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Substation Drainage Management Plan

East Limerick Substation Development

Final Report

Prepared for

Harmony Solar East Limerick Limited

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This report describes work commissioned by Harmony Solar East Limerick Limited, by an instruction dated 13/12/2024. The Client's representative for the contract was Fred Tottenham of Harmony Solar East Limerick Limited. Jack Shanahan, Aneeque Ahmed and Michael O'Donoghue of JBA Consulting carried out this work.

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List of Abbreviations

Abbreviation	Definition
BESS	Battery Energy Storage System
CIRIA	Construction Industry Research and Information Association
Cv	Volumetric Runoff Coefficient
DDF	Depth–Duration–Frequency
DSM	Digital Surface Model
DTM	Digital Terrain Model
GDSDS	Greater Dublin Strategic Drainage Study
GIS	Geographic Information System
IPP	Independent Power Producer
JBA	JBA Consulting Engineers and Scientists Limited
LCA	Landscape Character Area
LCCC	Limerick City and County Council
LDP	Limerick Development Plan
LiDAR	Light Detection and Ranging
LILO	Loop-In Loop-Out
M5-60	Five-year return-period rainfall depth for a 60-minute duration
mOD	Metres above Ordnance Datum
OPW	Office of Public Works
PSDP	Project Supervisor Design Process
Qbar	Greenfield Runoff Rate
SAAR	Standard Average Annual Rainfall
SSFRA	Site-Specific Flood Risk Assessment
SuDS	Sustainable Drainage Systems
TLI	TLI Group
TSO	Transmission System Operator

1 Introduction

1.1 Terms of Reference of Scope

JBA Consulting Engineers and Scientists Limited was appointed by Harmony Solar East Limerick Limited to prepare a Drainage Management Plan in support of the planning application for the Proposed Substation Development.

Harmony Solar East Limerick Limited is seeking planning permission for a substation development within the townlands of Gotoon, Coolscart, and Kilfrush in County Limerick. The Proposed Substation Development comprises 17.02 ha.

1.2 Aims and Objectives

The purpose of this report is to establish the existing surface water drainage conditions within and adjacent to the Proposed Substation Development and assess how these conditions may be affected by the proposed buildings/ compounds, access tracks and other impermeable or compacted surfaces. The assessment considers the existing topography, surface water features, field drains and indicative overland flow paths that influence the movement of runoff through the site.

The Drainage Management Plan sets out how surface water runoff will be collected, conveyed, treated, attenuated, and discharged in a controlled manner. Its principal aim is to demonstrate that the Proposed Substation Development can be accommodated without increasing flood risk or causing an adverse effect on downstream receptors. Key objectives of this report are:

1. Assess existing drainage conditions and flow paths
2. Identify areas generating additional runoff.
3. Develop a sustainable drainage strategy.
4. Incorporate SuDS for runoff management and pollution treatment
5. Provide runoff interception and an appropriate SuDS treatment train
6. Maintain drainage pathways and provide safe exceedance routes
7. Align the strategy with the Flood Risk Assessment.
8. Define requirements for detailed design, construction and O&M

1.3 Development Proposal

Harmony Solar East Limerick Limited is seeking planning permission for a substation development within the townlands of Gotoon, Coolscart, and Kilfrush in County Limerick.

The planning permission seeks a 10-year planning permission for the construction of a 220kV Loop In Loop Out (LILO) substation and associated works within a site of 17.02 hectares which will include the following:

- Transmission System Operator (TSO) compound with an area of approximately 14,158m², containing a two-storey 220kV GIS substation building with a footprint of approximately 1,844m², a total floor area of 3,550.8m², and a height of 20.7 m.
- Customer compound with an area of approximately 4,576m², containing a customer building with a footprint of approximately 346.2 m², a total floor area of 311.8m² and a height of 7.62m.
- 220kV customer transformer positioned within bunded enclosures, with a height of 9.5m above finished ground level.
- 220kV electrical infrastructure including transformers, switchgear, gantries, insulators, conductors, protection and control equipment, and all associated electrical plant and apparatus.
- A Battery Energy Storage System (BESS) located within a dedicated BESS compound and including:
    - 55 no. containerised battery storage modules, each measuring 6.06 m long, 2.44 m wide and 2.9 m high.
    - 28 no. containerised transformer and power conversion / conditioning units, each measuring 6.06 m long, 2.44 m wide and 2.9 m high.
    - Ancillary BESS infrastructure including inverters, transformers, switchgear, control equipment, thermal management systems, fire detection and suppression systems, acoustic screening, and associated electrical plant.
- Removal of 1 no. existing 25m high steel lattice tower, and the installation of 2 no. steel lattice towers of 26.5m high, foundations and associated insulators, hardware, and conductor.
- 4no. lightning protection masts, with a height of 18m.
- 1 no. telecommunications mast, with a height of 37.52m.
- 140m of underground electrical cable and associated ducting, including joint bays, cable sealing end compounds, marker posts, and associated infrastructure.
- Internal access tracks.
- A new access point from the L1509 public road.
- Removal of derelict farm building.
- Landscaping and biodiversity enhancement measures.
- Security gates, boundary fencing and all associated ancillary development, site works and services.

A Natura Impact Statement will be submitted with the application.

1.4 Report Structure

This Drainage Management Plan for the Proposed Substation Development is structured as follows:

Section 2 describes the location, topography, ground conditions, surface water features, and existing drainage characteristics of the site. Together, these establish the baseline conditions against which the potential effects of the Proposed Substation Development are assessed.

Section 3 outlines the applicable surface water drainage requirements and presents the proposed drainage strategy. It describes the runoff catchments, collection and conveyance measures, discharge control, attenuation, SuDS measures, water-quality treatment, transformer-oil management, and exceedance arrangements. The section also presents the hydraulic assessment undertaken to demonstrate the performance of the proposed drainage system.

Section 4 summarises the principal findings of the assessment and the overall drainage management approach for the Proposed Substation Development.

Section 5 identifies the recommendations and further requirements for site investigation, detailed design, construction, operation, and maintenance.

The supporting drainage layout and hydraulic model results are included in the appendices.

2 Site Background

2.1 Location

The site of the Proposed Substation Development is situated in the townlands of Gotoon, Coolscart, and Kilfrush in County Limerick. The Overall Project further extends to the townlands of Ballyhaukish, Millfarm, Coolalough, Ballycahill, Newtown and Knocklong. The Proposed Substation Development comprises 17.02 ha. The site is located south-west of the village of Hospital and north-west of Knocklong village. See Figure 2-1 for site location.

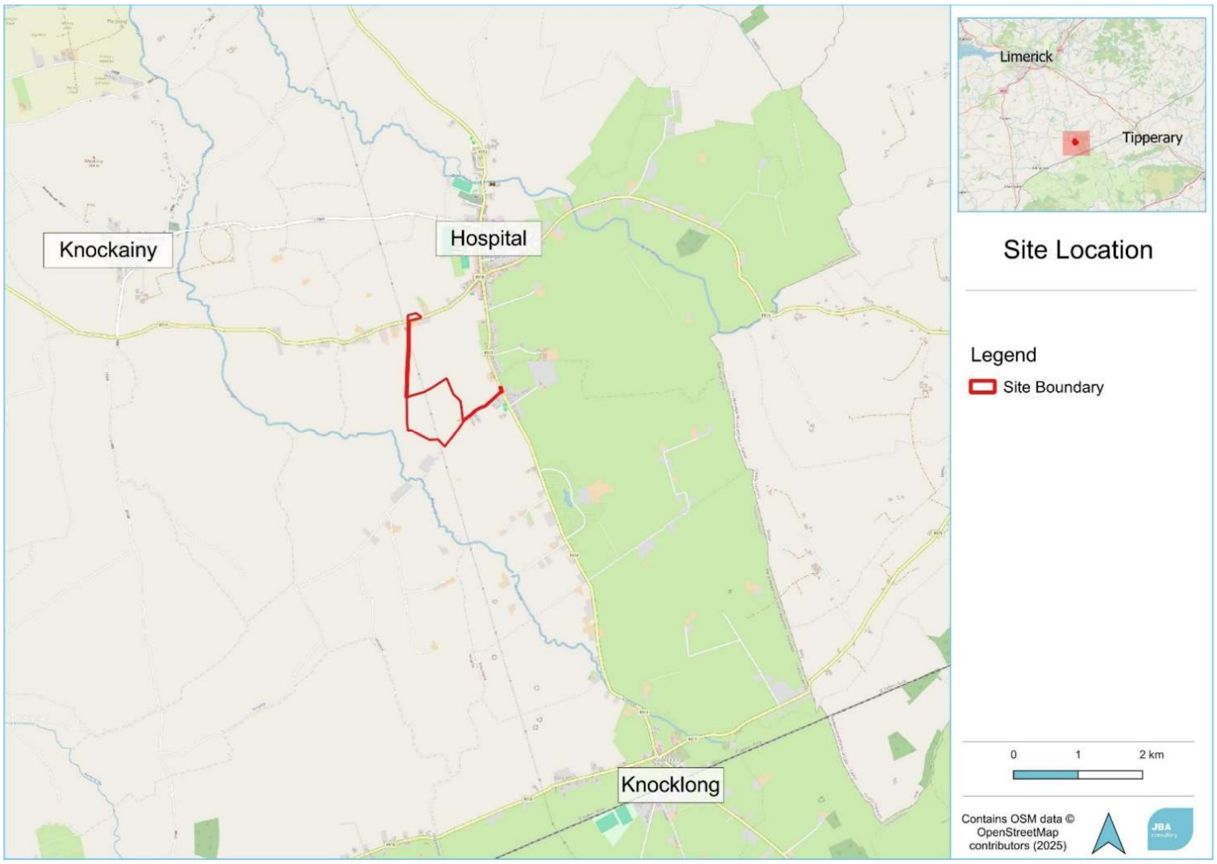


Figure 2-1 Site Location

The Proposed Substation Development land is in agricultural use at present. There is an existing agricultural building located within the south-east corner of the parcel, and a derelict shed structure located in the northern area of the parcel. The parcel benefits from existing hedgerows along the field boundaries. The land is in agricultural use at present. It lies entirely within the 'Agricultural Lowlands' Landscape Character Area (LCA) as designated within the Limerick Development Plan 2022-2028.

There are no residential dwellings within the red line boundary for the Proposed Substation Development. There are, however, residential properties and farm holdings within the surrounding area, including properties located along the L1509 public road to the south of the site and within the wider rural area between Hospital and Knocklong. The site associated with the Proposed Substation Development is within four private landownerships. Agreements are in place between the landowners and the Applicant to facilitate the construction and operation of the Proposed Substation Development on these lands. Letters of consent from the landowners have been provided to the Applicant and will be submitted with the SID application.

2.2 Site Topography and Natural Overland Flow Paths

The Proposed Substation Development is located within a 17.02 ha land parcel in a predominantly rural agricultural landscape. The available LiDAR data show gently undulating terrain with a clear overall fall from the northern part of the land parcel towards the lower-lying southern boundary.

To support the assessment of site topography and drainage characteristics, LiDAR elevation data have been reviewed using both a Digital Surface Model (DSM) and a Digital Terrain Model (DTM). The DSM represents elevations inclusive of vegetation, buildings, and other surface features, whereas the DTM provides a bare-earth representation of ground levels. The DTM is therefore more suitable for identifying the overall direction of fall, local catchment divides, low points, and indicative overland flow paths. The DSM has been used as a supporting dataset to understand where existing vegetation and surface features may influence the movement of runoff.

The LiDAR data indicate that ground levels generally range from approximately 88.5 mOD along the northern part of the land parcel to approximately 81 mOD at the southern boundary. This represents an overall fall of approximately 7.5 m across the site. The fall is not uniform, and localised changes in gradient occur throughout the agricultural fields; however, the overall direction of fall is from north to south. Indicative overland flow directions derived from the DTM are shown in Figure 2-2.

