Lime Down
Solar Park

Environmental Statement

Volume 3, Flood Risk Assessment and Outline Drainage Strategy – Lime Down E1 (Tracked)

~~June~~ July 2026

Revision 4~~3~~

Planning Inspectorate Reference: EN010168

Document Reference: APP/6.3

APFP Regulation 5(2)(a)

Appendix 11-7: Flood Risk Assessment and Outline Drainage Strategy – Lime Down E1

Prepared by: [redacted]

For: Lime Down Solar Park Ltd

Site: Lime Down Solar Park

Date: ~~08/06/2026~~09/07/2026

Document Ref: 317212-07

~~Issue-03~~Issue-04

www.arthian.com

Contents

Tables

Figures

Annexes

1. Site Details

1.1.1 The aim of this section of the report is to outline key environmental information associated with the baseline environment of Lime Down E1.

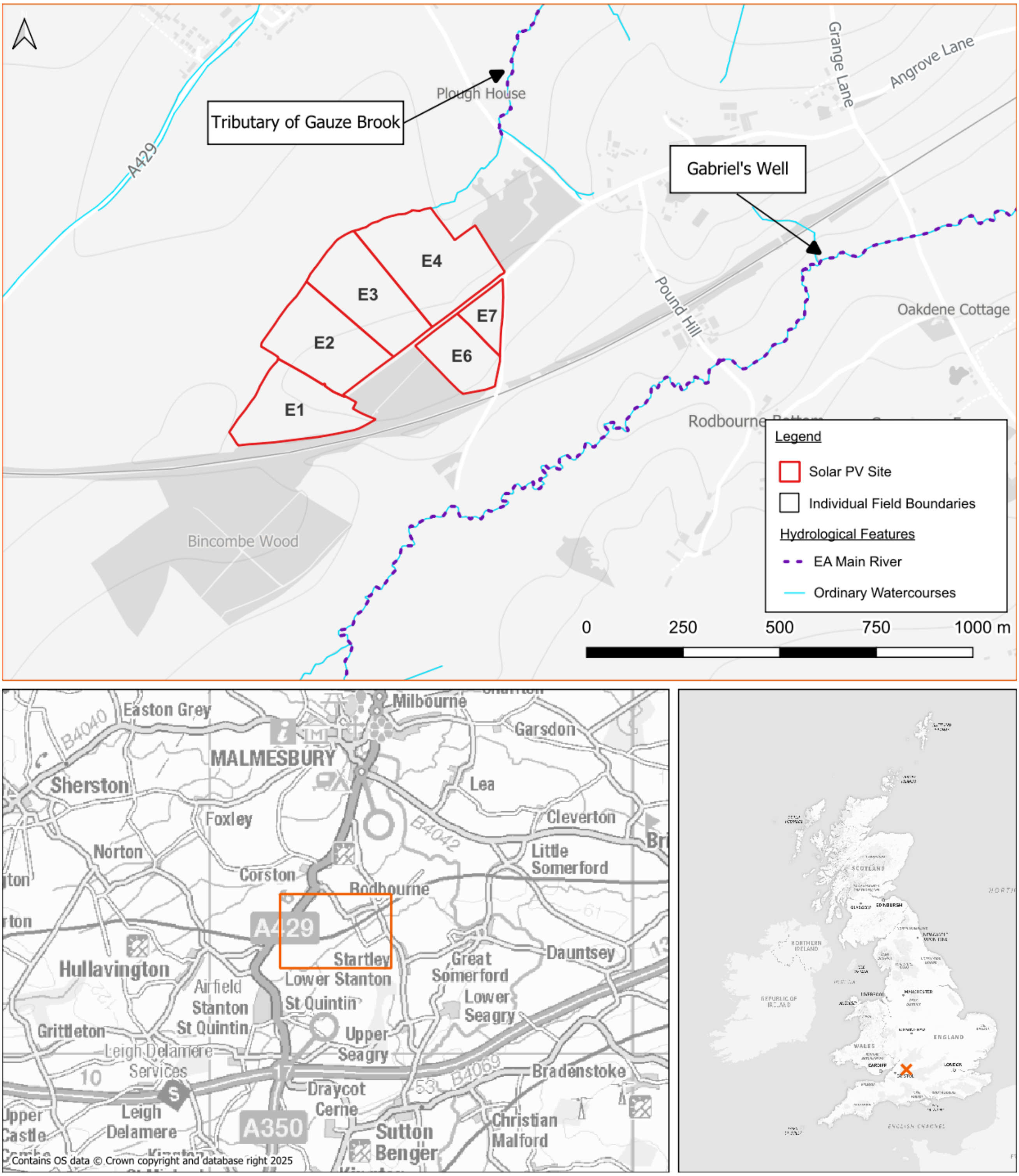


Figure 1: Site Location

1.2 Site Location

1.2.1 Lime Down E1 is located approximately 3.2km southwest of Malmesbury, a town in north Wiltshire. The Site is centred at National Grid Reference 392677E, 183040N.

1.3 Existing Site Conditions

1.3.1 Online mapping (including Google Maps / Google Streetview imagery)i accessed May 2025 shows that the Scheme area comprises agricultural / arable fields. The Scheme area is bordered by more rural land in all orientations with a railway line to the south. Access is provided via an unnamed road leading off Pound Hill.

1.4 Topography

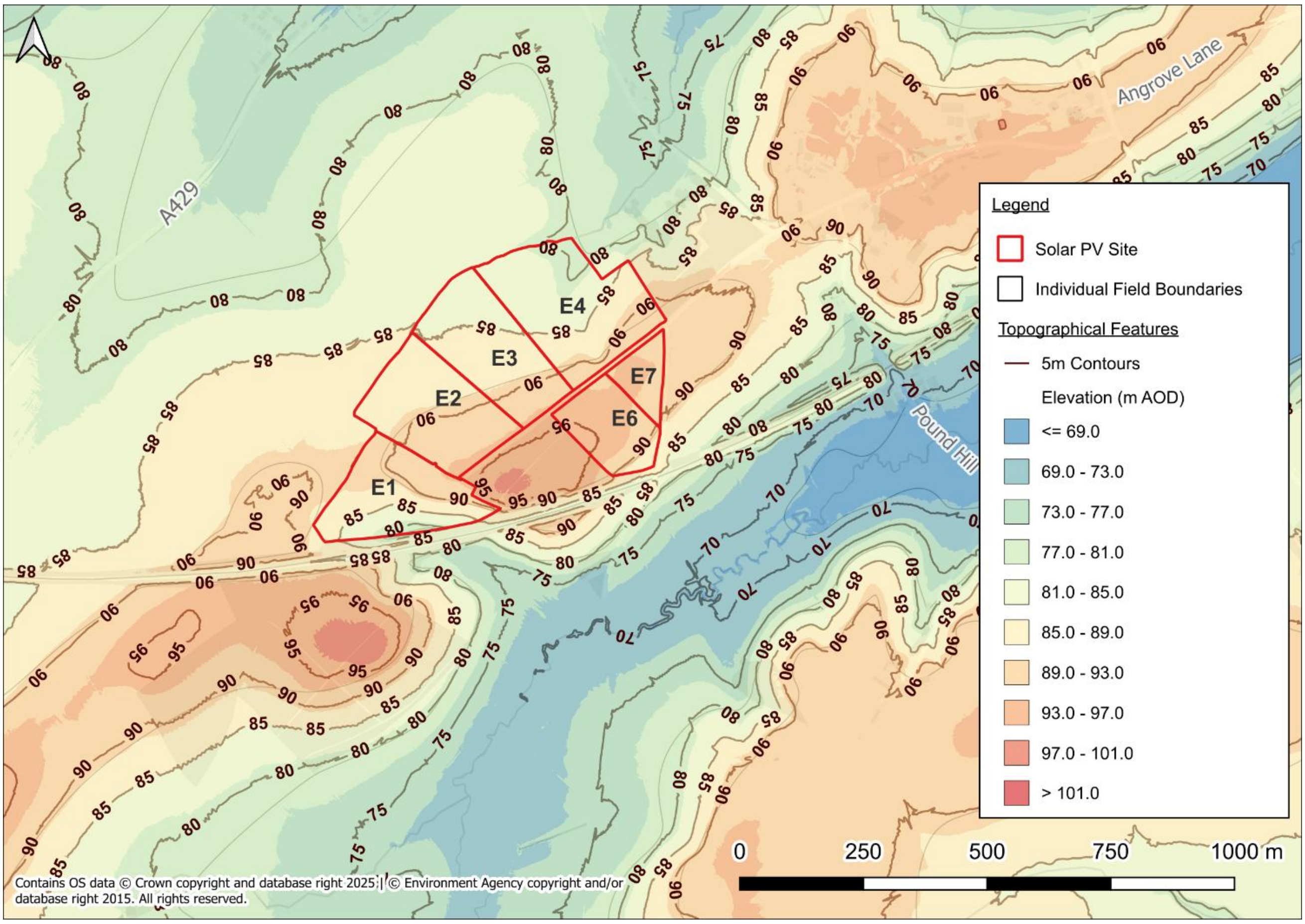


Figure 2: LiDAR Plan

1.4.1 Topographic levels to metres Above Ordnance Datum (m AOD) have been derived from a 1m resolution Environment Agency (EA) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). A review of LiDAR ground elevation data shows that Lime Down E1 slopes from approximately 97m AOD in the southwest to approximately 80m AOD in the north (Figure 2).

1.5 Hydrology

1.5.1 The nearest watercourse is Gabriel's Well, a Main River, which is located approximately 200m to the south of Lime Down E1.

1.5.2 Other watercourses in the area include a tributary of Gauze Brook, which begins as an Ordinary Watercourse at the north-eastern boundary of Lime Down E1, before it becomes a Main River approximately 260m north-east.,

1.5.3 Main Rivers are within the jurisdiction of the EA and land drainage ditches and Ordinary Watercourses which fall within the jurisdiction of the Wiltshire County Council Lead Local Flood Authority.

1.6 Water Framework Directive Status

1.6.1 Lime Down E1 is located within the Avon Bristol Rural Catchment, largely within the Gauze Brook – source to conf R Avon (Brist) Water Body Catchment and partially within the Rodbourne Bk – source to conf R Avon (Brist) Water Body Catchment.

1.6.2 The Gauze Brook – source to conf R Avon (Brist) Water Body catchment has a Cycle 3 Ecological status of Moderate in 2019 in 2022 and a Failing chemical status in 2019 (no data in 2022). The Rodbourne Bk – source to conf R Avon (Brist) Water Body catchment has a Cycle 3 Ecological status of Moderate in 2019 and 2022 and a Failing chemical status in 2019 (no data in 2022). A summary of the Water Body Classifications for the catchments are included as Annex A.

1.7 Geology

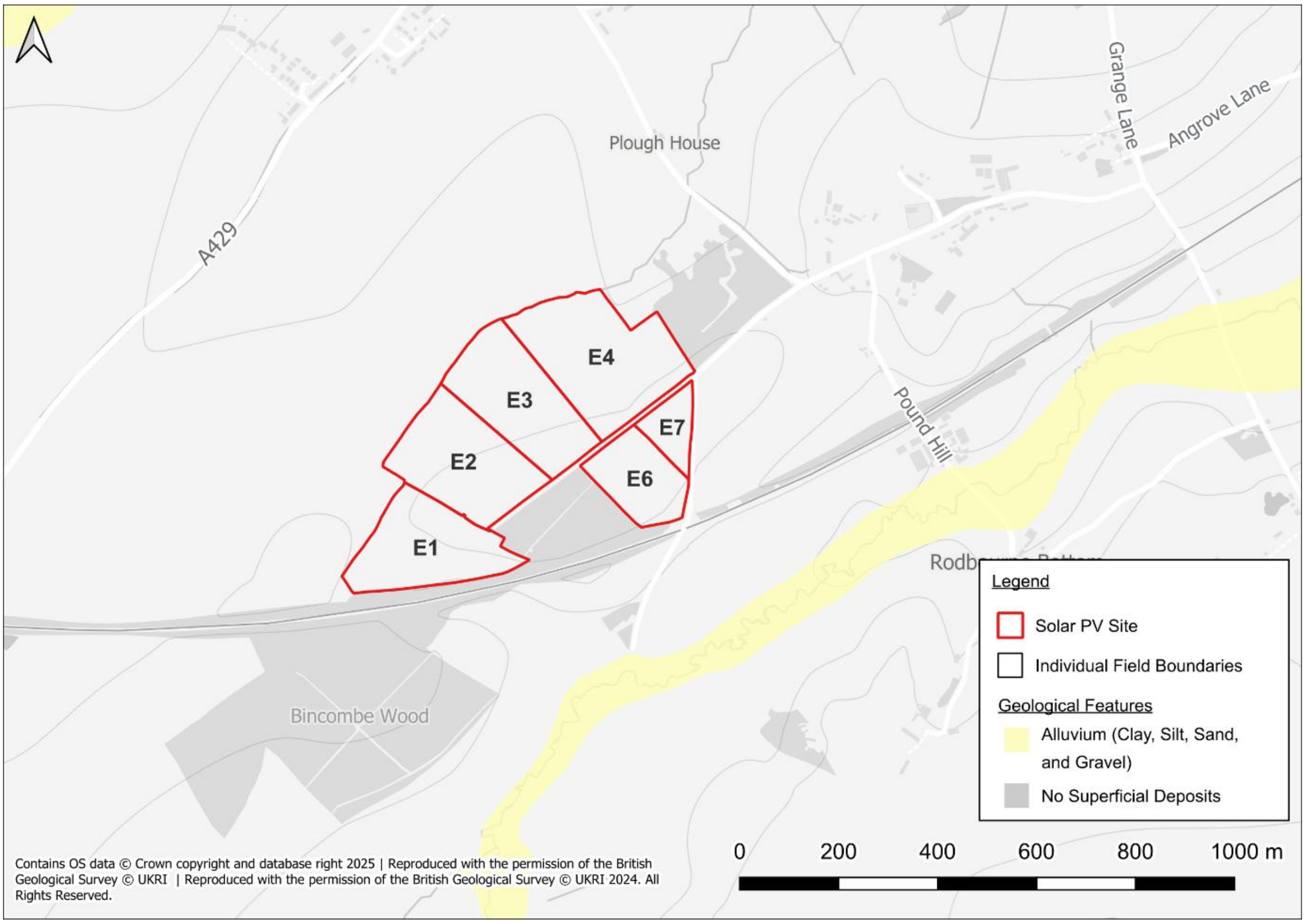


Figure 3: Superficial Deposits

1.7.1 Reference to the British Geological Survey (BGS)ii online mapping (1:50,000 scale) indicates that Lime Down E1 is not underlain by superficial deposits (see Figure 3 for deposit location).

