



Land North of Bronwylfa Road, Wrexham – Outline Drainage Strategy

INVA-ACM-LGY-XX-RP-CE-001000

27nd November 2024

Quality information

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BS	British Standards
CCS	Construction Consolidation Site
CIRIA	Construction Industry Research and Information Association
DMRB	Design Manual for Roads and Bridges
EIA	Environmental Impact Assessment
ESS	Energy Storage System
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FRS	Fire and Rescue Service
LLFA	Lead Local Flood Authority
LFRMS	Local Flood Risk Management Strategy
NFCC	National Fire Chiefs Council
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NRW	Natural Resource Wales
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems

Terminology

Energy Storage System	An energy storage system which uses rechargeable batteries to store and distribute energy as electricity. This allows energy from renewable sources to be stored and released as required.
Sustainable Drainage System	A collection of water management practices and measures that aim to align modern drainage systems with natural water processes. This includes, amongst other measures, infiltration and attenuation.
Q _{BAR}	Mean annual flood, the value of the average annual flood event recorded in a river.

1. Introduction

1.1 Purpose of Report

AECOM have been commissioned by Innova Renewables Developments to revise and update the outline surface water drainage strategy for the proposed energy storage site (ESS) on the land north of Bronwylfa Road, Rhostyllen, Wrexham (hereafter referred to as 'the Site'). As previously, this revised outline drainage strategy is intended to support the planning application for the site.

Building on the JBA Outline Drainage strategy of February 2024¹ this revised strategy sets out to develop and take due cognisance of the following:

- Consideration of the possibility that hazardous chemicals which could be generated from the operating ESS infrastructure through equipment failure will interact with the proposed drainage system.
- Further ground investigation information which has been made available since the date of the original report
- Taking the opportunity revise the FEH data from 1999 data to 2013 data.

The revised elements of this report focus on what is termed the 'main site of interest' in the previous report, i.e. the 5.5 ha main development area comprising transmission sub-station, battery ESS unit arrays, circulation areas and SuDS basin.

1.2 Site Location

See Appendix A1 for a site location plan which outlines the red boundary and surrounding area.

The main site is approximately 5.5Ha in size and is an agricultural land parcel located circa 3km southwest of Wrexham City Centre. The Legacy National Grid Sub-station is approximately 750m to the east of the site. It is proposed that the development site will connect to this.

A former railway line bounds the northern boundary (set at a higher level to the site and is bounded by mature vegetation) and the A483 bounds the east which sits in a cutting bounded by mature vegetation. The B5097/Bronwylfa Road forms the southern boundary and a single-track road, Cadwgan Lane, bounds the west.

There are existing field access points at the site's southern boundary from the B5097 and north west corner from Cadwgan Lane.

The land to the west of Cadwgan Lane is an L-shaped agricultural field extending to approximately 3.4 Ha. An access track for abnormal indivisible loads (extending to approx. 0.2Ha) is proposed within this field.

Agricultural land and uses form the sites immediate surroundings to the north, south and west with various residential properties dispersed throughout. The village of Rhostyllen is located on the eastern side of the A483.

¹ Land North of Bronwylfa Road, Wrexham – Outline Surface Water Drainage Strategy Version 4. (JBA Consulting, February 2024)

2. Existing Site Features

2.1 Site Topography

The main site area comprises a single agricultural field which extends to approximately 5.5 Ha.

Topographic survey information² identifies that the site generally falls in an easterly direction, with levels falling from approximately 116.5m AOD in the west to around 105.6m AOD in the east towards the A483. See Figure 1.

The land to the west of Cadwgan Lane generally falls in a south-easterly direction towards a low point before reaching Bronwylfa Road. Over the area where the abnormal access road is proposed, the land falls from approximately 113.07mAOD at the proposed entrance to the main site and connects to Bronwylfa Road at a level of 112.28mAOD.

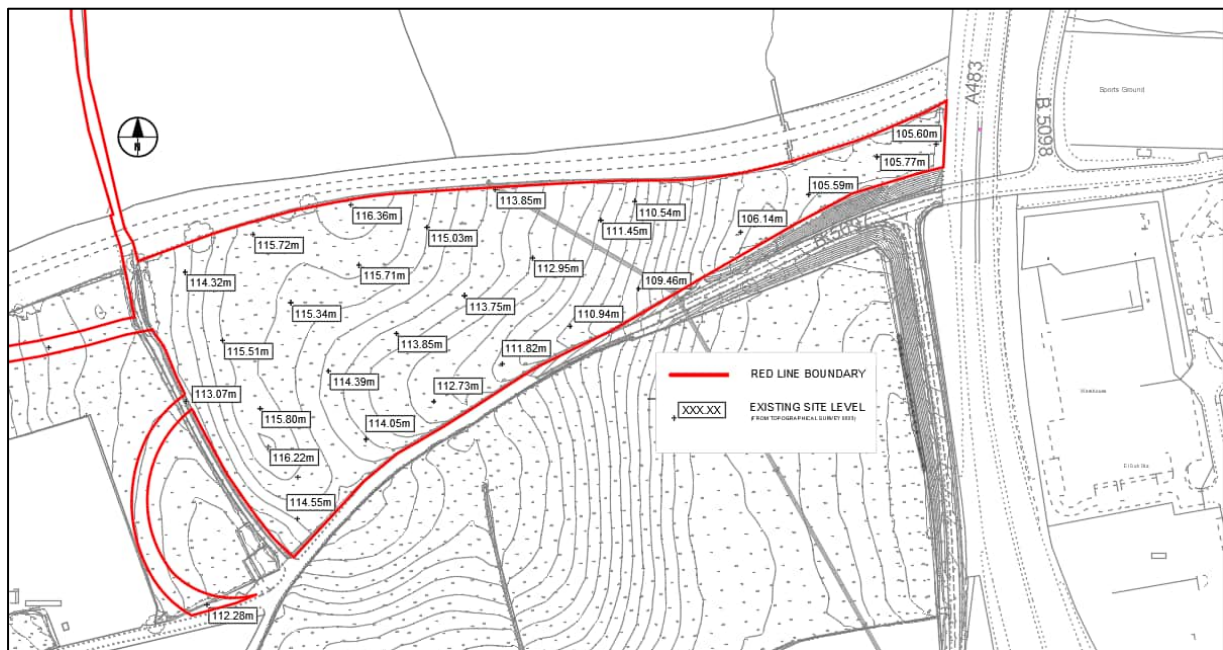


Figure 1. Site Topography

A copy of the topographic survey is included within Appendix A2.

2.2 Existing Watercourses

No watercourses are identified within the development site. The closest watercourses are the River Clywedog which flows in an easterly direction approximately 500m to the north of the site (refer to Appendix A1 for watercourse locations).

There is an unnamed ordinary watercourse approximately 250m to the north-west of the site, which is a tributary to the River Clywedog. The Pentrebychan Brook is around 550m to the south of the site and outfalls into the Glanyrafon Brook on the eastern side of the A483. The Glanyrafon Brook then flows generally in an easterly direction before converging with the River Clywedog about 2km to the east of the site.

Asset plans do not identify any structured drainage within the vicinity of the site, so it is assumed the site infiltrates at present.

² Obtained from RPS Group in March 2023

2.3 Existing Utilities

Statutory undertaker's utility records³ do not identify any existing underground services within the site. There is an 11kV overhead cable crossing the site which is proposed to be diverted as part of the development proposals. The location of the overhead cable is shown on the constraints plan in Appendix A3.

2.4 Existing Trees

A baseline tree survey was provided by Innova and informs root protection zones that are required to be avoided. These predominantly impact the east of the site. The tree survey results are shown on the constraints plan in Appendix A3.

2.5 Public Right of Way

There is an existing public right of way (PRoW) crossing the site from the southern boundary, extending north across the railway embankment and continuing to Mill Bridge. The PRoW is located on the eastern side of the site and is shown on the constraints plan in Appendix A3 and will be retained.

³ Utility Search Report by Cornerstone Projects Ltd Dated 25 August 2022.

3. Development Proposals

The main component parts of the Energy Storage System will comprise the following:

1. **Transmission Substation, comprising:**
 - Main control room / welfare accommodation & 400 kV GIS hall
 - Primary 33kV sub-station buildings
 - Externally located Sub-station plant including transformers, shunt reactors, harmonic filters and the like
 - Site Circulation Roads
2. **Energy Storage System (ESS) unit arrays area comprising:**
 - Energy storage unit containers + associated MV Skids
 - Access tracks
3. **Open space within site boundary for landscaping, soil storage and other infrastructure**
4. **Western access road**

The preliminary site layout is shown on the following page, and the key components are highlighted in Figure 2 below. This is subject to change as detailed design progresses.

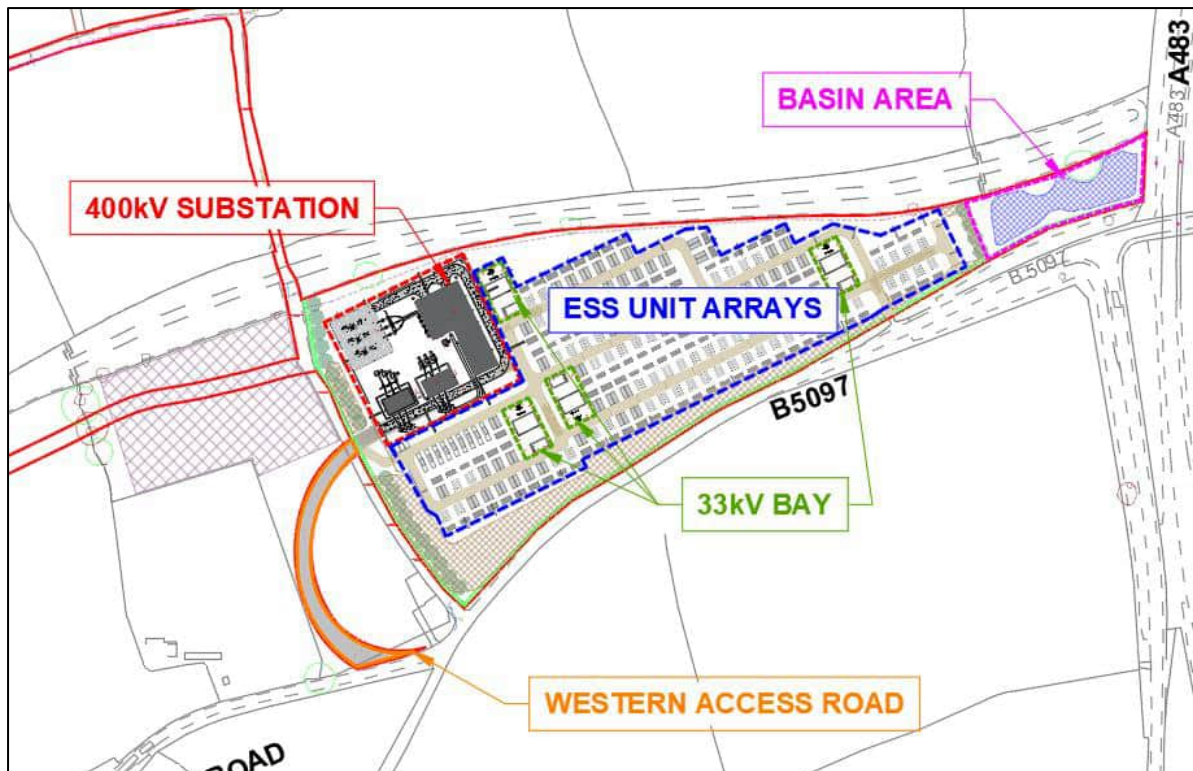
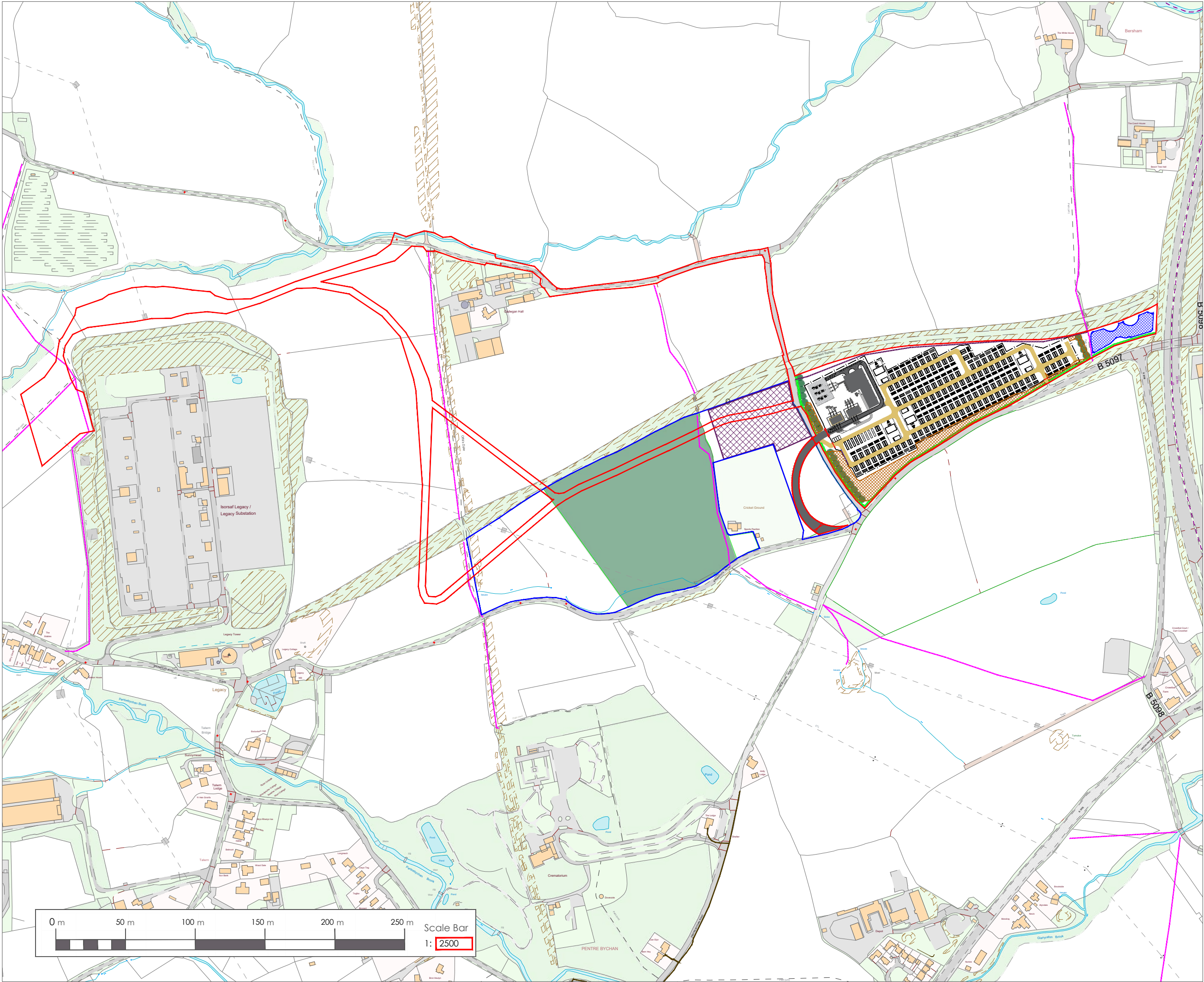


Figure 2. Main Components of the Development Proposals



KEY:

- Development Boundary
- Additional Land Within Applicants Control
- ESS Unit
- 400kV Substation
- 33kV Bay
- Access Track
- Access Road
- Permissive Footpath
- Bund
- Attenuation Basin
- Construction Compound
- Ecological Enhancement Area
- Woodland Planting
- Hedgerow Enhancement
- Fenceline
- Access Gate
- Water Container
- Storage Container
- Office Container
- Parking Spaces
- PRoW



DATE: 19/04/2024

PROJECT TITLE:

Legacy

DRAWING TITLE:

Layout Plan

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4. Drainage Strategy Objectives

This drainage strategy for the proposal is developed with reference to current best practice and will comply with the requirements of the responsible bodies.

