West Burton Solar Project

Environmental Statement

Appendix 10.5: Flood Risk Assessment and Drainage Strategy – West Burton 3

Prepared by: Delta-Simons
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West Burton
SOLAR PROJECT

Flood Risk Assessment and Drainage Strategy

Appendix D - West Burton 3

Presented to: **West Burton Solar Project**

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Protecting people
and planet

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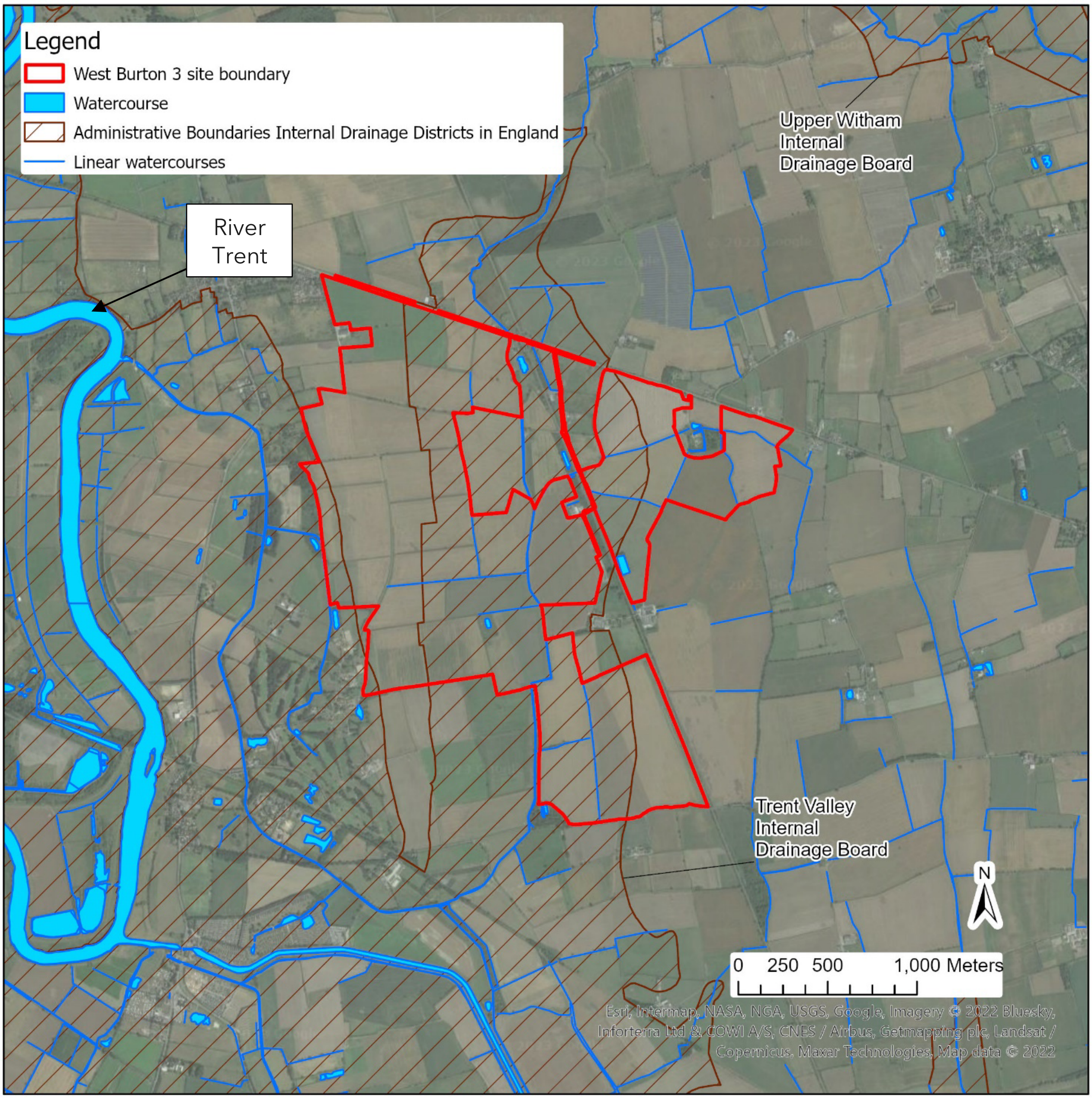
Annexes

1.0 Site Description

1.1.1 The term "Site" has been used in reference to the land parcels which make up the overall Scheme. For further details of the Scheme, please see Chapter 4 of the Environmental Statement (ES): Scheme Description [EN010132/APP/WB6.2.4].

1.1.2 The aim of this section of the report is to outline key environmental information associated with the baseline environment.



Site Location Plan	
Co-ordinates	Centred approximately at National Grid Reference 486182, 379745.

Site Location	The Site is located within a predominantly rural area with the surrounding area dominated by agricultural land and a number of farms. Residential dwellings and a golf course are present to the south west and commercial properties are present adjacent to the central area of the Site. The villages of Marton and Torksey are present to the north west and south west, respectively.
Existing Site Conditions	Online mapping (including Google Maps / Google Streetview imagery, accessed February 2023) shows that the Site is greenfield comprising agricultural / arable fields. A railway line bisects the Site, on the line between Saxilby and Gainsborough Lea Road stations.
Topography	Topographic levels to metres Above Ordnance Datum (m AOD) have been derived from a 1 m resolution Environment Agency (EA) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). A review of LiDAR ground elevation data shows that the Site slopes uphill in both directions (east and west) from a central low point of approximately 5 m Above Ordnance Datum (AOD) running north-south through the Site. Maximum elevation on the Site in the west is approximately 18 m AOD, and approximately 15 m AOD in the east. Given the size of the Site the gradients are shallow and the Site is relatively flat. A LiDAR extract is included in Annex A.
Hydrology	A series of unnamed drains run throughout the Site. Other watercourses in the area include the River Trent which is located 1.2 km west of the Site. The Site is partly located within the Trent Valley Internal Drainage Board (IDB).
Water Framework Directive Status	The Site is located across both the Skellingthorpe Main Drain and Marton Drain (tributary of Trent) Water Body Catchments. A summary of the Water Body Classifications for the catchments are included as Annexes B and C.
Geology	Reference to the British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the central portion of the Site is underlain by superficial deposits of Holme Pierrepont Sand and Gravel Member generally comprising Sand and Gravel. The majority of the Site is underlain by bedrock deposits of Scunthorpe Mudstone Formation consisting of interbedded Mudstone and Limestone with the western boundary underlain by Penarth Group consisting of mudstone. The geological mapping is available at a scale of 1:50,000 and as such may not be accurate on a Site-specific basis.
Hydrogeology	According to the EA's Aquifer Designation data, obtained from MAGIC Map's online mapping [accessed February 2023], the Pierrepont Sand and Gravel Member is classified as a Secondary A Aquifer. Secondary A Aquifers are 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers'; The underlying Scunthorpe Mudstone Formation is described as a Secondary B Aquifer. Secondary B Aquifers are '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. These are generally the water-bearing parts of the former non-aquifers'. The Penarth Group bedrock is described as a Secondary Undifferentiated Aquifer. Secondary Undifferentiated Aquifers are assigned in 'cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'. The EA's 'Source Protection Zones' data, obtained from MAGIC Map's online mapping, indicates that the Site is not located within a Groundwater Source Protection Zone.
Proposed Site Conditions	The proposed development for the Site comprises ground mounted solar photo-voltaic panels and conversion units with associated substation and battery storage area in the west of the Site, and access roads located throughout the remaining Site. An Illustrative Layout Plan is included as Annex D.

2.0 Assessment of Flood Risk

2.1 Tidal Flood Risk

2.1.1 The Site is situated inland at a minimum elevation of 5 m AOD. Therefore, the risk from tidal flooding is considered to be **Negligible**.

2.2 Fluvial Flood Risk

EA Online Maps

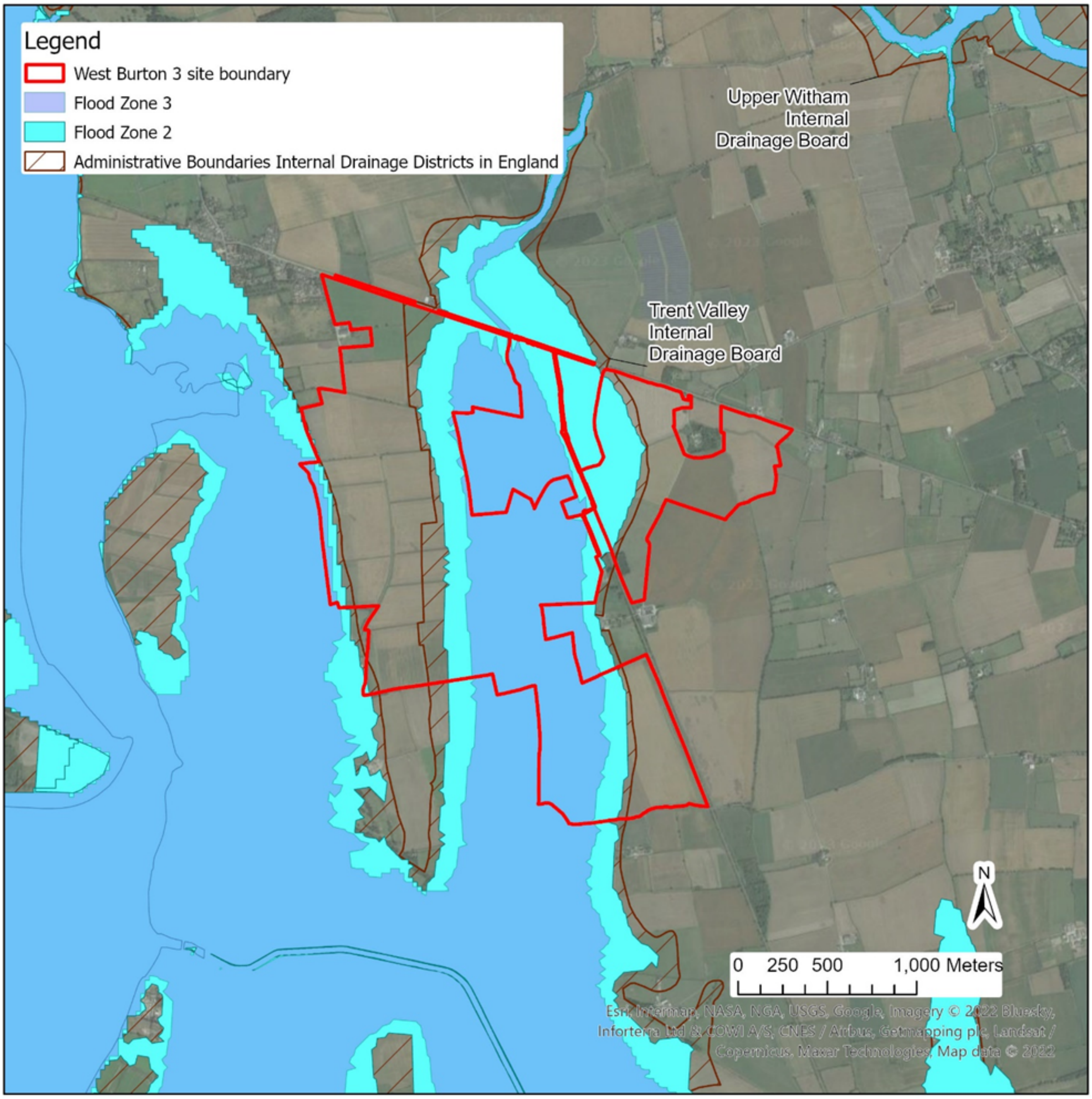


Figure 1: EA Flood Map for Planning

2.2.1 The EA's Flood Risk Map for Planning (Figure 1) indicates that the central extent of the Site is located within Flood Zones 2 and 3. The western and eastern peripheries of the Site are located in Flood Zone 1.

2.2.2 Fluvial risk across the Site is associated with a series of land drains, which ultimately discharge into the Foss Dyke Navigation 1.8 km southwest, and the River Till 3.5 km east of the Site. There is also a portion of flood risk derived from the River Trent, approximately 750 m west of the Site at its closest point.

2.2.3 The EA's Historic Flood Map (Annex E) indicates that the central area of the Site has flooded previously in 1795 and 1947, associated with flooding from the River Trent.

Flood Defences

2.2.4 The EA's Spatial Flood Defences Dataset indicates that there are no flood defences present within the vicinity of the Site.

EA Product Data / Consultation

2.2.5 Through consultation with the EA (Annex F), site-specific flood levels of 5.95 m AOD for the 1 % AEP + 20% CC event and 7.7 m AOD for the 0.1% AEP + 20% Climate Change (CC) event were confirmed.

2.2.6 The EA did not provide any GIS model data, therefore in order to assess the fluvial flood risk at the Site the 1 % AEP + CC flood level of 5.95 m AOD has been visualised across the Site's topography using elevation data to create a proxy flood depth map (Annex G). The proxy map indicates that the central portion of the Site is situated below the flood level, however the vast majority of the flooding within this area is shown to remain below 1 m in depths. Some flooding in excess of 1 m is expected across a minor proportion of the Site in the south.

2.2.7 The proxy flood map included in Annex G depicts indicative locations of the conversion units across the Site. The conversion units that are located within the flood extent will need to be raised as high as practicably possible above the 0.1% AEP + CC flood level (ideally 600 mm above).

2.2.8 Further details of the embedded flood mitigation measures that have been incorporated into the Site's design are provided in Section 2.7.

