



GONDOLIN
Land & Water
Civil Engineering & Environmental Solutions

Hunshelf BES - FRDA

Flood Risk & Drainage Assessment Report

Client: PWA Planning Ltd

Project/Proposal No: GON.0070.0040

Version: 1

Date: 04/10/2022





Document Information

Project Name:	Hunshelf BES - FRDA
Document Title:	Flood Risk & Drainage Assessment
Client Name:	PWA Planning Ltd
Document Status:	Final
Author:	Rose Briggs
Reviewed:	Stephen Donnan
Approved:	Zak Ritchie
Date:	04/10/2022
Version:	1
Project/Proposal Number:	GON.0070.0040

Revision History

Version	Date	Authored	Reviewed	Approved	Notes
1	2022-10-04	Rose Briggs	Stephen Donnan	Zak Ritchie	Final for Issue

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1. Introduction

1.1 Preamble

Gondolin Land and Water Ltd (Gondolin) has been appointed by PWA Planning on behalf of the the Applicant (Harmony Energy) to prepare a Flood Risk and Drainage Assessment (FRDA) in support of a planning application for a battery energy storage site (BES) located at 'Land off Tofts Lane, Sheffield, S6 5SL'.

This report addresses any potential flood risk to the proposed developments from all possible sources in accordance with best practice and National Planning Policy Framework (NPPF).

This report provides the relevant design information for the proposed site surface water drainage / SuDS scheme taking due cognisance of local / national drainage design guidance (CIRIA Report C753), Sheffield Council guidance as the Lead Local Flood Authority (LLFA).

1.2 Site Context

The site is located north-west of the village Stocksbridge, at approximate National Grid Reference (NGR): SE 26245 00025. The site currently comprises grazing fields and is accessed from the north via Tofts Lane. An existing substation site is located to the immediate east of the site with further grazing / agricultural fields surrounding the remainder of the site extents.

1.3 Development Details

The proposed development is for a battery storage facility with associated infrastructure. A proposed site plan is included in Appendix A.

1.4 Topography

A topographic survey has been undertaken for the site and this is duly incorporated within the proposed drainage / SuDS design and included within the relevant drawings.

The site area has a predominant fall to the north east. The maximum elevation within the site area is located at the south western corner of the site, at an elevation of approximately 283mAOD. The lowest elevation within the site area is along the north east boundary adjacent to Tofts Lane at approximately 280mAOD.

1.5 Geology and Hydrogeology

1.5.1 Geology

1.5.1.1 Superficial

Review of the British Geological Survey (BGS) ¹online geology maps indicates that no superficial deposits are recorded within the site extent or immediate surroundings.

1.5.1.2 Bedrock

Review of the BGS online geology maps shows that the bedrock geology at the site is the Greenmoor Rock Formation comprising Sandstone.

¹ British Geological Survey (2022) Natural Environment Research Council – online Geology of Britain Viewer, available at: <https://mapapps.bgs.ac.uk/geologyofbritain/home.html> (accessed on 12th August 2022)



1.5.2 Hydrogeology

Review of the BGS online hydrogeology maps indicates that the underlying bedrock is a Secondary B aquifer of moderate productivity, with all flow being virtually through fractures and other discontinuities.

The bedrock aquifer is classified as having a high vulnerability to transmittal of pollutants, likely due to the absence of overlying superficial deposits.

1.5.3 Site Investigation

No site investigation information is available at this stage, however review of adjacent freely available BGS Borehole Logs² confirms the presence of shallow clays based soils overlying sedimentary bedrock which is near the surface.

1.6 Local Hydrology and Existing Drainage Scheme

Review of the Flood Estimation Handbook (FEH) Web Service³ and other available mapping shows that the site lies within the surface water catchment of the Dean Brook, a minor watercourse whose headwaters are located approximately 200m north east of the site. The Dean Brook is a tributary to the River Don with their confluence being approximately 1.4km north east of the site.

Rainfall landing on the site will benefit from limited initial storage and infiltration within the clay based soils, and when the field capacity is exceeded runoff would be generated with overland flow following the local topography north east towards Tofts Lane. Existing road drainage is present on Tofts Lane, a combination of road gullies, pipework and ditches. This existing drainage system accepts runoff from Tofts Lane, excess runoff from the surrounding land and runoff from the existing substation site. The existing drainage system was observed to convey to the natural low point of the local area at the junction of Tofts Lane and Mucky Lane. From here, a piped outfall traverses the adjacent northern field and discharges to the Dean Brook.

Drawing FRDA-002 provides a hydrological overview of the site and local area.

2. Planning & Policy Context

2.1 Overview

This assessment has been completed in accordance with guidance presented within the current National Planning Policy Framework (NPPF).

This report has also been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development published by the Construction Industry Research and Information Association (CIRIA)⁴, the British Standards Institution (BSI) BS8533⁵ and the Environment Agency (EA) National Standing Advice on Development and Flood Risk⁶.

The assessment also references and takes due consideration (where appropriate) of the following principal guidance and policy documents:

- Environment Agency Flood Risk Assessment Standing Advice (2019);
- British Standards Institution Assessing and managing flood risk in development (2017);
- CIRIA Development and Flood Risk Guidance for the Construction Industry, Report C624 (2004);

² British Geological Survey (2022) Natural Environment Research Council – online Geoindex Viewer, available at: https://mapapps2.bgs.ac.uk/geoindex/home.html?layer=BGSBoreholes&_ga=2.143409717.1600983522.1661451085-123240606.1661451085 (accessed on 30th August 2022)

³ UK Centre for Ecology and Hydrology (2022) Flood Estimation handbook Web Service, available at: <https://fehweb.ceh.ac.uk/> (accessed on 12th August 2022)

⁴ CIRIA Report C624, Development and Flood risk: guidance for the construction industry (October 2004)

⁵ BS8533:2017, Assessing and managing flood risk in development: Code of Practice (December 2017)

⁶ Environment Agency, April 2012, Flood Risk Assessment: Standing Advice (updated March 2019)



- CIRIA The SuDS Manual, Report C753 (2015);
- Planning Practice Guidance on Flood Risk and Coastal Change (Updated August 2022); and
- Sheffield Council Strategic Flood Risk Assessment (2008).

2.2 National Planning Policy

2.2.1 Flood Zone Classification

The definition of EA Flood Zones is provided in PPG Table 1: Flood Zones:

- **Zone 1** - *low probability* is defined as land which could be at risk of flooding from fluvial or tidal flood events with less than 0.1% (1:1,000 year) Annual Exceedance Probability (AEP) of occurrence.
- **Zone 2** - *medium probability* is defined as land which could be at risk of flooding with an annual probability of occurrence between 1% and 0.1% from fluvial sources and between 0.5% and 0.1% from tidal sources.
- **Zone 3a** - *high probability* is defined as land which could be at risk of flooding with an annual probability of occurrence greater than 1% (1:100 year) from fluvial sources and greater than 0.5% (1:200 year) from tidal sources.
- **Zone 3b** - *the functional floodplain* is defined as land where water has to flow or be stored in times of flood. Function floodplain will normally comprise:
 - Land having an annual probability of occurrence greater than 3.3% (1:30 year), with any infrastructure operating effectively; or
 - Land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain in agreement with the Environment Agency.

In assessing the Flood Zone Classification, the protection afforded by any flood defence structures is not taken into account by the EA.

Review of the EA Flood Map for Planning confirms that the Hunshelf site is located within Flood Zone 1.

2.2.2 Flood Risk Vulnerability

With reference to PPG Table 2: *Flood Risk Vulnerability Classification*, whilst battery storage developments are not specifically addressed, it is considered that they are classified as 'essential infrastructure' and would fall under the following definition:

"Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood."

2.2.3 Flood Risk Compatibility

PPG Table 3: *Flood Risk Vulnerability and Flood Zone 'Compatibility'* (replicated as Table 1 below) confirms that the site is appropriate for 'Essential Infrastructure' use in its designated Flood Zone 1, and does not require an Exception Test, refer to highlighted table cell.

A sequential test is also not required as the site is already located in Flood Zone 1 and there are no other material flood risks identified (refer to Table 2).



Table 1 Flood Risk Vulnerability and Flood Zone ‘Compatibility’

Flood Risk Vulnerability Classification (PPG Table 2)		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone (PPG Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test Required	✓	✓	✓
	Zone 3a	Exception Test Required	X	Exception Test Required	✓	✓
	Zone 3b (functional floodplain)	Exception Test Required	X	X	X	✓

Key: ✓ Development is appropriate x Development should not be permitted

3. Flood Risk Assessment

3.1 Screening Assessment of Potential Source of Flood Risk

3.1.1 Overview

There are a number of potential sources of flooding which should be evaluated in accordance with best practice and NPPF such as:

- Flooding from rivers or fluvial flooding;
- Flooding from the sea or tidal / coastal flooding;
- Flooding from land;
- Flooding from groundwater;
- Flooding from sewers; and
- Flooding from reservoirs, canals, and other artificial sources.

The flood risk from each of these potential sources is discussed in the following sections and a ‘screening assessment’ is presented in Section 3.1.8 which confirms any potential flood risk sources requiring a more detailed analysis and specification of bespoke mitigation measures.