The drainage strategy aims to achieve the following main principles and objectives:

- Develop a surface water strategy to drain the working and operational areas of the site effectively.
- Avoid flooding the plant and buildings in heavy rainfall events.
- Attenuate post-development surface water flows prior to discharging to the water environment at agreed rates of discharge and attenuation per the LLFA requirements.
- Convey surface water flows from the development to the water environment in a form that mimics or provides betterment to existing conditions.
- Treat any potential contaminants from the development site prior to discharge to the water environment, including containment of any water associated with firefighting requirements in accordance with national guidance and the site-specific fire strategy.

4.1 Data Collection

Table 1 below lists typical data which is utilised to inform the design of the drainage strategy and sets the basis of the methodology outlined through the various sections below. The list is not exhaustive.

Table 1. Data Collection

Purpose	Data	Comments
Topographic Data	Site topographical survey provided by RPS Group in March 2023.	Details the site topography and characteristics
Hydrological Data	Flood Estimation Handbook (FEH) 2013 data	Obtained from the FEH Web Service for the site to inform the rainfall data within the hydraulic model.
Site Features	Ordnance Survey 1:25,000 map, Constraints plan + Tree Survey provided by Innova	Informs the surrounding site features
Existing/Proposed Utilities	Utility Search Report provided by Innova carried out in August 2022 by Cornerstone Projects Ltd	Provides record information on existing utilities within the site e.g. Water Supplier, Gas, Sewers, BT, Electricity, 3 rd Party Searches.
Existing Ground Conditions	Ground Investigation information by Gibbs Geotechnical in May 2023 Ground Investigation information by South West Geotechnical Ltd in May 2024	Provides ground investigation information on infiltration and groundwater levels.
Proposed Site Levels	Proposed Levels and Cut Fill provided from Innova by Stantec dated September 2023.	Informs proposed site levels and post development overland flow.

5. Surface Water Drainage Strategy

Drawing INVA-ACM-LGY-XX-DR-CE-001161 attached in Appendix B1 presents the proposed surface water drainage strategy for the site and accompanies the relevant sections below.

Surface water flows are captured, attenuated, restricted and treated before being discharged to the water environment in line with the parameters outlined below.

5.1 Design Criteria

5.1.1 Regulatory Design Standards

The drainage strategy is developed with reference to best practice and current guidelines, including the following:

- C753 'The SuDS Manual' (CIRIA 2015)
- Statutory Standards for Sustainable Drainage Systems – Designing, Constructing, Operating and Maintaining surface water drainage systems (Welsh Government, 2018)
- Planning Policy Wales (Edition 9, November 2016)
- The Building Regulations 2010

This revised strategy adopts the most up-to-date Flood Estimation Handbook Data from 2013 in accordance with CIRIA C753.

In accordance with Welsh Government guidance:

- Surface water runoff or events up to the 1% AEP Return period (1 in 100-year event) plus climate change allowance should be managed to protect people and property on and adjacent to the site from flooding.
- Surface water (SW) shall be discharged to Standard S1 which describes the preferred routes for discharge of runoff from a site in the following hierarchy (Priority Level 1 is preferred (highest) priority, and 4 and 5 used in exceptional circumstances):
 - Priority Level 1: SW runoff is collected for reuse.
 - Priority Level 2: SW runoff is infiltrated into the ground.
 - Priority Level 3: SW runoff is discharged to a surface water body.
 - Priority Level 4: SW runoff is discharged to a surface water sewer; highway drain or other.
 - Priority Level 5: SW runoff is discharged to a combined sewer.
- The site runoff should be restricted to the 1 in 2 (QBAR) greenfield runoff event.
- If infiltration components are proposed, a factor of safety of 10 should be applied and the half drain down time should aim to be within 24 hours.

In accordance with the Flood and Water Management Act 2010 (enacted in Wales in 2019), all new developments must incorporate Sustainable Urban Drainage Systems to control the quantity of runoff, manage quality of runoff, improve amenity and create biodiversity to a site.

The surface water strategy is therefore designed to prevent flooding across the site during the 1 in 100-year event plus a 40% allowance for climate change. As the nature of the proposed development is for energy storage, it is unlikely surface water will be suitable for reuse, and this will not likely be a viable disposal strategy. SuDS are therefore incorporated into the design, and infiltration is prioritized for surface water runoff to discharge.

5.2 Drainage Catchment

The Flood Estimation Handbook (FEH) data from the FEH Web Service is used to establish the likely drainage catchment associated with the site and the corresponding rainfall characteristics of the site.

The site falls within the catchment of the Pentrebychan Brook/Glanyrafon Brook to the south. Key rainfall catchment characteristics for the site, as obtained from the FEH Web Service, are shown in Table 2.

Table 2. FEH Rainfall Characteristics

FEH Rainfall Characteristics

Standard Average Annual Rainfall (SAAR)	953
Standard Percentage Runoff (SPR host)	42.78%

A plan showing an extract of the catchment from the FEH Web Service can be found in Appendix A4.

5.3 Proposed Development Platform Levels

The proposed platforming levels and cut fill analysis for the Site were designed by Stantec in September 2023. Drawing INVA-ACM-LGY-XX-DR-CE-001163 attached in Appendix B3 shows the proposed site levels and overland flow and the development proposals.

The proposed site levels for the main site (comprising the substation and ESS areas) generally mimic the existing natural falls over the site, the majority of which fall in an easterly direction. The proposed basin location sits at the natural low area to the east of the site.

The western access road falls away from the site from a level of 113.2m AOD towards Bronwylfa Road, where it connects at the existing level of approximately 112.28m AOD.

The levels are designed to control overland flows to two relief points which eventually fall south towards the B5097. These fall in the general direction of the drainage catchment, towards the Pentrebychan Brook/Glanyrafon Brook to the south.

5.4 Infiltration

In keeping with guidance within The SuDS Manual⁴ there are several design considerations to account for when assessing the use of infiltration. Those considerations relevant to this development proposal are assessed to be:

- The risk of pollution from infiltrating polluted surface water runoff from the site
- Soil infiltration rates should be shown to be of 10^{-6} m/s (36 mm/hr) or greater. Allied to this, a minimum distance of 1m is required between the base of the infiltration system and the maximum likely groundwater level
- The risk of slope instability or solifluction due to infiltration

Each of these relevant factors is discussed in turn below.

5.4.1 Risk of Pollution

A separate Environmental Site Assessment report⁵ acknowledges that during the operational and decommissioning phases, the development has the potential to cause pollution incidents through fire and explosion in the ESS units.

This revised drainage strategy considers the site-specific conditions if, during a fire event in one of the ESS units, there is a release of chemicals to the local groundwater system. The revised strategy is developed in such a way that hazardous substances are prevented from being released to the water environment, and the input of pollutants to groundwater is limited so as not to cause pollution.

In this context, the previously proposed approach of infiltration is not appropriate, and the risk to groundwater contamination is addressed by the introduction of HDPE-lined, tank-like storage under the areas of risk (i.e., within the ESS unit arrays). The lined tanks or 'pods' are filled with open-graded stone to provide both storage volume and the normal surface of circulation areas around the ESS units and infrastructure.

Drawing Nos INVA-ACM-LGY-XX-DR-CE-001161 and INVA-ACM-LGY-XX-DR-CE-1164 in Appendix B1 and B2 respectively demonstrate the typical plan and sectional arrangements of the lined 'pods' which will protect groundwater environment from potential contamination.

The strategy recognises The National Fire Chiefs Council (NFCC) guidance on expected requirements. NFCC Guidance is in development at the time of writing, but the emerging approach requires that *"Suitable environmental protection measures should be provided. This should include systems for containing and managing water runoff. System capability / capacity should be based on anticipated water application rates, including the impact of water based fixed suppression systems."*

The strategy adopts the current '*water application rates*' in assessing the volume of potentially contaminated water which is to be addressed in respect of contaminant risk. At present, fire fighting water supply should be capable of delivering no less than 1,900 litres per minute for at least 2 hours. This equates to a storage capacity of no less than 228 cubic metres, with the volume carried through in the attenuation aspects of the revised strategy. In respect of the role of the lined tanks (or pods) in addressing contamination risk, a process of isolate-contain-test-discharge is to be adopted, further explained in Table 3.

⁴ The Suds Manual (Ciria Publication C753) published by the Construction Industry Research & Information Association (CIRIA, 2015)

⁵ Environmental Site Assessment Legacy Site, Wrexham Innova Renewables Limited (Innova) Project number: 60727919 INVA-ACM-LGY-XX-RP-GE-090824 [N0] September 2024

Table 3. Integration of groundwater protection with Drainage Strategy

Process	Features	Integration with Drainage Strategy
Isolate	Isolation of water used in fire fighting to protect the water environment in the event of a fire. Control points incorporated to close off normal drainage routes. These can take the form of manually operated penstocks, or valves controlled by alarm systems linked to the ESS units. Manual control points should be accessible.	Control points will be co-located with localised attenuation to control surface water flows in normal operation to a rate set to optimise the available volume.
Contain	The identified volume of fire water should be contained in 'pods' which store the potentially contaminated liquid until it's properties can be verified. Pods constructed with HDPE liner resistant to chemical degradation as tank-like structures. Pods will be required to hold a minimum volume of 228m³ .	The storage capacity can be used as localised attenuation as part of overall site attenuation volume. Allowable discharge rates to be set commensurate with the volume available in containment pods
Test	Post fire event, the contained water is tested to confirm whether there are residual contaminants	Control points (as chambers) can be used as accessible testing locations.
Discharge	If testing proves contained water is OK, water can be allowed to drain as normal. If not, the affected pod volume is drained down and removed from site	

The requirement to properly protect the groundwater environment from potential contamination precludes the use of infiltration across appreciable parts of the development. Compared to the previous strategy, this results in an increase in the impermeable areas considered in the surface water strategy.

Figure 3 below (which is replicated in Section 5.5) summarises the areas of the site taken forward in the strategy as impermeable. In summary, discharge from the site is predominantly via infiltration through the base of the basin at the east part of the development, or locally in selected areas elsewhere.

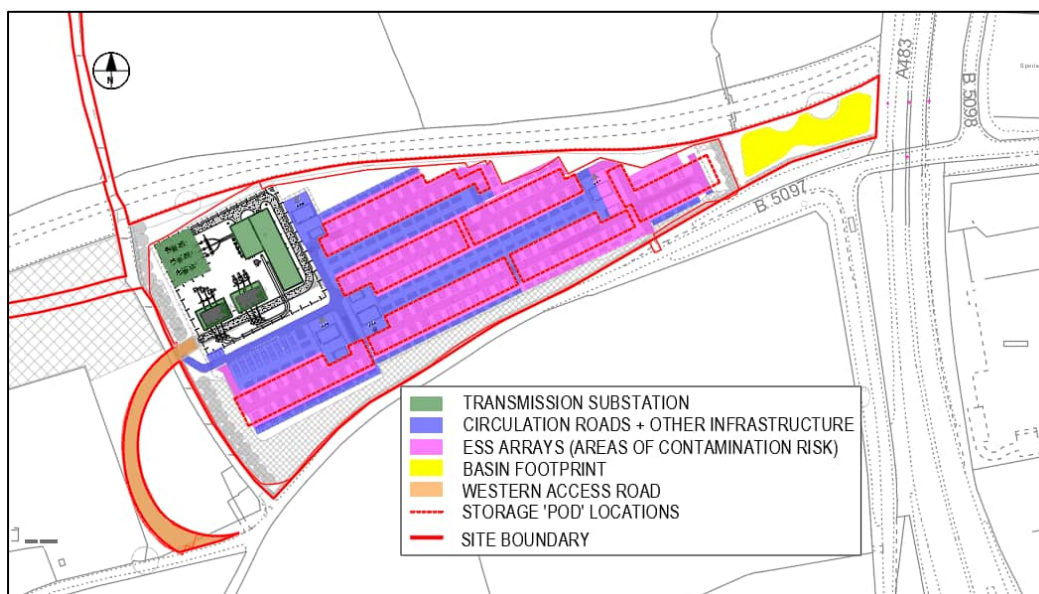


Figure 3. Site areas assumed impermeable for this strategy

5.4.2 Soil Infiltration and Groundwater Levels

Ground Investigations and infiltration tests were conducted by Gibbs Geotechnical in May 2023. Five trial pits were excavated at the site to a depth of 1 metre. This ground investigation was referenced in the previous iteration of the surface water drainage strategy.

Subsequent to the previous drainage strategy, further Ground Investigations were undertaken by Southwest Geotechnical Ltd in May 2024 comprising 6 standard trial pits, 5 extended trenches and 5 window sample boreholes. No further infiltration testing was undertaken, but this subsequent ground investigation provided information on groundwater levels across the site which have been incorporated in this revised strategy.

Figure 4 on the following page provides a summary of ground investigation information taken across the site to date. A summary of the relevant soil and groundwater data is set out in Table 4 below.

Table 4. Summary of Ground Investigation Results

Ground Investigation Reference	Depth of TP/WS (bgl)	Recorded water level (bgl)	Infiltration Value
May 2023 Ground Investigation by Gibbs Geotechnical			
TP6	1.00m	-	8.5×10^{-5} m/s
TP7	1.00m	-	2.5×10^{-5} m/s
TP8	1.00m	-	Data Error
TP9	1.00m	-	6.2×10^{-6} m/s
TP10	1.00m	-	1.2×10^{-4} m/s
May 2024 Ground Investigation by South West Geotechnical Ltd			
TP01	2.55m	-	-
TP03	2.70m	2.0m (112.30m)	-
TP06	3.00m	2.0m (111.80m)	-
TP08	2.60m	2.0m (108.37m)	-
TP09	2.80m	-	-
TP10	2.70m	1.9m (111.87m)	-
TP02	1.00m	-	-
TP04	0.85m	-	-
TP05	3.60m	-	-
TP07	0.85m	-	-
TP11	0.60m	-	-
WS01	3.43m	2.94m (112.07m)	-
WS02	3.00m	-	-
WS03	3.90m	-	-
WS04	3.45m	2.8m (109.57m)	-
WS05	5.45m	2.22m (103.91m)	-