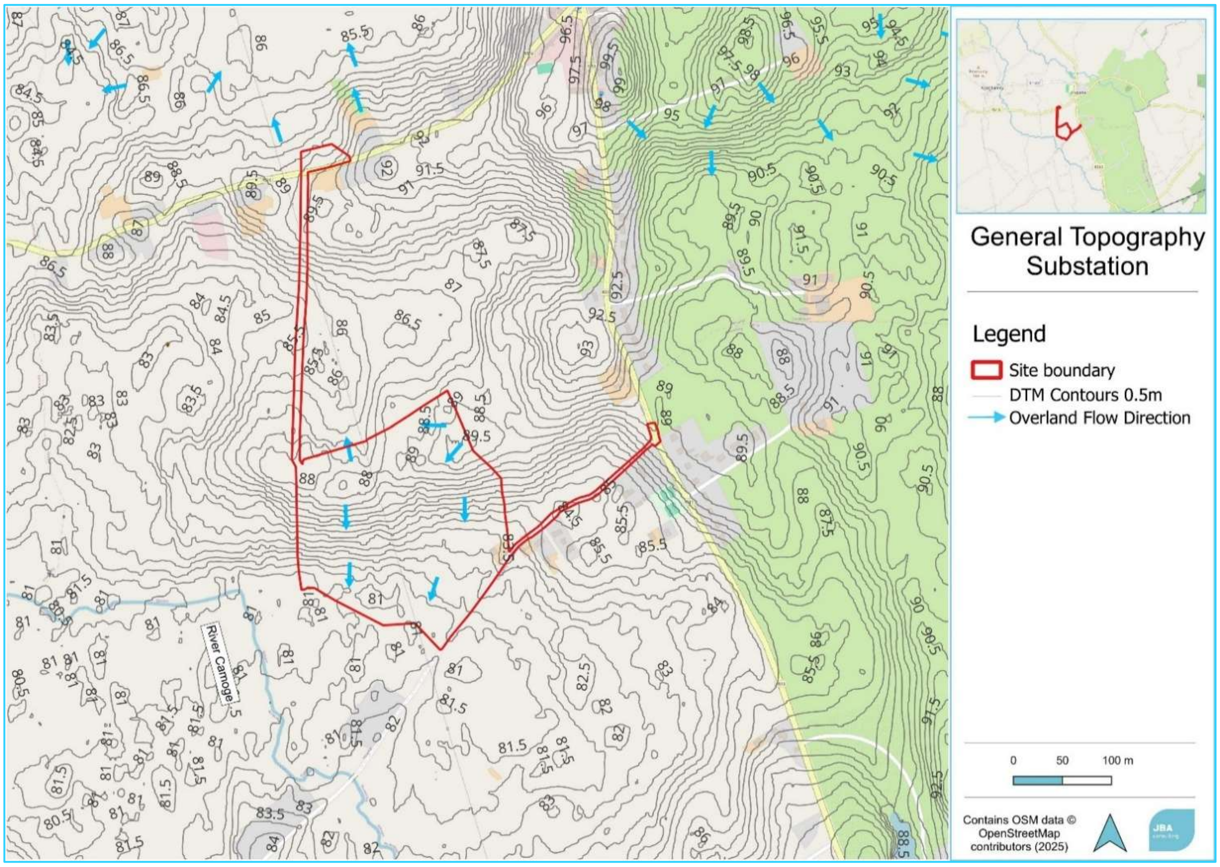


Figure 2-2 Site Topography

2.3 Existing Land Use and Ground Conditions

The Proposed Substation Development is located within a predominantly rural agricultural landscape characterised by pasture fields, hedgerows and dispersed rural development. The site itself remains largely undeveloped and is currently used for agricultural grazing and grassland management. Existing development within the site is limited to an agricultural building in the south-east and a derelict shed structure in the northern part of the land parcel.

A Site-Specific Flood Risk Assessment (separate enclosure) has been prepared for the Proposed Substation Development. The assessment provides further information on the site geology, mapped subsoils, groundwater setting and groundwater vulnerability and should be read alongside this Drainage Management Plan.

Site-specific infiltration rates, seasonal groundwater levels, and the suitability of the ground for infiltration drainage have not yet been established.

Therefore, the hydraulic assessment conservatively assumes that no infiltration contribution is provided by the proposed SuDS measures.

Site investigation and infiltration testing shall be undertaken before detailed design to confirm the soil profile, permeability, groundwater conditions, and suitability of any proposed unlined SuDS components. Incidental infiltration may occur, but it shall not be relied upon in the hydraulic design unless supported by representative site-specific testing.

2.4 Surface Waterbodies

A review of the available mapping datasets and site drainage information indicates that the Proposed Substation Development is influenced by mapped watercourses, OPW arterial drainage channels and smaller unmapped field drains. The principal surface water drainage features relevant to the Proposed Substation Development are shown in Figure 2-3.

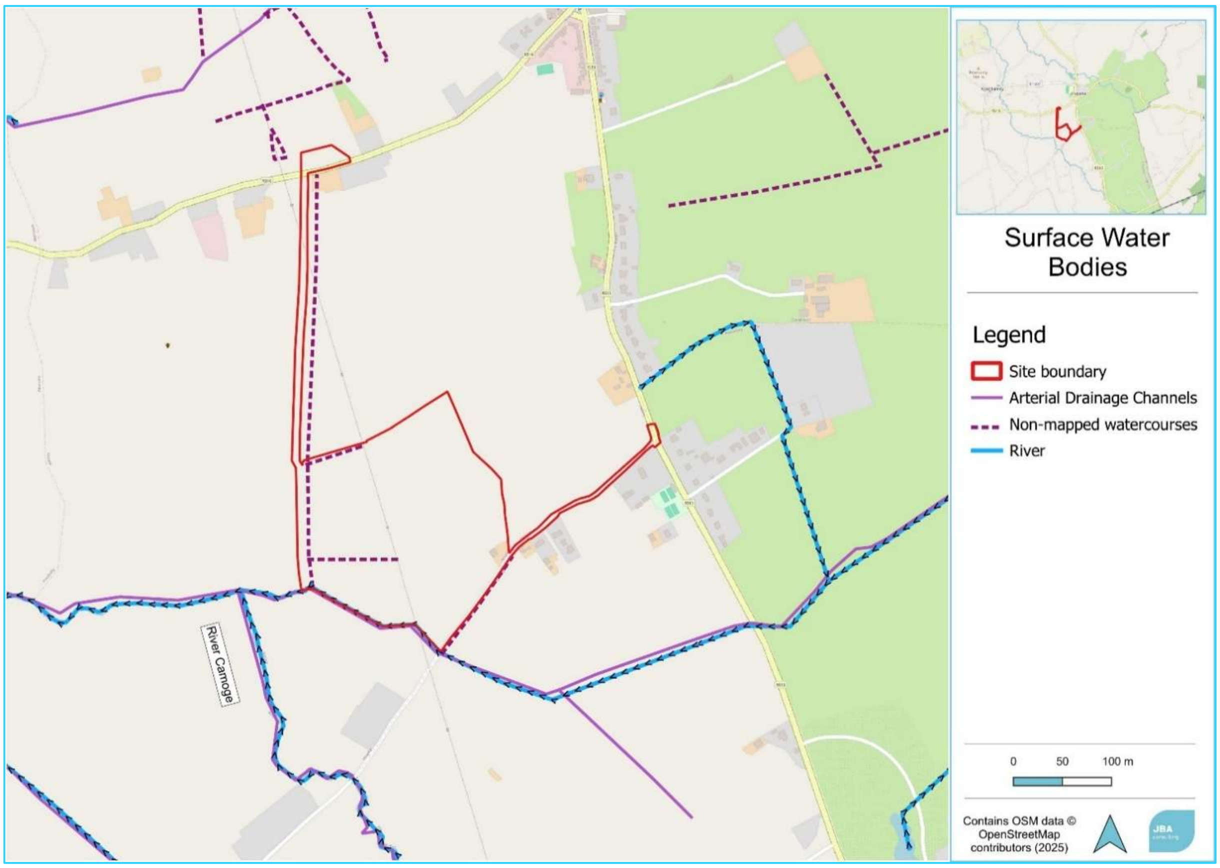


Figure 2-3 Surface Waterbodies

The River Camogue and River Mahore are the principal hydrological features in the wider area. The Proposed Substation Development is located within the catchment of the River Camogue, and a tributary of the River Camogue follows the southern boundary of the site. This tributary receives runoff from the lower-lying southern part of the land parcel and forms the principal receiving watercourse in the vicinity of the Proposed Substation Development.

Smaller field drains and open drainage ditches have also been identified within and adjacent to the site. Although these features are not shown as mapped rivers, they form part of the local agricultural drainage network by intercepting shallow overland flow and conveying runoff downslope towards the receiving watercourse. Their absence from national river mapping should not be interpreted as an absence of drainage function.

The Site-Specific Flood Risk Assessment (SSFRA) provides further information on the wider watercourse network, OPW arterial drainage features, receiving watercourses, proposed drain diversion and associated flood risk and should be read alongside this Drainage Management Plan.

For the purposes of this Drainage Management Plan, the smaller field drains and open drainage ditches within and adjacent to the site form part of the existing local drainage network. These features intercept shallow overland flow and convey runoff downslope towards the lower-lying southern boundary and proposed diverted drain which will convey flows towards the downstream receiving watercourse.

3 Proposed Drainage Management

3.1 Stormwater Drainage Legislation

The surface water drainage strategy for the Proposed Substation Development has been developed having regard to the following principal policy and guidance documents:

- Limerick Development Plan 2022-2028.
- Limerick City and County Council Surface Water/SuDS Specification 2022.
- CIRIA C753, The SuDS Manual.
- Greater Dublin Strategic Drainage Study; and
- The Planning System and Flood Risk Management Guidelines for Planning Authorities.

Limerick Development Plan 2022-2028 (LDP) sets out the policy for stormwater management and that all new developments should incorporate Sustainable Urban Drainage Systems. Objective CAF O11 states:

"It is an objective of the Council to promote integration and delivery of nature-based solutions and infrastructure in new developments, including surface water management, public realm and community projects as a means of managing flood risk and enhancing the natural environment."

In addition, Limerick Development Management Standards 11.3.11 states,

"With this in mind, all new developments will be required to manage and minimise surface water runoff by the use of Sustainable Drainage Systems (SuDS), unless otherwise agreed with the Planning Authority. Previously developed sites which are being redeveloped should aim to achieve greenfield run-off rates.

A comprehensive Storm Water Management Plan will provide an understanding of the mechanisms of surface water flooding and propose mitigation measures both at a local and strategic level. In this regard, cognisance shall be taken of guidance provided in the following documents: Department of the Environment, Heritage and Local Government, The Planning System and Flood Risk Management (Nov 2009 – Guidelines for Planning Authorities); CIRIA Manual C753 – The SuDS Manual (2015); Greater Dublin Strategic Drainage Study - GDSDS (2005) and current best practise.

The SuDS philosophy is to replicate, as closely as possible, the natural drainage from a site prior to its development and adopts the following four pillars of water quantity, water quality (including ground water protection), amenity and biodiversity."

Accordingly, the stormwater management strategy for the Proposed Substation Development has been developed to align with the policies of Limerick City and County Council, ensuring that surface water runoff is managed in a sustainable manner, existing drainage pathways are maintained where feasible, and no adverse impacts arise to downstream receptors.

Furthermore, The Limerick Development Plan 2022–2028 supports renewable energy development under Policy CAF P6, which states,

“It is a policy of the Council to support renewable energy commitments outlined in national and regional policy, by facilitating the development and exploitation of a range of renewable energy sources at suitable locations throughout Limerick, where such development does not have a negative impact on the surrounding environment landscape, biodiversity, water quality or local amenities, to ensure the long-term sustainable growth of Limerick.”

The Proposed Substation Development aligns with this objective by facilitating the generation of solar energy in a manner consistent with environmental protection and sustainable drainage principles.

In accordance with this policy and guidance framework, the drainage strategy seeks to manage runoff close to source, maintain existing drainage pathways where practicable, restrict the discharge rate, provide attenuation for the required design events, treat routine surface water pollution, provide safe exceedance routes and no adverse impacts arise to downstream receptors. The drainage strategy and supporting hydraulic assessment are presented in subsequent sections.

3.2 Proposed Drainage Strategy

The Proposed Substation Development comprises a range of features with different surface characteristics and drainage requirements, including access tracks, buildings, compounds, BESS infrastructure, and associated hardstanding areas. The principal development features and access track arrangement are shown in Figure 3-1.

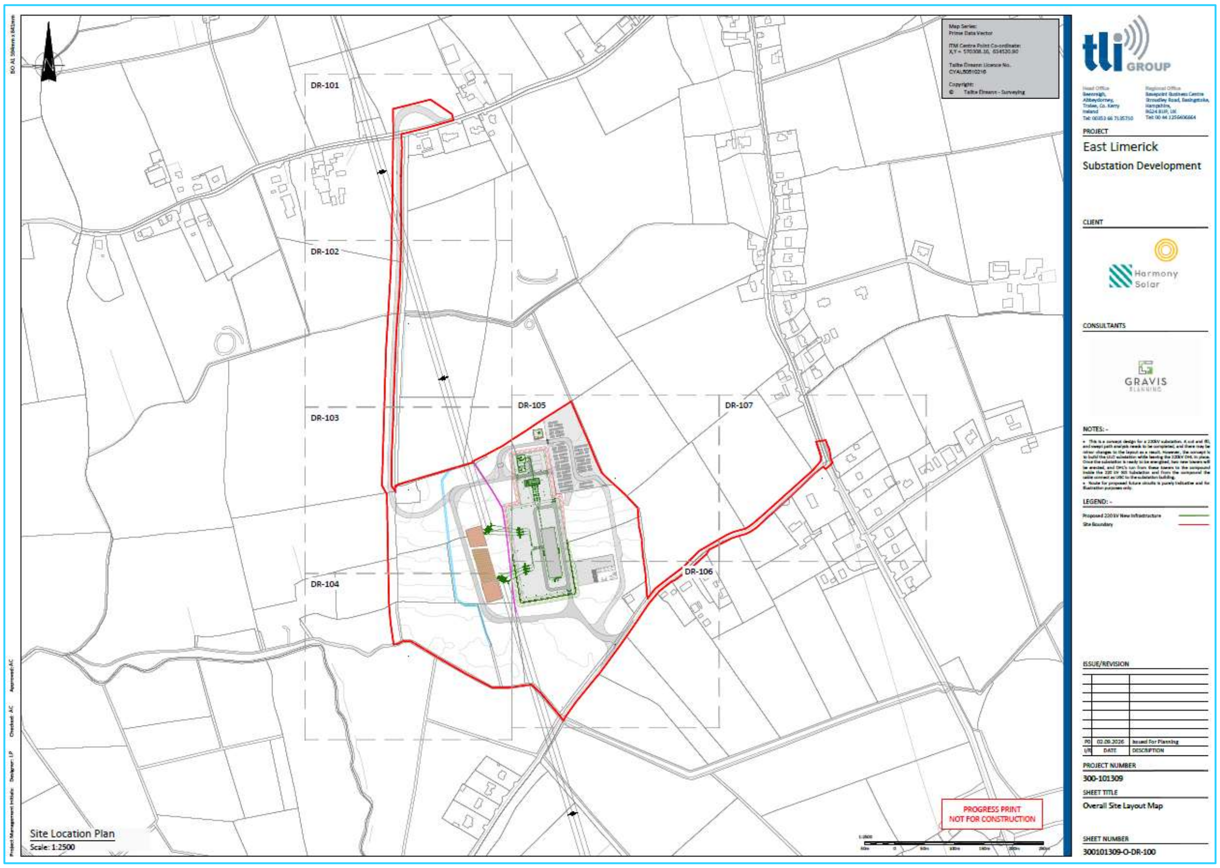


Figure 3-1 Proposed Substation Development Layout

Accordingly, the proposed drainage strategy is divided into two distinct systems:

- an interception and cross-drainage system serving the access tracks; and
- a surface water drainage and SuDS system serving the buildings, compounds, BESS infrastructure, and associated hardstanding areas.

