Tween Bridge Solar Farm

A Nationally Significant Infrastructure Project in the Energy Sector

Preliminary Environmental Information Report

Chapter 10 – Water Resource

October 2023

Visit: www.tweenbridgesolar.co.uk
Email: info@tweenbridgesolar.co.uk

10. Water Resource

10.1. Introduction

10.1.1. This chapter of the working draft PEIR identifies the potential impacts on the water environment from the construction, operation and decommissioning of the Scheme. The water environment includes surface waterbodies (e.g. rivers, streams, ditches, canals, lakes and ponds, etc.), groundwater bodies, as well as flood risk and drainage.

10.1.2. This assessment reports on the baseline and Scheme design information available at the time of writing this working draft PEIR. The PEIR will be updated as further assessments become available and any updates to the baseline will be reported in the next iteration of the PEIR which will be presented as part of the statutory pre-application consultation. Early responses from consulteesand the scoping opinion dated 13 March 2023 have been taken into account during the preparation of this chapter and this is discussed in detail below.

10.1.3. The potential impacts on the water environment resulting from the Scheme focus on four main events:

- Erosion/sediment movement.
- Chemical/pollution events.
- Alteration/interruption of surface water flows.
- Alteration/interruption of ground water flows.

10.1.4. This chapter is supported by the following figures and appendix. All figures are located within the text of this chapter.

- **Appendix 10.1** Flood Risk Assessment
- **Figure 10.1** - Flood Map for Planning
- **Figure 10.2** – RoFSW Extents
- **Figure 10.3** – RoFSW 1 in 1000 year Depth
- **Figure 10.4** – BGS Bedrock Geology
- **Figure 10.5** – Hydrogeology Aquifer Classification
- **Figure 10.6** – Hydrogeology Aquifer Classification
- **Figure 10.7** – RoFSW 1 in 1000 year Depths

10.1.5. Baseline and assessment work is ongoing, It is anticipated that the following information will be made available for the next iteration of the PEIR: -

- Consideration of Cumulative Impacts

- Assessment of detailed design
- Provision of a Drainage Strategy drawing.

10.2. Consultation

10.2.1. A summary of consultation responses received to date is provided in Table 10.1 below.

Table 10.1 : Summary of Consultation

CONSULTEE	SUMMARY OF CONSULTEE RESPONSE	HOW RESPONSE HAS BEEN ADDRESSED BY APPLICANT
Internal Drainage Board (Doncaster East IDB)	Any cable crossings under IDB owned rhynes will need to be directionally drilled. All pumping stations are maintained on a set schedule. 9m offset must be kept to IDB watercourse. Other watercourses would suggest using 5m easement to one side minimum. Try to use existing crossings where possible, any new crossings would preferably be a bridge rather than a culvert. We could put a culvert crossing in if we are removing one further along, and therefore creating a like for like replacement.	Restrictions noted and relayed to the layout designer in relation to 9m offsets already noted as an IDB requirement. Directions drilling noted to the client for consideration with cable routing. Access arrangements to be discussed with transport consultants to determine any new crossings needed for vehicles, both construction and maintenance. **Any further details in response to these comments can be supplied in the next iteration of this PEIR chapter.**
Environment Agency (Sustainable Places – Lincolnshire & Northamptonshire Area)	EA product 4 data has been sent through to Pegasus showing flood levels for the worst case event showing levels around 1-2m AOD. Critical Flood Level (CFL) of 4.1m AOD is being requested for the battery storage units and substations which does not align with the flood mapping.	Further flood modelling has been noted by the EA and has been requested but not received to date. Agreement in place to review new data against site proposals to determine height of raising. Should levels of 4.1m not be achievable the EA have noted they would considered protection / resilience and

	Solar panels were agreed to be less of a concern and do not need to be set at 4.1m AOD. Flood deference not preferable and all alternatives to be investigated prior to this suggestion. The EA have noted that assessment of impact on the development's operation should be reviewed if a 4.1m AOD flood event was to occur. The EA would prefer not to have anything within the Flood Zone 3b area of the site however would accept solar panels in this location, subject to a Sequential Test and Exception Test being applied. Flood displacement would need to be compensated appropriately and connected hydraulically. Any crossings for cables under the main rivers need to be directionally drilled.	are open to discussions on what this might be. Work is ongoing with regards to the sequential test and it is expected that this will be available for the next iteration of the PEIR.

10.3. Assessment Approach

Methodology

10.3.1. The technical guidance of the NPPF requires assessment of all potential sources of flooding with respect to new development. This has been carried out in a separate Flood Risk Assessment ('the FRA') by Pegasus Group and is included as a Technical Appendix of this PEIR (Technical Appendix 10.4). The FRA assesses the risk of flooding from the following sources:

- Fluvial (river flooding)
- Tidal (river flooding caused by the sea)
- Pluvial (surface water flooding)
- Groundwater
- Flooding from sewers
- Artificial sources (canals and reservoirs).

Assessment of Significance

10.3.2. The approach followed during the assessment considered the degree (or the 'significance') of the potential effects upon the hydrological and hydrogeological characteristics of the Site. The significance has been defined taking into account the sensitivity of the receiving environment and the potential magnitude of the impact, consistent with the broad methodology set out in Chapter 3 of this report. For this Chapter, the definition of the receiving environment is set out in Table 10.2 below taken from the Design Manual for Roads and Bridges guidance LA103 documents:

Table 10.2: Definition of the Receiving Environment

Sensitivity	Definition
High	Receptor with a high quality and rarity, regional or national scale and limited potential for substitution/replacement Inner Source Protection zone (Zone 1) Site of Special Scientific Interest ('SSSI') or Special Area of Conservation ('SAC') Excellent water quality Large scale industrial agricultural abstractions >1000m^3/day within 2km downstream, or abstractions for public drinking water supply Designated salmonid fishery and/or salmonid spawning grounds present Watercourse widely used for recreation, directly related to watercourse quality (e.g. swimming, salmon fishery etc.) within 2km downstream Conveyance of flow and material, main river >10m wide Active floodplain area (important in relation to flood defence)
Medium	Receptor with a medium quality and rarity, local scale and limited potential for substitution/replacement or receptor with a medium quality and rarity, regional or national scale and limited potential for substitution/replacement Outer Source Protection Zone (Zone 2) Nitrate Vulnerable Zone Principal Aquifer Good water quality Large scale industrial agricultural abstractions 500-1000m^3/day within 2km downstream

	Surface water abstractions for private water supply for more than 15 people Designated salmonid fishery and/or cyprinid fishery Watercourse used for recreation, directly related to watercourse quality (e.g. swimming, salmon fishery etc.) Conveyance of flow and material, main river >10m wide Active floodplain area (important in relation to flood defence)
Low	Receptor with a low quality and rarity, local scale and limited potential for substitution/replacement or receptor with a low quality and rarity, regional or national scale and limited potential for substitution/replacement Total Catchment Source Protection Zone (Zone 3) Secondary Aquifer Fair water quality Industrial/agricultural abstractions 50-499m^3/day within 2km downstream Designated cyprinid fishery or undesignated for fisheries - Occasional or local recreation (e.g. local angling clubs) Groundwater abstractions 50-500m^3/day - Private water supplies present Designated cyprinid fishery, salmonid species may be present and catchment locally important for fisheries Watercourse not widely used for recreation, or recreation use not directly related to watercourse quality
Negligible	Receptor with a negligible quality and rarity, local scale and limited potential for substitution/replacement No SPZ Unproductive Strata Environmental equilibrium stable and resilient to changes that are greater than natural fluctuations, without detriment to its present character Polluted/poor water quality Industrial/agricultural abstractions < 50m^3/day within 2km downstream Fish sporadically present or restricted, no designated fisheries; not used for recreation

	Watercourse < 5m wide Area does not flood/is located in EA Flood Zone 1 Receptor heavily engineered or artificially modified and may dry up during summer months

10.3.3. The magnitude of the impact/change includes the timing, scale, size and duration of the potential impact. For the purposes of this assessment, the magnitude criteria are defined in Table 10.3 below taken from the Design Manual for Roads and Bridges guidance LA103 document.

