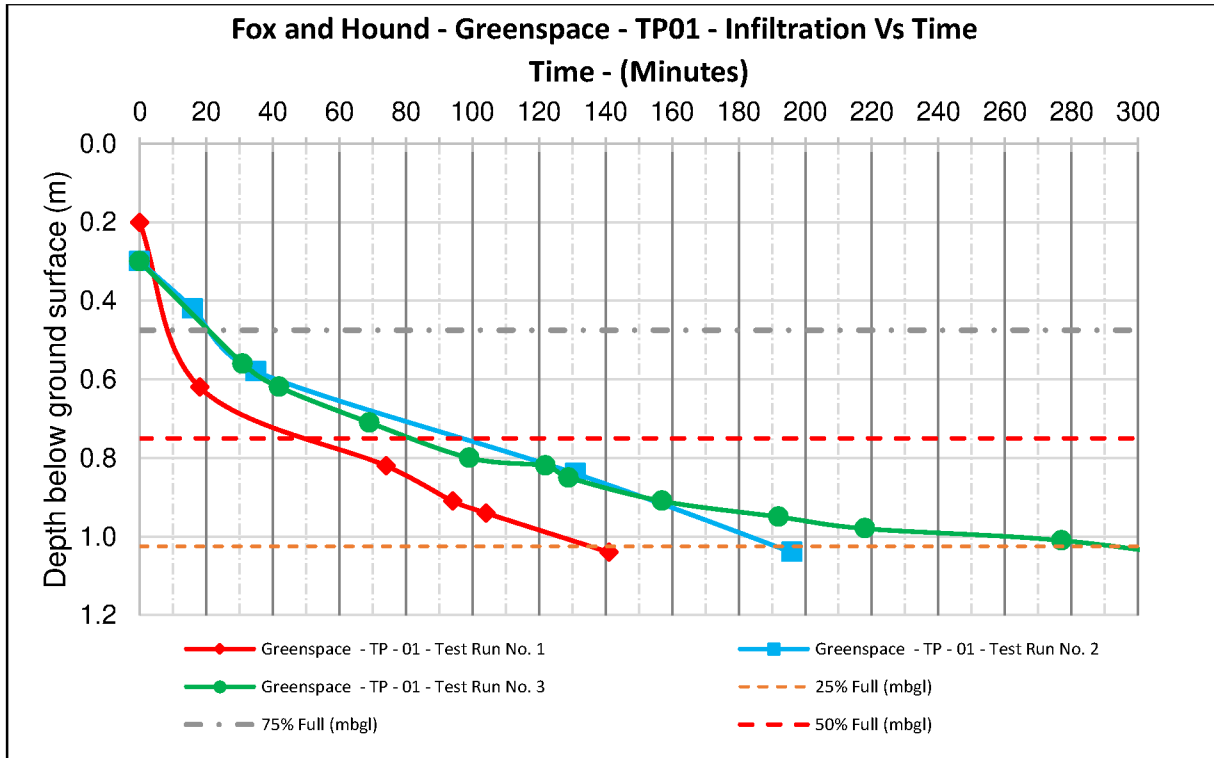


11.2.6 Site Investigation Photos





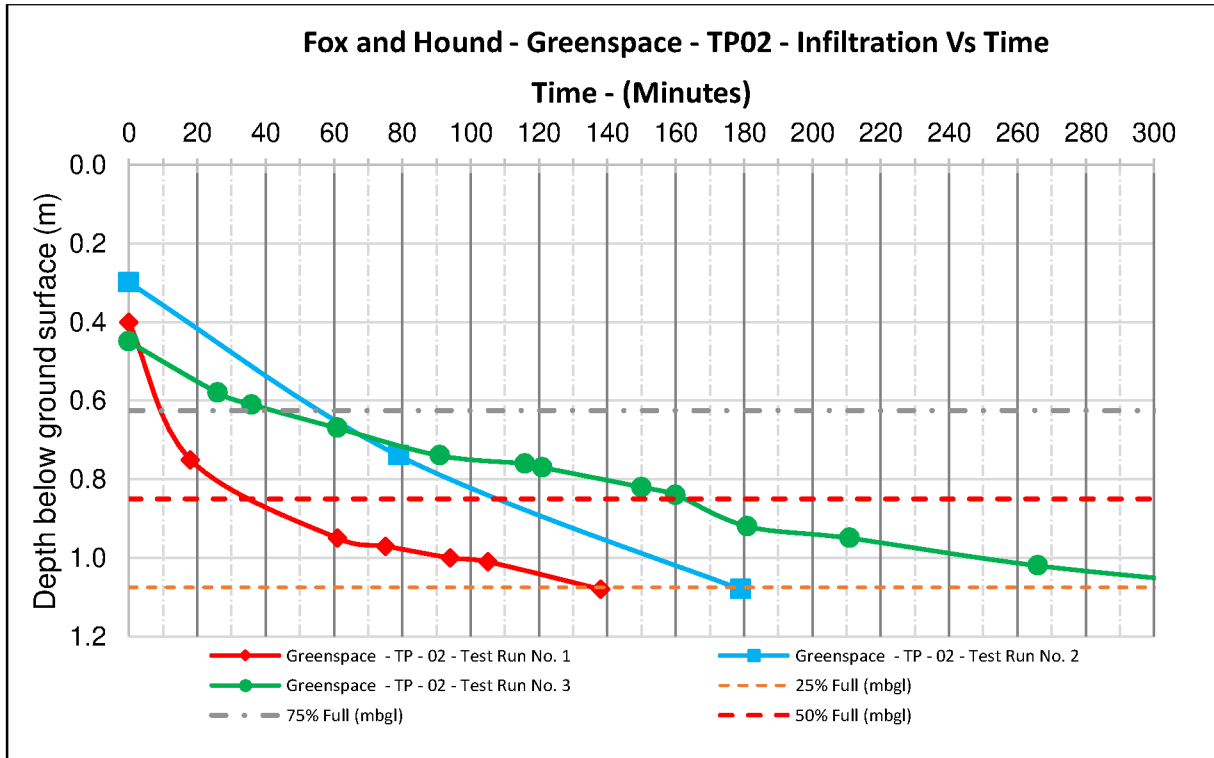
11.2.7 Infiltration Testing Graph (TP01)



11.2.8 Infiltration Data and Results (TP01)

Greenspace - TP - 01 - Test Run No. 1									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	1.1	0.2	0.00	0	0 0:00	11:46:00	1.025	0.75	0.475
	0.68	0.6	0.30	18	1080.00 0:18	12:04:00	1.025	0.75	0.475
	0.48	0.8	1.23	74	4440.00 1:14	13:00:00	1.025	0.75	0.475
	0.39	0.9	1.57	94	5640.00 1:34	13:20:00	1.025	0.75	0.475
	0.36	0.9	1.73	104	6240.00 1:44	13:30:00	1.025	0.75	0.475
	0.26	1.0	2.35	141	8460.00 2:21	14:07:00	1.025	0.75	0.475
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 01 - Test Run No. 2									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	1	0.3	0.00	0	0 0:00	14:19:00	1.025	0.75	0.475
	0.88	0.4	0.27	16	960.00 0:16	14:35:00	1.025	0.75	0.475
	0.72	0.6	0.58	35	2100.00 0:35	14:54:00	1.025	0.75	0.475
	0.46	0.8	2.18	131	7860.00 2:11	16:30:00	1.025	0.75	0.475
	0.26	1.0	3.27	196	11760.00 3:16	17:35:00	1.025	0.75	0.475
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 01 - Test Run No. 3									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	1	0.3	0.00	0	0 0:00	09:13:00	1.025	0.75	0.475
	0.74	0.6	0.52	31	1860.00 0:31	09:44:00	1.025	0.75	0.475
	0.68	0.6	0.70	42	2520.00 0:42	09:55:00	1.025	0.75	0.475
	0.59	0.7	1.15	69	4140.00 1:09	10:22:00	1.025	0.75	0.475
	0.5	0.8	1.65	99	5940.00 1:39	10:52:00	1.025	0.75	0.475
	0.48	0.8	2.03	122	7320.00 2:02	11:15:00	1.025	0.75	0.475
	0.45	0.9	2.15	129	7740.00 2:09	11:22:00	1.025	0.75	0.475
	0.39	0.9	2.62	157	9420.00 2:37	11:50:00	1.025	0.75	0.475
	0.35	1.0	3.20	192	11520.00 3:12	12:25:00	1.025	0.75	0.475
	0.32	1.0	3.63	218	13080.00 3:38	12:51:00	1.025	0.75	0.475
	0.29	1.0	4.62	277	16620.00 4:37	13:50:00	1.025	0.75	0.475
	0.23	1.1	5.53	332	19920.00 5:32	14:45:00	1.025	0.75	0.475

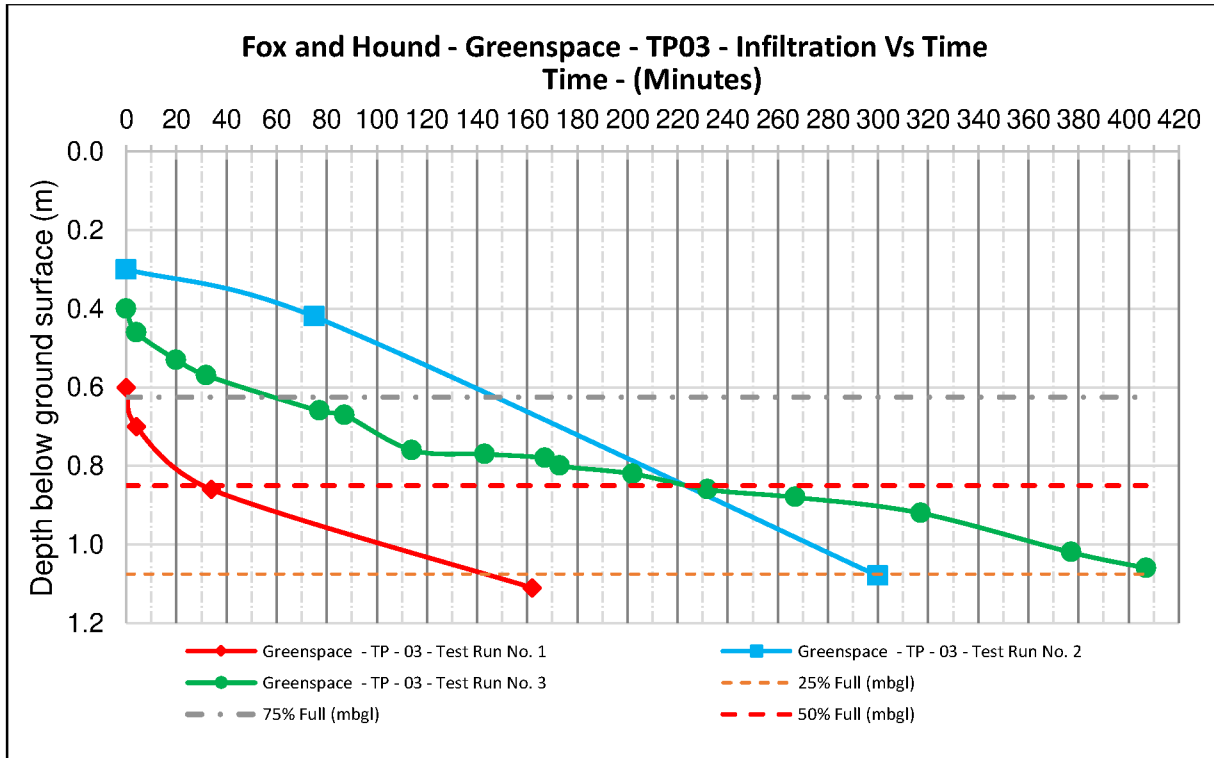
11.2.9 Infiltration Testing Graph (TP02)



11.2.10 Infiltration Data and Results (TP02)

Greenspace - TP - 02 - Test Run No. 1									
insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.9	0.4	0.00	0	0 0:00	13:07:00	1.075	0.85	0.625
	0.55	0.8	0.30	18	1080.00 0:18	13:25:00	1.075	0.85	0.625
	0.35	1.0	1.02	61	3660.00 1:01	14:08:00	1.075	0.85	0.625
	0.33	1.0	1.25	75	4500.00 1:15	14:22:00	1.075	0.85	0.625
	0.3	1.0	1.57	94	5640.00 1:34	14:41:00	1.075	0.85	0.625
	0.29	1.0	1.75	105	6300.00 1:45	14:52:00	1.075	0.85	0.625
	0.22	1.1	2.30	138	8280.00 2:18	15:25:00	1.075	0.85	0.625
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 02 - Test Run No. 2									
insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	1	0.3	0.00	0	0 0:00	15:09:00	1.075	0.85	0.625
	0.56	0.7	1.32	79	4740.00 1:19	16:28:00	1.075	0.85	0.625
	0.22	1.1	2.98	179	10740 2:59	18:08:00	1.075	0.85	0.625
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 02 - Test Run No. 3									
insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.85	0.5	0.00	0	0 0:00	09:19:00	1.075	0.85	0.625
	0.72	0.6	0.43	26	1560.00 0:26	09:45:00	1.075	0.85	0.625
	0.69	0.6	0.60	36	2160.00 0:36	09:55:00	1.075	0.85	0.625
	0.63	0.7	1.02	61	3660.00 1:01	10:20:00	1.075	0.85	0.625
	0.56	0.7	1.52	91	5460.00 1:31	10:50:00	1.075	0.85	0.625
	0.54	0.8	1.93	116	6960.00 1:56	11:15:00	1.075	0.85	0.625
	0.53	0.8	2.02	121	7260.00 2:01	11:20:00	1.075	0.85	0.625
	0.48	0.8	2.50	150	9000.00 2:30	11:49:00	1.075	0.85	0.625
	0.46	0.8	2.67	160	9600.00 2:40	11:59:00	1.075	0.85	0.625
	0.38	0.9	3.02	181	10860.00 3:01	12:20:00	1.075	0.85	0.625
	0.35	1.0	3.52	211	12660.00 3:31	12:50:00	1.075	0.85	0.625
	0.28	1.0	4.43	266	15960.00 4:26	13:45:00	1.075	0.85	0.625
	0.23	1.1	5.43	326	19560.00 5:26	14:45:00	1.075	0.85	0.625
	0.22	1.1	5.93	356	21360.00 5:56	15:15:00	1.075	0.85	0.625

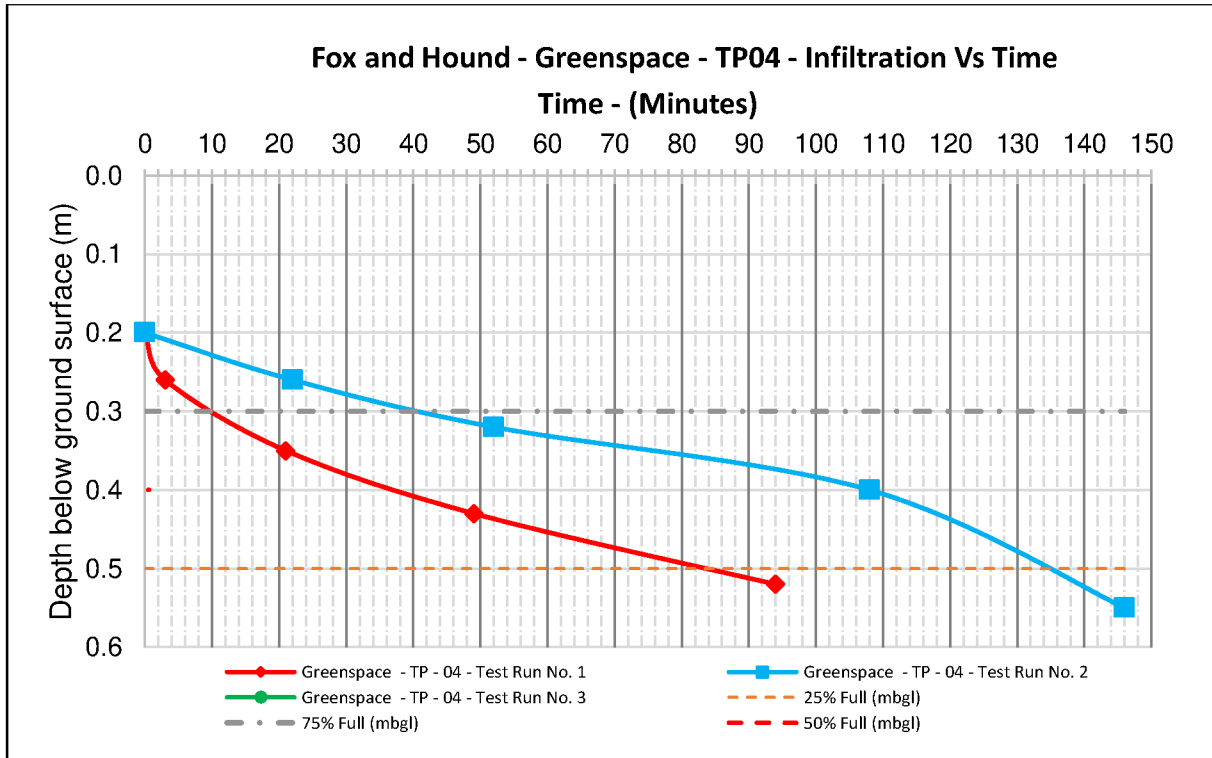
11.2.11 Infiltration Testing Graph (TP03)



11.2.12 Infiltration Data and Results (TP03)

Greenspace - TP - 03 - Test Run No. 1									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.7	0.6	0.00	0	0 0:00	13:26:00	1.075	0.85	0.625
	0.6	0.7	0.07	4	240.00 0:04	13:30:00	1.075	0.85	0.625
	0.44	0.9	0.57	34	2040.00 0:34	14:00:00	1.075	0.85	0.625
	0.19	1.1	2.70	162	9720.00 2:42	16:08:00	1.075	0.85	0.625
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 03 - Test Run No. 2									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	1	0.3	0.00	0	0 0:00	13:13:00	1.075	0.85	0.625
	0.88	0.4	1.25	75	4500.00 1:15	14:28:00	1.075	0.85	0.625
	0.22	1.1	5.00	300	18000 5:00	18:13:00	1.075	0.85	0.625
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 03 - Test Run No. 3									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.9	0.4	0.00	0	0 0:00	08:28:00	1.075	0.85	0.625
	0.84	0.5	0.07	4	240.00 0:04	08:32:00	1.075	0.85	0.625
	0.77	0.6	0.33	20	1200.00 0:20	08:48:00	1.075	0.85	0.625
	0.73	0.7	0.53	32	1920.00 0:32	09:00:00	1.075	0.85	0.625
	0.64	0.8	1.28	77	4620.00 1:17	09:45:00	1.075	0.85	0.625
	0.63	0.9	1.45	87	5220.00 1:27	09:55:00	1.075	0.85	0.625
	0.54	1.0	1.90	114	6840.00 1:54	10:22:00	1.075	0.85	0.625
	0.53	1.1	2.38	143	8580.00 2:23	10:51:00	1.075	0.85	0.625
	0.52	1.2	2.78	167	10020.00 2:47	11:15:00	1.075	0.85	0.625
	0.5	1.3	2.88	173	10380.00 2:53	11:21:00	1.075	0.85	0.625
	0.48	1.4	3.37	202	12120.00 3:22	11:50:00	1.075	0.85	0.625
	0.44	1.5	3.87	232	13920.00 3:52	12:20:00	1.075	0.85	0.625
	0.42	1.6	4.45	267	16020.00 4:27	12:55:00	1.075	0.85	0.625
	0.38	1.7	5.28	317	19020.00 5:17	13:45:00	1.075	0.85	0.625
	0.28	1.8	6.28	377	22620.00 6:17	14:45:00	1.075	0.85	0.625
	0.24	1.9	6.78	407	24420.00 6:47	15:15:00	1.075	0.85	0.625