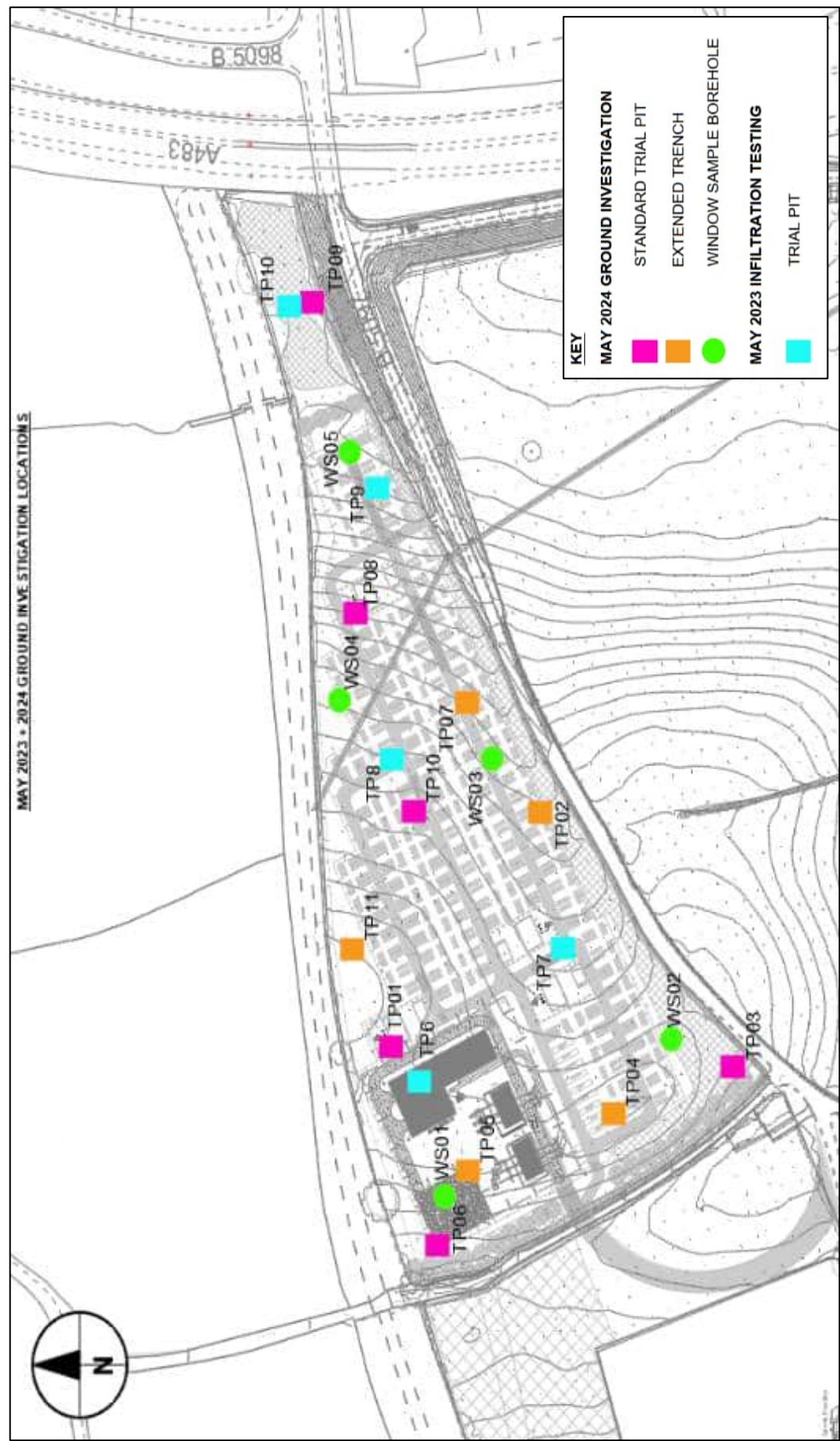


Figure 4. Ground Investigation Locations

In respect of the results and their application in the surface water drainage strategy:

Infiltration Basin

- i. The infiltration rate of 1.2×10^{-4} m/s from Trial Pit 10 (May 2023) meets the minimum required infiltration rate set out in The SuDS Manual and is applied in the design as this is located within the proposed infiltration basin location.
- ii. Trial Pit 09 (May 2024) was excavated to a depth of 2.80m bgl within the proposed infiltration basin location i.e. down to an approximate level of 102.88mAOD. No ground water was encountered.
- iii. The base of the infiltration basin is set at 104.60mAOD. Groundwater is therefore not considered a constraint to the design within the infiltration basin location as the minimum separation of 1 metre required between the base of the infiltration system and the maximum likely groundwater level is satisfied.

The infiltration basin (set at 104.60mAOD) infiltrates only through the base of the basin i.e. not including the side slopes. The basin is required to be 900mm depth with a 300mm freeboard allowance.

The Q_{BAR} greenfield discharge per hectare been calculated as 5.6 l/s/Ha using ICP SUDS and is provided in Appendix C.

Western Access Road

There is currently no information on infiltration rates or groundwater levels directly within the western access road location. The western access road is assumed to infiltrate subject to further ground investigation in the area to confirm the groundwater level and infiltration capacity.

The infiltration rate from Trial Pit 07 is applied of 2.5×10^{-5} m/s as this is the closest trial pit to the western access road location.

5.4.3 Slope Stability

Seepage analysis undertaken by AECOM⁶ identified that the sides of the edges of the basin are required to be partially lined to mitigate risk associated with groundwater seepage impacting the embankment between the east boundary of the site and the A483. Infiltration has therefore only been applied to the base of the infiltration basin within the modelling analysis. Effective performance of infiltration on the base of the basin requires effective up-stream pre-treatment to remove sediment and silt to prevent clogging and subsequent failure of the basin.

⁶ Innova Legacy Site, Wrexham A483 Slope Stability Review (Rev 2) AECOM Technical Note 31 October 2024

5.5 Attenuation Requirements

The surface water strategy is designed to prevent flooding across the site during a 1 in 100-year storm event, with an additional 40% allowance for climate change.

The attenuation of design event flows is provided in a combination of features incorporated within the design:

- The Attenuation Basin to the east of the development site, which is the primary point of discharge via infiltration.
- Utilisation of the storage capacity made available for the unlikely instance of a fire event in the storage 'pods' within the ESS array areas.
- Locally to the western access road as part of the lower construction layers which adopt open-graded aggregate.

The attenuation requirements for the infiltration basin and western access road were modelled separately using InfoDrainage software. All modelled attenuation features are utilised at full capacity for the 1 in 100 year plus 40% critical storm event. Each model is iterated to optimise the utilisation of all attenuation features to demonstrate that no flooding occurs within the site for the 1 in 100-year event plus a 40% allowance for climate change.

Table 5 and Figure 3 on the following pages outline the allowable discharge and attenuation requirements based on the surface water modelling results.

The attenuation requirements are discussed in relevant sections below for the infiltration basin and western access road, respectively.

5.5.1 Infiltration Basin Attenuation

The infiltration basin is sized to attenuate impermeable areas from the transmission substation, circulation roads and other infrastructure and ESS Arrays (areas of contamination risk).

The granular sub-base below the ESS Arrays is locally lined and separated into 7No. storage 'pods' across the site which each hold a minimum volume set by firewater capacity requirements of some 228m³. The requirement for the storage 'pods' is discussed in Section 5.4.1.

The storage pods will be utilised for surface water storage capacity through provision of a suitable flow control which will discharge back into the main network at a restricted rate and eventually into the infiltration basin where it will discharge into the groundwater. The ESS storage 'pods' are therefore incorporated into the model for the infiltration basin to understand how the entire site (excluding the western access road) integrates hydraulically.

The Infodrainage model and results for the infiltration basin are attached in Appendix D. The results demonstrate that the attenuation tanks/'pods' and infiltration basin provide the required storage and no flooding occurs for the 1 in 100 year + 40% climate change event.

The set parameters used to determine the final attenuation requirements for the storage 'pods' and infiltration basin are further outlined below:

Storage 'Pods'

For the purpose of this concept strategy, the depth of stone around the ESS units is set at 750mm. This depth is reduced to 400mm where the 'pod' extends over road locations to allow for sufficient road make-up at the surface. Refer to Appendix B2 for a detailed drawing outlining the general strategy for the lined pods over both ESS and road locations.

The areas for locally lined storage 'pods' are set to avoid assumed cable routes and to achieve the minimum volume of 228m³ based on the stone depths stated and assuming a voidage of 30% in line with CIRIA C753.

The overall storage provided through the 7 'pods' is 1672m³.

The suitable flow control applied to each tank is assumed as a hydrobrake within the model. The hydrobrake control from each 'pod' has been set at 1l/s which was the minimum allowable discharge to achieve an orifice plate of 50mm or above. Design and Construction Guidance and Sewerage Sector Guidance recommend the minimum orifice size as 50mm.

The 'pods' are incorporated into the InfoDrainage model as tanks with a depth of 750mm. The porosity value applied to each tank is adjusted to ensure the capacity is accurately represented, taking into account the reduced stone depth to 400mm at road locations.

It should be noted that the outlet control manhole from each 'pod' shall also be fitted with a suitable automatic penstock which closes in the event of a fire to contain potentially contaminated fire-fighting water within the voidage of the stone and isolate the 228m³ of water volume from the main network. This water will be subject to further testing and disposal in line with the site emergency response plan.

Infiltration Basin

Based on Ground Investigation results discussed in Section 5.4.2, the basin is assumed to infiltrate into the ground at a rate of 1.2×10^{-4} m/s, subject to further ground investigation.

The area available for the basin is constrained to the west by a public right of way route highlighted in Section 2.5, and the confines of the site boundary and avoiding root protection zones highlighted in Section 2.4. The basin's base level is set at 104.60m.

Through iterative modelling of the basin's depth, assuming 1 in 3 side slopes, the basin needs to be 900mm deep with an additional 300mm freeboard, resulting in a total depth of 1.2m. This configuration is necessary to attenuate the required volume of 1281.5m³ for the 1 in 100-year event plus a 40% climate change allowance, without causing flooding.

5.5.2 Western Access Road

As outlined in Section 5.3, the proposed levels for the western access road slope away from the rest of the site towards Bronwylfa Road. Consequently, the western access road is treated as hydraulically independent from the rest of the site. It is locally treated and attenuated within the lower construction layers, which use open-graded aggregate.

The Infodrainage model and results for the western access road are attached in Appendix E. The results demonstrate that the stone make up below the Western Access Road provides the required storage and no flooding occurs for the 1 in 100 year +40% climate change event.

Based on Ground Investigation results discussed in Section 5.4.2, the western access road runoff is assumed to infiltrate into the ground at a rate of 2.5×10^{-5} m/s through the base and sides of the stone, subject to further ground investigation.

The storage is modelled as a tank with an assumed porosity of 30%. Through iterative modelling of the tank's depth, and assuming the storage is available across the total area of the access track (0.21Ha), it is determined that a stone depth of 200mm is required to attenuate the necessary volume of 115m³ for the 1 in 100-year event plus a 40% climate change allowance, without causing flooding.

It should be noted that to achieve appropriate treatment for the western access road, a suitable filtration layer is required to provide treatment and includes a geotextile layer at the base which separates the foundation from the subgrade.

Given the current slope and proposed levels of the western access road, the design requires check dams at specified locations to optimise the storage provided and enhance infiltration.

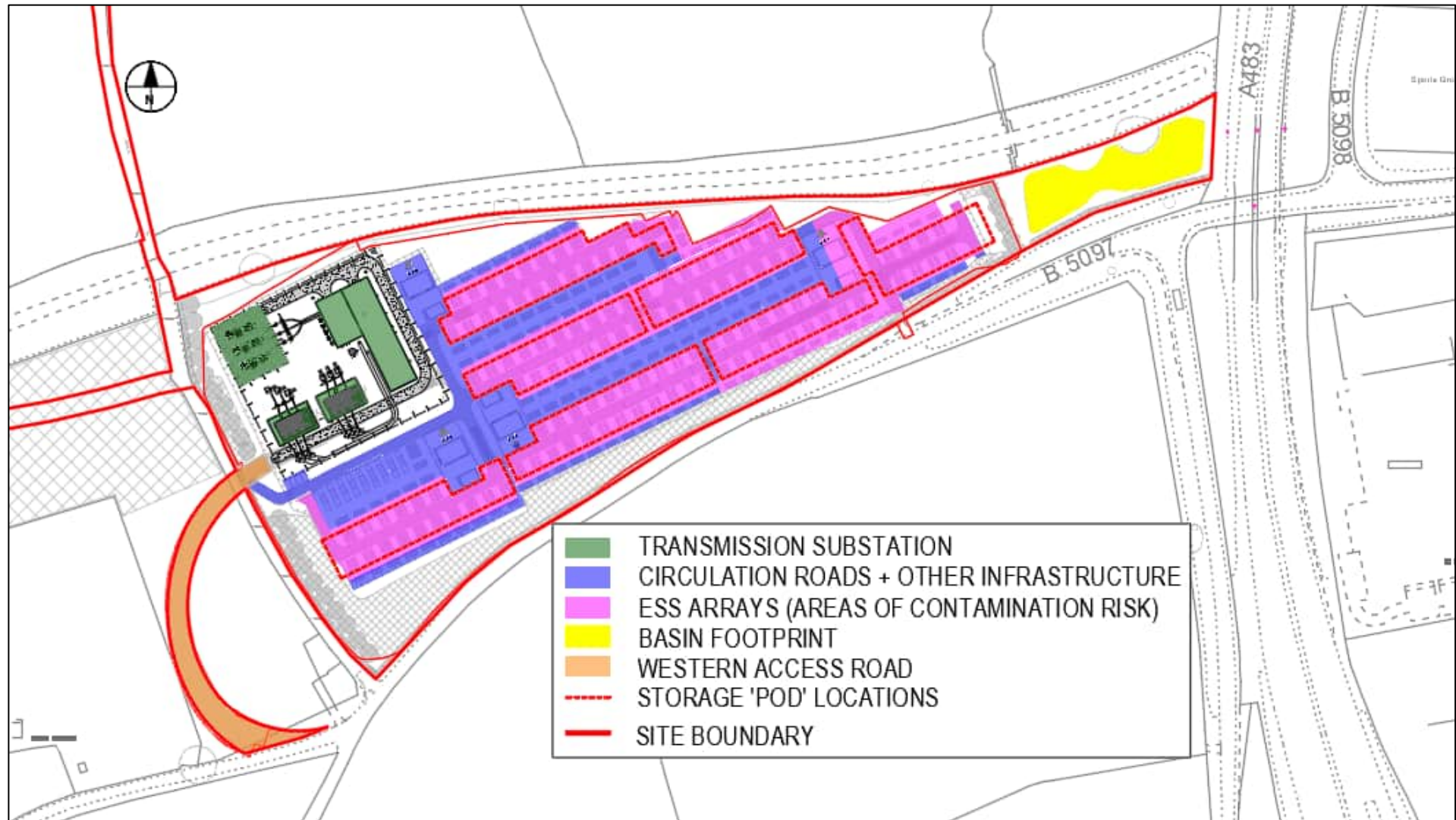


Figure 5 (replicated). Summary of Impermeable Areas assumed within the Drainage Model

5.5.3 Attenuation Summary

Table 5 summarises the attenuation requirements for the 1-in-100-year critical storm event, including a 40% allowance for climate change, as provided in this drainage strategy and depicted in the layout in Appendix B1.

Table 5. Allowable Discharges and Attenuation

Site Area	Imp. Area (Ha)	Total Imp. Area (Ha)	Drainage Feature	Allowable Discharge	Attenuation Required/Provided in this Drainage Strategy (m ³)
Transmission Substation	0.27	3.26	Infiltration Basin	1.2 x 10 ⁻⁴ m/s infiltration rate to base of the basin	1282 m ³ ⁽³⁾
Circulation Roads & other Infrastructure ⁽¹⁾	1.04				
Basin Footprint	0.20				
ESS Arrays (Areas of Contamination Risk) ⁽²⁾	1.75		Containment / Storage Pods ⁽³⁾	1l/s per storage 'pod' ⁽³⁾	Total provided within all 'pods'= 1672m ³
Western Access Road	0.21	0.21	Porous Pavement Construction	2.53 x 10 ⁻⁵ m/s infiltration rate to base and sides of infiltration component	115m ³

Notes:

⁽¹⁾ Include all areas within the general ESS site area which do not discharge through the storage 'pods'. For the purposes of this strategy, these areas have been assumed 100% impermeable, with no restrictions on surface water flow at source. This is a conservative approach.

⁽²⁾ Include all areas assumed to be discharging through the storage 'pods'. For the purposes of this strategy, these have been assumed 100% impermeable and have restricted flows at source.

⁽³⁾ The restricted storage 'pods' outfall into the infiltration basin at a restricted rate. This is accounted for in the attenuation requirement for the infiltration basin.

5.5.4 Half Drain Down Time

Infiltration Basin

The criteria for achieving the half drain time for the infiltration basin is 13 hours for the critical storm event for the 1 in 100 year + 40% climate change. This achieves the criteria for the half drain time to be within 24 hours per Welsh Government Guidance.

