Technical Appendix

Lairdmannoch Energy Park

Technical Appendix 8-6: Drainage Impact Assessment

Lairdmannoch Energy Park Limited

May 2025

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Glossary of Terms

Term	Definition
The Applicant	Lairdmannoch Energy Park Limited
The Agent	Atmos Consulting Limited
Environmental Advisors and Planning Consultants	Atmos Consulting Limited
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of carrying out, in a systematic way, an assessment of the likely significant environmental effects from a development.
Environmental Impact Assessment Regulations	Electricity Works (Environmental Impact Assessment)(Scotland) Regulations 2017 ('the EIA Regulations')
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the EIA Regulations.
The Proposed Development	Lairdmannoch Energy Park
The Proposed Development Site	The full application boundary as per Figure 1-1

List of Abbreviations

Abbreviation	Description
BESS	Battery Energy Storage System
BGS	British Geological Survey
FEH	Flood Estimation Handbook
IH R124	Institute of Hydrology Report 124
SuDS	Sustainable Drainage Systems

1 Introduction

1.1 Preamble

Gondolin Land and Water Ltd ('Gondolin') has been appointed by Atmos Consulting Ltd ('Atmos') on behalf of Lairdmannoch Energy Park Limited ('the Applicant') to prepare a Drainage Impact Assessment for the Battery Energy Storage Site (BESS) element of an application for consent under Section 36 of the Electricity Act (Scotland) 1989 (as amended) to develop an Energy Park consisting of 9 wind turbines at up to 180 m to tip height, ground mounted solar panels, battery energy storage systems (BESS) and associated infrastructure including electrical transformers, hardstandings, access roads, cabling, borrow pit and electrical substation (the 'Proposed Development').

This report assesses the potential increase in surface water runoff attributed to the BESS element of the Proposed Development, taking due cognisance of national drainage design guidance (CIRIA Report C753) and Dumfries and Galloway Council guidance and proposes a surface water management strategy to manage this. The strategy is in accordance with sustainable drainage principles and allows the site to remain free of flooding during design storm events, whilst ensuring no increase of flood risk to offsite receptors and ensures no deterioration of the water environment.

1.2 Site Context & Proposed BESS

The Proposed Development would be located 7km north-east of Gatehouse of Fleet and 10km west of Castle Douglas in Dumfries and Galloway) and lies entirely within the planning authority area of Dumfries and Galloway Council.

The BESS area is considered 'greenfield' as it is currently an undeveloped area of upland with no history of development. The BESS area is located in the northern portion of the Proposed Development and shares a development platform with the proposed substation. Access to the BESS area would be gained via a proposed access track to the west. The Proposed Development would be connected to the public road network via an upgraded access track to the south-west of the development area.

A site location plan is included as Figure 1-1, a plan showing the Proposed Development is included as Figure 1-2 and a proposed block plan of the BESS area is included as 3-11.

1.3 Topography

Digital terrain data from the Scottish Remote Sensing Portal has been obtained for the Proposed Development Site extents and this is duly incorporated within the proposed drainage / SuDS design and included within the relevant drawings.

The BESS area has a gentle fall to the north-east. The maximum elevation is approximately 213m AOD at the western corner of the BESS area, while the minimum elevation is approximately 207m AOD at the eastern corner.

1.4 Geology and Hydrogeology

1.4.1 Geology - Superficial

Review of the British Geological Survey (BGS) online geology maps indicates that no superficial deposits are present within the BESS area, with some areas of peat present across the wider Proposed Development Site.

1.4.2 Geology - Bedrock

Review of the BGS online geology maps shows that the bedrock geology at the BESS area is from the Cairnharrow Formation comprising thin to medium-bedded greywacke with interbedded silty mudstone.

1.4.3 Hydrogeology

Review of the BGS online hydrogeology maps indicates that the underlying bedrock within the Proposed Development is a low productivity aquifer, comprising highly indurated greywackes with limited groundwater in the near surface weathered zone and secondary fractures.

1.5 Local Hydrology and Existing Drainage Scheme

Review of the Flood Estimation Handbook (FEH) Web Service and other available mapping shows that the BESS area lies within the catchment of the Anstool Burn. The Anstool Burn discharges into Loch Mannoch to the south-east of the BESS area which subsequently discharges into the Tarff Water to the east.

A hydrological summary and characteristics for the BESS area are shown in Table 8-6-1. The data shown is taken from the FEH Web Service and the point characteristics of the site has been delineated from NGR: NX 65045 62420.

A hydrological overview is enclosed as Figure 8-6-1.

Table 8-6-1: Hydrological Summary

Point Location (NGR)	BFIHOST19[A]	PROPWET[B]	SAAR[C] (mm)
NX 65045 62420	0.265	0.64	1648

[A]BFIHOST19 = Base Flow Index derived using the UK Hydrology of Soil Types (Host) classification (released 2019)
[B]PROPWET = Proportion of Time the Soil Moisture Deficit (SMD) was equal to, or below, 6mm during 1961-1990
[C]SAAR= Standard Annual Average Rainfall

2 Proposed Surface Water Drainage Design

2.1 Design Overview

The proposed drainage / SuDS scheme has been developed to manage the surface water runoff from the BESS development area.

The BESS development area would be constructed as a platform and would be constructed with semi-permeable materials (e.g. crushed gravel) to allow rainwater to infiltrate into the underlying makeup, where it would be intercepted by perforated pipework and conveyed into a controlled storage structure (i.e. SuDS Retention Pond).

The internal access tracks would be drained via a combination of a perimeter filter drains and by grading track surfaces towards crushed gravel areas where it would be collected via the subsurface perforated pipework. Internal access tracks within the platform area would have a nominal crossfall towards the areas of granular material to avoid ponding on the track surfaces.

The perforated pipework and perimeter filter drain would convey runoff to a SuDS Pond located to the north-east of the BESS platform. The perimeter filter drain and SuDS pond would provide suitable treatment and attenuation prior to discharge to the adjacent watercourse.

The proposed drainage layout is enclosed as Figure 8-6-2 with typical drainage details included on Figure 8-6-3.

2.2 Design Criteria

2.2.1 Drainage Discharge Locations

The hierarchy for favoured disposal options of surface water runoff from development sites is as follows:

- Infiltration to Ground;
- Discharge to Surface Waters; or
- Discharge to Sewer.

Table 8-6-2 below discusses the disposal method suitability in the context of the site and the BESS element of the Proposed Development.

Table 8-6-2: Suitability of Surface Water Disposal Methods

Surface Water Disposal Method	Suitability Description	Method Suitable? (Y/N)
Infiltration to Ground	Review of the site geology (see Section 1.4.1) indicates that no superficial soils are likely to be present within the BESS area. The geology and ground conditions suggests that infiltration is not considered to be a viable disposal method.	N
Surface Water Discharge	Existing drains are present to the north of the proposed SuDS pond which subsequently discharges to the Anstool Burn. A gravity discharge can be made to the existing drains.	Y
Sewer Discharge	No public surface water / combined sewers are located within the immediate vicinity of the BESS element of the Proposed Development.	N

Taking the above into account, it is proposed that surface water runoff from the BESS area is discharged to the existing drain. This mimics the pre-development hydrological regime albeit in a more formalised manner.

2.2.2 Water Quantity Review

Greenfield runoff rates have been estimated through application of methodology outlined in IH R124[1] as set out within the Interim Code of Practice for SuDS (ICP).

The IH R124 method can be used to estimate Greenfield runoff release rates for a range of AEP events, or return periods, by applying regional growth curve factors to the mean annual peak runoff (i.e. QBAR).

The UK hydrological region for the Proposed Development is Region 2 therefore the appropriate growth curve factors for this region have been incorporated into the analysis undertaken in the MicroDrainage software suite. The hydrological characteristics incorporated into the runoff modelling are shown below.

- Average Annual Rainfall (SAAR): 872 mm/year
- Soil Index: 0.4
- UK Hydrological Region No. 1

The greenfield runoff results are presented in Table 8-6-3 for a range of AEP storm events.

Table 8-6-3: Estimation of the Greenfield (Pre-Development) Rate of Runoff

AEP (%)	Return Period (1 in X Years)	Unit Greenfield Runoff Rate (l/s/Ha)
50	2	13.28
QBAR		14.53
3.3	30	27.55
1	100	38.20
0.5	200	43.29
0.1	1000	55.92

In accordance with CIRIA Report C753 (the SuDS Manual) it is proposed to limit surface water discharge from the BESS element of the Proposed Development to QBAR greenfield rates (14.53l/s/ha) for all design events up to and including the 0.5 % AEP plus 38% climate change uplift. This also provides the relevant runoff volume control.

The total impermeable area for the BESS element of the Proposed Development is 0.318 ha, Accordingly, a **4.6 l/s** limiting discharge rate has been applied to the proposed SuDS attenuation pond. This is based on a runoff coefficient of 1 being applied which is a 'worst case' assumption.

[1] Institute of Hydrology Report No. 124 (1994) (IH R124), Flood estimation for small catchments, June 1994

2.2.3 Water Quality Review (Simple Index Approach)

In accordance with CIRIA Report C753, it is necessary to undertake a 'Water Quality Risk Management' assessment to determine the suitability of SuDS methods from a water quality perspective. The approach outlined below is based on the 'Simple Index Approach' for discharge to surface water as detailed in the SuDS Manual (Section 26.7, Tables 26.2 and 26.3).

Table 8-6-4 below compares the SuDS Mitigation Indices against the Pollution Hazard Indices for the BESS area. This is based on the application of a filter drain and pond for industrial roofs and access tracks.

Table 8-6-4: SuDS Water Quality Design Criteria: Index Approach Review

Land Use	Pollution Hazard and SuDS Mitigation Indices Comparison					
	Total Suspended Solids (TSS)		Metals		Hydro-Carbons	
	Pollution Index	Mitigation Index	Pollution Index	Mitigation Index	Pollution Index	Mitigation Index
Other Roofs (industrial / commercial)	0.3	**0.7**	0.2	**0.7**	0.05	**0.5**
Low traffic roads	0.5		0.4		0.4	

The *SuDS Mitigation Index* offered by the proposed SuDS is ≥ *Pollution Hazard Index* for each Land Use type and therefore the water quality assessment criteria is satisfied. It is noted that filter drains are also proposed as part of the drainage arrangements, but to provide a conservative approach the mitigation provided by these has not been included in the assessment above.