The access track system will intercept runoff and maintain existing overland flow paths across the site. The developed-area drainage system will collect and convey runoff from impermeable and compacted surfaces to appropriate SuDS measures for treatment, attenuation, and controlled discharge.

The specific SuDS components will be determined based on the proposed site layout, ground levels, available space, ground conditions, pollution risks, and hydraulic assessment presented in the following sections.

3.3 Access Track Interception and Cross-Drainage System

It is identified that the introduction of access tracks and associated infrastructure has the potential to locally interrupt natural overland flow paths and, if not appropriately designed, lead to the accumulation of surface water upslope of these features. The proposed drainage strategy therefore focuses on maintaining existing flow routes across the site and ensuring that overland flow continues to convey downslope in a controlled and dispersed manner. However, for the hardstanding areas within the substation area these need to be dealt with via a stormwater network with attenuation as the newly hardstanding areas will increase surface runoff compared to the greenfield scenario. This will be discussed further in Section 3.4.

To maintain these existing flow paths where possible, the following interventions are proposed:

- Interception trenches will be provided upslope of access tracks at locations where natural overland flow paths would otherwise be interrupted. A typical arrangement is illustrated in Figure 3-2 with detailed drawing provided in Drawing no. OSP-JBAI-XX-XX-DR-C-0010-A3-C01-Substation_Drainage_Details. A conceptual visualization of complete strategy is shown in Figure 3-3. These trenches will intercept shallow surface runoff, preventing ponding upstream of the tracks and allowing flows to be conveyed in a controlled manner across the site. They will be shallow, vegetated features that integrate with the existing ground conditions, allowing a proportion of runoff to infiltrate where ground conditions permit.
- Check dams will be incorporated within trackside drains and interception trenches at regular intervals (typically approximately 40 - 80 m), as these features will reduce flow velocities, promote sediment deposition, and limit erosion within the drainage channels.
- Internal access tracks themselves will be constructed in an unbound material, allowing surface water to infiltrate through to the sub-soil underneath. To protect the structural integrity of the tracks themselves, it will be necessary to construct a camber in the profile. This will shed some run-off laterally to the trackside drains or into the grassed areas adjacent.
- Existing on-site drainage ditches or features, where present, will be cleaned and locally regraded as necessary to restore their existing function, without deepening, realignment, or formalisation.
- Site access points from the public road network will be designed to prevent runoff from discharging onto the public road, with entrance gradients directing flows back into the site. Surface water entering from the public road will be conveyed along access tracks and intercepted by trackside drainage features, including interception trenches, where it will be managed and allowed to disperse and infiltrate.

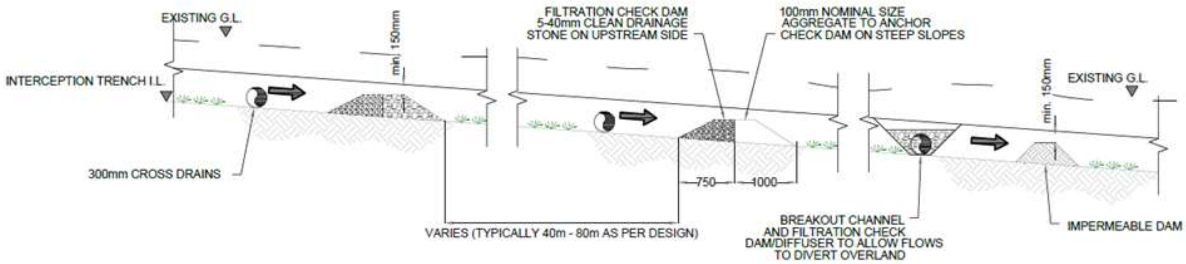


Figure 3-2 Proposed Check Dams with Trackside Drains/Interception Trenches

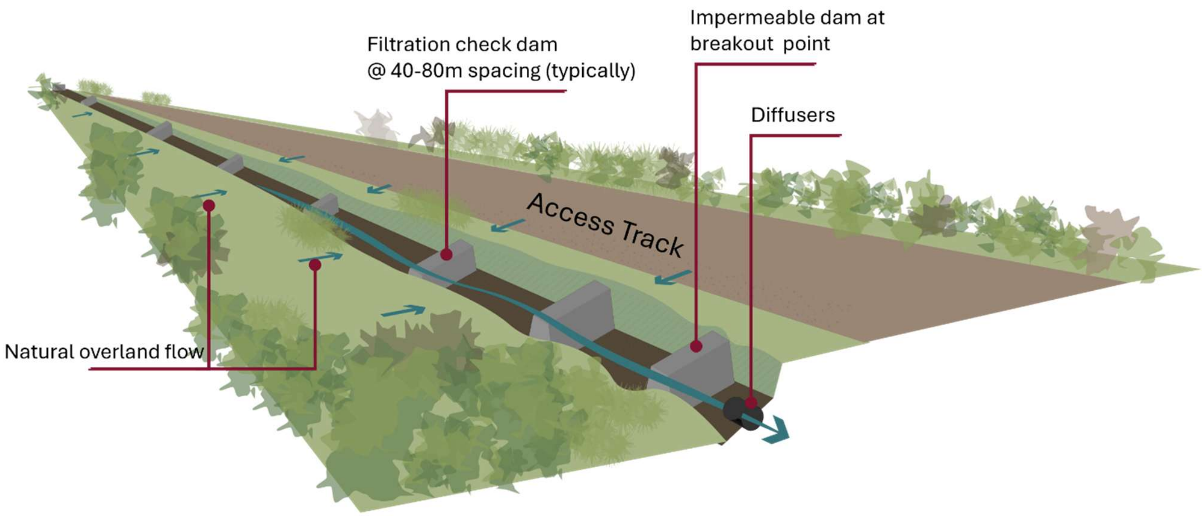


Figure 3-3 3D Visualization of proposed interception trench system

3.4 Hardstanding Drainage System

The buildings, compounds, BESS infrastructure, and associated hardstanding areas will increase the rate and volume of surface water runoff compared with the existing greenfield condition. These areas will therefore be served by a formal surface water drainage system, separate from the access track interception system described in Section 3.3. The areas included within the formal drainage catchment are identified in Figure 3-4, based on the latest layout information provided by TLI

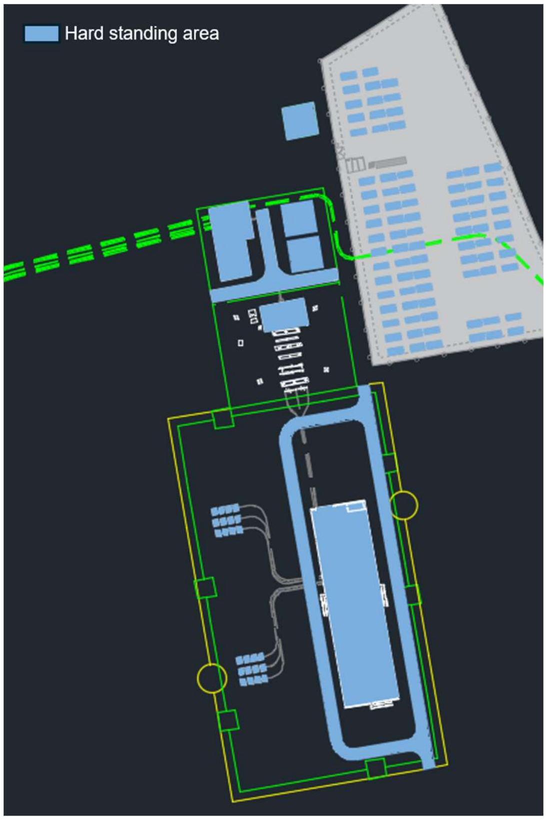


Figure 3-4 Hardstanding areas within Substation

Runoff from the principal building and its surrounding access track will be collected by gullies and conveyed to the proposed vegetated swales. The remaining identified hardstanding areas will be appropriately graded so that runoff discharges directly to the adjacent swales without passing through a separate gully or piped collection system.

The swales will be arranged around the developed areas and will follow the general direction of fall across the site. Cross-connection culverts will be provided where access tracks or other infrastructure interrupt the continuity of the swales.

The swale network will convey runoff towards the proposed attenuation pond located within the lower part of the site. The pond will temporarily store runoff generated during rainfall events and discharge it at a controlled rate through the proposed flow-control structure and outfall to the diverted drain.

The proposed diverted drain will convey the controlled discharge towards the downstream receiving watercourse. The pond and outfall arrangement will be coordinated with the alignment and levels of the proposed drain diversion to maintain positive drainage and avoid erosion or obstruction at the discharge point.

The swales and attenuation pond will form a SuDS management train, providing runoff conveyance, attenuation and treatment of routine diffuse pollution. The proposed components are intended to remain unlined where site-specific ground and groundwater conditions permit.

Infiltration has not been relied upon in the hydraulic assessment. This provides a conservative basis for determining the required conveyance and attenuation performance where the underlying ground provides limited infiltration.

A typical schematic of the proposed hardstanding drainage system is shown in Figure 3-5:

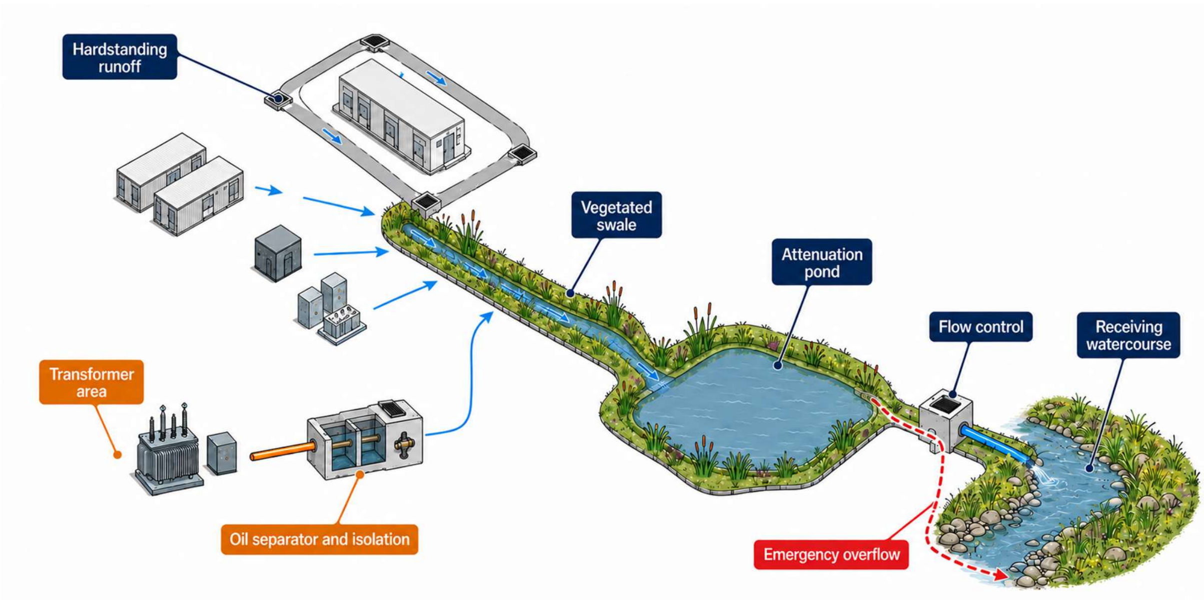


Figure 3-5 Typical schematic of the proposed hardstanding drainage and SuDS system

he Simple Index Approach will be used to assess routine pollution associated with runoff from roofs, the building access track and other hardstanding areas. Runoff from the transformer area, including any controlled drainage, will pass through the oil separator and drainage-isolation arrangement proposed by TLI before discharging to the upstream swale. No untreated runoff from the transformer area will discharge directly to the swales, attenuation pond, or proposed diverted drain which will convey flows towards the downstream receiving watercourse.

The indicative arrangement is shown on the Substation Drainage Layout, Drawing No. OSP-JBAI-XX-XX-DR-C-0009-A3-P01.

3.4.1 Hydraulic Assessment

The formal drainage catchment enclosed by the proposed drainage system extends to approximately 2.5543 ha. Following procedure was adopted to finalize the surface water strategy:

3.4.1.1 Sub-Catchment definition

For hydraulic modelling, the directly connected hardstanding areas were divided into three sub-catchments: southern, central, and northern as shown in Figure 3-6 .

