MOTT MACDONALD

LT 14 Western Isles HVDC

Arnish Moor Drainage Impact Assessment

February 2025

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LT 14 Western Isles HVDC

Arnish Moor Drainage Impact Assessment

February 2025

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Issue and Revision Record

Revision	Date	Originator	Checker	Approver	Description
P01	16/09/24	E. Walker/ A. Bukhari	A. Ruiz-Diaz	R. McGowan	First Issue.
P02	11/10/24	E. Walker	A. Ruiz-Diaz	R. McGowan	Second Issue with minor changes.
P03	13/11/24	E. Walker	A. Ruiz-Diaz	R. McGowan	Third issue including response to SSE comments.
P04	04/02/25	A. Ruiz-Diaz	A. Ruiz-Diaz	R. McGowan	Planning Submission
P05	17/02/25	E. Walker	A. Ruiz-Diaz	R. McGowan	Updated to include response to SSE Legal comments.

Document reference: 109647-MMD-ARNI-XX-RP-CE-0002 P05

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1 Introduction

This document outlines the Arnish Moor drainage strategy for a proposed High Voltage Direct Current (HVDC) converter station and Alternating Current (AC) substation.

1.1 Project Overview and Scope

The applicant is seeking Planning Permission in Principle (PPiP) under the 1997 Act for consent to construct and operate a new strategic transmission hub approximately 2km southwest of Stornoway on the Isle of Lewis (the 'Site'). The project is referred to and described as the Lewis Hub (and hereafter also referred to interchangeably as 'the Proposed Development').

Mott MacDonald Limited's (MML) scope of works is designing the site's civil works and platform design, to accommodate the HVDC convertor station within Arnish Moor. Practically the AC substation platform design shall be similar to the adjacent HVDC converter station. The scope does not cover the internal drainage design of the substation and converter station sites and as such these are not discussed within this report.

Also designed by other parties is the HVDC cable route, for which landfall is situated approximately 3- 4km away from the Arnish Moor Site.

The purpose of this report is to provide a high-level summary of the drainage strategy for flows in and out of the site, as well as any impacted watercourses. Any land drains impacted shall be diverted where necessary, to tributaries of the nearest watercourse, the River Creed.

Both the temporary works during construction, including laydown areas and permanent works and operation phase are considered in this report.

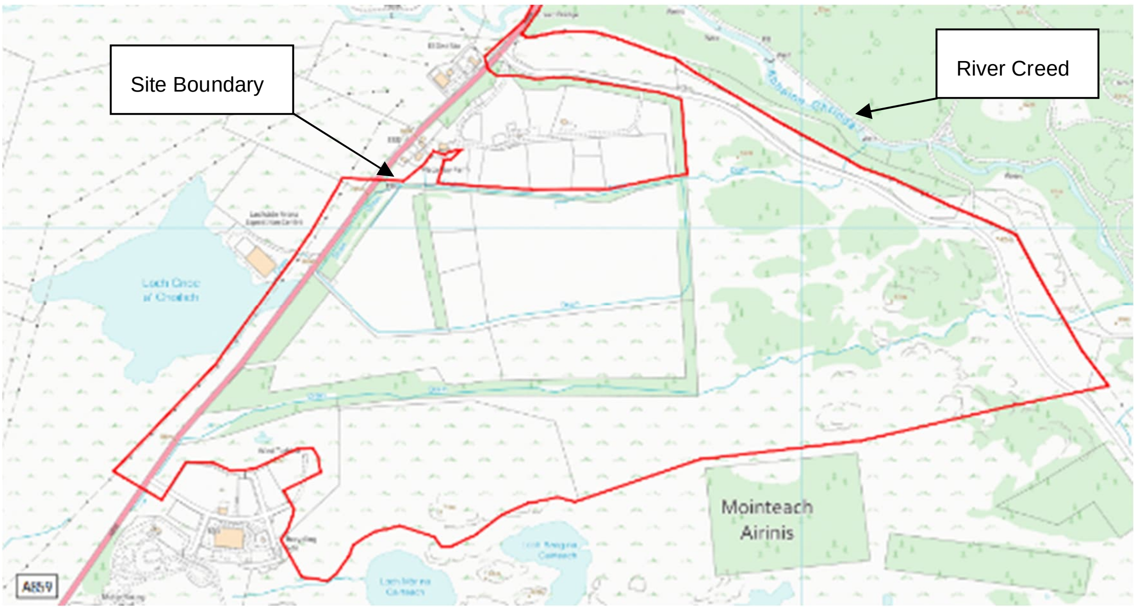
The site features are as follows:

- Permanent Access Roads – proposed roads connecting to A859 and the Arnish Road shall provide access to the AC substation and Converter station.
- HVDC Converter Station Site Platform – Site platform to be +55.500 mAOD,
  - HVDC Convertor Station - Located within platform,
  - Internal site roads.
- AC GIS Substation Platform – Site Platform to be +55.500 mAOD,
  - AC 400kV 132kV GIS substation – Located within platform,
  - Internal site roads.
- Temporary Construction Compounds
  - Laydown Area 2 – To be at 55.50mAOD with an area of 39,900m^2,
  - Laydown Area 3 – To be 55.50mAOD with an area of 20,500m^2 .

1.2 Site Location

The new proposed site for converter station and substation are to be located within the Arnish Moor site and adjacent to Macaulay Farm & College, an education centre for students with special needs, east of the A859 and south of Lews Castle and the existing Marybank Quarry. Stornoway township lies north-east of the site. Next Figure shows the Arnish Moor site boundary.

Figure 1-1: Arnish Moor Site Boundary



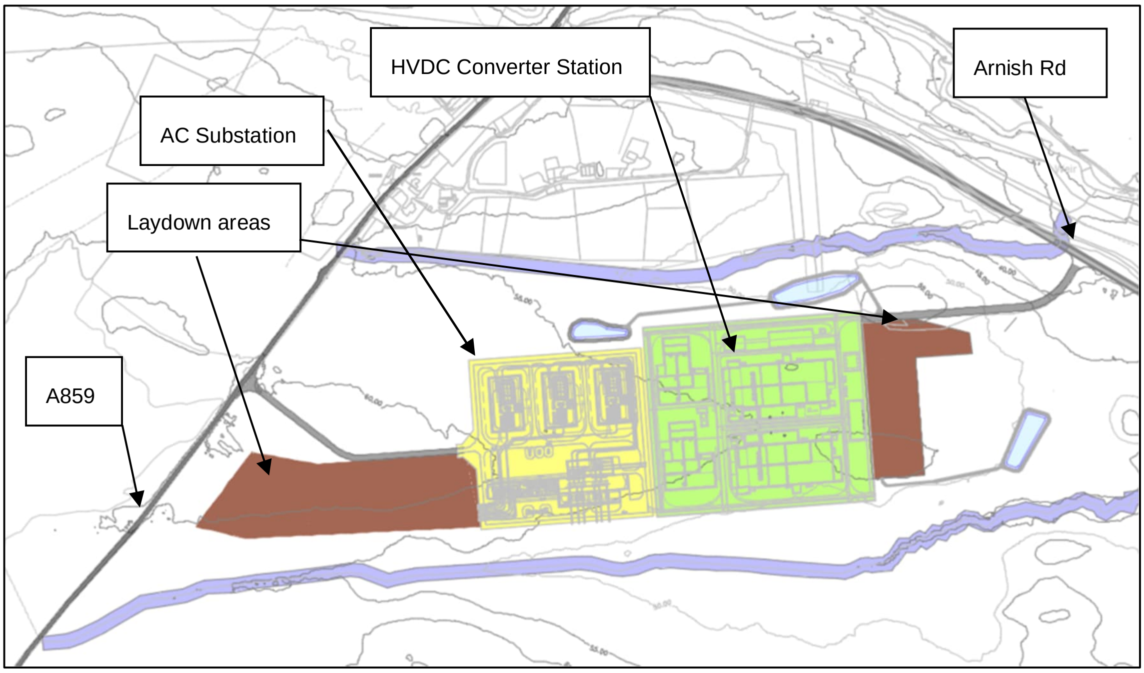
Source: SSEN Red Line Boundary Site 8 Macaulay Farm LT14-LEWI-0802-DR-0001

The proposed layout that indicates the AC Substation, HVDC Convertor Station and all Laydown Areas is shown in Figure 1-2, Laydown area 1 was removed during optioneering. Table 1.1: Coordinates of Permanent and Temporary Compound Platforms gives the coordinates (centrally at the platforms) of the permanent converter station and substation platforms as well as the associated temporary construction compounds (TCCs).

Table 1.1: Coordinates of Permanent and Temporary Compound Platforms

Reference	Permanent/ Temporary	Easting (m)	Northing (m)
AC Substation	Permanent	140402	931769
HVDC Converter Station	Permanent	140656	931823
Laydown Area 2	Temporary	140006	931715
Laydown Area 3	Temporary	140848	931966

Figure 1-2: Permanent and Temporary Platforms Within Arnish Moor Site with Peat Depths



Source: Proposed Permanent Surface Water Layout - 109647-MMD-ARNI-XX-DR-CE-0003.

1.3 Data Sources

The following data sources have been used for this assessment:

Table 1.2: Data Sources

Name	File Ref	Source	Date Received	Revision
Aerial Maps	-	Microsoft, Bing Maps	August 2024	-
OS Mapping	0100022432	Ordnance Survey	-	-
British Geological Survey (BGS) Website	-	BGS website	August 2024	-
Redline Boundary Site 8 Macaulay Farm	LT14-LEWI-0802-DR-0001	SSEN	April 2024	P03
LT14 Western Isles HVDC Drainage Design Planning Support Scope of Works	-	SSEN	-	-
SSEN LT14 Lewis Substation & Convertor Hub Layout Design Basis Statement	LT14-SSEN-XX-XX-RP-C-001	SSEN	July 2024	00
Arnish Moor Permanent Drainage Layout	109647-MMD-ARNI-XX-DR-CE-0003	Mott MacDonald	November 2024	P03
Arnish Moor Temporary Drainage Layout	109647-MMD-ARNI-XX-DR-CE-0004	Mott MacDonald	November 2024	P03
Arnish Moor Foul Water Layout	109647-MMD-ARNI-XX-DR-CE-0001	Mott MacDonald	November 2024	P04

Name	File Ref	Source	Date Received	Revision
Arnish Moor Site Water Supply Layout	109647-MMD-ARNI-XX-DR-CE-0006	Mott MacDonald	November 2024	P04
LT14 Western Isles Arnish Moor Flood Risk Assessment	109647-MMD-ARNI-XX-RP-CE-0005	Mott MacDonald	August 2024	P01
Peat Probing Factual Report	109647-MMD-00-XX-RP-GE-0002	Mott MacDonald	April 2024	B
LT14 Western Isles HVDC Geotechnical and Geoenvironmental Preliminary Desk Study	109647-MMD-00-XX-RP-GE-004-C	Mott MacDonald	October 2023	C
LT14 Western Isles HVDC Site Observation Note	109647-MMD-00-XX-TN-CE-0019	Mott MacDonald	August 2023	P01
Standardised Drainage Strategy	ASTIDC-STAN-MMD-DRAI-INFR-RPT-C-0004	SSEN/Tony Gee's	June 2024	P04
Drainage Strategy Drainage Split Network Technical Note	ASTIDC-STAN-MMD-XX-XX-TN-C-0002	SSEN/Tony Gee's	June 2024	P01
Scottish Water Records	-	Scottish Water	August 2024	-
SEPA Flood Maps	-	SEPA	August 2024	-
SEPA Drinking Water Protected Area Maps	-	SEPA	-	-

1.4 Standards and Guidance

The following standards and guidance have been used for this assessment:

Table 1.3: Standards and Guidance

Document Name	Document Reference	Publisher
Building Standards Technical Handbook – Non-Domestic	-	Scottish Government
Gravity drainage systems inside buildings	BS EN 12056-2:2000	British Standards Institute
Local Flood Risk Management Plan	-	Western Isles Council
National Planning Framework 4 (NPF4) 2024	NPF4	Scottish Government
Outer Hebrides Local Development Plan	-	Western Isles Council
SP-NET-CIV-502 Drainage Specification	SP-NET-CIV-502	Scottish Hydro Electric Transmission
SP-PS-419 Transformer Bund Specification	SP-PS-419	Scottish Hydro Electric Transmission
The SuDS Manual	C753	Construction Industry Research and Information Association

2 Existing Conditions

The existing conditions of the Arnish Moor site are summarised in Table 2.1.

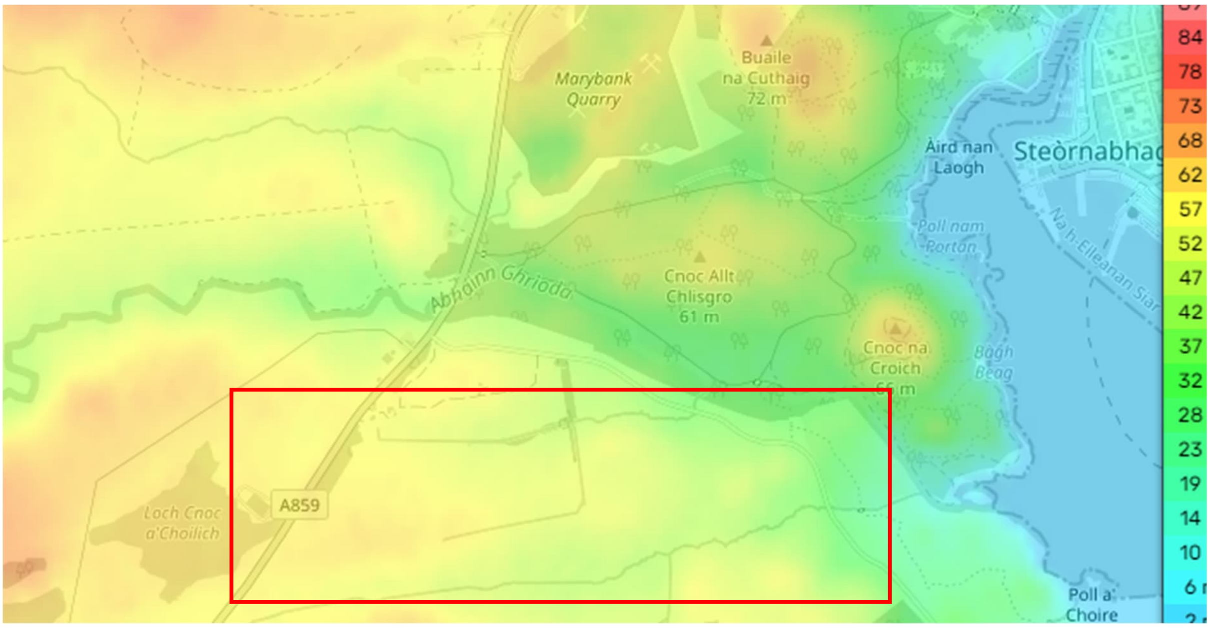
Table 2.1: Summary of Existing Conditions

Conditions	Description	Source of data
Location	The Arnish Moor site is located just south of Stornoway town on the Isle of Lewis, grid reference NB 140131 931885. The site is on the south-eastern side of the A859 across from Loch Cnoc a' Choilich and south of the existing Marybank Quarry and Mccaulay Farm & College. Western Isles Council are the local authority also known as Comhairle nan Eilean Siar.	Bing Maps
Land use	Macaulay Farm and College, a special needs educational centre offering courses from animal husbandry to construction is adjacent to the greenfield site, with grazing livestock nearby. There are some trees that are intended to be retained. Currently, the land is vacant with a peat bog throughout.	NLS Maps, Bing Maps, Ordnance Survey
Existing Drainage	There is a natural drainage system, within the greenfield area of the site. There may be some existing drainage present within Macaulay Farm which should be kept maintained throughout the works. At this time, there is insufficient GI to assess exact details of existing drainage networks. There are two main watercourses that cross the width of the site, shown in Figure 2.2. There are some field drains that cross the site, which will need to be diverted. The eastern boundary of the site is approximately 70m from the River Creed. A search of the available Scottish Water records for existing sewers and water mains identified an existing combined sewer in the A859.	Scottish Water records. Bing Maps, Macaulay Farm College Website.
Topography	Existing topography for the Arnish Moor site can be viewed on Figure 2.1. The ground slopes from the southwest with high ground of 62 mAOD at Laydown Area 2 and higher ground sloping down towards the site. The rest of the land varies with gentle slopes of 40-60 mAOD, with basin locations of 50m AOD. The ground across Laydown Area 3, the substation and convertor station slope down to Arnish Road and the River Creed. Along the east side of the A859 the land slopes northeast gradually. Around the connection point to the A859 from eastern access road the level is approximately 60 mAOD, the western access road and Arnish Road is 39 mAOD. The converter station and substation are 56m AOD and 58 mAOD respectively.	Cyberhawk Topographcal Survey
Soil Conditions and Geology	Studies have shown bedrock to be Outer Hebrides Thrust Zone Mylonites Complex Protocataclasite and	-LT14 Western Isles – Geotechnical and

