



Drainage Strategy

Florence Arts Centre,

Egremont, Cumbria, CA22 2NR

December 2025



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Client: Sue Mackay

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Approved: Andrew Webb

Issue Record

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Contents

1.0	Background.....	4
1.1	Brief.....	4
1.2	Objectives	4
1.3	Background Information.....	4
2.0	Surface Water Drainage	5
2.1	Suds Methodology.....	5
2.2	Proposed Drainage	6
2.3	Source Control	7
2.4	SuDS Suitability Assessment	8
2.5	Water Quality	9
2.6	Exceedance Events	9
2.7	Maintenance Issues	10
2.8	Safety Issues	10
2.9	Drainage During Construction.....	10
2.10	Surface Water Drainage Summary	11
3.0	Foul Water Drainage.....	12
3.1	Site Location and Description	12
3.2	Maintenance Issues	12
3.3	Safety Issues	12
4.0	Conclusion	13
5.0	Design Standards	13
	Appendix A – Proposed Drainage Arrangement.....	14
	Appendix B – Proposed Drainage Calculations	15
	Appendix C – Typical Maintenance Schedule	16
	Appendix D – Vortiflo Specification	18
	Appendix E – Proposed SuDS Details	19

1.0 Background

1.1 Brief

BDN Ltd. has been commissioned by Sue Mackay to assess the drainage requirements for the development of Florence Arts Centre and is to include a small extension, paved parking areas, play area, associated access improvements, and landscaping works. As a new development, Sustainable Drainage Systems (SuDS), surface and foul water drainage must be considered. This report gives an overview of the methodology used, summarises the options investigated and the drainage proposals for the development.

The Drainage Strategy will be used to support a detailed planning application.

A site location plan is shown in Figure 1.1, the proposed development boundary is outlined. The site is centred around Ordnance Survey Grid Ref: NY 01700 10300 with a post code of CA22 2NR.

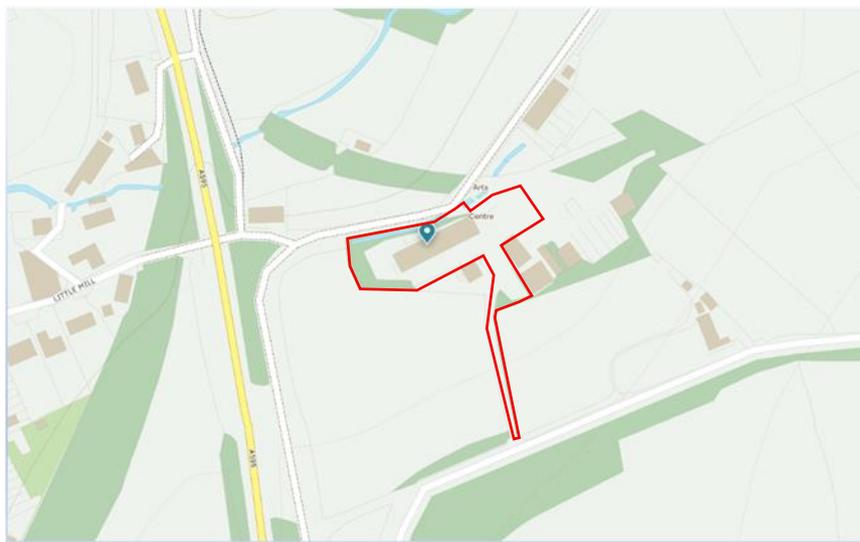


Figure 1.1 Ordnance Survey Map – Site Location

1.2 Objectives

The Objectives of this strategy are as follows:

- To establish the existing drainage characteristics of the site.
- To assess the post development runoff from the site.
- To determine the suitability of SuDS to manage post development surface runoff.
- To assess the post development foul flows from the site.
- To determine a suitable discharge location for foul flows.

1.3 Background Information

The site is an existing arts centre located off Little Mill in Egremont with an approximate area of 0.46ha. The site is on the east side of Egremont, east of the A595 Egremont Bypass and is surrounded by pasture.

A new access to the site will be formed from Little Mill to the south of the site which is to create a one-way system for the site with the existing access to the north proposed to be exit only.

2.0 Surface Water Drainage

2.1 Suds Methodology

The following methodology was used to produce a SuDS strategy for the site:

- Calculate pre-development/Greenfield runoff, using the method outlined in the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS).
- Calculate the required post development attenuation/storage required for the critical storm with a return period of 30 years in line with the National Planning Policy Framework (NPPF).
- Test the sensitivity of the site by investigating the volume of runoff produced during storms with a return period of 100 year plus 50% allowance for climate change in line with the NPPF.

Surface water attenuation provided is provided within the existing drainage to ensure that surface water flows for up to a 30-year return period storm are attenuated below ground or within designated at surface features with no road/property/overland flooding. The proposed development must also test the sensitivity of the site for a 100-year return period storm with a 50% allowance for climate change to ensure that no flooding of properties or third part land occurs.

The potential methods of discharge in order of preference are:

- Discharge via infiltration
- Discharge to watercourse
- Discharge to surface water sewer
- Discharge to combined sewer

A Phase 2 Geoenvironmental Appraisal (refer to Appendix B) has been completed by Spire Geotechnical for the site;

Made ground was recorded to depths of between 0.40m and 2.60m. The made ground generally included a granular fill consisting of a silty sandy gravel, gravel overlies a clay fill. The granular fill was generally observed as compacted, and included a range of anthropogenic deposits, including brick, ballast, sandstone etc. The made ground overlies firm and stiff clay deposits, and locally loose sand deposits, the latter of which was recorded in the south at the location of the track roadway. Whilst not encountered within the boreholes or trial pits, trapped/perched shallow groundwaters may be present, and appropriate pumps/dewatering equipment should be available to manage excess ingress into excavations/trenches.

Based on the hierarchy of discharge of surface water, the preferred method of surface water disposal is by infiltration. However, based on the geological information available for the site, infiltration is not considered a viable option to discharge.

The Ordnance Survey and EA maps show that to the north of the site is an unnamed watercourse. This is considered to be a viable location to discharge. It is proposed that the surface water system will discharge into this watercourse, as will the foul sewer once it has passed through a foul water treatment plant.

