EAST PARK ENERGY

East Park Energy

EN010141

Outline Surface Water Management Plan

Document Reference: EN010141/DR/7.13

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

May 2026

Version P03

EAST PARK ENERGY

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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APFP Regulation Reference:	Regulation 5(2)(q)
Planning Inspectorate Scheme Reference:	EN010141
Application Document Number:	EN010141/DR/7.13
Author:	Wallingford HydroSolutions

Version	Date	Status
P01	September 2025	DCO Submission
P02	April 2026	Deadline 1
P03	May 2026	Deadline 3

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TABLES

1.0 INTRODUCTION

1.1 Purpose of the Document

1.1.1 This outline Surface Water Management Plan (oSWMP) has been prepared on behalf of BSSL Cambsbed 1 Ltd (the Applicant) for the construction, operation and decommissioning phases of the East Park Energy project ('the Scheme').

1.1.2 This oSWMP includes recommendations for the most appropriate measures to manage surface water run-off at the Site during the construction and operational phases of the project. It considers the scale and nature of the development in the context of surface water drainage and the relevant guidance and legislation. In summary, this report:

- Provides appropriate mitigation measures to manage the quality of surface water run-off during construction, with a provisional layout of mitigation features provided for the hard standing area (i.e., the BESS and substation area) and further recommendations on construction methods based on best practice guidance; and
- Provides appropriate mitigation measures to manage the treatment in addition to the rate and volume of surface water run-off during operation, with a provisional layout of mitigation features for the hard standing area and adjoining impermeable tracks.

1.1.3 This oSWMP is a control document that will be certified as part of the Development Consent Order (DCO) and secured via a Requirement in Schedule 2 of the **draft DCO [EN010141/DR/3.1]**. Should the Scheme be consented, the DCO will require that a final Surface Water Management Plan (SWMP) in substantial accordance with this oSWMP is prepared prior to commencing the construction phase.

1.1.4 The Site is located on land to the north-west of St Neots on the border between Bedford Borough and Huntingdonshire District. The Site location is shown in Figure 1.

1.2 Sources of Information

1.2.1 The main sources of data and guidance used to inform this plan are as follows:

- Environment Agency's (EA) Surface Water Flood Mapping – To help determine surface water flow paths across the Site[1];
- Flood Estimation Handbook (FEH) Catchment Data - To define catchment boundaries[2];
- Defra Magic Map - To identify groundwater aquifers and source protection zones[3];
- BGS Geology of Britain Viewer - To identify bedrock and superficial deposits[4];
- Landis Soilscapes Map - To identify soil types[5];
- Plans of the Scheme available in the **Works Plan [EN010141/DR/2.3]**, and **ES Vol 3 Figure 2-1: Illustrative Environmental Masterplan [EN010141/DR/6.3]**; and
- 1m LiDAR Data[6].

1.3 Relationship with Other Management Plans

1.3.1 This oSWMP is part of a framework of environmental management documents that will be implemented across the lifetime of the Scheme. The following plans are relevant and will be developed separate to the oSWMP, pursuant to DCO Requirements:

- **Construction Environmental Management Plan (CEMP)**: This plan will set out how the construction phase of the Scheme will be managed to avoid, reduce, or mitigate environmental impacts. It will cover topics like

1 EA Surface Water Flood Maps. 2023. Available at: https://flood-map-for-planning.service.gov.uk/
2 FEH Web Service. 2022. Available at: https://fehweb.ceh.ac.uk/
3 DEFRA Magic Map. 2022. Available at: https://magic.defra.gov.uk/magicmap.aspx
4 BGS Geology of Britain Viewer. 2024. Available at: https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/
5 Landis Soilscapes Map. 2022. Available at: http://www.landis.org.uk/soilscapes/
6 Environment Agency. National LiDAR Programme. 2024. Available at: https://www.data.gov.uk/dataset/f0db0249-f17b-4036-9e65-309148c97ce4/national-lidar-programme

pollution prevention measures, dust and noise control, protection of wildlife, site waste management, and incident response protocols. The CEMP ensures that commitments made in the ES are translated into practical measures on-site. An **outline Construction Environmental Management Plan [EN010141/DR/7.3]** has been prepared and submitted with the application for development consent;

- **Operational Environmental Management Plan (OEMP)**: This plan will set out how the operational phase of the Scheme will be managed to control environmental risks. An **outline Operational Environmental Management Plan [EN010141/DR/7.5]** has been prepared and submitted with the application for development consent;
- **Decommissioning Environmental Management Plan (DEMP):** This plan will set out how the decommissioning phase of the Scheme will be managed to control environmental risks. An **outline Decommissioning Environmental Management Plan [EN010141/DR/7.6]** has been prepared and submitted with the application for development consent;
- **Landscape and Ecological Management Plan (LEMP)**: This plan will set out measures for landscape planting, habitat management, and biodiversity net gain, ensuring that mitigation planting and screening vegetation are effectively maintained An **outline Landscape and Ecological Plan [EN010141/DR/7.7]** has been prepared and submitted with the application for development consent;
- **Soil Management Plan (SMP)**: This plan will ensure the sustainable management of soils and materials by setting out strategies for handling, storage, and reuse of soils. An **outline Soil Management Plan [EN010141/DR/7.9]** has been prepared and submitted with the application for development consent;
- **Battery Safety Management Plan (BSMP)**: This plan describes the safety measures and protocols for the BESS, including fire detection and suppression systems, emergency response procedures, and regulatory compliance. An **outline Battery Safety Management Plan [EN010141/DR/7.10]** has been prepared and submitted with the application for development consent.

- **Archaeological Mitigation Strategy (AMS):** This plan sets out the management of archaeological remains, both known and currently unknown, across the lifetime of the Scheme. An **outline Archaeological Mitigation Strategy [EN010141/DR/7.15]** has been prepared and submitted with the application for development consent.

2.0 THE SCHEME

2.1 Order Limits

2.1.1 The area of land required for the construction, operation and maintenance of the Scheme, which includes land required for permanent and temporary purposes, is shown on **ES Vol 3 Figure 1-1: Site Location [EN010141/DR/6.3]**. This is referred to as the 'Order Limits' or the 'Site'.

2.2 The Site

2.2.1 The 'Site' is located to the north-west of the town of St Neots, and is across two administrative areas; Bedford Borough Council (BBC) (a unitary authority) and Huntingdonshire District Council (HDC) (a two-tier authority with Cambridgeshire County Council). The Site location is shown on **ES Vol 3 Figure 1-1: Site Location [EN010141/DR/6.3]**. The Site area extends to approximately 773 hectares (ha).

2.2.2 With reference to **ES Vol 3 Figure 1-2: Site References [EN010141/DR/6.3]**, for ease of reference the Order Limits have been sub-divided into East Park Sites A to D, in which all of the above ground infrastructure proposed as part of the operational Scheme would be located (excluding works to the Eaton Socon Substation). The Order Limits also cover land outside of East Park Sites A to D which will be required for access, cabling, and the grid connection to the Eaton Socon Substation. East Park Sites A to D can be described as follows:

- **East Park Site A** – covering land west of the B660 between Pertenhall and Swineshead at the western end of the Site. East Park Site A comprises arable fields located to the north, west and east side of a small hill that lies between Pertenhall and Riseley. East Park Site A lies either side of the Pertenhall Brook, with access proposed from the B660 to the east.
- **East Park Site B** – covering land between Pertenhall, Keysoe, and Little Staughton. East Park Site B comprises arable fields located north of an

elevated ridgeline which runs between Keysoe and Little Staughton. East Park Site B is crossed by a number of small watercourses, with access proposed from the B660, Great Staughton Road, Little Staughton Road, and an unnamed road between Little Staughton and Great Staughton Road.

- **East Park Site C** – covering land south of Great Staughton. East Park Site C comprises arable fields located south of the River Kym, with access proposed from Moor Road to its south-eastern boundary, and from Little Staughton Road to the north-west.
- **East Park Site D** – covering land around Pastures Farm between Great Staughton and Hail Weston. East Park Site D comprises arable fields with access proposed via a new access from the B645.

2.2.3 With reference to **ES Vol 3 Figure 1-2: Site References [EN010141/DR/6.3]**, there are three linear corridors proposed for underground cabling that connect the different parts of the Site and provide a grid connection to the Eaton Socon Substation. These are also shown on **Figure 1-2** and identified as:

- **Cable Corridor – Site B to Site C** – which connects Site B to Site C across an unnamed road and arable fields.
- **Cable Corridor – Site C to Site D** – which connects Site C to Site D across Moor Road and an arable field.
- **Grid Connection – Site D to Eaton Socon Substation** – which connects Site D to the Eaton Socon Substation and crosses open arable fields, the Duloe Brook, and Duloe Road and Bushmead Road.

2.3 The Scheme

2.3.1 The Scheme comprises a new ground-mounted solar photovoltaic energy generating station and an associated on-site battery energy storage system (BESS) on land to the north-west of St Neots. The Scheme also includes the associated infrastructure for connection to the national grid at the Eaton Socon National Grid Substation.

2.3.2 The Scheme would allow for the generation and export of 400 megawatts (MW) of renewable electricity, as well as the storage of 100 MW of electricity in the BESS. The precise generating capacity and storage capacity will be subject to detailed design, but it should be noted that the Applicant presently has a grid connection agreement with National Grid for 400 MW export and 100 MW import.

2.3.3 Subject to the Scheme securing Development Consent in Winter 2026/27 it is anticipated that works would start on site in early 2028 and be completed by mid-to late 2030 (although initial energisation of the Scheme is likely to commence prior to 2030). The Scheme comprises a temporary development with an operational phase of 40 years; decommissioning activities would therefore likely commence in 2070, 40 years after commissioning.

2.3.4 A more detailed description of the Scheme is provided within **ES Vol 1 Chapter 2: The Scheme [EN010141/DR/6.1]**.

3.0 HAZARDS

3.1 Surface Water

Silts and Sediment Pollution

3.1.1 Sediment pollution is the single main pollutant in rainwater run-off from construction sites. Any areas of exposed ground, earthworks (i.e. topsoil stripping of the Site, excavation for utility trenches, culvert and outfall construction in the banks of watercourses) and stockpiles of granular or soluble material could result in the introduction of fine sediment into the watercourses on the Site, particularly during periods of heavy rain if no mitigation measures are maintained. Run-off may also emanate from poor site drainage provision, washing and cleaning activities and after rainfall events that exceed the capacity of the drainage system to be installed.