Flood ‘risk’ definitions within the screening exercise are based on a qualitative technical assessment taking into account the information reviewed, risk to site users and the Proposed Development itself.

3.1.2 Fluvial Flooding

Review of the Environmental Agency’s Flood Map for planning⁷ indicates that the site is situated wholly within *Flood Zone 1*. Due to the site area being within *Flood Zone 1*, it is considered to have a low risk of flooding from rivers. This means that each year this area has a probability of flooding of less than 1% (1:1,000).

Taking all of the above into account, it is therefore considered there is ‘**Low Risk**’ of flooding at the site from this source.

3.1.3 Tidal/Coastal Flooding

The site is located sufficiently inland from tidally influenced waters and the coast, thus is not subject to tidal or coastal flood risk and designated as ‘**No Risk**’ to the site.

⁷ Environment Agency Flood Map for Planning, available at: <https://flood-map-for-planning.service.gov.uk> (Accessed on 12th of August 2022)



Flooding from this source is therefore not considered further in the assessment.

3.1.4 Flooding from Land (Pluvial or Surface Water Flooding)

Review of the EA Surface Water Flood Map⁸ shows the site is designated as a 'low risk' area for surface water flooding. Due to the sloping nature of the surrounding topography, any accumulation of surface water flooding would readily shed north east, towards Tofts Lane and the Dean Brook. The proposed drainage strategy (see Section 4) inherently considers the potential risk of overland flow entering the site from upgradient areas via a 'cut-off' filter drain to capture this upgradient runoff and allow it to pass downgradient following the existing hydrological regime.

Taking the above into account it is considered that there is '**Low Risk**' of flooding to the site from land, therefore this source will not be considered further in the assessment.

3.1.5 Groundwater Flooding

Review of the Sheffield Strategic Flood Risk Assessment (SFRA) and the accompanying Flood Zone map indicates the site is not located within an area at high risk of being susceptible to groundwater flooding. The SFRA for within Sheffield Council district also notes that there are no known incidents of groundwater flooding within the Sheffield area, with the potential risk of groundwater flooding being extremely low.

Taking the above into account it is considered that the Proposed Development site is at '**Low Risk**' of groundwater flooding and therefore flooding from this source is not considered further.

3.1.6 Flooding from Sewers / Drainage Systems

The Sheffield SFRA details that there are no Critical Drainage Areas within or near the development site, as to be expected given the rural nature of the site. The existing drainage network located along Tofts Lane is located downgradient of the site.

Taking the above into account, it is considered that there is '**Negligible Risk**' of flooding to the development site from sewers and/or drainage systems and therefore this source will not be considered further in the assessment.

3.1.7 Flooding from Infrastructure Failure / Blockage

Review of the EA Reservoir Flood Map⁹ for the area indicates that the site does not fall within any extent of flooding from reservoirs. Review of the SFRA indicates that the site is not located in or near to any canals or reservoirs and that there are no records of breaching or overtopping in the area.

There are no other significant infrastructure i.e. culverts, pumping stations, aqueducts etc located upstream or in hydraulic continuity / proximity to the site which may pose a flood risk during a failure scenario.

It is therefore considered that there is '**No Risk**' of flooding at the site from this source, and thus will not be considered further.

3.1.8 Flood Risk Screening Assessment Review

A summary of the potential flood risk to the site from the sources reviewed in presented in Table 2 below.

This 'Screening Assessment' is used to identify if any sources of flood risk are required to be investigated in more detail i.e., a 'Technical' more detailed assessment which may include consideration / specification of bespoke flood mitigation measures for the site development if considered necessary.

⁸ Environment Agency Surface Water Flood Map, available at: <https://www.gov.uk/check-long-term-flood-risk> (Accessed on 12th of August 2022)

⁹ Environment Agency Reservoir Flood Map, available at: <https://www.gov.uk/check-long-term-flood-risk> (Accessed on 12th of August 2022)



Table 2 Flood Risk Screening Assessment

Potential Flood Source	Screening Assessment of Flood Risk at Site ¹	Requiring Further Consideration i.e. Technical Assessment?
Fluvial flooding	Low Risk	No
Tidal flooding	No Risk	No
Flooding from land	Low Risk	No
Groundwater flooding	Low Risk	No
Flooding from sewers / artificial drains	Negligible Risk	No
Flooding due to infrastructure failure / blockage	No Risk	No

Notes: ¹only Flood Risks designated as being 'medium' or 'high' warrant further investigation

The Screening Assessment shows that the site is at a 'low', 'no' or 'negligible' risk of flooding from the review of all potential sources. As such, all possible sources of flooding for the area are considered not applicable or insignificant, and therefore are not considered further.

4. Proposed Surface Water Drainage Design

4.1 Design Overview

The proposed drainage / SuDS scheme for the proposed development will comprise the management of surface water runoff from the battery storage development platform and intercepted surface water catchments upgradient of the proposed development area.

The battery storage development area will be drained via a sub-surface herringbone drainage system conveying runoff to a SuDS basin. The development area will be constructed with semi-permeable materials to allow rainwater to infiltrate into the underlying formation makeup where it will be intercepted by the perforated pipework. From here, the drainage will be routed to a SuDS attenuation basin via conventional drainage measures. The SuDS basin will provide suitable treatment and attenuation prior to discharge to the adjacent existing drainage system on Tofts Lane at the site entrance and eventually discharging to the Dean Brook.

Given the siting of the proposed development being on sloping topography, runoff from the upgradient undeveloped catchments will need to be managed as part of the site development. As such it is proposed to capture these flows via upgradient cut-off filter drain along the development's southwestern boundary and convey this to the existing drainage system along Tofts Lane. This approach mimics the existing hydrological regime of the site area albeit in a more formalised manner.

The Proposed Drainage Scheme layout is presented in Drawing FRDA-003 and has been designed to a 1% AEP event plus a 40% climate change uplift for increased rainfall intensities.

4.2 Design Criteria

4.2.1 Drainage Discharge Locations

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

1. Infiltration to Ground;
2. Discharge to Surface Waters; or
3. Discharge to Sewer.

Table 3 below discusses the disposal method suitability in the context of the site and proposed development.



Table 3 Suitability of Surface Water Disposal Methods

Surface Water Disposal Method	Suitability Description	Method Suitable? (Y/N)
Infiltration to Ground	Review of the site geology and hydrogeology indicates that there is a lack of superficial soil cover across the site area. The underlying bedrock material at the site is indicated on BGS mapping as Sandstone, although adjacent borehole logs also suggest the presence of mudstones. The borehole logs also shows there is a show soil cover which is predominately clay based. Given the nature of the clay based soils and shallow soil cover to bedrock, infiltration to ground is considered unviable.	N
Surface Water Discharge	The site is located adjacent and upgradient to the Dean Brook allowing for a gravity discharge to be made to the watercourse (via the existing drainage network on Tofts Lane). This replicates the natural hydrological regime at the site albeit in a more formalised manner.	Y
Sewer Discharge	No public sewers are located in the proximity and downgradient of the site to enable a connection to be made.	N

Taking the above into account it is proposed that surface water runoff from the development is discharged to the Dean Brook via the land drainage measures along Tofts Lane as per the existing site (natural) hydrological regime.

4.2.2 Water Quantity Review

Greenfield runoff rates have been estimated through application of methodology outlined in IH R124¹⁰ as set out within the Interim Code of Practice for SuDS (ICP).

The IHR124 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 site area is Region 10 therefore the appropriate growth curve factors for this region have been incorporated into the analysis undertaken in the MicroDrainage (2020) software suite¹¹.

The catchment the hydrological characteristics shown in Table 1 have been incorporated into the runoff modelling and results are presented below in Table 4 for a range of AEP storm events.

- Average Annual Rainfall (SAAR): 1084mm/year
- Soil Index: 0.500
- UK Hydrological Region No. 10

Table 4 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	8.58
QBAR		9.21
3.3	30	15.62
1	100	19.16
0.5	200	21.74
0.1	1000	28.00

¹⁰ Institute of Hydrology Report No. 124 (1994) (IH R124), Flood estimation for small catchments, June 1994

¹¹ MicroDrainage (2020). WinDes Drainage Design and Modelling Software (Version 2020.1.3)



In accordance with CIRIA Report C753 (the SuDS Manual) it is proposed to limit surface water discharge from the proposed development to QBAR greenfield rates for all design events up to and including the 1 % AEP plus 40% climate change uplift.

The total impermeable area for the proposed development is **0.152 ha**. Accordingly, a **1.4 l/s** discharge rate has been applied to the proposed discharge strategy. This is based on a runoff coefficient of 1 being applied.

4.2.3 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 waters as detailed in the SuDS Manual (Section 26.7, Tables 26.2 and 26.3).

Table 5 below compares the SuDS Mitigation Indices against the Pollution Hazard Indices for the proposed development. This is based on the application of a SuDS basin discharging to surface waters.

Table 5 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	0.5	0.2	0.5	0.05	0.6
Low traffic roads	0.5		0.4		0.4	

The *SuDS Mitigation Index* offered by the proposed SuDS is \geq *Pollution Hazard Index* for each *Land Use type* and therefore the water quality assessment criteria is satisfied. In addition, further pollution mitigation would be provided from the infiltration process through the platform makeup into the herringbone drainage system.