2.2.9 A proxy flood map of the 0.1% AEP + 20% CC flood level is included in Annex H. The map indicates that depths within the central Site area increase to above 2 m during this scenario, with areas in the south of the Site holding flood depths greater 2.7 m. It should be noted that as the operational life of the Scheme will not exceed 40 years, the 0.1% AEP + 20% CC is extremely unlikely to occur within this time period and is considered a residual risk. In the unlikely scenario that this event did occur, approximately 21% of the Site would be covered by flood depths that exceed 2.3 m, panels within this area could become submerged by flooding and become inoperable. The Scheme has been designed so that in this scenario it would be possible to electrically isolate damaged infrastructure and replace it without affecting the operation of the rest of the Scheme..

Summary

2.2.10 Based on the evidence provided above, the western and eastern extents of the Site are expected to remain flood free across all flood risk scenarios. The central portion of the Site is shown to flood during the 1% AEP + 20% CC event, the vast majority of flooding is expected to remain below 1 m in depth. Deeper flooding in excess of 2 m is expected during the 0.1% + 20% CC event however as the operational life of the scheme will not exceed 40 years, the likelihood of this event occurring is very low, and is therefore considered a residual risk.

2.2.11 The Site includes embedded mitigation measures including the proposed solar panels being raised above surrounding ground levels and associated power infrastructure appropriately raised and waterproofed. Embedded mitigation measures are considered in 3.2 of the covering report [EN010132/APP/WB6.3.10.1] and in section 2.7 of this appendix.

2.2.12 It can therefore be concluded that the Site is at **Low** risk of fluvial flooding, therefore no specific mitigation is considered necessary.

2.3 Surface Water Flood Risk

2.3.1 The EA's Long-Term Flood Risk Map (Figure 2) indicates that the majority of the Site is at Very Low (<0.1% Annual Probability) risk of surface water flooding. There are some areas of Low to High (0.1 – >3.3%) risk present within the central extents of the Site.

2.3.2 Flood depths are expected to remain below 300 mm during the High and Medium Risk scenarios in all areas excluding a small portion in the north of the Site, which is expected to reach depths between 300 and 900 mm, associated with ponding behind the railway.

2.3.3 The surface water extents shown on the EA's Long-Term Flood Risk Map largely concur with the Flood outlines shown on the EA Flood Map for Planning which are associated with land drains which cross the Site.

2.3.4 There is no indication within relevant third party reports to suggest that the Site has historically experienced surface water flooding.

2.3.5 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**.

2.3.6 The battery storage and substation will be bunded to ensure that all infrastructure remains flood free across all surface water flood risk scenarios. The proposed solar panels and power stations 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.

2.3.7 The impact of the proposed substation/battery storage area is covered in Sections 3.0, to ensure that surface water risk is not exacerbated.

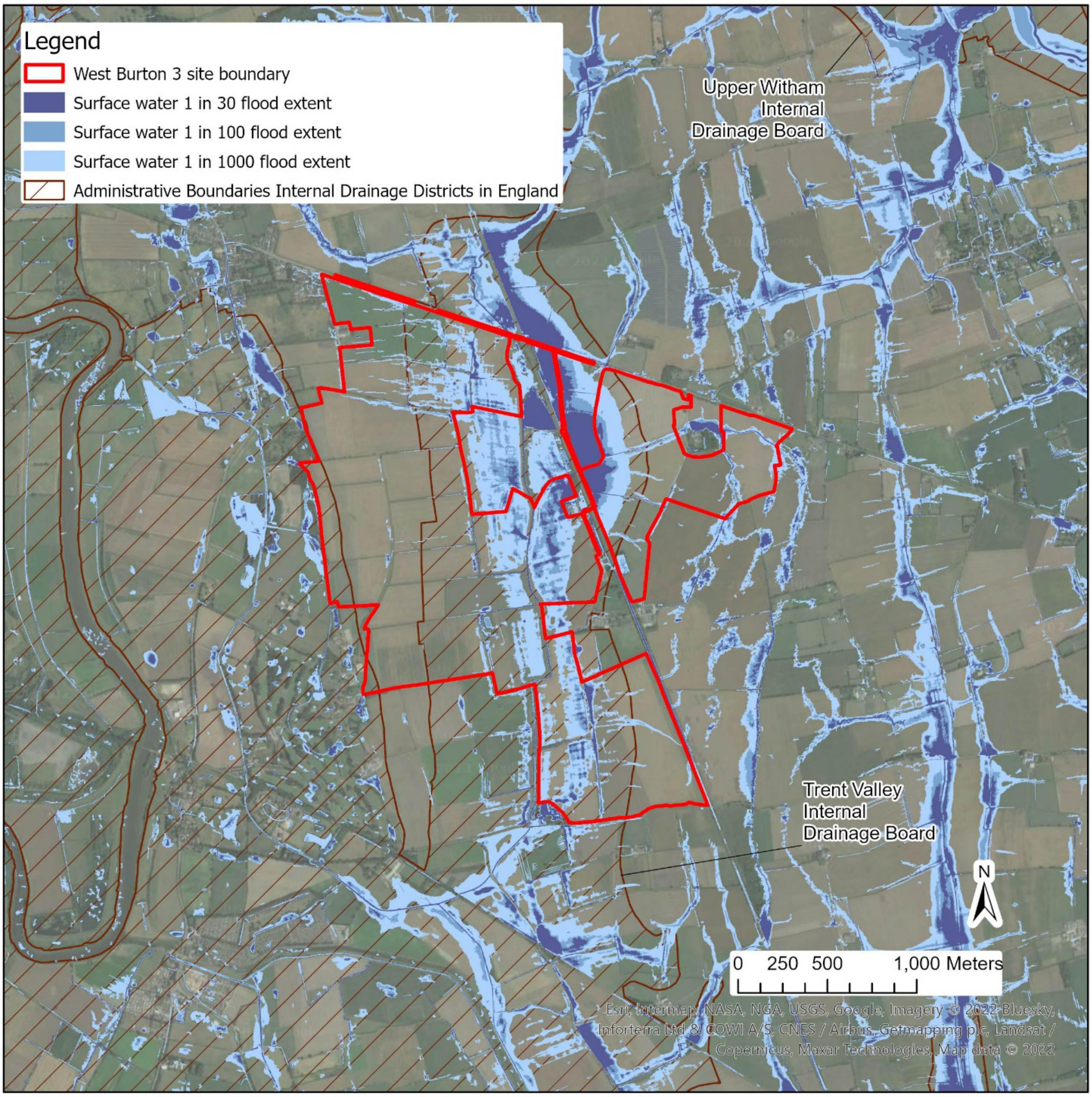


Figure 2: EA's Long-Term Flood Risk Map (Flood Risk from Surface Water)

2.4 Groundwater Flood Risk

2.4.1 There is no information within relevant third party reports to suggest that the Site has experienced historical groundwater flooding.

2.4.2 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.

2.4.3 It can therefore be concluded that the risk of groundwater flooding is **Low** and no specific mitigation measures are required.

2.5 Artificial Sources Flood Risk

Sewer Flooding

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

2.5.2 On the basis of the Site's rural setting, the presence of sewerage infrastructure is unlikely.

2.5.3 It can therefore be concluded that the risk of sewer flooding is **Low**.

Reservoir Flooding

2.5.4 The EA 'Flood Risk from Reservoirs' map shows that the Site is not within the extents of a reservoir breach. The EA states within their Preliminary Flood Risk Assessment for England (dated October 2018) that 'reservoir flooding is extremely unlikely to happen'. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the EA ensure that reservoirs are inspected regularly, and essential safety work is carried out. It can therefore be concluded that the risk from reservoir flooding is considered to be Negligible.

Canal Flooding

2.5.5 There are no canals within the vicinity of the Site. Therefore, the risk from canal flooding is considered to be **Negligible**.

2.6 Summary of Flood Risk

2.6.1 It can be concluded that the risk to the Site from all sources of flooding is **Negligible to Low**, and therefore mitigation is not required in this instance., however it would be prudent to include the below mitigation measures.

2.7 Embedded Mitigation

2.7.1 8m easements have been established around all watercourses, including Main Rivers and Ordinary Watercourses and 9 m from IDB assets.

2.7.2 All service cabling should be designed and installed to be flood resilient / water compatible. This should be achieved in accordance with appropriate design standards and best practise guidance.

2.7.3 Either fixed or tracker panels will be utilised throughout the Sites.

2.7.4 The minimum height of the lowest part of the fixed solar panel units will be 0.6 m above ground level. There is potential to increase the height of the lowest part of the panel by raising the lower end of the panel mounting frames, which could provide at least 0.6 m of freeboard above any flooding. The maximum specified height of the upper edge of the fixed panels will remain at 3.5 m above ground levels.

2.7.5 Fixed panels should be located within areas of the Site which are located in Flood Zone 1 or in areas where flood depths do not exceed 0.6 m.

2.7.6 The tracker solar panel units will be mounted on raised frames (usually raised a minimum of 0.4 m) when on maximum rotation angle) and will therefore be raised above surrounding ground levels and fitted with a tracking system. During times of flooding, solar panels may be stowed by the tracking system algorithm onto a horizontal plane, to the minimum post height of 2.3 m above ground level. This ensures that all sensitive and electrical equipment on the solar panel is raised to a minimum of 2.3 m above ground level in the horizontal position. As stated above, there is a residual risk that if the 0.1% AEP + CC event were to occur some of the panels could become inoperable due to flood depths reaching above 2.3 m.

2.7.7 Based on the Illustrative Layout Plan (Annex D) the battery storage and substation have been sequentially located outside of the flood zone extents. Where feasible, other electrical equipment such as the conversion units should also be located outside the flood extent. Where this is not a feasible option, the sensitive electrical equipment should be raised as high as practicably possible (ideally 0.6 m above the 0.1% AEP + CC flood level, or as high as practiable).

Flood Warnings and Evacuation

2.7.8 Flood Warnings / Flood Alerts do not cover this area. However, access to the Site will be required relatively infrequently, typically by technicians for maintenance and inspection works or Site management. Such works can be scheduled as to avoid the site during times of flood.

2.8 Residual 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 on-Site land drains and potentially impact the Site. 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 further mitigation beyond what is proposed is required.

2.8.2 In the event of the defences failing or an exceedance event occurring, the residual risk to people working within the Site can be managed through the implementation of an appropriate Site management plan, which recognises the residual risks and details what action is to be taken by staff in the event of a flood to put occupants in a place of safety.

2.9 Impact on Off-Site Flood Risk

2.9.1 The battery storage and substation have been sequentially located outside the Flood Zone extents. The solar 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 proposed development and no increased in flood risk elsewhere.

2.9.2 Surface water management for the proposed ground mounted panels has been considered within Section 5.0 of the Covering Report [EN010132/APP/WB6.3.10.1].

2.9.3 Surface water management for the proposed substation and battery storage area has been considered in Section 3.0 below.

3.0 Substation and Battery Storage Drainage Strategy

3.1 Introduction

3.1.1 The Illustrative Site Layout Plan (Annex D) indicates that a substation and associated battery storage infrastructure are proposed to be located in the west of the Site.

3.1.2 Approximately 0.71 Ha of hardstanding areas will be introduced in the form of foundation pads for the substation and battery storage.

3.1.3 The increase in hardstanding area will result in an increase in surface water runoff rates and volumes. In order to ensure the proposed development will not increase flood risk elsewhere, surface water discharge from the Site will be controlled via a flow control device such as a Hydrobrake or orifice plate and the resultant attenuation will be provided utilising the most appropriate SuDS methods as detailed in the drainage strategy below and secured through DCO.

3.2 Existing Runoff Rates

3.2.1 The existing greenfield runoff rates for the substation and battery storage Site have been estimated using the Revitalised Flood Hydrography Model (ReFH2) method provided as Table 1 below.

3.2.2 The existing 1 in 2 year event greenfield rate is 3.23 l/s.

3.2.3 Restricting runoff from the substation / battery Site to the existing 1 in 2 year event greenfield rate is proposed to ensure a significant betterment during higher intensity storms and to ensure the drainage system is self-cleansing.

Table 1: Greenfield Runoff Rates

Return Period (years)	Runoff Rate (l/s)
1 in 2	3.23
1 in 10	6.72
1 in 30	9.27
1 in 100	12.51
1 in 1000	21.48

3.3 Attenuation Storage

3.3.1 In order to achieve the above discharge rate, attenuation storage will be required.

3.3.2 MicroDrainage Quick Storage Estimates have been undertaken to determine the potential attenuation requirements during both the 1 in 30 year + 20% CC and the 1 in 100 year + 20% CC events based on the hardstanding value of 0.71 Ha. Quick Storage Estimate outputs are included as Annex I and are summarised in Table 2.

Table 2: Summary of Attenuation Requirements

Return Period	Attenuation Requirement (m^3)

1 in 30 + 20% CC	331 – 424
1 in 100 + 20% CC	454 - 577

3.3.3 The attenuation volumes are provided for indicative purposes only and should be verified at the detailed design stage.

3.4 Drainage Hierarchy

3.4.1 The recommended surface water drainage hierarchy (Paragraph 080 of the NPPG: Flood Risk and Coastal Change) is to utilise soakaway systems or infiltration as the preferred option, followed by discharging to an appropriate watercourse. If this is not feasible, the final option is to discharge to an existing public sewer.

Surface Water Discharge to Soakaway / Porous Surfacing

3.4.2 The first consideration for the disposal of surface water is infiltration (soakaways and permeable surfaces). No superficial deposits are recorded across the Site area where the substation and battery storage is proposed. The bedrock geology comprises Scunthorpe Mudstone Formation consisting of mudstone and limestone (interbedded).

