RAINCLOUD

WALPOLE BESS

SUDS STRATEGY

DECEMBER 2024

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CONTROL SHEET

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Site ID	Prepared by	Signature	Date	Version	Comment
062	Liam Nevins BSc hons MCIWEM C.WEM		12/12/2024	2-1	Minor updates following review

RAINCLOUD

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RAINCLOUD

1 EXECUTIVE SUMMARY

The Proposed Development involves the installation of approximately 0.81 ha of impermeable hardstanding at the BESS compound.

Infiltration is not feasible due to the presence of clays and shallow groundwater at the Site.

A detention basin will be used to provide approximately 595 m^3 storage for the 1 % AEP critical storm, plus a 25 % uplift for climate change, discharging to a drainage ditch at Q_{BAR} 1.2 l/s for the positively drained area.

The SuDS design has been checked against the 1 % AEP event + 40 % climate change allowance and there is 1 % headroom for the critical storm.

The detention basin in the BESS Compound will be used to contain fire suppression water in the rare event of a battery fire. The storage required for a firefighting event is 228 m^3 and therefore the detention basin is oversized for spent fire-fighting run-off.

The Proposed Development will therefore be compliant with the requirements of Paragraphs 167 and 169 of the National Planning Policy Framework, Planning Practice Guidance, FSCC Guidance, the LCC Guidance, Policy 3: Design of New Development, Policy 4: Approach to Flood Risk, Policy 31: Climate Change and Renewable and Low Carbon Energy of the Local Plan and the SuDS Manual 2015.

2 INTRODUCTION

2.1 Background

Raincloud Consulting Ltd ('Raincloud') has been commissioned to undertake a Sustainable Drainage System Strategy ('SuDS Strategy') for the proposed Walpole Battery Energy Storage System (BESS) ('the Proposed Development') on land within the existing Sutton Bridge Solar Farm ('the Site'). The Site lies to the east of the River Nene and 500 m south-east of Sutton Bridge Power Station, approximately 1.25 km south and east of the village of Sutton Bridge.The Proposed Development is for a BESS with associated infrastructure and equipment including fencing, security cameras, cabling and access tracks, SuDS and biodiversity net gain provisions. The Point of Connection (PoC) into the electricity grid is via the existing Sutton Bridge Solar Farm substation.

The full description of the Proposed Development is provided in the Planning, Design and Access Statement which accompanies the planning application.

2.2 Guidance and Policy

The Development is located wholly within the jurisdiction of the South Holland District Council (the Council).

This document is intended to meet the requirements of:

- National Planning Practice Guidance (2014) (as amended 2022);
- The revised National Planning Policy Framework (as amended 2023);
- The Environment Act (2021);
- Non-Statutory Technical Standards for Sustainable Drainage Systems (2015);
- Environment Agency (EA) - Rural Sustainable Drainage Systems (RSuDS)[1];
- EA - Pollution Prevention Guidelines (PPG) Controlled Burn: PPG28 (archived but still relevant);
- CIRIA - Containment systems for the prevention of pollution. Secondary, tertiary and other measures for industrial and commercial premises (C736) (2014);
- National Fire Chiefs Council (NFCC) – Grid Scale Battery Energy Storage System planning – Guidance for FRS[2] (2022);
- NFPA 855 Standard for the Installation of Stationary Energy Storage Systems[3];
- Department for Business and Trade - UK Battery Strategy (2023)[4]; and
- Lincolnshire County Council (LCC) - Lincolnshire Development Roads and Sustainable Drainage Design Approach 2021 Edition[5].

2.3 Development Description

A full description of the Development can be found in the Planning, Design and Access Statement[6] which accompanies the planning application.

In summary, it will comprise a BESS with associated infrastructure and equipment including fencing, security cameras, cabling and access tracks, SuDS and biodiversity net gain provisions.

The Development will involve the installation of permeable aggregate. The BESS Compound totals approximately 0.811 hectares (ha).

The aggregate access tracks will be semi-permeable. Only occasional maintenance visits will be required, following a short construction period, thereby significantly reducing the potential for compaction over time and maintaining infiltration potential.

[1] https://assets.publishing.service.gov.uk/media/5a7b956b40f0b645ba3c541b/scho0612buwh-e-e.pdf
[2] https://nfcc.org.uk/wp-content/uploads/2023/10/Grid-Scale-Battery-Energy-Storage-System-planning-Guidance-for-FRS.pdf
[3] https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855
[4] https://www.gov.uk/government/publications/uk-battery-strategy
[5] https://www.lincolnshire.gov.uk/downloads/download/62/development-road-and-sustainable-drainage
[6] IC Planning 2024

However, to allow for some compaction of the stone, the aggregate tracks are assessed as 75 % impermeable within this SuDS Strategy.

2.4 Site Characteristics & Local Context

The Site is drained by a Kings Lynn Internal Drainage Board (IDB) drain approximately 40 m north of the BESS Compound, identified as asset ID DRN039G0103, which in turn discharges to the River Nene via Chalk Lane Sluice[7].

Topography at the Site is generally flat and ranges from 3.5 m above ordnance datum (AOD) to 1.8 m AOD, as shown in Plate 1.

Plate 1: Topography at the Site



[7] http://www.wlma.org.uk/uploads/KLIDB_039G_ChalkLane.pdf

3 BESS SUDS STRATEGY

The Proposed Development will drain surface water to an attenuation structure via a piped network and release to the hydrological environment at greenfield rates.

3.1 Geology

BGS mappings[8] shows that the BESS compound is underlain by tidal flat deposits – (clay and silt) and mudstone of the Ampthill Clay Formation, which is classified as an Unproductive Aquifer. The superficial aquifer is designated as Unproductive.

The Soilscapes dataset[9] indicates that superficial cover is classed as "*loamy and clayey soils of coastal flats with naturally high groundwater*".

The Groundwater Vulnerability Map classes the Site as an Unproductive Aquifer.

3.2 Infiltration Potential

Trail pits undertaken by South West Geotechnical (2021) show groundwater was encountered in the three borehole logs closest to the Proposed Development at a depth between 2.3 m and 1.25 m BGL.

Plate 2 shows the impeded drainage conditions at the Site.

[8] https://mapapps2.bgs.ac.uk/geoindex/home.html

[9] https://www.data.gov.uk/dataset/26d61739-e05b-420d-8fd0-d11edffa8b27/soilscapes

Plate 2: Impeded drainage at the Site



Due to the impeded drainage conditions at the Site infiltration as a means of surface water disposal should not be promoted as a primary option for the Proposed Development.

Additionally, in the rare event of a battery container fire, the potential for contaminated fire suppression water to enter groundwater and cause pollution also precludes infiltration as a drainage option.

As such, a containment system which utilises a detention basin (underlain by an impermeable membrane) which discharges to a watercourse is the next compliant option with regard to the surface water disposal hierarchy outlined in the SuDS Manual.

The Development will discharge to the unnamed tributary / land drain of the River Nene, approximately 40 m north of the BESS Compound area via a detention basin.

3.3 Rainfall Details and Greenfield Calculations

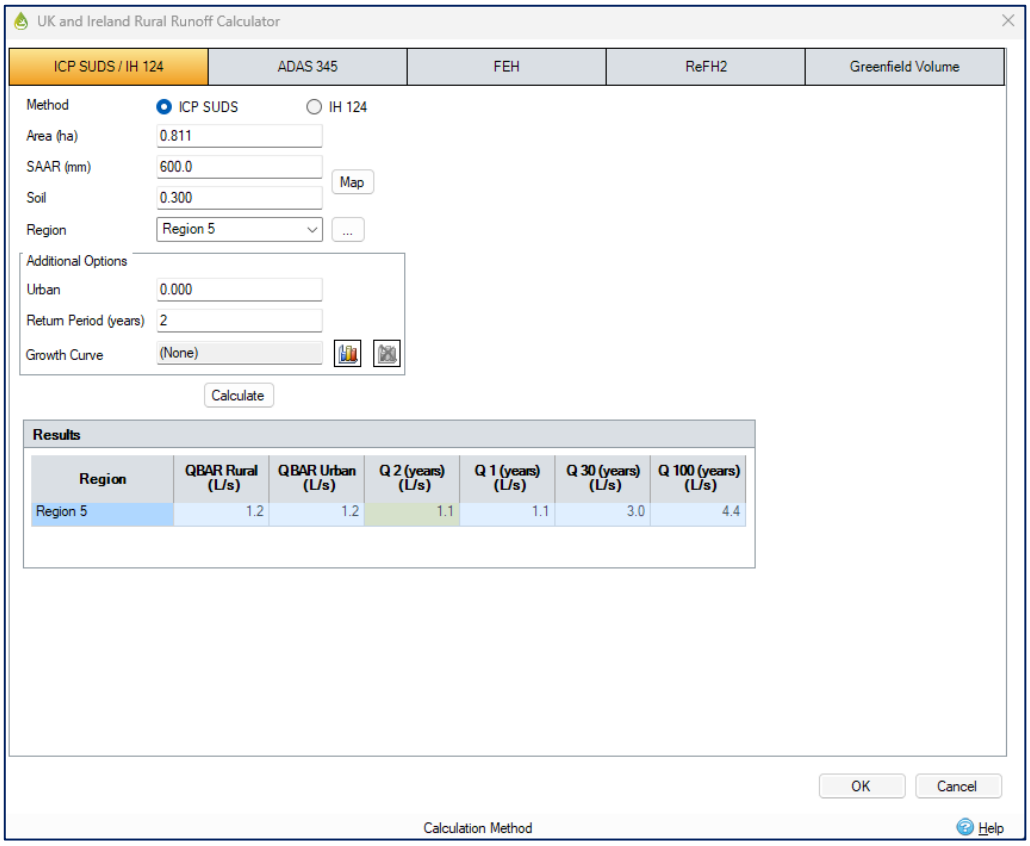
Runoff from the Site shall, in principle, replicate the quality and quantity of the runoff from the Site in its "greenfield" state, in so far as it is reasonable and practicable.

Based on a contributing area of 0.811 ha (the BESS compound area), the existing greenfield average annual flood (Q_{BAR}) runoff from each area was calculated as 1.2 l/s, using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) Mean Annual Flood[10] and

[10] https://www.susdrain.org/files/resources/other-guidance/nswg_icop_for_suds_0704.pdf

Institute of Hydrology (IoH) 124 methods using Info Drainage software, and is shown on Plate 3 and in Appendix B.

Plate 3: Q_{BAR} derived from IoH 124 method



Contributing catchments are shown in Plate 4, while Table 1 outlines the impermeable areas in each catchment.