3.1.2 The Scheme involves the construction of solar arrays, a BESS, substation, cabling, access tracks and other associated infrastructure within the upper catchments of a number of small watercourses. Where new tracks pass over watercourses, it is expected that crossings of suitable capacity will be installed. However, during heavy rainfall sediment from the construction area may be at risk of entering these watercourses with associated impacts.

3.1.3 There would be an increased pollution risk from elevated suspended sediment loads which could potentially impact on the physical, chemical and microbiological water quality characteristics of the watercourses. Consequent impacts and heavy silt deposition could include impacts on aquatic vegetation by sediment coating of leaves; visual changes to the watercourse; damage to fish gills by sediment particles (if present); and silting.

Oils, Hydrocarbons, Concrete and Other Chemicals

3.1.4 Construction works will necessitate the use of heavy plant and machinery, as well as the temporary storage of oils and diesel at site compounds. Everyday operation and maintenance of this plant has the potential to result in chemical contamination of the environment through oil and fuel leaks from vehicles, chemical storage leaks and accidental spillages etc. which may become mobilised during storm events. Construction plant may also generate a point source of hydrocarbons and to a lesser extent heavy metals that could enter surface waters directly or via leaching through the subsoil.

Land Drainage

3.1.5 There is a risk of surface water flooding of working areas. This is most likely to occur during heavy rainfall events which exceed the capacity of any installed drainage system or due to ground conditions resulting in standing water. Impacts associated with flood risk can also occur due to construction activities such as ground reprofiling. The works may also have the potential to alter drainage pathways.

3.2 Groundwater

3.2.1 Key activities associated with the construction phase that could have potential environmental impacts on groundwater are listed as follows:

- Site clearance;
- Construction of road access for construction works;
- Movement of construction machinery;
- Maintenance of construction machinery and equipment;
- Earthworks, excavation and grading; and
- Horizontal Directional Drilling.

3.2.2 The above activities involve changes and/or movements in the terrain which can result in alterations to the dynamics of groundwater resources.

3.2.3 The construction phase will require site clearance, excavation and grading, temporary road access and establishment of temporary site facilities which can have negative effects on groundwater aquifers. These activities may alter water dynamics by:

- Disrupting or interrupting aquifer flow should earthworks (excavations) reach groundwater levels;
- Varying groundwater levels, should groundwater from these aquifers be used during construction (e.g. dewatering);
- Pollution (including chemical, siltation and changes in pH, redox and oxygen content) of groundwaters (e.g. from oil leaking from construction vehicles); and
- Release of existing pollution to the wider environment through the disturbance of contaminated soils.

3.2.4 Groundwater protection policy in England and Wales uses aquifer designations that are consistent with the Water Framework Directive. Based on this, the bedrock and superficial drift aquifer designations across the Site were reviewed using the British Geological Society (BGS) Aquifer Designation Map (England)[7]. Only the superficial drift aquifer designations were available for the Site, which are Secondary A and Secondary (undifferentiated) designations. The Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers while the Secondary (undifferentiated) aquifers have variable characteristics of rock types with only a minor value. These are characterised by predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. There is also a small area with a principal bedrock aquifer designation approximately 800m south-west of the Site.

3.2.5 The hydrogeological characteristics of the underlying deposits across the Site were also reviewed using BGS Hydrogeological Maps[8]. The maps showed the deposits are uniformed across the Site and are rocks with essentially no groundwater.

[7] *British Geological Survey (BGS) Aquifer Designation Dataset for Wales. 2024. Available at: https://mapapps2.bgs.ac.uk/geoindex/home.html*
[8] *British Geological Survey (BGS) Hydrogeological Map. 2024. Available at: https://www.bgs.ac.uk/datasets/hydrogeology-625k/*

3.2.6 Based on the BGS groundwater vulnerability maps[9], groundwater vulnerability varies from low to medium-low across the Site, with most of the Site having a low vulnerability classification. In this regard groundwater is expected to have limited with minimal interaction with the surface. Notwithstanding this, some protection measures should be provided to protect groundwater in the area.

[9] *British Geological Survey (BGS) Groundwater Vulnerability Map (England). 2017. Available at: https://magic.defra.gov.uk/MagicMap.aspx*

4.0 CONSTRUCTION

4.1 Water Quality Measures

4.1.1 The following sections outline the general and specific measures for the Scheme, which have been developed after considering the local receptors, topography, and layout. A section outlining the management of spillage risk is also provided based on general best practice. Details of the indicative drainage layout plans covering the location of the main sediment control measures are provided in Section 6.5.

General Measures

4.1.2 Good surface water management during construction is essential to ensuring that sediment does not pollute downstream watercourses. Therefore, the practices outlined below would be followed to reduce the risk of pollutants mobilisation.

4.1.3 Vegetation cover would be retained for as long as possible to minimise the potential impact of soil stripping, and where bare ground is unused, new vegetation or alternative cover would be established at the earliest opportunity. If there is no time to establish grass cover on a slope, a roughened earthworks profile will provide better erosion control than leaving it smooth. Excavation would take place as soon as possible after the vegetation is stripped to minimise the period during which soil can be eroded. Where possible these works would be undertaken during dry months. Trenching or excavation activities in open land will cease during periods of intense rainfall and temporary bunding would be provided as required, to reduce the risk of sediment transport to the natural drainage system.

4.1.4 In terms of temporary access tracks, these would be completed as soon as possible and will be made of heavy-duty plastic to protect soils from run-off. Temporary fences or markers would also be used to ensure contractors disturb the minimum area only, for example, preventing the tracking of heavy machinery across surrounding land. For temporary access tracks located within Areas of Archaeological Constraints (AAC), shallow drainage swales are proposed along either side of the tracks. These swales will intercept and convey run-off from the track, reducing the risk of increased run-off, waterlogging or erosion adjacent to the temporary tracks. The Site would be developed in phases wherever possible, with surface water run-off initially managed through a range of sediment treatment measures and temporary SuDS to reduce the run-off rate and volume of discharge to the local drainage network. Along steeper sections of the track where the velocity of surface run-off could pose a significant risk of scour through the construction site, phasing will be vital to reduce the area of exposed ground at any given time.

4.1.5 In both construction and operation, the movement of traffic would be controlled to minimise soil compaction and disturbance. Vehicle movements (including HGVs and plant machinery) outside the defined tracks and hardstanding areas would be avoided where possible. Routine mechanical maintenance of vehicles will be carried out off-site or in one of the construction compounds.

4.1.6 Temporary drainage pathways would be established to direct surface water away from at risk areas and towards the surface water drainage network via sediment controls. The aim of the drainage scheme would be to ensure that water from surrounding land is excluded from the area of development and where this is not possible the volumes draining onto the Site are significantly reduced. There will be no unapproved discharge of foul or contaminated drainage from the Site either to groundwater or any surface waters, whether direct or via a soakaway.

4.1.7 Clay plugs would be inserted within cable trenches at a frequency to suit the specific location to prevent gullying of trenches and preferential routing.

4.1.8 A programme of surface water quality monitoring would be undertaken before and during the construction phase to provide assurance as to the absence of water quality impacts.

Specific Measures

V-Shaped Ditches

4.1.9 For the proposed access tracks, where there are predicted (from pluvial flood mapping) or known areas of concentration of surface water run-off, it is recommended that V-shaped ditches (or shallow ditches combined with bunds), or recharge trenches be placed on the upslope side of the construction area. These will convey surface water from upslope to piped crossings beneath the construction areas. Where space allows and in locations where siltation is likely (i.e. steep slopes with limited vegetation cover) a geotextile sump upslope of each crossing could be used to offer further treatment. In areas at grade or fill areas where embankments are proposed, multiple piped crossings would be used to limit the volume of discharge draining to one outfall. Where ditch lengths are significant, check dams or straw bales will be used to interrupt flows and provide some interim treatment. As standard, check dams would be in place where the longitudinal slope of a ditch exceeds 3% (Plate 1).

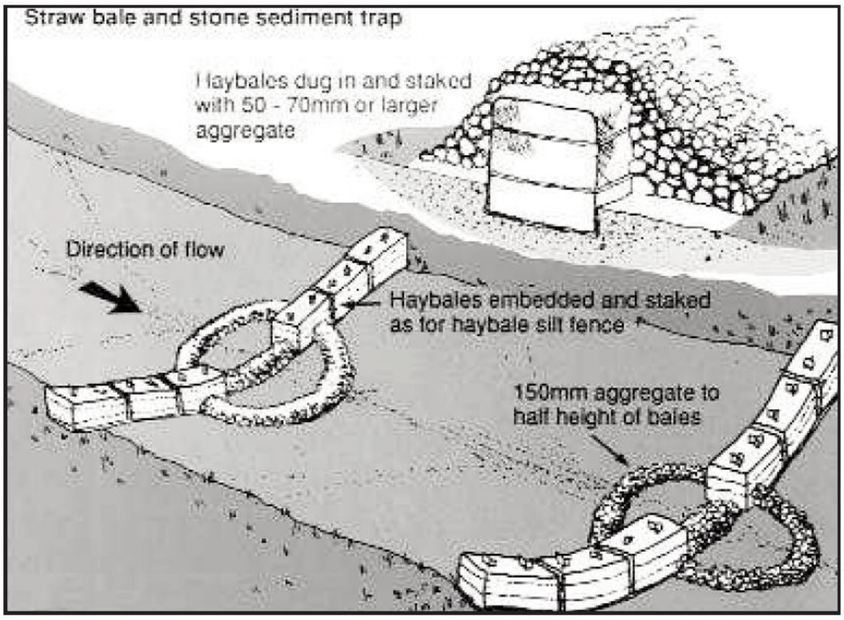

Plate 1 – Typical layout of check Dams (Source; CIRIA, 2006[10])

[10] *CIRIA, 2006, Control of water pollution from linear construction projects Site guide (C649).*

Filter Strips

4.1.10 Downslope of the construction area, a filter strip would run along the entire length of the excavated construction area. Widths of 5m have been demonstrated to be very effective in terms of water quality performance even for steeper slopes[11], provided the density of vegetation cover is sufficient. Therefore, where there is enough space available it is recommended that the minimum filter strip width be set at 5m. Where slopes are significant, greater widths would be provided.

