Dean Moor
Solar Farm

Environmental Statement: Appendix 2.4 – Flood Risk Assessment and Outline Drainage Strategy (1 of 3)

on behalf of **FVS Dean Moor Limited**

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Prepared by: Stantec UK Ltd
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DEAN MOOR SOLAR FARM
ENVIRONMENTAL STATEMENT
APPENDIX 2.4 – FLOOD RISK ASSESSMENT AND OUTLINE DRAINAGE STRATEGY
PLANNING INSPECTORATE REFERENCE EN010155
PREPARED ON BEHALF OF FVS DEAN MOOR LIMITED

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, Regulation 5(2)(a)

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1 Introduction

1.1 Background

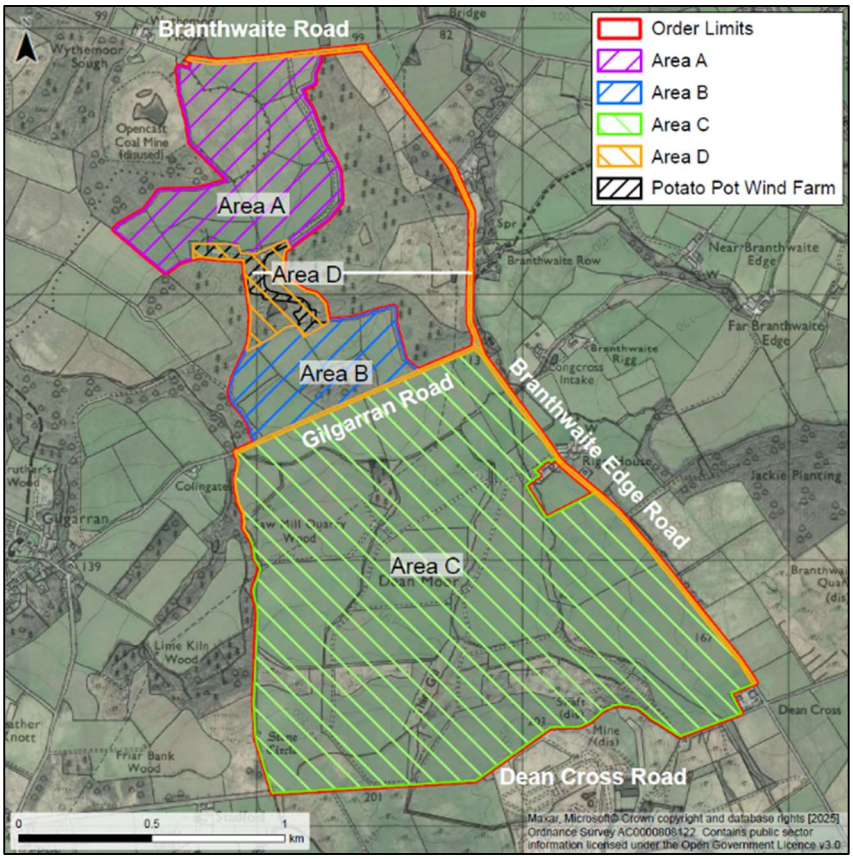
1.1.1 This Flood Risk Assessment ('FRA') and outline Drainage Strategy ('ODS') has been prepared on behalf of FVS Dean Moor Ltd (the 'Applicant'). The FRA is prepared to support an application for a Development Consent Order ('DCO') for the Dean Moor Solar Farm ('the Proposed Development') on approximately 276.50ha of land located between the villages of Gilgarran and Branthwaite in West Cumbria (the Site) (Environmental Statement ('ES') Figure 1.1) [**REF: 6.2**].

1.1.2 The term FRA is being used to encompass both the Flood Risk Assessment and the ODS, with the Drainage Strategy ('DS') secured by a DCO Requirement.

1.1.3 For ease of reference the Site is divided primarily into four areas referred to as Areas 'A', 'B', 'C', and 'D' as shown on ES Figure 3.1 [**REF: 6.2**].