Conditions	Description	Source of data
	Lewisian Complex-Gneiss, with a fault line down the middle of the site, shown in Figure 2.5 and the British Geology Survey (BGS) viewer. Also, peat probing has recorded depths of 0.5-4m across the site, with the majority, > 1m. Ground investigation is limited, with further geotechnical records currently being compiled.	Geoenvironmental Preliminary Desk Study. -Peat Probing Factual Report 100109647 109647-MMD-00--XX-RP-GE-0002 | B.
Ground Permeability	The site is considered low permeability, though with a high ground water table in its current greenfield blanket bog form, infiltration drainage systems such as soakaways would not normally be considered suitable.	Peat Probing Factual Report 100109647 109647-MMD-00--XX-RP-GE-0002 | B.
Groundwater Levels and Drinking Water Protected Areas	As the Isle of Lewis lies within the Western Isles ground water drinking protected area but not SEPA's surface water drinking water protection area. Measures to protect groundwaters during construction shall be put in place with SEPA. SEPA's long term flood maps indicate low risk of flooding from ground water sources.	British Geological Survey (BGS) andSEPA Drinking Water Protection Areas Maps.
Land Contamination/Geohazards	The risk of contamination is unknown, further geotechnical study is ongoing.	Peat Probing Factual Report 100109647 109647-MMD-00--XX-RP-GE-0002 | B
Watercourses and Drainage features	There are 2 main land drains that cross the site, north & south to the River Creed, a watercourse to the east of the proposed converter station and substation. The Creed flows north to south. The land drains' source is Loch Cnoc a Choilich, across the A859 south-west of the site. The converter station and substation sites are constrained by the land drains and River Creed to the northeast.	
Flood Risk	A Level 3 Flood Risk Assessment (FRA) with 2D hydraulic analyses based on FEH reFH2 has been carried out including TUFLOW modelling and concluded minimal flood risk to the site. The extent of flooding of the 2 watercourses is unknown and more detailed assessment is required. There are no records of historical flooding of the site. SEPA's flood maps showed that the long-term flooding of the site is: Medium level risk from surface water flooding indicated by historic flood events, shown in Figure 2.7. SEPA's surface water flood map in the northern most extremity shows Loch Cnoc a Choilich has potential to flood with a low probability factor. No river or coastal flooding has been identified. The proposed converter station and substation are located outside of the floodplain of the River Creed. There is a low potential risk of flooding by a reservoir approximately 4km upstream of the River Creed in a very extreme event, as covered by the Flood Risk Assessment.	Arnish Moor Site Level 3 Flood Risk Assessment
Potable Water Mains	The nearest distribution main, feeding from Marybank tank, is a 180mm main in the A859, with a branch close to Macaulay farm which is a scour, there is also a 125mm main in Arnish Road. It is understood that	Scottish Water Records

Conditions	Description	Source of data
	the main in Arnish Road is in the process of being replaced.	
Sewers	There are Scottish Water sewers, a 90mm PE pipe assumed to be a rising main adjacent to the access road junction and a combined 200mm DI pipe, shown in Figure 2.4, further north along the A859.	Scottish Water Records

Figure 2-1: Existing Topography of Arnish Moor Site

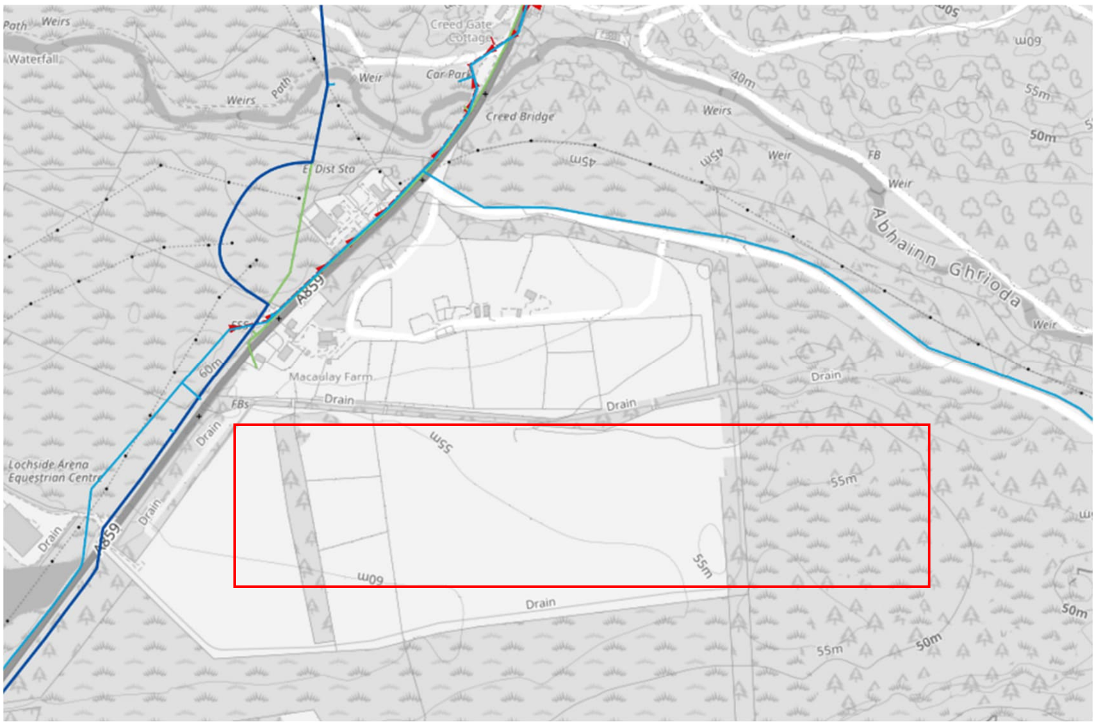


Source: Mott MacDonald & https://en-gb.topographic-map.com (2024)

Figure 2-2: Existing Drainage of Arnish Moor Site

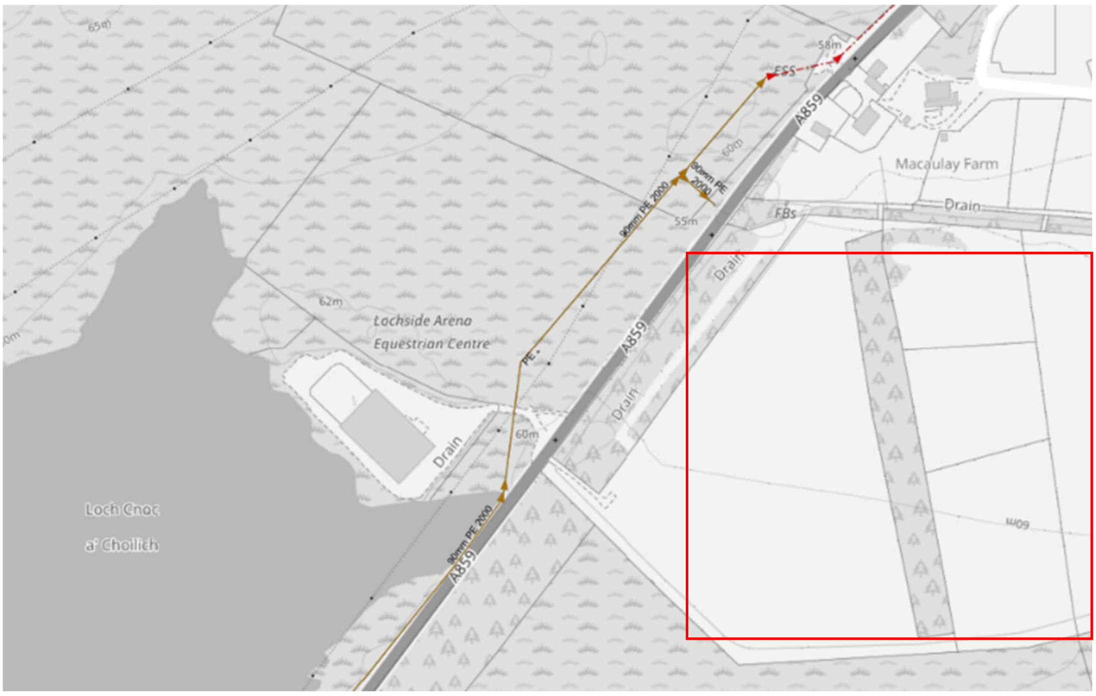
Source: Mott MacDonald LT14 – LEWIS – DIA FRA Support Email 13/08.24

Figure 2-3: Arnish Moor Scottish Potable Water Assets



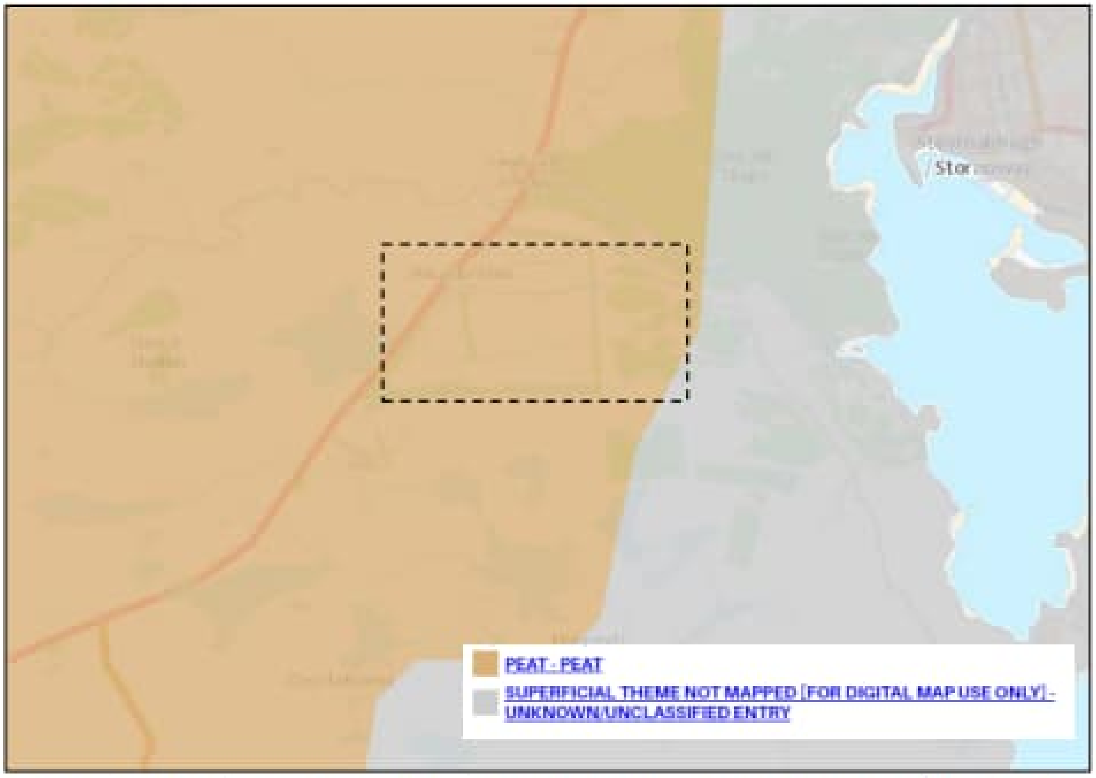
Source: Scottish Water Records, scotwater_20240813_113516_252430.

Figure 2-4: Scottish Water Foul Water Assets



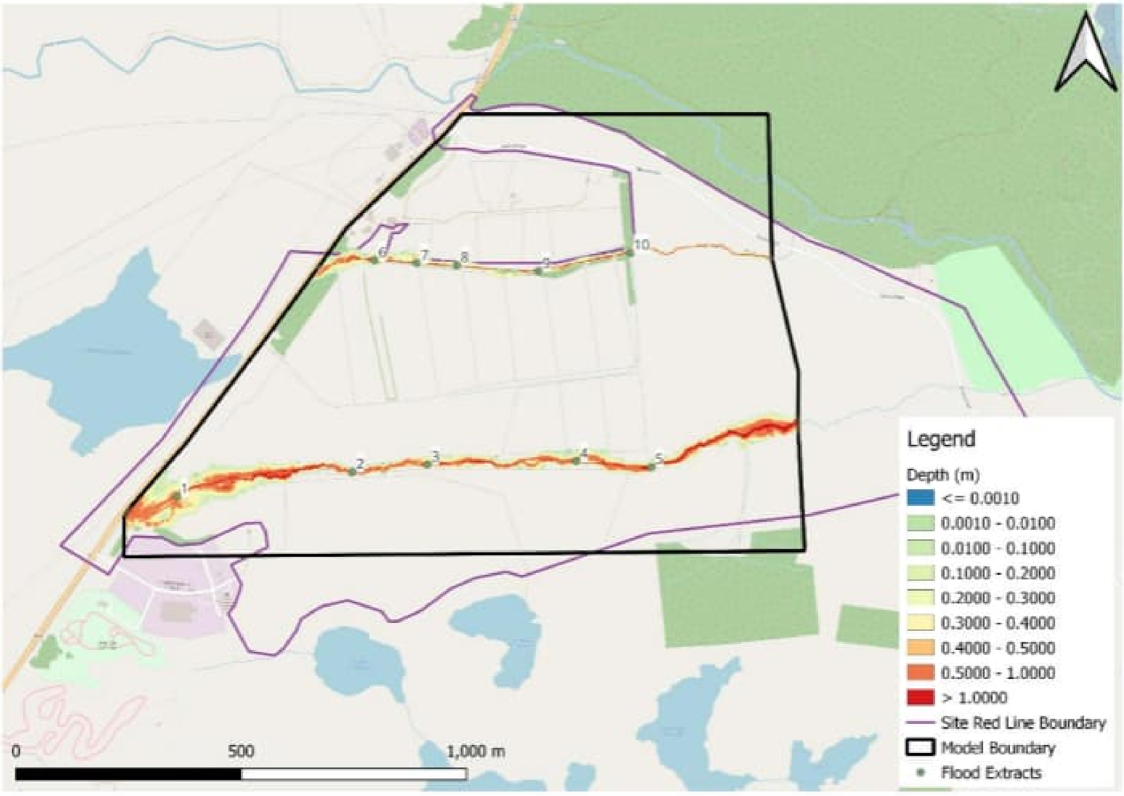
Source: Scottish Water Records Drawing scotwater_20240813_114121_876899.

Figure 2-5: Geology of Arnish Moor Site



Source: Extract from BGS GeoIndex Onshore Viewer. Contains British Geological Survey materials © UKRI [2024].

Figure 2-6: Flood Map for 0.1% AEP (1 in 1000yr) with Climate Change Allowance



Source: LT14 Western Isles HVDC-Arnish Moor FRA Level 3Flood Risk Assessment Report by Mott MacDonald.

3 Foul Water Drainage Strategy

3.1 Developed Sites

3.1.1 Proposed Solution

There will be welfare facilities within the converter station and substation buildings, therefore permanent foul sewerage is required.

SSE's hierarchy for the disposal of foul flows in SP-NET-CIV-502 is as follows:

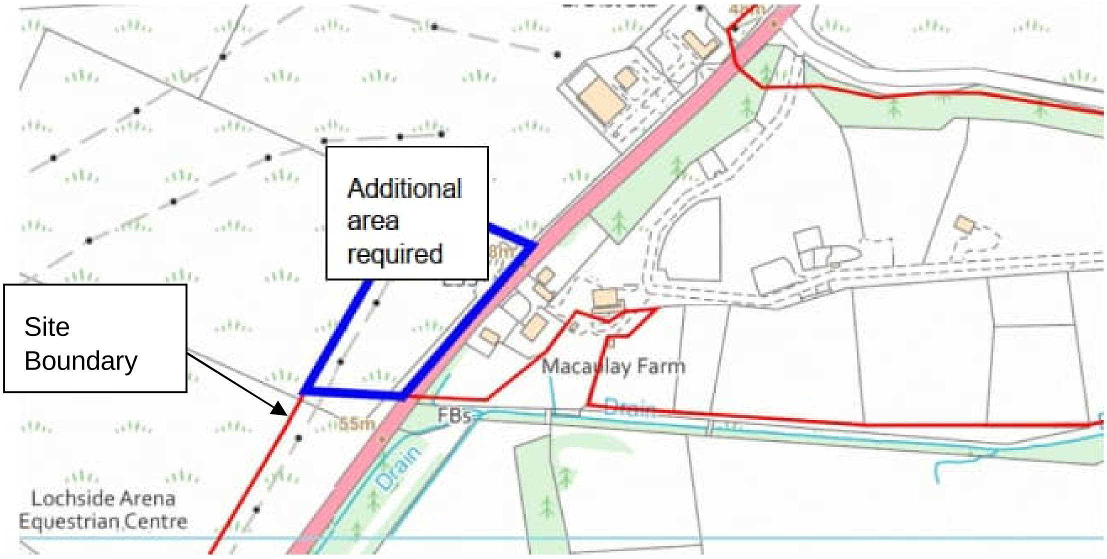
'With reference to SEPA Guidance WAT-RM-03, where a connection to an existing sewer is not feasible an appropriate treatment and discharge system shall be provided to comply with CAR license requirements and the associated SEPA guidance in WAT-RM-03.'