4.1.11 It is also recognised that the performance of filter strips is limited in heavy soils such as clay. This soil type is present in the southern section of East Park A, the eastern section of East Park B, most of East Park C and across the entirety of East Park D. In these areas, it is recommended that some of the additional sediment control measures outlined later in this section are considered.

Silt Fencing

4.1.12 Silt fencing is recommended as a primary treatment method within any area of earthworks. These will act to break up any preferential flow paths and divert and filter run-off. It is recommended that these be spaced transversally across the construction area. In terms of spacing, they would be placed at more regular intervals where necessary, for example in steeper sections. Plate 2 shows an example of good practice silt fence installation.

[11] *CIRIA (2015), The SuDS Manual (C753)*

Plate 2 – Example of good practice in silt fence installation (Source: Geosynthetics, 2021[12])

Settlement Ponds

4.1.13 If necessary, where other measures described above are not sufficient, settlement ponds would be installed for use as part of the construction phase. These would be sited downslope of the main construction areas to effectively capture and treat run-off from these areas. After the construction phase the ponds will be reinstated to the current conditions. The ponds will be sized to ensure sufficient treatment during construction.

Horizontal Directional Drilling (HDD)

4.1.14 HDD or other trenchless techniques will be used to install underground ducts to accommodate cables. This process can require the use of bentonite as a lubricant for the drill bore which has the potential to breakout at the drive shaft

[12] *Geosynthetics. 2022. Available at:* http://www.geosyn.co.uk/product/silt-stop-premium-and-high-flow-silt-fences

or spill from tanks, potentially entering surface or groundwater bodies. The use of the lubricant material will be carefully controlled to avoid these risks, with mitigation measures set out in the **outline Construction Environmental Management Plan [EN010141/DR/7.3]** and also described within the **outline Archaeological Mitigation Strategy [EN010141/DR/7.16].**

Watercourse Crossings

4.1.15 Whilst the tracks, cabling and grid connection have been designed to minimise the number of watercourse crossings and use existing tracks located along the access route where possible, the creation of new crossings is expected to be required. If crossings are not designed correctly, desiccation could occur during periods of low flow, thus disconnecting the upper reaches of a stream (with potential ecological and resource consequences). The crossings would need to be sized appropriately to ensure that they would have the conveyance capacity for appropriate design floods. If not, the tracks in the vicinity of the crossing could flood, resulting in scour and potential track failure, thereby potentially releasing significant sediment into the surrounding watercourses. Where practicable, existing crossings will be utilised instead of creating new crossings.

4.1.16 Where existing crossings are adopted, these will be widened and strengthened as necessary with the commitment that the type of structure and bed profile will not be changed, and best practice drainage will be adopted.

4.1.17 The locations of the required watercourse crossings are set out in **ES Vol 1 Chapter 2: The Scheme [EN010141/DR/6.1]** (for the location of each potential crossing, refer to **ES Vol 3 Figure 2-3: Indicative Crossing Plan [EN010141/DR/6.3]**). Additional details of these crossings have also been provided within **ES Vol 2 Appendix 8-3: Watercourse Crossing Assessment [EN010141/DR/6.2]**. The detailed design of crossings would be confirmed by a survey of the watercourse prior to construction and would be agreed upon with the LLFA prior to construction, as the crossings are at ordinary watercourses. The only main river is the Pertenhall Brook however, the crossing on this watercourse will be maintained.

4.1.18 The majority of the proposed permanent crossings are proposed to be open span crossings and so the detrimental effects expected would be minimal. This is due to the retention of the natural bed formation with this type of crossing meaning flow rates and habitats remain in situ. These proposals are in line with Cambridgeshire County Councils Culvert Policy[13] which in most cases is opposed to culverting of watercourse, instead preferring the use of bridges where crossings are required. Where the length of the crossing deck has made open span bridging of a stream impractical (i.e. the entrance to the main access track to the BESS and Substation), a buried culvert is proposed, which would maintain the natural bed substrate through the feature.

4.1.19 Six temporary watercourse crossings are required during construction, of which two will use Bailey Bridges and four using culverts. The culverts will in these cases be buried, so as to retain the natural bed formation. These locations are also given in **ES Vol 1 Chapter 2: The Scheme [EN010141/DR/6.1]** (for the location of each potential crossing refer to **ES Vol 3 Figure 2-3: Indicative Crossing Plan [EN010141/DR/6.3]**).

4.1.20 Horizontal drills and trenches will also be used for cabling. The crossings will be designed to ensure they would not disconnect the watercourses at times of low flow. The bed profile would remain unchanged to prevent a change in geomorphology of the channel.

4.1.21 At all crossings silt fences would be erected along watercourse banks adjacent to, upstream and downstream of crossing locations to intercept polluted run-off during construction and trafficking, as required.

Additional measures in vulnerable locations

4.1.22 It is recognised that some areas of the Site are more vulnerable than others and these may require additional surface water protection measures. These areas would include, but are not limited to:

[13] *Cambridgeshire County Council. 2013. Culvert Policy. Available at: https://www.cambridgeshire.gov.uk/asset-library/Cambridgeshires-Culvert-Policy.pdf Accessed on 07/08/2025*

- Existing overland flow paths/watercourses;
- Watercourse crossings;
- Slopes; and
- Stockpiles.

4.1.23 In these areas additional treatment measures may be required. For example, where there are existing overland flow paths silt fencing could be placed perpendicular to flow direction to break the force of run-off reducing the risk of scour downslope. Where surface water conveyed by a ditch discharges directly to a watercourse, an additional level of protection would be provided along the banks of the watercourse. This would comprise a combination of filter strips and silt fencing.

4.1.24 The hard standing area with the East Park BESS and Substation compound will require parallel to contour drainage upslope during construction.

4.1.25 Meshes, netting, mat and sheeting made of natural or man-made material can be used and may prove particularly useful in locations where bare ground is unused. Specifically, biodegradable geotextiles such as coconut matting in conjunction with silt fencing could be used (see Plate 3).

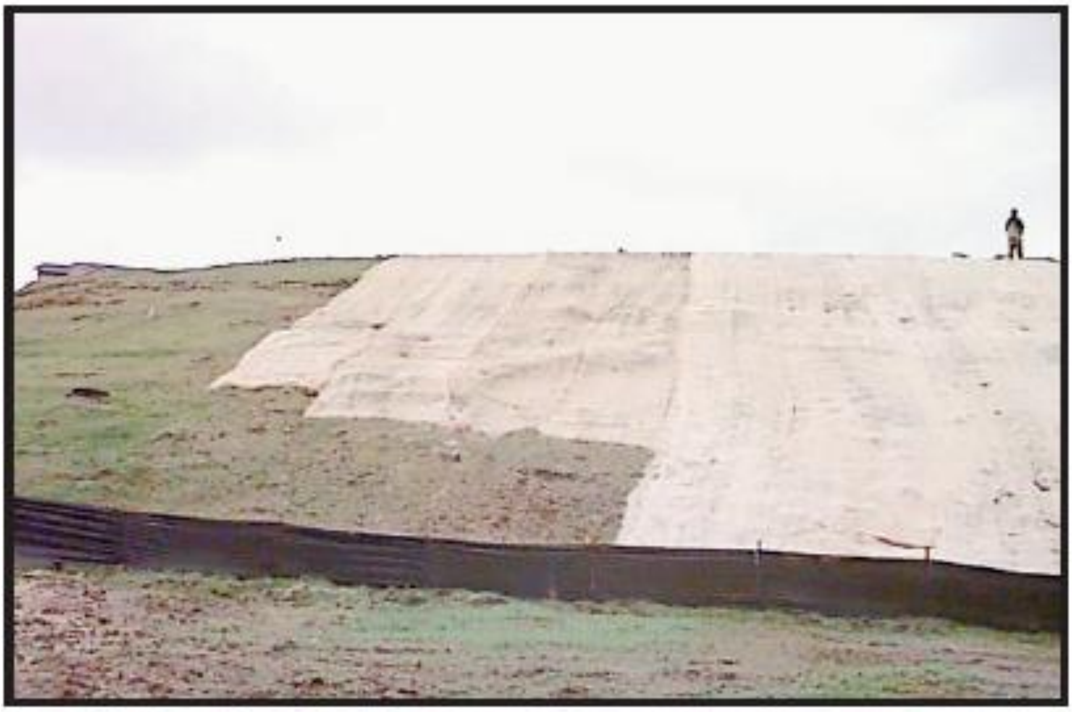

Plate 3 – Coconut matting and silt fence (Source: CIRIA, 2006[10])

Spillage Risk

4.1.26 In addition to the specific measures outlined above, minimisation of pollution events during the construction phase will also be ensured by the adequate maintenance of vehicles, the responsible handling and storage of potentially polluting materials and liquids and suitable training of staff. To reduce the impact of accidental spillages (*e.g*. from plant fuel) during construction, appropriate planning will identify such risks and the precautionary measures to be taken such as:

- Equipment and spill kits would be provided to contain and clean up any spills to minimise the risk of pollutants entering watercourses, groundwater dependent terrestrial ecosystems (GWDTE), or flush areas;
- Refuelling of vehicles and plant machinery would be confined to the designated fuelling areas and would be carefully controlled using drip trays;

- Temporary bunding would be provided as required, to reduce the risk of oil or chemical spills to the natural drainage system;
- Vehicles, plant machinery and equipment would be cleaned at designated washout areas located conveniently and within a controlled area of the Site. These areas will be lined so as to prevent infiltration to groundwater. The washdown areas will be located at least 10 m from the top of bank of watercourses. Runoff from these areas will be appropriately stored and subsequently treated, either by onsite options such as oil separators and settlement lagoons, or else stored and then tankered and appropriately treated offsite;
- All fuel and chemicals would be stored within appropriately specified containers and within specifically designed stores / storage areas, located at least 10 m from the top of bank of watercourses. These will be covered areas to prevent the accumulation of rainfall and will be lined with impermeable surfacing to prevent infiltration. There will be bunding around the perimeter of these areas with an appropriate valve outlet to allow any standing water to be released. An oil separator will be used on the outlet from these bunded areas. The bunded areas will have a minimum capacity of 110% of the capacity of the fuel/chemical containers. There will be appropriate measures to control access and to avoid spillages;
- Concrete batching and any onsite washout would occur in designated areas, which would be lined to prevent infiltration of high alkaline content flow and would be covered to minimise the ingress of rainwater to the containment areas;
- Drip trays would be placed under standing machinery;
- All solid and liquid waste materials would be properly disposed of in controlled landfill sites away from the Site;
- Training of staff in emergency procedures would be undertaken and spillage response kits will be easily accessible at all times; and
- Areas at particular risk of spillage would have a temporary protective layer laid to prevent infiltration into the soil and reduce the risk to groundwater.

