



Fosse Green Energy

Preliminary Environmental Information Report

VOLUME

3

**Appendix 9-C: Preliminary Flood
Risk Assessment**

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Prepared for:

Fosse Green Energy Limited

Prepared by:

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Executive Summary

- ES 1 This Preliminary Flood Risk Assessment (Preliminary FRA) forms a technical appendix to **Preliminary Environmental Information (PEI) Report Volume 1, Chapter 9: Water Environment** for the proposed Fosse Green Energy project (hereafter referred to as the 'Proposed Development').
- ES 2 The Proposed Development comprises solar photovoltaic (PV) panel arrays, Battery Energy Storage System (BESS), interconnecting buried medium-voltage cables, an Onsite Substation, and connection to the national electricity transmission network via a buried high-voltage Grid Connection Cable.
- ES 3 A full description of the Proposed Development is included in **PEI Report Volume 1, Chapter 3: The Proposed Development**.
- ES 4 The design life of the Proposed Development is anticipated to be 60 years, and decommissioning is expected to commence thereafter.
- ES 5 The Site is located approximately 9km south and south west of Lincoln City centre, located within the North Kesteven District of Lincolnshire. The area within and surrounding the Proposed Development is a primarily rural setting, comprising of open agricultural fields, individual trees, woodlands, hedgerows, linear tree belts, farm access tracks, local transport roads and villages.
- ES 6 In this Preliminary FRA and throughout the PEI Report the following definitions are used to describe the key areas of the Proposed Development shown in **PEI Report Volume 2, Figure 1-1: Proposed Development Location**.
- The Site** – the maximum extent of land required for the construction, operation (including maintenance), and decommissioning of the Proposed Development. The Site comprises the Principal Site and the Grid Connection Corridor. The boundary of the Site is referred to as the Site Boundary. The total area of the Site is 1,426 hectares (ha).
 - Principal Site** – the area of the Site covered by the ground-mounted solar photovoltaic (PV) panels, Solar Stations, Battery Energy Storage System (BESS), Onsite Substation, planting and mitigation areas, interconnecting cables between solar PV areas, and associated infrastructure. The Principal Site includes Interconnecting Cable Corridors, Solar PV Array Areas, and areas of habitat enhancement and mitigation planting. The total area of the Principal Site is 1,065ha.
 - Cable Corridor** – the area of the Site in which the 400 kilovolt (kV) and associated cables (the Grid Connection Cables) will be installed between the Onsite Substation and the proposed Navenby Substation. The proposed Navenby Substation is subject to a separate application and

does not form part of the Proposed Development. The Cable Corridor partially overlaps the Principal Site and is 407ha.

- ES 7 This Preliminary FRA primarily relates to the Principal Site during the operational phase of the Proposed Development, as works within the Cable Corridor are proposed to be installed below ground and therefore not anticipated to have any impact on long term flood risk (i.e. there will be no permanent above ground-built development). The underground cabling is inherently flood protected. Flood risk during the construction of the Proposed Development is to be managed by the onsite contractors through the final Construction Environment Management Plan (CEMP), to be developed post DCO. A Framework CEMP is included in **PEI Report Volume 3, Appendix 3-A**.
- ES 8 The Proposed Development within the Principal Site will consist of the following infrastructure:
- a. Solar PV panels (also known as 'modules');
 - b. PV module mounting structures;
 - c. BESS;
 - d. Inverters;
 - e. Step-up transformers;
 - f. Switchgear;
 - g. An Onsite Substation and control buildings;
 - h. Onsite cabling;
 - i. Ancillary infrastructure (e.g. combiner boxes, weather stations);
 - j. Electricity export via high-voltage cable and connection to the National Electricity Transmission System;
 - k. Fencing and security;
 - l. Access tracks; and
 - m. Landscaping and biodiversity enhancement areas.
- ES 9 The physical infrastructure proposed across the Site is described a further detailed in **PEI Report Volume 1, Chapter 3: The Proposed Development**.
- ES 10 This Preliminary FRA has been prepared in accordance with the requirements of the Overarching National Policy Statement (NPS) for Energy (EN-1) (Ref. 1), the NPS for Renewable Energy Infrastructure (EN-3) (Ref. 2), and Electricity Networks Infrastructure (EN-5) (Ref. 3), and the National Planning Policy Framework (NPPF) (Ref. 4). The proposed use of the Proposed Development would be classed as 'Essential Infrastructure' in accordance with Annex 3 of NPPF (Ref. 4).
- ES 11 The vast majority of the Principal Site lies within Flood Zone 1. Small areas of Flood Zone 2 and 3 associated with Main Rivers are present in areas near the boundary of the Principal Site, including the Witham Washlands Flood

Storage Area. The Site also has flood plain associated with Ordinary Watercourses (Mill Dam Dyke) and along field boundaries.

- ES 12 Areas where the extents of Flood Zone 2 overlap with Solar PV Panels in the Principal Site have been identified within this Preliminary FRA and are referred to as “interaction zones”. No other permanent built development is located within Flood Zone 2 (or 3).
- ES 13 Proposed edge swales located in the western extents of Fields 26, 31 and 34 will provide a reduction in surface water flood risk to properties along the Avenue in Morton, where surface water mapping (Ref. 15Ref. 6) shows a risk of ponding at the low spot where the properties lie. These edge swales will capture the majority of the runoff from Solar Station Compounds and runoff from the solar PV panel fields, reducing peak runoff rates during storm events, for up to and including the 1 in 100 year plus 40% climate change event (for where new impermeable surfaces are introduced). Fields 26 and 34 are discussed further within the **PEI Report Volume 3, Appendix 9-D: Preliminary Drainage Strategy** as these are proposed to utilise infiltration swales, which will capture runoff and infiltrate to ground with no discharges to a watercourse. Refer to Annex D of this FRA for the outline drainage strategy overview and Principal Site layout drawing (60682158-ACM-ZZ-XX-DR-CE-000023) for field numbers.
- ES 14 Small sections of the Cable Corridor lie within Flood Zone 2 and 3 extents; however, the cable route will have no permanent above ground, built development during the operational phase of the Proposed Development.
- ES 15 This Preliminary FRA assesses the Proposed Development in more detail relative to each flood risk area.
- ES 16 The flood risk summary **Table 1** indicates the overall flood risk across the Proposed Development.

Table 1: Proposed Development Flood Risk Summary

Flood Risk Source	Pre-Proposed Development Flood Risk Level	Post-Proposed Development Flood Risk Level	Comment
Fluvial	Low–High Low (majority of Principal Site and majority of Cable Corridor) – High (small area of Cable Corridor where crossing the River Brant and Witham Washlands Flood Storage Area).	Low–High Low (Principal Site and majority of Cable Corridor) – High (small area of Cable Corridor where crossing the River Brant and Witham Washlands Flood Storage Area).	Solar PV Panel infrastructure within Flood Zones 2 and 3. “interaction zones” are not envisaged to alter the existing flood extents, topography and are proposed to be installed to enable sufficient freeboard to remain operational in times of flood. No change to flood risk level.

Flood Risk Source	Pre-Proposed Development Flood Risk Level	Post-Proposed Development Flood Risk Level	Comment
Tidal	Low (Residual)	Low (Residual)	Tidal sea level assessment undertaken, Principal Site at low risk from River Witham and River Brant due to site levels, except for Field 59, where sea level rise may impact the site during the H++ scenario. However, residual risk is Low as tidal defences at Boston designed for beyond 300 years including climate change and, in addition, embedded mitigation for the credible maximum scenario exceed mitigation requirements for potential sea level rise. No change to flood risk level.
Pluvial	Low–Medium	Low–Medium	Increased surface water runoff is proposed to be managed on-site to mimic the pre-Proposed Development conditions for up to and including the 1 in 100 + 40% climate change (CC) event, with discharge rates limited to existing Greenfield rates. No change to flood risk level.
Groundwater	Medium	Medium	North Kesteven District Council's Strategic Flood Risk Assessment (SFRA) indicates the area the Site Boundary is located within is deemed not to be at risk of groundwater flooding, with no recorded groundwater flood events. No Change to flood risk level
Sewers	Low	Low	No records of sewer flooding in the Principal Site within the North Kesteven District Council SFRA. No proposed connection to public foul or surface water sewers. No change to flood risk level.
Artificial Sources	Low	Low	Environment Agency online mapping shows the maximum extent of flooding from artificial sources are not located within the vicinity of the Site Boundary. No change to flood risk level.

- ES 17 When considered within the context of national, regional and local planning policy in respect of development and flood risk, this Preliminary FRA concludes that the area of the Proposed Development remains safe for its lifetime, does not increase flood risk elsewhere, and fulfils the Government's wider criteria for sustainable development.

1. Introduction

1.1 Background

- 1.1.1 This Preliminary Flood Risk Assessment (Preliminary FRA) forms a technical appendix to **Preliminary Environmental Information (PEI) Report Volume 1, Chapter 9: Water Environment** for the proposed Fosse Green Energy project (hereafter referred to as the 'Proposed Development').
- 1.1.2 The area within and surrounding the Proposed Development is primarily rural, comprising open agricultural fields, individual trees, woodlands, hedgerows, linear tree belts, farm access tracks, local transport roads and villages. The area within and surrounding the Proposed Development is described in more detail in **PEI Report Volume 1, Chapter 2: The Site and Surroundings**.
- 1.1.3 This Preliminary FRA primarily relates to the Principal Site during the operational phase of the Proposed Development, as permanent infrastructure associated with the Cable Corridor will all be underground with no permanent above ground-built development. The Cable Corridor is therefore considered to not have an impact on long term flood risk during the operation of the Proposed Development as there will be no change to contributing areas or changes to the existing runoff and drainage regime.
- 1.1.4 Flood risk during construction and decommissioning of the Proposed Development across the Principal Site and Cable Corridor is to be managed in-situ for the duration of works via flood risk and pollution management mitigation measures documented within the Construction Environmental Management Plan (CEMP) which will be submitted with the DCO application. **A Framework CEMP** is included in **PEI Report Volume 3, Appendix 3-A**.

1.2 FRA Objectives

- 1.2.1 The minimum requirements for FRAs, as outlined in the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) (paragraph 5.8.15) (Ref. 1) are to:
- "Be proportionate to the risk and appropriate to the scale, nature, and location of the project;*
 - Consider the risk of flooding arising from the project in addition to the risk of flooding to the project;*
 - Take the impacts of climate change into account, across a range of climate scenarios, clearly stating the development lifetime over which the assessment has been made;*
 - Be undertaken by competent people, as early as possible in the process of preparing the proposal;*
 - Consider both the potential adverse and beneficial effects of flood risk management infrastructure, including raised defences, flow channels,*

flood storage areas and other artificial features, together with the consequences of their failure and exceedance;

- f. Consider the vulnerability of those using the site, including arrangements for safe access;*
- g. Consider and quantify the different types of flooding (whether from natural and human sources and including joint and cumulative effects) and include information on flood likelihood, speed-of-onset, depth, velocity, hazard and duration;*
- h. Identify and secure opportunities to reduce the causes and impacts of flooding overall, making as much use of natural flood management techniques as part of an integrated approach to flood risk management;*
- i. Consider the effects of a range of flooding events including extreme events on people, property, the natural and historic environment and river and coastal processes;*
- j. Include the assessment of the remaining (known as 'residual') risk after risk reduction measures have been taken into account and demonstrate that these risks can be safely managed, ensuring people will not be exposed to hazardous flooding;*
- k. Consider how the ability of water to soak into the ground may change with development, along with how the proposed layout of the project may affect drainage systems, Information should include:*
 - i. Describe the existing surface water drainage arrangements for the site.*
 - ii. Set out (approximately) the existing rates and volumes of surface water run-off generated by the site. Detail the proposals for restricting discharge rates.*
 - iii. Set out proposals for managing and discharging surface water from the site using sustainable drainage systems an accounting for the predicted impacts of climate change. If sustainable drainage systems have been rejected, present clear evidence of why their including would be inappropriate.*
 - iv. Demonstrate how the hierarchy of drainage options has been followed*
 - v. Explain and justify why the types of SuDS and method of discharge have been selected and why they are considered appropriate. Where cost is a reason for not including SuDS, provide information to enable comparison with the lifetime costs of a conventional public sewer connection.*
 - vi. Explain how sustainable drainage systems have been integrated with other aspects of the development such as open space or green infrastructure, so as to ensure an efficient use of the site.*
 - vii. Describe the multifunctional benefits the sustainable drainage system will provide.*

- viii. Set out which opportunities to reduce the causes and impacts of flooding have been identified and included as a part of the proposed sustainable drainage system.*
 - ix. Explain how run-off from the completed development will be prevented from causing an impact elsewhere.*
 - x. Explain how the sustainable drainage system been designed to facilitate maintenance and, where relevant, adoption. Set out plans for ensuring an acceptable standard of operation and maintenance throughout the lifetime of the development.*
 - l. Detail those measurements that will be included to ensure the development will be safe and remain operational during a flooding event throughout the development's lifetime without increasing flood risk elsewhere.*
 - m. Identify and secure opportunities to reduce the causes and impacts of flooding overall during the period of construction, and*
 - n. Be supported by appropriate data and information, including historical information on previous events."*
- 1.2.2 The principal objectives of the Preliminary FRA, taking into account the above, are to:
- a. Identify potential forms of flooding, including rivers, watercourses, surface water flooding, groundwater flooding, flooding from sewer systems and other forms of flooding, relevant to the Proposed Development;
 - b. Establish the risk of flooding in relation to the Proposed Development;
 - c. Determine the effects of the Proposed Development on flooding elsewhere either through displacement of floodwaters or increased runoff; and
 - d. Suggest appropriate flood mitigation measures for the Proposed Development, including a strategy for disposal of surface water run-off following the principles of Sustainable Drainage Systems (SuDS).
- 1.2.3 The robust and comprehensive detail assessed and included in this Preliminary FRA and the accompanying Preliminary Drainage Strategy (**PEI Report Volume 3, Appendix 9-D**) will be developed to support a DCO application for the Proposed Development.

1.3 Scope of Work

- 1.3.1 In preparing this Preliminary FRA, the Applicant has:
- a. Obtained relevant data and information from statutory and other authorities;
 - b. Considered the potential sources of flooding;
 - c. Assessed the risk of flooding to the Proposed Development;

- d. Assessed the impact of off-site flooding (displaced water) on third parties;
- e. Considered the impact of climate change; and
- f. Considered mitigation requirements for the design and any residual risk.

1.4 Proposed Development Description

- 1.4.1 The Proposed Development comprises the construction, operation (including maintenance), and decommissioning of ground mounted solar PV panel arrays to generate solar electricity and store the energy within a Battery Energy Storage System (BESS) for import and export to the national electricity transmission network.
- 1.4.2 **PEI Report Volume 1, Chapter 3: Proposed Development** provides further details of the Proposed Development and programme for site preparation, construction, and decommissioning works.

1.5 Proposed Development Extent

- 1.5.1 The Site Boundary is made up of two main elements:
 - a. 'the Principal Site', covering approximately 1065ha which is the location where ground mounted solar photovoltaic (PV) panel arrays, BESS and an Onsite Substation will be installed; and
 - b. 'the Cable Corridor', which will comprise the underground electrical cables required to connect the Principal Site to the National Electricity Transmission System.
- 1.5.2 As discussed in Section 1.1, this Preliminary FRA is focused primarily on assessing flood risk to and from the Proposed Development within the Principal Site. The development infrastructure within the Cable Corridor is inherently protected from flood risk to the Proposed Development and increasing flood risk elsewhere, as all infrastructure is buried below ground during the operational phase, i.e. there is no permanent above ground infrastructure proposed along the Cable Corridor.

1.6 Existing Land Use

- 1.6.1 The Principal Site consists of mostly greenfield agricultural land, with some local roads connecting rural dwellings to villages adjacent to the Site Boundary.
- 1.6.2 The Principal Site Boundary has been set to only occupy natural landscape, avoiding existing developments and buildings. It is estimated to cover less than 1% existing impermeable area. Therefore, existing land within the Principal Site Boundary is considered 100% permeable (0% impermeable) for the purposes of this assessment. This represents a worst-case approach to the existing catchment surface water greenfield runoff rates.
- 1.6.3 **Table 2** provides a summary of the existing Principal Site permeable and impermeable areas.

Table 2: Principal Site Boundary Existing Contributing Areas

	Permeable Area (ha)	Impermeable Area (ha)	Percentage Impermeable
Principal Site Boundary	1065	0%	0%

- 1.6.4 The Cable Corridor consists of similar land use to the Principal Site, with the additional feature near Fen Lane, where the Route overlaps with the Witham Washlands Flood Storage Area (FSA) associated with the Main Rivers Brant and Witham. It is anticipated that any of the Proposed Development infrastructure within the Cable Corridor boundary will not impose a change to permeable/impermeable areas following construction. Therefore, only the Principal Site has been assessed in detail to ensure the Proposed Development remains safe from future flood risk, does not increase flood risk elsewhere, and fulfils the Government's wider criteria for sustainable development.

1.7 Development Proposals

- 1.7.1 The Proposed Development within the Principal Site will consist of the following infrastructure:
- Solar PV panels (also known as 'modules');
 - PV panel mounting structures;
 - Battery Energy Storage System (BESS);
 - Inverters;
 - Transformers;
 - Switchgear;
 - An Onsite Substation and control buildings;
 - Onsite cabling;
 - Ancillary infrastructure (e.g. combiner boxes, weather stations);
 - Electricity export and import via high-voltage Grid Connection Cable and connection to the National Electricity Transmission System;
 - Fencing and security;
 - Access tracks; and
 - Landscaping and biodiversity enhancement areas.
- 1.7.2 **PEI Report Volume 1, Chapter 3: The Proposed Development** provides further details of the components of the Proposed Development.
- 1.7.3 **PEI Report Volume 2, Figure 3-2A and Figure 3-2B** shows the indicative Site Layout Plan.

1.8 Consultees

- 1.8.1 The following stakeholders have been consulted during the PEI Report consultation, and the Preliminary FRA will be reviewed taking into account any comments made prior to the DCO submission:
- Lead Local Flood Authority – Lincolnshire County Council;
 - The Environment Agency;
 - Upper Witham Internal Drainage Board; and
 - Trent Valley Internal Drainage Board.

2. Legislation and Planning Policy

- 2.1.1 Legislation, planning policy, and guidance relating to flood risk and pertinent to the Proposed Development is set out in the following sections.

2.2 National Planning Policy

- 2.2.1 The Energy National Policy Statements (NPS) set out the Government's national policy for energy infrastructure. It has effect for the decisions by the Secretary of State on applications for energy developments that are nationally significant under the Planning Act 2008. They were first designated and published in 2011. They were most recently updated in November 2023, and came into force in January 2024.
- 2.2.2 Since the first publication of the NPS for Energy in 2011, reviews have been undertaken by the Government to ensure the policies are updated to align with the policies set out in the Governments Energy white paper: Powering our net zero future (Ref. 26), setting out how the UK will clean up its energy system and reach net zero emissions by 2050, which was published in 2020.
- 2.2.3 This Preliminary FRA considers the in force NPS documents from January 2024 as follows:
- NPS EN-1 (Ref. 1);
 - NPS EN-3 (Ref. 2); and
 - NPS EN-5 (Ref. 3).

Overarching National Policy Statement (NPS) for Energy (EN-1)

- 2.2.4 NPS EN-1 (Ref. 1) is part of a suite of NPSs issued by the Secretary of State for Energy Security and Net Zero. It sets out the Government's policy for delivery of major energy infrastructure.
- 2.2.5 The objectives of this Preliminary FRA are in line with paragraph 5.8.15 of NPS EN-1.

2.2.6 Paragraph 5.8.13 of NPS EN-1 states a site-specific flood risk assessment should be provided for all energy projects in Flood Zones 2 and 3 in England or Zones B and C in Wales. In Flood Zone 1 in England or Zone A in Wales, an assessment should accompany all proposals involving:

- sites of 1 hectare or more;
- land which has been identified by the EA or NRW as having critical drainage problems;
- land identified (for example in a local authority strategic flood risk assessment) as being at increased flood risk in future;
- land that may be subject to other sources of flooding (for example surface water), and;
- where the EA or NRW, Lead Local Flood Authority, Internal Drainage Board or other body have indicated that there may be drainage problems.

2.2.7 Paragraph 5.8.14 states the assessment should identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account.

2.2.8 Paragraph 5.8.18 NPS EN-1 recommends that applicants should arrange:

“pre-application discussions before the official pre-application stage of the NSIP process with the EA or NRW, and, where relevant, other bodies such as Lead Local Flood Authorities, Internal Drainage Boards, sewerage undertakers, navigation authorities, highways authorities and reservoir owners and operators”.

2.2.9 Paragraphs 5.8.25 NPS EN-1 explains the range of sustainable approaches to surface water drainage management.

2.2.10 Paragraph 5.8.26 of NPS EN-1 states:

“Site layout and surface water drainage systems should cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from the site without adverse impacts”.

2.2.11 Paragraph 5.8.27 NPS EN-1 states:

“The surface water drainage arrangements for any project should, accounting for the predicted impacts of climate change throughout the development’s lifetime, be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project, unless specific off-site arrangements are made and result in the same net effect”.

