Scottish & Southern Electricity Networks
TRANSMISSION

APPENDIX 12.2: DRAINAGE IMPACT ASSESSMENT

LT379 Greens 400kV Substation

Drainage Impact Assessment

GRNS4-LT379-SEBAM-DRAI-ZZ-RPT-C-0002

CONTROL SHEET

PREPARED BY:	Fairhurst Group LLP 300 Bath Street Glasgow, G2 4JR +44 141 204 8800 https://www.fairhurst.co.uk
CLIENT:	Siemens Energy BAM Joint Venture (SEBAM)
PROJECT NAME:	LT379 Greens 400kV Substation
REPORT TITLE:	Drainage Impact Assessment
PROJECT NUMBER:	156918ASTI3W
DOCUMENT NUMBER:	GRNS4-LT379-SEBAM-DRAI-ZZ-RPT-C-0002
STATUS:	S5

Issue & Approval Schedule		Name	Signature	Date
	Prepared by	Rhea Duncan	[Signed copy held on file]	21/08/2024
	Checked by	Roger Minto	[Signed copy held on file]	21/08/2024
	Approved by	Roger Minto	[Signed copy held on file]	21/08/2024

Revision Record	Rev.	Date	Status	Description	Signature	
	P01	21/08/24	S5	ISSUED TO SSE	By	RD
					Checked	RM
					Approved	RM
	P02	01/11/24	S5	ISSUED TO SSE	By	RD
					Checked	RM
					Approved	RM

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1.0 INTRODUCTION

1.1 General

1.1.1 Fairhurst have been appointed by Siemens Energy BAM Joint Venture (SEBAM) to produce a drainage strategy to inform the drainage design proposals at the proposed Greens 400kV Substation in Aberdeenshire. The site is part of Scottish and Southern Electricity Networks (SSEN) £7bn upgrade of their onshore electricity transmission infrastructure.

1.1.2 This Drainage Impact Assessment (DIA) report will assess potential impacts of existing watercourse / channels and their required realignments, surface water and foul water drainage across the site. This report also considers any relevant information from the Drainage Strategy report compiled for the proposed substation at Greens.

1.1.3 For the Drainage Strategy report see document no. GRNS4-LT379-SEBAM-DRAI-ZZ-RPT-C-0001

1.1.4 The site is part of SSEN's £7bn upgrade of their onshore electricity transmission infrastructure.

1.1.5 The development forms part of a proposed 400kv upgrade from the existing 275kV network between Beauly and Peterhead. The proposed substation at Greens is part of this network route.

1.1.6 This DIA has been compiled to outline the potential impacts for the substation platform to support the planning application for the proposed electrical substation at Greens.

1.1.7 While this report takes into account any relevant information from ground investigation reports and flood risk assessments, these reports will be issued separately to the client.

1.1.8 This DIA covers the drainage system designed by Fairhurst only. Patterson Reeves & Partners (PRP) are responsible for substation platform drainage design inside the substation platform fenceline.

1.2 Site Location

1.2.1 The proposed substation site at Greens is situated approximately 10km east of the town of Turriff, Aberdeenshire. The site can be accessed via the B9170 then along an unnamed road to the site entrance

1.2.2 The site is situated approximately 6.3km west of New Deer and 3.6km south east of Cuminestown. The site also lies approximately 2.9km north west of an existing substation at New Deer. The site lies north of the Main of Greens residential property. A plan of the location of the proposed development in relation to the local area is provided in *Figure 1*.

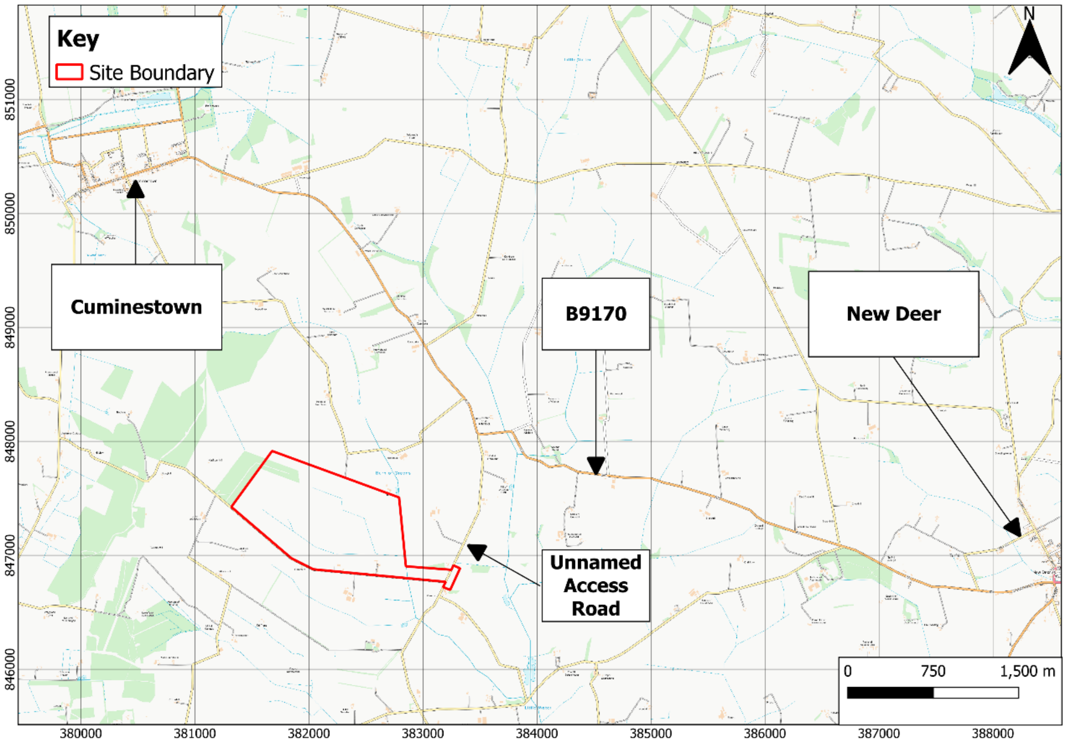

Figure 1: Indicative Site Location

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1.2.3 The site within the red line boundary is approximately 114.5ha. The proposed substation platform covers an area of approximately 21.5ha within the substation fenceline. An additional perimeter track will also be provided around the substation platform outside of the substation fenceline. An additional overhead line pylon platform is also proposed to the north of the substation platform, with a total hardstanding area of 2.1ha. The associated proposed access tracks contribute to an approximate additional 2.0ha. The remainder of the site has been allocated to the proposed SuDS features and access roads within the site. During the construction phase, temporary laydown areas and access routes will be present throughout the site. Refer to the proposed site layout drawings in **Appendix 1** for details of the proposed and temporary arrangements within the site boundary.

1.3 Design Considerations

1.3.1 The DIA has been prepared to define the scheme for the site with regards to the proposed drainage channel realignments, surface water and foul water drainage. The assessment will consider overall drainage impacts for the proposed substation platform.

1.3.2 The DIA will assess the surface water run-off and any foul water from the proposed site. This report will also discuss the management of existing groundwater and temporary drainage during the construction, and the maintenance of the completed network. The drainage has been prepared to the requirements and recommendations of the following documents:

- SEPA Water Assessment and Drainage Assessment Guide
- Aberdeenshire Council - Drainage Impact Assessment: Guidance for Developers and Regulators (Aberdeenshire Council)
- CIRIA – SuDS Manual C753
- SSEN Earthworks Specification SP-NET-CIV-501
- SSEN Drainage Specification SP-NET-CIV-502

- Sewers for Scotland v4.0 (note this document was considered as a reference for design although not applicable as the drainage will not be vested by Scottish Water)

1.3.3 Further to the above documentation the DIA also relies on information provided in the Drainage Strategy.

1.4 Drainage assumptions within the Substation

1.4.1 The drainage design within the Greens substation fenceline is being designed by PRP. Assumptions have been made during the drainage design to allow for a worst-case scenario, to provide a conservative design for the proposed SuDS design for the site. Assumed details include:

- The substation platform shall be assumed to be 100% impermeable for the purposes of the drainage design outwith the substation platform;
- Global Entry Time to drainage features outside of the substation platform is set at 120 minutes;
- All oily water or foul water requiring specific treatment due to operations within the substation platform shall be treated sufficiently as part of the PRP drainage philosophy and design. The run-off shall then connect to the proposed Fairhurst designed SuDS drainage outside of the substation platform fenceline for attenuation purposes;
- All surface water run-off from hard standing surfaces within the substation platform fenceline will discharge to the proposed SuDS drainage outside of the fenceline, and tie-in points coordinated between PRP and Fairhurst;
- Platform drainage will discharge to four separate locations from the substation platform to the proposed surface water system:
  - No. 1 to the north of the platform;
  - No. 2 to the east of the platform;
  - No. 3 to the east of the platform;
  - No. 4 to the south of the platform

2.0 EXISTING SITE DESCRIPTION

2.1 Existing Site

2.1.1 The site is located in a rural area and is currently used for agricultural purposes. The site is bounded to the west/northwest by a forested area with the rest of the site bounded by agricultural fields and access roads. There are a few neighbouring residential dwellings and agricultural properties nearby.

2.1.2 The site is accessible via the B9170, followed by an unnamed road for approximately 1.5 km towards the site entrance. Another minor road near the entrance runs along the southern boundary providing access to the western extent of the site. There are also agricultural access tracks within the site boundary branching off the un-named road to the south of the site. Refer to *Figure 2* for locations of existing access routes.

2.1.3 An Existing Site layout can be seen in in **Appendix 2.**

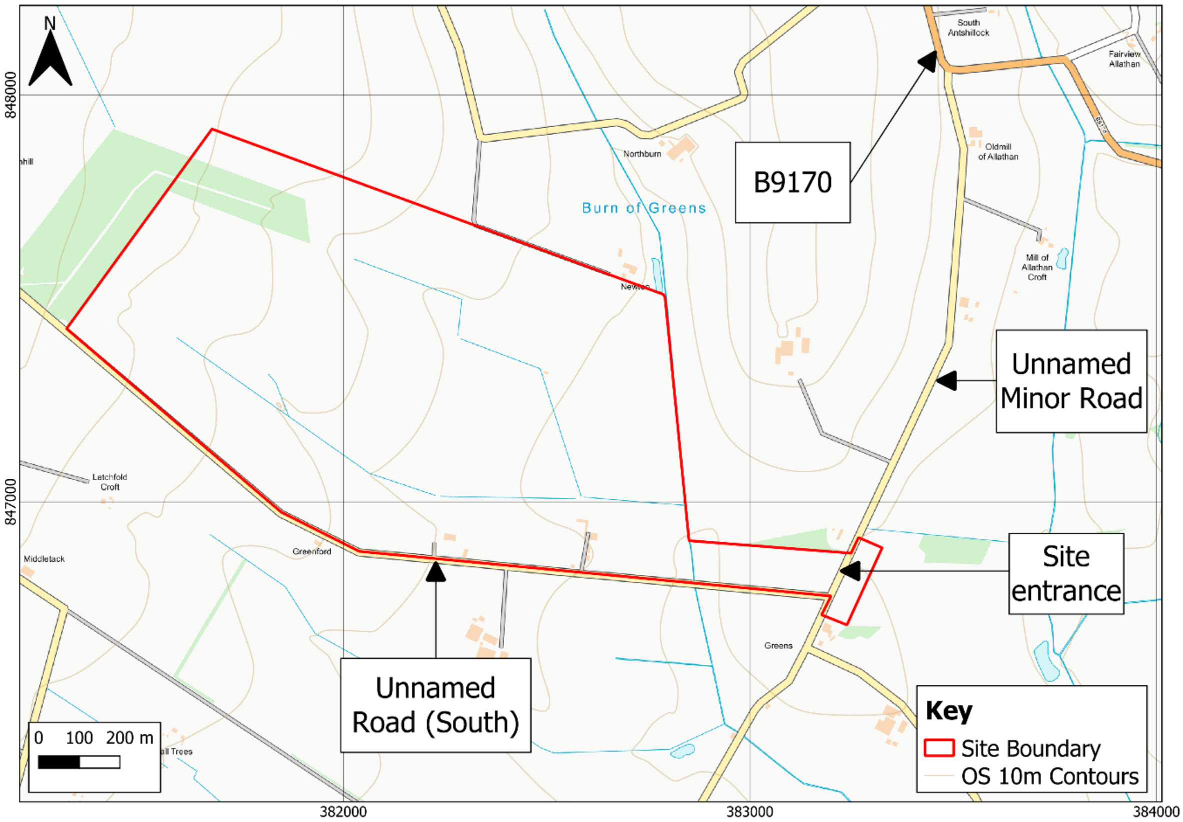

Figure 2: Existing Access Routes

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2.2 Site Topography

2.2.1 The site topography within the redline boundary generally slopes from northwest to southeast with a fall in elevation from 155mAOD (northwest) to 102mAOD (southeast) over approximately 1.5km.

2.3 Ground Conditions

2.3.1 Ground investigation information has been obtained from the Fairhurst – Geo-environmental Desk Study Report (Document no. GRNS4-LT379-SEBAM-ZZ-ZZ-RPT-G-0001).

2.3.2 The current site features made ground, peat and alluvium. Glacial till which is present site wide, is typically cohesive clay with sand, gravel and cobbles also present. Locally glacial till is described as granular mixes of silty gravel, sand and cobbles.

Peat

2.3.3 Peat deposits have been identified around the site (approx. 1km north, west and south) and also within the site boundary. Ground investigations indicate a small area of marsh, possibly peat, at the south western area of the site.

Groundwater

2.3.4 Groundwater levels are shallow throughout the site and range from depths of 0.6mbgl to 3.3mbgl.

2.3.5 Due to the shallow depths of the groundwater, careful management will be required during the construction phase (particularly with any excavations) with long term management plans required for the post-construction phase.

2.4 Flood Risk

2.4.1 A review of *SEPA Flood Maps* shows a 10% risk of fluvial flooding along the eastern area of the site associated with the Burn of Greens. No coastal or pluvial flooding is shown at the location.

2.4.2 Due to a higher likelihood of fluvial flooding, Aberdeenshire Council guidelines state a flood risk assessment (FRA) should be carried out to assess potential flooding implications resulting from the project. Please refer to Fairhurst prepared FRA, GRNS4-LT379-SEBAM-DRAI-ZZ-RPT-C-0003, which provides full details of the flood risk across the site and the corresponding impacts.

2.5 Utilities

2.5.1 SSEN currently have existing utilities within the site including below ground service cables and overhead mains cables (LV mains) to existing properties in and around the site.

2.5.2 Health and Safety Executive guidance note GS6: Avoiding danger from overhead power lines, must be followed during the planning and construction phases.

2.5.3 Utility information supplied by Scotia Gas Networks (SGN), states that there are no gas assets within the site boundary and to the immediate vicinity of the site.

3.0 EXISTING WATERCOURSES AND DRAINAGE FEATURES

3.1 Watercourses

3.1.1 The closest watercourse shown on the OS 1:50,000 scale map is the nearby Burn of Greens. This runs along the eastern boundary of the site and flows north to south.

3.1.2 Refer to **Appendix 2** for details on existing water features near the proposed substation platform.

3.2 Drainage Features

3.2.1 There are a number of existing drainage features present on site. Two small engineered ditches flow south eastwards through the site and merge upstream of where they discharge to the Burn of Greens at the south eastern corner of the site. It was confirmed by the landowner during a visit to site that these engineered ditches are fed by springs within the site boundary. Field drains are also present in addition to the engineered ditches.

3.2.2 During a site visit in May 2024 by Fairhurst, a private water supply and several areas of saturated ground and possible ground springs were observed. The observations from the site visit are shown in *Figure 3* below.

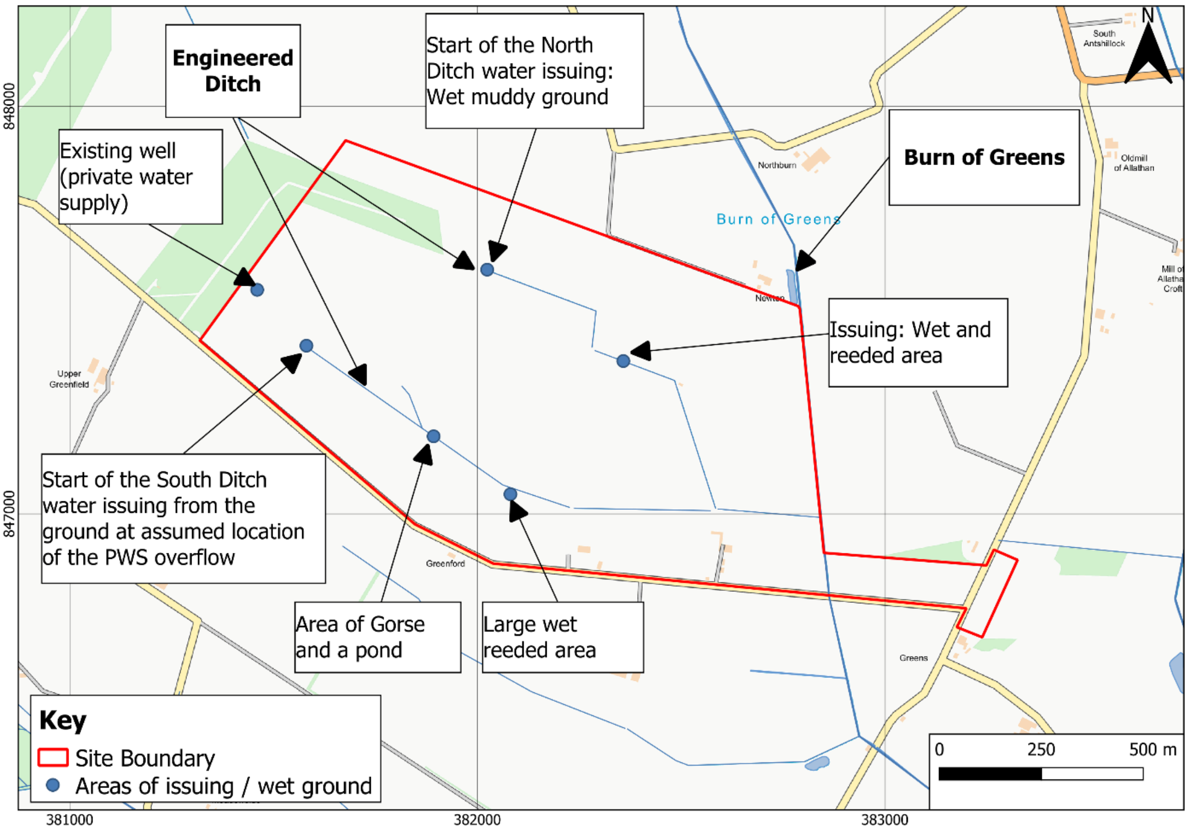

Figure 3: Drainage Feature Locations
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4.0 PROPOSED DEVELOPMENT

4.1 Proposed Substation

4.1.1 In order to upgrade the existing Beauly to Peterhead overhead line from 275kV to 400kV, additional substations are required for the line to allow connection to the upgraded circuit. This includes the proposed Greens 400kV substation.

4.1.2 The proposed Greens 400kV substation development consists of the main substation platform and an OHL Pylon platform, which has an approximate total area of 23.6ha, with the finished platform level of 129.5mAOD. The 23.6ha area does not include engineered slopes and earthworks extents.

4.1.3 The finished development proposals incorporate bunds on site to contain noise and conceal views of the substation from the surrounding areas.

4.1.4 The proposed drainage arrangement for the Greens substation is shown below in *Figure 4*.

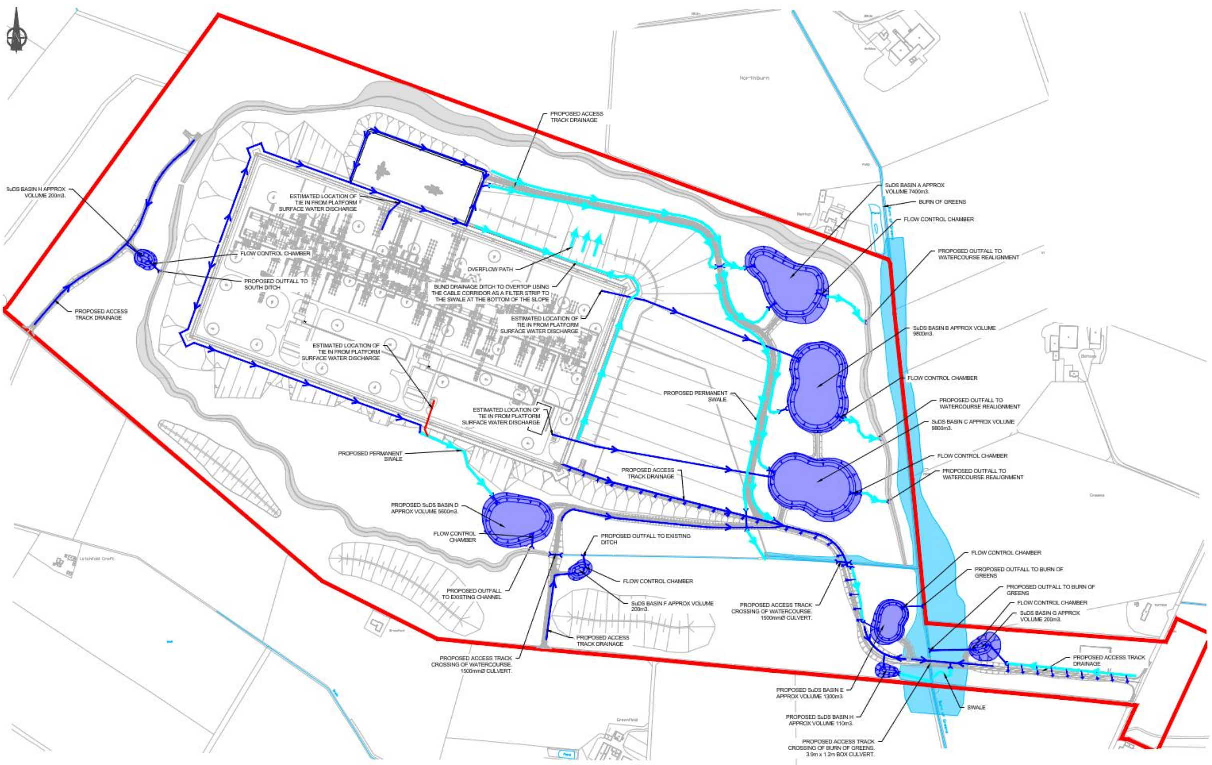

Figure 4: Greens 400kV Proposed Substation Drainage Layout

4.1.5 The proposed substation platform shall be formed of a build-up of a minimum of 1.0m crushed rock and will be predominantly free draining material, acting as a drainage blanket. This makes up part of the PRP drainage philosophy of the drainage inside the fenceline of the substation platform.

4.1.6 The substation will contain several buildings and hardstanding areas which will be impermeable. It is assumed that the PRP substation platform drainage design includes sufficient remediation measures for any oil that may contaminate run-off. Details of the PRP drainage philosophy can be found in **Appendix 3**.

4.1.7 The drainage for the area within the fenceline of the substation platform will be designed by PRP. See *Figure 5* for the PRP layout agreed with SEBAM as the current available layout to be used at the date of this report. This can be found, along with their associated drainage philosophy, in **Appendix 3**.

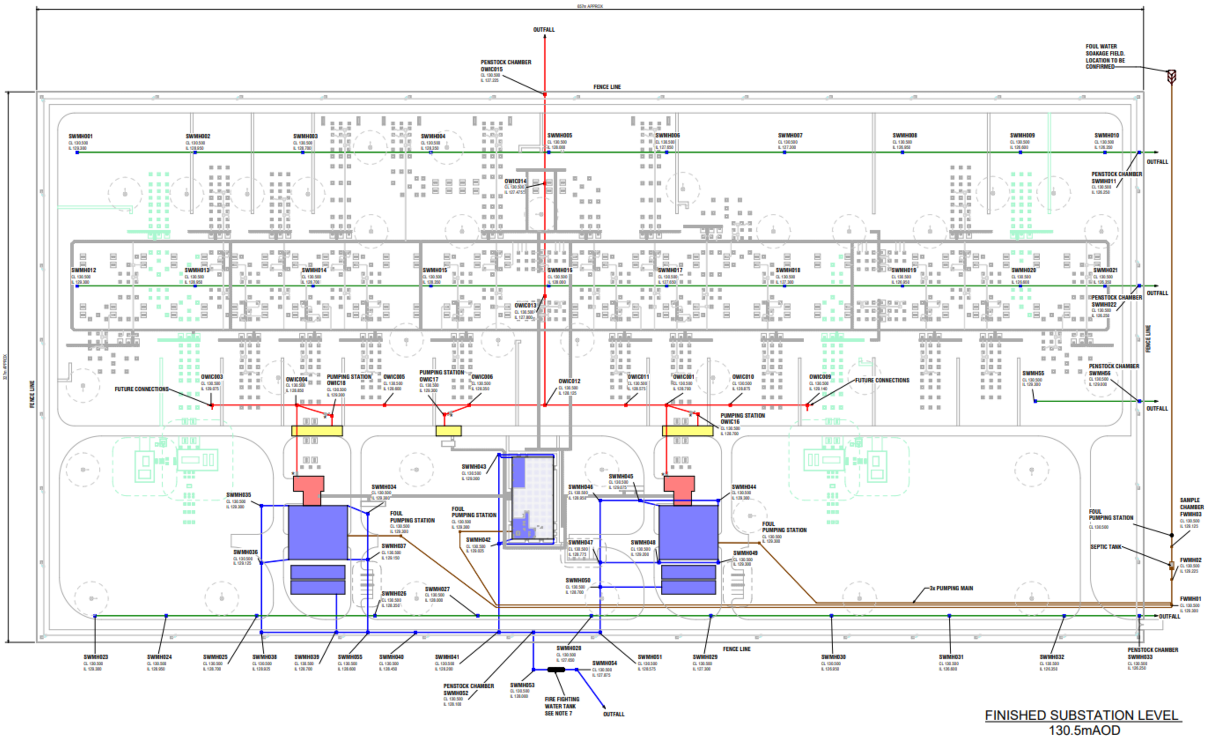

Figure 5: PRP Proposed Substation Layout

4.2 Proposed Access Tracks

4.2.1 The substation proposes access from an unnamed road approximately 1.5 km south of the B9170. The platform access track will traverse the site in a westerly direction towards the platform. Approximately 750m along the track, it splits to provide access to the northern side of the platform and the OHL pylons platform. This is named the tower access track. A secondary access track is also provided located to the west of the platform. A final alternative access track provided to the south of the platform, and west of the Parkside of Greens property within the site. The alternative access track shall act as an emergency access track to allow access in the event that the Burn of Greens experiences a high level of flooding. The proposed substation extent and access tracks at Greens are shown below in *Figure 6*.

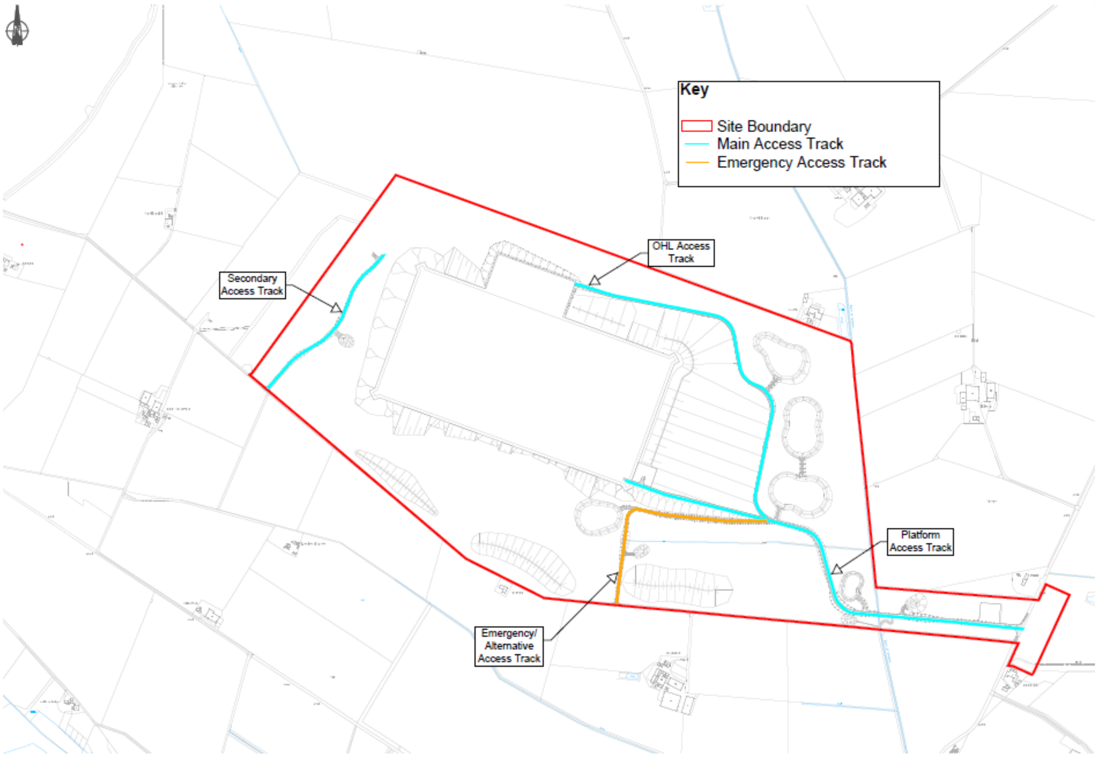

Figure 6: Proposed Access Track Locations

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4.2.2 The proposed track will have areas of cut and/or fill along the length of the tracks, which shall contain suitable drainage. It is proposed that the main access track will have a bound surface. All other access tracks within the site are to be of un-bound granular construction. SSEN specifications state that unbound granular material used be Type 2 sub-base.