4.1.27 The above measures are for the protection of surface water, groundwater, and watercourses.

5.0 OPERATION AND DECOMMISSIONING

5.1.1 During the operational and decommissioning phases the general SuDS approach adopted during construction will continue to be used with the swales and attenuation basin at the BESS compound remaining and becoming part of the permanent works through until decommissioning.

5.1.2 However, temporary features such as silt fences and geotextile matting can be removed given the reduced pollution hazard during the operational phase, and reinstated as required at decommissioning. This hazard is reduced due to a decreased frequency in the movement of plant, materials, equipment and people on the Site as well as increased vegetation over time.

5.1.3 A Decommissioning Surface Water Management Plan will be prepared prior to decommissioning. The plan will be agreed with the relevant planning authority prior to decommissioning works commencing and will involve monitoring of groundwater and surface water quality prior to, during and for an agreed period of time after decommissioning has taken place.

6.0 STORAGE VOLUME

6.1.1 Storage volumes will be provided on Site during construction and operation. The primary purpose of storage during construction is to provide sufficient treatment of surface water run-off and reduce run-off rates and volumes from impermeable areas. During operation, these principles remain the same, however there is a formal requirement to attenuate post-development flows and run-off volumes to pre-development greenfield conditions.

6.1.2 To guide the provision of storage volumes for during the operation phase of the Scheme, the geology and soil characteristics for the Site was reviewed using BGS Geology Viewer[14] and Soilscapes[15], respectively. This indicated that the Site is underlain by bedrocks of mudstone with low permeability and has areas of clayey soils with slightly impeded drainage potential.

6.1.3 On-site water supply will be provided for the East Park BESS in the event of a fire in accordance with the National Fire Chief Council (NFCC) guidance on the design and layout of BESS[16]. . The guidance recommends that consideration should be given within the site design to manage water run-off such that, in an emergency, polluted water may be safely contained and treated. This will reduce the risk of polluting groundwater or local watercourses. Based on the Site's geology, soil characteristics and the NFCC guidance, the main principle underpinning the outline drainage plan is to provide sufficient storage for surface water run-off from the impermeable bunded area and tracks associated with the East Park BESS and substation. The storage provided will also be able to store contaminated water from the BESS compound in emergencies.

6.1.4 The following sections detail how greenfield run-off rates have been estimated and used to determine required storage volume for run-off from the proposed

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[14] *BGS Geology View, 2025. Available at: https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/*
[15] *Landis Soilscapes Viewer, 2025. Available at: https://www.landis.org.uk/soilscapes/*
[16] *National Fire Chiefs Council (NFCC) Grid Scale Battery Energy Storage System planning – Guidance for FRS. November 2022.*

impermeable areas. It also provides details on the specific SuDS features being used to manage surface water at the Site during the operation phase.

6.2 Site Characteristics

6.2.1 The Site extends to approximately 773 ha and for ease of reference has been subdivided into East Park Sites A to D, in which all the proposed above ground infrastructure as part of the operational scheme will be located, as shown in Figure 1.

6.2.2 The BESS and Substation compound will have an impermeable surface finish (likely to be concrete or an impermeable membrane) to meet the National Fire Chiefs Council (NFCC) guidance mentioned in paragraph 6.1.3. The compound will be designed such that any run-off can be directed towards an adjacent storage feature shown as Work No. 6B on the **Works Plan [EN010141/DR/2.3]**.

6.2.3 The access tracks throughout most of the Site will be constructed of permeable compacted stone, except for the tracks within and around the BESS and Substation compound and the track along the access route from the Main Site Access at the B645. Tracks internal to the BESS and Substation compounds will be constructed of concrete or asphalt.

6.2.4 The land take requirements for the PV panels will be 28% of the overall Order Limits. However, the panels will be installed at a fixed angle and will be elevated on pile driven support frame mounting structures arranged in rows on an east-west axis facing south. The maximum height of the panels along the top (northern) edge of the array will be 3.0m above existing ground levels, and the minimum height along the bottom (southern) edge of the array will be 0.8m above the existing ground levels. Therefore, natural ground surface will be left below the panels. The grass sward beneath the panels will also be reinstated and maintained to prevent any potential erosion and rilling. The vegetation under and between the panels will maintain/improve the existing hydrological regime, i.e., allow run-off to follow drainage pathways to ditches or watercourse as it would at pre-development conditions.

6.2.5 A point descriptor has been taken from the Flood Estimation Handbook (FEH) Web Service[17] to define the hydrological characteristics of the Site. This was extracted at the centroid of the Order Limits. The single point descriptor in combination with the soil map data was sufficient for defining the hydrological characteristics, as the geology of the Site and surrounding areas are relatively homogeneous. The location of the point descriptor is shown in Figure 2.

6.3 Greenfield Run-off Rates

6.3.1 To estimate run-off and determine the volume requirements for the impermeable areas, greenfield run-off rates have been calculated for the Order Limits using the point descriptor data summarised in Table 1. The calculations are based upon a combination of the Standard Average Annual Rainfall (SAAR), base flow index (BFIHOST) and the portion of time soils are wet (PROPWET).

Table 1 – FEH Point Descriptor

Point Descriptor	Value
SAAR (mm)	554
PROPWET (mm)	0.24
BFIHOST	0.376

6.3.2 Run-off rates for the existing greenfield land have been calculated using ReFH2, which is the current recommended method outlined in the CIRIA SuDS manual[18]. The rates and volumes have been estimated over the entire Site area and for a range of storms up to and including the 1.0% AEP event plus a 40% upper end allowance for climate change for the Upper and Bedford Ouse Management Catchment. A 40% upper end allowance has been applied

[17] UK Centre for Ecology & Hydrology, 2025. Flood Estimation Handbook (FEH) Web Service.
[18] CIRIA (2015), The SuDS Manual (C753)

for the 2070s epoch (2061 to 2125) in accordance with the EA's guidance for climate change allowance in flood risk assessments[19]. The guidance recommends assessing the credible maximum scenario for Nationally Significant Infrastructure Projects (NSIPs) and the 2070s epoch is appropriate as the development's lifetime falls between 2061 and 2100. Table 2 below presents the greenfield run-off rates as the unit rate per hectare. The associated calculations are provided in Appendix 1.

Table 2 – Greenfield Run-off Rates

Return Period	Greenfield Run-off Rate (l/s/ha)
2-year	2.30
30-year	4.95
100-year	6.36
100-year + 20% CC	9.24

6.4 Estimated Volume

6.4.1 The provision of SuDS storage at a site can be achieved by providing attenuation only storage – utilised to store run-off and release at equivalent greenfield rates.

6.4.2 Given the expected ground conditions with poor infiltration, SuDS storage has been sized using the attenuation only approach. This is deemed acceptable considering the negligible loss of permeable area across the Site as outlined in Section 6.5 below.

6.4.3 The hydraulic modelling package Causeway Flow was used to determine the storage volume required for the impermeable areas across the Site (i.e., within East Park Site D for the BESS and substation compounds) for the design event, i.e., 1.0% AEP event plus a 40% climate change allowance.

[19] *Environment Agency (EA), 2016. Flood risk assessments: climate change allowances.*

The associated calculations are provided in Appendix 2. In this case, the maximum outflow rate from the attenuation storage is limited to the equivalent greenfield run-off rate for the design event over the impermeable site area, 2.7ha for the BESS and substation compounds (including the ancillary buildings, tracks around compound and hardstanding for the storage tanks) and 0.4ha for the access track extending from the BESS compound to the B645. The volumes provided are an upper bound estimate of what will be required for the 1.0% AEP + CC design event. The basin is also required to temporarily store the 456,000 litres of on-site water supply provided in the event of a fire.

Table 3 – Storage Volume Estimates

Return Period	BESS Compound Storage Estimate	Access Track (extending from BESS compound) Storage Estimate
	m^3	m^3
100-year + 40% CC	1,904	309

6.4.4 Based on the required storage volume specified in Table 3 for the BESS Compound, the basin is designed with a top area of 1,270 m^2 and a total depth of 1.5 m, which includes a 300mm freeboard. The design incorporates 1:3 side slopes, allowing for a balance between spatial efficiency and safety. The proposed dimensions are considered appropriate as the top area can be accommodated at the designated location without compromising buried utilities or affecting the tie-in level at the final discharge point from the main conveyance swale (see paragraph 6.5.7). The design also maintains the required 300 mm freeboard while ensuring the maximum water depth does not exceed the 2 m maximum threshold, stated in the CIRIA SuDS Manual. Safety considerations for the basin during both the construction and operation phases have been evaluated as part of the overall drainage strategy, which is detailed in paragraph 6.5.9.

6.4.5 The available headroom within the basin, above the firewater volume is 1,448 m^3. This calculated as the total required storage for the BESS compound during a 1.0% AEP + CC event minus the firewater volume of 456 m^3 firewater requirement. This headroom is approximately equivalent to the storage volume required for a 2.0% AEP + CC return period. The basin has not been sized to detain the design flood and the firewater volumes as the joint probability of a maximum design flood occurring at the same time as a major fire event is considered negligible, and significantly lower than the 1.0% annual probability of the design flood alone.

6.4.6 Current guidance notes[20] an aspiration criterion that a storage volume equivalent to 15mm of rainfall should be provided to improve stormwater quality (termed “treatment volume”) 15mm of rainfall equated to 150m^3 of storage per hectare of impervious area contributing. The storage would be provided in line with the SuDS infrastructure shown in the indicative drainage layout plan in Figure 3.

6.5 Surface Water Management Strategy

6.5.1 Given the rural setting of the Site and the negligible impact the solar panels will have on surface water run-off, supported by a previous study[21] on the hydrological implications of solar farms and the configuration of the panels outlined in paragraph 6.2.4, no hard engineered solutions are proposed in the surface water management strategy for the solar panels. As such, run-off management will be provided at the source through natural land management.