2.3 SuDS Performance Review

2.3.1 Key Design Details

The SuDS attenuation pond has been sized to accommodate the 0.5% AEP plus 38% climate change event. The key design parameters / geometry are summarised in Table 8-6-5 below.

Table 8-6-5: SuDS Pond Summary Design Details

Parameter	Unit	SuDS Pond	*Notes*
Total Depth	m	1.5	*As measured from AutoCAD design*
Storage Depth	m	1.0	*As measured from AutoCAD design*
Permanent Water Depth	m	0.5	*Below outlet level*
Storage Area	m^2	586	*As measured from AutoCAD design*

Internal Slope	1 in X	4	
Available Storage Volume	m^3	406	*As measured from MicroDrainage*
Limiting Discharge Rate	l/s	4.6	*To be provided by Hydrobrake Optimum (or similar)*

2.3.2 Hydraulic Analysis

The SuDS Pond has been modelled using the industry standard MicroDrainage Source Control software suite and a summary of the modelling results is included as Table 8-6-6 below.

Table 8-6-6: SuDS Pond Hydraulic Modelling Summary

AEP (%)	Max. Water Depth (above Perm. Water Level) (m)	Freeboard Allowance (mm)	Max Outflow Rate (l/s)	Critical Storm Duration (hours)
50	0.201	799	4.5	6
10	0.298	702	4.6	6
3.3	0.385	615	4.6	6
1	0.500	500	4.6	6
0.5	0.574	426	4.6	6
0.5 + 38% CC	0.789	211	4.6	8

The results above confirm that surface water runoff generated from the BESS area can be attenuated and discharged at rates less than the greenfield QBAR for each rainfall event, for all design events up to and including the 200yr + 38% CC event.

As additional contingency and in accordance with CIRIA Report C753, a suitable freeboard depth from the maximum water level to the SuDS Pond crest level has been factored into the design.

Full copies of the hydraulic modelling and model details are enclosed as Annex 8-6-1.

2.3.3 Exceedance Flow Considerations

The attenuation features would be designed to manage exceedance flows beyond the design event and available freeboard.

Exceedance flows from the SuDS ponds would follow the natural topography and rejoin the existing drains to the north of the proposed pond. Exceedance flows would therefore be routed away from the BESS area in a northerly direction.

2.4 Drainage Maintenance Strategy

2.4.1 Overview

To ensure efficient operation of the proposed surface water management / SuDS scheme, drainage components would be inspected and maintained throughout the life of the BESS. Regular inspection / maintenance would ensure efficient operation and prevent potential failure / blockage of drainage components.

The following provisional maintenance plan has been developed from best practice guidance, professional experience and information provided in CIRIA Report C753 (The SuDS Manual).

All drainage components would be retained under private ownership, with the Applicant remaining responsible for ongoing maintenance. This maintenance schedule would be integrated into the overall site operating and maintenance strategy and tailored / refined over time as required.

The following sections provide maintenance actions for specific drainage elements.

2.4.2 SuDS Pond

Table 8-6-7 below provides the inspection and maintenance recommendations set out in Table 22.1 of CIRIA Report C753.

Table 8-6-7: SuDS Pond Maintenance Requirements

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Cut the meadow grass	Half yearly
	Inspect marginal and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, pipework for evidence of blockage and damage	Monthly
	Inspect for signs of poor water quality	Monthly
	Inspect silt accumulation	Half yearly
	Inspect outlet / litter screen and Hydrobrake manhole for debris / blockages	Weekly
	Hand cut submerged and emergent aquatic plants	Annually
	Remove 25% of bank vegetation from water's edge	Annually
	Tidy dead growth before start of growing season	Annually
Occasional Maintenance	Remove sediment from the main body of pond	As required (likely only every 25-50 years with effective pre-treatment)
Remedial Actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Aerate pond if signs of eutrophication are detected	As required
	Repair inlets or outlets	As required

2.4.3 Filter Drains

Table 8-6-8 below provides the inspection and maintenance recommendations set out in Table 16.1 of CIRIA Report C753.

Table 8-6-8: Filter Drain Maintenance Requirements

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly (or as required)
	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
Occasional Maintenance	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

2.4.4 Swales and Land Drainage

Table 8-6-9 below provides the inspection and maintenance recommendations set out in Table 17.1 of the CIRIA Report C753.

Table 8-6-9: Swales and Land Drainage Maintenance Requirements

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Cut grass	Monthly (during growing season)
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets and outlets for blockages and clear if required	Monthly
	Inspect silt accumulation	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth	As required
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

2.4.5 Inspection Chambers and Manholes

It is recommended that inspection chamber and manhole covers are lifted at least yearly to check for debris / silt accumulations and check the drainage runs are flowing freely.

Any silt / debris accumulations should be manually removed and jet washed where required.

3 Conclusion

Gondolin Land and Water Ltd ('Gondolin') has been appointed by Atmos Consulting Ltd ('Atmos') on behalf of Lairdmannoch Energy Park Limited ('the Applicant') to prepare a Drainage Impact Assessment for the Battery Energy Storage Site (BESS) element of an application for consent under Section 36 of the Electricity Act (Scotland) 1989 (as amended) to develop an energy park consisting of 9 wind turbines at up to 180 m to tip height, ground mounted solar panels, battery energy storage systems (BESS) and associated infrastructure including electrical transformers, hardstandings, access roads, cabling, borrow pit and electrical substation (the 'Proposed Development').

This report assesses the potential increase in surface water runoff attributed to the BESS element of the Proposed Development taking due cognisance of national drainage design guidance (CIRIA Report C753) and Dumfries and Galloway Council guidance and proposes a surface water management strategy to manage this. The strategy is in accordance with sustainable drainage principles and allows the site to remain free of flooding during design storm events, whilst ensuring no increase of flood risk to offsite receptors and ensures no deterioration of the water environment.

Taking all of the above into account it is considered there is no impediment to the BESS being consented on the grounds of drainage provision. The BESS element of the Proposed Development would remain safe and sustainable in surface water drainage terms for the lifetime of the Proposed Development.

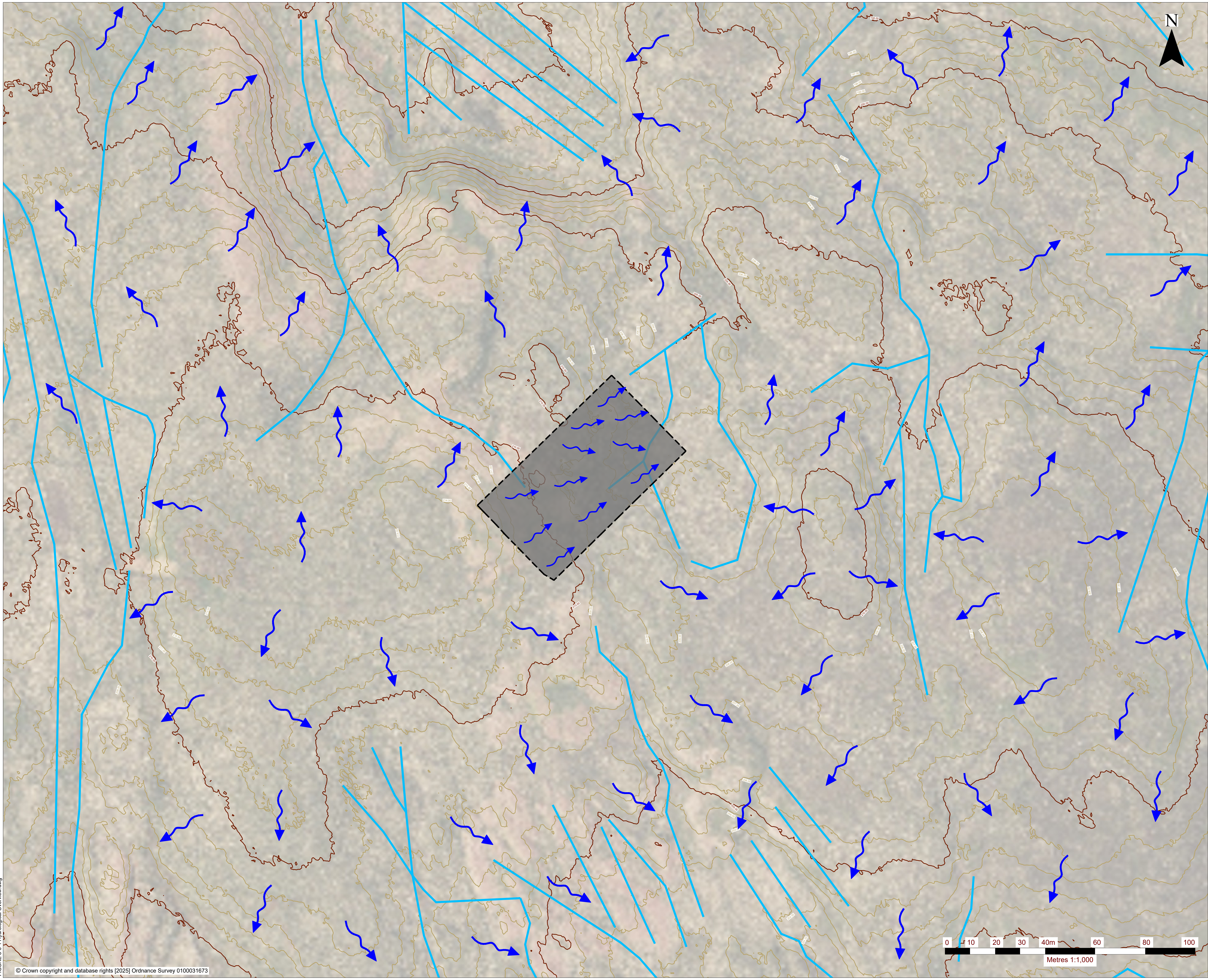
4 References

British Geological Survey (2025). GeoIndex Onshore: Borehole Records, Superficial Deposits, Bedrock Geology and Hydrogeology. Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html [accessed on 11/03/24]

Dumfries and Galloway Council (2020). Surface Water Drainage and Sustainable Drainage Systems (SuDS), Supplementary Guidance. Available at: https://www.dumfriesandgalloway.gov.uk/sites/default/files/2024-08/Sustainable_Drainage_Systems_SG_LDP2_Adopted.pdf [accessed on 11/03/24]

Institute of Hydrology (1994). Report No. 124 (IH R124), Flood Estimation for Small Catchments

