Proposed Solar PV Development

Preliminary Environmental Information Report Chapter 10 Hydrology and Flood Risk

Byers Gill Solar

Reference: EN010139

Revision 1 | May 2023

JBM Solar
33 Broadwick St
London
W1F 0DQ
United Kingdom
www.jbm-solar.com

Contents

Tables

Figures

Appendices

10 Hydrology and flood risk

10.1 Introduction

10.1.1 This chapter presents the findings of the preliminary assessment of the likely significant effects arising from the construction, operation and decommissioning of Byers Gill Solar ('the Proposed Development') on hydrology and flood risk.

10.1.2 This chapter details the methodology followed for the assessment, summarises the regulatory and policy framework, and describes the existing environment in the area surrounding the Proposed Development. Following this, the design, mitigation and residual effects of the Proposed Development are discussed, along with the limitations of the assessment.

10.1.3 Hydrology and Flood Risk aspects considered within the chapter for the Proposed Development include:

- Effects of water quality on surface water, groundwater, designated sites and water abstractions; and
- Water resources, covering fluvial flood risk and surface water drainage.

10.1.4 Some of the content discussed in this chapter will cross-refer with discussions in other chapters. It may be useful to make reference to other chapters, most notably; Chapters 6 Biodiversity and Chapter 8 Cultural Heritage and Archaeology.

10.1.5 The effects of changes to water quality on aquatic ecology is presented in Chapter 6 Biodiversity. This chapter assesses the effects of a change in water resources as a result of the Proposed Development to receptors. The effects of a change in groundwater levels on the preservation of buried archaeology is presented in Chapter 8 Cultural Heritage and Archaeology. Resilience to impacts from climate change has been assessed within the Climate Change Resilience (CCR) Assessment (Appendix 5.1).

10.1.6 The approach to cumulative assessment of both in-combination effects across disciplines and with other projects is outlined in Chapter 13 Cumulative Effects. Further information is required to allow for a proportionate assessment to be made including the agreement of a list of cumulative developments to be considered.

10.1.7 Where in-combination effects are identified cross topics, these will be considered during the assessment process and reported within the appropriate topic chapter where the effect has been identified.

10.2 Competent expert advice

10.2.1 The Hydrology and Flood Risk report has been completed by Natalie Brisland. Natalie Brisland (BSC. PIEMA) is a Principal Consultant at Wallingford HydroSolutions (WHS) and has 12 years experience specialising in Environmental Impact Assessment (EIA) and environmental management. She has experience authoring and leading hydrological assessments for EIA as well and EIA management and coordination. Natalie oversees and leads on EIA projects for WHS. In hydrological impact assessment, Natalie has experience in the renewable energy sector with a focus on onshore wind farm and solar farm projects. Natalie authors and oversees the production of Environmental Statement (ES) chapters as well as supporting technical appendices including private water supply risk assessments, peat management plans, groundwater dependant terrestrial ecosystem (GWDTE) assessments and Water Framework (WFD) assessment.

10.3 Legislative and policy framework

10.3.1 The relevant legislation, planning policy and guidelines which underpin the assessment methodology for hydrology and flood risk and inform the scope of the assessment are outlined in this section.

Legislation

10.3.2 The Water Framework Directive (WFD, 2000/60/EC), has the main objectives of protecting, enhancing and restoring Europe's waters, with the aim of achieving 'good' status, establishing a baseline of no deterioration and encouraging the sustainable use of water resources and the water environment. This directive resulted in the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003, which transposed the WFD into law in England and Wales and provided a timetable for its implementation.

10.3.3 Where relevant, the assessment takes into account the legislative protection afforded to water resources. The main national legal and policy framework is set by the following:

- Water Act 2003, as amended;
- Water Act 2014;
- Land Drainage Act 1991, as amended;
- Water Industry Act 1991;
- Water Resources Act 1991 (as amended 2009);
- Environmental Permitting (England and Wales) Regulations (and Amendments) 2016;
- Control of Pollution (Oil Storage) (England) Regulations 2001;
- Environmental Damage (Prevention & Remediation) Regulations 2009;
- The EC Groundwater "Daughter" Directive (2006/118/EC);
- The EC Nitrates Directive (91/676/EEC);
- The Priority Substances Directive 2013/39/EU;
- The Conservation of Habitats and Species Regulations 2010 (which implement the EC Habitats Directive 92/43/EEC);
- The Flood Risk Regulations 2009 (which implemented the EC Flood Directive 2007/60/EC);
- Flood and Water Management Act 2010; and
- Environment Act 2021.

Water quality standards and objectives

10.3.4 The water quality of England's rivers is classified by the Environment Agency (EA), which has developed a classification scheme for surface waters following the requirements of the WFD, as part of the river basin management plans (RBMP). This classification scheme assesses the quality of aquatic ecosystems within rivers, lakes, estuaries and coastal waters and the extent to which they have been adversely affected.

10.3.5 The scheme assesses the condition of each river, lake, estuary and coastal water and assigns it a 'status' from high, good, moderate, poor to bad. If a water body is classified as high or good status, then it has a healthy ecology which deviates only slightly from natural conditions. Such a water body is an important natural heritage asset and can support a wide range of uses such as recreation, fishing and drinking water supply. If a water body is classified as moderate, poor or bad, then the ecology is adversely affected and the range of uses which can be supported is reduced.

10.3.6 As part of the RBMPs, water body data is published by the EA containing details of the current water body classification, current pressures on the water body and measures to address these and classification objectives for 2021 and 2027.

Policy

10.3.7 The following national and local policies of relevance have been considered:

National

10.3.8 The national policies of relevance include:

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

10.3.9 The Overarching National Policy Statement (NPS) for Energy (EN-1) [1] sets out the national policy for energy infrastructure and has influence on the decisions by the Infrastructure Planning Commission (IPC) (now Secretary of State or SoS) on applications for energy developments. Applicants should ensure that their applications are consistent with the instructions and guidance in the NPS.

10.3.10 Relevant sections to water quality of this NPS include Section 5.15 'Water quality and resources'. This section considers the impact of infrastructure development on the water environment.

National Policy Statement for Renewable Energy Infrastructure (NPS EN-3):

10.3.11 The NPS for Renewable Energy Infrastructure (EN-3) [2] sets out the Government's policy for delivery of major renewable energy infrastructure and should be read in conjunction with NPS EN-1.

10.3.12 Section 2.5.84 is relevant to water quality and states that the IPC (now Secretary of State) should be satisfied that the applicant has demonstrated measures to minimise adverse impacts on water quality and resources.

National Policy Statement for Electricity Network Infrastructure (NPS EN-5)

10.3.13 The NPS for Electricity Network Infrastructure (EN-5) [3] focuses on infrastructure for electricity networks and should be read alongside NPS EN-1 where relevant to a project. Part 2.4 of NPS EN-5 reiterates the need for resilience of new energy network infrastructure to climate change to be assessed and taken into account by the applicant, including in relation to flooding.

Draft National Policy Statements for Energy

10.3.14 On 30 March 2023, a draft suite of revised energy NPS were published for public consultation, which is ongoing at the time of preparation of this PEIR. The revised energy NPS are not designated and therefore the existing NPS EN-1, EN-3 and EN-5 remain the national policy documents of most relevance and importance, however the revised NPS are summarised in PEIR Appendix 1.1 Planning Policy Framework.

National Planning Policy Framework:

10.3.15 The National Planning Policy Framework (NPPF) [4] sets out the planning policies for England and describes how these should be applied. The NPPF also sets out the aims for development to contribute towards sustainable development.

10.3.16 Relevant sections of the NPPF to the water environment include Section 14: 'Meeting the challenge of climate change'. This section considers the impact of climate change to flood risk, coastal change and water supply.

10.3.17 Paragraphs 159 to 169 set out the need to avoid areas at risk of flooding and for developments to be made safe for its lifetime. Where this cannot be achieved, national policy is clear that new development should not be allowed.

10.3.18 Section 15 of the NPPF: 'Conserving and enhancing the natural environment' is relevant to water quality and sets out the requirement of: 'e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as RBMPs.'

National Planning Practice Guidance

10.3.19 The NPPF is supported by the National Planning Practice Guidance (NPPG) [5] and provides guidance across a range of topic areas. The section entitled 'Flood Risk and Coastal Change' provides guidance on the 'sequential test' and 'exception test' which must be applied to steer development to areas with the lowest probability of flooding. The document also provides guidance on Flood Risk Assessments (FRA) and sets out flood risk issues from different types of development. Guidance on surface water management including consultation with the Lead Local Flood Authority (LLFA) is also included.

10.3.20 Guidance on climate change focuses on suitable mitigation and adaptation measures in the planning process. This includes considering availability of water and water infrastructure for the lifetime of a development and designing responses to promote water efficiency and protect water quality.