Table 10.3: Magnitude of Change

Magnitude	Criteria	Description and example
High	Results in loss of attribute	Fundamental (long term or permanent) changes to the hydrology/hydrogeology: • Loss of EC designated Salmonid fishery • Loss of designated species/habitats • Change in water quality status of river reach • Compromise employment source • Pollution of potable source of abstraction • Loss of flood storage/increased flood risk
Medium	Results in impact on integrity of attribute or loss of part of attribute	Material but non-fundamental and short to medium term changes to the hydrogeology or water quality: • Loss in productivity of a fishery • Contribution of a significant proportion of the effluent in the receiving water, but insufficient to change its water quality status • Reduction in the economic value of the feature • Reduced reliability and quality of a supply at a groundwater abstraction source
Low	Result in minor impact on attribute	Detectable but non-material and transitory changes to the hydrogeology or water quality: • Measurable change in attribute, but of limited size and/or proportion

		• Measurable but limited change in a groundwater supply reliability and quality
Negligible	Results in an impact on attribute but of insufficient magnitude to affect the use/integrity	No perceptible changes to hydrogeology or water quality: • No significant effect on the economic value of the receptor • No change in a groundwater supply reliability and quality • No increase in flood risk

10.3.4. Consistent with the methodology set out in Chapter 3 of this report, the sensitivity of the receiving environment together with the magnitude of the change/impact defines the significance of the effect prior to the application of mitigation measures. So, for the purposes of assessing effects on the water environment, Table 10.4 sets out the relevant significance criteria.

Table 10.4: Significance Criteria

Magnitude of Change	Sensitivity of Receptor			
	High	**Medium**	**Low**	**Negligible**
High	Major	Major	Moderate	Negligible
Medium	Major	Moderate	Minor to Moderate	Negligible
Low	Moderate	Minor to Moderate	Minor	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

10.3.5. Therefore, potential effects are concluded to be of major, moderate, minor or negligible. The shaded boxes in Table 10.4 represent effects considered to be significant.

Legislative and Policy Framework

10.3.6. This assessment is based on the following legislation, policy and guidance:

10.3.7. Water Framework Directive:

The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 ('WFD Regulations 2017') consolidate, revoke and replace the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003, which transpose the European Union (EU) Water Framework Directive (WFD) into national law. The WFD is a wide-ranging piece of European legislation that establishes a new legal framework for the protection, improvement and sustainable use of surface waters, coastal waters and groundwater across Europe in order to:

- Promote sustainable water use.

- Contribute to the mitigation of floods and droughts.
- Prevent deterioration and enhance status of aquatic ecosystems, including groundwater; and
- Reduce pollution.

Water management has historically been co-ordinated according to administrative or political boundaries. The WFD promotes a new approach based upon management by river basin - the natural geographical and hydrological unit. River basin management plans, published by the Environment Agency (EA) and the Department for Environment Food & Rural Affairs (Defra), include clear objectives in respect of water quality and pollution control and a detailed account of how objectives are to be met within a prescribed timeframe.

10.3.8. Flood and Water Management Act 2010

10.3.9. The Flood and Water Management Act (FWMA) 2010 takes forward some of the proposals set out in three previous strategy documents published by the UK Government: Future Water, Making Space for Water and the UK Government's response to the Sir Michael Pitt Review of the summer 2007 floods. In doing so, it gives the EA a strategic overview of flood risk and gives local authorities responsibility for preparing and putting in place strategies for managing flood risk from groundwater, surface water and ordinary watercourses in their areas.

The FWMA 2010 (Schedule 3) proposed the establishment of Sustainable drainage systems (SuDS) Approval Bodies (the SAB) at county or unitary local authority levels. The role of the SAB was envisaged as implementing the recommendations of the Pitt Review (2008) in promoting the use of SuDS within future development.

Following a period of consultation, the proposed role of the SAB has been amended, with the promotion of SuDS being incorporated into the planning process. This has been achieved by designating LLFA's as statutory consultees with regards to 'local' sources of flood risk and surface water management. The Ministerial Written Statement HCWS161 details this change in policy, which came into effect in April 2015.

The FWMA 2010 also amends Section 106 of the Water Industry Act 1991 (WIA) in respect of the right of connection to a public sewer. As the role of the SAB has been removed following HCWS161, this process is now subsumed into the planning process under the purview of the LLFA.

10.3.10. The National Planning Policy Framework (2021):

Chapter 14 of the NPPF "Meeting the challenge of climate change, flooding and coastal change" highlights the requirements on planning applications in relation to taking a proactive approach to mitigating and adapting to climate change, moving development away from flood risk areas where possible and considering marine and coastal management where applicable.

10.3.11. The Planning Policy Guidance (PPG) (2021):

The PPG for "Flood risk and coastal change" advises how to take account of and address the risks associated with flooding and coastal change in the planning process.

10.3.12. The Overarching National Policy Statement for Energy 1 (NPS EN-1) (2011):

The Secretary of State must be satisfied that the scheme is or forms part of a project in the field of energy, or a business or commercial project of a prescribed description; and that it is nationally significant either by itself or in combination with one or more other developments in the field of energy.

EN-1, in conjunction with any relevant technology specific NPS, will be the primary policy for Secretary of State decision making on projects in the field of energy for which a direction has been given under section 35.

10.3.13. The National Policy Statement for Electricity Networks Infrastructure (Draft NPS EN-3) (2023):

10.3.14. The draft NPS EN-3 (September 2021) introduced ground mounted solar, and this was retained for the 2023 amendments. With regards to factors influencing site selection and design identifying how it is for the applicant to decide what applications to bring froward and the government does not seek to direct applicants to sites for renewable energy infrastructure (with the exception of offshore wind). Further sections highlight that climate change adaption and seeks that for solar sites, sites proposed in low lying exposed areas, the applicant should consider how the plant will be resilient to increased risk of flooding and impact of higher temperatures.The National Policy Statement for Electricity Networks Infrastructure (NPS EN-5) (2011):

This National Policy Statement (NPS), taken together with the Overarching NPS for Energy (EN-1), provides the primary policy for decisions taken by the Secretary of State on applications it receives for electricity networks infrastructure (see Section 1.6 of this NPS).

10.3.15. North and North East Lincolnshire Strategic Flood Risk Assessment (SFRA) (2022):

This Strategic Flood Risk Assessment (SFRA) is an update of the original report, which was published in 2011. The main purpose of an SFRA is to provide the information needed for a planning authority to take flood risk into account when making land use allocations and determining planning applications.

The purpose of this update is to ensure the SFRA provides a comprehensive and robust evidence base to inform the preparation and production of the North Lincolnshire Local Plan to 2038 and the future review of the North East Lincolnshire Local Plan.

This revised SFRA will be used by both North and North East Lincolnshire Councils in decision making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk taking into account the latest and most up to date information.