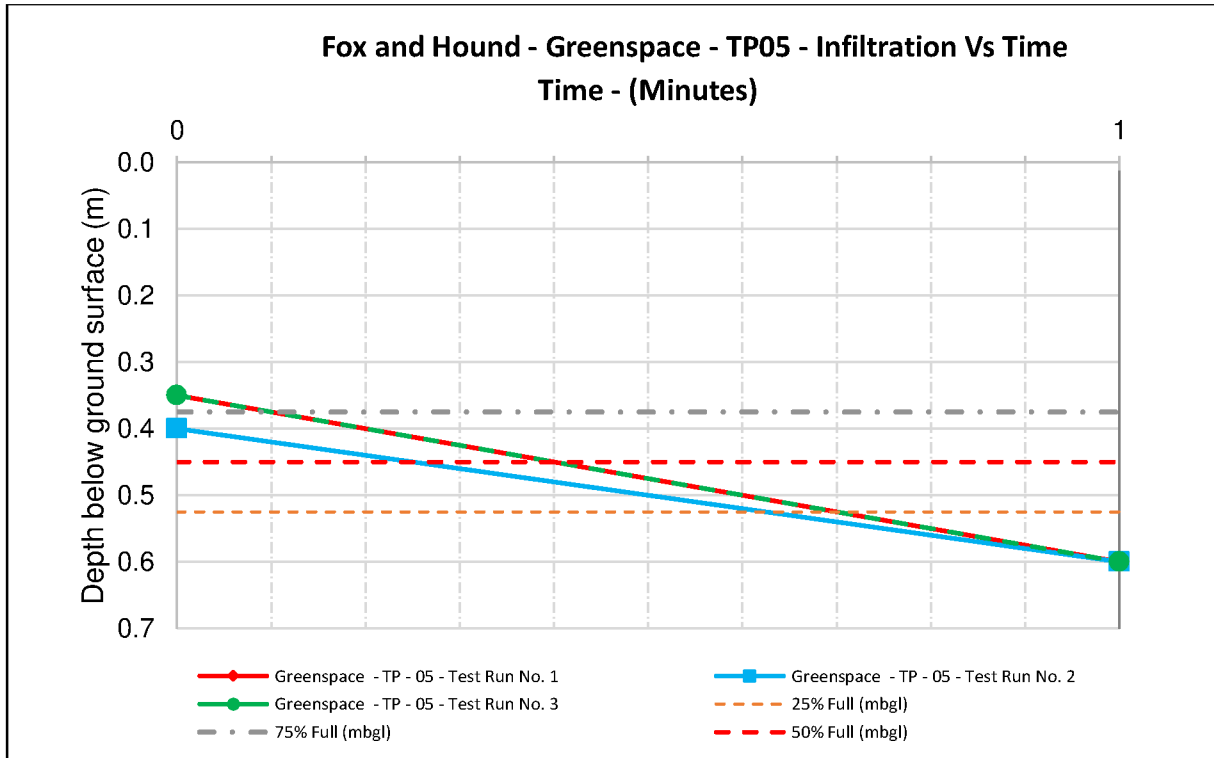
11.2.13 Infiltration Testing Graph (TP04)



11.2.14 Infiltration Data and Results (TP04)

Greenspace - TP - 04 - Test Run No. 1									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.4	0.2	0.00	0	0 0:00	10:26:00	0.5	0.40	0.3
	0.34	0.3	0.05	3	180.00 0:03	10:29:00	0.5	0.40	0.3
	0.25	0.4	0.35	21	1260.00 0:21	10:47:00	0.5	0.40	0.3
	0.17	0.4	0.82	49	2940.00 0:49	11:15:00	0.5	0.40	0.3
	0.08	0.5	1.57	94	5640.00 1:34	12:00:00	0.5	0.40	0.3
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 04 - Test Run No. 2									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.4	0.2	0.00	0	0 0:00	12:04:00	0.5	0.40	0.3
	0.34	0.3	0.37	22	1320.00 0:22	12:26:00	0.5	0.40	0.3
	0.28	0.3	0.87	52	3120 0:52	12:56:00	0.5	0.40	0.3
	0.2	0.4	1.80	108	6480.00 1:48	13:52:00	0.5	0.40	0.3
	0.05	0.6	2.43	146	8760 2:26	14:30:00	0.5	0.40	0.3
Reached 25% within 24 hours. Second run undertaken.									

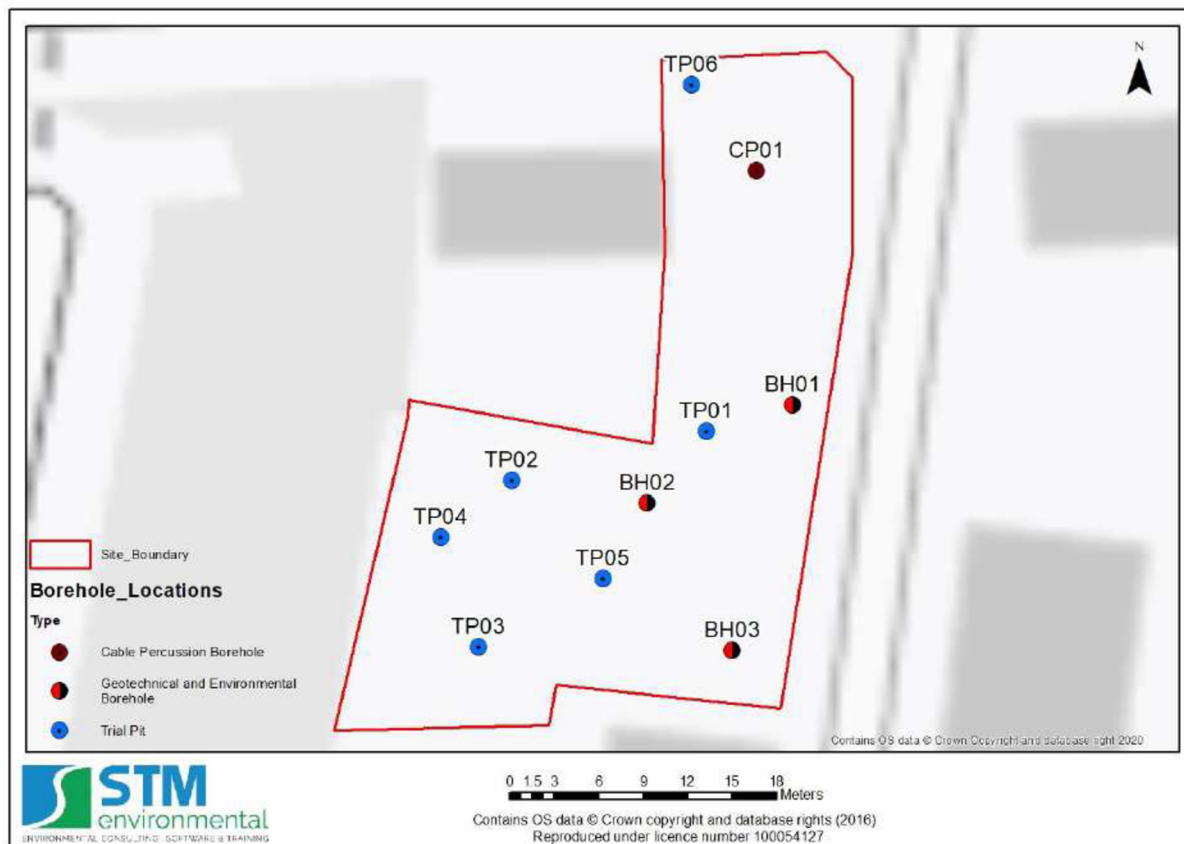
11.2.15 Infiltration Testing Graph (TP05)



11.2.16 Infiltration Data and Results (TP05)

Greenspace - TP - 05 - Test Run No. 1									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.25	0.4	0.00	0	0 0:00	12:01:00	0.525	0.45	0.375
	0	0.6	0.02	1	60.00 0:01	12:02:00	0.525	0.45	0.375
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 05 - Test Run No. 2									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.2	0.4	0.00	0	0 0:00	10:14:00	0.525	0.45	0.375
	0	0.6	0.02	1	60.00 0:01	10:15:00	0.525	0.45	0.375
Reached 25% within 24 hours. Second run undertaken.									
Greenspace - TP - 05 - Test Run No. 3									
Insert time according to the measured units									
Dip Reading	Water Level Above Base	Depth (mbgl)	Time (hours)	Time (minutes)	Time (s)	Time	25% Full (mbgl)	50% Full (mbgl)	75% Full (mbgl)
	0.25	0.4	0.00	0	0 0:00	10:18:00	0.525	0.45	0.375
	0	0.6	0.02	1	60.00 0:01	10:19:00	0.525	0.45	0.375

11.2.17 Borehole and Trial Pit Location Map



11.3 Appendix 3 – Flood Risk Mapping

11.3.1 Flood Map For Planning (EA)

PDF to follow this page.

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
563249/174049

Created
26 Jun 2024 16:09

Your selected location is in flood zone 1, an area with a low probability of flooding.

You will need to do a flood risk assessment if your site is **any of the following:**

- bigger than 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.

Flood risk data is covered by the Open Government Licence **which** sets out the terms and conditions for using government data. <https://www.nationalarchives.gov.uk/doc/open-government-licence/version/3/>

Use of the address and mapping data is subject to Ordnance Survey public viewing terms under Crown copyright and database rights 2022 OS 100024198. <https://flood-map-for-planning.service.gov.uk/os-terms>

Flood map for planning

Your reference
<Unspecified>

Location (easting/northing)
563249/174049

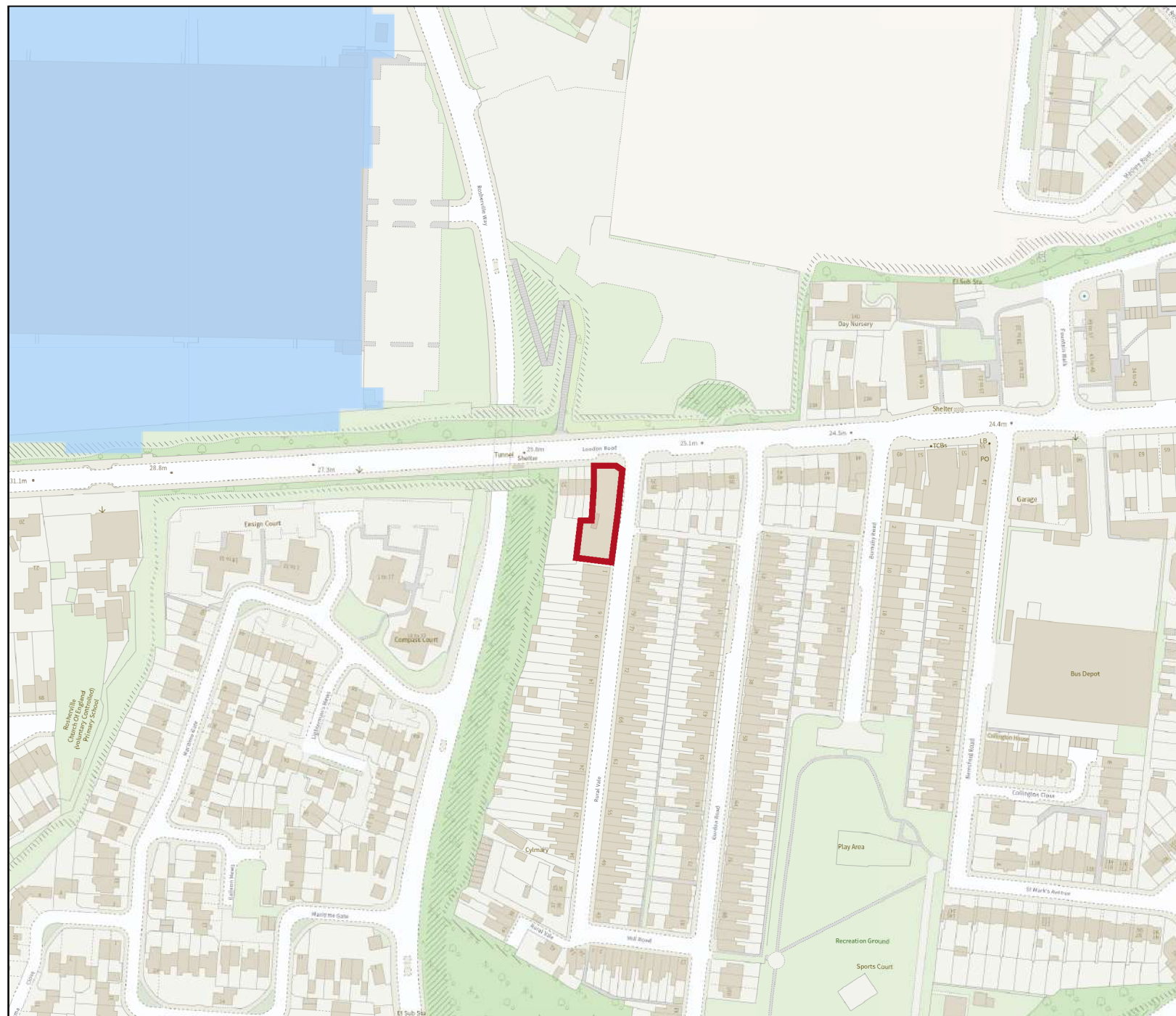
Scale
1:2500

Created
26 Jun 2024 16:09

-  Selected area
-  Flood zone 3
-  Flood zone 2
-  Flood zone 1
-  Flood defence
-  Main river
-  Water storage area

0 20 40 60m

Page 2 of 2



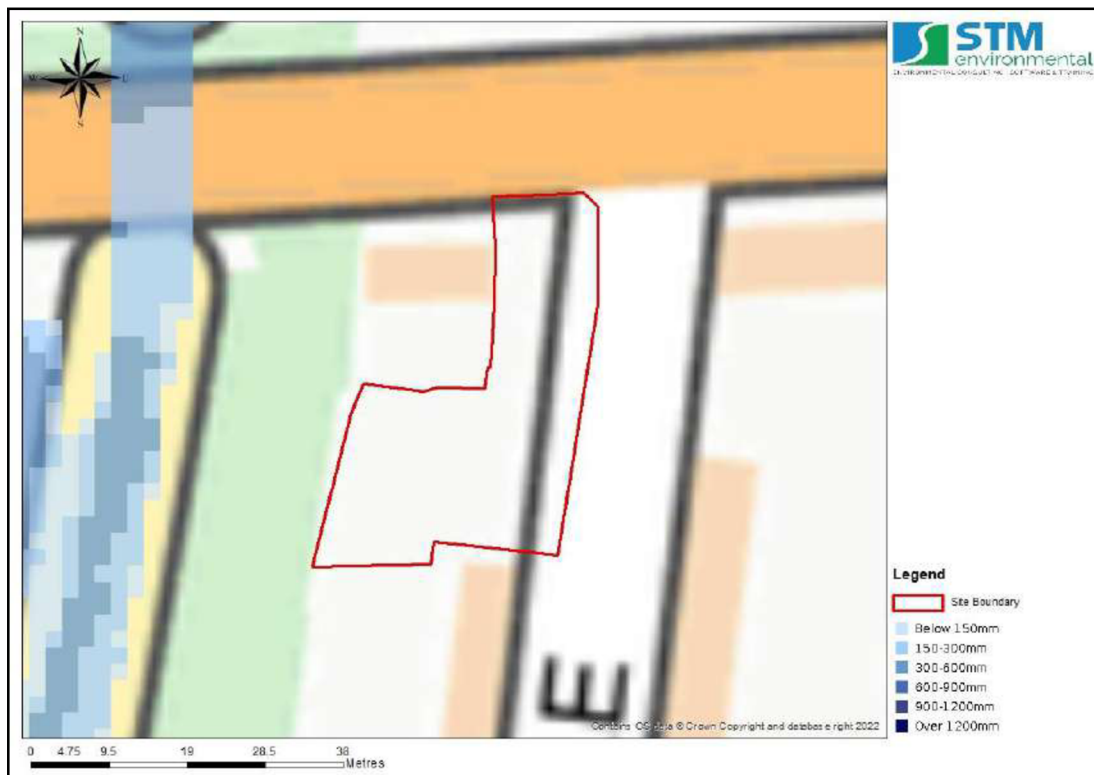
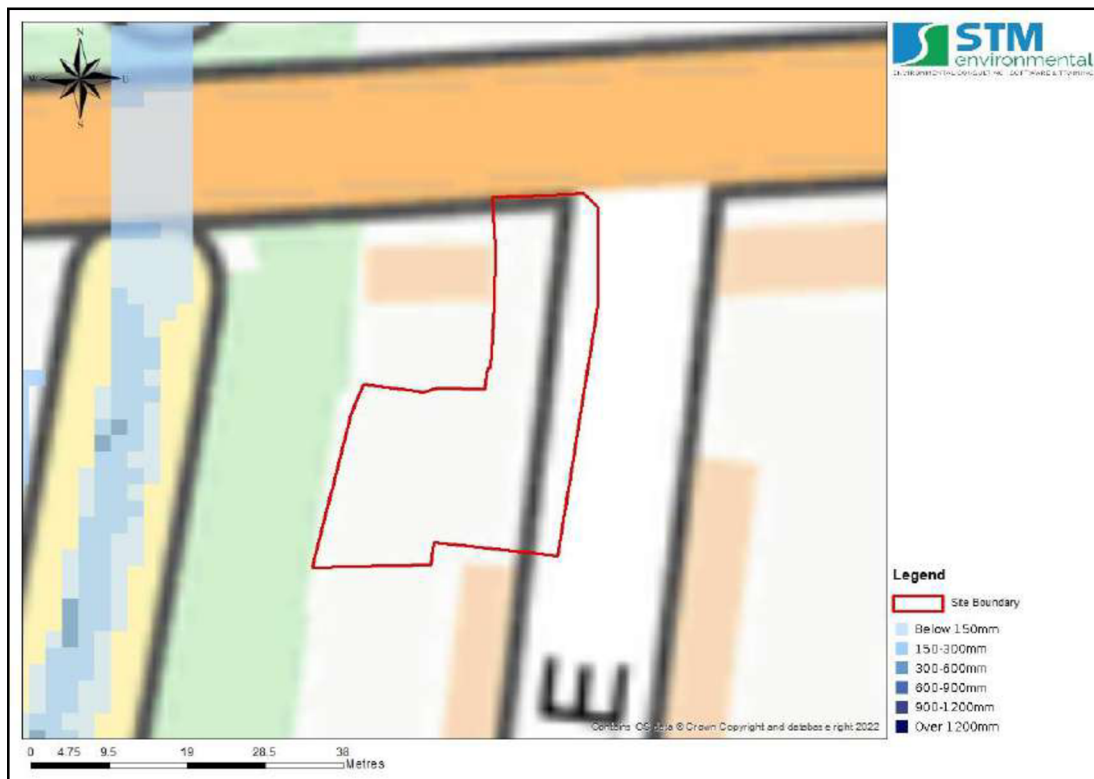
11.3.2 Long Term Fluvial Flood Risk Map (EA)