Plate 4: BESS Compound - Contributing Catchments

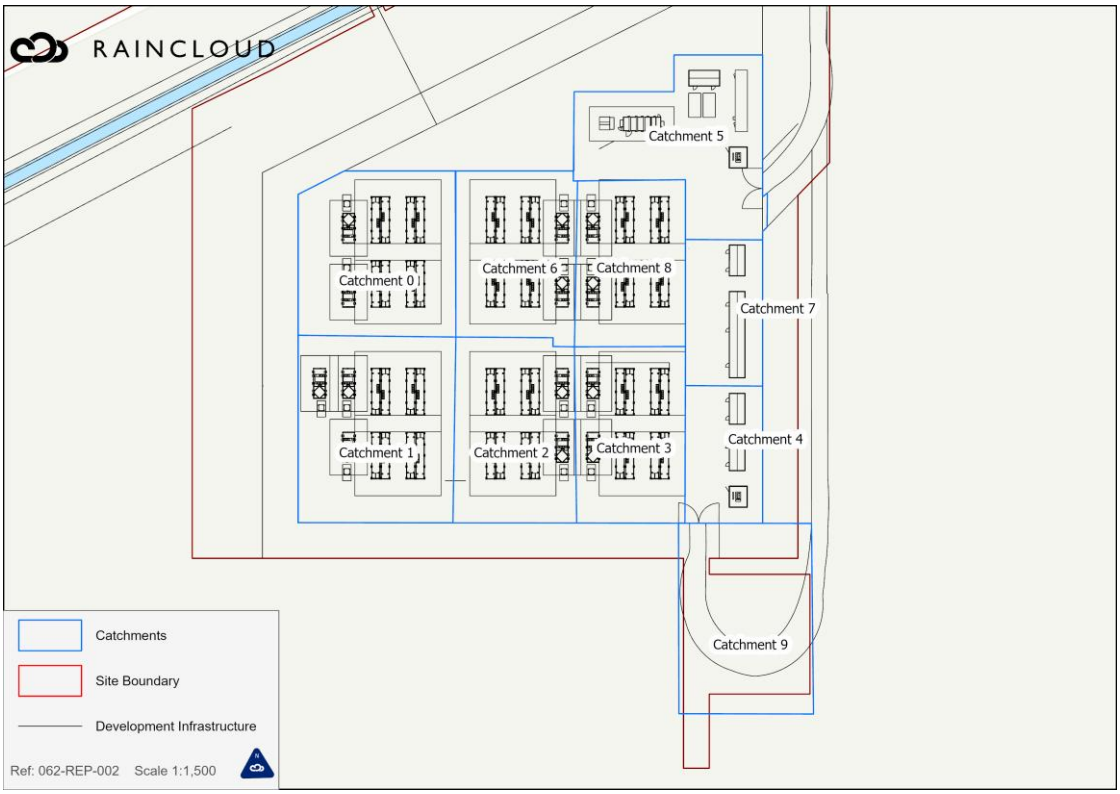


Table 1: Catchment Characteristics

Catchment	Area (ha)	Impermeable Area (ha)	% Impermeable
0	0.1	0.0791	79.1
1	0.114	0.08995	78.9
2	0.087	0.06935	79.7
3	0.076	0.0611	80.4
4	0.042	0.032825	78.2
5	0.097	0.076825	79.2
6	0.079	0.06335	80.2
7	0.044	0.034725	78.9
8	0.071	0.05735	80.8
9	0.1	0.028	28.0
Total	0.81	0.5	

Q_{BAR} has therefore been used to throttle positive discharge from the detention basin.

Rainfall profiles have been derived from Flod Estimation Handbook (FEH) data and a plus 25 % uplift for climate change, using the Central climate change allowance of the EA's Flood risk assessments: climate change allowances Guidance[11], which is outlined in Table 2.

Table 2: Nene Catchment[12] peak rainfall allowances: 2070 Epoch

Return Period	Central Allowance %
3.33 %	25
1 %	25

The SuDS design has also been assessed against the 1 % annual exceedance probability (AEP) + 40 % CC in accordance with *Applying climate change allowances to SuDS design* of the LLFA Guidance.

An Urban Creep allowance has not been applied to calculations as the Development is a commercial site *i.e.* not residential and no further hardstanding areas will be installed during the operational phase.

3.4 Attenuation Volume

A SuDS option which utilises a piped network to drain the BESS Compound and substation areas to a lined detention basin is proposed as a way of attenuating the increase in surface water run-off rates at the Development, with a positive discharge to the existing drainage ditch onsite.

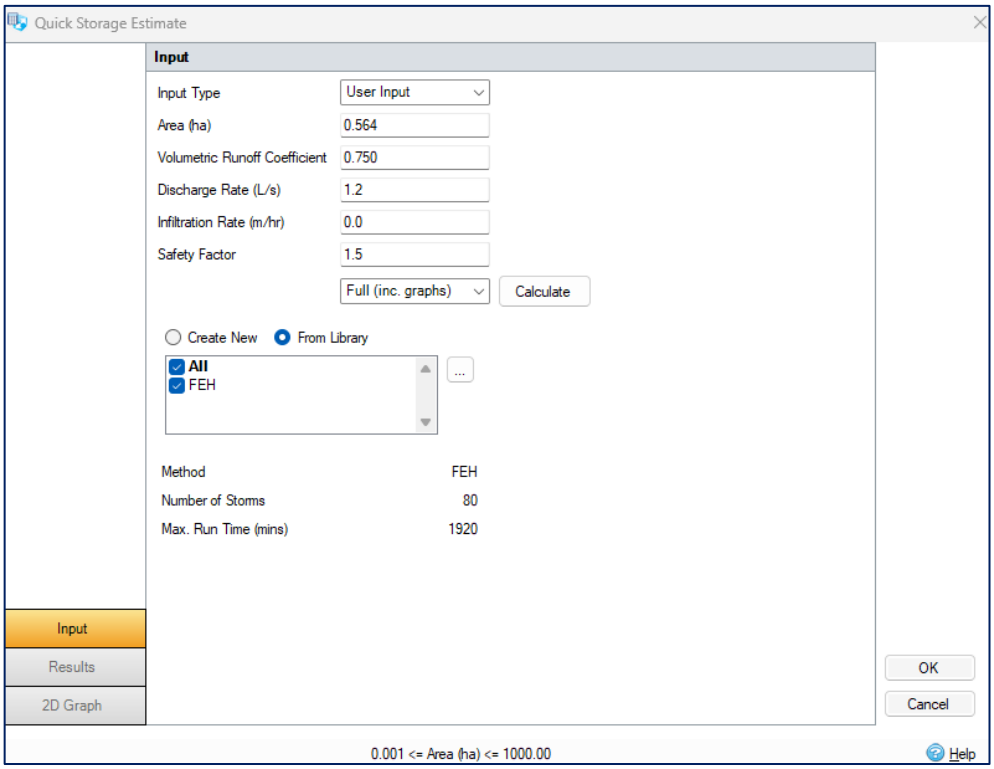
The Site has been divided into ten (10 No) contributing catchments to provide the inflow to the SuDS system. Positively drained areas will connect to manholes via filter drains.

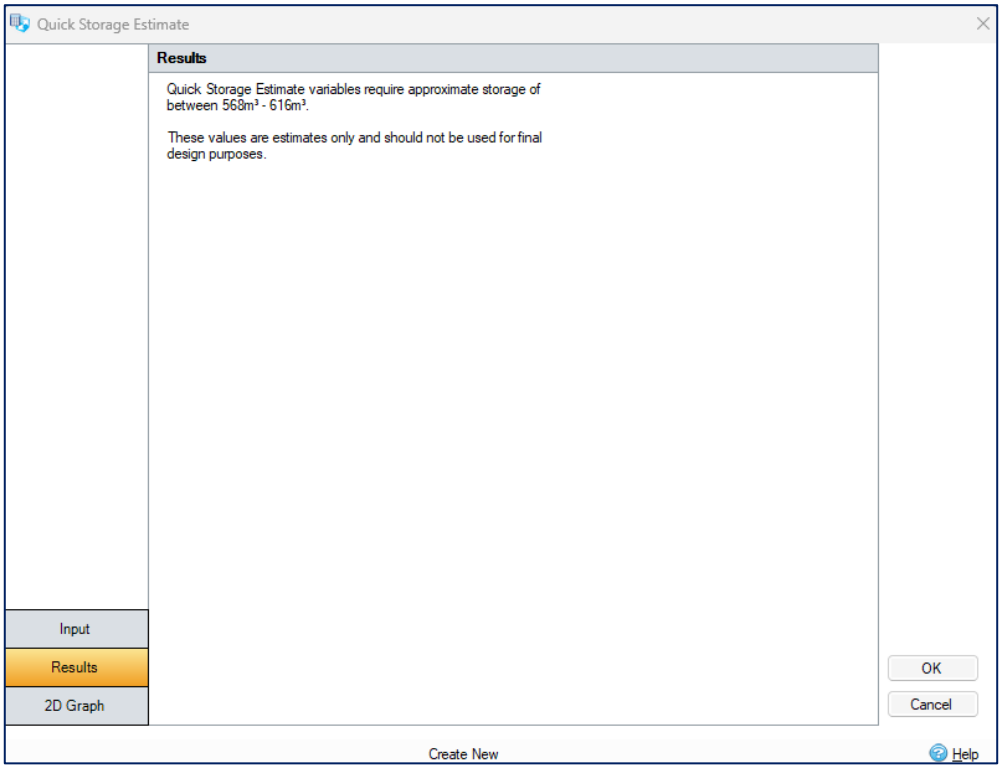
Based on a contributing drainage area of 0.811 ha, FEH rainfall data and Q_{BAR} rate 1.2 l/s, approximately 616 m^3 of storage would be required for the 1 % AEP return period plus 25 % for climate change, as shown in Plate 5.