Three potentially feasible options have been identified as summarised below.

1. Option 1: The first consideration and preferred of the available options, is to convey the foul flows to an existing sewer. The nearest Scottish Water foul sewer to connect to is approximately 500m to the northwest of the site adjacent to A859. Due to the site topography, a gravity sewer connection is not feasible and pumping would be required. This would require a pumping station within the site being maintained by SSE, along with a rising main and sewer offsite adjacent to the A859.
2. Option 2: An alternative option, with reference to SEPA Guidance WAT-RM-03, if the technical issues of designing and operating a pumping system for such low flows are such that Option 1 is unfeasible, would be to provide an appropriate package sewerage treatment plant and discharge system, suitable for a population equivalent of 1-2 persons. The most likely outfall for this would be the southern watercourse. This treatment system would be maintained by SSE.
3. Option 3: The third potential option is a septic tank discharging through a mounded soakaway, designed to BR 478, Mound Filter Systems for the treatment of domestic wastewater. This could be formed at an area of the site such as Laydown adjacent to the HVDC platform. The natural percolation rates may be out with those suggested within BR 478, Mound Filter Systems for the treatment of domestic wastewater, however as there are up to 3 metres of imported fill, appropriate percolation may be achievable. A traditional soakaway through a field drainage system is not considered appropriate due to the ground conditions.

With regard to Option 1, informal discussions with Scottish Water have primarily indicated that the most appropriate connection is the gravity feed to Creed Pumping Station. This would involve construction adjacent to the rising main/sewer adjacent to the A859, see Figure 2.4 for the assumed connection point and Figure 3-1 for the route of the new rising main and sewer. Scottish Water also indicated that there was a potential connection point in the Business Park to the south of the site but this has been discounted due to the distance from the site and the topography.

Figure 3-1: Additional land for sewer connection



Source: OpenStreet Maps

The Creed Pumping Setation is further downstream and once foul flows from the development are conveyed into the existing pumping station, they will be pumped north to Scottish Water's sewerage system in Stornoway.

The anticipated foul flows from the substation and converter station sites are expected to be low and infrequent. Consequently, implementing a flushing system may be required to reduce the risk of septicity occurring during periods of low usage.

The proposed pumping stations will be provided with a minimum of 24 hours emergency storage.

3.1.2 Foul Water Units

The assumed facilities provided within the converter station and substation are summarised in Table 3.1 below. The discharge units of the proposed facilities have been extracted from BS EN 12056-2:2000 Table 2.

Table 3.1: Summary of Foul Water Units

Converter Station / Substation	Facility Type	Number	Discharge Units (l/s)	Σ Discharge Units (l/s)
Converter Station	WC with 9 litre cistern	2	2.5	5.0
	Wash hand basin	2	0.5	1.0
	Kitchen sink	1	1.3	1.3
Substation	WC with 9 litre cistern	4	2.0	8
	Wash hand basin	4	0.5	2
	Kitchen sink	2	1.3	2.6
			Total:	19.9

Source: Discharge units extracted from BS EN 12056-2:2000 Table 2

The peak foul water flow rate can be calculated using the discharge unit method in accordance with BS EN 12056-2 Section 6.3.1. The proposed design flow associated with the above facilities is Q = k * (DU)1/2.

Where:

k = 0.5 (frequency factor for occasional use).

DU = Total discharge units.

The total number of discharge units for both the converter station and substation is 19.9l/s. Therefore, the peak foul water flow rate from both sites has been calculated as 2.2l/s[1]

3.2 Construction Phase

For the temporary construction compounds of both the converter station and substation sites, effluent from site accommodation will be collected in a septic holding tank and removed from site as controlled waste. The foul effluent shall be removed from site by licensed waste disposal companies and the effluent shall be taken to a fully recognised and licensed sewage treatment works.

[1] It is noted that Scottish Water tend to use a different methodology for estimating peak flows. The connection application to Scottish Water is likely to be based on a lower value than this.

4 Surface Water Drainage Strategy

4.1 Design Guidance and Policy

The proposed surface water drainage design is indicated in the next drawings:

- Surface water permanent drainage layout: 109647-MMD-ARNI-XX-DR-CE-0003
- Surface water temporary water layout: 109647-MMD-ARNI-XX-DR-CE-0004

A standard drainage strategy report and technical note have been produced by Tony Gee on behalf of SSEN and MML, the according data for Arnish has been referenced below.

- SSEN-ASTI-HVDC Standardisation Drainage Strategy, ASTIDC-STAN-MMD-DRAI-INFR-RPT-C-0004 Rev P04, Tony Gee prepared for SSEN/MML
- SSEN-ASTI Drainage Split Network Technical Note, ASTIDC-STAN-MMD_XX_XX_TN_C_0002 Rev P01

The drainage strategy for the proposed development has been developed based on the following guidance:

- Flood and Water Management Act 2010 [2];
- The SuDS Manual (C753)[3]; and
- Sewers for Scotland 4th Edition
- Scottish Environmental Protection Agency (SEPA) Guidance, SEPA Silt Control Guidance.
- Environmental Standards for River Morphology (WAT-SG-21) [4]
- Engineering in Water Environment - River Crossing (WAT-SG-25)[5]
- Engineering in the water environment good practice Sediment Management (WAT-SG-26)[6]
- Engineering in the water environment good practice Temporary Construction (WAT-SG-29)[7]
- SEPA Flood Risk and Controlled Activities Regulations[8].
- Scottish Planning Policy (SPP, 2014)[9];
- Planning Advice Note 61: Sustainable urban drainage systems
- Energy Networks Association ETR 138 – Flood Resilience for Critical Infrastructure[10]

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[2] Flood and Water Management Act 2010 (2010). [Online]. https://www.legislation.gov.uk/ukpga/2010/29/introduction [Date Accessed: May 2022].

[3] CIRIA, The SuDS Manual (2015). [Online]. Available at: https://www.susdrain.org/resources/SuDS_Manual.html [Date Accessed: May /2022].

[4] SEPA supporting guidance: good practice guides WAT-SG-25 Engineering in Water Environment - River Crossing https://www.sepa.org.uk/media/151036/wat-sg-25.pdf

[5] SEPA supporting guidance: good practice guides WAT-SG-25 Engineering in Water Environment - River Crossing https://www.sepa.org.uk/media/151036/wat-sg-25.pdf

[6] SEPA supporting guidance: good practice guides WAT-SG-26 Engineering in Water Environment – Sediment Management https://www.sepa.org.uk/media/151036/wat-sg-26.pdf

[7] SEPA supporting guidance: good practice guides WAT-SG-29 Engineering in Water Environment - Temporary Construction Methods https://www.sepa.org.uk/media/151036/wat-sg-29.pdf

[8] "The Water Environment (Controlled Activities) (Scotland) Regulations 2011, A Practical Guide" by SEPA https://www.sepa.org.uk/media/34761/car_a_practical_guide.pdf

[9] "Scottish Planning Policy" by The Scottish Government, 2014, revised December 2020 https://www.gov.scot/binaries/content/documents/govscot/publications/factsheet/2021/05/transport-scotland-core-documents/documents/policy/scottish-planning-policy-spp/scottish-planning-policy-spp/govscot%3Adocument/scottish-planning-policy.pdf

[10] Engineering Technical Report 138 "Resilience to Flooding of Grid and Primary Substations" by Energy Networks Associations, issue 3 2018 https://www.ena-eng.org/ena-docs/D0C3XTRACT/ENA_ET_138_-_Annex_Extract_180902050351.pdf

- SSEN Generic Electricity Substation Design Manual for Civil, Structural and Building Engineering:
  - SP-NET-CIV-501 Earthworks, Specification, SSEN, July 2020
  - SP-NET-CIV-502 Drainage Specification, SSEN, July 2020.
  - SP-NET-CIV-503 Pavements and Roadways Specification, SSEN, July 2019.
  - SP-NET-CIV-504 Ducting, Trenching and Trench Covers Specification, SSEN, June 2016.
  - SP-NET-CIV-509 Substation Bunds Specification, SSEN, July 2020.

The SSE specification SP-NET-CIV-502 indicates the "design" standards for the site are as follows:

- 1 in 200-year return period protection for operational areas;
- 1 in 1000-year return period protection for "critical infrastructure" as defined in SSE Specification and Planning Guidance;
- Off-site discharge at 1 in 2-year greenfield runoff rate and 1 in 200-year return period protection for off-site flooding.

4.1.1 Climate Change

SEPA defines allowances for the effects of climate change on peak rainfall intensities. The peak rainfall intensity allowances for each river basin region in accordance with SEPA requirements is 48% allowance of climate change.

It is worth noting that SSE specification SP-NET-CIV-502 states that a climate change allowance of 20% (by factoring the rainfall intensity hyetograph values) shall be applied to FEH rainfall data. A climate change allowance of 48% shall be considered for the surface water drainage design as per SEPA's requirements, embedding conservatism into the surface water drainage design. This climate change allowance value shall be applied to the 1 in 200-year return period, considering no flooding of the operational areas of the permanent converter station and substation platforms.

Similarly, a climate change allowance of 48% has also been applied to the design of the surface water drainage design for the temporary construction compounds. A climate change allowance may not be required for the temporary condition, however this is to be discussed and agreed with SEPA.

4.1.2 Disposal of Flows

It should be acknowledged that the satisfactory collection, control and discharge of storm water is a principal planning and design consideration.

The NPF4 states that for new developments, the best way of reducing flood risk within the development is to:

- Control the water at source through sustainable system (SuDS).
- Consider exceedance flow route when the capacity of the drainage system is exceeded.

SuDS should mimic natural drainage and reduce the amount and rate of water flow by:

- Infiltrating into the ground,
- Holding water in storage areas, and
- Slowing the flow of water.

The design will meet the following discharge hierarchy (with acceptable justification for moving between levels) by the CIRIA C753 SuDS manual:

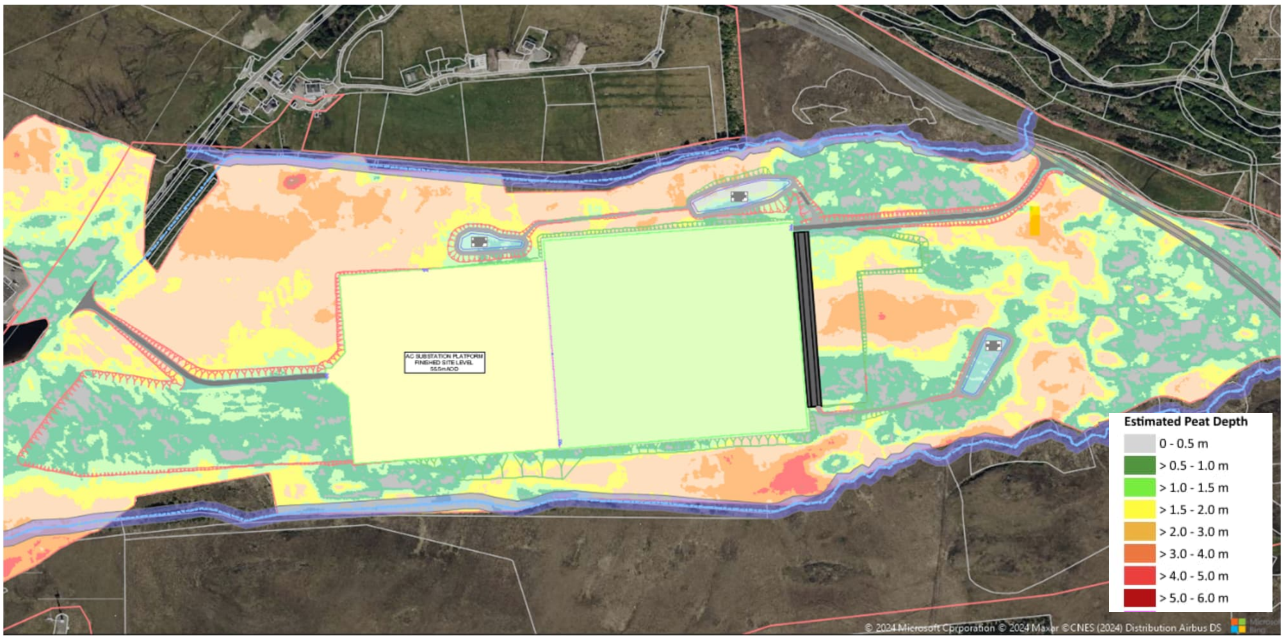
1. Infiltration to the maximum extent that is practical –where it is safe and acceptable to do so.
2. Discharge to surface waters.
3. Discharge to surface water sewer.
4. Discharge to combined sewer (last resort).

It is necessary to identify the most appropriate method of controlling and discharging surface water from the site. Where possible, surface water run-off from the developed site will be drained in such a way as to mimic the natural drainage system and thereby implement a SuDS approach. The design should seek to improve the local run-off profile by using systems that can either attenuate run-off and reduce peak-flow rates or positively impact on the existing flood profile.

The assessment followed to design the runoff flows is in accordance with SSE specification SP-NET-CIV-502 which states that the preferred method of estimating the rainfall depth is to use the depth-duration-frequency rainfall model contained within the Flood Estimation Handbook (FEH).

Due to the high presence of peat, which is underlain by impermeable bedrock, the site is considered low permeability, though with a high ground water table in its current greenfield blanket bog form. Additionally, a shallow groundwater table has been assumed owing to the areas of standing water observed throughout the site. Therefore, in its current greenfield blanket bog form, infiltration drainage systems would not normally be considered suitable and in accordance with the discharge hierarchy specified within the SuDS manual, flows shall instead be attenuated and discharged into the nearest available watercourse.   SUDs basins are sited in areas of shallow peat depth, as shown in Figure 4.1.

Figure 4-1 Peat zoning with proposed pond locations



Source: Peat Probing Factual Report 109647-MMD-00-XX-RP-GE-0002

However, it is recognised that constructing SuDS, including detention basins, within a peat covered site will require significant removal of peat. While this DIA illustrates a viable surface water drainage design can be accommodated on the site, adopting what is considered a worst case for peat management, 'the Proposed Development' is committed to reducing the impact of the development, including drainage, on the environment. As the design develops, the Project will continue to refine the drainage design with the aim of minimising the environmental impact. Several novel approaches are being considered for within and out with the station confines, one of which includes forming low level surface bund arrays within the wider peat in order to diffuse surface runoff around the perimeter of the site and attenuate the drainage without removing the peat.

4.2 Proposed Surface Water Drainage Strategy: Developed Sites

Surface water runoffs from both the HVDC convertor station and AC substation site are to be conveyed and attenuated within detention basins north and south respectively of the substation and convertor station, refer to 109647-MMD-ARNI-XX-DR-CE-0003. The outflows shall be limited to the equivalent 1 in 2-year greenfield runoff rates for the respective catchments (Appendix B). The preference of SSEN, is via gravity, however where this is not possible a pumped solution may be used.

The outfall from the detention basins shall discharge into existing drainage ditches/watercourses then to the River Creed. Track access (pavements and roadways) for maintenance vehicles shall be provided to all outfalls. Headwalls shall be provided at all positions where a drainage system discharges into open water.

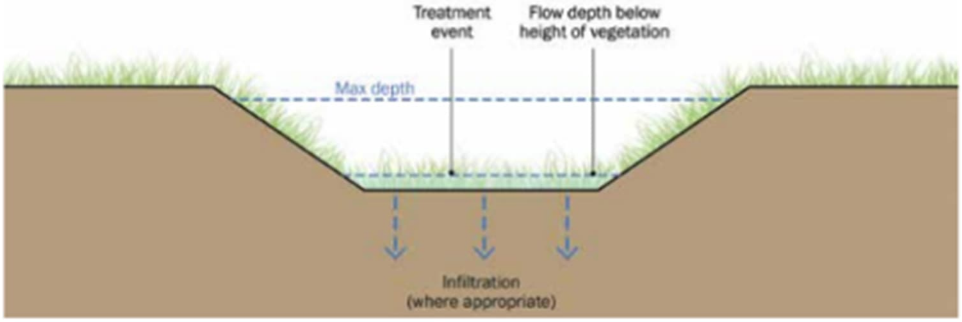
The entirety of the surface water runoff from the AC substation will be conveyed into a swale then detention basin located in the southeast side of the site. The flow from the HVDC converter station will be conveyed to a standardised single outfall, in the northeast corner of the station, into a detention basin in the northeast of the site.