UK Centre for Ecology and Hydrology (2025). Flood Estimation Handbook Web Service. Available at: https://fehweb.ceh.ac.uk/ [accessed on 11/03/24]



NOTES

1. DTM DATA TAKEN FROM SCOTTISH REMOTE SENSING PORTAL.
2. ALIGNMENT OF EXISTING DRAINS PROVIDED BY ATMOS CONSULTING LTD.

LEGEND

- EXISTING MAJOR CONTOURS (5m INTERVALS)
- EXISTING MINOR CONTOURS (1m INTERVALS)
- EXISTING MINOR WATERCOURSE / DITCH
- PROPOSED EXTENTS OF BESS
- OVERLAND FLOWPATH

REV	DATE	DESCRIPTION	BY	CHK
00	03/25	INITIAL ISSUE	GD	RL

CLIENT: LAIRDMANNOCH ENERGY PARK

PROJECT: LAIRDMANNOCH EP

DRAWING TITLE: **HYDROLOGICAL OVERVIEW (BESS AREA)**

SCALE: 1:1,000 @ A2

DATE: MARCH 2025

DRAWING NUMBER: **FIGURE 8-6-1**

REV: **00**

DRAWING STATUS: EIA

GONDOLIN LAND & WATER LTD
15 Quayside Street
Edinburgh
EH6 6EJ
Registered Company No. SC706920

GONDOLIN Land & Water

FIGURE 8-6-1 Hydrological Overview.dwg

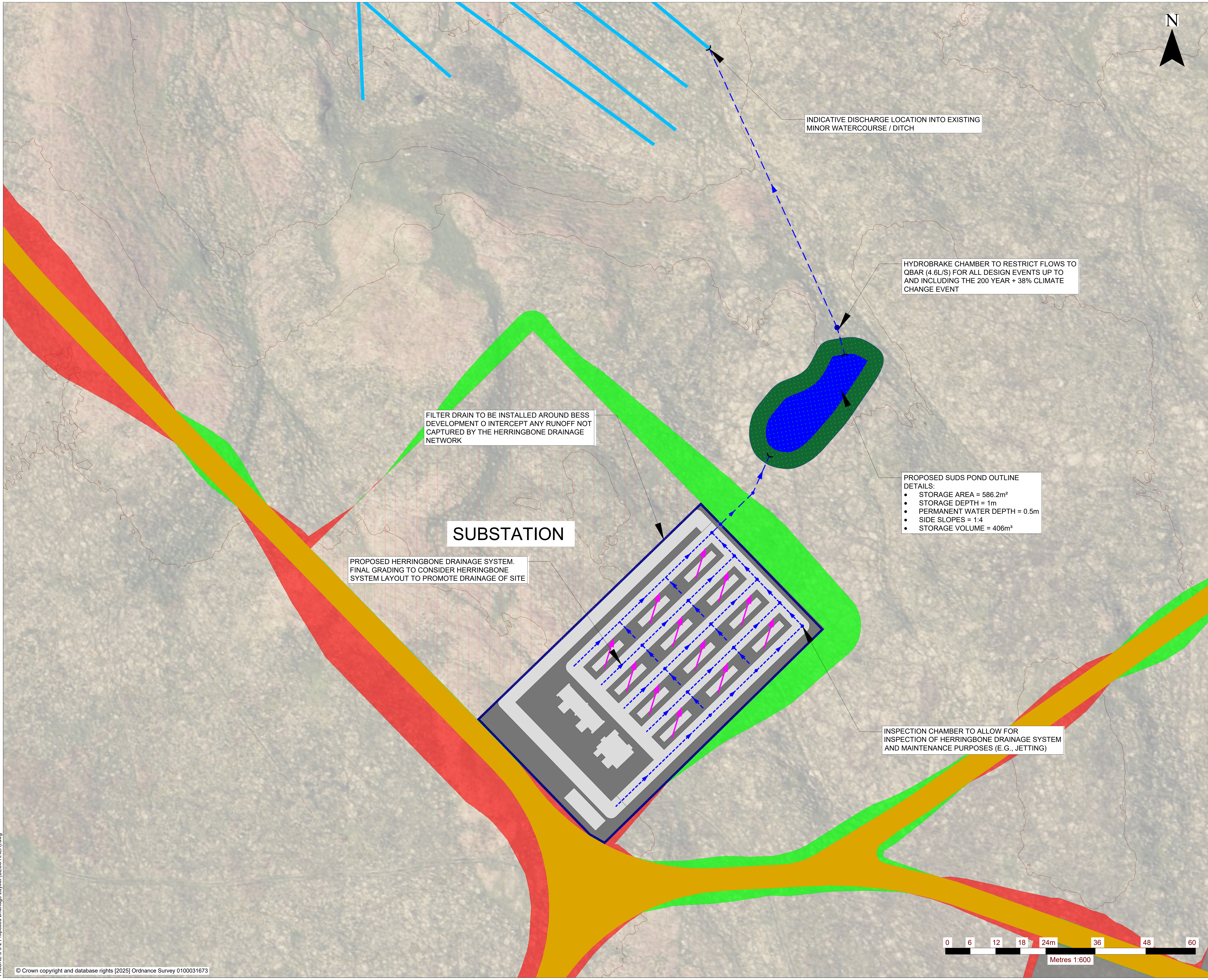


FIGURE 8-6-2 Proposed Drainage Layout (BESS AREA).dwg

NOTES

1. DTM DATA TAKEN FROM SCOTTISH REMOTE SENSING PORTAL.
2. ALL DRAINAGE TO BE CONSTRUCTED IN ACCORDANCE WITH SEWERS FOR SCOTLAND AND / OR THE SCOTTISH TECHNICAL HANDBOOK WHERE APPLICABLE.
3. FINAL COVER AND INVERT LEVELS TO BE CONFIRMED DURING DETAILED DESIGN STAGE.
4. DRAINAGE DESIGN SHOULD BE CONSIDERED PROVISIONAL OUTLINE DETAIL AND NOT FOR CONSTRUCTION.
5. SITE POST DEVELOPMENT FLOW PATHS TO REMAIN AS PER THE EXISTING SITE PROFILE.
6. BESS AREA INTERNAL LAYOUT PROVIDED BY ATMOS CONSULTING LTD ON 04/03/25.

LEGEND

- EXISTING MAJOR CONTOURS (5m INTERVALS)
- EXISTING MINOR CONTOURS (1m INTERVALS)
- EXISTING MINOR WATERCOURSE / DITCH (NOT ALL SHOWN)
- PROPOSED SURFACE WATER CONVENTIONAL PIPEWORK
- PROPOSED SURFACE WATER PERFORATED PIPEWORK
- PROPOSED FILTER DRAIN
- PROPOSED SURFACE WATER MANHOLE / INSPECTION CHAMBER
- PROPOSED HYDROBRAKE CHAMBER
- PROPOSED SUDS POND
- PROPOSED HEADWALL
- PROPOSED GRADING DIRECTIONS (SUBSURFACE & SURFACE)
- PROPOSED FILL EXTENTS
- PROPOSED CUT EXTENTS
- PROPOSED TRACK

REV	DATE	DESCRIPTION	BY	CHK
01	04/25	DISCHARGE LOCATION UPDATED	GD	RL
00	03/25	INITIAL ISSUE	GD	SD

CLIENT:
LAIRDMANNOCH ENERGY PARK

PROJECT:
LAIRDMANNOCH

DRAWING TITLE:
PROPOSED DRAINAGE LAYOUT (BESS AREA)

