WHITESTONE SOLAR FARM

Volume 5 - Reports and Statements

5.17: Outline Surface Water Drainage Strategy

Application Document ref. EN0110020/APP/5.17
Revision 01
June 2026

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
Regulation 5(2)(q)

Document status					
Version	**Purpose of document**	**Authored by**	**Reviewed by**	**Approved by**	**Review date**
Rev 01	DCO Submission	CP	AD	DL	June 2026

Approval for issue		
Whitestone Net Zero Ltd.	[redacted]	1 June 2026

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A.1	Topographical Data

Glossary

Term	Meaning
EA Main River	These are usually larger rivers and streams designated by the Environment agency that play a critical role in regional drainage and flood risk management.
Study Area	This is an area which is defined for each environmental topic which includes the Order Limits as well as potential spatial and temporal considerations of the impacts on relevant receptors.
The Applicant	Whitestone Net Zero Ltd
The Proposed Development	The proposed Whitestone Solar Farm.
The Site	The land planned to be used for solar PV array and associated infrastructure, BESS, substations, and landscaping and habitat enhancement. The Site is split into W1, W2, and W3.
Whitestone 1 (W1)	The northern parcels of the Whitestone Solar Farm.
Whitestone 2 (W2)	The middle parcels of the Whitestone Solar Farm.
Whitestone 3 (W3)	The southern parcels of the Whitestone Solar Farm.

Acronyms

Acronym	Meaning
AEP	Annual Exceedance Probability
BESS	Battery Energy Storage System
BGS	British Geological Survey
CDC	City of Doncaster Council
Cv	Volumetric coefficient
DCC	Derbyshire County Council
DCO	Development Consent Order
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EIA	Environmental Impact Assessment
ES	Environmental Statement
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
FRS	Fire and Rescue Service
GI	Ground Investigation
ICP	Interim Code of Practice
LLFA	Lead Local Flood Authority
LPA	Local Planning Authority
NEDDC	North East Derbyshire District Council
NFCC	National Fire Chiefs Council

Acronym	Meaning
NGR	National Grid Reference
NPS	National Policy Statement
NPPF	National Planning Policy Framework
oBSMP	Outline Battery Safety Management Plan
OEM	Original Equipment Manufacturer
oLEMP	Outline Landscape and Ecology Management Plan
oOEMP	Outline Operational Environmental Management Plan
oSWDS	Outline Surface Water Drainage Strategy
PCS	Power Conversion Systems
PPG	Planning Practice Guidance
PV	Photovoltaic
RMBC	Rotherham Metropolitan Borough Council
SAC	Special Area of Conservation
SIA	Simple Index Approach
SPA	Special Protection Areas
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System
TSS	Total Suspended Solids
UKSO	UK Soil Observatory
W1	Whitestone 1
W2	Whitestone 2
W3	Whitestone 3
WFD	Water Framework Directive

Units

Units	Meaning
ha	Hectares
km	Kilometre
kV	Kilovolt
MW	Megawatts
m AOD	Metres Above Ordnance Datum

1 INTRODUCTION

1.1 Overview

1.1.1 This Outline Surface Water Drainage Strategy (oSWDS) has been prepared for Whitestone Net Zero Ltd (the Applicant) in support of the application for development consent for the Whitestone Solar Farm development (the Proposed Development) and reflects inputs of consultation and discussions with relevant stakeholders. The preparation of a final Surface Water Drainage Strategy is secured by a requirement in Schedule 2 to the **Draft DCO [EN0110020APP/3.1].** This document should be read in conjunction with **Environmental Statement (ES) Volume 2, Chapter 10: Water Resources and Flood Risk [EN0110020/APP/6.1].**

1.2 The Order Limits

1.2.1 The extent of the Order Limits is shown in the **Location Plans [EN0110020/APP/2.1]** and the Proposed Development is described in full in **ES Volume 1, Chapter 5: The Proposed Development [EN0110020/APP/6.6]** and shown spatially on the **Works Plans [EN0110020/APP/2.3].**

1.3 The Proposed Development

1.3.1 The Proposed Development comprises the construction, operation and maintenance, and decommissioning of more than 100 megawatts (MW) of solar photovoltaic (PV) arrays, Battery Energy Storage System (BESS), onsite substations and supporting infrastructure, and grid connection infrastructure.

1.4 Purpose of this Outline Surface Water Drainage Strategy

1.4.1 The purpose of this oSWDS is to set out the key management and monitoring procedures in relation to surface water and drainage that will be required during the lifetime of the Proposed Development.

1.4.2 This is an outline document based on the design set out in **ES Volume 1, Chapter 5: The Proposed Development [EN0110020/APP/6.5]** and includes measures that have been identified as part of the Environmental Impact Assessment (EIA) process. These measures are to ensure that any significant adverse environmental effects reported in the Environmental Statement (ES) will be either avoided or mitigated.

1.4.3 If the DCO is granted, a detailed Surface Water Drainage Strategy will be prepared in accordance with the principles of this outline plan and agreed with the relevant planning authority.

1.5 Site Description

1.5.1 The Order Limits are located east of Sheffield, South Yorkshire, within the administrative areas of the City of Doncaster Council (CDC) and Rotherham Metropolitan Borough Council (RMBC). The southern extent of the Order Limits slightly encroaches into North East Derbyshire District Council (NEDDC) within Derbyshire. This is shown in **ES Volume 3, Figure 3.1: Order Limits [EN0110020/APP/6.19].**

1.5.2 The Site is currently predominantly agricultural fields. Hedgerows, trees and woodland form the boundaries to many of the fields within the Site.

1.5.3 Due to the scale of the Proposed Development, and the distance between areas of the Site, the Site has been split into three distinct areas, which are shown in, **ES Volume 3, Figure 3.2 Site Referencing [EN0110020/APP/6.19]** and are referred to as:

- Whitestone 1 (W1), located south of Conisbrough
- Whitestone 2 (W2), located between Aston in the west and Dinnington in the east; and
- Whitestone 3 (W3), located south of Wales and Kiveton Park.

1.5.4 The Proposed Development will connect to the proposed new Long Lane 400kV substation near Brinsworth at approximate NGR SK 444895. An application for planning permission to construct the Long Lane substation was submitted by National Grid to RMBC in November 2025 **[ref. RB2025/1468[1]]**.

2 PLANNING POLICY AND GUIDANCE

2.1 Introduction

2.1.1 The following sections summarise the national and local planning policy, and relevant guidance, which have informed the preparation of this oSWDS.

2.2 Overarching National Policy Statement (NPS) for Renewable Energy Infrastructure (EN-1) (2025)

2.2.1 The Overarching NPS for Energy (EN-1)[2] provides the primary basis for making decisions on applications for Nationally Significant Infrastructure Projects related to renewable energy infrastructure in the UK. Regarding drainage, EN-1 highlights a comprehensive approach to addressing and mitigating flood-related challenges to ensure public safety and promote environmental sustainability. Key considerations include: `

- Paragraph 5.8.25, which describes the meaning of the Sustainable Drainage Systems (SuDS) as follows: *"In this NPS, the term SuDS refers to the whole range of sustainable approaches to surface water drainage management including, where appropriate:*
  - *Source control measures including rainwater recycling and drainage;*
  - *Infiltration devices to allow water to soak into the ground, that can include individual soakaways and communal facilities;*
  - *Filter strips and swales, which are vegetated features that hold and drain water downhill mimicking natural drainage patterns;*
  - *Filter drains and porous pavements to allow rainwater and runoff to infiltrate into permeable material below ground and provide storage if needed;*
  - *Basins, ponds and tanks to hold excess water after rain and allow controlled discharge that avoids flooding; and*
  - *Flood routes to carry and direct excess water through developments to minimise the impact of severe rainfall flooding."*
- Paragraph 5.8.26: "*Site layout and surface water drainage systems should cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from site without adverse impacts.*"
- Paragraph 5.8.27: "*The surface water drainage arrangements should, accounting for the predicted impacts of climate change throughout the development's lifetime, be such that the volumes and peak flow rates of surface water discharge leaving the site are no greater than the rates prior to the proposed project, unless specific off-site arrangements are made and result in the same net effect."*

- Paragraph 5.8.28: "*It may be necessary to provide surface water storage and infiltration to limit and reduce both the peak rate of discharge from the site and the total volume discharged from the site. There may be circumstances where it is appropriate for infiltration facilities or attenuation storage to be provided outside the project site, if necessary, through the use of a planning obligation.*"
- Paragraph 5.8.32: *"Where development may contribute to a cumulative increase in flood risk elsewhere, the provision of multifunctional sustainable drainage systems, natural flood management and green infrastructure can also make a valuable contribution to mitigating this risk whilst providing wider benefits."*

2.3 National Policy Statement for Renewable Energy Infrastructure (EN-3) (2025)

2.3.1 The NPS[3] for Renewable Energy Infrastructure (EN-3) forms part of a suite of energy infrastructure NPSs and should be read in conjunction with EN-1. EN-3 sets out general principles to be applied in the assessment of development consent applications for renewable energy projects. It also provides specific clauses relevant to drainage considerations, including guidance on the submission of Flood Risk Assessments (FRA), the use of permeable access tracks and implementing SuDS. In relation to drainage, the guidance sets out the following paragraphs relevant to the Proposed Development:

- Paragraph 2.10.76: "*Where a FRA has been carried out this must be submitted alongside the applicant's ES. This will need to consider the impact of drainage. As solar PV panels will drain to the existing ground, the impact will not, in general, be significant.*"
- Paragraph 2.10.77: "*Where access tracks need to be provided, permeable tracks should be used, alongside the incorporation of SuDS, such as swales and infiltration trenches, should be used to control any runoff where recommended.*"
- Paragraph 2.10.78: "*Given the temporary nature of solar PV farms, sites should be configured or selected to avoid the need to impact on existing drainage systems and watercourses.*"
- Paragraph 2.10.146: "*Water management is a critical component of site design for ground mount solar plants. Where previous management of the site has involved intensive agricultural practice, solar sites can deliver significant ecosystem services value in the form of drainage, flood attenuation, natural wetland habitat, and water quality management.*"

2.4 National Planning Policy Framework

2.4.1 The National Planning Policy Framework (NPPF)[4], confirms that major developments should incorporate SuDS unless there is clear evidence that this would be inappropriate. The NPPS sets out at paragraph 182 that systems used should:

- Take account of advice from the Lead Local Flood Authority (LLFA);
- Have appropriate proposed minimum operational standards;

- Have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
- Where possible, provide multifunctional benefits.