2.2.12 Paragraph 5.8.28 of NPS EN-1 states:

“It may be necessary to provide surface water storage and infiltration to limit and reduce both the peak rate of discharge from the site and the total volume discharged from the site. There may be circumstances where it is appropriate for infiltration facilities or attenuation storage to be provided

outside the project site, if necessary, through the use of a planning obligation”.

- 2.2.13 Paragraph 5.8.29 of NPS EN-1 requires a sequential approach to be applied to the layout and design of projects with more vulnerable uses being located on parts of the site at lower probability and residual risk of flooding by using Sustainable Urban Drainage Systems (SuDS).
- 2.2.14 Paragraph 5.8.30 of NPS-EN-1 states where a development may result in an increase in flood risk, on-site level-for-level compensatory storage, accounting for the predicted impacts of climate change over the lifetime of the development, should be provided.
- 2.2.15 Paragraph 5.8.32 of NPS EN-1 states where development may contribute to a cumulative increase in flood risk elsewhere, the provision of multifunctional sustainable drainage systems, natural flood management and green infrastructure can also make a valuable contribution to mitigating this risk whilst providing wider benefits.
- 2.2.16 Paragraph 5.8.33 of NPS EN-1 also requires flood warning and evacuation plans for areas of development identified to be at risk of flooding.
- 2.2.17 Paragraph 5.8.36 of NPS EN-1 states that:
- “in determining an application for development consent, the Secretary of State should be satisfied that where relevant:*
- “the application is supported by an appropriate FRA”.*
- 2.2.18 Paragraph 5.8.41 of NPS EN-1 states that:
- “Energy projects should not normally be consented within Flood Zone 3b, or Zone C2 in Wales, or on land expected to fall within these zones within its predicted lifetime. This may also apply where land is subject to other sources of flooding (for example surface water). However, where essential energy infrastructure has to be located in such areas, for operational reasons, they should only be consented if the development will not result in a net loss of floodplain storage and will not impede water flows”.*
- 2.2.19 Paragraph 5.8.42 of NPS EN-1 states:
- “Exceptionally, where an increase in flood risk elsewhere cannot be avoided or wholly mitigated, the Secretary of State may grant consent if they are satisfied that the increase in present and future flood risk can be mitigated to an acceptable and safe level and taking account of the benefits of, including the need for, nationally significant energy infrastructure as set out in Part 3 above. In any such case the Secretary of State should make clear how, in reaching their decision, they have weighed up the increased flood risk against the benefits of the project, taking account of the nature and degree of the risk, the future impacts on climate change, and advice provided by the EA or NRW or other relevant bodies”.*

National Policy Statement for Renewable Energy NPS EN-3

- 2.2.20 This NPS, taken together with the Overarching National Policy Statement for Energy (EN-1), provides the primary policy for decisions by the Secretary of State on applications they receive for nationally significant renewable energy infrastructure.
- 2.2.21 Paragraph 2.4.11 of NPS EN-3 (Ref. 2) notes that:
- “Solar photovoltaic (PV) sites may also be proposed in low lying exposed sites. For these proposals, applicants should consider, in particular, how plant will be resilient to:*
- a. Increased risk of flooding; and*
 - b. Impact of higher temperature.”*
- 2.2.22 While NPS EN-3 does not mention a need for an FRA or implications for drainage, paragraph 2.10.84 of NPS EN-3 does state:
- “Where a Flood Risk Assessment has been carried out this must be submitted alongside the applicant's ES. This will need to consider the impact of drainage. As solar PV panels will drain to the existing ground, the impact will not, in general, be significant.”*
- 2.2.23 Paragraph 2.10.84 NPS EN-3 states where a Flood Risk Assessment has been carried out this must be submitted alongside the applicant's ES and will need to consider the impact of drainage. This Preliminary FRA has considered drainage for the PEI Report. and will be updated if required, to ensure this requirement is met for the DCO submission.
- 2.2.24 Paragraph 2.10.85 of NPS EN-3 states,
- “Where access tracks need to be provided, permeable tracks should be used, and localised Sustainable Drainage Systems (SuDS), such as swales and infiltration trenches, should be used to control any run-off where recommended.”*
- 2.2.25 Paragraph 2.10.87 of NPS EN-3 states:
- “Culverting existing watercourses/drainage ditches should be avoided.”*
- 2.2.26 The Proposed Development has a design principle, to utilise existing water crossing locations to avoid the need for new culverts. Should a new crossing, requiring a culvert to be proposed, it is expected that the least impacting design be utilised, (e.g. arch rather than box or pipes) to mitigate impact to flood risk levels.

National Policy Statement for Electricity Networks Infrastructure (EN-5)

- 2.2.27 National Policy Statement for electricity networks infrastructure (EN-5) (Ref. 3) principally concerns high voltage transmission systems and distribution systems in addition to associated infrastructure.

2.2.28 Paragraph 2.3.2 of NPS EN-5 explains that:

“as climate change is likely to increase risks to the resilience of electrical infrastructure it requires applicants to “set out to what extent the Proposed Development is expected to be vulnerable, and, as appropriate, how it has been designed to be resilient to:

- a. flooding, particularly for substations that are vital to the network; and especially in light of changes to groundwater levels resulting from climate change;”*
- b. the effects of wind and storms on overhead lines;*
- c. higher average temperatures leading to increased transmission losses;*
- d. earth movement or subsidence caused by flooding or drought (for underground cables); and*
- e. coastal erosion – for the landfall of offshore transmission cables and their associated substations in the inshore and coastal locations respectively.”*

2.2.29 Paragraph 2.3.3 of NPS EN-5 reiterates the requirements set out in NPS EN-1 (Ref. 1) that *“future increased risk of flooding would be covered in any flood risk assessment”*.

2.2.30 The infrastructure for the Onsite Substation and either the single BESS Compound (AC-Coupled) or Solar Station Compound (DC-Coupled) options are all located within Flood Zone 1 and at low risk from other sources of flooding, ensuring the infrastructure will remain operational in times of flood. The Solar Station Compounds include BESS containers.

2.2.31 For PV Panels located in Flood Zone 2 and 3, these will have mitigation in the form of raised mounting heights to ensure they remain operational in times of flood with suitable freeboard above the predicted flood levels (fluvial flood risk to PV panels is discussed further in section 4.3).

National Planning Policy Framework (NPPF)

2.2.32 The NPPF (Ref. 4) was first published in March 2012, superseding previous national planning policy statements and guidance, The NPPF was subsequently revised in July 2021, September 2023 and in December 2023. This Preliminary FRA complies with the latest revised version of the NPPF published in December 2023.

2.2.33 Flood Risk and Coastal Change Planning Practice Guidance (PPG) (Ref. 5) was also published in 2014 to support the implementation of the NPPF. The PPG was last updated in August 2022; this Preliminary FRA complies with this and all other current national and local policy.

2.2.34 Section 14 of the NPPF, entitled, *“Meeting the challenge of Climate Change, Flooding and Coastal Change”* (paragraphs 158–175), sets out the requirements to assess flood risk and climate change for developments. Paragraph 175 states:

“major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate.”

2.2.35 The assessment of flood risk is based on the definitions in as extracted from the PPG in Table 3.

Table 3: Flood Zones – Reproduced from Table 1 of the PPG 2014 (Ref. 5)

Flood Zone	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as ‘clear’ on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic FRAs areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

2.2.36 Annex 3: “*Flood Risk vulnerability classification*” of the NPPF, classifies the Flood Risk Vulnerability of various land uses as extracted in **Table 4**.

Table 4: Development Type and Vulnerability Classification – Reproduced from Annex 3 of the NPPF (Ref. 4)

Development Type	Definition
Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. • Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. • Wind turbines. • Solar farms.
Highly Vulnerable	• Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. • Emergency dispersal points. • Basement dwellings.

Development Type	Definition
	• Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as “essential infrastructure”)
More Vulnerable	• Hospitals. • Residential institutions such as residential care homes, children’s homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Police, ambulance and fire stations which are not required to be operational during flooding. • Buildings used for shops, financial, professional and other services, restaurants and cafes, hot food takeaways, offices, general industry, storage and distribution, non–residential institutions not included in “more vulnerable”, and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment works which do not need to remain operational during times of flood. • Sewage treatment works (if adequate measures to control pollution and manage sewage during flooding events are in place). • Car Parks
Water-compatible Development	• Flood control infrastructure. • Water transmission infrastructure and pumping stations. • Sewage transmission infrastructure and pumping stations. • Sand and gravel working. • Docks, marinas and wharves. • Navigation facilities. • Ministry of Defence installations.

Development Type	Definition
	• Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in his category, subject to a specific warning and evacuation plan.

2.2.37 The Proposed Development falls within the definition of ‘Essential Infrastructure’. The overall aim of the sequential approach is to steer new development to areas of lowest flood risk, i.e., Flood Zone 1 and low surface water flood risk (Sequential Test, see section below). Where there are no reasonable sites available outside areas at risk of flooding, Flood Zones 2 and 3 may be considered, subject to passing the Exception Test, as required and set out in **Table 5** below.

2.2.38 Surface water flood risk has been reviewed alongside the Environment Agency published Updated Flood Map for Surface Water (EA uFMfSW (Ref. 6)).

2.2.39 The EA uFMfSW (Ref. 6) shows where areas could be potentially susceptible to surface water flooding in an extreme rainfall event.

2.2.40 The latest mapping assesses flooding resulting from severe rainfall events based on the following three scenarios:

- High Risk: 1 in 30 year (0.33%) annual probability event;
- Medium Risk: 1 in 100 year (1%) annual probability event; and
- Low Risk: 1 in 1000 year (0.1%) annual probability event.

2.2.41 Land at lower than 1 in 1000 (0.1%) annual probability of flooding is considered to be a “Very Low” risk.

The Sequential Test and Exception Test

2.2.42 NPS EN-1 (Ref. 1) and the NPPF (Ref. 4) set out the requirements of the Sequential Test, which is a risk-based test that should be applied at all stages of development.

2.2.43 All plans should apply a sequential, risk-based approach to the location of development – taking into account all sources of flood risk and the current and future impacts of climate change – so as to avoid, where possible, flood risk to people and property. They should do this, and manage any residual risk, by:

- a. Applying the sequential test and then, if necessary, the exception test as set out below;
 - b. Safeguarding land from development that is required, or likely to be required, for current or future flood management;
 - c. Using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding, (making as much use as possible of natural flood management techniques); and
 - d. Where climate change is expected to increase flood risk so that some existing development may not be sustainable in the long-term, seeking opportunities to relocate development, including housing, to more sustainable locations.
- 2.2.44 The aim of the Sequential Test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the development in areas with a lower risk of flooding. A Strategic FRA will provide the basis for applying this test. The sequential test approach should be used in areas known to be at risk now or in the future from any forms of flooding.
- 2.2.45 If it is not possible for development to be located within areas of lower risk of flooding (taking into account wider sustainable development objectives), the Exception Test may have to be applied. The need for the Exception Test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3: “*Flood Risk vulnerability classification*” of the NPPF. **Table 5** below reproduces the flood risk vulnerability and flood zone compatibility, as set out in Table 2 of the PPG (Ref. 5).

Table 5: Flood Risk Vulnerability and Flood Zone ‘Compatibility’ – Reproduced from Table 2 of the PPG 2022 (Ref. 5)

Flood Zone	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required	✓	✓	✓
Zone 3a	Exception Test Required	✗	Exception Test Required	✓	✓
Zone 3b (functional Floodplain)	Exception Test Required	✗	✗	✗	✓

✓ Development is appropriate

✗ Development should not be permitted

█ Flood Zones that the Proposed Development sits within

2.2.46 The NPPF (Ref. 4) states in paragraph 170 that, for the Exception Test to be passed, it should be demonstrated that both of the following elements should be satisfied for development to be allocated or permitted:

- The development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- The development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

2.2.47 Both elements of the Exception Test should be satisfied for development to be allocated or permitted.

2.2.48 The sequential approach to the design and layout of the Proposed Development complies with paragraph 5.8.29 of NPS EN-1 (Ref. 1) in relation to the layout of the Proposed Development’s infrastructure.

2.2.49 Paragraph 2.3.9 of NPS EN-3 (Ref. 2) states:

“As most renewable energy resources can only be developed where the resource exists and where economically feasible, and because there are no limits on the need established in Part 3 of EN-1, the Secretary of State should not use a sequential approach in the consideration of renewable energy projects (for example, by giving priority to the re-use of previously developed land for renewable technology developments).”

2.2.50 The sequential approach in selecting the location of the Site for the Proposed Development will be set out in the ES and the Planning Statement, to be submitted as part of the DCO application.

2.3 Local Planning Policy

- 2.3.1 The Site Boundary is located within the administrative areas of North Kesteven District Council and Lincolnshire County Council.
- 2.3.2 Lincolnshire County Council will consider the Preliminary FRA (through consultation with the Environment Agency and North Kesteven District as necessary) as the Site Boundary is predominately within Flood Zone 1.
- 2.3.3 The following key planning documents and salient policies have been considered to inform this Preliminary FRA:
 - a. Lincolnshire County Council:
 - i. Preliminary FRA (2011) (Ref. 7)
 - ii. Second Cycle Preliminary FRA for Lincolnshire (2017) (Ref. 8)
 - iii. Central Lincolnshire Local Plan (2023) (Ref. 9)
 - iv. Joint Flood Risk and Water Management Strategy 2019-2050 (Ref. 10)
 - b. North Kesteven District Council:
 - i. North Kesteven Strategic Flood Risk Assessment (2009) (Ref. 11)

2.4 Internal Drainage Boards

- 2.4.1 Internal Drainage Boards (IDB) are local public authorities that manage water levels within areas of special drainage need (Internal Drainage Districts) in England and Wales. Works relating to watercourses within these designated areas of the Site Boundary must seek consent from the relevant IDB.
- 2.4.2 The Site Boundary is located across two IDBs, Upper Witham and Trent Valley.
- 2.4.3 The following documents have been considered to inform this Preliminary FRA:
 - a. Upper Witham Internal Drainage Board;
 - i. Policy Statement on Water Level and Flood Risk Management Asset List (Ref. 12), and
 - ii. Upper Witham Internal Drainage Board Byelaws (Ref. 13)
 - b. Trent Valley Internal Drainage Board;
 - i. Planning and Byelaw Policy (Ref. 14), and
 - ii. Advice Note, AN06: Surface Water (Ref. 15).

3. Supporting Information

3.1 Contributing Areas

- 3.1.1 Within hydrology, it is generally understood that permeable surfaces absorb rainfall whilst impermeable surfaces repel rainfall leading to surface water runoff. For a site, the total impermeable area is often referred to as the site's Contributing Area. The Contributing Area is used as part of the calculation to determine the volume of surface water runoff generated within the site. Developing greenfield sites (typically entirely permeable land) often increases the site's Contributing Area as natural permeable surfaces are sealed by impermeable surfaces.
- 3.1.2 For the Proposed Development across the Principal Site, some existing permeable surfaces will be replaced by proposed impermeable surfaces.
- 3.1.3 The solar PV panels are assumed to not contribute to the total post-Development impermeable area as the mounting structures holding the solar PV panels are usually supported by galvanised steel legs driven into the ground, therefore mitigating the need for concrete footings. This assumption is compliant with Paragraph 2.10.84 of NPS EN-3 (Ref. 2). The ground beneath the solar PV panels remains permeable, where runoff from the panels can drain at source for the majority of rainfall events.
- 3.1.4 It is noted that, in potentially archaeologically sensitive areas, PV panels may require concrete footings instead of being piled. At this stage no concrete footings are proposed; however, the Preliminary FRA will be updated for the DCO submission to confirm if any concrete footings are proposed and assess the flood risk to ensure no increase in flood risk off site occurs.
- 3.1.5 It is understood that interception of rainfall by the solar PV panels will impose negligible impact on the with-Proposed Development surface water runoff rates as the ground below and surrounding the solar PV panels is proposed to consist of suitable planting such as native grassland and wildflower mix, which will provide a permeable surface area and reduce the risk of erosion of soils.
- 3.1.6 A comparison of the proposed and existing Principal Site has been undertaken to demonstrate how the with-Development Contributing Area will be affected compared to the pre-Development scenario.
- 3.1.7 **Table 6** below presents this overall comparison refer to **PEI Report Volume 3, Appendix 9-D: Preliminary Surface Water Drainage Strategy** for detailed breakdowns of impermeable areas within the Site Boundary).

Table 6: Pre- and Post-Development Contributing Areas within Principal Site Boundary

	Total Area (ha)	Pre- Development contributing area (ha)	Post- development contributing area (ha)	Pre- development t PIMP*	Post- development PIMP*
Principal Site	1065	0	10.01	0%	0.94%**

*- Percentage Impermeable Area (PIMP) – percentage of an area that is impermeable.

** - Assumed operational buildings/compound areas are 100% PIMP. Photovoltaic (PV) panel areas assumed to have effective 0% PIMP.

3.2 Existing Drainage

- 3.2.1 The area within the Principal Site is largely greenfield. LiDAR data has been utilised to assess topography. It is unknown if formal piped drainage systems are present across the Site, although it is likely there is historical sub-surface field drainage across the fields proposed for PV panels; however, this is not typically mapped data.
- 3.2.2 The Principal Site is located across two River Basin Districts; the majority of the site is located with the Anglian River Basin District and a small portion on the western side of the site is within the Humber River Basin District. Plate 1 below presents the boundary between the two districts with a black line and labels indicating the extents of the operational catchment's waterbody extents.

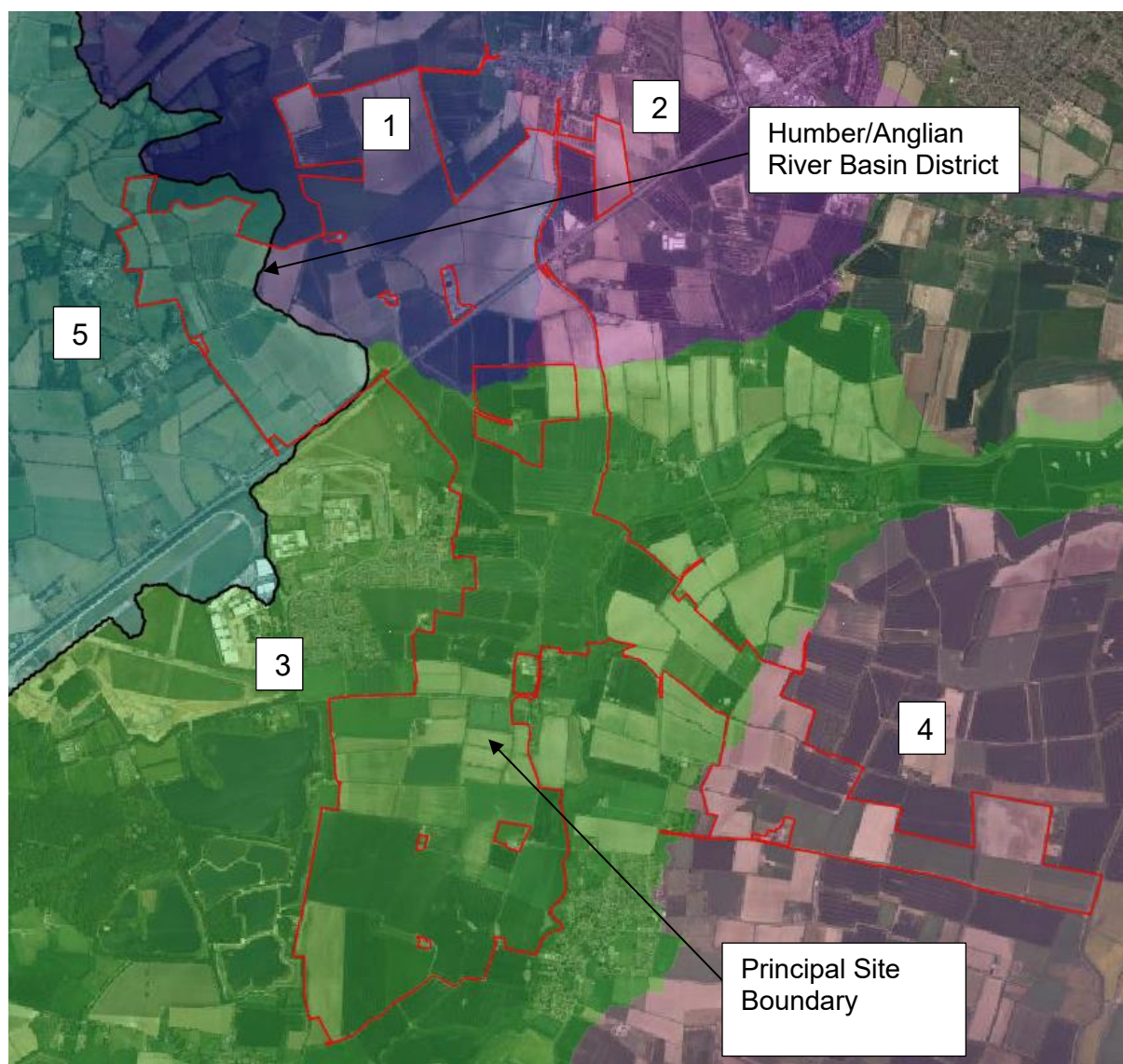


Plate 1: River Basin Districts

Label	River Bain District	Operational Catchment	Waterbody
1	Anglian	Witham Upper	Boultham Catchwater Drain
2	Anglian	Witham Upper	South Hykeham Catchwater
3	Anglian	Witham Upper	Witham - conf Cringle Bk to conf Brant
4	Anglian	Witham Upper	Brant - Lower
5	Humber	Trent and Trib	The Fleet Lower

3.2.3 The majority of the Principal Site is drained east of the black line shown in Plate 1 via ordinary watercourses which are located within four Waterbody catchments belonging to the Anglian River Basin District, labelled 1–4 in Plate 1. These catchments convey flows to the River Witham (a Main River), either via the River Brant or ordinary watercourses. The River Witham is

located adjacent to the Eastern boundary of the Principal Site, flowing north towards Lincoln. There is a fluvial flood risk model available of the two Main Rivers (Brant and Witham), provided by the Environment Agency (last updated in 2015).