10.3.16. North Lincolnshire Council Development and Flood Risk Guidance Note (April 2013):

This guidance note provides local advice to developers, applicants and council officers on the application of national planning policy contained within the National Planning Policy Framework (NPPF) which aims to avoid inappropriate development in areas of flooding by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

10.3.17. North Lincolnshire Local Flood Risk Management Strategy (August 2016):

Much of North Lincolnshire is flat and low lying and is therefore susceptible to flooding from a range of sources. Therefore, whilst this document focuses on local flood risks, it also sets out how all of the Risk Management Authorities covering North Lincolnshire have agreed to work together to consider risks from all potential sources of flooding. The Environment Agency is currently developing a Flood Risk Management Plan for the Humber catchment, within which North Lincolnshire is located, which will consider flooding from non-local sources, such as rivers and the sea.

10.3.18. The CIRIA SUDS Manual (CIRIA 753):

The SuDS Manual (2015) expands upon the framework set out by the Government's Non-Statutory Technical Standards for SuDS and sets out the latest industry practice and guidance regarding the planning, design, construction, management and maintenance of SuDS.

Scoping Criteria

10.3.19. The following Hydrology and Flood Risk related comments were provided in the Planning Inspectorate Scoping Opinion dated 13 March 2023.

Table 10.5: Extract of aspect based scoping table from Scoping Opinion for Tween Bridge Solar Farm

ID	REF	MATTER	PLANNING INSPECTORATE COMMENTS	APPLICANT'S RESPONSE
3.9.2	Paras 8.3 and 8.25; Figure 8.1	Flood risk	The ES and Flood Risk Assessment including accompanying figures should distinguish between areas of Flood Zones 3a and 3b. The scoping consultation response from the Environment Agency (Appendix 2 of this Opinion) states that indicative locations for components including the proposed National Grid substation and BESS are within Flood Zone 3b. Any mitigation measures to reduce significant effects from flooding should be described in the ES and their delivery secured through the DCO or other legal mechanism.	These comments will be addressed by the Flood Risk Assessment and Drainage Strategy reports.
3.9.3	Para 8.7	Underlying geology	Paragraph 8.7 of the Scoping Report states that *"It is unlikely that Made Ground exists beneath the site boundary"*. This is not consistent with the information provided within Section 7 of the Scoping Report, which identifies	Addressed within the draft PEIR chapter.

			manmade working and placement of alluvium. The ES should present consistent baseline information across relevant aspect chapters. Impacts resulting from disturbance of any made ground which are likely to result in significant effects on hydrological/ hydrogeological receptors should be assessed in the ES.	
3.9.4	Para 8.18	Surface Water Management Strategy	A draft/ outline copy of the Surface Water Management Strategy (proposed for the operational phase) should be appended to the ES.	To be provided in the final version of the PEIR.
3.9.5	Para 8.27	Sensitive receptors	The table at paragraph 8.27 of the Scoping Report ('Summary of Potential Environmental Receptors') lists only a single receptor type (groundwater) with no reference to flood risk, surface water or other specific receptors. The ES should present a complete list of hydrological, hydrogeological and flood risk receptors which are likely to be impacted by the Proposed Development and assess any likely significant effects on those receptors. Paragraph 7.15 of the Scoping Report describes overall groundwater vulnerability to pollution as *"Low or Medium",* while the table at paragraph 8.27 describes the Source Protection Zone (SPZ) below Thorne as *"low"* sensitivity. In some places, groundwater should be considered highly vulnerable due to the presence of SPZ3. The approach to determining the sensitivity/ vulnerability of identified receptors should be explained in the ES and clearly and consistently cross referenced across the Ground Conditions and Hydrology and Flood Risk ES assessments.	Addressed within the draft PEIR chapter.
3.9.6	n/a	Water Framework	The Scoping Report identifies the potential for contamination of surface water and groundwater bodies. Given the geographic location of the Proposed	Addressed within the draft PEIR chapter.

		Directive (WFD)	Development, the ES should consider the potential impacts on WFD water bodies. The Applicant's attention is drawn to the Inspectorate's Advice Note Eighteen: The WFD in this regard. The ES should explain the relationship between the Proposed Development and any relevant water bodies in relation to the current relevant River Basin Management Plan.	

Limitations to the Assessment

10.3.24. This Chapter is limited to the effects from rainfall falling on the Site as well as increase in sea levels and its management in flow and quality in relation to the receiving watercourses. It does not consider the ecology of the habitats, which is covered in Chapter 8 of this PEIR.

10.3.25. By its nature, rainfall, cantecedent conditions and characteristics vary, as well as conditions related to normal rainfall standards; exceedance events could potentially cause nuisance, which are beyond the scope of this assessment.

10.3.26. The FRA and PEIR chapter are reliant on publicly available data and additional data provided by consultees; it is assumed that this information is correct and complete.

10.4. Baseline Conditions

Site Description and Context

10.4.1. Tween Bridge Solar Farm broadly lies between the settlements of Thorne and Crowle, occupying separate parcels of land within a relatively flat agricultural landscape predominantly in arable use for the cultivation of cereal crops with some areas of modified grassland and short rotation coppice. Many of the field boundaries are subdivided into rectilinear parcels by long linear drainage ditches., some with partial or sporadic hedgerows. The Schemes development parcels are dissected by several major roads and routes, including the M180 motorway, the A18, the South Humberside Main Line railway route and Stainforth & Keadby Canal.

10.4.2. Numerous other minor roads cross the landscape connecting scattered residential properties and farmsteads, many of which lie adjacent or in proximity to the site. Tween Bridge Wind Farm and substation lies in the northern part of the site . Overhead power lines and lattice pylons runs across the northern part of the Scheme which creates other vertical elements within the landscape. There are wooden pole lines and masts within the Draft Order Limits.

10.4.3. Bar the two areas of significant woodland to the north and south of the site associated with former peat extraction at Hatfield Moors and Thorn Moors, the landscape contains relatively limited areas of vegetation, largely limited to field boundaries in the form of hedgerows, which many are incomplete and gappy. There are occasional scattered trees or groups of trees and some small woodland copses.

10.4.4. There are four number Public Rights of Way (PRoW) that are located within or close to the Scheme. (See Figure 6.4 Recreation Plan). Public Footpath FP19 (Thorne) lies in the central

northern part of the site forming part of the access to Tween Bridge Solar Scheme. Public Footpath FP15 (Thorne) lies just beyond the most north western boundary of the Scheme. In the north eastern part of the Scheme Public Right of Way (Footpath 17) lies beyond the Scheme area forming a continuation of an unnamed north-east/south west Byway. Footpath 18 runs from the unnamed byway south eastwards into the western side of Crowe.

10.4.5. For the purposes of reporting a parcel and a parcel number have been created to divide areas of the DOL for the Scheme to assist with reporting and to aid the reader. The land plan is provided at illustration 1 and a scaled drawing is provided at Appendix 4.1.

Baseline Survey Information

10.4.6. There are many field drain ditches running across the Site, assumed to be used for agricultural drainage within most of the development. The closest main river noted by the EA are the two drains running adjacent to the canal crossing the midsection of the Site. The IDB map provided shows a large number of rhynes across the Site that will be a key asset of the IDB requiring 9m easements where appropriate.

10.4.7. The Site is currently agricultural greenfield area, typically there should not be pipework under the fields however it has been identified from the IDB mapping that there are culverted pipes owned and maintained by the IDB.

10.4.8. Geological data held by the British Geological Survey ('BGS') indicates that the bedrock geology underlying the Site is Sherwood Sandstone Group - Sandstone. Sedimentary bedrock & Mercia Mudstone Group - Mudstone. Sedimentary bedrock.