- **Area A** – Land south of Branthwaite Road (approximately 40.2ha);
- **Area B** – Land south of Branthwaite Road and north of Gilgarran Road (approximately 19.9ha);
- **Area C** – Land south of Gilgarran Road and north of Dean Cross Road (approximately 203ha);
- **Area D** – Land connecting Areas A and B, including Potato Pot Wind Farm (the 'Wind Farm'), Gilgarran Road between Areas B and C, and Branthwaite Edge Road (approximately 13.4ha).

Figure 1.1: Solar Farm Area Plan (Extract of ES Figure 3.1)



1.1.4 The Site falls within the administrative area of Cumberland Council (the Council), which is also the Lead Local Flood Authority ('LLFA'). Several ordinary watercourses flow through the Site serving a land drainage function, including the Thief Gill. The Lostrigg Beck originates in the central east of the Site (within Area C) and flows beyond the Site in the north-east, where it becomes an Environment Agency ('EA') 'main river' watercourse (see Figure 3.1).

1.1.5 This assessment has been prepared in accordance with the National Policy Statement ('NPS') for Energy ('EN-1')[1], Renewable Energy Infrastructure ('EN-3')[2], and the national Planning Practice Guidance ('PPG')[3]. The FRA takes into account the requirements of the EA, Council policy (as Local Planning Authority ('LPA') and LLFA), and the Environmental Impact Assessment ('EIA') Scoping Opinion (ES Appendix

[1] HM Government (2024). Department of Energy Security & Net Zero (DESNZ). Overarching National Policy Statement for energy (EN-1)

[2] HM Government (2024). DESNZ. National Policy Statement for renewable energy infrastructure (EN-3)

[3] HM Government (2022). Ministry of Housing, Communities and Local Government (MHCLG). Planning Practice Guidance. Guidance Flood risk and coastal change

2.2) [**REF: 6.3**] and has included a review of relevant flood risk documents for the area, including the Council's Preliminary Flood Risk Assessment ('PFRA')[4], and Strategic Flood Risk Assessment ('SFRA')[5].

1.1.6 Mitigation measures are proposed to eliminate or limit the risk of flooding from surface water runoff in an extreme rainfall event. The drainage strategy for the Proposed Development will prioritise nature-based solutions for flood risk mitigation.

1.2 Scope

1.2.1 This FRA includes:

- A review of readily available information on flooding using data provided by the EA and other stakeholders including, where available, the SFRA;
- Evaluation of background hydrology;
- Assessment of the risks from all sources of flooding;
- Hydraulic analysis to demonstrate the suitability of the proposed approach;
- Assessment of the impacts of climate change on all forms of flooding; and,
- Consideration of the surface water drainage requirements and setting out the proposed ODS.

1.3 Proposed Development

1.3.1 The Proposed Development comprises the construction, operation, and decommissioning of solar photovoltaic ('PV') energy generating station with a total capacity exceeding 50 MW comprising solar PV arrays, grid connection infrastructure, associated infrastructure and green infrastructure - see further details in section 8.4 of this FRA.

1.3.2 The Proposed Development will be within the 'Order Limits' as shown in ES Figure 1.1. The FRA is based on the Parameter Plan, reproduced as Figure 1.2 of this FRA (Figure 3.4 of the ES). The description of the Site

[4] Cumbria County Council. (2011). Flood Risk Regulations 2009 – Preliminary Flood Risk Assessment: Preliminary Assessment Report.

[5] Cumbria County Council. (2018). Cumbria Minerals and Waste Local Plan. Strategic Flood Risk Assessment.