- 3.2.4 The remaining area lies within land designated as the Humber River basin district and labelled as no. 5 in Plate 1. This area is associated with the Fleet Lower Catchment which serves an ordinary watercourse, Mill Dam Dyke, a tributary of the River Trent. The Mill Dam Dyke becomes a designated Main River approximately 3.3km from the closest point of the Principal Site Boundary. There is no Environment Agency Fluvial Model available for this Main River, following a Product 6 data request in April 2023.
- 3.2.5 In general, it is assumed that for low intensity rainfall events, rainfall is collected within the waterbody catchments across the Principal Site, naturally draining to ground or to ordinary watercourses located along the field boundaries identified by LiDAR data before discharging to larger Main Rivers downstream.
- 3.2.6 For rainfall events where rainfall exceeds the infiltration capacity of the ground or the maximum discharge rates of the ordinary watercourses within the two catchments, it is assumed that any excess runoff would flow overland and pond in lower lying areas and surrounding watercourses before naturally draining / evaporating after the event has occurred.

3.3 Existing Flood Risk from All Sources

- 3.3.1 **Table 7** summarises the Pre-Development flood risk across the Site Boundary. Note the Site Boundary has been marked indicatively on the maps within this report to represent the perspective of the Principal Site and Cable Corridor and surroundings in the context of the North Kesteven SFRA (Ref. 11) (refer to **PEI Report Volume 2, Figure 1-2: Site Boundary Plan** for the extent of the Site Boundary).

Table 7: Pre-Development Flood Risk Mapping

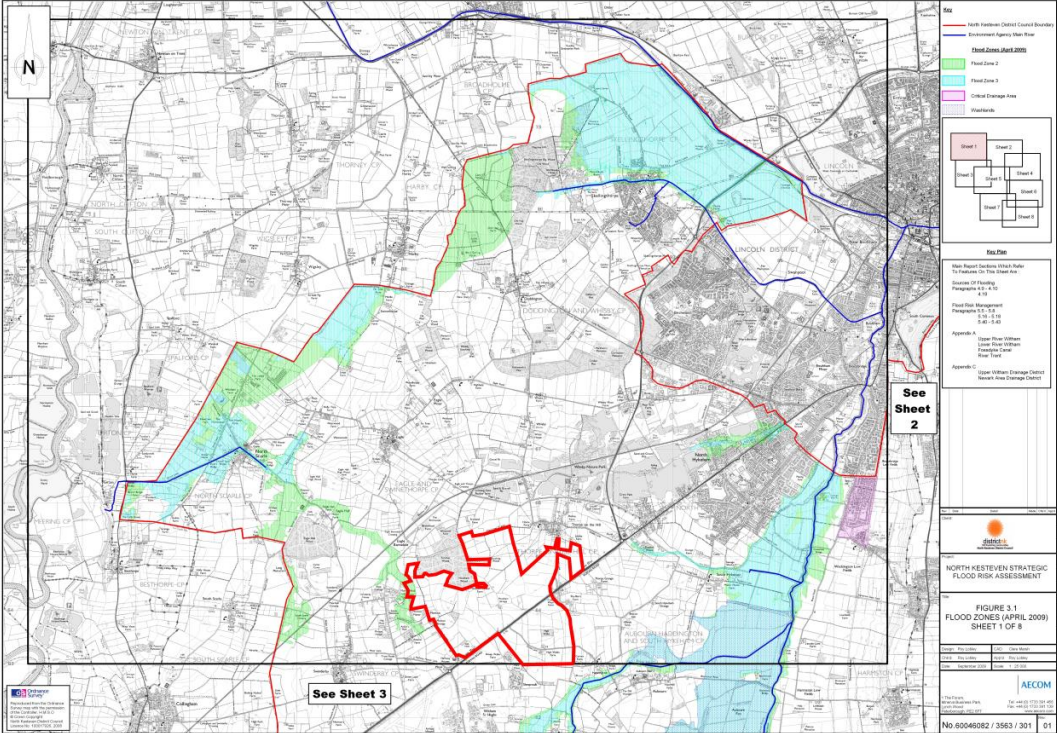
Flood Risk Source	Flood Risk Level	Mapping and Comments
Fluvial	Low to High	

Plate 2: North Kesteven District Council SFRA Mapping Sheet 1

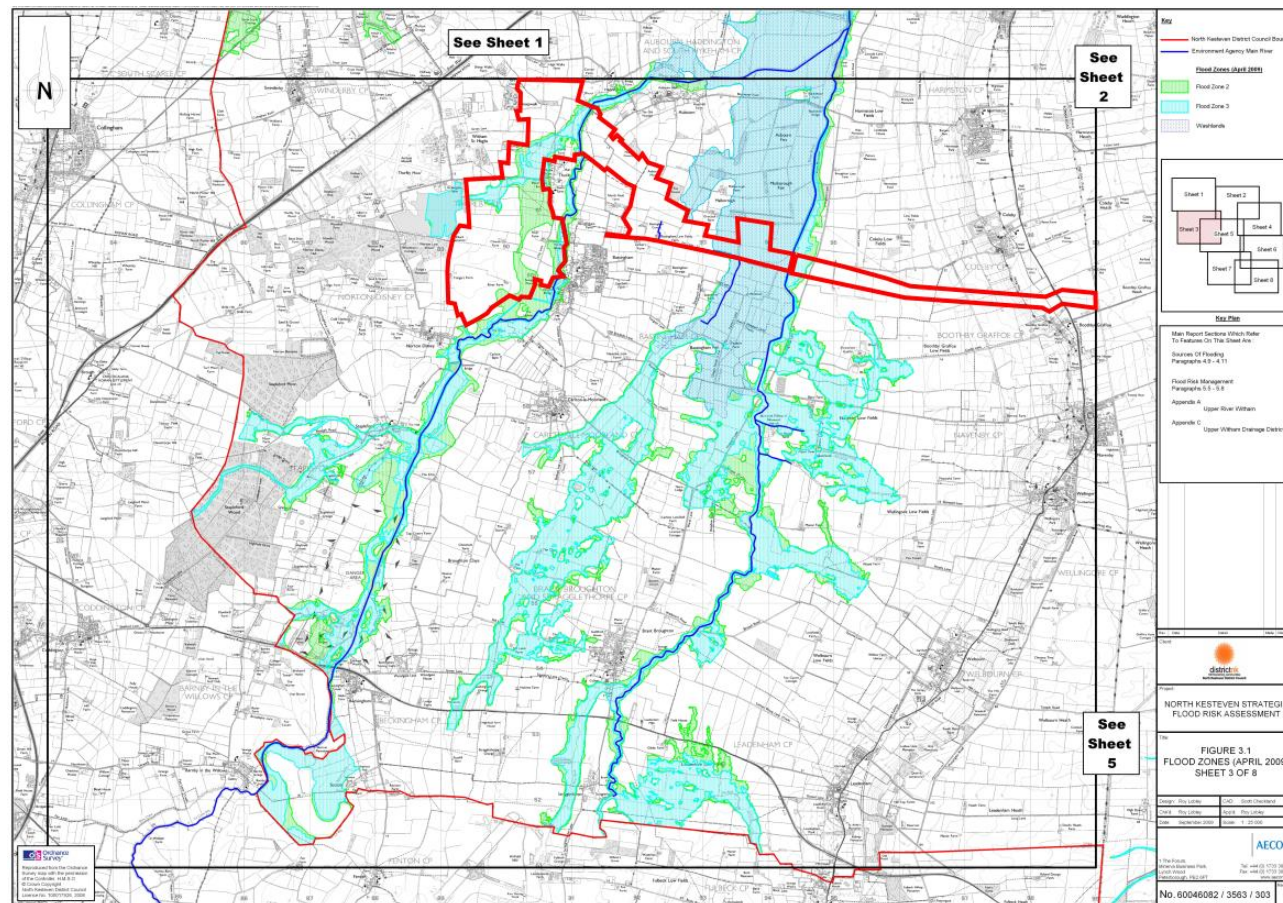


Plate 3: North Kesteven District Council SFRA Mapping Sheet 3

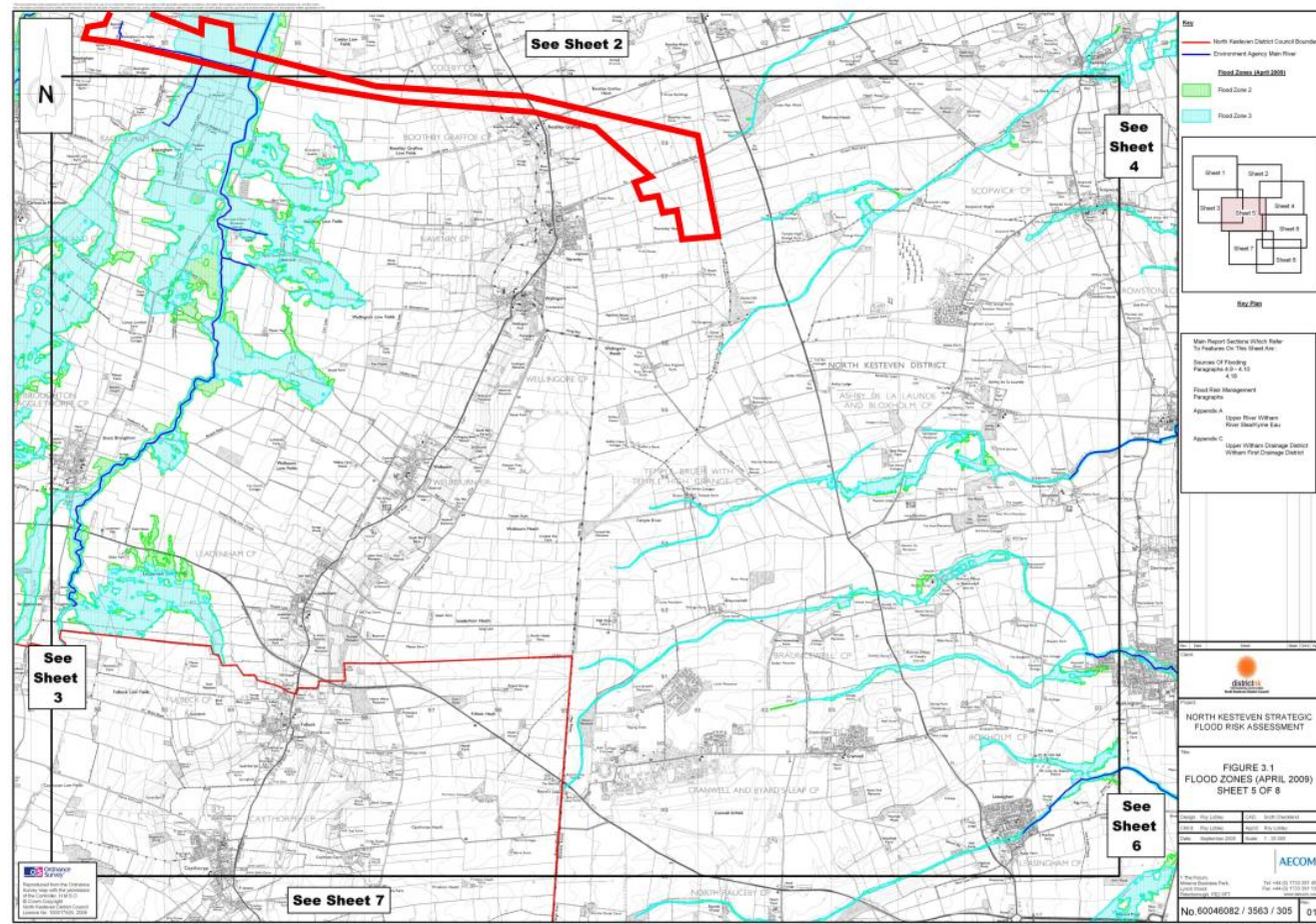


Plate 4: North Kesteven District Council SFRA Mapping Sheet 5

Flood Risk Source	Flood Risk Level	Mapping and Comments
		North Kesteven District Council SFRA (Ref. 11) mapping indicates that the majority of the Principal Site is located within Flood Zone 1, however there are significant areas designated as Flood Zone 2 and 3 associated with a flood storage area west of the river Witham (Witham Washlands Flood Storage Area).
Tidal	Low (Residual) - Medium	The majority of the Site Boundary (east of the A46) is considered to be at a low residual risk of tidal flooding as the River Witham and Trent is protected for up to the 300 year event with an allowance for climate change by the Grand Sluice tidal defence in Boston, approximately 45km from the centre of the Principal Site. Mill Dam Dyke, a Main River, located approximately 4km west of the Site Boundary (Morton Hall area) is subject to tidal influence, this may impose a tidal risk to the Principal Site Boundary as an ordinary watercourse that is a tributary to Mill Dam Dyke runs parallel with part of the Site Boundary.

Flood Risk Source	Flood Risk Level	Mapping and Comments
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Surface Water
Low to High

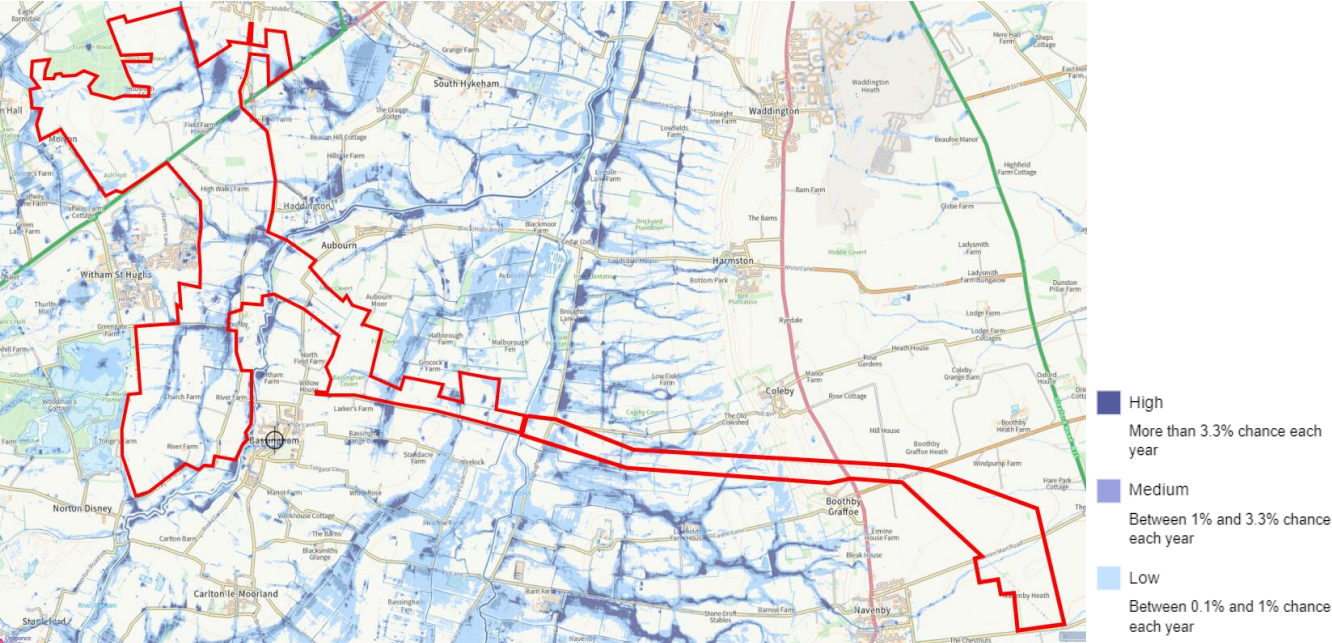


Plate 5: Online Maps for Planning Surface Water Risk (Ref. 6)

The risk of surface water flooding across the Site Boundary varies from very low to high. The areas of higher risk are likely associated with fluvial flood risk and areas of low topography where surface water sits and pools rather than draining away, or show areas at risk from flooding from smaller Ordinary Watercourses and/or local land drains.

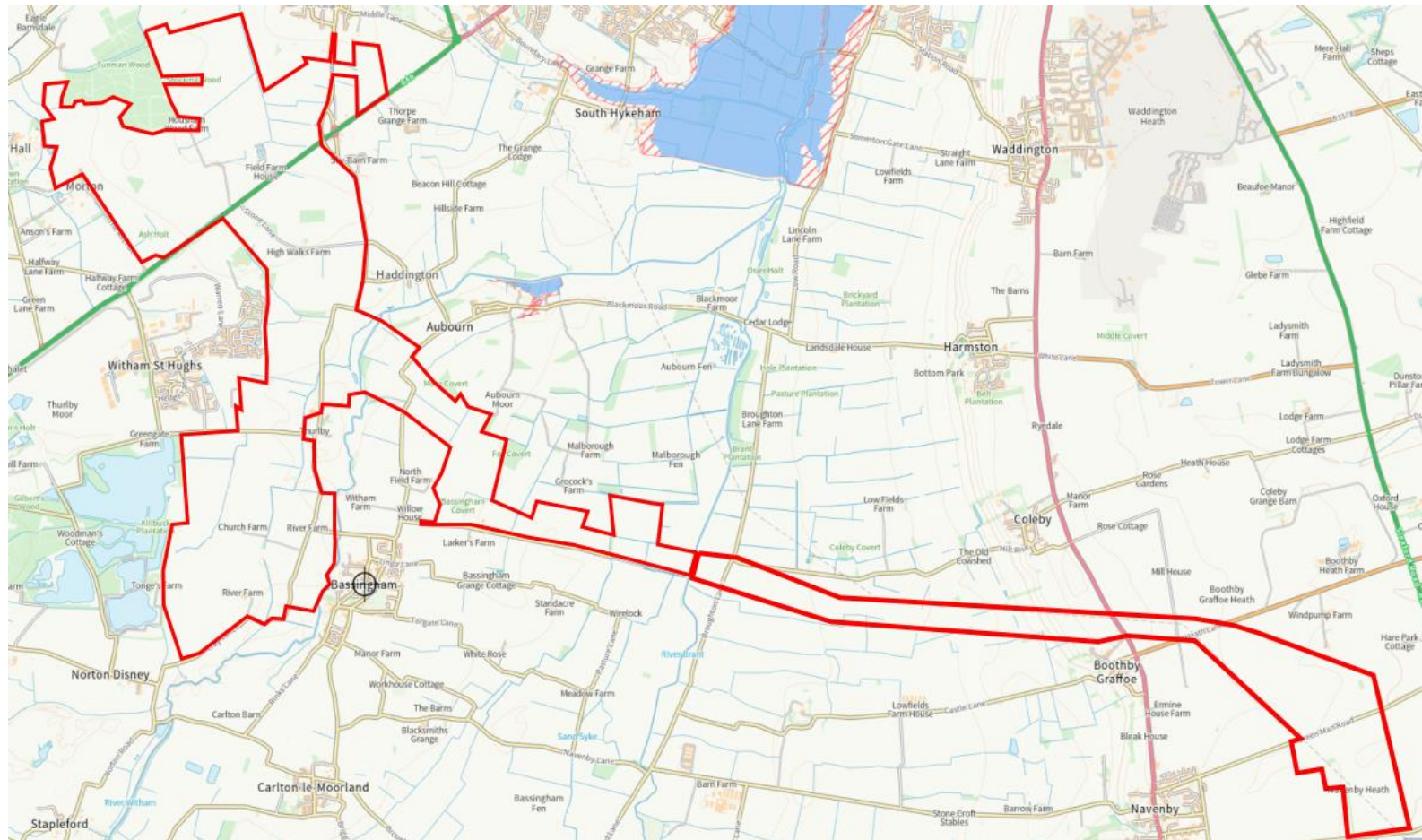
Groundwater Low

North Kesteven District Council's SFRA indicates the area the Site Boundary is located within is deemed not to be at risk of groundwater flooding, with no recorded groundwater flood events.

No site-specific ground investigation information has been undertaken, however, a review of selected BGS borehole records available indicate shallow groundwater at depths of 2 to 3m below ground level (bgl) is likely to present in the Site Boundary, particularly in the river valleys and where the permeable superficial deposits are encountered. The depth to groundwater in the underlying bedrocks is currently unknown.

Flood Risk Source	Flood Risk Level	Mapping and Comments
Sewers	Low	The Site Boundary is located predominantly within rural agricultural land. However, where the Boundary crosses roads and in closer proximity to settlements there is a risk of flooding from sewers, specifically nearer to sewerage treatment plants located to the south, adjacent to of the Principal Site Boundary.