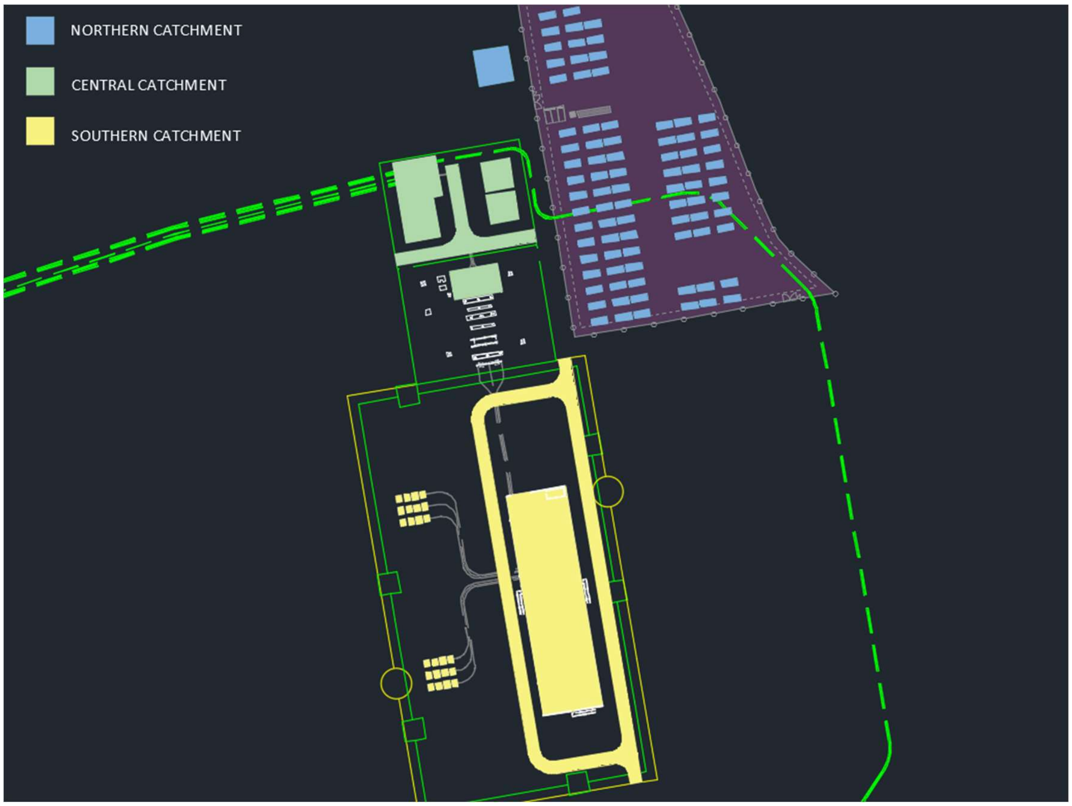


Figure 3-6 Hydraulic model sub-catchments

The hardstanding areas in these catchments are described in Table 3 1,Table 3 2 and Table 3 3, below:

Table 3-1 Southern Catchment

Description	Area (m^2)	Area (ha)
220kV GIS substation building	1,844.376	0.1844
Gantry hardstanding	120.000	0.0120
Impermeable access track	1,818.196	0.1818
Total	3,782.572	0.3782

Table 3-2 Central Catchment

Description	Area (m^2)	Area (ha)
Customer / IPP building	395.505	0.0396
Plinths	300.000	0.0300
Transformer area	196.548	0.0197
Impermeable access track	391.015	0.0391
Total	1283.068	0.1284

Table 3-3 Northern Catchment

Description	Area (m^2)	Area (ha)
BESS units	1,226.242	0.1226
Northern tower area	252.000	0.0252
Total	1,478.242	0.1478

The total area assigned as direct inflow to the formal drainage system is 6,543.882 m^2, or c. 0.6544 ha. The remaining c. 1.9 ha within the formal drainage catchment has not been assigned as direct inflow because it comprises pervious and/or hydraulically disconnected surfaces and deemed not to be contributing to surface runoff. Runoff from these pervious areas will be managed through interception system described in Section 3.3.

The final site grading shall be reviewed during detailed design. Where any additional surfaces if found to drain directly to the swales or attenuation pond, shall be incorporated into the hydraulic model using appropriate runoff parameters.

3.4.1.2 Allowable discharge

To assess the suitability of the proposed attenuation, the allowable discharge from the site must be determined.

As per LCCC's Surface Water/SuDS Specification 2022 the allowable discharge should be set to the greater **restriction** of Qbar or 2l/s/ha.

Table 3-4 Greenfield Run-off Rate Calculation

Greenfield Run-off Rate			
Catchment Area	=	2.5543	ha
SAAR	=	1031	mm
Soil type	=	3	
Soil Index	=	0.37	
Qbar =0.00108 x Area^ (0.89) x SAAR^ (1.17) x Soil ^ (2.17)			
Qbar for 50 ha	=	0.226	m^3/s
	=	226	l/s
Unit Qbar	=	4.5	l/s
Project Area Qbar	=	11.5	l/s

Alternatively, 2l/s/ha equates to an allowable discharge of 5.1l/s.

Table 3-5 Discharge Criterion for the Proposed Substation Development

Discharge criterion	Calculated rate
Estimated Qbar	11.5 l/s
2 l/s/ha applied to 2.5543 ha	5.1 l/s
Adopted maximum discharge rate	**5.1 l/s**

Consequently, the maximum discharge from the attenuation system has therefore been restricted to 5.1 l/s.

3.4.1.3 Hydraulic model configuration

A hydraulic model of the proposed surface-water drainage system was developed using Causeway Flow+ v17.0. The following parameters were included in the Causeway Flow model:

- Design return period: 5-Years
- Climate change allowance:30%
- Urban Creep allowance: 10%
- M5-60: 16.1mm (Met Eireann DDF data appended to this report)
- Ratio r: 0.265 (Met Eireann DDF data appended to this report)
- Cv: 1.0 (Runoff reduction factor of 100% applied as per LCCC Surface Water/SuDS Specification 2022)
- Time of entry: 4 minutes
- Storm duration: 15 to 10,080 minutes

No infiltration allowance has been included in the hydraulic assessment. The available storage and discharge performance have therefore been assessed without relying upon infiltration into the underlying ground.

3.4.1.4 Hydraulic model results

In order to deal with the surface runoff generated by the hardstanding areas of the substation area a hydraulic model was created in Causeway Flow. The network has been designed on 5-year return period to cater peak flows generated during the 5-year rainfall event plus Climate Change and Urban Creep allowances without surcharging.

The formal drainage network was assessed for rainfall durations ranging from 15 to 10,080 minutes. The critical storage event for the 1-, 30- and 100-year simulations was the 1,440 minute summer storm. The results indicate no flooding from the modelled drainage nodes for the assessed events, with discharge from the attenuation pond restricted to the adopted maximum rate of 5.1 l/s.

Finalized model consists of swales having 1500 mm base width and 300 mm depth and an attenuation system with a capacity of 509.3 m^3 with the maximum modelled pond level of 84.545 mOD. However, proposed pond size is given as 600 m^3.

3.4.2 SuDS Assessment

The SuDS strategy focuses on mimicking and preserving the natural hydrological regime, rather than replacing it with engineered drainage systems. This approach is consistent with the principles of the CIRIA SuDS Manual (C753) and GDSDS which prioritise source control, infiltration, and natural conveyance. There are four key pillars that SUDS design should aim to incorporate. These are presented in figure below.

The Proposed Substation Development differs from conventional urban development because impermeable surfaces are concentrated within defined buildings, compounds, and access areas, while much of the surrounding site will remain vegetated and permeable. The drainage strategy has therefore been developed as a combination of natural drainage preservation and formal SuDS measures.

Outside the formal hardstanding drainage catchment, existing overland flow pathways will be maintained through the access-track interception and cross-drainage system described in Section 3.3. Within the formal drainage catchment, runoff will be managed through surface grading, gullies serving the principal building area, vegetated swales, an attenuation pond, and a controlled discharge to the proposed diverted drain which will convey flows towards the downstream receiving watercourse.

The proposed strategy applies the SuDS management hierarchy as follows:

Table 3-6 SuDS management hierarchy for the Proposed Substation Development

SuDS management level	Application to the Proposed Substation Development
Prevention	Impermeable surfaces have been limited to the buildings, plant areas and access infrastructure required for operation of the Proposed Substation Development.

SuDS management level	Application to the Proposed Substation Development
Source control	Runoff from most hardstanding areas will be directed by surface grading to adjacent vegetated swales, allowing runoff to be managed close to where it is generated.
Site control	The swales and attenuation pond will convey, treat and temporarily store runoff before controlled discharge.
Regional control	The attenuated runoff will discharge at a controlled rate to the proposed diverted drain which will convey flows towards the downstream receiving watercourse.

The proposed drainage strategy also addresses the four principal pillars of SuDS as follows:

Table 3-7 SuDS pillars and Proposed Substation Development

SuDS Pillar	Application to the Proposed Substation Development
Water quantity	Runoff will be conveyed and attenuated before being discharged at a controlled rate
Water quality	Vegetated swales and the attenuation pond will provide settlement and treatment of routine runoff, with separate controls for the transformer area
Amenity	Open vegetated drainage features will be integrated into the site layout where compatible with operational and security requirements.
Biodiversity	Vegetated swales and pond margins will provide opportunities for habitat creation and ecological enhancement.

No infiltration has been relied upon in the hydraulic assessment. The swales and attenuation pond may remain unlined where site investigation confirms suitable ground and groundwater conditions and where this is compatible with pollution-control requirements.

3.4.2.1 Interception

Interception should be achieved for the first 5mm of rainfall as per Table 24.6 of The CIRIA SuDS Manual (C753). Interception is intended to prevent runoff from small rainfall events from discharging directly from the site.

For the Proposed Substation Development, it will be achieved via swales and the attenuation pond being suitable to be considered as a detention basin for interception. The capacity for interception within the site is summarised in Table 3-8.

Table 3-8 Interception

Component	Area (m²)	Interception Capacity (m²)
Swale	710.98	3,554.94
Detention Basin	600.00	3,000
Total	1,310.98	6,554.94
Hardstanding Area	6,543.83	-
Required	**-**	**6,543.88**
Provided	**-**	**6,554.94**

The proposed SuDS components therefore provide interception for an effective impermeable area of 6,554.94 m², compared with the identified hardstanding area of 6,543.88 m². The available interception provision is therefore sufficient.

The retained intercepted volume will be depleted between rainfall events through evapotranspiration and infiltration (where supported by site investigation at detailed design stage).

3.4.3 Pollution management using SuDS train

The proposed drainage strategy incorporates a SuDS management train to manage routine diffuse pollution associated with runoff from roofs, hardstanding areas, and internal access infrastructure. Runoff will pass through vegetated swales before entering the attenuation pond, which will operate as a detention basin. The swales will provide filtration and sedimentation, while the detention basin will provide a further stage of treatment before controlled discharge to the proposed diverted drain which will convey flows towards the downstream receiving watercourse.

The suitability of the proposed treatment train has been assessed using the Simple Index Approach presented in Chapter 26 of The SuDS Manual (C753) and detailed in Table 3-10. The assessment compares the pollution hazard indices associated with the proposed land uses against the mitigation indices provided by the proposed SuDS components.

Two representative land-use categories have been adopted:

- other roofs, representing runoff from the 220kV GIS substation building, Customer / IPP building and other roofed structures; and
- commercial yards and associated roads, representing runoff from compounds, hardstanding areas, and impermeable access tracks.

The SuDS Mitigation Indices assesses routine diffuse pollution associated with rainfall runoff from roofs, roads and hardstanding areas which will be catered for by the proposed Swale and Pond. As per Table 26.2 of C753 the SuDS Mitigation Indices from the proposed SuDS measures on site are as follows:

Table 3-9 Pollution hazard indices

Land use	Hazard Level	Total suspended solids	Metals	Hydrocarbons
Other Roofs (typically commercial/industrial roofs)	Low	0.3	0.2	0.05
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7

From table above highest applicable pollution hazard index is considered. Where two SuDS components operate in series, the combined mitigation index is calculated as follows:

Combined mitigation index = Mitigation Index_1 + 0.5 x (Mitigation Index_2)

Table 3-10 SuDS mitigation indices

SuDS component	Total suspended solids	Metals	Hydrocarbons
Vegetated swale	0.5	0.6	0.6
Detention basin	0.5	0.5	0.6
Combined mitigation index	**0.75**	**0.85**	**0.9**
Highest applicable pollution hazard index	**0.7**	**0.6**	**0.7**
Assessment	**Sufficient**	**Sufficient**	**Sufficient**

The combined mitigation indices exceed the corresponding pollution hazard indices. The proposed vegetated swales and detention basin therefore provide sufficient treatment for routine diffuse pollution from the identified roofs, hardstanding areas, and access infrastructure.

The Simple Index Approach does not assess accidental transformer-oil releases. However, for accidental release of transformer oil, TLI Drawing No. 300101309-O-DR-208-N0 identifies an oil separation arrangement serving the transformer area. Runoff from the transformer area gullies, together with any controlled discharge from the transformer area, will pass through the TLI proposed oil separator before connecting to the site surface-water drainage network. The final separator and drainage-isolation arrangements will be coordinated with TLI during detailed design, and no untreated drainage from the transformer area will connect directly to the downstream surface-water system.

3.4.4 Exceedance and Residual Risk

During rainfall events that exceed the design capacity of the drainage system, or where a local blockage occurs, excess runoff will be managed at the surface. The site generally falls from north to south, and exceedance flows will be directed towards the lower southern boundary and the proposed diverted drain, broadly following the existing topography.

The final site grading and emergency overflow from the attenuation pond shall provide continuous exceedance routes that direct runoff away from buildings, critical electrical infrastructure, access points, and neighbouring land. The routes shall not result in uncontrolled discharge onto the public road.