Local

10.3.21 The Proposed Development lies within the administrative boundaries of Darlington Borough Council and Stockton-on-Tees Borough Council and the northern extent borders Durham County Council. Planning policy of relevant to the assessment which would be considered includes:

Stockton-on-Tees Local Plan [6]

10.3.22 Policy SD5 Directs new development towards areas of low flood risk (Flood Zone 1), ensuring flood risk is not increased elsewhere, and working with developers and partners to reduce flood risk."

10.3.23 Policy ENV4 highlights the prioritisation of Sustainable Drainage Systems (SuDS), managing surface water at source and the importance of ensuring developments do not increase the surface water run off rates above the greenfield rates

10.3.24 Policy ENV7 states that, where contamination may present a risk to the water environment, proposals must demonstrate "that development will not cause the site or surrounding environment to become contaminated".

10.3.25 Policy SD8 ensures that developments need to "protect and enhance ecological and green infrastructure".

10.3.26 The Stockton Strategic Flood Risk Assessment (SFRA) [7] aims to locate new development primarily in low flood risk and sustainable areas and identifies whether the application of the Exception Test is necessary. The SFRA recommends opportunities offered by new developments to reduce the causes and impacts of flooding through better management of surface water and storage of flood water.

Darlington Borough Local Plan [8]

10.3.27 Policy DC2 ensures that development should focus on low risk flood areas, be safe over its lifetime, not increase flood risk anywhere else and take opportunities to mitigate flood risk and prioritise SuDS.

10.3.28 Policy DC3 states that new developments are required to "incorporate measures to prevent and reduce their pollution".

10.3.29 The Darlington SFRA aims to locate new development primarily in low flood risk and sustainable areas and identifies whether the application of the Exception Test is necessary. The SFRA recommends opportunities offered by new developments to reduce the causes and impacts of flooding through better management of surface water and storage of flood water.

Guidance

10.3.30 Effects of the Proposed Development on the water environment has been undertaken in accordance with the legislation summarised above and the guidance in the Design Manual for Roads and Bridges (DMRB) [9] and Guidelines for Ecological Impact Assessment [10]. Where appropriate, informed professional judgement has been used, primarily in relation to geomorphology, where there is a lack of published guidance to date.

10.3.31 Flood risk has been assessed in accordance with the requirements of the NPPF [4] and the accompanying online flood risk guidance.

10.3.32 In addition, the CIRIA Environmental Good Practice on Site [11] and Control of Water Pollution from Construction Sites [12] have been taken into consideration when identifying mitigation measures.

10.4 Assessment methodology

Baseline methodology

10.4.1 Information used to characterise the baseline environment has primarily been sourced through desk study. Sources used include:

- BGS Geology Viewer [13];
- EA Flood Risk Maps [14];
- EA Catchment Data Explorer [15];
- GeoSmart Groundsure Flood Risk Map [16]
- Magic Maps [17]; and
- LiDAR [18].

10.4.2 In addition to the desk study, a site walkover was undertaken on the 16 and 17 February 2023. The aim of the walkover was to ground truth the mapped data and identify any receptors which may not have been picked up as part of the desk study. The walkover also included consultation with land owners to identify unmapped land drainage within the Site Area.

Assessment of effects

10.4.3 The sensitivity of the baseline environment has been assessed using the criteria defined in Table 10-1. The criteria for the determination of the sensitivity of receptors has been established based upon available guidance, legislation, statutory designation and/or professional judgement.

Table 10-1 Assessment of sensitivity

Receptor Sensitivity	Criteria
High	▪ The receptor has low capacity to absorb change without fundamentally altering its present character. ▪ The receptor is of very high environmental value and/or National or International ecological status (i.e. Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC)). ▪ Environmental equilibrium is precarious and highly sensitive to change. ▪ Designated fishery or used for other freshwater ecological interests. ▪ Active floodplain. ▪ Land use includes essential infrastructure or highly vulnerable or more vulnerable development (as defined in the NPPF) ▪ Abstractions for public water supply; or abstractions for private water supply supplying more than 10m3/day for human consumption or serves more than 50 persons. ▪ Watercourse widely used for activities relating to water quality (e.g. fisheries, swimming, etc).
Medium	▪ The receptor has moderate capacity to absorb change without significantly altering its present character. ▪ The receptor has some environmental importance. Local or Regional ecological status (i.e. Good or Moderate water body status or target objective). ▪ Environmental equilibrium is stable and copes well with natural fluctuations. ▪ Contains some flood alleviation features. ▪ Land use includes less vulnerable development (as defined by the NPPF) ▪ Abstractions for private water supplies supplying less than 10m3/day for human consumption or serves less than 50 persons. ▪ Watercourse is not widely used for activities relating to water quality.
Low	▪ The receptor is tolerant of change without detriment to its character and is of low environmental value. ▪ Low ecological status (i.e. Poor or Bad water body status and not subject to higher target objectives). ▪ Environmental equilibrium is stable and resilient to changes greater than natural fluctuations. ▪ Land use includes water compatible development (as defined by the NPPF). ▪ Fish sporadically present or restricted. ▪ Does not contain any flood alleviation features. ▪ No abstractions for private water supply. ▪ Watercourse is not used for activities relating to water quality.

10.4.4 The assessment of impacts as a result of the Proposed Development was then conducted using the following process.

- Examination of infrastructure design, construction, operational and decommissioning methodologies;
- Identification of potential impacts using the criteria presented in Table 10-2, differentiated between short term construction impacts and long term operational and design impacts for each direct and indirect receptor;
- Identification of potential significant effects using the significance criteria outlined in Table 10-3.
- For each potential effect, identification of mitigation measures to avoid, minimise or remedy any adverse impacts and enhance any beneficial impacts; and
- Identification of residual effects following the implementation of mitigation measures, differentiating between short term construction impacts and long term operational and design impacts.

Table 10-2 Assessment of impact magnitude

Magnitude	Change to Baseline Environment
High	▪ The long-term loss of resource and/or quality; partial loss of or damage to key characteristics, features or elements; or ▪ Increase in peak flood level >100mm.
Medium	▪ Long term measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one or more key characteristics, features or elements; or ▪ Short term loss of resource and/or quality; partial loss of or damage to key characteristics, features or elements; or ▪ Increase in peak flood level >50mm.
Low	▪ Long term very minor loss or detrimental alteration to one or more characteristics, features or elements; or ▪ Short term measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements; or ▪ Increase in peak flood level >10mm.
Negligible	▪ Short term very minor loss or detrimental alteration to one or more characteristics, features or elements; or ▪ Negligible change to peak flood level ≤+/-10mm.
No Change	▪ No loss or alteration of characteristics, features or elements.

10.4.5 The significance of effects upon the baseline environment is defined as a function of the sensitivity of receptors and the magnitude of impact on the baseline conditions, as presented in Table 10-3. The significance criteria is based upon the principles of the Chartered Institute of Ecology and Environmental Management's (CIEEM) guidelines for ecology impact assessments in the United Kingdom and the DMRB (Highways England et al, 2020).

10.4.6 Moderate or major effects are deemed significant in terms of the EIA Regulations. Effects that are of a minor, negligible change or result in no change are judged to be not significant. Differentiations between categories in Table 10-3 are based upon professional judgement. A moderate or major effect as a result of an impact would require additional mitigation, whereas a minor or negligible effect would not require mitigation; although mitigation may be provided as part of standard good practice in construction, operation and decommissioning.

Table 10-3 Significance of effect

Site Sensitivity	Magnitude of Impact				
	High	**Medium**	**Low**	**Negligible**	**No Change**
High	Major	Major	Moderate	Minor	No change
Medium	Major	Moderate	Minor	Negligible	No change
Low	Moderate	Minor	Negligible	Negligible	No change

10.5 Scoping and consultation

10.5.1 A number of stakeholders have been consulted to gather baseline data and inform the assessment. The consultees and the reasons for consultation with them is described in the following sections.

Scoping

10.5.2 A Scoping Report was submitted to the Planning Inspectorate (PINS) on 27 October 2022, and a Scoping Opinion was provided by PINS on 6 December 2022 (see PEIR Appendices 4.1 and 4.2), which included responses relating to hydrology and flood risk from the Environment Agency, Natural England and the LLFA. These responses have been considered and included, where appropriate, in this chapter, and Table 10-4 includes a summary of how this chapter of the PEIR has responded to each Scoping Opinion comment.