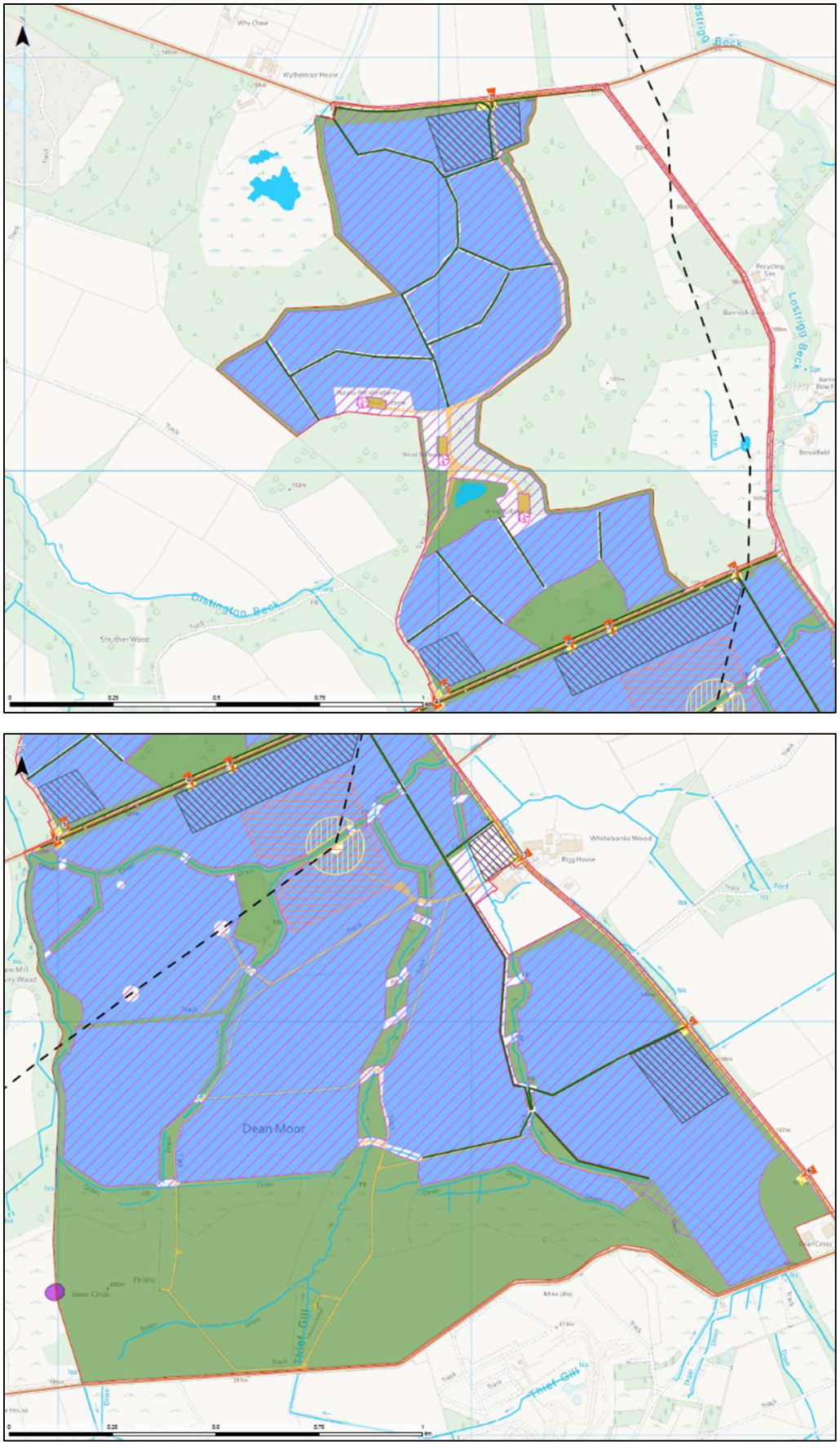
and the Proposed Development is as set out in ES Chapter 3 – Site and Proposed Development Description [**REF: 6.1**].

1.3.3 The Proposed Development will include the following key elements of infrastructure:

- Solar PV panels;
- Solar PV array mounting structures;
- Power Conversion System ('PCS') Units in the form of Inverters and Transformers;
- Grid Connection Infrastructure comprising Customer and DNO Substation Buildings and external electrical equipment and ancillary infrastructure within a Security Fence;
- Perimeter Fencing, Gates, CCTV cameras, electrical cabling, and other associated infrastructure;
- Access from the highway and internal access tracks; and
- Green infrastructure including landscape planting and ecological enhancements.