Artificial
Sources Low



Maximum extent of flooding from reservoirs:

● when river levels are normal ▨ when there is also flooding from rivers

Plate 6: Online Flood Maps for Planning Artificial Sources



Flood Risk Source	Flood Risk Level	Mapping and Comments
		Environment Agency online mapping show the maximum extent of flooding from artificial sources are not located within the vicinity of the Site Boundary.

3.4 Watercourses

- 3.4.1 Watercourses are designated as Main Rivers or Ordinary Watercourses. Main Rivers are identified on the Statutory Main River Map (Ref. 16) and are maintained by the Environment Agency, whereas ordinary watercourses are maintained by the Lead Local Flood Authority (Lincolnshire County Council).
- 3.4.2 The following watercourses lie within the Site Boundary:
- a. Main River:
 - i. The River Witham
 - ii. The River Brant
 - b. Ordinary Watercourses:
 - i. Mill Dam Dyke
 - ii. Numerous LLFA/IDB field drains
- 3.4.3 **PEI Report Volume 2, Figure 9-1: Surface Water Bodies and Their Attributes** shows the locations of the watercourses within the Site Boundary.

3.5 Geology and Hydrology

- 3.5.1 A desk top assessment has been completed to determine bedrock and superficial geology within the Site Boundary. These maps indicate there is an approximately north-south geological boundary separating the Site Boundary.
- 3.5.2 Scunthorpe Mudstone (Mudstone and Limestone interbedded) Formation Group, which is designated a Secondary B aquifer and Charmouth Mudstone Formation Group, also a Secondary B aquifer to the west, and Lincolnshire Limestone, a Principal aquifer to the east.
- 3.5.3 A desktop assessment has been completed using the British Geological Society online mapping (Ref. 17) (finding bedrock and superficial geology within the Site Boundary. These maps indicate there is an approximately north-south geological boundary separating the Site Boundary.

Bedrock

- 3.5.4 Bedrock: Scunthorpe Mudstone (Mudstone and Limestone interbedded) Formation Group, which is designated a Secondary B aquifer and Charmouth Mudstone Formation Group, also a Secondary B aquifer to the west of Bassingham, and Lincolnshire Limestone, a Principal aquifer to the east of Bassingham.

Superficial Deposits

- 3.5.5 Alluvium - Clay, silt, sand and gravel, is found surrounding the River Witham. Fulbeck Sand and Gravel Member - Sand and gravel, and Balderton Sand and Gravel Member - Sand and gravel is also found in the vicinity of the Main Rivers within the Principal Site Boundary.

- 3.5.6 The online "Soilscape" map viewer (Ref. 18), describes the soils beneath the Principal Site as 'Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils' with 'Impeded drainage' properties, and 'Naturally wet very acidic sandy and loamy soils' with 'Naturally wet' drainage properties.

4. Assessment of Existing Flood Risk (Principal Site)

4.1 Flood Risk from all Sources

- 4.1.1 This Section assesses the flood risk from the following sources against the Indicative Site Layout Plan as shown within **PEI Report Volume 2, Figure 3-2A** and **3-2B** during the operational phase of the Proposed Development:
- Fluvial (Rivers and the Sea);
 - Surface Water;
 - Sewers;
 - Groundwater; and
 - Artificial waterbodies.
- 4.1.2 The methodology used to assess the flood risk is detailed below:
- Low:** where little risk is identified or any theoretical risk identified is classified as low within Local Authority SFRAs and/or EA flood risk mapping extents, with low probability of flooding occurring.
 - Medium:** where risk is identified within Local Authority SFRA and/or EA flood risk mapping extents indicating a medium probability, but manageable flood risk with little to no mitigation required; and
 - High:** where modelled levels within Local Authority SFRA and/or EA flood risk mapping extents show risk to the Site Boundary as a high probability of flood risk and where mitigation needs to be considered and residual risks controlled.
- 4.1.3 In line with the sequential approach, all proposed buildings/compound areas, substation / transformers stations and BESS and the majority of the solar PV panels will be located outside of Flood Zones 2 and 3 i.e., in Flood Zone 1.
- 4.1.4 The Main Rivers and other Ordinary Watercourses within and surrounding the Site Boundary will not be impacted by a change in flood risk level within the Cable Corridor as no permanent above ground installations are proposed for the operational phase of the Proposed Development.
- 4.1.5 PV infrastructure shown to be at flood risk in the Principal Site is to be mitigated as set out in Section 8.
- 4.1.6 **Table 8** provides a summary of flood risk as a result of the Proposed Development. Each source of flood risk is discussed in further detail in the sections below.

Table 8: With-Development Flood Risk Summary (Operational Phase)

Flood Risk Source	Flood Risk Level	Comments
Fluvial	(Principal Site) Low– with areas of Medium to High risk associated with Rivers Brant and Witham watercourses.	Generally, the majority of Principal Site is situated in areas classified as Flood Zone 1 (Low Risk). As also shown in PEI Repot Volume 2, Figure 9-3: Fluvial Flood Risk and Plate 7 below; there are areas of flood risk located within the Principal Site Boundary associated with the River Brant and River Witham that have been assessed using the 2015 EA fluvial modelling extents that interact with some areas of proposed PV Panel fields. There is also an area adjacent to the Principal Site Boundary to the north west associated with an ordinary watercourse that is a tributary to a Main River (Mill Dam Dyke) which do not interact with the proposed infrastructure where there is no fluvial model available. The area of overlap is hereby referred to in this Preliminary FRA as the “Interaction Zone”.

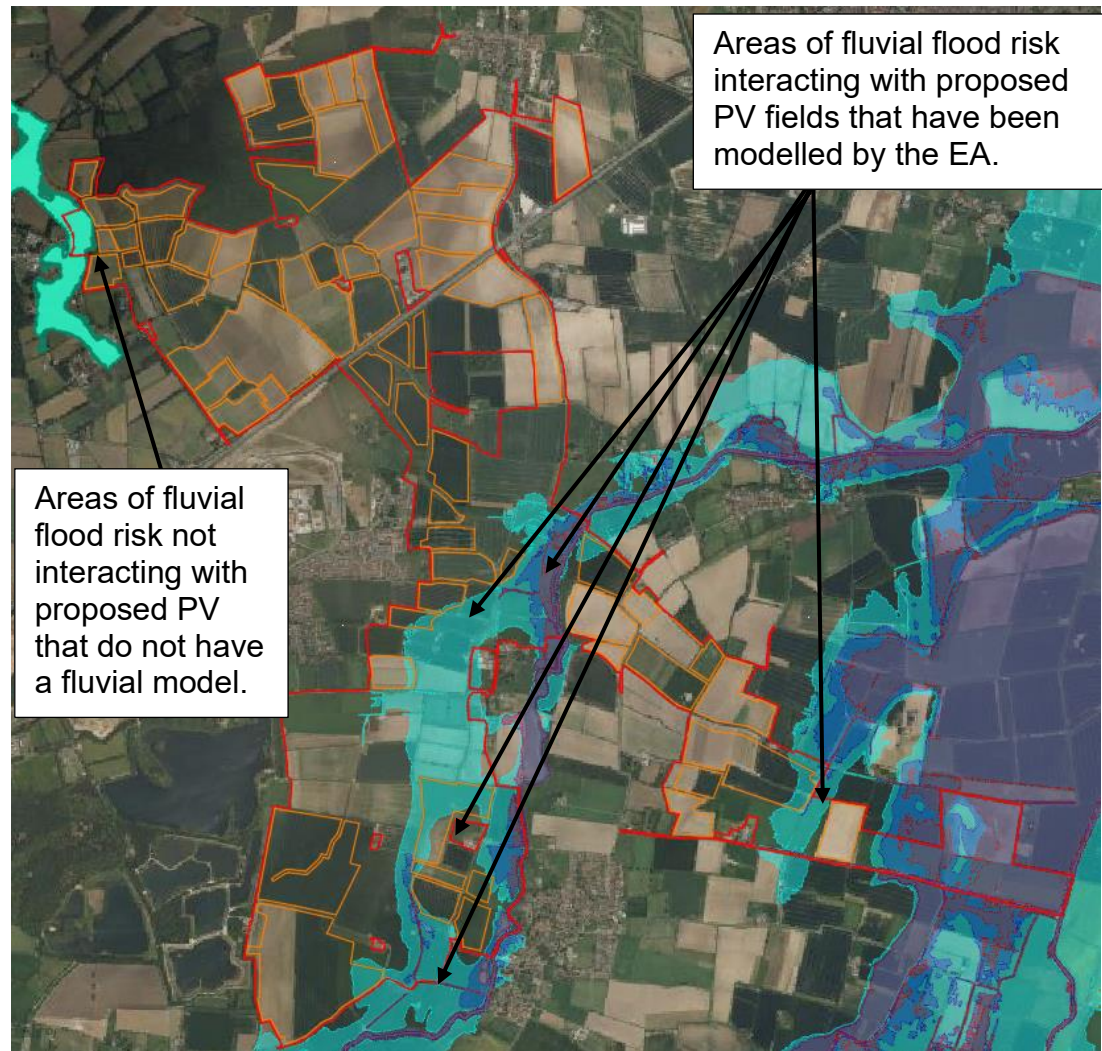


Plate 7: Fluvial Flood Risk overview

Flood Risk Source	Flood Risk Level	Comments
		<i>Source: DEFRA online Flood Zone 2 Dataset (Ref. 22) (2024), DEFRA online Flood Zone 3 Dataset (Ref. 23) (2024). Copyright and database right 2024. Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community</i> The Proposed Development does not propose any above ground infrastructure other than PV panels within the flood risk areas above. Where there are PV panels overlapping with flood risk areas (called interaction zones), these has been limited to the current day 1 in 1000 year flood extents (Flood Zone 2). There is no permanent above ground infrastructure proposed for the operational phase within the 1 in 100 year + Climate Change Flood Zone 3a extents or within the Flood Zone 3b (functional floodplain). No change to pre-Proposed Development flood risk level.
Tidal	Low (residual)	No change to flood risk level as a result of the Proposed Development.
Surface Water	Medium	Surface water flood risk is generally low across the Principal Site, with some areas of Medium risk associated with natural topography. Solar PV panels and mounting structures will not increase surface water flood risk as they are not considered to alter the existing drainage regime. Any increased surface water runoff from impermeable areas is proposed to be managed to mimic the pre-Proposed Development conditions for up to and including the 1 in 100 + 40% Climate Change (CC) event as detailed in PEI Report Volume 3, Appendix 9-D: Preliminary Surface Water Drainage Strategy. Flood Risk will not increase elsewhere as a result and, therefore, remains Medium.
Groundwater	Low	PEI Report Volume 3, Appendix 9-D: Preliminary Surface Water Drainage Strategy does not propose to utilise infiltration techniques to discharge increased surface water runoff. No change to flood risk level.
Sewers	Low	The Proposed Development does not impact any existing sewage infrastructure, and no new infrastructure is proposed. No change to pre-Proposed Development flood risk level.

Flood Risk Source	Flood Risk Level	Comments
Artificial Sources	Very Low	The Proposed Development does not impact artificial sources of flood risk and does not propose above ground infrastructure located within the vicinity of an existing artificial flood risk source. No change to pre-Proposed Development flood risk level.

4.2 Climate Change

- 4.2.1 As of July 2021, the climate change allowances used in FRAs have changed, and now propose peak river flow allowances based on Water Framework Directive catchment areas, instead of nationwide allowances in previous iterations of guidance.
- 4.2.2 The DEFRA mapping website '*Climate change allowances for peak river flow in England*' (Ref. 19) has been reviewed to confirm the revised climate change allowances for the catchment areas that cover the Site; these are the Witham and the Lower Trent and Erewash catchments. These values have been used in this assessment.

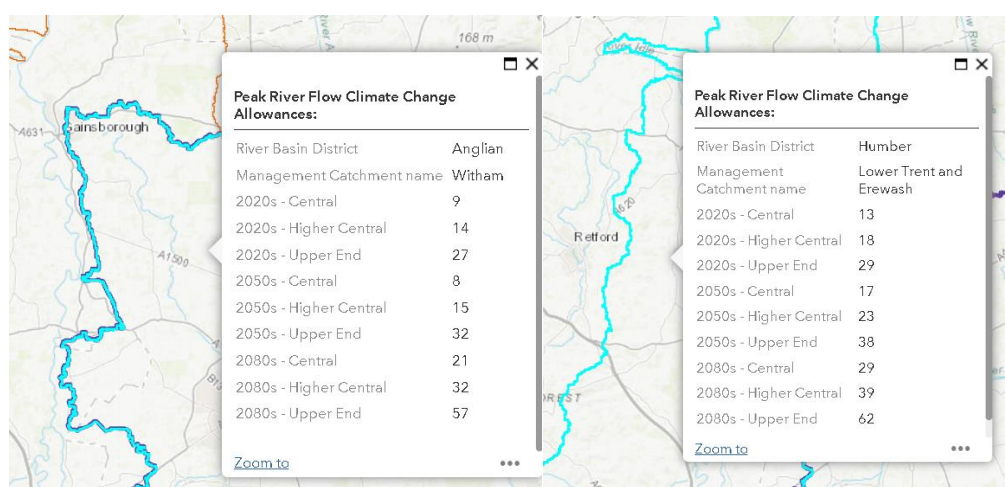


Plate 8: DEFRA Climate Change Allowances for Peak River Flow in England (accessed September 2024)

- 4.2.3 Climate change allowances relate to predicted percentage increase in peak river flows as a result of the effects of climate change, which development projects like the Proposed Development must take into account in their design.
- 4.2.4 The current allowance for design purposes for the Proposed Development are the Higher Central allowance of 39% and 32% (for Essential Infrastructure), for the Lower Trent and Erewash Management Catchment and Witham Management Catchment, respectively.
- 4.2.5 As the Proposed Development is located across the two Management Catchments, the highest value of 39% allowance has been used to provide a robust assessment for design across the whole Principal Site based on a worst-case scenario.
- 4.2.6 An additional assessment for Essential Infrastructure projects is the application of the H++ Scenario climate change allowance for sea level rise; a sensitivity assessment to ensure infrastructure can operate in extreme events involving a tidal influence. Previously, the H++ Scenario would be applied to Infrastructure projects of this scale. The H++ scenario provides an

estimate of sea level rise and river flood flow change beyond the likely range (i.e. an extreme event beyond expected climate change allowances) but within physical plausibility. It is useful for contingency planning to understand what might be required if climate change were to happen much more rapidly than expected.

- 4.2.7 Section 4.4 discusses the H⁺⁺ Scenario for the Proposed Development.

Credible Maximum Scenario (CMS)

- 4.2.8 Nationally significant infrastructure projects (NSIPs) are major infrastructure projects which include solar farms with an output greater than 50MW, such as the Proposed Development.
- 4.2.9 The online Environment Agency guidance (“Flood risk assessments: climate change allowances”) (Ref. 20) indicates that for “*Assessing credible maximum scenarios for nationally significant infrastructure projects, new settlements or urban extensions*”:
- “If you develop NSIPs you may need to assess the flood risk from a credible maximum climate change scenario”* (CMS).
- 4.2.10 The test should be treated as a ‘sensitivity test’, to help assess how sensitive a proposal is to changes in the climate for different future scenarios. This will ensure the Proposed Development can be adapted to large-scale climate change over its lifetime.
- 4.2.11 As the Principal Site is almost entirely within the Witham Management Catchment, the CMS allowance to be referred to in this assessment is the Upper End for the 2080s Epoch, from Plate 8 this value is 57%. This is considered a reasonable approach to the assessment of flood risk to the Proposed Development.

4.3 With-Proposed Development Fluvial Flood Risk

- 4.3.1 The following section provides an assessment of the fluvial flood risk level to and from the Principal Site. The assessment demonstrates that the Proposed Development will not result in an increase to existing flood risk within and surrounding the site through the implementation the Preliminary Drainage Strategy and identifies any areas within the Principal Site Site Boundary where mitigation measures may be required to protect the Proposed Development, to on-site infrastructure and off site, from future fluvial flood events when taking climate change into consideration.

Fluvial Flood Risk as a result of the Proposed Development Infrastructure

- 4.3.2 The Preliminary Drainage Strategy proposes that increased surface water flows from the Proposed Development as a result of new impermeable areas, within the Principal Site, will be managed and discharged to watercourses (or to ground via “Rural SuDS” (RSuDS) techniques where

watercourses are not in close proximity). Surface water discharge will be limited to existing greenfield rates via sustainable drainage techniques.

- 4.3.3 The strategy to control the with-Proposed Development discharge rates to mimic the pre-Proposed Development run-off conditions, mitigates any increases to peak river flow rates within the watercourses utilised for outfall locations within the Principal Site boundary. This strategy will result in no increase to fluvial flood risk levels within vicinity of the Principal Site throughout the design life of the Proposed Development.

Fluvial Flood Risk to the Proposed Development Infrastructure

- 4.3.4 In general, the majority of the Principal Site is located within Flood Zone 1, with three areas of Flood Zone 2 and 3 extents located within proximity to the above ground infrastructure proposed to be located within PV panel fields.
- 4.3.5 **Plate 9** below presents the Flood Risk Extents utilised in assessing flood risk for the Principal Site.
- 4.3.6 The light and dark blue flood risk extents shown on **Plate 9** have been extracted from the Environment Agency's 2015 Fluvial Model of the River Witham and River Brant and the green flood risk extents for the Mill Dam Dyke extracted from the Environment Agency's Online Flood Map for Planning datasets (Ref. 21 and Ref. 22) i.e. there is no detailed hydraulic model for the Mill Dam Dyke.

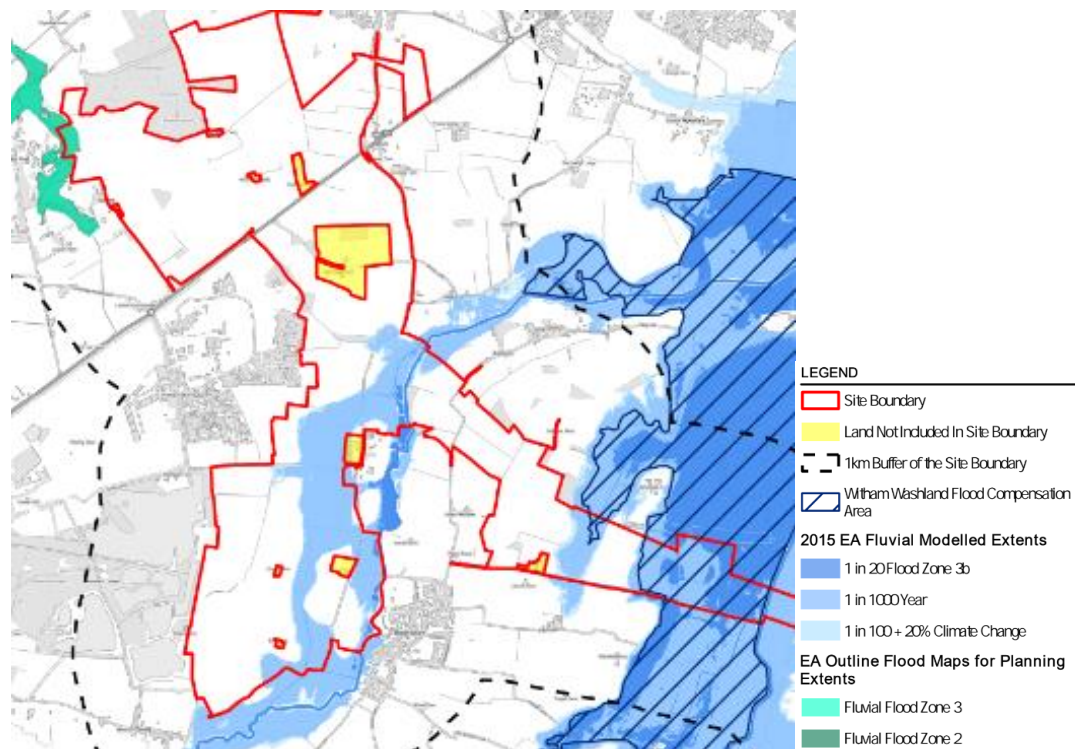


Plate 9: Extract of PEI Report Volume 2, Figure 9-3 Fluvial Flood Risk

4.3.7 There are two separate flood risk datasets available within the Proposed Development boundary: for the Mill Dam Dyke catchment and the Upper Witham Catchment. The proposed method of fluvial flood risk assessment for each of the two catchments has been undertaken as follows:

- a. Fluvial Flood Risk for Mill Dam Dyke:
 - i. The approach to the fluvial flood risk within this catchment comprises a hydraulic catchment and watercourse capacity check in lieu of the detailed hydraulic model to inform flood depths across the solar PV fields along the Mill Dam Dyke and any residual flood risk and mitigation requirements.
 - ii. As the location of the solar PV fields are very near the top of the Mill Dam Dyke catchment, with a small catchment, it is considered there is no fluvial interaction, with just a pluvial runoff relationship with the watercourse.
- b. Fluvial Flood Risk for River Brant and Witham:

Flood Zone 3a

- i. The fluvial flood risk model for the Upper Witham fluvial catchment (including the River Witham and Brant) was published in 2015 and include climate change allowances for 20% for the 1 in 100 year event.
- ii. During correspondence with the EA during a meeting in November 2023, the EA confirmed in the meeting (included in the correspondence in Annex C) that the model was being updated in 2024 to account for current climate change allowances. The EA responded by letter on 21 December 2023 confirming that this Preliminary FRA can utilise the 2015 model data to assess the current climate change allowances, uplifting the climate change allowances to 32% for design and 57% for sensitivity. At this stage for the PEI Report, the revised modelling has not been reviewed by the EA; this will be completed at ES stage, to agree with the EA and to ultimately agree the FRA for the DCO submission.
- iii. However, should the updated modelling be published prior to the DCO application submission, the Preliminary FRA will be updated to reflect the most up to date model extents accordingly.
- iv. For this Preliminary Flood Risk Assessment, the 1 in 100 year plus 20% climate change extent has been used for the assessment and potential mitigation, alongside the 1 in 1000-year extent.