Table 10-4 Response to the Scoping Opinion

ID	Reference	Stakeholder	Comment	Response
3.1.3	**Table 5.2**	PINS	**Precipitation change** ▪ The Inspectorate is content to scope this matter out on the basis that precipitation changes are not anticipated to be exacerbated by the Proposed Development; it is noted and agreed that impacts to the Proposed Development from increased frequency and duration of precipitation events is scoped in.	▪ The impacts of increased precipitation have been assessed as part of the Climate Change Resilience (CCR) Assessment (Appendix 5.1). ▪ As confirmed within the FRA (Appendix 10.1), a 40% increase in rainfall will be taken into account in sizing of SuDS features.
3.1.5	**Paragraph 5.7.2.2 and Table 5.7**		**Resilience to impacts from climate change during construction and decommissioning** ▪ The Inspectorate agrees that this can be scoped out of the assessment on the basis that impacts from flooding will be assessed in the Flood Risk Chapter and that mitigation measures to manage potential extreme weather events, including use of weather alert systems and appropriate storage of materials, will be implemented.	▪ As this matter has been agreed to be scoped out, this has not been included within the assessment. ▪ The impacts of extreme weather events have been assessed as part of the CCR Assessment (Appendix 5.1). ▪ An FRA is provided at Appendix 10.1 which assess impacts from flooding.
3.7.10	**Table 11.8 and paragraph 11.8.13 to 11.8.39**		**Hydrology – effects to water quality from siltation of runoff and pollution events – all phases And Hydrology – effects to water quality impacts to designated sites – all phases** ▪ The Scoping Report proposes to scope out effects on water quality from siltation of runoff and pollution events for all phases on the basis that earthworks would be 'minimal', any spoil would be managed in line with appropriate guidance and mitigation would be secured through the CEMP to avoid pollution events and to reduce scour (such as soil bungs, grass strip filters and silt traps). The	▪ Impacts from herbicides and pesticides has been included in the water quality assessment in this chapter. ▪ It is considered a drilling fluid breakout plan isn't required at this stage and should be conditioned prior to the start of construction. Agreement will be sought from PINS for the ES. ▪ Water quality effects from construction (including earthworks/excavations) is scoped into this chapter.

ID	Reference	Stakeholder	Comment	Response
			Scoping Report anticipates that due to the nature of operation, the site would not provide a pathway for significant effects during operation. ▪ The Inspectorate notes that impacts from herbicide and pesticide mobilisation have not been discussed in the Scoping Report and that horizontal directional drilling may be required but a breakout plan is not proposed. Additionally, there is no evidence to support or secure that earthworks/excavations will be 'minimal' and not lead to adverse effects. ▪ The Inspectorate does not consider enough evidence regarding the final design and control measures has been provided to scope this matter out during construction or decommissioning. The ES should identify relevant pathways of effect, the likely mitigation required to mitigate such effects and any monitoring required; this should include a drilling fluid breakout plan which should also be submitted with the Application.	
3.7.11	**Table 11.8 and paragraph 11.8.13 to 11.8.39**		**Hydrology – effects from surface water runoff from soil compaction, pluvial and fluvial flooding impacts – all phases And Hydrology – effects from flooding to designated sites – all phases** ▪ Effects from pluvial and fluvial flooding and surface water runoff from soil compaction are proposed to be scoped out on the basis that the site is predominantly located in flood zone 1 (Figure 11.2) and that SuDS will be	▪ Flood risk is assessed in this chapter and supported by an FRA (Appendix 10.1). The FRA considers groundwater flooding, such as identifying the likely areas of flooding and likely levels. The design has avoided putting drainage features in these areas.

ID	Reference	Stakeholder	Comment	Response
			employed to ensure flood risk is not increased on site. Additionally, any sensitive infrastructure will be located outside of flood zones 2 and 3 and where solar panels are located in these areas, electrical equipment will be located above the design flood levels. A Construction Traffic Management Plan (CTMP) is proposed to ensure that vehicle movements are minimised and restricted to access tracks and roads to reduce distribution and concentration of soil compaction. ▪ Impacts from groundwater flooding have not been considered in the Scoping Report. Sensitive receptors are also located within the red line boundary (principal aquifer and source protection zone) and Scoping Report paragraph 11.6.15 identifies that groundwater levels are 'high' across the Proposed Development site. Additionally, the Inspectorate considers that compaction can occur across the site as each panel will require machinery access for construction. ▪ The Inspectorate does not consider that sufficient evidence has been provided to scope this matter out. The ES should assess significant effects to/from flooding where they are likely to occur.	
N/A	**EA consultee advice**	EA	▪ Infiltration SuDS may not be suitable and lined retention/ attenuation basins are worth considering	▪ The Drainage Strategy (Appendix 10.1) assumes that infiltration is not suitable. Infiltration testing is proposed to be undertaken at the ES stage.
N/A	**FRA Advice**		▪ From our knowledge of specific flooding issues in this area we can advise that the FRA should consider the following, in particular:	▪ This information is included within in the FRA (Appendix 10.1).

ID	Reference	Stakeholder	Comment	Response
			– Clearly state the lifetime of the development – Ensuring that mitigation measures are adequate at the sites of increased flood risk for the lifetime of the development – Ensuring that access and egress of onsite workers is considered, and detailing a flood plan for emergency planning – Consider flood risk offsite	
	Groundwater		▪ We recommend the proposed development sites are assessed against location/proximity to public water supply abstractions. SPZs provide the public water supply protection from all chemical pollutants. Thus, if any discharge to groundwater will not be attenuated before being abstracted, then mitigation will be required. ▪ We welcome the statements relating to the FRA, Surface water management and site drainage plans and Construction Environmental Management Plan (CEMP), which will be submitted as part of the Development Consent Order application, in that they will include risk of flooding from groundwater sources and pollution prevention measures. However, we would require either the FRA, water management/drainage plans and CEMP or the ES to consider the potential increase in	▪ Abstraction and groundwater resources are assessed within this chapter. ▪ The FRA considers groundwater flooding (Appendix 10.1).

ID	Reference	Stakeholder	Comment	Response
			groundwater flood risk from infiltration (from SuDS).	
			▪ The scoping report has noted that groundwater is shallow. Thus, it will be very reactive to infiltration and surface discharge. Infiltration SuDS may not be suitable and thus it would be worth considering lined retention/attenuation basins to protect or improve baseflow in the surface water courses. Some of the water courses suffer from low flows and at these times water quality deteriorates due to lack of dilution for the current discharges. New development should consider where this situation could be improved to gain additional environmental/cost benefits	▪ The drainage design doesn't include attenuation basins and therefore this opportunity isn't available.
N/A	**Groundwater/surface water nitrate vulnerable zone**		▪ The proposed sites lie within a groundwater/surface water nitrate vulnerable zone. Development should not mobilise nitrate pollution and cause deterioration in quality of controlled waters. Nitrate can arise from fertilisers, manure and domestic sewerage systems. ▪ Current and historical land use was predominantly agriculture (arable) thus the risks of mobilising herbicides and pesticides via proposed drainage schemes should also be considered.	▪ Effects on the Nitrate Vulnerable Zone (NVZ) has been included in this chapter.
			▪ The Little Stainton Beck forms the southern boundary of Site D but then cuts through the site northwards through a slight valley feature before running parallel to the road and then crossing under it. The Little Stainton Beck is an Ordinary Watercourse and Site D is at the	▪ The mitigation zone along Little Stainton Beck has been increased in size and ranges from 30m to 50m wide.

ID	Reference	Stakeholder	Comment	Response
			top of its catchment, therefore the river flows will be far smaller than those for Site F. ▪ The route of the beck through the site is marked as a mitigation zone. It may be worthwhile considering making this zone slightly larger to allow for climate change induced channel movement and slope instability.	

Consultation

10.5.3 The results of consultation with the LLFA, carried out as part of the assessment are summarised in Table 10-5 below.

Table 10-5 Response to Consultation

Stakeholder	Comment	Response
LLFA	▪ Agree that no formal SuDS features are required to attenuate runoff for this development. Agree that any panels located within the flood zone can be raised above the flood level with no further mitigation.	▪ Agreed
LLFA	▪ Consider that the flood depths shown by the pluvial mapping in Panel Area C (Square Wood) are incorrect as the mapping doesn't take into account topography and existing drainage corrects.	▪ Agreed

10.6 Assessment assumptions and limitations

10.6.1 The assessment has been undertaken using desk-based information. The assessment is therefore reliant on third party data which is assumed to be correct. No further assessment limitations have been identified.

10.6.2 This PEIR provides preliminary information based on the design of the Proposed Development to date and the data gathered at this point in time. Some of the information gathered will be supplemented and provided in full and final form within the ES.

10.6.3 The PEIR is intended to inform statutory consultation responses. A more detailed assessment of the identified direct effects and potential indirect amenity effects on identified sensitive receptors will be undertaken at the ES stage, drawing on the further assessment work of other disciplines.

10.6.4 Information gaps at the PEIR stage, for example infiltration testing data, will be addressed as part of the ES. More specific mitigation measures will also be considered at the ES stage.

10.6.5 The assessment has been undertaken using desk-based information and a site walkover. The assessment is mainly reliant on third party data which has been confirmed by the site visit where possible and is assumed to be correct. No further assessment limitations have been identified.

10.7 Study area

10.7.1 The Proposed Development is located within an area of undulating mixed farmland that is mainly arable but with some improved pasture used for rearing sheep and occasionally cattle.

10.7.2 The key focus of this chapter is flood risk, water quality and groundwater. The study area for each aspect is described below.