[11] https://environment-test.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3059

[12] https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3033

Plate 5: InfoDrainage – Quick Storage Estimates



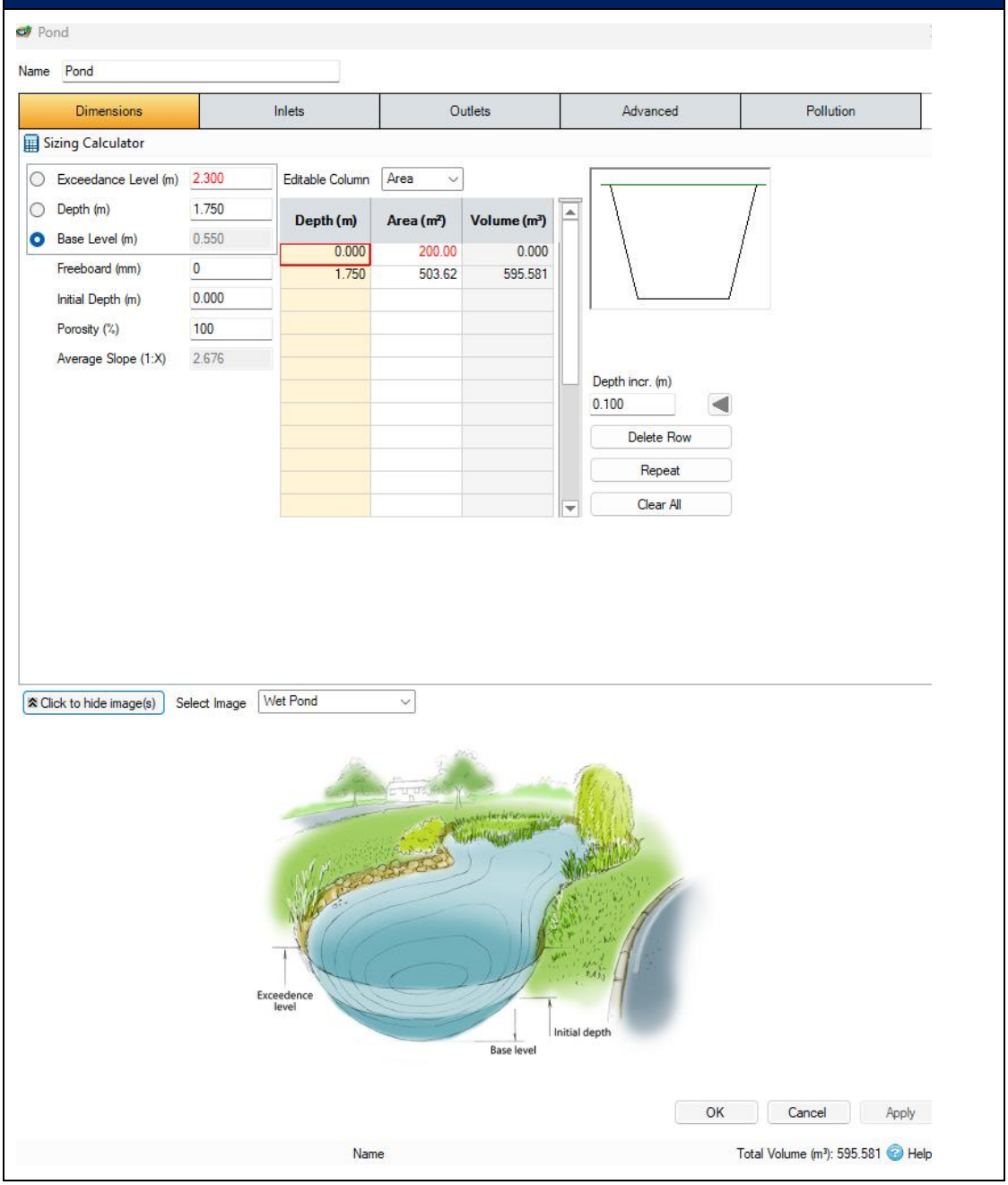


In the rare event of a battery unit fire the NFCC Guidance (November 2022) recommends the ability to capture firewater and not have uncontained releases to the hydrological environment.

A detention basin has therefore been designed with the parameters outlined in Table 3.

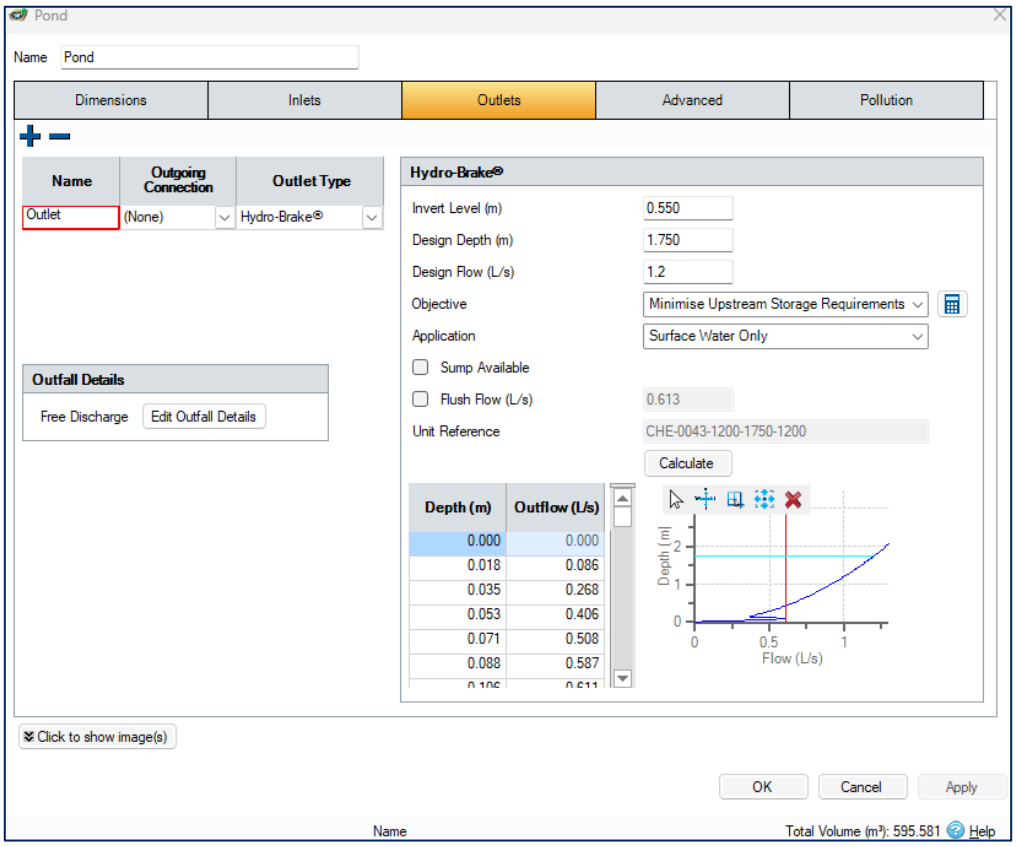
Table 3: Detention basin parameters

BASIN



Discharge will be throttled using a Hydro-Brake® or similar (model to be confirmed – likely to be Hydro-Brake Optimum), as shown in Plate 6.

Plate 6: Hydro-Brake Properties



A penstock will be placed on the outlet and closed in the event of a fire suppression incident (see Section 3)

The outline design parameters have been validated for a number of storm durations, including the critical storm, during the 3.33 % and 1 % AEP events, and the critical event for the return periods is shown in Appendix B of this report.

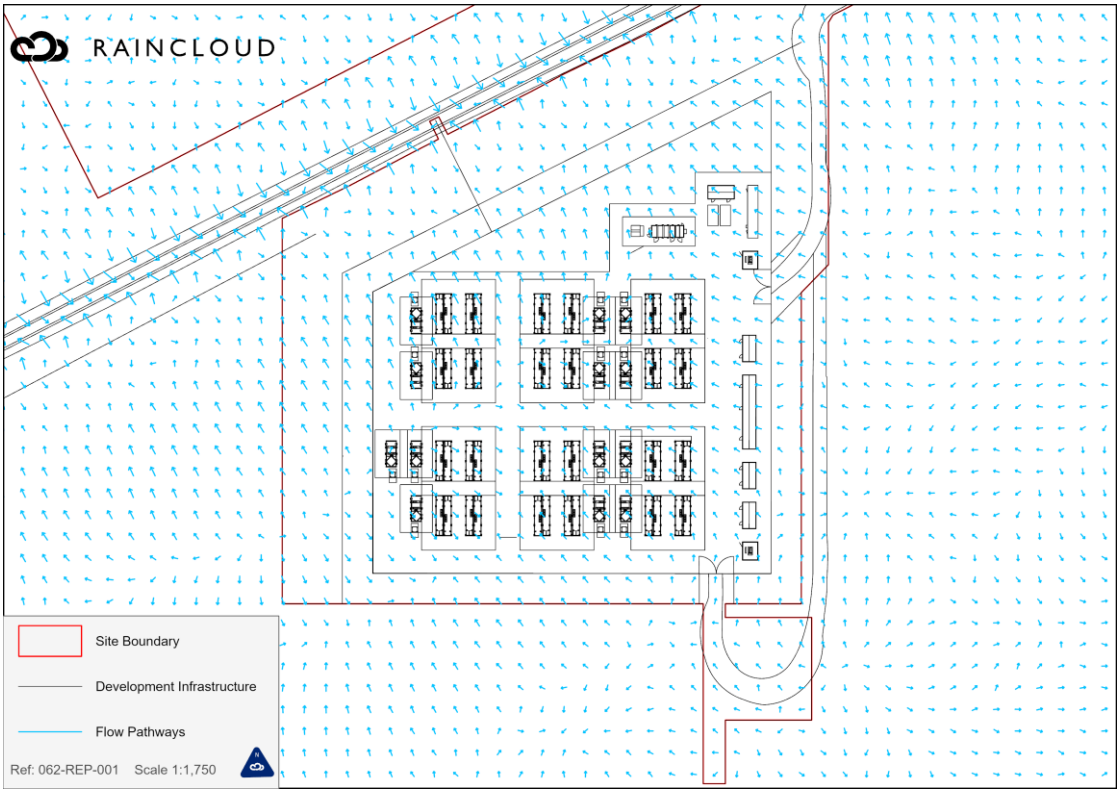
The schematic of the drainage system is shown in Plate 8.

3.5 Overland Flows

Overland flow routes have been produced using a direct deluge model in Info Drainage.

As the Site slopes gently from the south, it is not anticipated that the Development will generate significant overland flows. Plate 7 shows the direction of surface water flow based on 50 mm of direct rainfall, indicated by blue flow arrows.