6.5.2 Proposed grassland under the panels is specified in the **outline Landscape and Ecological Management Plan (OLEMP) [EN010141/DR/7.7]**. This involves a mixture of grazing pasture or neutral grassland and species-diverse grassland. Seeding will be carried out in accordance with BS 4428:1989 Code of Practice for general landscape operations (excluding hard surfaces). Advanced seeding will take place between the last crop being harvested and the beginning of the construction phase. The purpose of

[20] *Environment Agency (EA), (2013), Report – SC030219, Rainfall runoff management for developments.*
[21] *Cook, L. M., & McCuen, R. H. (2011). Hydrologic response of solar farms, Journal of Hydrologic Engineering, 18(5), 536-541.*

advance seeding the areas will be to allow the grasslands to establish and suitably bind the soils prior to the start of construction. In this way, the grassland should be established once the solar panels are in place and would be able to prevent scouring along the panel driplines. Maintenance proposals for grassed areas under panels are discussed in Table 6 below.

6.5.3 To support watering of the landscaped area under the panels, rainwater harvesting tanks are proposed within East Park Site D at the East Park substation and the storage, operations and maintenance building. The roofs of these buildings will intercept initial rainfall onto the area and provide a nominal amount of storage. The storage provided for rainwater harvesting has conservatively not been accounted for in attenuation storage calculations for the proposed drainage strategy.

6.5.4 Surface water run-off from the impermeable areas in East Park Site D will be intercepted using a combined basin-swale system. Details on the combined system for each option are provided in the sections below.

6.5.5 In the combined basin-swale system (see Figure 3), the basin will provide attenuation storage for the run-off from the impermeable BESS and substation compounds, ancillary buildings, access tracks around the compound and the storage tank hardstandings, and the swales will intercept run-off from the access tracks and act as conveyance channels.

6.5.6 The BESS and substation compound will be impermeable and surface water run-off will be directed towards the adjacent detention basin. In normal operation the basin will allow for the attenuated discharge of surface water run-off into the proposed swale and then into an existing unnamed watercourse located within the development boundary in the northeast of the Site. However, in emergency situations a sluice gate is being proposed to isolate the basin and to prevent contaminated run-off leaving the Site. The sluice gate will be an actuated gate control system integrated with the fire detection system, enabling automatic closure upon the activation of the fire alarm within the BESS compound. This will ensure that contaminated run-off is not discharged but contained for appropriate collection and treatment.

6.5.7 The swales running parallel to the access tracks around the hardstanding will collect run-off from the tracks and discharge it into the basin via a culvert. A main conveyance swale will run parallel to the long section of the track extending from the BESS compound, which will simultaneously act as the conveyance channel from the basin while intercepting run-off from that section of the access track. A flow control will be used at the outlet of this main swale where its discharges to a nearby watercourse along the Order Limits on the B645. Based on the guidance for surface conveyance systems in the CIRIA SuDS manual[22], the main swale is designed to convey the peak design flow rate from the total impermeable area. Its geometry, calculated using the Manning's conveyance equation[23], is a base width of 1.0m, total depth of 0.6m (includes a 300mm freeboard) and a top width of 4.6m, with 1 in 3 side slopes. It will also have a 3m maintenance buffer on the side not adjoining the road.

6.5.8 The drainage plan also proposes culverts for underground conveyance where required, such as to cross sections of the tracks to provide the required connectivity between adjacent swales and the basin. For the connection between the basin and main conveyance swale, the culvert must cross existing buried gas and water lines. The required distance from these lines and their depth will be confirmed with Anglian Water and National Gas to finalise the viability of the culverted connection between basin and main swale. Trial pits will be required to confirm the depth of these services, which will need to be known to finalise the alignment and levels for the proposed surface water drainage network.

6.5.9 Safety considerations for the key drainage features were assessed in line with the Construction (Design and Management) Regulations 2015 (CDM 2015)[24] and the CIRIA SuDS Manual[22] to identify, eliminate or reduce foreseeable

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[22] *CIRIA (2015), The SuDS Manual (C753)*
[23] *Chow, V. T. (1959). Open-channel hydraulics. ISBN: 978-1-93284-618-8.*
[24] *Health and Safety Executive (HSE). (2015). The Construction (Design and Management) Regulations 2015.*

health and safety risks during the construction, operation and maintenance of the SuDS features.

6.5.10 The assessment focuses on the two primary SuDS features, the 1.5 m deep detention basin and the main conveyance swale (4.6 m top width, 1.0 m base). To mitigate the risks of soil collapse and access, both features are designed with 1:3 side slopes. This gradient aligns with the industry-standard threshold for ensuring “self-rescue” and safe mechanical maintenance access. While a 1.5 m water depth is significant, the risk is managed by ensuring that the basin functions as a dry pond during normal conditions, which will only utilise maximum storage during extreme storm events or fire emergencies both of which have a low probability occurrence. The existing slope gradient at the basin location is also relatively shallow at approximately 1:65, which means that its geometry can be accommodated without an excessive earthwork footprint. Additionally, the solar farm’s rural location and restricted public access significantly reduced the likelihood of unauthorised entry, ensuring the residual risk remains as low as reasonably practicable.

Water Quality Protection

6.5.11 The capacity of the combined basin-swale drainage system to provide sufficient water quality protection for day-to-day use under normal conditions was assessed using the Simple Index Approach[22]. The pollution hazard for the impermeable areas can be classified as low based on a ‘low traffic road’ land use classification. The pollution hazard indices for the contaminant types at the low pollution hazard level are shown in Table 4 and the pollution mitigation indices for the proposed SuDS features are shown in Table 5.

Table 4 – Pollution hazard indices for different land use classifications

Land Use	Pollution hazard level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Low traffic roads	Low	0.5	0.4	0.4

Table 5 – Indicative SuDS mitigation indices for discharges to surface water

SuDS Component	Mitigation indices		
	TSS	Metal	Hydrocarbons
Lagoon (Detention basin)	0.5	0.5	0.6
Swale	0.5	0.6	0.6

6.5.12 Based on the pollution hazard and SuDS mitigation indices presented above, the basin and swale will deliver adequate treatment of the run-off as the total pollution mitigation index for each contaminant type is equal to or exceeds the respective pollution hazard index for the contaminant type.

6.5.13 In the event of a fire or other similar incident, the sluice gate will be automatically closed, and potentially contaminated water will be collected and treated off site.

Maintenance Plan

6.5.14 The maintenance plan has been produced using the relevant guidance from the CIRIA SuDS Manual[11] and the key maintenance items for the proposed drainage strategy have been broken down in Table 6.

Table 6 – Operation and maintenance requirements for proposed drainage features

Feature	Maintenance Activity	Typical Frequency
Lagoon (Detention basin)	Remove litter and debris	Monthly
	Cut grass – for spillways and access route	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)

Feature	Maintenance Activity	Typical Frequency
	Inspect banksides, structures and pipework for evidence of physical damage	Monthly
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required.
	Check sluice and other mechanical devices	Quarterly
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required
Swale	Remove litter and debris	Monthly or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season or as required)
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, and record areas where water is ponding > 48 hrs	Monthly, or when required
	Inspect vegetation cover	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
	Repair erosion or other damage by re-turfing or reseeding	As required or if bare soil is

Feature	Maintenance Activity	Typical Frequency
		exposed over 10% or more of the swale treatment area
	Repair erosion or other damage by returfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
Landscaping		
Establishment Period (Years 1-5)		
	Inspect the ground around and under the panels for strips of bare soil (riling). If it is found that strips of bare soil are occurring beneath the solar arrays due to rainwater run-off (rilling) then these areas will be scarified, the soil cultivated locally and then reduced to a fine till, and the areas re-seeded with an appropriate hardy water-tolerant grass seed mix. For grazed grassland, At times where the ground is very wet or waterlogged, then livestock will be moved appropriately to prevent the ground being churned up by hooves, which could encourage rilling and bare patches of soil.	Monthly and following period of heavy rainfall
	Grazing within the grazing pasture and neutral grassland will be restricted and rotated throughout the site to a small number of sheep following planting to thicken up the grass sward and maintain a minimum grass height of 50mm. More details provided in OLEMP	Continuous review of grazing regime and groundcover
	If required, for grazed grassland the grass will be cut after 3 months by mechanical strimmer to a height of minimum 50mm. For species diverse grassland, grass will be cut to 75mm after first seeding and annually thereafter to 150mm.	Every 3 months (as required) for grazed grassland Annually for species diverse grassland
	Planted areas will be inspected during periods of warm weather and drought. If it is considered that the ground conditions are too dry or the plants are showing signs of drought stress, the planted areas will be watered until weather conditions are considered suitable for watering to cease.	As required - weather dependent

Feature	Maintenance Activity	Typical Frequency
	The sward composition of the grazing pasture will be reviewed annually to identify any problem weeds, such as ragwort, thistle, Dock etc, and management of these weeds would be undertaken as appropriate.	Annually
Operational Period (5 Years-)		
	The long-term management of the grazing pasture would continue as per the establishment period, with maintenance through grazing to achieve neutral grassland, and an annual cut in August of each year. The long-term management of the species-diverse grassland would continue as per the establishment period.	Annually

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1.1 The main conclusions and recommendations for the SWMP are outlined below and an indicative layout provided in the plans in Figures 2 and 3.