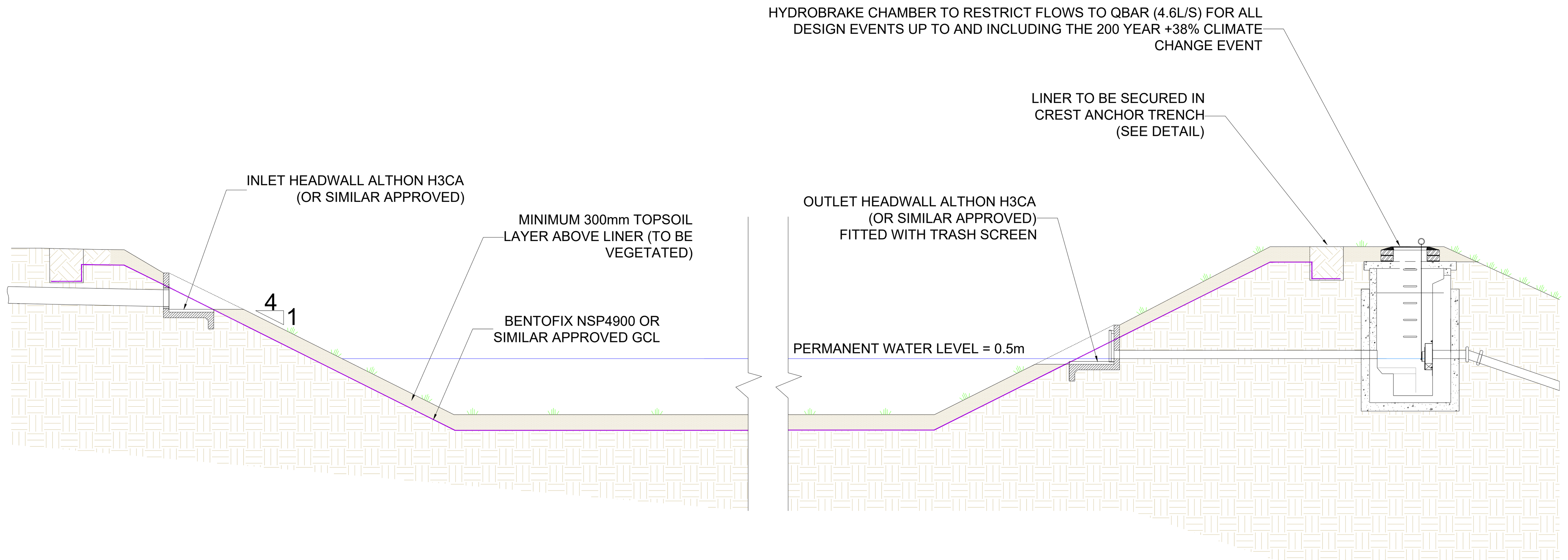
SCALE: 1:600 @ A2
DATE: APRIL 2025

DRAWING NUMBER: **FIGURE 8-6-2**
REV: **01**

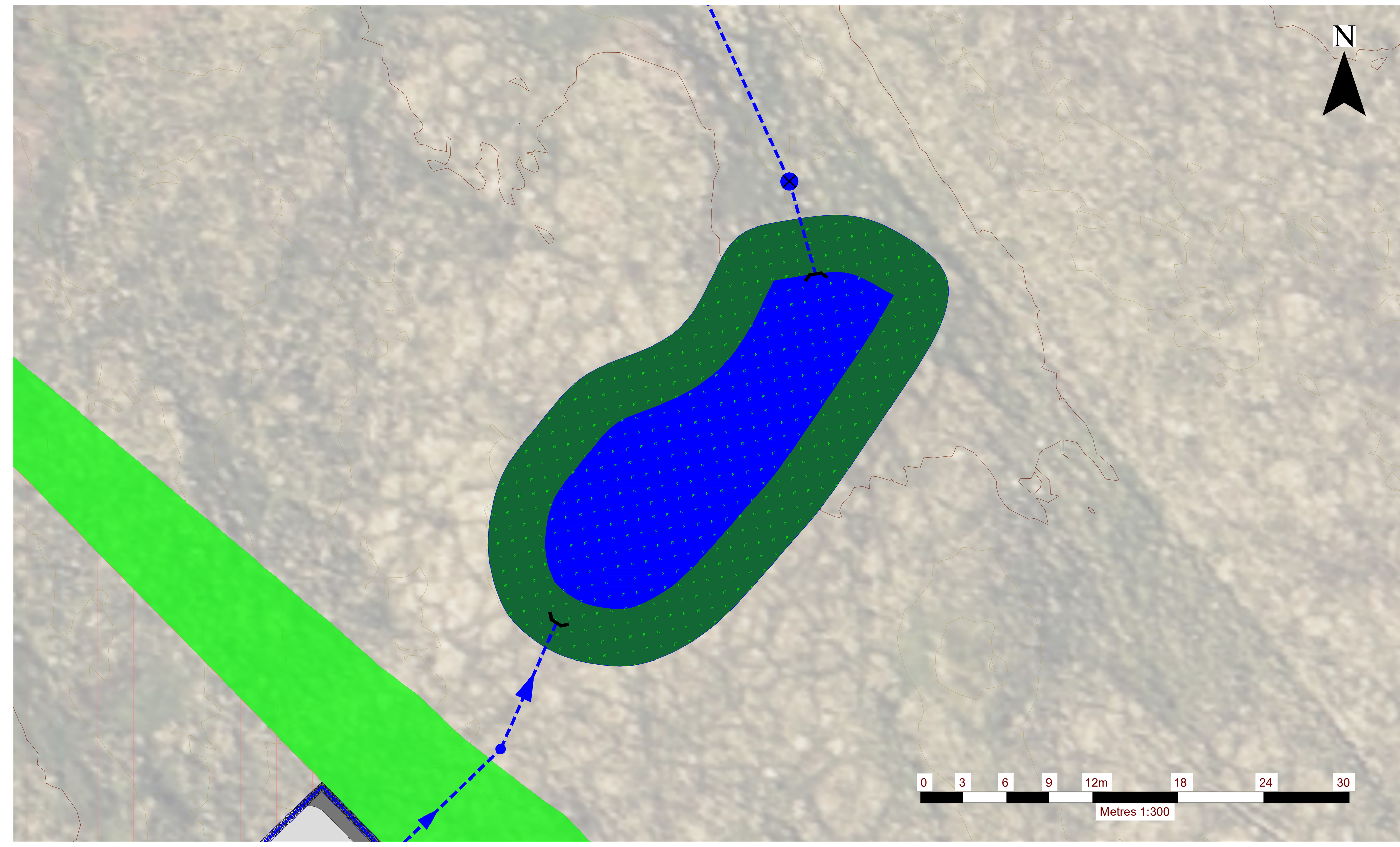
DRAWING STATUS:
EIA

GONDOLIN LAND & WATER LTD
15 Quayside Street
Edinburgh
EH6 6EJ
Registered Company No. SC706920

GONDOLIN Land & Water

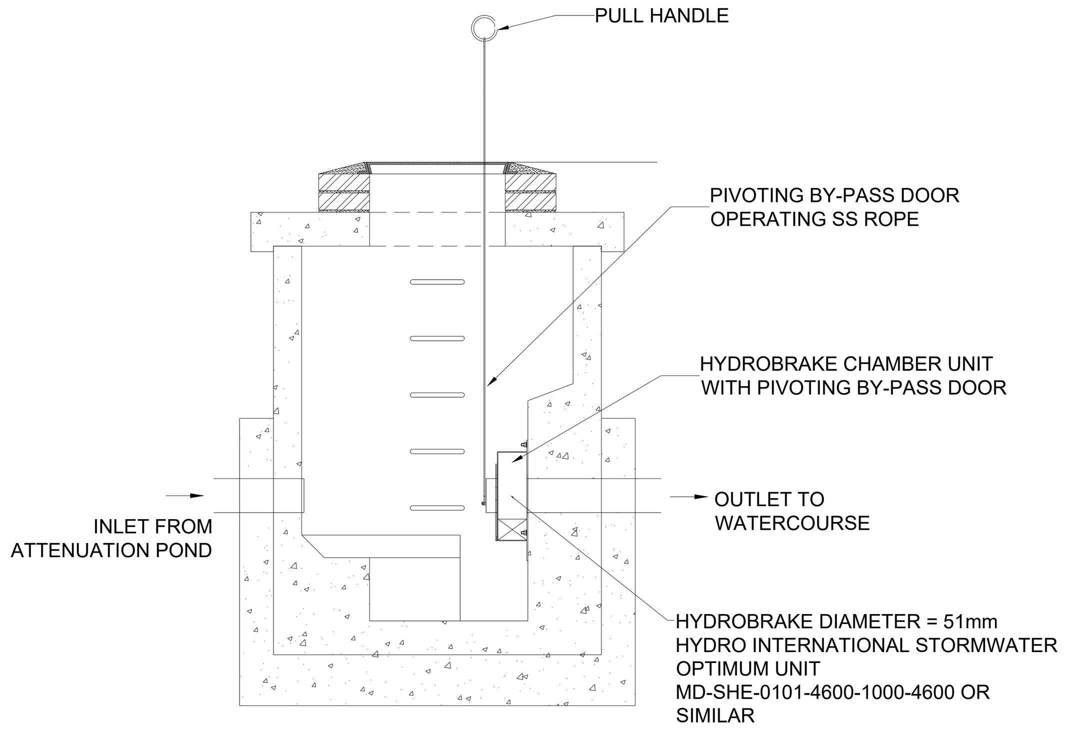


TYPICAL SECTION THROUGH ATTENUATION POND
NTS

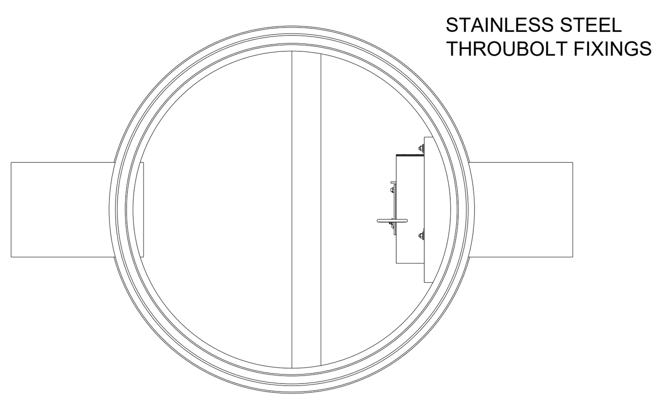


NOTES

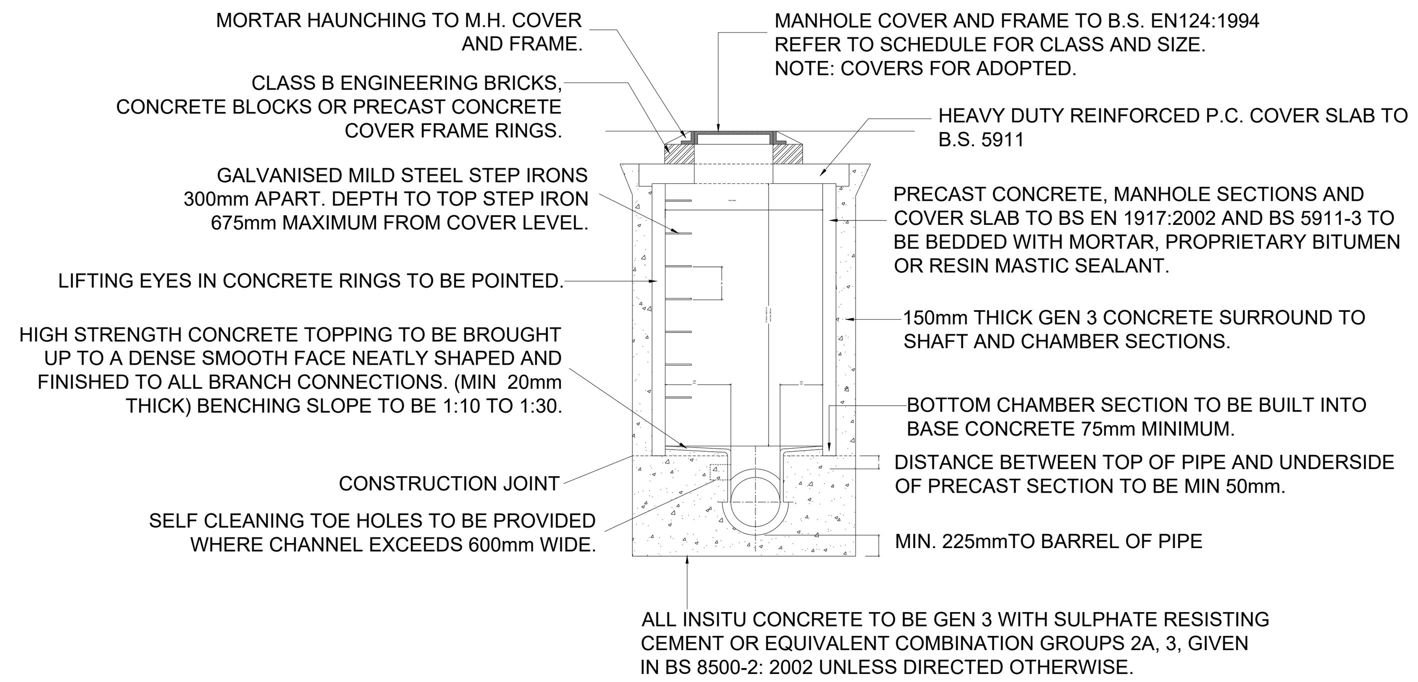
1. DO NOT SCALE THIS DRAWING.
2. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT MANUFACTURER'S DRAWINGS AND SPECIFICATIONS.
3. ALL PIPEWORK TO BE UPVC TO BS 4660 AND BS EN 1401-1, CLASS SN4 WITH FLEXIBLE JOINTS AND KITEMARK CERTIFIED (OR SIMILAR APPROVED).
4. THE CONTRACTOR IS TO REMAIN RESPONSIBLE FOR THE TEMPORARY STABILITY OF THE SURROUNDING GROUND THROUGHOUT THE CONSTRUCTION.
5. BEDDING CLASSES REFER TO THOSE GIVEN IN DMRB VOLUME 4, SECTION 2, PART 5, HA40/01, APPENDIX B.
6. ALL RELEVANT DRAINAGE ITEMS TO BE INSTALLED IN ACCORDANCE WITH LATEST EDITION OF 'SEWERS FOR ADOPTION'.
7. FOR DRAINAGE LAYOUT SEE 'FIGURE 8-6-2'
8. MANHOLE COVERS IN TRAFFICKED AREAS TO BE D400 LOAD CLASSIFICATION
9. MANHOLE COVERS ON NON-TRAFFICKED AREAS CAN BE B125 OR C250 LOAD CLASSIFICATION (AT CONTRACTORS DISCRETION).