1.7.2 Lime Down E1 is identified as being underlain by Kellaways Clay Member, comprising of mudstone (see Figure 4 for deposit location):

1.7.3 The geological mapping is available at a scale of 1:50,000 and as such may not be accurate on a Site-specific basis.

1.7.4 There are no British Geological Survey boreholes located at Lime Down E1.

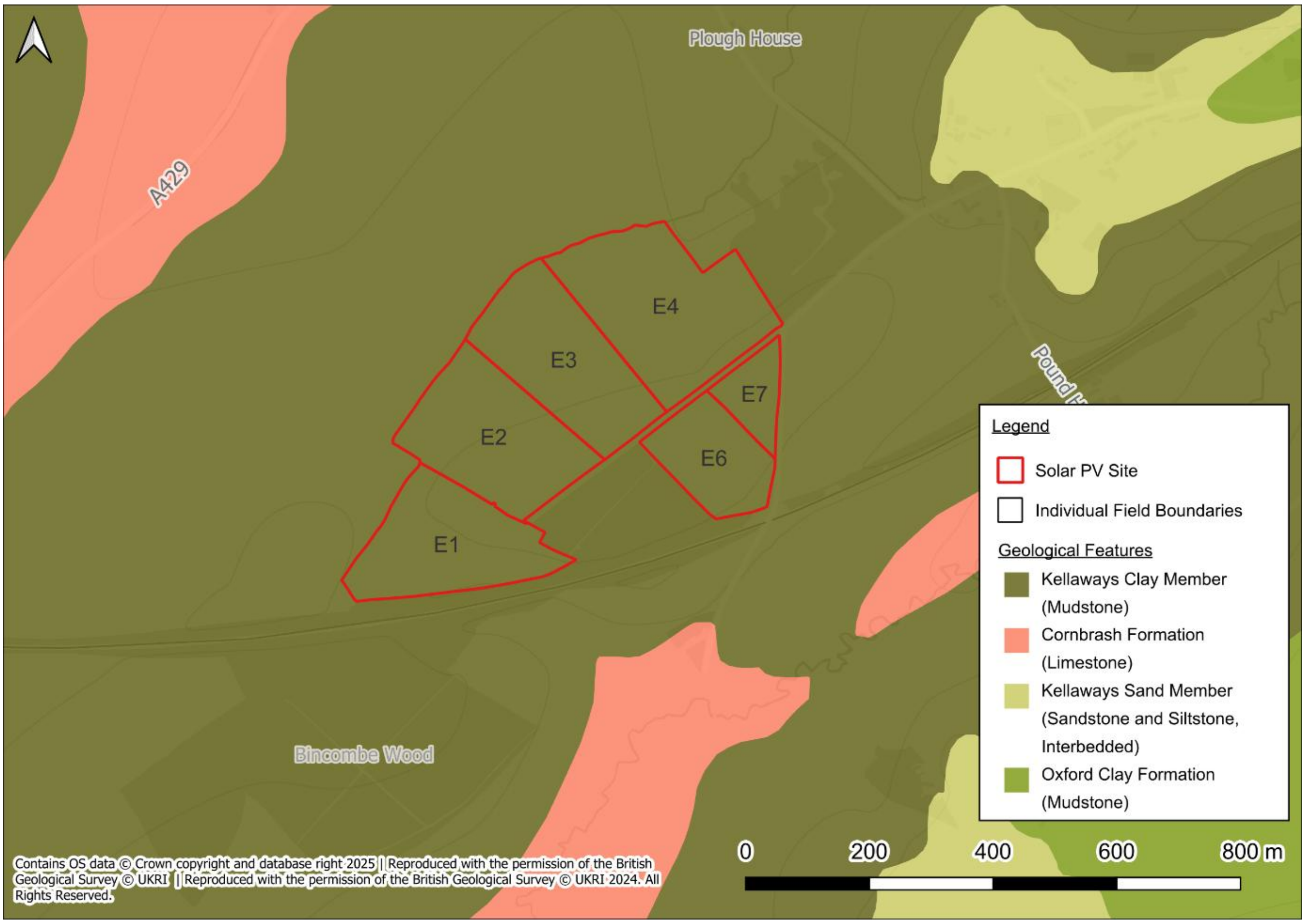


Figure 4: Bedrock Deposits

1.8 Hydrogeology

1.8.1 According to the EA's Aquifer Designation data, obtained from MAGIC Map's online mappingiii [accessed 02/06/25], the Forest Marble Formation is classified as a Secondary A Aquifer.

1.8.2 According to the EA's Aquifer Designation data, obtained from MAGIC Map's online mapping [accessed 02/06/25], the Kellaways Clay Member is classified as Unproductive.

1.8.3 Lime Down E1 is not underlain by superficial deposits and there are no identified aquifers.

1.8.4 The EA's 'Source Protection Zones' data, obtained from MAGIC Map's online mapping [accessed

02/06/25], indicates that Lime Down E1is not located within a Groundwater Source Protection Zone.

1.9 Proposed Site Conditions

1.9.1 Lime Down E1 proposes a ground mounted solar photo-voltaic plant with associated electrical infrastructure, including a substation located in Field E6, and access. See **ES Volume 1, Chapter 3: The Scheme [EN010168/APP/6.1].**

1.9.2 An **Outline Landscape and Ecological Management Plan (LEMP) [EN010168/APP/7.18]** has been developed to support the DCO application. This details that the vast majority of the Site is proposed to be utilised for Solar PV Panels and supporting infrastructure, with internal access and peripheral areas comprising landscaped buffers, in line with the embedded mitigation described throughout the ES.

1.9.3 Where a 132kV or 400kV substation is proposed within this area, the detailed design will include a controlled drainage strategy for the substation compound. This will include sealed drainage or sealed drainage components where required, together with suitable treatment, interception, containment and isolation measures to prevent spills, leaks or firewater from affecting ground or controlled waters. The drainage principles for substations are set out in **the Firewater Containment and Drainage Strategy – Lime Down Substation [EN010168/EXAM/9.9],** which is the governing reference for containment and release matters.

2. Assessment of Flood Risk

2.1.1 The aim of this section of the report is to assess and summarise the existing flood risk at Lime Down E1.

2.2 Tidal Flood Risk

2.2.1 Lime Down E1 is situated at a minimum of approximately 80m AOD and is significantly above sea level. Therefore, there is **Negligible** risk from tidal flooding.

2.3 Fluvial Flood Risk

2.3.1 According to the EA's Flood Map for Planning (updated in March 2025)iv, Lime Down E1 is almost entirely within Flood Zone 1, meaning it is at low risk from fluvial flooding (<0.1% annual probability). A small part of Field E4 extends into Flood Zone 2, associated with a tributary of Gauze Brook flowing north-east, but this does not encroach into any areas proposed for Scheme. The proposed substation in Field E6 is located entirely within Flood Zone 1 and outside any mapped fluvial flood extents, and is therefore considered to be at low risk of fluvial flooding. Flood maps are included as Figure 5 below and **ES Volume 2, Figure 11-6: Lime Down E1 Fluvial and Surface Water Risk Map [EN010168/EXAM/6.2] (Rev 2)** produced at Deadline 3 of Examination

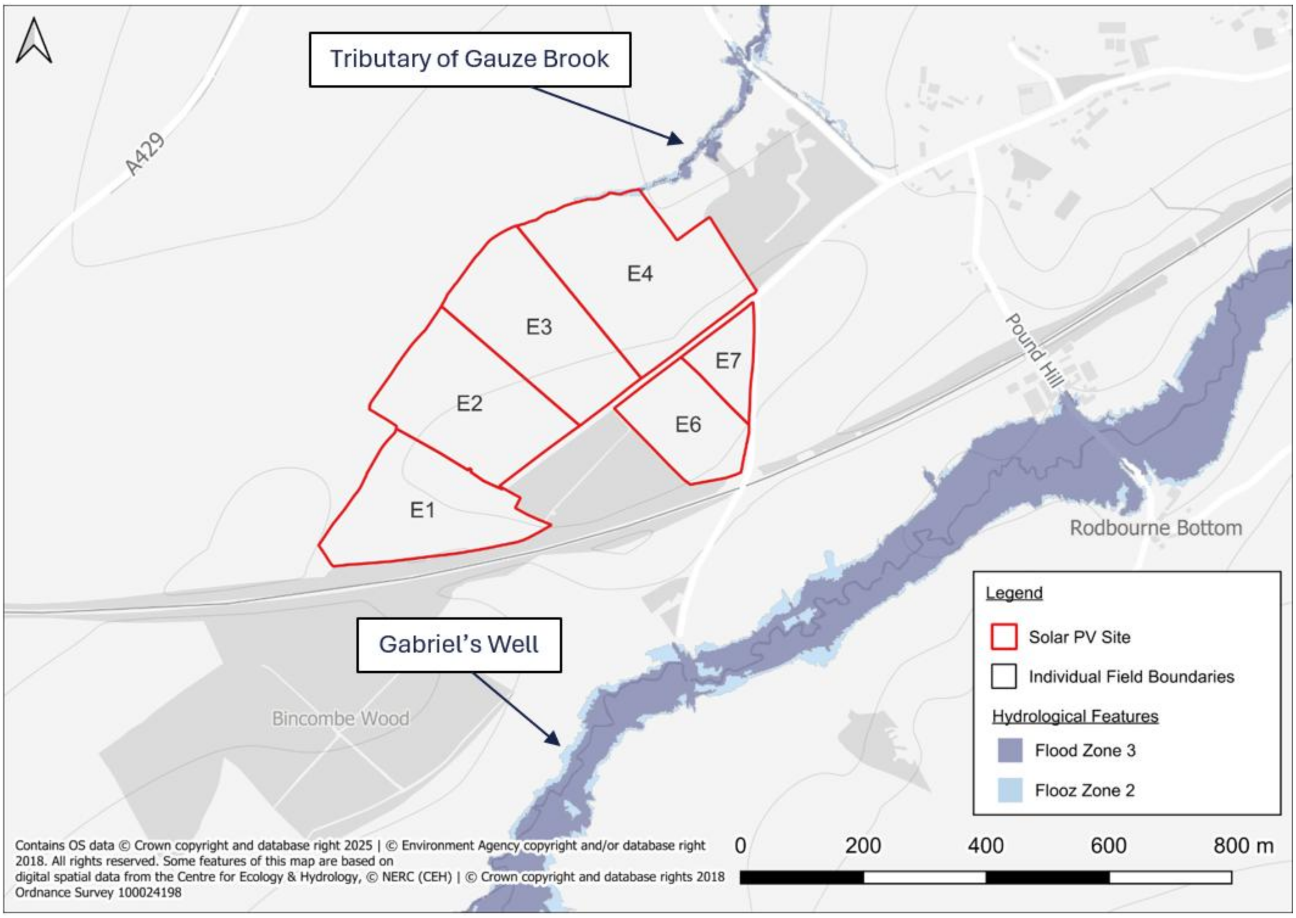


Figure 5: EA's Flood Map for Planning

2.3.2 As above, the nearest watercourse is a tributary of Gauze Brook, located at the north-eastern boundary of the Lime Down E1 which flows in a north-easterly direction. Any out of channel flooding from the Ordinary Watercourse will flow in a north-easterly direction following the areas sloping topography.

2.3.3 The EA 'Historical Flood Map' indicates that Lime Down E1 has no recorded history of flooding on the Lime Down E1 or in the immediate vicinity. The nearest recorded flood event occurred approximately 60m south of Lime Down E1, in May 1932.

2.3.4 There is no site-specific information within third party reports relating to fluvial flood risk.

2.3.5 In the absence of modelled flood data, surface water flood maps can be used to provide an understanding of potential fluvial flood risk from any smaller watercourses. There are no formal flow routes picked up by the surface water mapping which direct water into Lime Down E1.

2.3.6 To estimate flood levels for a 1% Annual Exceedance Probability (AEP) event with a 71% climate change allowancev, Manning's open channel flow formula was applied. A detailed explanation of the calculation, including sources of data and the chosen coefficients, is provided in Annex B. This method was selected as it provides a practical estimate of flow characteristics based on channel shape, roughness, and gradient, particularly where detailed hydraulic modelling has not been undertaken. Cross-sectional data from EA LiDAR, captured in Q1 2020 and detailed in Annex B, informed the calculations. The estimated flood levels suggest limited extents, expected to be smaller than those shown on the EA's 0.1% surface water mapping. This mapping is referenced for context only and was not used as an input to the calculation. The estimated flood extents derived from the Manning's assessment are anticipated to be more limited in extent than those indicated by the EA's 0.1% AEP surface water mapping. The EA mapping has therefore been used as a precautionary indication of potential exceedance flow routes and extents only, with the 1% AEP plus climate change Manning's assessment adopted as the basis for the design event assessment.

2.3.7 It is noted that the Manning's calculation was completed prior to the release of updated NaFRA2 mapping in January 2025. The revised mapping shows a reduction in surface water flood extents across the Site. This supports the view that the current Manning's calculation remains conservative, and there is no requirement to update it.

Consultation

2.3.8 Consultation has been undertaken throughout the EIA process with the EA and Wiltshire Council. Comments and recommendations received have been noted and applied throughout this Flood Risk Assessment and Drainage Strategy. A record of consultation and The Applicant's responses are included in ES Chapter 11: Hydrology, Flood Risk and Drainage.

2.3.9 Lime Down E1 is not located within an Internal Drainage Board.

Summary

2.3.10 Given the above, Lime Down E1 is therefore considered to be at Low risk of fluvial flooding.

2.4 Surface Water Flood Risk

2.4.1 The EA's National Flood Risk Assessment Mapping (NaFRA), known as the 'Long Term Flood Risk Map' (Surface Water)[vi], was updated in January 2025. The NaFRA mapping provides an updated view of surface water flooding across the Site, however it should be noted that at the time of writing, the NaFRA mapping only delivers climate change insight up to the year 2060.

2.4.2 According to the EA's Long Term Flood Risk Map (Surface Water) the majority of Lime Down E1 is at Very Low risk of surface water flooding, meaning it has a <0.1% annual probability of flooding. However, there are some small areas of Low to High risk (0.1 - >3.3% annual chance of flooding), particularly at Fields E1 – E4 and a small section in the southernmost extent of Field E6. The areas of risk in Fields E2 – E4 are associated with the presence of the tributary of Gauze Brook which flows in a north-easterly direction. Other areas of risk across Lime Down E1 are associated with topographic depressions within the Fields and ponding along the railway line to the south.