- Flood Risk: Any area hydrologically linked to the Site Area will be assessed;
- Water Quality: Impacts will be investigated up to 1km downstream of the Site Area, to be extended if there is a protected area reasonably close to the Site Area; and
- Groundwater: Any principal aquifers or source protection zone (SPZ) with hydrological connectivity to the Proposed Development.

10.8 Baseline conditions

10.8.1 The baseline conditions for the Proposed Development at the time of the PEIR are presented below.

Surface hydrology and Site Area drainage

10.8.2 The Proposed Development is located within the Tees catchment in the north-east of England. The Site Area is drained via three main sub-catchments associated with the River Skerne, Newton Beck and Whitton Beck. The baseline characteristics and each of the sub-catchments are presented on Figure 10.1 and described below.

River Skerne sub-catchment

10.8.3 The River Skerne sub-catchment is 180km^2 in size and drains the western extent of the Site Area (the majority of Panel Area A and the north-west section of Panel Area B). A number of unnamed tributaries drain the site into the River Skerne which continues to flow through Darlington and ultimately flows into the River Tees approximately 10km south of the Proposed Development Site . The River Skerne, is designated as a WFD water body (see section below for more details on WFD classifications) and is classified by the EA as a main river.

10.8.4 No protected areas are located within this sub-catchment however the mouth of the River Tees is designated as a SSSI, Special Protection Area (SPA) and Ramsar site (see below). The land use of the catchment is predominantly arable and horticultural with sub-urban areas including Newton Aycliffe.

Newton Beck sub-catchment

10.8.5 The Newton Beck sub-catchment is 3km^2 in size and drains a small section of the southern extent of the Site Area (the eastern extent of Area A and small sections to the west of Area B and C). The Newton Beck runs south for approximately 2km until confluence with the River Skerne. A number of unnamed tributaries drain the site into the Newton Beck, all of which are classified as ordinary watercourses.

10.8.6 Within this catchment is Newton Ketton Meadow SSSI which is designated due to it being one of the few remaining unimproved traditional hay meadows on the coastal plains between the River Tees and the River Tyne. This SSSI is located 110m south east from the Proposed Development.

10.8.7 The land use of the catchment is predominantly improved grassland and arable and horticulture with a few properties surrounding Newton Ketton.

Bishopton Beck/Whitton Beck sub-catchment

10.8.8 The Bishopton Beck/Whitton Beck sub-catchment is 50km^2 in size and drains the eastern section of the Site Area (all of Areas D, E, F and G and the eastern sections of Areas B and C). Several tributaries including Byers' Gill and Little Stainton Beck drain the Site Area into Bishopton Beck which is a WFD water body.

10.8.9 Bishopton Beck (which later is named Whitton Beck and then Billingham Beck) flows generally in an easterly direction through the village of Bishopton. Bishopton Beck is classified by the EA as a main river. The Beck drains into the river Tees which flows thorough the Teesmouth and Cleveland Coast SPA, Ramsar site and SSSI, which is located 20km east from the Proposed Development. The Teesmouth and Cleveland Coast SPA covers 1,247 hectares and is home to a variety of rare species of invertebrates and birds.

Topography

10.8.10 As shown in Figure 10.2, the Proposed Development is located on top of Whinny Hill at approximately 109.8m AOD at its highest point which slopes away gently in all directions. The majority of the Site Area drains to the east, south and west. A description of each of the Panel Areas within the Proposed Development is as follows:

- Panel Area A: Slopes west towards the bottom of the valley and into the River Skerne;
- Panel Area B: The is the highest point of the Proposed Development as it sits atop Whinny Hill, and the slope descends in a southerly direction;
- Panel Area C: Panel Area C is situated around Byers' Gill Wood and is situated at the bottom of Whinny Hill. This section is significantly less steep than both Panel Area A and B, and the slope runs south east;
- Panel Area D: This area lies to the east of Whinny Hill, and is less steep than Panel Area A or B, however, there is still a clear southern slope across the site.
- Panel Area E: Situated to the west of Bishopton, Panel Area E is fairly flat and slopes towards Bishopton Beck in the east.
- Panel Area F: Situated to the north east of Bishopton, Panel Area F sits on top of a smaller hill and slopes downwards in all directions from the centre. Ultimately, Panel Area F drains into Bishopton Beck to the north.

Designated sites

10.8.11 Newton Ketton Meadow is a SSSI located within the Newton Beck sub-catchment located approximately 100m south of the Proposed Development, across agricultural farmland (Figure 10.1). Due to drainage from the Newton Beck Sub-catchment being from north to south, it can be considered that the Site and the SSSI are hydrologically linked.

10.8.12 Teesmouth and Cleveland Coast is a Ramsar site, SPA and SSSI which is located 20km east from the Proposed Development. The Site Area drains via several tributaries into the River Tees which flows through the Teesmouth and Cleveland Coast site. As the Teesmouth and Cleveland Coast site is a tidal habitat being feed from rivers which drain the Site Area it can, despite the distance, be considered to be hydrologically linked. Multiple other tributaries also drain into the River Tees.

10.8.13 The Proposed Development is situated within a moderate Countryside Stewardship Water Quality Priority Area meaning incentives are offered to adopt less pollutive agricultural practices. The Proposed Development site is also located in NVZs S245 and S243. NVZs are designated in areas where high levels of nitrates are measured in watercourses which generally originate from agricultural practices and industrial pollution.

Geology and hydrogeology

Solid geology

10.8.14 Due to the size of the Proposed Development, the Site Area is underlain by a number of different types of bedrock (Figure 10. 3). Information gathered from the BGS Geology Viewer [13] indicates that bedrock deposits present are bands of Dolostone, Mudstone, Limestones and Sandstone. The eastern extent of the Site Area is predominantly underlain by Roxby

formation Mudstone with smaller parcels of limestone and sandstone present. The central and western extent of the site is predominantly Ford formation Dolostone, with bandings of Limestone present, running through the central zone.

Superficial geology

10.8.15 Information gathered from the BGS Geology Viewer indicates that the Proposed Development is underlain by a layer of Diamicton (Till). Small pockets of clay, silt, sand and gravel are also present. A large pocket of sand and gravel is present in the eastern extent of the Site Area at NGR: 436365.9, 521467.7. Clay, silt and gravel is present in smaller parcels across the entire extent of the Site Area.

Soils

10.8.16 Information obtained from Magic Maps [17] shows that the Proposed Development is underlain by clayey soils, described as "slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils". An Agricultural Land Classification (ALC) survey has been undertaken which states that the majority of soil types present are brown / dark greyish brown clay or medium / heavy clay loam. The ALC results are described in Appendix 9.1.

Hydrogeology

10.8.17 The Proposed Development is underlain by a Principal Aquifer [15] associated with the Carboniferous Limestone deposits. Groundwater Vulnerability across the majority of the Proposed Development is Medium, with sporadic pockets of low groundwater vulnerability at Panel Areas A, B, C, D, and F.

10.8.18 There are a number of borehole records [19] within the Site Area, a borehole at Little Stainton Beck at NGR: 434294, 521076 indicates 5m of clay overlying a sandy silt. No water was encountered in the clay, however, the silt is reported as wet and is likely to be the underlying aquifer. A borehole at Little Stainton Village struck water at 5.8m depth, and 5.8m of dry clay was recorded overlying sand and then a finely laminated silt at a depth of 21m. A further borehole to the east of the Site near Newton Beck also indicates 5m of clay overlaying a 'Very clayey' pebbly sand. A borehole at Great Stainton Church, north of Byers' Gill Wood again shows similar records. At this borehole clay was identified for 7m depth, then 'Clayey' sandy silt was encountered at 7m depth with 'very little water' and further clay until 18.3m depth.

Groundwater dependant terrestrial ecosystems

10.8.19 A habitat survey has been undertaken for the Proposed Development, full details of the survey can be found in Chapter 6: Biodiversity. The UK Habitats Classification survey indicates a few areas classified as Holcus-Juncus neutral grassland, located mainly along the banks of watercourses, including Newton Beck and other unnamed watercourses. Holcus-Juncus is described as neutral grassland with Yorkshire Fog and Rushes. This category is equivalent to NVC community MG10 which, according to relevant guidance [20] is classified as a moderately groundwater dependant habitat.

10.8.20 Based on the location of these habitat throughout the Site Area and their association with surface water features, it is considered most likely that these habitats are surface water fed rather than groundwater fed. Therefore, no assessment on groundwater dependant terrestrial ecosystems will be undertaken in this chapter.

Water quality

10.8.21 The WFD River and Groundwater Bodies Catchment Cycle 3 (2022-2027) datasets have been used to assess the status and vulnerability of nearby watercourses in terms of water quality and ecological health. The Proposed Development is located within the Northumbria River Basin District RBMPs and in the following WFD catchments:

- Skerne from Demons Beck to Tees (ID GB103025072596);
- Bishopton Beck from Source to Billingham Beck (ID: GB103025072280); and
- Billingham Beck from Bishopton Beck to Brierle (ID: GB103025072360).