The wider assessment of overland flow and flood risk is provided in the Site-Specific Flood Risk Assessment submitted as a separate enclosure. While the exceedance flow routes are shown in drawing OSP-JBAI-XX-XX-DR-C-0011-A3-C01-Substation_Exceedance_Flows.

3.5 Health and Safety

Health and safety risks associated with the construction, operation and maintenance of the proposed drainage system have been considered during development of the drainage strategy. The design uses shallow, open, and accessible SuDS components where practicable and shall provide safe maintenance access to the swales, attenuation pond, flow-control chamber, outfall, oil separator, and drainage-isolation arrangements.

The identified design risks and associated mitigation measures are recorded in the project-specific Design Risk Assessment included in Appendix C. The Design Risk Assessment shall be reviewed as the design develops and communicated to the appointed PSDP, Contractor and site operator. It does not replace the Contractor’s method statements, task-specific risk assessments or the project Safety and Health Plan.

3.6 Operation and Maintenance

The drainage systems serving the Proposed Substation Development shall be inspected and maintained throughout the operational life of the development to ensure that they continue to provide their intended interception, conveyance, attenuation, treatment, and exceedance functions.

Unless otherwise agreed, responsibility for the drainage infrastructure will remain with the operator of the Proposed Substation Development. The indicative inspection and maintenance requirements are summarised in Table 3-11.

Table 3-11 Indicative drainage inspection and maintenance schedule

Drainage component	Inspection frequency	Typical maintenance requirements
Access tracks, interception trenches, and trackside drain	Quarterly and following significant rainfall	Remove litter, debris, and accumulated sediment; repair erosion, rutting, and damaged vegetation; reinstate track camber and drainage falls where required.
Check dams, cross-underdrains, and diffusers	Six-monthly and following significant rainfall	Check for blockage, displacement, erosion, and scour; clear pipes and outlets; repair check dams and reinstate stone or vegetation around diffusers.
Gullies, pipes, and manholes	Six-monthly and following any reported drainage problem	Remove debris and sediment; clean gully sumps; jet or survey pipes where restricted flow or blockage is identified; repair damaged covers and chambers.
Vegetated swales	Quarterly during the first year and six-monthly thereafter	Manage vegetation; remove litter and invasive species; repair erosion and bare areas; remove sediment where conveyance or treatment capacity is reduced; maintain check dams and the required interception-storage zones.
Attenuation pond operating as a detention basin	Quarterly and following significant rainfall	Inspect inlets, banks, base, and outlet; remove litter and excessive sediment; manage vegetation; repair erosion or animal damage; confirm that storage above the interception zone recovers between rainfall events.
Flow-control device and outlet chamber	Six-monthly and following any reported flooding	Inspect and clear the flow-control opening; check the chamber and associated pipework; confirm that the device remains securely installed and operates as intended.

The site operator shall retain a drainage maintenance register. The register shall record inspection dates, observed condition, maintenance undertaken, waste removed, photographs and any corrective actions required.

4 Conclusions

The drainage strategy for the Proposed Substation Development has been developed in accordance with SuDS principles and the site-specific drainage assessment. It is intended to preserve existing overland flow pathways outside the formal drainage catchment, manage the additional runoff generated by the proposed hardstanding areas and avoid increasing flood risk to downstream or third-party receptors.

The strategy comprises two complementary drainage systems:

- Outside the formal hardstanding drainage catchment, shallow interception trenches, trackside drains, check dams, cross-underdrains and diffusers will maintain the continuity of existing overland flow pathways across the access tracks. These measures will limit localised ponding and prevent the access infrastructure from creating new barriers to flow or concentrating runoff towards adjacent land.
- Within the formal drainage catchment, runoff from the buildings and hardstanding areas will be collected through surface grading, gullies, and vegetated swales. The swales will convey runoff to the proposed attenuation pond, which will operate as a detention basin and discharge at a controlled maximum rate of 5.1 l/s to the proposed diverted drain which will convey flows towards the downstream receiving watercourse. The pond will provide attenuation storage and a dedicated interception zone for the first 5 mm of rainfall.

The hydraulic assessment incorporates the stated climate-change and urban creep allowances. The results indicate no flooding from the modelled drainage nodes during rainfall events up to and including the 100-year event, with discharge restricted to the adopted maximum rate. No infiltration has been relied upon in demonstrating the hydraulic performance of the formal drainage system.

The proposed SuDS measures provide sufficient interception and treatment for routine runoff from the identified roofs, hardstanding areas, and access infrastructure. Runoff collected from the transformer area will pass through the TLI-proposed oil separator before entering the upstream swale.

During events exceeding the capacity of the drainage system, exceedance flows will generally follow the site topography towards the lower southern boundary and proposed diverted. The wider flood-risk assessment is provided in the separate Site-Specific Flood Risk Assessment.

The drainage infrastructure shall be inspected and maintained throughout the operational life of the Proposed Substation Development to preserve its interception, conveyance, attenuation, and treatment functions.

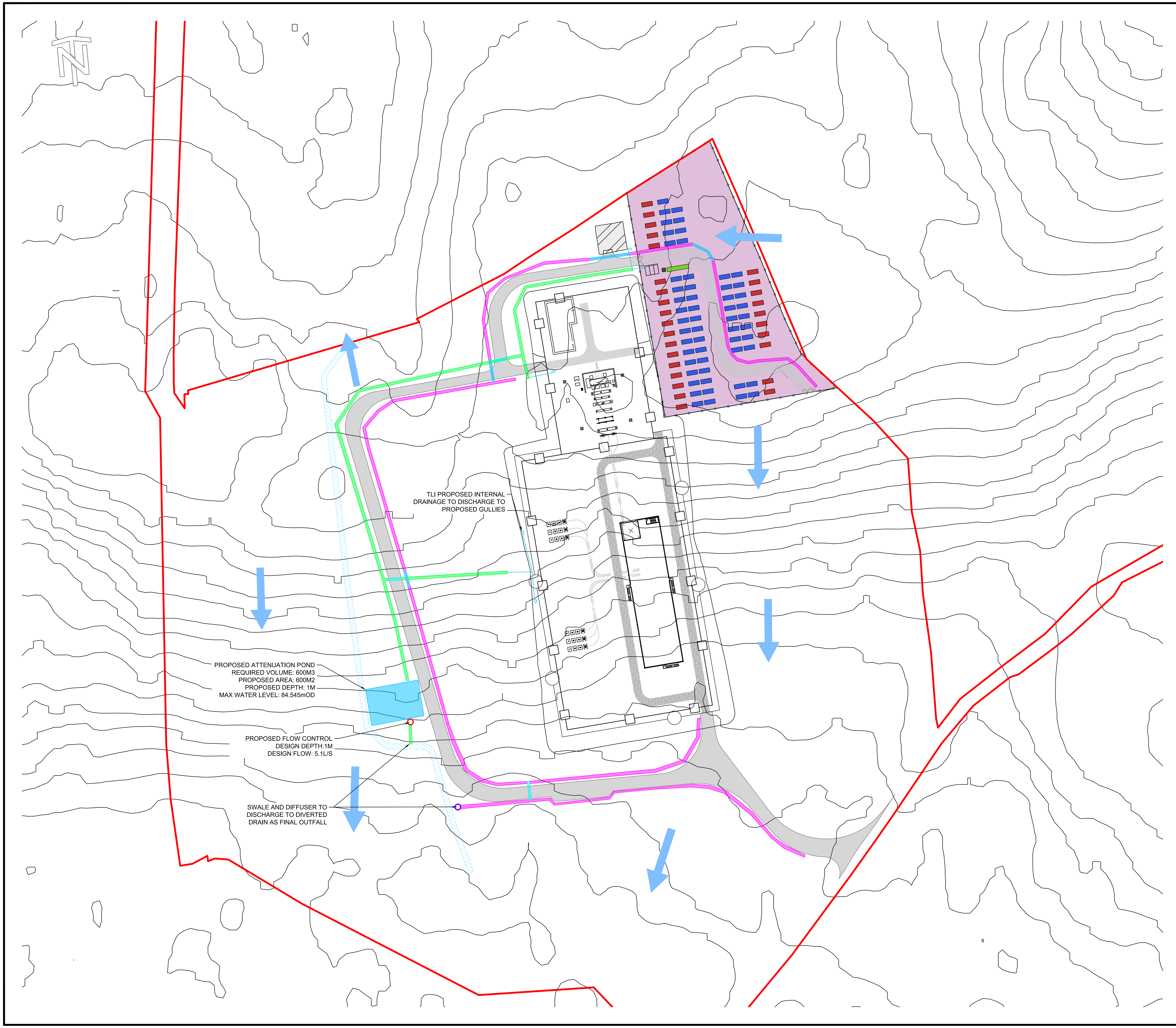
Subject to the implementation of these measures, the Proposed Development is not anticipated to adversely affect existing surface water drainage patterns or flood risk and will maintain baseline hydrological conditions across the site and its surroundings.

5 Recommendations

The following recommendations are made:

- Access tracks and associated infrastructure have been developed to align with existing overland flow paths identified through topographic assessment and site observations. Any material alteration to layout, levels or drainage features during construction shall be subject to drainage review to ensure that existing runoff behaviour and flow paths are maintained.
- Construction activities should be managed to minimise soil compaction, with reinstatement measures implemented promptly following works to restore infiltration capacity.
- Existing field boundaries, drainage features, hedgerows, and boundary vegetation should be retained where practicable. Where material regrading or alteration of a boundary drainage feature is proposed, consideration should be given to the potential effect on existing overland flow pathways and runoff behaviour.
- The inspection and maintenance requirements set out in Section 3.6 should be incorporated into the site's operational procedures. These should cover the swales, attenuation pond, gullies, interception trenches, check dams, diffusers, cross-underdrains, chambers, flow-control device, outfall, and oil separator.
- Site investigation and infiltration testing may be undertaken during detailed design to assess the infiltration potential of the underlying ground. The current drainage design conservatively assumes no infiltration. Where suitable infiltration is demonstrated, it may be considered when optimising the proposed SuDS components, provided that the required attenuation, interception, treatment, and groundwater-protection performance is maintained.
  The drainage-related residual risks identified in the Design Risk Assessment included in Appendix C should be communicated to the relevant project parties and considered during construction and maintenance activities.

A Appendix A (Drawings)



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LEGEND:

- INTERCEPTION TRENCH
- SWALE (1500mm x 300mm)
- DRAIN (TO BE DIVERTED)
- PROPOSED ACCESS TRACK
- SUBSTATION ACCESS TRACK
- BESS UNITS
- GULLIES
- CROSS CONNECTION CULVERT
- OVERLAND FLOW DIRECTION
- PROPOSED FLOW CONTROL
- BESS AREA
- DIFFUSER
- RED LINE BOUNDARY

NOTES:

INTERCEPTION TRENCHES TO CAPTURE ACCESS TRACKS OUTSIDE SUBSTATION AREA

SWALES TO CAPTURE SUBSTATION AREA, BESS UNITS AND ACCESS TRACKS WITHIN SUBSTATION AREA

FOR PROPOSED SWALES AND POND INFILTRATION HAS NOT BEEN CONSIDERED IN THE DESIGN. HOWEVER, THESE FEATURES SHOULD BE UNLINED TO ALLOW FOR INFILTRATION TO OCCUR.

ALL RUNOFF FROM TRANSFORMER AREA GULLIES, INCLUDING ANY CONTROLLED DISCHARGE FROM THE TRANSFORMER, SHALL PASS THROUGH THE TLI-PROPOSED OIL SEPERATOR, OR EQUIVALENT APPROVED SYSTEM, BEFORE CONNECTING TO THE SURFACE WATER DRAINAGE NETWORK

NO UNTREATED DRAINAGE FROM THE TRANSFORMER COMPOUND SHALL CONNECT DIRECTLY TO THE SWALES, POND OR RECIEVING WATER.