The half drain time is provided in the '*stormwater controls summary*' section on page 25 of the modelling results attached in Appendix D.

Western Access Road

The criteria for achieving the half drain time for the permeable paving is 3 hours for the critical storm event for the 1 in 100 year + 40% climate change. This achieves the criteria for the half drain time to be within 24 hours per Welsh Government Guidance.

The half drain time is provided in the '*stormwater controls summary*' section on page 5 of the modelling results attached in Appendix E.

5.6 Surface Water Treatment

5.6.1 SuDS Assessment Methodology

The provision of SuDS is required to meet the treatment requirements outlined in 'CIRIA C753 – The SuDS Manual' and in accordance with LLFA guidance.

The CIRIA SuDS Manual (C753) outlines an approach to SuDS selection. The guidance suggests a risk-based approach based on land use type and specific contaminants. The design is therefore developed based on a Simple Index Approach (SIA).

The SIA assigns a pollution hazard index to runoff from a proposed land use type, and a mitigation index to a proposed SuDS feature. Where the mitigation index is greater or equal to the pollution hazard index, compliance with the guidance is achieved. Where more than one SuDS feature is utilised, the following calculation is used to calculate the mitigation index:

$$\text{Total SUDS mitigation index} = \text{mitigation index}_1 + 0.5(\text{mitigation index}_2)$$

Table 26.2 within CIRIA C753 provides the initial basis for determining the likely pollution hazard generated based on end use and catchment run off characteristics. Table 6 has applied the figures from Table 26.2 to define the anticipated pollution hazard indices for the proposed development.

Table 6. Pollution Hazard Indices for Proposed Development

Run-off Characteristics	Pollution Hazard Level	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Liquid Hydrocarbons (free floating oils)
Commercial/Industrial roofs <i>(Substation buildings, ESS units, Buildings/Units within Contractor Area)</i>	Low	Low	0.3	0.2	0.05
Low traffic roads (general access roads) and non-residential parking infrequent change <i>(All access roads)</i>	Low	Low	0.5	0.4	0.4

The final SuDS features are subject to detailed design and should deliver mitigation indices greater than the pollution indices outlined in Table 6 if discharging to controlled waters. As the surface water outfalls to groundwater, it is considered that appropriate SuDS treatment will be required.

5.6.2 SuDS Implementation Strategy

Treatment is provided within the infiltration basin and the stone make-up of the access roads, sub-station and energy storage platforms.

It should be noted that to deliver adequate treatment, the selected SuDS component(s) should have a total pollution mitigation index (for each contaminant type) that equals or exceeds the pollution hazard index (for that contaminant type).

Table 7 below identify the options to treat surface water based on this strategy. Final treatment features will be developed as part of the detailed design.

Table 7, based on CIRIA C753 Table 26.4 indicates SuDS mitigation component options for the site for discharging to groundwater.

Table 7. Mitigation indices for Proposed SuDS Components for discharges to groundwater

SuDS	Ciria Descriptors	Total Suspended Solids (TSS)	Metals	Liquid Hydrocarbons (free floating oils)
Infiltration trench/ Granular Platform	Underlain by soil with good contaminant attenuation potential ² of at least 300mm in depth ³	0.4 ⁴	0.4	0.4
Constructed permeable pavement	Suitable filtration layer is included that provides treatment and includes a geotextile at the base separating the foundation from the subgrade underlain by soil with good contaminant attenuation potential ² of at least 300mm in depth ³	0.7 ⁴	0.6	0.7
Infiltration Basin	A soil with a good contaminant attenuation potential ² of at least 300mm in depth ³	0.4 ⁴	0.3	0.3

1. All designs must include a minimum of 1m unsaturated depth of aquifer material between the infiltration surface and the maximum likely groundwater level.

2. For example, as recommended in Sniffer (2008a and 2008b). Scott Wilson (2010) or other appropriate guidance.

3. Alternative depths may be considered where it can be demonstrated that the combination of the proposed depth and soil characteristics will provide equivalent protection to the underlying groundwater. (See Note 1)

4. If significant volumes of sediment are allowed to enter an infiltration system, there will be a high risk of rapid clogging and subsequent system failure.

Outline pollution hazard indices for the proposed development are assessed against proposed SuDS features to identify potential requirements for any supplementary treatment options.

Table 8. Overall Mitigation Indices for Development

Area	Proposed SuDS Treatment Measure	Indices	Total Suspended Solids (TSS)	Metals	Liquid Hydrocarbons (free floating oils)
Commercial/ Industrial Roofs	Granular Platform and Infiltration Basin	Pollution	0.3	0.2	0.05
		Mitigation	0.6	0.55	0.55
General Access Roads within the ESS area	Granular Platform and Infiltration Basin	Pollution	0.5	0.4	0.4
		Mitigation	0.6	0.55	0.55
Western Access Road	Permeable Paving	Pollution	0.5	0.4	0.4
		Mitigation	0.7	0.6	0.7

Table 8 demonstrates that the proposed SuDS features will provide appropriate mitigation.

5.7 Exceedance Routes

Flood events which exceed the 1 in 100 + 40% storm event will result in overland flows across the site. The extent and duration of flooding, maximum depths, velocity and finalised flood routes will be established through detailed hydraulic modelling at detailed design following confirmation of the finalised platforming levels and drainage strategy.

A drawing showing the exceedance route for the site based on the current platforming strategy is shown on drawing no INVA-ACM-LGY-XX-DR-CE-001163 at Appendix B3.

6. Land Drainage

No land drainage is known or been declared by the owner of the site and none identified during Geophysical Surveys or GI works undertaken to date.

Any existing land drainage that may be encountered would be required to be maintained and carefully managed through avoidance, repair work and diversion of drains where necessary.

Perimeter drainage shall be installed at the boundaries of cut and fill earthworks to manage overland flows within the site boundary and protect key development areas.

7. Summary & Conclusions

7.1 Overview

AECOM have revised and updated the outline surface water drainage strategy for the proposed energy storage site (ESS) on the land north of Bronwylfa Road, Rhostyllen, Wrexham. The strategy builds on the JBA Outline Drainage strategy of February 2024⁷. The revised strategy has developed the following strands:

- Consideration of the possibility that hazardous chemicals which could be generated from the operating ESS infrastructure through equipment failure will interact with the proposed drainage system.
- Further ground investigation information which has been made available since the date of the original report
- Taking the opportunity revise the FEH data from 1999 data to 2013 data.

7.2 Principles and Objectives

The drainage strategy addresses the following main principles and objectives:

- Development of a surface water strategy to drain the working and operational areas of the site effectively.
- Avoid flooding the plant and buildings in heavy rainfall events.
- Attenuation of post-development surface water flows prior to discharging to the water environment at agreed rates of discharge and attenuation per the LLFA requirements.
- Conveyance of surface water flows from the development to the water environment in a form that mimics or provides betterment to existing conditions.
- Treatment of contaminants from the development site prior to discharge to the water environment, including containment of any water associated with firefighting requirements in accordance with national guidance and the site-specific fire strategy.

The strategy is designed to prevent flooding across the site during the 1 in 100-year event plus a 40% allowance for climate change.

7.3 Discharge Priority

As the nature of the proposed development is for energy storage, it is unlikely surface water will be suitable for reuse, and this will not likely be a viable disposal strategy. SuDS are therefore incorporated into the design, and infiltration is prioritised for surface water runoff to discharge.

In keeping with guidance within The SuDS Manual⁸ there are several design considerations to account for when assessing the use of infiltration. Those considerations relevant to this development proposal are assessed to be:

- The risk of pollution from infiltrating polluted surface water runoff from the site
- Soil infiltration rates should be shown to be of 10^{-6} m/s (36 mm/hr) or greater. Allied to this, a minimum distance of 1m is required between the base of the infiltration system and the maximum likely groundwater level
- The risk of slope instability or solifluction due to infiltration

⁷ Land North of Bronwylfa Road, Wrexham – Outline Surface Water Drainage Strategy Version 4. (JBA Consulting, February 2024)

⁸ The Suds Manual (Ciria Publication C753) published by the Construction Industry Research & Information Association (CIRIA, 2015)

7.4 Risk of Pollution

A separate Environmental Site Assessment report ⁹ acknowledges that during the operational and decommissioning phases, the development has the potential to cause pollution incidents through fire and explosion in the ESS units. In this context, the previously proposed approach of infiltration is not appropriate across the whole site, and the risk to groundwater contamination is addressed by the introduction of HDPE-lined, tank-like storage under the areas of risk (i.e., within the ESS unit arrays). The lined tanks or 'pods' are filled with open-graded stone to provide both storage volume and the normal surface of circulation areas around the ESS units and infrastructure.

In respect of the role of the lined tanks (or pods) in addressing contamination risk, a process of isolate-contain-test-discharge is to be adopted, further explained in Table 3 of the report, replicated below.

Table 7. Integration of groundwater protection with Drainage Strategy (replicated)

Process	Features	Integration with Drainage Strategy
Isolate	Isolation of water used in fire fighting to protect the water environment in the event of a fire. Control points incorporated to close off normal drainage routes. These can take the form of manually operated penstocks, or valves controlled by alarm systems linked to the ESS units. Manual control points should be accessible.	Control points will be co-located with localised attenuation to control surface water flows in normal operation to a rate set to optimise the available volume.
Contain	The identified volume of fire water should be contained in 'pods' which store the potentially contaminated liquid until it's properties can be verified. Pods constructed with HDPE liner resistant to chemical degradation as tank-like structures. Pods will be required to hold a minimum volume of 228m³ .	The storage capacity can be used as localised attenuation as part of overall site attenuation volume. Allowable discharge rates to be set commensurate with the volume available in containment pods
Test	Post fire event, the contained water is tested to confirm whether there are residual contaminants	Control points (as chambers) can be used as accessible testing locations.
Discharge	If testing proves contained water is OK, water can be allowed to drain as normal. If not, the affected pod volume is drained down and removed from site	

7.5 Ground Investigation

Ground Investigations and infiltration tests were conducted in May 2023, and subsequent to the previous drainage strategy, further Ground Investigations were undertaken by in May 2024.

The combined information has been utilised in the revised strategy to reference in the design.

7.6 Attenuation

The attenuation of design event flows is provided in a combination of features incorporated within the design:

- The Attenuation Basin to the east of the development site, which is the primary point of discharge via infiltration.

⁹ Environmental Site Assessment Legacy Site, Wrexham Innova Renewables Limited (Innova) Project number: 60727919 INVA-ACM-LGY-XX-RP-GE-090824 [N0] September 2024

- Utilisation of the storage capacity made available for the unlikely instance of a fire event in the storage 'pods' within the ESS array areas.
- Locally to the western access road as part of the lower construction layers which adopt open-graded aggregate.

The attenuation requirements for the infiltration basin and western access road were modelled separately using InfoDrainage software.

The attenuation requirements for the 1-in-100-year critical storm event, including a 40% allowance for climate change, are provided in this drainage strategy and depicted in the layout in Appendix B1.

The results for each model demonstrate that the attenuation tanks/'pods' and infiltration basin provide the required storage and no flooding occurs for the 1 in 100 year + 40% climate change event.

7.7 Treatment

The provision of SuDS is required to meet the treatment requirements outlined in 'CIRIA C753 – The SuDS Manual' and in accordance with LLFA guidance. The guidance suggests a risk-based approach based on land use type and specific contaminants and the design is therefore developed based on a Simple Index Approach (SIA).

The anticipated pollution hazard indices for the proposed development have been identified, and the proposed SuDS features will provide appropriate mitigation. Table 8 which demonstrates this is replicated below.

Table 8. Overall Mitigation Indices for Development (Replicated)

Area	Proposed SuDS Treatment Measure	Indices	Total Suspended Solids (TSS)	Metals	Liquid Hydrocarbons (free floating oils)
Commercial/Industrial Roofs	Granular Platform and Infiltration Basin	Pollution	0.3	0.2	0.05
		Mitigation	0.6	0.55	0.55
General Access Roads within the ESS area	Granular Platform and Infiltration Basin	Pollution	0.5	0.4	0.4
		Mitigation	0.6	0.55	0.55
Western Access Road	Permeable Paving	Pollution	0.5	0.4	0.4
		Mitigation	0.7	0.6	0.7

Flood events which exceed the 1 in 100 + 40% storm event will result in overland flows across the site. The extent and duration of flooding, maximum depths, velocity and finalised flood routes will be established through detailed hydraulic modelling at detailed design following confirmation of the finalised platforming levels and drainage strategy.

The proposed site levels for the main site (comprising the substation and ESS areas) generally mimic the existing natural falls over the site, the majority of which fall in an easterly direction. The proposed basin location sits at the natural low area to the east of the site.

The levels are designed to control overland flows to a relief point which eventually falls south towards the B5097. This falls in the general direction of the drainage catchment, towards the Pentrebychan Brook/Glanyrafon Brook to the south.

7.8 Conclusion

This revised drainage strategy for the proposed energy storage site (ESS) on the land north of Bronwylfa Road, Rhostyllen, Wrexham has predominately been required to consider the protection of the water environment and any potential interaction of contaminants with the proposed drainage system.

The revised strategy also takes the opportunity to further consider more recent ground investigation information and Rainfall data sets in order to present a robust assessment.

The strategy establishes how contamination risk is to be sufficiently managed by virtue of the lined and contained open stone under the areas of risk. This intervention has subsequently altered the extent of impermeable areas across the site, which in turn required the revised approach to surface water discharge, attenuation and treatment of surface water from the development proposals.

The revised drainage strategy is developed with reference to best practice and current guidelines, and fully addresses the main principles and objectives, i.e.

- A surface water strategy which drains the working and operational areas of the site effectively.
- Flooding of the plant and buildings is avoided in heavy rainfall events.
- Post-development surface water flows are suitably attenuated prior to discharging to the water environment at agreed rates of discharge and attenuation per the LLFA requirements.
- Conveyance of surface water flows from the development to the water environment are in a form that mimics or provides betterment to existing conditions.
- Treatment - including contaminants - of surface water run-off from the development site prior to discharge to the water environment is provided.

This strategy effectively demonstrates that the attenuation tanks and infiltration basin provide the necessary storage. No flooding occurs up to a 1 in 100-year event, including climate change allowance.