Surface water flows will be restricted to a flow rate agreed with the Lead Local Flood Authority (LLFA) to ensure that there will be no additional flooding to the surrounding area due to the development.

To ensure the water quality entering the water network does not have a detrimental impact to the environment, the design will look to incorporate source control features in compliance with the SuDS guidelines to delay the time of entry of flows to the network and provide a suitable level of treatment. The level of treatment is required to be proportional to the level of risk.

2.2 Proposed Drainage

It is proposed to provide a surface water drainage system serving roofs, footpaths, and all hard-standing areas for the development. The area of the site is 0.460ha, with an impermeable area of 0.288ha proposed to be positively drained.

The greenfield runoff flow rate for the area has been calculated using the IH 124 Input Method (calculations carried out using MicroDrainage).

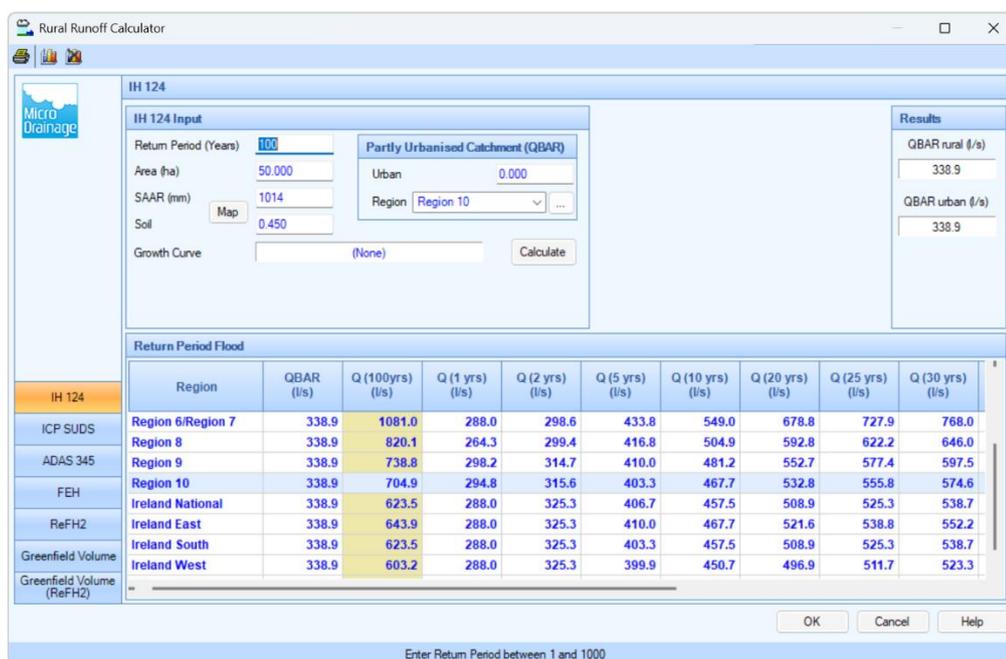


Figure 2.2 FSR Method Greenfield Runoff Calculations in MicroDrainage

Based on the total site area of 0.46ha the following greenfield run off rates for the following return period events have been calculated:

QBar	3.118 l/s
1 in 1 year	2.712 l/s
1 in 30-year	5.286 l/s
1 in 100-year	6.485 l/s

For a new development on a previously undeveloped site, surface water discharge would typically be restricted to the QBAR greenfield runoff rate. For this site, the QBAR has been calculated as 3.1 l/s, which will be maintained to align with the discharge arrangements for the wider site.

MicroDrainage has been used to determine the surface water attenuation requirements for a 1 in 100-year return period event, with flows restricted to the calculated QBAR of 3.1 l/s.

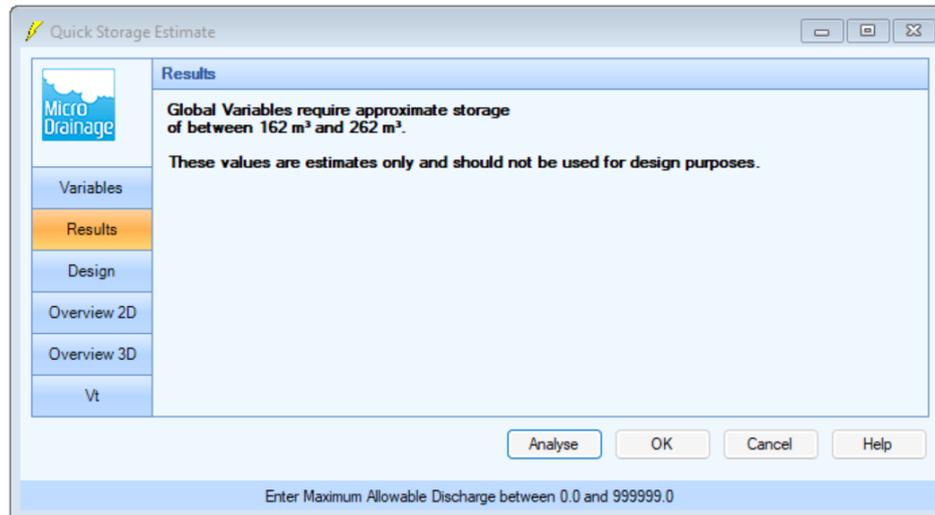


Figure 2.2.1 MicroDrainage attenuation estimate

MicroDrainage has been used to model the proposed surface water drainage and carry out a simulation for various return periods that for a 1 in 30-year return period event there is no exceedance of the network and for a 1 in 100 plus 50% for climate change (CC) surface water flows are directed away from buildings and retained on site. See Appendix A for proposed drainage layout and Appendix B for MicroDrainage calculations.

It is proposed to drain hardstanding areas of the site via linear drainage and permeable surfacing. The staff car parking area will drain via permeable pavement. The levels and falls across the site will be designed to direct surface water away from buildings towards soft landscaping areas where possible.

It is important to note the need to remove silt from runoff prior to discharge into SUDS features. SuDS such as filter drains, swales, bioretention systems and pervious pavements are sustainable alternatives to proprietary treatment systems otherwise required to manage silt.