- Good surface water management during construction is essential to ensure that sediment does not pollute downstream watercourses;
- Vegetation cover would be retained for as long as possible and track construction phased to minimise the potential for soil stripping;
- Temporary drainage pathways will be established to direct surface water away from at risk areas and towards the SuDS and surface water drainage network via sediment controls;
- The aim of the drainage scheme will be to ensure that water from surrounding land is excluded from the Scheme and where this is not possible the volumes draining onto the Scheme are significantly reduced;
- Further guidance provided in this document on construction activities, vehicle access/maintenance, felling and spillage control would also be followed to further ensure pollution control;
- For the proposed road, where there are predicted (from pluvial flood mapping) or known areas of concentration of surface water run-off, it is recommended that V-shaped ditches (or shallow ditches combined with bunds), or recharge trenches be placed on the upslope side of the construction area;
- Downslope of the construction areas, a filter strip would run along the entire length of the excavated construction area. Where there is enough space available it is recommended that the minimum filter strip width be set at 5m. Vegetation would not be disturbed within this filter strip to enable treatment of any direct run-off from earthworks;
- Silt fencing is recommended as a primary treatment method within the earthworks. These will act to break up any preferential flow paths and divert and filter run-off. These would be set at regular intervals where necessary;

- It is recognised that some areas on site are more vulnerable than others and these may require additional surface water protection measures, including implementing a number of measures in series to ensure adequate treatment;
- It is envisioned that during the operational phase, the general SuDS approach adopted during construction will continue to be used. However, several features such as silt fences will be removed given the reduced pollution hazard during the operation phase;
- The SuDS solution for the PV panels is to use natural land management (i.e., reinstate and maintain vegetation cover) under and around the raised panels allowing overland flows similar to pre-development conditions;
- The outline drainage plan is for the impermeable area in East Park Sites D. It uses a combined basin-swale system to provide SuDS storage with attenuation on site during operation to treat and manage run-off from the impermeable areas;
- The basin will collect run-off from the BESS and substation compounds including tracks within and immediately outside the compound. It will also collect run-off from the O&M building and its hard standing. The swale system is divided into; (i) a series of swales running parallel to the tracks around the BESS compound that will convey run-off into the detention basin, and (ii) a main swale running parallel to the main track extending from the BESS compound to the main site access. This main swale will simultaneously intercept run-off from the main track section while combining and conveying this run-off with that from the basin. The main swale will discharge into a nearby watercourse at the main site access via a controlled outlet;
- The basin will also collect contaminated run-off from the BESS compound (with the capacity to store the entire 456,000 litres of firewater) during an emergency. There will be a sluice gate that can be automatically closed in the event of a fire to contain this contaminated run-off; and
- The estimated required volume for the basin is based on the 1.0% AEP rainfall event plus a 40% climate change allowance and the total

impermeable area of the BESS and substation compounds, ancillary buildings and tracks within and around the BESS compound.

ANNEX 1 – GREENFIELD RUN-OFF RATES

ReFH2 Greenfield Runoff Estimate
Calculation Sheet

Site Name	East Park Energy
Site Location	Bedford/Huntington Border
X (Eastings)	508218
Y (Nothings)	263813
Engineer	Ajani Jacobs
Checked by	Daniel Hamilton
Reference	WHS1967
Revision	1
Date	11-Jul-24

Site Description

Total Area (ha)	766
Existing Developed area (ha)	0
SAAR (mm)	554
PROPWET(mm)	0.24
BFIHOST19	0.37

Rainfall Parameters

Duration (hh:mm:ss)	11:00:00
Timestep (hh:mm:ss)	01:00:00
SCF (Seasonal correction factor)	0.65
ARF (Areal correction factor)	1 [0.97]
Seasonality	Winter

Loss Model Parameters

Cini (mm)	132.55
Cmax (mm)	311.17

Routing Parameters

Tp (hr)	6.76
Up	0.65
Uk	0.8

Baseflow Parameters

BF0 (m^3/s)	0.29
BL (hr)	45.83
BR	1.22

Growth Curves and Discharge rates

Event	*Q/Qmed*	*Q (l/s)*	*Q (l/s/ha)*
Q1	**-**	**1538.40**	**2.01**
Q2	1.00	1761.76	**2.30**
Q30	**2.15**	**3795.01**	**4.95**
Q100	**2.77**	**4874.84**	**6.36**
Q100(CC)	**3.53**	**6227.03**	**8.13**
Q1000	4.90	8634.05	11.27

ANNEX 2 – SUDS FEATURES CALCULATION SHEET

East Park Energy - SuDS Required Storage Calculations

WHS1967 - Eaton Socon (East Park Energy)

Information Sheet

Parameter			Source /rational
Impermeable Area			Extracted from dwg in QGIS
Storage volume required			Calculated in Causeway Flow
Climate change allowance (%)	40		EA Peak Rainfall Allowance for Upper and Bedford Ouse Management Catchment (Credible Maximum - .i.e, Upper End Allowance) https://environment.data.gov.uk/hydrology/climate-change-allowances/rainfall
Peak discharge (l/s/ha) **For attenuation**	-		Soakways for buildings (if applicable)
	4.95		Greenfield runoff rates (30yr)
	9.24		Greenfield runoff rates (100yr + 40% CC)
Geology	Bedrock geology - *Mudstone* Superficial deposits: General site - *Sand, Gravel, Diamicton, Clay and Silt* Section of site with buildings - *Unavailable*		https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/
Soil information	General site (including the area with buildings): *Lime-rich loamy and clayey soils with slighly impeded drainage. Texture - clayey, some loamy.* *Areas of loamy freely draining and loamy & clayey impeded drainage through the site.*		https://www.landis.org.uk/soilscapes/
Infiltration rates*:	Best-estimate	Worst-case	
m/s	0.000001	0.00000001	CIRIA SuDS Manual pg. 546 (based geology and soil information)
m/h	0.0036	0.000036	

* Soil type/texture:
Very poor infiltration media/Silty clay loam

Infiltration range: $1x10^{-8}$ - $1x10^{-6}$

East Park Energy - SuDS Required Storage Calculations

Required Storage Estimate and Headroom Assessment for Basin

Impermeable Area Summary

Feature	Impermeable area, Ha
hard surface	17729
O&M building	755.66
Substation control building	1027.59
Tracks (Inside & around BESS compound)	7379
Water storage (57m2 ea.)	114
TOTAL	**27005.25**

Note:
Access track to be made from permeable material.
Hard surface under transformer to made of no. fine crushed stone.

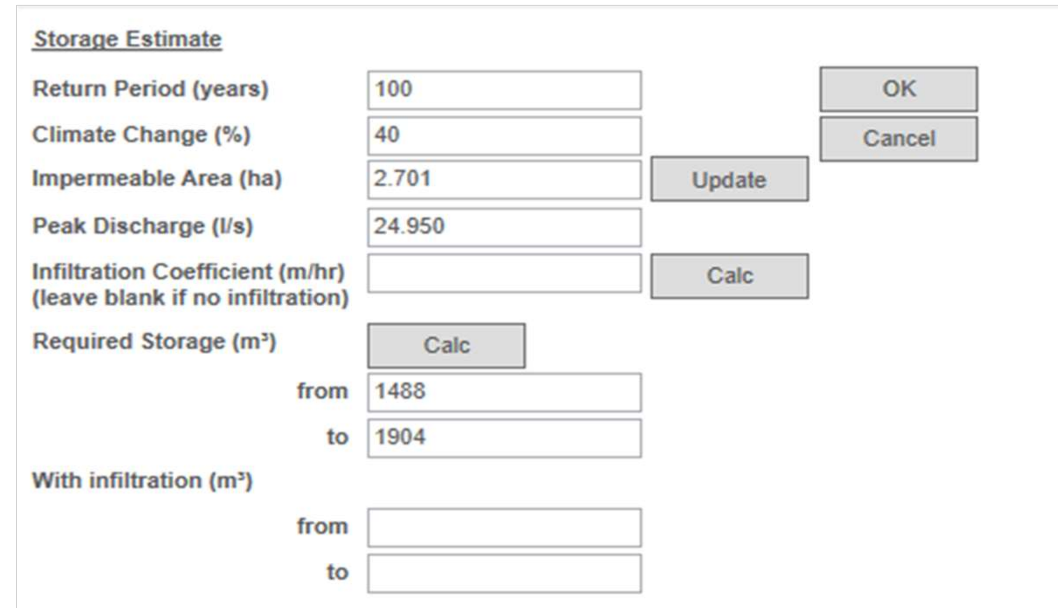
Requried Storage Vol. Estimate

Component	Impermeable Area		Required storage with infiltration, m^3		Required storage without infiltration**	
	m^2	Ha	Best-estimate	Worst-case	m^3	m^3/ha
Hard surface (entire hard surface area)*	27005.25	2.7	-	-	1488- 1904	705.19

*the lagoon will provide storage for all the impermeable area except the section of the track extending from the BESS compound

**discharging at 100yrCC greenfield rate (l/s/Ha) per impermeable area (Ha) 24.95

Storage feature should be able to accommodate entire fire water stores: 456,000 l
456 m^3



Extracted from Causeway FLOW

Storage capacity above firewater volume 1448 m3

Runoff volumes from ReFH

Return Period	Direct runoff vol (ReFH)	
	ML	m^3
1yr	0.19	190
2yr	0.222	222
30yr	0.905	905
30yrCC	1.33	1330
50yr	1.01	1010
50yrCC	1.5	1500
75yr	1.11	1110
75yrCC	1.65	1650
100yr	1.19	1190
100yrCC	1.76	1760
200yr	1.4	1400
1000yr	2.18	2180

∴ Storage cap. Above firewater volume is ~equivalent to the 2.0% AEP + CC return period (50yrCC)