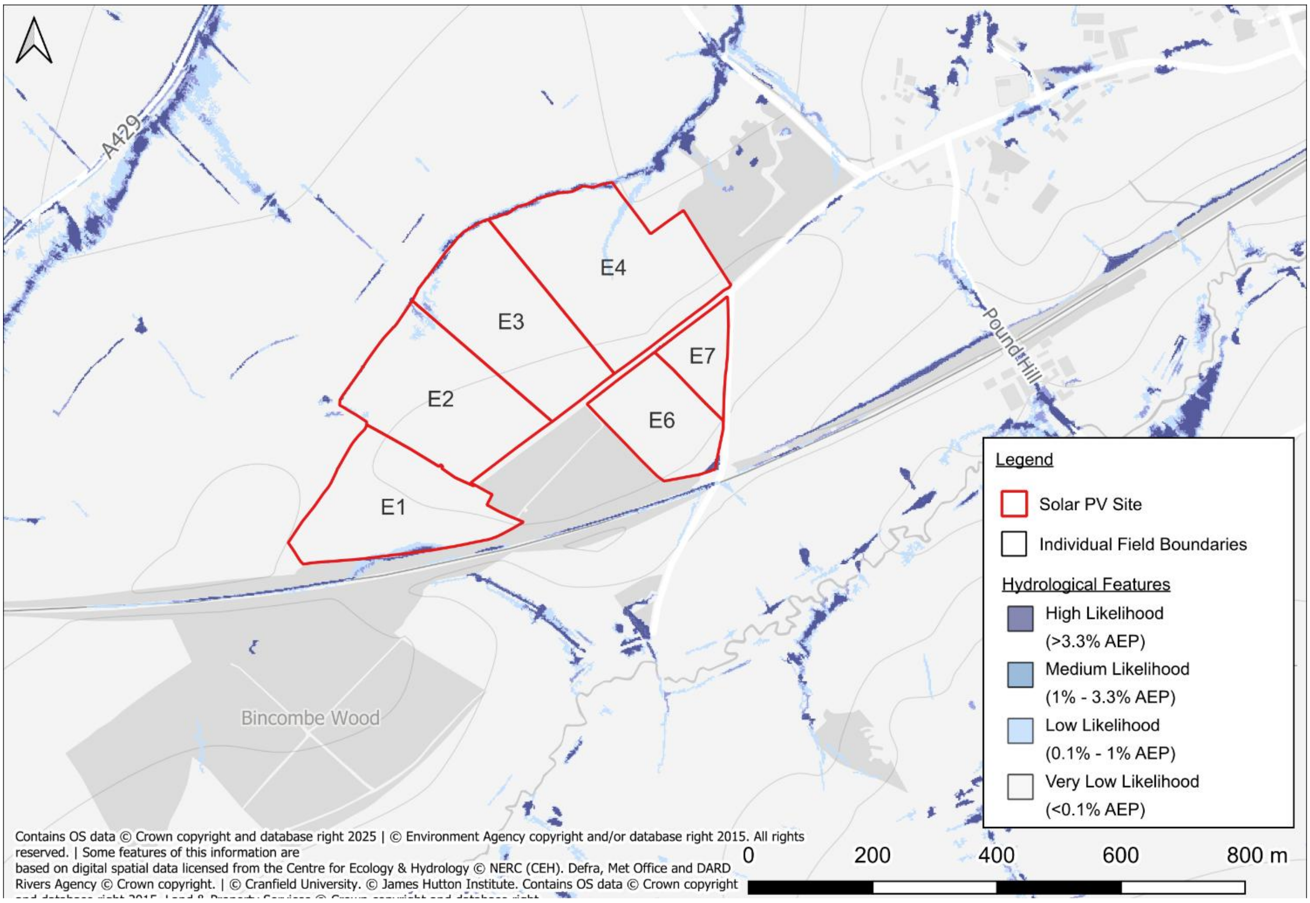


Figure 6: EA's Long-Term Flood Risk Map (Flood Risk from Surface Water)

2.4.3 With reference to the depth mapping provided by the NaFRA data, flood depths are anticipated to be low, with depths remaining largely below 300mm which is considered passable to people and vehicles. Some depths between 300mm and 600mm are anticipated in Fields E1 and E6 however these are small areas associated with topographic low points, and do not form flow routes within the Site.

2.4.4 The proposed substation in Field E6 is located in the northern part of the field, outside the mapped surface water flow paths. Although the southern extent of Field E6 shows some localised risk, the substation will be sequentially located within the area of lowest risk and raised above surrounding ground levels.

2.4.5 There is no indication within relevant third-party reports (listed in 'Sources of Information' in **ES Volume 3, Appendix 11-1: Flood Risk Assessment and Outline Drainage Strategy – Covering Report [EN010168/APP/6.3]**) to suggest that Lime Down E1 has historically experienced surface water flooding.

2.4.6 Based on the above and considering the embedded mitigation as part of the design of the solar panels, the overall risk of surface water flooding is considered to be Low. The proposed solar panels will be raised above surrounding ground levels and will be appropriately waterproofed, thereby reducing the potential to be impacted in the event of surface water flooding.

2.4.7 Associated electrical infrastructure, such as inverters, transformers, cabling and substations, will be located outside mapped flood extents where feasible, or otherwise elevated above the design flood level with appropriate freeboard, in line with the embedded mitigation strategy outlined in **Appendix 11.1: Flood Risk Assessment and Outline Drainage Strategy – Covering Report [EN010168/APP/6.3].**

2.4.8 Smaller electrical components such as conversion units, where present, are minor in scale and will be protected through elevation or localised resilience measures, consistent with the approach set out in the Covering Report. The potential for the development to exacerbate surface water flood risk off-site is also addressed through the use of appropriate SuDS features, as described in the Covering Report.

2.5 Groundwater Flood Risk

2.5.1 The geology is identified above in Section 1.0. There were no boreholes identified from BGS records at Lime Down E1.

2.5.2 There is no information within relevant third-party reports (listed 'Sources of Information' in **ES Volume 3, Appendix 11-1: Flood Risk Assessment and Outline Drainage Strategy – Covering Report [EN010168/APP/6.3]**) to suggest that Lime Down E1 has experienced historical groundwater flooding.

2.5.3 No buildings, other than the supporting unstaffed infrastructure, and no basement levels are identified on plans which may otherwise be at increased risk from groundwater seepage.

2.5.4 Soilscapes[vii] mapping indicates that Lime Down E1 is located in 'impeded drainage'.

2.5.5 It can be concluded that the risk of groundwater flooding is Low and no site-specific mitigation measures are required.

2.6 Sewer Flooding

2.6.1 No site-specific incidents of sewer flooding have been identified from relevant third-party reports.

2.6.2 On the basis of Lime Down E1's rural setting, the presence of sewerage infrastructure is unlikely. Utility records have been checked and identify no public sewers within Lime Down E1.

2.6.3 It can therefore be concluded that the risk of sewer flooding is **Negligible.**

2.7 Reservoir and Canal Flooding

2.7.1 There are no canals within the vicinity of Lime Down E1, therefore there is no associated risk.

2.7.2 The EA 'Flood Risk from Reservoirs' map shows that Lime Down E1 is not at risk of flooding from reservoirs.

2.7.3 It can therefore be concluded that there is **Negligible** risk of flooding from artificial sources.

2.8 Residual Flood Risks

2.8.1 A residual risk is an exceedance event, such as the 1 in 1000 year (0.1% AEP) flood event that would overtop the unnamed Gauze Brook tributary and potentially impact Lime Down E1. As the probability of a 1 in 1000 year flood event occurring is 0.1% in any given year, the probability is low and, therefore, no additional mitigation beyond the embedded mitigation measures of the Scheme is required.

2.8.2 In the event of the defences failing or an exceedance event occurring, the residual risk to people working or present in the vicinity, as construction workers, residents, or public right of way (PRoW) users, within Lime Down E1 can be managed through the implementation of an appropriate Site management plan. This plan will recognise the residual risks and outline the actions to be taken by staff in the event of a flood to ensure that occupants are placed in a place of safety,

2.9 Summary of Flood Risk

2.9.1 It can be concluded that the risk to Lime Down E1 from all sources of flooding is **Negligible** to **Low**, however, it would be prudent to include the below mitigation measures.

2.10 Embedded Mitigation

2.10.1 Embedded Mitigation is detailed in **ES Volume 3, Appendix 11-1: Flood Risk Assessment and Outline Drainage Strategy – Covering Report [EN010168/APP/6.3].**

2.10.2 During the construction phase, temporary works and construction activities will be managed to maintain existing floodplain storage, floodplain capacity and overland flood flow routes. Temporary compounds, plant and material storage will be located outside areas identified as potentially susceptible to flooding where reasonably practicable, and construction activities will be undertaken in accordance with the **Outline CEMP [REP2-019]** to ensure flood risk is not increased elsewhere.

2.11 Impact on Off-Site Flood Risk

2.11.1 The Solar PV Panels and associated electrical infrastructure, including inverters, transformers, cabling, and substations, will, where possible, be located outside the flood extent. If this is not feasible, they will be elevated with appropriate freeboard above the local flood level. These components will be installed on concrete foundations or pads mounted on frames, allowing floodwater to flow freely underneath. This approach prevents any loss of floodplain volume and ensures there is no increase in flood risk elsewhere - areas where panels are proposed in Flood Zones 2 / 3 have undergone the appropriate floodplain storage calculations – see **ES Volume 3, Appendix 11-6 and 11-8 [EN010168/APP/6.3]**. The components are insignificant in size with detailed dimensions provided in ES Chapter 3: Scheme

Description. Additionally, any units incorporating hardstanding surfaces will feature SuDS measures to mitigate any increase in surface water runoff. Together, these measures ensure the Scheme does not contribute to an increase in flood risk.

2.11.2 Surface water management has been considered in **ES Volume 3, Appendix 11-1: Flood Risk Assessment and Outline Drainage Strategy – Covering Report [EN010168/APP/6.3].**

3. Outline Drainage Strategy

3.1 Introduction

3.1.1 Lime Down E1 forms part of the wider Scheme and includes Solar PV Panelled Areas, one 132kV Substation with associated access track, and three Conversion Units / 33kV Sub-distribution Switch Rooms. This section provides the Outline Drainage Strategy for Lime Down E1. It identifies the areas requiring formal drainage consideration, sets out the basis of the runoff and attenuation calculations, and demonstrates that a feasible drainage solution can be accommodated within the assessed design envelope. Excluding the 132kV Substation, the associated access track where conservatively assessed as hardstanding surfaces, and the Conversion Unit / 33kV Sub-distribution Switch Room equipment pads, Lime Down E1 will remain largely permeable following development. Solar PV infrastructure is not treated as contributing to the overall extent of positively drained hardstanding surfaces for the purposes of this Outline Drainage Strategy.

3.1.2 For the purpose of this assessment, this Outline Drainage Strategy is split as follows:

- A description of surface water drainage from the Solar PV Panelled Areas, excluding the 132kV Substation, the 132kV Substation access track and the Conversion Units / 33 kV Sub-distribution Switch Rooms; and
- An outline drainage strategy for the positively drained hardstanding surfaces, comprising the 132kV Substation, the 132kV Substation access track where conservatively assessed as hardstanding surfaces, and the Conversion Units / 33kV Sub-distribution Switch Rooms.

3.1.3 The detailed drainage layout, final SuDS components, conveyance routes, levels, outfalls, flow controls, treatment train, isolation arrangements and maintenance regime will be confirmed at detailed design and secured through the relevant DCO drainage requirement.

3.2 Solar PV Panelled Areas

3.2.1 Solar PV panelled areas are not treated as formal impermeable drainage catchments within this Outline Drainage Strategy. The panels are elevated above ground level, drain to the existing ground, are not sealed into a drainage network, and do not create a connected impermeable surface.

3.2.2 This approach is supported by national policy and the submitted evidence base. **NPS EN-3 paragraph 2.10.84** recognises that solar PV panels drain to the existing ground and that the drainage impact will not, in general, be significant. This position is also addressed in **ES Volume 1, Chapter 11: Hydrology, Flood Risk and Drainage [REP1-017], ES Volume 3, Appendix 11-1: Flood Risk Assessment and Outline Drainage Strategy - Covering Report [REP1-037]** and **the Applicant's Response to the Lead Local Flood Authority on Hydraulic Modelling Requirements [REP2-045].**

3.2.3 The Applicant's review of the relevant research and guidance confirms that, where vegetated ground cover is established and maintained, soil compaction is avoided or remediated, and connected preferential flow routes are not created, solar PV panels are not predicted to increase surface water runoff rates or volumes in a manner that requires formal attenuation.

3.2.4 The principal effect of the panels is local redistribution of rainfall within the same field, including potential concentration at panel drip-lines. This does not generate additional rainfall volume. Whether redistributed rainfall becomes runoff is governed by the condition of the receiving ground, including vegetation cover, soil structure, compaction, surface roughness, slope and hydrological connectivity.

3.2.5 Those controlling factors are addressed through the embedded mitigation secured for the Scheme. Construction phase controls are secured through **the Outline Construction Environmental Management Plan [REP2-019]** and **Outline Soil Resources Management Plan [APP-280]**, including controls on construction trafficking, soil handling, temporary drainage, decompaction and reinstatement. Operational ground cover and land management controls are secured through **the Outline Landscape and Ecological Management Plan [APP-283]** and **Outline Operational Environmental Management Plan [REP2-021]**, including the establishment and maintenance of vegetated ground cover beneath and between the arrays.

3.2.6 On this basis, no formal attenuation storage is proposed for the solar PV panelled areas. Additional built SuDS across the panelled fields would not be proportionate, as the policy and evidence base indicate that solar PV panels do not materially increase surface water runoff where the relevant ground condition, vegetation and flow connectivity controls are secured. The Outline Drainage Strategy for these areas is therefore to maintain diffuse drainage to the existing ground, preserve existing field-scale flow behaviour, protect existing drainage features, and manage soil and vegetation condition through the secured construction and operational controls. Internal access tracks within the Solar PV Panelled Areas will be formed using permeable materials and, where practicable, maintained at existing ground levels. These tracks are not treated as positively drained hardstanding surfaces requiring formal attenuation, except where specifically and conservatively assessed within this Outline Drainage Strategy, such as the 132kV Substation access track.

3.3 Drainage Strategy – Proposed Hardstanding Surfaces

3.3.1 Lime Down E1 currently comprises agricultural land. For the purposes of the runoff calculations, the undeveloped areas are treated as greenfield and permeable, with existing field drainage and local drainage features forming part of the baseline drainage regime. Table 1 identifies the assessed hardstanding surfaces within Lime Down E1. These areas have been included within this Outline Drainage Strategy because they would either be positively drained or have been conservatively assessed as requiring positive drainage.