2.5 Planning Practice Guidance

2.5.1 The Planning Practice Guidance (PPG)[5] provides additional advice to Local Planning Authorities to ensure the correct application of the NPPF when assessing developments in areas at risk of flooding. Specifically, the PPG includes guidance on managing flood risk and coastal change, which encompasses considerations for drainage. It advises on the integration of SuDS and is intended to support the development of effective mitigation strategies that account for drainage impacts.

2.5.2 The PPG highlights that preference should be given to multi-functional SuDS and solutions that adhere to the following hierarchy of drainage options:

- Ground infiltration (except for BESS compound locations);
- To a surface water body;
- To a surface water sewer, highway drain or another drainage system; and
- To a combined sewer.

2.6 National Standards for Sustainable Drainage Systems

2.6.1 The National Standards for SuDS[6] provide the statutory framework for the design, construction, operation and maintenance of surface water drainage for new developments in England. They establish a consistent, performance-based approach to managing runoff, ensuring that drainage systems are designed to reduce flood risk, protect water quality, and deliver wider environmental and sustainability benefits. The standards promote a site-wide, integrated SuDS strategy that manages water as close to source as practicable and ensures long-term resilience under future climate conditions.

2.6.2 Management of Extreme Rainfall and Flooding (Standard 3), requires that where surface water is discharged to an above ground watercourse, sewer or other piped drainage system, both the peak runoff rate and total runoff volume from the development during the 1% Annual Exceedance Probability (AEP) (1 in 100-year rainfall event) are controlled to avoid increasing flood risk elsewhere. Discharge from the development must be restricted as close as reasonably practicable to the equivalent greenfield runoff rate for the contributing area, for all rainfall events up to and including the 1 in 100-year event (with climate change allowance). As such, post-development runoff rates should not exceed those associated with the site in its pre-development condition.

2.6.3 Runoff Destinations (Standard 1) sets out a clear hierarchy for the disposal of surface water, prioritising infiltration and onsite management before any connection to a watercourse or sewer, The development must demonstrate that higher-priority options, such as infiltration, have been assessed and utilised where feasible, supported by appropriate Ground Investigation (GI) and infiltration testing. Discharge to a combined sewer is only permissible where all other options are demonstrably unviable.

2.6.4 Management of Everyday Rainfall (Interception) (Standard 2) requires that the first 5mm of rainfall is retained on site for the majority of events through infiltration, evapotranspiration or reuse. This reduces the frequency of runoff, supports water quality treatment and aligns with the SuDS principle of managing water at source. The design must demonstrate that interception is achieved across the site wherever practicable.

2.6.5 Water Quality (Standard 4) requires that SuDS features provide adequate treatment to prevent pollution of receiving waters. Treatment requirements are determined by the pollution hazard level associated with different site areas, such as solar panel runoff, access tracks and hardstanding within the BESS compound. Appropriate SuDS components such as vegetated swales, filter strips, bioretention features or attenuation basins with sediment forebays must be incorporated to ensure compliance with the required treatment indices.

2.6.6 Amenity and Biodiversity (Standard 5 and 6) require that SuDS contribute positively to site amenity and biodiversity. For solar and BESS developments, this typically includes the use of vegetated SuDS features, meadow or species-rich grassland plating, and integration with ecological enhancement measures. These elements support multifunctional land use and deliver wider environmental benefits alongside drainage functionality.

2.6.7 Design of Drainage for Construction, Operation, Maintenance, Decommissioning and Structural Integrity (Standard 7) requires that SuDS are designed for safe operation, inspection and maintenance throughout the lifetime of the development. This includes providing appropriate access for maintenance, incorporating sediment management measures, and ensuring that SuDS components remain functional under future climate change scenarios. The drainage strategy must therefore demonstrate that the proposed SuDS are robust, maintainable and resilient over the long term.

2.7 Local Planning Policy and Guidance

Planning Policy Summary

2.7.1 This oSWDS has been prepared to align with the requirements of national and local planning policy, and guidance. It sets out the parameters required to manage the discharge of surface water runoff from the three separate Site areas through the promotion of suitable SuDS measures.

2.7.2 The local planning policies and guidance for CDC, RMBC and NEDDC emphasise the importance of managing drainage impacts and flood risks in development projects.

2.7.3 There are commonalities between the policies where they prioritise the implementation of SuDS where feasible to manage surface water runoff and mitigate flood risks and highlight the importance of no net increase in surface water runoff due to development, ensuring that flood risks are not exacerbated in the surrounding areas.

2.7.4 Where a policy identifies a worst-case scenario, this will be adopted as a baseline for the oSWDS. The policies do not appear to conflict fundamentally, but if there is a worst-case scenario from the three policies, this will be used to support the drainage design of the Proposed Development.

City of Doncaster Council Local Plan[7]

2.7.5 Policy 56 (Drainage) of the CDC Local Plan focuses on ensuring that development sites incorporate satisfactory drainage measures to manage wastewater and surface water runoff effectively, thereby reducing flood risk to existing communities. Key requirements include:

- Adequate means of foul sewage disposal and treatment, with capacity available in time to serve the development.
- No increase in flood risk onsite and no flooding to land or buildings elsewhere.
- Reduction in surface water runoff on brownfield sites and no increase on existing rates for greenfield sites.
- Utilisation of SuDS unless technically unfeasible.
- Appropriate disposal of surface water, preferably through infiltration based systems (except for BESS compound locations), watercourse discharge, or discharge to a public water sewer or highway drain, in that order.

Rotherham Metropolitan Borough Council Local Plan[8]

2.7.6 Policy SP 47, Understanding and Managing Flood Risk and Drainage, of the RMBC Local Plan emphasises controlling surface water runoff using SuDS.

2.7.7 When designing new developments and associated drainage systems, the Local Plan confirms that applicants must demonstrate an understanding of surface water flows and potential overflow during extreme flood events. This understanding should inform the design of the development proposals, incorporating suitable mitigation measures where appropriate.

2.7.8 The RMBC Local Plan states in Paragraph 4.263 that surface water runoff should be controlled as near to its source as possible through the implementation of SuDS, which include a variety of techniques such as:

- Soakaways;
- Infiltration trenches;
- Permeable pavements;
- Grassed swales;
- Green roofs; and
- Ponds and wetlands.

2.7.9 The RMBC Local Plan confirms that these SuDS techniques offer significant advantages over traditional piped drainage systems by reducing flood risk, promoting groundwater recharge absorbing pollutants, and improving water quality. The diversity of available SuDS options means that most developments can incorporate these systems, leading to multiple benefits such as cost reduction and decreased maintenance needs. Additionally, SuDS contribute to enhancing water quality and supporting green infrastructure initiatives.

North East Derbyshire District Council Local Plan[9]

2.7.10 Policy SDC11 (Flood Risk and Drainage) of the NEDDC Local Plan addresses flood risk and drainage and confirms that development will not be permitted unless:

- There is no net increase in surface water runoff for the lifetime of the development on all new development. Surface water runoff should be managed at source wherever possible, avoiding disposal to combined sewers;
- Part of the development site is set aside for surface water management, and uses measures to contribute to flood risk management in the wider area; and
- The development incorporates a SuDS to manage surface water drainage, in accordance with national SuDS standards, unless it is proven that SuDS are not appropriate in a specific location. Where SuDS are provided, arrangements must be put in place for their whole life management and maintenance.

2.7.11 The Local Plan goes on to confirm in Paragraph 2 of SDC11 that "*development will only be permitted where adequate foul water treatment and drainage infrastructure currently exists, or can be made available to serve the development unless the developer can demonstrate acceptable alternative private solutions".*

3 DESIGN ASSUMPTIONS

3.1.1 This section details the design assumptions made as part of the production of this oSWDS.

3.1.2 The solar PV modules will be mounted from the ground by a minimum of 400mm, in accordance with the **Outline Design Parameters [EN0110020/APP/7.3],** allowing rainfall / runoff to infiltrate the ground beneath them, with any existing land drains to be protected or replaced. Therefore, the solar PV modules will not lead to a substantive increase in impermeable area within the Site. The drainage regime of the solar PV areas is assumed to remain consistent with its pre-developed state. Refer to Section 5.2 of this document for solar module runoff research.

3.1.3 The Site's access roads will not lead to a substantive increase in permeable area. Surface water falling on the access roads will runoff to the adjacent ground.

3.1.4 The BESS area, which will incorporate an impermeable barrier beneath its gravel subbase, is considered to be 100% impermeable.

3.1.5 The impermeable areas of the onsite substations, including: roof areas, concrete slabs, foundations and gravelled surround are considered to be 100% impermeable due to the materials they are made from. Assuming the gravelled areas are 100% impermeable is a conservative approach for the preliminary size of attenuation basins across the Site. This also allows for finalisation of sizing of bunds, without effecting the modelling completed, as it is assumed the full substation will not have infiltration.

3.1.6 A volumetric coefficient (Cv) of 1 has been applied to the impermeable areas (e.g. substation roof, foundation, slab, BESS area, gravelled and basin areas), as it is expected that 100% of runoff generated from these areas will enter the drainage system.

3.1.7 The drainage system for the BESS area and onsite substations has been designed to accommodate runoff from a 0.5% AEP (1 in 200-year) rainfall event, with a 45% allowance for climate change (to account for increases in peak rainfall intensity).

3.1.8 A potential fire event within the BESS area has been incorporated into the outline surface water drainage strategy. The BESS area will be impermeably lined (unless proven that infiltration is unviable from ground investigation (GI) results) ensuring that all runoff (including firewater) drains to a dedicated attenuation basin. This basin has been sized to accommodate both the design rainfall event and the required firewater containment volume. To prevent contaminated runoff from entering the wider drainage network during an incident, an automatically operated valve, i.e., a penstock valve, will be installed on the basin outfall. The valve will automatically close in the event of a fire, isolating the attenuation basin and retaining all runoff and firewater within the BESS's lined drainage ponds. A manual override will be provided as a secondary safeguard. Further details can be found in the **Outline Battery Safety Management Plan (oBSMP) [EN0110020/APP/5.15]**, including post fire water testing regimes.

3.1.9 The discharge of runoff from the BESS area and onsite substations via infiltration is unlikely to be viable due to predominantly clay ground conditions identified from BGS maps. This will be confirmed with on-site ground investigation (GI) works such as infiltration testing during detailed design.

3.1.10 The inverter stations and associated Power Conversion System (PCS) units comprise a minimal impermeable footprint relative to the overall area of the Site. Therefore, the surface water runoff is anticipated to be negligible and has not been included within the high-level hydraulic model for attenuation basin sizing at this stage.