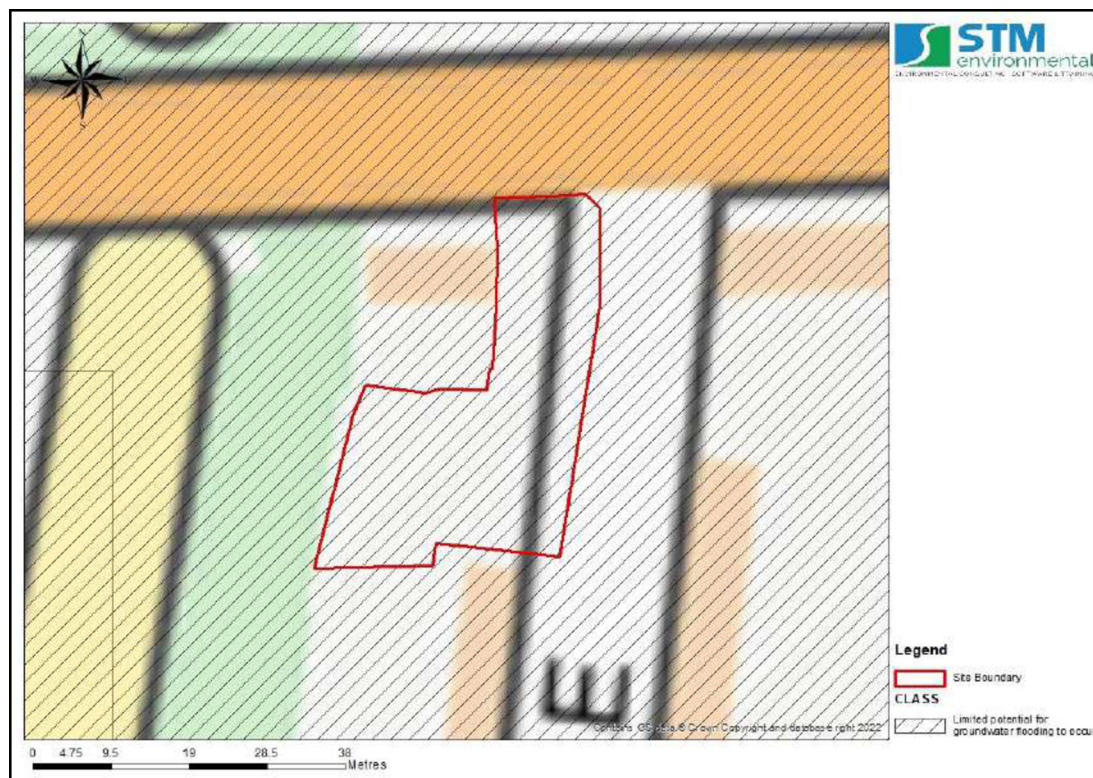
11.3.3 Long Term Pluvial Flood Risk Map (EA)



11.3.4 Surface water flood depth during the 1 in 100 and 1 in 1000 year rainfall return periods (Source: EA, 2016).



11.3.5 Groundwater flooding susceptibility (Source: BGS, 2016).



11.4 Appendix 4 – Runoff Rate and Storage Calculations

11.4.1 UK SuDS

PDF to follow this page.

Calculated by:	Georgia Travers
Site name:	Fox and Hound
Site location:	DA11 9JH

Site Details

Latitude:	51.44192° N
Longitude:	0.34765° E
Reference:	4040876011
Date:	Jun 07 2024 10:59

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	0.0921
-----------------------	--------

Methodology

Q _{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

Soil characteristics

	Default	Edited
SOIL type:	3	3
HOST class:	N/A	N/A
SPR/SPRHOST:	0.37	0.37

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

Hydrological characteristics

	Default	Edited
SAAR (mm):	551	551
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

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Greenfield runoff rates

Default

Edited

Q_{BAR} (l/s):	0.2	0.2
1 in 1 year (l/s):	0.17	0.17
1 in 30 years (l/s):	0.46	0.46
1 in 100 year (l/s):	0.64	0.64
1 in 200 years (l/s):	0.75	0.75

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

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Calculated by: Georgia Travers

Site name: Fox and Hound

Site location: DA11 9JH

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site Details

Latitude: 51.44193° N

Longitude: 0.34760° E

Reference: 4224099944

Date: Jun 07 2024 11:01

Site characteristics

Total site area (ha): 0.0921

Significant public open space (ha): 0

Area positively drained (ha): 0.0921

Impermeable area (ha): 0.0668

Percentage of drained area that is impermeable (%): 73

Impervious area drained via infiltration (ha): 0

Return period for infiltration system design (year): 10

Impervious area drained to rainwater harvesting (ha): 0

Return period for rainwater harvesting system (year): 10

Compliance factor for rainwater harvesting system (%): 66

Net site area for storage volume design (ha): 0.09

Net impermeable area for storage volume design (ha): 0.07

Pervious area contribution to runoff (%): 30

Methodology

esti IH124

QBAR estimation method: Calculate from SPR and SAAR

SPR estimation method: Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	3	3
SPR:	0.37	0.37

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	63
Rainfall 100 yrs 12 hrs:	--	90.86
FEH / FSR conversion factor:	1.18	1.18
SAAR (mm):	551	551
M5-60 Rainfall Depth (mm):	20	20
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydrological region:	7	7
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 10 year:	1.62	1.62
Growth curve factor 30 year:	2.3	2.3

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the net site area and the estimates of QBAR and other flow rates will have been reduced accordingly.

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Design criteria

MORE INFO

Climate change allowance factor:	1.4	Growth curve factor 100 years:	3.19	3.19
Urban creep allowance factor:	1.1	Q _{BAR} for total site area (l/s):	0.2	0.2
Volume control approach	Use long term storage	Q _{BAR} for net site area (l/s):	0.2	0.2
Interception rainfall depth (mm):	5			
Minimum flow rate (l/s):	2			

Site discharge rates	Default	Edited	Estimated storage volumes	Default	Edited
1 in 1 year (l/s):	2	2	Attenuation storage 1/100 years (m³):	34	34
1 in 30 years (l/s):	2	2	Long term storage 1/100 years (m³):	0	0
1 in 100 year (l/s):	2	2	Total storage 1/100 years (m³):	34	34

This report was produced using the storage estimation tool developed by HRWallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement, which can both be found at <http://uksuds.com/terms-and-conditions.htm>. The outputs from this tool have been used to estimate storage volume requirements. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of these data in the design or operational characteristics of any drainage scheme.

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11.4.2 IH24 Method

Item	Value		Greenfield Run-off Rate - 1 in 100 + CC (l/s)	0.9066	
Climate Change Allowance Factor	1.40		Total Post Development Run-off Rate - 1 in 100 + CC (l/s)	1.8136	
SAAR(mm) - Current	551.00		Difference between Greenfield and Post Development Run Off Rates - 1 in 100 + CC (l/s)	0.9071	
SAAR (mm) + CC	771.40		Volume of Storage Required to meet Greenfield Discharge - Difference between Post Development and Greenfield 1 in 100 + CC volumes (m3)	19.5927	
SPR (Greenfield)	0.37		Difference between 3 * Greenfield and Post Development 1 in 100 + CC Run Off Rates	-0.9061	
SPR (Impermeable)	0.53		Volume of Storage Required to meet 3 * Greenfield Discharge - Difference between Proposed Development and 3 * Greenfield 1 in 100 + CC (m3)	-19.5713	
Site Area (ha)	0.0883				
Impermeable Area (Pre Development - ha)	0.0000				
Permeable Area (Pre Development - ha)	0.083000		Greenfield (l/s)	Pre - Development (l/s)	Post Development (l/s)
Impermeable Area (Post Development - ha)	0.074800	Qbar	0.19	0.19	0.38
Permeable Area (Post Development - ha)	0.013500	1 in 1	0.15	0.15	0.33
GCF (1 in 1)	0.85	1 in 30	0.44	0.44	0.88
GCF (1 in 30)	2.30	1 in 100	0.81	0.81	1.22
GCF (1 in 100)	3.19	1 in 100 + CC	0.91	0.91	1.81
Hydrological Region	7				
Soil Type	3				
Rainfall 100 Yrs 6 hours mm	63				
GREENFIELD RUN-OFF	QBAR50	Run-Off Rate l/s	l/s/ha (QBarA)	3 times greenfield (l/s)	Volume (6 hr) - Standard (m3)
Qbar	108.5556	0.1917	2.1711		
1 in 1		0.1630	1.8454	0.4889	3.5198
1 in 30		0.4409	4.9936	1.3228	9.5241
1 in 100		0.8116	6.9258	1.8347	13.2095
GREENFIELD RUN-OFF + CC					
Qbar Impermeable	160.9244	0.2842	3.2185	0.8526	6.1386
1 in 1 + CC		0.2416	2.7357	0.7247	5.2178
1 in 30 + CC		0.6536	7.4025	1.9609	14.1187
1 in 100 + CC		0.9066	10.2670	2.7197	19.5820
PRE -DEVELOPMENT RUN-OFF (i.e. same rainfall)		Impermeable Surface Run-Off (l/s/ha (QBarA))			Volume (6 hr)
Impermeable Surface Calculation					
Qbar Impermeable	236.7735	0.0000	#DIV/0!	0.0000	0.0000
1 in 1		0.0000	#DIV/0!	0.0000	0.0000
1 in 30		0.0000	#DIV/0!	0.0000	0.0000
1 in 100		0.0000	#DIV/0!	0.0000	0.0000
Permeable Surface Calculation		Permeable Surface Run-off (l/s)			
Qbar Permeable	108.5556	0.1917	14.2007	0.5751	
1 in 1		0.1630	12.0706	0.4889	3.5198
1 in 30		0.4409	32.5616	1.3228	9.5241
1 in 100		0.6116	45.3002	1.8347	13.2095
Impermeable Surface Calculation + Permeable Surface Calculation					
Qbar	345.3291	0.1917	#DIV/0!	0.5751	0.0000
1 in 1		0.1630	#DIV/0!	0.4889	3.5198
1 in 30		0.4409	#DIV/0!	1.3228	9.5241
1 in 100		0.6116	#DIV/0!	1.8347	13.2095
PRE DEVELOPMENT RUN-OFF + CC (increased rainfall)		Impermeable Surface Run-Off (l/s)			
Impermeable Surface Calculation					
Qbar Impermeable	350.9966	0.0000	0.0000		0.0000
1 in 1 + CC		0.0000	0.0000		0.0000
1 in 30 + CC		0.0000	0.0000		0.0000
1 in 100 + CC		0.0000	0.0000		0.0000
Permeable Surface Calculation		Permeable Surface Run-off (l/s)			
Qbar Permeable	160.9244	0.2842	21.0513	0.8526	
1 in 1 + CC		0.2416	17.8936	0.7247	5.2178
1 in 30 + CC		0.6536	48.4180	1.9609	14.1187
1 in 100 + CC		0.9066	67.1538	2.7197	19.5820
Impermeable Surface Calculation + Permeable Surface Calculation					
Qbar	511.9210	0.2842	21.0513	0.8526	0.0000
1 in 1 + CC		0.2416	17.8936	0.7247	5.2178
1 in 30 + CC		0.6536	48.4180	1.9609	14.1187
1 in 100 + CC		0.9066	67.1538	2.7197	19.5820
POST DEVELOPMENT RUN-OFF (i.e. same rainfall)		Impermeable Surface Run-Off (l/s/ha (QBarA))			Volume (6 hr)
Impermeable Surface Calculation					
Qbar Impermeable	236.7735	0.3542	4.7355	1.0626	
1 in 1		0.3011	4.0251	0.9032	6.5034
1 in 30		0.8147	10.8916	2.4441	17.5973
1 in 100		1.1299	15.1051	3.3898	24.4067
Permeable Surface Calculation		Permeable Surface Run-off (l/s)			
Qbar Permeable	108.5556	0.0293	2.1711	0.0879	
1 in 1		0.0249	1.8454	0.0747	0.5381
1 in 30		0.0674	4.9936	0.2022	1.4561
1 in 100		0.0935	6.9258	0.2805	2.0196
Impermeable Surface Calculation + Permeable Surface Calculation					
Qbar	345.3291	0.3835	8.9968	1.1506	
1 in 1		0.3290	5.8706	0.9709	7.0415
1 in 30		0.8821	15.8851	2.6463	19.0534
1 in 100		1.2234	22.0320	3.6703	26.4263
POST DEVELOPMENT RUN-OFF + CC (increased rainfall)		Impermeable Surface Run-Off (l/s)			
Impermeable Surface Calculation					
Qbar Impermeable	350.9966	0.5251	7.0199		11.3420
1 in 1 + CC		0.4453	5.9659		9.5407
1 in 30 + CC		1.2077	16.1458		26.0865
1 in 100 + CC		1.6750	22.3836		36.1809
Permeable Surface Calculation		Permeable Surface Run-off (l/s)			
Qbar Permeable	160.9244	0.0434	3.2185	0.1303	
1 in 1 + CC		0.0368	2.7357	0.1108	0.7977
1 in 30 + CC		0.0999	7.4025	0.2998	2.1585
1 in 100 + CC		0.1386	10.2670	0.4158	2.9939
Impermeable Surface Calculation + Permeable Surface Calculation					
Qbar	511.9210	0.5685	10.2384	0.1303	11.3420
1 in 1 + CC		0.4833	8.7027	0.1108	10.4384
1 in 30 + CC		1.3076	23.5484	0.2998	28.2451
1 in 100 + CC		1.8136	32.6806	0.4158	39.1747

11.4.3 MRM – Post - Development

Rainfall Methodology	FSR	▼								
FSR Region	England & Wales	▼								
M5-60 (mm)	20.000									
Ratio-R	0.400									
Summer CV	☒	0.750								
Winter CV	☒	0.840								
Analysis Speed	Normal	▼								
Skip Steady State	☐									
Drain Down Time (mins)	240									
Additional Storage (m³/ha)	20.0									
☒ Check Discharge Rate(s)	Calc									
	<table border="1"> <thead> <tr> <th>Return Period (years)</th> <th>Q (l/s)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>11.1</td> </tr> <tr> <td>30</td> <td>26.3</td> </tr> <tr> <td>100</td> <td>33.3</td> </tr> </tbody> </table>	Return Period (years)	Q (l/s)	1	11.1	30	26.3	100	33.3	▲ ▼
Return Period (years)	Q (l/s)									
1	11.1									
30	26.3									
100	33.3									
☒ Check Discharge Volume	Calc									
100 year +40% 360 minute (m³)	49									

11.4.4 Causeway Flow Storage Calculations

<u>Storage Estimate</u>			
Return Period (years)	100		OK
Climate Change (%)	40		Cancel
Impermeable Area (ha)	0.075	Update	
Peak Discharge (l/s)	0.000		
Infiltration Coefficient (m/hr) (leave blank if no infiltration)	0.02400	Calc	
Required Storage (m ³)	Calc		
	from	58	
	to	58	
With infiltration (m ³)			
	from	26	
	to	56	

11.5 Appendix 5 – Drainage Asset Search

PDF to follow this page.



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Date: 25/04/24

Scale: 1:500

Map Centre: 563240,174048

Data updated: 12/04/24

Our Ref: 1454203 - 2

Wastewater Plan A4

The positions of pipes shown on this plan are believed to be correct, but Southern Water Services Ltd accept no responsibility in the event of inaccuracy. The actual positions should be determined on site. This plan is produced by Southern Water Services Ltd (c) Crown copyright and database rights 2024 Ordnance Survey 100031673. This map is to be used for the purposes of viewing the location of Southern Water plant only. Any other uses of the map data or further copies is not permitted.

WARNING: BAC pipes are constructed of Bonded Asbestos Cement.

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement.



matthew@stmenvironmental.co.uk

Former Fox and Hound



11.6 Appendix 6 – SuDS Suitability Assessment

SuDS Technique	Typical Uses	Potential Issues	Potential Suitability
Rainwater harvesting	Capture of rainwater into a tank(s) for use (usually non-potable) such as irrigation, toilet flushing, vehicle or plant cleansing.	Care is needed to prevent the development of bacteria, algae and insect infestation.	Suitable - Costly
Infiltration: Soakaways Infiltrations trenches and basins	Infiltration components are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, into the groundwater.	Groundwater table is potentially < 3m below surface. Could increase flood risk. Maintenance	Suitable
Green/brown /blue roofs	Used on flat or shallow pitched roofs to provide a durable roof covering which also provides thermal insulation, amenity space, biodiversity habitat as well as attenuation of rainwater.	Maintenance - Ensuring safe access	Unsuitable – Pitched Style Roofing
Raingardens	Creation of planted landscaped areas to allow the diversion of a portion of rainwater from either downpipes or surrounding paved surfaces. Raingardens can either allow infiltration into the ground or have tanked systems for water retention.	Space Required; Require maintenance;	Partially Suitable - Space
Permeable pavements / surfaces	Permeable hard surfaces that allow rainwater to pass through either into the ground or to tanked systems. Good as interception storage.	Potential impact of saturation on pavement stability to be considered. May require extensive use of impermeable membranes and under-drainage. Maintenance required.	Suitable
Swales	Dry ditches used as landscape features to allow the storage and infiltration of rainwater. Often used as linear features alongside roads, footpaths or rail lines but capable of being integrated into the design of many open spaces.	Finding available space in proposed site layout	Unsuitable - Topography
Detention basin/ponds	Landscape features designed to store and in some cases infiltrate rainwater. Detentions basins are usually dry, whereas a pond should retain water. These features need areas of open space but can often be combined with other sustainable drainage techniques.	Potential health and safety issues. Finding available space in proposed site layout	Unsuitable - Space
Storage tanks/ Geocellular storage	Usually below ground level, they attenuate rainwater for later slow release back into the drainage system.	Pumping may sometimes be required to empty the tank into the drainage system	Suitable
Oversized piping	Using larger than necessary pipework creates additional space to store rainwater.	Lacks the wider benefits of the green infrastructure-based techniques	Suitable

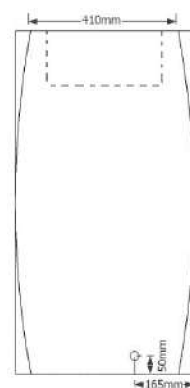
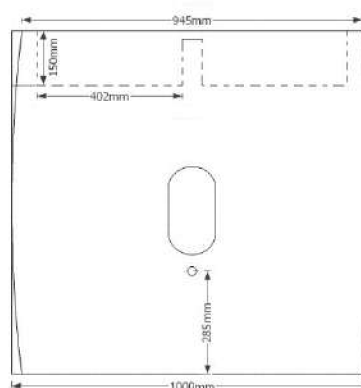
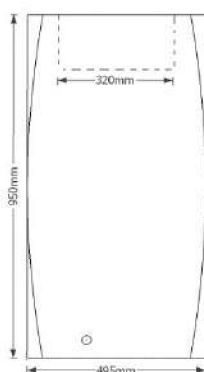
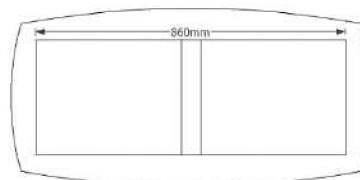
11.7 Appendix 7 – Details of Proposed Of SuDS

11.7.1 Combined Rainwater Butt and SuDS Planters

PDF to follow this page.