Table 1: Proposed Hardstanding Surfaces

Hardstanding Infrastructure	Hardstanding Area (m^2)
132kV Substation	9,000
132kV Substation Access Track	8,310
Conversion Units / 33kV Sub-Distribution Switch Rooms	225 (3 × 75 m^2)

3.3.2 The assessed hardstanding surfaces have been identified using the indicative infrastructure areas currently proposed for Lime Down E1, or, where the final equipment layout is not fixed, the relevant maximum design parameters set out in ES Volume 1, Chapter 3: The Scheme [EN010168/APP/6.1]. Where the Works Plan envelope or indicative infrastructure area is smaller than the relevant Chapter 3 maximum parameter, the assessed area has been limited to the area that can feasibly be accommodated within Lime Down E1. This provides a conservative but realistic basis for demonstrating that the required drainage infrastructure can be delivered within the assessed design envelope.

3.3.3 The assessed hardstanding surfaces have the potential to increase surface water runoff rates and volumes if unmanaged. Surface water runoff from these areas will therefore be controlled so that the Scheme does not result in a material increase in flood risk on-site or elsewhere.

3.3.4 Wiltshire Council Sustainable Drainage Systems (SuDS) Guidance[1] states the following:

"With regards the control of surface water discharges from new development, Wiltshire Council requires post development discharges from greenfield sites to provide 30% betterment over pre-development discharges for all storm events between the 1 in 1year and 1 in 100year return period events."

3.3.5 A fixed detailed drainage layout drawing or sketch is not submitted at this outline stage. The purpose of this Outline Drainage Strategy is to demonstrate that a feasible drainage solution can be accommodated within Lime Down E1 based on the assessed hardstanding surfaces, greenfield runoff rates, controlled discharge rates, indicative attenuation volumes, SuDS options, containment principles and maintenance arrangements. The detailed drainage design, including the final layout, levels, outfall arrangement, isolation measures and maintenance access, will be submitted and approved in accordance with the relevant DCO drainage requirement before the relevant part of the authorised development commences.

3.4 Drainage Hierarchy

3.4.1 The proposed surface water drainage strategy has been prepared in accordance with the drainage hierarchy set out in the National Standards for Sustainable Drainage Systems (SuDS) and in line with Paragraph 080 of the National Planning Practice Guidance (NPPG): Flood Risk and Coastal Change. The hierarchy prioritises reuse and infiltration where feasible, followed by discharge to an above-ground surface water body, discharge to a surface water sewer or other surface water drainage system, and finally discharge to a combined sewer.

3.4.2 The following drainage hierarchy review considers normal operation. In the event of a potential pollution incident, including a firewater scenario where relevant, the drainage system would be isolated and managed in accordance with the relevant containment strategy. Firewater management is discussed further below.

3.4.3 The hierarchy establishes the following order of preference for runoff destinations:

- Priority 1: Collect surface water for reuse within the development (e.g. irrigation or non-potable supply).
- Priority 2: Infiltrate runoff to the ground, where ground conditions and groundwater levels permit.
- Priority 3: Discharge runoff to an above-ground surface water body such as a watercourse, pond or wetland.
- Priority 4: Discharge runoff to a surface water sewer, highway drain or other drainage system.
- Priority 5: Discharge runoff to a combined sewer.

3.4.4 Where higher levels of the hierarchy cannot be achieved, proportionate justification must be provided to demonstrate compliance with national policy while ensuring effective flood risk management and long-term sustainability.

Priority 1: Surface Water Collected for non-Potable Use

[1] https://www.wiltshire.gov.uk/media/13768/Wiltshire-Council-Drainage-Betterment-Strategy/pdf/Wiltshire_Council_Drainage_Betterment_Strategy__June_2024.pdf?m=1731336788693

3.4.5 Rainwater harvesting has been considered for the proposed development. However, Lime Down E1 does not include a sustained non-potable demand capable of receiving and using runoff from the positively drained hardstanding surfaces during design rainfall events. Reuse therefore cannot provide the sole means of disposal, and a secondary discharge route is required.

Priority 2: Surface Water Infiltrated to Ground

3.4.6 Where surface water collected for non-potable use (Priority 1) cannot be the sole method of disposal, the next consideration is infiltration (soakaways and permeable surfaces).

3.4.7 As described above, the Site is not underlain by superficial deposits and the underlying bedrock comprises the Kellaways Clay Member, comprising mudstone. Soilscapes mapping describes the majority of the Site, including the area where the 132kV Substation is proposed, as having "*slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils with impeded drainage*".

3.4.8 In line with the National Standards for SuDS, infiltration should only be used where ground conditions are suitable, groundwater is protected, and land stability is not compromised. The available ground condition information indicates that infiltration potential is likely to be limited, with impeded drainage soils and mudstone bedrock reducing the likelihood of reliable long-term soakaway performance.

3.4.9 Infiltration is therefore not considered suitable as the primary method of surface water disposal for the 132kV Substation drainage catchment. This avoids relying on soakaways where ground conditions are unlikely to provide adequate infiltration capacity, particularly during prolonged or high intensity rainfall.

3.4.10 This does not preclude the use of permeable surfaces, shallow filter drains or local French drain arrangements as source-control features for small, discrete areas of supporting infrastructure, where appropriate. Such features would manage small volumes locally and would not be relied upon as the primary outfall for the 132kV Substation drainage catchment.

3.4.11 Surface water from the 132kV Substation and other positively drained hardstanding surfaces will therefore be managed through a controlled drainage system, with attenuation and restricted discharge to an appropriate receiving drainage feature or watercourse.

Priority 3: Discharge to an Above Ground Surface Water Body

3.4.12 Where surface water collected for non-potable use (Priority 1) cannot be the sole method of disposal, and infiltration to ground (Priority 2) has been demonstrated to be unsuitable, discharge to an above ground waterbody should be the next consideration.

3.4.13 The nearest watercourse is Gabriel's Well, a Main River, which is located approximately 200m to the south of Lime Down E1. Discharge to this watercourse at controlled rates is considered feasible by gravity, subject to detailed design of the outfall arrangement and any necessary approvals.

Priority 4: Discharged to a Surface Water Sewer, or Another Piped Surface Water Drainage System

3.4.14 As described above, discharge to Gabriel's Well appears feasible; therefore, a connection to a public surface water sewer is not proposed. Should detailed design demonstrate that direct discharge to the watercourse is not feasible, alternative lower-priority destinations would be reviewed in accordance with the drainage hierarchy and subject to the relevant approvals.

Priority 5: Discharge to a Combined Sewer

3.4.15 As described above, discharge to Gabriel's Well appears feasible; therefore, discharge to a combined sewer is not proposed.

3.5 Surface Water Discharge

3.5.1 In accordance with the 2025 National Standards for SuDS in England Guidance, runoff destinations have been assessed following the required hierarchy.

3.5.2 As infiltration is not considered suitable as the primary discharge route for the 132kV Substation drainage catchment, runoff from the positively drained hardstanding surfaces will be attenuated on Site and discharged at controlled rates to Gabriel's Well in line with greenfield runoff principles and the LLFA requirement for 30% betterment.

3.5.3 Greenfield runoff rates have been calculated for each assessed hardstanding surface using the FEH Statistical (2025) method and are summarised in Table 2. The proposed discharge rates and associated attenuation volumes are indicative and have been prepared using the indicative infrastructure areas currently proposed, or the maximum relevant design parameters set out in **ES Volume 1, Chapter 3: The Scheme [APP-055]** where the final equipment layout is not fixed. Greenfield calculation input parameters and results are provided in Annex C.

3.5.4 This approach demonstrates that a feasible drainage solution can be accommodated within Lime Down E1 and that peak runoff from positively drained hardstanding surfaces can be controlled so that the Scheme does not result in a material increase in flood risk on-site or elsewhere. The attenuation volumes are indicative and are provided to demonstrate the feasibility of the Outline Drainage Strategy. The final drainage design may rationalise the number, location and form of SuDS components, provided the detailed design remains within the assessed design envelope and achieves the drainage principles secured through the relevant DCO drainage requirement.

Table 2: Greenfield Runoff Rates

Infrastructure	1 in 2 year (l/s)	1 in 30 year (l/s)	1 in 100 year (l/s)	1 in 2 year +30% betterment (l/s)	Proposed Discharge Rate (l/s)	Attenuation (m³)
132kV Substation	5.4	11.4	14.2	3.8	3.8	954.7
132kV Substation Access Track	5.0	10.5	13.1	3.5	3.5	880.3
Conversion Units / 33kV Sub-distribution Switch Rooms	0.1	0.3	0.3	0.1	0.1	6.2 per unit; 18.6 cumulative

3.6 Sustainable Drainage Systems

3.6.1 The SuDS appraisal approach outlined in the SuDS Manual (C753) has been applied to determine the most suitable methods for achieving sustainable surface water attenuation and conveyance to support the proposed development. The SuDS options summarised in Table 3 below have been considered:

Table 3: SuDS Options for Proposed Development

SuDS Measure	Amenity Benefit	Biodiversity Benefit	Suitability for Proposed Development	Reasoning
Soakaways	Although soakaways are typically below ground, they can contribute to amenity by allowing the land above to be used for landscaping or recreation. When integrated with visible SuDS features or planting, they can enhance the visual quality of a site and support multifunctional, attractive spaces.	Soakaways support biodiversity indirectly by promoting groundwater recharge and maintaining natural hydrological conditions. When combined with vegetated SuDS components, they can enhance habitat connectivity and contribute to ecological networks across a site.	X	As described above, the use of soakaways is not considered to be feasible.
Swales, Detention Basins and Ponds	Swales, detention basins and ponds contribute positively to site amenity by providing visually attractive, multifunctional spaces that enhance the quality and character of a development. These features can be integrated within the landscape as green corridors, linking open spaces and promoting interaction between people and water. When appropriately designed, they offer opportunities for recreation, education and visual interest, creating a more appealing and liveable environment.	Swales, detention basins and ponds deliver significant biodiversity value through the provision of varied and connected habitats. Swales function as linear green corridors, enabling wildlife movement and supporting diverse vegetation. Detention basins create temporary wetland conditions that benefit a range of species, while ponds provide permanent aquatic and marginal habitats supporting invertebrates, amphibians and birds. Collectively, these features enhance habitat diversity, strengthen ecological	✓	Sufficient space is available on site to utilise a pond, basin or swale as an above ground attenuation feature. In order to facilitate gravity drainage, attenuation features should be located towards the topographic lower levels.

		connectivity and contribute to the establishment of a resilient green-blue network across the site.		
Filter Drains/ Strips	Filter drains and filter strips can contribute to site amenity by creating attractive, vegetated edges that soften hard surfaces and integrate drainage within the landscape. When aligned along roads or paths, they form part of functional green corridors that enhance visual quality and support a sense of place.	These features provide ecological value through vegetated zones that support invertebrates and small fauna. When linked with other SuDS components, they strengthen habitat connectivity and contribute to the wider green-blue network promoted within the SuDS approach.	✓	Filter drains are trenches filled with stone/gravel that create temporary subsurface storage for the filtration, attenuation, and conveyance of surface water runoff. Ideally, filter drains receive lateral inflow from adjacent impermeable surfaces pretreated over a filter strip. Filter drains can help manage peak flows by naturally limiting rates of conveyance through the filter medium and by providing attenuation storage when the rate of flow at the outlet is controlled.
Bioretention Systems	Bioretention systems, including rain gardens and bioretention planters, provide attractive, vegetated features that enhance the streetscape and create visually appealing focal points within developments. They contribute to high-quality, multifunctional spaces by integrating drainage into the landscape and improving the relationship between people, water and planting.	These systems deliver biodiversity value through diverse planting and soil conditions that support pollinators, invertebrates and small fauna. They also play a key role in improving water quality by filtering and treating pollutants from surface runoff before infiltration or discharge. Collectively, they enhance ecological connectivity and contribute to the wider green-blue infrastructure.	✓	Bioretention systems (including rain gardens and raised box planters) are shallow landscaped depressions that can reduce runoff rates and volumes and treat pollution. They also provide attractive landscape features and biodiversity. Bioretention systems can help reduce flow rates from a site by promoting infiltration / evapotranspiration and providing some attenuation storage. Bioretention systems can also provide very effective treatment functionality. Bioretention systems are a very flexible surface water management component that can be integrated into a wide variety of developments / densities using different shapes, materials, planting, and dimensions. Bioretention systems (including rain gardens) should be considered within the detailed drainage design stage.

Rainwater Harvesting	Rainwater harvesting systems can contribute to site amenity by visibly demonstrating sustainable water management and promoting environmental awareness. When integrated within building or landscape design, they can enhance the character of a development by supporting water features, irrigation, or other non-potable uses that add functional and aesthetic value to spaces.	By reducing surface water runoff, rainwater harvesting systems help protect downstream SuDS features and receiving watercourses from pollution and erosion. Stored water can also be used to support planting and green infrastructure, indirectly benefiting biodiversity through improved vegetation health and habitat provision.	X	The attenuation benefits provided through the use of rainwater harvesting are considered to be limited and would only be realised when the tanks were not full. Water usage on site is unlikely to be significant and therefore the benefit of retaining water is limited.
Green Roofs	Green roofs enhance the visual quality of buildings and contribute to the creation of more attractive and liveable urban environments. They can provide accessible or visual green spaces within dense developments, offering opportunities for recreation, relaxation, and improved wellbeing while demonstrating sustainable design in practice.	Green roofs support biodiversity by providing valuable habitats for invertebrates, birds, and pollinators, particularly where native or species-rich planting is used. They also improve water quality and reduce runoff rates by capturing, filtering, and slowly releasing rainfall, supporting the wider SuDS objectives of managing water quantity, quality, and ecology.	X	Green roofs are not identified on development plans. Given the nature of the Scheme, green roofs are not considered a practical option. The benefits achieved through installing a green roof would be disproportionate to the significant ongoing maintenance and construction costs involved.
Porous/ Permeable Surfacing (infiltration)	Porous and permeable surfaces can enhance the quality and functionality of developed areas by integrating drainage directly into hardstanding such as car parks, footpaths and access roads. They maintain a natural appearance, reduce surface water ponding, and	Infiltration-based permeable surfaces promote natural groundwater recharge and improve water quality by filtering and retaining pollutants within the sub-base before infiltration. When combined with adjacent vegetated SuDS features, they can contribute to	X	Controlled drainage measures, including sealed surfacing or sealed drainage components where required, can be incorporated within the 132kV Substation Area to prevent uncontrolled infiltration of spills, leaks or firewater into ground or controlled waters. The detailed drainage design should include appropriate treatment, interception, containment and isolation measures

	contribute to safer, more attractive public spaces while supporting the seamless integration of SuDS within the built environment.	habitat connectivity and support the wider green-blue network across a site.		proportionate to the substances stored and the sensitivity of the receiving environment. The drainage principles are set out in the **Firewater Containment and Drainage Strategy – Lime Down Substation [REP3-120].** The final extent, depth and configuration of any lined permeable surfacing or lined sub-base storage will be confirmed at detailed design. Where such storage is used, the available storage volume will be calculated based on the surface area, proposed depth and appropriate void ratio for the selected material. Typically, the storage offered can be calculated by multiplying the surface area of the permeable surfacing (m^2) by the proposed depth (m) by a porosity ratio of 0.3.
Porous/ Permeable Surfacing (Lined)	Lined porous and permeable surfaces provide an attractive, functional drainage solution that manages runoff close to source while maintaining the appearance and usability of hardstanding areas such as car parks, courtyards and footpaths. They support high-quality, multi-functional urban design by integrating water management within the built environment without detracting from site amenity.	Although infiltration is prevented, lined permeable surfaces still contribute to SuDS objectives by providing effective pollutant removal through filtration and sedimentation within the surface and sub-base layers. By controlling and treating runoff before discharge to other SuDS components, they protect downstream water quality and can indirectly support biodiversity by maintaining cleaner flows to connected green-blue infrastructure.	✓	
Underground Attenuation Tanks / Geocellular Storage / Oversized Pipes	Underground attenuation tanks and geocellular storage systems provide essential runoff control while preserving the use and appearance of surface areas. By locating storage below ground, they enable land above to be used for landscaping, parking, or recreation, supporting efficient land use and maintaining overall site amenity.	These systems offer limited direct biodiversity value but can contribute indirectly by facilitating above-ground green spaces and protecting downstream SuDS features. When designed with pre-treatment measures, they assist in pollutant removal, improving water quality prior to discharge and supporting the performance of connected ecological SuDS components.	X	Underground attenuation storage is not proposed, as alternative SuDS features have been selected that provide sufficient on-site attenuation while offering additional water quality, amenity, and biodiversity benefits.