4.2.3 Access tracks are proposed to allow for the maintenance of the proposed permanent SuDS basins and other SuDS features. SuDS access tracks will be unbound unless stated otherwise.

5.0 PROPOSED DRAINAGE

5.1 Drainage Principles

5.1.1 The principles of the drainage strategy for the new 400kV substation at Greens in Aberdeenshire will be to replicate the existing quality and quantities of run-off presently at the site wherever it is reasonable and practical to do so. All post development run-off shall also be dispersed in accordance with local authority (Aberdeenshire Council) and SEPA guidelines, and SSEN drainage specification (*Document number SP-NET-CIV-502*).

5.2 Design Philosophy

5.2.1 In addition to SSEN drainage specification and Local Authority guidelines, the proposed surface water design has been designed to follow the philosophy detailed in *CIRIA C753: The SuDS Manual* wherever possible. The manual states:

- Wherever possible, run-off should be managed at source (i.e. close to where the rain falls) with residual flows then conveyed downstream to further storage or treatment components where required.
- The passage of water between individual components should be through the use of above ground conveyance systems (e.g. swales and rills).
- Pipework may be a more suitable option depending on the specific scheme, especially where space is limited.
- Pre-treatment (the removal of litter and sediment) and maintenance are vital to ensure the long-term and sustained effectiveness of all Sustainable Drainage Systems (SuDS) components.
- Overland flow routes may also be required to convey and control floodwater safely during extreme events.

5.2.2 All proposed drainage within the site will be drained using SuDS principles and will be adhered to during the design with the following:

- Natural run-off collection and diversion (where required);
- Platform surface water run-off drainage collection and routing; and
- SuDS basins, cut-off drains & ditches for treatment and attenuation.

5.2.3 The existing engineered ditches within the site are required to be realigned to accommodate the proposed substation design and associated works. This is addressed in *Section 10*.

5.3 Design Assumptions

5.3.1 Fairhurst have received instruction from SSE to assume the substation platform as 100% impermeable, for the purposes of the drainage design. Further assumptions include:

- The substation surface run-off will be collected via filter drains within the platform;
- Global Entry time to drainage features for the substation platform is set to 120 minutes;
- All oily water or water which requires specific treatment due to operations within the substation platform fenceline shall be treated sufficiently inside the fenceline as part of the PRP drainage design. The run-off shall then connect to the proposed Fairhurst designed SuDS drainage outside of the substation platform fenceline for attenuation purposes;
- All surface water run-off from hardstanding surfaces within the substation platform fenceline will discharge to the SuDS drainage outside of the fenceline, and tie-in points shall be coordinated between PRP and Fairhurst;

- The platform drainage will discharge surface water to four separate locations from the substation platform:
  - No. 1 to the northern boundary of the platform;
  - No. 2 to the eastern boundary of the platform;
  - No. 3 to the eastern boundary of the platform; and
  - No. 4 to the southern boundary of the platform.

5.4 Design Parameters

5.4.1 The design shall adhere to the relevant SSEN specifications to meet the client's requirements. These specifications are listed below:

- SP-NET-CIV-502 – Drainage Specification
- SP-NET-CIV-503 – Pavements and Roadways

5.4.2 The following publications have also been considered in design decisions in accordance to SSEN SP-NET-CIV-005 – Drainage Specification:

- CIRIA C753: The SuDS Manual
- SEPA: Scottish Flood Hazard and Risk Information
- SUDSWP: Water Assessment and Drainage Assessment Guide

5.4.3 The *SSEN Drainage Specification*, document number SP-NET-CIV-502 states the following with regards to design requirements: "*The strategy shall identify the levels of flood protection for the site. As a minimum these shall include:*

- *1 in 200-year rainfall period protection for operational areas;*
- *1 in 1000-year rainfall return period protection for critical equipment;*
- *1 in 200-year rainfall return period for off-site flooding*."

5.4.4 SSEN specifications state that both the platform and access road should be considered as operational areas. This will be determined by the Contractor through consultation with the SSE Transmission Project Engineer.

5.4.5 The *Aberdeenshire Council Drainage Impact Assessment guidance* states "*In general terms the rate and volume of surface water run-off from the post-development situation should not exceed the surface water run-off from the existing site*." However, in line with current *SSEN Drainage Specification – SP-NET-CIV-502*, "*the surface water drainage strategy shall be, in principle, to mimic the quality and quantity of the run-off from the site in its 'greenfield' state, in so far as it is reasonable and practicable and where appropriate additional post development run-off shall be dispersed in accordance with local authority and SEPA guidance.*"

5.4.6 Aberdeenshire Council guidance states that "*The design of the SUDS measures on the site should be as follows using simulation to determine the critical duration associated with specified rainfall return periods:*

- *Attenuation measures should be designed such that SUDS features will not overflow during a 10-year return period rainfall event.*
- *A sensitivity test to assess the effect of the 50-year return period rainfall event on the surrounding property and road network, to ensure that failure of the measures will not have a detrimental effect on these areas, may be required.*

- *A further sensitivity test to ensure that there is no flooding to property during the 200-year return period rainfall event may also be required.*"

5.4.7 The drainage design has accommodated on-site storage of up to and including the 1 in 200-year return period storm with a discharge rate equivalent to the 1 in 2-year return period, of 44.1 l/s to accommodate SSEN Specifications. Please refer to *Section 7.5*, *Table 4* for details on proposed discharge rates.

5.4.8 Climate change allowances have been added when considering the proposed surface water drainage design within the development site. The *SEPA climate change allowances for flood risk assessment in land use planning, version 4, Table 2* recommends a 37% uplift for rainfall data at Greens, which falls within the North-East Scotland basin region. This climate change allowance shall be considered during surface water drainage design as required by SEPA guidelines.

5.5 Drainage Outfall Options

5.5.1 The options available for discharging surface water are recommended by *CIRIA C753: The SuDS Manual* hierarchy. The hierarchy with site relevant considerations are summarised in *Table 1* below:

Table 1: CIRIA C753: The SuDS Manual Outfall Hierarchy Outfall Options

Outfall Method	Suitability	Comments
Infiltrate run-off back into the ground.	Suitability is not known at this time as no infiltration test have been completed.	Conclusive infiltration tests are required prior to confirming if this option is available at the Greens development site.
Discharge run-off to watercourse	Burn of Greens runs along East of the proposed site, there is a risk of flooding at the burn. An FRA has been carried out to ensure any crossings/pipes are of a size that is unlikely to contribute to raising flood risk, and has assisted in design decisions.	An FRA has been provided in line with the proposed design, GRNS4-LT379-SEBAM-DRAI-ZZ-RPT-C-0003.
Discharge run-off to surface or combined sewers.	There are no known Scottish Water sewers at the site location so there could be no discharge to a sewer network.	Not feasible.
Discharge run-off into existing water features such as ponds.	Proximity to existing watercourses/drainage features to be examined to determine suitability.	Proposed SuDS basins have been designed to connect with existing/proposed water features.

6.0 DRAINAGE STRATEGY: PLATFORM

6.1 Patterson Reeves and Partners Drainage

6.1.1 All drainage within the substation platform fenceline has been designed by PRP, and information in this Section summarises the PRP strategy. Information provided in the PRP drainage philosophy shows the platform to be constructed with a 1m free-draining granular material to provide infiltration through the platform, acting as a drainage blanket. It has been assumed this will be positively drained to the proposed surface water drainage design outside of the substation fenceline.

6.1.2 Flows from the run-off from proposed building roofs and pumped flows from the bunds and tanker standing areas are positively drained into pipework which are sized to prevent any surface flooding during a 1 in 1000-year return period storm. The philosophy of the surface water drainage strategy is to replicate the equivalent Greenfield run-off rates.

6.1.3 The PRP drainage philosophy states that drains associated with oily water within the substation platform shall drain positively via "*intelligent pumping systems which will detect the presence of oil. These will cease operation if oil is detected. Flows from these locations will pass through above -ground oil separators, before passing downstream.*"

6.1.4 Further information can be found on the drainage drawing provided by PRP, and can be referred to in **Appendix 3**.

6.1.5 Calculations have been carried out by Fairhurst to estimate the attenuated volume of surface water run-off from the platform to the maximum allowable discharge rate. The attenuation storage design has been developed on the basis that the platform has a 100% impermeable area at formation level to allow for the worst-case scenario for the attenuation storage volume requirements. Following completion of geotechnical assessment across the site, the final volumes will be determined during the detailed design stage.

7.0 PROPOSED DRAINAGE: SUDS & ATTENUATION

7.1 Access Track

7.1.1 The unbound access track roads are to drain via filter drains where possible. This includes the Secondary Access Track and Alternative Access Track. The Tower Access Track will discharge to a drainage ditch/ swale. Surface water run-off from the tracks will flow through a series of below ground pipe systems or collection ditches/ swales. Once the surface water run-off has been collected, it will outfall to the proposed SuDS basins for treatment and attenuation before discharging into one of the proposed realigned water channels, discharging to the Burn of Greens.

7.1.2 For the proposed bound Platform Access Track, surface water run-off shall be collected by gullies and flow towards a series of below ground pipe systems and/or swales. Once the surface water run-off has been collected, it will outfall to a proposed SuDS basin for treatment and attenuation before eventually discharging into one of the existing or proposed realigned channels, discharging to the Burn of Greens.

7.2 SuDS Specification

7.2.1 The SuDS and attenuation system on site has been designed in accordance with:

- SSEN Drainage Specification document SP-NET-CIV-502
- CIRIA C753: The SuDS Manual

7.3 Simple Index Analysis (SIA) Tool

7.3.1 All proposed SuDS schemes are designed in compliance with *CIRIA C753: The SuDS Manual (2015)*. The *Simple Index Analysis (SIA) Tool* has been developed by SEPA to assess the suitability of proposed SuDS components at a development and to minimise any risks to the water quality of any receiving waterbodies.

7.3.2 Outputs from the SIA study for each area are detailed below for the substation platform.

7.3.3 PRP are dealing with all required treatment of the substation platform site operations, including for any required specialist treatments. For example, oily water treatment shall be designed and contained within the substation platform. Therefore, it is assumed Fairhurst will provide suitable treatment for both low trafficked roads, and simple industrial roofing.

7.3.4 As detailed in *Section 6*, Information provided by PRP drainage philosophy shows the platform is to be constructed with a 1m free-draining granular material to provide infiltration through the platform and will act as a drainage blanket. This has been included to the SIA tool as a filter drain for design purposes. As detailed in Section 6, the proposed 1m free-draining granular material shall be above a 100% impermeable formation layer, which requires all surface water run-off from the substation platform to be positively drained to the external drainage and SuDS system.

Table 2: SIA Tool Summary Table - Platform (Roads)

Run-off area land-use description	**Platform: Low Trafficked Roads**			
Pollution hazard indices:	Hazard Level	Suspended Solids	Metals	Hydrocarbons
	Low	0.5	0.4	0.4
Pollution mitigation indices (SuDS basin):		0.5	0.5	0.6
Pollution mitigation indices (Filter drain):		0.4	0.4	0.4
Total mitigation Index:		0.9	0.9	1.0
Sufficiency:		Sufficient	Sufficient	Sufficient

Table 3: SIA Tool Summary Table - Platform (Roofs)

Run-off area land-use description	**Platform: Commercial / Industrial Roofing (High Potential for Metal Leaching Assumed)**			
Pollution hazard indices:	Hazard Level	Suspended Solids	Metals	Hydrocarbons
	Low	0.3	0.8	0.05
Pollution mitigation indices (SuDS basin):		0.5	0.5	0.6
Pollution mitigation indices (Filter drain):		0.4	0.4	0.4
Total mitigation Index:		0.9	0.9	1.0
Sufficiency:		Sufficient	Sufficient	Sufficient

7.3.5 Both *Table 2* and *Table 3* above show that sufficient treatment has been proposed for the substation platform based on the assumptions stated in paragraph 7.3.4.

7.4 SuDS/Drainage Catchments

7.4.1 Catchment analysis indicates that the natural catchment of the proposed development site currently discharges to the existing engineered ditches prior to ultimately discharging to the Burn of Greens.

7.4.2 The substation platform and OHL platform areas cover a total of approximately 23.6ha, not including engineered slopes and natural catchments. It is proposed to split this area into four catchments for attenuation purposes to mimic the natural catchment characteristics as best as possible. Overland flow and excess surface water flow from the platform will be collected via perimeter drainage and discharged to one of four SuDS basins.

7.4.3 Similarly, run-off from the proposed substation access tracks will be collected via suitable SuDS features that have been included within the verge of the proposed road. Five additional basins have been proposed to deal with road run-off to accommodate level variations and provide effective drainage.

7.4.4 The substation platform, OHL pylon platform and access tracks have an approximate combined area of 25.6ha and have been considered as 100% impermeable areas in order to investigate the most conservative attenuation requirements.

7.4.5 A proposed layout plan of the proposed SuDS basins is shown on the Permanent Drainage Drawing - GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0171 within **Appendix 7**. The proposed SuDS basins are labelled from A-G on this layout drawing.

7.5 Discharge Rates

7.5.1 The rate of surface water run-off from the post-development scenario has been designed to not exceed the Greenfield surface water run-off from the existing site. Greenfield run-off rates have been calculated using a number of methods with the most conservative value taken forward into the design. Please refer to *Table 4* below for a summary of Greenfield run-off rates.

7.5.2 The discharge from the basins will be limited to the equivalent Greenfield run-off rates via vortex control chambers located immediately downstream of the basin outlets. The basins have been conservatively sized to discharge up to the 1 in 200-year storm event, to the 1 in 2-year Greenfield rate. This also includes an allowance for climate change.

Table 4: Discharge Rate Methods and Results

Impermeable Area	Substation Platform		OHL Platform		Access Road	
Return Period/Method	1 in 2-year	1 in 200-year	1 in 2-year	1 in 200-year	1 in 2-year	1 in-200 year
IH124	44.1	136.3	3.8	11.7	3.4	10.5
ReFH2	68.4	237.2	5.9	20.3	5.2	18.2
FEH	91.2	300.4	7.8	25.7	7.0	23.1

7.5.3 The most conservative discharge rates for the SuDS basins have been calculated using the IH124 method, allowing a discharge rate of 44.1 l/s across the site for the substation platform area.

7.5.4 Greenfield calculations can be found in **Appendix 4**.

7.6 Attenuation

7.6.1 The proposed substation site surface water run-off will be gathered by perimeter drainage around the substation platform. This run-off will then be carried to the proposed SuDS basins, where it will be treated and attenuated, and finally discharged at the required discharge rate into nearby realigned water channels.

7.6.2 Following the guidelines and assumptions outlined in *Section 5*, source control calculations using MicroDrainage software have been produced to estimate the total storage volume required for attenuating the surface water run-off from the proposed substation platform. The attenuation has been designed to store rainfall events up to and including the 1 in 200-year return period event for the catchment area of the platform, and discharge to a 1 in 2-year Greenfield run-off rate. This conservative approach has been used to provide suitable storage extents across the site to allow each storm event to be attenuated to the corresponding Greenfield run-off rate within the site red line boundary.

7.6.3 There are four proposed SuDS basins, A, B, C and D, at the site to treat and attenuate surface water run-off from the proposed substation platform. Calculations have shown that a total storage volume for the substation platform of approximately 33,800m³ is required.

7.6.4 Source Control estimations can be found in **Appendix 5**.

7.6.5 The drainage design has been further evaluated by producing an preliminary drainage model in MicroDrainage. This has been used to validate the proposed arrangement and storage requirements. The summary and results can be found in **Appendix 6**.

7.7 Basin Design

7.7.1 All SuDS basins have been designed to accommodate a maximum run-off from a 1 in 200-year storm event from hardstanding areas (platform and access road) plus a 37% allowance for climate change in accordance with SEPA requirements (*SEPA: Climate Change Allowances for Flood Risk Assessment in Land Use Planning. Version 4, 2023*).

7.7.2 The discharges from the basins have been designed to limit to the equivalent Greenfield run-off rates via vortex control chambers. Following the guidance of *CIRIA C753: The SuDS Manual*, the SuDS basins have been designed to a 1.5 m depth allowing for 300mm of freeboard and providing 1.2 m depth of storage. This ensures a sufficient design head for the proposed vortex control chamber to successfully control the discharge from the basin. All basins have been designed with a 1 in 4 side slope.

7.7.3 A summary of overall storage volumes is provided in *Table 5* below.

Table 5: Summary of SuDS Basins

Basin I.D.	Area Serviced	Impermeable Area (ha)	Attenuation Capacity (m³)	Receiving Watercourse
A	12.5% of platform + OHL area	4.8	7400	North realigned channel
B	37.5% of platform	8.1	9800	North realigned channel
C	37.5% of platform	8.1	9800	North realigned channel
D	12.5% of platform	2.7	5000	South realigned channel
E	Access track	1.58	1300	Burn of Greens
F	Access track	0.213	200	Existing channel
G	Access track	0.213	200	Burn of Greens
H	Access Track		200	South realigned channel
I	Access Track	0.187	110	Burn of Greens

SuDS Basins A & D

7.7.4 SuDS basins A and D receive run-off from the platform via swales at the toe of the platform earthworks. The basins discharge to the realigned channels to the south and north of the platform.

SuDS Basins B & C

7.7.5 SuDS basins B & C receive run-off from the platform via carrier pipes to the east of the platform. The SuDS basins then discharge to the north channel realignment.

SuDS Basins E, F, G, H & I

7.7.6 SuDS basins E, F, G, H and I receive run-off from access tracks via suitable SuDS facilities that have been included adjacent to the proposed road. SuDS basins E, G & I outfall to the Burn of Greens. Basin F discharges to the existing channel located to the south-east of the platform. Basin H discharge to the north realigned channel.

7.7.7 A proposed 3.5m access track for the purposes of maintenance is proposed. Further cut and fill will be required to tie back in to the natural topography of the surrounding landscape.

7.7.8 The proposed permanent drainage and SuDS arrangement can be seen in **Appendix 7**.

7.8 Cut-Off Ditches

7.8.1 Cut-off ditches are proposed to allow for the management of the overland flows at the top of the substations cut slope using the same philosophy as the above channel realignment. Ditches will be designed in line with the site's natural topography, providing channel capacity for up to and including the 1 in 200-year return period rainfall event. As the catchment is natural run-off it is proposed to discharge directly into the existing channels on or near the site.

7.9 Burn of Greens Crossing Drainage

7.9.1 The proposed platform access track is required to cross the Burn of Greens. The platform access track proposal in this area provides a solution which incorporates similar levels to the existing local road, located south of the new proposal. This proposal has been developed to minimise any impact to the existing 1 in 200-year + 37% climate change flood extents of the Burn of Greens. For details on Flood Risk please refer to the Flood Risk Assessment, GRNS4-LT379-SEBAM-DRAI-ZZ-RPT-C-0003.

7.9.2 A low point on the platform access track surface is proposed within the flood extent. This low point results in a surface water drainage solution to meet the treatment and attenuation requirements encroaching into the 1 in 200-year + 37% climate change flood extent of the Burn of Greens. Therefore, a solution has been proposed that avoids encroaching into the flood extent which will require a derogation from standards.

8.0 DRAINAGE STRATEGY: TEMPORARY DRAINAGE

8.1 Temporary Platform Drainage

8.1.1 Temporary drainage at the platform area has been designed to collect and control surface water run-off during the construction phase of works. This also includes the control of temporary 'laydown areas' required during the construction phase.

8.1.2 The proposed temporary drainage network consists of:

- Conveyance ditches around the temporary laydown areas. These have been designed to collect any run-off from the laydown areas before conveying to the temporary settlement lagoons prior to discharging to the existing watercourse;
- Temporary piped crossings under access tracks;
- Temporary settlement lagoons to remove silts and suspended solids prior to discharge to the receiving watercourses.

8.1.3 The proposed settlement lagoons have been designed in accordance to *CIRIA C648 & C649 – Control of water pollution from linear construction projects.* This guidance describes the use of the 1 in 10-year storm event for a temporary drainage design. The guide allows for adjustments to this design event taking into account the nature of the risk and the duration of the construction activity. An assessment has been undertaken considering the worst-case scenario in the guidance of a 1 in 10-year event to establish temporary treatment volumes required, for the duration of the construction activities.

8.1.4 The sizing of the temporary settlement lagoons has been undertaken based on the following assumptions:

- Conveyance ditches around the temporary laydown areas contributing to run-off of surface water that requires treatment;
- All surface water run-off requires treatment before discharge;
- No climate change allowance has been included;
- Run-off is collected in each catchment and directed towards a single location before discharge;
- All run-off is to be stored for approximately 6-10 hours to allow settlement for assumed fine silts. Note this will require confirmation from the geotechnical team upon further site inspections and design.

8.1.5 The temporary lagoon areas required to store the surface water run-off volume (assuming 1m depth of water) utilising natural settlement of the material are:

- Catchment 1 (½ of substation platform Area & Area 1) = 5600m^2
- Catchment 2 (Area 2) = 800m^2
- Catchment 3 (Area 3, 4 & 5) = 2400m^2
- Catchment 4 (½ of substation platform Area, Area 6 & Welfare / Office Laydown Area) = 7300m^2
- Catchment 5 (Area 5) = 800m^2
- Catchment 6 (OHL Platform) = 1000m^2

8.1.6 Refer to **Appendix 8** for information on the temporary lagoons, contributing catchment areas and associated discharge rates.

8.1.7 To provide a settlement lagoon for the substation platform run-off during the construction period, the use of the permanent features is proposed. It is to be noted that following construction, the SuDS basin is to be cleaned of any silt, debris build up from use prior to the permanent use.

8.1.8 In addition to the volumes of storage quoted above, allowance in the overall lagoon volume is required for freeboard, and to accommodate local topography.

8.1.9 The discharge rates for the temporary drainage design have been determined using *CIRIA C648 – Table 19.2*, which provides a suitable time for settlement based on the required run-off area and volume for each temporary laydown area. See *Figure 7* below. The discharge rates for the temporary lagoons range between 0.23 – 2.32l/s, depending on the corresponding laydown area.

Partical settling velocities for soil type as shown in CIRIA C648 Table 19.2

Solid type	mm/sec	m/hr*[1]		Proposed Typical pond/ tank depth (m)
Fine Clay	0.001	0.0036		0.5
Fine Silt	0.02	0.072		1
Medium silt	0.05	0.18		1.5
Course Sand	30	108		2
Flocculated Silt	10	36		2.5

Figure 7: Extract from CIRIA C648, Table 19.2

8.1.10 The proposed temporary drainage arrangement drawing can be seen in **Appendix 7**.

8.1.11 The proposed temporary drainage sizing estimations can be seen in **Appendix 8**.

9.0 DRAINAGE STRATEGY: CHANNEL REALIGNMENTS

9.1.1 Two channel realignments have been designed to divert existing channels around the proposed substation platform and associated works. The channels currently provide conveyance of natural springs within the site to the Burn of Greens.

9.1.2 During the design for the channel realignments, any activities proposed within the site that may affect the natural environment, including channels, may require authorisation from SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011(CAR) and further amendments of 2013, 2017 and 2021.

9.1.3 Channels that require realignments have been designed to accommodate a 1 in 200-year flow. The channel's calculations are based on the Manning's equation for a trapezoidal cross-section:

- Q = v*A = (1/n)*AR^(2/3)*S^(1/2)

Where:

- Manning's 'n' = 0.05 for a natural stream/stony channel for diverted channels
- S = Average channel slope based on the gradient between the channel tie-in level and the channel bed level
- R = Hydraulic radius (m), which is equal to the Flow Area / Wetted Perimeter
- A = Flow area (m^2)

9.1.4 Channel side slope gradients have been proposed as 1 in 3, but geotechnical advice will be needed to confirm this. The bed width of the channel is proposed as 1.2m. LiDAR information available for the site has been used to estimate existing channel extents and dimensions, but confirmation of this will be required prior to detailed design. With confirmation of additional details, the channel can be adjusted to complement the natural settings. The typology of the channels has been taken into consideration during the design, providing sinuosity to the channels to allow for naturalisation of the channels.

9.1.5 The design has implemented the typology for the catchment setting and channel average bed slope based on the table provided in *Buffington and Montgomery (2013) - Geomorphic Classification of rivers in Scroder J., Wohl E. (eds) Treastise on Geomorphology, Vol9, Academic Press, San Diego CA, pages 730-767*. *Table 6* below shows an extract.

Table 6: Extract from Buffington and Montgomery (2013)

Type	Slope (%)	Slope (1:X)
Cascade	>7.5%	>1:13
Step pool	3% – 7.5% Or 2% – 3% (>150W/m^2 in 1:2-year event)	1:33 – 1:13 Or 1:50 - 1:33 (>150W/m^2 in 1:2-year event)
Plane bed	1% – 2% Or 2% – 3% (<150W/m^2 in 1:2-year event)	1:100 – 1:50 Or 1:50 – 1:33(<150W/m^2 in 1:2-year event)
Plane riffle	0.5% - 1%	1:200 – 1:100
Pool riffle	0.2% - 0.5%	1:500 – 1:200
Low gradient passive meandering (dune-ripple bed)	<0.2%	<1:500

9.1.6 Channel crossings and realignments have been designed to accommodate a 1 in 200-year return period, as well as additional consideration for climate change. Piped crossings have been proposed to necessitate the installation of a headwall or a retaining wall at both the inlet and outlet as required. Headwalls are viewed as improvements to the existing baseline conditions.

9.1.7 Sustainable and ecological material choices shall be specified at detailed design stages where possible, once further investigations of the existing channels are carried out.

9.1.8 The proposed channel realignment drawing – GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0170 can be seen in **Appendix 7**.

10.0 DRAINAGE STRATEGY: GROUNDWATER

10.1.1 The British Geological Society (BGS) digital mapping indicate that the rock group underlying the site (Southern Highland Rock Group), is a low productivity aquifer with small amounts of groundwater in the near surface with secondary fractures.

10.1.2 There is a potential for groundwater flooding to occur at surface and below ground level at the site due to shallow ground water levels which has been identified in the Fairhurst – Geo-environmental Desk Study Report (Document no. GRNS4-LT379-SEBAM-ZZ-ZZ-RPT-G-0001). This will be considered at detailed design stage.

10.1.3 Please refer to the Geo-Environmental Report No. GRNS4-LT379-SEBAM-ZZ-ZZ-RPT-G-0001 for details on potential groundwater flooding.

10.2 Design Considerations

10.2.1 Groundwater has been observed to be shallow at the proposed substation site and throughout the site. Due to the shallow groundwater depths, careful management will be required to monitor excavation stability during construction and also in the long term e.g. operation, slope stability and any groundwater changes which may cause flooding or dewatering of localised peat. Changes to existing groundwater and surface water control measures such as drains and pumps should be carefully planned.

11.0 DRAINAGE STRATEGY: BURN OF GREENS CROSSING

11.1.1 The Burn of Greens, and associated flood extents encroach the eastern red line boundary of the proposed site. A crossing is proposed of the existing Burn of Greens as part of the proposed access track to the substation in the south east of the site.

11.1.2 SEPA fluvial flood maps indicates out-of-bank flooding along the Burn of Greens during a 1 in 200-year plus climate change event. Due to the increased likelihood of fluvial flooding at the Burn of Greens, a Flood Risk Assessment (FRA) will be required for the site. Please refer to GRNS4-LT379-SEBAM-DRAI-ZZ-RPT-C-0003 for FRA.

11.1.3 A meeting was held with Aberdeenshire Council on 25 June 2024, where Fairhurst and SEBAM presented a range of options and scenarios for the proposed Burn of Greens crossing for consideration. It was concluded that the crossing shall be of similar level and arrangement as the existing road crossing just south of the red line boundary. This shall consist of a single span crossing, which shall prevent any increase in flood risk outside of the red line boundary in the design event. The crossing shall be allowed to overtop in the 1 in 200-year plus climate change scenario, similar to the existing road crossing. An alternative emergency access route is available to the site in extreme storm events.