ECOSURE OASIS WATER GARDEN

Product description: 375 litre water butt with double planter



Product Information

Height	Length	Depth	Weight	Outlets	Bowl depth	Bowl capacity	Reservoir capacity
950mm	1000mm	495mm	25kg	3 x ½" BSP	2 x 150mm	2 x 19 litre	375 litre

PRODUCT NOTES:

- Site on a flat, level base
- Use supplied spade bit to fit rainwater diverter, below the bottom of the planter bowls
- Fit bib tap to fill a watering can
- Fit plastic shut off valve to drain the tank completely – choose which side you want to use

Sizes approximate, owing to shrinkage

PRODUCT DETAILS:

- Available in a variety of colours to suit location
- Minimalist design
- 3 x ½" brass threaded outlets moulded into the tank
- Butts can be connected together using bottom outlets
- Complete with brass tap, plastic isolation valve with hose connector and unfiltered rainwater diverter

OPTIONAL EXTRAS:

- Guttermate filter diverter
- Tank connectors

BENEFITS:

- Frost proof in winter; plastic will not crack
- Slimline design - ideal when space is limited
- Shape maintained when full of water
- Robust, heavy duty product; industrial strength
- Opaque plastic reduces algae growth in sunlight
- Colour samples available upon request
- Rotationally moulded for strength & durability
- 2 year warranty against manufacturing defects



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RAIN GARDENS

Rain gardens are a type of **Sustainable Drainage System (SuDS)** that capture rainfall before it enters the piped network and either releases it slowly into the network or allows it to infiltrate into the ground.

They are flexible in design and are excellent examples of how SuDS components can be integrated into a streetscape without negatively impacting the primary function of our streets and spaces.

The performance of a rain garden can be enhanced by engineering the sub-base to include a gravel layer that helps to filter pollutants and provides more storage capacity for rainwater.

Rain gardens can help improve surface water management whilst performing a range of other functions such as amenities, reduced pollution and improved biodiversity.



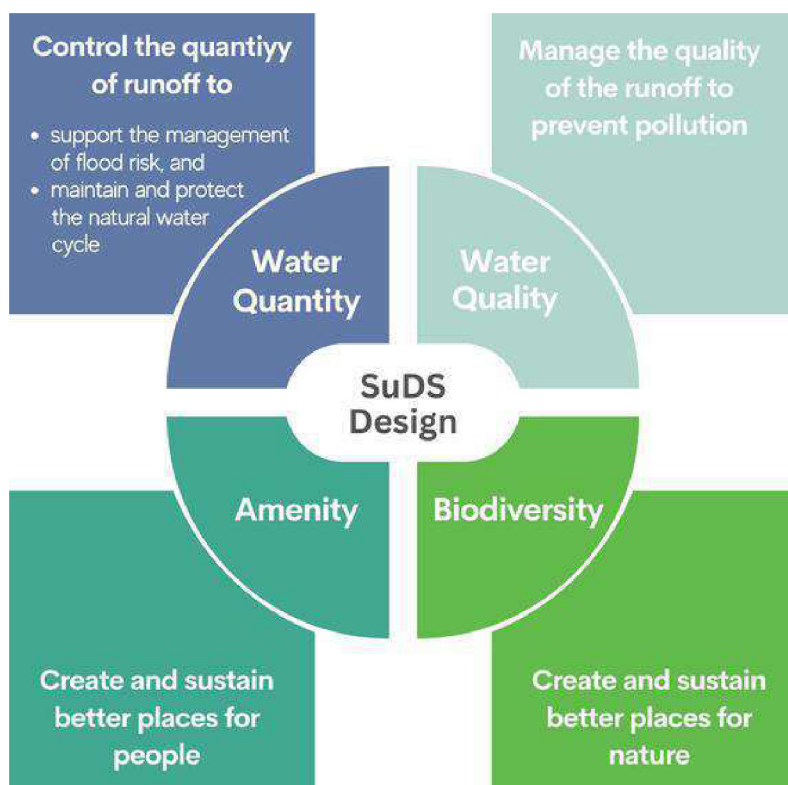
Coppermill Rain Gardens

DESIGNING A RAIN GARDEN

- Technical Sheet -

1/ Choose the right location

The first step is to determine the location of your rain garden. Rain gardens are best located at low points where surface water will flow to. However, where rain gardens are being created as part of a larger scheme the overall layout may determine the most suitable location, so some flexibility is required.



2/ Composition of a rain garden

Source: The SuDS Manual 2015, CIRIA

A rain garden typically comprises the following features:

- 1. Freeboard:** The freeboard provides potential water storage space, above the topsoil. The freeboard depth is measured from the carriageway or footpath level to the top of the topsoil.
- 2. Topsoil:** Topsoil usually consists of a mixture of soil, sand and compost. Soil permeability can be specified according to the ratio of these three components. Rain gardens often have a sandier soil composition than normal to allow faster infiltration.
- 3. Sub-base:** The sub-base should be 100-500mm deep. The depth of the sub-base will vary depending on the required storage capacity and budget. A deeper sub-base will help store more water.

3/ Calculate the size and depth

Making a rain garden bigger (and therefore storing more water) increases the flood risk management benefit, however, this needs to be balanced against cost and availability of space.

BENEFITS

- Reduces flood risk and erosion by slowing heavy rainfall.
- Flexible layout to fit into the landscape.
- Low maintenance garden, it can absorb up to 30% more water than grass.
- Enhances wildlife habitat for biodiversity.
- Improves public health and wellbeing.
- Increases amenity space.
- Aesthetic improvements.
- Improves air quality.
- Reduces urban heat island effect.



600m2 of rain gardens with a cycle path to both sides



Rain Gardens at Royal Docks Corridor

11.7.2 Permeable Paving

PDF to follow this page.

Priora Sub-Base Construction

The aggregate installed beneath a Marshalls Priora surface is an essential element of the Marshalls Priora system. The aggregate must provide sufficient porosity to store water in the voids between the granular elements. It must also be of sufficient structural strength to withstand the loads to which the structure will be subjected.

Therefore, for the Marshalls Priora system to work effectively, we provide thorough aggregate specification to help source the correct material.

For detailed aggregate specification please see page 45, and for details of Marshalls Priora Aggregate, please see page 34.

6mm Jointing

6mm Laying Course

20mm Sub-base

Capping Layer (Optional)

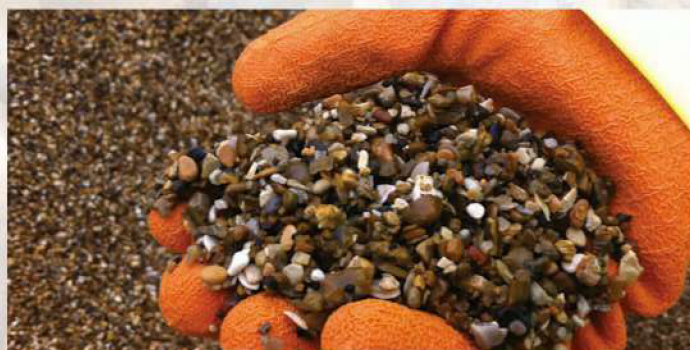
Marshalls M15 Grid (Optional)

Jointing

A traditional concrete block pavement would use sand to fill the joints between the blocks. A Marshalls Priora system requires a more open graded coarse material, which will allow water to easily pass through into the sub-base without clogging.

It should also be of an angular nature to maximise interlock within the aggregate and between the blocks to provide additional stability to the surface layer.

Jointing Aggregate Specification:
6mm Open Graded Crushed Rock



6mm Aggregate

Laying Course

The large size of sub-base material aggregate creates an uneven surface when compacted and has an open textured surface. Therefore a laying course material is required, to provide a flatter platform onto which the blocks are laid. This should prevent any rocking or instability of the blocks in-situ.

Crucially, the laying course in a Marshalls Priora system should also provide maximum infiltration properties, allowing water to flow freely through the joints.

Laying Course Aggregate Specification:
6mm Open Graded Crushed Rock

Sub-Base

In addition to providing structural stability (as it would in a traditional pavement), the sub-base of a Marshalls Priora system must also provide sufficient hydraulic capacity to store water. This is achieved by using an aggregate with a high permeability.

Permeability is measured in terms of the aggregate/ void ratio. We recommend the use of an aggregate with a void ratio of between 30% - 32%. In effect this means that every 3m³ of aggregate can store approximately 1m³ of water

Sub-Base Aggregate Specification:
20mm Open Graded Crushed Rock



20mm Aggregate

Capping Layer

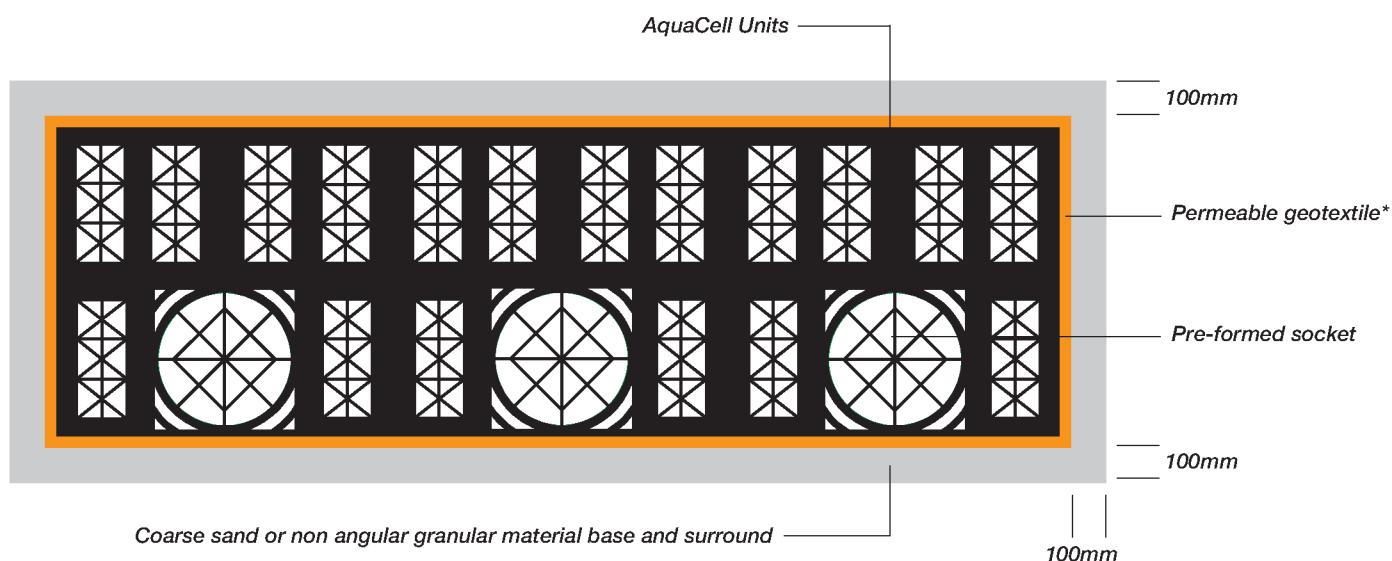
A capping layer is required on weak ground to improve the bearing capacity of the pavement. Ground is considered "weak" when the CBR (California Bearing Ratio) is below 5%. Marshalls M15 Grid can be used at the interface of the capping layer and the subgrade to confine the capping material and stabilise the structure, reducing the amount of capping material required. See page 45 for Capping Material specification. See page 33 for information on M15 Grid.

Full specification of suitable aggregate is set out in EN 13242: 2002

11.7.3 Geocellular Storage

PDF to follow this page.

Guidance Note 1 – Typical Soakaway Installation Method



Example shows the use of AquaCell Eco. However, a soakaway can also be installed as shown using either of the other versions of AquaCell units (Prime, Core or Plus) as appropriate.

** The geotextile should be selected according to specific site conditions. Typically, however, a 300g non-woven material will be suitable. Specialist advice should be sought if surrounding soil characteristics exhibit a high degree of fines/low infiltration capacity and/or there is a high risk of damage from ground contaminants.*

Typical Installation Procedure

1. Excavate the trench to the required depth ensuring that the plan area is slightly greater than that of the AquaCell units.
2. Lay 100mm bed of coarse sand or non angular granular material, level and compact.
3. Lay the geotextile* over the base and up the sides of the trench.
4. Lay the AquaCell units parallel with each other. In multiple layer applications, wherever possible, continuous vertical joints should be avoided. AquaCell units can be laid in a 'brick bonded' formation (i.e. to overlap the joints below). For single layer applications use the AquaCell Clips and for multi layers use the AquaCell Clips and the AquaCell Shear Connectors (vertical rods).
5. Fix the Adaptors to the AquaCell units as required and connect pipework.
6. In order to prevent silt from entering the tank, clogging inlet pipework and reducing storage capacity, it is recommended that the Domestic Silt Trap (6LB300) or the standard Silt Trap (6LB600) is installed prior to the inlet pipework.
7. Wrap and overlap the geotextile covering the entire AquaCell structure.
8. Lay 100mm of coarse sand or non angular granular material between the trench walls and the AquaCell structure and compact.
9. Lay 100mm of coarse sand or non angular granular material over the geotextile and compact.
10. Backfill with suitable material.
11. Rainwater from roof areas may discharge directly into the soakaway but rainwater from car parks must discharge through a catchpit manhole and/or a petrol interceptor.

11.8 Appendix 8 – SuDS Maintenance Manual

All maintenance activities will be the responsibility of Super Asset Management Ltd. They will appoint a management company to undertake the general maintenance duties within the site and will join service agreements with the suppliers and manufactures of the SuDS/Pumps when required.

The information presented below is taken from the CIRIA SuDS Manual (Report c753) and [SuDS](#). Further details on installation and maintenance can be found detailed below and online.

11.8.1 Pervious Pavements

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations - pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment.	Super Asset Management Ltd will be responsible for setting up the management company.
Occasional maintenance	Stabilise and mow contributing and areas.	As required.	
	Removal of weeds or manage using weed killer applied directly into the weeds rather than spraying.	As required - once per year on less frequently used pavements.	
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.	
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and lost material.	As required.	

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging).	Super Asset Management Ltd will be responsible for setting up the management company.
Monitoring	Initial Inspection.	Monthly for three months after installation.	
	Inspect for evidence of poor operation and/or weed growth - if required, take remedial action.	Three-monthly, 48h after large storms in first six months.	
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.	
	Monitor Inspection chambers.	Annually.	

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy). Therefore, if litter management is already required at the site, this should have marginal cost implications.

11.8.2 Geo-Cellular Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings.	Annually.	Super Asset Management Ltd will be responsible for setting up the management company.
	Cleaning of gutters and any filters on downpipes.	Annually (or as required based on inspections).	
	Trimming any roots that may be causing blockages.	Annually (or as required).	
Occasional maintenance	Remove sediment and debris from manhole, storage structure and components and floor of inspection tube or chamber and inside of concrete manhole rings.	As required, based on inspections.	
Remedial actions	Reconstruct geocellular and/or replace or clean void fill, if performance failure occurs	As required	Super Asset Management Ltd will be responsible for setting up the management company.
	Replacement of clogged geotextile (will require reconstruction of soakaway).	As required.	
Monitoring	Inspect silt raps and note rate of sediment accumulation.	Monthly in the first year and then annually.	
	Check soakaway to ensure emptying is occurring.	Annually.	

Maintenance will usually be carried out manually, although a suction tanker can be used for sediment / debris removal for large systems. If maintenance is not undertaken for long periods, deposits can become hard-packed and require considerable effort to remove.

Replacement of the geocellular units will be necessary if the system becomes blocked with silt. Effective monitoring will give information on changes in infiltration rate and provide a warning of potential failure in the long term.

Areas draining to infiltration components should be regularly swept to prevent silt being washed off the surface. This will minimize the need for maintenance.

Maintenance responsibility should be placed with an appropriate organisation, and maintenance schedules should be developed during the design phase.

11.8.3 Rain Garden Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris in inlet and outlet components	Quarterly; As required.	Super Asset Management Ltd will be responsible for setting up the management company.
	Inspection & Cleaning of gutters and any filters on downpipes feeding into rain gardens as required.	Quarterly; As required.	
	Remove, replace and maintain vegetation as required; Ensuring cuttings are removed to prevent debris build up; Weeding of flower bed to maintain the desired vegetation, density and biodiversity - Vegetation management	Monthly inspections Summer; As required Quarterly during Winter month; Or as required.	
Remedial actions	Replace dead or overgrown vegetation as required.	As required.	
	Replacement of clogged geotextile (will require reconstruction of raingarden).	As required.	
Monitoring	Inspect silt traps / discharge points and note rate of sediment accumulation and ensure no erosion pathways forming.	Monthly in the first year and then annually.	
	Check raingardens are emptying as required following a storm event occurring.	After storms; When possible.	

Maintenance will be carried out manually. All monitoring and maintenance will be carried out by the appointed estate management company that undertakes the general landscaping maintenance.

11.8.4 SuDS Planters Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris in inlet and outlet components	Quarterly; As required.	Super Asset Management Ltd will be responsible for setting up the management company.
	Inspection & Cleaning of gutters and any filters on downpipes feeding into rain gardens as required.	Quarterly; As required.	
	Remove, replace and maintain vegetation as required; Ensuring cuttings are removed to prevent debris build up; Weeding of flower bed to maintain the desired vegetation, density and biodiversity - Vegetation management	Monthly inspections during Spring / Summer Autumn / Winter - As required.	
Remedial actions	Replace dead vegetation as required. Cut back vegetation as required.	As required.	
Monitoring	Inspect silt traps / discharge points and note rate of sediment accumulation and ensure no erosion pathways forming.	Monthly in the first year and then annually.	
	Check Planters are emptying as required following a storm event occurring.	After storms; When possible.	

Maintenance will be carried out manually. All monitoring and maintenance will be carried out by the appointed estate management company that undertakes the general landscaping maintenance.

11.8.5 SuDS Rain Water Butt Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris in inlet and outlet components;	Quarterly; As required. Increase freq. to Monthly during Autumn;	Super Asset Management Ltd will be responsible for setting up the management company.
	Inspection & Cleaning of gutters and any filters on downpipes feeding into the Rain Water Butts.	Quarterly; Increase freq. to Monthly during Autumn;	
Remedial actions	Cleaning of the water butt. Fully drain the water butt and clear out debris and enable access; Scrub out the inside of the butt or tank with a coarse brush, if accessible, using a proprietary cleaning product such as Just Water Butt Cleaner or garden disinfectant; Rinse with clean water; Cleaning of Gutters; Clean or fit a new filter;	Annually; Or as required.	
Remedial actions	Use water/empty water butts - to clean, water plants (inside & out); Empty water Butt more frequently during the winter, to allow for storage during storms and to keep the water fresh;	Once every two weeks; as required	

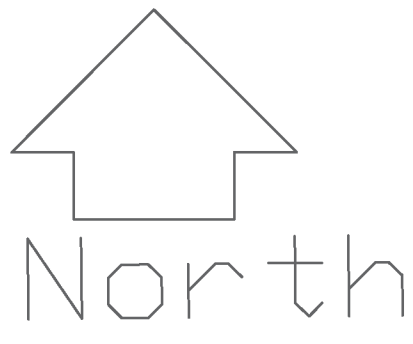
Maintenance will be carried out manually. All monitoring and maintenance will be carried out by the appointed estate management company that undertakes the general landscaping maintenance.