Flood Zone 3b

- i. The 2015 hydraulic model provides the 1 in 20-year extent for Flood Zone 3b (Functional Floodplain). It is acknowledged the current extent of Flood Zone 3b requirement is now the 1 in 30-year extent.
- ii. However, as discussed in more detail below, the solar PV fields are shown to be outside of the 1 in 100 year plus 20% climate change extents, and therefore, not within flood zone 3b extents. Given the

1 in 30 year extent is expected to remain within the 1 in 100 year plus 20% climate change scenario, no above ground infrastructure will be located within Flood Zone 3b.

Fluvial Flood Risk for Mill Dam Dyke

- 4.3.8 The fluvial flood risk area identified by the green flood risk extents in Plate 9 have been taken from the Environment Agency's Online Flood Maps for Planning data download service (Ref. 21 and Ref. 22).
- 4.3.9 These extents provide the present-day Flood Zone 2 and 3 extents associated with the Mill Dam Dyke watercourse located in the northwestern boundary of the Principal Site located within the Humber River Basin District (as shown in Plate 10).

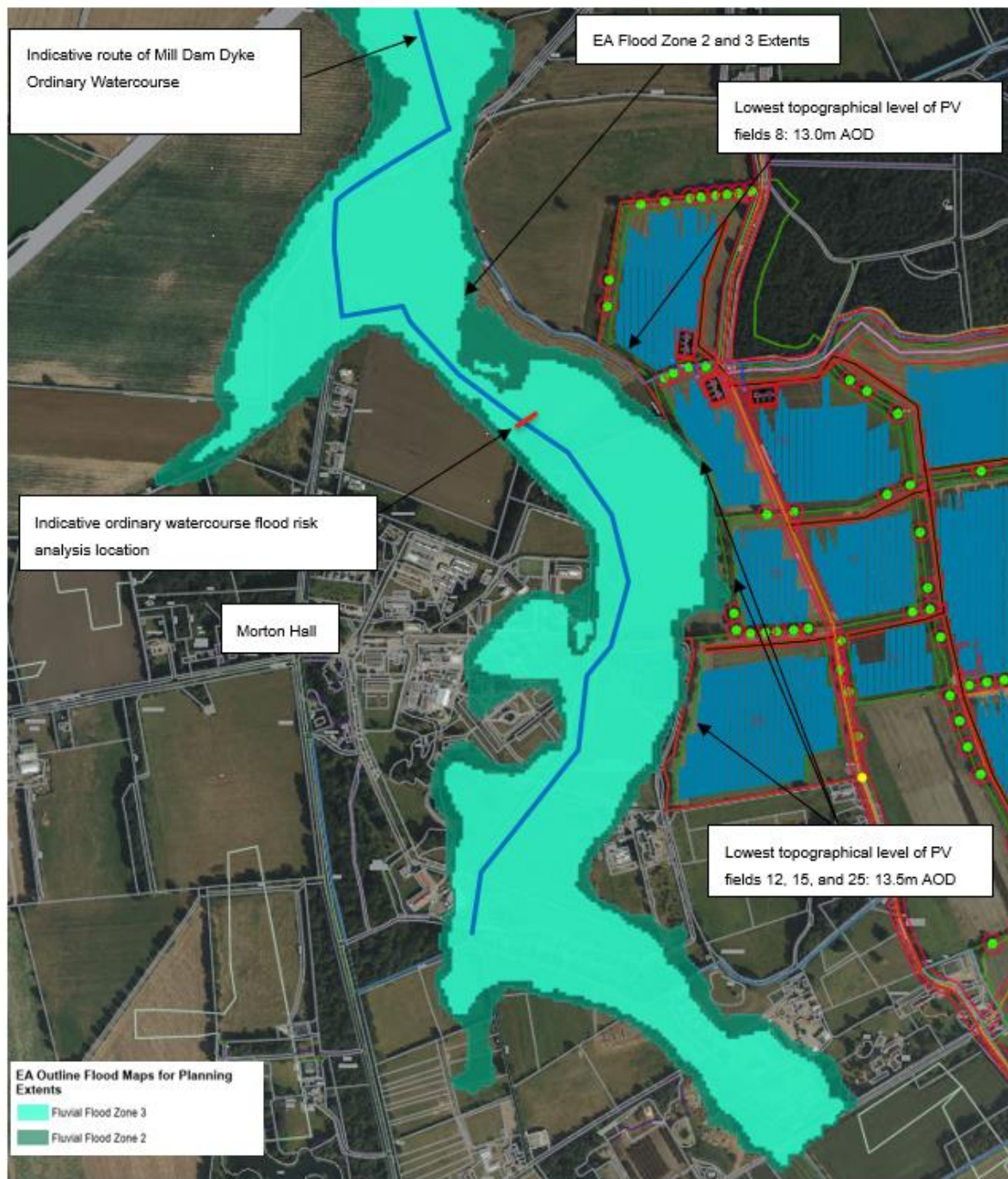


Plate 10: Flood Zone Extents near Morton Hall

4.3.10 As a hydraulic fluvial model of the watercourse is not available to assess the effect of climate change on the flood risk extents for the lifetime of the Proposed Development, the following parameters have been defined using LiDAR data to predict the expected flood levels and extent for PV field nos. 8, 12, 16 and 25 during the design flood event, and including a check for sensitivity:

- a. The contributing catchment area upstream of the Mill Dam Dyke analysis location.

- b. The greenfield run-off rates expected to enter the Mill Dam Dyke at the analysis location for the design and sensitivity scenarios (taking into account increased flows for climate change).
- c. The existing hydraulic capacity of the ditch at the analysis location.
- d. The excess discharge during the design and sensitivity scenarios that cannot be conveyed by the existing channel capacity at the analysis location expected to cause flooding in the area surrounding the ordinary watercourse.
- e. The expected depth the excess discharge would rise to above the ordinary watercourse ditch bank level into the flood channel towards the proposed PV Panel infrastructure.

The contributing catchment area upstream of the Mill Dam Dyke analysis location

- 4.3.11 A catchment area of 4.38km² has been defined using LiDAR Map data and FEH catchment boundaries.

The greenfield run-off rates expected to enter the Mill Dam Dyke at the analysis location, for the design and credible maximum scenario (taking into account increased flows for climate change)

- 4.3.12 The Mill Dam Dyke and its contributing catchment are located wholly within the Lower Trent and Erewash Management Catchment. The Environment Agency Climate Change Allowances for peak river flow in England and have been incorporated into the catchment runoff rate calculations in line with statutory guidance.
- 4.3.13 The catchment runoff discharge rate contributing to the Mill Dam Dyke upstream of the analysis location has been calculated by the HR Wallingford Greenfield Runoff Rate Estimation Tool (using FEH Data), refer to Annex B for fluvial analysis calculations. A 3D ground surface model extracted from LiDAR data (Ref. 23) provides level data to estimate a gradient of the long profile of the watercourse. The gradient of the Mill Dam Dyke in this location is approximately 1 in 96. This gradient has been used in calculating the existing ditch hydraulic capacity, refer to Annex B for calculations.
- 4.3.14 For the 2080's Epoch; the "Higher Central" (design) allowance requires an additional 39% for fluvial modelling and the "Upper End" (sensitivity) allowance requires an additional 57% for climate change allowances.
- 4.3.15 To provide a robust approach to the analysis, a conservative overestimate of the potential discharge rates that the Mill Dam Dyke may become subject to have been applied. The design discharge rate for the Mill Dam Dyke has been taken as the greenfield 1 in 100 year rate increased by 50% (1.5 x 1 in 100 year rate), and the sensitivity check discharge rate has taken as the greenfield 1 in 100 year rate increased by 100% (2 x 1 in 100 year rate). **Table 9** provides the estimated Greenfield Runoff rates using the FEH method and the increased design and sensitivity discharge rates to be used in this analysis.

Table 9: Greenfield Runoff Rates (Using FEH data)

Ditch	Catchment Area (km ²)	Qbar (Cumecs)	1 in 1 year (Cumecs)	1 in 30 year (Cumecs)	1 in 100 year (Cumecs)	1 in 100 year + 50% (Cumecs) Higher Allowance (Design)	1 in 100 year + 100% (Cumecs) Upper Allowance (Sensitivity)
Morton Hall Ordinary Watercourse	4.38	0.40	0.35	0.98	1.43	2.15	2.86

The existing hydraulic capacity of the ditch at the analysis location

- 4.3.16 An open channel flow calculation has been undertaken to estimate the existing capacity of the Mill Dam Dyke. The calculation utilised 0.25m level contours produced in ArcGIS software from LiDAR map data obtained from the DEFRA download service (Ref. 23) along with the channel gradient of 1 in 96, to estimate the hydraulic capacity of Mill Dam Dyke at the analysis location.

Table 10: Existing Ditch Capacity

Watercourse	Capacity (Cumecs)
Mill Dam Dyke	0.29

The excess overland flow during the design and sensitivity scenarios that cannot be conveyed within the existing channel capacity at the analysis location is expected to cause flooding in the area surrounding the Mill Dam Dyke

- 4.3.17 The excess overland flows that cannot be contained and conveyed within the exiting Mill Dam Dyke channel profile during the flood events is calculated by comparing the difference between the 1 in 100 year + CC (Cumecs) Higher/Sensitivity Allowance discharge rates (**Table 11**) with the Existing Ditch Capacity (**Table 10**).

Table 11: Excess Discharge Rates

Flood Event	Expected Greenfield rate entering Mill Dam Dyke (Cumecs)	Existing Ditch capacity (Cumecs)	Excess discharge rate (Cumecs)
1 in 100 year + 50% (Cumecs) Higher Allowance (Design)	2.15	0.29	1.86
1 in 100 year + 100% (Cumecs) Upper Allowance (Sensitivity)	2.86	0.29	2.57

The expected depth of the excess discharge would rise to above the ordinary watercourse ditch bank level overland towards the proposed PV Panel infrastructure

- 4.3.18 A further open channel flow calculation uses the following parameters to determine the expected flood depth across flood channel during flood events:
- The geometry of the adjacent land (flood channel) to the Mill Dam Dyke analysis location provided by the LiDAR data to determine the cross-sectional profile of the flood channel predicted to be partially filled with greenfield runoff during flood events; and,
 - The excess discharge rates during the flood events to calculate the expected flood depth above the bank level of the Mill Dam Dyke.
- 4.3.19 Plate 11 provides a schematic diagram of the cross section at the analysis during a flood event.

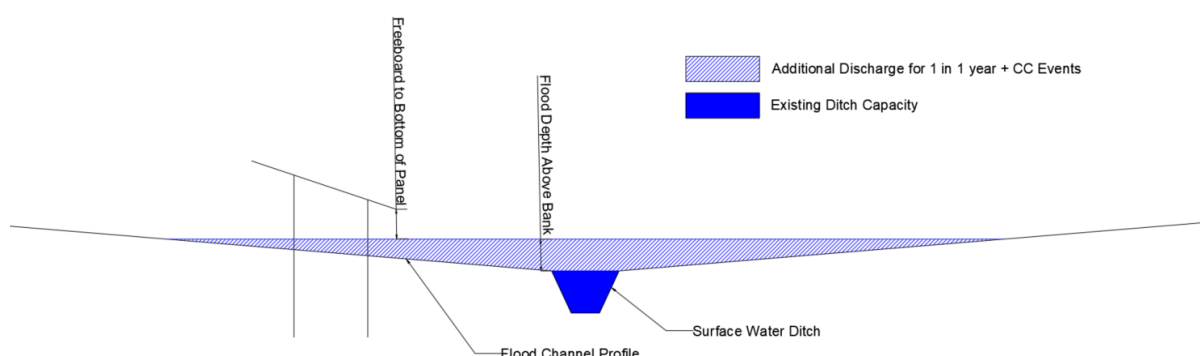


Plate 11: Example Analysis Cross-section (not to scale)

Table 12: Predicted flood levels (1 in 100 year + CC Higher Central Allowance)

Flood Event	Max Flood Depth Above Bank (m)	Top of Bank Level	Max Flood Depth Above Bank (m)
1 in 100 year + 50% Higher Central Allowance (Design)	0.220	12.50	12.720
1 in 100 year + 100% Upper End Allowance (Sensitivity)	0.265	12.50	12.765

- 4.3.20 The findings of the above analysis, indicate that during the design and sensitivity scenarios, the flood depth would not extend out from the Mill Dam Dyke into the flood channel far enough to impact the PV fields identified in **Plate 10**, as the fields have a higher topography, with the lowest point of

13m AOD in Field 8. The analysis, therefore, concludes that there is no residual fluvial flood risk to the Proposed Development infrastructure in this area for the duration of its lifespan and there is no mitigation required in this area, incorporating the impacts of climate change.

- 4.3.21 During consultation with the Environment Agency, the above analysis methodology was recognised as appropriate for small scale fluvial flood risk areas (refer to Annex C).

Fluvial Flood Risk for River Brant and Witham

- 4.3.22 For the River Brant and Witham Main River watercourses, the EA has undertaken detailed hydraulic modelling, the extents of which are identified in **PEI Report Volume 2, Figure 9-3: Fluvial Flood Risk**.
- 4.3.23 Other than solar PV panels, the Proposed Development design does not propose any permanent above ground infrastructure within Flood Zone 2 or 3.
- 4.3.24 The figures below show the following fluvial extents from the 2015 hydraulic model:
- a. Purple - Flood Zone 3b (1 in 20 year);
 - b. Dark Blue - Flood Zone 3a (1 in 100 year plus 20% climate change); and
 - c. Cyan - Flood Zone 2 (1 in 1000 year).
- 4.3.25 **PEI Report Volume 2, Figure 9-3: Fluvial Flood Risk** and the figures below indicate there are no solar PV panels within the Flood Zone 3b or Flood Zone 3a climate change extents.
- 4.3.26 Therefore, for the design storm event including climate change, there is no mitigation required to raise solar PV panels above the floodplain to ensure a 300mm freeboard is maintained.

Credible Maximum Scenario (CMS)

- 4.3.27 In lieu of the updated hydraulic model extents to indicate the 57% climate change scenario, the 2015 modelled Flood Zone 2 extent (1 in 1000 year) has been used to assess the sensitivity, effectively applying the CMS requirement, to the Proposed Development from extreme flood events, to demonstrate the Proposed Development will remain operational in times of flood.
- 4.3.28 PV panel fields where Flood Zone 2 interacts with the PV Arrays include fields: 46, 47, 50, 52, 55, 57, 61, 62, 63, and 65, as shown on the figures below.