11.1.4 The impact of the new crossing on the Burn of Greens flood extent has been investigated using hydraulic flood modelling, which assisted in providing the required sizing and overall arrangement of the proposed crossing. The findings of the modelling exercise are included within the FRA report, GRNS4-LT379-SEBAM-DRAI-ZZ-RPT-C-0003.

11.1.5 Hydraulic modelling has confirmed the requirement for a single span culvert of dimensions 3.9m wide by 0.9m height.

11.1.6 Please refer to **Appendix 7** for proposed Burn of Greens crossing details.

12.0 DRAINAGE STRATEGY: FOUL WATER MANAGEMENT

12.1.1 Foul water drainage management within the substation platform has been designed by PRP. Refer to drawing *GRNS4-LT379-SEBAM-DRAI-XX-LAY-C-0001* in **Appendix 3**. PRP design philosophy references the foul design shall comply with *Sewers for Scotland*. However, it should be noted that the foul drainage within the site does not connect to multiple dwellings and will not be adopted by Scottish Water. The PRP drainage philosophy also states that "*foul drains are to be 100mm internal diameter… and will drain directly into a foul pumping station… and shall be pumped to a manhole outside the substation security fence. From there foul water shall drain via gravity into a septic tank. The outfall of the septic tanks shall drain into another duty/standby pumping station from where it will be pumped to a foul soakage field.*" Please refer to **Appendix 3** for full details.

12.1.2 During construction the office and welfare facilities will be connected to a septic tank to contain the foul water from the facilities. Full design details will be determined once the contractor has provided details of the site set-up and welfare provision. Septic tanks shall be designed in accordance with BS 6297 and have a minimum of 5m clearance from adjacent buildings of plant.

12.1.3 Septic tanks and infiltration systems are to be sized based on calculations from the *Code of Practice British Flow and Loads – 4* guidance. To assess the requirements for the proposed foul water system details (for both the temporary and permanent conditions), coordination with PRP and the contractor at later stages is required.

13.0 MAINTENANCE REQUIREMENTS

13.1.1 All drainage features will require regular maintenance to ensure their functionality. The frequency of a maintenance schedule varies depending on the feature type and may become less frequent over time. CIRIA C753: The SuDS Manual provides recommended maintenance requirements, which are summarised in *Tables 7 to 9*.

13.1.2 The proposed maintenance and inspection strategy shall be confirmed by the SHE Transmission Project Engineer for all drainage systems.

13.2 Filter Drains

Table 7: Filter Drain Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Inspect filter drain surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage.	Monthly
	Litter and debris removal from filter drain surface, access chambers & pre-treatment devices	Monthly/As required
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation and to establish appropriate silt removal frequencies.	Six monthly
	Remove sediment from pre-treatment devices.	Six monthly/as required
Occasional Maintenance	Removal or control of tree roots where they are encroaching the sides of the filter drain using recommended methods (e.g: NJUG, 2007 or BS 3998:2010).	As required
	At locations with high pollution loads, remove surface geotextile and replace and wash and replace overlying filter mediums	5 yearly or as required
	Clear perforated pipework of blockages	As required

13.3 Swales and Ditches

Table 8: Swales and Ditches Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Inspect inlets/outlets and overflows for blockages and clear if required	Monthly
	Litter and debris removal	Monthly/as required
	Grass cutting – to retain grass height within specified design range.	Monthly (during growing season) or as required
	Manage other vegetation and remove nuisance plants	Monthly at start then as required
	Inspect infiltration surfaces for ponding, compaction & silt accumulation. Record areas where ponding occurs for >48 hours.	Monthly/as required
	Inspect vegetation coverage	Monthly for 6 months then quarterly for 2 years then half yearly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Bi-annually
Occasional Maintenance	Reseed areas of poor vegetation growth and alter plant types to better suit conditions if required	As required of if bare soil is exposed over 10% or more of swale treatment area.
Remedial Maintenance	Repair erosion or other damage by re-turfing or re-seeding.	As required
	Re-level uneven surfaces and reinstate design levels.	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required
	Remove and dispose of oil or petrol residues using safe standard practices	As required

13.4 SuDS Basins

Table 9: SuDS Basins Maintenance Schedule

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

14.0 CONCLUSION

14.1.1 This Drainage Impact Assessment report shows the proposed drainage infrastructure and the methodology behind the designs. Design parameters have also been included in this report and appropriate guidelines have been observed in order to influence the design process.

14.1.2 Fairhurst are responsible for all surface water drainage proposals outside of the substation platform boundary fence. All drainage inside the fence line is designed by Patterson Reeves and Partners (PRP). Coordination between both parties is ongoing to ensure these drainage designs align as they progress to detailed design.

14.1.3 The proposed permanent surface water drainage has been designed in accordance with Aberdeenshire Council, SEPA and SSEN guidance. Greenfield run-off rates and attenuation volumes to be stored up to and including the 1 in 200-year return event storm. This has contributed to the SuDS design throughout the scheme allowing for the sizing of the attenuation basins of up to 33,800m^3 storage capacity for run-off from the substation platform (excluding earthworks), and for associated access roads within the site. Filter drains and swales / ditches shall convey surface water from the platform and the access roads to the SuDS basins, and discharge treated surface water run-off into the proposed channels across the site in 8 no. locations.

14.1.4 The temporary surface water design has also been considered. This consists of conveyance ditches around the temporary construction 'laydown area' platforms, which then discharge to settlement lagoons. The settlement lagoons have been designed to allow the settlement of suspended solids prior to discharge to the natural environment, for up to the 1 in 10-year storm event.

14.1.5 The existing north and south drainage channels have been incorporated into the design around the platform. The channel realignments of the existing channels have been designed to accommodate the location of the proposed substation platform and associated access tracks and work areas. This has been designed with current best practice, and shall include sinuosity where possible.

14.1.6 The surface water and foul water drainage within the substation platform has been designed by PRP. Further details can be found in the design philosophy provided by PRP in drawing BING4-LT521-SEBAM-DRAI-XX-LAY-C-0001, in **Appendix 3**.

14.1.7 Groundwater has been observed to be shallow at the proposed substation site and throughout the site. Due to the shallow groundwater depths, careful management will be required to ensue excavation stability during construction and also in the long term, e.g. operation, slope stability and any groundwater changes which may cause flooding or dewatering of localised peat. Changes to existing groundwater and surface water control measures such as drains and pumps should be carefully planned. Please refer to the Geo-

Environmental Report No. GRNS4-LT379-SEBAM-ZZ-ZZ-RPT-G-0001 for details on potential ground water flooding.

14.1.8 Consultations are ongoing to confirm the proposed Burn of Greens crossing. Details can be found in the Flood Risk Assessment.

Appendix 1 Proposed Site Boundary and Layouts

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
(REFER TO CDM REGISTER GRNS4-LT379-SEBAM-ZZ-EXT-REG-OS-0001)

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

CONSTRUCTION RISK

REFER TO RISK REGISTER
4 Abnormal load vehicles
6 Unrecorded Services
5 Watercourse/groundwater

MAINTENANCE / CLEANING RISK

· Inspection and Maintenance requirements for Suds features to be defined at detailed design

DECOMMISSIONING / DEMOLITION RISK

No known residual hazard at this stage of the design development

DRAWING STATUS: ISSUED FOR REVIEW S4

REVISION:	P01		PROJECT REF. GRNS4-LT379	ISSUED FOR FINAL REVIEW	P02.01		PROJECT REF. GRNS4-LT379	LANDSCAPING AMENDED
DRAWN:	FF	16/07/2024			SM	21/10/24		
CHECKED:	CG	16/07/2024			FF	21/10/24		
APPROVED:	CG	16/07/2024			CG	21/10/24		

KEY
TRACK ALIGNMENT
SITE BOUNDARY
GRADED EARTHWORKS SLOPES
ENGINEERING EARTHWORK SLOPES

METRES @ 1:2500 — 0, 20, 50, 100, 250

NOTES
1. THE PROPOSALS SHOWN ON THIS DRAWING HAVE BEEN DETERMINED FROM TOPOGRAPHICAL SURVEY INFORMATION PROVIDED BY OTHERS
2. SITE LAYOUT BASED ON DRAWING ND2-SK-001(04)
3. SUBSTATION LAYOUT ESTABLISHED FROM SIEMENS.RVT FILES (June 2024)
4. DESIGN PROPOSALS SHOWN ARE PRELIMINARY AND SUBJECT TO DETAILED DESIGN.
5. SEE DRAWING GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0109 FOR TEMPORARY WORKS LAYOUT
6. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
7. SUDS FEATURES INSPECTION & MAINTENANCE REQUIREMENTS TO BE DEFINED DURING DETAILED DESIGN

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Project: GREENS 400kV SUBSTATION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

Title: LT379 - GREENS PERMANENT WORKS LAYOUT

Subcon. Drawing No.: FAIRHURST GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0108

Contractor Drawing No.: GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0108

Customer Drawing No.: GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0108

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
AC	AC	FF	CG	15/04/2024	1:2500	A1	01 of 01	P02.01

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
(REFER TO CDM REGISTER GRNS4-LT379-SEBAM-ZZ-EXT-REG-OS-0001)

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

CONSTRUCTION RISK

REFER TO RISK REGISTER
4 Abnormal load vehicles
6 Unrecorded Services
5 Watercourse/groundwater

MAINTENANCE / CLEANING RISK

· Inspection and Maintenance requirements for Suds features to be defined at detailed design

DECOMMISSIONING / DEMOLITION RISK

No known residual hazard at this stage of the design development

METRES @ 1:2500 — 0, 20, 50, 100, 250

DRAWING STATUS: ISSUED FOR REVIEW S4

REVISION:	P01		PROJECT REF. LT379-GRNS4	ISSUED FOR FINAL REVIEW	P02.01		PROJECT REF. GRNS4-LT379	LANDSCAPING AMENDED
DRAWN:	AC	16/07/2024			SM	21/10/24		
CHECKED:	FF	16/07/2024			FF	21/10/24		
APPROVED:	CG	16/07/2024			CG	21/10/24		

KEY

- TRACK ALIGNMENT
- PERMANENT TRACKS FOR USE WITH TEMP TRACKS
- SITE BOUNDARY
- GRADED EARTHWORKS SLOPES
- ENGINEERING EARTHWORK SLOPES

NOTES

1. THE PROPOSALS SHOWN ON THIS DRAWING HAVE BEEN DETERMINED FROM TOPOGRAPHICAL SURVEY INFORMATION PROVIDED BY OTHERS
2. SITE LAYOUT BASED ON DRAWING ND2-SK-001(04)
3. SUBSTATION LAYOUT ESTABLISHED FROM SIEMENS.RVT FILES (June 2024)
4. DESIGN PROPOSALS SHOWN ARE PRELIMINARY AND SUBJECT TO DETAILED DESIGN.
5. SEE DRAWING GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0108 FOR PERMANENT WORKS LAYOUT
6. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
7. SUDS FEATURES INSPECTION & MAINTENANCE REQUIREMENTS TO BE DEFINED DURING DETAILED DESIGN

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Project: GREENS 400kV SUBSTATION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

Title: LT379 - GREENS TEMPORARY WORKS LAYOUT

Subcon. Drawing No. FAIRHURST GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0109

Contractor Drawing No. GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0109

Customer Drawing No. GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0109

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
FF	AC	FF	CG	17/06/2024	1:2500	A1	01 of 01	P02.01

Appendix 2 Existing Drainage Layout

NOTES
1. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
2. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS ON SITE AND REPORT ANY DIFFERENCE TO THE DESIGNER
3. ALL LEVELS ARE IN METRES (m) ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE.
4. SERVICES TO BE CONFIRMED TO ALLOW FOR COORDINATION
5. FURTHER INVESTIGATION REQUIRED TO CONFIRM ALL EXISTING TRACK DRAINS, DITCHES, CHANNELS AND ISSUES ON SITE
6. REFER TO DRAWINGS GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0170, GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0171, GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0173 FOR PROPOSED DRAINAGE

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

DRAWING STATUS: S5 ISSUED FINAL REVIEW

REVISION:	P01		PROJECT REF. GRNS4-LT379	01 - FIRST ISSUE - 21/08/2024	P02		PROJECT REF. GRNS4-LT379	ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN	21/08/2024			C.McLAUGHLIN	01/11/2024		
CHECKED:	R.DUNCAN	21/08/2024			R.DUNCAN	01/11/2024		
APPROVED:	R.MINTO	21/08/2024			R.MINTO	01/11/2024		

LEGEND:
- EXISTING DRAINAGE CHANNEL/FEATURE
- RED LINE SITE BOUNDARY

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Project: GREENS 400kV SUBSTATION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING EXISTING DRAINAGE LAYOUT

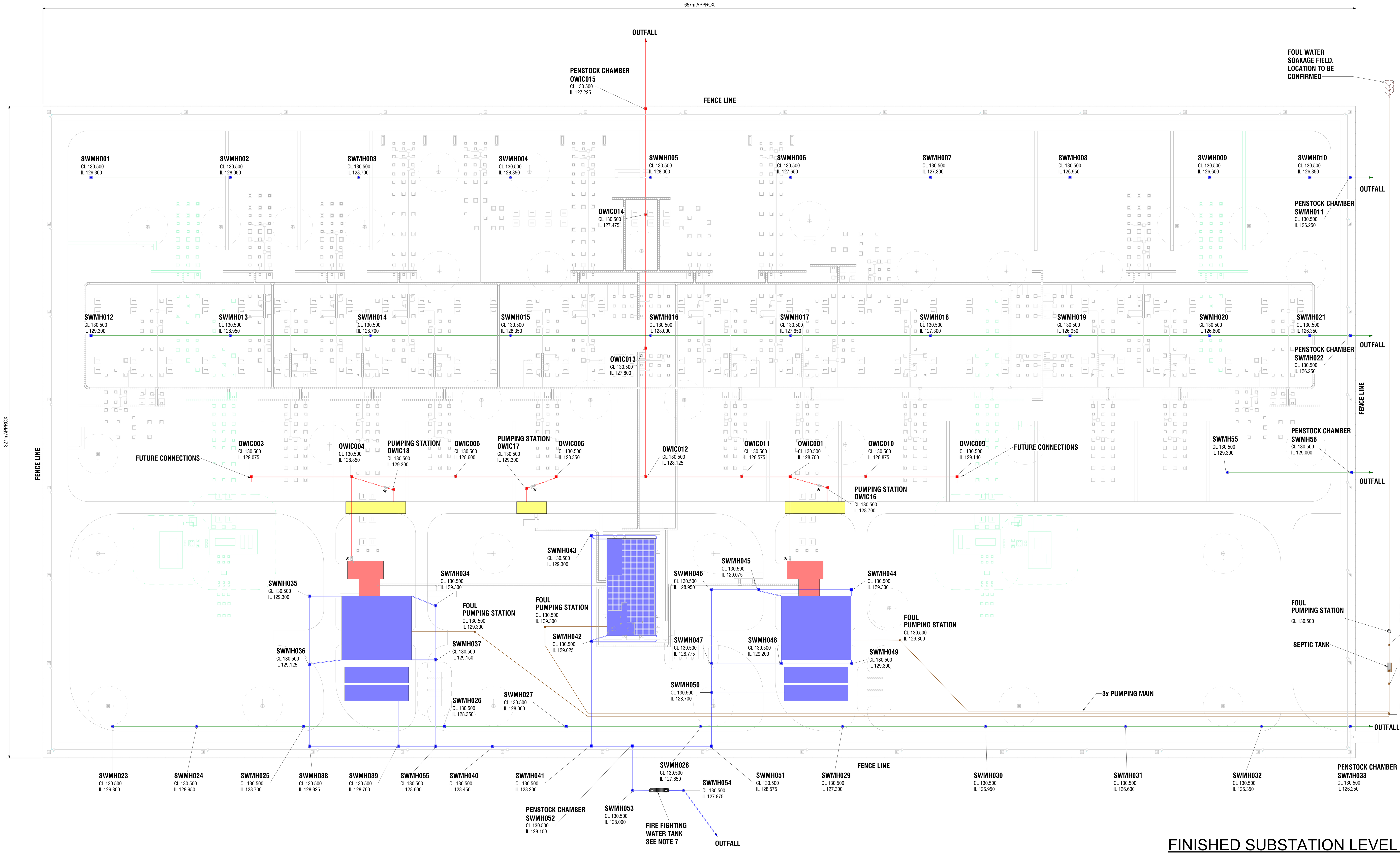
Subcon. Drawing No.: FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0176

Contractor Drawing No.: GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0176

Customer Drawing No.: GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0176

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	1:2500	A1	1 of 1	P02

Appendix 3 Proposed PRP Layout



DRAINAGE LEGEND

- CARRIER DRAIN - 225 DIA. TYPICAL
- FILTER DRAIN - 225 DIA. TYPICAL
- OILY WATER DRAIN - 150 DIA. TYPICAL
- FOUL WATER DRAIN - 100 DIA. TYPICAL
- SURFACE WATER CHAMBER
- OILY WATER CHAMBER
- FOUL WATER CHAMBER
- BUND
- BUILDING
- TANKER STAND AREA
- * ABOVE GROUND OIL SEPERATOR

ALL CHAMBER COVERS WITHIN 2m OF FENCELINE SHALL BE GRP

1. DO NOT SCALE, WORK TO DIMENSIONS SHOWN. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS SHOWN OTHERWISE.

2. THE CONTRACTOR IS RESPONSIBLE FOR THE LOCATION OF ALL EXISTING SERVICES WITHIN THE WORKS AREA AND FOR THE STRUCTURAL STABILITY THROUGHOUT THE WORKS.

3. CONTRACTORS ARE TO BE AWARE OF THEIR RESPONSIBILITIES UNDER THE CDM REGULATIONS & COMPLY WITH THEM AT ALL TIMES. NOTE THAT ANY HAZARDS IDENTIFIED ON THE DRAWINGS ARE ONLY THOSE WHICH MAY NOT BE OBVIOUS TO COMPETENT PERSONS OR ARE UNUSUAL OR WHICH MIGHT BE DIFFICULT TO MANAGE.

4. WORKING AREAS AND METHODS TO BE AGREED BEFORE WORK COMMENCES.

5. THE TERM 'CONTRACTOR' REFERS TO THE CONTRACTOR RESPONSIBLE FOR THE INDIVIDUAL ELEMENT OF THE WORKS.

6. UNLESS NOTED OTHERWISE THE SPECIFICATION FOR THE WORKS IS :-
- SP-NET-CIV-501, SPECIFICATION FOR EARTHWORKS - Rev 1.00 July 2020.
- SP-NET-CIV-502, DRAINAGE SPECIFICATION - Rev 1.01 July 2020.
- WHERE PROPRIETARY ITEMS HAVE BEEN SPECIFIED, SIMILAR APPROVED PRODUCTS WILL BE ACCEPTABLE BUT
- ONLY WHERE AGREED WITH PATTERSON REEVES & PARTNERS.

7. MINIMUM 120,000 LITRE BURIED FIRE FIGHTING WATER STORAGE TANK.HYDRANTS WILL NOT BE PROVIDED, WATER STORAGE TANK SHALL BE ACCESSIBLE FROM OUTSIDE THE SUBSTATION. FIRE FIGHTING AUTHORITY WILL NEED TO USE THEIR OWN SUCTION DEVICE TO GAIN ACCESS TO FIRE FIGHTING WATER.

DRAINAGE PHILOSOPHY

A) NORMAL SITE OPERATION

SURFACE WATER

APART FROM BUILDINGS, IMPERMEABLE ROADS AND BUNDS, THE SITE WILL GENERALLY BE SURFACED IN A LAYER OF STONE CHIPPINGS ON TOP OF A POROUS SUB-BASE LAYER THAT WILL ACT AS A DRAINAGE BLANKET. THE SSE SPECIFICATION CALLS FOR THIS 725MM SUB-BASE TO HAVE AN ABSORBENCY OF 3x10 -2 /M/S. RAINFALL WILL INFILTRATE INTO THE BLANKET. DUE TO THE SIGNIFICANT CUT AND FILL WORKS, THERE WILL BE A SIGNIFICANT DEPTH OF ABSORBENT GRANULAR MATERIAL OVER A LARGE PORTION OF THE SITE I.E THE FILLED SECTION. THE UNDERLYING ROCK WILL BE CUT AS REQUIRED AND PROCESSED ON-SITE TO BE USED AS ENGINEERED FILL. THE DEPTH OF UNDERLYING PROCESSED FILL WILL BE SEVERAL METRES THICK IN PLACES AND IT IS ANTICIPATED, SUBJECT TO TESTING THIS WILL ALLOW RAINFALL TO BE ABSORBED.

PAVED AREAS WILL DRAIN DIRECTLY INTO THE PLATFORM. SURFACE WATER FLOWS WILL BE GIVEN INITIAL TREATMENT AS IT PASSES THROUGH THE STONE BLANKET LAYER. SURFACE WATER WILL DRAIN OUT FROM THE SUBSTATION DRAINAGE BLANKET VIA A CHAMBER TO THE NORTH AND TO THE SOUTH INLINE WITH SWECO OVERALL DRAINAGE STRATEGY.

A SERIES OF FILTER DRAINS ARE PROPOSED, DEPENDING ON THE FINDINGS OF THE SITE INVETIGATION THESE MAYBE OMITTED AT DETAILED DESIGN STAGE.

FLOWS FROM THE RUNOFF FROM BUILDING ROOFS AND PUMPED FLOWS FROM BUNDS AND TANKER STANDING AREAS WILL BE POSITIVELY DRAINED INTO PIPEWORK WHICH WILL BE SIZED TO PREVENT ANY SURFACE FLOODING DURING A 1 IN 1000 YEAR RETURN PERIOD STORM, PLUS CLIMATE CHANGE. FLOWS TO DOWNSTREAM WATERCOURSES WILL BE RESTRICTED TO THE GREEN FIELD RUNOFF RATE FOR THE AREAS OF THE BUILDINGS AND BUNDS. ANY EXCESS VOLUMES OF STORMWATER WILL BE ATTENUATED IN A DETENTION BASIN/WETLAND POND(S).

THE PHILOSOPHY OF THE SURFACE WATER DRAINAGE STRATEGY IS IN PRINCIPLE TO MIMIC THE QUALITY AND QUANTITY OF THE RUNOFF FROM THE SITE IN ITS 'GREENFIELD' STATE. IN SO FAR AS IT IS REASONABLE AND PRACTICABLE, WHERE APPROPRIATE ADDITIONAL POST-DEVELOPMENT RUNOFF SHALL BE DISPERSED IN ACCORDANCE WITH LOCAL AUTHORITY, SEPA AND SEWERS FOR SCOTLAND.

DESIGN EVENT RAIN-FALL SHALL BE BASED ON THE USE OF THE MOST RECENT VERSION OF THE 'FLOOD ESTIMATION HANDBOOK' SPECIFIC TO THE LOCATION OF THE DEVELOPMENT. AN ALLOWANCE FOR CLIMATE CHANGE SHALL BE APPLIED IN ACCORDANCE WITH SEPA CLIMATE CHANGE (CC) ALLOWANCES FOR FLOOD RISK ASSESSMENTS IN LAND USE PLANNING, VERSION 1.

AS A MINIMUM, THE SURFACE WATER DRAINAGE SYSTEM WILL FULLY MANAGE SURFACE WATER FLOWS RESULTING FROM THE DEVELOPED SITE UP TO THE 1 IN 1000-YEAR + CC RAIN FALL RETURN PERIOD PROTECTION FOR 'CRITICAL EQUIPMENT'. TO REMOVE DOUBT, THIS HAS BEEN ASSUMED TO BE ANY AREA INSIDE THESE SUBSTATION SECURITY FENCE LINE. IN ADDITION, A MINIMUM OF 1 IN 200-YEAR + CC RAIN-FALL RETURN PERIOD PROTECTION WILL BE PROVIDED FOR OFF-SITE FLOODING.

ANALYSIS IDENTIFIES THE FLOWS FROM THE GREENFIELD SITE WHICH WILL BE COVERED WITH BUILDINGS OR BUNDS/TANKER STANDING AREAS IS 0.6L/S DURING A 1 IN 1 YEAR RETURN PERIOD STORM. THE PROPOSAL IS TO LIMIT THE MAXIMUM FLOW INTO DOWNSTREAM WATERCOURSES FROM THE POSITIVELY DRAINED BUILDINGS AND BUNDS TO 0.6L/S, EVEN DURING 1 IN 200 YEAR RETURN PERIOD STORMS PLUS CC.

BASED ON THE ABOVE PHILOSOPHY, AN INFODRAINAGE MODEL HAS ESTABLISHED THAT THERE NEEDS TO BE AN ATTENUATION VOLUME OF 300m³. A HYDROBRAKE CHAMBER WITH A DISCHARGE RATE OF 0.6L/S SHALL BE PROVIDED ON THE POND OUTFALL, THIS IS TO CATER FOR THE AREA OF THE SITE DIRECTLY WITHIN THE PERIMETER SECURITY FENCE ONLY. FOLLOWING THE MOST INTENSE STORM THAT HAS BEEN MODELLED, THE WATER LEVEL WILL RETURN BACK TO NORMAL IN APPROXIMATELY 48 HOURS.

INLETS INTO THE SWALES AND INTO THE POND SHALL BE MADE USING PRE-CAST CONCRETE SWALE INLET UNITS. THE OUTLET FROM THE POND SHALL BE A PRE-CAST CONCRETE HEADWALL UNIT WITH A WEIR AND SUMP, HANDRAIL, GATE AND INTEGRATED STEPS FOR EASE OF ACCESS FOR INSPECTION AND MAINTENANCE ACTIVITIES.

IN ADDITION TO THIS, IT IS A REQUIREMENT OF SEPA TO FOLLOW THE PRINCIPLES SET OUT IN THE SUDS MANUAL BY PROVIDING LEVELS OF TREATMENT TO SURFACE WATER FLOWS, WHILST AT THE SAME TIME PROVIDING A NATURAL AND STABLE HABITAT FOR PLANTS AND WILDLIFE. THE PONDS OUTSIDE THE SUBSTATION SHALL BE DESIGNED IN ACCORDANCE WITH SEWERS FOR SCOTLAND 4.0 CLAUSE 2.9.

THE ABOVE PROPOSAL IS A RECOGNISED STANDARD WAY OF ACHIEVING THE SUDS PRINCIPLES. EQUIPMENT CONTAINING OIL WILL BE SITUATED IN IMPERMEABLE BUNDS. BECAUSE THERE MAY BE OIL PRESENT WITHIN WATER WITHIN THESE BUNDS, INTELLIGENT PUMPING SYSTEMS WHICH WILL DETECT THE PRESENCE OF OIL WILL BE USED. THESE WILL CEASE OPERATION IF OIL IS DETECTED. IN ADDITION, FLOWS FROM THESE LOCATIONS WILL PASS THROUGH ABOVE-GROUND OIL SEPARATORS, BEFORE PASSING DOWNSTREAM.

IN ADDITION, COOLING PLANT CONTAINING GLYCOL WILL ALSO BE HOUSED IN BUNDS. RAINWATER ENTERING THESE BUNDS WILL ALSO BE PUMPED OUT INTO THE SURFACE WATER SYSTEM. IF A PRESSURE DROP IS INDICATED IN THE GLYCOL PIPEWORK, THE SURFACE WATER PUMPS WILL SWITCH OFF ENSURING CONTAMINATED WATER IS RETAINED WITHIN THE COOLER BUND.
SURFACE WATER FROM THE POTENTIAL OILY WATER SOURCES WILL DISCHARGE INTO A SEPARATE PIPE TO THAT WHICH IS DRAINING THE BUILDING ROOFS ETC. BOTH MAIN DRAIN RUNS WILL ULTIMATELY CONNECT TO SWALES OUTSIDE THE SECURITY FENCELINE. THIS SHALL BE IN ACCORDANCE WITH FIGURE 6.1 OF SP-NET-CIV-502. SURFACE WATER FROM BUILDINGS SHALL ONLY CONNECT INTO THE DRAINAGE SYSTEM DOWNSTREAM OF THE SAMPLE POINT. FROM THIS POINT, A COMMON SWALE WILL CONTINUE TO THE WETLAND POND/DETENTION BASIN.
WHERE OILY WATER AND SURFACE WATER CARRIER DRAINS ARE USED WITHIN THE SUBSTATION, THE CHAMBERS SHALL BE CONSIDERED AS 'MANHOLES', IN ACCORDANCE WITH SP-NET-CIV-502 THESE CHAMBERS SHALL HAVE 1200mm INTERNAL DIAMETER AND SHALL ALL BE BENCHED. CATCHPITS SHALL NOT BE USED WITHIN THE SUBSTATION.