HYDROBRAKE OPTIMUM CHAMBER
NTS



PLAN



TYPICAL MANHOLE CHAMBER
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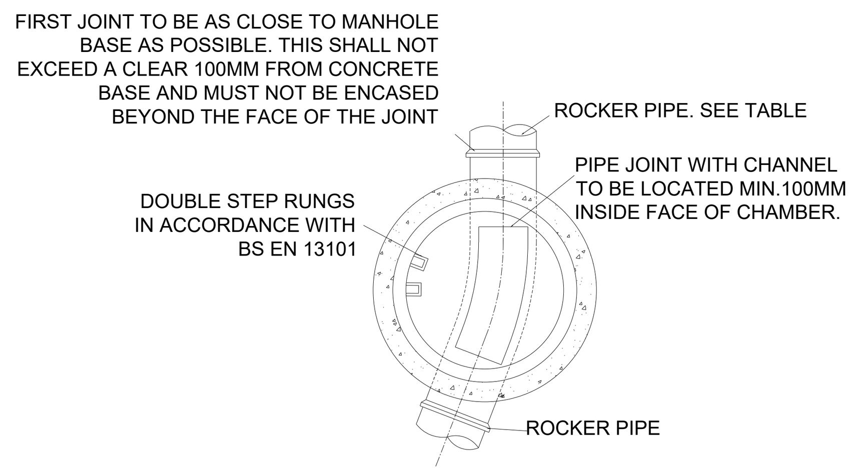

PLAN ON MANHOLE
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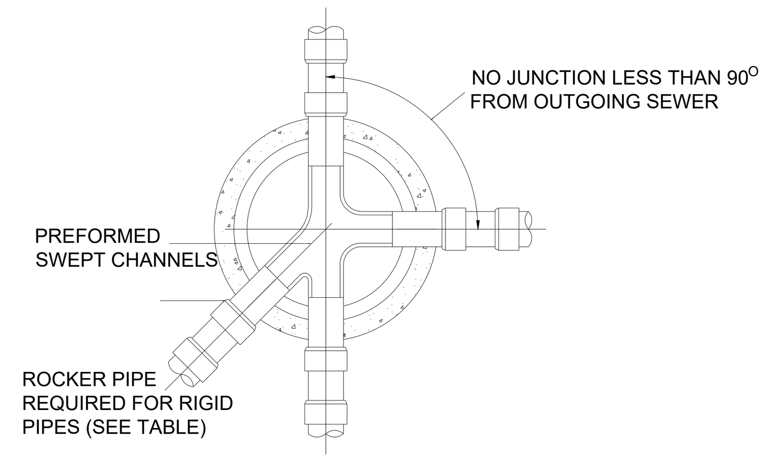

TYPICAL MANHOLE ARRANGEMENT OF PIPE JUNCTIONS
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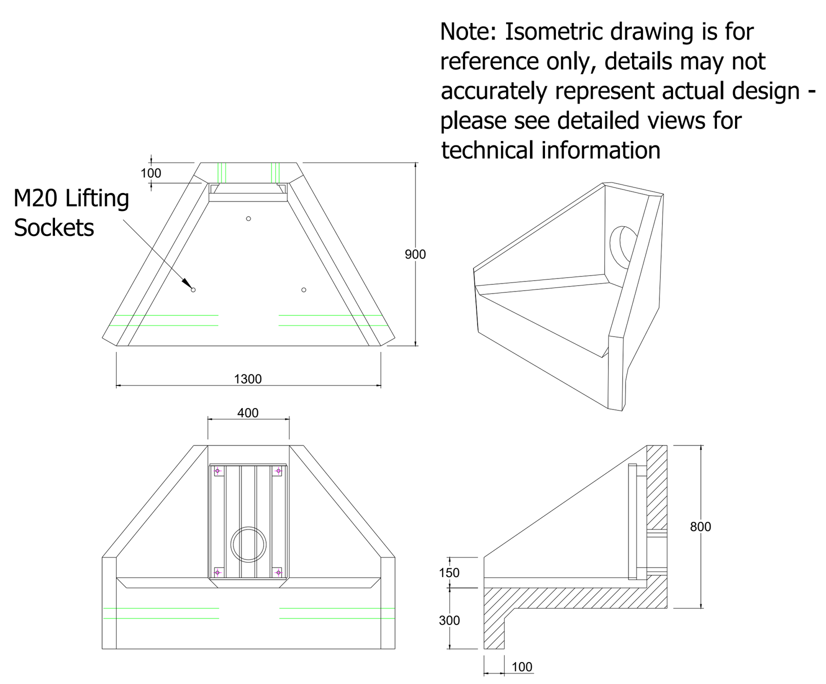
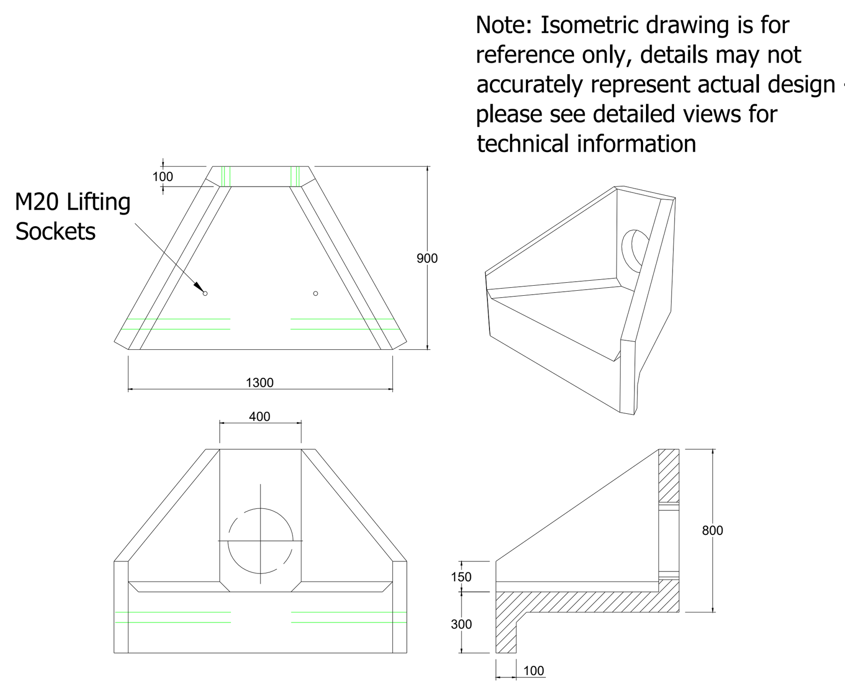


PRECAST CONCRETE OUTLET HEADWALL WITH TRASH SCREEN (ATHLON H3CA OR SIMILAR) - FITTED TO SUDS POND OUTFLOW



PRECAST CONCRETE INLET HEADWALL (ATHLON H3CA OR SIMILAR) - FITTED TO SUDS POND INFLOW

NOTE: RIGID PIPES BUILT INTO MANHOLES SHALL HAVE A FLEXIBLE JOINT AS CLOSE AS FEASIBLE TO THE EXTERNAL FACE OF THE STRUCTURE AND THE LENGTH OF THE NEXT ROCKER PIPE SHALL BE AS IN THE TABLE BELOW