During extreme storm events in excess of a 1 in 30-year return period event, exceedance flows will be retained within the below ground network. Once the peak of a storm subsides the flows will drain from the network and discharge at the restricted flow rate. This will ensure all buildings are protected from flooding and that any exceedance flows are managed within the site boundary.

2.3 Source Control

A requirement of the LLFA is to retain the first 5mm of rainfall on site of all rainfall events. Source control can be met through a number of measures such as rainwater harvesting, permeable paving etc. or evapotranspiration.

The site is not in a SPZ; it is assessed full infiltration is not possible requiring the drainage system to be wrapped.

Interception Mechanism	Base area of surface receiving run off (m ²)	% against total imp. site area (2,880m ²)
Permeable Paving	719	24.97

The interception provided by the proposed SUDs features account for 100% of the overall amount of interception required.

0.288ha ×5mm (rainfall) =14.4m³ storage volume required

A minimum 50mm of aggregate will be provided beneath the permeable paving and filter drain outlet pipework to provide the source control storage required to retain the first 5mm of rainfall.

2.4 SuDS Suitability Assessment

The NPF states that SuDS should be incorporated in all new developments unless evidence of unsuitability is provided. Therefore, the following SuDS components have been considered for the site:

SuDS Component	Description	Site Suitability	Comments
Rainwater Harvesting	Systems that collect runoff from the roof of a building or other paved surface for use.	✓	Potential for water butts for soft landscaping irrigation.
Green Roof	Planted soil layers on the roof of buildings that slow and store runoff.	✗	Roof layout unsuitable.
Soakaway	Systems that collect and store runoff, allowing it to infiltrate into the ground.	✗	Ground conditions unsuitable.
Permeable Pavement	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/ or allowed to infiltrate into the ground below.	✓	Parking areas to be constructed with permeable paving.
Filter Drain	Trench lined with geotextile and filled with gravel into which runoff water is led, either directly from the drained surface or via filter strip.	✗	Site layout unsuitable.
Infiltration Trench	Systems that collect and store runoff, allowing it to infiltrate to the ground.	✗	Ground conditions unsuitable.
Swale	Vegetated channels (sometimes planted) used to convey and treat runoff.	✗	Site layout unsuitable.
Bio-retention Area	Shallow landscaped depressions that allow runoff to pond temporarily on the surface. Before filtering through vegetation and underlying soils.	✗	Site layout unsuitable.
Infiltration Basin	Vegetated depressions that store and treat runoff, allowing it to infiltrate into the ground.	✗	Ground conditions unsuitable.
Detention Basin	Vegetated depressions that store and treat runoff.	✗	Site layout unsuitable.
Pond	Permanent pools of water used to facilitate treatment of can also be stored in attenuation zone above pool.	✗	Existing pond located to the west of the site not considered suitable.
Stormwater Wetlands	Permanent pools of water used to facilitate treatment of runoff can also be stored in attenuation zone above pool.	✗	Size of development unsuitable.

Proprietary Device	Subsurface structures designed to provide treatment of runoff.	x	Not considered appropriate
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2.5 Water Quality

The LLFA and LASOO stipulate that water quality should be considered as part of a major application. Where water contaminants are being washed into the drainage network offsite the total pollutant load to the receiving surface water body is potentially high.

By applying the simple index approach stated in Ciria C753 the potential hazard indices for the proposed development are shown below:

Site Hazard Indices						Proposed Mitigation Measure
Land Use	Area (ha)	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons	
Commercial Roof	0.002	Low	0.3	0.2	0.05	N/A
Car Park	0.157	Low	0.5	0.4	0.4	Permeable Paving

	Mitigation Indices		
Type of SUDS Feature	Total Suspended Solids	Metals	Hydrocarbons
Permeable Paving	0.7	0.9	0.9

By comparing the combined SUDS mitigation indices for the proposed SUDS components to the potential hazard indices for this development it is shown that water quality has been considered and mitigated for in accordance with CIRIA C753.

2.6 Exceedance Events

The existing finished floor levels shall remain with external ground levels designed to safely route overland flows away from buildings, using the less vulnerable parts of the proposed development to convey and attenuate / store overland flows.

Overland flows resulting from exceedance events are expected to leave the developed site towards the low-lying north and west of the site, as currently occurs, without posing any increased flood risk on site or elsewhere.

2.7 Maintenance Issues

The sewer network within the development site is to be private and is not proposed to be offered for adoption to United Utilities. The sewer network for the site should be designed to operate at a level required by current best practice as defined within the DCG.

The surface water pipes are designed with a minimum velocity of 1m/s at pipe full flow and with a roughness of 0.6mm. The pipe should provide enough capacity to convey all the surface runoff flows to attenuation and treatment facilities.

A private inspection and maintenance agreement will be required for the onsite drainage, to be conducted in accordance with the maintenance schedules identified in Appendix C.

Regular SUDS scheme inspections will:

- Help determine future maintenance activities.
- Confirm hydraulic, water quality, amenity, and ecological performance.
- Allow identification of potential system failures, e.g. blockage, poor infiltration, poor water quality etc.

During the first year of operation, inspections should ideally be conducted after every significant storm event to ensure proper functioning.

2.8 Safety Issues

Surface water pipework and manholes will be designed in accordance with DCG along with the appropriate building regulations to ensure suitable access for maintenance and operation as required.

2.9 Drainage During Construction

Drainage is typically an early activity in the construction of a development, taking form during the earthworks phase. However, the connection of piped drainage system to SuDS components should not take place until the end of construction works, unless a robust strategy for silt removal prior to occupation of the site is implemented.

Silt-laden runoff from construction sites represents a common form of waterborne pollution and cannot enter SuDS components not specifically designed to manage this, as it can overwhelm the system and pollute receiving water features. Any gullies and piped systems should be capped off during construction and fully jetted and cleaned prior to connection to SuDS components.

The three principal aspects of drainage during construction are conveying runoff, controlling runoff and trapping sediments:

- Conveyance of runoff can be achieved through small ditches / swales, channels and drains. Runoff control measures should be implemented to ensure that runoff does not overwhelm the temporary drainage system causing flooding on site or elsewhere.
- Control of runoff can be achieved through perimeter ditches or appropriate grading to ensure that any runoff from the construction site stays on site. Runoff rates leaving the site should be managed so they do not exceed pre-development conditions.
- Construction runoff should be directed to dedicated infiltration basins with adequate upstream sediment and pollution control such as sediment basins, silt fences and straw bales prior to infiltration or off-site discharge.