FOUL WATER
SEWERS FOR SCOTLAND V4.0 STIPULATES THAT ALL GRAVITY SEWER PIPES SHALL BE 150mm INTERNAL DIAMETER AND SHALL BE UPVC. HOWEVER, THE FOUL DRAINAGE HERE DOESN'T CONNECT MULTIPLE PROPERTIES AND THEREFORE NOT CONSIDERED TO BE A 'SEWER'. WHERE GRAVITY DRAINS ARE PROVIDED THESE WILL BE 100mm INTERNAL DIAMETER. THE FOUL DRAIN FROM THE BUILDING SHALL DRAIN DIRECTLY INTO A FOUL PUMPING STATION (DUTY/STANDBY). THE PUMPING MAIN SHALL BE 50 DIA. (1200 DEEP TO CROWN) AND SHALL BE PUMPED TO A MANHOLE OUTSIDE THE SUBSTATION SECURITY FENCE. FROM THERE FOUL WATER SHALL DRAIN VIA GRAVITY INTO A SEPTIC TANK (ALSO LOCATED OUTSIDE THE SUBSTATION FENCELINE) LOCATED AS CLOSE AS PRACTICALLY POSSIBLE TO THE ENTRANCE FOR EASE OF ACCESS FOR MAINTENANCE. THE OUTFALL FROM THE SEPTIC TANK SHALL DRAIN INTO ANOTHER DUTY/STANDBY PUMPING FROM WHERE IT WILL BE PUMPED TO A FOUL SOAKAGE FIELD. THE SOAKAGE FIELD SHALL BE LOCATED IN AN AREA WHERE THERE ARE SUITABLE DRAINAGE CHARACTERISTICS. ALSO WHERE THE LEVELS PERMIT THE SOAKAGE FIELD TO BE NO GREAT THAN 700mm TO CROWN OF PIPE. ALL IN ACCORDANCE WITH BS 6297 WHICH COVERS 'DEALING WITH DIFFICULT SITES AND GROUND CONDITIONS', THIS MUST BE REFERRED TO WHEN DETERMINING THE CORRECT LOCATION. REFER TO FIGURE 6 OF BS 6297.

B) DRAINAGE MANAGEMENT DURING THE CONSTRUCTION PHASE

IT IS PROPOSED THAT THE WETLAND/ATTENUATION POND BE CONSTRUCTED AT AN EARLY STAGE SO THAT IT CAN BE USED AS A MEANS TO CONTROL SILT FLOWS BEFORE WATER GETS INTO THE WATERCOURSE. IT IS RECOMMENDED THAT CUT-OFF DITCHES ARE CONSTRUCTED WHICH WILL DIRECT FLOWS DURING CONSTRUCTION INTO THE POND. THE POND WILL HAVE A MINIMUM DEPTH OF 300mm AT ALL TIMES AND THEREFORE THIS WILL PROVIDE SUFFICIENT ROOM FOR SILTS TO SETTLE. THE POND WILL BE SUBJECT TO REGULAR INSPECTION TO ENSURE THAT ANY BUILDUP OF SILTS IS REMOVED PROMPTLY. WITH THIS MITIGATION IN PLACE, THE WATER BEING DISCHARGED WILL REMAIN IN COMPLIANCE WITH THE ENVIRONMENTAL QUALITY STANDARD FOR SURFACE WATER, I.E. 40MG/L OF SEDIMENT. IN ADDITION TO THE ABOVE AN OIL ABSORPTION AND DEBRIS BOOM SHOULD BE PLACED IN FRONT OF THE POND OUTFALL.

A MONITORING REGIME SHOULD BE DEVELOPED FOR THE WATER BEING DISCHARGED TO TRACK TURBIDITY, PH AND OVERALL QUALITY. IN THE EVENT THAT QUALITY DECREASES, FURTHER TREATMENT MEASURES MAY NEED TO BE PUT IN PLACE.

OILY WATER HANDLING AREA
TANKER STAND AREAS PROVIDED AS SHOWN

FINISHED SUBSTATION LEVEL 130.5mAOD

0 15 30 45 60 75 m
SCALE 1:750

CDM REGULATIONS:

SIGNIFICANT OR UNUSUAL RESIDUAL HAZARDS HIGHLIGHTED BELOW:

THERE ARE NO RISKS UNFAMILIAR TO A COMPETENT CONTRACTOR

SAFE METHODS OF WORK ARE THE RESPONSIBILITY OF THE CONTRACTOR AND ARE TO BE IDENTIFIED IN THE HEALTH AND SAFETY PLAN.

N E S W

ISSUE	DRAWN	CHECKED	APPROVED	STATUS	PROJECT REF	DESCRIPTION
01	H.Hooper 20.02.2024	G.Hooper 20.02.2024	N.Patterson 20.02.2024	FOR REVIEW	PROJECT REF: LT000289	FIRST ISSUE
02	H.Hooper 31.05.2024	G.Hooper 31.05.2024	N.Patterson 31.05.2024	FOR REVIEW	PROJECT REF: LT000289	PLATFORM FILTER DRAINAGE AND FOUL ADDED
03	H.Hooper 24.07.2024	G.Hooper 24.07.2024	N.Patterson 24.07.2024	FOR REVIEW	PROJECT REF: LT000289	SIEMENS LAYOUT + DRAINAGE UPDATED
04	H.Hooper 13.08.2024	G.Hooper 13.08.2024	N.Patterson 13.08.2024	FOR REVIEW	PROJECT REF: LT000289	FILTER DRAIN INVERT LEVELS REVISED
05	H.Hooper 17.09.2024	G.Hooper 17.09.2024	N.Patterson 17.09.2024	FOR REVIEW	PROJECT REF: LT000289	VARIOUS LAYOUT CHANGES + ADDITIONS
06	H.Hooper 26.09.2024	G.Hooper 26.09.2024	N.Patterson 26.09.2024	FOR REVIEW	PROJECT REF: LT000289	OVERALL DIMS CORRECTED, PUMPING STATION ARRANGEMENT CORRECTED

DRAWING STATUS: **FOR REVIEW**
FOR REVIEW / FOR CONSTRUCTION / AS-BUILT
DRAWING TO BE PRINTED IN COLOUR ONLY

Customer: Scottish & Southern Electricity Networks	Project: GREENS 400kV SUBSTATION
SIEMENS energy + bam Joint Venture Substation Delivery Framework	Title: OVERVIEW & PHILOSOPHY DRAINAGE -
Subcontractor: Patterson Reeves & Partners	Client DRG No. GRNS4-LT379-SEBAM-DRAI-XX-LAY-C-0001; Contractor DRG No. -

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
M.Patterson	H.Hooper	G.Hooper	N.Patterson	June 2024	1:750	A0	01 of 01	06

Appendix 4 Greenfield Run-Off Calculations

IH 124 Mean Annual Flood

Input

Return Period (years)	200	Soil	0.300
Area (ha)	50.000	Urban	0.000
SAAR (mm)	840	Region Number	Region 1

Results	**l/s**
QBAR Rural	112.8
QBAR Urban	112.8
Q200 years	316.9
Q1 year	95.9
Q2 years	102.5
Q5 years	135.3
Q10 years	163.0
Q20 years	192.7
Q25 years	203.9
Q30 years	213.1
Q50 years	239.6
Q100 years	279.7
Q200 years	316.9
Q250 years	329.3
Q1000 years	409.4

Appendix 5 MicroDrainage Source Control Calculations

Summary of Results for 200 year Return Period (+37%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.699	0.199	28.3	5127.0	O K
30 min Summer	98.760	0.260	40.0	6689.9	O K
60 min Summer	98.840	0.340	43.4	8736.1	O K
120 min Summer	98.944	0.444	44.0	11414.8	O K
180 min Summer	99.019	0.519	44.0	13335.6	O K
240 min Summer	99.079	0.579	44.0	14879.5	O K
360 min Summer	99.175	0.675	44.0	17337.1	O K
480 min Summer	99.251	0.751	44.0	19295.9	O K
600 min Summer	99.315	0.815	44.0	20948.0	O K
720 min Summer	99.371	0.871	44.0	22391.4	O K
960 min Summer	99.450	0.950	44.0	24421.2	O K
1440 min Summer	99.565	1.065	44.0	27377.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.175	0.0	1728.2	133
30 min Summer	68.310	0.0	2505.7	146
60 min Summer	44.792	0.0	5326.0	174
120 min Summer	29.371	0.0	6738.8	230
180 min Summer	22.946	0.0	7180.7	288
240 min Summer	19.259	0.0	7182.0	346
360 min Summer	15.046	0.0	7035.6	462
480 min Summer	12.629	0.0	6839.8	578
600 min Summer	11.024	0.0	6625.3	696
720 min Summer	9.866	0.0	6386.3	814
960 min Summer	8.156	0.0	6006.6	1048
1440 min Summer	6.236	0.0	5842.7	1516

Note: Source Control Quick Storage Estimates up to 1440 min. duration only.

Summary of Results for 200 year Return Period (+37%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	98.723	0.223	33.4	5735.6	O K
30 min Winter	98.791	0.291	42.5	7489.4	O K
60 min Winter	98.881	0.381	43.8	9797.2	O K
120 min Winter	98.999	0.499	44.0	12817.1	O K
180 min Winter	99.083	0.583	44.0	14983.9	O K
240 min Winter	99.151	0.651	44.0	16726.2	O K
360 min Winter	99.259	0.759	44.0	19502.1	O K
480 min Winter	99.345	0.845	44.0	21722.5	O K
600 min Winter	99.418	0.918	44.0	23600.0	O K
720 min Winter	99.481	0.981	44.0	25217.2	O K
960 min Winter	99.570	1.070	44.0	27488.0	O K
1440 min Winter	99.700	1.200	44.0	30850.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Winter	104.175	0.0	2033.2	133
30 min Winter	68.310	0.0	2875.3	146
60 min Winter	44.792	0.0	5966.6	174
120 min Winter	29.371	0.0	7149.7	230
180 min Winter	22.946	0.0	7249.7	286
240 min Winter	19.259	0.0	7182.2	342
360 min Winter	15.046	0.0	6964.7	456
480 min Winter	12.629	0.0	6699.2	572
600 min Winter	11.024	0.0	6395.0	688
720 min Winter	9.866	0.0	6217.8	802
960 min Winter	8.156	0.0	6174.0	1030
1440 min Winter	6.236	0.0	6225.2	1488

Note: Source Control Quick Storage Estimates up to 1440 min. duration only.

Appendix 6 Initial MicroDrainage Model Summary & Results

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	200	PIMP (%)	100
M5-60 (mm)	14.000	Add Flow / Climate Change (%)	37
Ratio R	0.200	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	200	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	8	Number of Storage Structures	28	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	200	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.200	Storm Duration (mins)	30
Ratio R	0.250		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: 31, DS/PN: 1.030, Volume (m³): 4305.7

Unit Reference	MD-SHE-0231-2900-1200-2900
Design Head (m)	1.200
Design Flow (l/s)	29.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	231
Invert Level (m)	115.546
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	29.0	Kick-Flo®	0.854	24.6
Flush-Flo™	0.403	28.9	Mean Flow over Head Range	-	24.4

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)**	**Depth (m)**	**Flow (l/s)**
0.100	7.7	0.800	26.1	2.000	37.0	4.000	51.8	7.000	67.9
0.200	23.1	1.000	26.6	2.200	38.8	4.500	54.8	7.500	70.2
0.300	28.4	1.200	29.0	2.400	40.4	5.000	57.7	8.000	72.5
0.400	28.9	1.400	31.2	2.600	42.0	5.500	60.4	8.500	74.6
0.500	28.7	1.600	33.3	3.000	45.0	6.000	63.0	9.000	76.7
0.600	28.2	1.800	35.2	3.500	48.5	6.500	65.5	9.500	78.8

Hydro-Brake® Optimum Manhole: 48, DS/PN: 2.015, Volume (m³): 176.3

Unit Reference	MD-SHE-0174-1540-1200-1540
Design Head (m)	1.200
Design Flow (l/s)	15.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	174
Invert Level (m)	105.815
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	15.4	Kick-Flo®	0.809	12.8
Flush-Flo™	0.366	15.4	Mean Flow over Head Range	-	13.2

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	6.2	0.400	15.4	0.800	13.0	1.400	16.6	2.000	19.6
0.200	14.5	0.500	15.2	1.000	14.1	1.600	17.7	2.200	20.5
0.300	15.3	0.600	14.8	1.200	15.4	1.800	18.7	2.400	21.4

Hydro-Brake® Optimum Manhole: 48, DS/PN: 2.015, Volume (m³): 176.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
2.600	22.3	4.000	27.4	5.500	31.9	7.000	35.8	8.500	39.4
3.000	23.8	4.500	29.0	6.000	33.3	7.500	37.1	9.000	40.5
3.500	25.7	5.000	30.5	6.500	34.6	8.000	38.2	9.500	41.5

Hydro-Brake® Optimum Manhole: 60, DS/PN: 4.010, Volume (m³): 19132.1

Unit Reference	MD-SHE-0165-1360-1200-1360
Design Head (m)	1.200
Design Flow (l/s)	13.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	165
Invert Level (m)	105.439
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	13.6	Kick-Flo®	0.801	11.2
Flush-Flo™	0.364	13.6	Mean Flow over Head Range	-	11.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.9	0.800	11.3	2.000	17.3	4.000	24.1	7.000	31.6
0.200	12.8	1.000	12.5	2.200	18.1	4.500	25.5	7.500	32.7
0.300	13.5	1.200	13.6	2.400	18.9	5.000	26.9	8.000	33.7
0.400	13.6	1.400	14.6	2.600	19.6	5.500	28.1	8.500	34.7
0.500	13.4	1.600	15.6	3.000	21.0	6.000	29.3	9.000	35.7
0.600	13.1	1.800	16.5	3.500	22.6	6.500	30.5	9.500	36.6

Hydro-Brake® Optimum Manhole: 78, DS/PN: 6.016, Volume (m³): 1662.7

Unit Reference	MD-SHE-0219-2580-1200-2580
Design Head (m)	1.200
Design Flow (l/s)	25.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	219
Invert Level (m)	114.148
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	25.8	Kick-Flo®	0.845	21.8
Flush-Flo™	0.391	25.8	Mean Flow over Head Range	-	21.8

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

Hydro-Brake® Optimum Manhole: 78, DS/PN: 6.016, Volume (m³): 1662.7

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	7.4	0.800	23.0	2.000	32.9	4.000	46.0	7.000	60.4
0.200	21.6	1.000	23.6	2.200	34.5	4.500	48.7	7.500	62.4
0.300	25.5	1.200	25.8	2.400	36.0	5.000	51.3	8.000	64.4
0.400	25.8	1.400	27.8	2.600	37.4	5.500	53.7	8.500	66.3
0.500	25.5	1.600	29.6	3.000	40.0	6.000	56.0	9.000	68.2
0.600	25.1	1.800	31.3	3.500	43.1	6.500	58.2	9.500	70.0

Hydro-Brake® Optimum Manhole: 140, DS/PN: 7.024, Volume (m³): 657.0

Unit Reference	MD-SHE-0116-6400-1200-6400
Design Head (m)	1.200
Design Flow (l/s)	6.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	116
Invert Level (m)	99.393
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.200	6.4	Kick-Flo®	0.751	5.1
Flush-Flo™	0.354	6.4	Mean Flow over Head Range	-	5.6

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)**	**Depth (m)**	**Flow (l/s)**
0.100	4.1	0.800	5.3	2.000	8.1	4.000	11.3	7.000	14.7
0.200	6.0	1.000	5.9	2.200	8.5	4.500	11.9	7.500	15.2
0.300	6.3	1.200	6.4	2.400	8.9	5.000	12.5	8.000	15.7
0.400	6.3	1.400	6.9	2.600	9.2	5.500	13.1	8.500	16.2
0.500	6.2	1.600	7.3	3.000	9.8	6.000	13.7	9.000	16.6
0.600	6.0	1.800	7.7	3.500	10.6	6.500	14.2	9.500	17.0

Hydro-Brake® Optimum Manhole: 155, DS/PN: 12.005, Volume (m³): 2.2

Unit Reference	MD-SHE-0032-5000-1000-5000
Design Head (m)	1.000
Design Flow (l/s)	0.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	32
Invert Level (m)	113.322
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**	**Control Points**	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	1.000	0.5	Kick-Flo®	0.288	0.3
Flush-Flo™	0.143	0.3	Mean Flow over Head Range	-	0.4

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

Hydro-Brake® Optimum Manhole: 155, DS/PN: 12.005, Volume (m³): 2.2

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)	Depth (m)	Flow (l/s)
0.100	0.3	0.800	0.5	2.000	0.7	4.000	0.9	7.000	1.2
0.200	0.3	1.000	0.5	2.200	0.7	4.500	1.0	7.500	1.2
0.300	0.3	1.200	0.5	2.400	0.7	5.000	1.0	8.000	1.3
0.400	0.3	1.400	0.6	2.600	0.8	5.500	1.1	8.500	1.3
0.500	0.4	1.600	0.6	3.000	0.8	6.000	1.1	9.000	1.3
0.600	0.4	1.800	0.6	3.500	0.9	6.500	1.2	9.500	1.4

Hydro-Brake® Optimum Manhole: 163, DS/PN: 13.007, Volume (m³): 328.7

Unit Reference	MD-SHE-0059-1400-0770-1400
Design Head (m)	0.770
Design Flow (l/s)	1.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	98.431
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.770	1.4	Kick-Flo®	0.490	1.1
Flush-Flo™	0.238	1.4	Mean Flow over Head Range	-	1.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	0.800	1.4	2.000	2.2	4.000	3.0	7.000	3.9
0.200	1.4	1.000	1.6	2.200	2.3	4.500	3.1	7.500	4.0
0.300	1.4	1.200	1.7	2.400	2.3	5.000	3.3	8.000	4.1
0.400	1.3	1.400	1.8	2.600	2.4	5.500	3.4	8.500	4.2
0.500	1.2	1.600	1.9	3.000	2.6	6.000	3.6	9.000	4.4
0.600	1.3	1.800	2.1	3.500	2.8	6.500	3.7	9.500	4.5

Hydro-Brake® Optimum Manhole: 178, DS/PN: 14.008, Volume (m³): 2.0

Unit Reference	MD-SHE-0049-1200-1200-1200
Design Head (m)	1.200
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	144.577
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.2	Kick-Flo®	0.438	0.8
Flush-Flo™	0.215	0.9	Mean Flow over Head Range	-	0.9

Hydro-Brake® Optimum Manhole: 178, DS/PN: 14.008, Volume (m^3): 2.0

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

Depth (m)	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**	**Depth (m)**	**Flow (l/s)**
0.100	0.9	0.800	1.0	2.000	1.5	4.000	2.1	7.000	2.7
0.200	0.9	1.000	1.1	2.200	1.6	4.500	2.2	7.500	2.8
0.300	0.9	1.200	1.2	2.400	1.6	5.000	2.3	8.000	2.9
0.400	0.8	1.400	1.3	2.600	1.7	5.500	2.4	8.500	2.9
0.500	0.8	1.600	1.4	3.000	1.8	6.000	2.5	9.000	3.0
0.600	0.9	1.800	1.4	3.500	2.0	6.500	2.6	9.500	3.1

Storage Structures for Storm

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

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	90.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	2250.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	127.205	Membrane Depth (mm)	0

Porous Car Park Manhole: 2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	45.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	1125.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	126.603	Membrane Depth (mm)	0

Porous Car Park Manhole: 7, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	45.0
Membrane Percolation (mm/hr)	1000	Length (m)	45.0
Max Percolation (l/s)	562.5	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	125.515	Membrane Depth (mm)	0

Porous Car Park Manhole: 8, DS/PN: 1.007

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	3750.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	124.995	Membrane Depth (mm)	0

Cellular Storage Manhole: 30, DS/PN: 1.029

Invert Level (m)	116.604	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	6400.0	0.0	1.200	6400.0	0.0

Porous Car Park Manhole: 32, DS/PN: 2.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	3750.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	127.169	Membrane Depth (mm)	0

Porous Car Park Manhole: 33, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	3750.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	126.595	Membrane Depth (mm)	0

Porous Car Park Manhole: 34, DS/PN: 2.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	3750.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	125.963	Membrane Depth (mm)	0

Porous Car Park Manhole: 35, DS/PN: 2.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	45.0
Max Percolation (l/s)	1875.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	125.219	Membrane Depth (mm)	0

Porous Car Park Manhole: 40, DS/PN: 3.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	45.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	1125.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	127.585	Membrane Depth (mm)	0

Cellular Storage Manhole: 47, DS/PN: 2.014

Invert Level (m)	106.041	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	7892.0	0.0	1.200	9476.0	0.0

Porous Car Park Manhole: 49, DS/PN: 4.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	100.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	2500.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	127.192	Membrane Depth (mm)	0

Porous Car Park Manhole: 54, DS/PN: 5.000

Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.30
Membrane Percolation (mm/hr)	1000	Invert Level (m)	127.549
Max Percolation (l/s)	3750.0	Width (m)	150.0
Safety Factor	2.0	Length (m)	90.0

Porous Car Park Manhole: 54, DS/PN: 5.000

Slope (1:X)	1000.0	Evaporation (mm/day)	3
Depression Storage (mm)	0	Membrane Depth (mm)	0

Porous Car Park Manhole: 55, DS/PN: 4.005

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	100.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	2500.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	124.999	Membrane Depth (mm)	0

Cellular Storage Manhole: 60, DS/PN: 4.010

Invert Level (m)	105.439	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	7881.0	0.0	1.200	9463.9	0.0

Porous Car Park Manhole: 62, DS/PN: 6.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	3750.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	127.019	Membrane Depth (mm)	0

Porous Car Park Manhole: 63, DS/PN: 6.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	3750.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	126.255	Membrane Depth (mm)	0

Porous Car Park Manhole: 64, DS/PN: 6.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	90.0
Membrane Percolation (mm/hr)	1000	Length (m)	45.0
Max Percolation (l/s)	1125.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	125.537	Membrane Depth (mm)	0

Porous Car Park Manhole: 67, DS/PN: 6.005

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	90.0
Membrane Percolation (mm/hr)	1000	Length (m)	45.0
Max Percolation (l/s)	1125.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	124.985	Membrane Depth (mm)	0

Porous Car Park Manhole: 68, DS/PN: 6.006

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	3750.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	123.644	Membrane Depth (mm)	0

Porous Car Park Manhole: 69, DS/PN: 6.007

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	3750.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	122.396	Membrane Depth (mm)	0

Porous Car Park Manhole: 70, DS/PN: 6.008

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	150.0
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	1250.0	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	121.478	Membrane Depth (mm)	0

Porous Car Park Manhole: 71, DS/PN: 6.009

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	100.0
Membrane Percolation (mm/hr)	1000	Length (m)	50.0
Max Percolation (l/s)	1388.9	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	0
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	121.068	Membrane Depth (mm)	0

Cellular Storage Manhole: 77, DS/PN: 6.015

Invert Level (m)	114.261	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	4669.0	0.0	1.200	5904.1	0.0

Cellular Storage Manhole: 139, DS/PN: 7.023

Invert Level (m)	99.408	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	**Area (m²)**	**Inf. Area (m²)**	**Depth (m)**	**Area (m²)**	**Inf. Area (m²)**
0.000	1638.0	0.0	1.200	2399.0	0.0

Cellular Storage Manhole: 154, DS/PN: 12.004

Invert Level (m)	113.427	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Cellular Storage Manhole: 154, DS/PN: 12.004

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	67.0	0.0	1.200	278.7	0.0

Cellular Storage Manhole: 162, DS/PN: 13.006

Invert Level (m) 98.449 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	72.4	0.0	0.770	195.1	0.0

Cellular Storage Manhole: 177, DS/PN: 14.007

Invert Level (m) 144.611 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	200.0	0.0	1.200	513.0	0.0

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	8	Number of Storage Structures	28	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	15.200	Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R	0.250	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years)	200
Climate Change (%)	37

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	120 Winter	200	+37%					127.423	-0.382
1.001	2	120 Winter	200	+37%					126.881	-0.322
1.002	3	120 Winter	200	+37%					126.574	-0.229
1.003	4	120 Winter	200	+37%					126.476	-0.224
1.004	5	120 Winter	200	+37%					126.369	-0.210
1.005	6	120 Winter	200	+37%					126.291	-0.212
1.006	7	60 Winter	200	+37%					125.972	-0.143
1.007	8	180 Winter	200	+37%					125.417	-0.178
1.008	9	120 Winter	200	+37%	200/15 Winter				125.264	0.161
1.009	10	120 Winter	200	+37%					124.375	-0.472
1.010	11	120 Winter	200	+37%					124.342	-0.483
1.011	12	120 Winter	200	+37%					124.279	-0.488
1.012	13	60 Winter	200	+37%					124.042	-0.492
1.013	14	60 Winter	200	+37%					123.381	-0.495
1.014	15	60 Winter	200	+37%					121.240	-0.495
1.015	16	60 Winter	200	+37%					119.815	-0.488
1.016	17	60 Winter	200	+37%					119.758	-0.470
1.017	18	60 Winter	200	+37%					119.723	-0.471
1.018	19	60 Winter	200	+37%					119.699	-0.474
1.019	20	60 Winter	200	+37%					119.577	-0.473
1.020	21	60 Winter	200	+37%					119.225	-0.736
1.021	22	60 Winter	200	+37%					119.135	-0.472
1.022	23	60 Winter	200	+37%					119.104	-0.488
1.023	24	60 Winter	200	+37%					118.731	-0.491
1.024	25	60 Winter	200	+37%					118.258	-0.491
1.025	26	60 Winter	200	+37%					117.833	-0.491
1.026	27	60 Winter	200	+37%					117.314	-0.739

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.29		60	154.7	OK	
1.001	2	0.000	0.44		66	220.5	OK	
1.002	3	0.000	0.70			243.1	OK	
1.003	4	0.000	0.72			250.3	OK	
1.004	5	0.000	0.75			258.1	OK	
1.005	6	0.000	0.75			331.4	OK	
1.006	7	0.000	0.94		39	480.8	OK	
1.007	8	0.000	0.74		100	380.0	OK	
1.008	9	0.000	1.49			588.8	SURCHARGED	
1.009	10	0.000	0.01			590.7	OK	
1.010	11	0.000	0.00			602.9	OK	
1.011	12	0.000	0.00			627.1	OK	
1.012	13	0.000	0.00			692.0	OK	
1.013	14	0.000	0.00			768.7	OK	
1.014	15	0.000	0.00			820.0	OK	
1.015	16	0.000	0.00			820.1	OK	
1.016	17	0.000	0.01			837.3	OK	
1.017	18	0.000	0.01			847.2	OK	
1.018	19	0.000	0.00			934.3	OK	
1.019	20	0.000	0.00			989.2	OK	
1.020	21	0.000	0.00			1011.8	OK	
1.021	22	0.000	0.00			1011.8	OK	
1.022	23	0.000	0.00			1101.6	OK	
1.023	24	0.000	0.00			1124.0	OK	
1.024	25	0.000	0.00			1128.2	OK	
1.025	26	0.000	0.00			1142.4	OK	
1.026	27	0.000	0.00			1145.7	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.027	28	1440 Winter	200	+37%					117.231	-0.711
1.028	29	1440 Winter	200	+37%					117.225	-0.658
1.029	30	1440 Winter	200	+37%					117.191	-0.162
1.030	31	1440 Winter	200	+37%	200/15 Summer				117.173	1.127
2.000	32	180 Winter	200	+37%					127.349	-0.420
2.001	33	240 Winter	200	+37%					126.810	-0.385
2.002	34	360 Winter	200	+37%					126.201	-0.362
2.003	35	480 Winter	200	+37%					125.463	-0.356
2.004	36	480 Winter	200	+37%					125.065	-0.295
2.005	37	480 Winter	200	+37%					124.976	-0.295
2.006	38	480 Winter	200	+37%					124.895	-0.291
2.007	39	480 Winter	200	+37%					124.835	-0.277
3.000	40	60 Winter	200	+37%					127.733	-0.452
2.008	41	60 Winter	200	+37%					124.505	-0.454
2.009	42	60 Winter	200	+37%					116.491	-0.431
2.010	43	60 Winter	200	+37%					110.635	-0.407
2.011	44	60 Winter	200	+37%					108.650	-0.393
2.012	45	60 Winter	200	+37%					107.319	-0.284
2.013	46	1440 Winter	200	+37%					106.967	-0.089
2.014	47	1440 Winter	200	+37%	200/720 Winter				106.860	0.144
2.015	48	1440 Winter	200	+37%	200/180 Summer				106.858	0.543
4.000	49	60 Winter	200	+37%					127.476	-0.316
4.001	50	60 Winter	200	+37%					126.251	-0.153
4.002	51	60 Winter	200	+37%					126.136	-0.137
4.003	52	60 Winter	200	+37%					126.019	-0.134
4.004	53	60 Winter	200	+37%					125.925	-0.139
5.000	54	120 Winter	200	+37%					127.621	-0.528
4.005	55	120 Winter	200	+37%					125.207	-0.392
4.006	56	120 Winter	200	+37%					115.277	-0.391
4.007	57	120 Winter	200	+37%					107.230	-0.273
4.008	58	120 Winter	200	+37%					106.330	-0.596
4.009	59	1440 Winter	200	+37%					105.803	-0.533
4.010	60	1440 Winter	200	+37%					105.796	-0.243
4.011	61	480 Summer	200	+37%					105.223	-0.599
6.000	62	120 Winter	200	+37%					127.179	-0.440
6.001	63	240 Winter	200	+37%					126.431	-0.424
6.002	64	360 Winter	200	+37%					125.760	-0.377
6.003	65	360 Winter	200	+37%					125.585	-0.403
6.004	66	360 Winter	200	+37%					125.369	-0.374
6.005	67	60 Winter	200	+37%					125.248	-0.337
6.006	68	180 Winter	200	+37%					123.944	-0.300
6.007	69	240 Winter	200	+37%					122.735	-0.261
6.008	70	360 Winter	200	+37%					121.846	-0.232
6.009	71	360 Winter	200	+37%					121.644	-0.024
6.010	72	480 Winter	200	+37%					120.970	-0.494
6.011	73	480 Winter	200	+37%					120.535	-0.494
6.012	74	480 Winter	200	+37%					120.401	-0.498
6.013	75	960 Winter	200	+37%					116.758	-0.899
6.014	76	1440 Winter	200	+37%					114.998	-0.284
6.015	77	1440 Winter	200	+37%					114.904	-0.257
6.016	78	1440 Winter	200	+37%					114.899	-0.149
7.000	79	60 Winter	200	+37%					126.668	-0.159
7.001	80	60 Winter	200	+37%					125.602	-0.169
7.002	81	60 Winter	200	+37%					124.158	-0.171
7.003	82	60 Winter	200	+37%					122.840	-0.170
7.004	83	60 Winter	200	+37%					121.276	-0.166
7.005	84	60 Winter	200	+37%					119.736	-0.161