Plate 7: Baseline Overland Flow direction

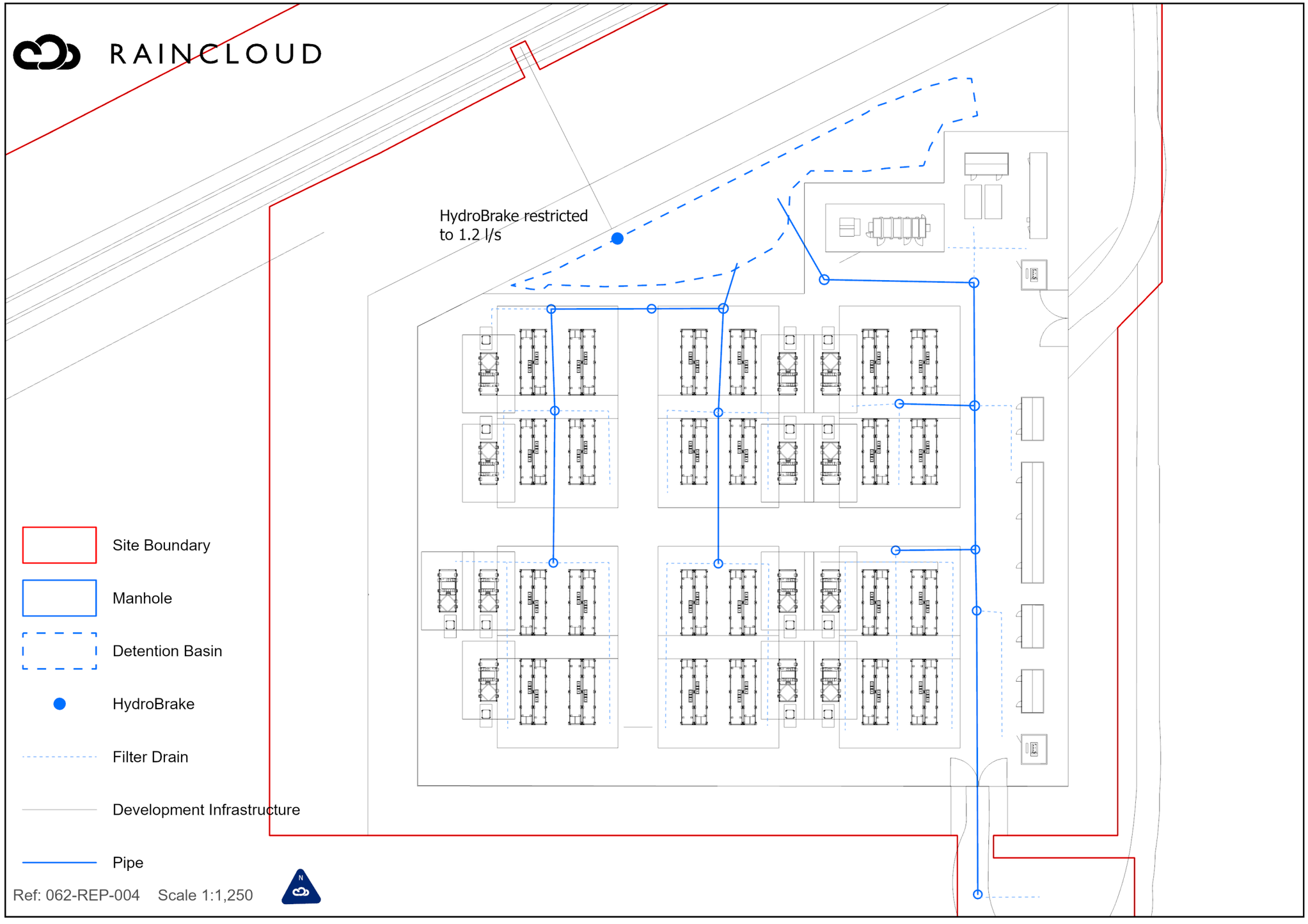


3.6 Source Control Structure

From the model outputs and Site inspection it is concluded that rainfall would drain from the surrounding areas to topographical low points onsite, identified by blue arrows on Plate 7.

As such, the detention basin will be located in the northern section of the BESS Compound, as shown in Plate 8.

Plate 8: Detention Basin and serving pipe network



3.7 Outfall

The outfall from the detention basin area will be to an existing agricultural field drain / ditch (shown in Plate 9) and detailed design of the outfall will be undertaken prior to construction and should form part of a appropriately worded planning condition.

Plate 9: Existing field drain for outfall



As the drain is not a Main River, consent / an Environmental Permit to discharge surface water is not required from the EA.

Consent from the Internal Drainage Board will be obtained prior to the construction phase of the Development.

3.8 The Simple Index Approach (SIA) Tool

As the Development will involve the creation of two car parking spaces for occasional maintenance visits and will involve significantly less than 300 traffic movements per day, Table 26.2 *Pollution hazard indices for different land use classifications* of the SuDS Manual identifies that the Development has a Pollution Hazard Level of Low, '*non-residential car parking with infrequent change (e.g., schools, offices) i.e., < 300 traffic movements/day*', equating to a Land Use Pollution Index of 0.5 (SS), 0.4 (metals) and 0.4 (hydrocarbons).

A SIA has been developed on behalf of the EA (and other Regulators such as the Scottish Environment Protection Agency (SEPA)) to support the implementation of the water quality

management design methods set out in the SuDS Manual, with appropriate cross referencing to the relevant 'Design Conditions' in the tool.

The permeable / porous road and cellular storage will be sufficient to effectively mitigate any suspended solids, metals and hydrocarbons held within surface water at the Proposed Development prior to discharging into the drain outside the Site, as the Aggregated Pollution Mitigation Indices for the run-off area are 0.85 (SS), 0.8 (metals) and 0.95 (hydrocarbons).

As such, the treatment of the surface water run-off will meet the minimum requirements of the pollution mitigation indices outlined in the SIA Tool.

3.9 Responsibilities & Long Term Management

It will be the responsibility of the Development operator to maintain effective drainage measures and rectify drainage measures that are not functioning adequately. A nominated person will also have responsibility for reporting on the functionality of drainage measures.

Where areas remain positively drained through the lifetime of the Development, the SuDS measures serving these areas will be checked on a regular basis. Should drainage measures require dredging or unblocking, this will be undertaken as soon as practicable by a local contractor engaged by the management company.

Table 4 outlines the maintenance schedule for the proposed cellular storage.

Table 4: Long-term Maintenance schedule for a Detention Basin[13]

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Litter removal	As required
	Cut grass – for spillways and access routes	Monthly (during growing season), or as required
	Grass cutting – meadow grass in and around basin	Half yearly (spring, before nesting season, and autumn)
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebay	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually
Occasional Maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial Actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

3.10 Hydrocarbon / Coolant Containment

Bunding for aspects of the Development which require coolant or lubricants will have concrete or lined earth embankments / containment walls with 110 % capacity, similar to components of traditional substations, as shown in Plate 10.

[13] Based on Table 22.1 - Operation and maintenance requirements for detention basins of the SuDS Manual

Plate 10: Typical bunding at substations




The bunds shall have a penstock to ensure that, in the event of non-fugitive leaks, liquids can be contained / isolated from the drainage system.

It is expected that the final dimensions will be confirmed following the detailed design phase and should form part of a appropriately worded planning conditon.

3.11 Construction Phase SuDS

Given the relatively short construction phase and gently sloping site it is not anticipated that significant amounts of sediment will be generated. The Proposed Development will adhere to a Construction Environmental Management Plan ("CEMP" - to be provided by the Construction Contractor), which will comply with the following:

- CIRIA C648 – Control of water pollution from linear construction projects[14];
- CIRIA C352 – Control of water pollution from construction sites[15];
- CIRIA SuDS Manual (C753)[16]; and
- CIRIA Guidance on the construction of SuDS (C768)[17].

Measures are likely to include swales, cut-off ditches and settlement lagoons to limit the potential for sediment laden water to be transferred to the hydrological environment. The CEMP should form part of a suitably worded planning condition.

Drainage measures outlined within this SuDS Strategy should be implemented as soon as practical by the Applicant's Contractor but in any event before the construction of any impermeable surfaces which are proposed to drain into the approved drainage system.

[14] CIRIA (2006) *C648: Control of water pollution from linear construction projects: Technical Guidance* [Online] Available at: https://www.ciria.org/ProductExcerpts/C648.aspx

[15] CIRIA (2001) *C532: Control of water pollution from construction sites: Guidance for consultants and contractors* [Online] Available at: https://www.ciria.org/ProductExcerpts/C532.aspx

[16] CIRIA (2015) *C753: The SuDS Manual*

[17] CIRIA (2017) *C768: Guidance on the construction of SuDS*

Measures such as drainage pipes should be installed at the same time as the excavations, or as soon as practicable thereafter.

4 FIRE WATER CONTAINMENT

4.1 Procedure

The Proposed Development operator will follow the accepted strategy of allowing a battery related fire to self-consume, reducing unnecessary risk of injury to site and firefighting personnel.

Should a fire occur, the affected enclosure will be allowed to self-consume until the fire is extinguished through consumption of the combustible materials within the battery container / enclosure. The firefighting procedure will be to apply water for fire suppression to adjacent BESS enclosures as a way of reducing the temperature of the adjacent containers and reducing the likelihood of the fire spreading.

As water will not be directly applied to affected BESS container, there is reduced potential for suppression water to become contaminated.

Water will be sourced from a tank located at the southern entrance to the BESS Compound which will have a capacity of 230 m^3, as outlined on drawing WAL-EDFR-BESS-ARC-DRG-371.01 of the Planning Application.

The nearest fire hydrant to the Site is located on King John Bank Road, approximately 1.3 km south east of the eastern access point to the Proposed Development.

4.2 Fire Suppressant Volume

Based on recommendations in NFPA 855 Standard for the Installation of Stationary Energy Storage Systems and NFCC – Grid Scale Battery Energy Storage System planning – Guidance for FRS, a burn time of 2 hours and a requirement of 1,900 l/min of fire suppression water has been used to calculate the volume of fire suppressant water required to be stored onsite in the event of a container fire.

This equates to 228 m^3 of water storage.

Given that the detention basin serving the BESS compound (outlined in Section 2.3) has been sized to accommodate 595 m^3, this is sufficient for storing the full fire suppressant water volume, even in the event of an intense or prolonged rainfall event.

A penstock will be placed on the outlet of the cellular storage and would be shut off in the event of a fire suppression event. It would remain closed until testing of the captured water has taken place. Water will then either be removed offsite by tankers to a licenced facility or discharged to the unnamed field drain (subject to agreement with the EA).

As the BESS Compound will be bunded there is limited potential for run-off to leave the Proposed Development.

5 CONCLUSION & COMPLIANCE

The Proposed Development involves the installation of approximately 0.81 ha of impermeable hardstanding at the BESS compound.

Infiltration is not feasible due to the presence of clays and shallow groundwater at the Site.

A detention basin will be used to provide approximately 595 m^3 storage for the 1 % AEP critical storm, plus a 25 % uplift for climate change, discharging to a drainage ditch at Q_{BAR} 1.2 l/s for the positively drained area.