4.3 SuDS Performance Review

4.3.1 Key Design Details

The SuDS basin has been sized to accommodate the 1% AEP plus 40% climate change event. The key design parameters / geometry are summarised in Table 6 below.

Table 6 SuDS Basin Summary Design Details

Parameter	Unit	Value	Notes
Total Depth	m	0.75	As measured from AutoCAD design
Storage Area	m ²	180	As measured from AutoCAD design
Total Storage Volume	m ³	107	As measured from MicroDrianage SourceControl
Limiting Discharge Rate	l/s	1.4	To be provided by Hydrobrake Optimum (or similar)

4.3.2 Hydraulic Analysis

The SuDS system has been modelled using the industry standard MicroDrainage software suite and a summary of the modelling results is included as Table 7 below.

The results below confirm that the increased runoff from the development can be adequately contained within the SuDS attenuation pond and limits the discharge to the equivalent QBAR (1.4 l/s) for all modelled events.



Table 7 SuDS Basin - Hydraulic Modelling Summary

AEP (%)	Max. Water Depth (m)	Freeboard Allowance (mm)	Max Outflow Rate (l/s)	Storage Volume (m³)	Critical Storm Duration (hours)
50	0.183	567	1.4	20.7	4
10	0.278	472	1.4	32.6	6
3.3	0.365	385	1.4	44.4	6
1	0.497	503	1.4	63.6	6
1 + 40% CC	0.700	50	1.4	96.8	8

Full copies of the hydraulic modelling and model details are enclosed as Appendix B.

4.4 Upgradient Interception Drainage

4.4.1 Overview

An effective strategy to intercept, manage and direct overland flow from the upgradient areas of proposed development is the incorporation of cut-off drains. The proposed cut-off measures would be in the form of a filter drain situated parallel (upslope) to the development platform as indicated on Drawing FRDA-003. As the overland flow upgradient of the development areas is 'clean' runoff no formal treatment of the runoff intercepted is required.

The upgradient cut-off filter drain will be routed to the down gradient side of the development platform and discharge to the existing drainage system along Tofts Lane that ultimately discharges to the Dean Brook. This approach mimics the existing hydrological regime of the site area albeit in a more formalised manner.

4.5 Drainage Maintenance Strategy

4.5.1 Overview

To ensure efficient operation of the proposed surface water management / SuDS scheme, drainage components should be inspected and maintained throughout the life of the development. Regular inspection / maintenance will 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 will be retained under private ownership, with the operator remaining responsible for ongoing maintenance. This maintenance schedule will 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.

4.5.2 SuDS Basin

Table 8 below provides the inspection and maintenance recommendations set out in Table 22.1 of CIRIA Report C753 for attenuation basins.

Table 8 SuDS Basin Maintenance Requirements

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Remove litter and debris	Monthly
	Cut the meadow grass	Half yearly



Maintenance Schedule	Required Action	Typical Frequency
	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 silt accumulation	Half yearly
	Inspect outlet and Hydrobrake manhole for debris / blockages	Monthly
	Tidy dead growth before start of growing season	Annually
Occasional Maintenance	Remove sediment from the main body of basin	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
	Relevel uneven levels and reinstate design levels	As required
	Repair inlets or outlets	As required

4.5.3 Filter Drains

Table 9 below provides the inspection and maintenance recommendations set out in Table 16.1 of CIRIA Report C753 for Filter Drains.

Table 9 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

4.5.4 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.



4.6 Construction Drainage Strategy

4.6.1 Overview

Outlined below are recommendations for mitigation measures to be implemented during construction to control water quality impacts. These mitigation measures take due cognisance of the Water Resources Act 1991 and CIRIA Report C532 (Control of Water Pollution from Construction Sites). Good practice measures set out in the relevant Pollution Prevention Guidance (PPGs) or the updated versions (where available), Guidance for Pollution Prevention (GPPs) would be followed, these include:

- GPP 5: Works and maintenance in or near water
- PPG 6: Working at construction and demolition sites
- PPG 7: The safe operation of refuelling facilities
- GPP 13: Vehicle washing and cleaning
- GPP 21: Pollution incident response planning
- GPP 22: Dealing with spills

The proposed operational drainage measures will be installed at the earliest convenience during the construction phase in order to be utilised during construction to control silt-laden runoff. The operational SuDS basin is to be located in a proposed lay-down area for the construction phase. At the post-planning stage, a construction method statement for the site will be prepared that shall include details on the potential construction phasing of the basin in order to provide construction drainage attenuation capabilities / treatment whilst affording lay down area space. Prior to completion of the construction phase, the proposed operational basin will be fully formed and any accumulation of sediment removed and disposed of correctly.

4.6.2 Sediment Management

Proposed mitigation for sediment management:

- Control and divert surface water entering site from surrounding land (via cut-off drains) to reduce potential impacted water volumes;
- Minimise use of stockpiles and/or cover and contain stockpiles and provide sediment interception measures at their bases, e.g. silt fencing or cut-off drains and check dams;
- If topsoil is to be stored, avoid constructing stockpiles more than 2m high. This will ensure anaerobic conditions do not occur and that the soil will remain fertile and capable of being re-seeded. It will also be less susceptible to erosion;
- Temporary drainage measures to be installed which provide filtration (filter drains or filter strips) and settlement (ponds/basins) to collect sediments prior to offsite discharge;
- Avoid mass overburden stripping on the site – expose parts of the site only when essential for operation;
- Temporary drainage measures and silt fencing to be installed around large areas of exposed soils;
- Ensure a robust site traffic management plan is in place to reduce sediment runoff risks. Good practices include; minimise turning of tracked vehicles where possible and manage dedicated turning areas appropriately (hard surfacing, silt fencing etc.), avoid unnecessary turning of large site plant and minimise overall routes on site to better manage sediment runoff;
- Prevent/reduce offsite sediment impacts to public roads. Good practices include; wheel wash facilities, site-road sweeping, , formally surfaced site car park and separate access points for cars and plant/deliveries (where possible);
- Bowers to be used to keep exposed earth and soils damp preventing dust generation reaching nearby watercourses (sediment build-up can be managed on-site); and
- Dedicated plant washing areas to control sediment runoff.



4.6.3 Excavation Management

Proposed mitigation for excavations:

- Relevant precautions to be taken to ensure no services are struck during excavations. Relevant emergency response and contacts in place in the event services are struck which could impact the water environment, e.g. oil line, water main, sewer;
- Excavation areas to be scanned for potential unrecorded culverts/field drains. De-watering measures to be present in the event of a leak;
- Existing culverts/field drains to be protected to prevent potentially polluted site runoff discharging to them prior to treatment;
- Prevent site runoff entering excavations and regular de-water to prevent infiltration to groundwater; and
- Any deep excavations (e.g. boreholes, piled foundations) should be protected to prevent infiltration of site runoff and a direct pathway to groundwater.

4.6.4 Concrete Works Management

Proposed mitigation for concrete works:

- If concrete is brought to site – provide dedicated concrete washout skip/basin to prevent any uncontrolled spilling of material in-site or nearby public roads;
- Concrete washout facilities to be regular maintained and solids to be disposed of safely;
- If on-site concrete batching – ensure necessary containment measures are in place and suitable disposal and cleaning methods;
- Robust emergency response in place for any concrete spillage on site;
- Correct disposal of any waste or surplus concrete in agreed suitable locations both onsite and offsite;
- Where applicable, shuttered pours should be used to prevent any concrete losses to ground;
- Ensure excavations are sufficiently dewatered before concreting begins and that dewatering continues while concrete sets; and
- Covering of freshly poured concrete surfaces to prevent any polluted runoff attributed with wet weather.

4.6.5 Chemical, Oils and Fuels Management

Proposed mitigation for chemicals, oils and fuels:

- Assign designated refuelling areas where appropriate and site them as far as practicably possible from adjacent field drains and public sewers; and
- Dedicated site operatives responsible for checking and maintaining temporary drainage measures;
- All site operatives to be made aware of preventative measures in place e.g. traffic systems, refuelling areas, maintenance rotas, concrete washout areas;
- All pollution prevention consumables and plant to be made readily available at all times.



5. Closure

Gondolin Land and Water Ltd has been appointed by PWA Planning on behalf of the Applicant (Harmony Energy) to prepare a Flood Risk and Drainage Assessment in support of a planning application for a battery energy storage site located at 'Land off Tofts Lane, Sheffield, S6 5SL'.

In accordance with national planning policy and guidance, all potential sources of flooding to the site have been considered. The Flood Risk Screening confirms that the site is overall of 'low risk' or lower from flooding from all sources and thus no bespoke flood mitigation measures are required.

Taking the above into account, it is considered that the proposed development is suitable, safe and sustainable in flood risk planning terms.

This report also assesses the potential increase in surface water runoff attributed to the proposed development 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.