3.1.11 SuDS used across the Site will be designed to avoid all archaeological sites and sensitive areas.

3.1.12 Flood Estimation Handbook (FEH)[10] rainfall data has been used for this assessment.

4 SITE APPRAISAL

4.1 Topography

4.1.1 The Site topography was assessed using Department for Environment, Food and Rural Affairs (DEFRA) and Environment Agency (EA) LiDAR data from 2022, with a contour map included in Appendix A.1.

4.1.2 Given the scale of the Site, ground levels vary considerably across the area. The highest elevation is at approximately 142 metres Above Ordnance Datum (mAOD) and the lowest elevation is approximately 28mAOD. Ground levels typically fall towards the ordinary watercourses and main river within the Site.

4.1.3 Whitestone 1 (W1) – Topography survey results showed the ground levels across W1 varied from 50mAOD to 110mAOD.

4.1.4 Whitestone 2 (W2) – Topography survey results showed the ground levels across W2 varied from 58mAOD to 122mAOD.

4.1.5 Whitestone 3 (W3) – Topography survey results showed the ground levels across W3 varied from 90mAOD to 142mAOD.

4.2 Land Use

4.2.1 The current and historic land use of the Site is covered in more detail in **ES Volume 2, Chapter 9: Ground Conditions and Land Quality [EN0110020/APP/6.9]**.

Current Land Use

4.2.2 W1 is located in South Yorkshire, approximately 1.3km to the south west of Conisbrough (centred on National Grid Reference (NGR) SK 503962). W1 covers an area of approximately 328ha comprising agricultural fields.

4.2.3 A more detailed description of the land within W1 is provided in **ES Volume 1, Chapter 3: The Site and Surrounding Area [EN0110020/APP/6.3]** and is illustrated in **ES Volume 3, Figure 3.2: Site Referencing [EN0110020/APP/6.19].**

4.2.4 W2 is located entirely within the administrative area of RMBC (centred on NGR 477874) and covers approximately 651ha, primarily consisting of agricultural land. The M1 motorway bisects W2, running north to south through its centre. W2 is bordered by the settlements of Wickersley to the north, North Anston to the southeast, Aughton to the southwest and Thurcroft and Dinnington to the east. A wind farm, comprising six turbines, is present within W2.

4.2.5 A more detailed description of the land within W2 is provided in **ES Volume 1, Chapter 3: The Site and Surrounding Area [EN0110020/APP/6.3]** and is illustrated in **ES Volume 3, Figure 3.2: Site Referencing [EN0110020/APP/6.19].**

4.2.6 W3 is situated within the administrative area of RMBC (centred on NGR SK 481807) and covers approximately 172ha of predominantly agricultural land. The southern extent of the Order Limits slightly crosses into the area of NEDDC within Derbyshire County Council (DCC). The M1 motorway bisects the southern portion of W3. Kiveton Park and the village of Wales are located approximately 500m to the north of W3. Northern W3 sits adjacent to Hard Lane to the east, while southern W3 is located within 50m of Harthill Reservoir to the east. To the south and west of W3 are the A618 and the Derbyshire County boundary respectively. Nearby residential receptors are primarily located in the villages of Woodall, Harthill, Kiveton Park and Wales, with an additional cluster of properties situated along the A618 to the southwest.

4.2.7 A more detailed description of the land within W3 is provided in **ES Volume 1, Chapter 3: The Site and Surrounding Area [EN0110020/APP/6.3]** and is illustrated in **ES Volume 3, Figure 3.2: Site Referencing [EN0110020/APP/6.19].**

Historic Land Use

4.2.8 The majority of the land within W1, W2 and W3 has historically been undeveloped agricultural land since the first available historical maps (included within **ES Volume 3, Appendix 9.2, 9.3 and 9.4: Landmark Envirocheck® report [EN0110020/APP/6.20]**) dated 1854. There have historically been drainage ditches present, along with tracks, roads, footpaths and some agricultural properties since the first available historical maps dated 1854.

4.3 Hydrology

4.3.1 W1 is located entirely within the Don and Rother Management Catchment, along with a short section of the associated Cable Corridors connecting W1 to W2. The western extents of W2 and W3 also fall within this catchment.

4.3.2 The eastern extents of W2 and W3 sit within the Idle and Torne Management Catchment, which also includes substantial sections of the Cable Corridors connecting W1, W2 and W3.

4.3.3 There are ten Water Framework Directive (WFD) designated watercourses within the Study Area. Details on the proximity of the WFD watercourses to the Order Limits, flow directions, and flow conditions are detailed in **ES Volume 2, Chapter 10: Water Resources and Flood Risk [EN0110020/APP/6.10]**. The WFD watercourses are shown in **ES Volume 3, Figure 10.2: Water Framework Directive Designated Watercourses [EN0110020/APP/6.19]**.

4.3.4 Within the Study Area, the River Rother is the only EA Main River, which flows from south to north, to the west of the Study Area. The hydrological network within the Study Area comprises several WFD designated watercourses, ordinary watercourses and drainage channels that provide hydrological connectivity to downstream EA Main Rivers. The Kearsley Brook and Hooton Brook convey flows northwards and westwards respectively, establishing hydrological pathways from the Study Area to the River Don, situated to the northwest and north of W1. The Anston Brook and Oldcotes Dyke Catchment drain eastwards towards the River Ryton, while Pigeon Bridge Brook and Ulley Brook both flow westwards towards the River Rother. The characteristics of these watercourses and their associated hydrological connectivity to the EA Main Rivers are summarised in **ES Volume 2, Chapter 10: Water Resources and Flood Risk [EN0110020/APP/6.10].**

4.3.5 The EA Main Rivers, ordinary watercourses, surface waterbodies and drainage channels within and hydrologically connected to the Study Area are shown in **ES Volume 3, Figure 10.3: Surface Watercourses and Waterbodies [EN0110020/APP/6.19]**.

4.3.6 The hydrology of the Site is covered in more detail in **Chapter 10: Water Resources and Flood Risk [EN0110020/APP/6.10].**

4.4 Flood Risk

4.4.1 The flood risk of the Site is covered in **ES Volume 2, Chapter 10: Water Resources and Flood Risk [EN0110020/APP/6.10].**

4.4.2 Government UK Flood Maps[11] show the Site largely avoids areas prone to surface water flooding with only small areas of the Site identified as having the potential to be affected. These are outlined in **ES Volume 2, Chapter 10: Water Resources and Flood Risk [EN0110020/APP/6.10]**, and design has been considerate of impacts, with approach outlined in these chapters.

4.5 Existing Surface Water Drainage

4.5.1 As the Site is predominantly agricultural land, it is anticipated that surface water largely infiltrates the ground with any exceedance becoming surface water runoff and entering the existing land drains, ditches and watercourses.

4.5.2 The location of watercourses has been identified from OS mapping and available LiDAR data.

4.5.3 The Proposed Development includes the following key components, which have been categorised under permeable (solar PV panels) and impermeable areas (BESS area and onsite substations) for the surface water drainage strategy, these are explained in further detail in Section 5.2 and 5.3 respectively.

4.6 Geology and Hydrogeology

4.6.1 A desktop study of the ground conditions has been carried out in **ES Volume 2, Chapter 9: Ground Conditions and Land Quality [EN0110020/APP/6.9]**. The ground conditions have been summarised below for each area of the Proposed Development.

Whitestone 1

4.6.2 W1 has predominantly slowly permeable, seasonally wet acid loamy and clayey soils based on the UK Soil Observatory (UKSO) Soilscapes data[12] (Soilscape 17). Some areas of freely draining, slightly acid loamy soils (Soilscape 6) are present in the western area; while freely draining, lime-rich loamy soils (Soilscape 5) occur in the northwest and east.

4.6.3 The British Geological Survey (BGS) GeoIndex online map viewer[13] indicates that the geological sequence underlying W1 comprises localised superficial deposits of glaciofluvial sand and gravel in the northwestern areas. No superficial deposits are mapped beneath the majority of W1. The underlying bedrock across most of W1 consists of sandstone, mudstone and siltstone of the Pennine Upper Coal Measures Formation, with localised areas in the southeast and north underlain by dolostone of the Cadeby Formation.

Whitestone 2

4.6.4 W2 is predominantly underlain by slow permeable, seasonally wet acid loamy and clayey soils (Soilscape 17) in the north and eastern areas according to UKSO Soilscapes data. Freely draining, slightly acid loamy soils (Soilscape 6) are present in the west and north, while the westernmost section of W2 comprises loamy and clayey floodplain soils with naturally high groundwater (Soilscape 20).

4.6.5 The BGS GeoIndex online map viewer indicates that the geological sequence underlying W2 includes superficial deposits of clay, silt, sand and gravel (Alluvium and Head) in the northwestern area, with glacial till present in the southeast. The underlying bedrock comprises sandstone, mudstone and siltstone of the Pennine Middle and Upper Coal Measures Formation.

Whitestone 3

4.6.6 W3 is described as comprising slowly permeable, seasonally wet acid loamy and clayey soils (Soilscape 17) according to UKSO Soilscapes data.

4.6.7 The BGS GeoIndex online map viewer indicates that the geological sequence underlying W3 comprises superficial deposits of clay, silt, sand and gravel (Head) across most of the area, with localised alluvium of similar composition in the east. The underlying bedrock consists of sandstone, mudstone and siltstone of the Pennine Middle Coal Measures Formation.

4.7 Supporting Information

Surface Water Drainage Hierarchy

4.7.1 The drainage hierarchy presented in **Table 4-1** has been used to assess the required management of surface water runoff, setting out the discharge locations in decreasing order of preference. This is in line with the hierarchy set out within the PPG as discussed in Section 2.5. The order of prioritisation is: (i) water reuse; (ii) discharge to groundwater; (iii) surface water body; (iv) surface water sewer; and (v) combined sewer.