MIN ROCKER PIPE LENGTH

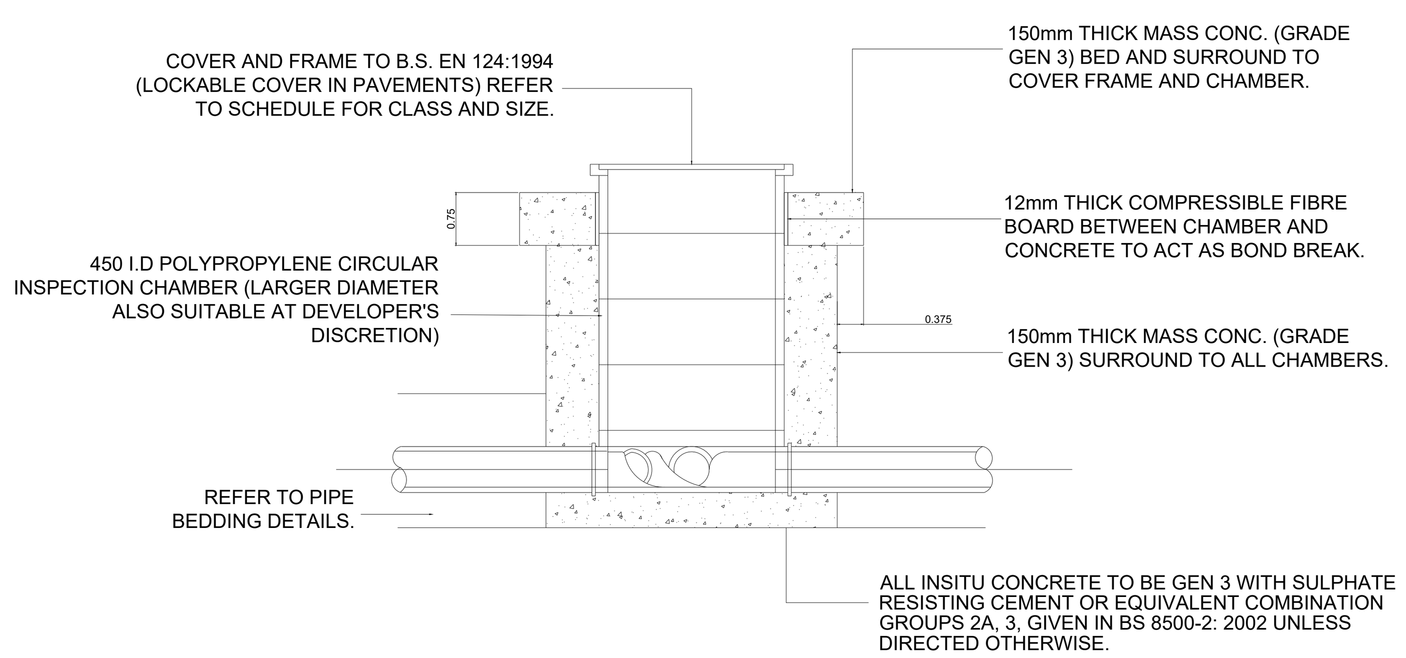
NOMINAL DIAMETER(mm)	L(mm)
150 to 600	600
over 600 to 750	1000
over 750	1250

INTERNAL DIAMETER OF MANHOLE

DIAMETER OF LARGEST PIPE IN MANHOLE (MM)	INTERNAL DIAMETER OF MANHOLE (MM)
LESS THAN 375	1200
375 to 450	1350
500 to 700	1500
750 to 900	1800
>900	PIPE DIAMETER +900

INTERNAL DIAMETER OF INSPECTION CHAMBERS

DIAMETER OF LARGEST PIPE IN MANHOLE (MM)	DIAMETER OF INSPECTION CHAMBER (MM)
LESS THAN 160	450
160 to 300	600
300 to 450	750



TYPICAL INSPECTION CHAMBER DETAIL
NTS

REV	DATE	DESCRIPTION	BY	CHK
01	04/25	DISCHARGE LOCATION UPDATED	GD	RL
00	03/25	INITIAL ISSUE	GD	RL

CLIENT:
LAIRDMANNOCH ENERGY PARK

PROJECT:
LAIRDMANNOCH EP

DRAWING TITLE:
TYPICAL DRAINAGE DETAILS (BESS AREA)

SCALE: 1:300 @ A2 (PLAN)
DATE: APRIL 2025

DRAWING NUMBER: **FIGURE 8-9-3**
REV: **01**

DRAWING STATUS: EIA

GONDOLIN LAND & WATER LTD
15 Quayside Street
Edinburgh
EH6 6EJ
Registered Company No. SC706920
GONDOLIN Land & Water

FIGURE 8-9-3 Typical Drainage Details (BESS AREA).dwg

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
FEH Rainfall Version	2013
Site Location	GB 265045 562420 NX 65045 62420
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+38

Time Area Diagram

Total Area (ha) 0.318

Time From:	(mins) To:	Area (ha)
0	4	0.318

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	249.4	1.000	586.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0101-4600-1000-4600
Design Head (m)	1.000
Design Flow (l/s)	4.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	101
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.6
Flush-Flo™	0.293	4.6
Kick-Flo®	0.633	3.7
Mean Flow over Head Range	-	4.0

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	5.0	3.000	7.7	7.000	11.5
0.200	4.5	1.400	5.4	3.500	8.3	7.500	11.9
0.300	4.6	1.600	5.7	4.000	8.8	8.000	12.2
0.400	4.5	1.800	6.0	4.500	9.3	8.500	12.6
0.500	4.4	2.000	6.3	5.000	9.8	9.000	12.9
0.600	4.0	2.200	6.6	5.500	10.2	9.500	13.3
0.800	4.1	2.400	6.9	6.000	10.7		
1.000	4.6	2.600	7.2	6.500	11.1		

Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.074	0.074	2.3	19.1	O K
30 min Summer	0.095	0.095	3.2	25.0	O K
60 min Summer	0.115	0.115	3.8	30.4	O K
120 min Summer	0.146	0.146	4.2	39.4	O K
180 min Summer	0.165	0.165	4.3	44.8	O K
240 min Summer	0.176	0.176	4.4	48.1	O K
360 min Summer	0.187	0.187	4.4	51.5	O K
480 min Summer	0.190	0.190	4.4	52.3	O K
600 min Summer	0.188	0.188	4.4	51.9	O K
720 min Summer	0.185	0.185	4.4	50.8	O K
960 min Summer	0.174	0.174	4.4	47.5	O K
1440 min Summer	0.150	0.150	4.3	40.6	O K
2160 min Summer	0.123	0.123	4.1	32.7	O K
2880 min Summer	0.108	0.108	3.6	28.6	O K
4320 min Summer	0.091	0.091	3.0	23.8	O K
5760 min Summer	0.081	0.081	2.6	21.2	O K
7200 min Summer	0.076	0.076	2.4	19.7	O K
8640 min Summer	0.072	0.072	2.2	18.7	O K
10080 min Summer	0.069	0.069	2.1	17.9	O K
15 min Winter	0.082	0.082	2.7	21.3	O K
30 min Winter	0.106	0.106	3.6	28.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	33.846	0.0	18.9	18
30 min Summer	23.410	0.0	26.6	32
60 min Summer	15.701	0.0	36.8	56
120 min Summer	11.392	0.0	53.7	90
180 min Summer	9.322	0.0	66.0	126
240 min Summer	8.034	0.0	75.9	162
360 min Summer	6.438	0.0	91.4	232
480 min Summer	5.454	0.0	103.3	302
600 min Summer	4.771	0.0	113.0	368
720 min Summer	4.263	0.0	121.2	434
960 min Summer	3.547	0.0	134.5	566
1440 min Summer	2.705	0.0	153.7	808
2160 min Summer	2.047	0.0	175.3	1152
2880 min Summer	1.683	0.0	192.2	1524
4320 min Summer	1.291	0.0	220.7	2244
5760 min Summer	1.083	0.0	247.7	2944
7200 min Summer	0.959	0.0	274.0	3672
8640 min Summer	0.876	0.0	300.2	4408
10080 min Summer	0.818	0.0	326.7	5136
15 min Winter	33.846	0.0	21.4	18
30 min Winter	23.410	0.0	30.0	31

Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.129	0.129	4.1	34.4	O K
120 min Winter	0.163	0.163	4.3	44.3	O K
180 min Winter	0.182	0.182	4.4	49.9	O K
240 min Winter	0.192	0.192	4.5	53.1	O K
360 min Winter	0.201	0.201	4.5	55.6	O K
480 min Winter	0.199	0.199	4.5	55.2	O K
600 min Winter	0.194	0.194	4.5	53.4	O K
720 min Winter	0.185	0.185	4.4	51.0	O K
960 min Winter	0.166	0.166	4.4	45.3	O K
1440 min Winter	0.132	0.132	4.1	35.2	O K
2160 min Winter	0.105	0.105	3.5	27.6	O K
2880 min Winter	0.090	0.090	3.0	23.6	O K
4320 min Winter	0.075	0.075	2.4	19.5	O K
5760 min Winter	0.067	0.067	2.0	17.4	O K
7200 min Winter	0.063	0.063	1.8	16.1	O K
8640 min Winter	0.059	0.059	1.6	15.3	O K
10080 min Winter	0.057	0.057	1.5	14.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	15.701	0.0	41.3	58
120 min Winter	11.392	0.0	60.2	96
180 min Winter	9.322	0.0	74.0	136
240 min Winter	8.034	0.0	85.1	176
360 min Winter	6.438	0.0	102.4	254
480 min Winter	5.454	0.0	115.8	326
600 min Winter	4.771	0.0	126.6	398
720 min Winter	4.263	0.0	135.8	464
960 min Winter	3.547	0.0	150.7	596
1440 min Winter	2.705	0.0	172.3	834
2160 min Winter	2.047	0.0	196.4	1172
2880 min Winter	1.683	0.0	215.3	1528
4320 min Winter	1.291	0.0	247.3	2248
5760 min Winter	1.083	0.0	277.4	2992
7200 min Winter	0.959	0.0	306.9	3672
8640 min Winter	0.876	0.0	336.3	4416
10080 min Winter	0.818	0.0	366.0	5080

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.122	0.122	4.1	32.5	O K
30 min Summer	0.160	0.160	4.3	43.4	O K
60 min Summer	0.196	0.196	4.5	54.3	O K
120 min Summer	0.231	0.231	4.6	65.0	O K
180 min Summer	0.249	0.249	4.6	70.8	O K
240 min Summer	0.260	0.260	4.6	74.3	O K
360 min Summer	0.271	0.271	4.6	77.7	O K
480 min Summer	0.272	0.272	4.6	78.2	O K
600 min Summer	0.269	0.269	4.6	77.2	O K
720 min Summer	0.264	0.264	4.6	75.4	O K
960 min Summer	0.249	0.249	4.6	70.6	O K
1440 min Summer	0.216	0.216	4.5	60.2	O K
2160 min Summer	0.173	0.173	4.4	47.2	O K
2880 min Summer	0.142	0.142	4.2	38.3	O K
4320 min Summer	0.112	0.112	3.8	29.6	O K
5760 min Summer	0.097	0.097	3.3	25.6	O K
7200 min Summer	0.089	0.089	3.0	23.2	O K
8640 min Summer	0.083	0.083	2.7	21.7	O K
10080 min Summer	0.079	0.079	2.6	20.6	O K
15 min Winter	0.136	0.136	4.2	36.5	O K
30 min Winter	0.179	0.179	4.4	49.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	58.086	0.0	33.3	18
30 min Summer	40.213	0.0	46.6	32
60 min Summer	26.759	0.0	63.2	60
120 min Summer	17.789	0.0	84.2	106
180 min Summer	13.928	0.0	98.9	142
240 min Summer	11.676	0.0	110.7	176
360 min Summer	9.061	0.0	128.9	246
480 min Summer	7.524	0.0	142.8	316
600 min Summer	6.492	0.0	154.0	386
720 min Summer	5.743	0.0	163.5	454
960 min Summer	4.713	0.0	178.9	586
1440 min Summer	3.542	0.0	201.6	838
2160 min Summer	2.648	0.0	226.9	1208
2880 min Summer	2.159	0.0	246.6	1556
4320 min Summer	1.635	0.0	279.8	2248
5760 min Summer	1.358	0.0	310.7	2944
7200 min Summer	1.191	0.0	340.6	3680
8640 min Summer	1.079	0.0	370.2	4408
10080 min Summer	1.000	0.0	399.8	5136
15 min Winter	58.086	0.0	37.5	18
30 min Winter	40.213	0.0	52.3	32