10.8.22 A summary of the overall, chemical, and ecological status of the waterbodies and catchments is provided in Table 10-6 with the exact locations of the WFD Catchments shown in Figure 10.4.

Table 10-6 WFD indicators for surface waterbodies

Water body	Chemical	Ecological	Overall status	Objective
Skerne from Demons Beck to Tees	Fail	Moderate	Moderate	Ecological: Good by 2027 Chemical: Good by 2063
Bishopton Beck from Source to Billingham Beck	Fail	Poor	Poor	Ecological: Good by 2027 Chemical: Good by 2063
Billingham Beck from Bishopton Beck to Brierle	Fail	Poor	Poor	Ecological: Good by 2027 Chemical: Good by 2063

10.8.23 Due to their proximity to each other, the WFD waterbodies all have similar reasons for not achieving a good ecological status, including poor soil management and sewage discharge (both continuous and intermediate). There is also very little confidence in any of these WFD waterbodies achieving a good ecological status by 2027 due to this being "disproportionately expensive" and having a "disproportionate burden". For the WFD waterbodies within the River Skerne, a chemical rating of Good by 2063 is "technically infeasible" [21].

10.8.24 Data published for the Northumbria River Basin District RBMP [22] predicted a gradual overall improvement in the ecological and chemical status of surface water bodies in the river basin district by 2021.

10.8.25 A WFD assessment is presented in Appendix 10.3 which describes the WFD water bodies in greater detail and assesses the effects of the Proposed Development on WFD water bodies.

Water Use

10.8.26 The following sections present the details of water use within the catchments draining the site.

Source protection zones

10.8.27 SPZ are defined around large and public potable groundwater abstraction sites and are in place to provide additional protection to safeguard drinking water quality. Zones are defined by groundwater travel time to an abstraction. The Proposed Development is situated within an SPZ 2 which is located through the centre of the Site Area and an SPZ 3 located in the western extent of the Site Area. SPZ 2 (Outer Protection Zone) is defined by the 400-day travel time from a point below the water tables and SPZ 3 is defined as the total area needed to support the abstraction or discharge from the protected groundwater source. The location of the SPZ is shown in Figure 10.1.

Drinking water protection zones

10.8.28 The Proposed Development is not within nor drains through a Drinking Water Safeguard Groundwater Zone[1] .

Private water supplies

10.8.29 Stockton On Tees Council and Darlington Borough Council were contacted regarding their records of any properties served by a private water supply (PWS) within the vicinity of the Proposed Development. Eight PWS were identified within the draining sub-catchments with information provided on the source location and type. The location of these identified PWS is shown on Figure 10.1. None of the PWS locations provided by Stockton on Tees Council and Darlington Borough Council are within the drainage pathway of the Proposed Development and therefore are not included in this assessment.

Abstraction licences

10.8.30 The EA was contacted to obtain information about other abstraction licenses within the area surrounding the Proposed Development. The information received shows that one abstraction is located within Byers Gill wood, outside of the Proposed Development Site. The abstraction is owned by Anglian Water and is a groundwater potable public water supply. The location of abstraction licences is shown on Figure 10.1. Further information will be obtained and will be presented in the final ES.

Flood risk

10.8.31 A FRA and Drainage Strategy is provided in Appendix 10.1 and includes a review of all sources of flooding relevant to the Proposed Development. A summary of the flood risk conditions is provided in this chapter.

Fluvial

10.8.32 Flood risk to the Proposed Development has been assessed by reviewing the EA online flood maps [23]. The EA flood maps consider the risk associated with the fluvial and tidal flood events during an undefended scenario, i.e. the presence of the fluvial or tidal defences are not considered.

10.8.33 The EA flood maps indicate that the Site Area is largely situated within Flood Zone 1, which is defined as an area having less than a 1 in 1,000 annual exceedance probability of flooding from main rivers. Therefore, the Proposed Development is not considered not to be at a significant risk of river flooding.

10.8.34 Two areas within the Site Area are located within Flood Zone 3 associated with Little Station Beck (Panel Area D at NGR: 434159, 521023) and Bishopton Beck (Panel Area F at NGR: 436070, 521592) respectively. Flood Zone 3 is defined as an area having less than a 1 in 100 annual exceedance probability of flooding from main rivers. The flood extent associated with the Bishopton Beck is immediately adjacent to the proposed solar PV modules in Panel Area F but conservatively has been assumed to encroach upon the solar PV modules. The Flood Zone for Little Stainton Beck indicates the flooding occurs at a sharp turn in the watercourse.

[1] DEFRA, Drinking Water Safeguard Zones (Groundwater), https://environment.data.gov.uk/dataset/6288b7b0-d465-11e4-b13c-f0def148f590 Accessed 08/03/2023.

10.8.35 The flood depths associated with these areas have been estimated from the EA Flood Maps using LiDAR data. The flood depth at Little Stainton Beck associated with Flood Zone 3 is estimated to be approximately 1m. At Billingham Beck the estimated depth is also 1m.

10.8.36 It should be noted that EA fluvial flood maps do not generally consider watercourses where the contributing catchment is less than 5km^2, therefore the minor tributaries around and within the Site Area are not represented by these maps. The Surface Water Mapping should therefore be consulted to establish a representation of fluvial flood risk within the Site Area, and this is detailed in Figure 10.5b.

10.8.37 Existing flood risk within the Site Area is shown on Figure 10.5a and 10.5b.

Surface water

10.8.38 A review of the EA surface water flood risk map indicates that the majority of the Proposed Development is at low risk of surface water flooding, with a chance of flooding of less than 0.1% (1 in 1,000 year) (Figure 10.5). Surface water flooding with a 3.3% AEP is modelled to occur at several locations on-site including south of Panel Area A and at various locations within Panel Area C around Byers Gill Wood. Depths of 1.5m, 1.2m and 1.3m have been estimates at Panel Area B01, C10 and D03 respectively. The Panel Area numbers are shown on Appendix 10.1 Figure 3.2.

10.8.39 Flooding correlating to lower return periods (0.1% AEP and 1.1% AEP) are located at the same locations as the 3.3% AEP event although cover a larger area. Sections of the Little Stainton Beck flood for higher return periods causing flooding in the southern section of Panel Area D and the eastern section of Panel Area C.

10.8.40 An area of an 3m flood depth has been estimated at Panel Area C (C09) around Square Wood (see Appendix 10.1 – Figure 3.2). Detailed assessment of the surface water flood risk at this location was carried out, and this included reviewing of data collected during a site visit, topographic data and aerial imagery.

10.8.41 Based on a review of the LiDAR ground level data, the topography is sloping downwards and is not obstructed or blocked anywhere. This was verified as part of a site visit, and there was no barrier to flow identified at the location. Further, the extensive drainage system installed at this location by the current land owner is not included in the EA flood maps. Therefore, there is reasonable evidence to believe that the depth has been inaccurately represented and the mapped flood extent is not accurate. It is not anticipated that flooding would occur in this area.

Groundwater

10.8.42 Results from the GeoSmart Groundwater Flood Risk Map [16] indicate that the majority of this Site Area is at negligible risk of groundwater flooding with small pockets of low and moderate groundwater flood risk (mostly around Panel Area F).

10.8.43 . The western part of the Site Area is considered to be at medium risk of surface water/groundwater interaction with the underlying aquifer which supports Anglian Water's potable water supply at Great Stainton. It was also noted that Panel Area D lies close to the public water supply borehole and a known/ possible foot and mouth disinfectant site (South Shields Farm).

Reservoir failure

10.8.44 There are several small reservoirs surrounding the Proposed Development (Figure 10.1) and runoff from the Site Area may drain into Bishopton Lake. According to data from the EA, the eastern extent of the Site Area, surrounding Bishopton and Carlton, is at significant risk of

flooding from reservoir failing. However, it should be noted that reservoir flooding is a rare event with a very low probability of occurrence. Current reservoir regulation, which has been further enhanced by the Flood and Water Management Act 2010, aims to make sure that all reservoirs are properly maintained and monitored to detect and repair any problem. Therefore, the risk of reservoir flooding is not thought to be high in this area.

Sewer

10.8.45 As the site is greenfield no sewage pipes are expected to run across the Site Area and consequently the risk of sewer flooding is considered negligible.

Baseline summary and sensitivity

10.8.46 Table 10-7 provides a summary of the sensitivity of baseline features within the Site Area.

Table 10-7 Baseline Sensitivity

Receptors	Sensitivity
Surface Water	
River Skerne	▪ Medium
Newton Beck	▪ Medium
Bishopton Beck	▪ Medium
Designated Sites	
Newton Ketton Meadows SSSI	▪ High
Teesmouth and Cleveland Coast SPA, Ramsar and SSSI	▪ High
Groundwater	
Principal Aquifer	▪ Medium
NVZ S245 and S243	▪ High
SPZ	▪ High
Water Supplies	
Public water supply	▪ High
Flood Risk	
Residential properties	▪ Medium
Farm Land	▪ Low

Future baseline

10.8.47 The baseline environment is unlikely to change from the current baseline under the "do nothing" scenario in terms of land use. However, climate is likely to prove more variable, with

observed historical and predicted future changes in global climate due to a combination of both natural and human causes. The changes in rainfall attributed to climate change have been incorporated into the assessment of flood risk and are included in the assessment presented in Appendix 10.1 FRA and Drainage Strategy.