Table 4-1: Surface water drainage hierarchy

Discharge location	Comment
Water Reuse	There is not a foreseeable demand for non-potable water on the Site throughout its design life with the exception of welfare facilities. Where reasonable, rainwater harvesting for the buildings at the substations may be utilised, for provision to site non-potable amenity infrastructure (e.g. toilets and washdown hosepipes) Although the panels will need washing as part of their maintenance, it is expected that they will be washed once every two years, and storing water for this infrequent use is not considered to be practical or appropriate. There is likely to be a small welfare area provided, which will include a toilet which is expected to be infrequently used. As the Site will be unmanned and any one area within it infrequently

Discharge location	Comment
	visited, rainwater harvesting systems could be considered for the purposes of toilet flushing. Any proposed fire suppression will have to always remain full to be ready in the event of a fire. Therefore, as storage will always be fully utilised, rainwater harvesting to feed this system is not considered viable.
To Groundwater	The feasibility of this option will be dependent on the underlying geology of the Site and studies are currently underway to confirm the ground conditions. The provision of unlined features (i.e. permeable sub-base and attenuation features) to encourage some natural infiltration has been considered. However, in the BESS and onsite substation areas where surface water drainage is required, there is a potential risk of contamination, primarily associated with fire water runoff, which will need to be contained during emergency events. As such, direct discharge to the ground via infiltration is not considered appropriate in these areas. Therefore, the feasibility of groundwater discharge is limited and will be subject to further assessment at detailed design. There are locations where unlined features could be considered further, including in solar areas if required, to improve on the baseline conditions. This could be beneficial in particular in the area adjacent to Firsby, and would be investigated in the detailed design phase.
To a Surface Water Body	There are many land drains and ordinary watercourses which cross the Site, and it is proposed that runoff from the onsite substations / BESS area will discharge to watercourses at greenfield runoff rates. In the event of a fire resulting in water contamination, the surface water from the onsite substation and BESS area will be collected in an attenuation basin, controlled by a penstock valve to contain polluted water as required. The basin will have an outlet to these watercourses with discharge only allowed if there is no contamination, with sampling confirmed as acceptable by the EA.
To a Surface Water Sewer	As above, it is proposed that surface water runoff will discharge to the surrounding watercourses with no need to discharge to any public sewer network.
To a Combined Sewer	As above, it is proposed that surface water runoff will discharge to the surrounding watercourses with no need to discharge to any public sewer network.

Sustainable Drainage Systems (SuDS)

4.7.2 The implementation of SuDS represents the most environmentally responsible and sustainable approach to managing surface water drainage. These systems must be designed to align with the SuDS hierarchy, which prioritises options that promote natural infiltration and minimise environmental impact.

4.7.3 A range of SuDS options is available to manage and attenuate surface water runoff effectively. **Table 4-2** presents an assessment of the constraints and opportunities associated with the various SuDS options, along with justifications for the selection of specific features to support the Proposed Development.

Table 4-2: BESS and substation sustainable drainage systems

Device	Description	Constraints / Comments	Suitable (Yes / No)
Green / brown / blue roofs (source control)	Provide soft / hard landscaping at roof level which reduces (green/brown) or temporarily stores (blue roofs) surface water runoff rate.	There are limited buildings proposed within the Site therefore the opportunity to incorporate green/brown roofs is limited. There is the potential for inclusion in localised areas, this will be assessed further at detailed design.	Yes
Soakaways (source control)	Store runoff and allow water to percolate into the ground via natural infiltration.	The underlying geology at the substation and BESS locations consists of mudstone and sandstone. Soakaways may be feasible, pending confirmation of infiltration of the ground. This will be assessed further at detailed design.	Yes
Permeable surfaces (source control)	Storm water is allowed to infiltrate through the surface into a storage layer, from which it can either infiltrate and / or slowly release to sewers.	Permeable surfacing and sub-base will be incorporated across the Site wherever possible, to provide water quality benefits and provide conveyance to attenuation features.	Yes
Rainwater harvesting (source control)	Reduces the annual average rate of runoff from a site by reusing water for non-potable uses e.g., toilet flushing or water butts.	As set out previously (see Table 4-1), there is minimal expected future demand for non-potable water on the Site throughout its design life, which could warrant the	Yes

Device	Description	Constraints / Comments	Suitable (Yes / No)
		inclusion of rainwater harvesting systems.	
Swales (permeable conveyance)	Broad shallow channels that convey / store runoff and allow infiltration (ground conditions permitting).	Swales (or managed ditches) will be incorporated wherever appropriate to provide additional SuDS benefits and aid in the management and conveyance of surface water runoff.	Yes
Filter drains & perforated pipes (permeable conveyance)	Trenches filled with granular materials (which are designed to take flows from adjacent impermeable areas) that convey runoff while allowing infiltration (ground conditions permitting).	Filter drains will be incorporated where possible (a potential option is in the form of underdrains to the permeable surfacing) to provide additional SuDS benefits and aid in the management and conveyance of surface water runoff.	Yes
Filter Strips (permeable conveyance)	Wide gently sloping areas of grass or dense vegetation that remove pollutants from runoff from adjacent areas.	The Site will be predominantly permeable surfacing; therefore the inclusion of filter strips is not a preferred SuDS solution for large areas of the site. However, it is still a feasible solution and the opportunity to incorporate these locally will be reviewed at detailed design.	Yes
Bioretention Systems / Rain Garden (end of pipe treatment)	A shallow landscaped depression which allows runoff to pond temporarily on the surface before filtering through vegetation and underlying soils. These features can also be accommodated within above ground planters.	On the basis that the majority of the Site will consist of permeable surfacing, there will be limited potential for the inclusion of rain gardens. However, the potential to incorporate these locally will be reviewed at detailed design.	Yes

Device	Description	Constraints / Comments	Suitable (Yes / No)
Infiltration basins (end of pipe treatment)	Depressions in the surface designed to store runoff and allow infiltration through the base downstream of the detention / attenuation basin penstocks.	The underlying geology at the substation and BESS locations consists of wet acid loamy and clayey soils. Infiltration basins may be feasible in parts of the site pending confirmation of infiltration characteristics of the ground.	Yes
Attenuation Basin / Pond (end of pipe treatment) / Retention Basin	Depressions in the surface designed to store runoff without infiltration through the base. Where appropriate, permanent pools can be incorporated (retention basin).	At the BESS compound location, detention basin(s) will be incorporated to attenuate surface water runoff prior to discharging at the greenfield rate to surrounding watercourses.	Yes
Attenuation underground (end of pipe treatment)	Oversized pipes or geocellular / sectional tanks designed to store water below ground level.	It is proposed that attenuation basins and other SuDS features will provide the sufficient volume of storage to manage surface water runoff generated from the substation and BESS locations. This precludes the need for any attenuation tanks.	No

Drainage Hierarchy and SuDS Selection

4.7.4 The drainage hierarchy will prioritise natural infiltration, discharge to watercourses, and attenuation basins at strategic low points, where feasible, in line with national and local planning policy.

4.7.5 SuDS features such as swales, filter drains, permeable surfacing, and attenuation basins will be assessed for suitability at each site. Constraints and opportunities will be documented, and the selection of features will be justified based on site-specific conditions.

5 OUTLINE SURFACE WATER DRAINAGE STRATEGY

5.1 Technical Approach

Overview

5.1.1 The oSWDS aims to mimic natural drainage conditions as far as possible, through the use of SuDS.

5.1.2 The technical approach for the Site reflects the current design stage of the Proposed Development, and is informed by the information available. The strategy has been designed to be adaptive to accommodate changes to the location of the onsite substations, BESS location and site-specific requirements. It will be developed through the detailed design phase to include further assessment, once more details of the Proposed Development are finalised.

5.1.3 For the purpose of assessing surface water drainage at the Site, the oSWDS considers runoff from the solar PV panels (permeable area) and runoff from the BESS area and onsite substations (impermeable areas) separately, in Sections 5.2 and 5.3 respectively.

5.1.4 A conservative approach has been used to provisionally size the attenuation basins required for each impermeable catchment area to ensure that there is adequate space available for the basins and options for discharge points.

5.1.5 There are currently three proposed attenuation basins for the Proposed Development, for the follow locations:

- Attenuation Basin 1: Satellite substation in W1
- Attenuation Basin 2: Primary substation and BESS area in W2
- Attenuation Basin 3: Satellite substation in W2

5.1.6 In general, the Site's access roads will not lead to a substantive increase in impermeable area and will be designed so that surface water falling on the access roads will runoff to the adjacent ground and associated run-off management swales. The roads themselves are also unbound stone, allowing for infiltration. However, it should be noted that the surface area of the access roads between the onsite substations and BESS area to the existing road network has been accounted for in the impermeable area used to size the attenuation basins. This is due to the possibility that the roads to the onsite substations may have bituminous surfacing, therefore adding to the impermeable area.

5.2 Proposed Solar PV Panel Surface Water Drainage

5.2.1 According to research conducted by Wallingford HydroSolutions[14], solar farms do not have a significant impact on runoff volumes, peak rates or time to peak rates when the ground below the panels is vegetated. This is because runoff from the panels falls directly to the ground, maintaining the natural hydrological regime. To minimise any potential impacts from the solar panels, the following measures are proposed, in line with Wallingford HydroSolutions' recommendations:

- **Minimise vegetation disturbance:** Efforts will be made to minimise disturbance to existing vegetation during construction;
- **Re-establish vegetation:** Any disturbed vegetation will be restored to ensure adequate vegetation cover is maintained across the Site; and
- **Regular maintenance:** Regular inspection and maintenance will be conducted to ensure adequate vegetation cover is maintained during construction and operation.

5.2.2 The proposed solar PV modules will be mounted at with a freeboard as defined in the **Outline Design Parameters [EN0110020/APP/7.3]**, typically on narrow diameter piled legs. This design avoids the creation of impermeable surfaces beneath the solar modules, allowing rainfall and runoff to infiltrate into the ground across the Site. As a result, it is considered that this will not increase impermeable areas within solar PV. There may be localised areas where ballast foundations are required (e.g. archaeological sensitivity areas), however from assessments to date these are expected to be highly limited, and able to be controlled by methods discussed in the document. Should these be required as determined in detailed design, surface water runoff from the Order Limits would be controlled to the similar level as outlined in this document.

5.2.3 Additionally, the Proposed Development will incorporate strategic SuDS features, such as filter drains, swales, and basins / scrapes within the solar PV array areas. These features will promote ground infiltration and provide ecological and biodiversity benefits. Cross-drains and cross-drain culverts will be used where appropriate.

5.3 Proposed Substation and BESS Area Surface Water Drainage

5.3.1 The impermeable areas within the Proposed Development which will need a designed surface water drainage system to manage surface water runoff are located at the two satellite substations (Work Nos. 4-1A and 4-2B), the BESS area and primary substation (Work No. 4-2A) located in W1 and W2.

5.3.2 At this stage of design, the impermeable area has been conservatively estimated to ensure sufficient space is available on Site for a worst-case attenuation basin. The 100% impermeable area used for sizing the attenuation basins therefore includes all key hardstanding areas, namely: the onsite substations (including the footprint of each substation's structural slab; the access road serving each substation (from the nearest main access road); the BESS area (including associated access roads), and the firewater tanks within the BESS area.

5.3.3 At this stage of the design, the BESS area has been assumed to be 100% impermeable as a worst-case scenario. This accounts for the potential requirement to install an impermeable barrier (e.g. clay liner or geotextile) beneath the subbase to prevent contaminants from infiltrating the underlying ground. The final requirement will be determined during detailed design and confirmed following the completion of GI works.