10.4.9. The Soilscape soils data shows the Site to be ' Slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils' and 'Raised bog peat soils' and 'Loamy and clayey soils of coastal flats with naturally high groundwater'. Therefore, it can be considered that the Site does not benefit from infiltration.

Fluvial (River) Flooding

10.4.10. The Flood Map for Planning generally defines the entire site as Flood Zone 3, at High risk of flooding, impacted by a 1 in 100 year fluvial flood event. There is a small area (approximately 4ha of the over 1,500ha site) at the far western end of the site that is defined as Flood Zone 1, at Low risk of fluvial flooding. The Flood Map for Planning is shown in Figure 10.1.

10.4.11. As detailed in the EA correspondence included in the FRA appendicies, parts of the site are also defined as Flood Zone 3b, the functional floodplain predicted to be impacted by a 1 in 30 year fluvial flood event. Where development is proposed here, level-for-level floodplain compensation will be required.

10.4.12. There are a large number of watercourses on site and in the surrounding area, many of which are managed by the IDB..

10.4.13. Correspondence with the EA highlights that the site is at risk of flooding from the River Trent, River Torne and associated Drains. The EA also highlight that land drainage represents the dominant flood risk at the site and that the site is located in the Isle of Axholme Critical Drainage Area which has a reported critical flood level of 4.1mAOD. The area is under the management of Doncaster East Internal Drainage Board (IDB).

10.4.14. As discussed above, mitigation measures on site are proposed to include raising proposed solar panels and infrastructure above the 1 in 1000 year tidal flood event levels which are in the approximate range of -1mAOD to 2.2mAOD. Although advised by the EA that the Site has a critical flood level of 4.1mAOD, given the ground levels on site generally vary between approximately -0.2mAOD and 2.6mAOD, it is not feasible to raise infrastructure above this critical flood level.

10.4.15. In addition, although no formal information has been provided as to how the critical flood level has been derived, it is understood based on discussions with the EA that this level accounts for an absolute worst-case scenario where no defences are acting to protect the Site. This includes failure of a range of IDB and EA controlled pumping stations which control water levels at the Site and a large surrounding area. Given the design life of that development of approximately 45 years, this event and the critical flood level of 4.1mAOD is considered a highly unrealistic scenario.

10.4.16. In addition to providing details of the critical flood level at the site, the EA also provided detailed hydraulic model data for the River Torne. The outputs of the River Torne model predict significantly reduced flood risk at the Site compared to the Tidal Trent model discussed above and as such, proposed mitigation measures designed against the tidal output will suitably protect the development from the fluvial flood risk associated with the River Torne.

10.4.17. Overall, the fluvial flood risk to the site is considered to be Low to Medium.

Tidal (River) Flooding

10.4.18. The Flood Map for Planning generally defines the entire site as Flood Zone 3, at High risk of flooding, impacted by a 1 in 200 year tidal flood event. Tidal flood risk at the Site is associated with the tidally influenced River Trent (there are also fluvial sources of flooding to consider – see Fluvial Flooding section below).

10.4.19. There is a small area (approximately 4ha of the over 1,500ha site) at the far western end of the site that is defined as Flood Zone 1, at Low risk of flooding.

10.4.20. The Flood Map for Planning also highlights flood defences at the site and defines the site as an area that benefits from a 'reduction in risk of flooding from rivers and sea due to defences'. The Flood Map for Planning is shown in Figure 10.1.

10.4.21. In addition to the Flood Map for Planning, the EA have provided detailed hydraulic model data for the Tidal Trent. Information provided by the EA is included in Appendix X.

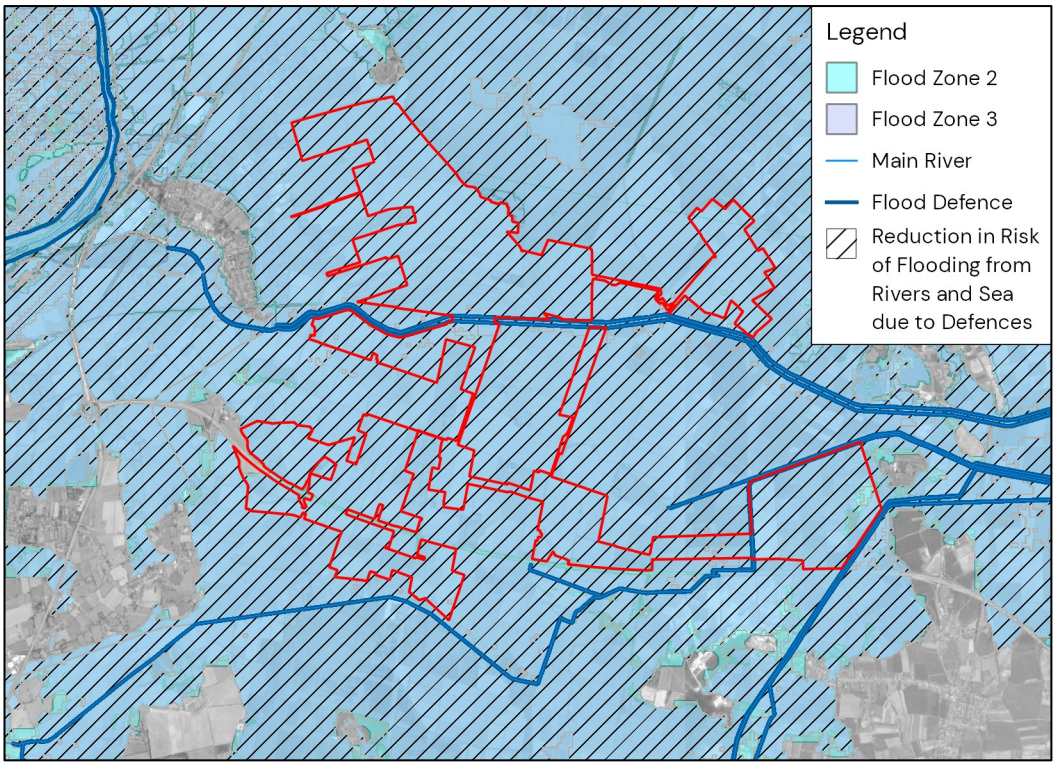
10.4.22. During a worst-case 1 in 1000 year flood event, the Tidal Trent model predicts flood levels on site to range from approximately -1mAOD to 2.2mAOD. Ground levels on site as defined by the topographic survey are generally in the approximate range of -0.2mAOD and 2.6mAOD.

10.4.23. Mitigation measures on site are proposed to include raising the lowest edge of all solar panels and infrastructure above the predicted 1 in 1000 year flood levels from the Tidal Trent Model (see above). The predicted tidal flood levels vary across the Site and as such, the level to which solar panels and infrastructure are raised across the Site may vary. A defensive bund is also proposed to be sited around the infrastructure on Site.

10.4.24. It should be noted that the EA have advised (in June 2023) that the Tidal Trent modelling has recently been updated. The required raising of panels and infrastructure will therefore be updated following receipt of this updated data.

10.4.25. With the proposed mitigation measures in place, the Scheme will be designed to remain safe and operational during a 1 in 1000 year tidal flood event, as informed by detailed hydraulic data from the EA. The tidal flood risk to the Scheme is therefore considered to be Low.