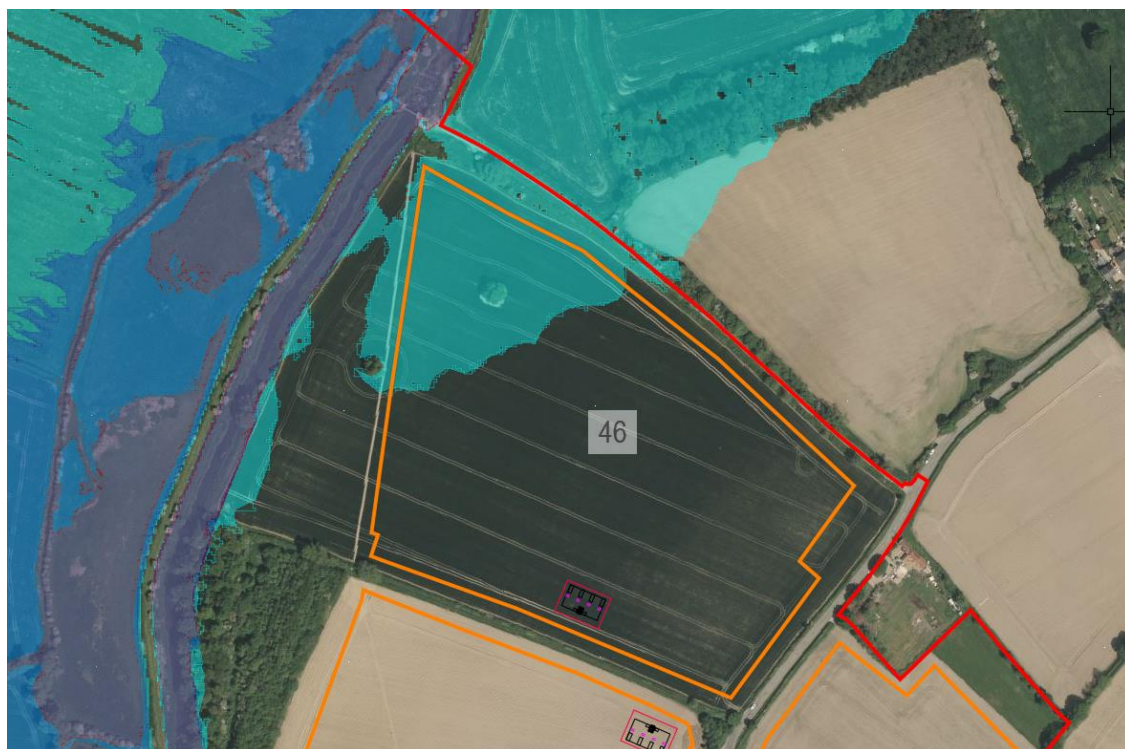


Plate 12: 2015 Model Fluvial Flood Extents Field 46



Plate 13: 2015 Model Fluvial Flood Extents Field 55

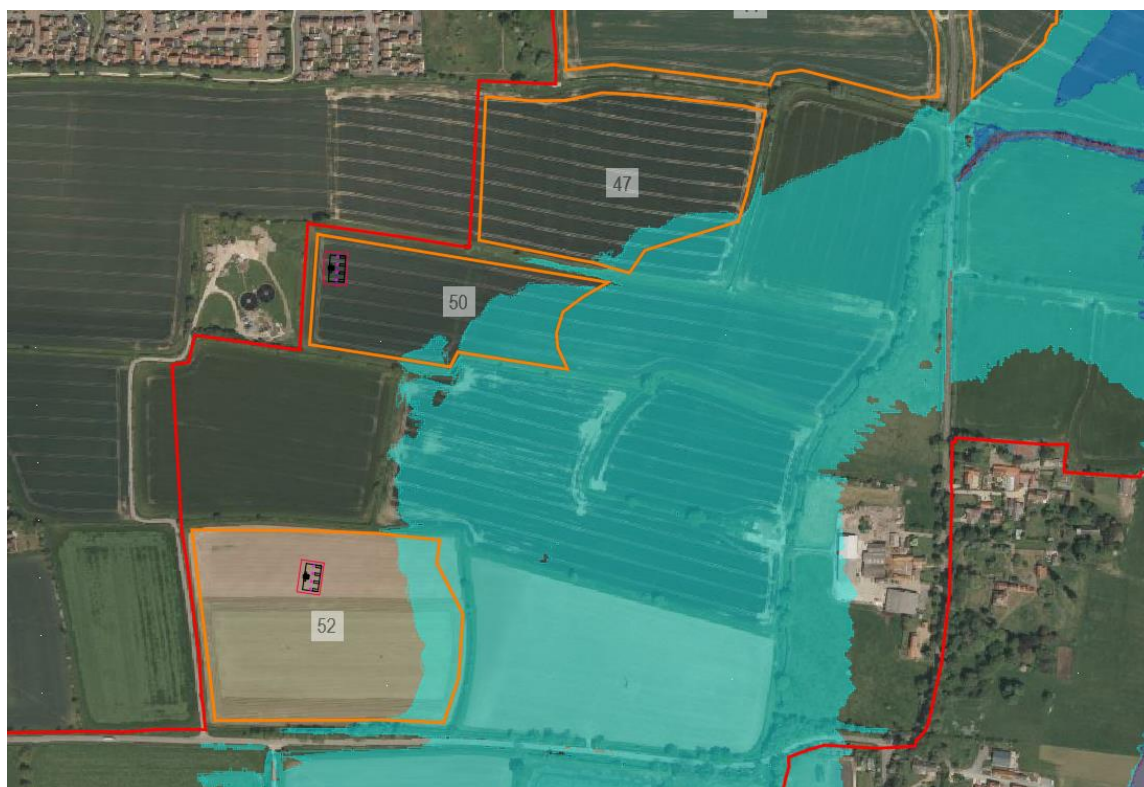


Plate 14: 2015 Model Fluvial Flood Extents Field 47, 50, 52

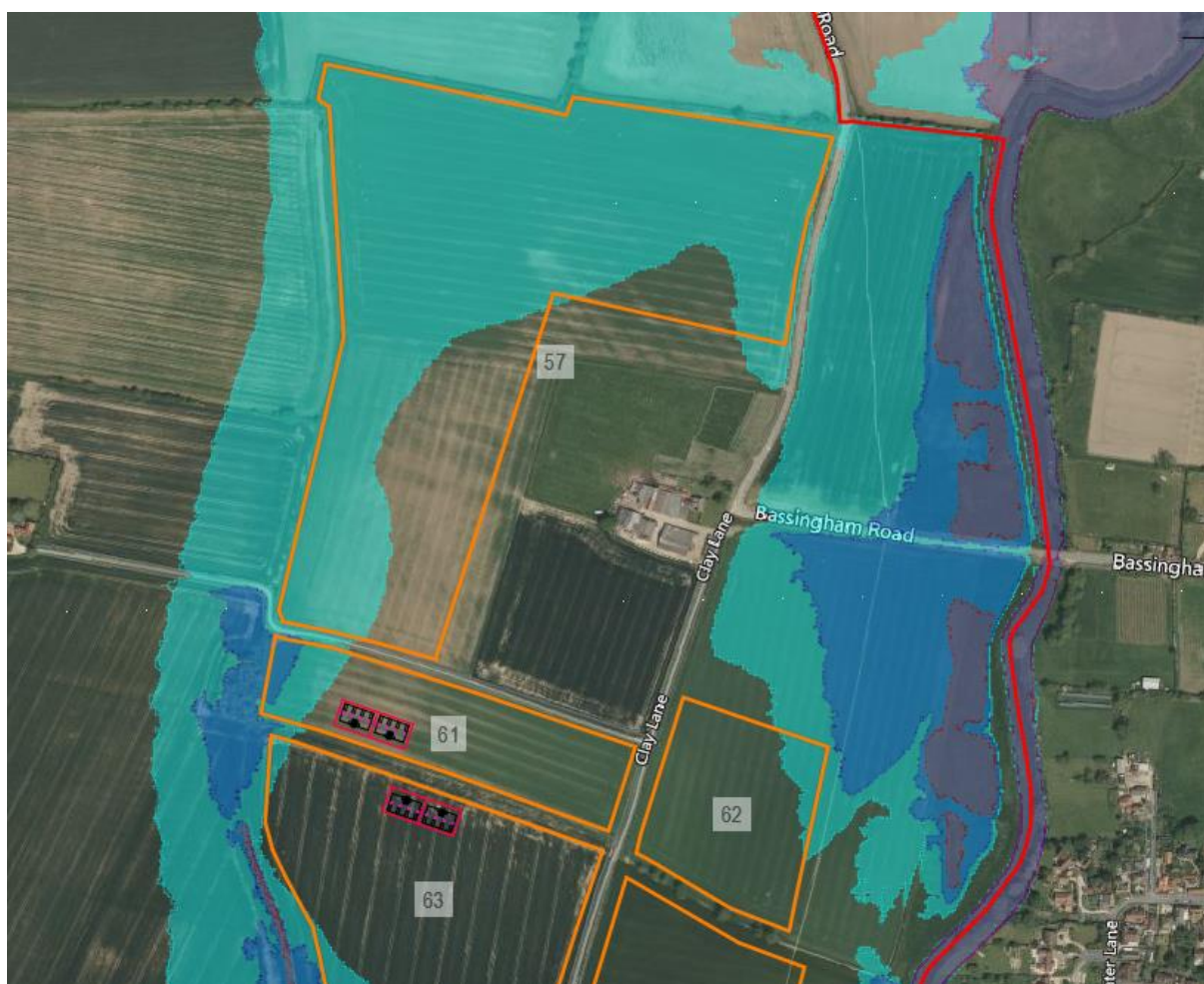


Plate 15: 2015 Model Fluvial Flood Extents Field 57, 61, 62

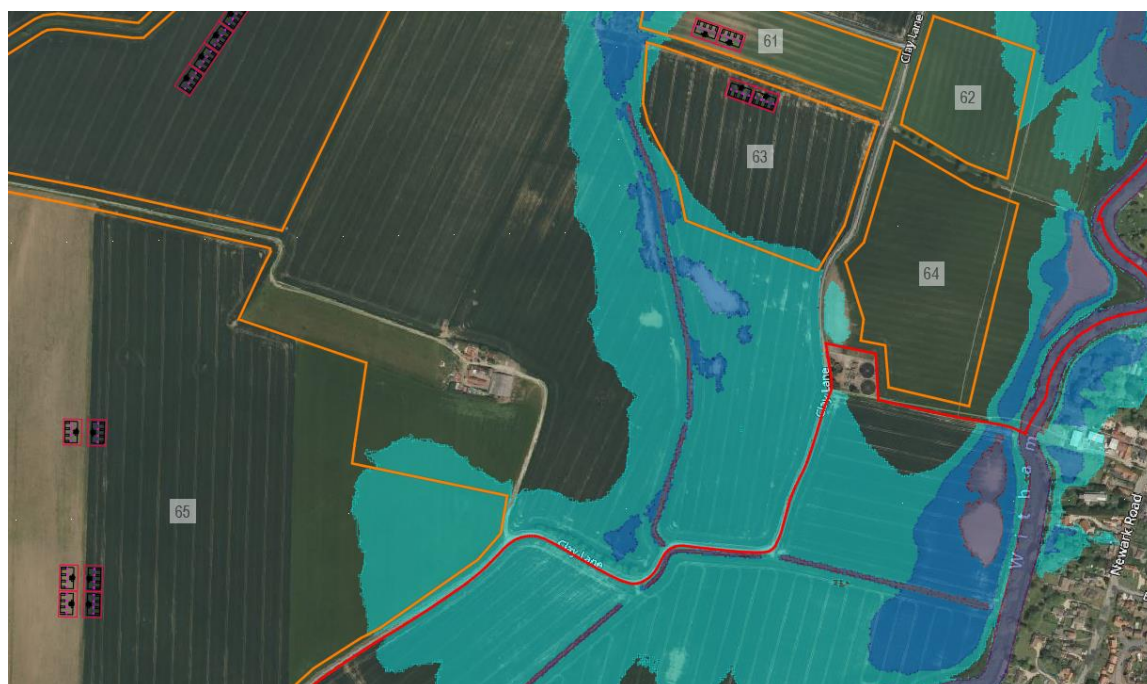


Plate 16: 2015 Model Fluvial Flood Extents Field 61, 62, 65

4.3.29 **Table 13** below includes the estimated Flood Zone 2 flood levels, from the 2015 hydraulic model data, and an analysis of the topographical levels taken from LiDAR data (Ref. 23), within each of the Flood zone 2 interaction zones, to confirm if the solar PV panels are safely above the flood level, and will remain operational in times of flood.

Table 13: Flood Zone 2 Interaction Zone Depths

Field No.	Maximum predicted flood level (m AOD)	Lowest topographical field level within flood Zone 2 Interaction Zone (m AOD)	Maximum flood depth within Flood Zone 2 Interaction Zone(m)
46	8.75	8.50	0.25
47	9.50	9.25	0.25
50	9.50	9.25	0.25
52	9.75	9.50	0.25
55	8.00	7.05	0.95
57	10.00	9.50	0.50
61	10.50	10.00	0.50
62	10.50	10.00	0.50
63	10.50	10.00	0.50
65	11.00	10.50	0.50

4.3.30 **Table 13** indicates, generally across the Flood Zone 2 areas of the Principal Site, a flood depth of approximately 0.50m for the 1 in 1000 year event extent. As solar PV panel heights are to be a minimum 800mm above ground, the vast majority of the solar PV panels are not at risk of fluvial flooding, taking into account the credible maximum scenario.

4.3.31 However, Field number 55 is noted to be a concise low spot within the Principal Site boundary. The flood depth in the far east corner of Field number 55 could experience flood depths up to 0.95m. This could inundate the small number of solar PV panels within the eastern part of Field number 55 by 200mm.

4.3.32 Within Field number 55, the minimum mounting height will be set to 8.10m AOD to provide a minimum 100mm clearance to the base of the PV panels during the 1 in 1000 year event, to ensure the Proposed Development will remain operational during times of extreme flood, taking into account the credible maximum scenario. This equates to raising solar PV panels by up to 250mm to achieve the 8.10m AOD level.

4.3.33 Therefore, with the embedded mitigation proposed, the Proposed Development fluvial flood risk for both the Mill Dam Dyke and the River Brant and Witham is considered to have been appropriately assessed, ensuring the Proposed Development will remain operational in times of flood.

Flood Defence Breach

- 4.3.34 The solar PV fields also benefit from flood defences along the River Witham and River Brant, either from natural high ground or embankments. Plate 17 below indicates the flood defences along the rivers Witham and Brant, taken from the Defra online spatial data download service for flood defences (Ref. 24), along with the standard of protection (SoP) and the defence type where they pass within the Principal Site boundary. The River Witham SoP differs depending on the river bank and natural ground level. The Environment Agency 2015 hydraulic model takes these flood defences into account within the published model extents.
- 4.3.35 These flood defences are operated and maintained by the Environment Agency to a high standard, such that the flood risk up to and including the return periods noted is considered a low residual risk.

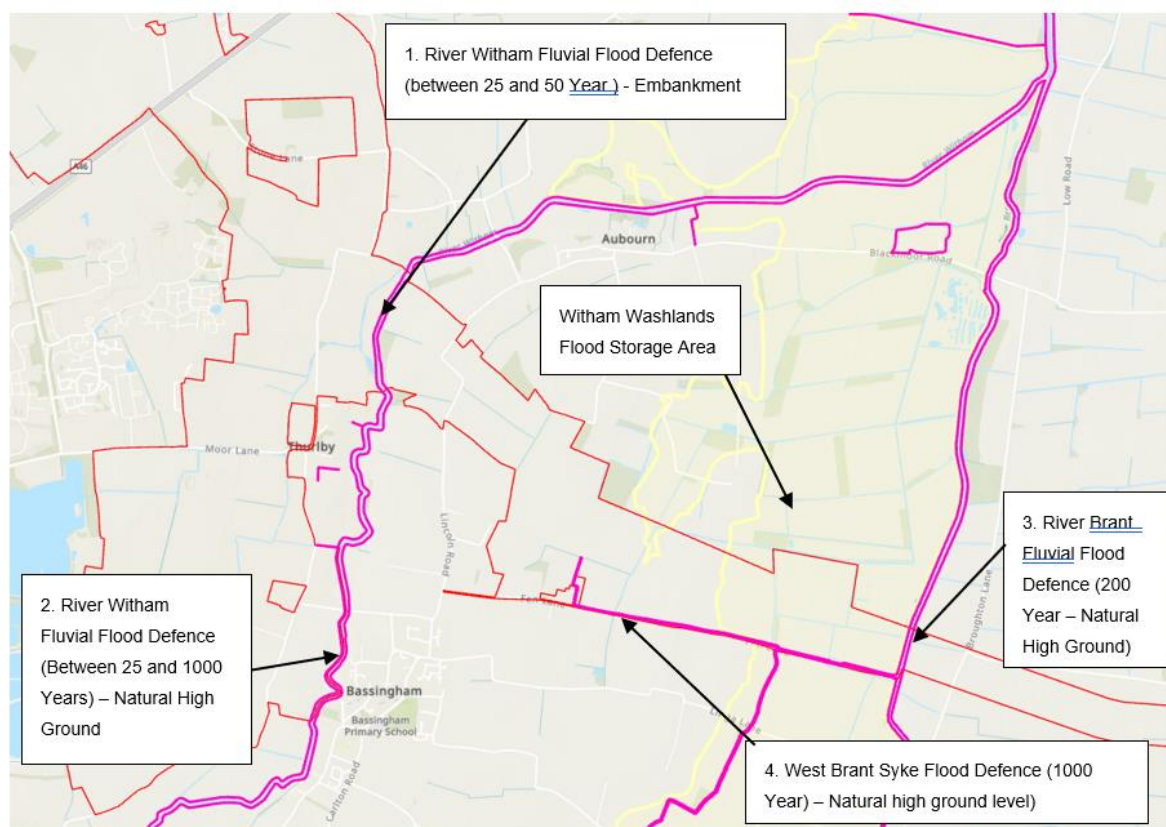


Plate 17: Environment Agency Fluvial Flood Defences Locations

- 4.3.36 The spatial flood defence data (Ref. 24) notes the defences shown for item 2, 3 and 4 in Plate 17 benefit from natural high ground to form the flood defences. A flood defence breach is associated with a failure of above ground man-made raised defences. As these defences are in areas of natural high ground, a breach of these defences is considered unlikely.
- 4.3.37 The reach of the River Witham (item 1 in Plate 17) benefits from raised man-made embankments, between Fields 45, 46 and 49. None of the solar PV fields or any other permanent above ground infrastructure lie within the 1 in

100 year plus climate change extent, and only Field 46 lies partially within the 1 in 1000 year extent.

- 4.3.38 The modelled 1 in 1000 year extent within the 2015 hydraulic model considers flood defences; however, the flood defences only provide up to a 1 in 50 year storm event. It is reasonable to consider that a breach during a 1 in 100 year event would not extend further than the modelled fluvial 1 in 100 year plus 20% climate change extent as the embankment would be overtopped in any case.
- 4.3.39 Field 46 could, in theory, be impacted by an embankment breach but as the 1 in 1000 year flood depth (noted in **Table 13**) is approximately 250mm, the solar PV panels are afforded approximately 550mm freeboard above this level, providing sufficient protection from a potential breach.
- 4.3.40 Given the lifetime of the Proposed Development is proposed to be 60 years, it is considered that a breach event within the Principal Site boundary is a low residual risk.

4.4 With-Proposed Development Tidal Flood Risk

- 4.4.1 Tidal flooding occurs when an exceptionally high tide, almost always accompanied by a storm tide surge, overtops and/or breaches the tidal defences along a coastline or tidal estuary.
- 4.4.2 Although North Kesteven does not lie along a coastline or does not have a tidal river flowing through the District, a small area around North Scarle falls within the River Trent's tidal floodplain.
- 4.4.3 The Mill Dam Dyke, which runs through North Scarle is considered a significant tidal flood risk source. The Mill Dam Dyke (or Girton Fleet downstream of Baxter Bridge) flows through the village of North Scarle and discharges into the River Trent via a modern tidal outfall sluice. The watercourse can become tide locked impacting on water levels within the channel at North Scarle.
- 4.4.4 The village of North Scarle is approximately 3.6km from the Proposed Development boundary, at a level of approximately between 9m AOD and 10m AOD. The tidal influence is not considered to pose a risk to the Site Boundary with minimum ground levels of PV panel fields approximately 13m AOD.
- 4.4.5 Another potential tidal influence within North Kesteven is determined by the ability of the River Witham to discharge via its tidal outfall at Boston (Grand Sluice). The River Witham's discharge can be restricted for significant periods of time when there is a high tide which has implications for fluvial flood risk as far upstream as North Kesteven.
- 4.4.6 Tidal flood risk to the Site generally is considered to be low. However, for a Proposed Development of this nature, an assessment of future sea level rise is required.

Sea Level Rise

- 4.4.7 Sea level rise allowances account for slow land movement. This is due to glacial isostatic adjustment from the release of pressure at the end of the last ice age. The northern part of the UK is slowly rising, and the southern part is slowly sinking. This is why net sea level rise is predicted to be less for the northwest and north-east than the rest of the country.
- 4.4.8 Sea level rise and the H++ scenario have been considered in this Preliminary FRA. An assessment of the impacts of future sea level rise has been undertaken to demonstrate the Principal Site is not at risk during its expected operational design life, taking into consideration the Boston Barrier Tidal Flood Defence Scheme.
- 4.4.9 The H++ is required to assess a site as part of a sensitivity test for NSIP, to ensure a proposed NSIP scheme is safe from flood risk for its lifetime.
- 4.4.10 There are a range of allowances for each river basin district and epoch for sea level rise, **Plate 18** presents the boundaries of the two River Basin catchments.



Plate 18: River Basin District Map, Environment Agent (online)

4.4.11 The climate change allowances are set out in Table 2 of the Environment Agency online Climate Change Assessment guidance (Ref. 25) and are based on percentiles. A percentile describes the proportion of possible scenarios that fall below an allowance level. **Table 14** below indicates the sea level rise estimate, for the epochs for the Humber and Anglian River basin catchments.

Table 14: Extract from Table 2 of Environment Agency Sea Level Rise Tables (Online)

River Basin District	Allowance	2036 to 2065 (mm/yr)	2036 to 2065 (mm/yr) – Cumulative Total	2066 to 2095 (mm/yr)	2066 to 2095 (mm/yr) – Cumulative Total	2095 to 2125 (mm/yr)	2095 to 2125 (mm/yr) – Cumulative Total
Humber Higher Central		8.4	252	11.1	333	12.4	372
Humber Upper End		11	330	15.3	459	17.6	528

Anglian	Higher Central	8.7	261	11.6	348	13.0	390
Anglian	Upper end	11.3	339	15.8	474	18.1	543

4.4.12 The design life of the Proposed Development is anticipated to be up to 60 years from 2033, as set out in **PEI Report Volume 1, Chapter 3: The Proposed Development**, and decommissioning is expected to commence thereafter.

4.4.13 For the sea level rise assessment, an additional year has been included to the 60-year design life to provide a conservative approach to the Proposed Development; therefore, the design life of the Proposed Development is assessed up to 2094.

Anglian River Basin District

4.4.14 For the Anglian River Basin District (River Witham and Brant catchment) Sea level rise poses a potential risk to Principal Site. It has been estimated, using the Environment Agency's online sea level rise data for the Anglian River basin management area, sea level could rise by approximately 1026.4mm by the year 2094. Refer to calculations in Annex A for more detail.

4.4.15 A rise of 1026.4mm would provide a predicted peak flood level of 7.07m AOD.

4.4.16 Applying the H++ analysis as a sensitivity test, i.e. applying a maximum 1.9m rise, the tidal level could theoretically reach 7.94m by 2100.

4.4.17 The lowest site level with infrastructure proposed to be located within areas proposed for solar PV panels in the Principal Site is 7.05m AOD, associated with Field number 55, north of Fen Lane and west of the Witham Washlands Flood Storage Area (from LiDAR data review). This level is below the H++ scenario level. This area is a concise low spot with the vast majority of the Principal Site being above 8.5m AOD.

4.4.18 The lowest level within the Principal Site, within Field number 55 is located within an area associated with the River Witham Catchment; the land within this catchment is fundamentally protected by the Boston Tidal Barrier (opened in 2020). The tidal barrier is designed to protect the River Witham catchment against tidal flooding for the 1 in 300 year event for the next 100 years, (up to the year 2120) which exceeds the design life for the Proposed Development. Therefore, sea level rise is unlikely to impact the Principal Site and is considered a low residual risk.

4.4.19 However, applying a conservative approach, within Field number 55 the lowest base of PV panels would need to be set at no lower than 8.04m AOD to ensure the PV panels will remain operational in times of severe flood, with potential failure of the Boston Tidal defences, or prolonged operation of the barrier which could potentially cause upstream levels to increase taken into account. However, as noted in paragraph 5.3.23 above, the minimum height of panels is proposed to be 8.10m to take into account the credible

maximum scenario, which is above the minimum level for any sea level rise mitigation.

- 4.4.20 Therefore, sea level rise does not provide a material flood risk to the Principal Site and is considered a low residual risk when taking into account the already proposed mitigation measures.

Humber River Basin District

- 4.4.21 For the Humber River Basin District (Mill Dam Dyke catchment) Sea level rise poses a potential risk to Principal Site. It has been estimated, using the Environment Agency's online sea level rise data (Ref. 25) for the Anglian River basin management area, sea level could rise by up to approximately 978.1mm by the year 2094 (with a 60 year design life plus one year for a cautionary approach); assessed by accumulating the mm/yr increase in sea level depth in each epoch up to the year 2094. Refer to Calculations in Annex A for more detail.
- 4.4.22 A rise of 978.1mm would provide a predicted peak flood level of 6.09m AOD.
- 4.4.23 Applying the H++ analysis as a sensitivity test, i.e. applying a maximum 1.9m rise, the tidal level could theoretically reach 7.01m by 2100.
- 4.4.24 The lowest point of the Principal Site surrounding the Mill Dam Dyke at Morton Hall is 13.5m AOD; therefore, it is considered the area of the Principal Site relating to the Mill Dam Dyke catchment is not at risk of sea level rise.
- 4.4.25 There is no permanent above ground infrastructure proposed along the Cable Corridor. As such, mitigation is not considered to be required to protect finished levels of proposed infrastructure due to sea level rise.
- 4.4.26 In summary, the flood risk to permanent above ground infrastructure (Principal Site) and the risk to people associated with sea level rise is considered a low residual risk, with no further mitigation required, in both the Humber and Anglian River Basin Districts.