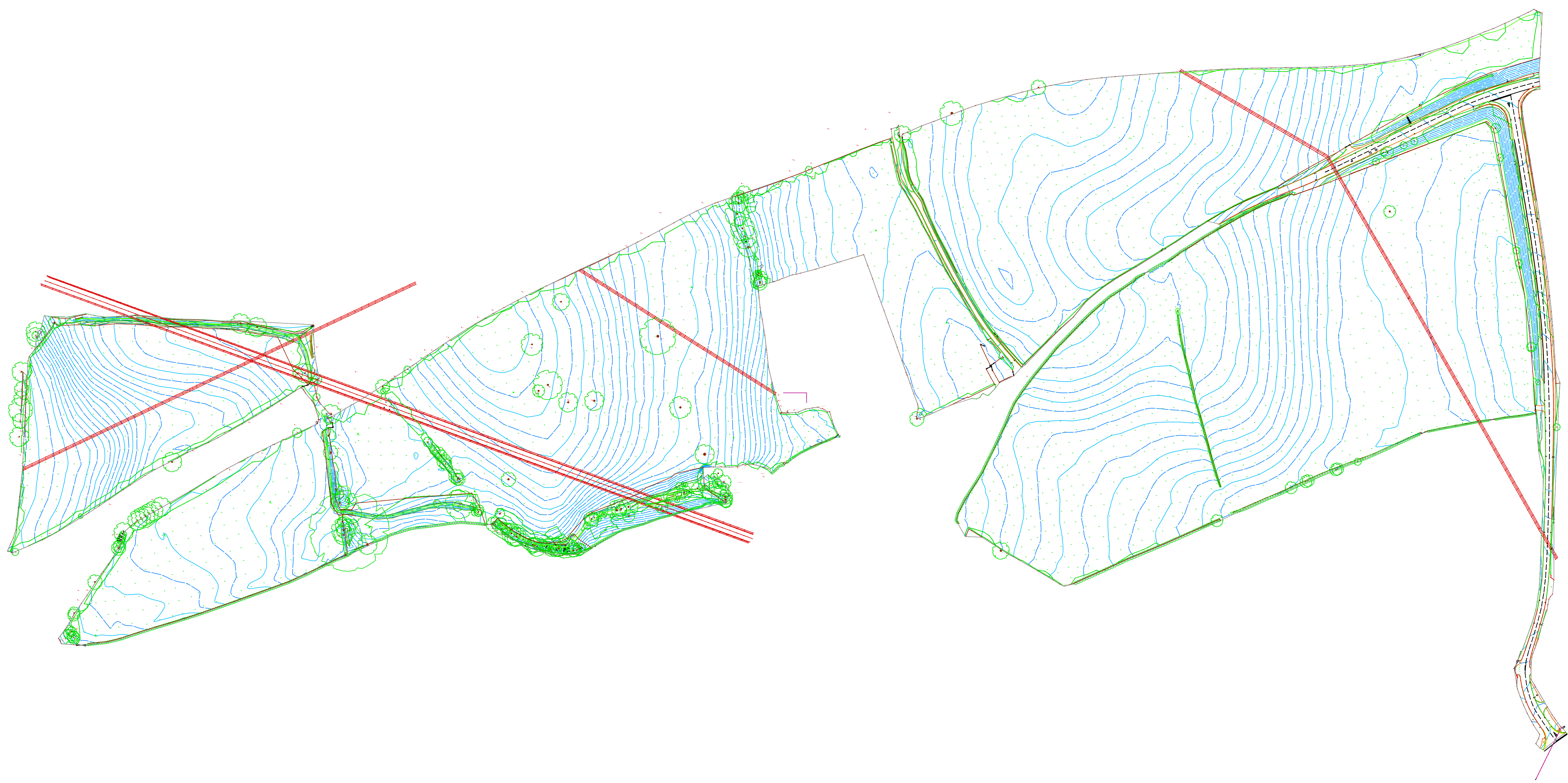
Appendix A Existing Site Characteristic Drawings

- A1 – Site Location Plan
- A2 – Site Topography (by RPS Group)
- A3 – Constraints Plan (by Innova)
- A4 – FEH Catchment Boundary

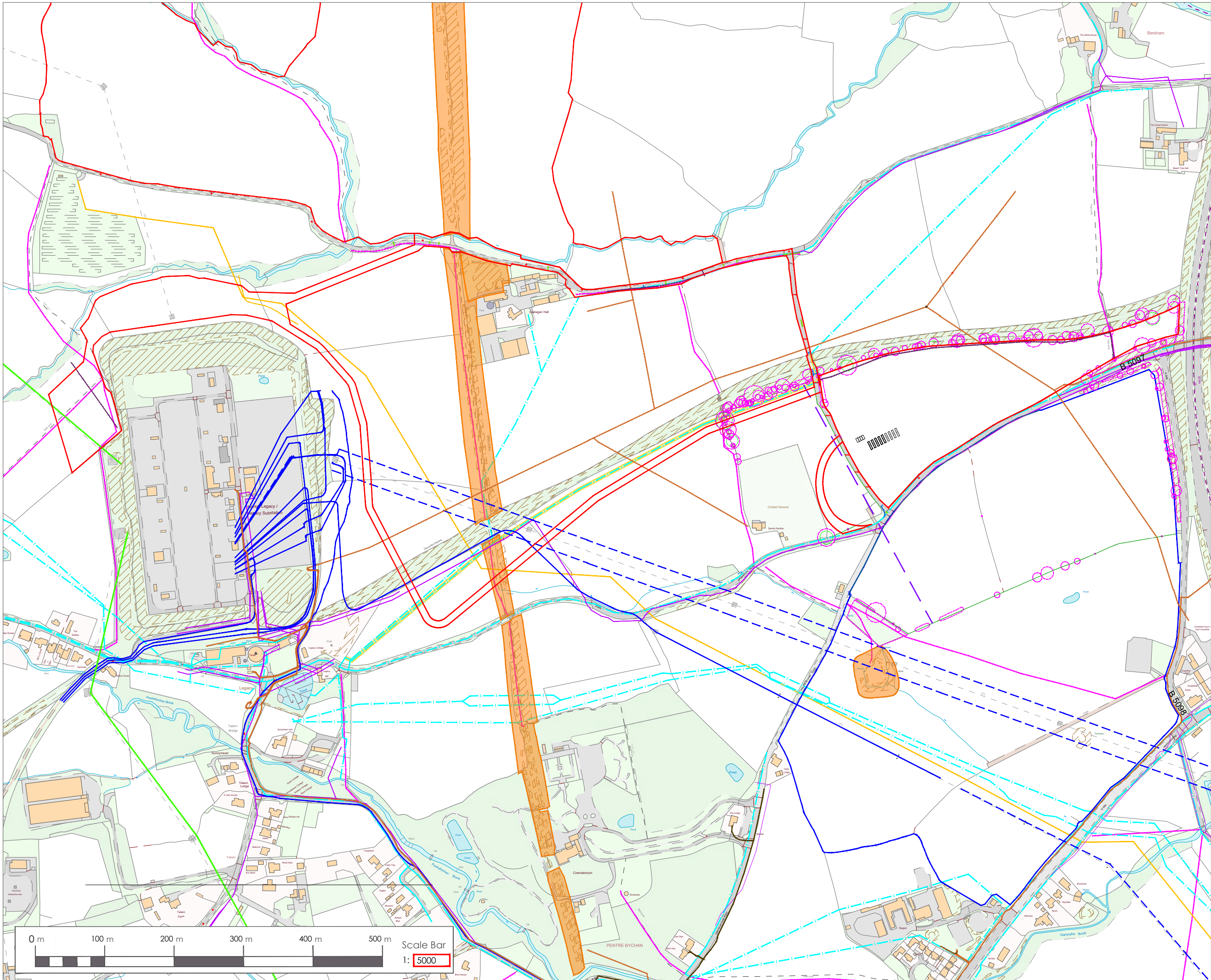
A1 – Site Location Plan

Rev: _

A2 – Site Topography (by RPS Group)



A3 – Constraints Plan (by Innova)



KEY:

- Development Boundary
- Overhead Transmission Cable
- Underground Transmission Cable
- Overhead High Voltage Cable
- Underground High Voltage Cable
- Water Mains
- Severn Trent 4 yard Corridor
- Gas Mains
- Low Voltage Cable
- Overhead Lines
- BT Fibre
- PRow
- Valley Area
- SSSI
- Scheduled Monuments
- Underground Gas Pipeline (GPR)
- BT Cable (GPR)
- Electric Cable (GPR)
- Radar Trace (GPR)
- Drainage Surface (GPR)
- Unidentified (GPR)
- Disused Gas Main



DATE: 05/02/2024

PROJECT TITLE:

Legacy

DRAWING TITLE:

Constraints Plan

DRAWING VERSION NUMBER:

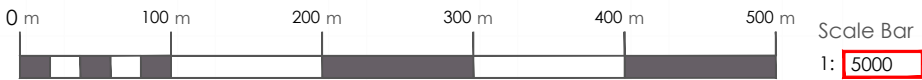
V4

SCALE: 1:5000

PAGE SIZE: A3

DRAWN BY: QR

APPROVED BY: WG



A4 – FEH Catchment Boundary

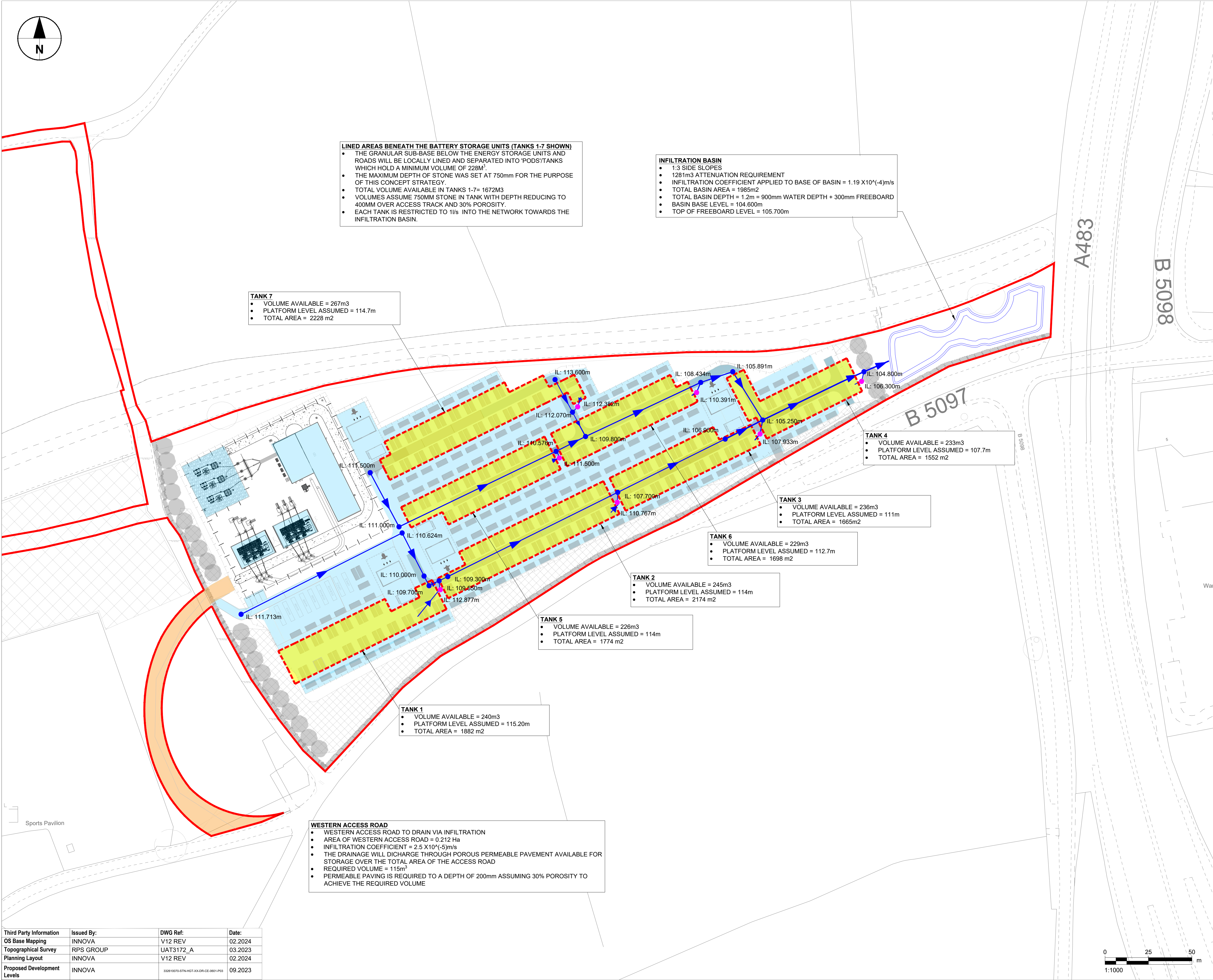


Appendix B Proposed Strategy Drawings

- B1 – Surface Water Drainage Strategy Plan
- B2 – Typical ESS Unit Storage ‘Pod’ Detail
- B3 – Proposed Site Levels and Overland Flow Drawing

B1 – Surface Water Drainage Strategy Plan

ISO A1 594mm x 841mm
Project Management Initials: Designer: EP Checked: CGY Approved: RQ
Last saved by: TESS GALLACHER(2024.11.22) Last Plotted: 2024.11.22
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Project

Transmission Portfolio
- Priority Projects



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- Notes**
- ALL DIMENSIONS SHOWN IN METERS UNLESS OTHERWISE STATED.
 - REFER TO INNOVA DRAWING "20240419 - L13 - Layout Plan" FOR GENERAL ARRANGEMENT

- KEY**
- 16.81 EXISTING GROUND LEVEL
 - RED LINE BOUNDARY
 - DENOTES PROPOSED SURFACE WATER/FIRE WATER DRAINAGE
 - INFILTRATION BASIN
 - LINED AREA TANK OUTLINE
 - LOCATION OF PROPOSED FLOW CONTROL MANHOLE
 - LOCATION OF PROPOSED SURFACE WATER DRAINAGE MANHOLE
 - EXTENT OF GRANULAR PLATFORM MAKEUP (ASSUMED IMPERMEABLE WITHIN MODEL)
 - EXTENT OF WESTERN ACCESS ROAD. MAKE UP TO BE CONFIRMED (ASSUMED IMPERMEABLE WITHIN MODEL)

ISSUE/REVISION

Rev	Date	Description	Drn/Chk/Appr
-	20.11.24	FIRST ISSUE	ERE/PRQ

Key Plan

Purpose Of Issue

FOR INFORMATION

Project Number

60727919

Sheet Title

LEGACY SITE
DRAINAGE STRATEGY
DRAINAGE LAYOUT

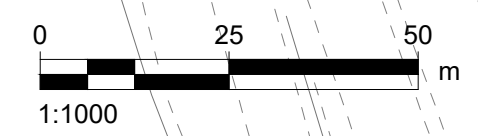
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INVA-ACM-LGY-XX-DR-CE-001161

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Rev: .