A permanent swale shall be constructed to the south of the site to convey earthworks & building drainage. There are also natural constrictions to the swales, due to earthwork slopes, that would create a tiered effect and add further levels of treatment, settlement areas prior to entry to the basins will be provided.

In the southwest side of the site, by Laydown area 2 substation cables are planned to be located and therefore these areas shall be kept clear from during the installation of the cables only, a temporary drainage diversion will be required at this area of the site.

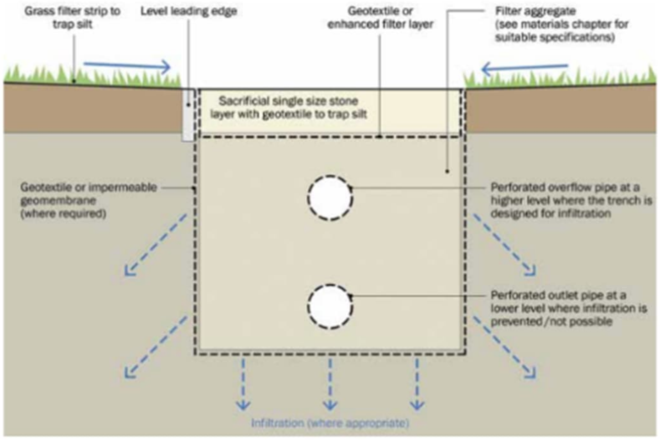
Kerbs and gullies are to be installed when required, with filter drains along both sides of the permanent access roads based on the camber, as specified in the standardised documents, to convey surface water runoff from the road. These should be maintained biannually and annually accordingly.

Figure 4-2 Typical detail of a swale



Source – The SUDs Manual, CIRIA C753

Figure 4-3 Typical detail of a filter drain



Source – The SUDs Manual, CIRIA C753

Filter drains are also to be placed at the toe of cuttings to intercept surface water runoff landing directly on the embankments such as along the northwestern walls of the AC substation.

Where there is a potential risk of oily water, such as at transformers, an above ground oil interceptor shall be installed with a connection to the surface water system. Roads adjacent to oily water sites will drain flow through the interceptor. An operation and maintenance plan shall be prepared for all apparatus.

The drainage system within the site platform has not been developed at this stage however the drainage downstream of the Converter Station has been based on a standardised platform layout developed by SSEN. A pipe gradient of 1:200/1:300, falling from one end of the platform to the other has been assumed, with the dimensions shown in Table 4.1.

Table 4.1: Drainage Corridor

Drainage Corridor Dimension	Size
Max Corridor Depth/ Width (m) **Convertor Station**	5.5m
	3.0m
Surface/foul water max pipe diameter	1200mm
	300mm

Source: SSEN-ASTI-HVDC Standardisation Drainage Strategy, ASTIDC-STAN-MMD-DRAI-INFR-RPT-C-0004 Rev P04, Tony Gee prepared for SSEN/MML)

4.2.1 Permanent Works

The permanent works include the normal features of a converter station and substation: buildings, transformers, internal roads, car parks, earthworks and external access roads.

The AC substation and HVDC converter station design life is 40 years (20 years first life maintenance).

The permanent works include but are not limited to:

- Site platforms of the converter station and substation compounds are to be +55.5mAOD. The site platforms will be constructed from permeable granular stone to attenuate flows.
- Buildings of varying use. A significant proportion of the converter station site is formed of buildings, typically utilising a steel frame construction with cladded exterior, with a reduced number present within the substation site.
- 2 No. permanent access roads to facilitate access within the substation compound.

4.2.2 Proposed Permanent Development Areas

The proposed impermeable areas of the permanent HVDC converter station and AC substation sites are summarised in Table 4.2. The percentage of impermeable areas was calculated by analysing the hardstanding surfaces (Internal roads, bunds, buildings and embankments) against the total area of the site. Permeable areas comprised the remaining areas of the exposed free-draining granular stone of the platform.

Table 4.2: Summary of Permanent Impermeable Areas

Catchment Reference	Total Catchment Area (ha)	Percentage of Impermeable Area (%)	Total Impermeable Area (roads, roofs, transformers bunds) (ha)
AC Substation	6.36	47	2.99
HVDC Converter Station	8.59	57	4.90
Permanent Access Road East	0.39	100	0.39
Permanent Access Road West	0.31	100	0.31

4.2.3 Pre-Development Runoff Rates for Permanent Structures

The greenfield runoff rates have been calculated using the online ‘HR Wallingford tool’ which follows the IH124 method. Appendix B contains the greenfield runoff rate for each permanent catchment area.

The contributing area, shown in **Table 4.3**, of each site considers the gross area of all catchments of the new development: new embankments, platforms, access roads; all works affected by the new converter station and substation.

Table 4.3: Permanent Catchment Pre-Development Runoff Rates

Pre-Development Runoff Rates					
Catchment Area Reference	**Contributing Area (ha)**	**QBAR (l/s)**	**1 in 2-year (l/s)**	**1 in 30-year (l/s)**	**1 in 200-year (l/s)**
AC Substation	6.36	107	96	209	304
HVDC Converter Station	8.59	128	116	251	365

*Eastern catchment of the permanent access road to discharge at a rate of 5l/s to prevent blockages to the flow control device.

Source: “Greenfield runoff rate estimation for sites” from HR Wallingford, www.uksuds.com

4.3 Proposed Surface Water Drainage Strategy: Construction Phase

As shown in 109647-MMD-00-XX-DR-CE-0003 & 0004, surface water runoff from the temporary construction compounds, laydown areas are to be conveyed into the north and south watercourses via temporary swales which will then be backfilled. Outflows of the widened swales shall be limited to the equivalent 1 in 2-year greenfield runoff rates.

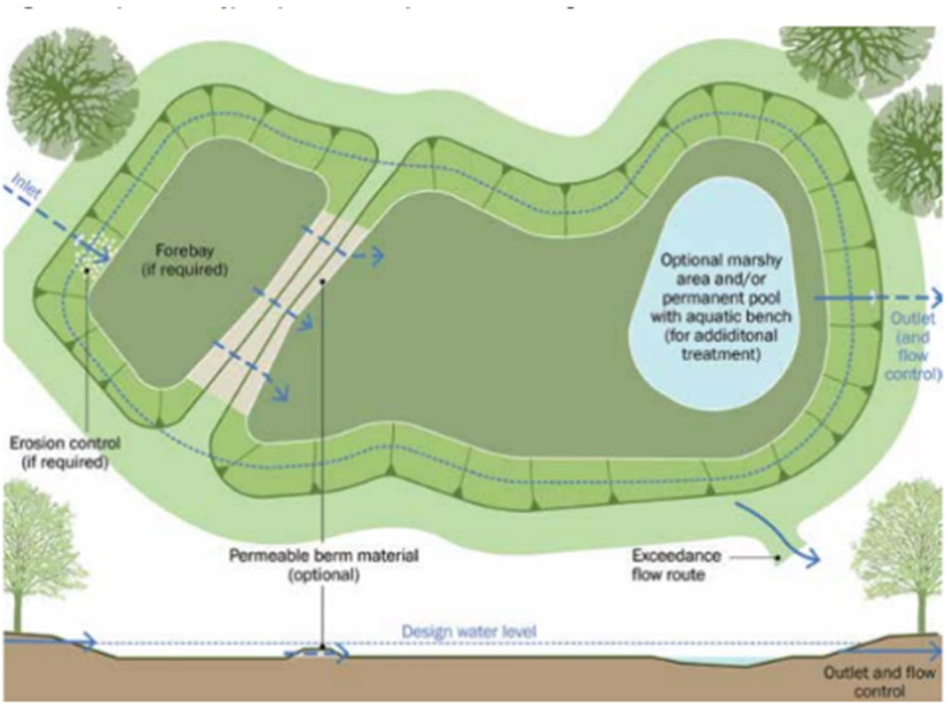
Perimeter swales covering the temporary compounds have been proposed to:

1. Intercept overland flows from the areas of higher ground located outside of the proposed development and to;
2. Capture any earthworks flows from embankments or at toe or cuttings
3. Contain any surface water runoff of the temporary and permanent compounds, therefore preventing any potential pollutants, including silts and fines, entering the surrounding watercourses during the construction stage (Refer to Section 5.2).

The swales to the south of the convertor station and substation will remain to convey the substation land and earthwork drainage.

Temporary drainage is required during the construction of the AC substation and HVDC converter station platforms. Due to the natural topography the swale is not a continual length but with constrictions. In addition to the perimeter swales, settlement lagoons have been proposed to attenuate surface water runoff and collect the volumes of silts/fines transported by the runoff during construction, as shown in next Figure. The settlement lagoons will partly be formed naturally along the length of the swale following the natural topography. The settlement lagoons will outfall into the nearest available watercourse with discharge rates being limited to the equivalent 1 in 2-year greenfield runoff rates shown in Table 4.3.

Figure 4-4 Typical detail of a detention basin with a forebay or settlement lagoon.



Source - The SUDs Manual, CIRIA C753.

The temporary settlement lagoons shall be extended and compartmentalised on site by the contractor as necessary to meet water quality standards through settlement and, if required, dosing. Once the platforms of the substation and converter station sites have been constructed, the settlement lagoons shall be modified and utilised as detention basins for the permanent drainage design.

4.3.1 Temporary Features

The temporary features of the proposed construction compounds include but are not limited to:

- Welfare facilities
- Internal roads
- Laydown/storage areas
- Vehicle/plant parking.
- Borrow Areas

Drainage will be constructed to prevent surface water runoff from entering the borrow pit from the adjoining land. Runoff from adjoining land shall be captured (in a perimeter gravel-filled drainage ditch, shallow v-ditch or similar) upslope of the borrow pit footprint. These waters shall then be directed (again via gravel-filled drainage ditch or shallow v-ditch) to a soakaway trench constructed on the downslope side of the borrow pit; or if a watercourse is downslope side of the borrow pit via dispersion sheet. Rainfall landing within the pit, and any groundwater collected within it, shall be directed towards the main headwall and collected in a sump. This water will then be directed, either via pump or by gravity drainage, to a series of settlement management ponds and/ or structures. These in turn will then discharge to soakaway trenches on the downslope side of the borrow pit. After the completion of the Construction phase, the borrow areas will be restored with new final land contours (similar to the pre-development contours/natural contours).

4.3.2 Proposed Temporary Development Areas

The proposed impermeable areas of the temporary HVDC converter station and AC substation construction compounds are highlighted within Table 4.4. The percentage of impermeable area also accounts for the embankments outside of the compound working areas.

Table 4.4: Summary of Temporary Impermeable Areas

Catchment Reference	Total Catchment Area (ha)	Percentage of Impermeable Area (%)	Total Impermeable Area (ha)
Laydown Area 2	4	50	2
Laydown Area 3	2.05	50	1.0

4.3.3 Pre-Development Runoff Rates for Temporary Structures

The greenfield runoff rate has been calculated using the online ‘HR Wallingford tool’ which follows the IH124 method. Appendix B contains the greenfield runoff rate for each temporary catchment area.

The contributing area, shown in **Table 4.5**, of each site considers the gross area of all catchments of the proposed temporary construction compounds: internal roads, laydown areas, car parking and welfare facilities.

Table 4.5: Temporary Catchment Pre-Development Runoff Rates

Pre-Development Runoff Rates

Catchment Area Reference	Contributing Area (ha)	QBAR (l/s)	1 in 2-year (l/s)	1 in 30-year (l/s)	1 in 200-year (l/s)
Laydown Area 2	4.41	57	56.7	110	161
Laydown Area 3	1.78	23	22.9	45	65

Source: "Greenfield runoff rate estimation for sites" from HR Wallingford, www.uksuds.com. Appendix B

4.4 Post-Development Discharge Rates and Proposed Attenuation Volume

Surface water run-off discharging from the development sites into the existing nearby watercourses shall be restricted to an appropriate discharge rate. As noted previously, a significant proportion of the site is currently undeveloped, therefore, in line with local and national guidelines, the flow restriction from the developed site shall be based on the estimated equivalent 1 in 2-year greenfield run-off rate for the undeveloped site.

The proposed discharge rates vary per catchment area; however, they shall be controlled by a suitable flow control device such as a Hydrobrake manhole or an orifice control at the attenuation basin outlet. The diameter of the chosen flow control device shall be set to achieve the desired outfall discharge rate for the catchment area served. To avoid blockage of the flow control device, the advisable minimum discharge rate is 5l/s.

The proposed permanent attenuation volume, shown in **Table 4.6**, would be provided onsite within the network of pipes (to be done by others) and outside the converter station and substation compounds via two detention basins. The required attenuation volumes for the two proposed detention basins are 4200 and 2000 m^3 to protect the site against the 1 in 200 year + cc event and critical equipment from the 1 in 1000 year + cc even whilst limiting discharge to greenfield runoff. The basins may reduce in size once the drainage design is complete and consideration is given to the attenuation volume provided by the onsite drainage system (swales, filter drains etc).

The permanent detention basins will be vegetated, non-permeable geo-textile lined with an inlet forebay. This will provide treatment of the runoff by allowing for settlement of silts, heavy metals and the removal of oxygen demanding material.

Table 4.6: Post-Development Discharge Rates

Catchment Area Reference	**Proposed Discharge Rate (1 in 2-year Greenfield Runoff Rate) (l/s)**	**Proposed Attenuation Volume (m^3)**
AC Substation	96.4	4200
HVDC Converter Station	115.6	2000

4.5 Exceedance Events

The proposed development will locally increase ground levels around the site boundary due to the requirement of constructing flat platforms for the converter station and substation. Any exceedance flow that could occur when rainfall exceeds the 1 in 200-year + 48% climate change allowance will be delivered to the proposed detention basins and permeable platforms. During time where the system may flood due to very large storm events, all excess water that cannot be contained within the permeable platform or SUDs features (basins) should be maintained within suitable exceedance areas and routes. These routes should direct flow towards the two watercourses.

4.6 Hydraulic Modelling: Convertor Detention Basin (AT-01)

The following parameters in Table 4.7 have been used in the hydraulic design and simulation using MicroDrainage modelling software.

Table 4.7: Hydraulic Modelling Parameters

Criteria	Parameter
Rainfall	
Rainfall Method	FEH /Modified Rational Method
Design Rainfall	FEH 2022- Point Rainfall GB 140358 931952 NB 40358 31952
Simulation Criteria	
Cv (Summer)	0.750
Cv (Winter)	1.000
Time of Concentration	5mins
Return Periods	
Permanent Catchment	1:2
	1:200 +48%
	1:1000 +48%
Percentage of Impervious (PIMP)	
Converter Station	57%
Substation	47%
Permanent Road-West	100%
Permanent Road-East	100%
Cut/Fill Slopes	21%
Laydown Area 2	50%
Laydown Area 3	50%
Catchment Areas	
Converter Station	8.59ha
Substation	6.36ha
Permanent Road-West	0.31ha
Permanent Road-East	0.39ha
Cut/Fill Slopes	3.56ha
Laydown Area 2	4ha
Laydown Area 3	2ha
Net Area	25.21ha
Detention Basin Structure – AT01	
Volume (m3)	4625.3
Flow Control Device Design Flow (l/s)	Hydro-Brake 105.00
Discharge Point	Outfall into North Watercourse

Criteria	Parameter
Detention Basin Structure – AT02	
Volume (m3)	2472.2
Flow Control Device Design Flow (l/s)	Hydro-Brake 96.43
Discharge Point	Outfall into South Watercourse

5 Water Quality Control

The proposed development provides a risk of water pollutants both during the temporary (construction) and permanent (operational) stages. SuDS features can be used to provide treatment to surface water runoff to prevent pollution of the receiving watercourses.

5.1 Developed Site Water Pollution Hazards

The following areas provide a risk of water pollution during the operational stage of the proposed development:

- External access road leading to the substation and converter station sites.
- Embankments of the converter station and substation platforms.
- Permanent drainage systems on the substation and converter station site.

The water quality control measures implemented within the internal substation and converter station drainage systems are as follows for the standardised HVDC platform design and AC Substation. Filter drains will be provided wherever feasible for surface water runoff but water quality will be mitigated ‘off platform’ in the attenuation basin described in this document. Oily water will be treated through above ground filters fed by oil discerning sump pumps and will also be directed to the attenuation basin. This satisfies the requirements for water quality as identified using the Simple Index method described in the SUDS manual (see appendix C).