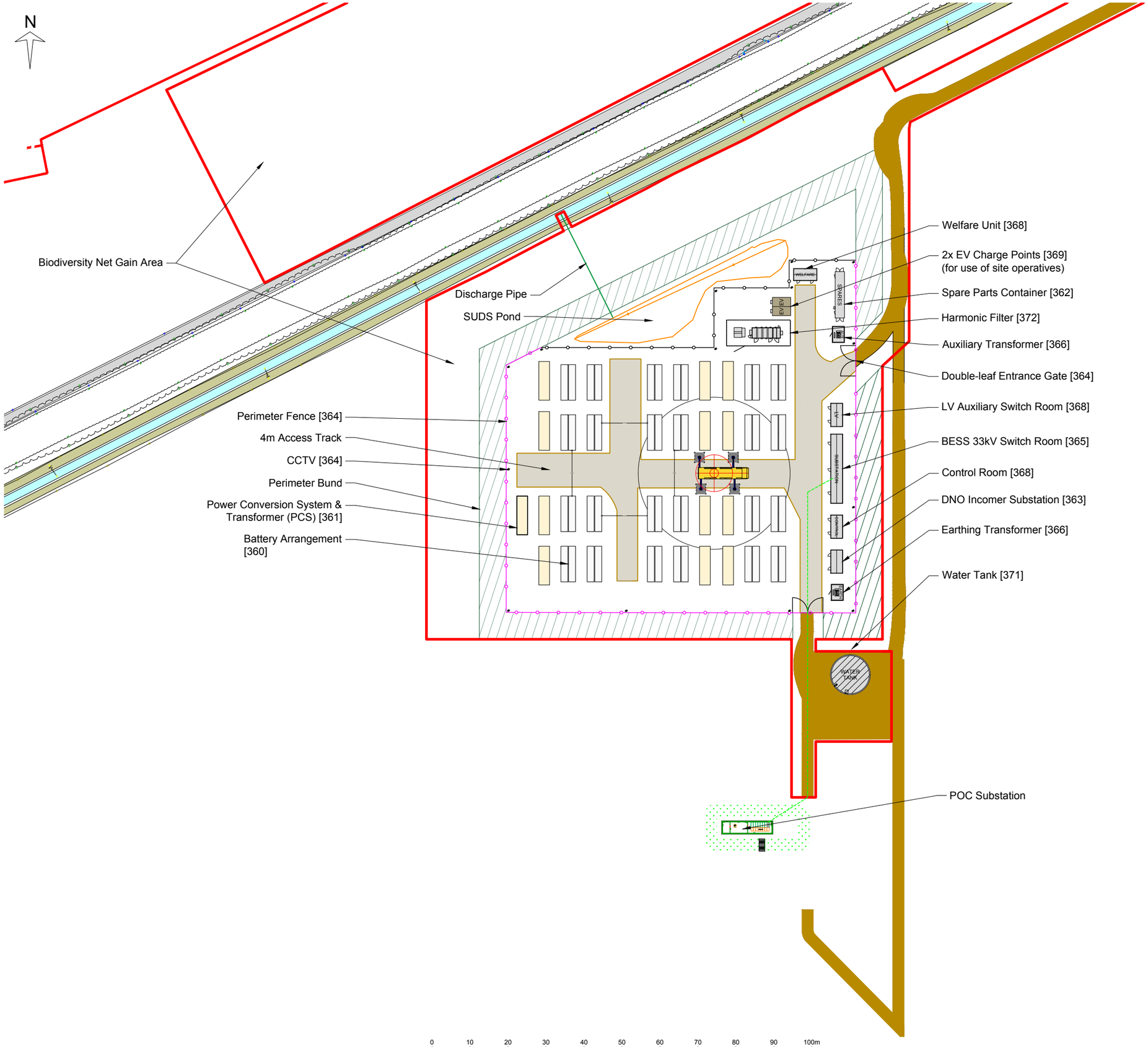
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The Proposed Development will therefore be compliant with the requirements of Paragraphs 167 and 169 of the National Planning Policy Framework, Planning Practice Guidance, FSCC Guidance, the LCC Guidance, Policy 3: Design of New Development, Policy 4: Approach to Flood Risk, Policy 31: Climate Change and Renewable and Low Carbon Energy of the Local Plan and the SuDS Manual 2015.

APPENDIX A: SITE LAYOUT

RAINCLOUD



NOTES

1. Drawing details and dimensions for planning purposes only.

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LEGEND

- PLANNING APPLICATION BOUNDARY
- PERIMETER FENCE
- ACOUSTIC PERIMETER FENCE (3.5M)
- PERIMETER BUND
- HV CABLE ROUTE

Rev	Description	Date	Checked
04	Consultant comments	14.11.24	SRY
03	Consultant comments	13.11.24	SRY
02	RLB adjusted	13.11.24	SRY
01	Draft Issue	12.11.24	SRY

Drawing No.
WAL-EDFR-BESS-CIV-PLN-301.04

Project
Walpole BESS

Title
Site Layout Plan

Scale	Drawn by	Checked	Date
1:1000 @A3	JL	SY	05.01.24

W: www.edf-re.uk
A: Cardinal Place, 80 Victoria Street, London SW1E 5JL

APPENDIX B: INFO DRAINAGE OUTPUTS

RAINCLOUD

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Inflows Storm Phase: Phase	www.raincloud-consulting.co.uk:		



Catchment Area

Type : Catchment Area

Area (ha)	0.694

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	100

Pond Type : Pond

Dimensions

Exceedance Level (m)	1.661
Depth (m)	1.500
Base Level (m)	0.161
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	2.671
Total Volume (m³)	677.719

Depth (m)	Area (m²)	Volume (m³)
0.000	310.00	0.000
1.500	610.43	677.719

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

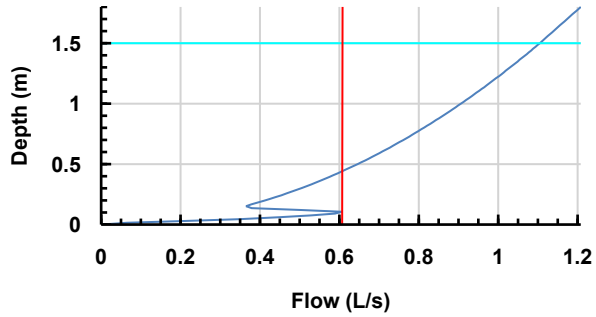
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	0.161
Design Depth (m)	1.500
Design Flow (L/s)	1.1
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐

Unit Reference	CHE-0043-1100-1500-1100



Advanced

Perimeter	Circular
Length (m)	70.197
Friction Scheme	Manning's n
n	0.035

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
Catchment Area	Pond		Time of Concentration	0.694	100	0	100	0.694
TOTAL		**0.0**		**0.694**				**0.694**

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

FEH

Type: FEH

Site Location	GB 548250 320900 TF 48250 20900
Return Period (years)	30.0
Rainfall Version	1999
C (1km)	-0.021
D1 (1km)	0.338
D2 (1km)	0.292
D3 (1km)	0.195
E (1km)	0.307
F (1km)	2.496

Pipe Options

Lock Slope Options	None
Design Options	Minimise Excavation
Design Level	Level Soffits
Min. Cover Depth (m)	0.600
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Pipe Size Library

Default

Add. Increment (mm)	75
Max. Diameter (mm)	0

Diameter (mm)	Min. Slope (1:X)	Max. Slope (1:X)
100	0.00	0.00
150	0.00	0.00

Manhole Options

Apply Offset	☐

Manhole Size Library

Default

Diameter / Width

Connection (mm)	Diameter / Length (m)	Width (m)
0	1.200	0.000
375	1.350	0.000
500	1.500	0.000
750	1.800	0.000

Additional Sizing

Connection (mm)	900
Diameter / Length (m)	0.900
Width (m)	0.000

Depth

Depth (m)	Diameter / Length (m)	Width (m)
0.000	1.050	0.000
1.500	1.200	0.000

Access

Depth (m)	Ladder Protrusion (mm)
0.000	130
3.000	230

Benching Requirements

Landing Width (mm)	500
Benching Width (mm)	225

Outfalls

Outfall	Outfall Type	Gated	Fixed Surcharged Level (m)	Level Curve
Pond	Free Discharge			



Catchment Area

Type : Catchment Area

Area (ha)	0.10

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	79.1



Catchment Area (1)

Type : Catchment Area

Area (ha)	0.114

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	78.9



Catchment Area (2)

Type : Catchment Area

Area (ha)	0.087

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	79.7



Catchment Area (3)

Type : Catchment Area

Area (ha)	0.076

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	80.4



Catchment Area (4)

Type : Catchment Area

Area (ha)	0.042

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	78.2



Catchment Area (5)

Type : Catchment Area

Area (ha)	0.097

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	79.2



Catchment Area (6)

Type : Catchment Area

Area (ha)	0.079

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	80.2



Catchment Area (7)

Type : Catchment Area

Area (ha)	0.044

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	78.9



Catchment Area (8)

Type : Catchment Area

Area (ha)	0.071

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	80.8

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Junctions Storm Phase: Phase (1)	www.raincloud-consulting.co.uk:		

Name	Junction Type	Easting (m)	Northing (m)	Cover Level (m)	Depth (m)	Invert Level (m)	Chamber Shape	Diameter (m)
Manhole	Manhole	548373.836	319427.523	3.269	1.185	2.084	Circular	1.200
Manhole (1)	Manhole	548373.836	319462.375	2.239	0.975	1.264	Circular	1.350
Manhole (2)	Manhole	548374.026	319448.187	3.027	1.259	1.769	Circular	1.200
Manhole (3)	Manhole	548397.261	319462.661	2.809	1.620	1.188	Circular	1.350
Manhole (4)	Manhole	548396.880	319427.428	2.843	1.433	1.410	Circular	1.200
Manhole (5)	Manhole	548396.880	319448.853	3.027	1.706	1.321	Circular	1.200
Manhole (6)	Manhole	548433.446	319420.762	3.396	0.803	2.593	Circular	1.200
Manhole (7)	Manhole	548433.160	319449.805	3.077	1.361	1.716	Circular	1.350
Manhole (8)	Manhole	548433.061	319467.240	2.793	1.219	1.574	Circular	1.350
Manhole (9)	Manhole	548411.869	319467.669	2.623	1.106	1.517	Circular	1.350
Manhole (10)	Manhole	548422.495	319450.084	2.811	0.878	1.933	Circular	1.200
Manhole (11)	Manhole	548421.979	319429.309	3.107	0.878	2.230	Circular	1.200
Manhole (12)	Manhole	548433.263	319429.424	3.321	1.247	2.074	Circular	1.200

Name	Lock
Manhole	None
Manhole (1)	None
Manhole (2)	None
Manhole (3)	None
Manhole (4)	None
Manhole (5)	None
Manhole (6)	None
Manhole (7)	None
Manhole (8)	None
Manhole (9)	None
Manhole (10)	None
Manhole (11)	None
Manhole (12)	None

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Junctions Storm Phase: Phase (1)	www.raincloud-consulting.co.uk:		

Inlets

Junction	Inlet Name	Incoming Item(s)	Bypass Destination	Capacity Type
Manhole	Inlet	Catchment Area (1)	(None)	No Restriction
Manhole (1)	Inlet	Pipe (1)	(None)	No Restriction
	Inlet (1)	Catchment Area	(None)	No Restriction
Manhole (2)	Inlet	Pipe	(None)	No Restriction
Manhole (3)	Inlet	Catchment Area (6) Pipe (2)	(None)	No Restriction
	Inlet (1)	Pipe (5)	(None)	No Restriction
Manhole (4)	Inlet	Catchment Area (2)	(None)	No Restriction
Manhole (5)	Inlet	Pipe (4)	(None)	No Restriction
Manhole (6)	Inlet	Catchment Area (4)	(None)	No Restriction
Manhole (7)	Inlet	Catchment Area (7)	(None)	No Restriction
	Inlet (1)	Pipe (7) Pipe (11)	(None)	No Restriction
Manhole (8)	Inlet	Catchment Area (5)	(None)	No Restriction
	Inlet (1)	Pipe (8)	(None)	No Restriction
Manhole (9)	Inlet	Pipe (9)	(None)	No Restriction
Manhole (10)	Inlet	Catchment Area (8)	(None)	No Restriction
Manhole (11)	Inlet	Catchment Area (3)	(None)	No Restriction
Manhole (12)	Inlet	Pipe (6)	(None)	No Restriction
	Inlet (1)	Pipe (10)	(None)	No Restriction