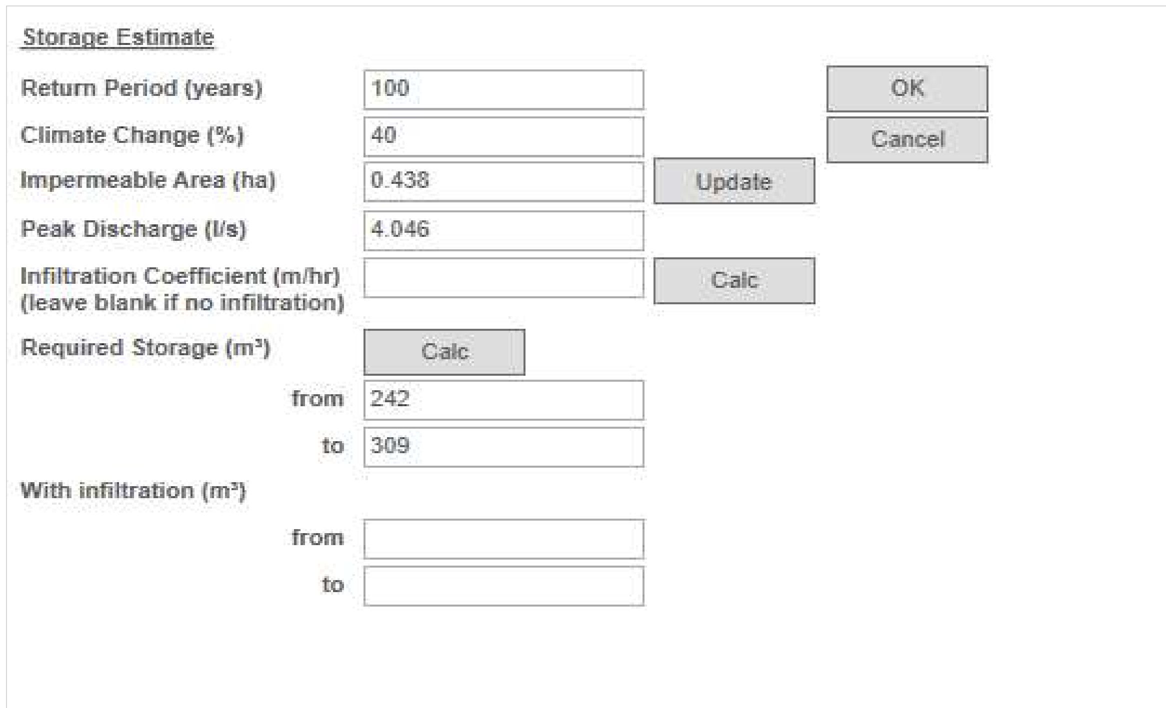
East Park Energy - SuDS Required Storage Calculations

Required Storage Estimate for Main Swale

Component	Impermeable Area		Required storage with infiltration,		Required storage without infiltration**	
	m^2	Ha	Best-estimate	Worst-case	m^3	m^3/ha
Access Tracks (extending from BESS compound)*	4379	0.4379	-	-	242 - 309	705.64
Total	**4379**	**0.4379**				

*The swale will provide storage/conveyance for access track extending from the BESS compound

****Discharging at 100yrCC greenfield rate (l/s/Ha) per impermeable area (Ha): 4.046**


Storage Estimate
Return Period (years): 100
Climate Change (%): 40
Impermeable Area (ha): 0.438
Peak Discharge (l/s): 4.046
Infiltration Coefficient (m/hr) (leave blank if no infiltration):
Required Storage (m^3)
from: 242
to: 309
With infiltration (m^3)
from:
to:
OK
Cancel
Update
Calc
Calc

East Park Energy - SuDS Required Storage Calculations

Main Conveyance Swale Geometry (Cross-section)

Total Imperameable Area for Swale (ha):	
BESS Compound	2.7
Access track and operations buidling	0.4379
Total	**3.14**

Maximum outflow to swale per impermeable area @ 100yr + 40% CC greenfield rate (l/s):

l/s	29.01	Flow input for Manning's Equation on page 5
m^3/s	0.03	

Swale Cross-section:

Depth of swale (*y* from mannings eqn flow on pg. 5)	0.24	m
Total depth (including 300m freeboard)	0.54	m
Top Width*	4.22	m

$$^{*}\ W = b + 2(sd)$$

Where:

W = Top width (m)

b = Base width (m), assuming 1 m wide base

s = Side slope horizontal ratio, (3 for a 1:3 slope)

d = Total depth (m)

Manning's Flow Equation for Open Channel

Q	0.03	<< Use goal seak to change y to get required value of Q
y	0.24	
S	0.0092	
n	0.4000	
A	0.40	
P	2.50	
R	0.16	

$$Q = VA = \left(\frac{1.00}{n}\right) AR^{\frac{2}{3}} \sqrt{S} \quad [SI]$$

Cross Section				Bed below WL					
X	**Y**	Above WL		**X**	**Bed Y**	**WL Y**	**Depth**	**Area**	**Wetted Perim**
-	2.00	Y	first LB above	5.29	0.24	0.24	-		
6.00	-	N		6.00	-	0.24	0.24	0.08	0.75
7.00	-	N		7.00	-	0.24	0.24	0.24	1.00
13.00	2.00	Y	first RB above	7.71	0.24	0.24	-	0.08	0.75
14.00	2.00	Y						-	-
15.00	2.00	Y						-	-
16.00	2.00	Y						-	-
17.00	2.00	Y						-	-
18.00	2.00	Y						-	-
19.00	2.00	Y						-	-
20.00	2.00	Y						-	-

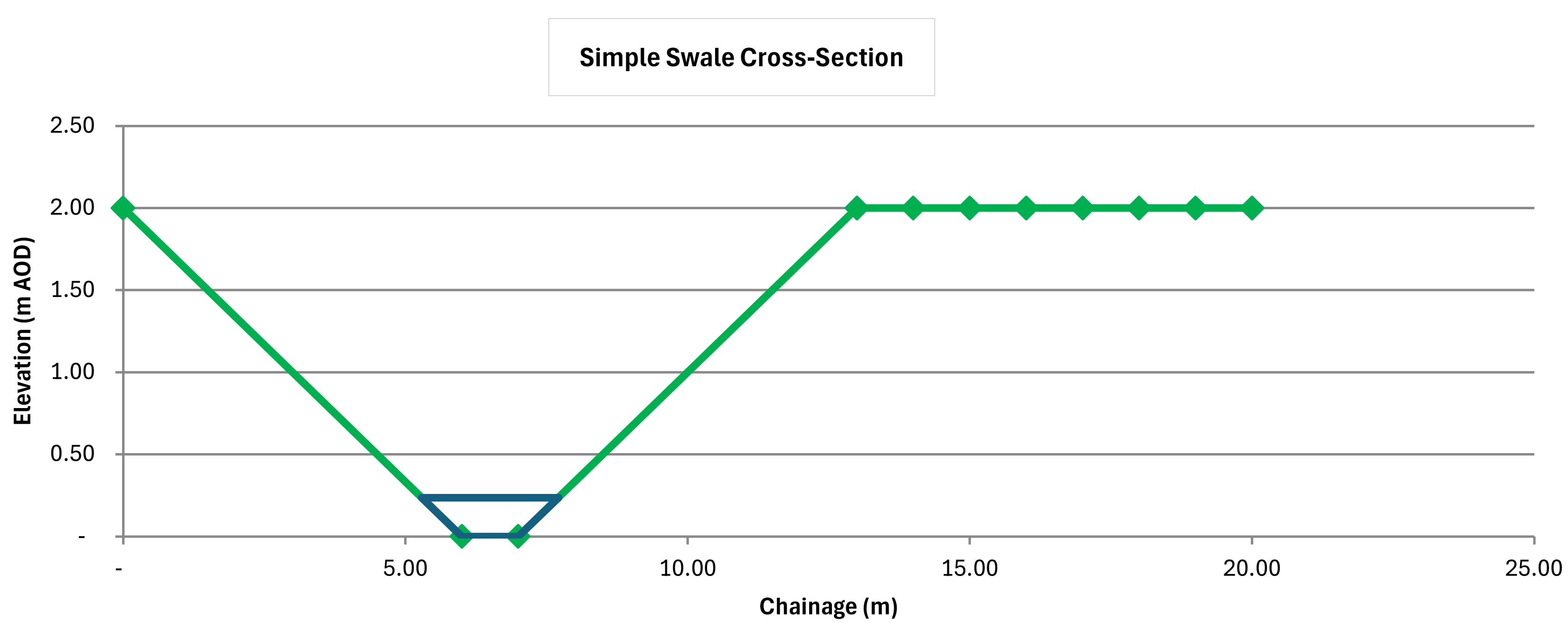
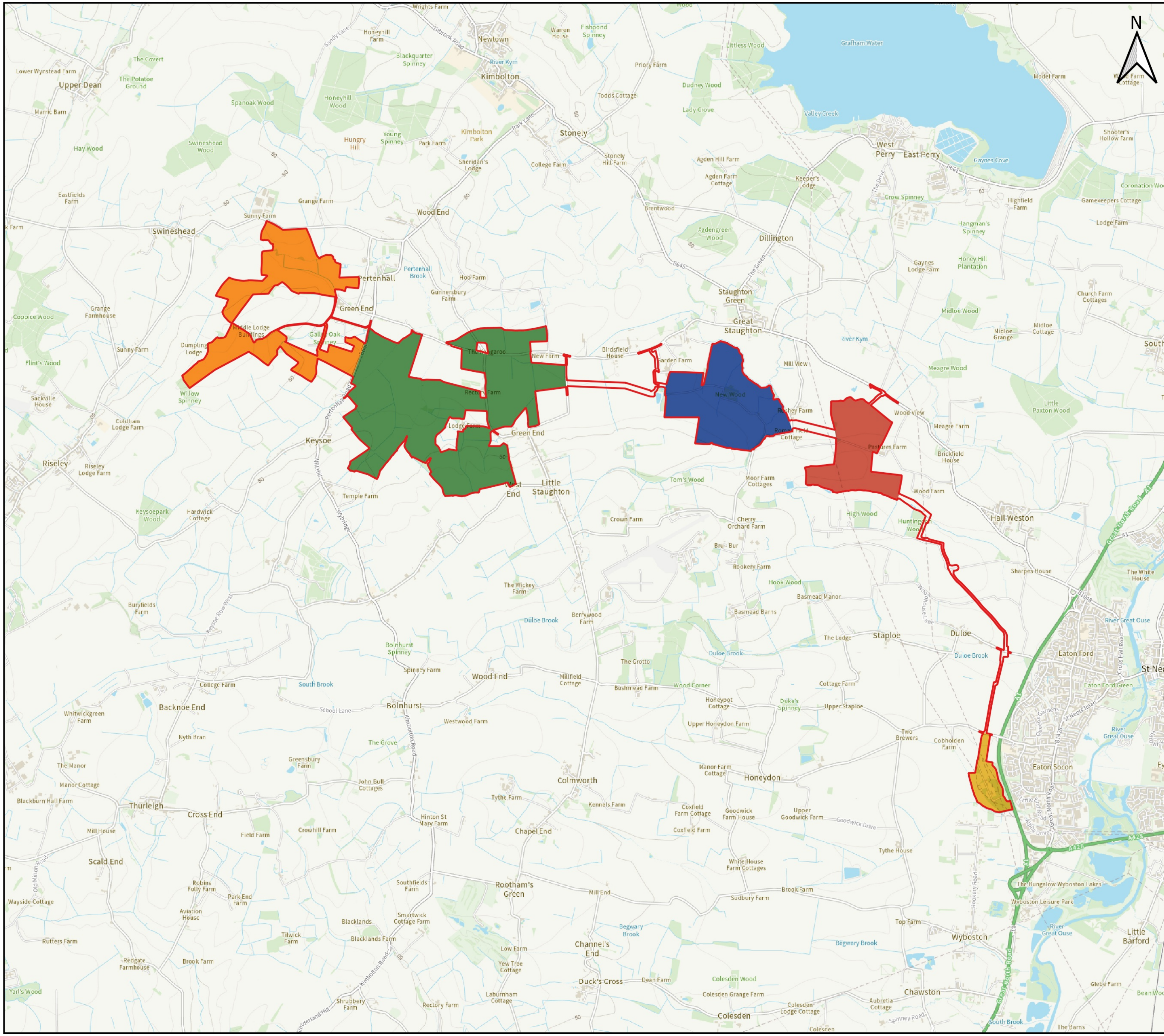