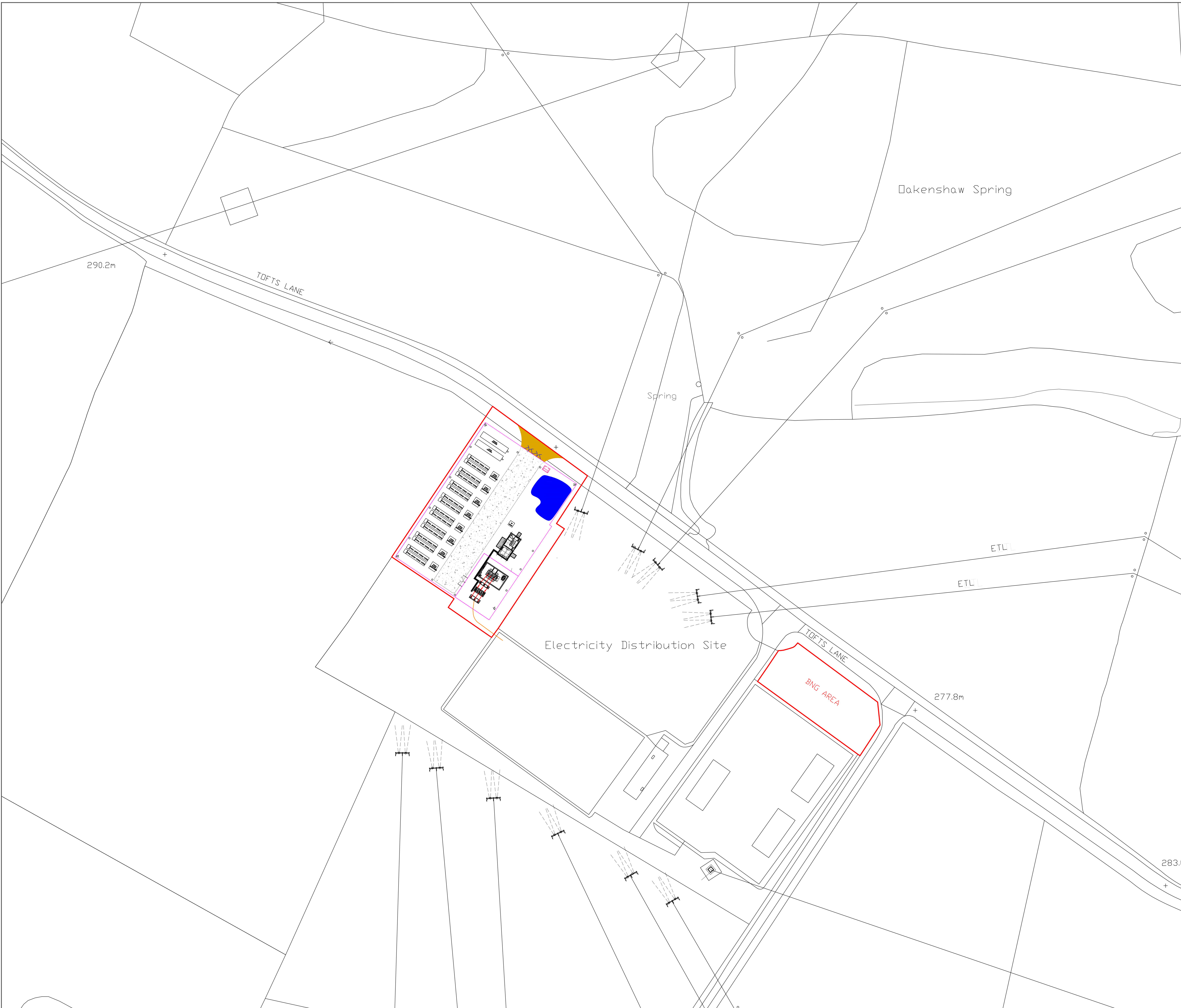
Principles and controls for the management of surface water runoff / drainage during the construction phase have also been outlined in the report.

Taking all of the above into account it is considered there is no impediment to the development proposals being granted planning permission on the grounds of flood risk and drainage provision.



Appendix A

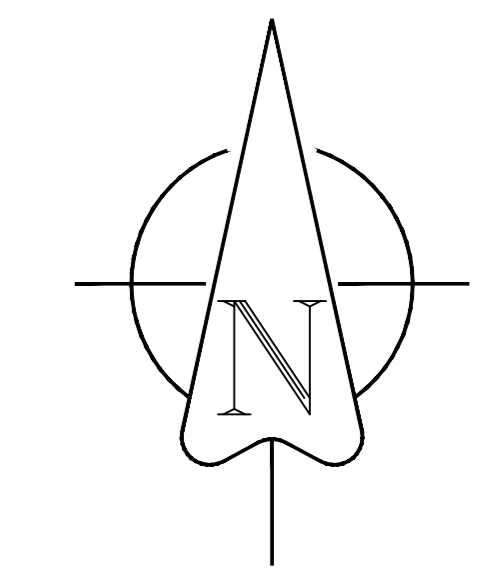
Proposed Development Plan



Notes:

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- KEY:
- Planning Application Boundary (0.48hectares)
 - 2.4m High Palisade Fence
 - Proposed new Access
 - BESS Site internal Road
 - Indicative Cable Route
 - SUDS Drainage Pond
 - Metering Annexe

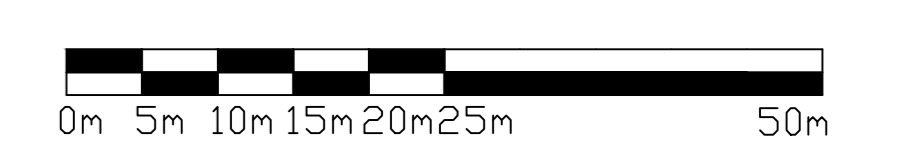


REV:	DESCRIPTION:	BY:	DATE:
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STATUS:

HARMONY ENERGY

Conyngham Hall
Knaresborough
HG5 9AY



PROJECT:
HUNSHELF


TITLE:
PROPOSED SITE PLAN (OPERATIONAL)

SCALE: A0 @ 1:500	DATE: 24/03/2023	DRAWN: EL	CHECKED: FN
DRAWING NO: HS_PSP_RevM			REVISION: M



Appendix B

MicroDrainage Modelling Extracts

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15 Quayside Street Edinburgh EH6 6EJ	Hunshelf BES SuDS Design	
Date 04/10/2022 12:23 File SuDS Design.SRCX	Designed by SD Checked by ZR	
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.300	Shortest Storm (mins)	15
Ratio R	0.313	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.152

Time (mins)		Area
From:	To:	(ha)
0	4	0.152

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Model Details

Storage is Online Cover Level (m) 0.750

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	105.0	0.750	180.0


Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0059-1400-0750-1400
Design Head (m)	0.750
Design Flow (l/s)	1.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.750	1.4
Flush-Flo™	0.233	1.4
Kick-Flo®	0.480	1.1
Mean Flow over Head Range	-	1.2

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	1.3	1.200	1.7	3.000	2.6	7.000	3.9
0.200	1.4	1.400	1.9	3.500	2.8	7.500	4.0
0.300	1.4	1.600	2.0	4.000	3.0	8.000	4.2
0.400	1.3	1.800	2.1	4.500	3.2	8.500	4.3
0.500	1.2	2.000	2.2	5.000	3.3	9.000	4.4
0.600	1.3	2.200	2.3	5.500	3.5	9.500	4.5
0.800	1.4	2.400	2.4	6.000	3.6		
1.000	1.6	2.600	2.5	6.500	3.8		

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Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	0.087	0.087	1.2	9.5	O K
30 min Summer	0.112	0.112	1.3	12.3	O K
60 min Summer	0.135	0.135	1.3	14.9	O K
120 min Summer	0.152	0.152	1.4	17.0	O K
180 min Summer	0.160	0.160	1.4	18.0	O K
240 min Summer	0.164	0.164	1.4	18.5	O K
360 min Summer	0.166	0.166	1.4	18.6	O K
480 min Summer	0.164	0.164	1.4	18.4	O K
600 min Summer	0.159	0.159	1.4	17.9	O K
720 min Summer	0.154	0.154	1.4	17.3	O K
960 min Summer	0.144	0.144	1.3	16.0	O K
1440 min Summer	0.123	0.123	1.3	13.6	O K
2160 min Summer	0.099	0.099	1.2	10.8	O K
2880 min Summer	0.083	0.083	1.2	9.0	O K
4320 min Summer	0.067	0.067	1.0	7.2	O K
5760 min Summer	0.057	0.057	0.9	6.2	O K
7200 min Summer	0.051	0.051	0.8	5.5	O K
8640 min Summer	0.047	0.047	0.7	5.0	O K
10080 min Summer	0.044	0.044	0.6	4.7	O K
15 min Winter	0.098	0.098	1.2	10.7	O K
30 min Winter	0.126	0.126	1.3	13.9	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	35.626	0.0	9.8	18
30 min Summer	23.983	0.0	13.4	32
60 min Summer	15.606	0.0	17.6	60
120 min Summer	9.970	0.0	22.6	100
180 min Summer	7.637	0.0	26.0	134
240 min Summer	6.312	0.0	28.6	168
360 min Summer	4.801	0.0	32.7	238
480 min Summer	3.953	0.0	35.9	306
600 min Summer	3.399	0.0	38.6	374
720 min Summer	3.004	0.0	40.9	442
960 min Summer	2.473	0.0	44.9	570
1440 min Summer	1.879	0.0	51.1	822
2160 min Summer	1.427	0.0	58.5	1172
2880 min Summer	1.174	0.0	64.1	1528
4320 min Summer	0.893	0.0	73.0	2248
5760 min Summer	0.733	0.0	80.2	2944
7200 min Summer	0.630	0.0	86.0	3672
8640 min Summer	0.556	0.0	91.1	4408
10080 min Summer	0.500	0.0	95.6	5144
15 min Winter	35.626	0.0	11.1	18
30 min Winter	23.983	0.0	15.0	32