3.4.3 Soilscapes mapping indicates that the substation and battery storage area is underlain by '*naturally wet very acid sandy and loamy soils with impeded drainage*'.

3.4.4 The proposed development is for battery storage which has a potential elevated risk of fire, which can lead to contamination being mobilised within firewater. Given the potential risk of mobilised contamination during a fire, it is proposed to control the surface water runoff during a fire event, stopping it from leaving the site so that the potentially contaminated runoff can be managed. Soakaways and / or porous surfacing releasing water to the ground, cannot be adequately controlled and is therefore, discounted as an appropriate option for the battery and substation sites. This is considered further in section 3.10 below.

3.4.5 Based on the above, it is unlikely that soakaways will be suitable for the discharge of surface water runoff.

Surface Water Discharge to Watercourse

3.4.6 Where soakaways are not suitable a connection to a watercourse is the next consideration.

3.4.7 The nearest watercourse is an unnamed land drain which runs to the east of the substation and battery storage area.

3.4.8 Based on an assessment of elevation date, the substation and battery storage area slopes from west to east towards the land drain. It is anticipated that a gravity fed connection can be achieved.

3.4.9 Runoff from the substation and battery storage area will be limited to a rate of 3.23 l/s.

Surface Water Discharge to Sewer

3.4.10 As described above, a connection to an existing land drain is considered feasible and therefore a connection to the public surface water sewer is not required.

3.5 Sustainable Drainage Systems

3.5.1 Attenuation storage should be provided in the form of Sustainable Drainage Systems (SuDS) where practical. The following SuDS options have been considered:

Soakaways

3.5.2 As described above, the use of soakaways is not considered to be feasible due to the underlying geology and potential contamination risk.

Swales, Detention Basins and Ponds

3.5.3 Based on the development plans there is limited space available to accommodate above ground storage features such as ponds and basins.

Rainwater Harvesting

3.5.4 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. However, rainwater harvesting techniques could be incorporated within the final design to feed the proposed fire water tanks.

Green Roofs

3.5.5 Based on the nature of the proposed development, the installation of green roofing is not considered feasible.

Permeable Surfacing

3.5.6 All proposed access roads will be constructed utilising permeable surfacing, with surface water passing to the ground mimicking the existing situation.

3.5.7 The substation and battery storage area should be constructed within a bunded area which is lined to prevent infiltration and filled with subgrade to provide attenuation. Storage would be provided within the sub-grade material prior to controlled release to the existing land drain. The amount of storage offered by the permeable surfacing is subject to sub-grade depth and Site gradient. The use of permeable surfacing should be considered further at the detailed design stage.

3.5.8 An approximate area of 1,970 m^2 is available if bunded areas are retained close to each row of batteries. By incorporating permeable surfacing with a subgrade depth of 0.45 m and a void ratio of 30% across 1,136 m^2 and permeable surfacing with a subgrade depth of 0.3 m and a void ratio of 30% across 834 m^2, there is potential to accommodate 228 m^3 of attenuation storage within the battery storage area.

3.5.9 Based on an area of 2,942 m^2, a subgrade depth of 0.3 m and a void ratio of 30%, there is potential to accommodate 265 m^3 of attenuation within the sub-grade of permeable surfacing in the access road within the substation area.

Underground Attenuation Tanks

3.5.10 Storage could be provided within underground attenuation tanks or within oversized pipes. Sufficient space for an underground tank is provided in the lower eastern extents of the development area however as described above, the incorporation of permeable surfacing with storage provided within the subgrade is considered to be the most suitable type of attenuation.

3.6 Preferred Drainage Scheme

3.6.1 A Conceptual Drainage Sketch (Annex J) has been prepared to illustrate the proposed drainage strategy for the substation and battery storage area.

3.6.2 It should be noted that detailed drainage design will be provided at the detailed design stage.

3.6.3 As soakaways are not considered to be appropriate, surface water runoff will be discharged to the existing land drain which is located to the east of the substation and battery storage area. Discharge will be limited to the 1 in 2 year greenfield rate of 3.23 l/s through a gravity-fed connection.

3.6.4 Attenuation will be required to achieve the above discharge rates. The attenuation can be provided by bunding the rows of batteries to an average heights of 0.45 and 0.3 m. The bunded areas can then be filled with subgrade to provide the required attenuation volume. Check damming of the bunded areas may be required to mitigate the topographical differences across the battery rows.

3.6.5 The total attenuation volume for the battery and substation area are provided in Table 3. MicroDrainage Source Control calculations are included as Annex K.

Table 3: Total Attenuation Volumes (m^3)

Attenuation Feature	Attenuation Volume (m^3)
Battery Group 1	153
Battery Group 2	75
Substation Access Road	265

3.7 Event Exceedance

3.7.1 Storage will be provided for the 1 in 100 plus 20% CC event. Storm events in excess of the 1 in 100 year plus 20% CC event should be permitted to produce shallow depth flooding.

3.8 Surface Water Treatment

3.8.1 In accordance with the CIRIA C753 publication 'The SuDS Manual' (2015), Low Traffic Roads have a 'very low' pollution hazard level. Table 4 below shows the pollution hazard indices for each land use.

Table 4: Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Low Traffic Roads	Low	0.5	0.4	0.4

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

3.8.2 Where practical, runoff will be directed to permeable surfacing. Table 5 below demonstrates that permeable pavement provides sufficient treatment.

Table 5: SuDS Mitigation Indices

	Mitigation Indices		
Type of SuDS	**Total Suspended Solids (TSS)**	**Metals**	**Hydrocarbons**
Permeable Surfacing	0.7	0.6	0.7

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

3.9 Maintenance

3.9.1 Maintenance of communal drainage features such as permeable surfacing will be the responsibility of the Site owner.

3.9.2 A maintenance schedule for permeable surfacing is included in Annex L.

3.10 Firewater Risks

3.10.1 Lincolnshire Fire and Rescue within their response to the PEIR have stated the Scheme must minimise fire risk through mitigations incorporated as part of the design. Within their response they state the following:

Ensure that sufficient water is available for manual fire-fighting. An external fire hydrant should be located in close proximity of the BESS containers. – The water supply should be able to provide a minimum of 1,900 l/min for at least 120 minutes (2 hours). Further hydrants should be strategically located across the development. These should be tested and serviced at regular intervals by the operator. If the site is remote from a pressure feed water supply, then an Emergency Water Supply (EWS) meeting the above standard should be incorporated into the design of the site e.g. an open water source and/or tank(s). If above ground EWS tanks are installed, these should include facilities for the FRS to discharge (140/100mm RT outlet) and refill the tank.

3.10.2 To ensure the proposed battery storage area provides adequate water in case of a fire. Water storage has been provided adjacent to the battery units. As requested by Lincolnshire Fire and Rescue the fire water storage unit will contain no less than 228 m^3 (1,900 l/min for at least 120 minutes (2 hours)).

3.10.3 Potential environmental risks are associated with the escape of firewater from the battery storage area.

3.10.4 The principal route for firewater loss from the Site is via the proposed surface water drainage system into the existing land drainage network. In order to isolate the Site's drainage, a sandfield valve should be installed at the outfall to the land drain. In the event of a fire, the valve can be activated to close off the battery storage area's drainage system. Flows will then back up in the system. The system will be designed to accommodate the 1 in 100 plus 20% climate change storm event, therefore a sufficient amount of storage is provided to contain a more frequent 1 in 10 year storm event. Each block of permeable surfacing will be bunded to contain any above ground firewater.

3.10.5 After a fire event, the wastewater will be tested to ascertain the level of contamination. A decision will then be made as to the appropriate methodology to dispose of the attenuated water. This may involve on-site treatment and release or tankering.

3.11 Other Considerations

3.11.1 Maintenance access to all land drains should be retained. Maintenance access can be ensured by providing 8m easements around all watercourses, including Main Rivers and Ordinary Watercourses and 9 m easements from IDB assets;

4.0 Conclusions and Recommendations

4.1 Conclusions

4.1.1 The proposed development comprises a solar energy substation and battery storage area in the west of the Site, with associated ground mounted solar photo-voltaic panels, conversion units and access roads located throughout the remaining Site.

Flood Risk

4.1.2 The EA 'Flood Map for Planning' map shows that the Site is partly located within Flood Zones 2 and 3.

4.1.3 Flood level information provided by the EA has indicates that the western and eastern extents of the Site are expected to remain flood free across all flood risk scenarios. The central portion of the Site is shown to flood during the 1% AEP + 20% CC event, the vast majority of flooding is expected to remain below 1 m in depth. Deeper flooding in excess of 2 m is expected during the 0.1% + 20% CC event however the likelihood of this event occurring during the Site's 40 year operational phase is very low, and is therefore considered a residual risk.

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

4.1.5 The solar panels will be mounted on raised frames and therefore raised above surrounding ground level allowing flood water to flow freely underneath. Therefore, there will be no loss of floodplain volume as a result of the proposed development.

Ground Mounted PV Panels Drainage Commentary

4.1.6 Surface water management for proposed ground mounted panels has been considered with Section 5.0 of the Covering Report.

4.1.7 The proposed development is free draining through perimeter gaps around all panels, allowing for infiltration as existing within the grassland/vegetation surrounding and beneath the panels. There will be minimal increase in impermeable area meaning the proposals will not increase surface water flood risk elsewhere.

4.1.8 Any surface water exceeding the infiltration capacity of the surrounding strata will naturally drain to the surrounding land drains in line with the existing scenario.

4.1.9 The heavily managed agricultural land will be replaced with grassland. This will help to reduce run off rates by increasing the roughness of the ground, help to increase infiltration by reducing compaction, and improve water quality by reducing erosion and mobilisation of pollutants. As a result, runoff rates may be reduced following development when compared to the existing greenfield scenario.

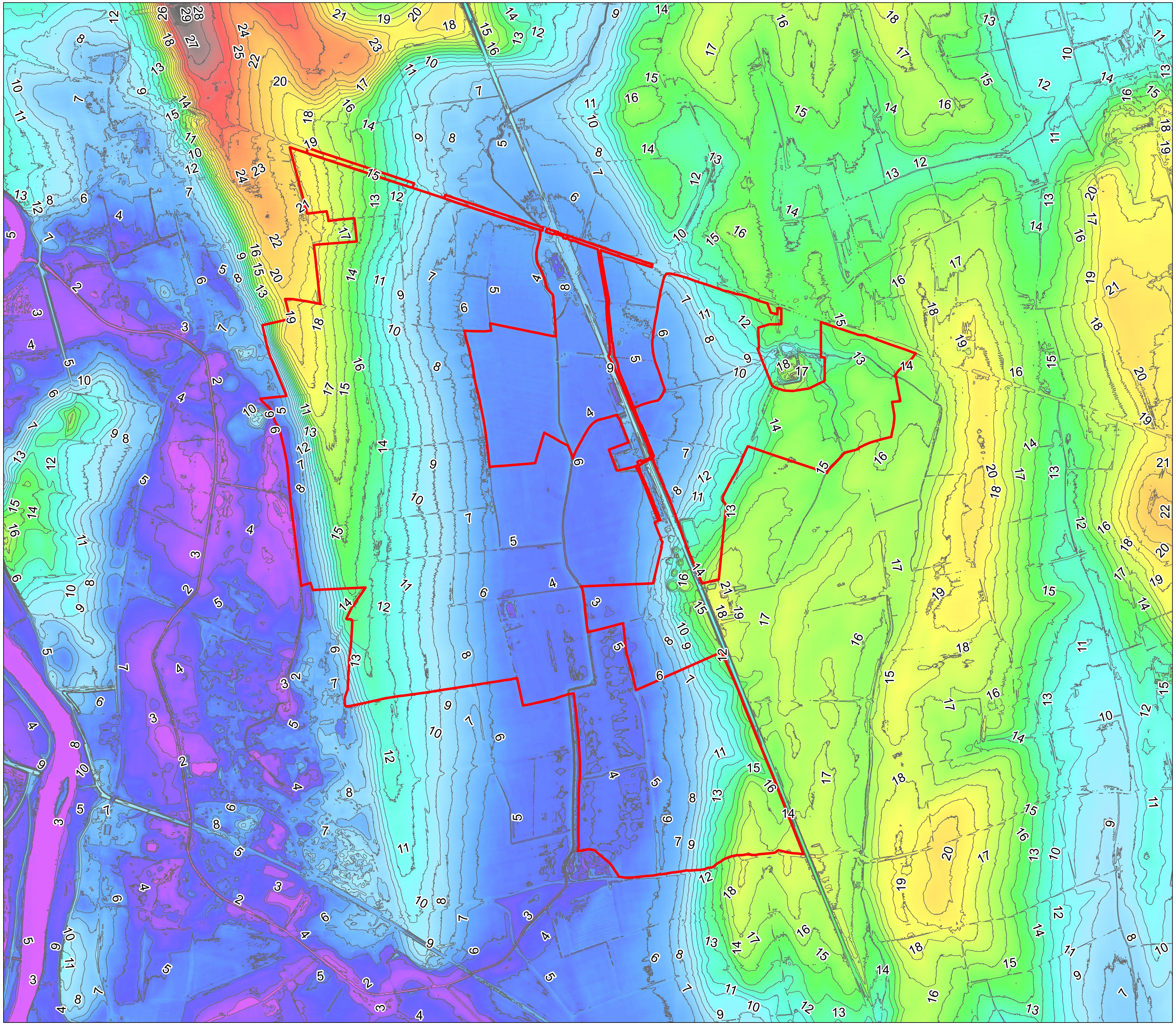
Battery Storage and Substation Drainage Strategy

4.1.10 The proposed substation and battery storage area will introduce impermeable drainage area in the form of battery storage, substation infrastructure and access. This will result in an increase in surface water runoff. In order to ensure the increase in surface water runoff will not increase flood risk elsewhere, flow control will be used, and attenuation provided on Site to accommodate storm events up to and including the 1 in 100 plus 20% CC event.