11.8.6 Flow Control Maintenance

Maintenance Schedule	Required Action	Typical Frequency	Responsibility
Regular maintenance	Inspect for sediment and debris;	Quarterly; As required.	Super Asset Management Ltd will be responsible for setting up the management company.
	Inspection & Cleaning of SuDS components upstream of flow control element.	Quarterly; Increase freq. to Monthly during Autumn;	
Remedial actions	Removal of debris and sediment;	Annually; Or as required.	
Remedial actions	Replacement of parts; Manhole cover, filters or components of flow control device;	As required;	
Monitoring	Ensure flow control device is function correctly during and after storm events; Check water levels up stream and downstream of flow control device	Monthly; During 1 st year of installation or during and after storm event; When possible Reduce to Quarterly following the 1 st year;	
	Check for damage to flow control components	Annually;	
	Check for securely fitting manhole lid; Ensures debris cannot enter the system unfiltered;	Annually;	

11.9 Appendix 9 – Drainage Modelling Results and Layout

11.9.1 SuDS Layout



RG1 - Rain Garden - 20m²

Total Depth: Variable - 0.60m

Surface Coverage	; Suitable Planting / Decorative Stone		
Bedding Material	; Imported well draining soil	; 400mm (Porosity 0.15)	; 1.2m ³
Filter Fleece	; Filter Fleece	; 2 - 5mm	; -
Permeable Aggregate	; MOT Type 3 (20mm crushed rock no fines)	; 200mm thickness (Porosity 0.3)	; 1.2m ³

P1a & P2a - Permeable Block Paving

Total Area - 165m²

Total Depth: Variable - 0.35 - 0.63m

Surface Coverage	; Permeable Block Paving	; As per Supplier
Bedding Material	; Bedding Sand/Granite	; As per Manufacture
Filter Fleece	; Filter Fleece	; 2 - 5mm
Permeable Aggregate	; MOT Type 3 (20mm crushed rock no fines)	; 350mm thickness
Porosity of 0.3;		

Approximately 17.3m³ attenuation;

Permeable sub-base extended to depth of Geocellular Storage Crates; Provides hydraulic connection and a maintenance access for any future repair tasks.

G1- Geocellular Attenuation

Area - 150m²

Width - 7.5m

Length - 20m

Total Depth: 0.98m

Back fill	; Infill between Geocellular storage an paving	
Protection	; Impermeable Membrane	; As per Manufacture
Geocellular Crates	; Geocellular Crates	; 400mm thick
Bedding Material	; Pea gravel surround	; 100 - 200mm

Approximately 57.1m³ attenuation;

Raised wall / Bund to ensure any exceedance event pool within the car parking area;

SuDS Planters

Approximately 1m³ Rainwater Attenuation;
Approximately 1.8m³ Rainwater Re-use

Filter Strip to help direct discharge into car park

Filter Strip - 30m²

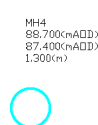
Total Depth: 0.5 - 0.60m

Surface Coverage	; Suitable Planting / Decorative Stone		
Bedding Material	; Imported well draining soil	; 300 - 400mm (Porosity 0.15)	; 1.5m ³
Filter Fleece	; Filter Fleece	; 2 - 5mm	; -
Permeable Aggregate	; MOT Type 3 (20mm crushed rock no fines)	; 200mm thickness (Porosity 0.3)	; 1.8m ³

Permeable paving sub-base lain below the paving below the bike and bin storage to prove a single conveyance route.

Project :SWDS - 2024 - 000026
Site :Former Fox and Hounds Public House,
:26-27 London Road, Northfleet, Gravesend
:DA11 9JH
Company :STM Environmental
Client :Sandeep Singh, Super Asset Group
Issue :No.1.0
By :Georgia Travers / Matthew Ashdown

Map Legend



Surface Water Manhole



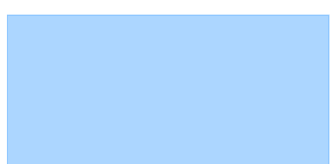
Surface Water Inspection Manhole



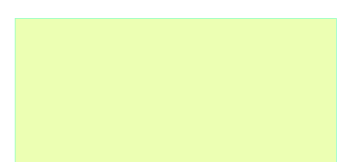
Flow Control Chamber



Rainwater Down Pipe



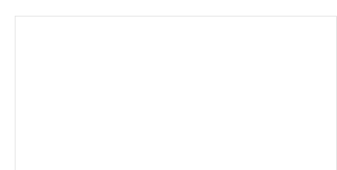
SuDS Planters



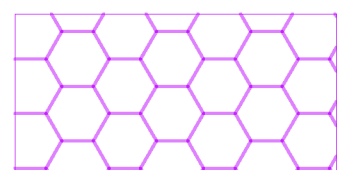
Soft Landscaping / Amenity Space



Permeable Paving



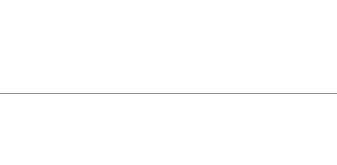
Impermeable Paving



Geocellular Storage



Rain Garden



Surface Water Pipe



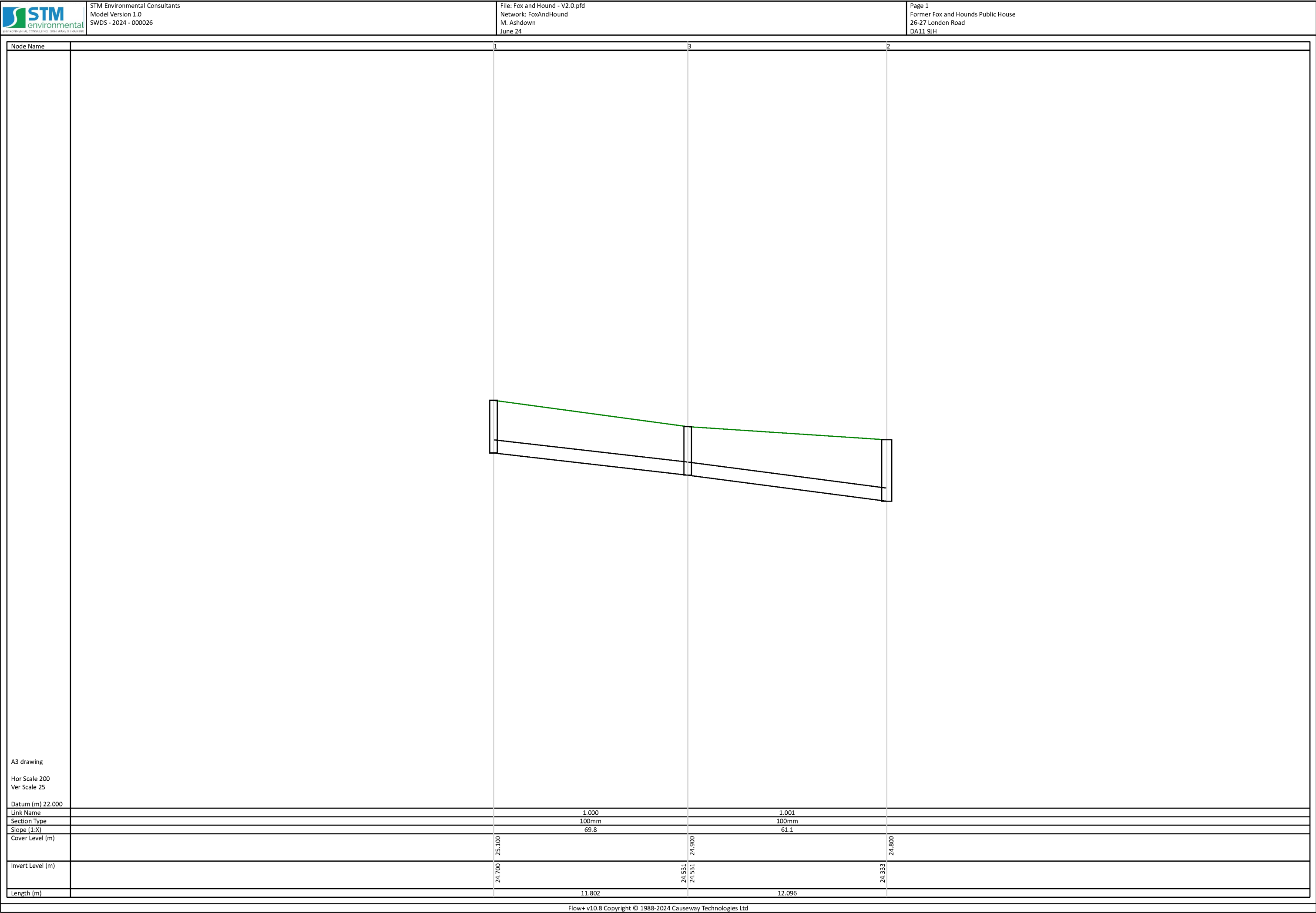
Perforated Pipe

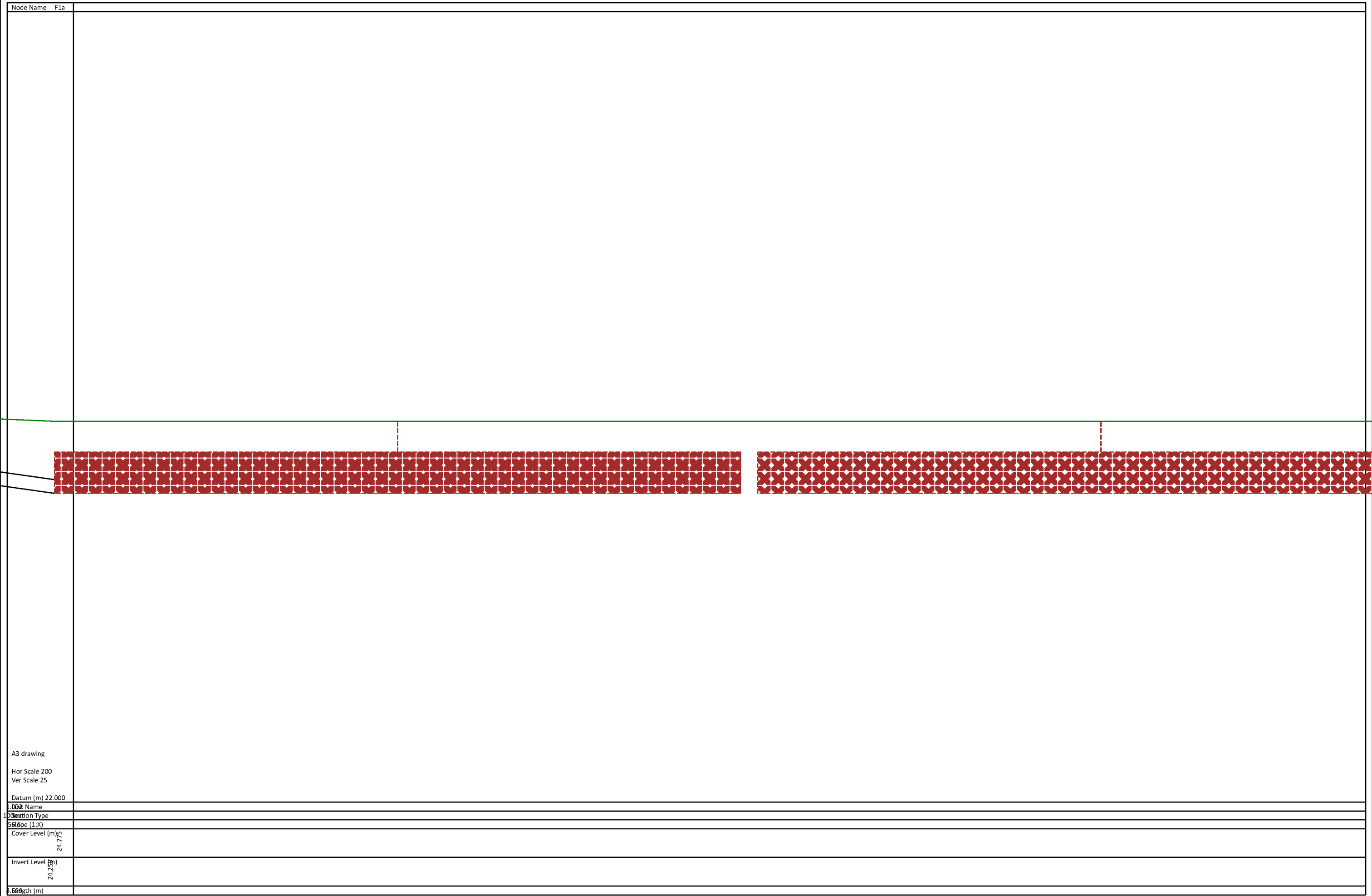
Slot Drainage Channel

Filter Strips

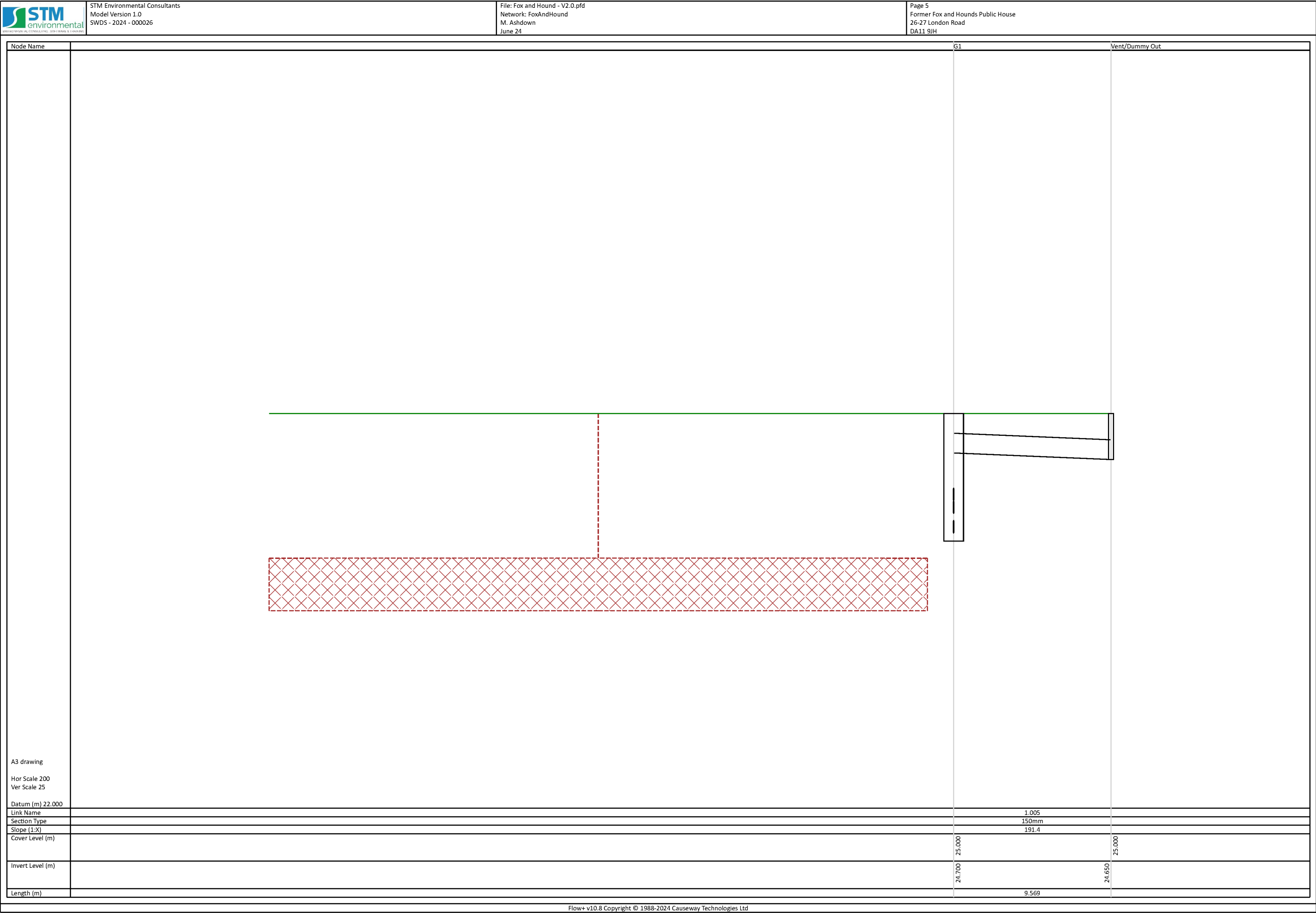
Overflow Flow Route

11.9.2 Model Section





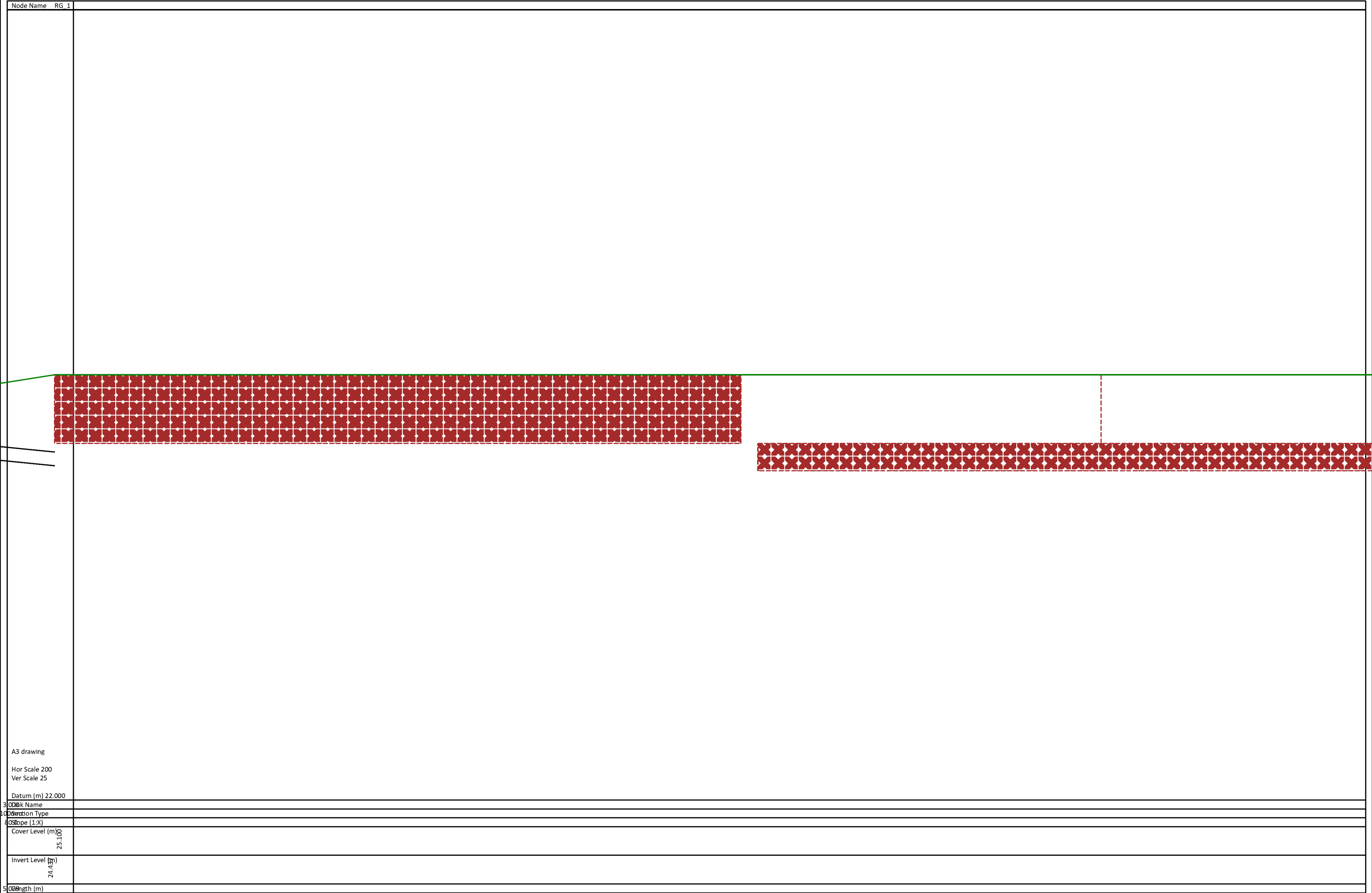
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[illegible]