1.3.4 The Proposed Development initially included a Battery Energy Storage System ('BESS') facility. However, as the BESS has been removed from the Proposed Development, no further discussion on this topic is included herein.

Figure 1.2: Parameter Plan (Extract of ES Figure 3.4)



1.4 Sources of Information

1.4.1 The FRA has been prepared based on the following sources of information:

- EA published 'Open Data'[6] datasets available online, reproduced with Ordnance Survey ('OS') mapping under licence (see Appendix A), extracts of which have been utilised in Figures within the main text;
- Topographic survey of the Site (see Appendix B);
- Parameter Plan (ES Figure 3.4, reproduced as FRA Figure 1.2);
- Stakeholder correspondence, including the EA, United Utilities Water ('UUW') and the Council (see Appendix C);
- Existing Utility Infrastructure (see ES Figure 2.2) **[REF: 6.2]**;
- Cook, McCuen (2013) *'Hydrological response of solar farms'*, Journal of Hydrologic Engineering, volume 18, issue 5[7];
- OS LiDAR Mapping, dated June 2021;
- UK Centre for Ecology & Hydrology, Flood Estimation Handbook (FEH) Web service dated 2023[8];
- British Geological Survey ('BGS'), Geology Viewer[9] and Borehole data, dated 2023;
- Construction Industry Research and Information Association (CIRIA), The SUDS Manual V.6, C753, dated 2015[10];
- Department for Energy Security & Net Zero, Overarching National Policy Statement for Energy (EN-1), dated January 2024;
- Department for Energy Security & Net Zero, National Policy Statement for Renewable Energy Infrastructure (EN-3), dated January 2024;
- EA 'Flood Risk Assessments: Climate Change Allowances', published February 2016, updated May 2022[11];
- EIA Scoping Report (ES Appendix 2.1) [**REF: 6.3**];
- The 'Cumbria County Council (CCC) Minerals and Waste Local Plan Strategic Flood Risk Assessment' ('SFRA'), produced 2015, updated June 2018;
- The Council's Allerdale Local Plan (Part 1) (July 2014)[12];

[6] Contains Ordnance Survey data © Crown copyright and database right [2023] and also contains Environment Agency information © Environment Agency and database right

[7] Cook, L. and McCuen, R. (2013). 'Hydrological response of solar farms.' Journal of Hydrologic Engineering, volume 18, issue 5.

[8] UK Centre for Ecology & Hydrology. (2023). Flood Estimation Handbook (FEH)

[9] British Geological Survey. (2023). Geology Viewer. [Online]. Available at: https://geologyviewer.bgs.ac.uk/. Accessed November 2023

[10] Construction Industry Research and Information Association. (2015). The SUDS Manual V.6, C753.

[11] HM Government (2016, last updated 2022). Environment Agency. Guidance Flood risk assessments: climate change allowances

[12] Allerdale Borough Council (2014). Allerdale Local Plan (Part 1).

- ‘CCC Flood Risk Regulations 2009 – Preliminary Flood Risk Assessment: Preliminary Assessment Report’, updated June 2011;
- ‘CCC Flood Risk Management Strategy 2022’, dated 2022[13];
- ‘CCC Cumbria Surface Water Management Plan’, November 2012[14]; and
- ‘CCC Cumbria Development Design Guide’, dated January 2023[15].

1.5 Consultation / Engagement

1.5.1 During the statutory consultation which ran in April/May 2024, consultees, including the EA and the LLFA, were engaged to provide insights and feedback regarding flood risks and mitigation measures relevant to the Proposed Development. The consultation was conducted in accordance with sections 42, 47, and 48 of the Planning Act 2008[16], and a summary of the key points arising from the consultation is set out in Table 1.1.

1.5.2 The EA response from the statutory consultation process was received on 29 April 2024 and subsequently reviewed to ensure that all feedback was incorporated into the FRA’s findings and recommendations.

1.5.3 A meeting with the LLFA was held on 5 June 2024 to discuss the hydrological conditions at the Site and to confirm agreement in principle to the proposed approach to surface water drainage, as summarised in Table 1.1, with copies of the EA response and records of discussions in the meeting minutes appended in Appendix C.