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Innovyze	Source Control 2020.1.3	

Summary of Results for 2 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
60 min Winter	0.152	0.152	1.4	17.0	O K
120 min Winter	0.172	0.172	1.4	19.4	O K
180 min Winter	0.179	0.179	1.4	20.3	O K
240 min Winter	0.183	0.183	1.4	20.7	O K
360 min Winter	0.181	0.181	1.4	20.5	O K
480 min Winter	0.175	0.175	1.4	19.8	O K
600 min Winter	0.167	0.167	1.4	18.8	O K
720 min Winter	0.158	0.158	1.4	17.7	O K
960 min Winter	0.140	0.140	1.3	15.6	O K
1440 min Winter	0.109	0.109	1.3	12.0	O K
2160 min Winter	0.080	0.080	1.2	8.7	O K
2880 min Winter	0.067	0.067	1.0	7.2	O K
4320 min Winter	0.053	0.053	0.8	5.7	O K
5760 min Winter	0.046	0.046	0.6	4.9	O K
7200 min Winter	0.041	0.041	0.6	4.4	O K
8640 min Winter	0.038	0.038	0.5	4.1	O K
10080 min Winter	0.036	0.036	0.5	3.8	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
60 min Winter	15.606	0.0	19.8	60
120 min Winter	9.970	0.0	25.3	114
180 min Winter	7.637	0.0	29.1	144
240 min Winter	6.312	0.0	32.1	182
360 min Winter	4.801	0.0	36.6	260
480 min Winter	3.953	0.0	40.2	334
600 min Winter	3.399	0.0	43.2	404
720 min Winter	3.004	0.0	45.8	476
960 min Winter	2.473	0.0	50.3	606
1440 min Winter	1.879	0.0	57.3	852
2160 min Winter	1.427	0.0	65.5	1188
2880 min Winter	1.174	0.0	71.8	1532
4320 min Winter	0.893	0.0	81.8	2248
5760 min Winter	0.733	0.0	89.8	2952
7200 min Winter	0.630	0.0	96.4	3680
8640 min Winter	0.556	0.0	102.1	4408
10080 min Winter	0.500	0.0	107.1	5120

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Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	0.130	0.130	1.3	14.4	O K
30 min Summer	0.167	0.167	1.4	18.8	O K
60 min Summer	0.203	0.203	1.4	23.1	O K
120 min Summer	0.231	0.231	1.4	26.6	O K
180 min Summer	0.240	0.240	1.4	27.8	O K
240 min Summer	0.245	0.245	1.4	28.4	O K
360 min Summer	0.248	0.248	1.4	28.8	O K
480 min Summer	0.246	0.246	1.4	28.5	O K
600 min Summer	0.241	0.241	1.4	27.9	O K
720 min Summer	0.235	0.235	1.4	27.2	O K
960 min Summer	0.222	0.222	1.4	25.5	O K
1440 min Summer	0.194	0.194	1.4	22.0	O K
2160 min Summer	0.156	0.156	1.4	17.5	O K
2880 min Summer	0.127	0.127	1.3	14.1	O K
4320 min Summer	0.090	0.090	1.2	9.8	O K
5760 min Summer	0.074	0.074	1.1	8.0	O K
7200 min Summer	0.064	0.064	1.0	6.9	O K
8640 min Summer	0.058	0.058	0.9	6.2	O K
10080 min Summer	0.053	0.053	0.8	5.6	O K
15 min Winter	0.145	0.145	1.4	16.2	O K
30 min Winter	0.187	0.187	1.4	21.2	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	53.335	0.0	14.9	18
30 min Summer	35.815	0.0	20.1	33
60 min Summer	23.155	0.0	26.2	62
120 min Summer	14.608	0.0	33.1	120
180 min Summer	11.063	0.0	37.7	156
240 min Summer	9.055	0.0	41.1	188
360 min Summer	6.822	0.0	46.5	256
480 min Summer	5.574	0.0	50.6	324
600 min Summer	4.763	0.0	54.1	394
720 min Summer	4.188	0.0	57.1	462
960 min Summer	3.417	0.0	62.1	598
1440 min Summer	2.562	0.0	69.8	854
2160 min Summer	1.920	0.0	78.7	1232
2880 min Summer	1.563	0.0	85.4	1584
4320 min Summer	1.169	0.0	95.7	2252
5760 min Summer	0.952	0.0	104.1	2952
7200 min Summer	0.812	0.0	111.0	3680
8640 min Summer	0.713	0.0	116.9	4408
10080 min Summer	0.638	0.0	122.0	5136
15 min Winter	53.335	0.0	16.7	18
30 min Winter	35.815	0.0	22.5	32

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Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
60 min Winter	0.227	0.227	1.4	26.2	O K
120 min Winter	0.261	0.261	1.4	30.4	O K
180 min Winter	0.273	0.273	1.4	32.0	O K
240 min Winter	0.276	0.276	1.4	32.4	O K
360 min Winter	0.278	0.278	1.4	32.6	O K
480 min Winter	0.273	0.273	1.4	32.0	O K
600 min Winter	0.264	0.264	1.4	30.9	O K
720 min Winter	0.254	0.254	1.4	29.6	O K
960 min Winter	0.232	0.232	1.4	26.7	O K
1440 min Winter	0.186	0.186	1.4	21.1	O K
2160 min Winter	0.132	0.132	1.3	14.6	O K
2880 min Winter	0.097	0.097	1.2	10.5	O K
4320 min Winter	0.069	0.069	1.0	7.4	O K
5760 min Winter	0.056	0.056	0.8	6.1	O K
7200 min Winter	0.050	0.050	0.7	5.3	O K
8640 min Winter	0.045	0.045	0.6	4.8	O K
10080 min Winter	0.042	0.042	0.6	4.5	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
60 min Winter	23.155	0.0	29.4	60
120 min Winter	14.608	0.0	37.1	118
180 min Winter	11.063	0.0	42.2	172
240 min Winter	9.055	0.0	46.1	220
360 min Winter	6.822	0.0	52.1	276
480 min Winter	5.574	0.0	56.7	354
600 min Winter	4.763	0.0	60.6	430
720 min Winter	4.188	0.0	64.0	504
960 min Winter	3.417	0.0	69.6	646
1440 min Winter	2.562	0.0	78.2	910
2160 min Winter	1.920	0.0	88.1	1276
2880 min Winter	1.563	0.0	95.7	1612
4320 min Winter	1.169	0.0	107.3	2276
5760 min Winter	0.952	0.0	116.6	2992
7200 min Winter	0.812	0.0	124.3	3672
8640 min Winter	0.713	0.0	130.9	4480
10080 min Winter	0.638	0.0	136.7	5144

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	0.163	0.163	1.4	18.3	O K
30 min Summer	0.212	0.212	1.4	24.3	O K
60 min Summer	0.260	0.260	1.4	30.4	O K
120 min Summer	0.300	0.300	1.4	35.6	O K
180 min Summer	0.315	0.315	1.4	37.5	O K
240 min Summer	0.319	0.319	1.4	38.2	O K
360 min Summer	0.323	0.323	1.4	38.6	O K
480 min Summer	0.321	0.321	1.4	38.4	O K
600 min Summer	0.317	0.317	1.4	37.8	O K
720 min Summer	0.310	0.310	1.4	36.9	O K
960 min Summer	0.296	0.296	1.4	35.0	O K
1440 min Summer	0.263	0.263	1.4	30.8	O K
2160 min Summer	0.217	0.217	1.4	24.8	O K
2880 min Summer	0.177	0.177	1.4	20.0	O K
4320 min Summer	0.122	0.122	1.3	13.5	O K
5760 min Summer	0.091	0.091	1.2	9.9	O K
7200 min Summer	0.076	0.076	1.1	8.2	O K
8640 min Summer	0.067	0.067	1.0	7.2	O K
10080 min Summer	0.060	0.060	0.9	6.5	O K
15 min Winter	0.182	0.182	1.4	20.6	O K
30 min Winter	0.237	0.237	1.4	27.4	O K


Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	67.395	0.0	18.9	18
30 min Summer	45.689	0.0	25.7	33
60 min Summer	29.711	0.0	33.7	62
120 min Summer	18.741	0.0	42.6	122
180 min Summer	14.131	0.0	48.1	180
240 min Summer	11.505	0.0	52.3	214
360 min Summer	8.613	0.0	58.7	278
480 min Summer	7.003	0.0	63.7	344
600 min Summer	5.960	0.0	67.7	412
720 min Summer	5.222	0.0	71.2	482
960 min Summer	4.235	0.0	77.0	616
1440 min Summer	3.148	0.0	85.8	882
2160 min Summer	2.336	0.0	95.8	1260
2880 min Summer	1.888	0.0	103.2	1616
4320 min Summer	1.397	0.0	114.4	2332
5760 min Summer	1.129	0.0	123.5	3000
7200 min Summer	0.957	0.0	130.8	3680
8640 min Summer	0.836	0.0	137.2	4408
10080 min Summer	0.746	0.0	142.7	5144
15 min Winter	67.395	0.0	21.2	18
30 min Winter	45.689	0.0	28.8	32