Third Party Information	Issued By:	DWG Ref:	Date:
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Topographical Survey	RPS GROUP	UAT3172_A	03.2023
Planning Layout	INNOVA	V12 REV	02.2024
Proposed Development Levels	INNOVA	332810070-STN-HST-XX-DR-CE-001161-P03	09.2023



B2 – Typical ESS Unit Storage ‘Pod’ Detail

B3 – Proposed Site Levels and Overland Flow Drawing

Rev: _

Appendix C Greenfield Runoff

Innova Legacy Project:	Date: 30/08/2024			
	Designed by: TG	Checked by: CM	Approved By: RQ	
Report Title: UK and Ireland Rural Runoff Calculator	AECOM Ltd:			

ICP SUDS / IH 124

Details

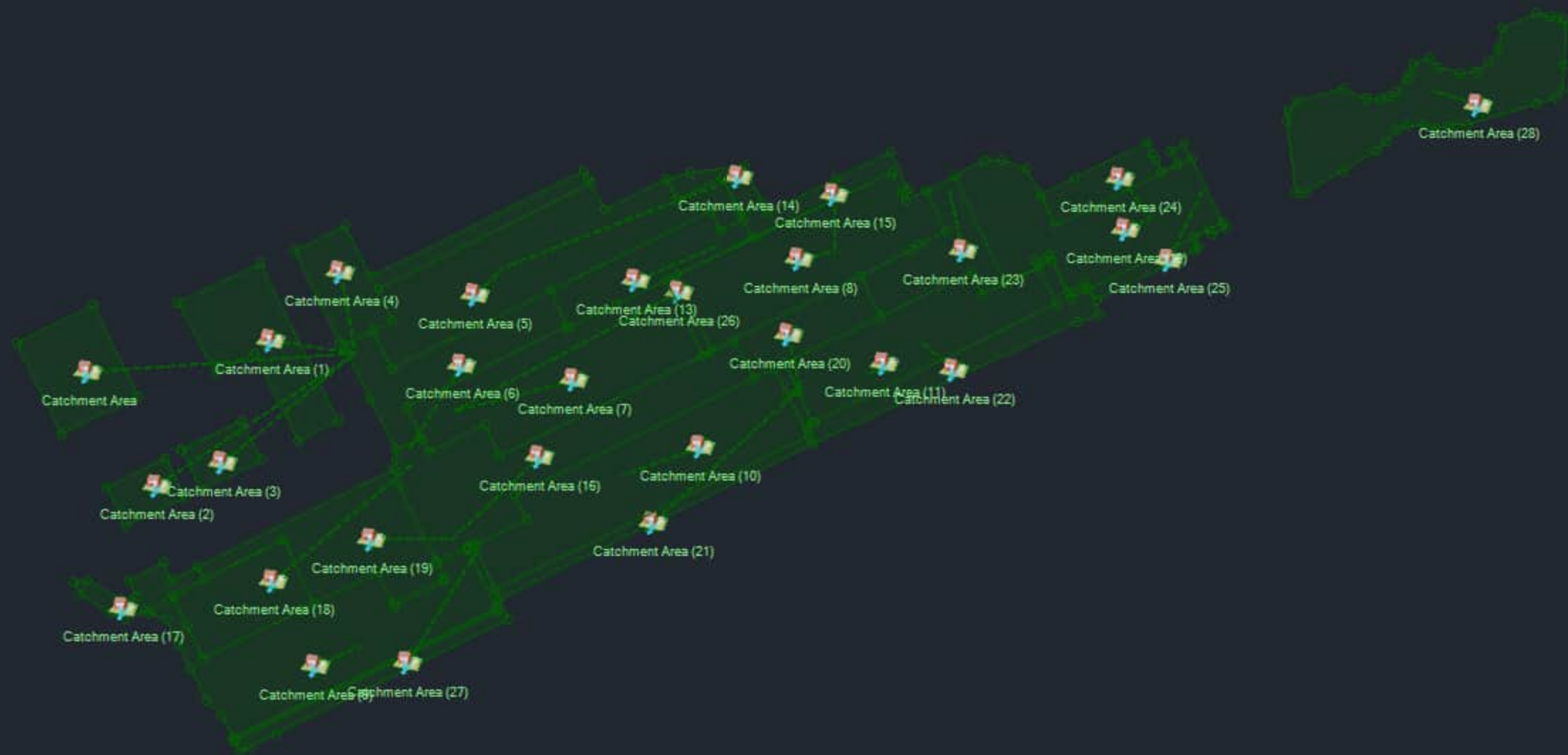
Method	ICP SUDS
Area (ha)	1.00
SAAR (mm)	789.0
Soil	0.47
Region	Region 9
Urban	0
Return Period (years)	0

Results

Region	QBAR Rural (L/s)	QBAR Urban (L/s)	Q 1 (years) (L/s)	Q 30 (years) (L/s)	Q 100 (years) (L/s)
Region 9	5.6	5.6	4.9	9.8	12.1

Appendix D Main Site Infiltration Basin Model Results





Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by:	Checked by:	Approved By:
	TG	CM	RQ
Report Details: Type: Junctions Storm Phase: Phase	AECOM Ltd:		



Name	Junction Type	Easting (m)	Northing (m)	Cover Level (m)	Depth (m)	Invert Level (m)	Chamber Shape	Diameter (m)
SW MH1	Manhole	1241.543	703.219	113.447	1.733	111.713	Circular	1.350
SW MH14	Manhole	1332.448	753.607	113.500	2.500	111.000	Circular	1.500
SW MH4	Manhole	1349.740	719.677	115.200	5.500	109.700	Circular	1.350
SW MH25	Manhole	1541.814	815.080	107.700	2.450	105.250	Circular	1.500
SW MH24	Manhole	1524.596	842.909	108.000	2.109	105.891	Circular	1.500
SW MH21	Manhole	1439.832	805.606	112.700	2.900	109.800	Circular	1.500
SW MH17	Manhole	1422.284	838.379	114.800	1.200	113.600	Circular	1.200
SW MH27	Manhole	1587.065	837.004	107.700	2.750	104.950	Circular	1.500
SW MH3	Manhole	1346.860	725.216	113.949	3.949	110.000	Circular	1.350
SW MH20	Manhole	1436.636	811.575	112.700	1.700	111.000	Circular	1.350
SW MH23	Manhole	1506.131	836.740	110.802	2.368	108.434	Circular	1.500
SW MH10	Manhole	1520.210	804.128	111.000	4.050	106.950	Circular	1.500
SW MH26	Manhole	1580.628	833.866	107.700	2.700	105.000	Circular	1.500
SW MH7	Manhole	1360.536	724.907	114.000	4.700	109.300	Circular	1.350
SW MH5	Manhole	1355.910	717.571	114.677	1.800	112.877	Circular	1.200
SW MH8	Manhole	1458.099	767.647	112.667	1.900	110.767	Circular	1.200
SW MH28	Manhole	1598.722	837.365	108.100	1.800	106.300	Circular	1.200
SW MH22	Manhole	1503.748	830.935	112.341	1.950	110.391	Circular	1.200
SW MH15	Manhole	1424.755	793.245	113.885	2.385	111.500	Circular	1.200
SW MH18	Manhole	1435.303	822.711	114.182	1.800	112.382	Circular	1.200
SW MH6	Manhole	1355.550	722.492	114.057	4.507	109.550	Circular	1.200
SW MH9	Manhole	1458.379	773.451	111.000	3.300	107.700	Circular	1.200
SW MH12	Manhole	1539.892	814.106	107.700	2.150	105.550	Circular	1.200
SW MH11	Manhole	1540.295	807.051	109.883	1.950	107.933	Circular	1.200
SW MH16	Manhole	1423.948	797.599	113.894	3.318	110.576	Circular	1.200
SW MH19	Manhole	1432.329	819.618	113.870	1.800	112.070	Circular	1.200
SW MH29	Manhole	1600.109	842.907	108.000	3.150	104.850	Circular	1.200
SW MH13	Manhole	1315.854	784.789	113.603	2.103	111.500	Circular	1.200
SW MH2	Manhole	1334.258	750.041	113.538	2.914	110.624	Circular	1.200

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
	Report Details: Type: Junctions Storm Phase: Phase		
		AECOM Ltd:	



Name	Lock
SW MH1	None
SW MH14	None
SW MH4	None
SW MH25	None
SW MH24	None
SW MH21	None
SW MH17	None
SW MH27	None
SW MH3	None
SW MH20	None
SW MH23	None
SW MH10	None
SW MH26	None
SW MH7	None
SW MH5	None
SW MH8	None
SW MH28	None
SW MH22	None
SW MH15	None
SW MH18	None
SW MH6	None
SW MH9	None
SW MH12	None
SW MH11	None
SW MH16	None
SW MH19	None
SW MH29	None
SW MH13	None
SW MH2	None

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Junctions Storm Phase: Phase	AECOM Ltd:		



Inlets

Junction	Inlet Name	Incoming Item(s)	Bypass Destination	Capacity Type
SW MH1	Inlet	Catchment Area (17)	(None)	No Restriction
SW MH14	Inlet	Catchment Area (6) Pipe (14)	(None)	No Restriction
SW MH4	Inlet	Pipe (5) (1)	(None)	No Restriction
SW MH25	Inlet	Pipe (6) (1) (1)	(None)	No Restriction
	Inlet (1)	Pipe (8)	(None)	No Restriction
SW MH24	Inlet	Pipe (9) (1)	(None)	No Restriction
SW MH21	Inlet	Pipe (11) (1)	(None)	No Restriction
		Pipe (10) (1)		
SW MH27	Inlet	Pipe (7) (1)	(None)	No Restriction
		Catchment Area (25)		
SW MH3	Inlet	Pipe (5) (2)	(None)	No Restriction
		Catchment Area (16)		
SW MH20	Inlet	Catchment Area (19)	(None)	No Restriction
		Pipe (11) (2)		
SW MH23	Inlet	Pipe (9)	(None)	No Restriction
		Pipe (4)		
SW MH10	Inlet	Catchment Area (23)	(None)	No Restriction
		Pipe (6) (2) (1)		
SW MH26	Inlet	Pipe (7)	(None)	No Restriction
SW MH7	Inlet	Pipe (6) (3)	(None)	No Restriction
SW MH5	Inlet	No Delay	(None)	No Restriction
SW MH8	Inlet	No Delay (8)	(None)	No Restriction
SW MH28	Inlet	No Delay (10)	(None)	No Restriction
SW MH22	Inlet	No Delay (11)	(None)	No Restriction
SW MH15	Inlet	No Delay (12)	(None)	No Restriction
SW MH18	Inlet	No Delay (13)	(None)	No Restriction
SW MH6	Inlet	Pipe (6)	(None)	No Restriction
	Inlet (1)	Catchment Area (27)	(None)	No Restriction
	Inlet (2)	Pipe (1)	(None)	No Restriction
SW MH9	Inlet	Pipe (6) (2)	(None)	No Restriction
		Pipe (2)		
SW MH12	Inlet	Catchment Area (20)	(None)	No Restriction
		Catchment Area (21)		
SW MH11	Inlet	Pipe (6) (1)	(None)	No Restriction
		Pipe (3)		
SW MH16	Inlet	No Delay (9)	(None)	No Restriction
		Pipe (10)		
SW MH19	Inlet	Pipe (10)	(None)	No Restriction
		Pipe (12)		
SW MH29	Inlet	Pipe (11)	(None)	No Restriction
		Pipe (5)		
SW MH13	Inlet	Catchment Area (13)	(None)	No Restriction
		600		
SW MH2	Inlet	Pipe (13)	(None)	No Restriction
		Catchment Area (1)		
SW MH13	Inlet	Catchment Area (3)	(None)	No Restriction
		Catchment Area (2)		
SW MH13	Inlet	Catchment Area	(None)	No Restriction
		Catchment Area (4)		
SW MH2	Inlet (2)	Pipe Catchment Area (18)	(None)	No Restriction

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
	Report Details: Type: Junctions Storm Phase: Phase		
AECOM Ltd:			



Outlets

Junction	Outlet Name	Outgoing Connection	Outlet Type
SW MH1	Outlet	Pipe	Free Discharge
SW MH14	Outlet (1)	Pipe (10)	Free Discharge
SW MH4	Outlet	Pipe (6)	Free Discharge
SW MH25	Outlet	Pipe (7)	Free Discharge
SW MH24	Outlet	Pipe (8)	Free Discharge
SW MH21	Outlet	Pipe (9)	Free Discharge
SW MH17	Outlet	Pipe (11)	Free Discharge
SW MH27	Outlet	600	Free Discharge
SW MH3	Outlet	Pipe (5) (1)	Free Discharge
SW MH20	Outlet	Pipe (11) (1)	Free Discharge
SW MH23	Outlet	Pipe (9) (1)	Free Discharge
SW MH10	Outlet	Pipe (6) (1)	Free Discharge
SW MH26	Outlet	Pipe (7) (1)	Free Discharge
SW MH7	Outlet	Pipe (6) (2)	Free Discharge
SW MH5	Outlet (1)	Pipe (1)	Free Discharge
SW MH8	Outlet (1)	Pipe (2)	Free Discharge
SW MH28	Outlet	Pipe (13)	Free Discharge
SW MH22	Outlet (1)	Pipe (4)	Free Discharge
SW MH15	Outlet (1)	Pipe (12)	Free Discharge
SW MH18	Outlet (1)	Pipe (5)	Free Discharge
SW MH6	Outlet	Pipe (6) (3)	Free Discharge
SW MH9	Outlet	Pipe (6) (2) (1)	Free Discharge
SW MH12	Outlet	Pipe (6) (1) (1)	Free Discharge
SW MH11	Outlet (1)	Pipe (3)	Free Discharge
SW MH16	Outlet	Pipe (10) (1)	Free Discharge
SW MH19	Outlet	Pipe (11) (2)	Free Discharge
SW MH29	Outlet	600 (1)	Free Discharge
SW MH13	Outlet	Pipe (14)	Free Discharge
SW MH2	Outlet	Pipe (5) (2)	Free Discharge

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:		





Pond

Type : Pond

Dimensions

Exceedance Level (m)	105.800
Depth (m)	1.200
Base Level (m)	104.600
Freeboard (mm)	300
Initial Depth (m)	0.000
Porosity (%)	100
Average Slope (1:X)	5.248
Total Volume (m³)	1281.499

Depth (m)	Area (m²)	Volume (m³)
0.000	1115.00	0.000
0.900	1757.00	1281.499
1.200	1985.00	1842.451

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	600 (1)
Bypass Destination	Catchment Area (28)
Capacity Type	(None)
	No Restriction

Outlets

Advanced

Base Infiltration Rate (m/hr)	0.4284
Safety Factor	10.0
Perimeter	Circular
Length (m)	102.918
Friction Scheme	Manning's n
n	0.035

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:		



Tank 7

Type : Tank

Dimensions

Exceedance Level (m)	114.700
Depth (m)	0.750
Base Level (m)	113.950
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	16
Average Slope (1:X)	0.00
Total Volume (m³)	267.439

Depth (m)	Area (m²)	Volume (m³)
0.000	2228.66	0.000
0.750	2228.66	267.439

Inlets

Inlet

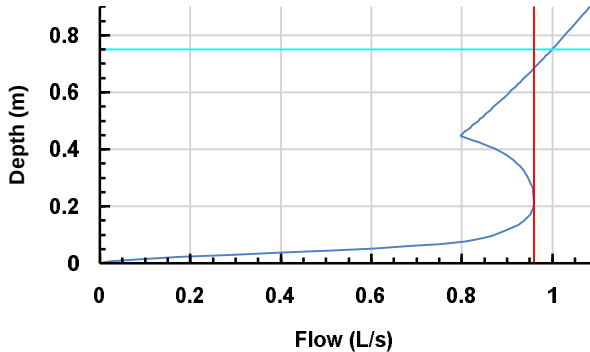
Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (5) Catchment Area (14)
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	No Delay (13)
Outlet Type	Hydro-Brake®
Invert Level (m)	113.950
Design Depth (m)	0.750
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☒

Unit Reference	SHE-0050-1000-0750-1000
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Advanced

Perimeter	Circular
Length (m)	123.792

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024			
	Designed by: TG	Checked by: CM	Approved By: RQ	
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:			



Tank 5

Type : Tank

Dimensions

Exceedance Level (m)	114.000
Depth (m)	0.750
Base Level (m)	113.250
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	17
Average Slope (1:X)	0.00
Total Volume (m³)	226.237

Depth (m)	Area (m²)	Volume (m³)
0.000	1774.41	0.000
0.750	1774.41	226.237

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (7)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (1)

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (26)
Bypass Destination	(None)
Capacity Type	No Restriction

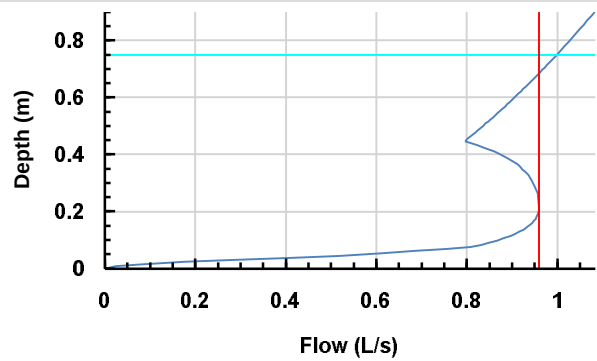
Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024			
	Designed by: TG	Checked by: CM	Approved By: RQ	
	Report Details: Type: Stormwater Controls Storm Phase: Phase			
AECOM Ltd:				

Outlets

Outlet

Outgoing Connection	No Delay (12)
Outlet Type	Hydro-Brake®
Invert Level (m)	113.250
Design Depth (m)	0.750
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☒

Unit Reference	SHE-0050-1000-0750-1000
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Advanced

Perimeter	Circular
Length (m)	94.421



Tank 6

Type : Tank

Dimensions

Exceedance Level (m)	112.700
Depth (m)	0.750
Base Level (m)	111.950
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	18
Average Slope (1:X)	0.00
Total Volume (m³)	229.346