1.5.4 A virtual meeting was held with the EA planning and modelling teams on 17th July 2025 to discuss further feedback provided in the EA’s Relevant Representation **[**RR-017**]**.

[13] Cumbria County Council. (2022). Flood Risk Management Strategy 2022.
[14] Cumbria County Council. (2012). Cumbria Surface Water Management Plan Phase 3 Report.
[15] Cumbria County Council. (2023). Cumbria Development Design Guide.
[16] HM Government (2008). Planning Act, 2008 c. 29

Table 1.1: Statutory Consultation Responses

Topic	Consultee Comment	Applicant's Response
Fluvial Flood Risk (Rivers and Sea)	**EA**: Concerns about the level of detail of the assessment of fluvial flood risks at the confluence with Lostrigg Beck particularly when allowing for climate change impacts. Concern that there could likely be fluvial flood risk at the confluence between the ordinary watercourses and the Lostrigg Beck where sensitive infrastructure (i.e. Grid Transmission infrastructure) is placed and we would like confidence that the risk has been investigated. **LLFA**: Confirm in June 2024 meeting (and subsequently in May 2025 formal response) that they are satisfied with the application of the existing open data sources for assessing the risk of flooding from all sources which is appropriate given the form of development and is generally considered more conservative The LLFA also acknowledged that the solar PV infrastructure would not impact floodplain storage and therefore had no objections regarding flood risk from the solar arrays.	This topic has been addressed via a comprehensive assessment that has been reinforced by engagement with the LLFA. Section 5 of this FRA provides an overview of flood risk from all sources. This includes the new Risk of Flooding from Rivers and Sea ('RoFRS') mapping, released in January 2025, which provides an overview of fluvial flood risk, including allowances for climate change. This confirms the Site is outside the fluvial flood risk area from the Lostrigg Beck in present day and climate change scenarios. The analysis confirms that the majority of the Site is at low flood risk, with isolated areas subject to higher risk due to local surface water flow routes and natural depressions. However, to verify use of the surface water mapping as a proxy for fluvial flood risk, a hydraulic analysis based on the generation of rating curves and utilising the EA-advised flows was agreed to be a proportionate response to address the EA's concerns (see Appendix D). Details on managing surface water runoff from the Site located in section 8 of this FRA. Section 8 also confirms that the solar PV infrastructure will not impact floodplain storage, aligning with LLFA position.
Pluvial Flood Risk (Surface Water)	**LLFA**: Expressed confidence in the outlined surface water management approach, describing it as robust. They recommend using this approach in areas with low or medium surface water flood risk but advised against using it in high-risk areas.	Section 8 of this report details a surface water management strategy that aligns with the LLFA recommendations. Measures will be focused in low to medium risk areas, while high-risk areas will be avoided where appropriate, addressing LLFA's advice.
Foundation Works Risk Assessment (FWRA)	**EA**: Advised that a foundation works risk assessment (FWRA) should be conducted if any If the ground investigation identifies contamination at	Addressed within the OCEMP (Appendix 5.1) [**REF: 6.3**] and ES Chapter 10 – Ground Conditions.