Outlets

Junction	Outlet Name	Outgoing Connection	Outlet Type
Manhole	Outlet	Pipe	Free Discharge
Manhole (1)	Outlet	Pipe (2)	Free Discharge
Manhole (2)	Outlet	Pipe (1)	Free Discharge
Manhole (3)	Outlet	Pipe (3)	Free Discharge
Manhole (4)	Outlet	Pipe (4)	Free Discharge
Manhole (5)	Outlet	Pipe (5)	Free Discharge
Manhole (6)	Outlet	Pipe (6)	Free Discharge
Manhole (7)	Outlet	Pipe (8)	Free Discharge
Manhole (8)	Outlet	Pipe (9)	Free Discharge
Manhole (9)	Outlet	Pipe (12)	Free Discharge
Manhole (10)	Outlet	Pipe (11)	Free Discharge
Manhole (11)	Outlet	Pipe (10)	Free Discharge
Manhole (12)	Outlet	Pipe (7)	Free Discharge



Pond

Type : Pond

Dimensions

Exceedance Level (m)	1.653
Depth (m)	1.500
Base Level (m)	0.153
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	2.83
Total Volume (m³)	692.011

Depth (m)	Area (m²)	Volume (m³)
0.000	310.00	0.000
1.500	631.55	692.011

Inlets

Inlet (1)

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (3)
Bypass Destination	(None)
Capacity Type	No Restriction

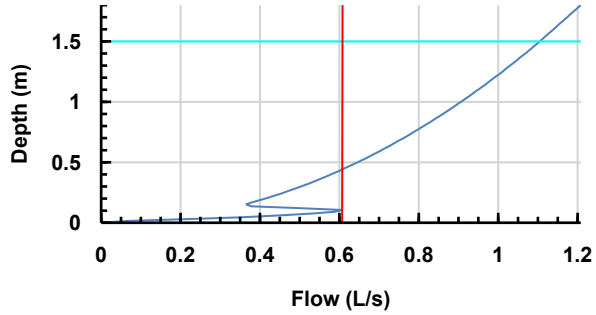
Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (12)
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®
Invert Level (m)	0.153
Design Depth (m)	1.500
Design Flow (L/s)	1.1
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐
Unit Reference	CHE-0043-1100-1500-1100



Advanced

Perimeter	Circular
Length (m)	72.578
Friction Scheme	Manning's n
n	0.035

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Connections Storm Phase: Phase (1)	www.raincloud-consulting.co.uk:		

Name	Length (m)	Connection Type	Slope (1:X)	Manning's n	Colebrook-White Roughness (mm)	Diameter / Base Width (mm)	Upstream Cover Level (m)	Upstream Invert Level (m)
Pipe	20.664	Pipe	65.552		0.6	225	3.269	2.084
Pipe (1)	14.190	Pipe	40.000		0.6	225	3.027	1.769
Pipe (2)	23.427	Pipe	310.000		0.6	375	2.239	1.264
Pipe (3)	6.236	Pipe	6.025		0.6	375	2.809	1.188
Pipe (4)	21.425	Pipe	240.000		0.6	300	2.843	1.410
Pipe (5)	13.813	Pipe	240.000		0.6	300	3.027	1.321
Pipe (6)	8.664	Pipe	23.493		0.6	150	3.396	2.593
Pipe (7)	20.382	Pipe	72.096		0.6	300	3.321	2.074
Pipe (8)	17.435	Pipe	260.000		0.6	375	3.077	1.716
Pipe (10)	11.284	Pipe	140.000		0.6	225	3.107	2.230
Pipe (11)	10.669	Pipe	160.000		0.6	225	2.811	1.933
Pipe (9)	21.196	Pipe	369.774		0.6	450	2.793	1.574
Pipe (12)	9.433	Pipe	6.918		0.6	450	2.623	1.517

Name	Downstream Cover Level (m)	Downstream Invert Level (m)	Lock	Culvert Type	Culvert Entrance
Pipe	3.027	1.769	None	(None)	(None)
Pipe (1)	2.239	1.414	None	(None)	(None)
Pipe (2)	2.809	1.188	None	(None)	(None)
Pipe (3)	2.510	0.153	None	(None)	(None)
Pipe (4)	3.027	1.321	None	(None)	(None)
Pipe (5)	2.809	1.263	None	(None)	(None)
Pipe (6)	3.321	2.224	None	(None)	(None)
Pipe (7)	3.077	1.791	None	(None)	(None)
Pipe (8)	2.793	1.649	None	(None)	(None)
Pipe (10)	3.321	2.149	None	(None)	(None)
Pipe (11)	3.077	1.866	None	(None)	(None)
Pipe (9)	2.623	1.517	None	(None)	(None)
Pipe (12)	2.327	0.153	None	(None)	(None)

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Inflow Summary Storm Phase: Phase (1)	www.raincloud-consulting.co.uk:		

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
Catchment Area	Manhole (1)		Time of Concentration	0.100	79.1	0	79.1	0.079
Catchment Area (1)	Manhole		Time of Concentration	0.114	78.9	0	78.9	0.090
Catchment Area (2)	Manhole (4)		Time of Concentration	0.087	79.7	0	79.7	0.070
Catchment Area (3)	Manhole (11)		Time of Concentration	0.076	80.4	0	80.4	0.061
Catchment Area (4)	Manhole (6)		Time of Concentration	0.042	78.2	0	78.2	0.033
Catchment Area (5)	Manhole (8)		Time of Concentration	0.097	79.2	0	79.2	0.077
Catchment Area (6)	Manhole (3)		Time of Concentration	0.079	80.2	0	80.2	0.064
Catchment Area (7)	Manhole (7)		Time of Concentration	0.044	78.9	0	78.9	0.035
Catchment Area (8)	Manhole (10)		Time of Concentration	0.071	80.8	0	80.8	0.058
TOTAL		**0.0**		**0.712**				**0.566**

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Network Design Criteria Storm Phase: Phase (1)	www.raincloud-consulting.co.uk:		

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

FEH

Type: FEH

Site Location	GB 548250 320900 TF 48250 20900
Return Period (years)	30.0
Rainfall Version	1999
C (1km)	-0.021
D1 (1km)	0.338
D2 (1km)	0.292
D3 (1km)	0.195
E (1km)	0.307
F (1km)	2.496

Pipe Options

Lock Slope Options	None
Design Options	Minimise Excavation
Design Level	Level Soffits
Min. Cover Depth (m)	0.600
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Pipe Size Library

Default

Add. Increment (mm)	75
Max. Diameter (mm)	0

Diameter (mm)	Min. Slope (1:X)	Max. Slope (1:X)
100	0.00	0.00
150	0.00	0.00

Manhole Options

Apply Offset	☐

Manhole Size Library

Default

Diameter / Width

Connection (mm)	Diameter / Length (m)	Width (m)
0	1.200	0.000
375	1.350	0.000
500	1.500	0.000
750	1.800	0.000

Additional Sizing

Connection (mm)	900
Diameter / Length (m)	0.900
Width (m)	0.000

Depth

Depth (m)	Diameter / Length (m)	Width (m)
0.000	1.050	0.000
1.500	1.200	0.000

Access

Depth (m)	Ladder Protrusion (mm)
0.000	130
3.000	230

Benching Requirements

Landing Width (mm)	500
Benching Width (mm)	225

Outfalls

Outfall	Outfall Type	Gated	Fixed Surcharged Level (m)	Level Curve
Pond	Free Discharge			



Catchment Area

Type : Catchment Area

Area (ha)	0.10

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	79.1



Catchment Area (1)

Type : Catchment Area

Area (ha)	0.114

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	78.9



Catchment Area (2)

Type : Catchment Area

Area (ha)	0.087

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	79.7



Catchment Area (3)

Type : Catchment Area

Area (ha)	0.076

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	80.4



Catchment Area (4)

Type : Catchment Area

Area (ha)	0.042

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	78.2



Catchment Area (5)

Type : Catchment Area

Area (ha)	0.097

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	79.2



Catchment Area (6)

Type : Catchment Area

Area (ha)	0.079

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	80.2



Catchment Area (7)

Type : Catchment Area

Area (ha)	0.044

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	78.9



Catchment Area (8)

Type : Catchment Area

Area (ha)	0.071

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	80.8



Catchment Area (9)

Type : Catchment Area

Area (ha)	0.10

Dynamic Sizing

Runoff Method	Time of Concentration
Summer Volumetric Runoff	0.750
Winter Volumetric Runoff	0.840
Time of Concentration (mins)	5
Percentage Impervious (%)	28

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Junctions Storm Phase: Phase (1) (1)	www.raincloud-consulting.co.uk:		

Name	Junction Type	Easting (m)	Northing (m)	Cover Level (m)	Depth (m)	Invert Level (m)	Chamber Shape	Diameter (m)
Manhole	Manhole	548373.524	319427.537	3.280	1.602	1.678	Circular	1.200
Manhole (1)	Manhole	548373.220	319463.504	3.000	1.772	1.228	Circular	1.200
Manhole (2)	Manhole	548373.738	319449.099	3.280	1.692	1.588	Circular	1.200
Manhole (3)	Manhole	548397.594	319463.587	2.785	1.795	0.990	Circular	1.350
Manhole (4)	Manhole	548396.880	319427.428	2.843	0.825	2.018	Circular	1.200
Manhole (5)	Manhole	548396.880	319448.853	3.027	1.143	1.884	Circular	1.200
Manhole (6)	Manhole	548433.446	319420.762	3.396	0.924	2.471	Circular	1.200
Manhole (7)	Manhole	548433.160	319449.805	3.077	1.359	1.719	Circular	1.350
Manhole (8)	Manhole	548433.061	319467.240	2.793	1.129	1.664	Circular	1.350
Manhole (9)	Manhole	548411.869	319467.669	2.623	1.061	1.562	Circular	1.350
Manhole (10)	Manhole	548422.495	319450.084	2.811	0.875	1.935	Circular	1.200
Manhole (11)	Manhole	548421.979	319429.309	3.107	0.875	2.232	Circular	1.200
Manhole (12)	Manhole	548433.263	319429.424	3.321	1.159	2.162	Circular	1.200
Manhole (13)	Manhole	548433.602	319380.561	3.594	0.875	2.719	Circular	1.200
Manhole (14)	Manhole	548387.436	319463.542	2.618	1.485	1.133	Circular	1.200

Name	Lock
Manhole	None
Manhole (1)	None
Manhole (2)	None
Manhole (3)	None
Manhole (4)	None
Manhole (5)	None
Manhole (6)	None
Manhole (7)	None
Manhole (8)	None
Manhole (9)	None
Manhole (10)	None
Manhole (11)	None
Manhole (12)	None
Manhole (13)	None
Manhole (14)	None