THE SEPERATOR TYPE, CAPACITY, OIL ALARM, AUTOMATIC CLOSURE/ISOLATION ARRANGEMENT, AND FINAL CONNECTION LEVELS SHALL BE CONFIRMED AND COORDINATED WITH TLI AT DETAILED DESIGN STAGE

CONSTRUCTION SEQUENCING SHALL BE COORDINATED TO ENSURE THAT TEMPORARY CONSTRUCTION AREAS DO NOT PREVENT THE DRAINAGE FEATURES FROM BEING CONSTRUCTED AND MADE OPERATIONAL BY SUBSTANTIAL COMPLETION OF THE SUBSTATION

Rev.	Description	Date	Author	Designer	Checker	Approver
C01	FOR PLANNING SUBMISSION	02/09/26	JS	JS	AA	MOD
P01	FOR REVIEW	28/08/26	JS	JS	AA	MOD

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Project Title

EAST LIMERICK SUBSTATION DEVELOPMENT

Drawing Title

SUBSTATION DRAINAGE LAYOUT

Client

HARMONY SOLAR EAST LIMERICK LIMITED

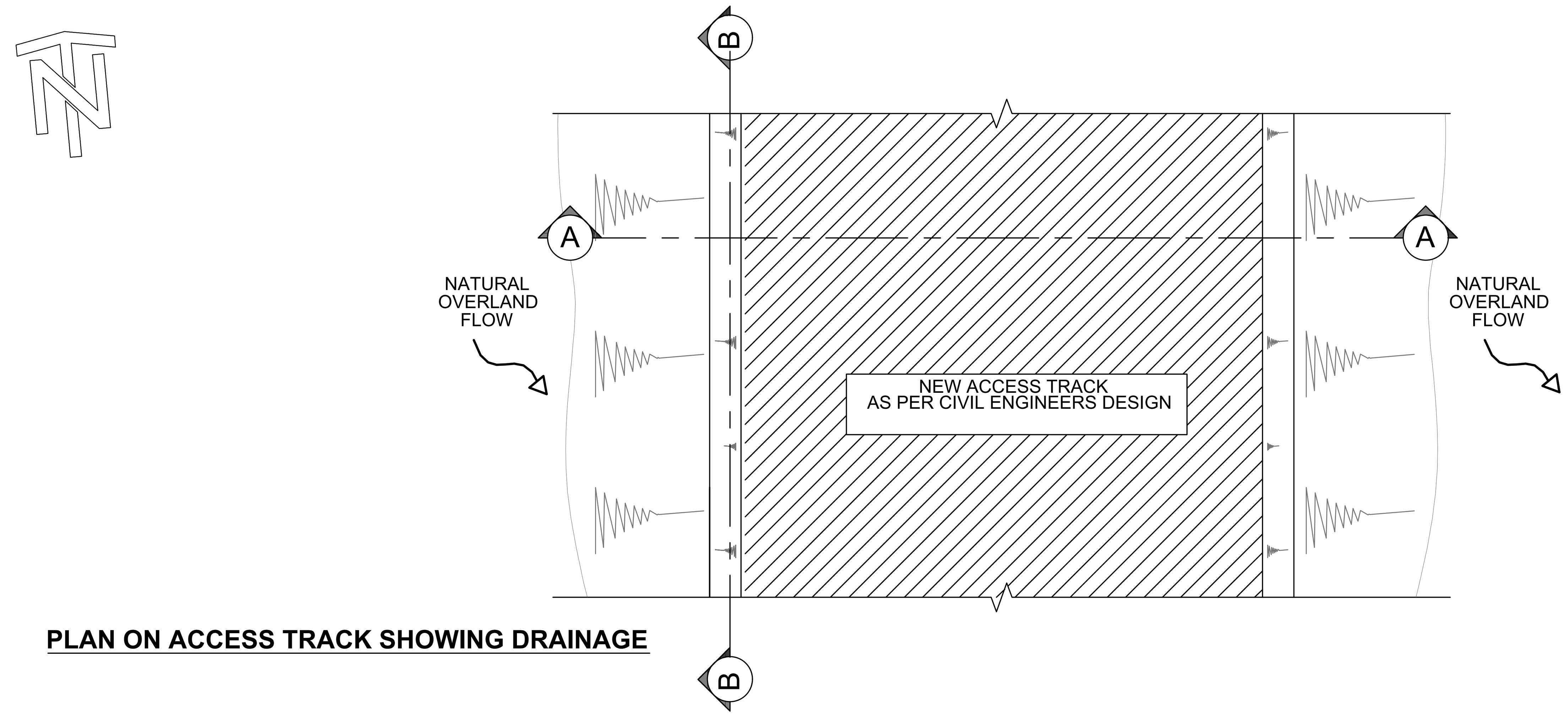
Parent Model
OSP-JBAI-XX-XX-DR-C-0009-A3-C01-Substation_Drainage_Layout.dwg

Security Classification	Scale
OFFICIAL	**1:1000**

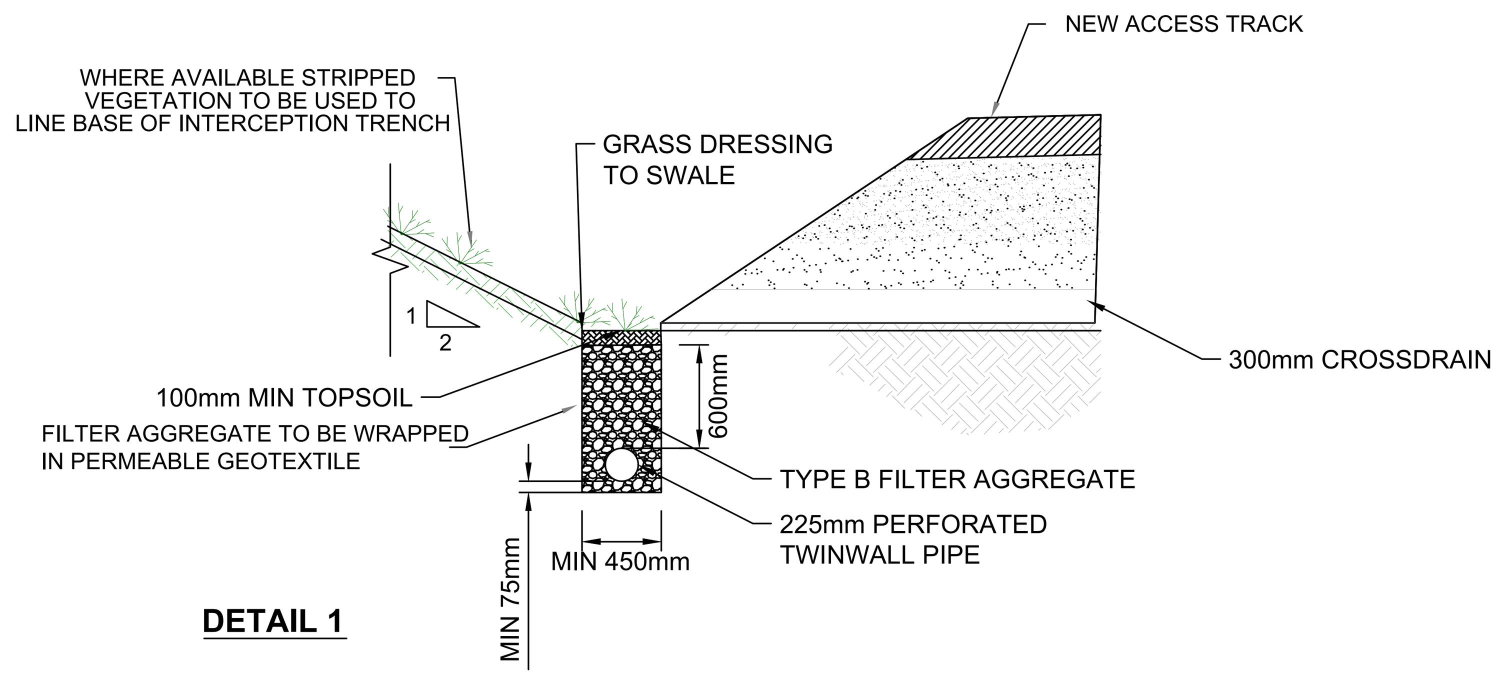
Author	Designer	Checker	Approver
JS	**JS**	**AA**	**MOD**

Suitability	Status	Revision
PUBLISHED DEFINITION	**A3**	**C01**

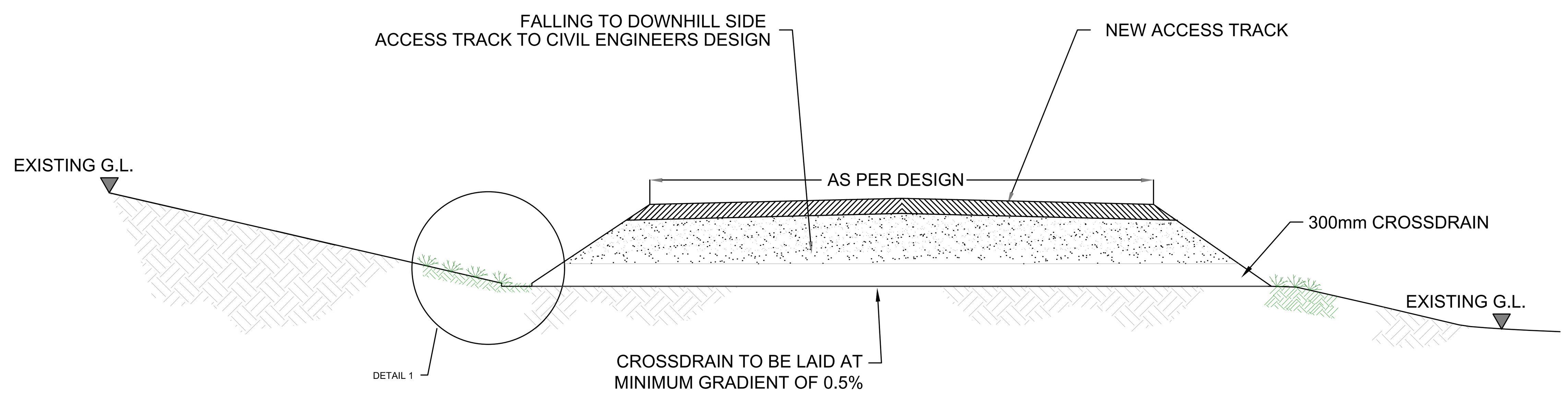
Information Container — A1 Sheet Size
OSP-JBAI-XX-XX-DR-C-0009-A3-C01



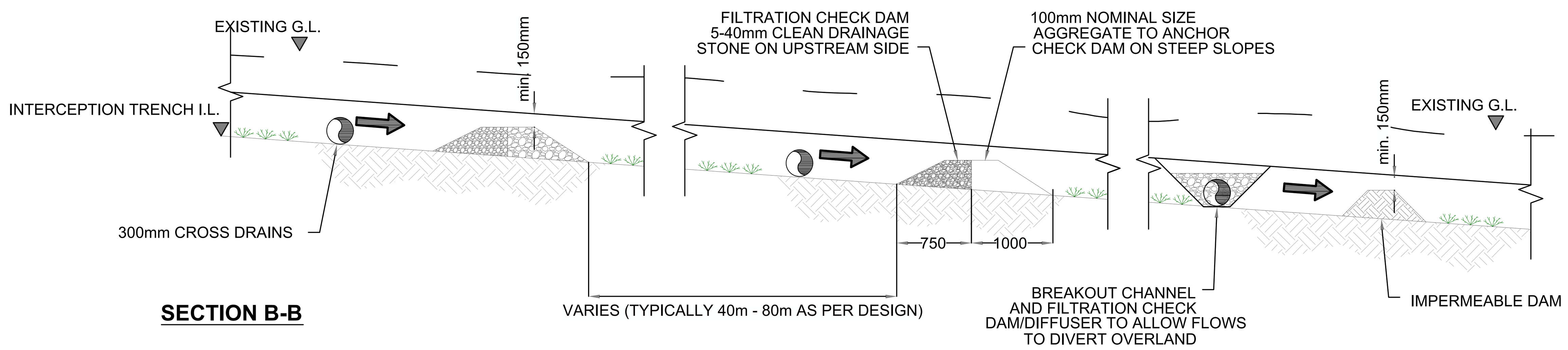
PLAN ON ACCESS TRACK SHOWING DRAINAGE



DETAIL 1



SECTION A-A



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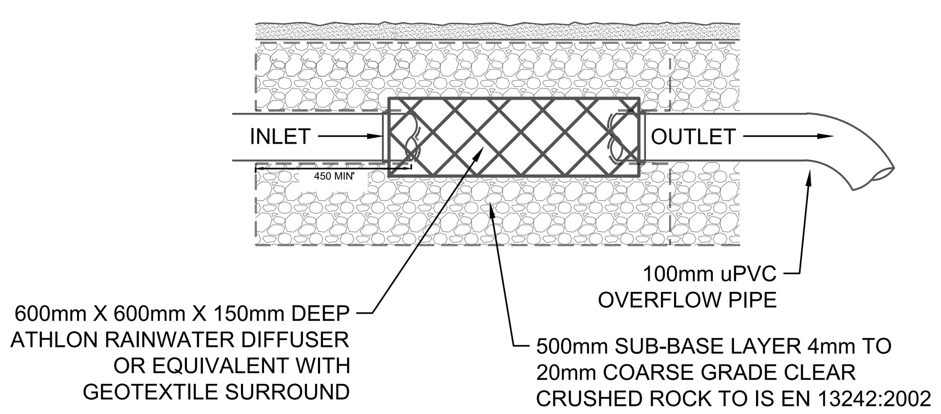
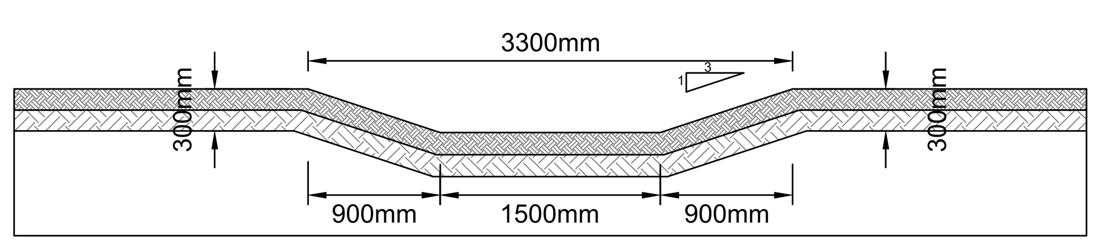
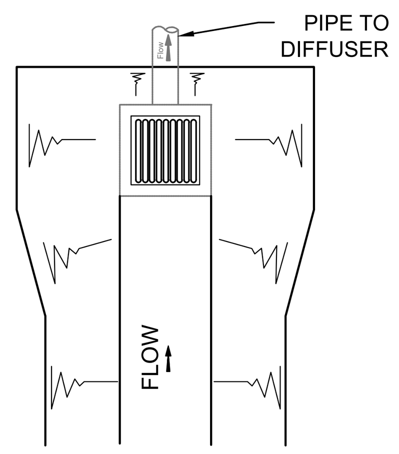


DIFFUSER DETAIL

TYPICAL SECTION THROUGH SWALE





SWALE OUTLET ARRANGEMENT

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Project Title
EAST LIMERICK SUBSTATION DEVELOPMENT