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Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
60 min Winter	0.291	0.291	1.4	34.3	O K
120 min Winter	0.338	0.338	1.4	40.6	O K
180 min Winter	0.357	0.357	1.4	43.2	O K
240 min Winter	0.364	0.364	1.4	44.2	O K
360 min Winter	0.365	0.365	1.4	44.4	O K
480 min Winter	0.362	0.362	1.4	43.9	O K
600 min Winter	0.354	0.354	1.4	42.9	O K
720 min Winter	0.344	0.344	1.4	41.5	O K
960 min Winter	0.321	0.321	1.4	38.3	O K
1440 min Winter	0.269	0.269	1.4	31.4	O K
2160 min Winter	0.197	0.197	1.4	22.4	O K
2880 min Winter	0.143	0.143	1.3	15.9	O K
4320 min Winter	0.084	0.084	1.2	9.1	O K
5760 min Winter	0.067	0.067	1.0	7.2	O K
7200 min Winter	0.057	0.057	0.9	6.1	O K
8640 min Winter	0.051	0.051	0.7	5.4	O K
10080 min Winter	0.047	0.047	0.7	5.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
60 min Winter	29.711	0.0	37.8	62
120 min Winter	18.741	0.0	47.7	118
180 min Winter	14.131	0.0	53.9	176
240 min Winter	11.505	0.0	58.6	230
360 min Winter	8.613	0.0	65.8	326
480 min Winter	7.003	0.0	71.3	372
600 min Winter	5.960	0.0	75.9	450
720 min Winter	5.222	0.0	79.8	526
960 min Winter	4.235	0.0	86.3	674
1440 min Winter	3.148	0.0	96.2	952
2160 min Winter	2.336	0.0	107.3	1324
2880 min Winter	1.888	0.0	115.6	1672
4320 min Winter	1.397	0.0	128.2	2292
5760 min Winter	1.129	0.0	138.3	3000
7200 min Winter	0.957	0.0	146.5	3736
8640 min Winter	0.836	0.0	153.6	4408
10080 min Winter	0.746	0.0	159.9	5040

Gondolin Land & Water Ltd		Page 9
15 Quayside Street Edinburgh EH6 6EJ	Hunshelf BES SuDS Design	
Date 04/10/2022 12:25 File SuDS Design.SRCX	Designed by SD Checked by ZR	
Innovyze	Source Control 2020.1.3	

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	0.209	0.209	1.4	23.9	O K
30 min Summer	0.274	0.274	1.4	32.2	O K
60 min Summer	0.339	0.339	1.4	40.8	O K
120 min Summer	0.396	0.396	1.4	48.7	O K
180 min Summer	0.419	0.419	1.4	52.0	O K
240 min Summer	0.428	0.428	1.4	53.4	O K
360 min Summer	0.432	0.432	1.4	54.0	O K
480 min Summer	0.430	0.430	1.4	53.6	O K
600 min Summer	0.425	0.425	1.4	52.8	O K
720 min Summer	0.418	0.418	1.4	51.9	O K
960 min Summer	0.401	0.401	1.4	49.5	O K
1440 min Summer	0.365	0.365	1.4	44.4	O K
2160 min Summer	0.310	0.310	1.4	36.9	O K
2880 min Summer	0.259	0.259	1.4	30.3	O K
4320 min Summer	0.180	0.180	1.4	20.3	O K
5760 min Summer	0.129	0.129	1.3	14.3	O K
7200 min Summer	0.098	0.098	1.2	10.7	O K
8640 min Summer	0.081	0.081	1.2	8.8	O K
10080 min Summer	0.072	0.072	1.1	7.8	O K
15 min Winter	0.232	0.232	1.4	26.8	O K
30 min Winter	0.305	0.305	1.4	36.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	87.093	0.0	24.5	18
30 min Summer	59.662	0.0	33.6	33
60 min Summer	39.045	0.0	44.3	62
120 min Summer	24.624	0.0	56.0	122
180 min Summer	18.478	0.0	63.0	182
240 min Summer	14.959	0.0	68.0	240
360 min Summer	11.120	0.0	75.8	334
480 min Summer	8.992	0.0	81.8	390
600 min Summer	7.619	0.0	86.6	452
720 min Summer	6.650	0.0	90.7	516
960 min Summer	5.360	0.0	97.5	652
1440 min Summer	3.945	0.0	107.6	922
2160 min Summer	2.896	0.0	118.8	1316
2880 min Summer	2.322	0.0	126.9	1676
4320 min Summer	1.697	0.0	139.0	2380
5760 min Summer	1.360	0.0	148.8	3064
7200 min Summer	1.146	0.0	156.7	3744
8640 min Summer	0.997	0.0	163.5	4408
10080 min Summer	0.886	0.0	169.4	5144
15 min Winter	87.093	0.0	27.4	18
30 min Winter	59.662	0.0	37.7	33

Summary of Results for 100 year Return Period


Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
60 min Winter	0.377	0.377	1.4	46.1	O K
120 min Winter	0.443	0.443	1.4	55.5	O K
180 min Winter	0.472	0.472	1.4	59.8	Flood Risk
240 min Winter	0.486	0.486	1.4	61.9	Flood Risk
360 min Winter	0.497	0.497	1.4	63.6	Flood Risk
480 min Winter	0.495	0.495	1.4	63.2	Flood Risk
600 min Winter	0.486	0.486	1.4	61.9	Flood Risk
720 min Winter	0.475	0.475	1.4	60.3	Flood Risk
960 min Winter	0.451	0.451	1.4	56.6	Flood Risk
1440 min Winter	0.393	0.393	1.4	48.3	O K
2160 min Winter	0.307	0.307	1.4	36.4	O K
2880 min Winter	0.230	0.230	1.4	26.5	O K
4320 min Winter	0.128	0.128	1.3	14.2	O K
5760 min Winter	0.082	0.082	1.2	9.0	O K
7200 min Winter	0.068	0.068	1.0	7.4	O K
8640 min Winter	0.059	0.059	0.9	6.4	O K
10080 min Winter	0.053	0.053	0.8	5.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
60 min Winter	39.045	0.0	49.7	62
120 min Winter	24.624	0.0	62.7	120
180 min Winter	18.478	0.0	70.6	178
240 min Winter	14.959	0.0	76.2	236
360 min Winter	11.120	0.0	85.0	348
480 min Winter	8.992	0.0	91.6	456
600 min Winter	7.619	0.0	97.0	552
720 min Winter	6.650	0.0	101.6	572
960 min Winter	5.360	0.0	109.2	720
1440 min Winter	3.945	0.0	120.5	1008
2160 min Winter	2.896	0.0	133.0	1404
2880 min Winter	2.322	0.0	142.2	1760
4320 min Winter	1.697	0.0	155.8	2420
5760 min Winter	1.360	0.0	166.7	3000
7200 min Winter	1.146	0.0	175.5	3744
8640 min Winter	0.997	0.0	183.1	4416
10080 min Winter	0.886	0.0	189.7	5144

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
15 min Summer	0.286	0.286	1.4	33.7	O K
30 min Summer	0.374	0.374	1.4	45.6	O K
60 min Summer	0.463	0.463	1.4	58.5	Flood Risk
120 min Summer	0.545	0.545	1.4	71.1	Flood Risk
180 min Summer	0.582	0.582	1.4	77.0	Flood Risk
240 min Summer	0.601	0.601	1.4	80.1	Flood Risk
360 min Summer	0.620	0.620	1.4	83.1	Flood Risk
480 min Summer	0.622	0.622	1.4	83.6	Flood Risk
600 min Summer	0.619	0.619	1.4	83.1	Flood Risk
720 min Summer	0.615	0.615	1.4	82.3	Flood Risk
960 min Summer	0.603	0.603	1.4	80.4	Flood Risk
1440 min Summer	0.576	0.576	1.4	75.9	Flood Risk
2160 min Summer	0.529	0.529	1.4	68.6	Flood Risk
2880 min Summer	0.476	0.476	1.4	60.4	Flood Risk
4320 min Summer	0.363	0.363	1.4	44.1	O K
5760 min Summer	0.274	0.274	1.4	32.2	O K
7200 min Summer	0.207	0.207	1.4	23.6	O K
8640 min Summer	0.159	0.159	1.4	17.8	O K
10080 min Summer	0.126	0.126	1.3	13.9	O K
15 min Winter	0.317	0.317	1.4	37.8	O K
30 min Winter	0.414	0.414	1.4	51.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
15 min Summer	121.930	0.0	34.4	19
30 min Summer	83.527	0.0	47.2	33
60 min Summer	54.663	0.0	62.1	64
120 min Summer	34.473	0.0	78.4	122
180 min Summer	25.870	0.0	88.2	182
240 min Summer	20.943	0.0	95.2	242
360 min Summer	15.568	0.0	106.2	360
480 min Summer	12.589	0.0	114.5	478
600 min Summer	10.667	0.0	121.3	526
720 min Summer	9.310	0.0	127.0	592
960 min Summer	7.503	0.0	136.4	722
1440 min Summer	5.523	0.0	150.5	994
2160 min Summer	4.055	0.0	166.3	1408
2880 min Summer	3.251	0.0	177.8	1820
4320 min Summer	2.376	0.0	194.8	2552
5760 min Summer	1.905	0.0	208.4	3232
7200 min Summer	1.605	0.0	219.4	3896
8640 min Summer	1.395	0.0	228.9	4584
10080 min Summer	1.240	0.0	237.2	5248
15 min Winter	121.930	0.0	38.5	18
30 min Winter	83.527	0.0	52.8	33