Inlets

Junction	Inlet Name	Incoming Item(s)	Bypass Destination	Capacity Type
Manhole	Inlet (1)	Catchment Area (1)	(None)	No Restriction
Manhole (1)	Inlet	Pipe (1)	(None)	No Restriction
	Inlet (1)	Catchment Area	(None)	No Restriction
Manhole (2)	Inlet	Pipe	(None)	No Restriction
Manhole (3)	Inlet (1)	Pipe (5) Pipe (14)	(None)	No Restriction
	Inlet (2)	Catchment Area (6)	(None)	No Restriction
Manhole (4)	Inlet	Catchment Area (2)	(None)	No Restriction
Manhole (5)	Inlet	Pipe (4)	(None)	No Restriction
Manhole (6)	Inlet	Catchment Area (4) Pipe (13)	(None)	No Restriction
Manhole (7)	Inlet	Catchment Area (7)	(None)	No Restriction
	Inlet (1)	Pipe (7) Pipe (11)	(None)	No Restriction
Manhole (8)	Inlet	Catchment Area (5)	(None)	No Restriction
	Inlet (1)	Pipe (8)	(None)	No Restriction
Manhole (9)	Inlet	Pipe (9)	(None)	No Restriction
Manhole (10)	Inlet	Catchment Area (8)	(None)	No Restriction
Manhole (11)	Inlet	Catchment Area (3)	(None)	No Restriction
Manhole (12)	Inlet	Pipe (6)	(None)	No Restriction
	Inlet (1)	Pipe (10)	(None)	No Restriction
Manhole (13)	Inlet	Catchment Area (9)	(None)	No Restriction
Manhole (14)	Inlet	Pipe (2)	(None)	No Restriction

Outlets

Junction	Outlet Name	Outgoing Connection	Outlet Type
Manhole	Outlet	Pipe	Free Discharge
Manhole (1)	Outlet	Pipe (2)	Free Discharge
Manhole (2)	Outlet	Pipe (1)	Free Discharge
Manhole (3)	Outlet	Pipe (12)	Free Discharge
Manhole (4)	Outlet	Pipe (4)	Free Discharge
Manhole (5)	Outlet	Pipe (5)	Free Discharge
Manhole (6)	Outlet	Pipe (6)	Free Discharge
Manhole (7)	Outlet	Pipe (8)	Free Discharge
Manhole (8)	Outlet	Pipe (9)	Free Discharge
Manhole (9)	Outlet	Pipe (3)	Free Discharge
Manhole (10)	Outlet	Pipe (11)	Free Discharge
Manhole (11)	Outlet	Pipe (10)	Free Discharge
Manhole (12)	Outlet	Pipe (7)	Free Discharge
Manhole (13)	Outlet	Pipe (13)	Free Discharge
Manhole (14)	Outlet	Pipe (14)	Free Discharge



Pond

Type : Pond

Dimensions

Exceedance Level (m)	2.300
Depth (m)	1.750
Base Level (m)	0.550
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	2.676
Total Volume (m³)	595.581

Depth (m)	Area (m²)	Volume (m³)
0.000	200.00	0.000
1.750	503.62	595.581

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (3)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (1)

Inlet Type	Point Inflow
Incoming Item(s)	Pipe (12)
Bypass Destination	(None)
Capacity Type	No Restriction

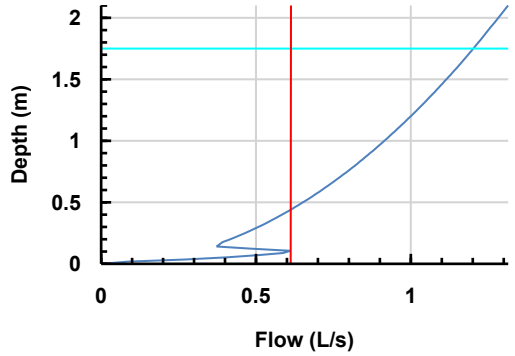
Outlets

Outlet

Outgoing Connection	(None)
Outlet Type	Hydro-Brake®

Invert Level (m)	0.550
Design Depth (m)	1.750
Design Flow (L/s)	1.2
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☐

Unit Reference	CHE-0043-1200-1750-1200



Advanced

Perimeter	Circular
Length (m)	71.397
Friction Scheme	Manning's n
n	0.04

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Connections Storm Phase: Phase (1) (1)	www.raincloud-consulting.co.uk:		

Name	Length (m)	Connection Type	Slope (1:X)	Manning's n	Colebrook-White Roughness (mm)	Diameter / Base Width (mm)	Upstream Cover Level (m)	Upstream Invert Level (m)
Pipe	21.562	Pipe	240.000		0.6	500	3.280	1.678
Pipe (1)	14.414	Pipe	40.000		0.6	500	3.280	1.588
Pipe (4)	21.425	Pipe	160.000		0.6	225	2.843	2.018
Pipe (5)	14.751	Pipe	19.816		0.6	225	3.027	1.884
Pipe (6)	8.664	Pipe	27.952		0.6	225	3.396	2.471
Pipe (7)	20.382	Pipe	69.615		0.6	225	3.321	2.162
Pipe (8)	17.435	Pipe	320.000		0.6	375	3.077	1.719
Pipe (10)	11.284	Pipe	160.000		0.6	225	3.107	2.232
Pipe (11)	10.669	Pipe	160.000		0.6	225	2.811	1.935
Pipe (9)	21.196	Pipe	206.578		0.6	375	2.793	1.664
Pipe (3)	13.205	Pipe	13.053		0.6	375	2.623	1.562
Pipe (12)	6.645	Pipe	15.102		0.6	375	2.785	0.990
Pipe (13)	40.201	Pipe	162.698		0.6	225	3.594	2.719
Pipe (2)	14.217	Pipe	150.000		0.6	500	3.000	1.228
Pipe (14)	10.157	Pipe	150.000		0.6	500	2.618	1.133

Name	Downstream Cover Level (m)	Downstream Invert Level (m)	Lock	Culvert Type	Culvert Entrance
Pipe	3.280	1.588	None	(None)	(None)
Pipe (1)	3.000	1.228	None	(None)	(None)
Pipe (4)	3.027	1.884	None	(None)	(None)
Pipe (5)	2.785	1.140	None	(None)	(None)
Pipe (6)	3.321	2.162	None	(None)	(None)
Pipe (7)	3.077	1.869	None	(None)	(None)
Pipe (8)	2.793	1.664	None	(None)	(None)
Pipe (10)	3.321	2.162	None	(None)	(None)
Pipe (11)	3.077	1.869	None	(None)	(None)
Pipe (9)	2.623	1.562	None	(None)	(None)
Pipe (3)	2.113	0.550	None	(None)	(None)
Pipe (12)	2.478	0.550	None	(None)	(None)
Pipe (13)	3.396	2.471	None	(None)	(None)
Pipe (2)	2.618	1.133	None	(None)	(None)
Pipe (14)	2.785	1.065	None	(None)	(None)

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Inflow Summary Storm Phase: Phase (1) (1)	www.raincloud-consulting.co.uk:		

Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
Catchment Area	Manhole (1)		Time of Concentration	0.100	79.1	0	79.1	0.079
Catchment Area (1)	Manhole		Time of Concentration	0.114	78.9	0	78.9	0.090
Catchment Area (2)	Manhole (4)		Time of Concentration	0.087	79.7	0	79.7	0.070
Catchment Area (3)	Manhole (11)		Time of Concentration	0.076	80.4	0	80.4	0.061
Catchment Area (4)	Manhole (6)		Time of Concentration	0.042	78.2	0	78.2	0.033
Catchment Area (5)	Manhole (8)		Time of Concentration	0.097	79.2	0	79.2	0.077
Catchment Area (6)	Manhole (3)		Time of Concentration	0.079	80.2	0	80.2	0.064
Catchment Area (7)	Manhole (7)		Time of Concentration	0.044	78.9	0	78.9	0.035
Catchment Area (8)	Manhole (10)		Time of Concentration	0.071	80.8	0	80.8	0.058
Catchment Area (9)	Manhole (13)		Time of Concentration	0.100	28.0	0	28.0	0.028
TOTAL		**0.0**		**0.811**				**0.594**

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Network Design Criteria Storm Phase: Phase (1) (1)	www.raincloud-consulting.co.uk:		

Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

FEH

Type: FEH

Site Location	GB 548250 320900 TF 48250 20900
Return Period (years)	30.0
Rainfall Version	1999
C (1km)	-0.021
D1 (1km)	0.338
D2 (1km)	0.292
D3 (1km)	0.195
E (1km)	0.307
F (1km)	2.496

Pipe Options

Lock Slope Options	None
Design Options	Minimise Excavation
Design Level	Level Soffits
Min. Cover Depth (m)	0.600
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Pipe Size Library

Default

Add. Increment (mm)	75
Max. Diameter (mm)	0

Diameter (mm)	Min. Slope (1:X)	Max. Slope (1:X)
100	0.00	0.00
150	0.00	0.00

Manhole Options

Apply Offset	☐

Manhole Size Library

Default

Diameter / Width

Connection (mm)	Diameter / Length (m)	Width (m)
0	1.200	0.000
375	1.350	0.000
500	1.500	0.000
750	1.800	0.000

Additional Sizing

Connection (mm)	900
Diameter / Length (m)	0.900
Width (m)	0.000

Depth

Depth (m)	Diameter / Length (m)	Width (m)
0.000	1.050	0.000
1.500	1.200	0.000

Access

Depth (m)	Ladder Protrusion (mm)
0.000	130
3.000	230

Benching Requirements

Landing Width (mm)	500
Benching Width (mm)	225

Outfalls

Outfall	Outfall Type	Gated	Fixed Surcharged Level (m)	Level Curve
Pond	Free Discharge			

Runoff Type	Dynamic
Output Interval (mins)	5
Time Step	Shortest
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

ICP SUDS / IH 124

Details

Method	ICP SUDS
Area (ha)	0.811
SAAR (mm)	600.0
Soil	0.3
Region	Region 5
Urban	0
Return Period (years)	2

Results

Region	QBAR Rural (L/s)	QBAR Urban (L/s)	Q 2 (years) (L/s)	Q 1 (years) (L/s)	Q 30 (years) (L/s)	Q 100 (years) (L/s)
Region 5	1.2	1.2	1.1	1.1	3.0	4.4

Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m³)
Catchment Area	FEH: 100 years: +40 %: 15 mins: Winter	0.10	71.7	33.151
Catchment Area (1)	FEH: 100 years: +40 %: 15 mins: Winter	0.11	81.7	37.801
Catchment Area (2)	FEH: 100 years: +40 %: 15 mins: Winter	0.09	63.1	29.206
Catchment Area (3)	FEH: 100 years: +40 %: 15 mins: Winter	0.08	55.3	25.562
Catchment Area (4)	FEH: 100 years: +40 %: 15 mins: Winter	0.04	29.6	13.694
Catchment Area (5)	FEH: 100 years: +40 %: 15 mins: Winter	0.10	69.6	32.197
Catchment Area (6)	FEH: 100 years: +40 %: 15 mins: Winter	0.08	57.6	26.660
Catchment Area (7)	FEH: 100 years: +40 %: 15 mins: Winter	0.04	31.6	14.618
Catchment Area (8)	FEH: 100 years: +40 %: 15 mins: Winter	0.07	52.3	24.206
Catchment Area (9)	FEH: 100 years: +40 %: 15 mins: Winter	0.10	25.4	11.747