10.9 Potential effects

Construction

10.9.1 During the construction of the Proposed Development, there is a risk of increased pollution from construction activities and vehicles. Chemical spills from construction vehicles or leaks caused by damaged solar PV modules during installation have the potential to run-off into the watercourses draining the site or percolate down and contaminate groundwater supplies. There is also a risk of chemical pollutants flowing overland through Newton Ketton Meadows (one of the SSSI sites).

10.9.2 The regular use of heavy construction vehicles in certain areas can also lead to soil compaction. This may result in reduced percolation and increased overland flow. This can increase flood risk downstream and result in soil erosion within the Site Area causing increased sedimentation in the watercourses. Installation of impermeable foundations also has the potential to increase the surface water runoff of the site resulting in flooding downstream.

10.9.3 An increase in temporary impermeable area during construction due to the addition of construction buildings and less permeable gravel tracks can lead to a temporary reduction in floodplain storage volume. As a result of this, flooding can increase within the Site Area and downstream.

10.9.4 During minor excavation for foundations or track construction the ground disturbance could lead to exposed soils which can be washed into nearby watercourses during periods of heavy rain. This could result in increased sedimentation and pollution of the watercourses that are hydrologically linked to the Site Area.

Operation

10.9.5 During operation, the potential impacts from the Proposed Development are mainly related to pollution from maintenance vehicles and activities, and through increased surface water run-off.

10.9.6 Fuel or oil spills from maintenance vehicles have the potential run-off into the watercourses draining the site or percolate down and contaminate groundwater supplies. there is also a risk of it flowing overland through Ketton Meadows (one of the SSSI sites). Similarly, maintenance activities such as the repair of damaged solar PV modules could result in contaminated runoff from entering the surface or groundwater system.

10.9.7 Maintenance vehicles accessing the Proposed Development can also lead to soil compaction in certain areas, resulting in reduced percolation and increased overland flow. This can increase flood risk downstream and also result in soil erosion within the Site Area. As such, causing increased sedimentation in the watercourses.

10.9.8 Soil compaction and increased hardstanding could cause an alternation in natural flow pathways. This could increase the speed at which surface water runoff enters watercourses and could result in increased flooding.

10.9.9 During operation, a long-term increase in impermeable area, due to the construction of Battery Energy Storage Systems (BESS), inverters, transformers, and a sub-station can lead to increases in flood risk. The impermeable areas would limit infiltration and may result in small increases in runoff rates and peak flood flows across the site. The infrastructure at the

Proposed Development may also alter flow paths of smaller watercourses and therefore impact flood risk and flood routes.

10.9.10 Due to the change of use from agriculture to solar PV modules and grassland, there is likely to be a reduction in the chemical loading of waterways due to cessation of the use of nitrate. This could help reduce the amount of nitrates entering nearby watercourses which can be beneficial ecological receptors and the overall health of the watercourse.

Decommissioning

10.9.11 Chemical spills from vehicles used in decommissioning activities, as well as leaks from damaged solar PV modules could occur during the decommissioning phase which have the potential to run-off into the watercourses draining the site or percolate down and contaminate groundwater supplies. There is also a risk of it flowing overland through Ketton Meadows SSSI.

10.9.12 Vehicles can also lead to soil compaction potentially resulting in reduced percolation and increased overland flow. This can increase flood risk downstream and result in soil erosion onsite, causing increased sedimentation in watercourses.

10.9.13 During decommissioning , there may be a temporary increase in the impermeable area within the Site Area and the flow pathways may be altered. Therefore, there may be a long term impact upon flood risk and flow routes if the Site Area is not returned to pre-development conditions.

10.9.14 Removal of structures associated with the supporting infrastructure of the Proposed Development may lead to exposed soils which can be washed into nearby watercourses during periods of rain. Resulting in increased sedimentation and pollution of the watercourses.

10.10 Design, mitigation and enhancements

Embedded design measures

10.10.1 The following mitigation measures have been designed into the Proposed Development to reduce effects in relation to hydrology and flood risk. In addition, further construction and operation mitigation is presented below.

10.10.2 An 8m buffer zone has been designed around the perimeter of watercourses within the Site Area for pollution and erosion control. Vegetation that will grow around this perimeter zone will increase infiltration, act to slow down surface water runoff and filter out sediment.

10.10.3 Where possible, building in areas at a fluvial flood risk has been avoided and critical infrastructure (including substation and electrical switchgear) has been located outside of flood zones. Where tracks are located within the fluvial flood zone they will remain at grade to ensure there is no loss of flood plain and panels will be raised above the 1 in 1000 year flood depth. No buildings such as the BESS, inverters, transformers, and sub-station have been situated within the fluvial flood zones so there has been no loss of flood storage.

10.10.4 All access tracks will be permeable to allow water to filtrate through and to maintain greenfield runoff rates. The small impermeable areas will have an apron of clean crushed stone to promote natural land drainage conditions in the vicinity of the structures. The apron will be at least 1m wide beyond the structure footprint with a depth of at least 300mm consisting of 40-70mm crushed stone. This is common practice for solar farm developments across the UK and deemed an appropriate measure to account for the introduction of a small impermeable area in a rural location.

Construction mitigation

10.10.5 An Outline Environment Management Plan (EMP), will be provided as part of the ES, will include measures that are considered standard good practice to be implemented by the contractor to reduce the likelihood of impacts or their magnitude, if they were to occur. These measures, and the proposed supporting monitoring plans, are outlined below.

Runoff and sediment management control

10.10.6 The following measures would be used to mitigate any potential impacts on the water quality of the sub-catchments through erosion during construction. These will also incorporated into the Outline Environment Management Plan submitted with the DCO application.

- Sediment control measures (silt fences, settlement/attenuation ponds etc.) would be used in the vicinity of watercourses, springs or drains where natural features (e.g. hollows) do not provide adequate protection;
- Trenching or excavation activities in open land would cease during periods of intense rainfall and temporary bunding would be provided as required, to reduce the risk of sediment transport to the natural drainage system;
- Permanent relocation or longer term storage of soils would be re-instated with vegetation as soon as practicable;
- The movement of construction traffic would be controlled to minimise soil compaction and disturbance. Vehicle movements (to include HGVs and plant machinery) outside the defined tracks and hardstanding areas would be avoided where possible;
- Areas of temporary tracks would be completed as soon as possible and surfaced appropriately to protect soils from runoff. Temporary fences or markers should be used to ensure minimal disturbance of the surrounding land;
- Wheel washing would be undertaken in designated areas only and sediment control measures would be used to ensure runoff from these areas would not enter directly into water courses;
- Tracks would be completed as soon as possible and surfaced appropriately to protect soils from runoff. Temporary fences or markers should be used to ensure minimal disturbance of the surrounding land; and
- No construction activities will take place within the watercourse buffer zones

Construction pollution prevention, water quality monitoring and emergency response plan

10.10.7 The potential impact on the water quality of the sub catchments draining the Site Area through chemical pollution, would be mitigated through the implementation of the FRA and Drainage Strategy (Appendix 10.1). The following pollution control measures will be included within the Outline Environmental Management Plan submitted with the DCO application and would be deployed within all sub catchments.

- Equipment would be provided to contain and clean up any spills to minimise the risk of pollutants entering the watercourses or surface water features;

- Trenching or excavation activities in open land would cease during periods of intense rainfall;
- Refuelling of vehicles and plant machinery (if required) would be confined to the designated fuelling areas and would be carefully controlled and placed away from areas with high groundwater dependency and outside watercourse buffers;
- Vehicles, plant machinery and equipment would be cleaned at designated washout areas located conveniently and within a controlled area of the Proposed Development;
- All fuel and chemicals would be stored within appropriately specified containers and within specifically designed stores / storage areas and would include appropriate measures to avoid spillages in line with the relevant legislation;
- Drip trays would be placed under standing machinery;
- All solid and liquid waste materials would be properly disposed of in controlled landfill sites away from the site;
- Routine mechanical maintenance of vehicles would be carried out off-site or in a suitable designated area of the Proposed Development; and
- There would be no unapproved discharge of foul or contaminated drainage from the Site Area either to groundwater or any surface waters, whether direct or via soakaway.

Flood mitigation

10.10.8 Temporary land take areas (construction compound with car parking, temporary storage area, temporary laydown areas, welfare facilities etc.) within the Site Area will be fully reinstated following construction to reduce areas of semi-impermeable surfaces. Temporary land take areas will be cleared of hardcore, re-graded with soil to a natural profile and re-vegetated.