4.5 With-Proposed Development Surface Water Flood Risk

- 4.5.1 As the Principal Site covers a large area, the surface water flood risk level varies from low to high across the Principal Site for the pre-Proposed Development scenario with areas of higher risk associated with topographical low spots and/or areas immediately surrounding watercourses.
- 4.5.2 The Preliminary Drainage Strategy (**PEI Report Volume 3, Appendix 9-D**) sets out how increases in surface water runoff as a result of the Proposed Development are proposed to be managed via SuDS techniques to ensure the existing surface water drainage regime is mimicked, mitigating the risk of increased surface run off from and to the Proposed Development.
- 4.5.3 The increases to impermeable areas are envisaged to be a result of localised runoff from; the Solar Station Compounds located across the PV

panel fields (in the case of a DC-coupled option), the single BESS compound (in the case of an AC-coupled option) and the Onsite Substation. The increase in surface water runoff from these areas is proposed to be managed via sustainable drainage techniques to temporarily attenuate the increased surface water flows before discharging to surrounding watercourses at restricted rates to mimic the pre-Proposed Development conditions for up to and including the 1 in 100 year + 40% climate change event.

- 4.5.4 It is considered that total impermeable areas where solar PV panels are proposed for the with-Proposed Development scenario will remain consistent to the pre-Proposed Development state. Therefore, the proposed PV panel areas are considered to not impact the post-Proposed Development surface water flood risk level associated specially in relation to PV panel areas adjacent to field drains (ordinary watercourses).
- 4.5.5 As part of the non-statutory consultation for the Proposed Development, properties along The Avenue in Morton, adjacent to solar PV fields 26, 31 and 34, are known to experience surface water flooding from natural overland runoff from these fields. The online flood map for surface water (Ref 6) indicates a medium flood risk to these properties.
- 4.5.6 Surface water runoff and mitigation is discussed in Section 7. Mitigation includes edge swales. Edge swales are proposed within the principles of the Preliminary Drainage Strategy, discussed in more detail within the **PEI Report Volume 3, Appendix 9-D: Preliminary Drainage Strategy**, to capture excess runoff from the PV fields. These edge swales will capture the peak runoff from Solar Station Compounds and runoff from the solar PV panel fields, reducing peak runoff rates during storm events, for up to and including the 1 in 100 year plus 40% climate change event (for the where new impermeable surfaces are introduced). Fields 26, 31 and 34 will be sized accordingly to capture overland surface water runoff; therefore, reducing the existing surface water flood risk to properties along The Avenue, providing betterment.
- 4.5.7 It is therefore envisaged that there will be no material increase to surface water flood risk on or surrounding the Principal Site for the with-Proposed Development scenario meaning surface water risk will therefore remain as existing.

4.6 With-Proposed Development Other Sources of Flood Risk

Groundwater

- 4.6.1 Groundwater flood risk is anticipated to remain unchanged, as there are no proposals for discharging surface water runoff via infiltration methods due to the underlying ground conditions not being suitable for such techniques except in areas where discharge to a watercourse is unachievable.

Sewers

- 4.6.2 The Proposed Development scenario does not propose to interact or alter any existing sewer infrastructure and therefore will result in no change to flood risk from such sources. Construction risk of exposing or damaging sewers during the construction phase of the Proposed Development will be included and managed within the Framework CEMP (**PEI Report Volume 3, Appendix 3-A**).

Artificial Sources

- 4.6.3 There are no Artificial Sources of flood risk within the Principal Site; therefore, flood risk remains low from Artificial Sources.

4.7 Temporary Construction Compounds (Principal Site)

- 4.7.1 During the construction phase of the Principal Site, one main construction compound and five secondary construction compounds are proposed within the Principal Site, the locations and maximum footprint of the compounds are shown in **PEI Report Volume 2, Figure 3-1: Construction Compounds and Access Locations**.
- 4.7.2 All temporary construction compounds are located within Flood Zone 1 and are in areas of very low surface water flood risk and low risk from groundwater, sewers and other artificial sources.
- 4.7.3 The temporary construction compounds are proposed to be in place for up to 30 months during the Construction Phase, being gradually built out and replaced with solar PV panels by the commencement of the Operational Phase, where located within the Principal Site.
- 4.7.4 The assessment of solar PV panels during the Operational Phase where temporary construction compounds are proposed within the Principal Site conclude that no mitigation measures will be required within construction compound locations.
- 4.7.5 Therefore, it is considered the temporary construction compounds within the Principal Site are considered to be at low risk of flooding from all sources.

4.8 Principal Site Flood Risk Summary

- 4.8.1 The increase in surface water runoff rates as a result of the with-Proposed Development scenario will be managed via sustainable drainage techniques proposed to mimic the pre-Proposed Development conditions detailed within the Preliminary Drainage Strategy (**PEI Report Volume 3, Appendix 9-D**).
- 4.8.2 In areas where Flood Zone 2 extends into PV Panel areas, mitigation of fluvial flood risk to Proposed Development infrastructure is not required, except within Field number 55, where panels in the far east corner will be raised by up to 250mm to a minimum level of 8.10m AOD to take into account the credible maximum scenario.

- 4.8.3 In summary, it is considered that flood risk levels from all sources within and surrounding the Site Boundary will remain unchanged, i.e. no increase in flood risk to the Proposed Development or elsewhere, with the embedded mitigation proposed, and the Proposed Development will remain operational in times of severe flooding.

5. Assessment of Flood Risk (Cable Corridor)

5.1 Flood Risk from all Sources

- 5.1.1 Long term flood risk resulting from the Cable Corridor is considered to be as existing for the operational phase, as the infrastructure will be buried throughout the corridor with no permanent above ground-built development.
- 5.1.2 **Table 15** below sets out the flood risk from all sources for the Cable Corridor only.

Table 15: Flood Risk Summary (Cable Corridor)

Flood Risk Source	Flood Risk Level	Mapping and Comments
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Fluvial	Low to Very High
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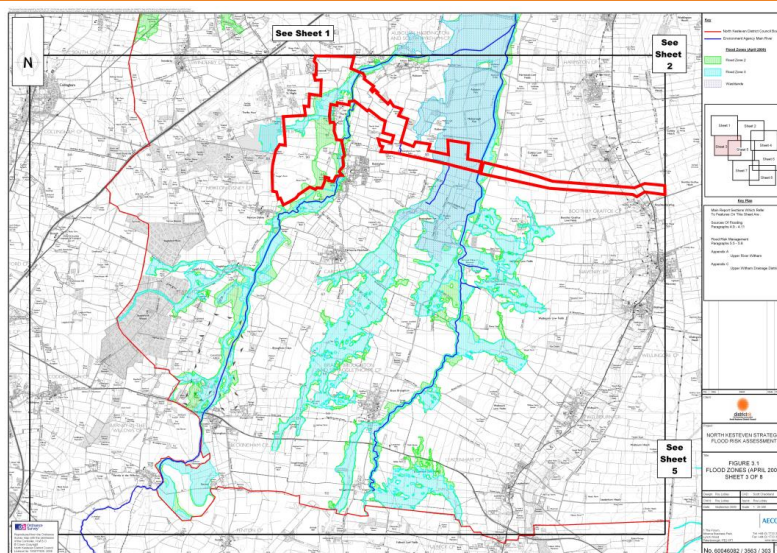


Plate 19: North Kesteven District Council SFRA Mapping Sheet 3

Flood Risk Source	Flood Risk Level	Mapping and Comments
----------------------	------------------------	----------------------

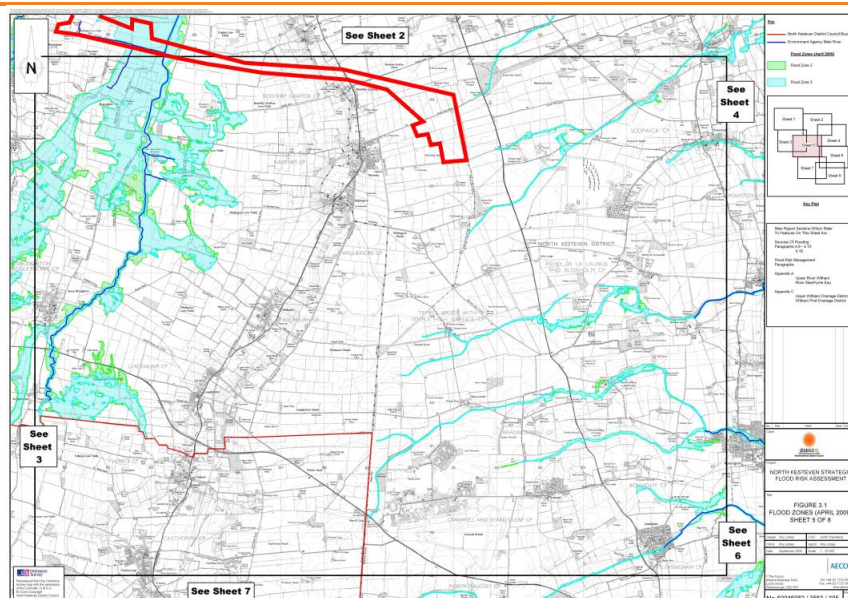


Plate 20: North Kesteven District Council SFRA Mapping Sheet 5

The Cable Corridor extends into an area of Flood Zones 2 and 3 associated with the River Witham. However, as no above ground infrastructure is proposed to be located within the Cable Corridor during the operational phase of the Proposed Development, the long term flood risk is expected to remain as existing, with no mitigation measured required as there will be no change to the floodplain.

As the Principal Site is located west of the River Witham, in order to connect power into the Grid near Navenby, there is no alternative cable route corridor that would avoid Flood Zones 2/3.

Tidal	Low	The Cable Corridor is not located within an area susceptible to tidal flood risk. No change to pre-Proposed Development flood risk level.
Surface Water	Low to High	No change to flood risk level and no increase in flood risk. No mitigation required for below ground cables. Any interaction with existing below ground drainage (land drains) will be managed and reinstated during construction and decommissioning and set out in the Framework CEMP (PEI Report Volume 3, Appendix 3-A).
Groundwater	Low-Medium	No historical groundwater flooding events are mentioned specifically within the North Kesteven SFRA. However, where the Cable Corridor crosses the River Witham, groundwater may be elevated within the alluvial deposits. There is no risk mapping for groundwater in this area, but as soils are largely impermeable the risk is considered medium, as the bedrock geology would not support large amounts of water storage, such as an aquifer. There may be a risk of groundwater ingress to excavations during the laying and potential removal of cables during the construction and decommissioning phases, the management of any water ingress to the excavations will be included in the Framework CEMP (PEI Report Volume 3, Appendix 3-A) and Framework DEMP (to be produced at the ES stage) respectively.
Sewers	Low	There are no confirmed sewers in the vicinity of the Cable Corridor. As there is no proposed connection to public sewers along the Cable

Flood Risk Source	Flood Risk Level	Mapping and Comments
		Corridor, there will be no increase in sewer flood risk as a result of the Proposed Development. Construction and decommissioning risk of exposing or damaging sewers will be included and managed via the Framework CEMP (PEI Report Volume 3, Appendix 3-A) and the Framework DEMP (to be produced at the ES stage) respectively.
Artificial Sources	Low (residual)	No change to flood risk level and no mitigation required.

5.2 Temporary Construction Compounds (Cable Corridor)

- 5.2.1 It is envisaged that there will be temporary construction compounds during the construction phase located within the Cable Corridor. The number and locations of these temporary construction compounds will be confirmed at the ES stage.
- 5.2.2 The locations of these compounds will be in locations outside of Flood Zone 2 and 3 extents and in areas of low risk from other sources e.g. surface water flood risk.

6. The Sequential Test and the Exception Test

- 6.1.1 The Sequential and Exception Tests have been considered to satisfy both the National Policy Statements, and NPPF requirements.
- 6.1.2 The Sequential and Exception Tests have been undertaken to satisfy both NPS EN-1 (Ref. 1) and NPPF (Ref. 4) requirements, as set out in Section 2.2 of this Preliminary FRA.
- 6.1.3 The Principal Site includes areas of high risk of flooding although is predominantly within Flood Zone 1.
- 6.1.4 The location of the Principal Site was dictated in part by the availability of a grid connection point at the proposed National Grid Navenby Substation. **PEI Report Volume 1, Chapter 4: Alternatives and Design Evolution** provides an explanation of site selection process along with how the Proposed Development had considered alternatives taking into account wider environmental and planning considerations.
- 6.1.5 As set out in **PEI Report Volume 1, Chapter 4: Alternatives and Design Evolution**, the location of the Principal Site was informed by the considerations outlined in the NPS EN-3 (Ref. 2) in relation to the siting of solar PV development.

- 6.1.6 A sequential approach has been applied to the layout and design of the Principal Site whereby the on-site substation, BESS and the majority of the solar PV arrays located in areas with the lowest risk of flooding from any source. As discussed in Section 4.3 above, there are areas where Solar PV panels are located within Flood Zone 2 extents. Where required, embedded mitigation within the design has been included to remain operation in times of flood. East-west tracking panels may be used enabling them to be tilted and as such provide greater resilience to instances of flooding in these areas. However, the Preliminary FRA has assessed a worst case scenario of fixed south facing panels with a minimum 800mm height above ground level. The Sequential Test is therefore considered passed for the Principal Site due to flood risk from any source to be low following the embedded mitigation.
- 6.1.7 In terms of the Exception Test and the provision of wider sustainability benefits, the Proposed Development will include habitat creation and enhancement as set out in **PEI Report Volume 1, Chapter 8: Ecology and Nature Conservation**. This will contribute to the Proposed Development providing biodiversity net gain in line with the Environment Act 2021 (Ref. 27). There are some areas of high-risk flooding within the Principal Site which are excluded from solar panels and are proposed to be used for ecological enhancement. Safeguarding these flood risk areas for ecological enhancement will secure these areas from future development, mitigating potential future increases to flood risk.
- 6.1.8 As detailed within Section 8 of this Preliminary FRA, embedded mitigation measures and an Outline Drainage Strategy (**PEI Report Volume 3, Appendix 9-D**) will be secured by a requirement in the DCO to be implemented, in order to ensure that the Proposed Development is safe for its lifetime and that there will be no increases in flooding elsewhere. Thus, the Proposed Development satisfies the second requirement of the Exception Test and will remain safe throughout its lifetime without increasing flood risk to third party land.
- 6.1.9 Therefore, as demonstrated above the Principal Site is considered to pass the Sequential and Exception Test.
- 6.1.10 As set out in paragraph 2.2.50 of this Preliminary FRA, the sequential approach in selecting the location of the Site for the Proposed Development will be set out in the ES and the Planning Statement, to be submitted as part of the DCO application.

7. Drainage Strategy

7.1 Drainage Strategy Principles

- 7.1.1 The Preliminary Drainage Strategy included in **PEI Report Volume 3, Appendix 9-D** proposes a system for new impermeable areas during the with-Proposed Development scenario designed to accommodate the 1 in 100-year storm, plus a 40% allowance for an increase in peak rainfall intensity due to climate change.

- 7.1.2 The Preliminary Drainage Strategy assumes:
- a. The solar PV panels and permeable access tracks will not lead to an increase in impermeable area within the Site Boundary; and
 - b. 100% of the runoff from the BESS areas and substation areas will contribute to runoff managed by a new drainage system.
- 7.1.3 The Preliminary Drainage Strategy proposes to attenuate runoff via sustainable drainage techniques (excluding infiltration to ground due to assumed geological conditions) and restrict at greenfield rates to watercourses within the Site Boundary as per the existing conditions.
- 7.1.4 Foul drainage is not considered within the drainage strategy as no connection to the public sewer is proposed, drainage will be dealt with via a septic tank arrangement or similar sealed system for the compound areas, emptied and maintained to recommended manufacturer advice.
- 7.1.5 Further details including contributing areas, runoff rates, water quality assessment and maintenance requirements are included within the Preliminary Drainage Strategy Report (**PEI Report Volume 3, Appendix 9-D**).

8. Residual Risks and Mitigation

8.1 Residual Risks to the Proposed Development

- 8.1.1 As discussed in Section 4.3, solar PV panels in Field 55 are to be set at a minimum level of 8.10m AOD, to provide freeboard to panels in the unlikely failure of the Boston tidal defences, ensuring the Proposed Development will remain operational in times of severe flood.
- 8.1.2 Solar panels may either be fixed south facing or tracker panels, which the latter can tilt to track the sun's movement throughout the day. The solar PV tracker panels can be fitted with sensors to detect flood water and can tilt the panels to raise the panels above predicted flood levels. However, the assessment of flood risk has been based on a worst case south facing tracker panel which has a fixed height of 800mm above the ground, the lowest height of any proposed PV panel as presented in **PEI Report Volume 1, Chapter 3: The Proposed Development**.
- 8.1.3 Residual flood risk from all sources to and from the Proposed Development is considered to be low.

8.2 Safe Access

- 8.2.1 Through the Sequential Test process and design iterations, there are no buildings located within the floodplain. The only structures within the floodplain are solar PV panels. All compounds for site staff, Solar Station Compounds, Onsite Substation and BESS Compound have been located out

of flood zones and it is envisaged access to solar PV panels within Flood Zone 2 and 3a would not be undertaken during flooding conditions.

- 8.2.2 During a flood event, any affected infrastructure will not be accessed or manned until flood waters recede.

9. Conclusions

- 9.1.1 This Preliminary FRA has been prepared to support the PEI Report.
- 9.1.2 The Preliminary FRA demonstrates flood risk, from all sources, will not increase as a result of the Proposed Development, within the PEI Report Boundary or elsewhere, with the proposed embedded mitigation in place.
- 9.1.3 A separate Preliminary Drainage Strategy (**PEI Report Volume 3, Appendix 9-D**) demonstrates surface water drainage will be managed effectively to ensure there is no increase in surface water runoff from the Proposed Development above the existing regime.

10. References

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- Ref. 2 National Policy Statement for Renewable Energy Infrastructure (EN-3). Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/37048/1940-nps-renewable-energy-en3.pdf
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- Ref. 5 Department of Communities and Local Government (2014, updated August 2022) National Planning Practice Guidance: Flood Risk and Coastal Change. Available online: <https://www.gov.uk/guidance/flood-risk-and-coastal-change>
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- Ref. 9 Central Lincolnshire Local Plan (2023). Available at: <https://www.n-kesteven.gov.uk/central-lincolnshire>
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- Ref. 12 Upper Witham Internal Drainage Board Policy Statement on Water Level and Flood Risk Management Asset List (2018). Available at: <https://witham3idb.gov.uk/wp-content/uploads/2020/12/UW-Policy-Statement-2018.pdf>
- Ref. 13 Upper Witham Internal Drainage Board Byelaws. Available at: <https://witham3idb.gov.uk/wp-content/uploads/2020/12/Upper-Witham-Internal-Drainage-Board-Byelaws.pdf>
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- Ref. 16 Environment Agency Statutory Main River Map (Online).

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- Ref. 18 Land Information Systems Soilscales soil types viewer (online). Available at: <https://www.landis.org.uk/soilscales/>
- Ref. 19 DEFRA climate change allowances for peak river flow in England (online). Available at: [available at: https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow](https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow)
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- Ref. 21 Defra online Flood Zone 2 Dataset (2024) DEFRA Spatial Data Download. Available at: <https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/FloodMapForPlanningRiversAndSeaFloodZone2&Mode=spatial>
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- Ref. 23 Defra Survey Data Download service (2024). Available at: <https://environment.data.gov.uk/survey>
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- Ref. 26 HMSO (2020). Energy White Paper: Powering our net future. Available at: <https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future>
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Annex A Sea Level Rise Calculation

Assessed using Environment Agency OnlineSea Level Rise calculation Table 2; <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

The following maps will help you find out which river basin district you are in:

[River basin district map](#)

[River basin district map that zooms in so you can find places close to river basin district boundaries](#)

For places in:

- *- Thames river basin district use 'south east' sea level rise allowances
 - *- Severn river basin district use 'south west' sea level rise allowances
 - *- parts of Solway Tweed river basin district on the west coast and Dee river basin district that are in England, use 'north west' sea level rise allowances
 - *- parts of Solway Tweed river basin district on the east coast that are in England, use 'Northumbria' sea level rise allowances
- The allowances in table 1 account for slow land movement. This is due to 'glacial isostatic adjustment' from the release of pressure at the end of the last ice age. The northern part of the UK is slowly rising and the southern part is slowly sinking. This is why net sea level rise is less for the north-west and north-east than the rest of the country.

Notes:

- *- To calculate sea level using table 1, add the allowances for the appropriate one of the 6 geographical areas:
up to 2035, use the mm for each year rates for the appropriate geographical area, starting from the present day extreme sea levels from Coastal design sea levels – coastal flood boundary extreme sea levels (2018)
 - *- from 2036 to 2065, get the increase in sea level by adding the number of years on from 2035 (to 2065), multiplied by the respective rate shown in table 1 for the appropriate geographical area – if the whole time period applies use the cumulative total
 - *- treat time periods 2066 to 2095 and 2096 to 2125 as you would 2036 to 2065
- Where it is appropriate to apply a credible maximum scenario, use the H++ allowance. There is no H++ value for sea level rise beyond 2100.

H++ (Sensitivity)

- *- For the change to relative mean sea level use the H++ scenario of 1.9m for the total sea level rise to 2100.