Flow+ v10.8 Copyright © 1988-2024 Causeway Technologies Ltd

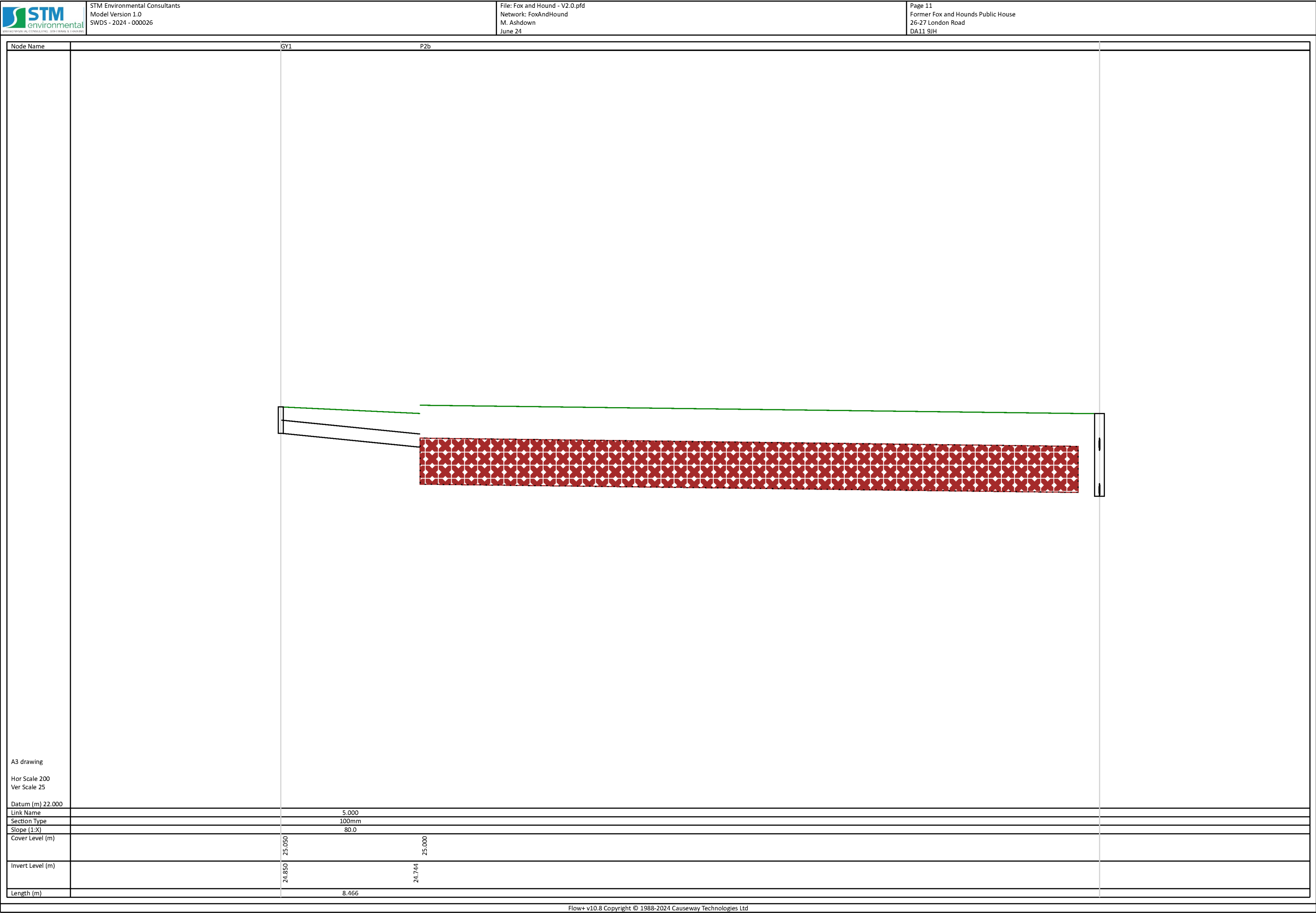
Roof1.2



24.500 25.000

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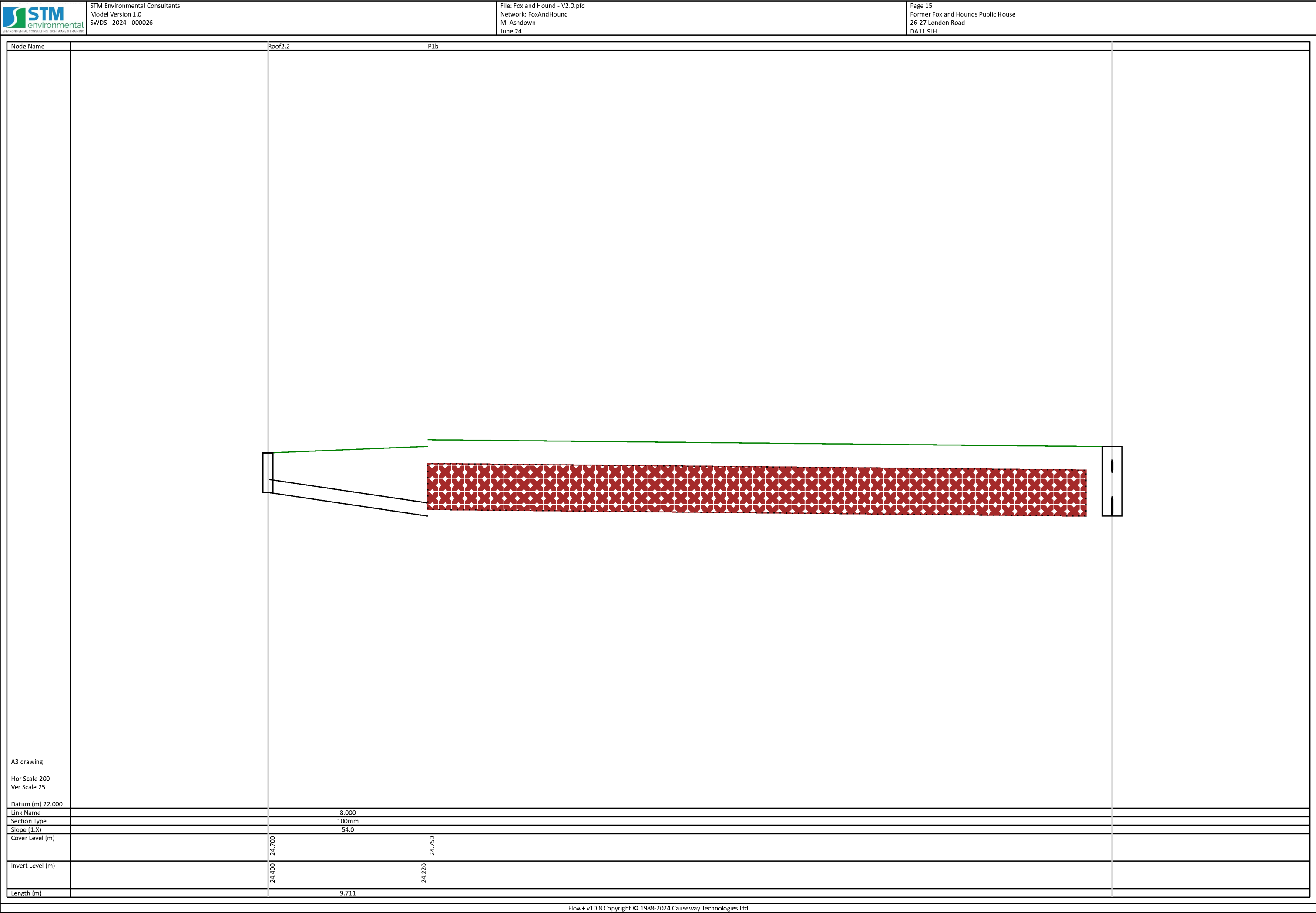
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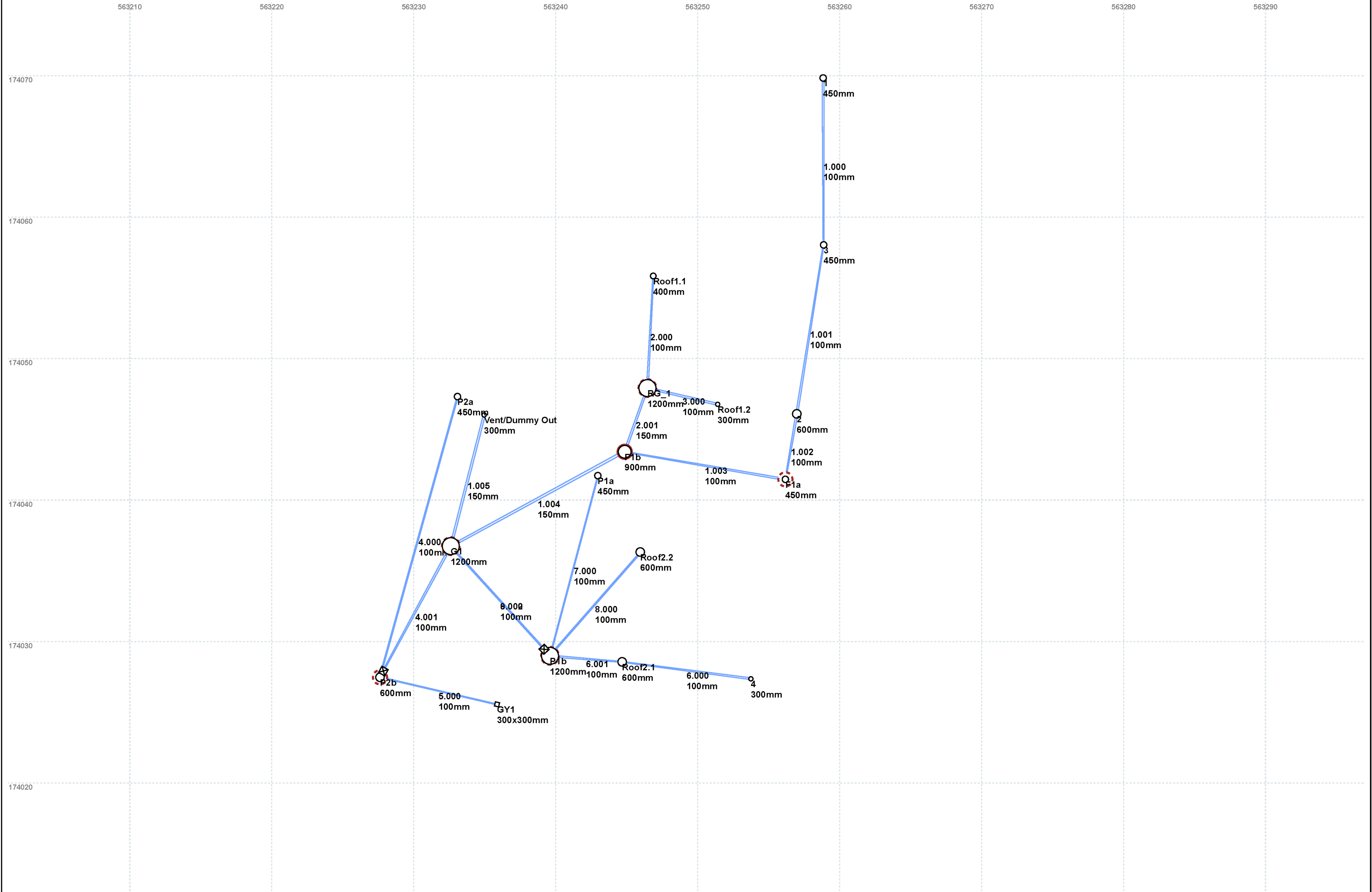
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11.9.3 Model Results

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	0.750	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	x
Maximum Rainfall (mm/hr)	50.0		

Adoptable Manhole Type

Max Width (mm)	Diameter (mm)	Max Width (mm)	Diameter (mm)
374	1200	749	1500
499	1350	900	1800

>900 Link+900 mm

Max Depth (m)	Diameter (mm)	Max Depth (m)	Diameter (mm)
1.500	1050	99.999	1200

Circular Link Type

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

Available Diameters (mm)

100 | 150

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)
Roof1.1		5.00	25.100	400		563246.872	174055.847	0.400
GY1	0.000	5.00	25.050	300	300	563235.867	174025.557	0.200
P1b			24.750	1200		563239.598	174028.987	0.530
Vent/Dummy Out			25.000	300		563234.959	174046.019	0.350
RG_1			25.100	1200		563246.462	174047.919	0.700
Roof2.2	0.012	5.00	24.700	600		563245.956	174036.328	0.300
P2b			25.000	600		563227.621	174027.471	0.630
G1			25.000	1200		563232.609	174036.744	0.970
Roof2.1	0.000	5.00	24.700	600		563244.680	174028.562	0.366
P1a	0.001	5.00	24.900	450		563242.966	174041.729	0.465
P2a		5.00	25.200	450		563233.081	174047.318	0.350
F1a	0.000	5.00	24.775	450		563256.178	174041.466	0.525
F1b	0.001	5.00	24.700	900		563244.860	174043.417	0.877
Roof1.2	0.018	5.00	25.000	300		563251.409	174046.769	0.500
1	0.002	5.00	25.100	450		563258.838	174069.844	0.400
2			24.800	600		563256.982	174046.095	0.467

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)
3	0.000	5.00	24.900	450		563258.876	174058.042	0.369
4	0.000	5.00	24.700	300		563253.751	174027.363	0.250

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	1	3	11.802	0.600	24.700	24.531	0.169	69.8	100	5.21	50.0
1.001	3	2	12.096	0.600	24.531	24.333	0.198	61.1	100	5.42	50.0
1.002	2	F1a	4.699	0.600	24.333	24.250	0.083	56.6	100	5.49	50.0
1.003	F1a	F1b	11.485	0.600	24.250	24.173	0.077	150.0	100	5.80	50.0
2.000	Roof1.1	RG_1	7.939	0.600	24.700	24.450	0.250	31.8	100	5.10	50.0
3.000	Roof1.2	RG_1	5.079	0.600	24.500	24.437	0.063	80.0	100	5.10	50.0
2.001	RG_1	F1b	4.778	0.600	24.400	24.340	0.060	80.3	150	5.17	50.0
1.004	F1b	G1	13.951	0.600	24.123	24.030	0.093	150.0	150	6.08	50.0
4.000	P2a	P2b	20.584	0.600	24.850	24.716	0.134	153.6	100	5.56	50.0
5.000	GY1	P2b	8.466	0.600	24.850	24.744	0.106	80.0	100	5.16	50.0
4.001	P2b	G1	10.529	0.600	24.370	24.238	0.132	80.0	100	5.76	50.0
8.000	Roof2.2	P1b	9.711	0.600	24.400	24.220	0.180	54.0	100	5.15	50.0
7.000	P1a	P1b	13.179	0.600	24.435	24.270	0.165	80.0	100	5.26	50.0
6.000	4	Roof2.1	9.149	0.600	24.450	24.336	0.114	80.0	100	5.18	50.0
6.001	Roof2.1	P1b	5.100	0.600	24.334	24.270	0.064	80.0	100	5.28	50.0
6.002	P1b	G1	10.441	0.600	24.220	24.089	0.131	80.0	100	5.48	50.0
9.000	P1b	G1	10.441	0.600	24.550	24.335	0.215	48.6	100	5.16	50.0
1.005	G1	Vent/Dummy Out	9.569	0.600	24.700	24.650	0.050	191.4	150	6.30	50.0

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	0.922	7.2	0.2	0.300	0.269	0.002	0.0	12	0.408
1.001	0.987	7.8	0.3	0.269	0.367	0.002	0.0	14	0.473
1.002	1.026	8.1	0.3	0.367	0.425	0.002	0.0	13	0.474
1.003	0.625	4.9	1.1	0.425	0.427	0.008	0.0	32	0.505
2.000	1.374	10.8	0.0	0.300	0.550	0.000	0.0	0	0.000
3.000	0.861	6.8	2.5	0.400	0.563	0.018	0.0	42	0.793
2.001	1.123	19.8	2.5	0.550	0.210	0.018	0.0	36	0.771
1.004	0.818	14.5	3.7	0.427	0.820	0.028	0.0	52	0.686
4.000	0.618	4.9	1.7	0.250	0.184	0.013	0.0	41	0.564
5.000	0.861	6.8	0.0	0.100	0.156	0.000	0.0	6	0.229
4.001	0.861	6.8	2.5	0.530	0.662	0.018	0.0	42	0.793
8.000	1.051	8.3	1.6	0.200	0.430	0.012	0.0	29	0.804
7.000	0.861	6.8	1.8	0.365	0.380	0.014	0.0	36	0.731
6.000	0.861	6.8	0.0	0.150	0.264	0.000	0.0	5	0.206
6.001	0.861	6.8	0.1	0.266	0.380	0.001	0.0	8	0.291
6.002	0.861	6.8	3.5	0.430	0.811	0.026	0.0	51	0.869
9.000	1.108	8.7	0.0	0.100	0.565	0.000	0.0	0	0.000
1.005	0.723	12.8	9.7	0.150	0.200	0.071	0.0	98	0.793

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	11.802	69.8	100	Circular	25.100	24.700	0.300	24.900	24.531	0.269
1.001	12.096	61.1	100	Circular	24.900	24.531	0.269	24.800	24.333	0.367
1.002	4.699	56.6	100	Circular	24.800	24.333	0.367	24.775	24.250	0.425
1.003	11.485	150.0	100	Circular	24.775	24.250	0.425	24.700	24.173	0.427
2.000	7.939	31.8	100	Circular	25.100	24.700	0.300	25.100	24.450	0.550
3.000	5.079	80.0	100	Circular	25.000	24.500	0.400	25.100	24.437	0.563
2.001	4.778	80.3	150	Circular	25.100	24.400	0.550	24.700	24.340	0.210
1.004	13.951	150.0	150	Circular	24.700	24.123	0.427	25.000	24.030	0.820
4.000	20.584	153.6	100	Circular	25.200	24.850	0.250	25.000	24.716	0.184
5.000	8.466	80.0	100	Circular	25.050	24.850	0.100	25.000	24.744	0.156
4.001	10.529	80.0	100	Circular	25.000	24.370	0.530	25.000	24.238	0.662
8.000	9.711	54.0	100	Circular	24.700	24.400	0.200	24.750	24.220	0.430
7.000	13.179	80.0	100	Circular	24.900	24.435	0.365	24.750	24.270	0.380
6.000	9.149	80.0	100	Circular	24.700	24.450	0.150	24.700	24.336	0.264
6.001	5.100	80.0	100	Circular	24.700	24.334	0.266	24.750	24.270	0.380
6.002	10.441	80.0	100	Circular	24.750	24.220	0.430	25.000	24.089	0.811
9.000	10.441	48.6	100	Circular	24.750	24.550	0.100	25.000	24.335	0.565
1.005	9.569	191.4	150	Circular	25.000	24.700	0.150	25.000	24.650	0.200