Depth (m)	Area (m²)	Volume (m³)
0.000	1698.86	0.000
0.750	1698.86	229.346

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
	Report Details: Type: Stormwater Controls Storm Phase: Phase		
AECOM Ltd:			

Inlets

Inlet (1)

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (8)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet

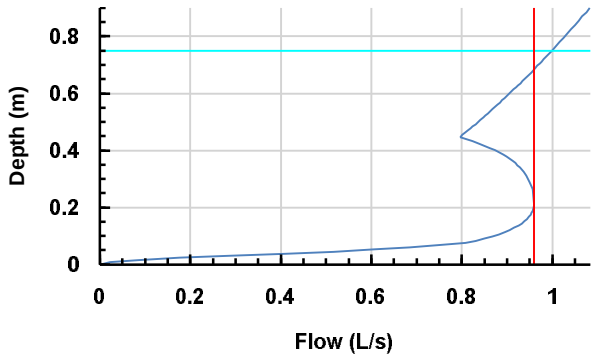
Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (15)
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	No Delay (11)
Outlet Type	Hydro-Brake®
Invert Level (m)	111.950
Design Depth (m)	0.750
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☒

Unit Reference	SHE-0050-1000-0750-1000
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Advanced

Perimeter	Circular
Length (m)	86.516

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:		



Tank2

Type : Tank

Dimensions

Exceedance Level (m)	114.000
Depth (m)	0.750
Base Level (m)	113.250
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	15
Average Slope (1:X)	0.00
Total Volume (m³)	244.570

Depth (m)	Area (m²)	Volume (m³)
0.000	2173.95	0.000
0.750	2173.95	244.570

Inlets

Inlet

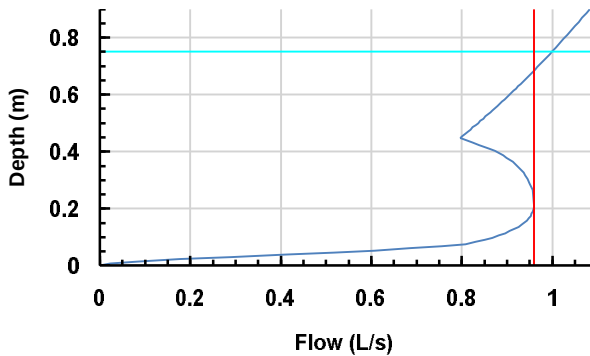
Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (10)
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	No Delay (8)
Outlet Type	Hydro-Brake®
Invert Level (m)	113.250
Design Depth (m)	0.750
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☒

Unit Reference	SHE-0050-1000-0750-1000
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Advanced

Perimeter	Circular
Length (m)	111.987

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:		



Tank 3

Type : Tank

Dimensions

Exceedance Level (m)	111.000
Depth (m)	0.750
Base Level (m)	110.250
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	19
Average Slope (1:X)	0.00
Total Volume (m³)	235.967

Depth (m)	Area (m²)	Volume (m³)
0.000	1655.91	0.000
0.750	1655.91	235.967

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (11)
Bypass Destination	(None)
Capacity Type	No Restriction

Inlet (2)

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (22)
Bypass Destination	(None)
Capacity Type	No Restriction

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:		

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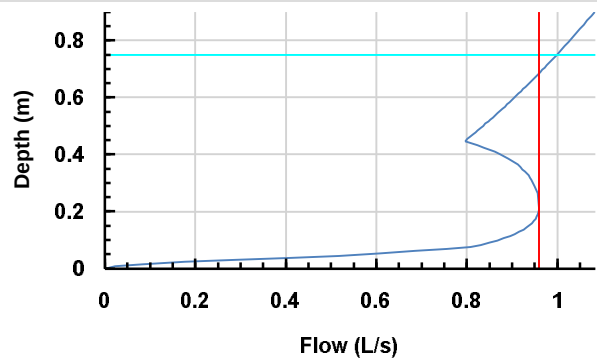
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Outlets

Outlet

Outgoing Connection	No Delay (9)
Outlet Type	Hydro-Brake®
Invert Level (m)	110.250
Design Depth (m)	0.750
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☒

Unit Reference	SHE-0050-1000-0750-1000
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Advanced

Perimeter	Circular
Length (m)	89.014

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:		



Tank 4

Type : Tank

Dimensions

Exceedance Level (m)	107.700
Depth (m)	0.750
Base Level (m)	106.950
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	20
Average Slope (1:X)	0.00
Total Volume (m³)	232.943

Depth (m)	Area (m²)	Volume (m³)
0.000	1552.96	0.000
0.750	1552.96	232.943

Inlets

Inlet (1)

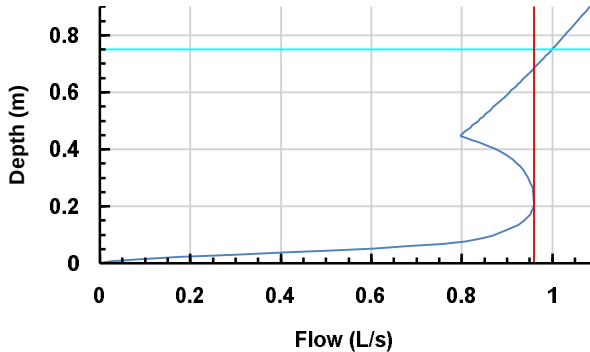
Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (12) Catchment Area (24)
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	No Delay (10)
Outlet Type	Hydro-Brake®
Invert Level (m)	106.950
Design Depth (m)	0.750
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☒

Unit Reference SHE-0050-1000-0750-1000



Advanced

Perimeter	Circular
Length (m)	78.392

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:		



Tank 1

Type : Tank

Dimensions

Exceedance Level (m)	115.200
Depth (m)	0.750
Base Level (m)	114.450
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	17
Average Slope (1:X)	0.00
Total Volume (m³)	239.929

Depth (m)	Area (m²)	Volume (m³)
0.000	1881.79	0.000
0.750	1881.79	239.929

Inlets

Inlet

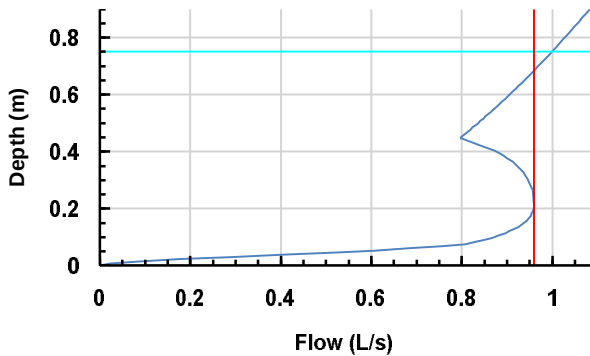
Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area (9)
Bypass Destination	(None)
Capacity Type	No Restriction

Outlets

Outlet

Outgoing Connection	No Delay
Outlet Type	Hydro-Brake®
Invert Level (m)	114.450
Design Depth (m)	0.750
Design Flow (L/s)	1.0
Objective	Minimise Upstream Storage Requirements
Application	Surface Water Only
Sump Available	☒

Unit Reference	SHE-0050-1000-0750-1000
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Advanced

Perimeter	Circular
Length (m)	99.803

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Connections Storm Phase: Phase	AECOM Ltd:		



Name	Length (m)	Connection Type	Slope (1:X)	Manning's n	Colebrook-White Roughness (mm)	Diameter / Base Width (mm)	Upstream Cover Level (m)	Upstream Invert Level (m)
Pipe (8)	32.725	Pipe	51.052		0.6	450	108.000	105.891
Pipe (5) (1)	6.243	Pipe	20.810		0.6	400	113.949	110.000
Pipe (11) (1)	6.771	Pipe	5.643		0.6	450	112.700	111.000
Pipe (9)	73.245	Pipe	53.620		0.6	450	112.700	109.800
Pipe (9) (1)	19.469	Pipe	7.656		0.6	450	110.802	108.434
Pipe (7)	43.121	Pipe	172.486		0.6	650	107.700	105.250
Pipe (7) (1)	7.161	Pipe	143.225		0.6	650	107.700	105.000
No Delay	20.188	No Delay						
Pipe (6)	6.456	Pipe	43.041		0.6	400	115.200	109.700
Pipe (6) (3)	5.540	Pipe	22.162		0.6	400	114.057	109.550
Pipe (6) (2)	109.224	Pipe	68.265		0.6	400	114.000	109.300
Pipe (6) (2) (1)	69.023	Pipe	138.046		0.6	400	111.000	107.700
Pipe (6) (1)	22.066	Pipe	15.761		0.6	650	111.000	106.950
Pipe (6) (1) (1)	2.155	Pipe	7.184		0.6	650	107.700	105.550
Pipe (10)	101.527	Pipe	239.349		0.6	450	113.500	111.000
Pipe (10) (1)	17.788	Pipe	22.928		0.6	450	113.894	110.576
Pipe (11)	21.281	Pipe	13.909		0.6	300	114.800	113.600
Pipe (11) (2)	9.123	Pipe	9.916		0.6	300	113.870	112.070
600	14.317	Pipe	143.175		0.6	650	107.700	104.950
600 (1)	66.306	Pipe	265.224		0.6	650	108.000	104.850
No Delay (8)	7.430	No Delay						
No Delay (9)	4.640	No Delay						
No Delay (10)	4.261	No Delay						
No Delay (11)	3.218	No Delay						
No Delay (12)	4.453	No Delay						
No Delay (13)	5.928	No Delay						
Pipe (5) (2)	27.841	Pipe	44.616		0.6	400	113.538	110.624
Pipe	103.867	Pipe	95.348		0.6	400	113.447	111.713
Pipe (1)	4.933	Pipe	1.483		0.6	350	114.677	112.877
Pipe (2)	5.811	Pipe	1.959		0.6	300	112.667	110.767
Pipe (3)	7.066	Pipe	3.237		0.6	450	109.883	107.933
Pipe (4)	6.275	Pipe	3.206		0.6	450	112.341	110.391
Pipe (5)	4.291	Pipe	13.752		0.6	300	114.182	112.382
Pipe (12)	4.429	Pipe	5.374		0.6	350	113.885	111.500
Pipe (13)	5.713	Pipe	3.940		0.6	300	108.100	106.300
Pipe (14)	35.323	Pipe	70.645		0.6	450	113.603	111.500

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Connections Storm Phase: Phase	AECOM Ltd:		



Name	Downstream Cover Level (m)	Downstream Invert Level (m)	Part Family	Lock	Flow Restriction (L/s)
Pipe (8)	107.700	105.250		None	
Pipe (5) (1)	115.200	109.700		None	
Pipe (11) (1)	112.700	109.800		None	
Pipe (9)	110.802	108.434		None	
Pipe (9) (1)	108.000	105.891		None	
Pipe (7)	107.700	105.000		None	
Pipe (7) (1)	107.700	104.950		None	
No Delay					
Pipe (6)	114.057	109.550		None	
Pipe (6) (3)	114.000	109.300		None	
Pipe (6) (2)	111.000	107.700		None	
Pipe (6) (2) (1)	111.000	107.200		None	
Pipe (6) (1)	107.700	105.550		None	
Pipe (6) (1) (1)	107.700	105.250		None	
Pipe (10)	113.894	110.576		None	
Pipe (10) (1)	112.700	109.800		None	
Pipe (11)	113.870	112.070		None	
Pipe (11) (2)	112.700	111.150		None	
600	108.000	104.850		All	
600 (1)	105.800	104.600		All	
No Delay (8)					
No Delay (9)					
No Delay (10)					
No Delay (11)					
No Delay (12)					
No Delay (13)					
Pipe (5) (2)	113.949	110.000		None	
Pipe	113.538	110.624		None	
Pipe (1)	114.057	109.550		None	
Pipe (2)	111.000	107.800		None	
Pipe (3)	107.700	105.750		None	
Pipe (4)	110.802	108.434		None	
Pipe (5)	113.870	112.070		None	
Pipe (12)	113.894	110.676		None	
Pipe (13)	108.000	104.850		None	
Pipe (14)	113.500	111.000		None	

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Inflow Summary Storm Phase: Phase	AECOM Ltd:		



Inflow Label	Connected To	Flow (L/s)	Runoff Method	Area (ha)	Percentage Impervious (%)	Urban Creep (%)	Adjusted Percentage Impervious (%)	Area Analysed (ha)
Catchment Area	SW MH13		Time of Concentration	0.089	100	0	100	0.089
Catchment Area (1)	SW MH13		Time of Concentration	0.118	100	0	100	0.118
Catchment Area (2)	SW MH13		Time of Concentration	0.030	100	0	100	0.030
Catchment Area (3)	SW MH13		Time of Concentration	0.031	100	0	100	0.031
Catchment Area (4)	SW MH13		Time of Concentration	0.097	100	0	100	0.097
Catchment Area (5)	Tank 7		Time of Concentration	0.254	100	0	100	0.254
Catchment Area (6)	SW MH14		Time of Concentration	0.111	100	0	100	0.111
Catchment Area (7)	Tank 5		Time of Concentration	0.231	100	0	100	0.231
Catchment Area (8)	Tank 6		Time of Concentration	0.209	100	0	100	0.209
Catchment Area (9)	Tank 1		Time of Concentration	0.251	100	0	100	0.251
Catchment Area (10)	Tank2		Time of Concentration	0.256	100	0	100	0.256
Catchment Area (11)	Tank 3		Time of Concentration	0.167	100	0	100	0.167
Catchment Area (12)	Tank 4		Time of Concentration	0.201	100	0	100	0.201
Catchment Area (13)	SW MH19		Time of Concentration	0.083	100	0	100	0.083
Catchment Area (14)	Tank 7		Time of Concentration	0.021	100	0	100	0.021
Catchment Area (15)	Tank 6		Time of Concentration	0.034	100	0	100	0.034
Catchment Area (16)	SW MH3		Time of Concentration	0.227	100	0	100	0.227
Catchment Area (17)	SW MH1		Time of Concentration	0.030	100	0	100	0.030
Catchment Area (18)	SW MH2		Time of Concentration	0.090	100	0	100	0.090
Catchment Area (19)	SW MH3		Time of Concentration	0.146	100	0	100	0.146
Catchment Area (20)	SW MH9		Time of Concentration	0.068	100	0	100	0.068
Catchment Area (21)	SW MH9		Time of Concentration	0.040	100	0	100	0.040
Catchment Area (22)	Tank 3		Time of Concentration	0.081	100	0	100	0.081
Catchment Area (23)	SW MH23		Time of Concentration	0.082	100	0	100	0.082
Catchment Area (24)	Tank 4		Time of Concentration	0.044	100	0	100	0.044
Catchment Area (25)	SW MH27		Time of Concentration	0.017	100	0	100	0.017
Catchment Area (26)	Tank 5		Time of Concentration	0.009	100	0	100	0.009
Catchment Area (27)	SW MH6		Time of Concentration	0.053	100	0	100	0.053
Catchment Area (28)	Pond		Time of Concentration	0.196	100	0	100	0.196
TOTAL		0.0		3.266				3.266

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Network Design Criteria Storm Phase: Phase	AECOM Ltd:		



Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

FEH

Type: FEH

Site Location	GB 332600 350700 SJ 32600 50700
Return Period (years)	100.0
Rainfall Version	2013
Data Type	Catchment

Pipe Options

Lock Slope Options	None
Design Options	Minimise Excavation
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Pipe Size Library

Default

Add. Increment (mm)	75
Max. Diameter (mm)	0

Diameter (mm)	Min. Slope (1:X)	Max. Slope (1:X)
100	0.00	0.00
150	0.00	0.00

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Network Design Criteria Storm Phase: Phase	AECOM Ltd:		