Gondolin Land & Water Ltd		Page 12
15 Quayside Street Edinburgh EH6 6EJ	Hunshelf BES SuDS Design	
Date 04/10/2022 12:24 File SuDS Design.SRCX	Designed by SD Checked by ZR	
Innovyze	Source Control 2020.1.3	

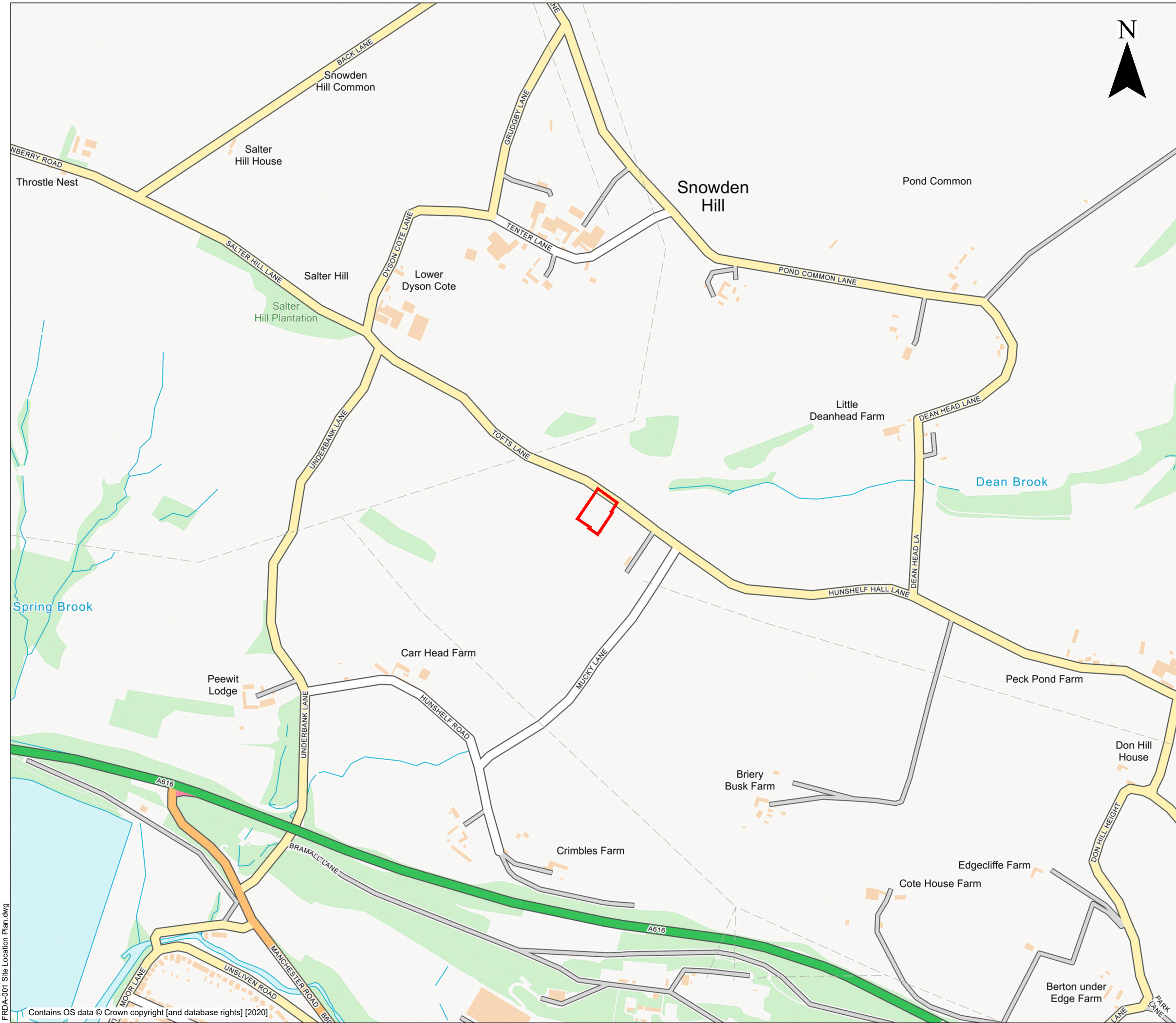
Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m ³)	Status
60 min Winter	0.513	0.513	1.4	66.0	Flood Risk
120 min Winter	0.603	0.603	1.4	80.4	Flood Risk
180 min Winter	0.645	0.645	1.4	87.4	Flood Risk
240 min Winter	0.668	0.668	1.4	91.2	Flood Risk
360 min Winter	0.692	0.692	1.4	95.4	Flood Risk
480 min Winter	0.700	0.700	1.4	96.8	Flood Risk
600 min Winter	0.699	0.699	1.4	96.6	Flood Risk
720 min Winter	0.693	0.693	1.4	95.6	Flood Risk
960 min Winter	0.678	0.678	1.4	92.9	Flood Risk
1440 min Winter	0.641	0.641	1.4	86.6	Flood Risk
2160 min Winter	0.573	0.573	1.4	75.5	Flood Risk
2880 min Winter	0.495	0.495	1.4	63.4	Flood Risk
4320 min Winter	0.318	0.318	1.4	37.9	O K
5760 min Winter	0.196	0.196	1.4	22.3	O K
7200 min Winter	0.126	0.126	1.3	13.9	O K
8640 min Winter	0.089	0.089	1.2	9.7	O K
10080 min Winter	0.075	0.075	1.1	8.2	O K

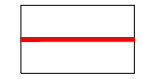
Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
60 min Winter	54.663	0.0	69.6	62
120 min Winter	34.473	0.0	87.8	120
180 min Winter	25.870	0.0	98.8	178
240 min Winter	20.943	0.0	106.7	236
360 min Winter	15.568	0.0	119.0	350
480 min Winter	12.589	0.0	128.3	462
600 min Winter	10.667	0.0	135.8	570
720 min Winter	9.310	0.0	142.2	670
960 min Winter	7.503	0.0	152.8	760
1440 min Winter	5.523	0.0	168.5	1068
2160 min Winter	4.055	0.0	186.2	1532
2880 min Winter	3.251	0.0	199.1	1988
4320 min Winter	2.376	0.0	218.2	2680
5760 min Winter	1.905	0.0	233.4	3336
7200 min Winter	1.605	0.0	245.8	3960
8640 min Winter	1.395	0.0	256.4	4504
10080 min Winter	1.240	0.0	265.7	5152



Drawings



LEGEND



SITE BOUNDARY

REV	DATE	DESCRIPTION	BY	CHK
02	03/23	SITE BOUNDARY UPDATED	SD	ZR
01	01/23	SITE BOUNDARY UPDATED	SD	ZR
00	10/22	INITIAL ISSUE	GD	SD