4.1.11 All methods of surface water discharge have been assessed. Soakaways are not considered to be a feasible option, therefore discharge of surface water to an existing land drain at a rate of 3.23 l/s appears to be the most practical option.

4.1.12 Attenuation storage will be required to restrict surface water discharge. Attenuation can be provided within the sub-grade of permeable surfacing (see Annex L).

Annex A – LiDAR Plan



Legend

West Burton 3 site boundary

Contours

LiDAR

39.36

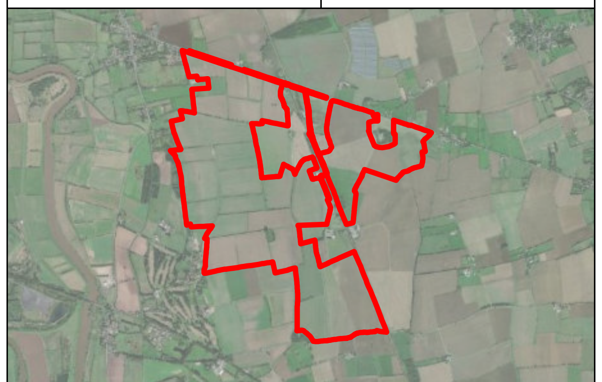
-1.49

0 200 400 600 800 Meters

N

Figure	LiDAR & Contours
Job	West Burton Solar Scheme
Client	West Burton Solar Scheme

Figure No.	B	Revision	A	Date	02/02/2023
Drawn	KH	Checked	EB	Scale	1:15,000 @ A3
Job No.	21-1098.03			Central GR	485776E 380303N



DO NOT SCALE.
NOT FOR CONSTRUCTION.

DeltaSimons

Annex B – Skellingthorpe Main Drain Water Body Classification Table

Classification Item	Cycle 2 2016 Classification	Cycle 3 2019 Classification	Cycle 3 Objectives		
Ecological	Moderate	Moderate	Moderate	2015	Disproportionately expensive: Disproportionate burdens;Disproportionately expensive: Unfavourable balance of costs and benefits;Technically infeasible: No known technical solution is available
Biological quality elements	Moderate	Moderate	Moderate	2015	Disproportionately expensive: Unfavourable balance of costs and benefits;Technically infeasible: No known technical solution is available
Invertebrates	Moderate	Moderate	Moderate	2015	Disproportionately expensive: Unfavourable balance of costs and benefits;Technically infeasible: No known technical solution is available
Macrophytes and Phytobenthos Combined	NA	NA	Not assessed	2015	
Physico-chemical quality elements	Moderate	Moderate	Moderate	2015	Disproportionately expensive: Disproportionate burdens;Disproportionately expensive: Unfavourable balance of costs and benefits;Technically infeasible: No known technical solution is available
Ammonia (Phys-Chem)	High	High	Good	2015	
Dissolved oxygen	Bad	Bad	Poor	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens;Disproportionately expensive: Unfavourable balance of costs and benefits;Technically infeasible: No known technical solution is available
Phosphate	High	High	Good	2015	
Temperature	High	High	Good	2015	
pH	High	High	Good	2015	
Hydromorphological Supporting Elements	Supports good	Supports good	Supports good	2015	
Hydrological Regime	Supports good	Supports good	Supports good	2015	
Supporting elements (Surface Water)	Moderate	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Mitigation Measures Assessment	Moderate or less	Moderate or less	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Specific pollutants	NA	NA	Not assessed	2015	
Arsenic	NA	NA	NA	NA	
Chlorothalonil	NA	NA	NA	NA	
Chromium (VI)	NA	NA	NA	NA	
Copper	NA	NA	NA	NA	
Iron	NA	NA	NA	NA	
Manganese	NA	NA	NA	NA	
Pendimethalin	NA	NA	NA	NA	
Zinc	NA	NA	NA	NA	
Chemical	Good	Fail	Good	2063	Natural conditions: Chemical status recovery time
Priority hazardous substances	Does not require assessment	Fail	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene	NA	Good	Good	2015	
Dioxins and dioxin-like compounds	NA	Good	Good	2015	
Heptachlor and cis-Heptachlor epoxide	NA	Good	Good	2015	
Hexabromocyclododecane (HBCDD)	NA	Good	Good	2015	
Hexachlorobenzene	NA	Good	Good	2015	
Hexachlorocyclohexane	NA		Good	2015	
Mercury and Its Compounds	NA	Fail	Good	2040	Natural conditions: Chemical status recovery time
Perfluorooctane sulphonate (PFOS)	NA	Good	Good	2015	
Polybrominated diphenyl ethers (PBDE)	NA	Fail	Good	2063	Natural conditions: Chemical status recovery time

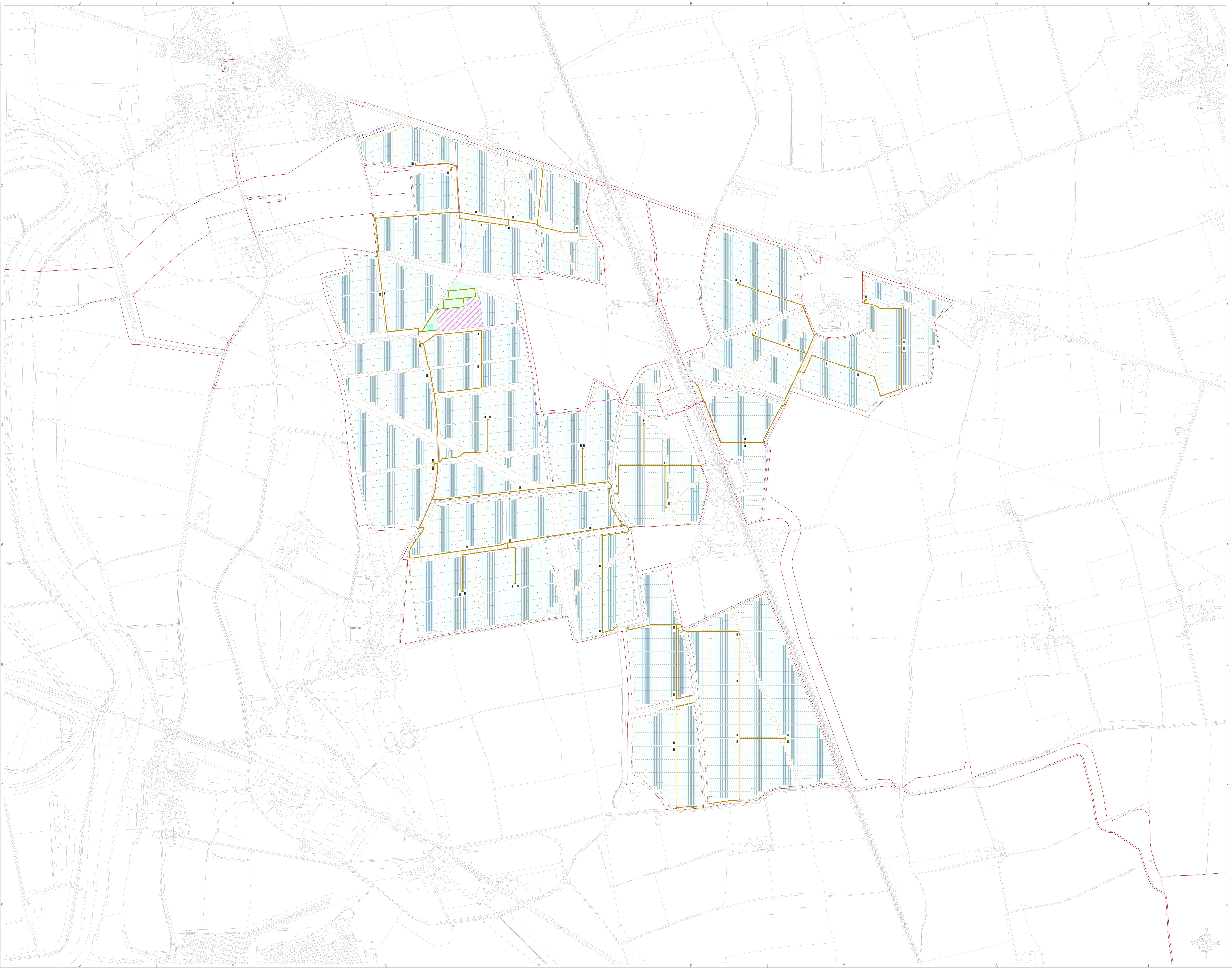
Priority substances	Does not require assessment	Good	Good	2015	
Cypermethrin (Priority)	NA	Good	Good	2015	
Fluoranthene	NA	Good	Good	2015	
Other Pollutants	Does not require assessment	Does not require assessment	Does not require assessment	2015	

Annex C – Marton Drain Water Body Classification Table

Classification Item	Cycle 2 2016 Classification	Cycle 3 2019 Classification	Cycle 3 Objectives		
Ecological	Moderate	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Biological quality elements	Good	Good	Good	2015	
Invertebrates	Good	Good	Good	2015	
Macrophytes and Phytobenthos Combined			Not assessed	2015	
Physico-chemical quality elements	Moderate	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Ammonia (Phys-Chem)	High	High	Good	2015	
Dissolved oxygen	Good	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Phosphate	Moderate	Good	Good	2021	Disproportionately expensive: Disproportionate burdens
Temperature	High	High	Good	2015	
pH	High	High	Good	2015	
Hydromorphological Supporting Elements	Supports good	Supports good	Supports good	2015	
Hydrological Regime	Supports good	Supports good	Supports good	2015	
Supporting elements (Surface Water)	Moderate	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Mitigation Measures Assessment	Moderate or less	Moderate or less	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Specific pollutants			Not assessed	2015	
Arsenic					
Chlorothalonil					
Chromium (VI)					
Copper					
Iron					
Manganese					
Pendimethalin					
Zinc					
Chemical	Good	Fail	Good	2063	Natural conditions: Chemical status recovery time
Priority hazardous substances	Does not require assessment	Fail	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene		Good	Good	2015	
Dioxins and dioxin-like compounds		Good	Good	2015	
Heptachlor and cis-Heptachlor epoxide		Good	Good	2015	
Hexabromocyclododecane (HBCDD)		Good	Good	2015	
Hexachlorobenzene		Good	Good	2015	
Hexachlorocyclohexane			Good	2015	
Mercury and Its Compounds		Fail	Good	2040	Natural conditions: Chemical status recovery time
Perfluorooctane sulphonate (PFOS)		Good	Good	2015	
Polybrominated diphenyl ethers (PBDE)		Fail	Good	2063	Natural conditions: Chemical status recovery time

Priority substances	Does not require assessment	Good	Good	2015	
Cypermethrin (Priority)		Good	Good	2015	
Fluoranthene		Good	Good	2015	
Other Pollutants	Does not require assessment	Does not require assessment	Does not require assessment	2015	

Annex D – Illustrative Site Layout Plan



General Legend:

	Order Limits
	Fence
	Potential Development Area
	Mounting Structure and Solar PV Modules
	Conversion Units
	Maintenance Tracks
	Electrical Substation
	Energy Storage Area
	Firefighting Water Supply
	West Burton High Voltage Cable
	Other Scheme's High Voltage Cable
	PRoW Footpath
	Gates
	Site Access
	Acoustic Barrier
	CCTV

Project: West Burton 3 Solar Project

Project Location: Land at Bellwood Grange farm, Brampton, LN1 2EG

Ownership: West Burton Solar Project Limited

Document Title: Figure 4.3 Illustrative Site Layout Plan (WB3)
APP/WB6.4.4.3 5(2)(a)

Sheet format: A0 "1189 x 841"