5.3.4 As a conservative assumption, the 100% impermeable area has been extended to include the access road serving each substation and any proposed surrounding gravelled areas. Should this section of access road be constructed using bituminous (asphalt) materials, it will act as an impermeable surface and therefore contribute to the surface water runoff volume directed to each attenuation basin.

5.3.5 The extent of the impermeable areas is shown in **Figure 5-1: Indicative Attenuation Basin** 1, **Figure 5-2: Indicative Attenuation Basin** 2 and **Figure 5-3: Indicative Attenuation Basin** 3 The attenuation basins are indicatively shown in blue hatching in these figures, and the basins are considered to be 100% impermeable.

5.3.6 A Cv of 1 has been applied to the impermeable areas to represent 100% of the runoff generated from these areas to enter the drainage system. This is a conservative approach.

5.3.7 The substation and BESS will be supported by hardstanding surfaces which will generate surface water runoff rather than allowing natural filtration into the ground. A high level hydraulic model has been created to evaluate and address potential runoff impacts. The findings and proposed drainage strategies for these areas are detailed in the Section 5.3.9 to 5.3.40.

5.3.8 A key consideration for the surface water drainage design of the substation and BESS areas is the potential contamination of runoff during a fire event. It is crucial that such runoff is contained and removed via tankering, ensuring it is not discharged into watercourses or waterbodies. Additional detail is provided in the Outline Battery Safety Management Plan provided to support the application for development consent.