The permanent or operational drainage system is designed to meet the water quality criteria and best practice pollution control measures set out in the CIRIA SuDS Manual. The site is categorized by appropriate pollution hazard level from Table 26.15 and Table 26.2 of the SuDS Manual. As an initial check, the Simple Index Approach, seen in Appendix C, has been applied to confirm the pollution risks are mitigated sufficiently as recommended in Section 26.7.1 ‘Water Quality Management: Design Methods’ of the SuDS Manual.

5.1.1 Operational Phase Substation and Converter Station Site

The proposed surface water drainage system will improve the water quality of surface water runoff from the proposed development, which will ultimately outfall to existing watercourses.

This will be done by using a treatment chain where each subsequent system within the proposed drainage network provides treatment to improve water quality.

The proposed surface water treatment method will depend on the potential hazards on the site and the sensitivity of the receiving water body to pollution.

In line with the SP-NET-CIV-509 and the 502, all transformers will have a totally sealed bund with a sump which has a water control unit to pump any water out. This will be directed through an above ground oil separator to pick up any potential small levels of residual oil before being discharged into the main operational platform drainage system.

Access roads will drain into a filter drain system or the permeable platform; this will provide an adequate level of water quality treatment.

A penstock valve shall be installed at each outfall, with sampling points incorporated downstream of the swale or basin prior to discharge entering the water environment. Each new outfall to existing watercourses will require a discharge consent, to be agreed with SEPA and the Local Flood Authority, Western Isles Council.

5.1.2 External Access Road

The external access road leading to the proposed converter station and substation sites will be occasionally used by staff and visitors and has therefore been considered as a very low trafficked area. Subsequently, it has been assumed that there will be no significant discharge of potential pollutants from this area.

Filter drains have been proposed either side of the permanent access road to intercept overland flows and prevent surface water runoff from the road directly entering the surrounding watercourses without treatment. The surface water runoff from the external access road shall pass through the filter drains, into swales and outfall to the north and south watercourses respectively, providing an appropriate level of treatment. As indicated in Table 26.15 from the SuDS Manual, filter drains are particularly effective at removing the main pollutants in runoff such as suspended solids, hydrocarbons and metals.

5.1.3 Embankments of the Converter Station & Substation Platforms

The embankments of the permanent site platforms provide a risk of pollution via the potential transportation of silt/fines as a result of rainfall landing directly on them. This risk shall be mitigated through:

- Filter drains at the toe of cutting slopes within the converter station and AC substation and;
- Swales at the toe of filling slopes outside of the converter station and AC substation fencing.

As stated in Section 5.1.2, filter drains are effective at removing suspended solids. Furthermore, check dams shall be installed within the swales to slow the water velocity within the swale, reducing erosion and encouraging silts/fines to settle. The check dams also provide a barrier, preventing the soil particles travelling through the permanent drainage network and entering the receiving watercourses.

5.1.4 Discharging Water into a River

To avoid existing waterbodies becoming contaminated by suspended sediments, the velocity of flows at the outfall should be reduced using baffles, blocks in the outfall apron or an energy-dissipater. The same consideration should be taken when over-pumping water along a watercourse.

Penstock valves will be installed to close or isolate the outfall in the event of a pollution incident.

5.2 Construction Phase Water Pollutant Hazards

During the construction stage, risks of water pollutants are present during:

1. The construction of the permanent substation and converter station platforms and;
2. The operations of the temporary construction compounds.

The following risks are provided during the above activities:

- Surface water runoff transporting silts and other fine particles to the surrounding watercourses.
- The potential spillage of fuel when refuelling plant, creating areas of contaminated land and watercourse pollution.
- Waste materials could contaminate the surrounding ground and watercourses, causing significant harm to the natural environment.

The objectives of the surface water management plan when considering the construction of the permanent substation and convertor station are to maintain the current water environment, ensure SEPA are satisfied water quality standards are met, maintenance of all mitigation measures, water flowing out of the site is not contaminated with oil.

To ensure pollution is minimised during construction best practice guidance and the General Binding Rules (GBRs) will be followed. A construction site license will be applied for prior to construction commencing outlining all pollution prevention measures. Such measures include attenuation, swales, check dams and silt management techniques ie silt fences, further detailed below.

To prevent contamination of the water network from mud on vehicles and areas under construction, temporary basins will be constructed which will fully be made permanent at a later stage in the construction process. This will be detailed in the Surface and Foul Water Management Plan and is shown on Drawings 109647-MMD-ARNI-XX-DR-CE-0003 to -0004.

For construction phasing activities and temporary silt mitigation measures, refer to the Construction Environmental Management Plan.

5.2.1 Transportation of Silts and Fines

The potential pollution of the surrounding watercourse caused by silts and other fine particles during the construction phase shall be mitigated through the use of:

- Perimeter swales with check dams installed;
- Settlement lagoons with an appropriately sized settlement bay to remove the silts/fines generated during construction and;
- Widened swales with forebays to remove silts/fines located to the south of the temporary construction compounds.

Surface water runoff from the temporary and permanent platforms will enter the perimeter swales and undergo a basic level of treatment via removal of any silts/fines. Where ground elevations permit, the settlement lagoons will act as an intermediate element between the perimeter swales and the proposed discharge points, therefore providing an additional level of treatment to surface water runoff.

The settlement lagoons are to be extended and compartmentalised on site by the Contractor as necessary to meet water quality control standards through settlement and, if required, dosing.

5.2.2 Spillage of Hazardous Substances

The prevention of fuel spillages shall be managed on site by the Contractor. It is advised that refuelling or handling of other hazardous substances shall take place within a water-tight bunded area located as far as practicably possible from the nearest watercourse. Spill kits shall be present on site and it is assumed that correct spill procedures shall be in place and managed by the competent Contractor on site.

5.2.3 Waste Materials

Waste materials shall be segregated and effectively managed on site. All waste material storage areas shall be located as far as practicably possible from the nearest watercourse.

5.3 Water Quality Design Criteria

The drainage systems on site will be designed to meet the water quality design criteria and good practice pollution control measures as outlined in the CIRIA SuDS manual. The different areas of the site will be categorised by the appropriate pollution hazard level from Table 26.2 of The SuDS Manual. As an initial check, the Simple Index Approach has been applied to confirm the pollution risks are mitigated sufficiently as recommended in Section 26.7.1 "Water quality management: design methods" of The SuDS Manual.

For the operational phase, the SuDS components stated above are proposed to provide sufficient pollution mitigation – refer to Appendix C.

6 Conclusions

This outline drainage strategy has concluded as follows, subject to further development and consultation with key stakeholders:

- A permanent foul water network is required to accommodate the proposed welfare facilities at both the substation and converter station sites, connecting to the existing Scottish Water network along the A859. The preferred solution for the permanent foul water network, foresees connecting into an existing combined sewer, owned and maintained by Scottish Water, through a series of pumped and gravity connections. The proposed connection point is into an existing manhole 1201 located to the west of the A859. If this solution is unfeasible due to technical issues, other options are provided in Section 3.1.1
- Effluent from temporary site accommodation will be collected within a septic holding tank and removed from site as controlled waste. The foul effluent shall be removed from site by licensed waste disposal companies and the effluent shall be taken to a fully recognised and licensed sewage treatment works.
- Tributaries of the River Creed are the most suitable receptor for surface water discharge from the proposed Arnish Moor substation and converter station sites.
- In the permanent stage, surface water runoff from the impermeable surfaces such as rooftops of the substation and converter station sites are to be conveyed to permanent open channels/swales that then widen into detention basins with settlement lagoons prior to discharging into the nearest available watercourse at the equivalent 1 in 2-year greenfield runoff rate. Sampling points shall be incorporated downstream of the swale or basin prior to discharge entering the water environment.
- Adjacent higher ground flows will be collected in the permanent open channels/swales. The collected flows will be discharged into the nearest available watercourse with no restriction to flow.
- In the construction stage, temporary swales that will be later backfilled and settlement lagoons are to be utilised to attenuate surface water runoff and remove silts/fines prior to discharging into the nearest available watercourse at the equivalent 1 in 2-year greenfield runoff rate.
- Access roads shall be drained via kerbs and gullies or CKD units where appropriate, out falling into the permanent swales then nearest available watercourse at the equivalent 1 in 2-year greenfield runoff rate. Sampling points shall be incorporated downstream of the roads prior to discharge into the river.
- The proposed drainage system has been designed to accommodate a 1 in 200-year return period and 48% climate change without surface flooding. A preliminary check of the 1 in 1000 (plus climate change event) year event has also been undertaken and critical equipment is suitably protected. The estimated required attenuation volumes for the two proposed detention basins are 4200m3 and 2000m3 approximately, whilst limiting discharge to greenfield runoff. It is envisaged that forming these basins will require significant removal of peat therefore further modelling will be undertaken as the design develops to refine these volumes with the aim of minimising the environmental impact.
- Discharge consents affecting the existing watercourses shall be agreed with SEPA and the Local Flood Authority, Western Isles Council.

Appendices

- Appendix A - Greenfield Runoff Calculations
- Appendix B - Attenuation Volume Calculations
- Appendix C - Water Quality Simple Index Approach

A. Greenfield Runoff Calculations

hr wallingford

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Euan Walker
Site name:	Arnish Moor Substation
Site location:	Arnish Moor

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

Site Details

Latitude:	58.20018° N
Longitude:	6.42078° W
Reference:	2638500466
Date:	Aug 30 2024 11:52

Runoff estimation approach

IH124

Site characteristics

Total site area (ha): 8.34

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	5	5
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.53

Hydrological characteristics

	Default	Edited
SAAR (mm):	1293	1293
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	107.14	107.14
1 in 1 year (l/s):	91.07	91.07
1 in 30 years (l/s):	208.92	208.92
1 in 100 year (l/s):	265.71	265.71
1 in 200 years (l/s):	304.28	304.28

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Euan Walker
Site name:	Arnish Moor Convertor Station
Site location:	Arnish Moor

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

Site Details

Latitude:	58.19997° N
Longitude:	6.41945° W
Reference:	4124721741
Date:	Aug 30 2024 11:46

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 10

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	5	5
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.53

Hydrological characteristics

	Default	Edited
SAAR (mm):	1293	1293
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	128.47	128.47
1 in 1 year (l/s):	109.2	109.2
1 in 30 years (l/s):	250.51	250.51
1 in 100 year (l/s):	318.59	318.59
1 in 200 years (l/s):	364.84	364.84

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Euan Walker
Site name:	Arnish Moor Substation
Site location:	Arnish Moor

Site Details

Latitude:	58.19921° N
Longitude:	6.42254° W
Reference:	1720343202
Date:	Aug 30 2024 12:00

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

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 4.41

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	5	5
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.53

Hydrological characteristics

	Default	Edited
SAAR (mm):	1293	1293
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	56.65	56.65
1 in 1 year (l/s):	48.16	48.16
1 in 30 years (l/s):	110.47	110.47
1 in 100 year (l/s):	140.5	140.5
1 in 200 years (l/s):	160.9	160.9

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Euan Walker
Site name:	Arnish Moor Substation
Site location:	Arnish Moor

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

Site Details

Latitude:	58.19921° N
Longitude:	6.42254° W
Reference:	4279862259
Date:	Aug 30 2024 12:03

Runoff estimation approach: IH124

Site characteristics

Total site area (ha): 1.78

Methodology

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

Soil characteristics

	Default	Edited
SOIL type:	5	5
HOST class:	N/A	N/A
SPR/SPRHOST:	0.53	0.53

Hydrological characteristics

	Default	Edited
SAAR (mm):	1293	1293
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

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

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

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

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

(3) Is SPR/SPRHOST ≤ 0.3?

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

Greenfield runoff rates

Default	Edited

Q_{BAR} (l/s):	22.87	22.87
1 in 1 year (l/s):	19.44	19.44
1 in 30 years (l/s):	44.59	44.59
1 in 100 year (l/s):	56.71	56.71
1 in 200 years (l/s):	64.94	64.94

B. Attenuation Volume Calculations

Summary of Results for 200 year Return Period (+48%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	50.186	0.286	72.0	1404.2	O K
30 min Summer	50.310	0.410	102.8	2032.2	O K
60 min Summer	50.466	0.566	104.9	2838.6	O K
120 min Summer	50.527	0.627	104.9	3159.3	O K
180 min Summer	50.548	0.648	104.9	3266.6	O K
240 min Summer	50.552	0.652	104.9	3288.1	O K
360 min Summer	50.552	0.652	104.9	3286.3	O K
480 min Summer	50.545	0.645	104.9	3252.2	O K
600 min Summer	50.535	0.635	104.9	3199.4	O K
720 min Summer	50.523	0.623	104.9	3134.5	O K
960 min Summer	50.495	0.595	104.9	2988.7	O K
1440 min Summer	50.436	0.536	104.9	2682.7	O K
2160 min Summer	50.361	0.461	104.2	2290.0	O K
2880 min Summer	50.305	0.405	102.6	2003.0	O K
4320 min Summer	50.244	0.344	93.4	1696.1	O K
5760 min Summer	50.212	0.312	82.0	1534.7	O K
15 min Winter	50.278	0.378	101.4	1866.3	O K
30 min Winter	50.446	0.546	104.9	2732.8	O K
60 min Winter	50.657	0.757	104.9	3848.8	O K
120 min Winter	50.745	0.845	107.7	4325.6	O K
180 min Winter	50.780	0.880	109.9	4513.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.291	0.0	1240.9	25
30 min Summer	102.386	0.0	1920.1	39
60 min Summer	73.216	0.0	2954.3	68
120 min Summer	42.979	0.0	3484.5	124
180 min Summer	31.233	0.0	3805.8	182
240 min Summer	24.853	0.0	4042.5	228
360 min Summer	17.992	0.0	4395.3	286
480 min Summer	14.278	0.0	4653.6	348
600 min Summer	11.929	0.0	4860.9	414
720 min Summer	10.300	0.0	5036.6	482
960 min Summer	8.174	0.0	5327.7	616
1440 min Summer	5.914	0.0	5765.7	876
2160 min Summer	4.308	0.0	6433.8	1252
2880 min Summer	3.465	0.0	6889.4	1596
4320 min Summer	2.582	0.0	7650.7	2296
5760 min Summer	2.123	0.0	8510.9	3008
15 min Winter	138.291	0.0	1712.5	25
30 min Winter	102.386	0.0	2617.6	39
60 min Winter	73.216	0.0	3971.7	68
120 min Winter	42.979	0.0	4678.2	124
180 min Winter	31.233	0.0	5106.7	180

Summary of Results for 200 year Return Period (+48%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	50.793	0.893	110.6	4584.3	O K
360 min Winter	50.790	0.890	110.5	4572.2	O K
480 min Winter	50.775	0.875	109.6	4491.0	O K
600 min Winter	50.760	0.860	108.6	4406.0	O K
720 min Winter	50.741	0.841	107.5	4302.0	O K
960 min Winter	50.697	0.797	104.9	4063.9	O K
1440 min Winter	50.596	0.696	104.9	3520.3	O K
2160 min Winter	50.453	0.553	104.9	2767.0	O K
2880 min Winter	50.347	0.447	103.9	2221.2	O K
4320 min Winter	50.245	0.345	93.7	1701.7	O K
5760 min Winter	50.206	0.306	79.5	1503.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	24.853	0.0	5422.4	236
360 min Winter	17.992	0.0	5893.0	342
480 min Winter	14.278	0.0	6237.4	386
600 min Winter	11.929	0.0	6513.9	462
720 min Winter	10.300	0.0	6748.0	540
960 min Winter	8.174	0.0	7135.9	692
1440 min Winter	5.914	0.0	7727.3	980
2160 min Winter	4.308	0.0	8603.8	1364
2880 min Winter	3.465	0.0	9216.4	1704
4320 min Winter	2.582	0.0	10250.1	2344
5760 min Winter	2.123	0.0	11364.3	3064

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
FEH Rainfall Version	2013
Site Location	GB 140358 931952 NB 40358 31952
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+48

Time Area Diagram

Total Area (ha) 5.601

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.867	4	8	1.867	8	12	1.867

Model Details

Storage is Online Cover Level (m) 51.100

Tank or Pond Structure

Invert Level (m) 49.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4800.0	0.800	5407.5	1.100	5644.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0407-1050-0800-1050
Design Head (m)	0.800
Design Flow (l/s)	105.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	407
Invert Level (m)	49.900
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	104.9
Flush-Flo™	0.534	104.9
Kick-Flo®	0.730	100.4
Mean Flow over Head Range	-	74.3

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	11.1	1.200	127.8	3.000	199.9	7.000	302.9
0.200	39.9	1.400	137.7	3.500	215.5	7.500	313.4
0.300	77.3	1.600	147.0	4.000	230.1	8.000	323.5
0.400	102.4	1.800	155.7	4.500	243.8	8.500	329.5
0.500	104.8	2.000	163.9	5.000	256.8	9.000	339.3
0.600	104.4	2.200	171.7	5.500	269.1	9.500	348.8
0.800	104.9	2.400	179.2	6.000	280.8		
1.000	116.9	2.600	186.3	6.500	292.1		