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.027	28	0.000	0.00			396.6	OK	
1.028	29	0.000	0.00			396.6	OK	
1.029	30	0.000	0.00			241.3	OK	
1.030	31	0.000	0.00			33.5	SURCHARGED*	
2.000	32	0.000	0.20		99	106.5	OK	
2.001	33	0.000	0.28		158	145.6	OK	
2.002	34	0.000	0.33		212	176.2	OK	
2.003	35	0.000	0.35		276	176.9	OK	
2.004	36	0.000	0.51			178.5	OK	
2.005	37	0.000	0.52			178.8	OK	
2.006	38	0.000	0.53			179.3	OK	
2.007	39	0.000	0.57			184.5	OK	
3.000	40	0.000	0.14		26	140.2	OK	
2.008	41	0.000	0.13			221.7	OK	
2.009	42	0.000	0.18			221.7	OK	
2.010	43	0.000	0.23			221.8	OK	
2.011	44	0.000	0.26			221.7	OK	
2.012	45	0.000	0.55			221.7	OK	
2.013	46	0.000	0.43			200.0	OK	
2.014	47	0.000	0.07			40.0	SURCHARGED	
2.015	48	0.000	0.00			15.4	SURCHARGED	
4.000	49	0.000	0.46		41	306.0	OK	
4.001	50	0.000	0.91			328.9	OK	
4.002	51	0.000	0.95			331.0	OK	
4.003	52	0.000	0.96			333.2	OK	
4.004	53	0.000	0.94			418.5	OK	
5.000	54	0.000	0.04		58	40.7	OK	
4.005	55	0.000	0.26		60	437.6	OK	
4.006	56	0.000	0.27			437.5	OK	
4.007	57	0.000	0.58			437.6	OK	
4.008	58	0.000	0.00			437.6	OK	
4.009	59	0.000	0.00			149.3	OK	
4.010	60	0.000	0.00			13.6	OK	
4.011	61	0.000	0.00			13.5	OK	
6.000	62	0.000	0.16		79	105.1	OK	
6.001	63	0.000	0.19		149	118.9	OK	
6.002	64	0.000	0.30		221	115.1	OK	
6.003	65	0.000	0.24			118.0	OK	
6.004	66	0.000	0.31			121.6	OK	
6.005	67	0.000	0.40		46	260.7	OK	
6.006	68	0.000	0.50		141	325.2	OK	
6.007	69	0.000	0.61		168	390.1	OK	
6.008	70	0.000	0.69		213	407.1	OK	
6.009	71	0.000	1.00		146	347.1	OK	
6.010	72	0.000	0.00			352.4	OK	
6.011	73	0.000	0.00			354.6	OK	
6.012	74	0.000	0.00			365.0	OK	
6.013	75	0.000	0.00			328.1	OK	
6.014	76	0.000	0.00			270.2	OK	
6.015	77	0.000	0.00			54.8	OK	
6.016	78	0.000	0.00			25.8	OK	
7.000	79	0.000	0.19			10.8	OK	
7.001	80	0.000	0.14			15.1	OK	
7.002	81	0.000	0.13			17.1	OK	
7.003	82	0.000	0.14			19.4	OK	
7.004	83	0.000	0.16			21.9	OK	

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.005	84	0.000	0.18			30.0	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
7.006	85	60 Winter	200	+37%					113.262	-0.146
7.007	86	60 Winter	200	+37%					106.647	-0.107
8.000	87	60 Winter	200	+37%					126.066	-0.115
8.001	88	60 Winter	200	+37%					124.389	-0.072
8.002	89	60 Winter	200	+37%	200/30 Winter				123.041	0.249
8.003	90	60 Winter	200	+37%	200/30 Summer				121.957	0.758
8.004	91	60 Winter	200	+37%	200/15 Winter				120.766	1.064
8.005	92	60 Winter	200	+37%	200/15 Summer				120.186	1.415
8.006	93	60 Winter	200	+37%	200/15 Summer				119.511	1.548
8.007	94	60 Winter	200	+37%	200/15 Summer				118.604	0.852
8.008	95	60 Winter	200	+37%	200/15 Summer				117.091	0.935
8.009	96	60 Winter	200	+37%	200/15 Summer				115.876	0.883
8.010	97	60 Winter	200	+37%					113.732	-0.127
8.011	98	60 Winter	200	+37%	200/60 Winter				112.551	0.001
8.012	99	60 Winter	200	+37%	200/30 Summer				112.054	0.254
8.013	100	60 Winter	200	+37%	200/30 Summer				111.590	0.490
8.014	101	60 Winter	200	+37%	200/15 Winter				111.064	1.014
8.015	102	60 Winter	200	+37%	200/15 Summer				110.434	0.934
8.016	103	60 Winter	200	+37%					107.711	-0.239
8.017	104	60 Winter	200	+37%	200/30 Winter				107.293	0.684
8.018	105	60 Winter	200	+37%	200/30 Summer				106.962	1.226
8.019	106	60 Winter	200	+37%	200/30 Summer				106.765	1.382
8.020	107	60 Winter	200	+37%	200/30 Summer				106.606	1.439
8.021	108	60 Winter	200	+37%	200/30 Summer				106.449	1.408
8.022	109	60 Winter	200	+37%	200/30 Summer				106.288	1.384
7.008	110	60 Winter	200	+37%	200/30 Summer				106.125	1.279
9.000	111	60 Winter	200	+37%					115.076	-0.149
9.001	112	60 Winter	200	+37%					114.953	-0.140
9.002	113	60 Winter	200	+37%					114.825	-0.123
9.003	114	60 Winter	200	+37%					114.330	-0.147
9.004	115	60 Winter	200	+37%					112.611	-0.101
9.005	116	60 Winter	200	+37%	200/60 Winter				109.413	0.063
9.006	117	60 Winter	200	+37%	200/60 Winter				108.045	0.410
9.007	118	60 Winter	200	+37%	200/15 Winter				106.203	0.806
7.009	119	60 Winter	200	+37%	200/30 Summer				105.826	1.124
7.010	120	60 Winter	200	+37%	200/15 Winter				105.185	1.126
7.011	121	60 Winter	200	+37%	200/15 Winter				104.814	0.968
7.012	122	60 Winter	200	+37%	200/15 Summer				104.439	0.984
7.013	123	60 Winter	200	+37%	200/15 Summer				104.060	0.859
7.014	124	60 Winter	200	+37%	200/15 Summer				103.676	0.564
7.015	125	60 Winter	200	+37%	200/30 Summer				103.289	0.155
7.016	126	60 Winter	200	+37%					102.427	-0.494
7.017	127	60 Winter	200	+37%					102.150	-0.481
7.018	128	60 Winter	200	+37%					102.127	-0.487
7.019	129	60 Winter	200	+37%					102.095	-0.489
7.020	130	60 Winter	200	+37%					102.056	-0.498
7.021	131	60 Winter	200	+37%					101.296	-0.447
7.022	132	60 Winter	200	+37%					100.914	-0.447
10.000	133	60 Winter	200	+37%					101.572	-0.178
10.001	134	60 Winter	200	+37%					100.885	-0.166
10.002	135	60 Winter	200	+37%					100.205	-0.040
10.003	136	60 Winter	200	+37%	200/60 Winter				100.159	0.030
10.004	137	60 Winter	200	+37%	200/15 Summer				100.073	0.155
10.005	138	1440 Winter	200	+37%	200/1440 Winter				100.067	0.039
7.023	139	1440 Winter	200	+37%	200/360 Winter				100.067	0.134
7.024	140	1440 Winter	200	+37%	200/360 Winter				100.068	0.150
11.000	141	60 Winter	200	+37%					113.593	-0.499

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

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.006	85	0.000	0.27			39.6	OK	
7.007	86	0.000	0.54			47.4	OK	
8.000	87	0.000	0.48			24.7	OK	
8.001	88	0.000	0.80			50.4	OK	
8.002	89	0.000	1.11			64.8	SURCHARGED	
8.003	90	0.000	1.23			71.1	SURCHARGED	
8.004	91	0.000	1.45			73.2	SURCHARGED	
8.005	92	0.000	2.30			77.6	SURCHARGED	
8.006	93	0.000	2.41			82.7	SURCHARGED	
8.007	94	0.000	2.22			88.4	SURCHARGED	
8.008	95	0.000	1.97			95.9	SURCHARGED	
8.009	96	0.000	2.11			101.3	SURCHARGED	
8.010	97	0.000	0.63			107.6	OK	
8.011	98	0.000	1.02			115.7	SURCHARGED	
8.012	99	0.000	1.22			123.8	SURCHARGED	
8.013	100	0.000	1.32			133.8	SURCHARGED	
8.014	101	0.000	1.44			145.5	SURCHARGED	
8.015	102	0.000	1.94			165.5	SURCHARGED	
8.016	103	0.000	0.45			190.9	OK	
8.017	104	0.000	0.62			209.1	SURCHARGED	
8.018	105	0.000	0.75			215.4	SURCHARGED	
8.019	106	0.000	0.84			220.4	SURCHARGED	
8.020	107	0.000	1.12			223.4	SURCHARGED	
8.021	108	0.000	1.09			227.6	SURCHARGED	
8.022	109	0.000	1.36			230.8	SURCHARGED	
7.008	110	0.000	1.18			269.2	SURCHARGED	
9.000	111	0.000	0.25			12.1	OK	
9.001	112	0.000	0.30			13.9	OK	
9.002	113	0.000	0.43			23.5	OK	
9.003	114	0.000	0.26			29.1	OK	
9.004	115	0.000	0.58			48.3	OK	
9.005	116	0.000	1.05			58.9	SURCHARGED	
9.006	117	0.000	0.96			70.6	SURCHARGED	
9.007	118	0.000	1.51			70.8	SURCHARGED	
7.009	119	0.000	1.00			341.9	SURCHARGED	
7.010	120	0.000	1.32			343.3	FLOOD RISK	
7.011	121	0.000	0.98			345.0	FLOOD RISK	
7.012	122	0.000	1.22			347.0	FLOOD RISK	
7.013	123	0.000	2.06			349.0	SURCHARGED	
7.014	124	0.000	2.46			350.8	SURCHARGED	
7.015	125	0.000	1.35			351.9	SURCHARGED	
7.016	126	0.000	0.00			361.2	OK	
7.017	127	0.000	0.00			364.4	OK	
7.018	128	0.000	0.00			366.7	OK	
7.019	129	0.000	0.00			366.7	OK	
7.020	130	0.000	0.00			368.8	OK	
7.021	131	0.000	0.00			368.7	OK	
7.022	132	0.000	0.00			368.8	OK	
10.000	133	0.000	0.10			6.2	OK	
10.001	134	0.000	0.16			13.3	OK	
10.002	135	0.000	0.62			22.5	OK	
10.003	136	0.000	0.72			26.6	FLOOD RISK	
10.004	137	0.000	1.26			35.0	FLOOD RISK	
10.005	138	0.000	0.15			6.6	SURCHARGED	
7.023	139	0.000	0.00			84.4	SURCHARGED	
7.024	140	0.000	0.00			6.3	SURCHARGED	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
11.000	141	0.000	0.00			139.0	OK	

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

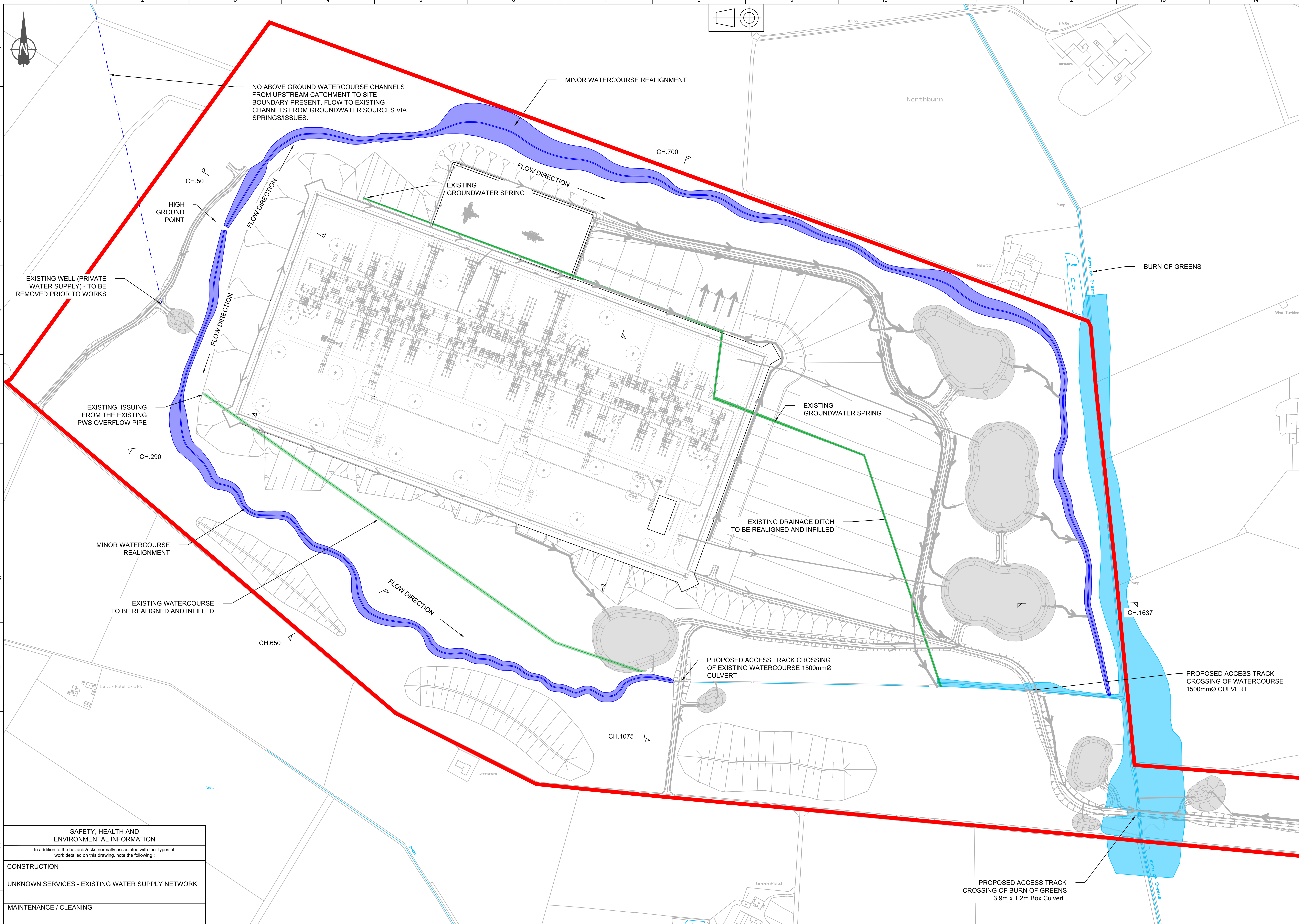
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
11.001	142	60 Winter	200	+37%					112.163	-0.499
11.002	143	60 Winter	200	+37%					111.296	-0.497
11.003	144	60 Winter	200	+37%					110.942	-0.493
11.004	145	60 Winter	200	+37%					108.418	-0.464
11.005	146	60 Winter	200	+37%					108.319	-0.484
11.006	147	60 Winter	200	+37%					107.901	-0.477
11.007	148	60 Winter	200	+37%					107.619	-0.591
11.008	149	60 Winter	200	+37%					106.617	-0.487
12.000	150	60 Winter	200	+37%					118.789	-0.173
12.001	151	60 Winter	200	+37%					117.396	-0.146
12.002	152	60 Winter	200	+37%					116.740	-0.170
12.003	153	1440 Winter	200	+37%	200/30 Summer				114.642	0.767
12.004	154	1440 Winter	200	+37%	200/15 Summer				114.641	0.989
12.005	155	1440 Winter	200	+37%	200/15 Summer				114.644	1.097
13.000	156	1440 Winter	200	+37%					102.475	-0.500
13.001	157	60 Winter	200	+37%					102.244	-0.499
13.002	158	60 Winter	200	+37%					102.168	-0.499
13.003	159	60 Winter	200	+37%					102.051	-0.498
13.004	160	360 Winter	200	+37%					101.894	-0.500
13.005	161	1440 Winter	200	+37%					98.662	-0.200
13.006	162	1440 Winter	200	+37%					98.661	-0.088
13.007	163	1440 Winter	200	+37%					98.661	-0.070
13.008	164	1440 Winter	200	+37%					98.201	-0.499
14.000	165	60 Winter	200	+37%					152.052	-0.173
14.001	166	60 Winter	200	+37%					149.616	-0.145
14.002	167	60 Winter	200	+37%					149.102	-0.115
14.003	168	60 Winter	200	+37%					148.529	-0.096
14.004	169	60 Winter	200	+37%					147.702	-0.111
15.000	170	60 Winter	200	+37%					148.708	-0.158
15.001	171	60 Winter	200	+37%					148.453	-0.144
15.002	172	60 Winter	200	+37%					148.133	-0.126
15.003	173	60 Winter	200	+37%					147.766	-0.098
15.004	174	60 Winter	200	+37%					146.888	-0.073
14.005	175	60 Winter	200	+37%	200/30 Winter				146.637	0.412
14.006	176	1440 Winter	200	+37%	200/15 Summer				146.069	1.148
14.007	177	1440 Winter	200	+37%	200/15 Summer				146.066	1.230
14.008	178	1440 Winter	200	+37%	200/15 Summer				146.075	1.273

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
11.001	142	0.000	0.00			235.2	OK	
11.002	143	0.000	0.00			310.5	OK	
11.003	144	0.000	0.00			823.1	OK	
11.004	145	0.000	0.01			1075.8	OK	
11.005	146	0.000	0.00			1293.6	OK	
11.006	147	0.000	0.01			1530.6	OK	
11.007	148	0.000	0.00			1530.6	OK	
11.008	149	0.000	0.00			1530.6	OK	
12.000	150	0.000	0.12			9.2	OK	
12.001	151	0.000	0.27			15.6	OK	
12.002	152	0.000	0.14			19.9	OK	
12.003	153	0.000	0.06			3.6	SURCHARGED	
12.004	154	0.000	0.02			0.9	SURCHARGED	
12.005	155	0.000	0.01			0.6	SURCHARGED	

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

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
13.000	156	0.000	0.00			3.7	OK	
13.001	157	0.000	0.00			34.1	OK	
13.002	158	0.000	0.00			53.2	OK	
13.003	159	0.000	0.00			73.7	OK	
13.004	160	0.000	0.00			40.6	OK	
13.005	161	0.000	0.00			21.4	OK	
13.006	162	0.000	0.00			15.1	OK	
13.007	163	0.000	0.00			1.4	OK	
13.008	164	0.000	0.00			1.4	OK	
14.000	165	0.000	0.12			11.0	OK	
14.001	166	0.000	0.28			16.9	OK	
14.002	167	0.000	0.48			23.1	OK	
14.003	168	0.000	0.62			35.0	OK	
14.004	169	0.000	0.51			42.9	OK	
15.000	170	0.000	0.20			8.7	OK	
15.001	171	0.000	0.28			13.7	OK	
15.002	172	0.000	0.40			19.9	OK	
15.003	173	0.000	0.61			32.3	OK	
15.004	174	0.000	0.79			39.0	OK	
14.005	175	0.000	0.82			83.0	SURCHARGED	
14.006	176	0.000	0.52			17.1	FLOOD RISK	
14.007	177	0.000	0.09			2.5	FLOOD RISK	
14.008	178	0.000	0.01			1.3	FLOOD RISK	

Appendix 7 Proposed Drainage Drawings



NOTES
1. THE PROPOSALS SHOWN ON THIS DRAWING HAVE BEEN DETERMINED FROM TOPOGRAPHICAL SURVEY INFORMATION PROVIDED BY OTHERS
2. SITE LAYOUT BASED ON DRAWING ND2-SK-001(04)
3. SUBSTATION LAYOUT ESTABLISHED FROM SIEMENS .RVT FILES (Apr & May 2024)
4. DESIGN PROPOSALS SHOWN ARE PRELIMINARY AND SUBJECT TO DETAILED DESIGN
5. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
6. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
7. REFER TO DESIGN DECISION LOG FOR ASSUMPTIONS ASSOCIATED WITH PROPOSED WATERCOURSE REALIGNMENT DESIGN.
8. TIE-IN LOCATIONS TO EXISTING WATERCOURSE TO BE CONFIRMED
9. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS ON SITE AND REPORT ANY DIFFERENCE TO THE DESIGNER
10. ALL LEVELS ARE IN METRES (m) ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE.
11. FOR PROPOSED PERMANENT DRAINAGE LAYOUT REFER TO DRAWING No. GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0171.
12. SERVICES TO BE CONFIRMED TO ALLOW FOR COORDINATION.
13. FINISHED SURFACE OF ACCESS TRACK TO BE CONFIRMED TO FINALISE TRACK DRAINAGE
14. FLOOD EXTENTS BASED ON PRELIMINARY FLOOD RISK ASSESSMENT MODELLING
15. ACCESS PROVISION TO SuDS FEATURES TO BE CONFIRMED
16. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
17. FOR CHANNEL REALIGNMENT SECTIONS REFER TO DRAWINGS GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0159 & GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0160

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

METRES @ 1:2500 — 0 20 50 100 250

PROPOSED WATERCOURSE REALIGNMENT

EXISTING WATERCOURSE TO BE REMOVED

FLOOD EXTENTS (INDICATIVE)

FORESTRY

DRAWING STATUS: S5 ISSUED FINAL REVIEW

REVISION:	P01		PROJECT REF: GRNS4-LT379 — 01 - FIRST ISSUE - 21/08/2024	P02		PROJECT REF: GRNS4-LT379 — ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN	21/08/2024		C.McLAUGHLIN	01/11/2024	
CHECKED:	R.DUNCAN	21/08/2024		R.DUNCAN	01/11/2024	
APPROVED:	R.MINTO	21/08/2024		R.MINTO	01/11/2024	

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Project: GREENS 400kV SUBSTATION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING PROPOSED WATERCOURSE REALIGNMENT LAYOUT

Subcon. Drawing No. FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0170

Contractor Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0170

Customer Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0170

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	1:2500	A1	1 of 1	P02

NOTES
1. THE PROPOSALS SHOWN ON THIS DRAWING HAVE BEEN DETERMINED FROM TOPOGRAPHICAL SURVEY INFORMATION PROVIDED BY OTHERS
2. SITE LAYOUT BASED ON DRAWING ND2-SK-001(04)
3. SUBSTATION LAYOUT ESTABLISHED FROM SIEMENS .RVT FILES (Apr & May 2024)
4. DESIGN PROPOSALS SHOWN ARE PRELIMINARY AND SUBJECT TO DETAILED DESIGN
5. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
6. REFER TO DESIGN DECISION LOG FOR ASSUMPTIONS ASSOCIATED WITH PROPOSED DRAINAGE DESIGN.
7. TIE-IN LOCATIONS OF DRAINAGE OUTFALLS TO EXISTING WATERCOURSE TO BE CONFIRMED.
8. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS ON SITE AND REPORT ANY DIFFERENCE TO THE DESIGNER
9. ALL LEVELS ARE IN METRES (m) ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE.
10. FOR PROPOSED WATERCOURSE REALIGNMENT REFER TO DRAWING No. GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0170.
11. SERVICES TO BE CONFIRMED TO ALLOW FOR COORDINATION.
12. FINISHED SURFACE OF ACCESS TRACK TO BE CONFIRMED TO FINALISE TRACK DRAINAGE
13. FLOOD EXTENTS BASED ON PRELIMINARY FLOOD RISK ASSESSMENT MODELLING.
14. ACCESS PROVISION TO SuDS FEATURES TO BE CONFIRMED
15. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
16. GULLY POSITIONS ON KERBED ROAD SHOWN INDICATIVELY.
17. SWALES SHOWN INDICATIVELY.