3.7 Attenuation Storage

Extreme Rainfall

3.7.1 Attenuation storage will be required to manage surface water runoff from the positively drained hardstanding surfaces and achieve the controlled discharge rates set out below. A combination of SuDS features, and flow control devices is proposed to manage surface water runoff at Lime Down E1.

3.7.2 The hardstanding surfaces requiring positive drainage have been identified using either the indicative area of the infrastructure proposed at Lime Down E1, or, where the final equipment layout is not fixed, the relevant maximum design parameters for that equipment set out in **ES Volume 1, Chapter 3: The Scheme [APP-055]**. The calculations are therefore conservative and are provided for illustrative purposes to demonstrate that a feasible drainage solution can be accommodated within Lime Down E1 and within the assessed design envelope.

3.7.3 Greenfield runoff rates have been calculated for each assessed hardstanding surface. The proposed discharge rates have then been restricted in accordance with the LLFA drainage requirement, with attenuation storage sized to manage runoff up to and including the 1% AEP plus 45% climate change event.

3.7.4 The larger hardstanding surfaces, including the 132kV Substation Area and associated access track where conservatively assessed as hardstanding surfaces, will be collected and conveyed to formal attenuation and flow control features prior to discharge at the restricted rate.

3.7.5 The Conversion Units / 33kV Sub-distribution Switch Rooms comprise small, discrete areas of supporting electrical infrastructure. Switchgear comprises electrical disconnect switches, fuses and circuit breakers used to control, protect and isolate electrical equipment. For the purposes of this assessment, runoff calculations have been based on the maximum 15m by 5m footprint for Integrated Conversion Units / 33kV Sub-distribution Switch Rooms defined in **ES Volume 1, Chapter 3: The Scheme [APP-055]**, equivalent to 75m^2 per unit. This provides a conservative basis for assessment.

3.7.6 For an individual 75m^2 unit, the indicative local storage volume is approximately 6.2m^3. Across Lime Down E1, three Conversion Units / 33kV Sub-distribution Switch Rooms are proposed, giving a cumulative assessed area of 225m^2 and a cumulative indicative local storage requirement of approximately 18.6m^3. The calculated greenfield runoff rates for the combined Conversion Unit / 33kV Sub-distribution Switch Room area are 0.1l/s for the 1 in 2 year event, 0.3l/s for the 1 in 30 year event and 0.3l/s for the 1 in 100 year event. Runoff from each unit will be managed locally through source-control SuDS, with final flow controls confirmed at detailed design.

3.7.7 Given the small contributing area, low calculated runoff volumes and dispersed nature of the infrastructure, it is not considered proportionate to provide long piped drainage connections from each unit to a formal outfall. Runoff from each unit will therefore be managed locally using a perimeter French drain, filter drain or equivalent source-control SuDS arrangement. These features will provide local storage and source control around the equipment pads and will not be relied upon as strategic attenuation basins or as part of a wider piped drainage network.

3.7.8 Final dimensions, aggregate specification, freeboard and maintenance requirements for the French drains will be confirmed at detailed design, having regard to the final equipment layout and local ground conditions. This approach is consistent with the drainage hierarchy and source control principles set out in CIRIA C753: The SuDS Manual, and avoids creating unnecessary point discharges from small, isolated areas of supporting electrical infrastructure.

3.7.9 Hydraulic calculations carried out in Causeway Flow demonstrate that the illustrative drainage approach has sufficient capacity to manage runoff from the assessed hardstanding surfaces up to and including the 1% AEP plus 45% climate change event. Key details for the proposed attenuation storage and flow control required to manage surface water runoff are summarised in the tables below. Hydraulic calculations are provided in Annex D.

Table 4: 132kV Substation Area Attenuation Storage

Contributing Area	9,000m^2
Flow Rate	3.8l/s
Flow Control	HydroBrake
Flow Control Design Head	1.0m
Estimated Required Volume (1 in 100 year +45%CC)	954.7m^3

Table 5: 132kV Access Tracks Attenuation Storage

Contributing area	8,310m^2
Flow Rate	3.5l/s
Flow Control	HydroBrake
Flow Control Design Head	0.75m
Estimated Required Volume (1 in 100 year +45%CC)	880.3m^3

Table 6: Conversion Unit/33kV Distribution Switch Room Attenuation Storage

Contributing Area	75m^2 (per unit)
Flow Rate	0.1l/s
Flow Control	HydroBrake
Flow Control Design Head	0.75m
Estimated Required Volume (1 in 100 year +45%CC)	6.2m^3 (per unit)

Everyday Rainfall

3.7.10 In addition to managing extreme rainfall events, measures should be implemented to ensure runoff generated during more frequent everyday rainfall events is sustainably managed. For these events, where practicable, the volume of runoff generated from the first 5mm of rainfall should not leave the Site.

Table 7: 132kV Substation Area Everyday Rainfall*

Contributing Area	9,000m^2
Rainfall Depth	0.005m
Runoff Volume	45.0m^3
Required Additional Depth	0.05m

Table 8: 132kV Access Tracks Everyday Rainfall*

Contributing Area	8,310m^2
Rainfall Depth	0.005m
Runoff Volume	41.55m^3
Required Additional Depth	0.04m

Table 9: Conversion Unit/33kV Distribution Switch Room Everyday Rainfall*

Contributing Area	75m^2
Rainfall Depth	0.005m
Runoff Volume	0.4m^3
Required Additional Depth	0.02m

**The calculations above assume that the storage is provided within a basin for the purposes of illustration. The final form of storage may differ depending on the detailed layout and may include other SuDS components capable of providing equivalent storage and treatment.*

3.7.11 As shown in the tables above, the everyday rainfall volumes are limited and can be accommodated within the preferred SuDS features by providing the required additional storage depth. This allows the first 5mm of rainfall to be retained and managed within the drainage system, through infiltration where local ground conditions permit, evaporation, evapotranspiration, or subsequent controlled release depending on the final SuDS arrangement.

3.8 Preferred Drainage Scheme

3.8.1 The viable SuDS features and associated hydraulic calculations have been reviewed above. The final extent and arrangement of hardstanding surfaces will be confirmed at detailed design; however, the calculations presented in this report have been prepared using the indicative infrastructure areas currently proposed, or the maximum relevant design parameters set out in **ES Volume 1, Chapter 3: The Scheme [APP-055]** where the final equipment layout is not fixed. The calculations are therefore conservative and are provided to demonstrate that a feasible drainage solution can be accommodated within Lime Down E1 and within the assessed design envelope.

3.8.2 Greenfield runoff rates have been calculated for the assessed hardstanding surfaces and the proposed discharge rates have been restricted in accordance with the LLFA drainage requirement. The identified receiving watercourse is Gabriel's Well located approximately 200m south of Lime Down E1, with the indicative cumulative controlled discharge rates provided within Tables 4, 5 and 6. The proposed SuDS features will attenuate surface water runoff from the positively drained hardstanding surfaces up to and including the 1% AEP plus 45% climate change event. The final drainage design will confirm the detailed layout, attenuation volumes, flow controls, outfall arrangement, treatment train, isolation measures and maintenance requirements, and will ensure that peak runoff from positively drained hardstanding surfaces are controlled so that the Scheme does not result in a material increase in flood risk on-site or elsewhere.

3.9 Event Exceedance

3.9.1 The illustrative SuDS approach has been sized to manage surface water runoff from the positively drained hardstanding surfaces up to and including the 1% AEP plus 45% climate change event. Storm events in excess of this design event may result in temporary shallow exceedance flooding within lower-risk areas of Lime Down E1.

3.9.2 Finished levels for sensitive electrical infrastructure and equipment plinths will be set above surrounding ground levels where practicable. Exceedance routes will be confirmed at detailed design and will direct residual flows away from critical equipment, buildings and access points where practicable, so that exceedance flooding does not result in a material increase in flood risk on-site or elsewhere.

3.10 Surface Water Treatment

3.10.1 In accordance with DEFRA's National standards for sustainable drainage systems and the Simple Index Approach as described in C753 The SuDS Manual (2015), other roofs have a 'low' pollution hazard level, with commercial yards classified as having a 'medium' pollution hazard level. The table below shows the pollution hazard indices for each land use.

Table 10: Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Other Roofs (typically commercial/industrial roofs)	Low	0.5	0.2**	0.4
Commercial Yard and Delivery Areas, Non-residential Car Parking and all roads except Low Traffic Roads	Medium	0.7	0.6	0.7

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' – Table 26.2

* Indices values range from 0-1.

** up to 0.8 where there is potential for metals to leach from the roof

3.10.2 Runoff from positively drained hardstanding surfaces will be routed through an appropriate SuDS treatment train before controlled discharge. Table 11 below demonstrates the mitigation indices for typical SuDS components that may be used within the final drainage design.

Table 11: SuDS Mitigation Indices

	Mitigation Indices		
Type of SuDS	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Permeable Surfacing	0.7	0.6	0.7
Swale	0.5	0.6	0.6
Detention basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' -Table 26.3

3.10.3 It is concluded that a suitable combination of SuDS components, such as detention basins, ponds, swales, lined permeable surfacing and/or filter drains, can provide sufficient treatment for the assessed pollution hazard indices. The final treatment train will be confirmed at detailed design and will be coordinated with the required attenuation, isolation and maintenance arrangements.

3.11 Firewater Consideration

3.11.1 The firewater containment and pollution control principles apply to the 132kV Substation drainage at Lime Down E1. Detailed design will identify the appropriate containment, isolation and treatment measures for the substation compound, in accordance with the principles set out in **Firewater Containment and Drainage Strategy – Lime Down Substation [REP3-120].**

3.11.2 The principal potential pathway for contaminated firewater or polluted runoff from the 132kV Substation Area would be through the proposed surface water drainage system. The drainage system will therefore be designed so that it can be isolated in the event of a pollution incident or firewater containment scenario. Where required, this will include lined drainage components, controlled outfalls and shut-off valves to prevent uncontrolled discharge to ground or surface water receptors.

3.11.3 In the event of a fire or pollution incident, the relevant outfall valve would be closed and retained water would be held within the drainage system. The retained water would then be sampled and tested to determine the appropriate disposal route. Depending on the results, this may comprise treatment and controlled discharge subject to the relevant approval, or removal from Site by tanker.

3.11.4 The detailed containment volume, valve arrangement, testing procedure, treatment requirements and maintenance regime will be confirmed through detailed design and will be consistent with the substation firewater containment strategy.

3.11.5 This does not alter the outline drainage assessment, which demonstrates that normal operational surface water runoff can be managed without increasing flood risk

3.12 Maintenance

3.12.1 Routine inspections and maintenance of the surface water drainage system is required to ensure that the drainage infrastructure continues to operate effectively for the lifetime of the development, without increasing flood risk on or off site.

3.12.2 Maintenance of surface water drainage features will be the responsibility of the undertaker or operator. Maintenance of the operational drainage system will be carried out in accordance with the final drainage design and the principles set out in **Outline Operational Environmental Management Plan [REP3-094]**. Firewater-related inspection, testing and maintenance requirements for the 132kV Substation drainage system will be confirmed in accordance with **Firewater Containment and Drainage Strategy – Lime Down Substation [REP3-120].**

3.12.3 The final maintenance arrangements will be confirmed at detailed design and will reflect the final drainage components, flow controls, treatment measures, isolation valves and outfall arrangements.

~~3.~~4. Conclusions and Recommendations

~~3.1.1~~4.1.1 Lime Down E1 ~~is for a~~comprises ground mounted Solar ~~farm and~~ PV Panels, one 132kV Substation, associated access track and supporting electrical infrastructure ~~and access~~.

Flood Risk

~~3.1.2~~4.1.2 Lime Down E1 is situated almost wholly within Flood Zone 1 with the exception of the northernmost extent of Field E4 which is located in Flood Zone 2. The extent of Flood Zone 2 is considered to be associated with a tributary of Gauze Brook (which flows in a north-easterly direction) and does not encroach into the area proposed for Scheme.

~~3.1.3~~4.1.3 The majority of Lime Down E1 is at Very Low risk of surface water flooding; however, there are some small areas of Very Low to High risk particularly at Fields E1 – E4 and a small section in the southernmost extent of Field E6. The areas of risk in Fields E2 – E4 are associated with the presence of the tributary of Gauze Brook. Other areas of risk across Lime Down E1 are associated with topographic depressions within the Fields and ponding along the railway line to the south.

~~3.1.4~~4.1.4 The risk of flooding from all sources has been assessed and the flood risk is considered to be **Negligible to Low** and therefore does not require site-specific mitigation measures.