Scale: 1:5000

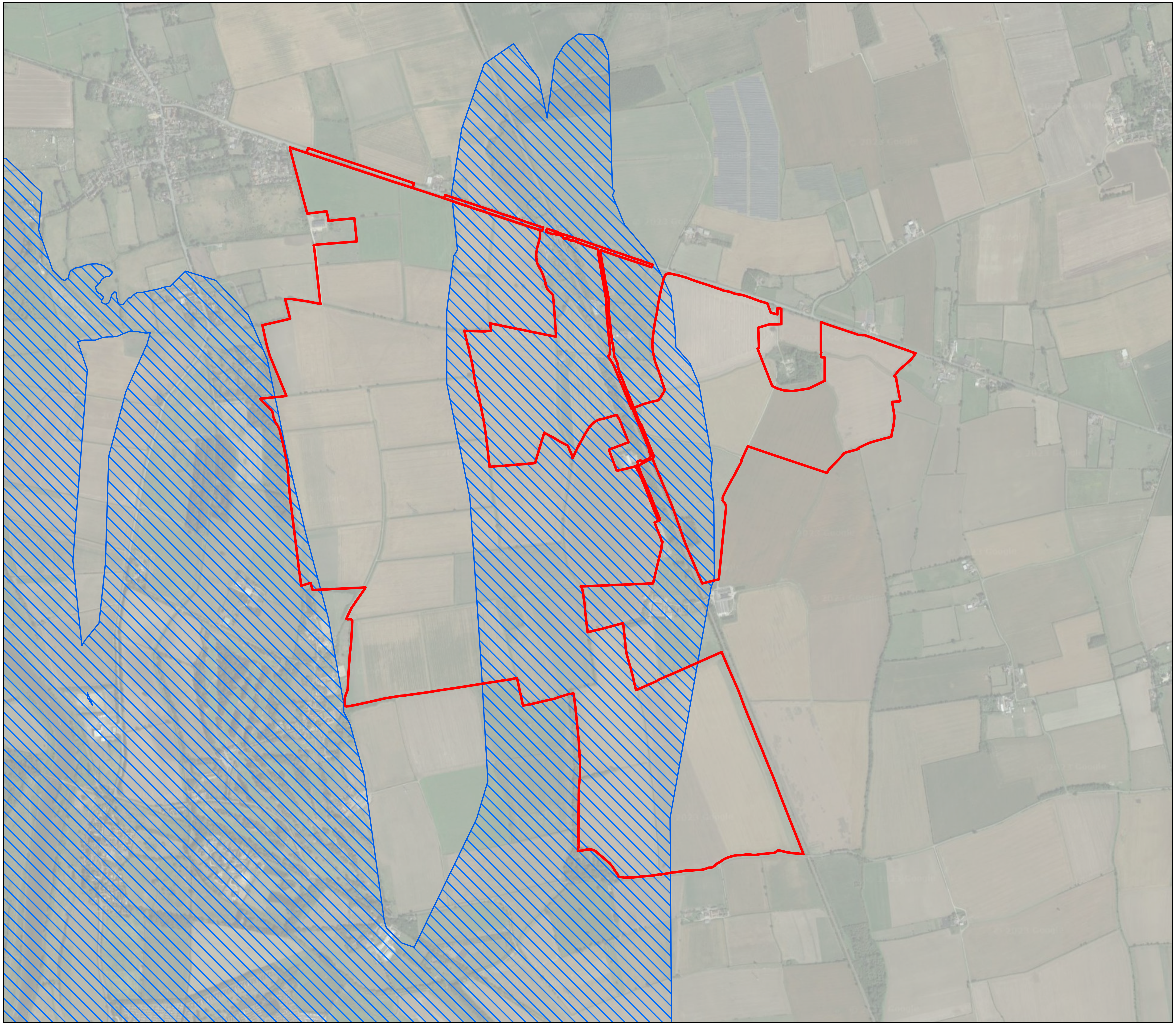
Document amendments:

			Comments
v.4	24/10/2022	A.A.	Illustrative Layout
v.5	09/11/2022	A.A.	Updated Track
v.6	18/11/2022	A.A.	Revised Red Line Boundary
v.7	11/01/2023	A.A.	Layout for Submission
v.8	02/02/2023	A.A.	Layout for Submission

Company: Island Green Power UK Limited
Unit 20.2, Coda Studios
189 Munster Road, London SW6 6AW

0 100 200 500

Annex E – EA Historic Flood Map



Legend

West Burton 3 site boundary

Historic Flood Map

0 150 300 450 600 Meters

N

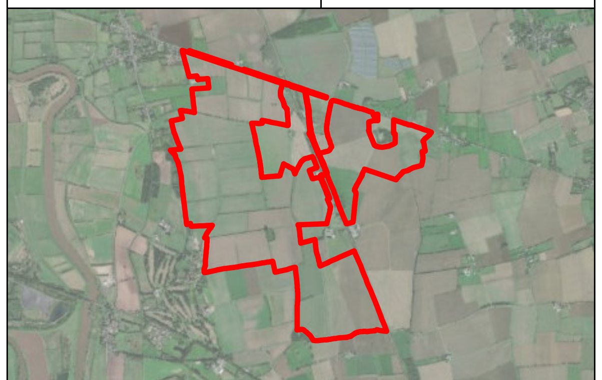


Figure	EA Historic Flood Map		
Job	West Burton Solar Scheme		
Client	West Burton Solar Scheme		
Figure No. C	Revision A	Date	03/02/2023
Drawn KH	Checked EB	Scale	1:15,000 @ A3
Job No.	21-1098.03	Central GR	485776E 380303N

DO NOT SCALE.
NOT FOR CONSTRUCTION.

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Annex F – EA Consultation Response

From: [redacted]
Sent: 28 March 2022 12:12
To: [redacted]
Cc: [redacted]
Subject: RE: Ref 210809/KAY12: 21-1098.01 - West Burton 1 / EA Data Request CCN/ 2021/ 229127

[redacted]

Apologies for the delay in getting round to looking at this.

I agree with your reading of the flood levels for the 1:100 and 1:100+cc [1 in 100 = 3.76 m AOD and 1 in 100 + CC = 5.94 / 5.95 m AOD] however the 1 in 1000 level is = **7.7 m AOD.** The maps provided by our Nottingham office could be a little clearer, to be honest, but if you zoom in you can see the decimal point showing a level of 7.7mAOD

The maps provided are for defended or breach scenarios, and therefore are not used to define flood zones as these are based on undefended scenarios. The defences for this site would be those along the Trent.

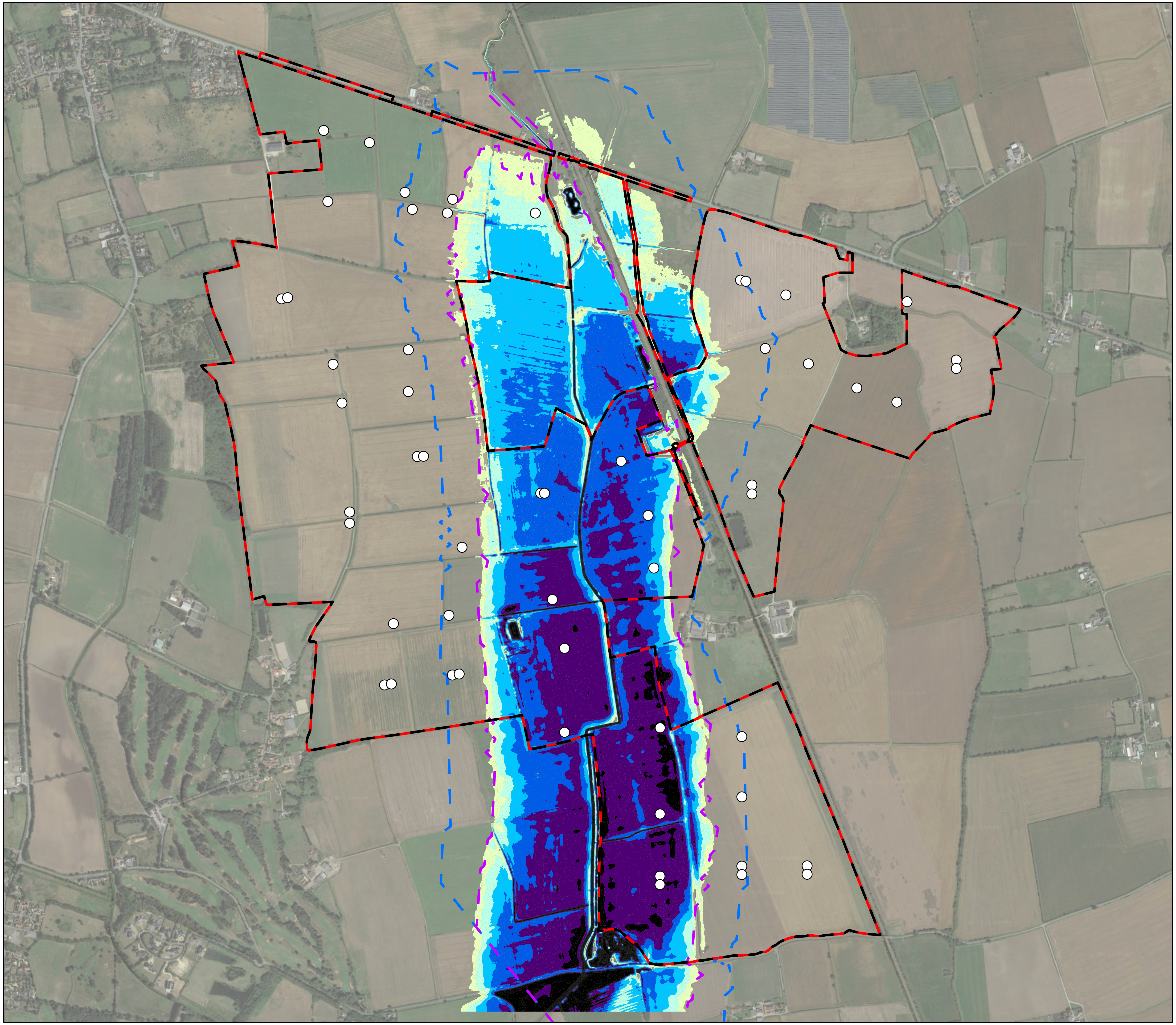
I am trying to recall the context of what I said in September and why. It is true the flood zones do not take account of the defences, though I am not sure why I said West Burton 3 was based on national modelling when I know the Trent modelling covers it. My apologies for this misinformation.

I have asked colleagues at the Nottingham office to provide the GIS shapefiles / ASCII grid files for the data they have already sent in the PDF maps.

Apologies again for the delay in responding.

Regards
[redacted]

Annex G – 1% AEP + 20% CC Flood Depth Map



Legend

West Burton 3 site boundary

FZ3

FZ2

Power stations

Flood Depth

<0.2 m

<0.4 m

<0.6 m

<0.8 m

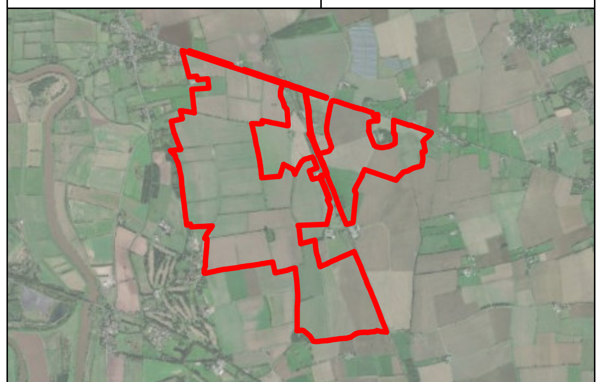
<1 m

>1

0 120 240 360 480 Meters

N

Figure	Flood Depths 1 in 100				
Job	West Burton Solar Scheme				
Client	West Burton Solar Scheme				
Figure No.	X	Revision	A	Date	13/02/2023
Drawn	KH	Checked	EB	Scale	1:12,000 @ A3
Job No.	21-1098.03			Central GR	485699E 380288N

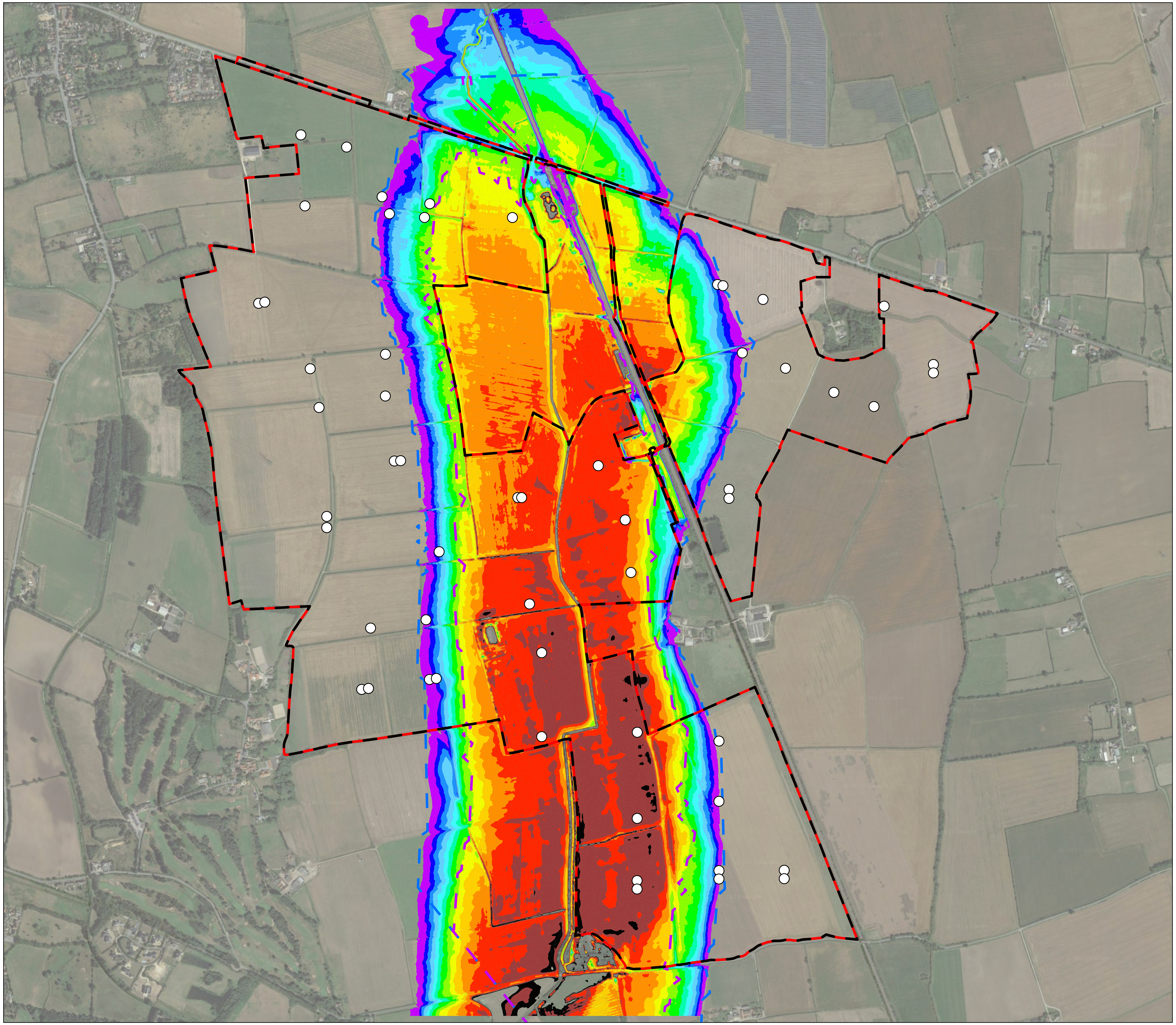


DO NOT SCALE.