Summary of Results for 1000 year Return Period (+48%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	50.277	0.377	101.4	1863.3	O K
30 min Summer	50.456	0.556	104.9	2785.3	O K
60 min Summer	50.680	0.780	104.9	3971.8	O K
120 min Summer	50.744	0.844	107.7	4317.3	O K
180 min Summer	50.763	0.863	108.8	4422.6	O K
240 min Summer	50.765	0.865	109.0	4434.9	O K
360 min Summer	50.752	0.852	108.2	4364.1	O K
480 min Summer	50.738	0.838	107.3	4288.2	O K
600 min Summer	50.724	0.824	106.4	4209.1	O K
720 min Summer	50.708	0.808	105.4	4124.9	O K
960 min Summer	50.675	0.775	104.9	3944.9	O K
1440 min Summer	50.603	0.703	104.9	3557.7	O K
2160 min Summer	50.502	0.602	104.9	3027.0	O K
2880 min Summer	50.423	0.523	104.9	2611.7	O K
4320 min Summer	50.317	0.417	103.0	2068.3	O K
5760 min Summer	50.262	0.362	99.2	1786.9	O K
15 min Winter	50.400	0.500	104.8	2494.0	O K
30 min Winter	50.639	0.739	104.9	3751.4	O K
60 min Winter	50.930	1.030	118.6	5345.2	Flood Risk
120 min Winter	51.018	1.118	123.4	5842.6	Flood Risk
180 min Winter	51.050	1.150	125.2	6023.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	184.230	0.0	1710.8	25
30 min Summer	139.179	0.0	2671.9	40
60 min Summer	100.655	0.0	4098.1	68
120 min Summer	57.217	0.0	4670.7	126
180 min Summer	40.887	0.0	5012.0	184
240 min Summer	32.183	0.0	5263.1	242
360 min Summer	22.977	0.0	5639.9	312
480 min Summer	18.093	0.0	5922.5	372
600 min Summer	15.037	0.0	6152.3	436
720 min Summer	12.932	0.0	6347.7	504
960 min Summer	10.204	0.0	6673.4	640
1440 min Summer	7.328	0.0	7171.8	912
2160 min Summer	5.306	0.0	7940.4	1296
2880 min Summer	4.252	0.0	8474.7	1652
4320 min Summer	3.160	0.0	9394.3	2344
5760 min Summer	2.596	0.0	10417.7	3048
15 min Winter	184.230	0.0	2339.3	26
30 min Winter	139.179	0.0	3612.9	40
60 min Winter	100.655	0.0	5495.9	68
120 min Winter	57.217	0.0	6259.4	124
180 min Winter	40.887	0.0	6714.5	182

Summary of Results for 1000 year Return Period (+48%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	51.061	1.161	125.7	6080.6	Flood Risk
360 min Winter	51.052	1.152	125.3	6032.8	Flood Risk
480 min Winter	51.026	1.126	123.9	5885.1	Flood Risk
600 min Winter	51.004	1.104	122.7	5763.7	Flood Risk
720 min Winter	50.982	1.082	121.5	5634.3	Flood Risk
960 min Winter	50.931	1.031	118.7	5353.0	Flood Risk
1440 min Winter	50.827	0.927	112.7	4771.5	Flood Risk
2160 min Winter	50.679	0.779	104.9	3968.3	O K
2880 min Winter	50.533	0.633	104.9	3188.0	O K
4320 min Winter	50.336	0.436	103.6	2166.0	O K
5760 min Winter	50.254	0.354	96.6	1746.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	32.183	0.0	7049.4	238
360 min Winter	22.977	0.0	7551.7	346
480 min Winter	18.093	0.0	7928.6	438
600 min Winter	15.037	0.0	8235.1	474
720 min Winter	12.932	0.0	8495.7	550
960 min Winter	10.204	0.0	8929.1	702
1440 min Winter	7.328	0.0	9586.8	1000
2160 min Winter	5.306	0.0	10610.5	1432
2880 min Winter	4.252	0.0	11330.2	1816
4320 min Winter	3.160	0.0	12577.1	2468
5760 min Winter	2.596	0.0	13907.0	3072

Rainfall Details

Rainfall Model	FEH
Return Period (years)	1000
FEH Rainfall Version	2013
Site Location	GB 140358 931952 NB 40358 31952
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+48

Time Area Diagram

Total Area (ha) 5.601

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.867	4	8	1.867	8	12	1.867

Model Details

Storage is Online Cover Level (m) 51.100

Tank or Pond Structure

Invert Level (m) 49.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4800.0	0.800	5407.5	1.100	5644.7

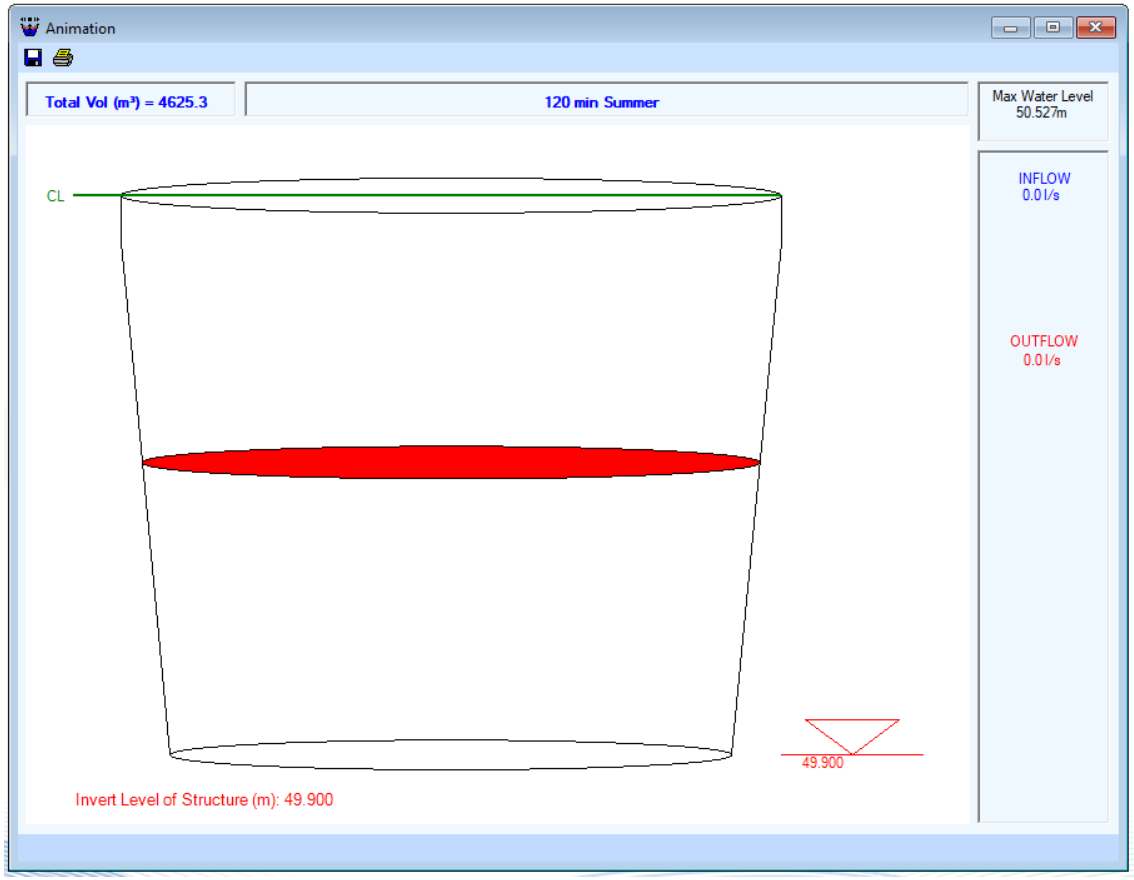
Hydro-Brake® Optimum Outflow Control

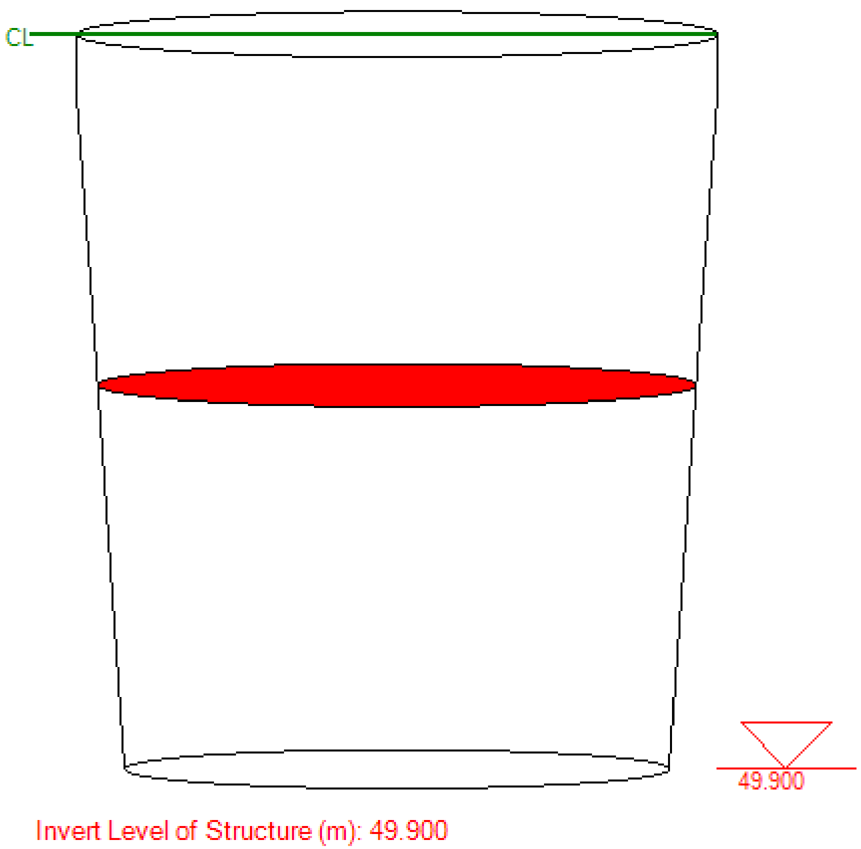
Unit Reference	MD-SHE-0407-1050-0800-1050
Design Head (m)	0.800
Design Flow (l/s)	105.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	407
Invert Level (m)	49.900
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	104.9
Flush-Flo™	0.534	104.9
Kick-Flo®	0.730	100.4
Mean Flow over Head Range	-	74.3

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	11.1	1.200	127.8	3.000	199.9	7.000	302.9
0.200	39.9	1.400	137.7	3.500	215.5	7.500	313.4
0.300	77.3	1.600	147.0	4.000	230.1	8.000	323.5
0.400	102.4	1.800	155.7	4.500	243.8	8.500	329.5
0.500	104.8	2.000	163.9	5.000	256.8	9.000	339.3
0.600	104.4	2.200	171.7	5.500	269.1	9.500	348.8
0.800	104.9	2.400	179.2	6.000	280.8		
1.000	116.9	2.600	186.3	6.500	292.1		


Animation
Total Vol (m³) = 4625.3
120 min Summer
Max Water Level
50.527m
CL
INFLOW
0.0 l/s
OUTFLOW
0.0 l/s
49.900
Invert Level of Structure (m): 49.900


CL
49.900
Invert Level of Structure (m): 49.900

Summary of Results for 200 year Return Period (+48%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	50.209	0.309	72.8	797.8	O K
30 min Summer	50.339	0.439	84.6	1150.8	O K
60 min Summer	50.499	0.599	85.0	1595.3	O K
120 min Summer	50.547	0.647	85.0	1732.7	O K
180 min Summer	50.553	0.653	85.0	1749.5	O K
240 min Summer	50.552	0.652	85.0	1744.6	O K
360 min Summer	50.540	0.640	85.0	1711.1	O K
480 min Summer	50.520	0.620	85.0	1655.0	O K
600 min Summer	50.497	0.597	85.0	1589.5	O K
720 min Summer	50.473	0.573	85.0	1520.6	O K
960 min Summer	50.424	0.524	85.0	1385.1	O K
1440 min Summer	50.340	0.440	84.6	1152.2	O K
2160 min Summer	50.256	0.356	82.5	924.0	O K
2880 min Summer	50.215	0.315	74.7	814.2	O K
4320 min Summer	50.170	0.270	60.4	695.2	O K
5760 min Summer	50.144	0.244	51.5	625.1	O K
15 min Winter	50.308	0.408	84.0	1064.9	O K
30 min Winter	50.486	0.586	85.0	1557.0	O K
60 min Winter	50.701	0.801	85.0	2177.7	O K
120 min Winter	50.774	0.874	88.7	2394.9	O K
180 min Winter	50.791	0.891	89.5	2444.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.291	0.0	782.0	24
30 min Summer	102.386	0.0	1184.6	38
60 min Summer	73.216	0.0	1756.8	66
120 min Summer	42.979	0.0	2067.5	122
180 min Summer	31.233	0.0	2256.0	162
240 min Summer	24.853	0.0	2395.0	192
360 min Summer	17.992	0.0	2602.6	256
480 min Summer	14.278	0.0	2754.9	324
600 min Summer	11.929	0.0	2877.5	390
720 min Summer	10.300	0.0	2981.6	458
960 min Summer	8.174	0.0	3154.5	586
1440 min Summer	5.914	0.0	3416.9	832
2160 min Summer	4.308	0.0	3771.1	1176
2880 min Summer	3.465	0.0	4040.4	1532
4320 min Summer	2.582	0.0	4499.1	2252
5760 min Summer	2.123	0.0	4971.2	2992
15 min Winter	138.291	0.0	1061.4	25
30 min Winter	102.386	0.0	1597.8	39
60 min Winter	73.216	0.0	2352.3	66
120 min Winter	42.979	0.0	2766.6	122
180 min Winter	31.233	0.0	3018.0	178

Summary of Results for 200 year Return Period (+48%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	50.786	0.886	89.3	2430.8	O K
360 min Winter	50.765	0.865	88.2	2367.5	O K
480 min Winter	50.736	0.836	86.8	2282.3	O K
600 min Winter	50.702	0.802	85.1	2180.6	O K
720 min Winter	50.665	0.765	85.0	2071.2	O K
960 min Winter	50.582	0.682	85.0	1833.0	O K
1440 min Winter	50.427	0.527	85.0	1391.7	O K
2160 min Winter	50.273	0.373	83.1	971.2	O K
2880 min Winter	50.213	0.313	74.1	809.1	O K
4320 min Winter	50.161	0.261	57.2	669.5	O K
5760 min Winter	50.132	0.232	47.7	594.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	24.853	0.0	3203.5	230
360 min Winter	17.992	0.0	3480.4	284
480 min Winter	14.278	0.0	3683.6	362
600 min Winter	11.929	0.0	3847.2	438
720 min Winter	10.300	0.0	3986.2	512
960 min Winter	8.174	0.0	4217.9	656
1440 min Winter	5.914	0.0	4572.7	904
2160 min Winter	4.308	0.0	5035.8	1236
2880 min Winter	3.465	0.0	5396.4	1560
4320 min Winter	2.582	0.0	6014.8	2288
5760 min Winter	2.123	0.0	6633.2	3000

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
FEH Rainfall Version	2013
Site Location	GB 140358 931952 NB 40358 31952
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+48

Time Area Diagram

Total Area (ha) 3.262

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.087	4	8	1.087	8	12	1.087

Model Details

Storage is Online Cover Level (m) 51.100

Tank or Pond Structure

Invert Level (m) 49.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2500.0	0.800	2943.5	1.100	3119.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0372-8500-0800-8500
Design Head (m)	0.800
Design Flow (l/s)	85.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	372
Invert Level (m)	49.900
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	85.0
Flush-Flo™	0.496	85.0
Kick-Flo®	0.711	80.2
Mean Flow over Head Range	-	61.9

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	10.5	1.200	103.4	3.000	161.7	7.000	244.9
0.200	37.2	1.400	111.5	3.500	174.3	7.500	253.4
0.300	70.1	1.600	119.0	4.000	186.1	8.000	261.5
0.400	83.9	1.800	126.0	4.500	197.2	8.500	266.7
0.500	85.0	2.000	132.6	5.000	207.6	9.000	274.6
0.600	83.9	2.200	139.0	5.500	217.6	9.500	282.3
0.800	85.0	2.400	145.0	6.000	227.1		
1.000	94.7	2.600	150.8	6.500	236.2		