Manhole Options

Apply Offset ☐

Manhole Size Library

Default

Diameter / Width

Connection (mm)	Diameter / Length (m)	Width (m)
0	1.200	0.000
375	1.350	0.000
500	1.500	0.000
750	1.800	0.000

Additional Sizing

Connection (mm)	900
Diameter / Length (m)	0.900
Width (m)	0.000

Depth

Depth (m)	Diameter / Length (m)	Width (m)
0.000	1.050	0.000
1.500	1.200	0.000

Access

Depth (m)	Ladder Protrusion (mm)
0.000	130
3.000	230

Benching Requirements

Landing Width (mm)	500
Benching Width (mm)	225

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024			
	Designed by: TG	Checked by: CM	Approved By: RQ	
	Report Title: Rainfall Analysis Criteria			
AECOM Ltd:				

Runoff Type	Dynamic
Output Interval (mins)	1
Time Step	Shortest
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall		
FEH (1)	Type: FEH	
Site Location	GB 331700 348400 SJ 31700 48400	
Rainfall Version	2013	
Data Type	Catchment	
Summer	☒	
Winter	☒	

Return Period

Return Period (years)	Increase Rainfall (%)
100.0	40.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200
720	1440
960	1920
1440	2880
2160	4320
2880	5760
4320	8640
5760	11520
7200	14400
8640	17280
10080	20160

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Inflows Summary Storm Phase: Phase	AECOM Ltd:		



Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m³)
Catchment Area	FEH (1): 100 years: +40 %: 15 mins: Winter	0.09	63.0	29.111
Catchment Area (1)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.12	83.5	38.566
Catchment Area (2)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.03	21.1	9.747
Catchment Area (3)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.03	21.6	9.970
Catchment Area (4)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.10	68.5	31.655
Catchment Area (5)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.25	178.8	82.609
Catchment Area (6)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.11	78.1	36.096
Catchment Area (7)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.23	163.0	75.296
Catchment Area (8)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.21	147.4	68.121
Catchment Area (9)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.25	177.0	81.774
Catchment Area (11)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.17	117.8	54.433
Catchment Area (12)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.20	141.7	65.453
Catchment Area (13)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.08	58.3	26.953
Catchment Area (14)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.02	14.7	6.774
Catchment Area (15)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.03	24.0	11.112

Innova Legacy Project: Drainage Strategy Infiltration Basin Model		Date: 22/11/2024			
		Designed by: TG	Checked by: CM		Approved By: RQ
Report Details: Type: Inflows Summary Storm Phase: Phase		AECOM Ltd:			

Catchment Area (16)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.23	160.2	74.020
Catchment Area (17)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.03	21.2	9.800
Catchment Area (18)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.09	63.4	29.282
Catchment Area (19)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.15	102.6	47.409
Catchment Area (20)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.07	47.9	22.146
Catchment Area (21)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.04	28.5	13.146
Catchment Area (22)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.08	57.3	26.497
Catchment Area (23)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.08	58.1	26.854
Catchment Area (24)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.04	31.3	14.453
Catchment Area (25)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.02	11.8	5.438
Catchment Area (26)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.01	6.4	2.945
Catchment Area (10)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.26	180.3	83.326
Catchment Area (27)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.05	37.3	17.229
Catchment Area (28)	FEH (1): 100 years: +40 %: 15 mins: Winter	0.20	138.4	63.946

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Junctions Summary Storm Phase: Phase	AECOM Ltd:		



Critical Storm Per Item: Rank By: Max. Depth

Junction	Storm Event	Cover Level (m)	Invert Level (m)	Max. Level (m)	Max. Depth (m)	Max. Inflow (L/s)	Max. Resident Volume (m³)	Max. Flooded Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Status
SW MH1	FEH (1): 100 years: +40 %: 15 mins: Winter	113.4 47	111.71 3	111.78 9	0.076	21.2	0.108	0.000	20.9	9.694	OK
SW MH14	FEH (1): 100 years: +40 %: 15 mins: Winter	113.5 00	111.00 0	112.07 1	1.071	321.5	1.893	0.000	325.5	155.151	Surcharged
SW MH4	FEH (1): 100 years: +40 %: 15 mins: Winter	115.2 00	109.7 00	111.46 6	1.766	273.4	2.528	0.000	272.0	160.578	Surcharged
SW MH25	FEH (1): 100 years: +40 %: 15 mins: Winter	107.7 00	105.2 50	106.56 3	1.313	778.1	2.320	0.000	777.2	428.027	Surcharged
SW MH24	FEH (1): 100 years: +40 %: 15 mins: Winter	108.0 00	105.8 91	107.24 6	1.355	433.6	2.395	0.000	422.7	211.999	Surcharged
SW MH21	FEH (1): 100 years: +40 %: 15 mins: Winter	112.7 00	109.8 00	110.17 5	0.375	383.5	0.662	0.000	379.9	184.353	OK
SW MH17	FEH (1): 100 years: +40 %: 15 mins: Summer	114.8 00	113.6 00	113.60 0	0.000	0.0	0.000	0.000	0.0	0.000	OK
SW MH27	FEH (1): 100 years: +40 %: 15 mins: Winter	107.7 00	104.9 50	105.87 8	0.928	784.8	1.640	0.000	783.4	432.990	Surcharged
SW MH3	FEH (1): 100 years: +40 %: 15 mins: Winter	113.9 49	110.0 00	111.65 2	1.652	320.1	2.364	0.000	273.4	161.842	Surcharged
SW MH20	FEH (1): 100 years: +40 %: 15 mins: Winter	112.7 00	111.00 0	111.06 0	0.060	58.9	0.086	0.000	58.9	28.221	OK
SW MH23	FEH (1): 100 years: +40 %: 15 mins: Winter	110.8 02	108.4 34	108.62 1	0.187	435.7	0.331	0.000	433.6	212.337	OK
SW MH10	FEH (1): 100 years: +40 %: 15 mins: Winter	111.00 0	106.9 50	107.12 6	0.176	359.2	0.312	0.000	359.0	214.982	OK
SW MH26	FEH (1): 100 years: +40 %: 15 mins: Winter	107.7 00	105.0 00	106.07 0	1.070	777.2	1.891	0.000	775.6	427.726	Surcharged
SW MH7	FEH (1): 100 years: +40 %: 15 mins: Winter	114.0 00	109.3 00	111.06 3	1.763	300.8	2.523	0.000	298.4	178.143	Surcharged
SW MH5	FEH (1): 100 years: +40 %: 960 mins: Winter	114.6 77	112.8 77	112.88 4	0.007	1.0	0.008	0.000	1.0	99.256	OK
SW MH8	FEH (1): 100 years: +40 %: 1440 mins: Winter	112.6 67	110.7 67	110.77 5	0.008	1.0	0.009	0.000	1.0	147.499	OK
SW MH28	FEH (1): 100 years: +40 %: 1440 mins: Winter	108.1 00	106.3 00	106.30 9	0.009	1.0	0.010	0.000	1.0	146.913	OK
SW MH22	FEH (1): 100 years: +40 %: 960 mins: Winter	112.3 41	110.3 91	110.39 9	0.008	1.0	0.009	0.000	1.0	99.432	OK
SW MH15	FEH (1): 100 years: +40 %: 1440 mins: Winter	113.8 85	111.50 0	111.51 0	0.010	1.0	0.011	0.000	1.0	146.815	OK
SW MH18	FEH (1): 100 years: +40 %: 1440 mins: Winter	114.1 82	112.3 82	112.39 5	0.013	1.0	0.015	0.000	1.0	147.963	OK

Innova Legacy Project: Drainage Strategy Infiltration Basin Model				Date: 22/11/2024							
Report Details: Type: Junctions Summary Storm Phase: Phase				Designed by:	Checked by:	Approved By:					
				TG	CM	RQ					
				AECOM Ltd:							

SW MH6	FEH (1): 100 years: +40 %: 15 mins: Winter	114.0 57	109.5 50	111.27 9	1.729	302.2	1.956	0.000	300.8	179.110	Surcharged
SW MH9	FEH (1): 100 years: +40 %: 15 mins: Winter	111.00 0	107.7 00	109.32 1	1.621	359.3	1.833	0.000	359.2	215.033	Surcharged
SW MH12	FEH (1): 100 years: +40 %: 15 mins: Winter	107.7 00	105.5 50	106.59 6	1.046	360.0	1.183	0.000	368.0	216.256	Surcharged
SW MH11	FEH (1): 100 years: +40 %: 1440 mins: Winter	109.8 83	107.9 33	107.94 1	0.008	1.0	0.009	0.000	1.0	147.176	OK
SW MH16	FEH (1): 100 years: +40 %: 15 mins: Winter	113.8 94	110.5 76	110.83 6	0.260	326.4	0.294	0.000	327.1	156.337	OK
SW MH19	FEH (1): 100 years: +40 %: 15 mins: Winter	113.8 70	112.0 70	112.16 1	0.091	59.2	0.103	0.000	58.9	28.230	OK
SW MH29	FEH (1): 100 years: +40 %: 15 mins: Winter	108.0 00	104.8 50	105.62 8	0.778	784.3	0.880	0.000	777.1	432.511	Surcharged
SW MH13	FEH (1): 100 years: +40 %: 15 mins: Winter	113.6 03	111.50 0	112.32 8	0.828	257.6	0.936	0.000	246.1	118.953	Surcharged
SW MH2	FEH (1): 100 years: +40 %: 15 mins: Winter	113.5 38	110.6 24	111.68 2	1.058	102.0	1.196	0.000	118.7	40.508	Surcharged

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	AECOM Ltd:		



Critical Storm Per Item: Rank By: Max. Avg. Depth

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Residual Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)
Pond	FEH (1): 100 years: +40 %: 960 mins: Winter	105.494	105.494	0.894	0.894	79.5	1271.083	0.000	1477.773	0.0	0.000	800	0.813
Tank 7	FEH (1): 100 years: +40 %: 1440 mins: Winter	114.699	114.699	0.749	0.749	9.8	267.101	0.000	0.000	1.0	147.980	2339	0.126
Tank 5	FEH (1): 100 years: +40 %: 1440 mins: Winter	113.998	113.998	0.748	0.748	8.6	225.604	0.000	0.000	1.0	146.829	1978	0.280
Tank 6	FEH (1): 100 years: +40 %: 1440 mins: Winter	112.700	112.700	0.750	0.750	8.7	229.200	0.000	0.000	1.0	147.054	2010	0.064
Tank2	FEH (1): 100 years: +40 %: 1440 mins: Winter	114.000	114.000	0.750	0.750	9.1	244.510	0.000	0.000	1.0	147.510	2141	0.025
Tank 3	FEH (1): 100 years: +40 %: 1440 mins: Winter	110.999	110.999	0.749	0.749	8.9	235.547	0.000	0.000	1.0	147.189	2061	0.178
Tank 4	FEH (1): 100 years: +40 %: 1440 mins: Winter	107.697	107.697	0.747	0.747	8.7	231.892	0.000	0.000	1.0	146.925	2036	0.451
Tank 1	FEH (1): 100 years: +40 %: 1440 mins: Winter	115.197	115.197	0.747	0.747	8.9	238.819	0.000	0.000	1.0	147.113	2093	0.463

Innova Legacy Project: Drainage Strategy Infiltration Basin Model	Date: 22/11/2024			
	Designed by:	Checked by:	Approved By:	
	TG	CM	RQ	
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	AECOM Ltd:			

Status
OK
OK
OK
OK
OK
OK
OK
OK

Appendix E Western Access Road Model Results



Innova Legacy Project: Western Access Road Permeable Paving Option	Date: 18/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Storm Phase: Phase	AECOM Ltd:		



Type : Tank

Dimensions

Exceedance Level (m)	114.000
Depth (m)	0.200
Base Level (m)	113.800
Freeboard (mm)	0
Initial Depth (m)	0.000
Porosity (%)	30
Average Slope (1:X)	0.00
Total Volume (m³)	126.956

Depth (m)	Area (m²)	Volume (m³)
0.000	2115.93	0.000
0.200	2115.93	126.956

Inlets

Inlet

Inlet Type	Point Inflow
Incoming Item(s)	Catchment Area
Bypass Destination	(None)
Capacity Type	No Restriction

Advanced

Base Infiltration Rate (m/hr)	0.0911
Side Infiltration Rate (m/hr)	0.0911
Safety Factor	10.0
Perimeter	Rectangular
Length (m)	152.652

Innova Legacy Project: Western Access Road Permeable Paving Option	Date: 18/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Network Design Criteria Storm Phase: Phase	AECOM Ltd:		



Flow Options

Peak Flow Calculation	(UK) Modified Rational Method
Min. Time of Entry (mins)	5
Max. Travel Time (mins)	30

FEH

Type: FEH

Site Location	GB 332600 350700 SJ 32600 50700
Return Period (years)	100.0
Rainfall Version	2013
Data Type	Catchment

Pipe Options

Lock Slope Options	None
Design Options	Minimise Excavation
Design Level	Level Soffits
Min. Cover Depth (m)	1.200
Min. Slope (1:X)	500.00
Max. Slope (1:X)	40.00
Min. Velocity (m/s)	1.0
Max. Velocity (m/s)	3.0
Use Flow Restriction	☐
Reduce Channel Depths	☐

Manhole Options

Apply Offset	☐
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Innova Legacy Project: Western Access Road Permeable Paving Option	Date: 18/11/2024			
	Designed by: TG	Checked by: CM	Approved By: RQ	
	Report Title: Rainfall Analysis Criteria			
AECOM Ltd:				

Runoff Type	Dynamic
Output Interval (mins)	1
Time Step	Shortest
Urban Creep	Apply Global Value
Urban Creep Global Value (%)	0
Junction Flood Risk Margin (mm)	300
Perform No Discharge Analysis	☐

Rainfall		
FEH (1)	Type: FEH	
Site Location	GB 331700 348400 SJ 31700 48400	
Rainfall Version	2013	
Data Type	Catchment	
Summer	☒	
Winter	☒	

Return Period

Return Period (years)	Increase Rainfall (%)
100.0	40.000

Storm Durations

Duration (mins)	Run Time (mins)
15	30
30	60
60	120
120	240
180	360
240	480
360	720
480	960
600	1200
720	1440
960	1920
1440	2880
2160	4320
2880	5760
4320	8640
5760	11520
7200	14400
8640	17280
10080	20160

Innova Legacy Project: Western Access Road Permeable Paving Option	Date: 18/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Inflows Summary Storm Phase: Phase	AECOM Ltd:		



Critical Storm Per Item: Rank By: Max. Inflow

Inflow	Storm Event	Inflow Area (ha)	Max. Inflow (L/s)	Total Inflow Volume (m³)
Catchment Area	FEH (1): 100 years: +40 %: 15 mins: Winter	0.21	149.2	68.928

Innova Legacy Project: Western Access Road Permeable Paving Option	Date: 18/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
Report Details: Type: Stormwater Controls Summary Storm Phase: Phase	AECOM Ltd:		





Critical Storm Per Item: Rank By: Max. Avg. Depth

Stormwater Control	Storm Event	Max. US Level (m)	Max. DS Level (m)	Max. US Depth (m)	Max. DS Depth (m)	Max. Inflow (L/s)	Max. Residant Volume (m³)	Max. Flooded Volume (m³)	Total Lost Volume (m³)	Max. Outflow (L/s)	Total Discharge Volume (m³)	Half Drain Down Time (mins)	Percentage Available (%)
Tank	FEH (1): 100 years: +40 %: 120 mins: Winter	113.976	113.976	0.176	0.176	52.1	111.790	0.000	77.156	0.0	0.000	174	11.945

Innova Legacy Project: Western Access Road Permeable Paving Option	Date: 18/11/2024		
	Designed by: TG	Checked by: CM	Approved By: RQ
	Report Details: Type: Stormwater Controls Summary Storm Phase: Phase		
			

Status
OK