Additional conveyance, control, and treatment measures should be installed as needed during grading. Slope stability needs to be considered when using open water features to convey, control and treat runoff across the site. Any necessary surface stabilisation measures should be applied immediately on all disturbed areas where construction work is either delayed or incomplete. Maintenance inspections should be performed weekly, and maintenance repairs should be made immediately after periods of rainfall.

All drainage infrastructure (namely underground features) must be protected from damage by construction traffic and heavy machinery through the implementation of measures such as protective barriers and storing construction materials away from the drainage infrastructure.

2.10 Surface Water Drainage Summary

Based on the investigation carried out to date, the surface water drainage strategy can be summarised as:

- Flows from the rooftops, roads, footpaths, and all hard-standing areas and conveyed via gravity.
- All flows will be conveyed by the drainage network and will not infiltrate into the ground.
- Flows will be drained to a new surface water network which in turn will discharge to the unnamed watercourse north of the site.
- A flow control device will restrict flows from the site to 3.1l/s
- No surcharge for the 1 in 1-year
- No flooding for the 1 in 30-year
- No building, third party land or access road flooding for the 1 in 100-year event + 50% CC

3.0 Foul Water Drainage

3.1 Site Location and Description

The foul water from the existing development currently drains to a septic tank. It is proposed to retain this arrangement subject to confirmation that the current system complies with the general binding rules.

It is not anticipated that there will be any trade effluent requirements from the site.

3.2 Maintenance Issues

The sewer network within the development plots is to be private and is not proposed to be offered for adoption to UU. The sewer network for the site should be designed to operate at a level required by current best practice as defined within the DCG.

The foul pipes should be designed to provide a self-cleansing regime with a minimum flow velocity of 0.75m/s at one-third design flow. Gradients should be restricted to no steeper than 1:10 to comply with safety standards.

3.3 Safety Issues

Foul water pipework and manholes will be designed in accordance with DCG along with the appropriate building regulations so as to ensure suitable access for maintenance and operation as required.

4.0 Conclusion

The drainage strategy has been produced for the proposed development on the site of Florence Arts Centre, Egremont. This report has been produced to present the drainage proposals for the development and document the underlying analysis, as required by the local authority planning process. The drainage strategy has been produced in accordance with the applicable regulatory framework and relevant best practice guidance, as set out within the report.

Ground conditions at the site are not considered to be permeable making infiltration drainage unfeasible at the development. The watercourse to the north of the site is considered to be a feasible location to discharge flows. Surface water runoff will therefore be discharged, via appropriate treatment, to the existing watercourse.

It is proposed that surface water discharge will be restricted to 3.1l/s using a flow control device in accordance with the agreed upon drainage plan for the greater site.

Foul drainage from the proposed development is to be discharged, via a foul water treatment plant, to the unnamed watercourse north of the site.

5.0 Design Standards

The following methodology was used to produce a SUDS strategy:

- BS EN 725:2008 – Drain and sewer systems outside buildings
- BS EN 12056-2:2000 – Gravity drainage systems inside buildings. Sanitary pipework, layout, and calculation
- SuDs Manual (CIRIA C753) 2015
- Building Regulations Approved Document Part H 2010 (With 2015 Amendments) Drainage and waste disposal
- National Building Specification
- GPP 3 – Use and design of oil separators in surface water drainage systems
- Civil Engineering Specification for the Water Industry (8th Edition)
- Design and Construction Guidance for foul and surface water sewers (2021)
- BRE Digest 365

Appendix A – Proposed Drainage Arrangement



Do not scale from drawings unless by agreement with Architect/Engineer. Work to figured dimensions only. Check all dimensions on site prior to commencing the works. Drawings to be read in conjunction with other relevant consultant information. Where any discrepancy is found to exist it should be reported to the Architect/Engineer immediately.

DRAINAGE LEGEND

- PROPOSED STORM SEWER AND MANHOLE
- PROPOSED PERMEABLE PAVING
- PROPOSED GRASSCRETE
- 600mm DIA. PRIVATE INSPECTION CHAMBER. TO BE USED WHERE DEPTH TO INVERT IS 3000mm OR LESS. REDUCED ACCESS FITTING REQUIRED AT DEPTHS GREATER THAN 1200mm
- 150mm DIA. WRAPPED PERFORATED PIPE C/W PERMAVOID DIFFUSER O.S.A. FOR PERMEABLE PAVEMENT (TYPE B).

NOTE:
ALL PRIVATE DRAINAGE TO BE 100mm RIGID PIPE OR 110mm FLEXIBLE PIPE UNLESS OTHERWISE SHOWN. PIPEWORK TO BE PVC-U UNLESS OTHERWISE STATED. ALL DRAINAGE / PIPE WORK TO BE INSTALLED IN ACCORDANCE WITH BUILDING REGULATIONS APPROVED DOCUMENT PART H 2010 AND RELATIVE GUIDANCE DOCUMENTS, MANUFACTURERS INSTALLATION & GUIDANCE LITERATURE AND NOTES.

GENERAL NOTES:

1. THIS DRAWING IS BASED ON ORDNANCE SURVEY AND TOPOGRAPHICAL SURVEY INFORMATION RECEIVED. WE CAN ACCEPT NO LIABILITY FOR DESIGN BASED ON INFORMATION RECEIVED.
2. THIS DESIGN HAS BEEN CARRIED OUT TO APPROPRIATE STANDARDS BUT IT IS TO BE CHECKED IN ACCORDANCE WITH PROCUREMENT AND REQUIREMENTS PRIOR TO THE COMMENCEMENT OF WORKS.
3. ALL LEVELS, DIMENSIONS AND DETAILS TO BE CONFIRMED BY THE CONTRACTOR PRIOR TO THE COMMENCEMENT OF CONSTRUCTION OR FABRICATION.
4. NO EXISTING BELOW GROUND CONDITIONS HAVE BEEN PROVIDED. THEREFORE, ALL INFORMATION IS TO BE VERIFIED FURTHER TO ANY SITE WORKS.
5. NO EXISTING SERVICES INFORMATION HAVE BEEN PROVIDED. THEREFORE, ALL INFORMATION IS TO BE VERIFIED FURTHER TO ANY SITE WORKS.
6. EXISTING GROUND LEVELS AND GROUND PROFILES HAVE BEEN TAKEN FROM THE INFORMATION PROVIDED AND AS SUCH ARE TO BE VERIFIED BY THE CONTRACTOR PRIOR TO THE COMMENCEMENT OF WORKS. ANY DISCREPANCIES TO BE BROUGHT TO THE ATTENTION OF THE ENGINEER.