Table 1: sea level allowances by river basin district for each epoch in mm for each year (based on a 1981 to 2000 baseline) – the total sea level rise for each epoch is in brackets

Area of England	Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher central	5.8 (203)	8.7 (261)	11.6 (348)	13 (390)	1.20
Anglian	Upper end	7 (245)	11.3 (339)	15.8 (474)	18.1 (543)	1.60
South east	Higher central	5.7 (200)	8.7 (261)	11.6 (348)	13.1 (393)	1.20
South east	Upper end	6.9 (242)	11.3 (339)	15.8 (474)	18.2 (546)	1.60
South west	Higher central	5.8 (203)	8.8 (264)	11.7 (351)	13.1 (393)	1.21
South west	Upper end	7 (245)	11.4 (342)	16 (480)	18.4 (552)	1.62
Northumbria	Higher central	4.6 (161)	7.5 (225)	10.1 (303)	11.2 (336)	1.03
Northumbria	Upper end	5.8 (203)	10 (300)	14.3 (429)	16.5 (495)	1.43
Humber	Higher central	5.5 (193)	8.4 (252)	11.1 (333)	12.4 (372)	1.15
Humber	Upper end	6.7 (235)	11 (330)	15.3 (459)	17.6 (528)	1.55
North west	Higher central	4.5 (158)	7.3 (219)	10 (300)	11.2 (336)	1.01
North west	Upper end	5.7 (200)	9.9 (297)	14.2 (426)	16.3 (489)	1.41

Area of England	Allowance	2000 to 2035 (mm/yr)	2000 to 2035 (mm) - Total	2036 to 2065 (mm/yr)	2036 to 2065 (mm) - cumulative	2066 to 2095 (mm/yr)	2066 to 2095 (mm) - cumulative	2096 to 2125 (mm/yr)	2096 to 2125 (mm) - cumulative	Cumulative rise 2000 to 2125 (metres)
Anglian	Higher central	5.8	203	8.7	261	11.6	348	13	390	1.2
Anglian	Upper end	7	245	11.3	339	15.8	474	18.1	543	1.6
South east	Higher central	5.7	200	8.7	261	11.6	348	13.1	393	1.2
South east	Upper end	6.9	212	11.3	339	15.8	474	18.2	546	1.6
South west	Higher central	5.8	203	8.8	264	11.7	351	13.1	393	1.21
South west	Upper end	7	245	11.4	342	16	480	18.4	552	1.62
Northumbria	Higher central	4.6	161	7.5	225	10.1	303	11.2	336	1.03
Northumbria	Upper end	5.8	203	10	300	14.3	429	16.5	495	1.43
Humber	Higher central	5.5	193	8.4	252	11.1	333	12.4	372	1.15
Humber	Upper end	6.7	235	11	330	15.3	459	17.6	528	1.55
North west	Higher central	4.5	158	7.3	219	10	300	11.2	336	1.01
North west	Upper end	5.7	200	9.9	297	14.2	426	16.3	489	1.41

Location	Design Life (yrs)	Estimated Year of First Operation	End Life (Worst Case)	RBMP	Higher Central 2000-2035 Total (mm)	Upper 2000-2035 Total (mm)	Higher Central 2036-2065 Total (mm)	Upper 2036-2065 Total (mm)	Higher Central 2066-2095 mm/yr	Upper 2066-2095 mm/yr	Years from 2066 to end life	
Fosse Green Solar (Chainage _3994, FID 6 Coastal Node) (Highest Level Near Site)	60	2033	2094	Anglian	203	245	261	339	11.6	15.8	28	
Sea Level (mAOD) (1 in 100 year 97.5% Percentile - C2_T100 - Worst Case 6.04												
Lowest Site Level - Fosse Green Solar (mAOD) 7.05												
										SUB_TOTAL Higher Central TOTAL Rise (mm) Higher Central	324.8 788.8	Total Adjusted to mAOD 6.83
										SUB-TOTAL Upper TOTAL Rise (mm) Upper	442.4 1026.4	
										H++ Scenario (mm)	1900	7.94
											Design Site Level Not at Risk	Fail
											Sensitivity Test	Fail

Location	Design Life (yrs)	Estimated Year of First Operation	End Life (Worst Case)	RBMP	Higher Central 2000-2035 Total (mm)	Upper 2000-2035 Total (mm)	Higher Central 2036-2065 Total (mm)	Upper 2036-2065 Total (mm)	Higher Central 2066-2095 mm/yr	Upper 2066-2095 mm/yr	Years from 2066 to end life	
Fosse Green Solar (Chainage 3888, FID 26 Coastal Node) (Highest Level Near Site) Sea Level (mAOD) (1 in 100 year 97.5% Percentile - C2_T100 - Worst Case 5.11 Lowest Site Level - Fosse Green Solar (mAOD) 13.50	60	2033	2093	Humber	193	235	252	330	11.1	15.3	27	
									SUB_TOTAL Higher Central TOTAL Rise (mm) Higher Central	299.7 744.7	Total Adjusted to mAOD 5.85	
									SUB-TOTAL Upper TOTAL Rise (mm) Upper	413.1 978.1	 6.09	
									H++ Scenario (mm)	1900	7.01	
										Design Site Level Not at Risk	Pass	
										Sensitivity Test	Pass	

Annex B Fluvial Analysis Calculations (Ordinary Watercourse)

Calculated by: Phoebe Martin

Site name: Fosse Green

Site location: Morton Ditch Catchment

Site Details

Latitude: 53.17015° N

Longitude: 0.68229° W

Reference: 3461239725

Date: Jul 09 2024 15:10

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

Runoff estimation
approach

FEH Statistical

Site characteristics

Total site area (ha): 437.4919615

Methodology

Q_{MED} estimation method: Calculate from BFI and SAAR

BFI and SPR method: Specify BFI manually

HOST class: N/A

BFI / BFIHOST: 0.613

Q_{MED} (l/s):

Q_{BAR} / Q_{MED} factor: 1.12

Notes

(1) Is $Q_{BAR} < 2.0$ l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is $SPR/SPRHOST \leq 0.3$?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Hydrological
characteristics

	Default	Edited
SAAR (mm):	580	577
Hydrological region:	5	5
Growth curve factor 1 year:	0.87	0.87
Growth curve factor 30 years:	2.45	2.45
Growth curve factor 100 years:	3.56	3.56
Growth curve factor 200 years:	4.21	4.21

Greenfield runoff rates

	Default	Edited
Q _{BAR} (l/s):		400.93
1 in 1 year (l/s):		348.81
1 in 30 years (l/s):		982.29
1 in 100 year (l/s):		1427.32
1 in 200 years (l/s):		1687.93

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

OPEN CHANNEL FLOW CALCULATIONS

Project: Fosse Green Solar
Section: Morton Ordinary Watercourse Flood Channel (Higher Allowance: 1.86 Cu)

Job No:
Date: 09.07.2024
Sheet No: 1 of 2
CB

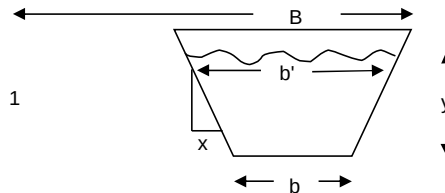
Made By: PM **Checked By:**

Free Board 0.00 m
 Width of channel base, b= 4.50 m
 Channel side slope, 1 in x= 327.0
 Max. water depth, y= 0.22 m

Cover Pipe Depth side slope half trench width

Existing ground level= 14.000 m
 Invert level of channel= 11.750 m
 Top channel width, B= 1352.00 m

area, A= 16.8168
 wetted perimeter, P= 148.3807
 top width at top water level, b'= 148.38
 hydraulic radius, R= 0.113336
 hydraulic mean depth, Dm= 0.113336
Velocity, m/s= 0.111445



Bed slope 1 in 690
 Manning's, n= 0.08

Harpwell Flood Channel (Higher Allowance: 9.7Cu)

Q= 1.8741579 cumecs or 1874.16 l/s

Existing ground level= m
 Proposed freeboard= m
 Proposed MIN invert level= m

m (300mm recommended)

Channel length= m
 Starting invert= m
 End Invert= m

ROUGHNESS VALUES

Type of channel	Condition	Manning's n
Grass channel, regularly maintained	Average, good	0.050
Grass channel, not maintained with dense weeds	Good	0.050
	Average	0.080
	Poor	0.120
Concrete	Average	0.013
	Poor	0.016
Black top	Average	0.017
	Poor	0.021

SIDE SLOPES

Material	Side Slope (H:V)
Rock	Nearly vertical
Muck and peat soils	¼:1
Stiff clay or earth with concrete lining	½:1 to 1:1
Earth with stone lining or earth for large channels	1:1
Firm clay or earth for small ditches	1½:1
Loose, sandy earth	2:1
Sandy loam or porous clay	3:1

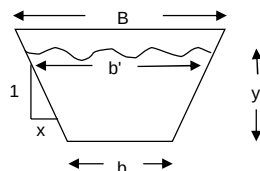
OPEN CHANNEL FLOW CALCULATIONS

Project: Fosse Green Solar Job No:
 Section: Morton Ordinary Watercourse Capacity Date: 28.11.22
 Made By: PM Checked By: Sheet No: 1 of 1
 CB

Free Board 0.00 m
 Width of channel base, b= 1.50 m
 Channel side slope, 1 in x= 2.0
 Max. water depth, y= 0.50 m

Cover Pipe Depth 0.50 side slope

Existing ground level= 12.500 m
 Invert level of channel= 12.000 m
 Top channel width, B= 4.50 m
 area, A= 1.2500
 wetted perimeter, P= 3.736068
 top width at top water level, b'= 3.5
 hydraulic radius, R= 0.334576
 hydraulic mean depth, Dm= 0.357143
 Velocity, m/s= 0.229341



Bed slope 1 in 690
 Manning's, n= 0.08

Q= 0.2866766 cumecs or 286.68 l/s

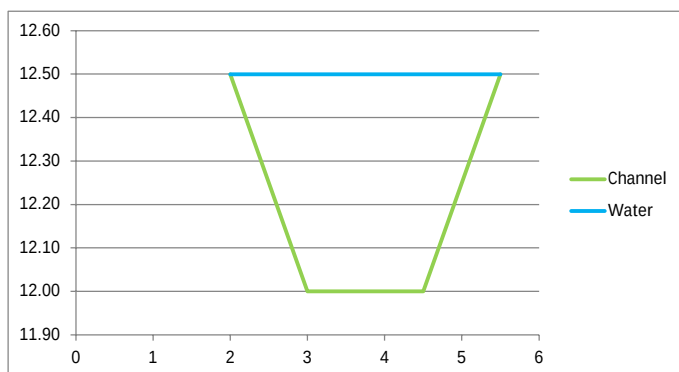
Existing ground level= m Channel length= m
 Proposed freeboard= m (300mm recommended) Starting invert= m
 Proposed MIN invert level= m End Invert= m

ROUGHNESS VALUES

Type of channel	Condition	Manning's n
Grass channel, regularly maintained	Average, good	0.050
Grass channel, not maintained with dense weeds	Good Average Poor	0.050 0.080 0.120
Concrete	Average Poor	0.013 0.016
Black top	Average Poor	0.017 0.021

SIDE SLOPES

Material	Side Slope (H:V)
Rock	Nearly vertical
Muck and peat soils	¾:1
Stiff clay or earth with concrete lining	½:1 to 1:1
Earth with stone lining or earth for large channels	1:1
Firm clay or earth for small ditches	1½:1
Loose, sandy earth	2:1
Sandy loam or porous clay	3:1



Annex C Environment Agency Correspondence

[REDACTED]

From: [REDACTED]@environment-agency.gov.uk>
Sent: 11 December 2023 17:01
To: [REDACTED]
Subject: Fosse Green Energy NSIP - flood risk advice
Attachments: Fosse Green Energy Solar Farm - Discretionary Advice Service Request

This Message Is From an External Sender

This message came from outside your organization. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Report Suspicious

Hi [REDACTED]

As you will be aware, AECOM have accepted our offer for charged planning advice, which is being set up by our finance team.

As we can now proceed, please can you let me know if you would like us to review and respond directly to the following flood risk enquiry in your initial email (attached) to inform your FRA methodology, or are you going to provide a document on the proposed approach to the FRA which will cover these elements instead?

- *Fluvial Modelling: Model extents were provided for the 2015 hydraulic model of the Upper Witham. We were not issued with the actual model files due to the current one being updated and due to be published in 2024. We have shown on the layout the climate change extents (20%) for the 1 in 100 and 1 in 1000 year events. We do not expect the current climate change allowance of 1 in 100 year plus 32% for the Higher Central to extend beyond the 1 in 1000 year plus 20% climate change though. The Credible Maximum Scenario (CMS), (Upper End allowance of 57%), sensitivity assessment would be worth discussing as well as to how we can assess this in lieu of the model update.*
 - o *Design Assumption – 300mm freeboard to be provided during the design event (1 in 100 year plus 32% cc). CMS Sensitivity test to ensure PV panels are not flooded during the Upper end Scenario (1 in 100 year plus 57% cc).*
 - o *Key queries:*
 - *Can we use the existing model to assess the new climate change allowances as it is not certain the revised model will be published by the time of the DCO. As it is only solar PV panels potentially at risk with a minimum ground clearance of 600mm which can be raised in flood risk areas, could this be a rational approach to the DCO.*
 - *Flood Zone 3b – current requirement is 1 in 30 year now; 2015 model extents show all built development is outside of the current 1 in 100 plus 20% cc extents, can it be agreed we are effectively not developing within the 1 in 30 year extent.*

Kind regards,

[REDACTED]

[REDACTED]

Planning Specialist, National Infrastructure Team

Environment Agency | Lutra House, Dodd Way Off Seedlee Road, Walton Summit Centre, Bamber Bridge, Preston, PR5 8BX

[REDACTED]@environment-agency.gov.uk

External: 020 302 51215 | Mobile: [REDACTED]

Team mailbox: NITeam@environment-agency.gov.uk

Please accept my thanks for your email in advance, I have made a commitment to stop sending e-mails that just say thank you. This will help me to reduce my carbon footprint <https://carbonliteracy.com/the-carbon-cost-of-an-email/>



**Creating a better place
for people and wildlife**



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Mr [REDACTED]
AECOM
Marlborough Court
10 Bricket Road
St Albans
AL1 3JX

Our ref: XA/2023/100051/01-L01
Your ref: 60700987
Date: 21 December 2023

Dear [REDACTED]

Nationally Significant Infrastructure Project (NSIP): Fosse Green Energy

Proposed solar and energy storage park with associated grid connection infrastructure, land 9km south west of Lincoln, North Kesteven, Lincolnshire

Flood risk advice – review of technical approach to fluvial flood risk

Thank you for seeking our cost recoverable advice on your proposed technical approach to fluvial flood risk in connection with the above development.

We are pleased to provide our advice to you under cost recovery agreement no. ENVPAC/1/NIT/00013 as set out below.

We have reviewed the flood risk enquiry element of your email dated 25 October 2023 and the accompanying site layout plan (Fosse Green South Installation Version 6 – Sheet 1 – Site Overview; dated 18 October 2023), along with the supporting flood risk technical note (ref. 60700987-ACM-FGEXX-TN-CIV-000001, dated 12 December 2023).

It is worth noting that the Upper Witham model is an Infoworks RS 1d-2d linked model developed by Mott Macdonald in 2015. AECOM are currently in the process of updating the 2015 model to a Flood Modeller-TUFLOW model, with the current programme for completion being the end of March 2024, although this will likely be delayed due to additional ongoing work to calibrate the model with the Storm Babet event of October 2023.

AECOM should already have a copy of the existing 2015 Infoworks RS model as part of the works they are undertaking for the EA to update the model. We would

have no issue with this modelling being shared internally within AECOM so the applicant has access to it.

Please see below our comments on your flood risk enquiry detailed in your email (dated 25 October 2023):

1. **AECOM's proposed design assumption:** *"300mm freeboard to be provided during the design event (1 in 100 year + 32% CC). CMS Sensitivity test to ensure PV panels are not flooded during the Upper End Scenario (1 in 100 year + 57% CC)".*

EA response: This appears to be a sensible assumption and aligns with the freeboard used for other solar farms.

2. **Question from AECOM:** *Can we use the existing model to assess the new climate change allowances as it is not certain the revised model will be published by the time of the DCO. As it is only solar PV panels potentially at risk within a minimum ground clearance of 600mm which can be raised in flood risk areas, could this be a rational approach to the DCO?*

EA response: This seems like a reasonable way forward in the absence of the current updated hydraulic modelling. However, we would expect the applicant to still cross-check the flood extents from the 2015 model with the updated FM-TUFLOW model outputs if this becomes available before the DCO submission.

3. **Question from AECOM:** *Flood Zone 3b – current requirement is 1 in 30 year now; 2015 model extents show all built development is outside of the current 1 in 100 + 20% CC extents, can it be agreed we are effectively not developing within the 1 in 30 year extent?*

EA response: This is considered a reasonable and pragmatic assumption.

Comments on the technical approach document:

Document name: Fluvial Flood Risk Technical Approach

Document ref: 60700987-ACM-FGEXX-TN-CIV-000001

Document date: 12/12/2023

Produced by: AECOM

Issue ref.	Doc ref.	EA Comments	
001	Section 1.5,	Issue	Other than the photovoltaic (PV) panels, the paragraph makes reference to there being no

	page 1		other permanent built infrastructure above ground during operation, so no further flood risk concerns. However, it is unclear what above ground structures, or ground raising works, may be required during the construction phases of the development.
		Impact	It is not clear from the technical note whether there will be any additional flood risk considerations necessary during the construction phases of the development. It is essential that the scheme does not result in an increase in flood risk elsewhere at any point during the construction or operation of the scheme.
		Suggested solution	Please can further information be provided on the construction phases of the works, including any temporary infrastructure or ground raising that may be required, and where this is expected to be situated. It is recommended that a sequential approach be taken, even for the construction stages, ensuring all works are located within Flood Zone 1, where possible. Should any structures or ground raising be required within Flood Zones 2 or 3 then it should be demonstrated that they will not result in an increase in flood risk elsewhere.
002	Section 3.1.1, page 4	Issue	How are you planning on determining the flood levels for the 1% annual probability (1 in 100 year), 0.1% annual probability (1 in 1000 year) and climate change scenarios? Have you been provided with these results as part of your product 6 dataset or were you planning on using the flood extent outlines and LiDAR data (e.g. where the flood outlines intersect the LiDAR)?
		Impact	It is not completely clear from the technical note how flood levels will be obtained and therefore how they will affect the development proposals.
		Suggested solution	Please add this detail to the technical note for clarity.

003	Section 3.1.1, page 4	Issue	It is not clear what is meant by the following statement: <i>“Assessing LiDAR topographic data to assess the potential impact on flood levels at the 1 in 100 and 1 in 1000 year climate change extents, in order to propose sufficient mitigation for the solar panel areas within the impacted areas.”</i>
		Impact	It is not completely clear from the technical note what this statement is referring to. Is this in respect to understanding the impact (flood risk detriment) of the PV mounting structures?
		Suggested solution	Please clarify in the technical note what specifically is meant by this statement and how any flood risk detriment associated with the PV mounting structures will be determined.
004	Section 3.1.1, page 4	Issue	Calculating flood levels for the plus 32% and plus 57% climate change scenarios by extrapolating the rate of increase from the plus 20% scenarios.
		Impact	This approach could over and potentially underestimate flood risk increases in some locations.
		Suggested solution	We appreciate you may not have been provided with a copy of the 2015 Infoworks RS model but scaling the 1% annual probability (1 in 100 year) inflows boundaries in the existing model by 32% and 57% would be the better approach here and allow for a more robust assessment. This approach would be reliant of having an Infoworks RS licence.

Additional comments/advice

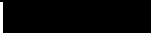
1. With regards to estimating the 1% annual probability (1 in 100 year) plus 32% and plus 57% flood levels, how exactly are you intending on determining flood levels and extents? Do you have an Infoworks RS licence? Would it be easier to just re-run the model with scalings of 32% and 57% applied to the 1% annual probability (1 in 100 year) design flows? AECOM are currently working on the model update for the Upper Witham, converting the existing Infoworks RS 2015

model into a Flood Modeller-TUFLOW model hence you may already have a copy of this.

2. The washland in this area (Witham Washland) fills to a level of around 7.65 metres above Ordnance Datum. Near to the site boundary, the existing 2015 Infoworks RS model is 1d only with floodplain flooding represented using a series of 1d storage units.
3. A portion of the red line boundary intersects Flood Zone 2 and 3 (XY coordinates: 488120, 364380) for a non-main river watercourse, which drains into the Mill Dam Dyke catchment and the tidal River Trent. The Environment Agency do not hold any detailed hydraulic modelling for this watercourse. This will also need to be considered.
4. If any of the development is located within the 1% annual probability (1 in 100 year) plus 32% climate change extent then an assessment of floodplain loss should be made, and floodplain compensation provided where required to ensure no impacts on flood risk elsewhere.

We trust the above is helpful. Should you require any additional information, or wish to discuss these matters further, please do not hesitate to contact me using the details below.

Yours sincerely


Planning Specialist – National Infrastructure Team
Direct dial: 
Direct email: @environment-agency.gov.uk

Annex D Outline Drainage Strategy / Scheme Layout

60682158-ACM-ZZ-XX-DR-CE-000023