Figure 10.1 – Flood Map for Planning



Pluvial (Surface Water) Flooding

10.4.26. The Risk of Flooding from Surface Water (RoFSW) dataset shows that the majority of the site is not predicted to be impacted by a 1 in 1000 year rainfall event and is a Very Low Risk of surface water flooding (see Figure X). The dataset also highlights areas of High to Low risk, impacted by a 1 in 30 and 1 in 1000 year rainfall event, respectively, spread across the site. These at-risk areas are generally isolated and associated with surface water arising within the site boundary itself.

10.4.27. During a 1 in 1000 year rainfall event, surface water flood depths on site are generally not predicted to exceed 600 to 900mm (see Figure X). The lowest edge of proposed solar panels and infrastructure in areas at risk of surface water flooding will be raised above the predicted 1 in 1,000 year flood depths. This will ensure that the proposed panels will be safe over their lifetime and that surface water flow patterns on site will not be impacted.

10.4.28. In addition to the above mitigation measures, surface water arising within the Site boundary itself with be managed with the proposed surface water drainage strategy for the Scheme.

10.4.29. Overall, with the proposed mitigation measures and drainage strategy in place, it is considered that the site is at Low risk of flooding from surface water.

Figure 10.2 – RoFSW Extents

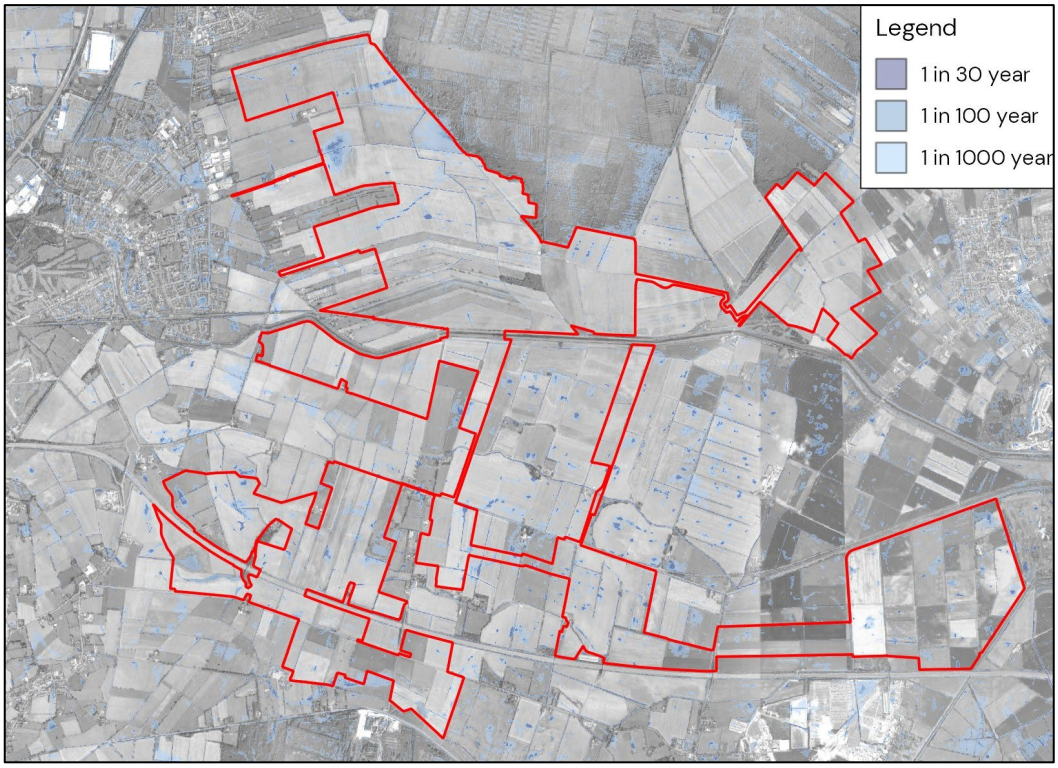
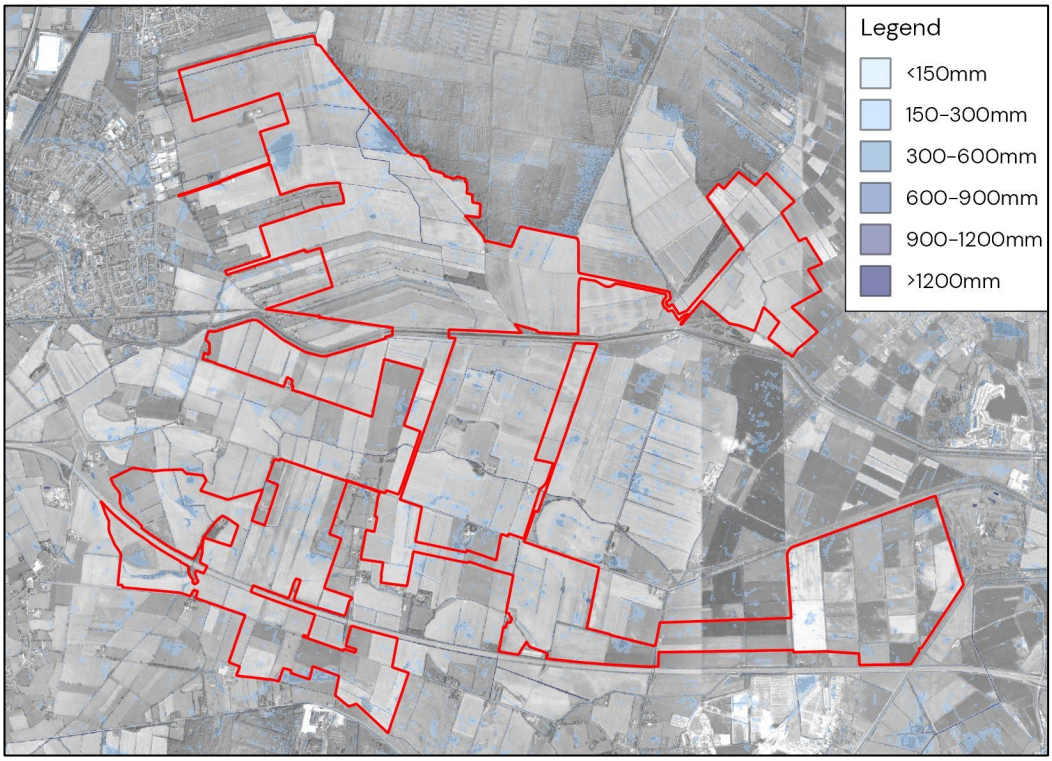


Figure 10.3 – RoFSW 1 in 1000 year Depth



Groundwater Flooding

10.4.30. BGS data show that the bedrock geology at the Site is split between 'Sherwood Sandstone Group – Sandstone' in the west and 'Mercia Mudstone Group – Mudstone' in the east (see Figure 10.4). It is considered likely that the sandstone in the west will be permeable, whilst the mudstone in the east is expected to be impermeable. There is potential for groundwater emergence where these two bedrocks meet.

10.4.31. The hydrogeology aquifer classification defines the western half of the Site (where sandstone is generally the underlying bedrock) as a highly productive aquifer, whilst the eastern half (generally underlain by mudstone) is defined as a low productivity aquifer. As with having two different bedrocks, there is potential for groundwater emergence where these two aquifer types meet.

10.4.32. BGS also record a wide range of superficial deposits at the site. These deposits include: 'Alluvium – Clay, Silt, Sand and Gravel', 'Hemingbrough Glaciolacustrine Formation - Clay, Silty', 'Warp – Clay and Silt', 'Peat', 'Glaciofluvial Deposits, Devensian - Sand and Gravel', 'Breighton Sand Formation - Sand, Silty' and 'Sutton Sand Formation – Sand'. Any clay superficial deposits across the site are expected to restrict groundwater emergence.