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.220	0.220	4.5	61.6	O K
120 min Winter	0.260	0.260	4.6	74.4	O K
180 min Winter	0.278	0.278	4.6	80.2	O K
240 min Winter	0.289	0.289	4.6	83.9	O K
360 min Winter	0.298	0.298	4.6	86.7	O K
480 min Winter	0.296	0.296	4.6	86.0	O K
600 min Winter	0.288	0.288	4.6	83.5	O K
720 min Winter	0.278	0.278	4.6	80.0	O K
960 min Winter	0.252	0.252	4.6	71.7	O K
1440 min Winter	0.200	0.200	4.5	55.4	O K
2160 min Winter	0.141	0.141	4.2	38.0	O K
2880 min Winter	0.113	0.113	3.8	30.0	O K
4320 min Winter	0.090	0.090	3.0	23.4	O K
5760 min Winter	0.078	0.078	2.5	20.4	O K
7200 min Winter	0.072	0.072	2.2	18.6	O K
8640 min Winter	0.068	0.068	2.0	17.5	O K
10080 min Winter	0.065	0.065	1.9	16.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	26.759	0.0	70.8	60
120 min Winter	17.789	0.0	94.3	116
180 min Winter	13.928	0.0	110.9	162
240 min Winter	11.676	0.0	124.0	188
360 min Winter	9.061	0.0	144.4	268
480 min Winter	7.524	0.0	160.0	344
600 min Winter	6.492	0.0	172.6	418
720 min Winter	5.743	0.0	183.2	492
960 min Winter	4.713	0.0	200.5	628
1440 min Winter	3.542	0.0	225.9	882
2160 min Winter	2.648	0.0	254.2	1232
2880 min Winter	2.159	0.0	276.2	1556
4320 min Winter	1.635	0.0	313.5	2248
5760 min Winter	1.358	0.0	348.1	2992
7200 min Winter	1.191	0.0	381.5	3680
8640 min Winter	1.079	0.0	414.7	4408
10080 min Winter	1.000	0.0	448.0	5136

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.168	0.168	4.4	45.7	O K
30 min Summer	0.221	0.221	4.5	61.9	O K
60 min Summer	0.272	0.272	4.6	78.0	O K
120 min Summer	0.311	0.311	4.6	91.3	O K
180 min Summer	0.328	0.328	4.6	96.9	O K
240 min Summer	0.338	0.338	4.6	100.2	O K
360 min Summer	0.346	0.346	4.6	103.2	O K
480 min Summer	0.346	0.346	4.6	103.2	O K
600 min Summer	0.342	0.342	4.6	101.8	O K
720 min Summer	0.335	0.335	4.6	99.5	O K
960 min Summer	0.318	0.318	4.6	93.5	O K
1440 min Summer	0.280	0.280	4.6	80.7	O K
2160 min Summer	0.226	0.226	4.5	63.4	O K
2880 min Summer	0.185	0.185	4.4	50.8	O K
4320 min Summer	0.134	0.134	4.2	35.8	O K
5760 min Summer	0.112	0.112	3.8	29.6	O K
7200 min Summer	0.101	0.101	3.4	26.5	O K
8640 min Summer	0.093	0.093	3.1	24.4	O K
10080 min Summer	0.088	0.088	2.9	22.9	O K
15 min Winter	0.187	0.187	4.4	51.4	O K
30 min Winter	0.246	0.246	4.6	69.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	80.919	0.0	46.9	18
30 min Summer	56.225	0.0	65.6	33
60 min Summer	37.155	0.0	87.9	62
120 min Summer	23.712	0.0	112.4	120
180 min Summer	18.149	0.0	129.1	160
240 min Summer	14.981	0.0	142.2	194
360 min Summer	11.393	0.0	162.2	260
480 min Summer	9.347	0.0	177.5	330
600 min Summer	7.998	0.0	189.9	398
720 min Summer	7.031	0.0	200.3	468
960 min Summer	5.720	0.0	217.3	604
1440 min Summer	4.260	0.0	242.7	866
2160 min Summer	3.157	0.0	270.6	1232
2880 min Summer	2.558	0.0	292.3	1588
4320 min Summer	1.921	0.0	328.8	2288
5760 min Summer	1.585	0.0	362.7	2960
7200 min Summer	1.382	0.0	395.0	3680
8640 min Summer	1.244	0.0	426.8	4408
10080 min Summer	1.147	0.0	458.5	5144
15 min Winter	80.919	0.0	52.7	18
30 min Winter	56.225	0.0	73.6	32

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.302	0.302	4.6	88.3	O K
120 min Winter	0.349	0.349	4.6	104.3	O K
180 min Winter	0.370	0.370	4.6	111.5	O K
240 min Winter	0.379	0.379	4.6	114.8	O K
360 min Winter	0.385	0.385	4.6	117.1	O K
480 min Winter	0.383	0.383	4.6	116.3	O K
600 min Winter	0.374	0.374	4.6	113.3	O K
720 min Winter	0.363	0.363	4.6	109.1	O K
960 min Winter	0.334	0.334	4.6	99.1	O K
1440 min Winter	0.273	0.273	4.6	78.6	O K
2160 min Winter	0.194	0.194	4.5	53.7	O K
2880 min Winter	0.142	0.142	4.2	38.2	O K
4320 min Winter	0.104	0.104	3.5	27.3	O K
5760 min Winter	0.088	0.088	2.9	23.0	O K
7200 min Winter	0.080	0.080	2.6	20.7	O K
8640 min Winter	0.074	0.074	2.3	19.2	O K
10080 min Winter	0.070	0.070	2.1	18.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	37.155	0.0	98.6	60
120 min Winter	23.712	0.0	126.0	118
180 min Winter	18.149	0.0	144.7	174
240 min Winter	14.981	0.0	159.3	224
360 min Winter	11.393	0.0	181.8	280
480 min Winter	9.347	0.0	198.9	360
600 min Winter	7.998	0.0	212.7	436
720 min Winter	7.031	0.0	224.5	512
960 min Winter	5.720	0.0	243.5	654
1440 min Winter	4.260	0.0	271.9	922
2160 min Winter	3.157	0.0	303.1	1280
2880 min Winter	2.558	0.0	327.4	1612
4320 min Winter	1.921	0.0	368.5	2252
5760 min Winter	1.585	0.0	406.2	2992
7200 min Winter	1.382	0.0	442.5	3672
8640 min Winter	1.244	0.0	478.2	4408
10080 min Winter	1.147	0.0	513.7	5144

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.230	0.230	4.5	64.6	O K
30 min Summer	0.303	0.303	4.6	88.5	O K
60 min Summer	0.371	0.371	4.6	112.1	O K
120 min Summer	0.416	0.416	4.6	128.5	O K
180 min Summer	0.434	0.434	4.6	135.2	O K
240 min Summer	0.441	0.441	4.6	137.7	O K
360 min Summer	0.445	0.445	4.6	139.2	O K
480 min Summer	0.442	0.442	4.6	138.3	O K
600 min Summer	0.436	0.436	4.6	136.1	O K
720 min Summer	0.428	0.428	4.6	133.1	O K
960 min Summer	0.409	0.409	4.6	125.8	O K
1440 min Summer	0.366	0.366	4.6	110.2	O K
2160 min Summer	0.303	0.303	4.6	88.3	O K
2880 min Summer	0.250	0.250	4.6	70.9	O K
4320 min Summer	0.177	0.177	4.4	48.4	O K
5760 min Summer	0.136	0.136	4.2	36.4	O K
7200 min Summer	0.117	0.117	3.9	31.0	O K
8640 min Summer	0.107	0.107	3.6	28.1	O K
10080 min Summer	0.099	0.099	3.3	26.1	O K
15 min Winter	0.255	0.255	4.6	72.6	O K
30 min Winter	0.336	0.336	4.6	99.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	113.205	0.0	66.1	18
30 min Summer	79.056	0.0	92.7	33
60 min Summer	51.827	0.0	122.9	62
120 min Summer	31.823	0.0	151.0	122
180 min Summer	23.824	0.0	169.7	180
240 min Summer	19.374	0.0	184.0	228
360 min Summer	14.454	0.0	206.0	288
480 min Summer	11.719	0.0	222.7	352
600 min Summer	9.946	0.0	236.3	420
720 min Summer	8.691	0.0	247.8	488
960 min Summer	7.011	0.0	266.5	624
1440 min Summer	5.168	0.0	294.6	894
2160 min Summer	3.798	0.0	325.6	1276
2880 min Summer	3.059	0.0	349.6	1640
4320 min Summer	2.275	0.0	389.6	2332
5760 min Summer	1.863	0.0	426.2	3000
7200 min Summer	1.614	0.0	461.5	3680
8640 min Summer	1.446	0.0	496.0	4408
10080 min Summer	1.325	0.0	530.0	5144
15 min Winter	113.205	0.0	74.1	18
30 min Winter	79.056	0.0	104.0	32