Drawing Title
SUBSTATION DRAINAGE DETAILS

Client
HARMONY SOLAR EAST LIMERICK LIMITED

Parent Model
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Security Classification	Scale
OFFICIAL	NOT TO SCALE

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JS	JS	AA	MOD

Suitability	Status	Revision
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Information Container — A1 Sheet Size
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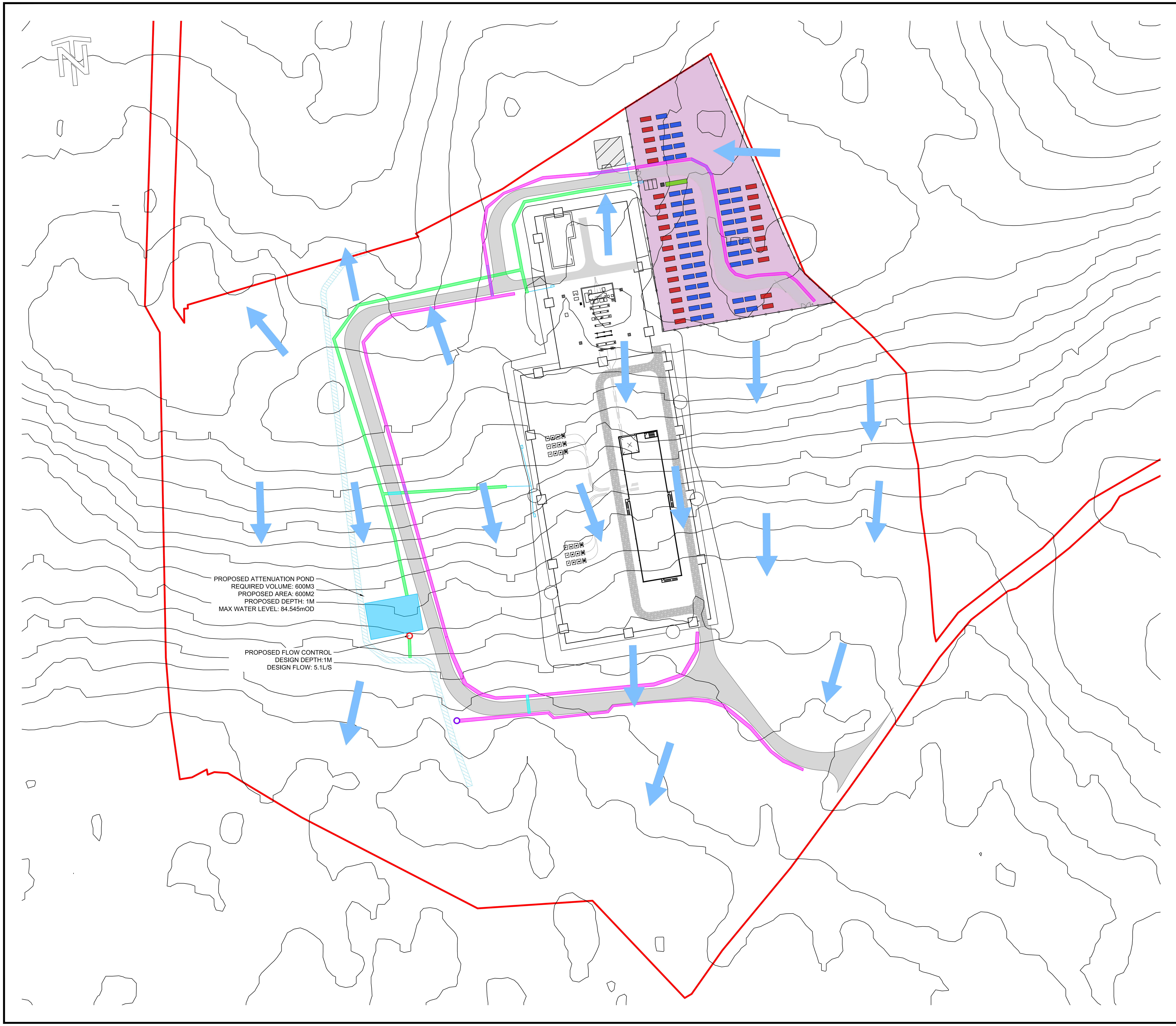

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C01	FOR PLANNING SUBMISSION	02/09/26	JS	JS	AA	MOD
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Project Title

EAST LIMERICK SUBSTATION DEVELOPMENT

Drawing Title

SUBSTATION EXCEEDANCE FLOWS

Client

HARMONY SOLAR EAST LIMERICK LIMITED

Parent Model
OSP-JBAI-XX-XX-DR-C-0011-A3-C01-Substation_Exceedance_Flows.dwg

Security Classification	Scale
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Author	Designer	Checker	Approver
JS	**JS**	**AA**	**MOD**

Suitability	Status	Revision
PUBLISHED DEFINITION	**A3**	**C01**

Information Container — A1 Sheet Size
OSP-JBAI-XX-XX-DR-C-0011-A3-C01

B Appendix B (Causeway Flow Model Results 100-Year Event)

JBA Consulting Engineers and

File: OSP-JBAI-XX-XX-CA-C-0001-S0-P01.01-Substa
Network: Storm
Jack Shanahan
31/08/2026

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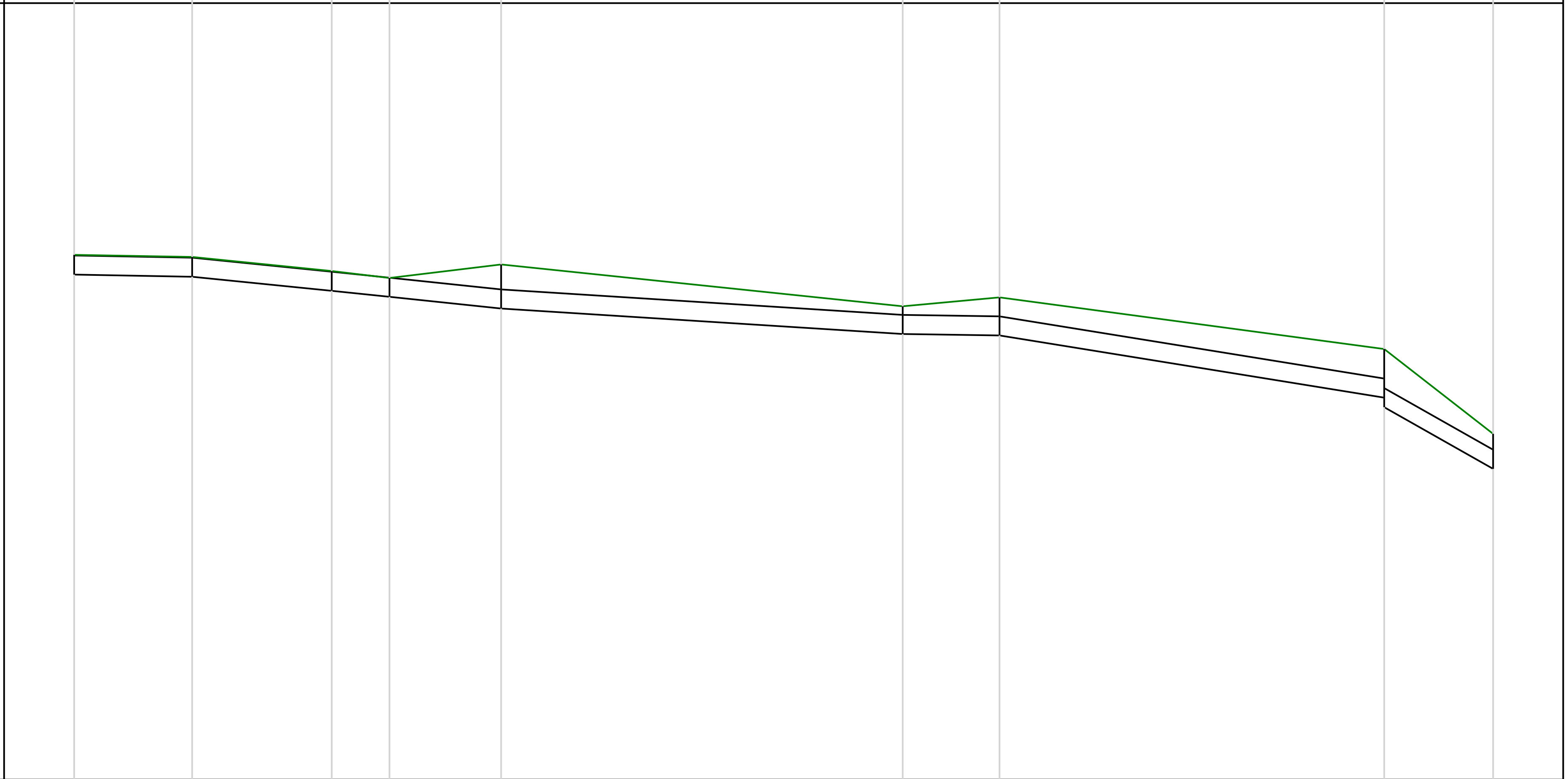

A4 drawing

Hor Scale 1500
Ver Scale 100

Datum (m) 80.000

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Slope (1:X)	817.2	148.7	144.7	142.9	236.4	991.0	92.7	26.5
Invert Level (m)	87.933 / 87.899	87.899 / 87.678	87.678 / 87.584	87.584 / 87.400	87.400 / 87.000	87.000 / 86.977	86.977 / 86.000	85.850 / 84.882
Length (m)	27.785	32.868	13.597	26.289	94.560	22.793	90.583	25.648

Node	9	4	5	6	11	12	13	15	16
Cover Level (m)	88.243	88.210	87.989	87.880	88.092	87.435	87.575	86.764	85.432

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A4 drawing Hor Scale 1500 Ver Scale 100 Datum (m) 79.000		
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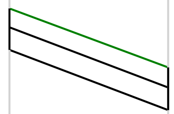

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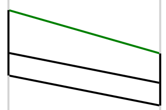
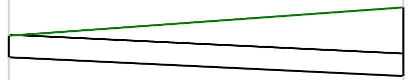


A4 drawing

Hor Scale 1500
Ver Scale 100

Datum (m) 82.000

Link Name	10	
Section Type	_/ 1500x300mn	
Slope (1:X)	75.0	
Cover Level (m)	88.669	88.092
Invert Level (m)	87.800	87.400
Length (m)	30.017	



A4 drawing

Hor Scale 1500
Ver Scale 100

Datum (m) 80.000

Node Name	14		15
Link Name		14	
Section Type		_/ 1500x300mm 1:3.0	
Slope (1:X)		313.1	
Cover Level (m)	86.387		86.764
Invert Level (m)	86.100	85.850	
Length (m)		78.277	

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	16.100	Minimum Backdrop Height (m)	0.200
Ratio-R	0.265	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
4			88.210	570287.884	634701.825	0.311	87.899
5			87.989	570255.554	634695.900	0.311	87.678
6			87.880	570249.632	634683.660	0.296	87.584
9	0.148	4.00	88.243	570315.333	634705.948	0.310	87.933
10	0.128	4.00	88.669	570261.462	634628.633	0.869	87.800
11			88.092	570254.394	634657.806	0.692	87.400
12			87.435	570161.989	634637.735	0.435	87.000
13			87.575	570148.586	634619.299	0.598	86.977
14	0.378	4.00	86.387	570253.923	634537.650	0.287	86.100
15			86.764	570175.790	634532.898	0.914	85.850
16			85.432	570182.749	634508.212	0.550	84.882
17			84.649	570189.250	634477.314	0.567	84.082

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
9	9	4	27.785	0.030	87.933	87.899	0.034	817.2	300	5.12	50.0
4	4	5	32.868	0.030	87.899	87.678	0.221	148.7	300	5.68	50.0
5	5	6	13.597	0.030	87.678	87.584	0.094	144.7	300	5.91	50.0
6	6	11	26.289	0.030	87.584	87.400	0.184	142.9	300	6.35	50.0
10	10	11	30.017	0.030	87.800	87.400	0.400	75.0	300	4.37	50.0
11	11	12	94.560	0.030	87.400	87.000	0.400	236.4	300	8.40	48.1
12	12	13	22.793	0.030	87.000	86.977	0.023	991.0	300	9.41	45.7
13	13	15	90.583	0.030	86.977	86.000	0.977	92.7	300	10.63	43.2
14	14	15	78.277	0.030	86.100	85.850	0.250	313.1	300	5.95	50.0
15	15	16	25.648	0.030	85.850	84.882	0.968	26.5	300	10.82	42.9
16	16	17	31.575	0.030	84.882	84.082	0.800	39.5	300	11.10	42.4

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
9	0.414	298.4	26.7	0.010	0.011	0.148	0.0	79	0.195
4	0.972	699.5	26.7	0.011	0.011	0.148	0.0	48	0.338
5	0.985	709.3	26.7	0.011	-0.004	0.148	0.0	48	0.343
6	0.991	713.7	26.7	-0.004	0.392	0.148	0.0	47	0.343
10	1.368	984.8	23.1	0.569	0.392	0.128	0.0	36	0.400
11	0.771	554.9	48.0	0.392	0.135	0.276	0.0	77	0.358
12	0.376	271.0	45.6	0.135	0.298	0.276	0.0	113	0.219
13	1.231	886.0	43.1	0.298	0.464	0.276	0.0	55	0.469
14	0.670	482.1	68.3	-0.013	0.614	0.378	0.0	103	0.368
15	2.302	1657.4	101.3	0.614	0.250	0.654	0.0	63	0.948
16	1.886	1357.9	100.1	0.250	0.267	0.654	0.0	71	0.832