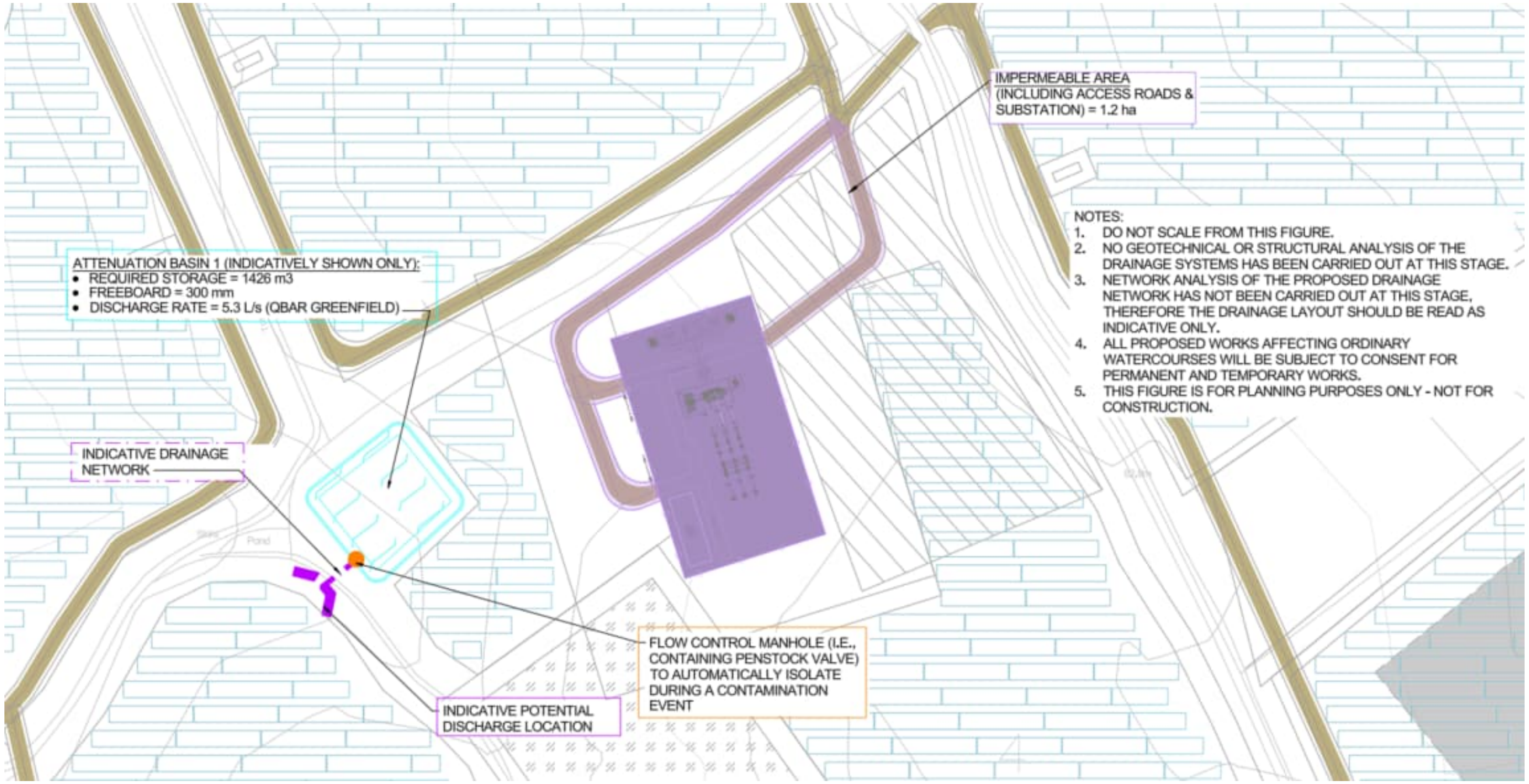

Figure 5-1: Indicative Attenuation Basin 1

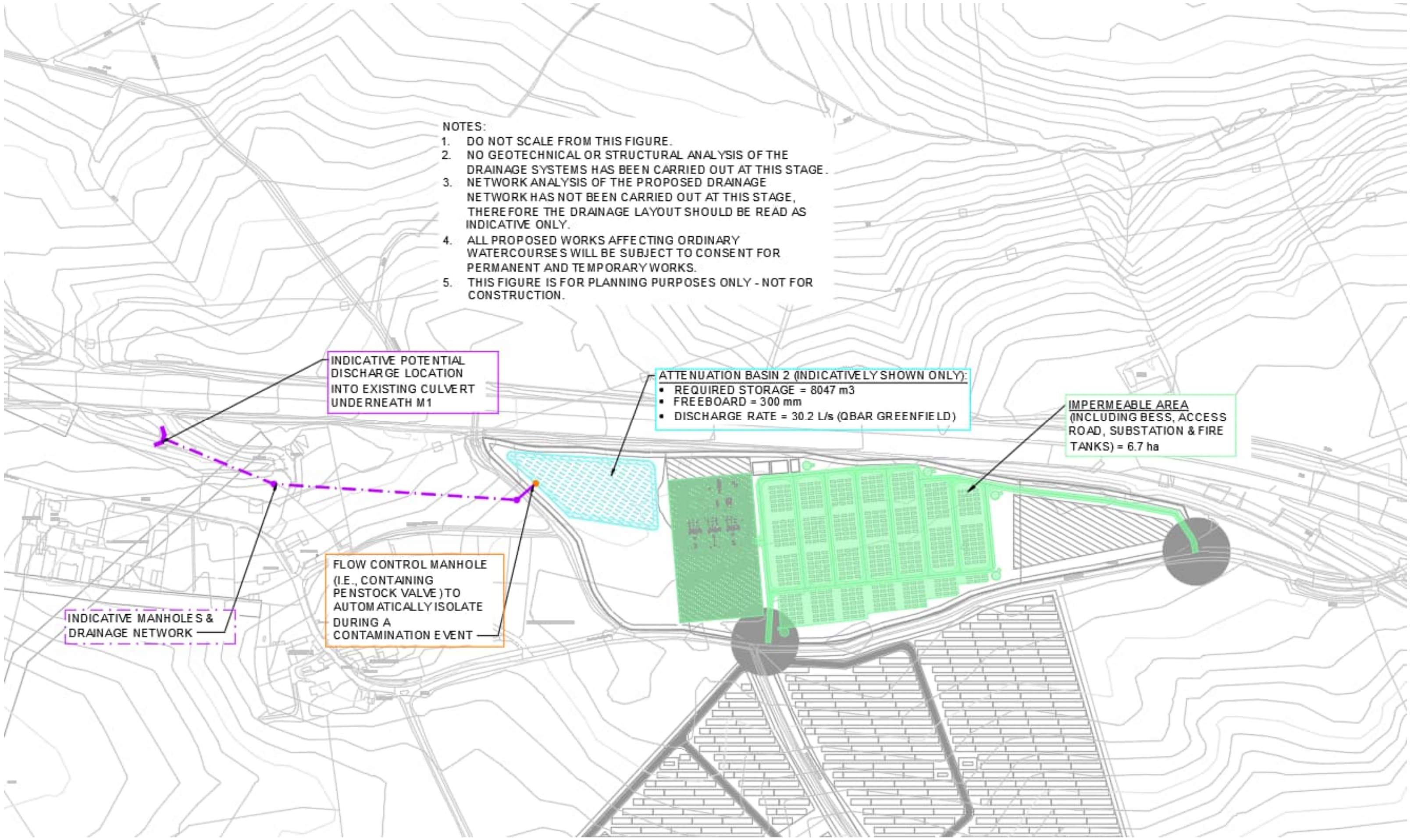

Figure 5-2: Indicative Attenuation Basin 2

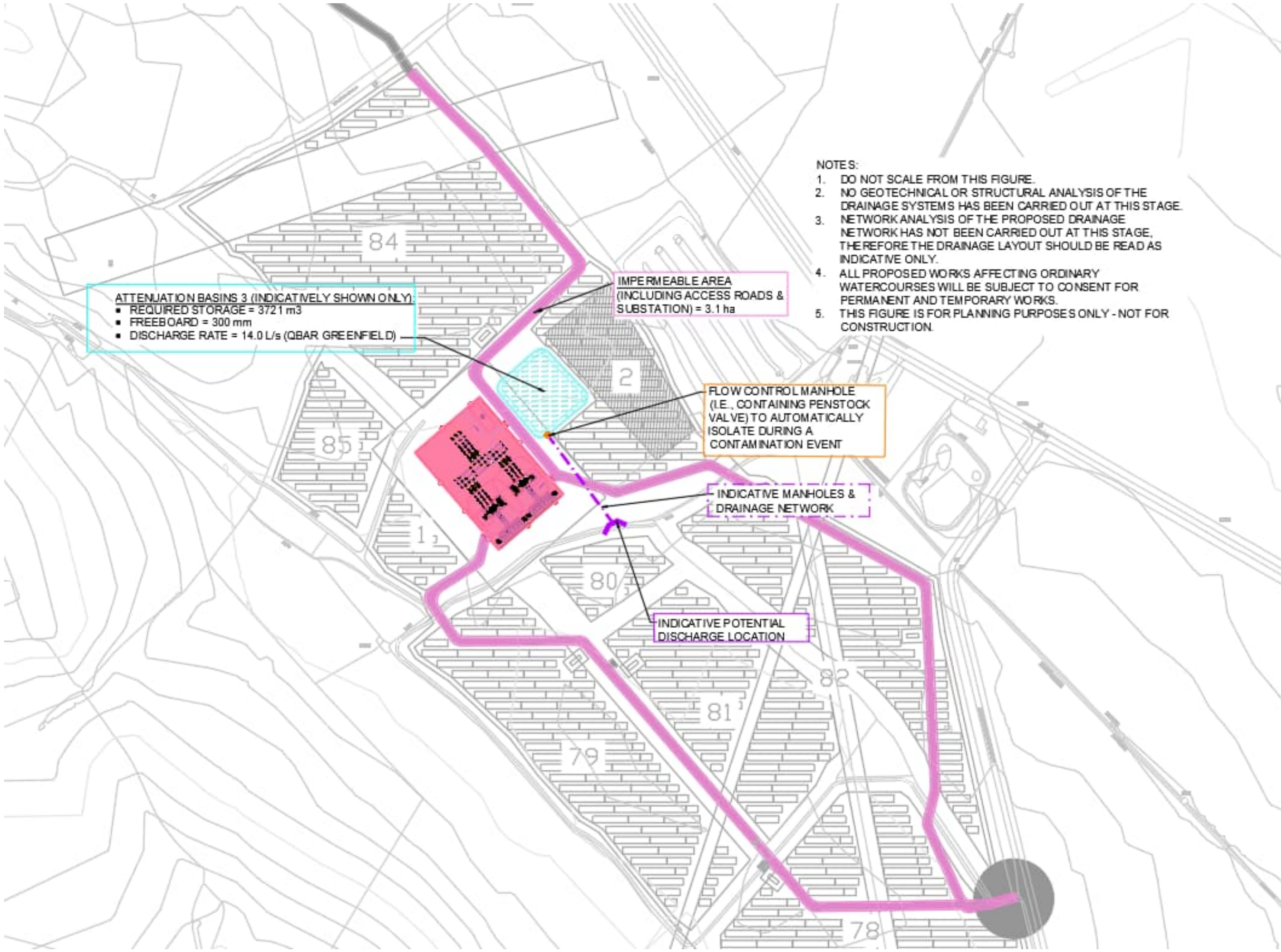

Figure 5-3: Indicative Attenuation Basin 3

Greenfield Runoff Rates

5.3.9 The equivalent greenfield runoff rates for each attenuation basin location have been calculated using the Interim Code of Practice (ICP)[15] SuDS method on InfoDrainage based on their contributing areas (which include the basins). These rates are shown in **Table 5-1**. These represent maxima based on worst case assumptions, including regarding the size of impermeable areas. Runoff rates and Attenuation Basin sizes are subject to review at detailed design.

Table 5-1: Greenfield runoff rates for BESS area and onsite substations

Return Period (Years)	Greenfield Runoff Rate (l/s)		
Basin Name and Impermeable Contributing Area	Attenuation Basin 1 (1.2 ha)	Attenuation Basin 2 (6.7 ha)	Attenuation Basin 3 (3.1 ha)
1	4.6	26.2	12.1
Qbar	5.3	30.2	14.0
30	9.5	53.6	24.8
100	11.2	63.0	29.2

Proposed Attenuation

5.3.10 Attenuation will be required across the Site to temporarily store surface water runoff generated from the onsite substations and BESS area, before it is discharged at the greenfield runoff rate. Attenuation will be provided in the form of basins adjacent to the BESS area and onsite substations.

5.3.11 In order to calculate attenuation requirements, rainfall data relevant to the geographical area needs to be defined. FEH 2022[16] rainfall data has been used. for this purpose.

5.3.12 The attenuation features for the substation and BESS areas have been provisionally sized to accommodate a conservative 0.5% AEP (1 in 200-year) rainfall event, with a 45% allowance for climate change. This is a conservative approach for industry standards and was used in the initial sizing of the attenuation basins.

5.3.13 The proposed basins will provide a minimum 300mm freeboard between the maximum water level in the 1 in 100-year plus climate change event and the top of the basin. During the 1 in 200-year flood event plus 45% climate change allowance, water levels will rise within this freeboard allowance. However, the basin will remain contained and will be designed to prevent overtopping.

5.3.14 Discharge from the attenuation basins to existing watercourses is proposed to be restricted to the Greenfield Qbar rate as shown in **Table 5-1**. Potential discharge locations have been identified from OS mapping and are considered feasible at this stage. The suitability and condition of these receptors will be confirmed during detailed design.

5.3.15 For Attenuation Basin 1, discharge is proposed to existing drainage ditches / field drains, subject to detailed design. For Attenuation Basin 2 discharge is proposed to an existing culvert which conveys flows beneath the M1 motorway. The discharge location for Attenuation Basin 3 is proposed to an existing drainage ditch / field drain.

5.3.16 The required storage volume (shown in **Table 5-2)** was determined by preparing a hydraulic model using InfoDrainage software.

5.3.17 The preferred solution to contain firewater should a fire occur at the Site is the use of an automated valve (i.e. a penstock valve) located downstream of the attenuation basin which will be triggered when the fire suppression system is turned on to isolate the water within the basin. This method ensures that potentially contaminated water would be contained and can then be tankered away instead of being discharged to watercourses. The appropriate arrangements are to be put in place prior to the Proposed Development becoming operational.

5.3.18 In addition to the attenuation requirements for regular surface water runoff during normal operation, the proposed basins will also be required to store fire water runoff in the event of a fire. The impact on attenuation requirements as a result of fire water runoff storage is discussed further in the Fire Water Runoff section (Paragraph 5.3.32 to 5.3.41). Further details can be found in the **oBSMP [EN0110020/APP/5.15].**

5.3.19 The required storage volume will be provided in the form of basins adjacent to the substation / BESS area. Basins will be between approximately 1m and 1.5m deep, with 1 in 3 side slopes and a 3m wide perimeter maintenance strip. The provisional location of the basins and outline design is shown in **Figure 5-1: Indicative Attenuation Basin** 1, **Figure 5-2: Indicative Attenuation Basin 2** and **Figure 5-3: Indicative Attenuation Basin 3**.

5.3.20 The provisional required storage volumes for each area are summarised in **Table 5-2**.

5.3.21 There is potential for the BESS area and / or onsite substations to require land raising above existing ground levels to facilitate gravity drainage to the existing watercourse network. This requirement will be confirmed through hydraulic modelling and level design development at detailed design stage.

Table 5-2 Provisional required storage volume for attenuation basins, subject to detailed design

Required Attenuation Basin Storage Volume based on preliminary design			
Name	**Attenuation Basin 1**	**Attenuation Basin 2**	**Attenuation Basin 3**
Impermeable area (ha)	1.2	6.7	3.1
Basin size (m^3)	1,426	8,047	3721

Water Quality

5.3.22 To assess the risk to receiving watercourses, an assessment has been undertaken of the proposed surface water drainage system in accordance with the Simple Index Approach (SIA) as detailed within The SuDS Manual (C753). This methodology ensures appropriate treatment and measures are implemented to effectively remove pollutants prior to the discharge of runoff.

5.3.23 The SIA first determines the pollution hazard level of the land use proposed and then assesses the level of treatment required by the proposed drainage system to provide sufficient water quality mitigation. The SIA requires that each of the three pollutants considered – total suspended solids; metals; and hydrocarbons – meet the following condition:

Total SuDS Mitigation Index ≥ Pollution Hazard Index

5.3.24 The impermeable areas within the Proposed Development consist of the BESS area and the onsite substations in W1 and W2. In accordance with the SuDS Manual this land use is best defined as 'commercial / industrial roofs'. **Table 5-3** details the pollution hazard indices associated with this land use. **Table 5-4** lists the mitigation indices associated with the basins. These values demonstrate the SIA condition is met for each of the pollutants as the mitigation indices are higher than the hazard indices. Therefore, it is anticipated that the basins proposed for the BESS area and onsite substations are sufficient to treat the runoff from these areas.

Table 5-3: Pollution hazard indices for BESS area and onsite substations

Pollution Hazard Indices				
Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other roof (typically commercial / industrial roofs)	Low	0.3	0.2	0.05

Table 5-4: Mitigation indices for BESS area and onsite substation basins

Pollution Mitigation Indices			
Type of SuDS Component	TSS	Metals	Hydrocarbons
BESS area / onsite substations attenuation basins	0.5	0.5	0.6

5.3.25 The access roads will not contribute to a substantive increase in impermeable area and will be very lightly trafficked during operation. The SIA has therefore not been applied to the access roads.

5.3.26 Firefighting water, and its potential contaminants, is not included in this section as any fire water applied to the BESS area would be contained within the basins and removed from the Site via controlled methods (e.g. tanker) if found to be polluted following testing (See Section 5.3 on Fire Water Runoff for further details).

Exceedance Flows

5.3.27 The proposed surface water drainage network has been designed to accommodate runoff from all rainfall events up to and including the 0.5% AEP (1 in 200-year) rainfall event, with a 45% allowance for climate change. In the event of rainfall exceeding the design standard, or in the case of a blockage within the drainage network, exceedance flows will be designed to be managed via controlled overland flow routes. These routes will be designed to direct flow away from critical infrastructure, including the BESS and onsite substation areas.

5.3.28 Exceedance flows will be conveyed in accordance with the finished levels of the Proposed Development and existing topography towards perimeter swales and attenuation features, and ultimately discharge to the receiving watercourse via established flow pathways.

5.3.29 Finished floor levels of all buildings and critical electrical infrastructure (i.e. the Substations and BESS) will be set a minimum of 600mm above the 1 in 100-year AEP fluvial flood level including an appropriate allowance for climate change (in accordance with the SuDS Manual (C753)). All sensitive equipment (including transformers, switchgear and control systems) will be constructed above this level, and flood-resilient design measures will be incorporated where necessary. The measures put in place across the Proposed Development will ensure there is no increase in flood risk elsewhere, with floodplain compensation provided where required, and residual risks (including breach and exceedance events) will be appropriately managed.

Amenity and Ecological Value of Sustainable Drainage System (SuDS) Features

5.3.30 SuDS features will not be on publicly accessible land. Consequently, the potential amenity benefit provided by the proposed drainage system is not considered relevant to the design. The design of the drainage, however, will be discrete so that it does not hinder the aesthetic value of the Proposed Development.