10.4.33. Given the significant number of watercourses on Site and in the surrounding area, it is considered unlikely that groundwater would rise above the fluvial/tidally influenced flood levels on Site.

10.4.34. Site topography is also not considered conducive to groundwater flooding – any ground water to emerge is generally expected to follow site topography and fall towards the watercourses on Site without accumulating to significant depths.

10.4.35. Overall, given the above, although there is potential for groundwater emergence on Site, the risk is considered to be Low.

Figure 10.4 – BGS Bedrock Geology

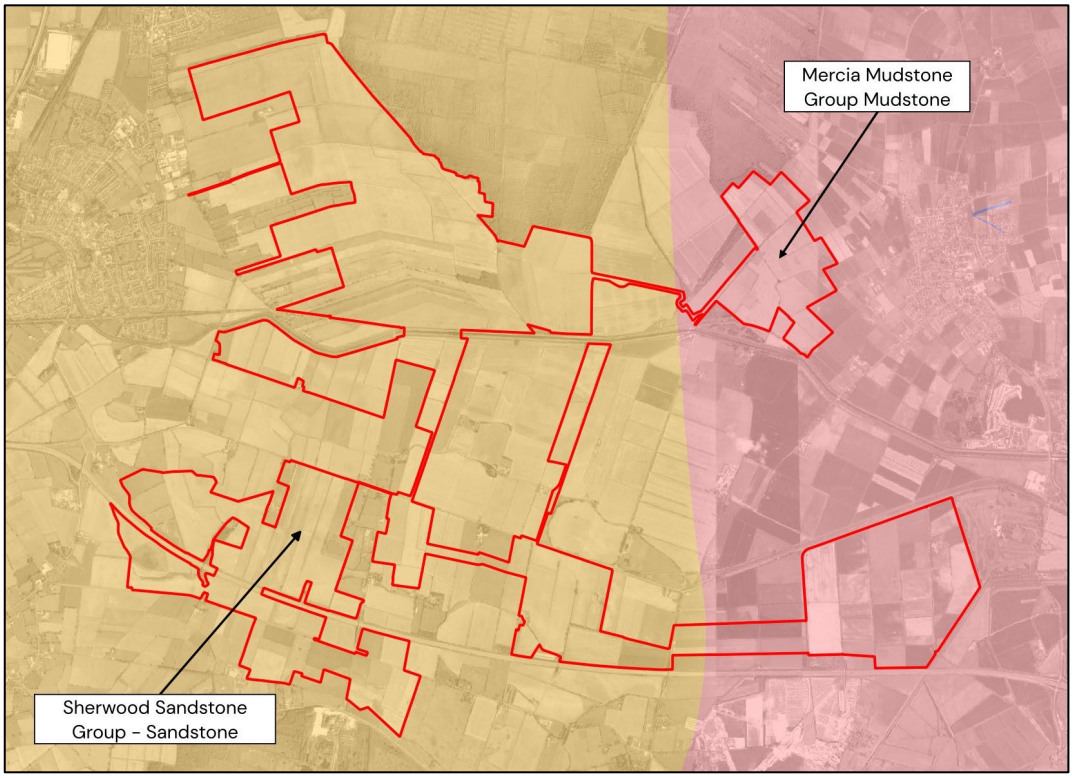
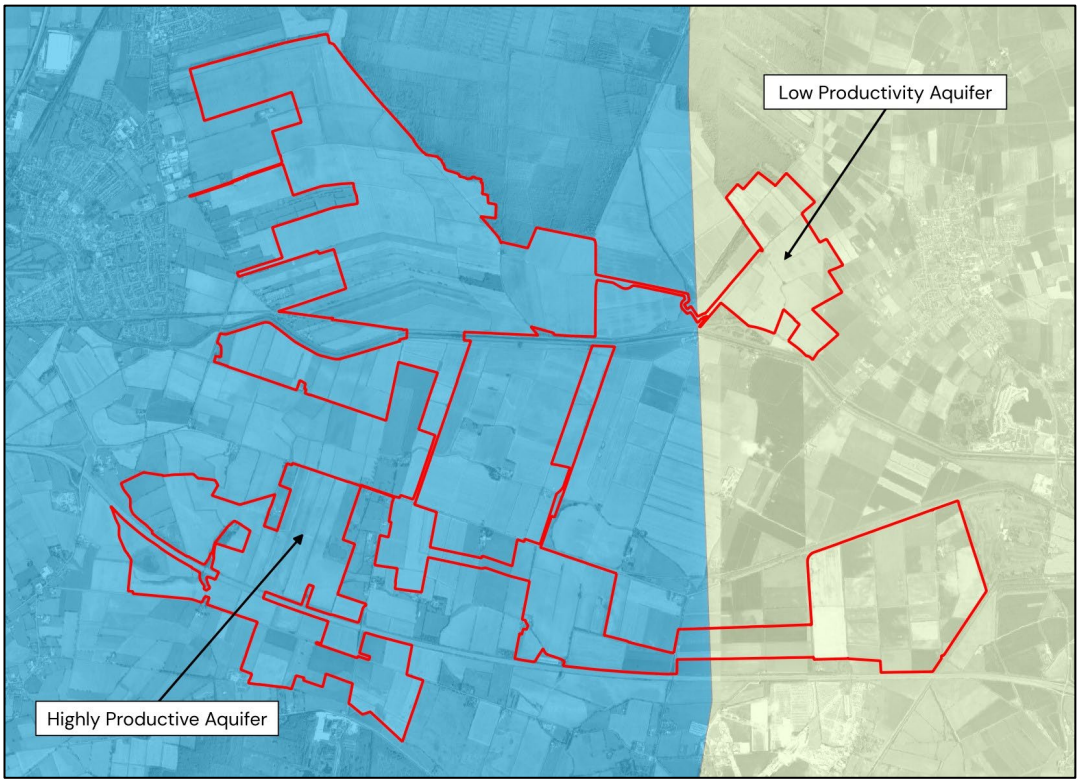


Figure 10.5 – Hydrogeology Aquifer Classification



Sewer Flooding

10.4.36. The Doncaster MBC Level 1 Strategic Flood Risk Assessment (2015) interactive mapping does not show any recorded flood events from the Severn Trent Water Floods Register that impact the Site.

10.4.37. The North and North East Lincolnshire Strategic Flood Risk Assessment (2022) states that 'sewerage drainage problems' have been mapped on their 'interactive maps'. These interactive maps have not been made available at the time of writing this report and as such, no records of sewer flooding at the site have been found.

10.4.38. As the Site is entirely greenfield, it is unlikely that there is an existing underground drainage network located within the Site boundary. Additionally, any flood water from sewers in the close vicinity of the Site would follow local topography and would not be expected to accumulate within the Site boundary.

10.4.39. The risk of flooding from sewers to the Site is therefore considered to be Low.

Flooding from Artificial Sources

10.4.40. The EA's Reservoir Flood Extents shows the extent of flooding should a catastrophic breach occur during a 'wet day' when local rivers had already overflowed their banks and highlights parts of the site to be at risk during a 'wet day' (see Figure 10.6). The Site is not shown to be at risk during a 'dry day' when local rivers are not overflowing their banks.