NOT FOR CONSTRUCTION.

DeltaSimons

Annex H – 0.1% AEP + 20% CC Flood Depth Map



Legend

West Burton 3 site boundary

FZ3

FZ2

Power stations

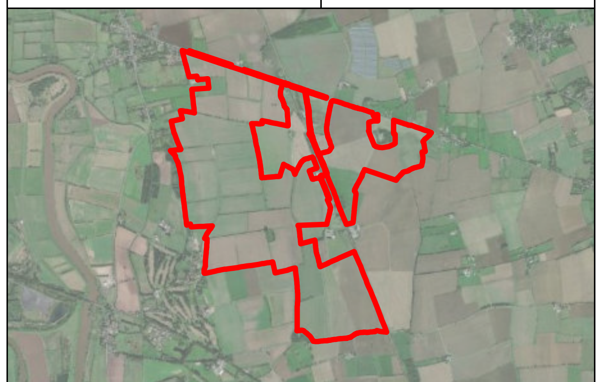
Contour max depth (m)

- 0.2 - 0.4
- 0.5 - 0.6
- 0.7 - 0.8
- 0.9 - 1.0
- 1.1 - 1.2
- 1.3 - 1.4
- 1.5 - 1.6
- 1.7 - 1.8
- 1.9 - 2.0
- 2.1 - 2.2
- 2.3 - 2.4
- 2.5 - 2.6
- 2.7 - 2.8
- 2.9 - 3.0

0 120 240 360 480 Meters

N

Figure	1 in 1000 + CC				
Job	West Burton Solar Scheme				
Client	West Burton Solar Scheme				
Figure No.	X	Revision	A	Date	10/02/2023
Drawn	KH	Checked	EB	Scale	1:12,000 @ A3
Job No.	21-1098.03			Central GR	485776E 380303N

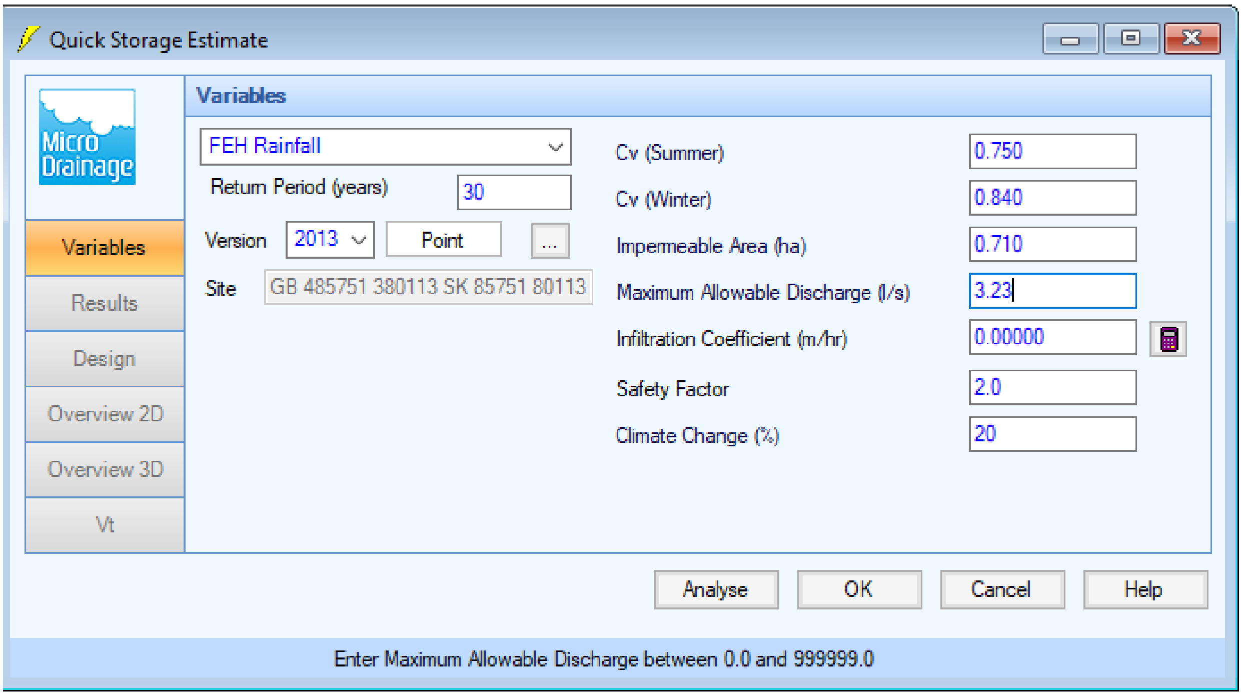


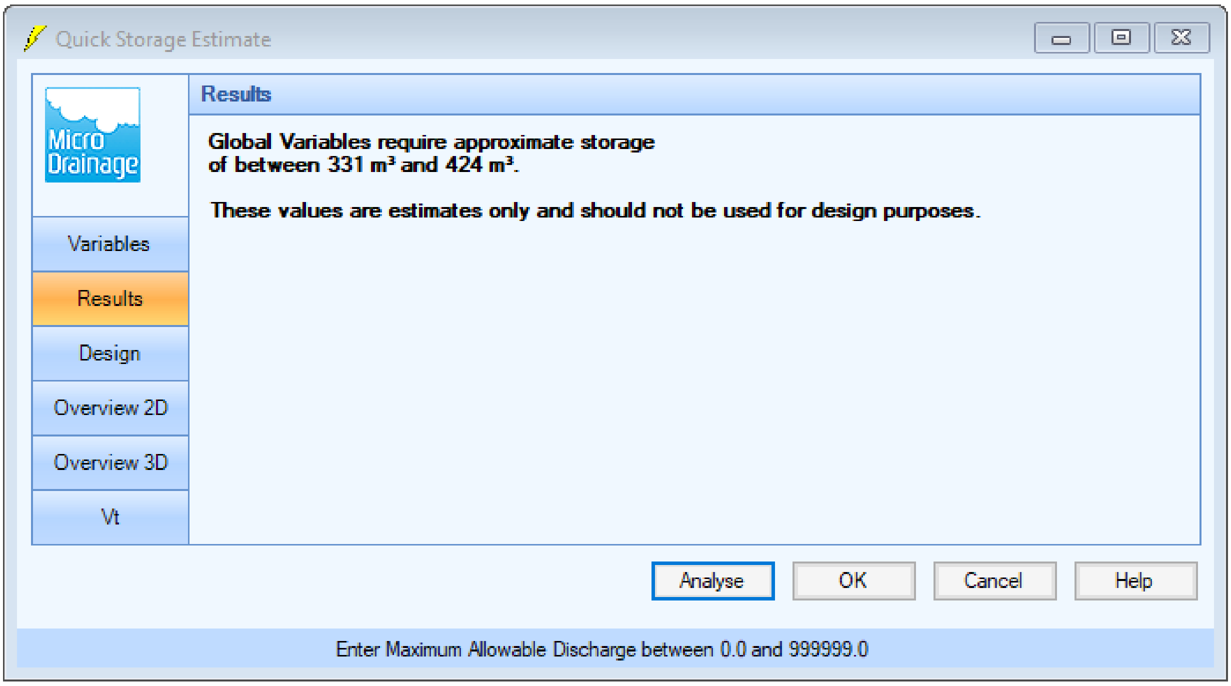
DO NOT SCALE.

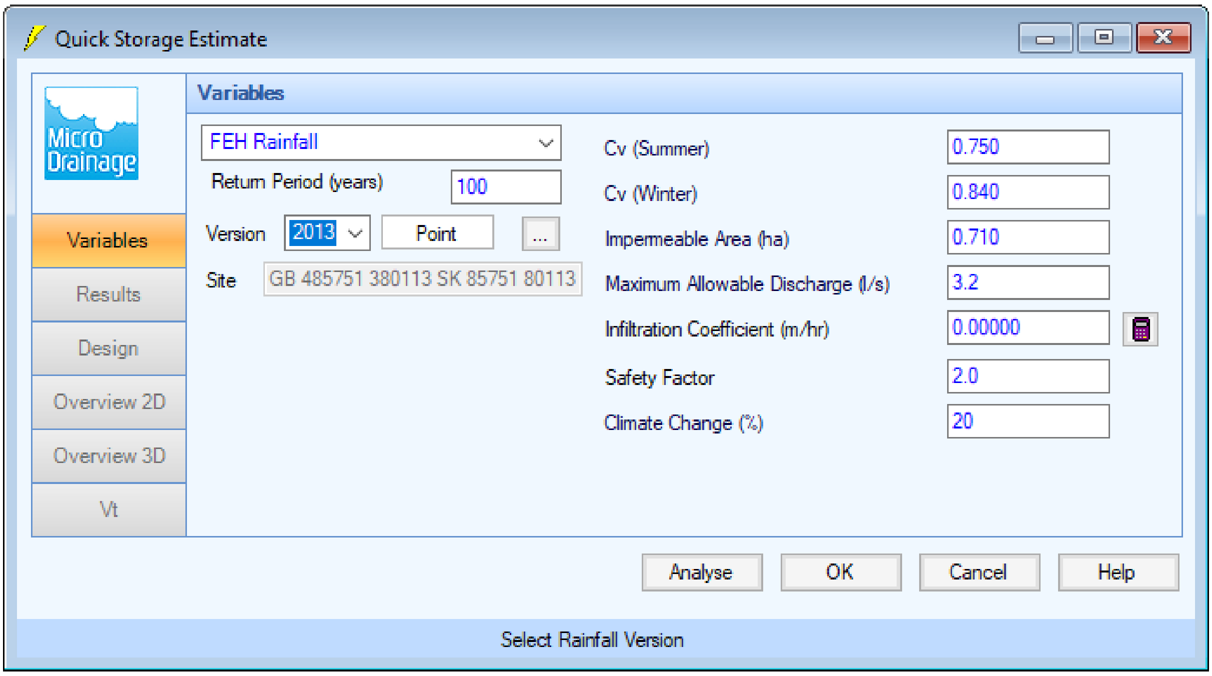
NOT FOR CONSTRUCTION.