10.10.9 A sustainable approach to the drainage (SuDS) of the Proposed Development has been assessed ensuring that off-site water is not compromised. Runoff and sediment management control measures would be implemented, and the FRA and Drainage Strategy (Appendix 10.1) describes the design standards and drainage to be adopted onsite.

Operation mitigation

10.10.10 During the operation of the Proposed Development vehicular access would be limited to maintenance activities. Equipment will be provided to contain and clean up any spills of fuel or lubricants as required. Regular inspection of the tracks would occur to ensure no unacceptable erosion is taking place, with appropriate practicable remedial action taken, should erosion be noted. No vehicle cleaning or refuelling would take place within the site and drip trays would be placed underneath any stationary maintenance vehicles.

10.10.11 Permeable access tracks will be used to reduce soil compaction across the Proposed Development and ensure free drainage. The access track will help to reduce site erosion caused by traffic while its permeability will act to maximise infiltration across the site.

10.10.12 Vegetation will be maintained under drip line of all solar PV modules to reduce erosion and ensure greenfield drainage is maintained. If livestock is to be used to maintain sward length

stock will be rotated and vegetation shall be maintained at all times. No feeding or livestock tending will take place within the watercourse buffer zones.

Enhancement

10.10.13 There will be increased vegetation on site, both in the 8m perimeter buffer zone and also under the solar PV modules. This will reduce erosion and sedimentation while also increasing the biodiversity of the area.

10.10.14 A buffer zone around Little Stainton Beck has been incorporated into the design to allow the watercourse to maintain natural course and allow space for geomorphic movements due to increase future flows.

10.11 Assessment of likely significant effects

Construction

Watercourses

10.11.1 As described in Section 10.9 here is a potential risk of increased pollution to watercourses during the construction phase. Chemical spills from construction vehicles or leaks caused by solar PV modules damaged during installation could run-off into the watercourses together with siltation from excavations. The construction methodology for installation of the solar PV modules involves piling the stilts into the ground with no large scale excavations. A flat area of land is required to install the sub-station, BESS, inverters, transformers and switchgear and some minor excavation may be required. This supporting infrastructure will sit on a concrete base with a gravel apron. The access tracks will be constructed of permeable material and will be undertaken early on in the construction phase.

10.11.2 Taking into consideration the low level of construction excavation and the mitigation measures presented in Section 10.10, the impact magnitude of increased pollution to watercourses has been assessed as negligible. All watercourses, taking into account their NVZ and WFD status together with their water use, have been assessed to be of medium sensitivity. Therefore, the significance of effect on the watercourses draining the site from an increase of pollution is minor, which is not significant.

Designated sites

10.11.3 As described in Section 10.9, there is a potential risk of increased pollution to designated sites during the construction phase. As with the watercourses draining the Site Area, there is a risk of pollution from construction vehicles, leaks caused by solar PV modules damaged during installation and from excavation. However, the mitigation presented in this chapter would reduce the magnitude of the impact to designated sites.

10.11.4 The Newton Ketton SSSI is located approximately 100m to the south of the Proposed Development and is not directly linked to the Site Area via a watercourse. Therefore, the potential hydrological link between any construction activities and the SSSI would be through surface water run-off over vegetated fields, which in itself would act as a mitigation buffer and treatment for any entrained pollution in surface water.

10.11.5 The Teesmouth and Cleveland Coast SPA, Ramsar and SSSI site is located approximately 5.4km east far enough downstream such that if any pollution should enter the watercourses draining the Site Area, the flow would be suitably diluted by the time it reaches the designated site. Therefore it is considered that no effect would occur.

10.11.6 Taking into consideration the low level of construction excavation and the mitigation measures presented in Section 10.10, together with the overland flow linkage between the Proposed Development and the Newton Ketton SSSI, the impact magnitude of increased pollution to designated site has been assessed as negligible. All designated sites have been assessed to be of high sensitivity. Therefore, the significance of effect on the designated sites draining the Site Area from an increase of pollution is minor, which is not significant.

Groundwater

10.11.7 As described in Section 10.9, there is a potential risk of increased groundwater pollution during the construction phase. Chemical spills from construction vehicles or leaks caused by panels damaged during installation could percolate down and contaminate groundwater supplies. Similar to watercourses and designated sites, mitigation methods detailed in Section 10.10 illustrate how the impact upon groundwater will be reduced during construction.

10.11.8 Taking into consideration the low level of construction excavation and the mitigation measures presented in Section 10.10, the impact magnitude of increased pollution to groundwater has been assessed as negligible. The groundwater body has been assessed to be of high sensitivity due to the SPZ and abstraction for potable water. Therefore, the significance of effect on groundwater from an increase of pollution is minor, which is not significant.

Water Supplies

10.11.9 As described in section 10.9, there is a potential risk of pollution to PWS and public water supplies during the construction phase. Fuel spills from the refuelling of vehicles and machinery could percolate into the groundwater and impact upon the water supplies as a result. A number of PWS locations were provided by Stockton-on-Tees Borough Council and Darlington Council and one Anglian Water public water supply located in Byers Gill have been identified, see Section 10.8. The location of the PWS are outside of the drainage pathway of the site and the public water supply is a borehole extracting from groundwater.

10.11.10 Taking into consideration the mitigation measures present in Section 10.10 and that there are no PWS identified within the drainage pathway, the impact magnitude has been assessed as no change. Therefore the significance of effect on the PWS is no change.

10.11.11 In relation to the public water supply (high sensitivity), the effects would be the same as the groundwater assessment above (also assessed as high). The impact magnitude on public water supplies would be negligible resulting in a minor significance of effect.

Flood risk

10.11.12 As described in Section 10.9, there is potential risk of increased flood risk downstream as a result of the use of heavy construction vehicles in certain areas which leads to soil compaction and increased overland flow. The impacts of this have been reduced through mitigation including implemented runoff control measures described in the Outline Drainage and Surface Water Management Plan. Temporary land take areas (construction compound with car parking, temporary storage area, temporary laydown areas, welfare facilities etc.) will be fully reinstated following the construction period to reduce areas of semi-impermeable surfaces.

10.11.13 Taking into consideration the mitigation measures presented in Section 10.10, the impact magnitude of increased flood risk has been assessed as negligible. Flood risk of nearby receptors (including residential dwellings and farm land) has been assessed to be of high to medium sensitivity. Therefore, the significance of effect of increased flood risk is negligible to none, which is not significant. Further information on flood risk and drainage solutions for the Proposed Development is presented in Appendix 10.1 FRA and Drainage Strategy.

Operation

Watercourses

10.11.14 As described in Section 10.9, there is a potential risk of increased pollution during operation. Fuel or oil spills from maintenance vehicles have the potential to run-off into the watercourses draining the site. Similarly, maintenance activities such as the repair of damaged solar PV modules could result in contaminated runoff entering watercourses. There is a low likelihood of fuel spills due to the low quantity of maintenance vehicles and the impacts would be reduced with appropriate mitigation measures, including equipment provided to contain and clean up any spills of fuels as required.

10.11.15 The change in land use from productive agricultural land to Solar PV Panels would result in the reduction in the use of spray chemicals and fertilisers. This could result in a reduction in the amount of phosphates and nitrates entering the draining watercourses. This could result in a beneficial effect in relation to the NVZ status of catchments S245 and S243.

10.11.16 Taking into consideration the mitigation measures presented in Section 2.10 and the maintenance of vegetative cover at all times, the overall impact magnitude of increased pollution to watercourses has been assessed as negligible. All watercourses, taking into account their NVZ and WFD status together with their water use, have been assessed to be of medium sensitivity. Therefore, the significance of effect on the watercourses draining the site from an increase of pollution is negligible, which is not significant.

Designated sites

10.11.17 As described in Section 10.9, and in the paragraphs above, there is a potential risk of increased pollution during operation. The impacts would be reduced with appropriate mitigation measures, including equipment provided to contain and clean up any spills of fuels as required. Similarly, the distance of the designated sites from the Proposed Development and the presence of intervening vegetation would also reduce the magnitude of impact.

10.11.18 Taking into consideration the mitigation measures presented in Section 10.10, the impact magnitude of increased pollution to designated sites has been assessed as negligible. All designated sites have been assessed to be of high sensitivity. Therefore, the significance of effect on the designated sites draining the site from an increase of pollution is minor, which is not significant.

Groundwater

10.11.19 As described in Section 10.9, there is a potential risk of increased groundwater pollution during the operational phase. Fuel or oil spills from maintenance vehicles have the potential to percolate into the groundwater. Similarly, maintenance activities such as the repair of damaged solar PV modules could result in contaminated water percolating into the groundwater. The impacts have been reduced with appropriate mitigation measures, including equipment provided to contain and clean up any spills of fuels as required.

10.11.20 Taking into consideration the low level of construction excavation and the mitigation measures presented in Section 2.10, the impact magnitude of increased pollution to groundwater has been assessed as negligible. The groundwater body has been assessed to be of high sensitivity. Therefore the significance of effect on the groundwater body draining the site from an increase of pollution is minor, which is not significant.