Link	US Node	Dia (mm)	Width (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	450		Manhole	Adoptable	3	450	Manhole	Adoptable
1.001	3	450		Manhole	Adoptable	2	600	Manhole	Adoptable
1.002	2	600		Manhole	Adoptable	F1a	450	Manhole	Adoptable
1.003	F1a	450		Manhole	Adoptable	F1b	900	Manhole	Adoptable
2.000	Roof1.1	400		Manhole	Adoptable	RG_1	1200	Manhole	Adoptable
3.000	Roof1.2	300		Manhole	Adoptable	RG_1	1200	Manhole	Adoptable
2.001	RG_1	1200		Manhole	Adoptable	F1b	900	Manhole	Adoptable
1.004	F1b	900		Manhole	Adoptable	G1	1200	Manhole	Adoptable
4.000	P2a	450		Manhole	Adoptable	P2b	600	Manhole	Adoptable
5.000	GY1	300	300	Manhole	Adoptable	P2b	600	Manhole	Adoptable
4.001	P2b	600		Manhole	Adoptable	G1	1200	Manhole	Adoptable
8.000	Roof2.2	600		Manhole	Adoptable	P1b	1200	Manhole	Adoptable
7.000	P1a	450		Manhole	Adoptable	P1b	1200	Manhole	Adoptable
6.000	4	300		Manhole	Adoptable	Roof2.1	600	Manhole	Adoptable
6.001	Roof2.1	600		Manhole	Adoptable	P1b	1200	Manhole	Adoptable
6.002	P1b	1200		Manhole	Adoptable	G1	1200	Manhole	Adoptable
9.000	P1b	1200		Manhole	Adoptable	G1	1200	Manhole	Adoptable
1.005	G1	1200		Manhole	Adoptable	Vent/Dummy Out	300	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)
Roof1.1	563246.872	174055.847	25.100	0.400	400			2.000	24.700	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)	
GY1	563235.867	174025.557	25.050	0.200	300	300		0	5.000	24.850	100
P1b	563239.598	174028.987	24.750	0.530	1200			1	8.000	24.220	100
								2	6.001	24.270	100
								3	7.000	24.270	100
								0-1	6.002	24.220	100
								0-2	9.000	24.550	100
Vent/Dummy Out	563234.959	174046.019	25.000	0.350	300			1	1.005	24.650	150
RG_1	563246.462	174047.919	25.100	0.700	1200			1	3.000	24.437	100
								2	2.000	24.450	100
								0	2.001	24.400	150
Roof2.2	563245.956	174036.328	24.700	0.300	600			0	8.000	24.400	100
P2b	563227.621	174027.471	25.000	0.630	600			1	5.000	24.744	100
								2	4.000	24.716	100
								0	4.001	24.370	100
G1	563232.609	174036.744	25.000	0.970	1200			1	9.000	24.335	100
								2	6.002	24.089	100
								3	1.004	24.030	150
								4	4.001	24.238	100
								0	1.005	24.700	150
Roof2.1	563244.680	174028.562	24.700	0.366	600			1	6.000	24.336	100
								0	6.001	24.334	100
P1a	563242.966	174041.729	24.900	0.465	450			0	7.000	24.435	100
P2a	563233.081	174047.318	25.200	0.350	450			0	4.000	24.850	100
F1a	563256.178	174041.466	24.775	0.525	450			1	1.002	24.250	100
								0	1.003	24.250	100
F1b	563244.860	174043.417	24.700	0.877	900			1	2.001	24.340	150
								2	1.003	24.173	100
								0	1.004	24.123	150

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)	
Roof1.2	563251.409	174046.769	25.000	0.500	300			0	3.000	24.500	100
1	563258.838	174069.844	25.100	0.400	450			0	1.000	24.700	100
2	563256.982	174046.095	24.800	0.467	600			1	1.001	24.333	100
								0	1.002	24.333	100
3	563258.876	174058.042	24.900	0.369	450			1	1.000	24.531	100
								0	1.001	24.531	100
4	563253.751	174027.363	24.700	0.250	300			0	6.000	24.450	100

Simulation Settings

Rainfall Methodology	FEH-22	Check Discharge Rate(s)	✓
Summer CV	0.750	2 year (l/s)	1.0
Winter CV	0.840	30 year (l/s)	2.5
Analysis Speed	Detailed	100 year (l/s)	3.1
Skip Steady State	x	Check Discharge Volume	✓
Drain Down Time (mins)	240	100 year +40% 360 minute (m³)	55
Additional Storage (m³/ha)	20.0		

Storm Durations

60 | 360

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Brownfield	Time of Concentration (mins)	5.00
Brownfield Method	MRM	Betterment (%)	0
Contributing Area (ha)	0.080	Q 2 year (l/s)	1.0
PIMP (%)	100	Q 30 year (l/s)	2.5
CV	0.750	Q 100 year (l/s)	3.1

Pre-development Discharge Volume

Site Makeup	Brownfield	CV	0.750	Betterment (%)	0
Brownfield Method	MRM	Return Period (years)	100	PR	0.750
Contributing Area (ha)	0.080	Climate Change (%)	40	Runoff Volume (m³)	55
PIMP (%)	100	Storm Duration (mins)	360		

Node P2b Online Orifice Control

Flap Valve	x	Design Depth (m)	0.700	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	24.370	Diameter (m)	0.024		

Node P1b Online Orifice Control

Flap Valve	x	Design Depth (m)	0.700	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	24.220	Diameter (m)	0.024		

Node P1b Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.02000	Invert Level (m)	24.220	Slope (1:X)	250.0
Side Inf Coefficient (m/hr)	0.02400	Time to half empty (mins)	73	Depth (m)	0.350
Safety Factor	2.0	Width (m)	4.800	Inf Depth (m)	
Porosity	0.30	Length (m)	12.500		

Node P2b Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.01800	Invert Level (m)	24.400	Slope (1:X)	350.0
Side Inf Coefficient (m/hr)	0.02400	Time to half empty (mins)	28	Depth (m)	0.350
Safety Factor	2.0	Width (m)	4.800	Inf Depth (m)	
Porosity	0.30	Length (m)	22.000		

Node G1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.02000	Safety Factor	2.0	Invert Level (m)	23.500
Side Inf Coefficient (m/hr)	0.02400	Porosity	0.95	Time to half empty (mins)	600

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	150.0	100.0	0.400	150.0	100.0	0.401	0.0	101.0

Node RG_1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	24.600
Side Inf Coefficient (m/hr)	0.02400	Porosity	0.15	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	15.0	0.0	0.400	15.0	0.0

Node RG_1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	24.400
Side Inf Coefficient (m/hr)	0.02400	Porosity	0.30	Time to half empty (mins)	6

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	15.0	0.0	0.200	15.0	0.0	0.201	0.0	0.0

Node F1a Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.02000	Safety Factor	2.0	Invert Level (m)	24.250
Side Inf Coefficient (m/hr)	0.02400	Porosity	0.15	Time to half empty (mins)	13

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	10.0	0.0	0.300	10.0	0.0	0.301	0.0	0.0

Node F1a Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.02000	Safety Factor	2.0	Invert Level (m)	24.250
Side Inf Coefficient (m/hr)	0.02400	Porosity	0.30	Time to half empty (mins)	13

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	30.0	0.0	0.300	30.0	0.0	0.301	0.0	0.0

Node F1b Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	24.123
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.15	Time to half empty (mins)	6

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	10.0	0.0	0.300	10.0	0.0	0.301	0.0	0.0

Other (defaults)

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

Approval Settings

Node Size	✓	Proportional Velocity	✓
Node Losses	✓	Return Period (years)	100
Link Size	✓	Minimum Proportional Velocity (m/s)	0.750
Minimum Diameter (mm)	150	Maximum Proportional Velocity (m/s)	3.000
Link Length	✓	Surcharged Depth	✓
Maximum Length (m)	100.000	Return Period (years)	100
Coordinates	✓	Maximum Surcharged Depth (m)	0.100
Accuracy (m)	1.000	Flooding	✓
Crossings	✓	Return Period (years)	30
Cover Depth	✓	Time to Half Empty	✓
Minimum Cover Depth (m)	1.200	Return Period (years)	30
Maximum Cover Depth (m)	3.000	Discharge Rates	✓
Backdrops	✓	2 year (l/s)	1.0
Minimum Backdrop Height (m)	0.200	30 year (l/s)	2.5
Maximum Backdrop Height (m)	1.500	100 year (l/s)	3.1
Full Bore Velocity	✓	Discharge Volume	✓
Minimum Full Bore Velocity (m/s)	1.000	100 year 360 minute (m ³)	100
Maximum Full Bore Velocity (m/s)	3.000		

Approval Results

The network has been designed using IDF rainfall

It contains 18 nodes (1 outfall) and 18 links

The total impermeable area is 0.071 ha

2 online controls have been defined

8 structures have been defined, providing 73m³ of storage below the flood risk level

Infiltration based on BRE 365 has been applied at 7 of the structures

Simulations have been completed using FEH-22 summer and winter storms from 15 to 1440 minute duration

15 manholes are smaller than that required by the library

Node	Required Dia (mm)	Actual Dia (mm)	Actual Width (mm)
Roof1.1	1200	400	
GY1	1200	300	300
Vent/Dummy Out	1200	300	
Roof2.2	1200	600	
P2b	1200	600	
Roof2.1	1200	600	
P1a	1200	450	
P2a	1200	450	
F1a	1200	450	
F1b	1200	900	
Roof1.2	1200	300	
1	1200	450	
2	1200	600	
3	1200	450	
4	1200	300	

7 connections have combined exit and entry losses less than the recommended total

Node	US Link	DS Link	US Exit Loss	DS Entry Loss	Angle (degrees)	Recommended Node Losses
P1b	8.000	6.002	0.250	0.250	97	1.200
P1b	7.000	6.002	0.250	0.250	123	1.200
RG_1	3.000	2.001	0.250	0.250	83	0.900
P2b	5.000	4.001	0.250	0.250	105	1.200
P2b	4.000	4.001	0.250	0.250	167	1.200
G1	1.004	1.005	0.250	0.250	133	1.200
F1a	1.002	1.003	0.250	0.250	90	0.900

15 circular links have diameters < 150mm

US Node	DS Node	Link	Dia (mm)
1	3	1.000	100
3	2	1.001	100
2	F1a	1.002	100
F1a	F1b	1.003	100
Roof1.1	RG_1	2.000	100
Roof1.2	RG_1	3.000	100
P2a	P2b	4.000	100
GY1	P2b	5.000	100
P2b	G1	4.001	100
Roof2.2	P1b	8.000	100

US Node	DS Node	Link	Dia (mm)
P1a	P1b	7.000	100
4	Roof2.1	6.000	100
Roof2.1	P1b	6.001	100
P1b	G1	6.002	100
P1b	G1	9.000	100

No links have lengths > 100.000m

No links have lengths that differ from their coordinated length by more than 1.000m

No links cross one or more other links

18 links have cover depth outside the range 1.200-3.000m

US Node	DS Node	Link	Minimum Depth (m)	Maximum Depth (m)
1	3	1.000	0.269	0.300
3	2	1.001	0.269	0.367
2	F1a	1.002	0.367	0.425
F1a	F1b	1.003	0.425	0.427
Roof1.1	RG_1	2.000	0.300	0.550
Roof1.2	RG_1	3.000	0.400	0.563
RG_1	F1b	2.001	0.210	0.550
F1b	G1	1.004	0.427	0.820
P2a	P2b	4.000	0.184	0.250
GY1	P2b	5.000	0.100	0.156
P2b	G1	4.001	0.530	0.662
Roof2.2	P1b	8.000	0.200	0.430
P1a	P1b	7.000	0.365	0.380
4	Roof2.1	6.000	0.150	0.264
Roof2.1	P1b	6.001	0.266	0.380
P1b	G1	6.002	0.430	0.811
P1b	G1	9.000	0.100	0.565
G1	Vent/Dummy Out	1.005	0.150	0.200

3 nodes have backdrops outside the range 0.200-1.500m

Node	US Link	DS Link	Backdrop (m)
P1b	7.000	6.002	0.050
Roof2.1	6.000	6.001	0.002
P1b	6.001	6.002	0.050

13 links have full bore velocity outside the range 1.000-3.000m/s

US Node	DS Node	Link	Velocity (m/s)
1	3	1.000	0.922
3	2	1.001	0.987
F1a	F1b	1.003	0.625
Roof1.2	RG_1	3.000	0.861
F1b	G1	1.004	0.818
P2a	P2b	4.000	0.618
GY1	P2b	5.000	0.861

US Node	DS Node	Link	Velocity (m/s)
P2b	G1	4.001	0.861
P1a	P1b	7.000	0.861
4	Roof2.1	6.000	0.861
Roof2.1	P1b	6.001	0.861
P1b	G1	6.002	0.861
G1	Vent/Dummy Out	1.005	0.723

9 links have peak proportional velocity outside the range 0.750-3.000m/s during the 100 year return period

US Node	DS Node	Link	Velocity (m/s)	Event
1	3	1.000	0.573	100 year 15 minute summer
3	2	1.001	0.645	100 year 15 minute winter
F1a	F1b	1.003	0.328	100 year 15 minute winter
P2a	P2b	4.000	0.141	100 year +40% CC 30 minute summer
GY1	P2b	5.000	0.311	100 year 60 minute winter
P1a	P1b	7.000	0.101	100 year 180 minute winter
4	Roof2.1	6.000	0.246	100 year 15 minute winter
Roof2.1	P1b	6.001	0.010	100 year 960 minute summer
P1b	G1	9.000	0.615	100 year +40% CC 120 minute winter

No links have a surcharged depth greater than 0.100m during the 100 year return period

No nodes flood during the 30 year return period

1 infiltrating structure failed to half empty in 1440 minutes during the 30 year return period

Node	Structure	Time to Half Empty (mins)
RG_1	Depth/Area	Not identified

No outfalls have a discharge rate greater than 1.0l/s during the 2 year return period

No outfalls have a discharge rate greater than 2.5l/s during the 30 year return period

No outfalls have a discharge rate greater than 3.1l/s during the 100 year return period

No outfalls have a discharge volume greater than 100m³ during the 100 year 360 minute storm

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 15 minute summer	106.020	30.000	2 year 240 minute winter	12.928	5.142
2 year 15 minute winter	74.400	30.000	2 year 360 minute summer	15.006	3.862
2 year 30 minute summer	67.904	19.214	2 year 360 minute winter	9.754	3.862
2 year 30 minute winter	47.652	19.214	2 year 480 minute summer	11.811	3.121
2 year 60 minute summer	44.370	11.726	2 year 480 minute winter	7.847	3.121
2 year 60 minute winter	29.478	11.726	2 year 600 minute summer	9.630	2.634
2 year 120 minute summer	30.355	8.022	2 year 600 minute winter	6.580	2.634
2 year 120 minute winter	20.167	8.022	2 year 720 minute summer	8.533	2.287
2 year 180 minute summer	24.203	6.228	2 year 720 minute winter	5.735	2.287
2 year 180 minute winter	15.733	6.228	2 year 960 minute summer	6.917	1.821
2 year 240 minute summer	19.459	5.142	2 year 960 minute winter	4.582	1.821

Rainfall

Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)	Event	Peak Intensity (mm/hr)	Average Intensity (mm/hr)
2 year 1440 minute summer	4.925	1.320	100 year 240 minute winter	37.091	14.754
2 year 1440 minute winter	3.310	1.320	100 year 360 minute summer	42.711	10.991
30 year 15 minute summer	280.222	79.293	100 year 360 minute winter	27.763	10.991
30 year 15 minute winter	196.647	79.293	100 year 480 minute summer	33.834	8.941
30 year 30 minute summer	180.714	51.136	100 year 480 minute winter	22.479	8.941
30 year 30 minute winter	126.817	51.136	100 year 600 minute summer	27.853	7.618
30 year 60 minute summer	119.627	31.614	100 year 600 minute winter	19.031	7.618
30 year 60 minute winter	79.477	31.614	100 year 720 minute summer	24.928	6.681
30 year 120 minute summer	72.173	19.073	100 year 720 minute winter	16.753	6.681
30 year 120 minute winter	47.950	19.073	100 year 960 minute summer	20.578	5.419
30 year 180 minute summer	54.790	14.099	100 year 960 minute winter	13.631	5.419
30 year 180 minute winter	35.615	14.099	100 year 1440 minute summer	14.892	3.991
30 year 240 minute summer	42.960	11.353	100 year 1440 minute winter	10.008	3.991
30 year 240 minute winter	28.542	11.353	100 year +40% CC 15 minute summer	504.486	142.752
30 year 360 minute summer	32.430	8.345	100 year +40% CC 15 minute winter	354.025	142.752
30 year 360 minute winter	21.080	8.345	100 year +40% CC 30 minute summer	328.689	93.008
30 year 480 minute summer	25.324	6.692	100 year +40% CC 30 minute winter	230.659	93.008
30 year 480 minute winter	16.825	6.692	100 year +40% CC 60 minute summer	218.329	57.698
30 year 600 minute summer	20.605	5.636	100 year +40% CC 60 minute winter	145.053	57.698
30 year 600 minute winter	14.078	5.636	100 year +40% CC 120 minute summer	130.374	34.454
30 year 720 minute summer	18.271	4.897	100 year +40% CC 120 minute winter	86.617	34.454
30 year 720 minute winter	12.279	4.897	100 year +40% CC 180 minute summer	99.168	25.519
30 year 960 minute summer	14.907	3.925	100 year +40% CC 180 minute winter	64.462	25.519
30 year 960 minute winter	9.875	3.925	100 year +40% CC 240 minute summer	78.160	20.655
30 year 1440 minute summer	10.714	2.872	100 year +40% CC 240 minute winter	51.928	20.655
30 year 1440 minute winter	7.201	2.872	100 year +40% CC 360 minute summer	59.795	15.387
100 year 15 minute summer	360.347	101.966	100 year +40% CC 360 minute winter	38.868	15.387
100 year 15 minute winter	252.875	101.966	100 year +40% CC 480 minute summer	47.368	12.518
100 year 30 minute summer	234.778	66.434	100 year +40% CC 480 minute winter	31.470	12.518
100 year 30 minute winter	164.757	66.434	100 year +40% CC 600 minute summer	38.994	10.666
100 year 60 minute summer	155.949	41.213	100 year +40% CC 600 minute winter	26.643	10.666
100 year 60 minute winter	103.609	41.213	100 year +40% CC 720 minute summer	34.899	9.353
100 year 120 minute summer	93.124	24.610	100 year +40% CC 720 minute winter	23.455	9.353
100 year 120 minute winter	61.870	24.610	100 year +40% CC 960 minute summer	28.809	7.586
100 year 180 minute summer	70.834	18.228	100 year +40% CC 960 minute winter	19.084	7.586
100 year 180 minute winter	46.044	18.228	100 year +40% CC 1440 minute summer	20.848	5.588
100 year 240 minute summer	55.829	14.754	100 year +40% CC 1440 minute winter	14.011	5.588