HEALTH & SAFETY AND CDM:

(THE FOLLOWING ARE TO BE READ IN CONJUNCTION WITH CONTRACTORS RISK ASSESSMENTS)

7. CONTRACTOR TO UNDERTAKE ALL POSSIBLE PRECAUTIONS WHEN EXCAVATING. ALL EXISTING SERVICES INFORMATION TO BE OBTAINED PRIOR TO THE COMMENCEMENT OF WORKS AND IDENTIFIED ON SITE USING CAT SCANNERS. EXCAVATION TO BE UNDERTAKEN WITH DUE DILIGENCE AND HAND DIGGING TO BE ADOPTED WHERE APPROPRIATE.
8. CONTRACTOR TO MINIMISE THE AMOUNT OF TIME ANY EXCAVATIONS REMAIN EXPOSED AND COMPLY WITH LEGISLATIVE AND GOOD PRACTICE GUIDELINES.
9. ALL TASKS TO BE UNDERTAKEN BY SUITABLY TRAINED AND EXPERIENCED OPERATIVES FOLLOWING APPROVED METHOD STATEMENTS WITH ADEQUATE RESOURCE ALLOCATED TO EACH TASK.
10. FOR ANY WORK REQUIRING COMPACTING OF MATERIALS AND CONCRETE, PERSONNEL TO USE SUITABLE PPE AND USE ONLY LOW VIBRATION EQUIPMENT. AMOUNT OF TIME OF USE TO BE LIMITED TO SAFE LEVELS IN ACCORDANCE WITH CONTRACTORS APPROVED METHOD STATEMENTS.
11. APPROPRIATE MANAGEMENT SAFETY PLAN TO BE IN PLACE FOR DEALING WITH POTENTIAL GROUND CONTAMINATION.
12. IN ORDER TO ENSURE THAT THE SIDE EXCAVATIONS REMAIN STABLE DURING EXCAVATIONS, CONTRACTOR TO ASSESS STABILITY AND PROVIDE TEMPORARY SHORING TO ENSURE SAFE WORKING AREA.

Revision	Date	Drawn	Description
PI	18/12/25	JFH	Initial Issue

Client & Project

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Address

Florence Arts Centre
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Drawing Title

Proposed Drainage Arrangement

Status / Stage	Sheet	Scale @ A1	Drawn	Checked
S2	1 of 1	1:200	JFH	AW

Drawing Number

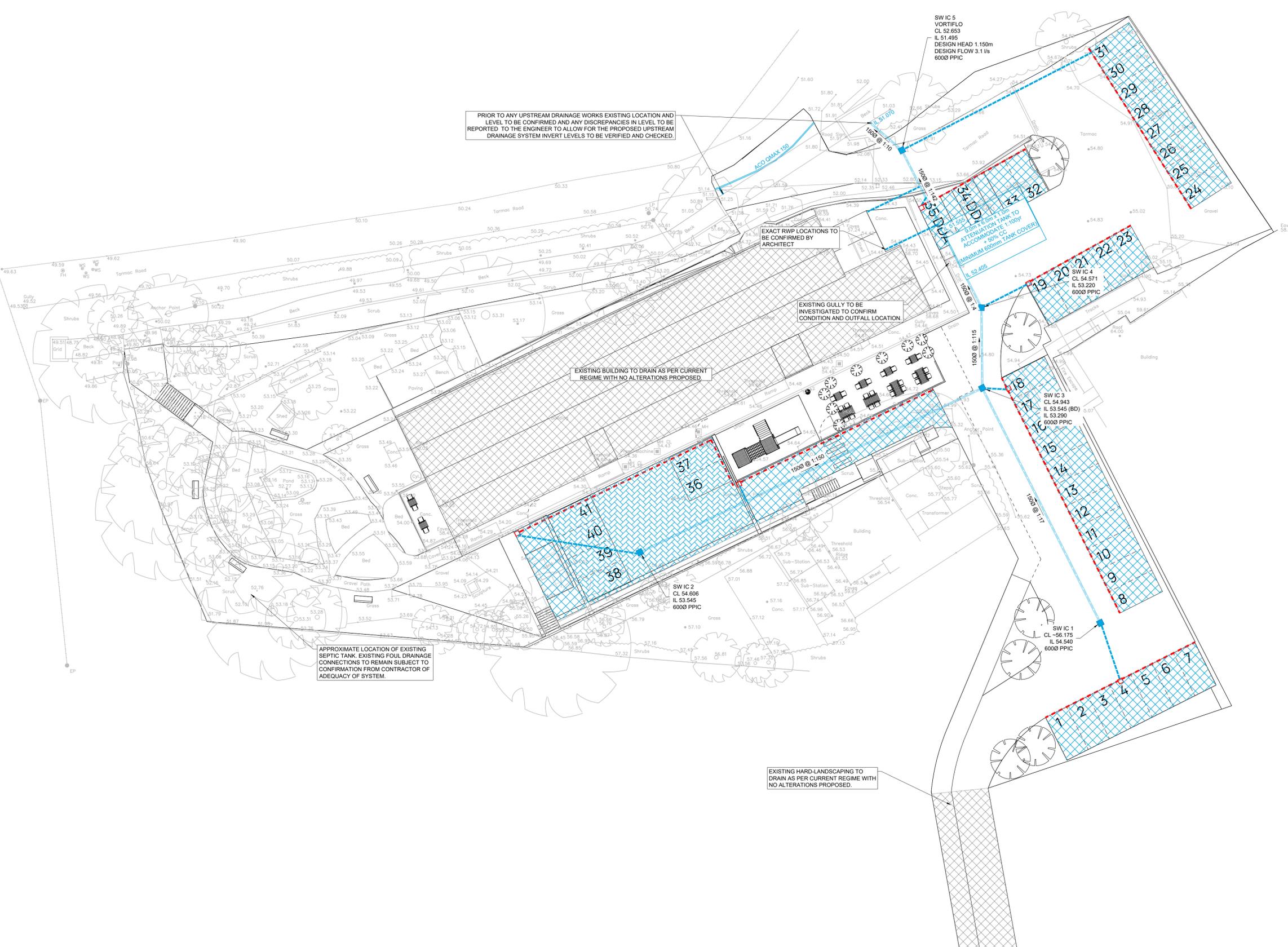
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Appendix B – Proposed Drainage Calculations