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

DRAWING STATUS: S5 ISSUED FINAL REVIEW

REVISION:	P01	PROJECT REF. GRNS4-LT379	01 - FIRST ISSUE - 21/08/2024	P02	PROJECT REF. GRNS4-LT379	ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN 21/08/2024			C.McLAUGHLIN 01/11/2024		
CHECKED:	R.DUNCAN 21/08/2024			R.DUNCAN 01/11/2024		
APPROVED:	R.MINTO 21/08/2024			R.MINTO 01/11/2024		

LEGEND:

- PROPOSED SWALE
- PROPOSED MANHOLE
- PROPOSED HEADWALL
- PROPOSED FILTER DRAIN/ CARRIER DRAIN
- PROPOSED SUDS BASIN
- FLOOD EXTENTS (INDICATIVE)
- PROPOSED GULLY

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Project: GREENS 400kV SUBSTATION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

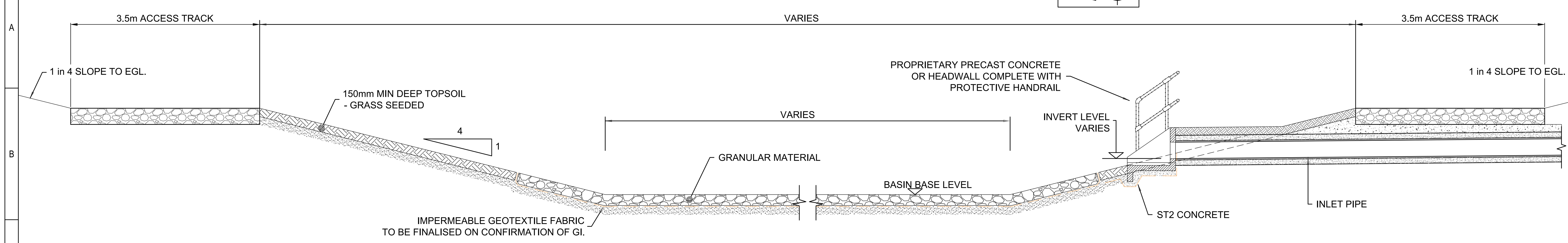
Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING PROPOSED PERMANENT DRAINAGE LAYOUT

Subcon. Drawing No. FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0171

Contractor Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0171

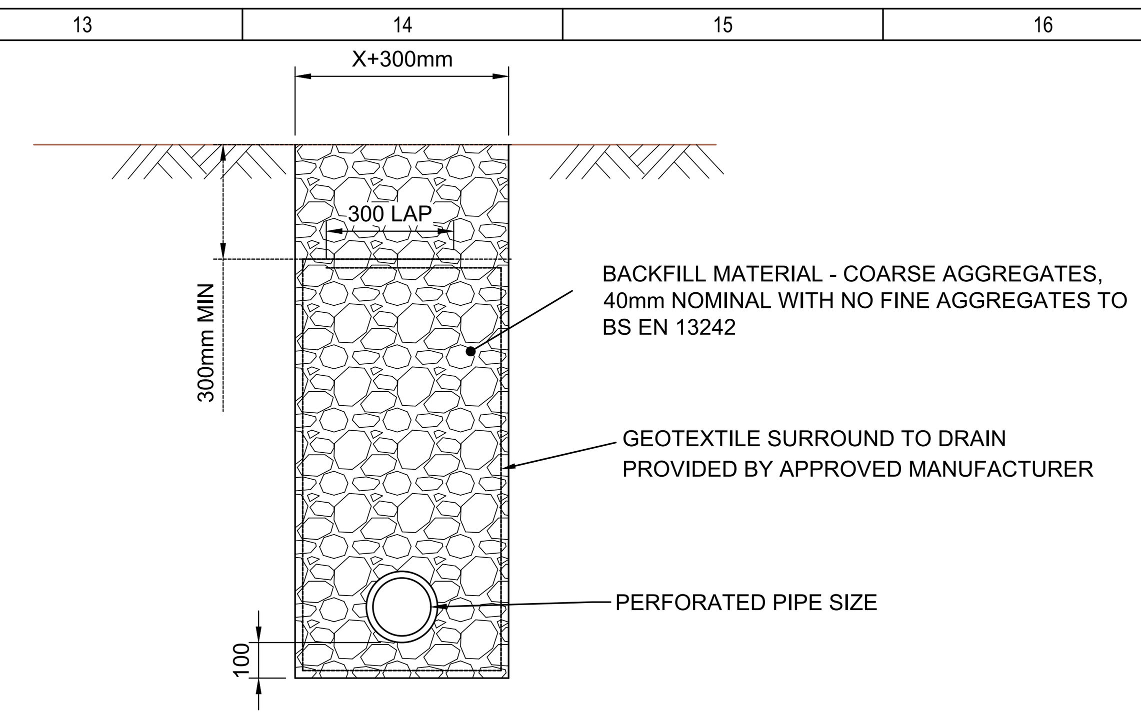
Customer Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0171

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	1:2500	A1	1 of 1	P02



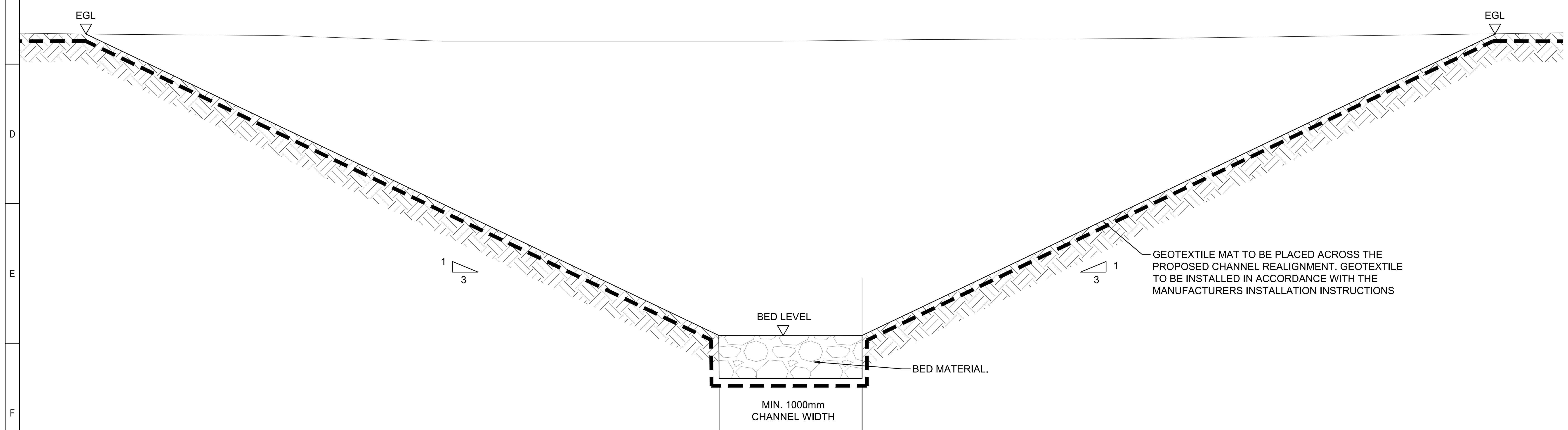
TYPICAL CROSS-SECTION THROUGH SUDS BASIN

SCALE 1:50



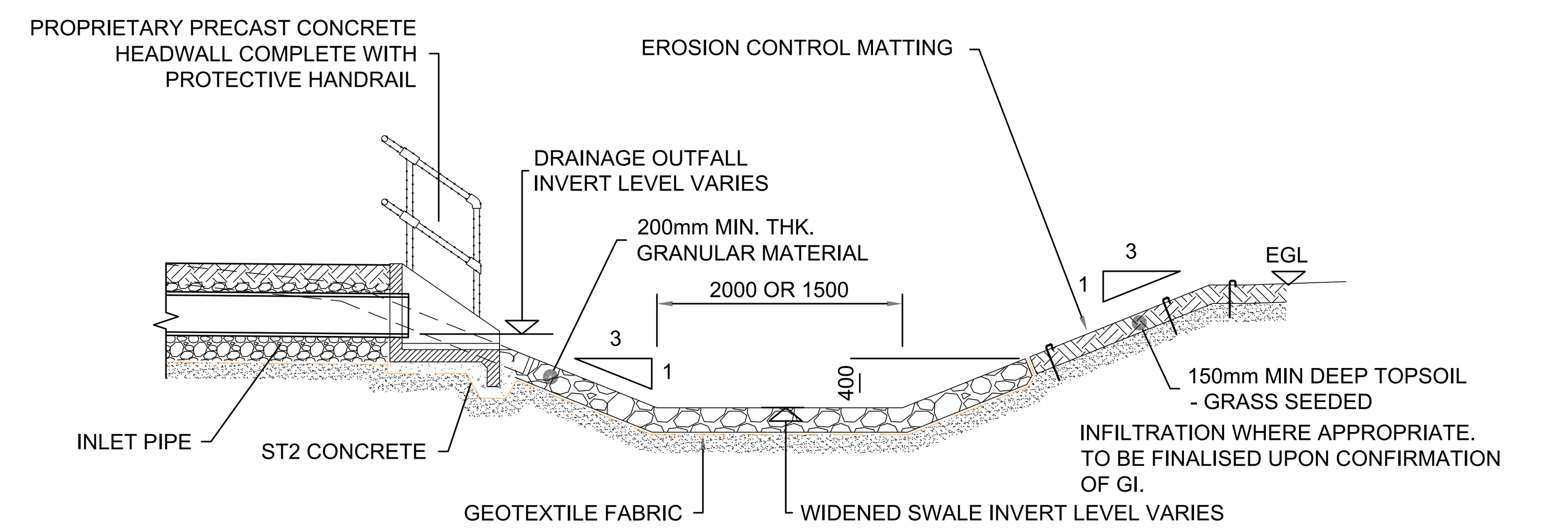
FD - FILTER DRAIN DETAILS

(SCALE 1:20)



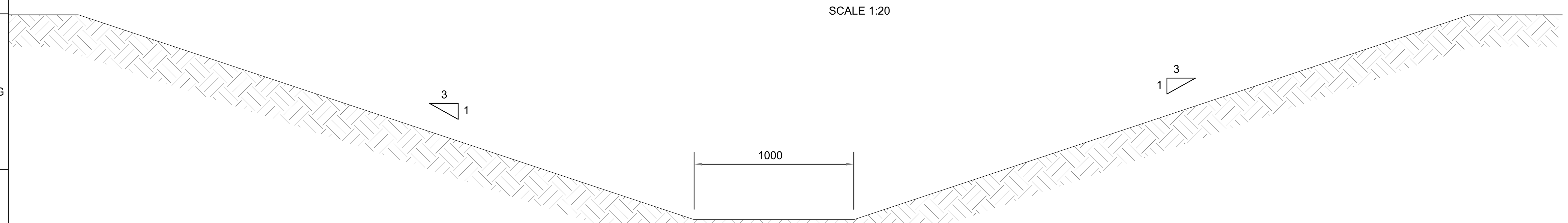
TYPICAL SECTION THROUGH WATERCOURSE REALIGNMENT CHANNEL

SCALE 1:20



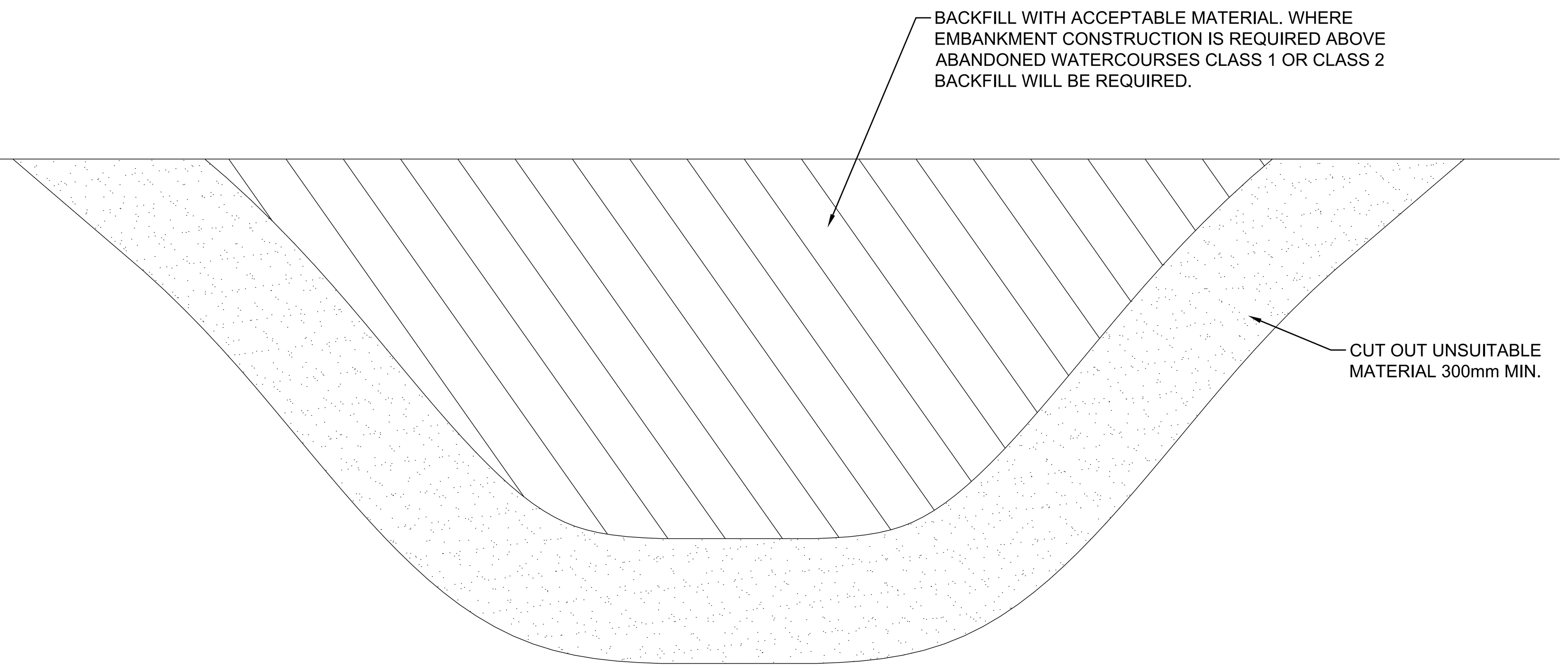
TYPICAL CROSS-SECTION THROUGH SWALE WITH INLET HEADWALL

SCALE 1:50



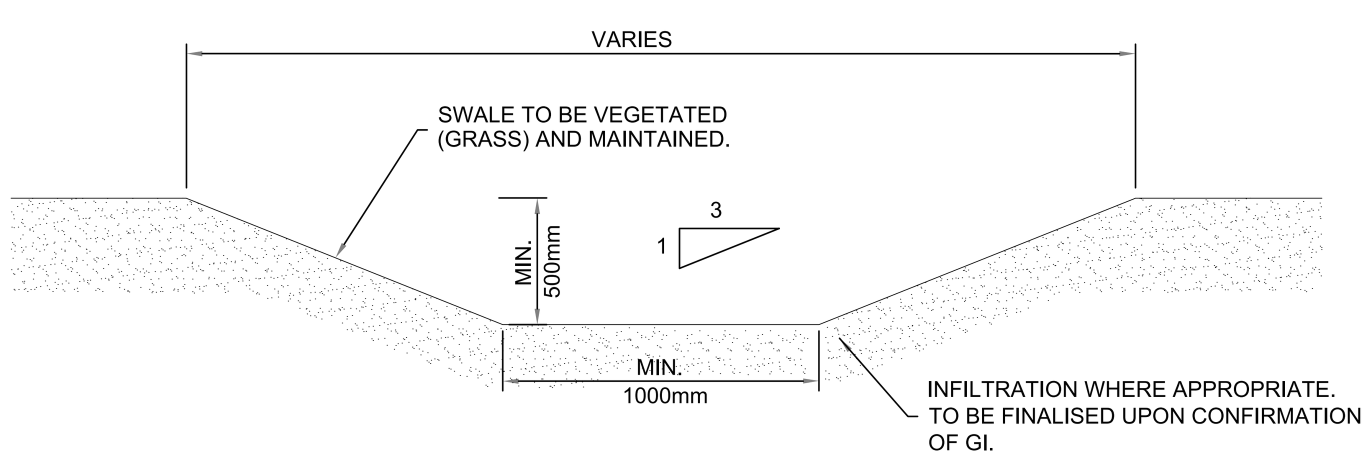
DITCH

SCALE 1:20



TREATMENT OF ABANDONED WATERCOURSES

SCALE 1:20



TYPICAL OPEN SWALE DETAIL

SCALE 1:20

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

METRES @ 1:50 — 0, 0.5, 1, 2, 5

METRES @ 1:20 — 0, 0.2, 0.5, 1, 2

DRAWING STATUS: S5 ISSUED FINAL REVIEW	REVISION:	P01		PROJECT REF. GRNS4-LT379	01 - FIRST ISSUE - 21/08/2024	P02		PROJECT REF. GRNS4-LT379	ISSUED FINAL REVIEW
	DRAWN:	C.McLAUGHLIN	21/08/2024			C.McLAUGHLIN	01/11/2024		
	CHECKED:	R.DUNCAN	21/08/2024			R.DUNCAN	01/11/2024		
	APPROVED:	R.MINTO	21/08/2024			R.MINTO	01/11/2024		

NOTES
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2. SITE LAYOUT BASED ON DRAWING ND2-SK-001(04)
3. SUBSTATION LAYOUT ESTABLISHED FROM SIEMENS .RVT FILES (Apr & May 2024)
4. DESIGN PROPOSALS SHOWN ARE PRELIMINARY AND SUBJECT TO DETAILED DESIGN
5. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
6. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
7. FOR DETAILS RELATING TO THE FLORA AND FAUNA WITHIN THE CHANNEL REALIGNMENTS AND SuDS PLEASE REFER TO LANDSCAPING DETAILS

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

Subcon. Drawing No. FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0172

Project: GREENS 400kV SUBSTATION

Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING TYPICAL DRAINAGE DETAILS

Contractor Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0172

Customer Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0172

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	1:2500	A1	1 of 1	P02

NOTES

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4. DESIGN PROPOSALS SHOWN ARE PRELIMINARY AND SUBJECT TO DETAILED DESIGN
5. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
6. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
7. REFER TO DESIGN DECISION LOG FOR ASSUMPTIONS ASSOCIATED WITH TEMPORARY DRAINAGE DESIGN.
8. TIE-IN LOCATIONS TO EXISTING WATERCOURSE TO BE CONFIRMED
9. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS ON SITE AND REPORT ANY DIFFERENCE TO THE DESIGNER
10. ALL LEVELS ARE IN METRES (m) ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE.
11. FOR PROPOSED WATERCOURSE REALIGNMENT REFER TO DRAWING No. GRNS4-LT379-SEBAM-ZZ-ZZ-D-C-0170.
12. SERVICES TO BE CONFIRMED TO ALLOW FOR COORDINATION.
13. FINISHED SURFACE OF ACCESS TRACK TO BE CONFIRMED TO FINALISE TRACK DRAINAGE
14. FLOOD EXTENTS BASED ON PRELIMINARY FLOOD RISK ASSESSMENT MODELLING
15. ACCESS PROVISION TO SuDS FEATURES TO BE CONFIRMED
16. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
17. TEMPORARY DRAINAGE SETTLEMENT LAGOONS SIZED UP FOR UP TO 1:10 YEAR RETURN PERIOD STORM EVENT IN ACCORDANCE WITH CIRIA GUIDANCE C648/C649.
18. CONTRACTOR PHASE DRAINAGE DISCHARGE CONSENTS BY OTHERS

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

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DRAWING STATUS: S5 ISSUED FINAL REVIEW

REVISION:	P01		PROJECT REF. GRNS4-LT379	01 - FIRST ISSUE - 21/08/2024	P02		PROJECT REF. GRNS4-LT379	ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN	21/08/2024			C.McLAUGHLIN	01/11/2024		
CHECKED:	R.DUNCAN	21/08/2024			R.DUNCAN	01/11/2024		
APPROVED:	R.MINTO	21/08/2024			R.MINTO	01/11/2024		

LEGEND:

- PROPOSED TEMPORARY DRAINAGE DITCH
- PROPOSED MANHOLE
- PROPOSED HEADWALL
- PROPOSED SUDS BASIN
- FLOOD EXTENTS (INDICATIVE)
- TEMPORARY SETTLEMENT LAGOON

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Project: GREENS 400kV SUBSTATION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

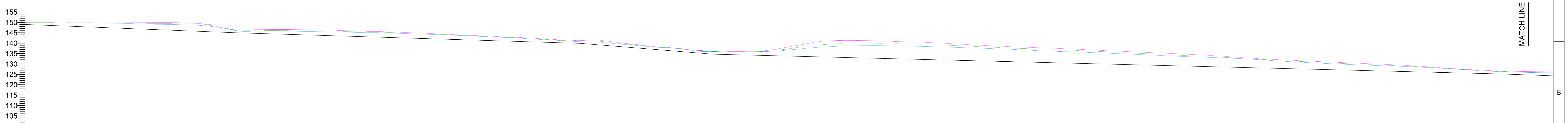
Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING PROPOSED TEMPORARY DRAINAGE LAYOUT

Subcon. Drawing No. FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0173

Contractor Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0173

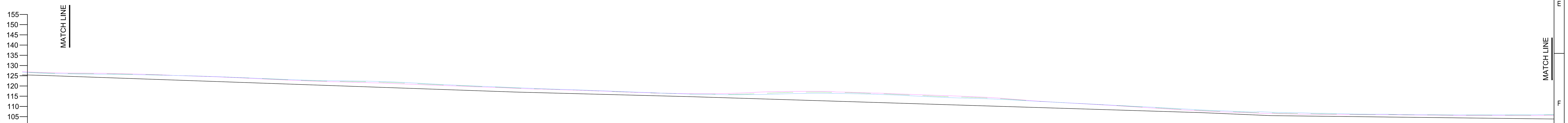
Customer Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0173

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	1:2500	A1	1 of 1	P02



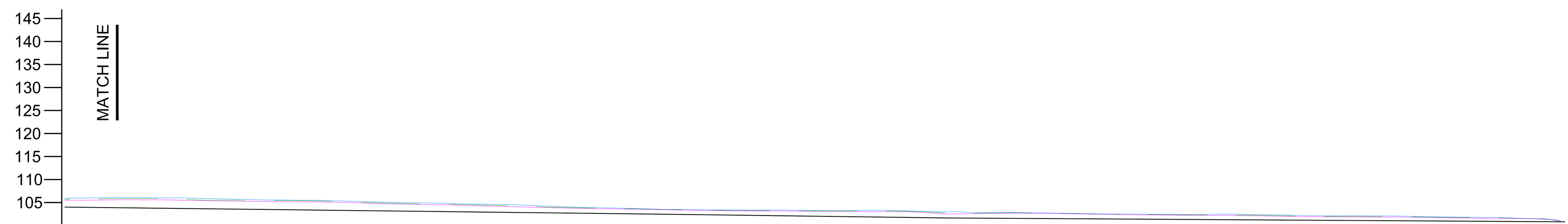
DATUM = 100.00mAOD

Row	Values
Existing Ground Levels (m AOD)	149.991 149.878 149.848 149.834 149.757 149.691 149.567 149.511 149.502 149.373 149.011 146.713 146.039 146.111 146.004 145.864 145.716 145.469 145.321 144.981 144.680 144.253 143.807 143.365 143.115 142.929 142.463 142.012 141.371 140.907 140.537 140.000 139.527 139.023 138.565 138.000 137.207 136.028 135.860 135.918 135.967 136.381 136.808 137.571 138.500 138.897 139.500 139.932 139.955 139.754 139.508 139.268 138.852 138.318 137.889 137.473 137.098 136.887 136.754 136.500 136.013 135.500 134.975 134.494 133.999 133.802 133.532 133.294 133.061 132.757 132.546 131.969 131.432 130.935 130.465 130.000 129.628 129.219 128.767 128.199 127.564 126.949 126.360 126.170 126.042 126.000
Proposed Left Bank Levels (m AOD)	150.188 150.154 150.151 150.135 150.033 149.985 149.916 149.579 148.257 146.477 146.529 146.594 146.522 146.315 146.075 145.738 145.503 145.118 144.711 144.236 143.754 143.305 142.877 142.352 141.722 141.256 141.505 140.298 139.196 138.193 137.289 136.441 136.081 136.027 136.443 137.994 139.753 141.110 141.323 141.212 140.897 140.594 140.210 139.689 139.120 138.628 138.173 137.815 137.434 136.979 136.498 136.048 135.625 135.170 134.702 134.175 133.557 132.832 132.279 131.786 131.314 130.864 130.413 130.010 129.544 128.989 128.291 127.545 126.987 126.588 126.361 126.282
Proposed Right Bank Levels (m AOD)	149.799 149.692 149.635 149.598 149.437 149.120 148.985 148.701 147.908 146.156 145.805 145.762 145.695 145.513 145.326 145.097 144.969 144.608 144.261 143.892 143.441 143.008 142.576 141.975 141.361 140.792 140.640 139.632 138.793 137.936 137.340 136.013 135.759 135.754 135.978 136.606 137.594 138.262 138.663 138.819 138.739 138.522 138.289 137.976 137.648 137.294 136.882 136.388 136.005 135.695 135.305 134.869 134.445 133.984 133.557 133.201 132.821 132.350 131.710 131.105 130.576 130.080 129.651 129.276 128.926 128.524 128.003 127.343 126.709 126.242 125.954 125.820
Proposed Bed Levels (m AOD)	148.999 148.607 148.215 147.823 147.431 147.039 146.647 146.255 145.863 145.471 145.024 144.759 144.451 144.144 143.836 143.528 143.220 142.913 142.605 142.297 141.989 141.682 141.374 141.066 140.758 140.451 140.143 139.907 138.903 138.089 137.274 136.459 135.644 134.700 134.489 134.239 133.988 133.737 133.487 133.236 132.985 132.734 132.484 132.233 131.982 131.732 131.481 131.230 130.979 130.729 130.478 130.227 129.977 129.726 129.475 129.224 128.974 128.723 128.472 128.222 127.971 127.720 127.469 127.219 126.968 126.717 126.467 126.216 125.965 125.714 125.464 125.195 124.869 124.518
Proposed Bed Gradient	-1:26 -1:32 -1:12 -1:40
Chainage (m)	0+000 0+010 0+020 0+030 0+040 0+050 0+060 0+070 0+080 0+090 0+100 0+110 0+120 0+130 0+140 0+150 0+160 0+170 0+180 0+190 0+200 0+210 0+220 0+230 0+240 0+250 0+260 0+270 0+280 0+290 0+300 0+310 0+320 0+330 0+340 0+350 0+360 0+370 0+380 0+390 0+400 0+410 0+420 0+430 0+440 0+450 0+460 0+470 0+480 0+490 0+500 0+510 0+520 0+530 0+540 0+550 0+560 0+570 0+580 0+590 0+600 0+610 0+620 0+630 0+640 0+650 0+660 0+670 0+680 0+690 0+700 0+710 0+720 0+730



DATUM = 100.00mAOD

Row	Values
Existing Ground Levels (m AOD)	126.360 126.170 126.042 126.000 125.967 125.909 125.840 125.626 125.367 125.067 124.783 124.449 124.006 123.807 123.542 123.089 122.783 122.430 122.199 122.068 121.755 121.344 120.862 120.387 119.987 119.590 119.355 119.155 118.894 118.743 118.497 118.381 118.182 118.027 117.682 117.296 117.099 116.935 116.726 116.563 116.434 116.312 116.101 116.018 116.000 115.870 116.178 116.600 116.904 117.000 117.004 116.979 116.864 116.750 116.638 116.413 116.000 115.500 114.975 114.655 114.339 113.834 113.177 112.780 112.517 112.015 111.421 110.878 110.629 110.318 110.000 109.721 109.408 109.149 108.699 108.086 107.555 107.178 106.901 106.621 106.444 106.360 106.295 106.245 106.147 106.078 106.060 106.000 106.003 105.912 105.853 105.747 105.718 105.715 105.708 105.685 105.842
Proposed Left Bank Levels (m AOD)	126.588 126.361 126.282 126.182 125.950 125.670 125.276 124.896 124.571 124.168 123.699 123.226 122.746 122.331 122.050 121.760 121.503 121.075 120.711 120.292 119.917 119.519 119.167 118.734 118.483 118.141 117.810 117.457 117.048 116.712 116.483 116.271 116.224 116.380 116.752 117.179 117.337 117.393 117.320 116.898 116.514 116.195 115.818 115.457 115.100 114.687 114.111 113.314 112.566 111.934 111.378 110.790 110.187 109.542 108.909 108.268 107.745 107.274 106.952 106.575 106.387 106.199 106.048 105.985 105.947 105.926 105.831 105.772 105.641 105.602 105.569 105.516 105.500
Proposed Right Bank Levels (m AOD)	126.242 125.954 125.820 125.738 125.605 125.422 125.223 124.949 124.654 124.279 123.881 123.473 123.048 122.736 122.554 122.434 122.244 121.866 121.345 120.782 120.318 119.884 119.516 119.077 118.717 118.351 117.988 117.604 117.257 116.846 116.437 116.035 115.995 115.712 115.800 115.946 116.234 116.406 116.365 116.222 115.965 115.590 115.086 114.598 114.205 113.907 113.521 112.980 112.450 111.943 111.438 110.898 110.373 109.883 109.378 108.800 108.235 107.803 107.404 107.278 107.008 106.793 106.619 106.387 106.196 106.160 105.973 105.924 105.868 105.880 105.856 105.951 105.982
Proposed Bed Levels (m AOD)	125.195 124.869 124.518 124.166 123.815 123.463 123.112 122.760 122.409 122.057 121.706 121.354 121.003 120.651 120.300 119.948 119.597 119.245 118.894 118.543 118.191 117.840 117.488 117.137 117.033 116.847 116.584 116.321 116.058 115.794 115.531 115.268 115.005 114.737 114.430 114.118 113.806 113.494 113.182 112.870 112.558 112.246 111.934 111.623 111.311 110.999 110.687 110.375 110.063 109.751 109.439 109.127 108.815 108.503 108.191 107.879 107.567 107.255 106.960 106.507 106.077 105.647 105.421 105.303 105.185 105.067 104.948 104.830 104.712 104.594 104.475 104.357 104.239 104.121 104.002 103.884
Proposed Bed Gradient	-1:28 -1:38 -1:32 -1:23 -1:85
Chainage (m)	0+710 0+720 0+730 0+740 0+750 0+760 0+770 0+780 0+790 0+800 0+810 0+820 0+830 0+840 0+850 0+860 0+870 0+880 0+890 0+900 0+910 0+920 0+930 0+940 0+950 0+960 0+970 0+980 0+990 1+000 1+010 1+020 1+030 1+040 1+050 1+060 1+070 1+080 1+090 1+100 1+110 1+120 1+130 1+140 1+150 1+160 1+170 1+180 1+190 1+200 1+210 1+220 1+230 1+240 1+250 1+260 1+270 1+280 1+290 1+300 1+310 1+320 1+330 1+340 1+350 1+360 1+370 1+380 1+390 1+400 1+410 1+420 1+430 1+440 1+450



DATUM = 100.00mAOD

Row	Values
Existing Ground Levels (m AOD)	105.842 105.861 105.522 105.481 105.405 105.361 105.174 104.992 104.878 104.752 104.702 104.500 104.185 103.888 103.709 103.487 103.393 103.341 103.274 103.240 103.152 103.151 103.125 102.832 102.703 102.761 102.724 102.656 102.585 102.500 102.432 102.354 102.302 102.237 102.043 101.975 101.938 101.779 101.653 101.500
Proposed Left Bank Levels (m AOD)	105.500 105.592 105.529 105.318 105.230 105.130 104.883 104.615 104.445 104.137 103.894 103.679 103.526 103.353 103.214 103.158 103.038 103.021 102.857 102.553 102.668 102.569 102.434 102.295 102.217 102.133 101.976 101.878 101.840 101.739 101.610 101.500
Proposed Right Bank Levels (m AOD)	105.982 106.100 106.007 105.754 105.555 105.479 105.192 104.947 104.753 104.556 104.216 103.903 103.678 103.478 103.378 103.377 103.304 103.315 103.118 102.903 102.849 102.683 102.508 102.451 102.418 102.418 102.228 102.115 102.106 101.926 101.790 101.573
Proposed Bed Levels (m AOD)	103.884 103.766 103.648 103.529 103.411 103.293 103.175 103.056 102.938 102.820 102.702 102.583 102.435 102.336 102.203 102.070 101.937 101.804 101.646 101.596 101.533 101.471 101.409 101.346 101.284 101.222 101.160 101.097 101.035 100.973 100.910 100.848 100.809
Proposed Bed Gradient	-1:85 -1:75 -1:161
Chainage (m)	1+450 1+460 1+470 1+480 1+490 1+500 1+510 1+520 1+530 1+540 1+550 1+560 1+570 1+580 1+590 1+600 1+610 1+620 1+630 1+640 1+650 1+660 1+670 1+680 1+690 1+700 1+710 1+720 1+730 1+740 1+750 1+760 1+766.289

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

METRES @ 1:1000 — 0 10 20 50 100

NOTES
1. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
2. REFER TO DESIGN DECISION LOG FOR ASSUMPTIONS ASSOCIATED WITH TEMPORARY DRAINAGE DESIGN.
3. TIE-IN LOCATIONS TO EXISTING WATERCOURSE TO BE CONFIRMED
4. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS ON SITE AND REPORT ANY DIFFERENCE TO THE DESIGNER
5. ALL LEVELS ARE IN METRES (m) ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE.