Topic	Consultee Comment	Applicant's Response
	the Site in the vicinity of where piled foundations will be used, to prevent potential contamination pathways.	
Water Quality	**EA & LLFA**: Expressed concern regarding water quality impacts from construction activities. EA stated it is broadly against the use of deep infiltration systems for surface water. LLFA added that any drainage proposals should avoid impacts on watercourses and that mitigation measures should be clearly outlined in the CEMP to address water quality risks during construction.	Water quality impacts at construction stage to be addressed through suitable mitigation as set out in the OCEMP (Appendix 5.1) which will be finalised and made fully detailed in the CEMP secured by a DCO Requirement. The ODS in FRA section 8 sets out the operational phase drainage proposals which avoids impact on watercourse by promoting measures such as buffer zones from watercourses, implementing filter materials where needed for improving water quality, and excludes the use of deep infiltration measures.
Watercourse crossing	**EA**: Confirmed that any crossings such as bridges or culverts will need to be designed to avoid ecological, geomorphological, and flood risk impacts.	The Proposed Development will aim to retain and reuse existing watercourse crossings. Where necessary, any new or improved crossings will be designed so they do not impede the ordinary watercourses across the Site. i.e., no lesser cross-sectional area than the existing channel. The OCEMP outlines the approach to watercourse crossings (including culverts/bridges or other structures). These would also be subject to an Ordinary Watercourse Consent ('OWC') process through the LLFA, or a Flood Risk Activity Permit ('FRAP') if within the proximity of a main river.
Watercourse Offsets	**LLFA**: Confirmed requirement for a minimum 8m buffer/offset to watercourses (taken from the centre of the top of the bank adjoining the watercourse), which aligns with EA guidance. Subsequent liaison was undertaken in February 2025 with both the LLFA and the EA. The LLFA email liaison (4th February 2025) was undertaken after an inconsistency was identified in the previous	Buffers that align with LLFA and EA requirements are established in the Work Numbers and Parameter Plan (Figure 1.2) for the Proposed Development. No development other than landscaping or crossings and outfalls which are subject to additional LLFA consents, will be undertaken in these buffers. Final layout and landscaping plans (including the LEMP) to be approved as DCO Requirements, will accord with the EA and LLFA guidance. The OCEMP sets out measures to be implemented to protect against

Topic	Consultee Comment	Applicant's Response
	correspondence relating to buffer offsets, and the LLFA reconfirmed that an 8m offset was required.	intrusion into these buffers during construction. As a strategy, the ODS within this FRA is based on the inclusion of these minimum buffers, and this ODS must be the basis of a final DS to be provided as a DCO Requirement.
Extreme Weather	**LLFA**: Advised that extreme weather events should be accounted for in the CEMP and the surface water management to mitigate impacts during construction. This includes specifying mitigation measures or shifting work to unaffected areas in case of high rainfall.	The OCEMP and Outline Soil Management Plan ('OSMP') (Appendix 5.3) **[REF: 6.3]** reflect the assessment of this FRA and includes provisions to account for extreme weather events, specifying measures in line with the LLFA's guidance to manage construction activities in the event of severe weather and high rainfall.
Sewer Flooding	**EA**: Raised concerns regarding the potential for sewer flooding impacts and requested confirmation of measures to prevent associated risks.	Engagement with UUW confirmed that they have no record of sewer flooding within the vicinity of the Site. Land searches provided in Appendix C show that there is a UUW clean water sewer runs along the eastern boundary within the Site (within the public highway but outside of where intrusive works would be undertaken).
Updated National Flood Risk Assessment ('NaFRA2')	**LLFA**: The LLFA also sought confirmation that the new NaFRA2 mapping would be used in the FRA, which was confirmed by email response. **EA**: The EA were also contacted in February 2025 to provide an overview of the Site mitigation strategy following release of the new NaFRA2 mapping. The EA response of 17th February 2025 confirmed that the EA were supportive of the proposed approaches but sought further detailed assessment of the surface water mapping. The EA response also indicated that the surface water mapping was only generated for catchments over 3km^2.	The updated NaFRA2 mapping is discussed in section 5.3 and 5.4. The Applicant considers the approach to be robust because of the proposed offsets from watercourses through the Site, the significant freeboard provided by the elevation of the proposed solar panels, and the well-defined and incised nature of the watercourses draining the Site. Nonetheless, as noted above, a hydraulic analysis (see Appendix D) has been undertaken to confirm the suitability of the mapping utilised in the FRA. Furthermore, the EA comment that the surface water mapping was only generated for catchments over 3km^2 is deemed to be an error as it refers instead to fluvial flood risk mapping (there are numerous drainage channels shown over the Site with evidently smaller catchments). The EA subsequently acknowledged this error.

1.6 Caveats and Exclusions

1.6.1 The Construction (Design and Management) Regulations 2015 ('CDM')[17] will apply to any future development of this Site which involves *'construction'* work, as defined by CDM. As such it is the responsibility of the Applicant (or any 'Client' in CDM terms) to fulfil its duties under CDM.