BDN Ltd		Page 1
The Old School Simpson Street Sunderland SR4 6DR	Florence Arts Centre Egremont, Cumbria CA22 2NR	
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Innovyze	Network 2020.1.3	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	16.700	Add Flow / Climate Change (%)	0
Ratio R	0.269	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	26.352	1.580	16.7	0.027	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.000	38.175	0.255	149.7	0.031	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	8.075	0.070	115.4	0.029	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	8.878	0.815	10.9	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	8.878	0.060	148.0	0.002	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	4.257	0.425	10.0	0.070	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.18	55.125	0.027	0.0	0.0	0.0	2.48	43.8	3.6
2.000	50.00	5.78	53.545	0.031	0.0	0.0	0.0	0.82	14.5	4.1
1.001	50.00	5.92	53.290	0.086	0.0	0.0	0.0	0.93	16.5	11.7
1.002	50.00	5.97	53.220	0.086	0.0	0.0	0.0	3.07	54.3	11.7
1.003	50.00	6.15	51.555	0.088	0.0	0.0	0.0	0.82	14.6	12.0
1.004	50.00	6.17	51.495	0.159	0.0	0.0	0.0	3.20	56.6	21.5

BDN Ltd		Page 2
The Old School Simpson Street Sunderland SR4 6DR	Florence Arts Centre Egremont, Cumbria CA22 2NR	
Date 18/12/2025 10:08 File S4726-BDN-XX-XX-CA-C-00...	Designed by JFH Checked by AW	
Innovyze	Network 2020.1.3	

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.027	0.027	0.027
2.000	User	-	100	0.031	0.031	0.031
1.001	User	-	100	0.029	0.029	0.029
1.002	-	-	100	0.000	0.000	0.000
1.003	User	-	100	0.002	0.002	0.002
1.004	User	-	100	0.070	0.070	0.070
				Total	Total	Total
				0.159	0.159	0.159

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.004		51.622	51.070	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1
Number of Input Hydrographs	0	Number of Storage Structures	6
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	16.700	Storm Duration (mins)	30
Ratio R	0.269		

BDN Ltd		Page 3
The Old School Simpson Street Sunderland SR4 6DR	Florence Arts Centre Egremont, Cumbria CA22 2NR	
Date 18/12/2025 10:08 File S4726-BDN-XX-XX-CA-C-00...	Designed by JFH Checked by AW	
Innovyze	Network 2020.1.3	

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 5, DS/PN: 1.004, Volume (m³): 1.4

Unit Reference	MD-SHE-0082-3100-1150-3100
Design Head (m)	1.150
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	51.495
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.150	3.1
Flush-Flo™	0.344	3.1
Kick-Flo®	0.706	2.5
Mean Flow over Head Range	-	2.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)						
0.100	2.4	1.200	3.2	3.000	4.8	7.000	7.2
0.200	2.9	1.400	3.4	3.500	5.2	7.500	7.4
0.300	3.1	1.600	3.6	4.000	5.5	8.000	7.7
0.400	3.1	1.800	3.8	4.500	5.8	8.500	7.9
0.500	3.0	2.000	4.0	5.000	6.1	9.000	8.1
0.600	2.8	2.200	4.2	5.500	6.4	9.500	8.3
0.800	2.6	2.400	4.4	6.000	6.7		
1.000	2.9	2.600	4.5	6.500	7.0		

BDN Ltd		Page 4
The Old School Simpson Street Sunderland SR4 6DR	Florence Arts Centre Egremont, Cumbria CA22 2NR	
Date 18/12/2025 10:08 File S4726-BDN-XX-XX-CA-C-00...	Designed by JFH Checked by AW	
Innovyze	Network 2020.1.3	

Storage Structures for Storm

Porous Car Park Manhole: 1, DS/PN: 1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.8
Membrane Percolation (mm/hr)	1000	Length (m)	4.8
Max Percolation (l/s)	22.4	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.775	Membrane Depth (mm)	100

Porous Car Park Manhole: 2, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	17.4
Membrane Percolation (mm/hr)	1000	Length (m)	17.4
Max Percolation (l/s)	84.1	Slope (1:X)	4.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	54.195	Membrane Depth (mm)	100

Porous Car Park Manhole: 3, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	26.4
Membrane Percolation (mm/hr)	1000	Length (m)	4.8
Max Percolation (l/s)	35.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	54.540	Membrane Depth (mm)	100

Porous Car Park Manhole: 4, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	12.0
Membrane Percolation (mm/hr)	1000	Length (m)	4.8
Max Percolation (l/s)	16.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	54.170	Membrane Depth (mm)	100

Cellular Storage Manhole: ATT, DS/PN: 1.003

Invert Level (m)	51.555	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	54.0	0.0	0.600	54.0	0.0
0.100	54.0	0.0	0.700	54.0	0.0
0.200	54.0	0.0	0.800	54.0	0.0
0.300	54.0	0.0	0.900	54.0	0.0
0.400	54.0	0.0	1.000	54.0	0.0
0.500	54.0	0.0	1.100	0.0	0.0

BDN Ltd		Page 5
The Old School Simpson Street Sunderland SR4 6DR	Florence Arts Centre Egremont, Cumbria CA22 2NR	
Date 18/12/2025 10:08 File S4726-BDN-XX-XX-CA-C-00...	Designed by JFH Checked by AW	
Innovyze	Network 2020.1.3	