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
Rainfall Events	Singular	Drain Down Time (mins)	240
FSR Region	Scotland and Ireland	Additional Storage (m³/ha)	20.0
M5-60 (mm)	16.100	Starting Level (m)	
Ratio-R	0.265	Check Discharge Rate(s)	x
Summer CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	30	10	0	100	30	10	0
30	30	10	0				

Node 17 Online Hydro-Brake® Control

Flap Valve	✓	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	84.082	Product Number	CTL-SHE-0113-5100-0500-5100
Design Depth (m)	0.500	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.1	Min Node Diameter (mm)	1200

Node 17 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	84.082
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1200.0	1200.0	0.500	1200.0	1261.4	0.501	0.0	1261.4

Results for 1 year +30% CC +10% A Critical Storm Duration. Lowest mass balance: 99.91%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	4	11	87.955	0.056	31.4	0.0000	0.0000	OK
15 minute summer	5	12	87.737	0.059	34.2	0.0000	0.0000	OK
15 minute summer	6	13	87.636	0.052	34.0	0.0000	0.0000	OK
15 minute summer	9	10	88.022	0.089	32.7	0.9394	0.0000	OK
15 minute summer	10	10	87.843	0.043	28.3	0.1404	0.0000	OK
30 minute summer	11	21	87.479	0.079	45.6	0.0000	0.0000	OK
30 minute summer	12	25	87.099	0.099	46.1	0.0000	0.0000	OK
60 minute summer	13	43	87.026	0.049	32.2	0.0000	0.0000	OK
15 minute summer	14	11	86.238	0.138	83.6	4.0096	0.0000	OK
30 minute summer	15	20	85.897	0.047	64.0	0.0000	0.0000	OK
15 minute summer	16	13	84.944	0.062	61.1	0.0000	0.0000	OK
1440 minute summer	17	930	84.236	0.154	15.4	185.0770	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	4	4	5	34.2	0.370	0.049	3.0377	
15 minute summer	5	5	6	34.0	0.388	0.048	1.1940	
15 minute summer	6	6	11	31.5	0.299	0.044	2.7842	
15 minute summer	9	9	4	31.4	0.257	0.105	3.4355	
15 minute summer	10	10	11	29.6	0.462	0.030	2.4628	
30 minute summer	11	11	12	46.1	0.350	0.083	13.5412	
30 minute summer	12	12	13	33.4	0.295	0.123	2.7004	
60 minute summer	13	13	15	28.3	0.429	0.032	6.0002	
15 minute summer	14	14	15	63.0	0.390	0.131	13.1156	
30 minute summer	15	15	16	62.2	0.687	0.038	2.3344	
15 minute summer	16	16	17	60.6	1.087	0.045	1.8308	
1440 minute summer	17	Hydro-Brake®		5.1				273.6

Results for 30 year +30% CC +10% A Critical Storm Duration. Lowest mass balance: 99.86%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	4	11	87.983	0.084	70.8	0.0000	0.0000	OK
15 minute summer	5	11	87.763	0.085	69.5	0.0000	0.0000	OK
15 minute summer	6	12	87.666	0.082	70.5	0.0000	0.0000	OK
15 minute summer	9	10	88.068	0.135	72.6	1.4137	0.0000	OK
15 minute summer	10	9	87.865	0.065	62.8	0.2110	0.0000	OK
15 minute summer	11	13	87.535	0.135	120.4	0.0000	0.0000	OK
30 minute summer	12	22	87.159	0.159	105.9	0.0000	0.0000	OK
30 minute summer	13	25	87.062	0.085	93.2	0.0000	0.0000	OK
15 minute summer	14	11	86.322	0.222	185.5	6.4373	0.0000	OK
60 minute summer	15	36	85.933	0.083	162.9	0.0000	0.0000	OK
15 minute summer	16	12	84.988	0.106	155.7	0.0000	0.0000	OK
1440 minute summer	17	1050	84.413	0.331	28.5	397.4366	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	4	4	5	69.5	0.469	0.099	4.8667	
15 minute summer	5	5	6	70.5	0.490	0.099	1.9561	
15 minute summer	6	6	11	69.0	0.366	0.097	5.2482	
15 minute summer	9	9	4	70.8	0.358	0.237	5.5555	
15 minute summer	10	10	11	62.9	0.575	0.064	5.0526	
15 minute summer	11	11	12	109.4	0.478	0.197	23.5653	
30 minute summer	12	12	13	93.2	0.445	0.344	5.0238	
30 minute summer	13	13	15	78.5	0.617	0.089	11.5622	
15 minute summer	14	14	15	161.5	0.548	0.335	24.2785	
60 minute summer	15	15	16	162.7	1.010	0.098	4.1532	
15 minute summer	16	16	17	157.5	1.501	0.116	3.4938	
1440 minute summer	17	Hydro-Brake®		5.1				344.0

Results for 100 year +30% CC +10% A Critical Storm Duration. Lowest mass balance: 99.77%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	4	11	87.997	0.098	92.8	0.0000	0.0000	OK
15 minute summer	5	11	87.776	0.098	91.1	0.0000	0.0000	OK
15 minute summer	6	12	87.679	0.095	90.6	0.0000	0.0000	OK
15 minute summer	9	10	88.086	0.153	94.1	1.6121	0.0000	OK
15 minute summer	10	10	87.875	0.075	81.4	0.2438	0.0000	OK
15 minute summer	11	12	87.560	0.160	157.7	0.0000	0.0000	OK
30 minute summer	12	21	87.182	0.182	136.4	0.0000	0.0000	OK
30 minute summer	13	24	87.079	0.102	127.0	0.0000	0.0000	OK
15 minute summer	14	11	86.352	0.252	240.3	7.3130	0.0000	OK
30 minute summer	15	20	85.949	0.099	224.3	0.0000	0.0000	OK
15 minute summer	16	12	85.007	0.125	212.3	0.0000	0.0000	OK
1440 minute summer	17	1140	84.513	0.431	35.1	517.6569	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	4	4	5	91.1	0.520	0.130	5.7631	
15 minute summer	5	5	6	90.6	0.530	0.128	2.3225	
15 minute summer	6	6	11	89.0	0.383	0.125	6.4086	
15 minute summer	9	9	4	92.8	0.397	0.311	6.5599	
15 minute summer	10	10	11	81.3	0.599	0.083	6.1933	
15 minute summer	11	11	12	158.8	0.527	0.286	29.3635	
30 minute summer	12	12	13	127.0	0.498	0.469	6.0825	
30 minute summer	13	13	15	109.7	0.691	0.124	14.4308	
15 minute summer	14	14	15	222.0	0.628	0.460	29.1075	
30 minute summer	15	15	16	222.2	1.105	0.134	5.2457	
15 minute summer	16	16	17	216.0	1.674	0.159	4.5635	
1440 minute summer	17	Hydro-Brake®		5.1				348.9

C Appendix C (Design Risk Assessment)

DESIGN RISK REGISTER

Client:	Harmony Solar East Limerick Limited
BIM Reference:	OSP
Project Name:	East Limerick Substation Development
Project Code	2024s1892
Project Stage	Conceptual

The Design Risk Register (DRR) is a live document, containing details of hazards associated with a project. It should be reviewed and revised as necessary throughout the various stages of design until handover.

Each revision must be approved by a Project Director or Technical Reviewer with appropriate competence, as stated in the Project Quality Plan (PQP).

Revision	Purpose of issue	Contributing Designers	Originated	Checked	Approved	Date
P01	For Review	JBA Consulting	JBA Consulting	AA	MOD	8/31/2026
C01	For Planning	JBA Consulting	JBA Consulting	AA	MOD	9/2/2026

AS THE DESIGNER, HAVE YOU CONSIDERED ALL REASONABLY FORESEEABLE HAZARDS/RISKS ASSOCIATED WITH THIS DESIGN DURING CONSTRUCTION, USE, OPERATION, MAINTENANCE AND FUTURE DECOMMISSIONING? IF YES PROCEED WITH APPROVAL.

Stage 1					Stage 2	Stage 3				Stage 4	
Identify					Eliminate / Reduce	Inform				Control	
Ref. no.	Location	Project element, material or activity	Identified significant health, safety, security, welfare, and environmental hazards and possible effects	People or environment at risk from the hazard	Design measures taken to eliminate the hazard or reduce the risk	Residual hazards and risks	Communication method	Drawing Numbers	Warning Triangle Type	Risk owner(s)	Recommended control measures
LIMITATION IN DESIGNS											
L01	XX	Interception trenches and Cross drains	Insufficient drainage capacity if existing agricultural drains change or become blocked	Maintenance Personnel	Drainage aligned with natural overland flow paths and existing field drainage patterns where possible	Localised flooding if downstream drains are obstructed	Safety File O&M Manual	C-0009	Flood risk	Client O&M	Maintain downstream drains and ensure periodic inspection
L02	XX	Construction near watercourses	Sediment runoff to ditches and streams	Environment	Design includes filtration check dams and diffusers to reduce sediment transport. However, performance depends on correct installation and maintenance.	Temporary sediment mobilisation	Environmental management plan		Adjacent to watercourse	PSDP PSCS	Temporary silt control measures
L03	XX	Cross drain pipe beneath access track	If cross-drain pipes beneath access tracks are installed at the specified minimum gradient of 1:200 insufficient hydraulic conveyance may occur resulting in silting/blocking of the crossing	Environment, Access track users	Design specifies minimum gradient of 1:200 to maintain positive drainage flow and prevent sediment accumilation.	Improper installation during construction could reduce hydraulic performance	Design drawings, drainage detail and contractor method statement	C-0010	Notes	PSCS Client O&M	Ensure pipe levels are set out accurately during construction and verified prior to backfilling
L04	XX	Diffuser discharge points	Concentrated flows causing erosion	Environment	Diffusers installed to dissipate energy and distribute flow	Minor erosion possible	Safety File O&M Manual	C-0009	Soil Erosion	Client O&M	Monitor outfall condition and reinstate vegetation if erosion occurs
CONSTRUCTION (MOST SIGNIFICANT RISKS)											
SC01	XX	Construction near field drains and ditches	Slips/falls into water features, flooding or erosion during works if heavy rain, pollution from site runoff	Construction operatives, road uses, adjacent third parties, receiving environment	Sequence works to avoid periods of wet weather, including temporary works	Temporary works may obstruct natural flow, heavy rainfall during works may cause localised flooding. Permanent drainage system may not be operational during early construction stages	Prelim H&S Plan Construction Phase H&S Plan	C-0009	Slippery surface	PSDP PSCS	Maintain temporary overland flow corridor free of stored materials, phased construction to maintain positive drainage, weather monitoring, ensure excavations are protected from runoff ingress. PSDP to incorporate all residual risks into their Prelim H&S Plan. PSCS to incorporate DRA and Prelim H&S Plan into their Construction Phase H&S Plan.
SC02	XX	Access tracks and drainage infrastructure located beneath overhead transmission lines	Construction plant or equipment may encroach into safe clearence zones of overhead transmission lines resulting in risk of electrocution or plant contact with live conductors	Construction personnel and site operatives	Overhead transmission line corridors identified within design drawings and construction exclusion zones to be established during works	Risk of plant interaction with OHTL if controls are not followed	Prelim H&S Plan Construction Phase H&S Plan	C-0009	Overhead Cables	PSDP PSCS	Establish safe working distances, install goalposts where required, and implement ESB safety guidance for working near OHTLs
SC03	XX	Pollution from Site Runoff During Construction	Pollutant runoff to ditches and streams	Environment	Wheel wash and track cleaning measures where necessary	Temporary sediment mobilisation	Environmental management plan	C-0009	Adjacent to watercourse	PSDP PSCS	Temporary silt control measures
ENVIRONMENT (MOST SIGNIFICANT RISKS)											
OPERATION AND MAINTENANCE / CLEANING (MOST SIGNIFICANT RISKS)											
SO01	XX	Interception trenches and Cross drains	Sediment accmulation reducing drainage capacity	Maintenance Personnel, track users	Check dams and gravel material proposed	Reduced drainage efficiency	O&M Manual		Flood risk	Client O&M	Periodic inspection and clearing
DECOMMISSIONING / DEMOLITION (MOST SIGNIFICANT RISKS)											
CONSTRUCTION											
C01	XX	Installation of diffuser units	Manual handling injuries	Construction workers	Small modular components used	Lifting injuries	Safety File	C-0009	Manual handling	PSDP PSCS	Mechanical lifting aids where necessary
C02	XX	Temporary storage of drainage materials (e.g. pipes, geotextiles)	Materials obstructing natural flow paths, causing localised flooding or runoff during storms	Construction personnel, environment	Storage zones designated away from flow paths in layouts	Storm events displacing materials	Environmental management plan	C-0010	General hazard	PSDP PSCS	Secure storage with bunding, weather forecasting integration into site plannig
ENVIRONMENT											
OPERATION AND MAINTENANCE / CLEANING											
O01	XX	Soil management measures	Construction activities may compact soils, reducing infiltration capacity and increasing surface runoff	Environment	Soil management measures such as chisel ploughing or equivalent cultivation following installation to alleviate construction-related compaction and promote vegetation establishment	Reduction in infiltration capacity	O&M Manual		Flood risk	Client O&M	Periodic inspection of soil condition and drainage pathways
DECOMMISSIONING / DEMOLITION											
D01		No project-specific decommissioning or demolition risks have been identified at this planning stage. Any relevant risks arising from the developed design will be assessed and recorded during detailed design.									

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