~~3.1.5 The Solar PV Panels and other electrical infrastructure, such as inverters, transformers, cabling and substation which is to be sat on a concrete foundation/pad that will be mounted on frames and raised above ground level allowing flood water to flow freely underneath. Therefore, there will be no loss of floodplain volume as a result of the Scheme.~~

4.1.5 Solar PV Panels are raised above ground level and do not form a connected impermeable drainage catchment. The proposed 132kV Substation is located in Flood Zone 1 and will be subject to a controlled drainage strategy. Where smaller electrical infrastructure is located in areas of mapped surface water interaction, it will be elevated or provided with appropriate local resilience measures in accordance with the embedded mitigation set out in the Covering Report.

Drainage Strategy

4.1.6 Solar PV panelled areas are not treated as formal impermeable drainage catchments within this Outline Drainage Strategy. The panels are elevated above ground level, drain to the existing ground, are not sealed into a drainage network, and do not create a connected impermeable surface.

4.1.7 Greenfield runoff rates have been calculated for the assessed hardstanding surfaces and the proposed discharge rates have been restricted in accordance with the LLFA drainage requirement. The identified receiving watercourse is Gabriel's Well approximately 200m south of Lime Down E1, with the indicative cumulative controlled discharge rates provided within Tables 4, 5 and 6. The proposed SuDS features will attenuate surface water runoff from the positively drained hardstanding surfaces up to and including the 1% AEP plus 45% climate change event. In addition, the everyday rainfall volumes are limited and can be accommodated within the preferred SuDS features by providing the required additional storage depth.

4.1.8 It is concluded that a suitable combination of SuDS components, such as detention basins, ponds, swales, lined permeable surfacing and/or filter drains, can provide sufficient treatment for the assessed pollution hazard indices.

4.1.9 In the event of a firewater incident, the drainage system will be designed so that it can be isolated in the event of a pollution incident or firewater containment scenario.

~~3.2~~4.2 Recommendations

~~3.2.1~~4.2.1 Embedded mitigation is detailed in **ES Volume 3, Appendix 11-1: Flood Risk Assessment and Outline Drainage Strategy – Covering Report [~~EN010168/APP/6.3],~~REP3-039]**. The final drainage design for the 132kV Substation, associated access track and supporting electrical infrastructure will be submitted and approved in ~~which this FRA has informed~~accordance with the relevant DCO drainage requirement.

Annexes

Annex A- Water Body Catchment Classifications Summaries

Classification Item	2019 Classification		2022 Classification	Cycle 3 Objectives		
	Cycle 2	Cycle 3	Cycle 3	Status	Year	Reasons
Ecological	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Biological Quality Elements	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Invertebrates	Moderate	Moderate	Moderate	Good	2015	
Macrophytes and Phytobenthos Combined	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Macrophytes sub element	Moderate	Moderate	Moderate			
Physio-Chemical Quality Elements	High	High	High	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Ammonia (Phys-Chem)	High	High	High	Good	2015	
Dissolved Oxygen	High	High	High	Good	2015	
Phosphate	High	High	High	Good	2015	Disproportionately expensive: Disproportionate burdens
Temperature	High	High	High	Good	2015	
pH	High	High	High	Good	2015	
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good	2015	
Hydrological Regime	Supports Good	Supports Good	Supports Good		2015	
Specific Pollutants				N/A	2015	
Copper						
Triclosan						
Zinc						
Chemical	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Priority Hazardous Substances	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene	Good	Good		Good	2015	
Cadium and Its Compounds						
Di(2-ethylhexyl)phthalate (Priority hazardous)						
Dioxins and dioxin-like compounds	Good	Good		Good	2015	
Heptachlor and cis-Heptachlor Epoxide	Good	Good		Good	2015	
Hexabromocyclododecane	Good	Good		Good	2015	
Hexachlorobenzene	Good	Good		Good	2015	
Hexachlorobutadiene	Good	Good		Good	2015	
Mercury and Its Compounds	Fail	Fail		Good	2040	Natural conditions: Chemical status recovery time
Nonylphenol						
Perfluorooctane sulphonate (PFOS)	Good	Good		Good	2015	
Polybrominated diphenyl ethers (PBDE)	Fail	Fail		Good	2063	Natural conditions: Chemical status recovery time
Tributyltin Compounds						
Priority substances	Good	Good	N/A	Good	2015	
Cypermethrin (Priority)	Good	Good		Good	2015	
Fluoranthene	Good	Good		Good	2015	
Lead and Its Compounds						
Nickel and Its Compounds						
Other Pollutants	N/A	N/A	N/A	N/A	2015	Did not require assessment

Rodbourne Bk – source to conf R Avon (Brist) Water Body Catchment Classification Summary

Classification Item	2019 Classification		2022 Classification	Cycle 3 Objectives		
	Cycle 2	Cycle 3	Cycle 3	Status	Year	Reasons
Ecological	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Biological Quality Elements	High	High	Good	Good	2015	
Invertebrates	High	High	High	Good	2015	
Macrophytes and Phytobenthos Combined	High	High	Good	Good	2015	
Macrophytes sub element	High	High	Good	Good		
Physio-Chemical Quality Elements	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Acid Neutralising Capacity						
Ammonia (Phys-Chem)	High	High	High	Good	2015	
Dissolved Oxygen	Poor	Poor	Poor	Good	2015	
Phosphate	Poor	Poor	Poor	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Temperature	High	High	High	Good	2015	
pH	High	High	High	Good	2015	
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good	2015	
Hydrological Regime	Does not support good	Does not support good	Supports Good	Does not support good		Disproportionately expensive: Unfavourable balance of costs and benefits
Morphology	Supports Good	Supports Good	Supports Good			
Supporting Elements (surface Water)				N/A	2015	
Specific Pollutants				N/A	2015	
Copper						
Triclosan						
Zinc						
Iron						
Maganese						
Chemical	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Priority Hazardous Substances	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene	Good	Good		Good	2015	
Cadium and Its Compounds						
Dioxins and dioxin-like compounds	Good	Good		Good	2015	
Heptachlor and cis-Heptachlor Epoxide	Good	Good		Good	2015	
Hexabromocyclododecane	Good	Good		Good	2015	
Hexachlorobenzene	Good	Good		Good	2015	
Hexachlorobutadiene	Good	Good		Good	2015	
Mercury and Its Compounds	Fail	Fail		Good	2040	Natural conditions: Chemical status recovery time
Nonylphenol						
Perfluorooctane sulphonate (PFOS)	Good	Good		Good	2015	
Polybrominated diphenyl ethers (PBDE)	Fail	Fail		Good	2063	Natural conditions: Chemical status recovery time
Priority substances	Good	Good	N/A	Good	2015	
Cypermethrin (Priority)	Good	Good	N/A	Good	2015	
Fluoranthene	Good	Good	N/A	Good	2015	
Lead and Its Compunds						
Nickel and Its Compunds						
Other Pollutants	N/A	N/A	N/A	N/A	2015	Did not require assessment

Classification Item	2019 Classification		2022 Classification	Cycle 3 Objectives		
	Cycle 2	Cycle 3	Cycle 3	Status	Year	Reasons
Ecological	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Biological Quality Elements	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Invertebrates	Moderate	Moderate	Moderate	Good	2015	
Macrophytes and Phytobenthos Combined	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Macrophytes sub element	Moderate	Moderate	Moderate			
Physio-Chemical Quality Elements	High	High	High	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Ammonia (Phys-Chem)	High	High	High	Good	2015	
Dissolved Oxygen	High	High	High	Good	2015	
Phosphate	High	High	High	Good	2015	Disproportionately expensive: Disproportionate burdens
Temperature	High	High	High	Good	2015	
pH	High	High	High	Good	2015	
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good	2015	
Hydrological Regime	Supports Good	Supports Good	Supports Good		2015	
Specific Pollutants				N/A	2015	
Copper						
Triclosan						
Zinc						
Chemical	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Priority Hazardous Substances	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene	Good	Good		Good	2015	
Cadium and Its Compounds						
Di(2-ethylhexyl)phthalate (Priority hazardous)						
Dioxins and dioxin-like compounds	Good	Good		Good	2015	
Heptachlor and cis-Heptachlor Epoxide	Good	Good		Good	2015	
Hexabromocyclododecane	Good	Good		Good	2015	
Hexachlorobenzene	Good	Good		Good	2015	
Hexachlorobutadiene	Good	Good		Good	2015	
Mercury and Its Compounds	Fail	Fail		Good	2040	Natural conditions: Chemical status recovery time
Nonylphenol						
Perfluorooctane sulphonate (PFOS)	Good	Good		Good	2015	
Polybrominated diphenyl ethers (PBDE)	Fail	Fail		Good	2063	Natural conditions: Chemical status recovery time
Tributyltin Compounds						
Priority substances	Good	Good	N/A	Good	2015	
Cypermethrin (Priority)	Good	Good		Good	2015	
Fluoranthene	Good	Good		Good	2015	
Lead and Its Compounds						
Nickel and Its Compounds						
Other Pollutants	N/A	N/A	N/A	N/A	2015	Did not require assessment

Gauze Brook - source to conf R Avon (Brist) Water Body Catchment Classification Summary

Gauze Brook - source to conf R Avon (Brist) Water Body Catchment Classification Summary

Classification Item	2019 Classification		2022 Classification	Cycle 3 Objectives		
	Cycle 2	Cycle 3	Cycle 3	Status	Year	Reasons
Ecological	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Biological Quality Elements	High	High	Good	Good	2015	
Invertebrates	High	High	High	Good	2015	
Macrophytes and Phytobenthos Combined	High	High	Good	Good	2015	
Macrophytes sub element	High	High	Good	Good		
Physio-Chemical Quality Elements	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Acid Neutralising Capacity						
Ammonia (Phys-Chem)	High	High	High	Good	2015	
Dissolved Oxygen	Poor	Poor	Poor	Good	2015	
Phosphate	Poor	Poor	Poor	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Temperature	High	High	High	Good	2015	
pH	High	High	High	Good	2015	
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good	2015	
Hydrological Regime	Does not support good	Does not support good	Supports Good	Does not support good		Disproportionately expensive: Unfavourable balance of costs and benefits
Morphology	Supports Good	Supports Good	Supports Good			
Supporting Elements (surface Water)				N/A	2015	
Specific Pollutants				N/A	2015	
Copper						
Triclosan						
Zinc						
Iron						
Maganese						
Chemical	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Priority Hazardous Substances	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene	Good	Good		Good	2015	
Cadium and Its Compounds						
Dioxins and dioxin-like compounds	Good	Good		Good	2015	
Heptachlor and cis-Heptachlor Epoxide	Good	Good		Good	2015	
Hexabromocyclododecane	Good	Good		Good	2015	
Hexachlorobenzene	Good	Good		Good	2015	
Hexachlorobutadiene	Good	Good		Good	2015	
Mercury and Its Compounds	Fail	Fail		Good	2040	Natural conditions: Chemical status recovery time
Nonylphenol						
Perfluorooctane sulphonate (PFOS)	Good	Good		Good	2015	
Polybrominated diphenyl ethers (PBDE)	Fail	Fail		Good	2063	Natural conditions: Chemical status recovery time
Priority substances	Good	Good	N/A	Good	2015	
Cypermethrin (Priority)	Good	Good	N/A	Good	2015	
Fluoranthene	Good	Good	N/A	Good	2015	
Lead and Its Compunds						
Nickel and Its Compunds						
Other Pollutants	N/A	N/A	N/A	N/A	2015	Did not require assessment

Annex B – Manning's Open Channel Flow Mapping

317212 Lime Down Solar E1

Manning's Open Channel Flow Calculation

Methodology

Cross-sections through the floodplain were extracted from Environment Agency (EA) LiDAR DTM data (flown March 2020) at the locations shown in Figure 1. These cross-sections can be considered representative of the channel and general floodplain adjacent to the site and at the location of the proposed development. The cross-sections were imported into Flood Modeller and the "tabulate cross section properties" tool was utilised to establish the level-flow relationship for the channel and wider floodplain. This tool utilises the Manning's open channel flow equation. Manning's 'n' roughness was set to $0.03s/m^{1/3}$ for the channel and $0.04s/m^{1/3}$ for the floodplain. These values were chosen based on Chow (1959)* and aerial imagery. The channel slope was set for each cross-section based on underlying LiDAR.

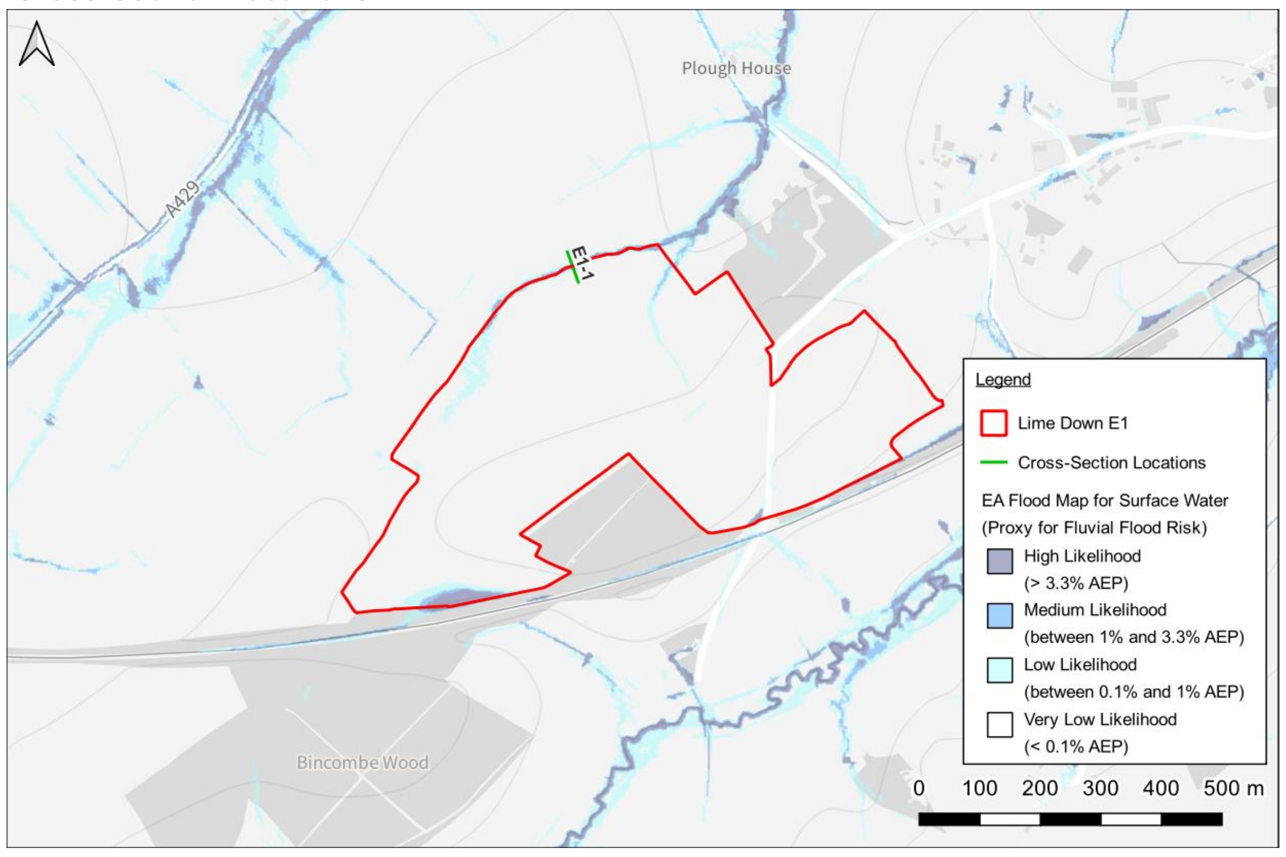
In the absence of detailed flood extent data covering the site, the extents of the EA surface water flood map (0.1% AEP event, present day) have been compared to underlying LiDAR data to provide an estimate of water levels. The surface water flood map has been used as a proxy for fluvial flooding given the similarity to the EA Flood Zone 2 extent and the additional detail it affords. The EA has since released the NaFRA2 mapping, however, a review of the flood extents indicates they are smaller across much of the study area. As such, the calculations presented here can be considered conservative.