Cellular Storage Manhole: ATT, DS/PN: 1.003

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
1.200	0.0	0.0	1.900	0.0	0.0
1.300	0.0	0.0	2.000	0.0	0.0
1.400	0.0	0.0	2.100	0.0	0.0
1.500	0.0	0.0	2.200	0.0	0.0
1.600	0.0	0.0	2.300	0.0	0.0
1.700	0.0	0.0	2.400	0.0	0.0
1.800	0.0	0.0	2.500	0.0	0.0

Porous Car Park Manhole: 5, DS/PN: 1.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	31.4
Membrane Percolation (mm/hr)	1000	Length (m)	4.8
Max Percolation (l/s)	41.9	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.250	Membrane Depth (mm)	100

BDN Ltd		Page 8
The Old School Simpson Street Sunderland SR4 6DR	Florence Arts Centre Egremont, Cumbria CA22 2NR	
Date 18/12/2025 10:08 File S4726-BDN-XX-XX-CA-C-00...	Designed by JFH Checked by AW	
Innovyze	Network 2020.1.3	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coefficient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 6
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.269
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 16.400 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600,
720, 960, 1440
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 50

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	15 Winter	100	+50%					55.181
2.000	2	15 Winter	100	+50%	100/15 Summer				53.981
1.001	3	15 Winter	100	+50%	30/15 Winter				53.778
1.002	4	15 Winter	100	+50%					53.315
1.003	ATT	240 Winter	100	+50%	30/15 Summer				52.649
1.004	5	240 Winter	100	+50%	1/15 Summer				52.644

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m ³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.094	0.000	0.30	6	12.3	OK	
2.000	2	0.286	0.000	0.90	4	12.6	SURCHARGED	
1.001	3	0.338	0.000	2.41	6	34.6	SURCHARGED	
1.002	4	-0.055	0.000	0.72	6	34.3	OK	
1.003	ATT	0.944	0.000	0.22		2.8	SURCHARGED	
1.004	5	0.999	0.000	0.08	117	3.1	FLOOD RISK	

Appendix C – Typical Maintenance Schedule

Drainage Maintenance Schedule

Maintenance of all drainage features not adopted by the local water authority will be the responsibility of the landowner or site operator and will need to be carried out by a competent contractor.

As required by CDM 2015 designs have been produced to ensure that all maintenance risks have been identified, eliminated, reduced and/ or controlled where appropriate.

Any manufacturer specific maintenance requirements are to be included as part of the site health and safety file.

Sewerage Maintenance Schedule

Drainage maintenance schedule covers collection gully's, pipework, and chambers.

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Removal of blockages to surface collection features and removal of silt from catch pits.	Annually, after autumn leaf fall or based on as required based on site specific observations.
Monitoring	Initial inspection.	Monthly for three months after installation.
	Inspect attenuation crates and flow control device – if required take remedial action.	Six-monthly.
	Inspect all drainage features.	Annually.
Remedial Actions	Cleansing of drainage features via rodding of jetting.	As required.

Permeable Pavement Maintenance Schedule:

Maintenance Schedule	Required Action	Typical Frequency
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 manufacturers recommendations – pay particular attention

		to areas where water runs onto pervious pavement from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator 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 50mm 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 replace lost jointing material.	As required.
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10-15 years or as required (if infiltration performance is reduced due to significant clogging).
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.

Appendix D – Vortiflo Specification

Product Type:

Vortex Flow Control Chamber

Model: **VFBC600**

600mm diameter, pre-assembled vortex flow control chamber, delivered ready to install. This model has a rotational moulded chamber base with 160mm or 225mm main pipework connections including two further 110mm, 160mm or 225mm side inlets at 90°, 270° from the outlet at 0°. Inlets are supplied as blanked ends that can be used as required.

Application

- Above ground access for inspection and maintenance of surface water pipe systems.
- Maximum installation depth to soffit of pipe of 3000mm.
- Designed for large housing or commercial developments.

Built to the following standards

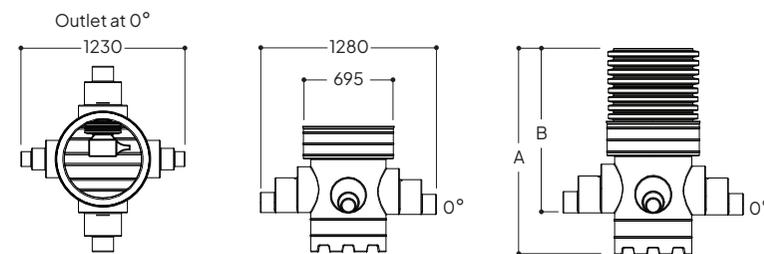
- Design & Construction Guidance (DCG) – Section C7.12
- CIRIA 753 10.2, 20.5 Compliance
- BS 8582 - 9.6

Features

- Single piece, pre-assembled chambers.
- Durable rotational moulded LLDPE base - chemical and impact resistant.
- 300mm sump depth.
- Profiled base which improves overall strength.
- Five standard depths available.
- Access shafts can be easily cut on-site to the required depth if needed.
- Chambers can be installed in granular backfill.

Quality Assurance

Before leaving our factory, chambers are tested in accordance to required standards.

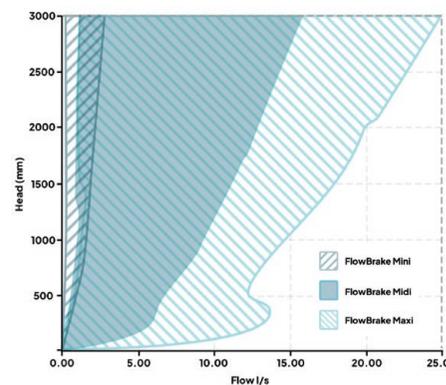


Model ref.	Main Pipework Connections Ø (mm)	Optional Side Inlets Ø (mm)	Overall Depth A (mm)	Inlet Invert B (mm)	Approx. Weight (kg)
VFBC600B/1	160, 225, 300*	110, 160, 225	1075	740	20
VFBC600B/1.5	160, 225, 300*	110, 160, 225	1555	1220	31
VFBC600B/2	160, 225, 300*	110, 160, 225	1945	1610	40
VFBC600B/2.4	160, 225, 300*	110, 160, 225	2335	2000	48
VFBC600B/3	160, 225, 300*	110, 160, 225	3005	2670	57

- Chambers over 1000mm soffit depth require our reduction/restriction caps to meet DCG.
- Inlet Invert measurements accurate to main inlet spigot. This measurement will vary depending on pipework used.
- We provide a range of adaptors to connect to various pipework dimensions and pipework types including Marley Quantum, Polysewer and UltraRib.
- *300mm twinwall connection only available on one inlet.