[17] Health and Safety Executive. The Construction (Design and Management) Regulations 2015.

2 Planning Policy Context

2.1.1 This FRA has been prepared in accordance with the relevant national and local planning policy and statutory authority guidance as detailed below.

2.2 National Policy Statement for Energy

2.2.1 The overarching NPS for Energy (EN-1) came into force in January 2024. This identifies both water quality and resources, and flood risk, as topics requiring consideration / assessment and requires that where a proposed development is likely to have effects on the water environment:

- Paragraph 5.16.3: *'Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the Project on, water quality, water resources and physical characteristics of the water environment'*;
- Paragraph 5.8.13 confirms that *'an application should be accompanied by a FRA for energy projects of 1ha or greater in FZ1 and all energy projects in FZ2 and FZ3'*;
- Paragraph 5.16.4: *'The applicant should make early contact with the relevant regulators, including the local authority, the Environment Agency… where appropriate, for relevant licensing and environmental permitting requirements'*;
- Paragraph 5.8.23: *'All projects should apply the Sequential Test to locating development within the site'*; and
- Paragraph 5.8.27: *'The surface water drainage arrangements for any project should, accounting for the predicted impacts of climate change throughout the development's lifetime, be such that the volumes and peak flow rates of surface water leaving the site are no greater than the rates prior to the proposed project, unless specific off-site arrangements are made and result in the same net effect.'.*

2.2.2 EN-1 refers applicants to the National Planning Policy Framework ('NPPF') and the associated Flood Risk and Coastal Change PPG for further details regarding the requirements for FRAs.

2.2.3 EN-1 Paragraph 5.8.36 confirms that preference should be given to locating projects in areas of lowest flood risk and development should not be consented in higher flood risk areas (Flood Zones ('FZs') 2 and 3 in England), accounting for all sources of flooding and the predicted impacts of climate change, unless sequential test requirements have been met.

2.2.4 The NPS for Renewable Energy Infrastructure ('EN-3') addresses climate change adaptation and requires applicants to set out how proposals would be resilient to rising sea levels and increased risk of flooding. In respect of water quality and resources, EN-3 refers to the assessment requirements set out in EN-1.

2.2.5 While EN-3 refers to EN-1 regarding the considerations to be accounted for to ensure that renewable energy infrastructure is safe and resilient to climate change, it does provide guidance on aspects of solar farm development:

- EN-3 Paragraph 2.4.11 notes that *'solar PV sites may be proposed in low lying, exposed sites…' and '…applicants should consider how plant will be resilient to the increased risk of flooding.'*
- Paragraph 2.10.84 goes on to advise that a FRA *'…will need to consider the impact of drainage. As solar PV panels will drain to the existing ground, the impact will not, in general, be significant.'*
- Paragraph 2.10.85 then promotes the use of localised SuDS for elements of the development, stating *'Where access tracks need to be provided, permeable tracks should be used, and localised Sustainable Drainage Systems (SuDS), such as swales and infiltration trenches, should be used to control any run-off where recommended.'*

2.2.6 The NPS for Electricity Networks Infrastructure ('EN-5') provides the basis for applications received for electricity network infrastructure and sets out factors influencing route selection and the impacts that may arise. However, EN-5 refers back to EN-1 on the assessment of flood risk and consideration of resilience to climate change and does not therefore set out additional policy in respect of flood risk.

2.3 National Planning Policy Framework and Guidance

2.3.1 National policy in relation to flood risk is contained within the NPPF in Section 14 *'Meeting the challenge of climate change, flooding and coastal change'*, the latest version of which was released in December 2024[18].

2.3.2 The associated PPG for 'Flood Risk and Coastal Change' provides greater detail on the flood risk policy requirements. In May 2022, the guidance

[18] HM Government (2024). MHCLG. National Planning Policy Framework.

within the PPG on the application of climate change allowances in FRAs was significantly updated[19].