Summary of Results for 1000 year Return Period (+48%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	50.307	0.407	84.0	1063.3	O K
30 min Summer	50.496	0.596	85.0	1587.6	O K
60 min Summer	50.725	0.825	86.2	2248.4	O K
120 min Summer	50.772	0.872	88.6	2389.5	O K
180 min Summer	50.773	0.873	88.6	2391.7	O K
240 min Summer	50.761	0.861	88.1	2355.9	O K
360 min Summer	50.738	0.838	86.9	2285.9	O K
480 min Summer	50.712	0.812	85.6	2210.4	O K
600 min Summer	50.685	0.785	85.0	2130.0	O K
720 min Summer	50.656	0.756	85.0	2047.3	O K
960 min Summer	50.598	0.698	85.0	1876.9	O K
1440 min Summer	50.485	0.585	85.0	1555.9	O K
2160 min Summer	50.361	0.461	84.8	1209.6	O K
2880 min Summer	50.282	0.382	83.3	993.5	O K
4320 min Summer	50.212	0.312	73.7	804.8	O K
5760 min Summer	50.178	0.278	63.0	716.5	O K
15 min Winter	50.440	0.540	85.0	1429.6	O K
30 min Winter	50.691	0.791	85.0	2147.5	O K
60 min Winter	50.985	1.085	98.5	3036.9	Flood Risk
120 min Winter	51.056	1.156	101.6	3258.2	Flood Risk
180 min Winter	51.068	1.168	102.1	3295.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	184.230	0.0	1060.4	25
30 min Summer	139.179	0.0	1630.1	39
60 min Summer	100.655	0.0	2426.3	68
120 min Summer	57.217	0.0	2762.2	124
180 min Summer	40.887	0.0	2962.6	180
240 min Summer	32.183	0.0	3110.2	210
360 min Summer	22.977	0.0	3332.2	272
480 min Summer	18.093	0.0	3499.1	338
600 min Summer	15.037	0.0	3635.3	406
720 min Summer	12.932	0.0	3751.5	476
960 min Summer	10.204	0.0	3946.3	610
1440 min Summer	7.328	0.0	4245.5	864
2160 min Summer	5.306	0.0	4649.3	1216
2880 min Summer	4.252	0.0	4964.4	1560
4320 min Summer	3.160	0.0	5516.3	2252
5760 min Summer	2.596	0.0	6082.0	2992
15 min Winter	184.230	0.0	1432.4	25
30 min Winter	139.179	0.0	2190.6	39
60 min Winter	100.655	0.0	3245.0	68
120 min Winter	57.217	0.0	3692.9	122
180 min Winter	40.887	0.0	3960.3	178

Summary of Results for 1000 year Return Period (+48%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	51.058	1.158	101.6	3265.1	Flood Risk
360 min Winter	51.019	1.119	100.0	3144.3	Flood Risk
480 min Winter	50.983	1.083	98.4	3032.6	Flood Risk
600 min Winter	50.944	1.044	96.7	2910.1	Flood Risk
720 min Winter	50.903	1.003	94.8	2783.2	Flood Risk
960 min Winter	50.820	0.920	90.9	2531.4	Flood Risk
1440 min Winter	50.661	0.761	85.0	2059.4	O K
2160 min Winter	50.432	0.532	85.0	1406.9	O K
2880 min Winter	50.291	0.391	83.6	1017.8	O K
4320 min Winter	50.199	0.299	69.9	771.7	O K
5760 min Winter	50.164	0.264	58.2	678.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	32.183	0.0	4157.2	232
360 min Winter	22.977	0.0	4453.3	294
480 min Winter	18.093	0.0	4676.1	370
600 min Winter	15.037	0.0	4857.8	446
720 min Winter	12.932	0.0	5012.9	522
960 min Winter	10.204	0.0	5272.6	670
1440 min Winter	7.328	0.0	5674.9	956
2160 min Winter	5.306	0.0	6206.8	1320
2880 min Winter	4.252	0.0	6628.6	1624
4320 min Winter	3.160	0.0	7371.7	2288
5760 min Winter	2.596	0.0	8114.3	3000

Rainfall Details

Rainfall Model	FEH
Return Period (years)	1000
FEH Rainfall Version	2013
Site Location	GB 140358 931952 NB 40358 31952
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+48

Time Area Diagram

Total Area (ha) 3.262

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	1.087	4	8	1.087	8	12	1.087

Model Details

Storage is Online Cover Level (m) 51.100

Tank or Pond Structure

Invert Level (m) 49.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2500.0	0.800	2943.5	1.100	3119.1

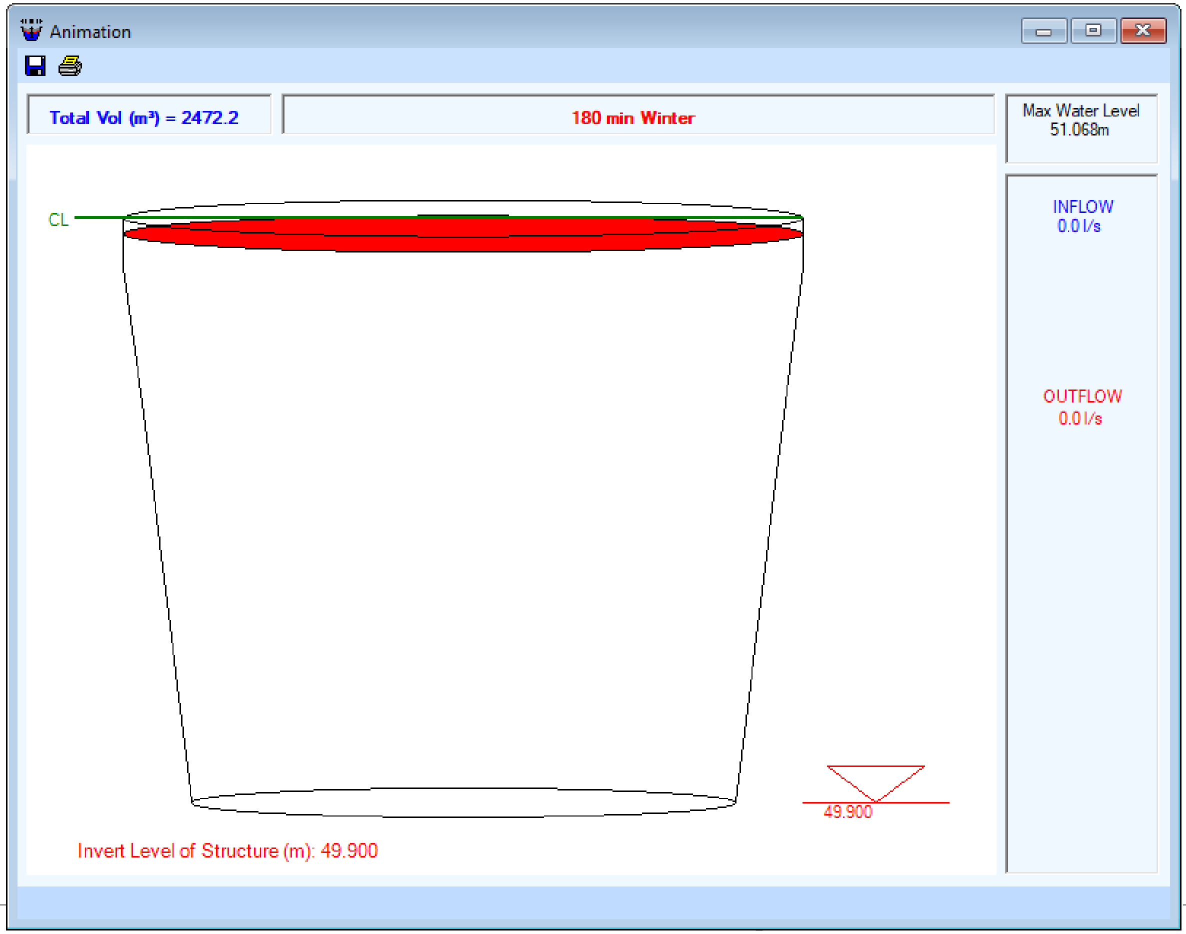
Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0372-8500-0800-8500
Design Head (m)	0.800
Design Flow (l/s)	85.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	372
Invert Level (m)	49.900
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	2100

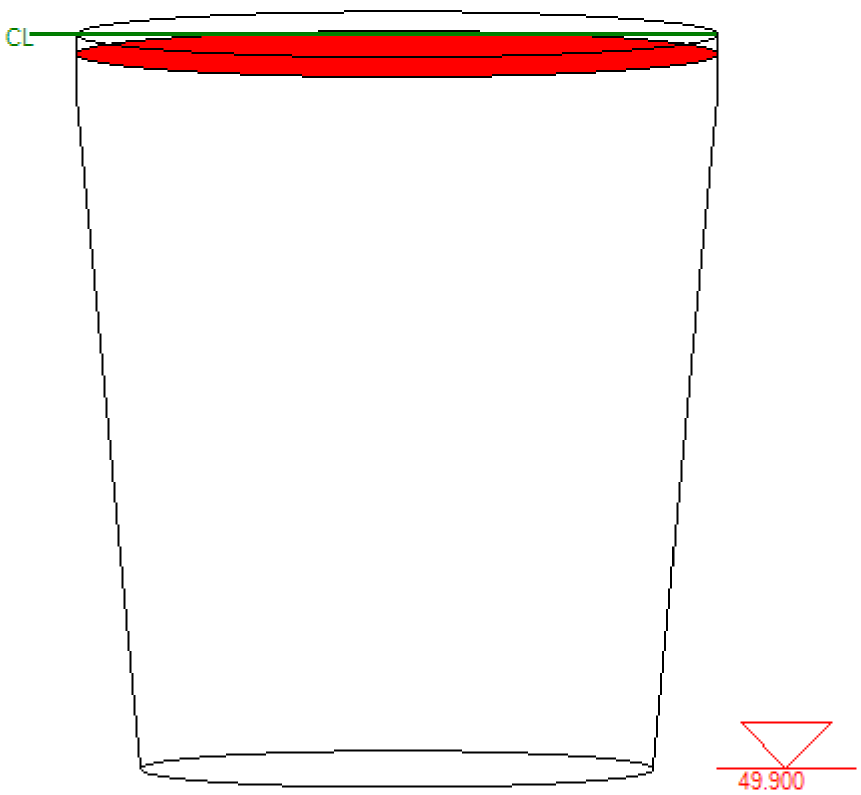
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	85.0
Flush-Flo™	0.496	85.0
Kick-Flo®	0.711	80.2
Mean Flow over Head Range	-	61.9

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	10.5	1.200	103.4	3.000	161.7	7.000	244.9
0.200	37.2	1.400	111.5	3.500	174.3	7.500	253.4
0.300	70.1	1.600	119.0	4.000	186.1	8.000	261.5
0.400	83.9	1.800	126.0	4.500	197.2	8.500	266.7
0.500	85.0	2.000	132.6	5.000	207.6	9.000	274.6
0.600	83.9	2.200	139.0	5.500	217.6	9.500	282.3
0.800	85.0	2.400	145.0	6.000	227.1		
1.000	94.7	2.600	150.8	6.500	236.2		



Animation
Total Vol (m³) = 2472.2
180 min Winter
Max Water Level
51.068m
CL
INFLOW
0.0 l/s
OUTFLOW
0.0 l/s
49.900
Invert Level of Structure (m): 49.900



Invert Level of Structure (m): 49.900

C. Water Quality Simple Index Approach

SIMPLE INDEX APPROACH: AN INTRODUCTION

1. The tool has been developed on behalf of SEPA to support the implementation (in Scotland) of the water quality management design methods set out in the SuDS Manual.

2. This tool provides an automated method for applying the Simple Index Approach to check the sufficiency of proposed SuDS components in mitigating water quality risks to receiving waterbodies.

3. There are some differences in the required approach in England, Wales and Northern Ireland. If the tool is used in these regions, the relevant supporting 'Design Conditions' stated by the tool must be fully considered and implemented.

4. Water quality design criteria and standards are set out in Chapter 4 of the SuDS Manual. Table 4.3 in the Manual sets out the minimum water quality management requirements for discharges to receiving surface waters and groundwater. Use of the Simple Index Approach is one of the key methods.

5. Chapter 26 of the SuDS Manual sets out the design methods for water quality management. The Simple Index Approach is described in Section 26.7.1 of the Manual and this text should be referred to when using this tool. Appendix C of the SuDS Manual also includes worked examples of applying the Simple Index Approach, although not using this tool.

6. The spreadsheet consists of 5 separate sheets as follows:

Sheet Number	Sheet Title	Sheet Description
1	Introduction (this sheet)	Introduction and context
2	The Tool	The tool (requiring user inputs)
3	Flowchart	A flowchart describing the process required to be taken by a tool user
4	Summary	Printable results summary table
5	Land Use Hazard Indices	The hazard indices used by the tool for each land use hazard type (for information only)
6	SuDS Pollution Mitigation Indices	The pollution mitigation indices used by the tool for each SuDS component type (for information only)

SIMPLE INDEX APPROACH: TOOL

1. The steps set out in the tool should be applied for each inflow or 'runoff area' (ie each impermeable surface area separately discharging to a SuDS component).

2. The supporting 'Design Conditions' stated by the tool must be fully considered and implemented in all cases.

3. Relevant design examples are included in the SuDS Manual Appendix C.

4. Each of the steps below are part of the process set out in the flowchart on Sheet 3.

5. Sheet 4 summarises the selections made below and indicates the acceptability of the proposed SuDS components.

DROP DOWN LIST	**RELEVANT INPUTS NEED TO BE SELECTED FROM THESE LISTS, FOR EACH STEP**
USER ENTRY	**USER ENTRY CELLS ARE ONLY REQUIRED WHERE INDICATED BY THE TOOL**

STEP 1: **Determine the Pollution Hazard Index for the runoff area discharging to the proposed SuDS scheme**

This step requires the user to select the appropriate land use type for the area from which the runoff is occurring

If the land use varies across the 'runoff area', either:

- use the land use type with the highest Pollution Hazard Index
- apply the approach for each of the land use types to determine whether the proposed SuDS design is sufficient for all. If it is not, consider collecting more hazardous runoff separately and providing additional treatment.

If the generic land use types suggested are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in the row below the drop down lists.

	Runoff Area Land Use Description		*Hazard Level*	*Pollution Hazard Indices*: Total Suspended Solids	Metals	Hydrocarbons
Select land use type from the drop down list (or 'Other' if none applicable): →	Other	Enter User Defined Indices in row below				
If the generic land use types in the drop down list above are not applicable, select 'Other' and enter a description of the land use of the runoff area and agreed user defined indices in this row:	Construction areas to facilitate high-voltage substation and converter station installation.			0.8	0.8	0.9
	Landuse Pollution Hazard Index			**0.8**	**0.8**	**0.9**

DESIGN CONDITIONS

1	2
Where indices are approved by the environmental regulator as part of the required risk assessment process, these should be entered in the 'User Defined Indices' row below. If indices are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.

STEP 2A: **Determine the Pollution Mitigation Index for the proposed SuDS components**

This step requires the user to select the proposed SuDS components that will be used to treat runoff - before it is discharged to a receiving surface waterbody or downstream infiltration component

If the runoff is discharged directly to an infiltration component, without upstream treatment, select 'None' for each of the 3 SuDS components and move to Step 2B

This step should be applied to evaluate the water quality protection provided by proposed SuDS components for discharges to receiving surface waters or downstream infiltration components (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

If you have fewer than 3 components, select 'None' for the components that are not required

If the proposed component is bespoke and/or a proprietary treatment product and not generically described by the suggested components, then 'Proprietary treatment system' or 'User defined indices' should be selected and a description of the component and agreed user defined indices should be entered in the rows below the drop down lists

	SuDS Component Description	*Pollution Mitigation Indices*: Total Suspended Solids	Metals	Hydrocarbons
Select SuDS Component 1 (i.e. the upstream SuDS component) from the drop down list: →	Swale	0.5	0.6	0.6

DESIGN CONDITIONS

1	2	3
SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B		

Select SuDS Component 2 (i.e. the second SuDS component in a series) from the drop down list:

Detention basin	0.5	0.5	0.6	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	

Select SuDS Component 3 (i.e. the third SuDS component in a series) from the drop down list:

Filter drain (where the trench is not designed as an infiltration component)	0.4	0.4	0.4	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Filter drains should be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events

If the proposed SuDS components are bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary treatment system' or 'User defined indices' and enter component descriptions and agreed user defined indices in these rows:

Aggregated Surface Water Pollution Mitigation Index	**0.95**	**>0.95**	**>0.95**

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

Is the runoff now discharged to an infiltration component?

Yes ? Go to Step 2B
No ? Go to Step 2C

STEP 2B: Determine the Pollution Mitigation Index for the proposed Groundwater Protection

This step requires the user to select the type of groundwater protection that is either part of the SuDS component or that lies between the component and the groundwater

This step should be applied where a SuDS component is specifically designed to infiltrate runoff (note: in England and Wales this will include components that allow any amount of infiltration, however small, even where infiltration is not specifically accounted for in the design).