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof1.1	1	24.700	0.000	0.0	0.0000	0.0000	OK
15 minute summer	GY1	1	24.850	0.000	0.0	0.0000	0.0000	OK
30 minute winter	P1b	28	24.313	0.093	2.6	1.3313	0.0000	OK
15 minute summer	Vent/Dummy Out	1	24.650	0.000	0.0	0.0000	0.0000	OK
15 minute winter	RG_1	11	24.437	0.037	2.5	0.2097	0.0000	OK
15 minute winter	Roof2.2	10	24.430	0.030	1.6	0.0313	0.0000	OK
30 minute winter	P2b	25	24.442	0.072	1.3	0.4694	0.0000	OK
15 minute winter	4.001:50%	11	24.330	0.026	1.0	0.0000	0.0000	OK
600 minute winter	G1	450	23.554	-0.476	0.9	7.7338	0.0000	OK
15 minute winter	Roof2.1	11	24.342	0.008	0.1	0.0023	0.0000	OK
15 minute winter	P1a	13	24.444	0.009	0.1	0.0016	0.0000	OK
15 minute winter	7.000:50%	11	24.389	0.036	1.9	0.0690	0.0000	OK
15 minute summer	P2a	1	24.850	0.000	0.0	0.0000	0.0000	OK
15 minute winter	4.000:50%	10	24.824	0.041	1.7	0.0000	0.0000	OK
120 minute winter	F1a	80	24.259	0.009	0.1	0.0974	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Roof1.1	2.000	RG_1	0.0	0.000	0.000	0.0000	
15 minute summer	GY1	5.000	P2b	0.0	0.000	0.000	0.0000	
30 minute winter	P1b	Orifice	G1	0.3				
15 minute summer	P1b	9.000	G1	0.0	0.000	0.000	0.0000	
30 minute winter	P1b	Infiltration		0.2				
15 minute winter	RG_1	2.001	F1b	2.4	0.732	0.120	0.0156	
15 minute summer	RG_1	Infiltration		0.0				
15 minute summer	RG_1	Infiltration		0.0				
15 minute winter	Roof2.2	8.000	P1b	1.6	0.581	0.191	0.0383	
30 minute winter	P2b	Orifice	4.001:50%	0.3				
30 minute winter	P2b	Infiltration		0.2				
15 minute winter	P2b	4.001	G1	1.0	0.605	0.143	0.0084	
15 minute summer	G1	1.005	Vent/Dummy Out	0.0	0.000	0.000	0.0000	0.0
240 minute winter	G1	Infiltration		0.3				
15 minute winter	Roof2.1	6.001	P1b	0.1	0.244	0.012	0.0066	
15 minute winter	P1a	7.000	7.000:50%	0.1	0.091	0.015	0.0094	
15 minute winter	P1a	7.000	P1b	1.8	0.724	0.268	0.0165	
15 minute summer	P2a	4.000	4.000:50%	0.0	0.000	0.000	0.0150	
15 minute winter	P2a	4.000	P2b	1.6	0.557	0.338	0.0303	
120 minute winter	F1a	1.003	1.003:50%	0.1	0.161	0.017	0.0035	

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1.003:50%	11	24.239	0.028	0.8	0.0000	0.0000	OK
15 minute winter	F1b	12	24.172	0.049	3.3	0.1067	0.0000	OK
15 minute winter	Roof1.2	10	24.545	0.045	2.5	0.0363	0.0000	OK
15 minute summer	1	9	24.712	0.012	0.2	0.0029	0.0000	OK
15 minute summer	2	12	24.350	0.017	0.3	0.0047	0.0000	OK
15 minute summer	3	10	24.545	0.014	0.3	0.0025	0.0000	OK
15 minute summer	4	1	24.450	0.000	0.0	0.0000	0.0000	OK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	F1a	Infiltration		0.0				
15 minute summer	F1a	Infiltration		0.0				
15 minute winter	F1a	1.003	F1b	0.8	0.461	0.163	0.0099	
15 minute winter	F1b	1.004	G1	3.2	0.651	0.222	0.0690	
15 minute winter	Roof1.2	3.000	RG_1	2.5	0.760	0.366	0.0165	
15 minute summer	1	1.000	3	0.2	0.478	0.028	0.0068	
15 minute winter	2	1.002	F1a	0.3	0.774	0.037	0.0021	
15 minute summer	3	1.001	2	0.3	0.546	0.040	0.0085	
15 minute summer	4	6.000	Roof2.1	0.0	0.000	0.000	0.0002	

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof1.1	1	24.700	0.000	0.0	0.0000	0.0000	OK
30 minute winter	GY1	22	24.859	0.009	0.1	0.0010	0.0000	OK
60 minute winter	P1b	57	24.449	0.229	4.5	3.9343	0.0000	SURCHARGED
15 minute summer	Vent/Dummy Out	1	24.650	0.000	0.0	0.0000	0.0000	OK
15 minute winter	RG_1	11	24.465	0.065	6.5	0.3635	0.0000	OK
15 minute winter	Roof2.2	10	24.450	0.050	4.2	0.0530	0.0000	OK
30 minute winter	P2b	29	24.489	0.119	3.6	1.8722	0.0000	SURCHARGED
15 minute winter	4.001:50%	10	24.344	0.040	2.2	0.0000	0.0000	OK
600 minute winter	G1	585	23.637	-0.393	1.7	19.5115	0.0000	OK
60 minute winter	Roof2.1	55	24.449	0.115	0.4	0.0349	0.0000	FLOOD RISK
60 minute winter	P1a	57	24.450	0.014	0.1	0.0027	0.0000	OK
60 minute winter	7.000:50%	58	24.449	0.096	2.4	0.4913	0.0000	OK
15 minute winter	P2a	11	24.860	0.010	0.2	0.0016	0.0000	OK
15 minute winter	4.000:50%	11	24.859	0.076	4.6	0.0000	0.0000	OK
15 minute winter	F1a	15	24.270	0.020	0.9	0.2163	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Roof1.1	2.000	RG_1	0.0	0.000	0.000	0.0023	
30 minute winter	GY1	5.000	P2b	0.1	0.311	0.015	0.0027	
60 minute winter	P1b	Orifice	G1	0.6				
15 minute summer	P1b	9.000	G1	0.0	0.000	0.000	0.0000	
60 minute winter	P1b	Infiltration		0.2				
15 minute winter	RG_1	2.001	F1b	6.4	0.945	0.324	0.0325	
15 minute summer	RG_1	Infiltration		0.0				
15 minute summer	RG_1	Infiltration		0.0				
15 minute winter	Roof2.2	8.000	P1b	4.1	0.744	0.502	0.0571	
30 minute winter	P2b	Orifice	4.001:50%	0.4				
30 minute winter	P2b	Infiltration		0.3				
15 minute winter	P2b	4.001	G1	2.2	0.755	0.324	0.0153	
15 minute summer	G1	1.005	Vent/Dummy Out	0.0	0.000	0.000	0.0000	0.0
15 minute winter	G1	Infiltration		0.3				
15 minute summer	Roof2.1	6.001	P1b	-0.6	0.245	-0.082	0.0335	
30 minute winter	P1a	7.000	7.000:50%	0.2	0.095	0.030	0.0244	
15 minute winter	P1a	7.000	P1b	4.6	0.898	0.675	0.0425	
15 minute winter	P2a	4.000	4.000:50%	-0.2	-0.057	-0.035	0.0349	
15 minute winter	P2a	4.000	P2b	4.3	0.723	0.895	0.0617	
15 minute winter	F1a	1.003	1.003:50%	0.4	0.304	0.090	0.0125	

Results for 30 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1.003:50%	11	24.259	0.048	2.2	0.0000	0.0000	OK
15 minute winter	F1b	11	24.211	0.088	8.8	0.1908	0.0000	OK
15 minute winter	Roof1.2	11	24.592	0.092	6.7	0.0749	0.0000	OK
15 minute summer	1	10	24.720	0.020	0.6	0.0048	0.0000	OK
15 minute summer	2	10	24.356	0.023	0.7	0.0066	0.0000	OK
15 minute winter	3	10	24.552	0.021	0.8	0.0038	0.0000	OK
15 minute summer	4	12	24.458	0.008	0.1	0.0007	0.0000	OK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	F1a	Infiltration		0.0				
15 minute summer	F1a	Infiltration		0.0				
15 minute winter	F1a	1.003	F1b	2.2	0.603	0.442	0.0207	
15 minute winter	F1b	1.004	G1	8.7	0.836	0.600	0.1452	
15 minute winter	Roof1.2	3.000	RG_1	6.5	0.912	0.959	0.0367	
15 minute winter	1	1.000	3	0.6	0.539	0.083	0.0134	
15 minute winter	2	1.002	F1a	0.8	0.893	0.096	0.0050	
15 minute winter	3	1.001	2	0.7	0.583	0.096	0.0154	
15 minute summer	4	6.000	Roof2.1	0.1	0.280	0.015	0.0237	

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof1.1	1	24.700	0.000	0.0	0.0000	0.0000	OK
60 minute winter	GY1	38	24.859	0.009	0.1	0.0010	0.0000	OK
60 minute winter	P1b	59	24.499	0.279	5.7	4.8891	0.0000	FLOOD RISK
15 minute summer	Vent/Dummy Out	1	24.650	0.000	0.0	0.0000	0.0000	OK
15 minute winter	RG_1	11	24.475	0.075	8.3	0.4215	0.0000	OK
60 minute winter	Roof2.2	57	24.499	0.099	2.7	0.1049	0.0000	OK
60 minute winter	P2b	49	24.513	0.143	3.1	2.6409	0.0000	SURCHARGED
15 minute winter	4.001:50%	10	24.350	0.046	2.7	0.0000	0.0000	OK
960 minute winter	G1	930	23.707	-0.323	1.8	29.4712	0.0000	OK
60 minute winter	Roof2.1	58	24.499	0.165	0.4	0.0501	0.0000	FLOOD RISK
60 minute winter	P1a	58	24.500	0.065	0.2	0.0122	0.0000	OK
60 minute winter	7.000:50%	58	24.499	0.146	3.2	1.1315	0.0000	SURCHARGED
15 minute winter	P2a	11	24.883	0.033	0.4	0.0052	0.0000	OK
15 minute winter	4.000:50%	11	24.882	0.099	5.9	0.0000	0.0000	OK
15 minute winter	F1a	14	24.276	0.026	1.1	0.2726	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Roof1.1	2.000	RG_1	0.0	0.000	0.000	0.0054	
60 minute winter	GY1	5.000	P2b	0.1	0.311	0.015	0.0027	
60 minute winter	P1b	Orifice	G1	0.6				
15 minute summer	P1b	9.000	G1	0.0	0.000	0.000	0.0000	
60 minute winter	P1b	Infiltration		0.2				
15 minute winter	RG_1	2.001	F1b	8.2	1.003	0.414	0.0391	
15 minute summer	RG_1	Infiltration		0.0				
15 minute summer	RG_1	Infiltration		0.0				
15 minute winter	Roof2.2	8.000	P1b	5.3	0.779	0.648	0.0616	
60 minute winter	P2b	Orifice	4.001:50%	0.4				
60 minute winter	P2b	Infiltration		0.3				
15 minute winter	P2b	4.001	G1	2.7	0.798	0.400	0.0179	
15 minute summer	G1	1.005	Vent/Dummy Out	0.0	0.000	0.000	0.0000	0.0
15 minute summer	G1	Infiltration		0.3				
15 minute summer	Roof2.1	6.001	P1b	-0.8	0.244	-0.112	0.0399	
15 minute winter	P1a	7.000	7.000:50%	0.3	0.091	0.044	0.0285	
15 minute winter	P1a	7.000	P1b	5.7	0.910	0.837	0.0515	
15 minute winter	P2a	4.000	4.000:50%	-0.4	-0.102	-0.075	0.0515	
15 minute winter	P2a	4.000	P2b	5.4	0.750	1.108	0.0727	
15 minute winter	F1a	1.003	1.003:50%	0.7	0.328	0.143	0.0166	

Results for 100 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1.003:50%	11	24.268	0.056	2.9	0.0000	0.0000	OK
15 minute winter	F1b	12	24.229	0.106	11.3	0.2288	0.0000	OK
15 minute winter	Roof1.2	11	24.654	0.154	8.6	0.1245	0.0000	SURCHARGED
15 minute summer	1	10	24.722	0.022	0.8	0.0054	0.0000	OK
15 minute summer	2	11	24.358	0.025	1.0	0.0072	0.0000	OK
15 minute winter	3	11	24.555	0.024	1.0	0.0043	0.0000	OK
60 minute winter	4	60	24.499	0.049	0.2	0.0043	0.0000	OK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	F1a	Infiltration		0.0				
15 minute summer	F1a	Infiltration		0.0				
15 minute winter	F1a	1.003	F1b	2.8	0.635	0.572	0.0257	
15 minute winter	F1b	1.004	G1	11.3	0.881	0.778	0.1781	
15 minute winter	Roof1.2	3.000	RG_1	8.3	1.060	1.225	0.0387	
15 minute summer	1	1.000	3	0.8	0.573	0.106	0.0157	
15 minute summer	2	1.002	F1a	1.0	0.907	0.121	0.0061	
15 minute summer	3	1.001	2	1.0	0.638	0.123	0.0181	
30 minute winter	4	6.000	Roof2.1	-0.3	0.233	-0.039	0.0457	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	Roof1.1	1	24.700	0.000	0.0	0.0000	0.0000	OK
15 minute winter	GY1	12	24.862	0.012	0.2	0.0015	0.0000	OK
120 minute winter	P1b	90	24.567	0.347	3.8	6.1983	0.0000	FLOOD RISK
15 minute summer	Vent/Dummy Out	1	24.650	0.000	0.0	0.0000	0.0000	OK
15 minute winter	RG_1	11	24.492	0.092	11.5	0.5199	0.0000	OK
120 minute winter	Roof2.2	88	24.569	0.169	2.3	0.1783	0.0000	FLOOD RISK
60 minute winter	P2b	55	24.560	0.190	4.3	4.1351	0.0000	SURCHARGED
15 minute winter	4.001:50%	10	24.359	0.055	3.8	0.0000	0.0000	OK
1440 minute winter	G1	1380	23.820	-0.210	1.8	45.5981	0.0000	OK
120 minute winter	Roof2.1	90	24.567	0.233	0.3	0.0709	0.0000	FLOOD RISK
120 minute winter	P1a	90	24.569	0.134	0.2	0.0251	0.0000	SURCHARGED
120 minute winter	7.000:50%	90	24.568	0.216	2.6	2.4587	0.0000	SURCHARGED
15 minute winter	P2a	11	24.958	0.108	1.0	0.0172	0.0000	FLOOD RISK
15 minute winter	4.000:50%	11	24.958	0.175	8.2	0.0000	0.0000	SURCHARGED
15 minute winter	F1a	13	24.290	0.040	1.8	0.4222	0.0000	OK

Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	Roof1.1	2.000	RG_1	0.0	0.000	0.000	0.0114	
15 minute winter	GY1	5.000	P2b	0.2	0.382	0.030	0.0044	
120 minute winter	P1b	Orifice	G1	0.7				
120 minute winter	P1b	9.000	G1	0.6	0.615	0.064	0.0094	
120 minute winter	P1b	Infiltration		0.2				
15 minute winter	RG_1	2.001	F1b	11.4	1.081	0.575	0.0504	
15 minute summer	RG_1	Infiltration		0.0				
15 minute summer	RG_1	Infiltration		0.0				
15 minute winter	Roof2.2	8.000	P1b	6.6	0.871	0.798	0.0760	
60 minute winter	P2b	Orifice	4.001:50%	0.5				
60 minute winter	P2b	Infiltration		0.3				
15 minute winter	P2b	4.001	G1	3.7	0.861	0.548	0.0227	
15 minute summer	G1	1.005	Vent/Dummy Out	0.0	0.000	0.000	0.0000	0.0
15 minute summer	G1	Infiltration		0.3				
15 minute summer	Roof2.1	6.001	P1b	-1.0	0.244	-0.153	0.0399	
30 minute winter	P1a	7.000	7.000:50%	-0.4	0.089	-0.062	0.0516	
15 minute summer	P1a	7.000	P1b	6.5	0.947	0.956	0.0516	
15 minute summer	P2a	4.000	4.000:50%	1.1	-0.174	0.222	0.0796	
15 minute winter	P2a	4.000	P2b	7.3	0.935	1.500	0.0772	
15 minute winter	F1a	1.003	1.003:50%	1.4	0.385	0.295	0.0260	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	1.003:50%	12	24.286	0.075	3.8	0.0000	0.0000	OK
15 minute winter	F1b	12	24.268	0.145	15.4	0.3137	0.0000	OK
15 minute winter	Roof1.2	11	24.780	0.280	12.0	0.2266	0.0000	FLOOD RISK
15 minute summer	1	10	24.726	0.026	1.1	0.0064	0.0000	OK
15 minute summer	2	10	24.362	0.029	1.4	0.0083	0.0000	OK
15 minute winter	3	11	24.560	0.029	1.4	0.0052	0.0000	OK
120 minute winter	4	90	24.568	0.118	0.2	0.0104	0.0000	FLOOD RISK
Link Event (Outflow)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	F1a	Infiltration		0.0				
15 minute summer	F1a	Infiltration		0.0				
15 minute winter	F1a	1.003	F1b	3.8	0.653	0.769	0.0401	
15 minute winter	F1b	1.004	G1	15.2	0.941	1.049	0.2221	
15 minute winter	Roof1.2	3.000	RG_1	11.5	1.475	1.707	0.0393	
15 minute summer	1	1.000	3	1.1	0.620	0.148	0.0204	
15 minute summer	2	1.002	F1a	1.4	0.915	0.172	0.0099	
15 minute winter	3	1.001	2	1.4	0.724	0.175	0.0226	
15 minute winter	4	6.000	Roof2.1	-0.5	0.246	-0.072	0.0575	

11.10 Appendix 10 – Water Quality Assessment

PDF to follow this page.

Site Address: Details: Issue Date	Former Fox and Hounds Public House, 26-27 London Road, Northfleet, Gravesend, DA11 9JH Water Quality Assessment - Simple Index Approach 1 Jan-24
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Pollution hazard indices for different land uses				
Land use	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.005
Other roofs (typical commercial/industrial roofs)	Low	0.3	0.23	0.005
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices), i.e. <300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways ¹	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. 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 ²	High	0.8	0.8	0.9

SuDS mitigation indices for discharge to Ground;			
Characteristics of the material overlying the proposed infiltration surface through which the run-off percolates	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by soil with good contaminant attenuation potential of at least 300mm in depth	0.6	0.5	0.6
A soil with good contaminant attenuation potential of at least 300mm in depth	0.4	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, e.g. graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20mm gravel) underlain by soil with good contaminant attenuation potential of at least 300mm in depth	0.4	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by soil with good contaminant attenuation potential of at least 300mm in depth	0.7	0.6	0.7
Bioretention underlain by soil with good contaminant attenuation potential	0.8	0.8	0.8
Total Mitigations Index	1.15	1.00	1.15

Water Quality - Simple Index Approach; Low Hazard Site Use		
Water Quality	Discharges to groundwater (for requirements, see Table 4.3)	Residential roofs: Land use hazard: Low For discharge to standard groundwater: Gross solids and sediment removal required; Low hazard indices: TSS: 0.7 Metals: 0.6 HCs: 0.4
	Discharges to surface waters	N/A
	Groundwater protection measures	Close Downpipes from Roof Level; Clean Rooftop Runoff; Residential parking: permeable paving surface plus a minimum of 300 mm underlying soils with good contaminant attenuation potential SuDS mitigation indices: TSS: 1.15 Metals: 1.0 HCs: 1.15 Result = Acceptable - Greater than Low Hazard Indices