Critical Storm Per Item: Rank By: Max. Flooded Volume

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
Manhole	FEH: 30 years: +0 %: 15 mins: Summer	3.280	1.678	1.802	0.125	36.9	0.141	0.000	36.0	16.031	OK
Manhole (1)	FEH: 30 years: +0 %: 15 mins: Summer	3.000	1.228	1.393	0.165	67.3	0.187	0.000	65.3	30.078	OK
Manhole (2)	FEH: 30 years: +0 %: 15 mins: Summer	3.280	1.588	1.665	0.077	36.0	0.087	0.000	35.0	16.017	OK
Manhole (3)	FEH: 30 years: +0 %: 15 mins: Summer	2.785	0.990	1.138	0.148	116.0	0.212	0.000	115.2	53.726	OK
Manhole (4)	FEH: 30 years: +0 %: 15 mins: Summer	2.843	2.018	2.160	0.141	28.5	0.160	0.000	27.7	12.380	OK
Manhole (5)	FEH: 30 years: +0 %: 15 mins: Summer	3.027	1.884	1.962	0.078	27.7	0.088	0.000	26.9	12.374	OK
Manhole (6)	FEH: 30 years: +0 %: 15 mins: Summer	3.396	2.471	2.551	0.080	24.2	0.090	0.000	23.2	10.776	OK
Manhole (7)	FEH: 30 years: +0 %: 15 mins: Summer	3.077	1.719	1.983	0.264	82.1	0.378	0.000	79.8	38.029	OK
Manhole (8)	FEH: 30 years: +0 %: 15 mins: Summer	2.793	1.664	1.908	0.244	111.2	0.349	0.000	108.7	51.646	OK
Manhole (9)	FEH: 30 years: +0 %: 15 mins: Summer	2.623	1.562	1.676	0.114	108.7	0.163	0.000	106.3	51.667	OK
Manhole (10)	FEH: 30 years: +0 %: 15 mins: Summer	2.811	1.935	2.067	0.132	23.6	0.149	0.000	22.8	10.245	OK
Manhole (11)	FEH: 30 years: +0 %: 15 mins: Summer	3.107	2.232	2.377	0.145	24.9	0.164	0.000	24.3	10.835	OK
Manhole (12)	FEH: 30 years: +0 %: 15 mins: Summer	3.321	2.162	2.317	0.156	47.5	0.176	0.000	45.0	21.597	OK
Manhole (13)	FEH: 30 years: +0 %: 15 mins: Summer	3.594	2.719	2.800	0.082	11.5	0.093	0.000	10.8	4.976	OK
Manhole (14)	FEH: 30 years: +0 %: 15 mins: Summer	2.618	1.133	1.293	0.161	65.3	0.182	0.000	63.1	30.061	OK

Critical Storm Per Item: Rank By: Max. Resident Volume

Storm Event	Stormwater Control	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Percentage Available (%)	Status
FEH: 100 years: +40 %: 960 mins: Winter	Pond	2.292	2.292	1.742	1.742	28.1	591.335	0.000	0.000	1.2	115.790	0.713	OK

Walpole BESS:	Date: 22/11/2024		
	Designed by: L. Nevins	Checked by:	Approved By:
Report Details: Type: Connections Summary Storm Phase: Phase (1) (1)	www.raincloud-consulting.co.uk:		

Critical Storm Per Item: Rank By: Max. Flow

Connection	Storm Event	Connection Type	From	To	Upstream Cover Level (m)	Max. US Water Level (m)	Max. Flow Depth (m)	Discharge Volume (m³)	Max. Velocity (m/s)	Flow / Capacity	Max. Flow (L/s)	Status
Pipe	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole	Manhole (2)	3.280	1.864	0.153	37.809	1.6	0.29	80.3	OK
Pipe (1)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (2)	Manhole (1)	3.280	1.708	0.194	37.823	1.1	0.12	78.8	OK
Pipe (4)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (4)	Manhole (5)	2.843	2.427	0.225	29.212	1.5	1.43	58.8	Surcharged
Pipe (5)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (5)	Manhole (3)	3.027	2.005	0.166	29.069	2.6	0.48	56.4	OK
Pipe (6)	FEH: 100 years: +40 %: 15 mins: Summer	Pipe	Manhole (6)	Manhole (12)	3.396	2.849	0.225	22.712	1.0	0.39	38.7	Surcharged
Pipe (7)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (12)	Manhole (7)	3.321	2.866	0.225	51.127	2.0	1.29	80.6	Surcharged
Pipe (8)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (7)	Manhole (8)	3.077	2.289	0.375	89.901	1.4	1.41	157.4	Surcharged
Pipe (10)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (11)	Manhole (12)	3.107	3.011	0.225	25.590	1.3	1.22	49.9	Flood Risk
Pipe (11)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (10)	Manhole (7)	2.811	2.423	0.225	24.140	1.2	1.19	48.9	Surcharged
Pipe (9)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (8)	Manhole (9)	2.793	2.132	0.328	122.053	2.2	1.6	221.9	Surcharged
Pipe (3)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (9)	Pond	2.623	1.751	0.375	121.880	2.2	0.39	218.7	OK
Pipe (12)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (3)	Pond	2.785	1.456	0.375	121.168	2.4	0.5	258.4	Surcharged
Pipe (13)	FEH: 100 years: +25 %: 15 mins: Winter	Pipe	Manhole (13)	Manhole (6)	3.594	2.836	0.193	10.494	0.8	0.54	21.9	OK
Pipe (2)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (1)	Manhole (14)	3.000	1.496	0.276	69.514	1.4	0.42	146.8	OK

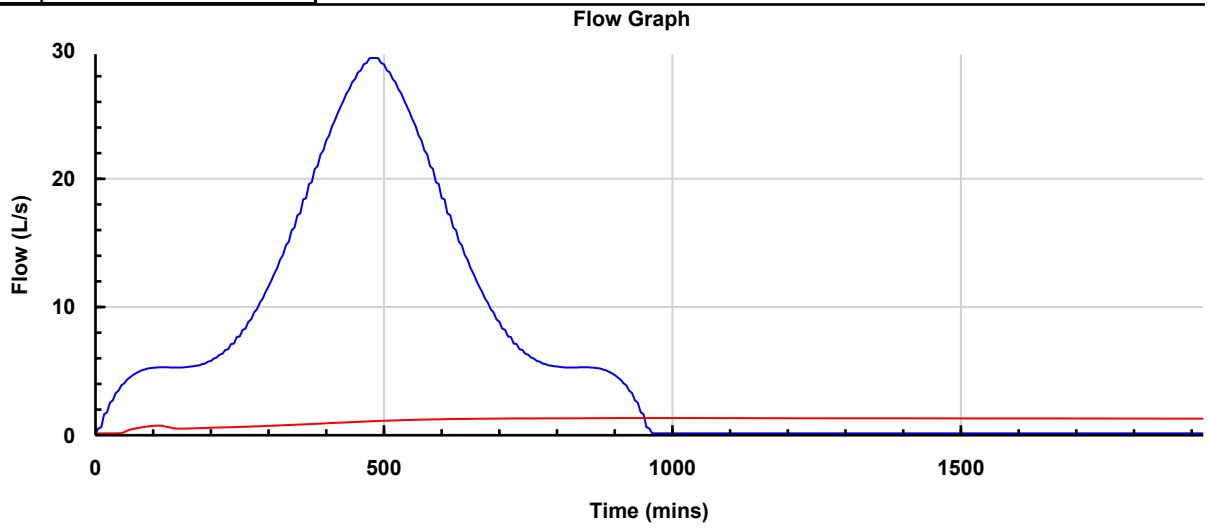
Pipe (14)	FEH: 100 years: +40 %: 15 mins: Winter	Pipe	Manhole (14)	Manhole (3)	2.618	1.456	0.357	67.046	1.5	0.41	142.9	OK

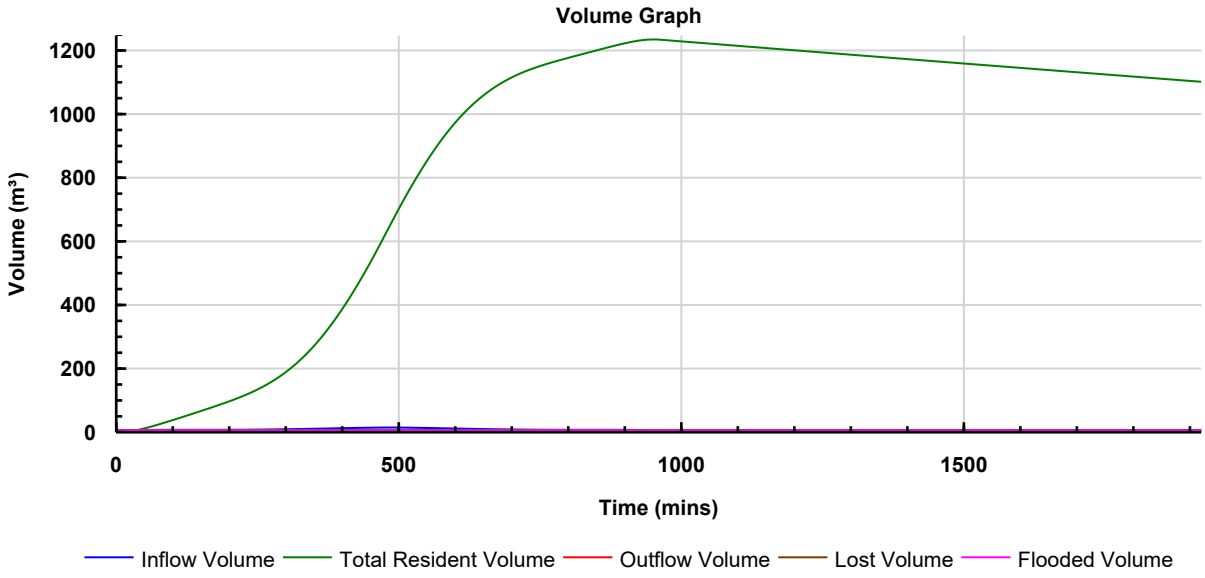
Phase (1) (1)
FEH: 100 years: Increase Rainfall (%): +40: 960 mins: Winter

Tables

Name	Max. Inflow (L/s)	Total Inflow Volume (m³)	Max. Outflow (L/s)	Total Outflow Volume (m³)
Pond			1.2	115.790
TOTAL	29.4	670.134	1.2	115.790

Graphs





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