Vortex Flow Control – FlowBrake Technology

Our FlowBrake's are a collection of units that have varying sizes and dimensions to suit your specific application. The FlowBrake range can come as stand-alone units or as a complete flow control chamber.



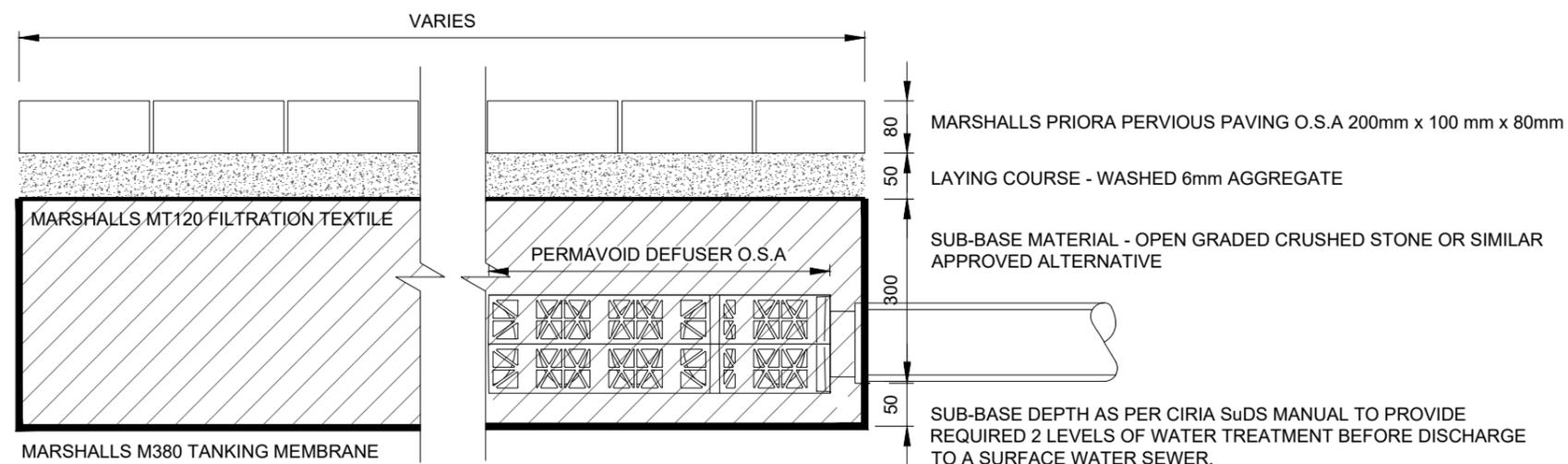
The graph opposite highlights the full range of flows available from the entire FlowBrake range, if a larger flow rate is required than the one applicable within this chamber, a larger chamber may be required. The VFBC600 features the FlowBrake Mini or the FlowBrake Midi, these versions of the FlowBrake have a range of flow rates up to 15 litres per second depending on the design head of the system.

For a detailed performance sheet tailored to your own application please get in contact with us.

Appendix E – Proposed SuDS Details

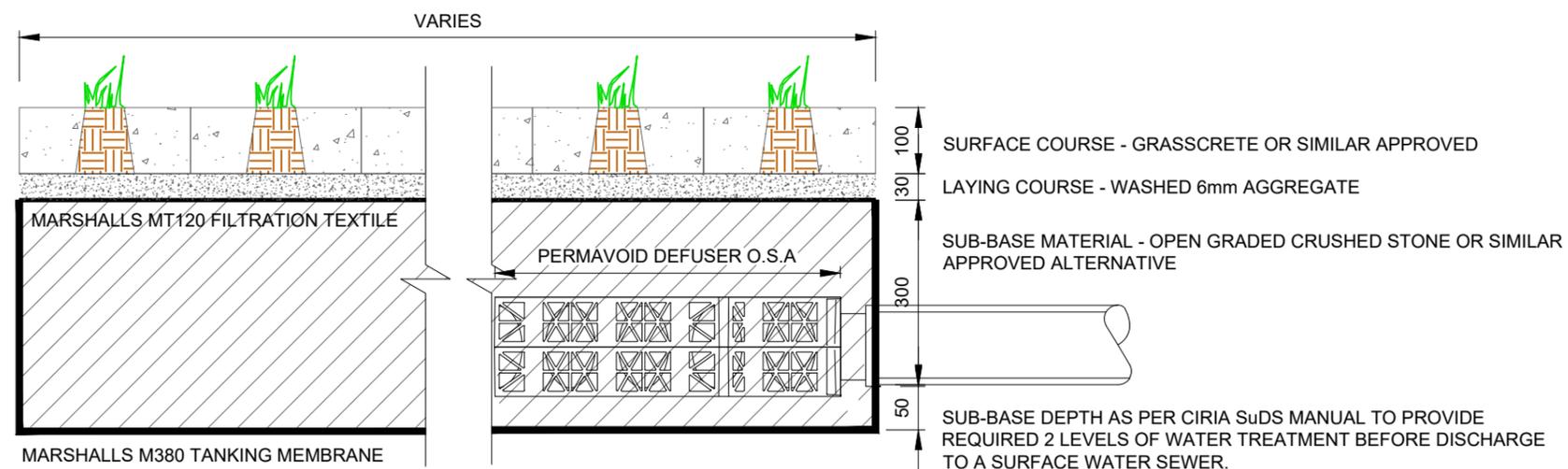


Do not scale from drawings unless by agreement with Architect/Engineer. Work to figured dimensions only. Check all dimensions on site prior to commencing the works. Drawings to be read in conjunction with other relevant consultant information. Where any discrepancy is found to exist it should be reported to the Architect/Engineer immediately.



PERMEABLE PAVING CAR PARKING BAYS

Scale 1:10



GRASSCRETE CAR PARKING BAYS

Scale 1:10