LEGEND:
- WATERCOURSE BASELINE
- EXISTING GROUND
- LEFT BANK PROFILE
- RIGHT BANK PROFILE

DRAWING STATUS: S5 ISSUED FINAL REVIEW

REVISION:	P01	PROJECT REF. GRNS4-LT379	01 - FIRST ISSUE - 21/08/2024	P02	PROJECT REF. GRNS4-LT379	ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN 21/08/2024			C.McLAUGHLIN 01/11/2024		
CHECKED:	R.DUNCAN 21/08/2024			R.DUNCAN 01/11/2024		
APPROVED:	R.MINTO 21/08/2024			R.MINTO 01/11/2024		

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

Subcon. Drawing No. FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0157

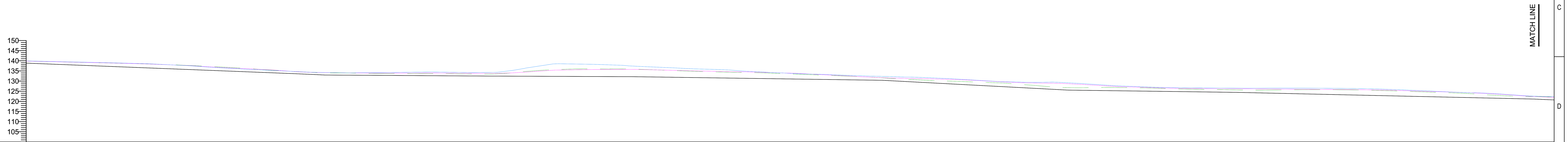
Project: GREENS 400kV SUBSTATION

Title: LT379 - GREENS 400kV SUBSTATION PROPOSED WATERCOURSE LONG SECTION - NORTH

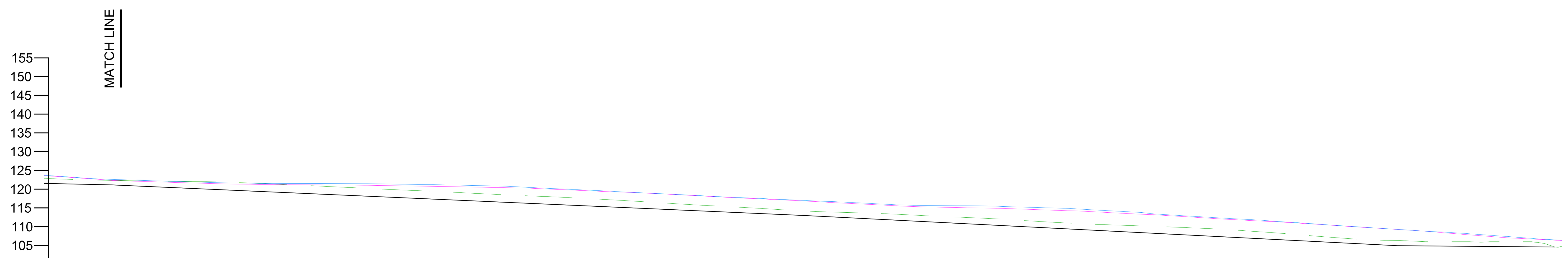
Contractor Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0157

Customer Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0157

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	28/06/2024	1:1000	A1	1 of 1	P02



Row	Values
Existing Ground Levels (m AOD)	149.650, 149.502, 149.402, 149.196, 148.950, 148.813, 148.682, 148.552, 148.420, 148.144, 147.702, 147.500, 147.236, 146.950, 146.727, 146.143, 145.451, 144.834, 144.309, 144.001, 144.004, 143.958, 143.886, 143.773, 143.720, 143.713, 143.666, 143.682, 143.690, 143.599, 143.500, 143.472, 144.056, 144.991, 145.605, 145.955, 145.976, 145.966, 146.014, 146.009, 145.914, 145.751, 145.543, 145.373, 145.168, 144.976, 144.818, 144.516, 144.316, 144.148, 143.801, 143.411, 143.034, 142.647, 142.250, 141.746, 141.118, 140.889, 140.594, 140.371, 140.185, 140.000, 139.847, 139.484, 139.084, 138.450, 137.662, 136.903, 136.672, 136.839, 136.832, 136.664, 136.412, 136.113, 136.055, 135.943, 135.863, 135.784, 135.657, 135.539, 135.629, 135.757, 135.777, 135.712, 135.587, 135.312, 134.998, 134.656, 134.305, 133.931, 133.295, 132.580, 132.410, 132.338, 132.250, 132.185
Proposed Left Bank Levels (m AOD)	149.650, 149.402, 149.165, 148.950, 148.682, 148.420, 148.115, 147.702, 147.236, 146.727, 146.143, 145.451, 144.834, 144.309, 144.001, 143.958, 143.773, 143.713, 143.682, 143.690, 143.599, 143.500, 143.472, 144.657, 144.991, 145.605, 145.955, 145.976, 146.014, 146.005, 145.543, 145.168, 144.818, 144.516, 144.316, 144.148, 143.801, 143.633, 143.411, 143.034, 142.647, 142.250, 141.746, 141.118, 140.388, 140.185, 139.948, 139.499, 139.084, 138.450, 137.334, 136.903, 136.756, 136.839, 136.887, 136.664, 136.164, 135.943, 135.784, 135.539, 135.629, 135.757, 135.776, 135.712, 135.660, 135.443, 134.998, 134.656, 134.305, 133.931, 133.295, 132.410, 132.250
Proposed Right Bank Levels (m AOD)	149.700, 149.479, 149.266, 149.052, 148.799, 148.546, 148.068, 147.590, 146.913, 146.309, 145.795, 145.305, 144.845, 144.373, 144.187, 144.001, 144.167, 144.229, 144.361, 144.493, 144.346, 144.243, 144.293, 146.216, 146.927, 148.445, 148.422, 148.260, 147.914, 147.760, 146.922, 146.494, 145.996, 145.741, 145.225, 144.653, 144.126, 143.968, 143.679, 143.398, 143.045, 142.642, 142.371, 142.113, 141.702, 141.451, 141.135, 140.349, 139.749, 139.505, 139.433, 139.372, 139.167, 138.184, 137.700, 137.230, 136.723, 136.652, 136.551, 136.502, 136.531, 136.517, 136.483, 136.378, 136.320, 136.151, 135.649, 135.230, 134.744, 134.357, 134.052, 132.752, 132.407
Proposed Bed Levels (m AOD)	148.850, 148.457, 148.063, 147.670, 147.277, 146.883, 146.490, 146.097, 145.704, 145.310, 144.917, 144.524, 144.130, 143.737, 143.564, 143.312, 142.967, 142.889, 142.826, 142.764, 142.701, 142.638, 142.575, 142.512, 142.449, 142.405, 142.363, 142.321, 142.278, 142.236, 142.194, 142.153, 142.005, 141.861, 141.717, 141.573, 141.429, 141.285, 141.141, 140.997, 140.853, 140.709, 140.564, 140.382, 139.994, 139.466, 138.937, 138.408, 137.880, 137.351, 136.822, 136.293, 135.765, 135.542, 135.465, 135.331, 135.198, 135.064, 134.930, 134.797, 134.663, 134.530, 134.434, 134.145, 133.921, 133.696, 133.472, 133.247, 133.023, 132.798, 132.574, 132.349, 132.125, 131.900, 131.675, 131.226, 131.132, 130.876
Proposed Bed Gradient	-1:25, -1:22, -1:159, -1:237, -1:69, -1:19, -1:75, -1:45
Chainage (m)	0+000, 0+010, 0+020, 0+030, 0+040, 0+050, 0+060, 0+070, 0+080, 0+090, 0+100, 0+110, 0+120, 0+130, 0+140, 0+150, 0+160, 0+170, 0+180, 0+190, 0+200, 0+210, 0+220, 0+230, 0+240, 0+250, 0+260, 0+270, 0+280, 0+290, 0+300, 0+310, 0+320, 0+330, 0+340, 0+350, 0+360, 0+370, 0+380, 0+390, 0+400, 0+410, 0+420, 0+430, 0+440, 0+450, 0+460, 0+470, 0+480, 0+490, 0+500, 0+510, 0+520, 0+530, 0+540, 0+550, 0+560, 0+570, 0+580, 0+590, 0+600, 0+610, 0+620, 0+630, 0+640, 0+650, 0+660, 0+670, 0+680, 0+690, 0+700, 0+710, 0+720, 0+730, 0+740, 0+750



DATUM = 100.00mAOD

Row	Values
Existing Ground Levels (m AOD)	132.580, 132.410, 132.338, 132.250, 132.185, 132.077, 132.051, 131.969, 131.861, 131.678, 131.463, 131.248, 131.023, 130.796, 130.500, 130.314, 130.000, 129.413, 128.925, 128.460, 128.032, 127.551, 127.000, 126.412, 125.798, 125.602, 125.281, 125.064, 124.697, 124.440, 124.127, 123.955, 123.783, 123.661, 123.473, 123.221, 122.988, 122.708, 122.543, 122.162, 121.521, 120.937, 120.515, 120.173, 119.781, 119.324, 118.610, 117.846, 117.133, 116.464, 116.208, 116.000, 115.873, 116.000, 114.506
Proposed Left Bank Levels (m AOD)	132.410, 132.250, 132.077, 131.969, 131.445, 131.248, 130.796, 130.314, 129.413, 128.492, 128.032, 127.551, 127.163, 126.412, 125.281, 124.697, 124.127, 123.783, 123.473, 122.988, 122.543, 122.313, 121.485, 120.950, 120.509, 120.202, 119.782, 119.324, 118.566, 117.557, 117.133, 116.538, 116.208, 116.000, 116.000, 115.873, 116.000, 114.749
Proposed Right Bank Levels (m AOD)	132.752, 132.407, 132.086, 131.792, 131.507, 131.498, 131.512, 131.469, 131.184, 130.780, 130.238, 129.785, 129.456, 128.818, 127.832, 127.398, 126.936, 126.514, 126.009, 125.636, 125.575, 125.543, 125.137, 124.864, 124.265, 123.773, 122.922, 122.317, 121.684, 120.807, 120.397, 119.872, 119.094, 118.538, 118.246, 117.852, 117.410, 116.404
Proposed Bed Levels (m AOD)	131.226, 131.132, 130.876, 130.434, 129.993, 129.551, 129.110, 128.668, 128.227, 127.785, 127.344, 126.902, 126.461, 126.019, 125.578, 125.136, 124.695, 124.253, 123.812, 123.370, 122.924, 122.416, 121.907, 121.399, 120.890, 120.382, 119.874, 119.365, 118.857, 118.348, 117.840, 117.332, 116.823, 116.315, 115.807, 115.298, 114.930, 114.821, 114.736, 114.651, 114.573
Proposed Bed Gradient	-1:23, -1:20, -1:117
Chainage (m)	0+730, 0+740, 0+750, 0+760, 0+770, 0+780, 0+790, 0+800, 0+810, 0+820, 0+830, 0+840, 0+850, 0+860, 0+870, 0+880, 0+890, 0+900, 0+910, 0+920, 0+930, 0+940, 0+950, 0+960, 0+970, 0+980, 0+990, 1+000, 1+010, 1+020, 1+030, 1+040, 1+050, 1+060, 1+070, 1+080, 1+090, 1+100, 1+110, 1+120, 1+130

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

METRES @ 1:1000 — 0, 10, 20, 50, 100

DRAWING STATUS: S5 ISSUED FINAL REVIEW				
REVISION:	P01	PROJECT REF. GRNS4-LT379 — 01 - FIRST ISSUE - 21/08/2024	P02	PROJECT REF. GRNS4-LT379 — ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN 21/08/2024		C.McLAUGHLIN 01/11/2024	
CHECKED:	R.DUNCAN 21/08/2024		R.DUNCAN 01/11/2024	
APPROVED:	R.MINTO 21/08/2024		R.MINTO 01/11/2024	

NOTES

1. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
2. REFER TO DESIGN DECISION LOG FOR ASSUMPTIONS ASSOCIATED WITH TEMPORARY DRAINAGE DESIGN.
3. TIE-IN LOCATIONS TO EXISTING WATERCOURSE TO BE CONFIRMED
4. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS ON SITE AND REPORT ANY DIFFERENCE TO THE DESIGNER
5. ALL LEVELS ARE IN METRES (m) ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE.

LEGEND:

- WATERCOURSE BASELINE
- EXISTING GROUND
- LEFT BANK PROFILE
- RIGHT BANK PROFILE

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

Subcon. Drawing No.: FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0158

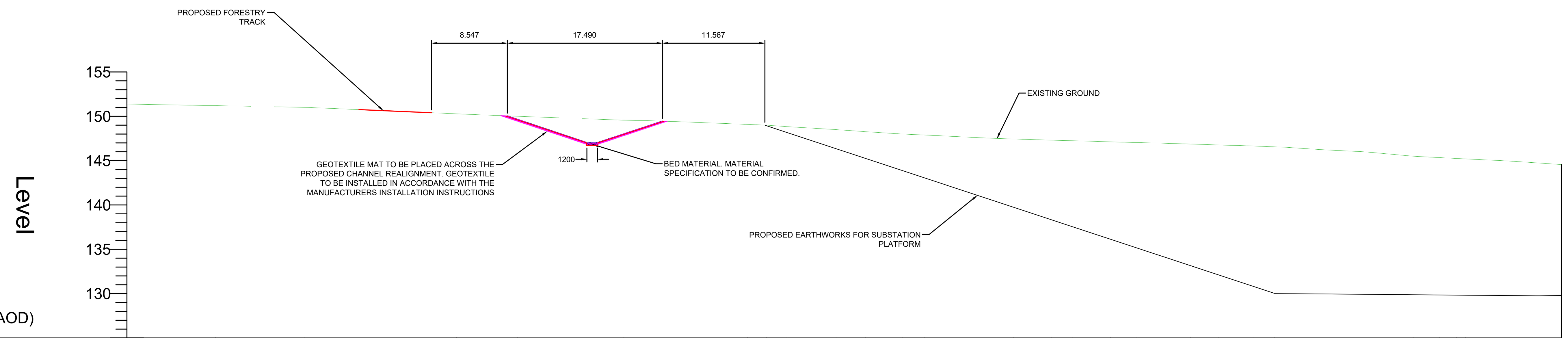
Project: GREENS 400kV SUBSTATION

Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING PROPOSED WATERCOURSE LONG SECTION - SOUTH

Contractor Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0158

Customer Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0158

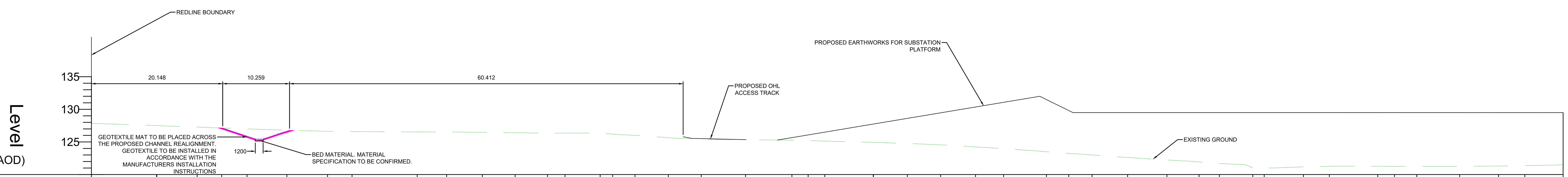
Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	AS SHOWN	A1	1 of 1	P02



Datum level: 125.000 (m AOD)

Existing Ground Levels (m AOD)	151.378, 151.201, 151.008, 150.282, 150.000, 149.560, 149.085, 149.000, 148.837, 148.500, 148.265, 148.000, 147.887, 147.500, 147.442, 147.307, 147.248, 147.122, 147.042, 146.869, 146.771, 146.649, 146.559, 145.500, 145.343, 145.194, 145.005, 144.779, 144.556
Proposed Bed Levels (m AOD)	151.378, 149.393
Chainage	0+000, 0+010, 0+020, 0+030, 0+040, 0+050, 0+060, 0+070, 0+080, 0+090, 0+100, 0+110, 0+120, 0+130, 0+140, 0+150, 0+160, 0+161.839

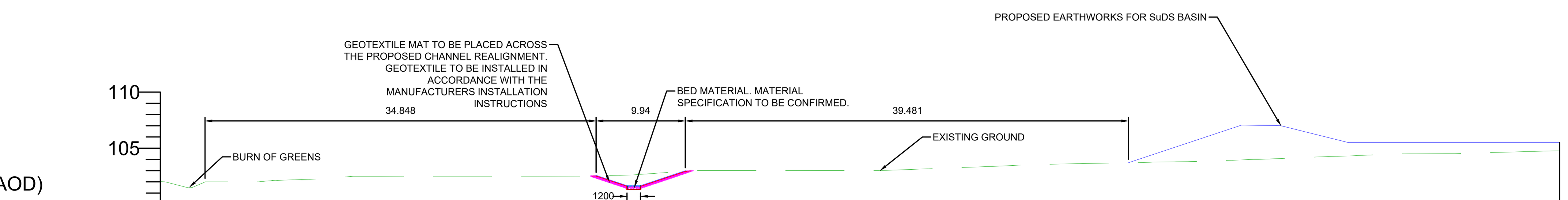
NORTH WATERCOURSE CROSS SECTION CH50 - CROSS SECTION
SCALE: 1:500



Datum level: 120.000 (m AOD)

Existing Ground Levels (m AOD)	127.500, 127.271, 127.135, 127.000, 126.792, 126.638, 126.597, 126.539, 126.516, 126.466, 126.408, 126.360, 126.349, 126.304, 126.195, 126.000, 125.650, 125.440, 125.348, 125.259, 125.195, 125.128, 124.930, 124.752, 124.547, 124.238, 123.976, 123.500, 123.255, 123.000, 122.611, 122.235, 121.937, 121.701, 121.020, 121.000, 121.184, 121.252, 121.266, 121.247, 121.237, 121.252, 121.306, 121.376
Proposed Bed Levels (m AOD)	127.130, 125.460, 126.645
Chainage	0+000, 0+010, 0+020, 0+030, 0+040, 0+050, 0+060, 0+070, 0+080, 0+090, 0+100, 0+110, 0+120, 0+130, 0+140, 0+150, 0+160, 0+170, 0+180, 0+190, 0+200, 0+210, 0+220, 0+225.879

NORTH REALIGNMENT CH700 - CROSS SECTION
SCALE: 1:500



Datum level: 100.000 (m AOD)

Existing Ground Levels (m AOD)	102.000, 102.123, 102.499, 102.500, 102.504, 102.505, 102.588, 102.616, 103.000, 103.001, 103.002, 103.002, 103.003, 103.223, 103.405, 103.594, 103.748, 103.844, 104.091, 104.182, 104.500, 104.512, 104.646, 104.763
Proposed Bed Levels (m AOD)	102.153, 102.435
Chainage	0+000, 0+010, 0+020, 0+030, 0+040, 0+050, 0+060, 0+070, 0+080, 0+090, 0+100, 0+110, 0+120, 0+124.687

NORTH REALIGNMENT CH1637 - CROSS SECTION
SCALE: 1:500

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

METRES @ 1:250 — 0, 2, 5, 10, 25

METRES @ 1:500 — 0, 5, 10, 20, 50

NOTES
1. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
2. REFER TO DESIGN DECISION LOG FOR ASSUMPTIONS ASSOCIATED WITH TEMPORARY DRAINAGE DESIGN.
3. TIE-IN LOCATIONS TO EXISTING WATERCOURSE TO BE CONFIRMED
4. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS ON SITE AND REPORT ANY DIFFERENCE TO THE DESIGNER
5. ALL LEVELS ARE IN METRES (m) ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE.

LEGEND:
EXISTING GROUND

DRAWING STATUS: S5 ISSUED FINAL REVIEW

REVISION:	P01		PROJECT REF: GRNS4-LT379 — 01 - FIRST ISSUE - 21/08/2024	P02		PROJECT REF: GRNS4-LT379 — ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN	21/08/2024		C.McLAUGHLIN	01/11/2024	
CHECKED:	R.DUNCAN	21/08/2024		R.DUNCAN	01/11/2024	
APPROVED:	R.MINTO	21/08/2024		R.MINTO	01/11/2024	

Customer: Scottish & Southern Electricity Networks — TRANSMISSION

Contractor: SIEMENS energy + bam — Joint Venture Substation Delivery Framework

Subcon. Drawing No. FAIRHURST — GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0159

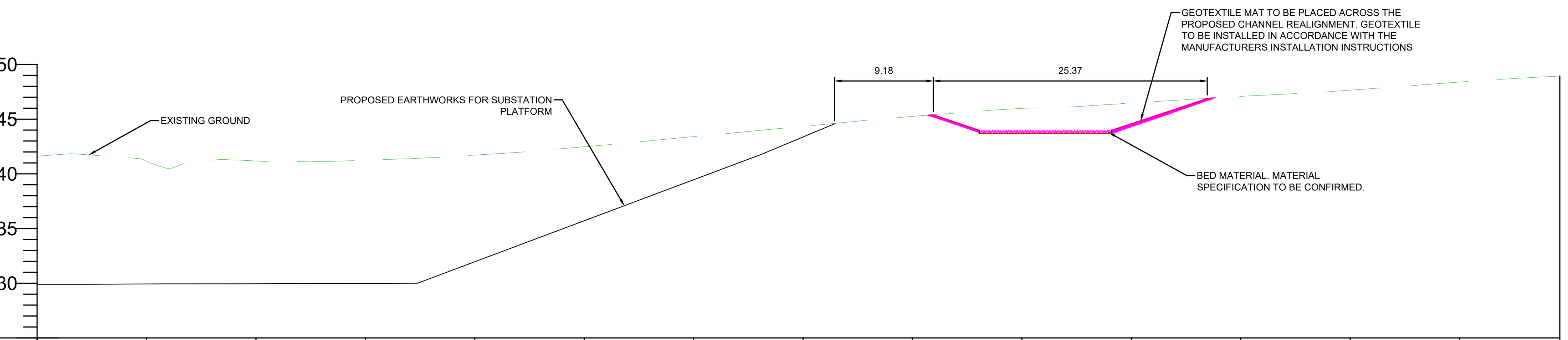
Project: GREENS 400kV SUBSTATION

Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING PROPOSED NORTH WATERCOURSE CROSS SECTIONS & DETAILS

Contractor Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0159

Customer Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0159

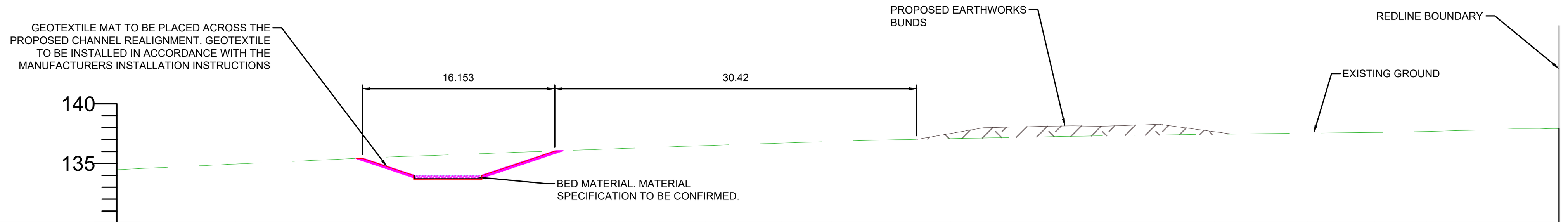
Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	1:500	A1	1 of 1	P02



Datum level: 125.000 (m AOD)

Existing Ground Levels (m AOD)	141.162	141.217	141.248	141.711	142.474	143.355	144.342	145.250	145.986	146.476	147.084	147.649	147.991	148.392	148.816
Proposed Bed Levels (m AOD)	145.410	143.999	143.998	143.998	144.000	144.590	146.000								
Chainage	0+000	0+010	0+020	0+030	0+040	0+050	0+060	0+070	0+080	0+090	0+100	0+110	0+120	0+130	0+139.157

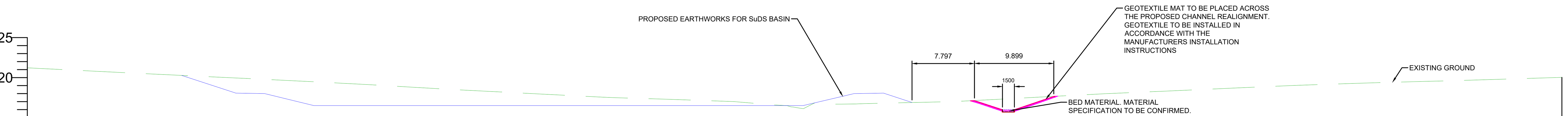
SOUTH REALIGNMENT CH290 - CROSS SECTION
SCALE: H 1:500,V 1:500. DATUM: 125.000



Datum level: 130.000 (m AOD)

Existing Ground Levels (m AOD)	134.500	134.947	135.416	135.788	136.163	136.361	136.518	136.704	136.836	137.000	137.078	137.269	137.443	137.550	137.596	137.682	137.773	137.888	137.924
Proposed Bed Levels (m AOD)	134.500	134.947	135.416	135.788	136.163	136.361	136.518	136.704	136.836	137.000	137.078	137.269	137.443	137.550	137.596	137.682	137.773	137.888	137.924
Chainage	0+000	0+010	0+020	0+030	0+040	0+050	0+060	0+070	0+080	0+090	0+100	0+110	0+120						

SOUTH REALIGNMENT CH650 - CROSS SECTION
SCALE: 1:500



Datum level: 115.000 (m AOD)

Existing Ground Levels (m AOD)	120.723	120.240	119.763	119.258	118.689	118.157	117.675	117.290	116.853	116.705	116.875	117.229	117.753	118.255	118.667	119.087	119.407	119.672	119.981		
Proposed Bed Levels (m AOD)	117.147	116.550	116.000																		
Chainage	0+000	0+010	0+020	0+030	0+040	0+050	0+060	0+070	0+080	0+090	0+100	0+110	0+120	0+130	0+140	0+150	0+160	0+170	0+180	0+190	0+191.552

SOUTH REALIGNMENT CH1075 - CROSS SECTION
SCALE: 1:500

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

METRES @ 1:250 — 0, 2, 5, 10, 25

METRES @ 1:500 — 0, 5, 10, 20, 50

NOTES
1. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
2. REFER TO DESIGN DECISION LOG FOR ASSUMPTIONS ASSOCIATED WITH TEMPORARY DRAINAGE DESIGN.
3. TIE-IN LOCATIONS TO EXISTING WATERCOURSE TO BE CONFIRMED
4. THE CONTRACTOR SHALL CHECK ALL DIMENSIONS ON SITE AND REPORT ANY DIFFERENCE TO THE DESIGNER
5. ALL LEVELS ARE IN METRES (m) ABOVE ORDNANCE DATUM UNLESS STATED OTHERWISE.