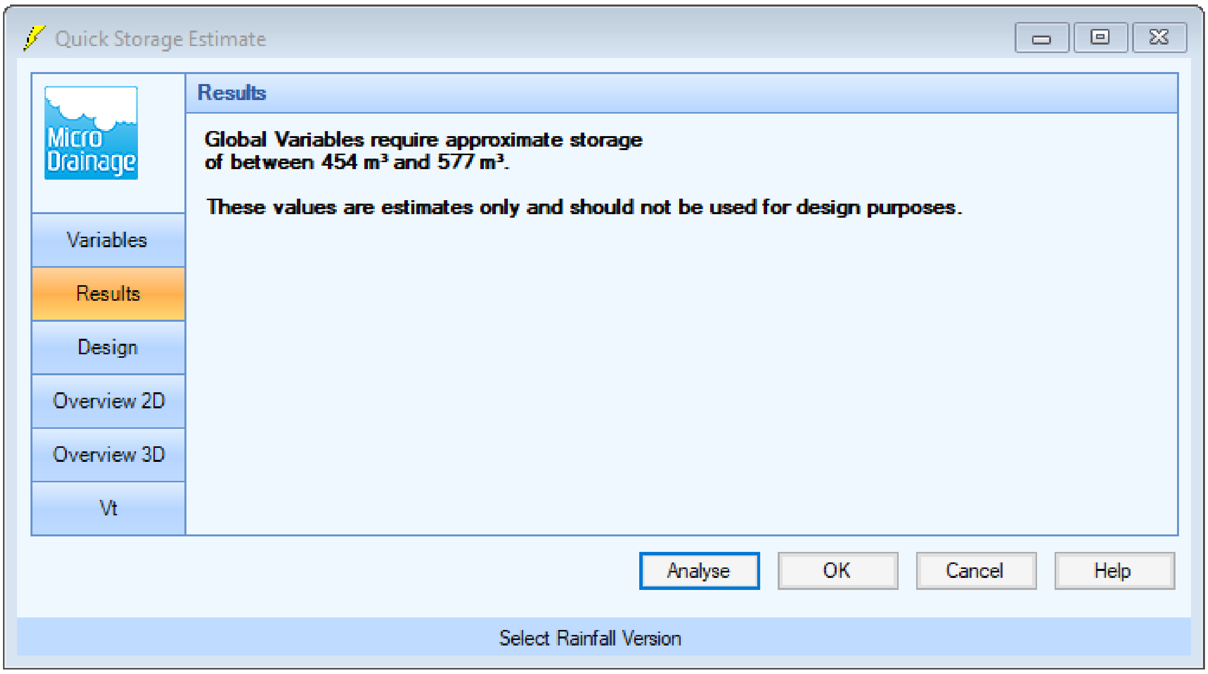
DeltaSimons

Annex I – MicroDrainage Quick Storage Estimate

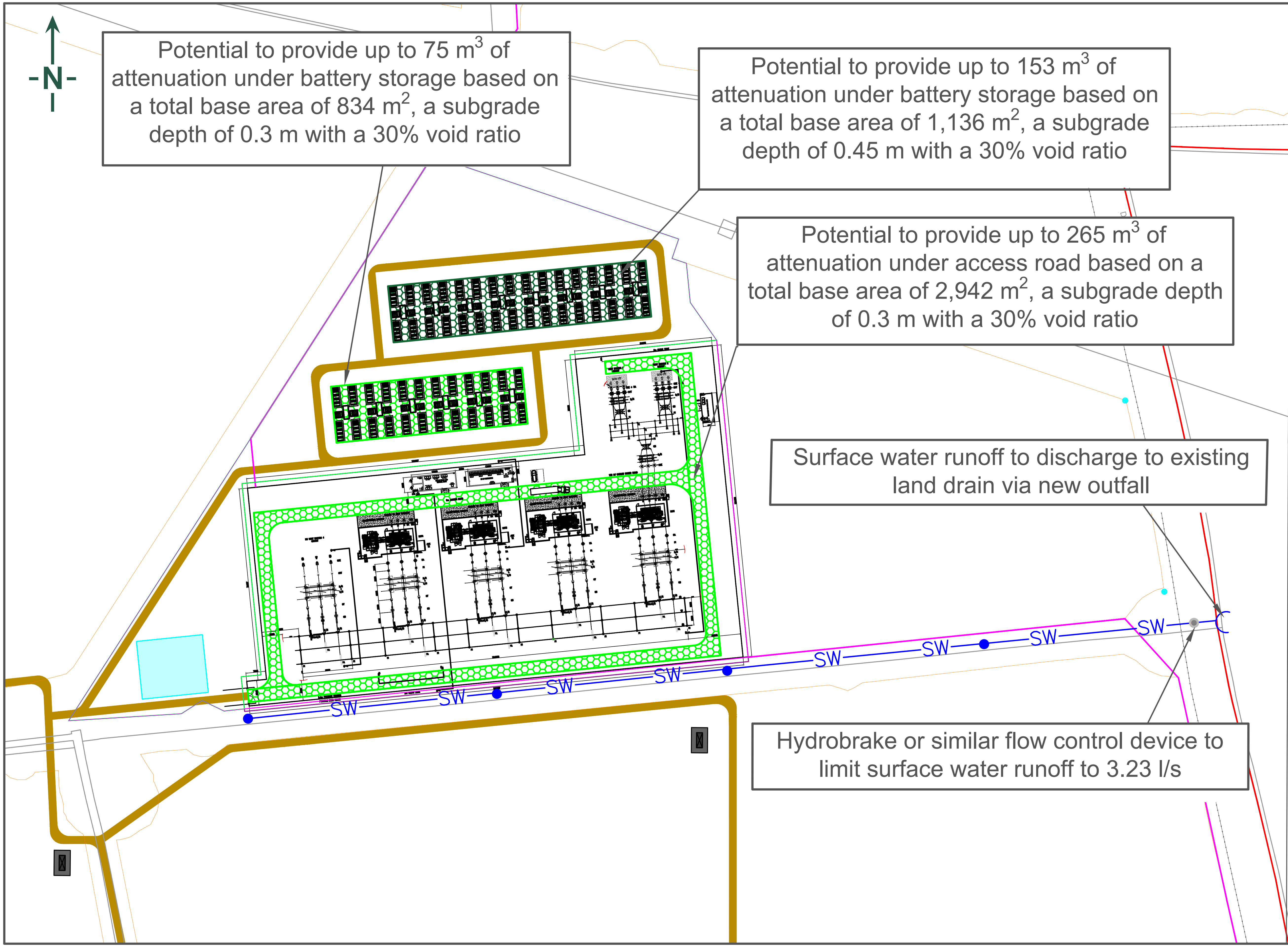

Quick Storage Estimate
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years) 30
Version 2013 Point ...
Site GB 485751 380113 SK 85751 80113
Cv (Summer) 0.750
Cv (Winter) 0.840
Impermeable Area (ha) 0.710
Maximum Allowable Discharge (l/s) 3.23
Infiltration Coefficient (m/hr) 0.00000
Safety Factor 2.0
Climate Change (%) 20
Analyse
OK
Cancel
Help
Enter Maximum Allowable Discharge between 0.0 and 999999.0


Quick Storage Estimate
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage of between 331 m³ and 424 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Enter Maximum Allowable Discharge between 0.0 and 999999.0


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Variables
FEH Rainfall
Return Period (years)
100
Version
2013
Point
...
Site
GB 485751 380113 SK 85751 80113
Cv (Summer)
0.750
Cv (Winter)
0.840
Impermeable Area (ha)
0.710
Maximum Allowable Discharge (l/s)
3.2
Infiltration Coefficient (m/hr)
0.00000
Safety Factor
2.0
Climate Change (%)
20
Analyse
OK
Cancel
Help
Select Rainfall Version


Quick Storage Estimate
Micro Drainage
Variables
Results
Design
Overview 2D
Overview 3D
Vt
Results
Global Variables require approximate storage
of between 454 m³ and 577 m³.
These values are estimates only and should not be used for design purposes.
Analyse
OK
Cancel
Help
Select Rainfall Version

Annex J – Conceptual Drainage Sketch



LEGEND

- Proposed permeable surfacing with a subgrade depth of 0.45 m
- Proposed permeable surfacing with a subgrade depth of 0.3 m
- SW Indicative Route of Proposed Surface Water Sewer
- Indicative Location of Proposed Surface Water Manhole
- Indicative Location of Proposed Flow Control Device (Hydrobrake or similar)

NOTES

1. All dimensions in metres and all levels in metres above ordnance datum unless shown otherwise .

2. This drawing provides a concept only and is not intended for detailed design. Detailed drainage design will be required at the detailed design stage.

3. Concept drawing base on 'West Burton 3 Layout for Submission 02-02-2023' prepared by Island Green Power UK Limited.

4. Surface water runoff to discharge to existing land drain at a restricted rate of 3.23 l/s for all events up to and including the 1 in 100 plus 20% climate change event.

5. Discharge location subject to agreement with LLFA and Trent Valley IDB.

Site Plan Provided by Client

DeltaSimons

TITLE:
Concept Drainage Sketch
West Burton 3 Battery Storage and Substation

DRAWN BY: EB	SCALE: Not to Scale	PROEJCT NO: 21-1098.03	
CHECKED BY: JR	REVISION: 1	APPENDIX: K	
DATE: 16/02/23			

Annex K – MicroDrainage Source Control Output

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.436	0.436	3.2	207.9	O K
30 min Summer	99.568	0.568	3.2	271.1	O K
60 min Summer	99.704	0.704	3.2	335.7	Flood Risk
120 min Summer	99.777	0.777	3.2	370.5	Flood Risk
180 min Summer	99.815	0.815	3.2	388.7	Flood Risk
240 min Summer	99.839	0.839	3.2	400.0	Flood Risk
360 min Summer	99.865	0.865	3.2	412.5	Flood Risk
480 min Summer	99.875	0.875	3.2	417.5	Flood Risk
600 min Summer	99.877	0.877	3.2	418.3	Flood Risk
720 min Summer	99.873	0.873	3.2	416.3	Flood Risk
960 min Summer	99.854	0.854	3.2	407.5	Flood Risk
1440 min Summer	99.809	0.809	3.2	385.8	Flood Risk
2160 min Summer	99.750	0.750	3.2	358.0	Flood Risk
2880 min Summer	99.698	0.698	3.2	333.1	O K
4320 min Summer	99.594	0.594	3.2	283.3	O K
5760 min Summer	99.499	0.499	3.2	238.0	O K
7200 min Summer	99.420	0.420	3.2	200.5	O K
8640 min Summer	99.354	0.354	3.2	168.9	O K
10080 min Summer	99.299	0.299	3.2	142.9	O K
15 min Winter	99.489	0.489	3.2	233.2	O K
30 min Winter	99.638	0.638	3.2	304.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	158.773	0.0	199.1	27
30 min Summer	103.775	0.0	249.5	41
60 min Summer	64.746	0.0	338.8	70
120 min Summer	36.429	0.0	380.3	130
180 min Summer	25.966	0.0	405.6	190
240 min Summer	20.414	0.0	424.0	248
360 min Summer	14.550	0.0	450.2	366
480 min Summer	11.444	0.0	467.7	486
600 min Summer	9.499	0.0	478.5	604
720 min Summer	8.158	0.0	483.0	722
960 min Summer	6.416	0.0	478.5	960
1440 min Summer	4.572	0.0	456.5	1196
2160 min Summer	3.263	0.0	622.0	1568
2880 min Summer	2.572	0.0	653.0	1988
4320 min Summer	1.844	0.0	699.8	2776
5760 min Summer	1.459	0.0	744.5	3528
7200 min Summer	1.217	0.0	776.4	4256
8640 min Summer	1.051	0.0	803.7	5008
10080 min Summer	0.929	0.0	827.1	5656
15 min Winter	158.773	0.0	221.1	26
30 min Winter	103.775	0.0	258.3	41

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.790	0.790	3.2	376.9	Flood Risk
120 min Winter	99.873	0.873	3.2	416.6	Flood Risk
180 min Winter	99.918	0.918	3.2	437.8	Flood Risk
240 min Winter	99.946	0.946	3.2	451.3	Flood Risk
360 min Winter	99.979	0.979	3.2	466.9	Flood Risk
480 min Winter	99.994	0.994	3.2	474.1	Flood Risk
600 min Winter	99.999	0.999	3.2	476.6	Flood Risk
720 min Winter	99.998	0.998	3.2	476.1	Flood Risk
960 min Winter	99.984	0.984	3.2	469.4	Flood Risk
1440 min Winter	99.933	0.933	3.2	445.3	Flood Risk
2160 min Winter	99.860	0.860	3.2	410.2	Flood Risk
2880 min Winter	99.791	0.791	3.2	377.3	Flood Risk
4320 min Winter	99.652	0.652	3.2	311.2	O K
5760 min Winter	99.499	0.499	3.2	238.0	O K
7200 min Winter	99.381	0.381	3.2	181.8	O K
8640 min Winter	99.290	0.290	3.2	138.4	O K
10080 min Winter	99.223	0.223	3.2	106.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	64.746	0.0	378.7	70
120 min Winter	36.429	0.0	424.1	128
180 min Winter	25.966	0.0	451.0	186
240 min Winter	20.414	0.0	469.6	244
360 min Winter	14.550	0.0	491.8	360
480 min Winter	11.444	0.0	498.7	476
600 min Winter	9.499	0.0	497.3	592
720 min Winter	8.158	0.0	494.0	704
960 min Winter	6.416	0.0	485.0	928
1440 min Winter	4.572	0.0	464.3	1342
2160 min Winter	3.263	0.0	696.3	1668
2880 min Winter	2.572	0.0	730.8	2136
4320 min Winter	1.844	0.0	780.4	3072
5760 min Winter	1.459	0.0	834.0	3808
7200 min Winter	1.217	0.0	869.8	4536
8640 min Winter	1.051	0.0	900.5	5192
10080 min Winter	0.929	0.0	927.1	5848

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 485751 380113 SK 85751 80113
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.710

Time From:	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**	**Time From:**	**(mins) To:**	**Area (ha)**
0	4	0.237	4	8	0.237	8	12	0.237

Model Details

Storage is Online Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	477.0	1.000	477.0

Hydro-Brake® Optimum Outflow Control

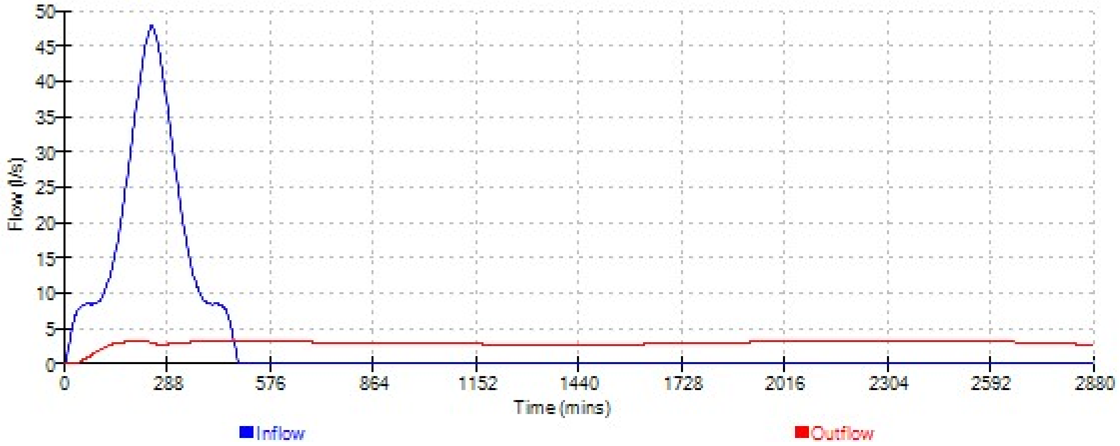
Unit Reference	MD-SHE-0085-3200-1000-3200
Design Head (m)	1.000
Design Flow (l/s)	3.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	85
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