Water Resources

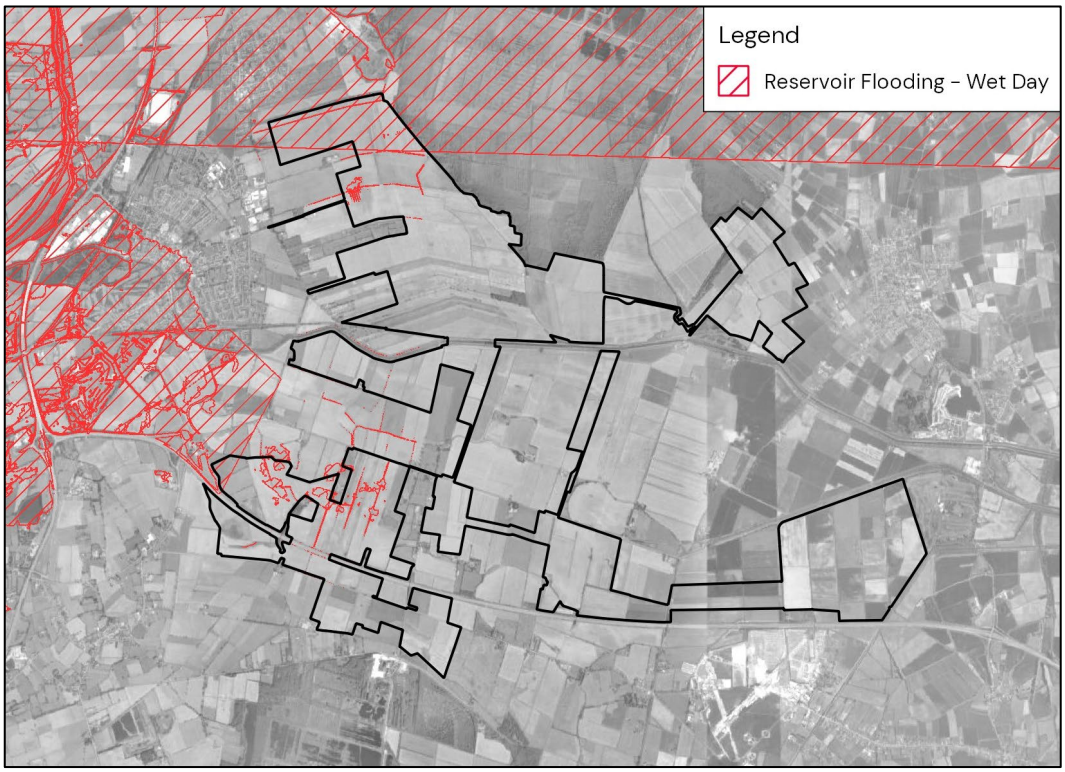
10.4.41. The North and North East Lincolnshire Strategic Flood Risk Assessment (2022) states that "reservoir flooding is extremely rare in the UK due to very strict regulations and mandatory assessments". As such, the likelihood and risk of a catastrophic reservoir breach occurring at the site is considered to be Very Low.

10.4.42. The Stainforth and Keadby Canal runs through the centre of the Site, roughly in line with the South Humberside Main Railway Line. The North and North East Lincolnshire Strategic Flood Risk Assessment (2022) advises that this canal is manages by British Waterways and only highlights flood risk associated with the canal where it is influenced by the River Ouse and River Don, which are both located a notable distance from the site.

10.4.43. There are no other artificial sources of flooding or canals located in the vicinity of the Site that would present a flood risk.

10.4.44. The Site is therefore considered to be at Low risk of flooding from artificial sources.

Figure 10.6 – Hydrogeology Aquifer Classification



Historic Flooding

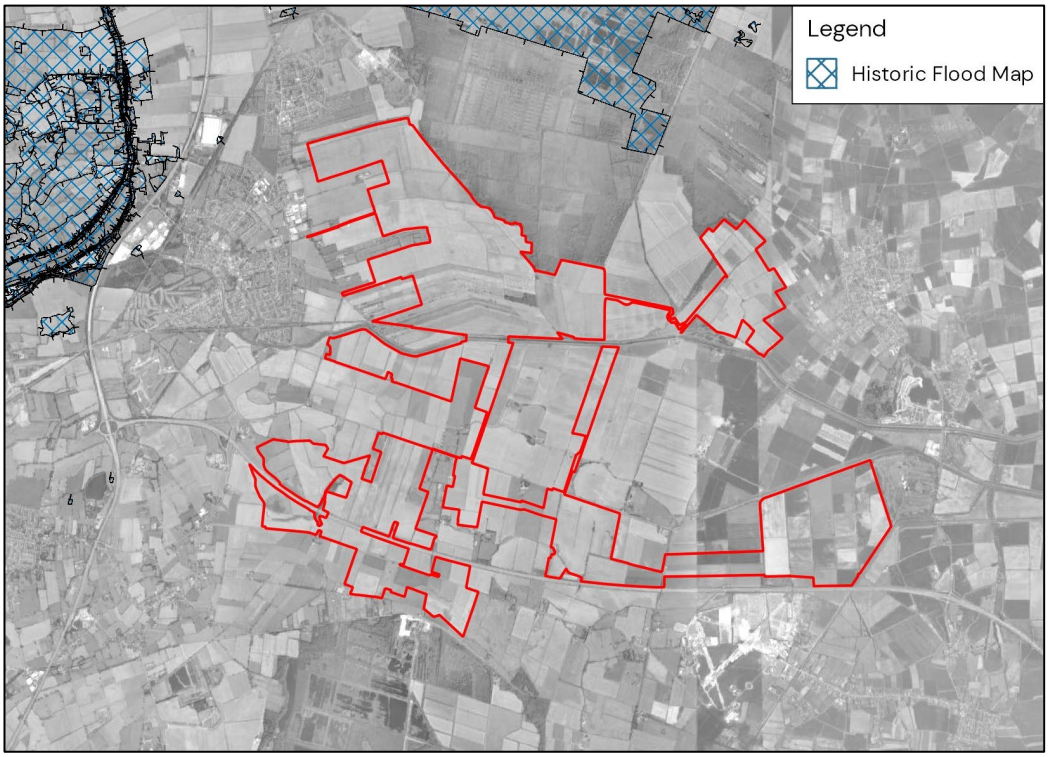
10.4.45. The EA's Recorded Flood Outlines dataset does not record any historic flood events impacting the Site. The nearest recorded historical events are located approximately 1.5km north of the northern end of the Site and 2.3km west of the site (see Figure 10.7).

10.4.46. The Doncaster MBC Level 1 Strategic Flood Risk Assessment (2015) (covering the western half of the Site) states that "DMBC have limited records regarding any flood incidents related to fluvial or tidal flooding" and do not record any historic flood events impacting the Site.

10.4.47. The North and North East Lincolnshire Strategic Flood Risk Assessment (2022) (covering the eastern part of the site) refers to the EA's mapping discussed above when discussing historical flooding in the region and as such, does not highlight any site specific historic flood events.

10.4.48. Overall, the historic flood risk to the Site is considered to be Low.

Figure 10.7 – RoFSW 1 in 1000 year Depths



10.5. Assessment of Likely Significant Effects

10.5.1. The likely significant effects of the Scheme during decommissioning are likely to be similar to those encountered during the construction phase due to the operations being the same. Therefore, those effects considered for construction below are similarly expected during the decommissioning phase.

Construction

Effects on Flood Risk and Drainage

10.5.2. There is the potential for mud and debris arising from the construction works to enter the existing surface water / land drainage system, causing blockages and restricting flow. This could result in localised flooding on the Site, especially after heavy or prolonged rainfall resulting in a potential risk to people and property.