FIGURE 1 – SITE LOCATION AND SUBDIVISION



Project :

East Park Energy

Client :

axis

Legend :

- Order Limits
- Site Subdivisions
  - East Park A
  - East Park B
  - East Park C
  - East Park D
  - Connection Point
- Access Routes/Internal Cabling & Grid Connection Corridors

Scale : 0 — 1,000 — 2,000 m

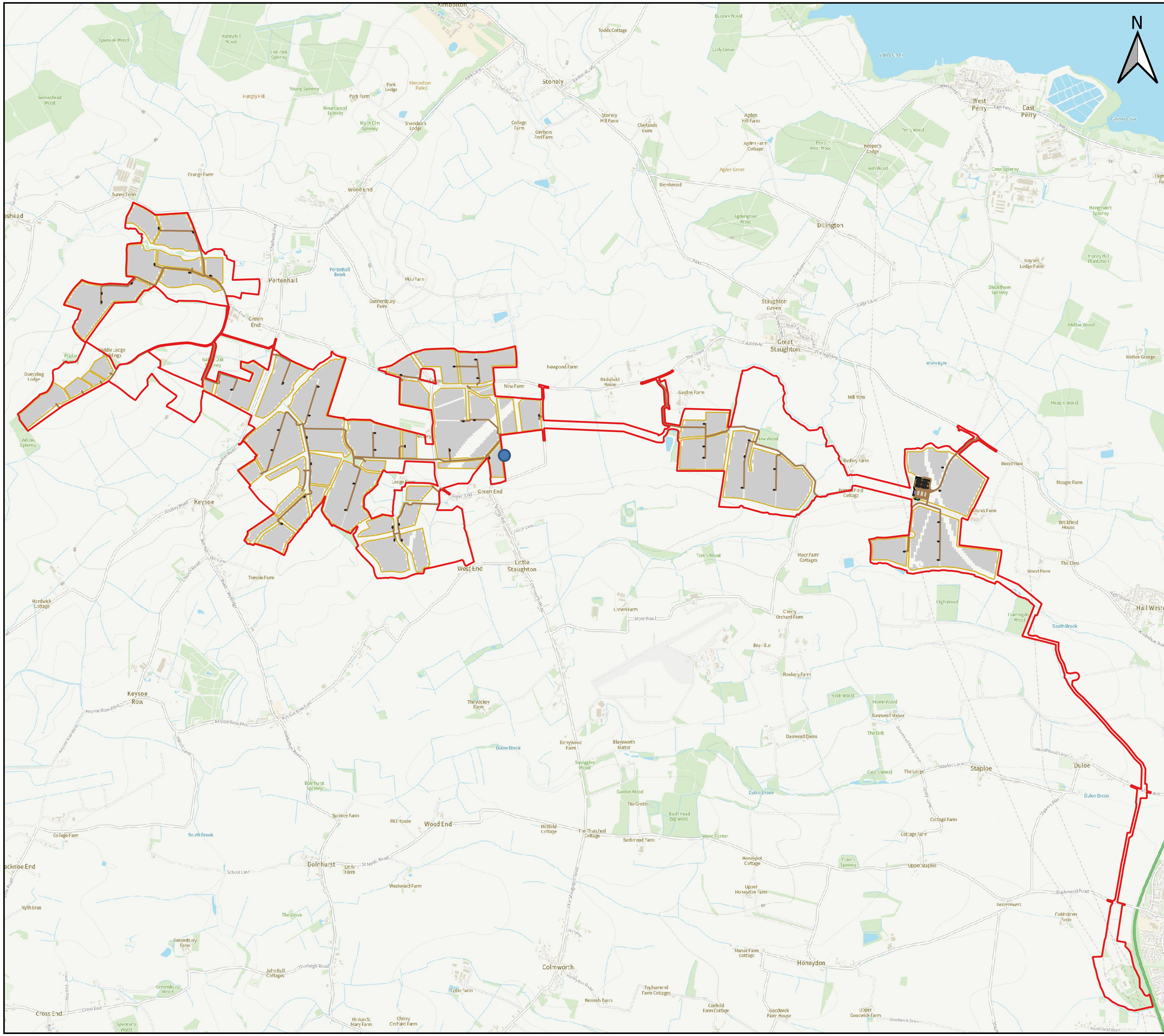
Title :

Figure 1: Site Location and Subdivisions

Drawing :	Rev :
WHS1967-T01-0001	3

WHS

FIGURE 2 – SITE AREA AND POINT DESCRIPTOR LOCATION



Project :

East Park Energy

Client :

axis

Legend :

Order Limits

Point Location (Centroid of site boundary)

Scale :

0 1,000 2,000 m

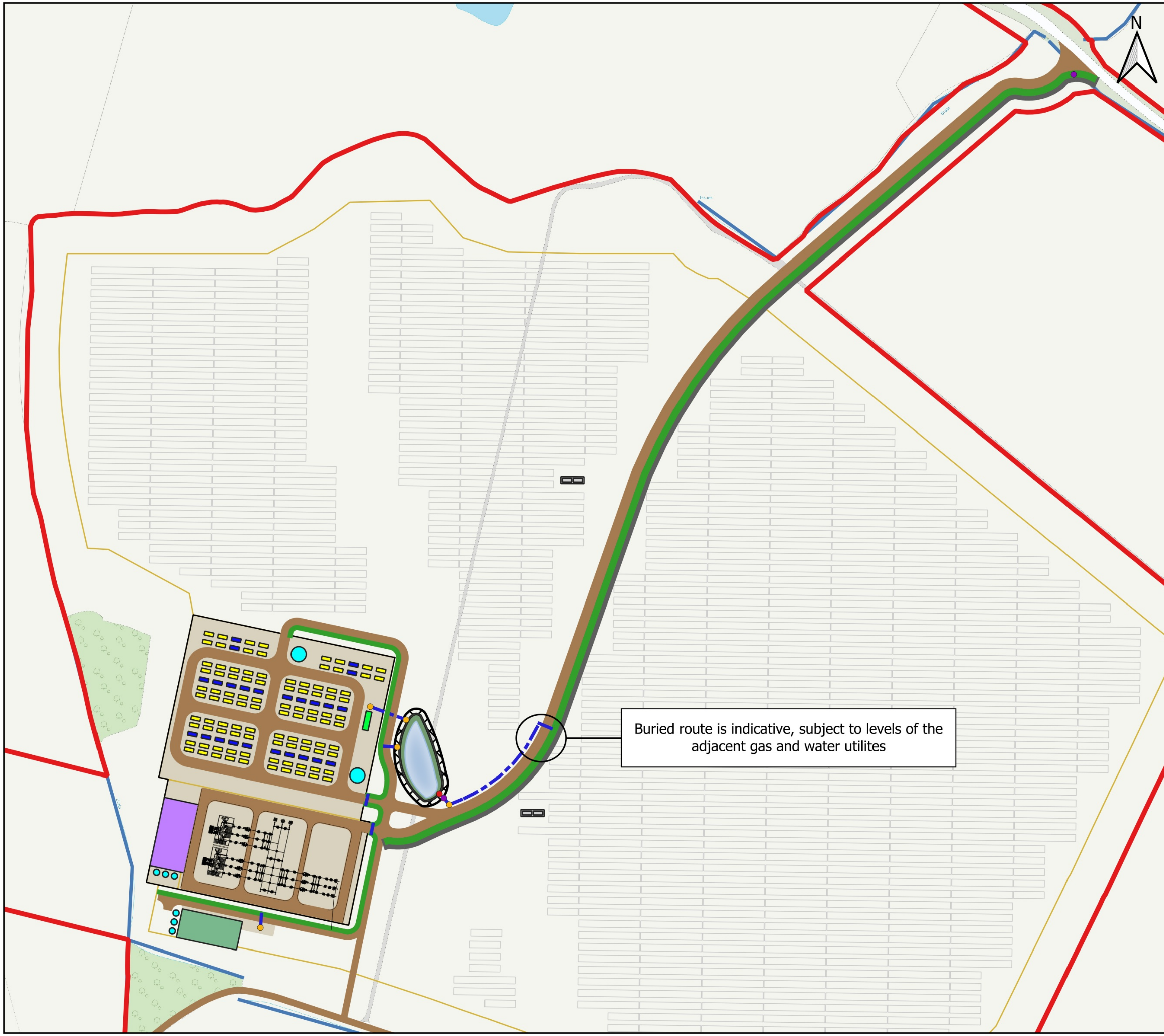
Title :

Figure 2: Site Area and Point Location

Drawing :	Rev :
WHS1967-T01-0002	3

WHS

FIGURE 3 – INDICATIVE DRAINAGE LAYOUT



Project :

East Park Energy

Client :

axis

Legend :

Layout

- Batteries
- Battery Control Building
- Transformers
- Water Storage
- PV Panels
- O&M building
- Substation Control Building
- Access Track
- Bunded Area
- Hard Surface

Outline Drainage

- Detention Lagoon
- Lagoon Maintenance Area
- Existing Watercourse

Surface Water Drain

- Culvert
- Swales (including Main Swale)
- Main Swale Maintenance Area
- Manholes
- Flow Control
- Sluice Gate

Scale : 0 50 100 m

Title :

Figure 3: Outline Drainage Plan

Drawing : WHS1967-T01-0003

Rev : 6

WHS