5.3.31 Incorporating swales within the Site provides an opportunity to add ecological value, with detailed assessments to be performed in detailed design phase to quantify benefit.

Fire Water Runoff

5.3.32 Fire water runoff from the BESS areas will be captured, by means of the measures as set out in Section 5.3, so it cannot discharge off site or to ground and will be tested/removed off site by tanker if contamination is found to be present.

5.3.33 The proposed BESS will require the provision of fire water tanks to supress a fire, should one occur. The BESS containers will contain an internal fire suppression system, with a sump to contain any water used in the event of an internal fire if compatible with the design of the original equipment manufacturer (OEM), or captured in the drainage system otherwise. This water will not be directed to the surrounding basins other than to those designed for firewater retention.

5.3.34 In the event of a fire, the fire service may use clean water to douse surrounding BESS units to prevent propagation of fire. This external firewater runoff may contain particles from a fire which could then enter the external drainage system within the BESS area. In the unlikely event of fire, water will be contained and tested / treated before being trucked offsite.

5.3.35 Any external fire water runoff will be contained within Attenuation Basin 2, where it will be held and tested before being released into the surrounding watercourses (if found to have no contaminants present, or contaminants that are within acceptable legal limits) or taken off site by a tanker for treatment elsewhere. The basin will then be cleaned of all contaminants. An Outline Battery Safety Management Plan has been submitted as part of this Application will set out details of fire management in more detail.

5.3.36 The basin serving the BESS area (Attenuation Basin 2) will be underlain with an impermeable barrier to prevent any contaminants entering the ground. It will be controlled by a penstock valve that can be closed before a fire is put out.

5.3.37 Appropriate access will be provided to the penstock valve so it can be easily reached in the event of a fire.

5.3.38 The National Fire Chiefs Council (NFCC) guidance 'Grid scale energy storage system planning – Guidance for Fire and Rescue Service (FRS)' (2025)[17] should be used to determine the volume storage of fire water runoff. The NFCC guidance states "*Where a flow of 25 litres (L) per second cannot be achieved, it would be prudent to provide an equivalent static supply of water on site that will provide for the same flow rate for a duration of 120 minutes. This equates to approximately 180,000L of water".*

5.3.39 The Government's Renewable and low carbon energy guidance[18] was revised in August 2023 to include discussions on BESS (Paragraphs 032 to 036 inclusive). Paragraph 034 notes (in the context of planning applications made to local planning authorities) the requirement for applicants to consider the NFCC guidance and engage with the relevant local FRS before submitting an application to the local planning authority, and Paragraph 035 notes that local planning authorities should consider the NFCC guidance when determining applications.

5.3.40 The use of Attenuation Basin 2 for both fire water storage and surface water storage creates the potential that, in the event of a fire, the basin may already contain surface water, therefore reducing the available capacity for fire water storage. To manage this risk, the basin will be sized to serve both purposes.

5.3.41 At this stage of design, it would be overly conservative to provide the required fire water storage on top of the already conservative, 0.5% AEP (1 in 200-year) rainfall event, with a 45% allowance climate change storage, already provided. This is because it is extremely unlikely that a fire will occur at the same time as the 1 in 200-year rainfall event. Therefore, taking a pragmatic approach, an allowance has been made for a 1 in 2-year rainfall event occurring at the same time as a fire. Therefore, the basin will need to contain the 1 in 2-year rainfall event plus the fire water storage runoff or the 0.5% AEP (1 in 200-year) rainfall event, with a 45% allowance for climate change on its own, whichever is greater (thereby providing for the worst-case scenario).

5.4 Maintenance Regime

5.4.1 The PPG and the SuDS Manual (C753) emphasise the necessity for developers to address the operation (and maintenance) of all SuDS throughout the lifetime of the Proposed Development.

5.4.2 Construction phase measures will be detailed in the **Outline Construction Environmental Management Plan (oCEMP) [EN0110020/APP/5.9]**. **Table 5-5** provides a detailed overview of the anticipated maintenance activities associated with each of the proposed SuDS features.

Table 5-5: Indicative SuDS maintenance schedule

Maintenance Task	Frequency
Permeable surfacing	
Brushing	Annually or as required
Stabilise contributing adjacent areas. Removal of weeds. Remediation to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace any lost jointing material.	As required
Jetting of main structure to remove any sediment build-up. Inspection for weed growth and silt accumulation.	Annually or as required
Swales	
Removal of litter and debris. Cut grass to maintain grass height within design range. Management of vegetation and nuisance plants. Inspection of inlets and outlets for blockages. Inspection of infiltration services for ponding, siltation and compaction of surfaces.	Quarterly checks and maintenance
Re-seed areas of poor vegetation growth and alter plant types to best suit conditions. Repair erosion or other damaged surfaces by re-turfing or re-seeding. Re-level uneven surfaces and reinstate design flood levels. Scarify and spike topsoil layers to promote infiltration, break up silt deposits and prevent compaction of the soil surface. Remove buildup of sediment in upstream and downstream areas.	As required
Filter Drains	
Removal of litter and debris from drain surface and pre-treatment surfaces (filter strips). Inspection of filter drain surface, inlet and outlet pipework for blockages and structural damage.	As required
Remove or control tee roots where any encroachment occurs using recommended methods. Clear any pipe work of any blockages.	As required
Detention / Attenuation Basins	
Removal of litter and debris. Cutting of grass, especially meadow grass in and around the basin. Management of vegetation and nuisance plants in and around the basin. Inspection of inlets and outlets for blockages and clear if required.	As required

Maintenance Task	Frequency
Inspection of bankside structures and pipework for structural damage.	
Checking of penstocks and other mechanical devices. Tidy dead growth prior to the growing season. Removal of sediment from inlets and outlets.	Annually
Re-seed areas of poor vegetation growth. Prune and trim any tree cuttings. Repair eroded areas through re-turfing or re-seeding. Realign rip-rap. Repair inlet and outlet features. Relevel uneven surfaces and reinstate design levels.	As required

6 CONCLUSION

6.1.1 This oSWDS presents a sustainable approach for managing surface water drainage at the Proposed Development. The strategy has been developed in accordance with national and local planning policies, confirming compliance with environmental regulations and best practice guidance.

6.1.2 The Site is primarily used for agriculture. Research by Wallingford HydroSolutions indicates that solar farms do not increase runoff and may decrease it by introducing ground cover that is more capable of absorbing runoff. Vegetation disturbance during construction will be minimised with regular inspection and maintenance to ensure that vegetation cover remains adequate and to minimise impacts of the solar panels on runoff or drainage. Strategic SuDS features (filter drains, swales, and scrapes) can also be incorporated within the solar array areas to encourage infiltration and provide ecological benefits.

6.1.3 The Proposed Development includes onsite substations and a BESS area, which will be provided on areas of hardstanding, increasing the potential for surface water runoff and flood risk on the Site and areas downstream of the infrastructure. Runoff from these areas, including the 0.5% AEP (1 in 200-year) rainfall event, with a 45% allowance for climate change, will be attenuated and discharged at greenfield runoff rates to replicate the Site’s natural drainage. Attenuation will be achieved through the provision of basins at natural low points where feasible and the formation of additional SuDS where required.

6.1.4 Special provisions, such as lining of basins or automatic flow valves, will be included for firewater management, ensuring that any potentially contaminated runoff is contained and safely removed from the site in accordance with environmental regulations.

6.1.5 Further hydraulic modelling will be used to refine the worst-case storage required in the design for Attenuation Basin 2 to confirm if this is generated by the 0.5% AEP (1 in 200-year) rainfall event, with a 45% allowance climate change. The volume requirements for containment of fire water runoff within Attenuation Basin 2 are subject to consultation with the local FRS, South Yorkshire FRS. This would include consultation with the LLFA on the potential requirement for an oil interceptor and sediment trap for the BESS and the substation areas, as part of detailed design.

6.1.6 At detailed design, design assumptions will be refined, such as applying a different Cv factor to gravelled areas where there will likely be absorption and / or evaporation of the water retained within the gravel base before it enters the drainage network.

6.1.7 In summary, this oSWDS supports the application for the Proposed Development aligning with relevant policies, supporting sustainable development practices and it will be finalised in conjunction with detailed design phase to ensure optimal performance and compliance throughout the lifecycle of the Proposed Development.

A.1 Topographical Data and Figures

Figure 6-1: W1 Topographical Data

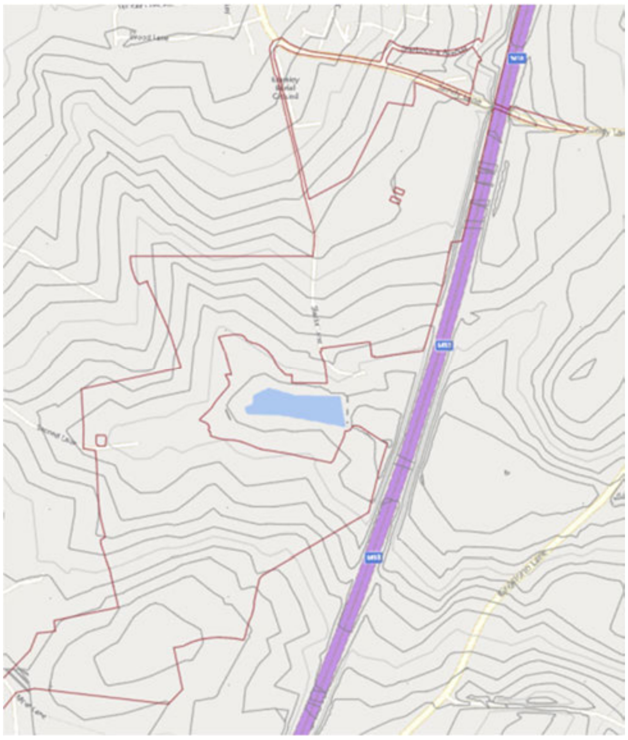

Figure 6-2: W2 Topographical Data (West of M18)