LEGEND:
— — — EXISTING GROUND

DRAWING STATUS: S5 ISSUED FINAL REVIEW

REVISION:	P01		PROJECT REF: GRNS4-LT379	01 - FIRST ISSUE - 21/08/2024	P02		PROJECT REF: GRNS4-LT379	ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN	21/08/2024			C.McLAUGHLIN	01/11/2024		
CHECKED:	R.DUNCAN	21/08/2024			R.DUNCAN	01/11/2024		
APPROVED:	R.MINTO	21/08/2024			R.MINTO	01/11/2024		

Customer: Scottish & Southern Electricity Networks TRANSMISSION	Project: GREENS 400kV SUBSTATION
Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework	Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING PROPOSED SOUTH WATERCOURSE CROSS SECTIONS & DETAILS
Subcon. Drawing No.: FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0160	Contractor Drawing No.: GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0160
	Customer Drawing No.: GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0160

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	1:250	A1	1 of 1	P02

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following :

CONSTRUCTION

UNKNOWN SERVICES - EXISTING WATER SUPPLY NETWORK

MAINTENANCE / CLEANING

NONE IDENTIFIED AT THIS DESIGN PHASE

DECOMMISSIONING / DEMOLITION

NONE IDENTIFIED AT THIS DESIGN PHASE

It is assumed that all works will be carried out by a competent contractor working, where appropriate, to an approved method statement

DRAWING STATUS: S5 ISSUED FINAL REVIEW

REVISION:	P01		P02	
DRAWN:	C.McLAUGHLIN	21/08/2024	C.McLAUGHLIN	01/11/2024
CHECKED:	R.DUNCAN	21/08/2024	R.DUNCAN	01/11/2024
APPROVED:	R.MINTO	21/08/2024	R.MINTO	01/11/2024

PROJECT REF. GRNS4-LT379 — 01 - FIRST ISSUE - 21/08/2024

PROJECT REF. GRNS4-LT379 — ISSUED FINAL REVIEW

NOTES

1. THE PROPOSALS SHOWN ON THIS DRAWING HAVE BEEN DETERMINED FROM TOPOGRAPHICAL SURVEY INFORMATION PROVIDED BY OTHERS
2. SITE LAYOUT BASED ON DRAWING ND2-SK-001(04)
3. SUBSTATION LAYOUT ESTABLISHED FROM SIEMENS .RVT FILES (Apr & May 2024)
4. DESIGN PROPOSALS SHOWN ARE PRELIMINARY AND SUBJECT TO DETAILED DESIGN
5. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
6. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
7. EXISTING WATERCOURSE LEVELS AT BURN OF GREENS TO BE CONFIRMED TO VERIFY DESIGN.

NOTES (CONT'D)

8. LEVELS ESTIMATED FROM 16394 Burn of Greens Sections.DWG AND 20240422-greens - topo.DWG
9. REFER TO GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0163 FOR PROPOSED INDICATIVE LONG SECTION AND CROSS SECTION FOR BURN OF GREENS CROSSING
10. REFER TO GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0150 FOR PROPOSED WATER CHANNEL REALIGNMENTS.
11. REFER TO GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0151 FOR PROPOSED PERMANENT DRAINAGE LAYOUT.
12. CONSULTATION WITH THIRD PARTIES ONGOING TO CONFIRM DESIGN.

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Project: GREENS 400kV SUBSTATION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

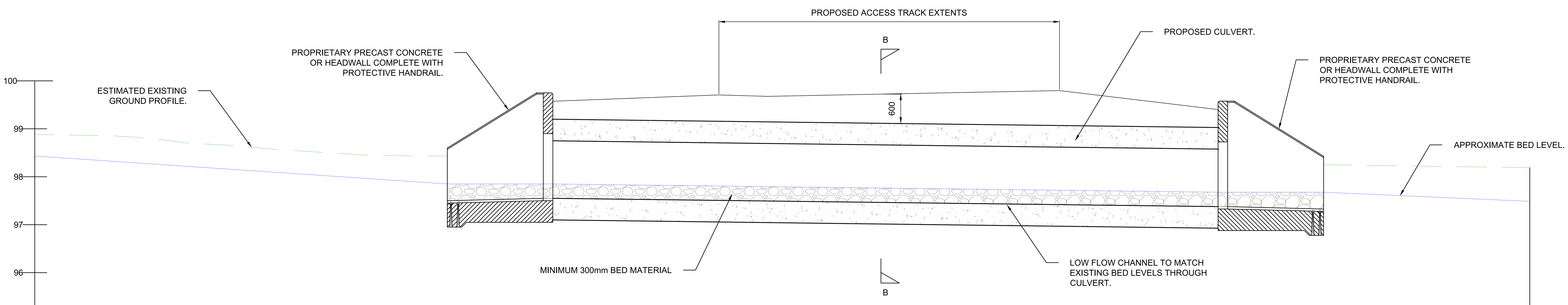
Title: LT379 - GREENS 400kV SUBSTATION ENGINEERING DRAWING PROPOSED BURN OF GREENS CROSSING - GENERAL ARRANGEMENT

Subcon. Drawing No.: FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0161

Contractor Drawing No.: GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0161

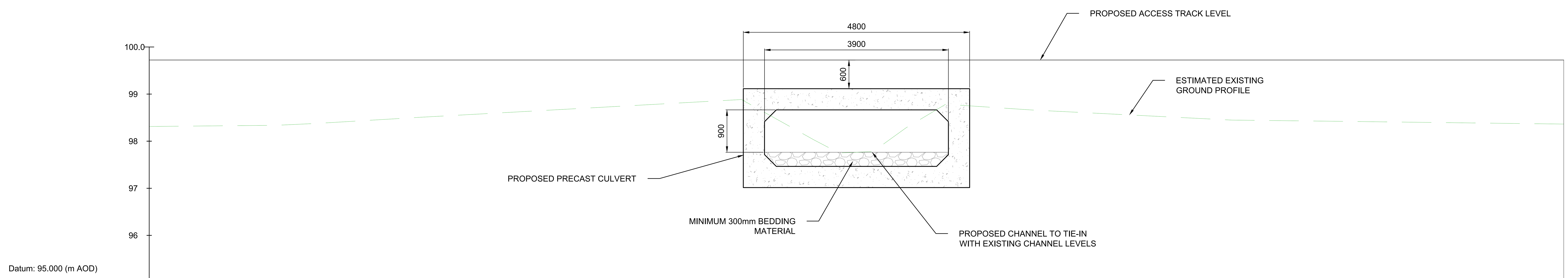
Customer Drawing No.: GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0161

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
A.Peters	C.McLaughlin	R.Duncan	R.Minto	21/08/2024	1:250	A1	1 of 1	P02



Existing Ground Levels (m AOD)	98.883	98.477	98.240		
Proposed Bed Levels (m AOD)	97.846	97.677			
Chainage (m)	0+000	0+010	0+020	0+030	0+031.164

BURN OF GREENS - INDICATIVE LONG SECTION A-A
SCALE: H 1:50,V 1:50. DATUM: 95.000



Proposed Levels (m AOD)	99.398	97.765	97.765												
Existing Levels (m AOD)	99.398	99.414	99.498	99.514	99.607	99.677	99.633	99.597	99.554	99.473	99.458	99.441	99.331	99.264	

BURN OF GREENS - INDICATIVE CROSS SECTION B-B
SCALE: H 1:50,V 1:50. DATUM: 95.000

METRES @ 1:50 — 0, 0.5, 1, 2, 5

DRAWING STATUS: S5 ISSUED FINAL REVIEW				
REVISION:	P01	PROJECT REF. GRNS4-LT379 / 01 - FIRST ISSUE - 23/07/2024	P02	PROJECT REF. GRNS4-LT379 / ISSUED FINAL REVIEW
DRAWN:	C.McLAUGHLIN 23/07/2024		C.McLAUGHLIN 01/11/2024	
CHECKED:	R.DUNCAN 23/07/2024		R.DUNCAN 01/11/2024	
APPROVED:	R.MINTO 23/07/2024		R.MINTO 01/11/2024	

NOTES
1. THE PROPOSALS SHOWN ON THIS DRAWING HAVE BEEN DETERMINED FROM TOPOGRAPHICAL SURVEY INFORMATION PROVIDED BY OTHERS
2. SITE LAYOUT BASED ON DRAWING ND2-SK-001(04)
3. SUBSTATION LAYOUT ESTABLISHED FROM SIEMENS .RVT FILES (Apr & May 2024)
4. DESIGN PROPOSALS SHOWN ARE PRELIMINARY AND SUBJECT TO DETAILED DESIGN
5. SITE CONSTRAINTS FROM UNDERGROUND HV CABLES AND ACCESS TO OHL TO BE CONFIRMED
6. ALL DIMENSIONS IN mm UNLESS STATED OTHERWISE
7. EXISTING WATERCOURSE LEVELS AT BURN OF GREENS TO BE CONFIRMED TO VERIFY DESIGN.

NOTES (CONT'D)
8. LEVELS ESTIMATED FROM 16394 Burn of Greens Sections.DWG AND 20240422-greens - topo.DWG
9. REFER TO GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0163 FOR PROPOSED INDICATIVE LONG SECTION AND CROSS SECTION FOR BURN OF GREENS CROSSING
10. REFER TO GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0150 FOR PROPOSED WATER CHANNEL REALIGNMENTS.
11. REFER TO GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0151 FOR PROPOSED PERMANENT DRAINAGE LAYOUT.

Customer: Scottish & Southern Electricity Networks TRANSMISSION

Project: GREENS 400kV SUBSTATION

Contractor: SIEMENS energy + bam Joint Venture Substation Delivery Framework

Title: LT379 - GREENS
PROPOSED BURN OF GREENS CROSSING -
PROPOSED SECTIONS

Subcon. Drawing No. FAIRHURST GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0163

Contractor Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0163

Customer Drawing No. GRNS4-LT379-SEBAM-DRAI-ZZ-D-C-0163

Designed	Drawn	Checked	Approved	Date	Scale	Size	Sheet	Revision
R.Duncan	C.McLaughlin	R.Duncan	R.Minto	23/07/2024	AS SHOWN	A1	1 of 1	P02

Appendix 8 Temporary Drainage Calculations

TEMPORARY SETTLING POND SIZING

This is a step-by-step procedure to provide the size required for settling provided sediment pollution. The information provided below is to be used to provide a proposed volume and or area required for the settlement of solids. All information gathered to produce sizing is assumed. Temporary sites <25Ha an assumed 1 in 10 year storm event have been reasonably selected for calculations. Any storm event greater than 1 in 10 is out of our control, overflow routes will need to be considered by contractors on a site-to-site basis.

Catchment Area is to be esstablished, what is the extent of the soil stripping required on site?

job number	156918
Site name	ASTI Greens

1 **catchment review**

Green field run off rate Q_{BAR}= 0.00108 x $(Area)^{0.89}$ x $(SAAR)^{1.17}$ x $(SOIL)^{2.17}$

Input			
Catchment Area	Ha	SAAR (mm) (from figure 18.1)	SPR (confirm from HR Wallingfords)
1/2 Platform & Area 1	11.66	840	0.3

Calculations			
Greenfield runoff rates (m^3/s)	Greenfield runoff rates (l/s)	10-year return rate (l/s)	10-year Greenfield runoff rates (m^3/hr)
0.072	71.706	101.823	366.564

Check Runoff rates with HR wallingford

https://www.uksuds.com/tools/greenfield-runoff-rate-estimation

2 **check**

Correct/ Update any assumptions in the table above with HR Wallingford results, Print off any HR Wallingford reports used and save in the file for reference.

Summary table

Rainfall Zone	Annual Rainfall can be estimated from Figure 18.1 or Known site-specific valuse can be used. The site-specific annual average rainfall is known to be around 1062mm (HR Wallingford/ MicroDrainage)	840
Soil Type	Soils are divided into the five classes shown in Table 18.3, (Confirm with HR Wallingford) The soil is Clayey and impermiable. It was decided that the runoff potential is "very high"	2
Peak Flow per hectare	Flood flows should be estimated from table 18.2. see table 18.2 to the right	2.8
Mean Annual Flood	Multiply this flood flow in liters/second/hectare by the catchment area. The catchmentarea here is 0.065km^2. Mean annual flood for the catchment = 8.4l/s/ha x 6.5ha	32.6
10-year return period flood	The mean annual flood can be multiplied by a factor for range of return periods (table 18.4). ie a site peak flow for a 10 year return period = 32.6 x 1.48.	48.3

Link to CIRIA C648 Guidance: CIRIA C648 Control of water pollution from linear construction projects.pdf

Table 18.5 *Regional factors for scaling mean annual flood*

Region	Return period (years) 5	10	25	50
Scottish Highlands	1.20	1.45	1.81	2.12
Lowland Scotland	1.11	1.42	1.81	2.17
North East England	1.25	1.45	1.70	1.90
North West England	1.19	1.38	1.64	1.85
Midlands (Severn-Trent area)	1.23	1.49	1.87	2.20
Lincolnshire, Norfolk	1.29	1.65	2.25	2.83
Southern (inc London and parts of Suffolk, Kent)	1.28	1.62	2.14	2.62
South West England	1.23	1.49	1.84	2.12
Wales	1.21	1.42	1.71	1.94

Table 18.2 *Mean annual flood peak flow for catchments < 50 ha (litres/second/hectare)*

Soil type	Annual rainfall (mm) < 600	600–800	800–1200	1200–1600	1600–3200	> 3200
1	0.3	0.4	0.6	0.9	1.7	2.4
2	1.4	1.8	2.8	4.1	7.7	10.8
3	2.6	3.4	5.2	7.7	14.4	20.1
4	3.3	4.4	6.7	9.9	18.6	26.0
5	4.2	5.5	8.4	12.4	23.3	32.7

Table 18.3 *Soil classes*

General soil description	Runoff potential	Soil class
Well-drained, sandy, loamy or earthy peat soils	Very low	1
Very permeable soils (eg gravel, sand with shallow groundwater or rock	Low	2
Very fine sands, silts and clays. Permeable soils with shallow groundwater in low-lying areas	Moderate	3
Clayey or loamy soils	High	4
Wet uplands, shallow, rocky soils on steep slopes, peats with impermeable layers at shallow depth	Very high	5

Table 18.4 *Factors for different return periods*

Return period (years)	5	10	25	50
Multiplier	1.22	1.48	1.88	2.22

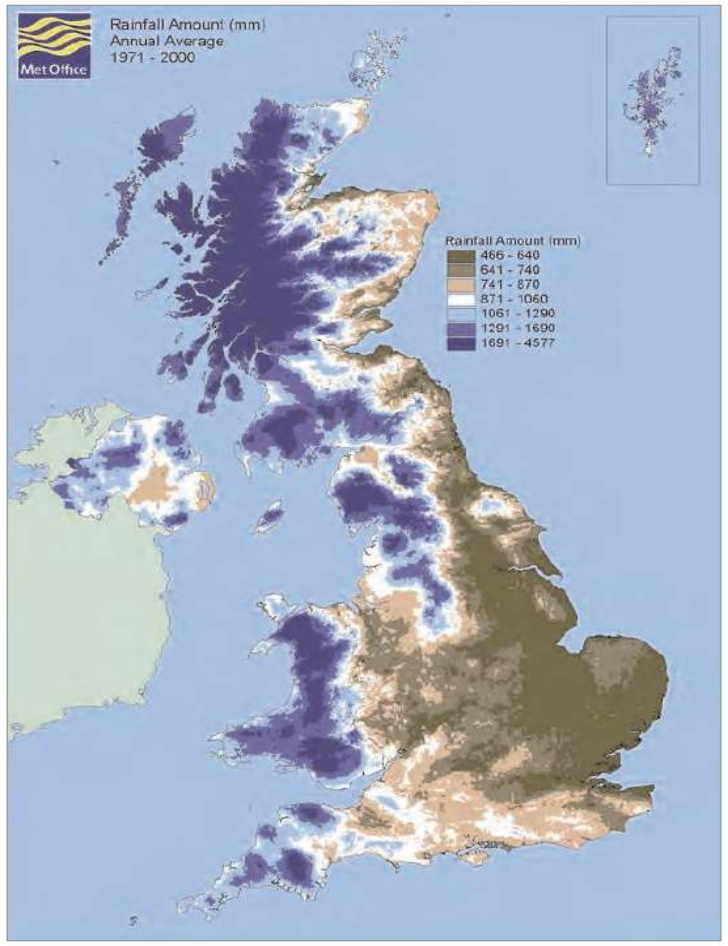


Figure 18.1 *Rainfall amount annual average (mm) 1971–2000 (courtesy Met Office)*

3. Sizing

3.1 Retention time for settlement

Use the drop down to select the proposed pond depth and Soil type
retention time selection table

Tank/ Pond Depth	Solid type	m/hr*[1]	Retention time (hr)	Retention time (days)
1	Fine Silt	0.0720	14	1

Partical settling velocities for soil type as shown in CIRIA C648 Table 19.2

Solid type	mm/sec	m/hr*[1]
Fine Clay	0.001	0.0036
Fine Silt	0.02	0.072
Medium silt	0.05	0.18
Course Sand	30	108
Flocculated Silt	10	36

Proposed Typical pond/ tank depth (m)
0.5
1
1.5
2
2.5

Table 19.2 *Theoretical range of retention times for a variety of particle sizes*

Water depth	Retention time (settling velocity)				
	Fine clay (0.001 mm/s)	Fine silt (0.02 mm/s)	Medium silt (0.05 mm/s)	Coarse sand (30 mm/s)	Flocculated silt (10 mm/s)
0.5 m	6 days	7 h	3 h	16 s	50 s
1 m	11 days	14 h	5.5 h	33 s	2 min
2 m	23 days	1 day	11 h	1 min	3 min

*[1] Convert mm/s to m/hr by a factor of 3.6

3.2 Total Rainfall depth

It has been assumed the total depth of rainfall comes from factoring the 5year return event - 60minute storm ratio 'r' (M5-60) estimated rainfall has been taken on approximate location in figure 3 to the right.

M5-60 'r' (mm): 0.2

It has been assumed the peak storm event is 10hrs, the duration factor has been taken from the Z1 table

Z1: 2.62

The growth factior has been selected for the 10 year storm event within the Scotland and Northern Ireland region

Z2: 1.2

To be conservative use the highest value for the 10-year growth factor from Table 18.5 above

10-year growth: 1.45

Select the higher value (conservitive): 1.45

Rainfall design M5-60 x Z1 x Z2 (mm): 0.760

Table 1: Values of factor *Z*1 for rainfall duration (*D*) and ratio (*r*)

Ratio (*r*)	Rainfall duration (*D*)									
	Minutes (min)				Hours (h)					
	5	10	15	30	1	2	4	6	10	24
0.12	0.22	0.34	0.45	0.67	1.00	1.48	2.17	2.75	3.70	6.00
0.15	0.25	0.38	0.48	0.69	1.00	1.42	2.02	2.46	3.23	4.90
0.18	0.27	0.41	0.51	0.71	1.00	1.36	1.86	2.25	2.86	4.30
0.21	0.29	0.43	0.54	0.73	1.00	1.33	1.77	2.12	2.62	3.60
0.24	0.31	0.46	0.56	0.75	1.00	1.30	1.71	2.00	2.40	3.35
0.27	0.33	0.48	0.58	0.76	1.00	1.27	1.64	1.88	2.24	3.10
0.30	0.34	0.49	0.59	0.77	1.00	1.25	1.57	1.78	2.12	2.84
0.33	0.35	0.50	0.61	0.78	1.00	1.23	1.53	1.73	2.04	2.60
0.36	0.36	0.51	0.62	0.79	1.00	1.22	1.48	1.67	1.90	2.42
0.39	0.37	0.52	0.63	0.80	1.00	1.21	1.46	1.62	1.82	2.28
0.42	0.38	0.53	0.64	0.81	1.00	1.20	1.42	1.57	1.74	2.16
0.45	0.39	0.54	0.65	0.82	1.00	1.19	1.38	1.51	1.68	2.03

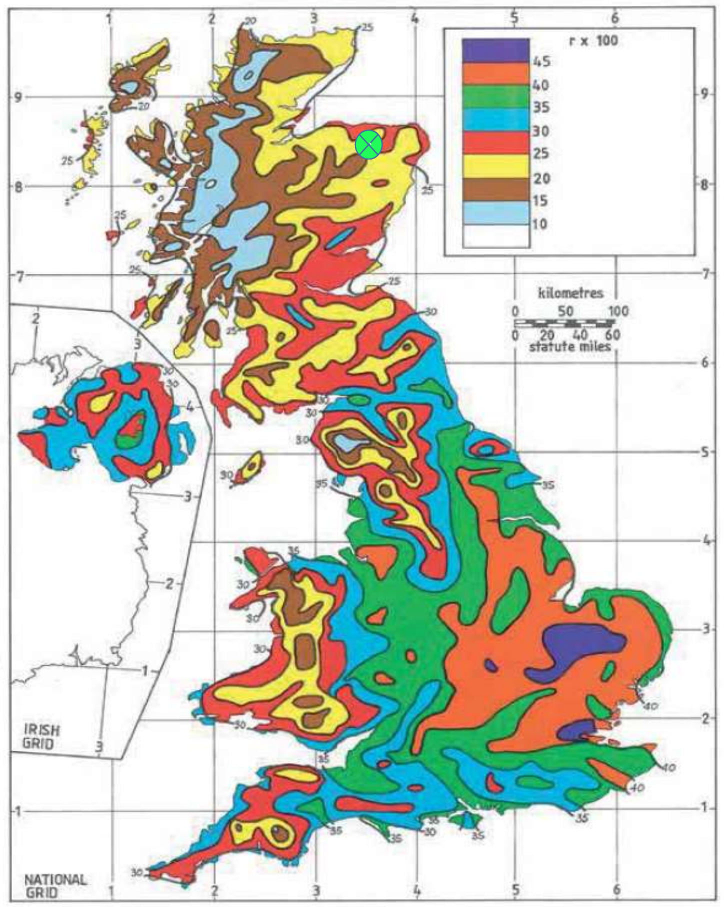


Figure 3: Ratio of 60-min to 2-day rainfall duration of a 5-year return period[1] (image © Department for Environment, Food & Rural Affairs)

3.3 Runoff & Storage Volume

Ciria C648 Provides a "crude estimation" to provide the volume of runoff

Runoff Volume = site area x rainfall total: 88.59268 m^3

It is assumed that there will be some permability C648 indicates a factor of 0.4-0.75 is used.
due to the level of Clay and the site visit a permeability value of 0.8 is used for low permeability

Runoff Volume = Site area x Rainfall total x permability: 70.874144 m^3

To allow the sizing of the settlement pond the outlet flow is required based on the time required for the suspended solids.
As the Pond is assumed to be 1m deep the runff volume can be considered as an area m^2

the discharge rate for the settlement pond Q (m^3/hr) =
Settlement time x Runoff Volume = 6.37867296 m^3/hr

Converted to liters/ second: 1.7718536 l/s

Table 2: Growth factor *Z*2 for M10 and M100 rainfall duration derived from M5 rainfall duration

M5 rainfall (mm)	M10 growth factor *Z*2		M100 growth factor *Z*2	
	England and Wales	Scotland and Northern Ireland	England and Wales	Scotland and Northern Ireland
5	1.20	1.18	1.84	1.91
10	1.22	1.19	1.91	1.97
15	1.23	1.19	1.95	1.97
20	1.24	1.20	2.00	1.97
25	1.24	1.19	2.03	1.93
30	1.24	1.18	2.01	1.89
40	1.22	1.18	1.97	1.85
50	1.21	1.18	1.94	1.82
75	1.19	1.17	1.90	1.78
100	1.17	1.16	1.81	1.72

3.4 Check

Volumes can be checked through HR Wallingfords SuDS Tool surface-water-storage-volume-estimation
Or the MicroDrainage source control can provide a quick estimation

Following the review of CIRIA C648 guidance when Clay is a potential pollutant to the water environment
the guidance indicates the flocculants will be required.
See extracts on the left.

Sizing settlement facilities

Suspended solids will settle out only when the water is still. Usually it is necessary to retain the water in the settlement tank or pond for several hours to allow the suspended solids to settle out. Retention time depends on the particle size, disturbance of the water, depth of water, temperature and particle density. Although it can be calculated (Masters-Williams *et al*, 2001), the particle size and density data are not usually readily available. A rule of thumb indicates that a retention time of 2–3 hours is adequate. However, finer particulate matter may require several days or more and therefore larger settlement facilities. Particles less than 2 mm (eg clays, chalk, coal shale) may never settle out and will require addition of a flocculant (see Section 19.2.6). In ideal conditions retention time is a function of settlement velocity and depth (Masters-Williams *et al*, 2001):

> Settlement facilities are best utilised as part of a comprehensive set of control methods. If the suspended solids are particularly fine, or the volume of water very high, no size of lagoon or conventional type of treatment will work. In this case, or if there is no space for alternative suitable treatment, specialist treatment can be used in the form of flocculants or a dynamic separator (see also Section 19.2.6).

Summary of Results for 10 year Return Period

Critical storm may not be identified, please run longer storm durations.

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.010	0.210	2.0	911.8	O K
30 min Summer	99.089	0.289	2.0	1268.9	O K
60 min Summer	99.185	0.385	2.0	1703.6	O K
120 min Summer	99.281	0.481	2.0	2153.2	O K
180 min Summer	99.349	0.549	2.0	2476.7	O K
240 min Summer	99.403	0.603	2.0	2736.3	O K
360 min Summer	99.487	0.687	2.0	3143.8	O K
480 min Summer	99.552	0.752	2.0	3463.5	O K
600 min Summer	99.605	0.805	2.0	3727.8	O K
720 min Summer	99.649	0.849	2.0	3954.0	O K
960 min Summer	99.723	0.923	2.0	4328.3	Flood Risk
1440 min Summer	99.836	1.036	2.0	4915.2	Flood Risk
15 min Winter	99.034	0.234	2.0	1021.8	O K
30 min Winter	99.123	0.323	2.0	1422.0	O K
60 min Winter	99.229	0.429	2.0	1909.2	O K
120 min Winter	99.336	0.536	2.0	2413.3	O K
180 min Winter	99.412	0.612	2.0	2776.3	O K
240 min Winter	99.472	0.672	2.0	3067.8	O K
360 min Winter	99.564	0.764	2.0	3525.7	O K
480 min Winter	99.636	0.836	2.0	3885.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	42.000	0.0	170.3	75
30 min Summer	29.200	0.0	169.9	89
60 min Summer	19.600	0.0	341.7	120
120 min Summer	12.400	0.0	339.7	178
180 min Summer	9.521	0.0	338.2	238
240 min Summer	7.900	0.0	337.0	298
360 min Summer	6.067	0.0	334.9	418
480 min Summer	5.025	0.0	333.0	536
600 min Summer	4.337	0.0	331.4	656
720 min Summer	3.842	0.0	329.8	776
960 min Summer	3.166	0.0	309.2	1016
1440 min Summer	2.396	0.0	113.2	1500
15 min Winter	42.000	0.0	170.5	75
30 min Winter	29.200	0.0	170.1	89
60 min Winter	19.600	0.0	341.9	118
120 min Winter	12.400	0.0	340.0	176
180 min Winter	9.521	0.0	338.6	236
240 min Winter	7.900	0.0	337.4	294
360 min Winter	6.067	0.0	335.4	412
480 min Winter	5.025	0.0	333.6	530

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
600 min Winter	99.694	0.894	2.0	4183.1	O K
720 min Winter	99.745	0.945	2.0	4442.5	Flood Risk
960 min Winter	99.830	1.030	2.0	4885.2	Flood Risk
1440 min Winter	99.953	1.153	2.0	5538.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
600 min Winter	4.337	0.0	331.9	648
720 min Winter	3.842	0.0	252.7	770
960 min Winter	3.166	0.0	76.1	1020
1440 min Winter	2.396	0.0	93.1	1500

Rainfall Details

Rainfall Model	FEH
Return Period (years)	10
FEH Rainfall Version	2013
Site Location	GB 382850 846800 NJ 82850 46800
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	1440
Climate Change %	+0

Time Area Diagram

Total Area (ha) 11.660

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	10	1.944	20	30	1.943	40	50	1.943
10	20	1.944	30	40	1.943	50	60	1.943

Time Area Diagram

Total Area (ha) 0.000

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.000

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4250.0	1.200	5431.7

Pump Outflow Control

Invert Level (m) 98.800

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0000	0.900	2.0000	1.700	0.0000	2.500	0.0000
0.200	2.0000	1.000	0.0000	1.800	0.0000	2.600	0.0000
0.300	2.0000	1.100	0.0000	1.900	0.0000	2.700	0.0000
0.400	2.0000	1.200	0.0000	2.000	0.0000	2.800	0.0000
0.500	2.0000	1.300	0.0000	2.100	0.0000	2.900	0.0000
0.600	2.0000	1.400	0.0000	2.200	0.0000	3.000	0.0000
0.700	2.0000	1.500	0.0000	2.300	0.0000		
0.800	2.0000	1.600	0.0000	2.400	0.0000		

Date: 24/10/2024
Above is the procedure that has been used to size the lagoons with settlement discharge rates
sizing of the lagoons have been set using the 1440 min (1day) volume
below is a summary of the proposed lagoons

Laydown Catchment	Area (Ha)	Discharge Rate (l/s)	Lagoon Volume provided (m3)
1. 1/2 Platform & Area 1	11.66	2	5600
2. Area 2	1.5	0.23	800
3. Area 3, 4 & 5	5.09	0.8	2800
4. 1/2 Platform, Area 6 and Welfare/office	15.23	2.32	7300
5. Area 7	1.7	0.25	800
6. OHL Platform	2.06	0.3	1000