'Groundwater protection' describes the proposed depth of soil or other material through which runoff will flow between the runoff surface and the underlying groundwater.

Where the discharge is to surface waters and risks to groundwater need not be considered, select 'None'

If the proposed groundwater protection is bespoke and/or a proprietary product and not generically described by the suggested measures, then a description of the protection and agreed user defined indices should be entered in the row below the drop down list

DESIGN CONDITIONS

1	2	3	4	

Pollution Mitigation Indices

	Total Suspended Solids	**Metals**	**Hydrocarbons**
Select type of groundwater protection from the drop down list: None			

If the proposed groundwater protection is bespoke/proprietary and/or the generic indices above are not considered appropriate, select 'Proprietary product' or 'User defined indices' and enter a description of the protection and agreed user defined indices in this row:

Groundwater Protection Pollution Mitigation Index	**0**	**0**	**0**

STEP 2C: Determine the Combined Pollution Mitigation Indices for the Runoff Area

This is an automatic step which combines the proposed SuDS Pollution Mitigation Indices with any Groundwater Protection Pollution Mitigation Indices

Combined Pollution Mitigation Indices

	Total Suspended Solids	**Metals**	**Hydrocarbons**
Combined Pollution Mitigation Indices for the Runoff Area	**0.95**	**>0.95**	**>0.95**

Note: If the total aggregated mitigation index is > 1 (which is not a realistic outcome), then the outcome is fixed at ">0.95". In this scenario, the proposed components are likely to have a very high mitigation potential for reducing pollutant levels in the runoff and should be sufficient for any proposed land use (note: where risk assessment is required, this outcome would need more detailed verification).

STEP 2D: Determine Sufficiency of Pollution Mitigation Indices for Selected SuDS Components

This is an automatic step which compares the Combined Pollution Mitigation Indices with the Land Use Hazard Indices, to determine whether the proposed components are sufficient to manage each pollutant category type

When the combined mitigation index exceeds the land use pollution hazard index, then the proposed components are considered sufficient in providing pollution risk mitigation.

In England and Wales, where the discharge is to protected surface waters or groundwater, an additional treatment component (ie over and above that required for standard discharges), or other equivalent protection, is required that provides environmental protection in the event of an unexpected pollution event or poor system performance. Protected surface waters are those designated for drinking water abstraction. In England and Wales, protected groundwater resources are defined as Source Protection Zone 1. In Northern Ireland, a more precautionary approach may be required and this should be checked with the environmental regulator on a site by site basis.

DESIGN CONDITIONS

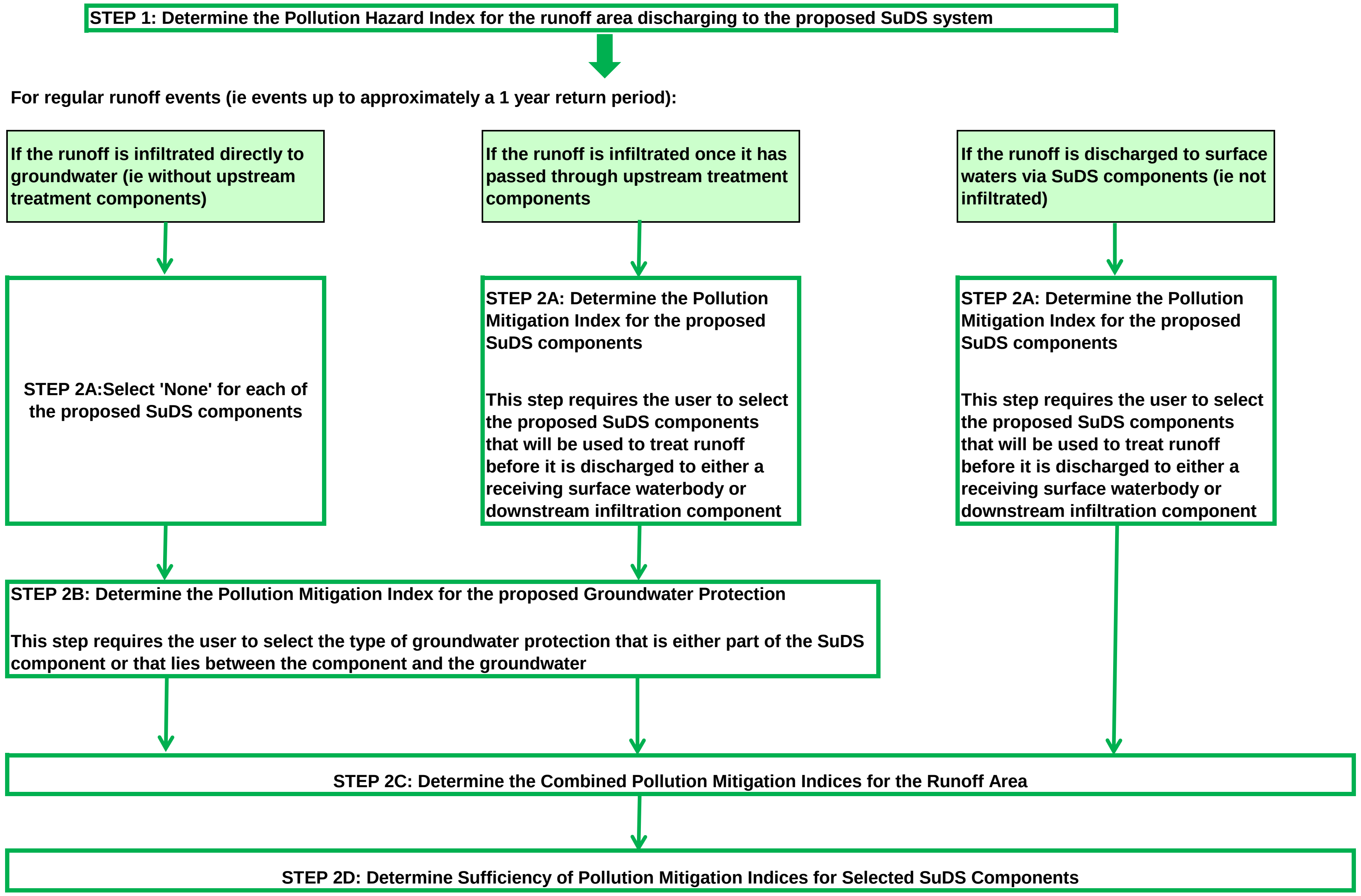
Sufficiency of Pollution Mitigation Indices

Total Suspended Solids	Metals	Hydrocarbons
Sufficient	Sufficient	Sufficient

1

Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see *Chapter 7 The SuDS design process*). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England

SIMPLE INDEX APPROACH: PROCESS FLOW CHART



SIMPLE INDEX APPROACH: SUMMARY TABLE

HRW shall not be liable for any direct or indirect damage claim, loss, cost, expense or liability howsoever arising out of the use or impossibility to use the tools, even when HRW has been informed of the possibility of the same. The user hereby indemnifies HRW from and against any damage claim, loss, expense or liability resulting from any action taken against HRW that is related in any way to the use of the tool or any reliance made in respect of the output of such use by any person whatsoever. HRW does not guarantee that the tool's functions meet the requirements of any person, nor that the tool is free from errors.

SUMMARY TABLE		DESIGN CONDITIONS 1	2	3	4
Land Use Type	Construction areas to facilitate high-voltage substation and converter station installation.	Where indices are approved by the environmental regulator as part of the required risk assessment process, these should be entered in the 'User Defined Indices' row below. If indices are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.		
Pollution Hazard Level					
Pollution Hazard Indices					
TSS	0.8				
Metals	0.8				
Hydrocarbons	0.9				
SuDS components proposed					
Component 1	Swale	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B			
Component 2	Detention basin	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B			
Component 3	Filter drain (where the trench is not designed as an infiltration component)	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Filter drains should be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
SuDS Pollution Mitigation Indices					
TSS	0.95				
Metals	>0.95				
Hydrocarbons	>0.95				
Groundwater protection type	None				
Groundwater protection Pollution Mitigation Indices					
TSS	0				
Metals	0				
Hydrocarbons	0				
Combined Pollution Mitigation Indices		Reference to local planning documents should also be made to identify any additional protection required for sites due to habitat conservation (see Chapter 7 The SuDS design process). The implications of developments on or within close proximity to an area with an environmental designation, such as a Site of Special Scientific Interest (SSSI), should be considered via consultation with relevant conservation bodies such as Natural England			
TSS	0.95				
Metals	>0.95				
Hydrocarbons	>0.95				
Acceptability of Pollution Mitigation					
TSS	Sufficient				
Metals	Sufficient				
Hydrocarbons	Sufficient				

SIMPLE INDEX APPROACH: LAND USE HAZARD INDICES

Land use characterisation *(User Define)*		***Pollution Hazard Level*** *(Tool Outcome)*	***Pollution Indices*** *(Tool Outcome)*			***DESIGN CONDITION*** *(Tool Outcome)*	***DESIGN CONDITION*** *(Tool Outcome)*
			Total Suspended Solids	**Metals**	**Hydrocarbons**	**1**	**2**
LAND USE	**TYPE**						
ROOF	Residential roofing	Very low	0.2	0.2	0.05		
	Commercial/Industrial roofing: Inert materials	Very low	0.3	0.2	0.05		
	Commercial/Industrial roofing: Low potential for metal leachin	Low	0.3	0.4	0.05	This classification should be informed by an assessment of the leachability of metals from the adopted roofing materials. Particular risks are likely to be posed by materials that include copper and galvanised steel	
	Commercial/Industrial roofing: Medium potential for metal lea	Medium	0.3	0.6	0.05	This classification should be informed by an assessment of the leachability of metals from the adopted roofing materials. Particular risks are likely to be posed by materials that include copper and galvanised steel	
	Commercial/Industrial roofing: High potential for metal leachin	High	0.3	0.8	0.05	This classification should be informed by an assessment of the leachability of metals from the adopted roofing materials. Particular risks are likely to be posed by materials that include copper and galvanised steel	
PARKING	Individual driveway	Low	0.5	0.4	0.4		
	Residential parking	Low	0.5	0.4	0.4		
	Non-residential parking with infrequent change (e.g. schools, offices, < 300 traffic movements a day)	Low	0.5	0.4	0.4		
	Non-residential car parking with frequent change (eg hospitals, retail)	Medium	0.7	0.6	0.7		
YARDS/DEPOTS	Standard commercial yard or delivery area	Medium	0.7	0.6	0.7	This classification is not appropriate for haulage yards, lorry parks, waste management areas, or chemical storage/handling zones	
	Haulage yard	High	0.8	0.8	0.9	These indices should only be used if considered appropriate by the required risk assessment and where approved by the regulator. If they are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.
	Lorry park	High	0.8	0.8	0.9	These indices should only be used if considered appropriate by the required risk assessment and where approved by the regulator. If they are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.
	Waste handling/management/distribution site	High	0.8	0.8	0.9	These indices should only be used if considered appropriate by the required risk assessment and where approved by the regulator. If they are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.
	Site where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured	High	0.8	0.8	0.9	These indices should only be used if considered appropriate by the required risk assessment and where approved by the regulator. If they are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.
	Other industrial site area	High	0.8	0.8	0.9	These indices should only be used if considered appropriate by the required risk assessment and where approved by the regulator. If they are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.
ROADS	Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)	Low	0.5	0.4	0.4		
	Roads (excluding low traffic roads, highly frequented lorry approaches to industrial estates, trunk roads/motorways)	Medium	0.7	0.6	0.7		
	Highly frequented lorry approaches to industrial estates	High	0.8	0.8	0.9	These indices should only be used if considered appropriate by the required risk assessment and where approved by the regulator. If they are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.

	Trunk roads/motorways	High	n/a	n/a	n/a	When designing SuDS for motorways / trunk roads, the guidance and risk assessment process set out in HD45/09 should always be followed. These indices should only be used if considered appropriate as part of any detailed risk assessment undertaken for the scheme	
OTHER	**Other**					Where indices are approved by the environmental regulator as part of the required risk assessment process, these should be entered in the 'User Defined Indices' row below. If indices are not considered appropriate, the risk assessment should use alternative measures of pollution hazard for the site.	In Scotland and Northern Ireland, the environmental regulator should be consulted as part of the licensing process required for High Risk sites. In England and Wales, the environmental regulator should be consulted prior to design (for pre-permitting advice) to determine the most appropriate design approach and requirements for risk assessment.

SIMPLE INDEX APPROACH: POLLUTION MITIGATION INDICES

GROUNDWATER POLLUTION MITIGATION INDICES	***Pollution Mitigation Indices*** *(Tool Outcome)* **Total Suspended Solids**	**Metals**	**Hydrocarbons**	***DESIGN CONDITION*** *(Tool Outcome)* 1	***DESIGN CONDITION*** *(Tool Outcome)* 2	***DESIGN CONDITION*** *(Tool Outcome)* 3	***DESIGN CONDITION*** *(Tool Outcome)* 4
Dense vegetation layer underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.6	0.5	0.6	All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		
300 mm minimum depth of soils with good contamination attenuation potential	0.4	0.3	0.3	All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		
Infiltration trench with suitable depth of filtration material underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.4	0.4	0.4	All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	The infiltration trench must include a suitable depth filtration layer that provides treatment (ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20mm gravel). The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		
Pervious pavement underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.7	0.6	0.7	All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	The permeable pavement must include a suitable filtration layer provides treatment and must include a geotextile at the base separating the foundation from the sub-grade. The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		
Bioretention component underlain by 300 mm minimum depth of soils with good contamination attenuation potential	0.8	0.8	0.8	All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	The underlying soils must provide good contaminant attenuation potential (eg as recommended in Sniffer 2008 (a) and (b) / Scott Wilson (2010) or other appropriate guidance). Alternative depth and soil combinations must provide equivalent protection to the underlying groundwater		
Proprietary product				Detailed assessment of performance of designed component in reducing inflow concentrations of each pollutant type required as evidence of adopted indices. Enter indices approved by the environmental regulator in appropriate 'User Defined Indices' row below	All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events	SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. WAT-RM-08 (SEPA, 2014) also provides a flow chart with a summary of checks on suitability of a proprietary system	See Chapter 15 Proprietary treatment systems for approaches to demonstrate product performance. Note: a British Water/Environment Agency assessment Code of Practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: http://www.britishwater.co.uk/Publications/codes-of-practise.aspx.
User defined indices				Detailed assessment of performance of designed component in reducing inflow concentrations of each pollutant type required as evidence of adopted indices. Enter indices approved by the environmental regulator in appropriate 'User Defined Indices' row below	All designs must include a minimum of 1 m unsaturated depth of subsoil or aquifer material between the infiltration surface and the maximum likely groundwater level. Infiltration components should always be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate lined zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
None							

SURFACE WATER POLLUTION MITIGATION INDICES	***Pollution Mitigation Indices*** *(Tool Outcome)* **Total Suspended Solids**	**Metals**	**Hydrocarbons**	***COMMENT*** *(Tool Outcome)*			
Filter strip	0.4	0.4	0.5	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B			
Filter drain (where the trench is not designed as an infiltration component)	0.4	0.4	0.4	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Filter drains should be preceded by upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		
Swale	0.5	0.6	0.6	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B			
Bioretention system (where the system is not designed as an infiltration component)	0.8	0.8	0.8	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B			
Pervious pavement (where the pavement is not designed as an infiltration component)	0.7	0.6	0.7	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B			
Detention basin	0.5	0.5	0.6	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B			
Pond or wetland	0.7	0.7	0.5	SuDS components can only be assumed to deliver these indices if they follow design guidance with respect to hydraulics and treatment set out in the relevant technical component chapters of the SuDS Manual. See also checklists in Appendix B	Ponds/wetlands should be preceded by an upstream component(s) that trap(s) silt, or designed specifically to retain sediment in a separate zone, easily accessible for maintenance, such that the sediment will not be re-suspended in subsequent events		

Proprietary treatment system	*0*	*0*	*0*	Detailed assessment of performance of designed component in reducing inflow concentrations of each pollutant type required as evidence of adopted indices. Enter indices approved by the environmental regulator in appropriate 'User Defined Indices' row below	SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution where there is a requirement to retrofit treatment. WAT-RM-08 (SEPA, 2014) also provides a flow chart with a summary of checks on suitability of a proprietary system	See Chapter 15 Proprietary treatment systems for approaches to demonstrate product performance. Note: a British Water/Environment Agency assessment Code of Practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: http://www.britishwater.co.uk/Publications/codes-of-practise.aspx.	
User defined indices	0	0	0	Detailed assessment of performance of designed component in reducing inflow concentrations of each pollutant type required as evidence of adopted indices. Enter indices approved by the environmental regulator in appropriate 'User Defined Indices' row below			
None	0	0	0				

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