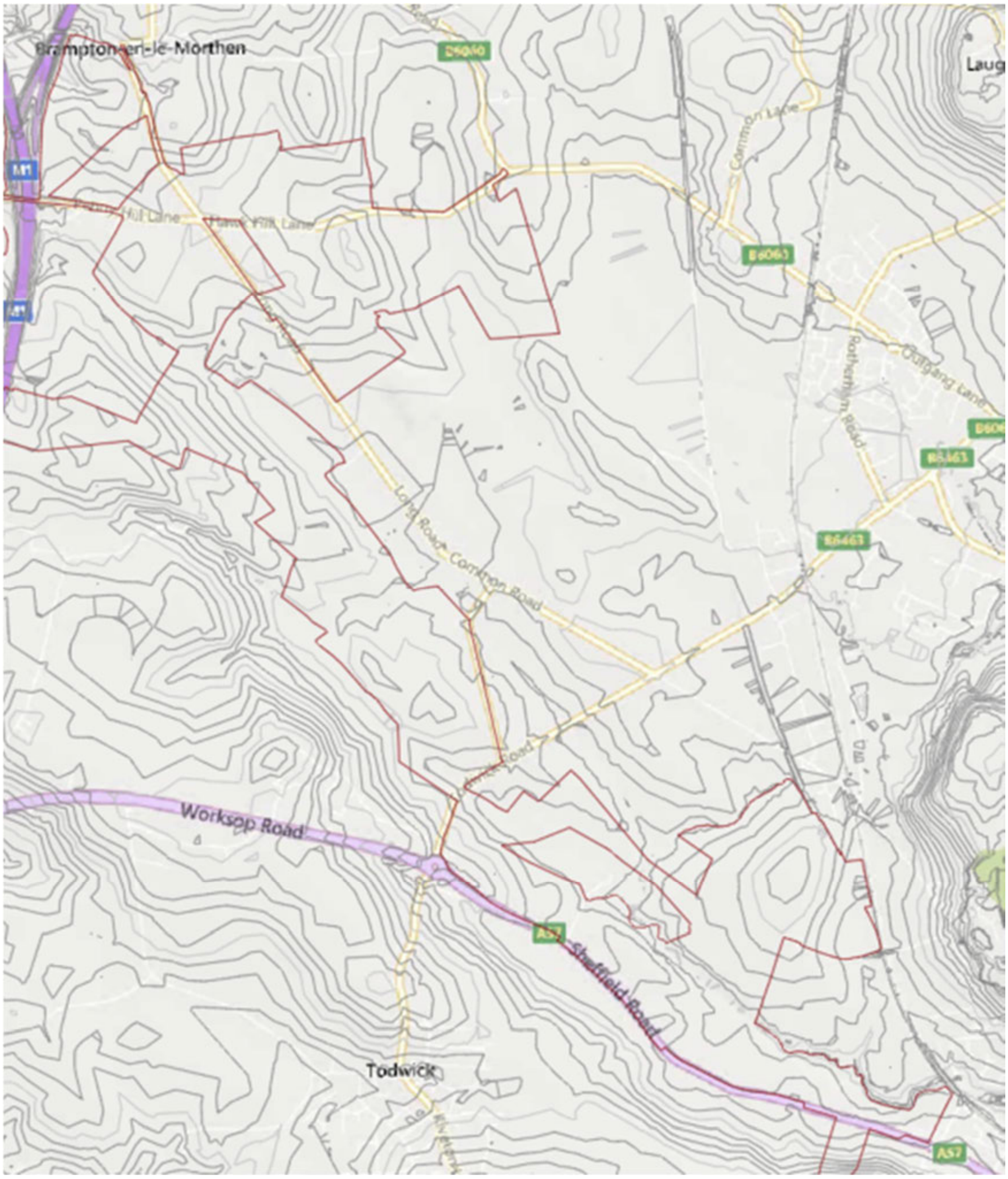

Figure 7: W2 Topographical Data (East of M1)

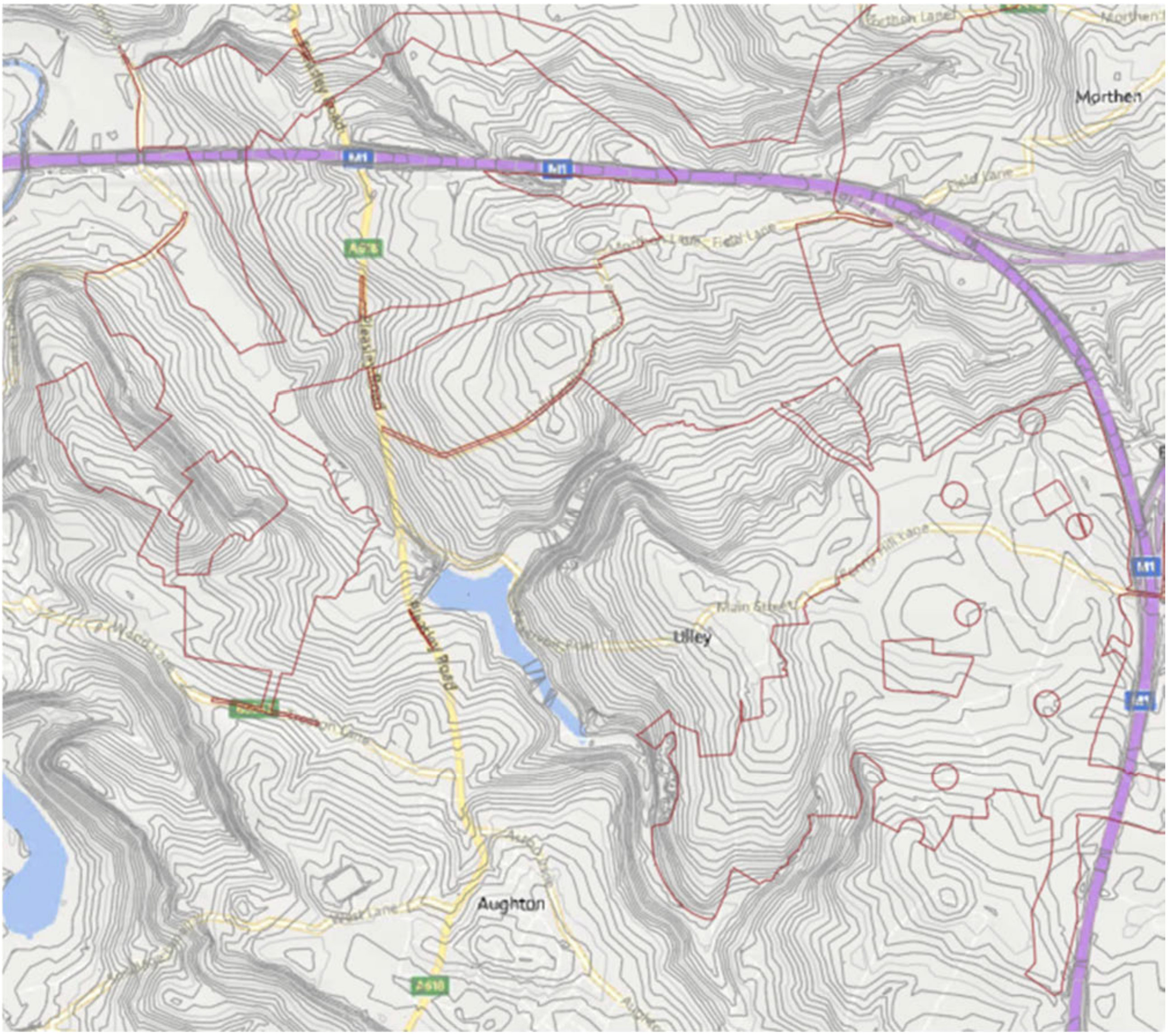

Figure 8: W2 Topographical Data (West of M1)

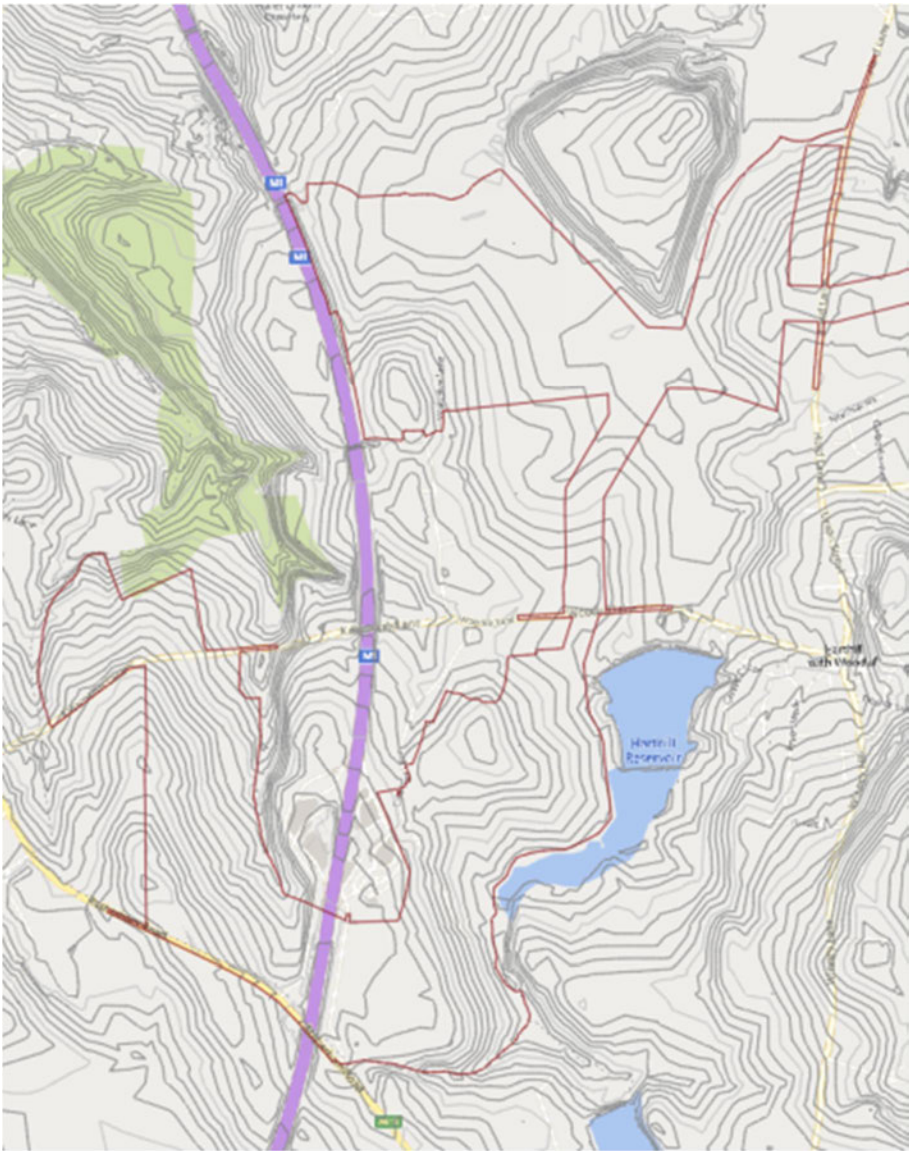

Figure 9: W3 Topographical Data

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