10.5.3. The sensitivity of construction workers and equipment to mud and debris blockages is considered to be **Medium**. The potential for mud and debris to block drainage networks is considered to have an effect of **Low Adverse** magnitude on flooding to the Site itself and

surrounding area which would result in flood risk to construction workers and equipment at the Site. The significance of effect is **Minor to Moderate Adverse**.

10.5.4. Temporary increase in impermeable area during construction has the potential to increase flooding both on and off Site. Temporary hard standing or compacted areas could result in rapid surface water runoff to local watercourses or cause an increase in overland flow. As the Site is not defined there is potential for overland flows to be generated and for localised flooding to occur.

10.5.5. The effects would be temporary and short term. The sensitivity of construction workers and equipment is considered to be **Medium** with the temporary effects considered to have an effect of **Medium Adverse** magnitude to people working within the Site as it could occur at a time of high flood risk (e.g. during a large storm event). The significance of effect is **Moderate Adverse**.

Effects on Water Resources

10.5.6. The Site is likely to involve construction of temporary access tracks. Access roads are expected to be constructed with compacted self-binding aggregate fill materials. Access roads would form long linear features that, in the event of rainfall, could become temporary drainage routes for surface water. With the potential for soil erosion and movement of sediment from shallow road excavations it would be necessary to ensure that pollution prevention measures within the Site are appropriate to prevent migration of silt to surface watercourses and groundwater bodies.

10.5.7. The sensitivity of surface water and groundwater bodies to silt contamination is considered to be **Medium**. Without mitigation, potential effects are considered of a **Medium** magnitude. The significance of the effect is **Moderate Adverse** on a temporary short-term basis.

10.5.8. During construction, fuel, hydraulic fluids, solvents, grouts, paints and detergents and other potentially polluting substances will be stored and / or used on the Site. Leaks and spillages could pollute groundwater bodies through infiltration as well as the surface watercourses. To allow such substances to enter a watercourse could be in breach of regulation 38(1) of the Environmental Permitting (England and Wales) Regulations 2016, therefore, measures to control the storage, handling and disposal of such substances will need to be in place prior to and during construction. The construction compound locations have not been determined at this stage.

10.5.9. The sensitivity of surface water and groundwater bodies to spillages, leakages and pollutants is considered to be **Medium**. Without mitigation measures spillages of chemicals/fuel stored could cause short term, temporary effects of a **Medium** magnitude on the local watercourses (medium importance). The significance of effect is **Moderate Adverse** on a temporary short-term basis.

Operation

Effects of Flood Risk and Drainage

10.5.10. An increase in the volume of water discharged to local watercourses as a result of increased hard standing area has the potential to increase the flood risk to areas downstream of the Scheme.

10.5.11. The sensitivity of people and property is considered **Medium**. Whilst the effects would be temporary and short term, this is considered to have an effect of **Medium Adverse** magnitude to people and property (considered to be up to very high importance) occurring at time of high flood risk (e.g. during a large storm event). The significance of effect is **Major Adverse**.

Effects on Water Resources

10.5.12. Spillages of pollutants (e.g. oil) on access tracks from maintenance vehicles can be transported to watercourses via runoff, where they could impact upon ecological life, or infiltrate to ground.

10.5.13. The receptors at risk are surface watercourses and groundwater bodies which are considered to be of **Medium** sensitivity. Without mitigation the increase in highway spillage risk is considered to have an effect of a **Low Adverse** magnitude. The significance of effect is **Minor Adverse** which is considered permanent if left unmitigated.

10.6. Mitigation, Enhancement and Residual Effects

Mitigation by Design

10.6.1. Where practical, at detailed design stage it is recommended that runoff from equipment and access tracks will be directed to permeable SuDS features with contributions being made from permeable surfacing, wildflower planting and linear infiltration trenches.

10.6.2. Future maintenance of the SuDS scheme should be privately managed by the Developer. An overview of possible SuDS features, and possible future maintenance will be provided in the Flood Risk Assessment and Drainage Strategy for the development.

10.6.3. Raising of panels above the designed flood water levels provided by the EA will be provided where applicable.

10.6.4. Bunding will be provided where possible to battery storage compound that are unable to be raised higher than the designed flood water levels provided by the EA.

10.6.5. Following the allocation of the mitigation measures through the DCO the residual effect is considered to be **Negligible**.

Additional Mitigation.

10.6.6. Where necessary a temporary drainage network will be installed prior to the commencement of construction and a maintenance plan, confirmed through a Construction Environmental Management Plan (CEMP), should be maintained throughout the duration of construction works on the Site. The drainage systems will be designed to good practice standards detailed within the CIRIA SuDS manual C753.

10.6.7. During the construction phase easements of 9m should be preserved adjacent to all receptors to ensure that there is a sufficient buffer from the sensitive receptor to the construction stages of development.

10.6.8. A drainage system will be developed to prevent silt-laden runoff from entering surface water drains, watercourses and ponds without treatment (e.g. earth bunds, silt fences, straw bales, or proprietary treatment) under any circumstances.

10.6.9. Construction SuDS (such as temporary attenuation) to be used during construction if necessary.

10.6.10. Following the implementation of mitigation measures the residual effect is considered to be **Negligible**.

Table 10.6: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure is proposed to be secured	
		By Design	By Requirements
1	Include silt management and control measures in the CEMP.		X
2	Ensure measures to control the storage, handling and disposal of pollutants are put in place prior to and during construction included in the CEMP.		X
3	Any proposed drainage features such as permeable surfacing, infiltration trenches and wildflower planting should be designed to good practice standards	X	
4	Maintaining the existing surface water run-off regime by utilising permeable surfacing for the Site access, linear infiltration trenches around any proposed infrastructure and wildflower planting at the leeward edge of solar panels.	X	
5	Raising panels above the designed flood water levels.	X	
6	Providing bunding as a flood deference for battery units to meet designed flood water levels.	X	

Residual Effects

10.6.11. With the embedded design measures described above and those within the CEMP, all identified potential effects have been assessed as being of negligible significance, and therefore not significant in terms of the EIA Regulations.

10.6.12. No further mitigation is proposed.

10.7. Cumulative and In-Combination Effects

10.7.1. As part of the consultation on the draft PEIR, the applicant will seek to agree the long list with the relevant local planning authorities. It is expected that consideration of cumulative effects will be provided within the next iteration of the PEIR.

Table 10.7: Summary of Effects, Mitigation and Residual Effects

Receptor / Receiving Environment	Description of Effect	Nature of Effect	Sensitivity Value	Magnitude of Effect	Geographical Importance	Significance of Effects	Mitigation / Enhancement Measures	Residual Effects
Construction								
Watercourse / Ground	Mud and debris Flood Risk	Temporary	Medium	Low		Minor / Moderate Adverse	CEMP	Negligible
Watercourse	Impermeable area increase Flood Risk	Temporary	Medium	Medium		Moderate Adverse	CEMP	Negligible
Watercourse / Ground	Pollutants (oils, etc)	Temporary	Medium	Medium		Moderate Adverse	CEMP	Negligible
Watercourse	Sediment movement	Temporary	Medium	Medium		Moderate Adverse	CEMP	Negligible
Operation								

Watercourse	Impermeable area increase Flood Risk	Permanent	Medium	Medium		Moderate Adverse	Flood Risk Assessment / Drainage Strategy detailed design and construction including O&M Manual for maintenance	Negligible
Watercourse / Ground	Pollutants (oils, etc)	Permanent	Medium	Medium		Moderate Adverse	Flood Risk Assessment / Drainage Strategy detailed design and construction including O&M Manual for maintenance	Negligible