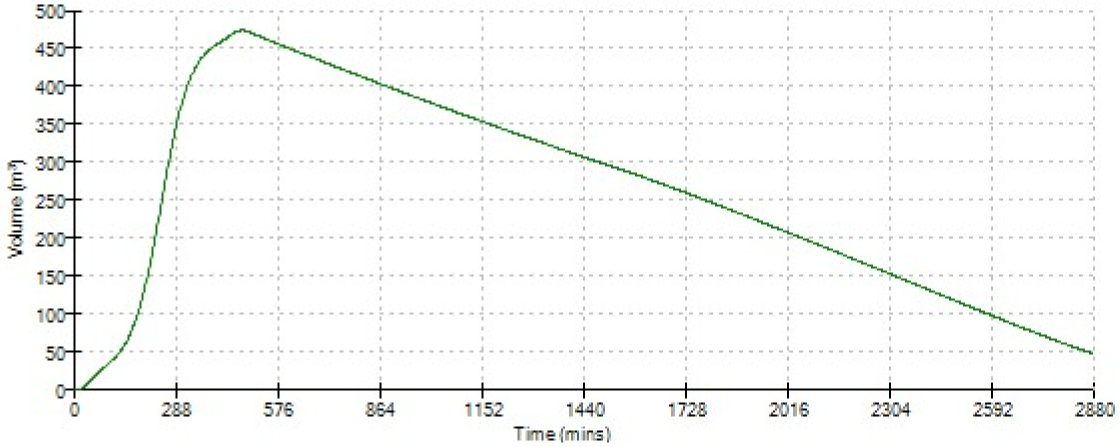
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.2
Flush-Flo™	0.296	3.2
Kick-Flo®	0.624	2.6
Mean Flow over Head Range	-	2.8

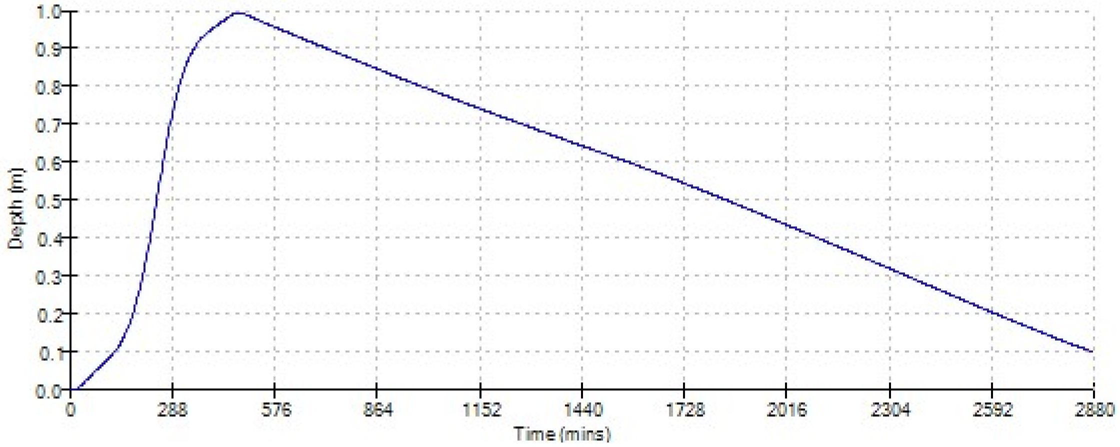
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	3.5	3.000	5.3	7.000	7.9
0.200	3.1	1.400	3.7	3.500	5.7	7.500	8.2
0.300	3.2	1.600	4.0	4.000	6.1	8.000	8.5
0.400	3.1	1.800	4.2	4.500	6.4	8.500	8.7
0.500	3.0	2.000	4.4	5.000	6.8	9.000	8.9
0.600	2.7	2.200	4.6	5.500	7.1	9.500	9.2
0.800	2.9	2.400	4.8	6.000	7.4		
1.000	3.2	2.600	5.0	6.500	7.7		

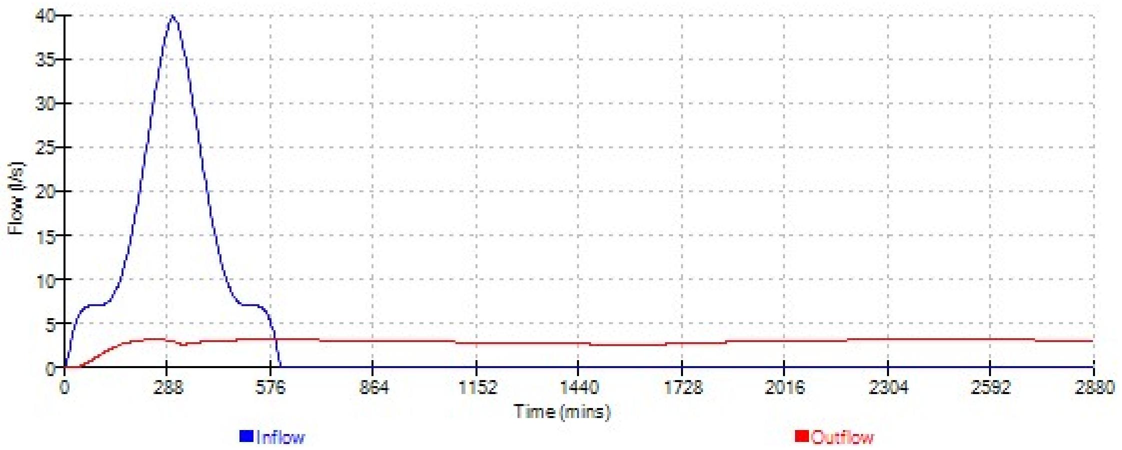
Event: 480 min Winter

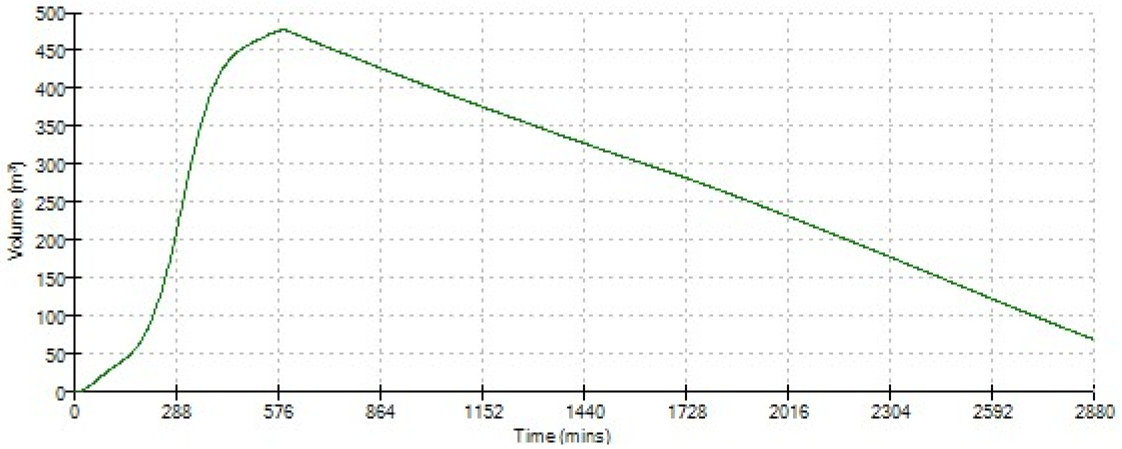


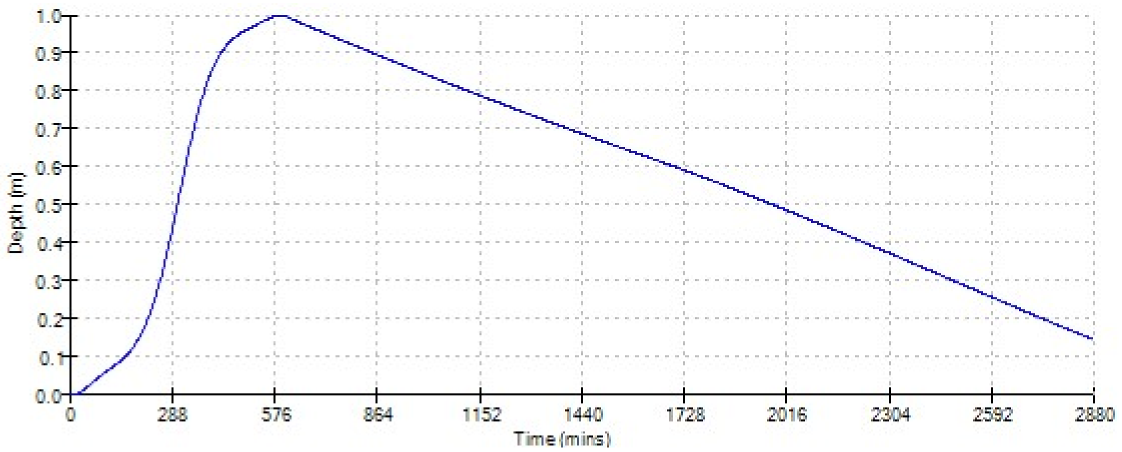




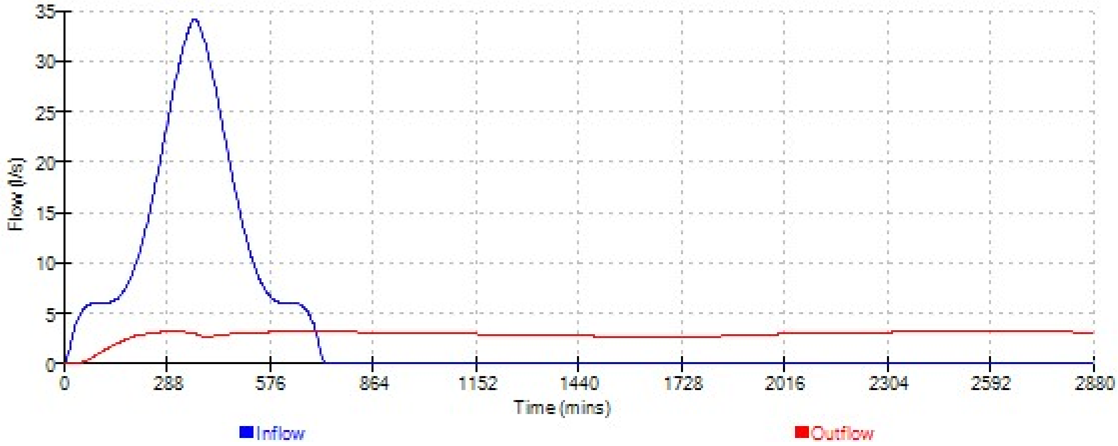
Event: 600 min Winter

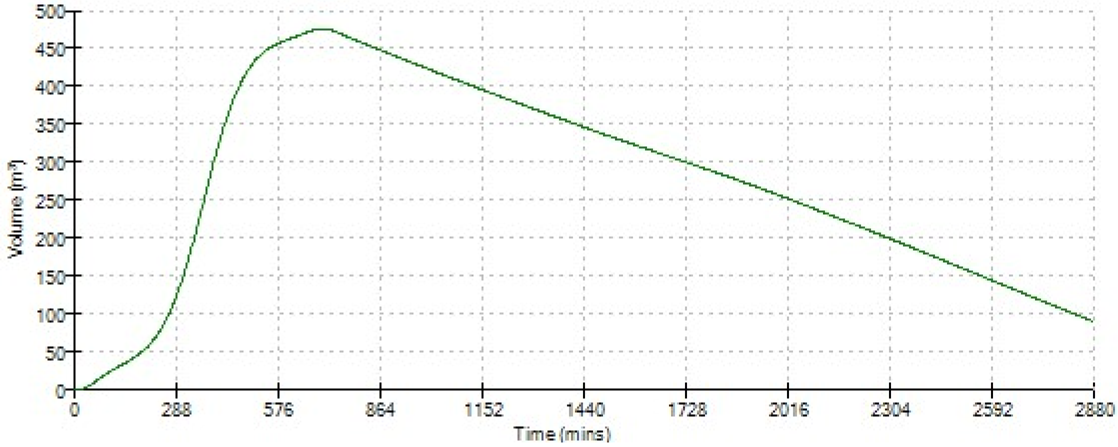


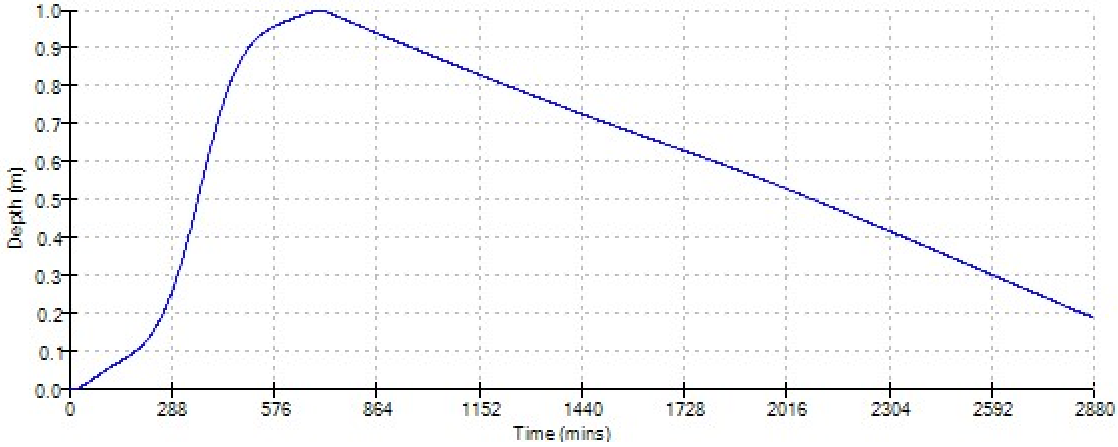




Event: 720 min Winter







Annex L – Permeable Surfacing Maintenance Schedule

Permeable Paving Maintenance Schedule

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on Site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and move contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level or the paving	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Inspect for evidence of poor operation and / or weed growth – if required, take remedial action	Three-monthly, 48hr after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Ref. Table 20.15, CIRIA C753 'The SuDS Manual'