CLIENT:
PWA PLANNING

PROJECT:
HUNSHELF BES

DRAWING TITLE:
SITE LOCATION PLAN

SCALE:
1:7,500 @ A3

DATE:
MARCH 2023

DRAWING NUMBER:
FRDA-001

REV:
02

DRAWING STATUS:
FOR PLANNING

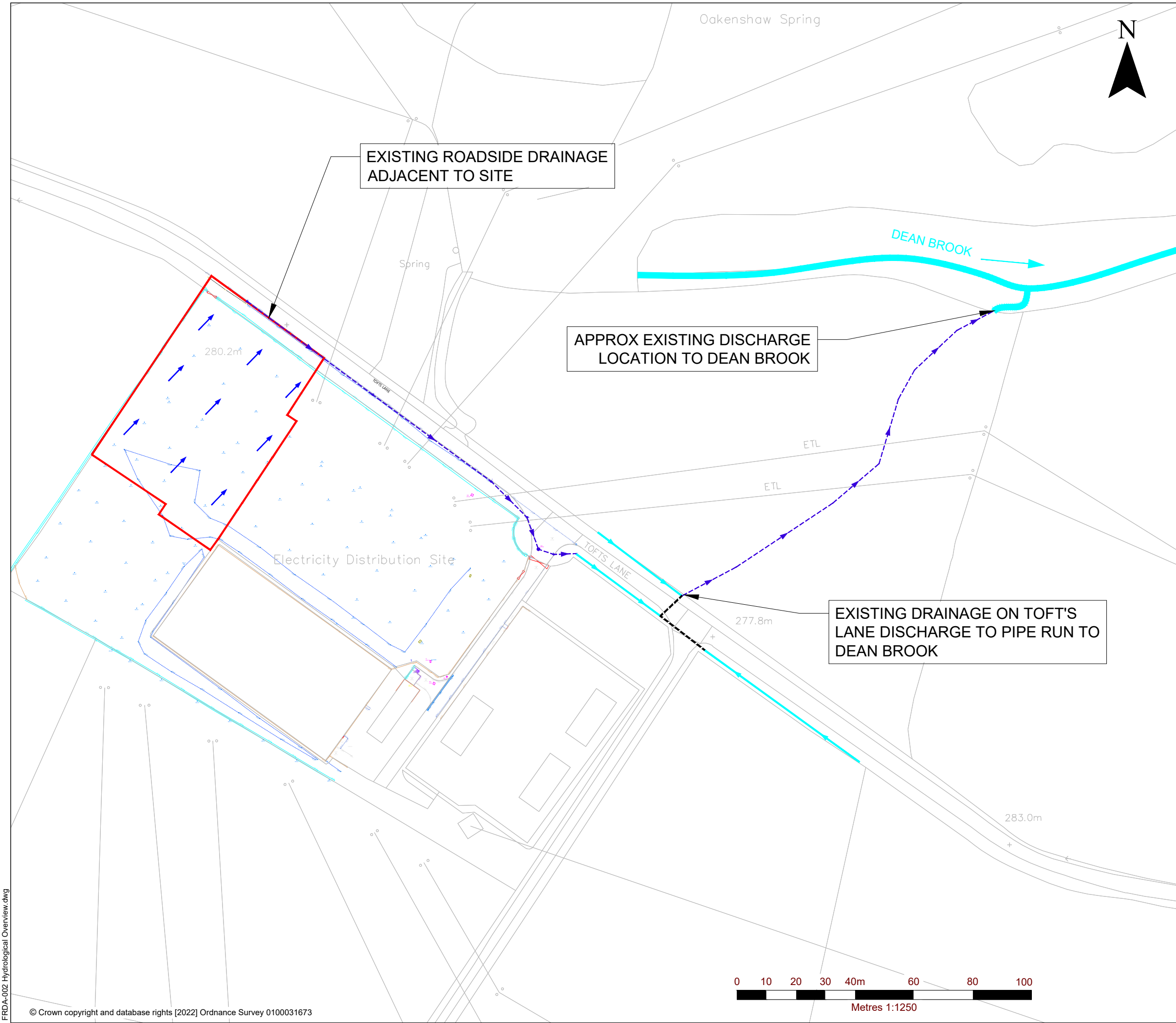
GONDOLIN LAND & WATER LTD
15 Quayside Street
Edinburgh
EH6 6EJ
Registered Company No. SC706920



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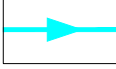

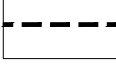

FRDA-001 Site Location Plan.dwg

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NOTES
 1. TOPOGRAPHIC SURVEY INFORMATION TAKEN FROM 'TOFTS LANE, HUNSHELF-CPLS-A0'.

LEGEND

-  SITE BOUNDARY
-  EXISTING PIPED DRAINAGE
-  EXISTING DRAINAGE DITCH
-  EXISTING WATERCOURSE
-  EXISTING CULVERT
-  OVERLAND FLOW PATH

REV	DATE	DESCRIPTION	BY	CHK
02	03/23	SITE BOUNDARY UPDATED	SD	ZR
01	01/23	SITE BOUNDARY UPDATED	SD	ZR
00	10/22	INITIAL ISSUE	GD	SD

CLIENT:
PWA PLANNING

PROJECT:
HUNSHELF BES

DRAWING TITLE:
HYDROLOGICAL OVERVIEW

SCALE:
 1:1,250 @ A3


DATE:
 MARCH 2023

DRAWING NUMBER:
FRDA-002

REV:
02

DRAWING STATUS:
FOR PLANNING

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 EH6 6EJ
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FRDA-002 Hydrological Overview.dwg



Spring



- NOTES**
1. SITE LAYOUT TAKEN FROM 'PA_HS_PSP_RevM - Proposed Site Plan (RevM)'.
 2. DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER SCHEME DRAWINGS.
 3. DESIGN SHOULD BE CONSIDERED PROVISIONAL TO BE REFINED AT DETAILED DESIGN STAGE.

- LEGEND**
- SITE BOUNDARY
 - EXISTING PIPED DRAINAGE
 - PROPOSED PERFORATED PIPEWORK
 - PROPOSED CONVENTIONAL PIPEWORK
 - PROPOSED SUDS BASIN
 - PROPOSED HYDROBRAKE CHAMBER
 - PROPOSED INSPECTION CHAMBER
 - PROPOSED GRADING FLOW ROUTES
 - PROPOSED HEADWALL
 - PROPOSED UPGRADIENT FILTER DRAIN

REV	DATE	DESCRIPTION	BY	CHK
02	03/23	SITE LAYOUT UPDATED	SD	ZR
01	01/23	SITE LAYOUT UPDATED	SD	ZR
00	10/22	INITIAL ISSUE	GD	SD

CLIENT:
PWA PLANNING

PROJECT:
HUNSHELF BES

DRAWING TITLE:
PROPOSED DRAINAGE STRATEGY

SCALE:
1:500 @ A3

DATE:
MARCH 2023

DRAWING NUMBER:
FRDA-003

REV:
02

DRAWING STATUS:
FOR PLANNING

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

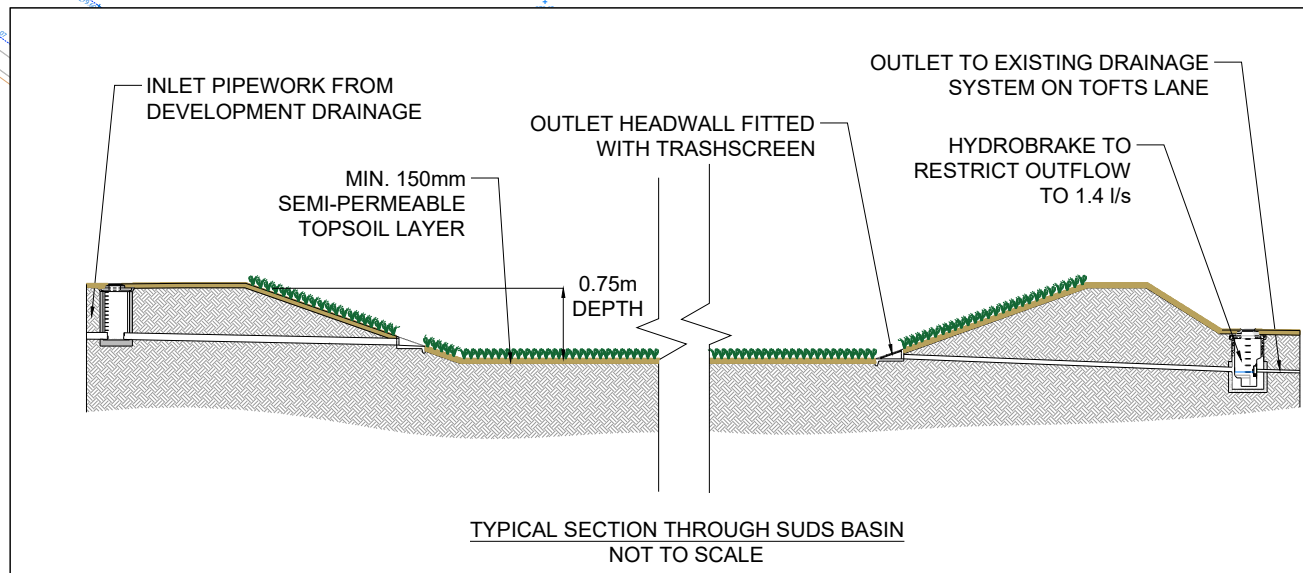
SITE DRAINAGE TO DISCHARGE TO EXISTING ROADSIDE DRAINAGE

CAPTURED UPGRADIENT FLOWS TO DISCHARGE TO EXISTING ROADSIDE DRAINAGE (MIMICKING EXISTING HYDROLOGICAL REGIME OF THE SITE)

HYDROBRAKE CHAMBER TO RESTRICT DISCHARGE TO GREENFIELD RUNOFF RATES (1.40 l/s)

PROPOSED SUDS BASIN:
STORAGE AREA = 180m²
STORAGE VOLUME = 106m³
SIDE SLOPES = 1 IN 2
TOTAL DEPTH = 0.75m

FILTER DRAIN TO CAPTURE UPGRADIENT 'CLEAN WATER' RUNOFF TO PREVENT OVERLAND FLOWS ENTERING SITE



FRDA-003 Drainage Layout.dwg



GONDOLIN
Land & Water

Civil Engineering and Environmental Solutions

Gondolin Land and Water Ltd is a small environmental and engineering consultancy business based in Scotland with coverage throughout the UK.

Registered Address:

35/1 Balfour Street, Edinburgh, EH6 5DL, UK

Registered Company No.

SC706920

Sectors:

Onshore Renewables & Storage | Infrastructure | Mining and Minerals
Property & Urban Regeneration | Corporate, Industrial & Manufacturing |
Waste Management