Within this excel workbook, the xlookup function has been used along with the Flood Modeller level-flow relationship for the cross-sections to determine the equivalent flow for each estimated water level, rounding up where a direct match is not found. The appropriate climate change uplifts have then been applied to these flows and a second xlookup used to determine the equivalent level for the increased flow.

Cross-sections have been located at suitable locations throughtout the proposed development. Whilst it is acknowledged that the Manning's open channel flow equation used to determine the level-flow relationship does not constitute detailed hydraulic modelling, the calculation can still be considered suitable to demonstrate the scale of the changes in water level that can be expected when considering a +71% uplift in flows (Avon Bristol and North Somerset Streams Management Catchment, 2080's higher allowance).

*Chow, V.T. (1959). Open-Channel Hydraulics. New York, NY: McGraw-Hill.

Cross-Section Locations



Calculated Flows and Levels

Cross-Section	Level Description	Estimated Flood Level (m AOD)	Estimated Equivalent Flow (m^3/s)	Flow +71% CC Uplift (m^3/s)	Equivalent Flood Level (m AOD)
E1-1	0.1% AEP EA FMfSW water level	81.75	10.2	17.4	81.90 (+146mm)

Tabulated Cross-Section Properties // E1-1

(Calculated by Flood Modeller)

Node	Flow (m^3/s)	Stage (m AOD)	Depth (m)	Velocity (m/s)	Froude no.	Area (m^2)	Conveyance (m^3/s)	Width (m)	W Perim. (m)	Slope
E1-1	0.000	80.751	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0155
E1-1	0.001	80.785	0.034	0.200	0.491	0.004	0.007	0.255	0.265	0.0155
E1-1	0.006	80.819	0.068	0.318	0.551	0.017	0.044	0.510	0.531	0.0155
E1-1	0.016	80.853	0.102	0.417	0.589	0.039	0.131	0.765	0.796	0.0155
E1-1	0.035	80.887	0.136	0.505	0.618	0.069	0.281	1.020	1.062	0.0155
E1-1	0.063	80.921	0.170	0.586	0.642	0.108	0.510	1.275	1.327	0.0155
E1-1	0.103	80.955	0.204	0.662	0.661	0.156	0.829	1.530	1.592	0.0155
E1-1	0.152	80.987	0.236	0.732	0.678	0.208	1.225	1.754	1.827	0.0155
E1-1	0.214	81.019	0.268	0.798	0.693	0.268	1.717	1.979	2.062	0.0155
E1-1	0.288	81.051	0.300	0.862	0.706	0.334	2.314	2.203	2.296	0.0155
E1-1	0.376	81.082	0.331	0.922	0.718	0.408	3.023	2.428	2.531	0.0155
E1-1	0.480	81.114	0.363	0.981	0.729	0.489	3.852	2.652	2.766	0.0155
E1-1	0.599	81.146	0.395	1.037	0.739	0.577	4.808	2.877	3.000	0.0155
E1-1	0.734	81.178	0.427	1.092	0.749	0.672	5.898	3.101	3.235	0.0155
E1-1	0.870	81.205	0.454	1.147	0.758	0.758	6.985	3.244	3.387	0.0155
E1-1	1.017	81.232	0.481	1.200	0.766	0.848	8.170	3.386	3.540	0.0155
E1-1	1.187	81.263	0.512	1.243	0.773	0.955	9.536	3.623	3.785	0.0155
E1-1	1.376	81.293	0.542	1.286	0.780	1.070	11.052	3.860	4.030	0.0155
E1-1	1.584	81.324	0.573	1.329	0.786	1.192	12.724	4.097	4.275	0.0155
E1-1	1.812	81.355	0.604	1.371	0.793	1.322	14.558	4.334	4.521	0.0155
E1-1	2.062	81.386	0.635	1.414	0.799	1.459	16.560	4.571	4.766	0.0155
E1-1	2.333	81.416	0.665	1.456	0.805	1.603	18.737	4.808	5.011	0.0155
E1-1	2.626	81.447	0.696	1.497	0.811	1.754	21.095	5.045	5.256	0.0155
E1-1	2.780	81.462	0.711	1.507	0.943	1.845	22.333	7.083	7.298	0.0155
E1-1	2.831	81.466	0.715	1.511	0.953	1.874	22.736	7.321	7.537	0.0155
E1-1	3.226	81.495	0.744	1.542	0.945	2.092	25.910	7.706	7.928	0.0155
E1-1	3.496	81.513	0.762	1.562	0.974	2.238	28.077	8.527	8.753	0.0155
E1-1	3.787	81.531	0.780	1.579	0.995	2.399	30.416	9.348	9.579	0.0155
E1-1	4.149	81.550	0.799	1.599	1.062	2.594	33.324	11.230	11.464	0.0155
E1-1	4.593	81.571	0.820	1.620	1.052	2.835	36.895	11.714	11.949	0.0155
E1-1	4.772	81.579	0.828	1.629	1.050	2.930	38.330	11.946	12.182	0.0155
E1-1	5.360	81.604	0.853	1.651	1.072	3.247	43.054	13.427	13.664	0.0155
E1-1	6.263	81.637	0.886	1.690	1.063	3.705	50.307	14.367	14.606	0.0155
E1-1	7.065	81.663	0.912	1.724	1.061	4.097	56.745	15.228	15.469	0.0155
E1-1	7.946	81.690	0.939	1.761	1.062	4.512	63.826	16.089	16.332	0.0155
E1-1	8.017	81.692	0.941	1.764	1.062	4.545	64.391	16.149	16.392	0.0155
E1-1	8.684	81.711	0.960	1.787	1.068	4.860	69.750	17.026	17.270	0.0155

Node	Flow (m^3/s)	Stage (m AOD)	Depth (m)	Velocity (m/s)	Froude no.	Area (m^2)	Conveyance (m^3/s)	Width (m)	W Perim. (m)	Slope
E1-1	9.398	81.730	0.979	1.810	1.073	5.192	75.483	17.903	18.148	0.0155
E1-1	10.164	81.750	0.999	1.827	1.085	5.563	81.639	19.238	19.484	0.0155
E1-1	10.244	81.752	1.001	1.829	1.086	5.602	82.282	19.373	19.619	0.0155
E1-1	11.077	81.771	1.020	1.853	1.088	5.978	88.969	20.235	20.482	0.0155
E1-1	11.962	81.790	1.039	1.878	1.091	6.371	96.080	21.097	21.345	0.0155
E1-1	12.010	81.791	1.040	1.879	1.132	6.393	96.467	22.753	23.001	0.0155
E1-1	12.058	81.792	1.041	1.880	1.146	6.416	96.855	23.380	23.628	0.0155
E1-1	12.639	81.808	1.057	1.859	1.125	6.798	101.523	24.393	24.641	0.0155
E1-1	13.007	81.815	1.064	1.866	1.125	6.970	104.475	24.845	25.094	0.0155
E1-1	14.360	81.839	1.088	1.898	1.120	7.566	115.342	25.828	26.078	0.0155
E1-1	15.814	81.862	1.111	1.932	1.117	8.184	127.019	26.811	27.062	0.0155
E1-1	15.938	81.864	1.113	1.935	1.116	8.238	128.021	26.910	27.161	0.0155
E1-1	17.990	81.896	1.145	1.970	1.119	9.130	144.499	28.865	29.117	0.0155
E1-1	18.347	81.901	1.150	1.978	1.118	9.275	147.367	29.069	29.321	0.0155
E1-1	20.322	81.926	1.175	2.028	1.116	10.020	163.231	29.758	30.013	0.0155
E1-1	22.421	81.952	1.201	2.079	1.116	10.783	180.090	30.448	30.704	0.0155
E1-1	24.642	81.977	1.226	2.131	1.117	11.563	197.933	31.137	31.395	0.0155
E1-1	24.730	81.978	1.227	2.133	1.117	11.594	198.640	31.172	31.430	0.0155
E1-1	26.783	82.001	1.250	2.171	1.120	12.339	215.127	32.204	32.463	0.0155
E1-1	28.951	82.025	1.274	2.209	1.123	13.108	232.538	33.237	33.497	0.0155
E1-1	29.217	82.028	1.277	2.212	1.123	13.208	234.680	33.415	33.675	0.0155
E1-1	31.513	82.053	1.302	2.241	1.128	14.062	253.119	34.945	35.206	0.0155
E1-1	33.801	82.075	1.324	2.277	1.131	14.842	271.499	35.921	36.182	0.0155
E1-1	36.742	82.103	1.352	2.315	1.136	15.869	295.122	37.492	37.755	0.0155
E1-1	37.078	82.106	1.355	2.320	1.137	15.982	297.819	37.641	37.904	0.0155
E1-1	40.799	82.138	1.387	2.370	1.142	17.211	327.709	39.193	39.458	0.0155
E1-1	42.962	82.156	1.405	2.400	1.145	17.904	345.078	39.991	40.257	0.0155
E1-1	45.197	82.173	1.422	2.429	1.148	18.611	363.032	40.789	41.056	0.0155
E1-1	45.422	82.175	1.424	2.430	1.148	18.693	364.841	40.954	41.220	0.0155
E1-1	46.762	82.189	1.438	2.426	1.151	19.278	375.601	42.609	42.876	0.0155
E1-1	47.691	82.196	1.445	2.436	1.152	19.577	383.063	42.967	43.234	0.0155
E1-1	51.506	82.220	1.469	2.497	1.155	20.627	413.703	43.325	43.593	0.0155
E1-1	55.471	82.245	1.494	2.558	1.159	21.686	445.551	43.684	43.952	0.0155
E1-1	59.582	82.269	1.518	2.619	1.163	22.753	478.577	44.042	44.311	0.0155
E1-1	61.654	82.284	1.533	2.632	1.166	23.422	495.221	45.116	45.385	0.0155
E1-1	64.978	82.305	1.554	2.665	1.171	24.381	521.916	46.190	46.460	0.0155
E1-1	66.281	82.315	1.564	2.667	1.175	24.848	532.382	47.264	47.534	0.0155
E1-1	71.982	82.346	1.595	2.734	1.181	26.328	578.173	48.215	48.486	0.0155
E1-1	72.737	82.350	1.599	2.742	1.196	26.523	584.237	49.520	49.791	0.0155
E1-1	75.581	82.368	1.617	2.757	1.189	27.419	607.080	50.004	50.274	0.0155
E1-1	79.224	82.386	1.635	2.797	1.192	28.323	636.342	50.487	50.758	0.0155
E1-1	84.515	82.411	1.660	2.856	1.197	29.592	678.839	51.024	51.296	0.0155
E1-1	89.980	82.436	1.685	2.914	1.202	30.874	722.739	51.561	51.833	0.0155
E1-1	97.456	82.470	1.719	2.985	1.210	32.646	782.785	52.635	52.908	0.0155
E1-1	97.921	82.475	1.724	2.975	1.214	32.912	786.520	53.709	53.982	0.0155

Annex C – Greenfield Calculations

Greenfield runoff rate estimation tool

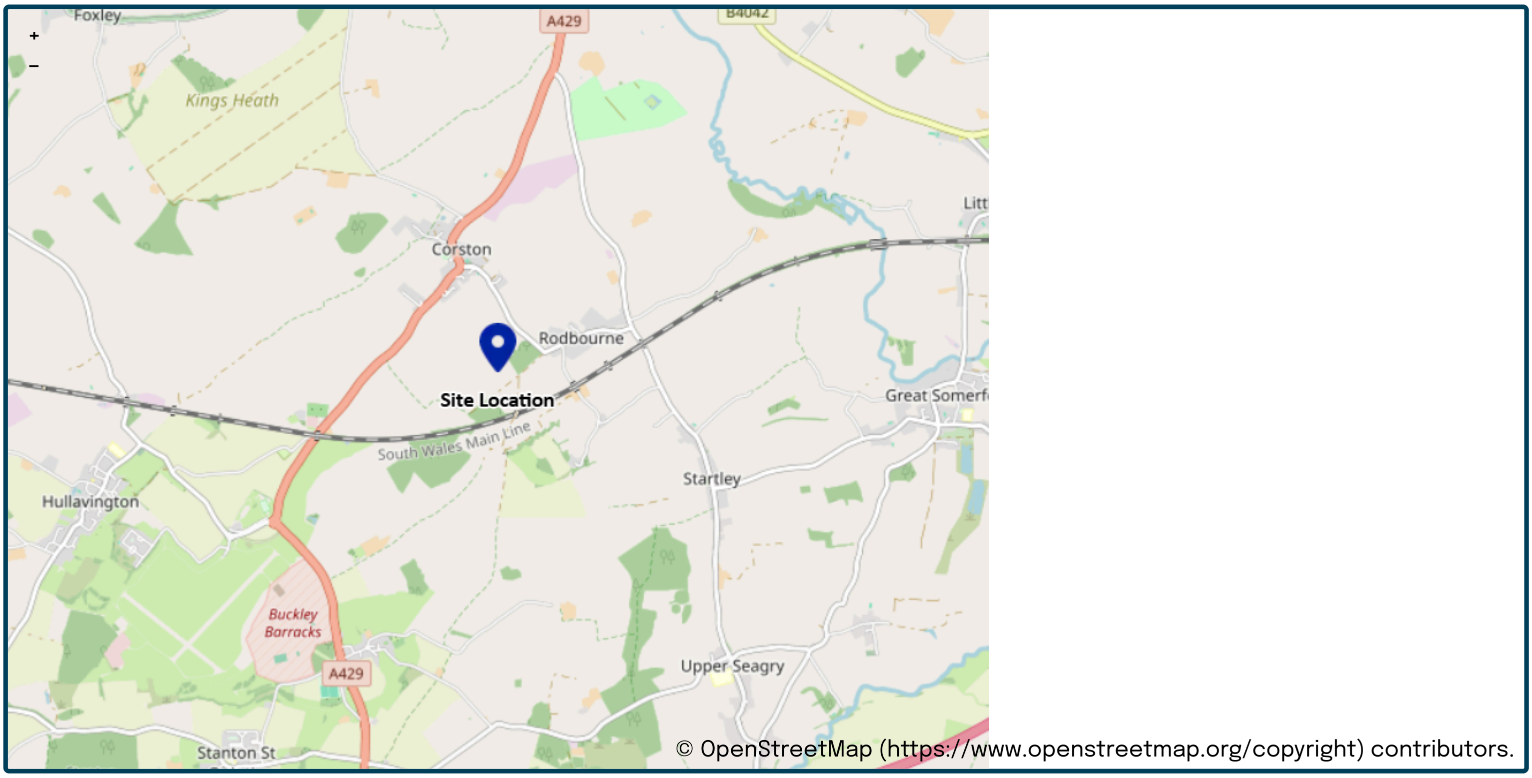
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance “Rainfall runoff management for developments”, SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