Water Supplies

10.11.21 As described in Section 10.9 there is a potential risk of pollution to water supplies during the operation phase. Fuel spills from the refuelling of vehicles and machinery could percolate into the groundwater and impact upon the PWS as a result. A number of PWS locations were provided by Stockton-on-Tees Borough Council and Darlington Council, see Section 10.8.28, however, the location of the PWS are outside of the drainage pathway of the Site Area. One public water supply is located close to the Site Area in Byers Gill Wood.

10.11.22 Taking into consideration the mitigation measures present in Section 2.10 and that there are no PWS identified within the drainage pathway, and therefore no impacts would occur. For the public water supply the assessment of effect would remain as minor and not significant as per the groundwater assessment above.

Flood risk

10.11.23 As described in Section 10.9, there is potential risk of increased flood risk downstream as a result of the use of maintenance vehicles in certain areas which leads to areas of soil compaction, increased overland flow, soil erosion and alteration of flow pathways on site. The impact of this have been addressed and reduced in the FRA and Drainage Strategy (Appendix 10.1), which includes a proposed drainage scheme and maintenance plan ensuring that surface water run-off is managed as per existing site conditions.

10.11.24 Similarly, the long term impacts associated with construction within the fluvial flood plain would be limited as there would be no reduction in flood plain or interruption of flows as the solar PV modules would be raised above the fluvial flood depth.

10.11.25 Taking into consideration the mitigation measures presented in Section 10.10, the impact magnitude of increased flood risk has been assessed as negligible. Flood risk of nearby receptors (including residential dwellings and farm land) has been assessed to be of high to medium sensitivity. Therefore, the significance of effect of increased flood risk is minor to negligible, which is not significant. Further information on flood risk and drainage solutions for the Proposed Development is presented in Appendix 10.1 FRA and Drainage Strategy.

Decommissioning

10.11.26 The likely effects during decommissioning are likely to no worse than those experience during the construction phase. The same construction mitigation would be employed which would reduce the impacts to nearby receptors. As such, the assessment of effects remains the same as the construction phase.

10.12 Monitoring

10.12.1 Long term monitoring of the Proposed Development will occur, this includes the monitoring and maintenance of vegetation beneath the solar PV panels to ensure that erosion is not increased and grass will be cut to a minimum height of 50mm through the Landscape and Ecology Management Plan. Litter and debris will be removed from Gravel Aprons surrounding buildings within the Site Area and silt accumulation will be inspected and appropriately removed to ensure no blockage to infiltration capacity occurs.

10.13 Summary

10.13.1 This chapter has considered:

- Water quality changes to watercourses draining the Site Area

- Water quality changes to Designated Sites that are hydrologically linked to the Site Area
- Water quality changes to groundwater bodies within the Site Area
- Water quality changes to water Supplies within the vicinity of the Site Area
- Altered Flood Risk as a result of the Proposed Development within the Site Area

10.13.2 A summary of the assessment has been included in Table 10-8 below

Preliminary construction assessment

10.13.3 Construction of the Proposed Development would have a minor effect on watercourses, designated sites and groundwater. A minor to no effect has been assessed for flood risk. No effects are considered likely for private water supplies. No significant effects have been identified.

Preliminary operational assessment

10.13.4 Operation of the Proposed Development would have a negligible effect on watercourses, designated sites and groundwater. A minor to no effect has been assessed for flood risk. No effects are considered likely for private water supplies. No significant effects have been identified.

Preliminary decommissioning assessment

10.13.5 The likely effects during decommissioning are likely to no worse than those experience during the construction phase. The same construction mitigation would be employed which would reduce the impacts to nearby receptors. As such, the assessment of effects remains the same as the construction phase.

Table 10-8 Summary of effects

Receptor	Description of potential impact	Embedded design, mitigation, and enhancement measures	Sensitivity of receptor	Duration and reversibility	Magnitude of impact	Significance of effect
Watercourses	▪ Potential risk of increased pollution to watercourses ▪ Pollution may increase due to runoff from vehicles and solar PV modules and increased sediment transport	▪ No large scale excavations proposed ▪ Runoff and sediment control measures including minimal soil disturbance measures ▪ 8m buffer zone surrounding watercourses ▪ Equipment to contain and clean up fuel spills	▪ Medium	▪ Short-term duration related to spillage/temporary increased pollution	▪ Negligible	▪ Negligible
Designated Sites			▪ High		▪ Negligible	▪ Minor
Groundwater	▪ Risk of increased pollution as a result of operation and maintenance activities ▪ Risk of pollutants percolating into groundwater		▪ High		▪ Negligible	▪ Minor
Water Supplies	▪ Potential risk to PWS and public water supply during operation and construction as a result of pollution from vehicles and solar PV panels	▪ No PWS are located within the drainage pathway of the Site Area ▪ Pollution control and mitigation measures as described above.	▪ High	▪ Short-term duration related to spillage/temporary increased pollution	▪ PWS - No change ▪ Public water supply - negligible	▪ PWS - no change ▪ Public water supply - negligible
Flood Risk	▪ Potential risk of increased flood risk downstream as a result of soil compaction and increased overland flow ▪ Potential risk of altered flow pathways during operation	▪ Run-off control measures ▪ Proposed drainage scheme and surface water management plan is detailed in the FRA and Drainage Strategy (Appendix 10.1)	▪ High	▪ Potential for long-term duration due to alteration of flow pathways	▪ Negligible	▪ Minor to negligible

Further work

10.13.6 Further assessment and development of mitigation measures will be undertaken as part of the ES and through the completion of the following surveys, assessments and management plans:

- Infiltration testing will be undertaken to identify the infiltration capacity of the ground at strategic points throughout the Site Area;
- Further details will be gathered on water supplies within proximity of the Proposed Development Site to inform the assessment;
- Continued consultation with key consultees will be undertaken; and
- Undertake the in-combination and cumulative effects assessments.

Bibliography

[1] Department of Energy and Climate Change, "National Policy Statement for Energy," 2011.

[2] Department of Energy and Climate Change, "The National Policy Statement for Renewable Energy Infrastructure," 2011.

[3] D. f. E. a. C. Change, "National Policy Statement for Electricity Networks Infrastructure (EN-5)," The Stationery Office, London, 2011.

[4] Ministry of Housing, Communities and Local Government, "National Planning Policy Framework," 2021.

[5] Ministry of Housing, Communities and Local Government, "National Planning Practice Guidance," 2019.

[6] Stockton-on-Tees Borough Council, "Local Plan," 2019.

[7] Stockton-on-Tees Borough Council, "Strategic Flood Risk Assessment," 2010.

[8] Darlington Borough Council, "Local Plan," 2022.

[9] Highways England et al, "LA113 - Road drainage and the water environment," 2020.

[10] CIEEM, "Guidelines for Ecological Impact Assessment (EcIA)," 2018, updated 2022.

[11] CIRIA, "Envrionmental Good Practice on Site (4th Edition) (C741)," 2015.

[12] CIRIA, "Control of Water Pollution from Construction Sites (C532)," 2001.

[13] BGS, "BGS Geology Viewer," [Online]. Available: https://www.bgs.ac.uk/map-viewers/bgs-geology-viewer/. [Accessed 08 03 2023].

[14] Gov.uk, "Flood Map for Planning Flood Zones 2 and 3," 2023. [Online]. Available: https://www.data.gov.uk/dataset/aad465cd-505b-46d9-bbfd-6d6b68471657/flood-map-for-planning-flood-zones-2-and-3. [Accessed 08 03 2023].

[15] DEFRA, "Explore catchment data," 2022. [Online]. Available: https://environment.data.gov.uk/catchment-planning/. [Accessed 08 03 2023].

[16] GeoSmart, "GeoSmart Groundwater Flood Risk Map," 2023.

[17] DEFRA, "Magic Maps," 2022. [Online]. Available: https://magic.defra.gov.uk/MagicMap.aspx. [Accessed 03 08 2023].

[18] DEFRA, "LiDAR Data Download," 2019. [Online]. Available: https://environment.data.gov.uk/DefraDataDownload/?Mode=survey. [Accessed 08 03 2023].

[19] BGS, "Borehole records," [Online]. Available: https://www.bgs.ac.uk/information-hub/borehole-records/. [Accessed 12 03 2023].

[20] Scottish Environment Protection Agency (SEPA), "Guidance on assessing the impacts of development proposals on groundwater abstractions," 2017.

[21] Envrionment Agency, "Catchment Data Explorer," 2021. [Online]. Available: https://environment.data.gov.uk/catchment-planning. [Accessed 28 March 2023].

[22] Gov.UK, "Northumbria river basin district river basin management plan," 2018. [Online]. Available: https://www.gov.uk/government/publications/northumbria-river-basin-district-river-basin-management-plan. [Accessed 08 03 2023].

[23] Environment Agency, "Flood Map for Planning," 2023. [Online]. Available: https://flood-map-for-planning.service.gov.uk/. [Accessed 10 March 2023].