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.411	0.411	4.6	126.6	O K
120 min Winter	0.463	0.463	4.6	146.3	O K
180 min Winter	0.486	0.486	4.6	155.3	O K
240 min Winter	0.497	0.497	4.6	159.5	O K
360 min Winter	0.500	0.500	4.6	160.8	O K
480 min Winter	0.494	0.494	4.6	158.6	O K
600 min Winter	0.486	0.486	4.6	155.1	O K
720 min Winter	0.473	0.473	4.6	150.4	O K
960 min Winter	0.444	0.444	4.6	138.8	O K
1440 min Winter	0.376	0.376	4.6	113.9	O K
2160 min Winter	0.279	0.279	4.6	80.6	O K
2880 min Winter	0.204	0.204	4.5	56.7	O K
4320 min Winter	0.123	0.123	4.1	32.8	O K
5760 min Winter	0.102	0.102	3.4	26.7	O K
7200 min Winter	0.090	0.090	3.0	23.5	O K
8640 min Winter	0.082	0.082	2.7	21.5	O K
10080 min Winter	0.078	0.078	2.5	20.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	51.827	0.0	137.7	62
120 min Winter	31.823	0.0	169.2	120
180 min Winter	23.824	0.0	190.1	176
240 min Winter	19.374	0.0	206.2	232
360 min Winter	14.454	0.0	230.8	336
480 min Winter	11.719	0.0	249.5	380
600 min Winter	9.946	0.0	264.7	458
720 min Winter	8.691	0.0	277.6	534
960 min Winter	7.011	0.0	298.5	682
1440 min Winter	5.168	0.0	330.0	966
2160 min Winter	3.798	0.0	364.7	1340
2880 min Winter	3.059	0.0	391.6	1676
4320 min Winter	2.275	0.0	436.5	2292
5760 min Winter	1.863	0.0	477.4	2992
7200 min Winter	1.614	0.0	516.9	3680
8640 min Winter	1.446	0.0	555.6	4416
10080 min Winter	1.325	0.0	593.9	5104

Summary of Results for 200 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.270	0.270	4.6	77.4	O K
30 min Summer	0.356	0.356	4.6	106.8	O K
60 min Summer	0.435	0.435	4.6	135.5	O K
120 min Summer	0.481	0.481	4.6	153.5	O K
180 min Summer	0.500	0.500	4.6	160.9	O K
240 min Summer	0.507	0.507	4.6	163.8	O K
360 min Summer	0.507	0.507	4.6	163.8	O K
480 min Summer	0.503	0.503	4.6	162.0	O K
600 min Summer	0.496	0.496	4.6	159.2	O K
720 min Summer	0.487	0.487	4.6	155.7	O K
960 min Summer	0.466	0.466	4.6	147.5	O K
1440 min Summer	0.421	0.421	4.6	130.2	O K
2160 min Summer	0.354	0.354	4.6	105.9	O K
2880 min Summer	0.295	0.295	4.6	85.9	O K
4320 min Summer	0.210	0.210	4.5	58.4	O K
5760 min Summer	0.158	0.158	4.3	43.0	O K
7200 min Summer	0.129	0.129	4.1	34.5	O K
8640 min Summer	0.116	0.116	3.9	30.7	O K
10080 min Summer	0.107	0.107	3.6	28.3	O K
15 min Winter	0.299	0.299	4.6	87.0	O K
30 min Winter	0.394	0.394	4.6	120.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	135.013	0.0	79.0	18
30 min Summer	94.599	0.0	111.2	33
60 min Summer	61.828	0.0	146.7	62
120 min Summer	37.202	0.0	176.7	122
180 min Summer	27.527	0.0	196.1	182
240 min Summer	22.207	0.0	211.0	240
360 min Summer	16.400	0.0	233.8	310
480 min Summer	13.219	0.0	251.3	372
600 min Summer	11.175	0.0	265.5	434
720 min Summer	9.737	0.0	277.6	502
960 min Summer	7.821	0.0	297.3	636
1440 min Summer	5.732	0.0	326.8	908
2160 min Summer	4.193	0.0	359.6	1296
2880 min Summer	3.369	0.0	385.1	1668
4320 min Summer	2.496	0.0	427.4	2376
5760 min Summer	2.037	0.0	466.1	3056
7200 min Summer	1.760	0.0	503.2	3744
8640 min Summer	1.572	0.0	539.4	4408
10080 min Summer	1.438	0.0	575.0	5144
15 min Winter	135.013	0.0	88.6	18
30 min Winter	94.599	0.0	124.6	33

Summary of Results for 200 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.480	0.480	4.6	153.0	O K
120 min Winter	0.534	0.534	4.6	174.6	O K
180 min Winter	0.558	0.558	4.6	184.5	O K
240 min Winter	0.569	0.569	4.6	189.3	O K
360 min Winter	0.574	0.574	4.6	191.3	O K
480 min Winter	0.566	0.566	4.6	187.9	O K
600 min Winter	0.555	0.555	4.6	183.4	O K
720 min Winter	0.543	0.543	4.6	178.3	O K
960 min Winter	0.512	0.512	4.6	165.9	O K
1440 min Winter	0.443	0.443	4.6	138.6	O K
2160 min Winter	0.339	0.339	4.6	100.8	O K
2880 min Winter	0.253	0.253	4.6	71.9	O K
4320 min Winter	0.147	0.147	4.2	39.6	O K
5760 min Winter	0.111	0.111	3.7	29.4	O K
7200 min Winter	0.097	0.097	3.3	25.4	O K
8640 min Winter	0.088	0.088	2.9	23.0	O K
10080 min Winter	0.082	0.082	2.7	21.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	61.828	0.0	164.4	62
120 min Winter	37.202	0.0	197.9	120
180 min Winter	27.527	0.0	219.7	178
240 min Winter	22.207	0.0	236.4	234
360 min Winter	16.400	0.0	261.9	344
480 min Winter	13.219	0.0	281.5	444
600 min Winter	11.175	0.0	297.5	474
720 min Winter	9.737	0.0	311.0	550
960 min Winter	7.821	0.0	333.1	700
1440 min Winter	5.732	0.0	366.0	982
2160 min Winter	4.193	0.0	402.8	1380
2880 min Winter	3.369	0.0	431.4	1728
4320 min Winter	2.496	0.0	478.9	2376
5760 min Winter	2.037	0.0	522.1	3000
7200 min Winter	1.760	0.0	563.6	3744
8640 min Winter	1.572	0.0	604.2	4408
10080 min Winter	1.438	0.0	644.2	5144

Summary of Results for 200 year Return Period (+38%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m^3)	Status
15 min Summer	0.359	0.359	4.6	107.7	O K
30 min Summer	0.471	0.471	4.6	149.3	O K
60 min Summer	0.573	0.573	4.6	191.0	O K
120 min Summer	0.641	0.641	4.6	220.8	O K
180 min Summer	0.674	0.674	4.6	235.8	O K
240 min Summer	0.692	0.692	4.6	244.2	O K
360 min Summer	0.707	0.707	4.6	251.2	O K
480 min Summer	0.707	0.707	4.6	251.2	O K
600 min Summer	0.702	0.702	4.6	248.6	O K
720 min Summer	0.695	0.695	4.6	245.4	O K
960 min Summer	0.678	0.678	4.6	237.6	O K
1440 min Summer	0.639	0.639	4.6	220.0	O K
2160 min Summer	0.571	0.571	4.6	190.0	O K
2880 min Summer	0.507	0.507	4.6	163.7	O K
4320 min Summer	0.397	0.397	4.6	121.3	O K
5760 min Summer	0.310	0.310	4.6	90.8	O K
7200 min Summer	0.249	0.249	4.6	70.7	O K
8640 min Summer	0.206	0.206	4.5	57.2	O K
10080 min Summer	0.175	0.175	4.4	47.9	O K
15 min Winter	0.396	0.396	4.6	121.0	O K
30 min Winter	0.518	0.518	4.6	167.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m^3)	Discharge Volume (m^3)	Time-Peak (mins)
15 min Summer	186.318	0.0	109.5	19
30 min Summer	130.546	0.0	153.8	33
60 min Summer	85.322	0.0	202.7	64
120 min Summer	51.339	0.0	244.0	122
180 min Summer	37.987	0.0	270.8	182
240 min Summer	30.646	0.0	291.4	242
360 min Summer	22.631	0.0	322.8	360
480 min Summer	18.242	0.0	346.9	478
600 min Summer	15.422	0.0	366.5	526
720 min Summer	13.437	0.0	383.2	592
960 min Summer	10.793	0.0	410.3	720
1440 min Summer	7.910	0.0	450.7	994
2160 min Summer	5.787	0.0	496.3	1384
2880 min Summer	4.649	0.0	531.6	1760
4320 min Summer	3.444	0.0	590.2	2508
5760 min Summer	2.811	0.0	643.3	3224
7200 min Summer	2.428	0.0	694.6	3896
8640 min Summer	2.170	0.0	744.6	4584
10080 min Summer	1.984	0.0	793.8	5248
15 min Winter	186.318	0.0	122.7	18
30 min Winter	130.546	0.0	172.3	33

Summary of Results for 200 year Return Period (+38%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.630	0.630	4.6	215.6	O K
120 min Winter	0.705	0.705	4.6	250.0	O K
180 min Winter	0.742	0.742	4.6	267.7	O K
240 min Winter	0.763	0.763	4.6	278.2	O K
360 min Winter	0.784	0.784	4.6	288.5	O K
480 min Winter	0.789	0.789	4.6	291.0	O K
600 min Winter	0.785	0.785	4.6	289.0	O K
720 min Winter	0.776	0.776	4.6	284.5	O K
960 min Winter	0.755	0.755	4.6	274.0	O K
1440 min Winter	0.705	0.705	4.6	250.3	O K
2160 min Winter	0.608	0.608	4.6	206.2	O K
2880 min Winter	0.504	0.504	4.6	162.6	O K
4320 min Winter	0.331	0.331	4.6	98.0	O K
5760 min Winter	0.214	0.214	4.5	59.7	O K
7200 min Winter	0.150	0.150	4.3	40.5	O K
8640 min Winter	0.120	0.120	4.0	32.0	O K
10080 min Winter	0.110	0.110	3.7	29.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	85.322	0.0	227.1	62
120 min Winter	51.339	0.0	273.3	120
180 min Winter	37.987	0.0	303.4	178
240 min Winter	30.646	0.0	326.3	236
360 min Winter	22.631	0.0	361.5	350
480 min Winter	18.242	0.0	388.5	462
600 min Winter	15.422	0.0	410.5	570
720 min Winter	13.437	0.0	429.1	670
960 min Winter	10.793	0.0	459.5	760
1440 min Winter	7.910	0.0	504.5	1068
2160 min Winter	5.787	0.0	555.9	1516
2880 min Winter	4.649	0.0	595.5	1900
4320 min Winter	3.444	0.0	661.2	2596
5760 min Winter	2.811	0.0	720.6	3240
7200 min Winter	2.428	0.0	778.0	3888
8640 min Winter	2.170	0.0	834.0	4488
10080 min Winter	1.984	0.0	889.3	5144