Project details

Date	23/06/2026
Calculated by	GH
Reference	317212
Model version	2.2.3

Location

Site name	Lime Down E1
Site location	



Site easting (British National Grid)	392796
Site northing (British National Grid)	182915

Site details

Total site area (ha)	0.9	ha

Greenfield runoff

Method

Method	FEH statistical (2025)

FEH statistical (2025)

	My value		Map value
SAAR9120 (mm)	821 mm		
BFIHOST19scaled	0.352		
QMed-QBar conversion	1.075		1.075
QMed (l/s)	5.4 l/s		
QBar (FEH statistical 2025) (l/s)	5.8 l/s		

Growth curve factors

	My value		Map value
Hydrological region	8		8
1 year growth factor	0.78		
2 year growth factor	0.93		
10 year growth factor	1.49		
30 year growth factor	1.95		
100 year growth factor	2.43		
200 year growth factor	2.78		

Results

Method	FEH statistical (2025)
Flow rate 1 year (l/s)	4.6 l/s
Flow rate 2 year (l/s)	5.4 l/s
Flow rate 10 years (l/s)	8.7 l/s
Flow rate 30 years (l/s)	11.4 l/s
Flow rate 100 years (l/s)	14.2 l/s
Flow rate 200 years (l/s)	16.3 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

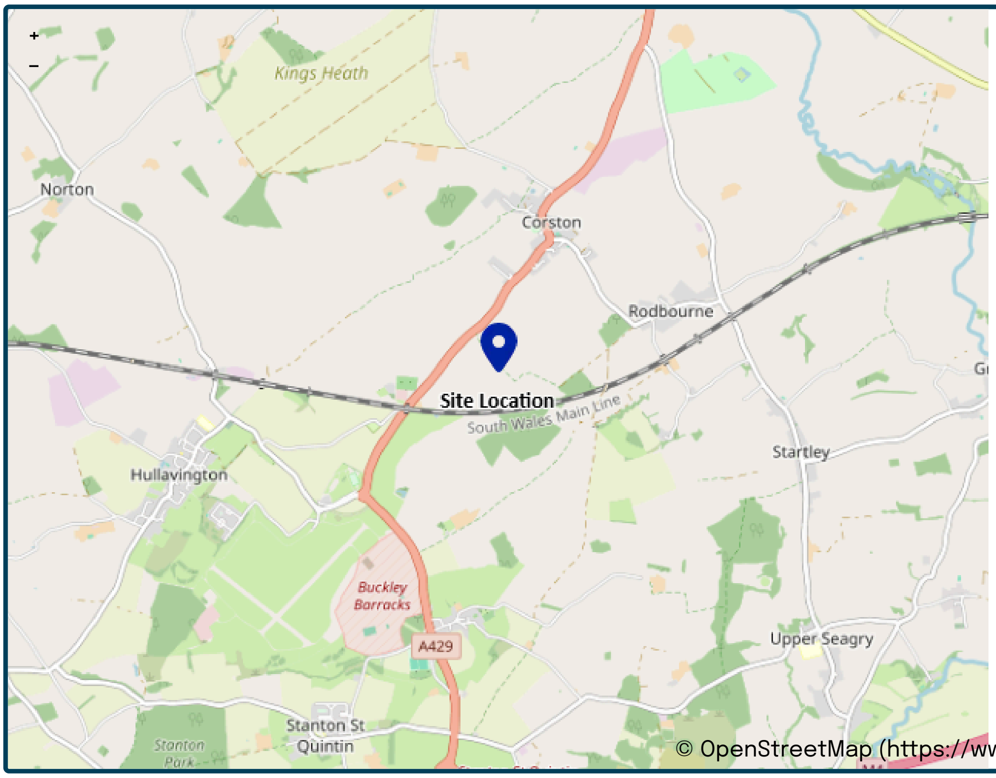
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

Project details

Date	08/07/2026
Calculated by	GH
Reference	317212
Model version	2.2.3

Location

Site name	Lime Down E1
Site location	



© OpenStreetMap (https://www.openstreetmap.org/copyright) contributors.

Site easting (British National Grid)	392072
Site northing (British National Grid)	182693

Site details

Total site area (ha)	0.831 ha

Greenfield runoff

Method

Method	FEH statistical (2025)

FEH statistical (2025)

	My value		Map value
SAAR9120 (mm)	821 mm		
BFIHOST19scaled	0.352		
QMed-QBar conversion	1.075		1.075
QMed (l/s)	5 l/s		
QBar (FEH statistical 2025) (l/s)	5.4 l/s		

Growth curve factors

	My value		Map value
Hydrological region	8		8
1 year growth factor	0.78		
2 year growth factor	0.93		
10 year growth factor	1.49		
30 year growth factor	1.95		
100 year growth factor	2.43		
200 year growth factor	2.78		

Results

Method	FEH statistical (2025)
Flow rate 1 year (l/s)	4.2 l/s
Flow rate 2 year (l/s)	5.0 l/s
Flow rate 10 years (l/s)	8.0 l/s
Flow rate 30 years (l/s)	10.5 l/s
Flow rate 100 years (l/s)	13.1 l/s
Flow rate 200 years (l/s)	15.0 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

Greenfield runoff rate estimation tool

www.uksuds.com | Greenfield runoff rate estimation tool (https://www.uksuds.com/)

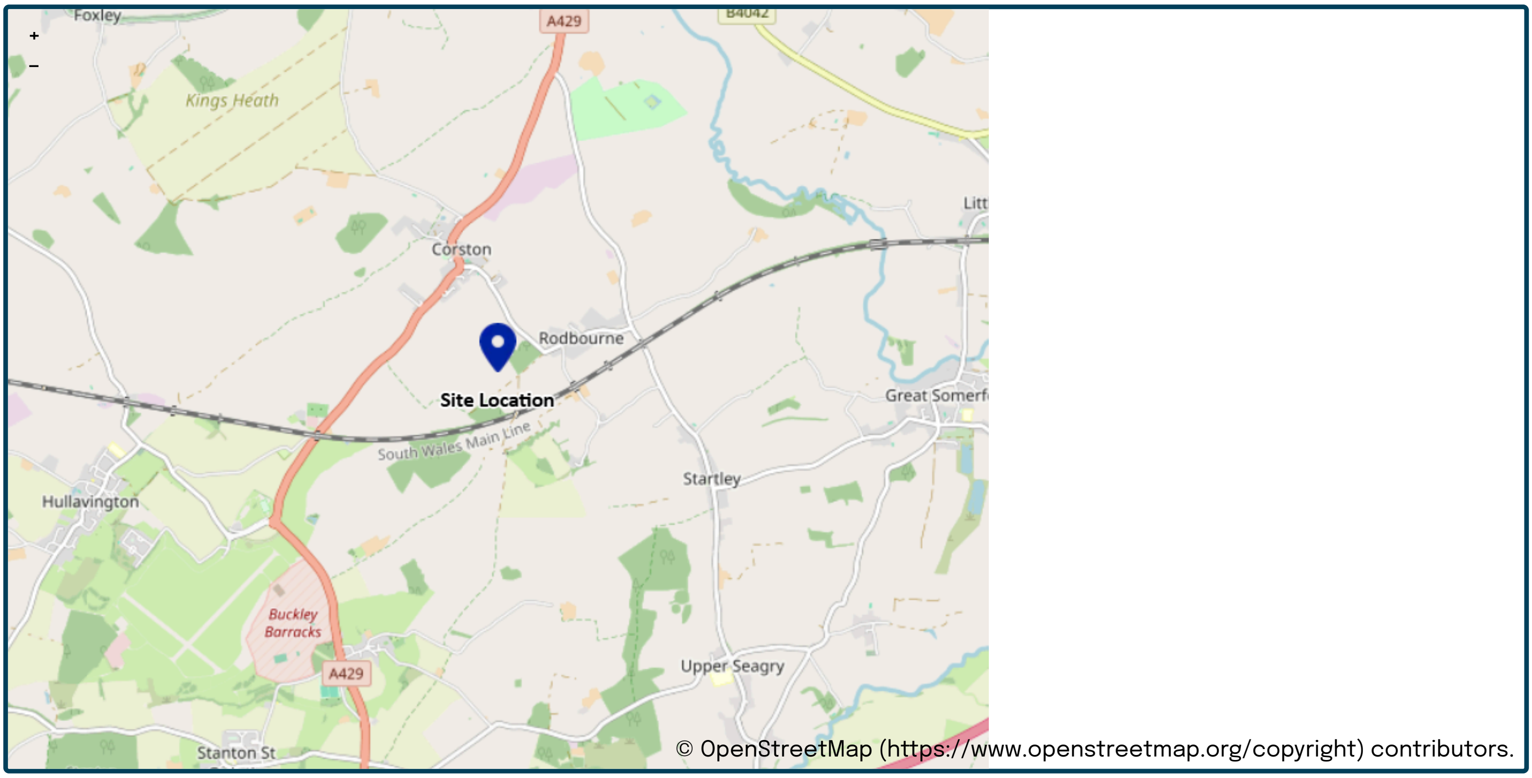
This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory standards for SuDS (Defra, 2015).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

Project details

Date	23/06/2026
Calculated by	GH
Reference	317212
Model version	2.2.3

Location

Site name	Lime Down E1
Site location	



Site easting (British National Grid)	392796
Site northing (British National Grid)	182915

Site details

Total site area (ha)	0.02 ha

Greenfield runoff

Method

Method	FEH statistical (2025)

FEH statistical (2025)

	My value		Map value
SAAR9120 (mm)	821 mm		
BFIHOST19scaled	0.352		
QMed-QBar conversion	1.075		1.075
QMed (l/s)	0.1 l/s		
QBar (FEH statistical 2025) (l/s)	0.1 l/s		

Growth curve factors

	My value		Map value
Hydrological region	8		8
1 year growth factor	0.78		
2 year growth factor	0.93		
10 year growth factor	1.49		
30 year growth factor	1.95		
100 year growth factor	2.43		
200 year growth factor	2.78		

Results

Method	FEH statistical (2025)
Flow rate 1 year (l/s)	0.1 l/s
Flow rate 2 year (l/s)	0.1 l/s
Flow rate 10 years (l/s)	0.2 l/s
Flow rate 30 years (l/s)	0.3 l/s
Flow rate 100 years (l/s)	0.3 l/s
Flow rate 200 years (l/s)	0.4 l/s

Please note runoff estimation is subject to significant uncertainty. Results are therefore normally reported to only 1 decimal place. Where 2 decimal places are provided, this does not indicate accuracy to this level, it has been adopted to prevent 'zero' figures from being reported. Outputs less than 0.01 l/s are reported as 0.01 l/s.

Disclaimer

Annex D – Hydraulic Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Storage	0.900	5.00	100.000	1200	0.000	0.000	1.000	99.000

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	Check Discharge Rate(s)	x
Rainfall Events	Singular	Drain Down Time (mins)	1440	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	0.0		
Analysis Speed	Normal	Starting Level (m)			

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	45	0	0

Node Storage Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	99.000	Product Number	CTL-SHE-0092-3800-1000-3800
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	3.8	Min Node Diameter (mm)	1200

Node Storage Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	99.000
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	900.0	900.0	1.000	1247.3	1266.1

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Storage	1410	99.903	0.903	35.0	954.7663	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
1440 minute winter	Storage	Hydro-Brake®	3.8	543.3

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Storage	0.831	5.00	100.000	1200	0.000	0.000	0.750	99.250

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	Check Discharge Rate(s)	x
Rainfall Events	Singular	Drain Down Time (mins)	1440	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	0.0		
Analysis Speed	Normal	Starting Level (m)			

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	45	0	0

Node Storage Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	99.250	Product Number	CTL-SHE-0093-3500-0750-3500
Design Depth (m)	0.750	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	3.5	Min Node Diameter (mm)	1200

Node Storage Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	99.250
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1050.0	1050.0	0.750	1324.4	1339.2

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Storage	1410	99.992	0.742	32.3	880.3179	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
1440 minute winter	Storage	Hydro-Brake®	3.5	511.9

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Storage	0.008	5.00	100.000	1200	0.000	0.000	0.750	99.250

Simulation Settings

Rainfall Methodology	FEH-22	Skip Steady State	x	Check Discharge Rate(s)	x
Rainfall Events	Singular	Drain Down Time (mins)	1440	Check Discharge Volume	x
Winter CV	1.000	Additional Storage (m³/ha)	0.0		
Analysis Speed	Normal	Starting Level (m)			

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	45	0	0

Node Storage Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	99.250	Product Number	CTL-SHE-0014-1000-0750-1000
Design Depth (m)	0.750	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	0.1	Min Node Diameter (mm)	1200

Node Storage Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	99.250
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	900

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	1.0	1.0	0.750	24.9	26.2

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
960 minute winter	Storage	915	99.842	0.592	0.4	6.1706	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	Outflow (l/s)	Discharge Vol (m³)
960 minute winter	Storage	Hydro-Brake®	0.1	10.1

[i] [redacted]

[iii] https://magic.defra.gov.uk/
[iv] https://flood-map-for-planning.service.gov.uk/
[v] https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow
[vi] https://check-long-term-flood-risk.service.gov.uk/postcode
[vii] https://www.landis.org.uk/soilscapes/