2.3.3 A key aspect of the NPPF is the sequential risk-based approach taken in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas. The NPPF sets out the requirement for the Sequential Test in paragraphs 173 to 177, extracts of which are included below. The Exception Test is detailed in paragraph 178. Further context is provided in section 6 of this FRA:

'173. A sequential risk-based approach should also be taken to individual applications in areas known to be at risk now or in future from any form of flooding, by following the steps set out below.

174. Within this context the aim of the sequential test is to steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test.

175. The sequential test should be used in areas known to be at risk now or in the future from any form of flooding, except in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk)…

…177. Having applied the sequential test, if it is not possible for development to be located in areas with a lower risk of flooding (taking into account wider sustainable development objectives), the exception test may have to be applied. The need for the exception test will depend on the potential vulnerability of the site and of the development proposed, in line with the Flood Risk Vulnerability Classification set out in Annex 3.'

2.3.4 The NPPF Annex 3 confirms the *'Flood risk vulnerability classification'* of a site, depending upon the proposed usage, and this classification is applied to PPG Table 2 *'Flood risk vulnerability and flood zone incompatibility'* to determine the suitability of development within a specified FZ and the requirements for additional planning tests (i.e. the Exception Test). As noted in section 6, the NPPF Annex 3 includes 'solar farms' as 'Essential Infrastructure', which is considered appropriate in FZs 1 and 2, and acceptable in FZs 3a and 3b subject to the Exception Test.

[19] HM Government (2016, last updated 2022). Environment Agency. Planning Practice Guidance. Flood risk assessments: climate change allowances

2.3.5 The PPG provides contingency allowances for the potential increases in peak river flow, peak rainfall intensity and sea level rise which are considered accordingly subject to the Site conditions – discussed further in section 5.

2.4 Local Policy and Guidance

2.4.1 Local planning policy in relation to flood risk is detailed in the adopted Allerdale Local Plan (Part 1).

2.4.2 Policy 'S29 Flood Risk and Surface Water Drainage' states:

'Developments should be avoided in locations that would be at risk of flooding or where it would increase the level of flooding elsewhere. Development within areas at the greatest risk of flooding, as identified within the Allerdale Strategic Flood Risk Assessment (SRFA) and/or Lead Local Flood Authority (LLFA) Local Flood Risk Management Strategy, will be strongly resisted. In order to minimise the risk to people, property and places from flooding, the Council will:

a) Assess all proposed development sites through both the Site Allocations process and development proposals against the SFRA and/or LLFA Local Flood Risk Management Strategy and ensure that new development is fully compliant with the national policy and guidance.

b) Ensure that developments identified in national policy as requiring a Flood Risk Assessment, should ensure that as a minimum, the scale and nature of the assessment should be appropriate with the development proposals and should be completed in accordance with national policy and guidance.

The Council will expect all developers to demonstrate that they have separated surface water from foul drainage to remove pressure on foul drainage system. The Council expect the incorporation and/or retention of soft landscaping, permeable surfaces, water storage systems and infiltration systems (SuDS) to have been considered for all developments.

The Council will expect all new developments to defer to the drainage hierarchy, seeking to incorporate Sustainable Drainage Systems (SuDS) in preference to discharge to local watercourses or the main sewer. Proposals seeking to discharge surface water to local watercourses or the main sewer will normally be resisted, unless it can be demonstrated to the satisfaction of the Council that:

c) Local ground conditions render a SuDS system impractical; or

d) The cost of installation, maintenance and, where appropriate, operation would render the scheme economically unviable.

In circumstances where a SuDS system is deemed practical and viable, developers will be required to seek the approval of the SuDS Approval Body (SAB) and to submit a management plan outlining how the system will be maintained and managed in the long term. Developers will be required to enter into a planning obligation in order to secure the long term management responsibilities of the SuDS in perpetuity.

2.4.3 The online CCC Cumbria Development Design Guide, provides guidance on the implementation of SuDS within Cumbria. Further detail in relation to this guidance is provided in section 8.

2.4.4 The CCC Flood Risk Management Strategy identifies the objectives and subsequent policies of the LLFA. These objectives P1 – P5 can be summarised as follows:

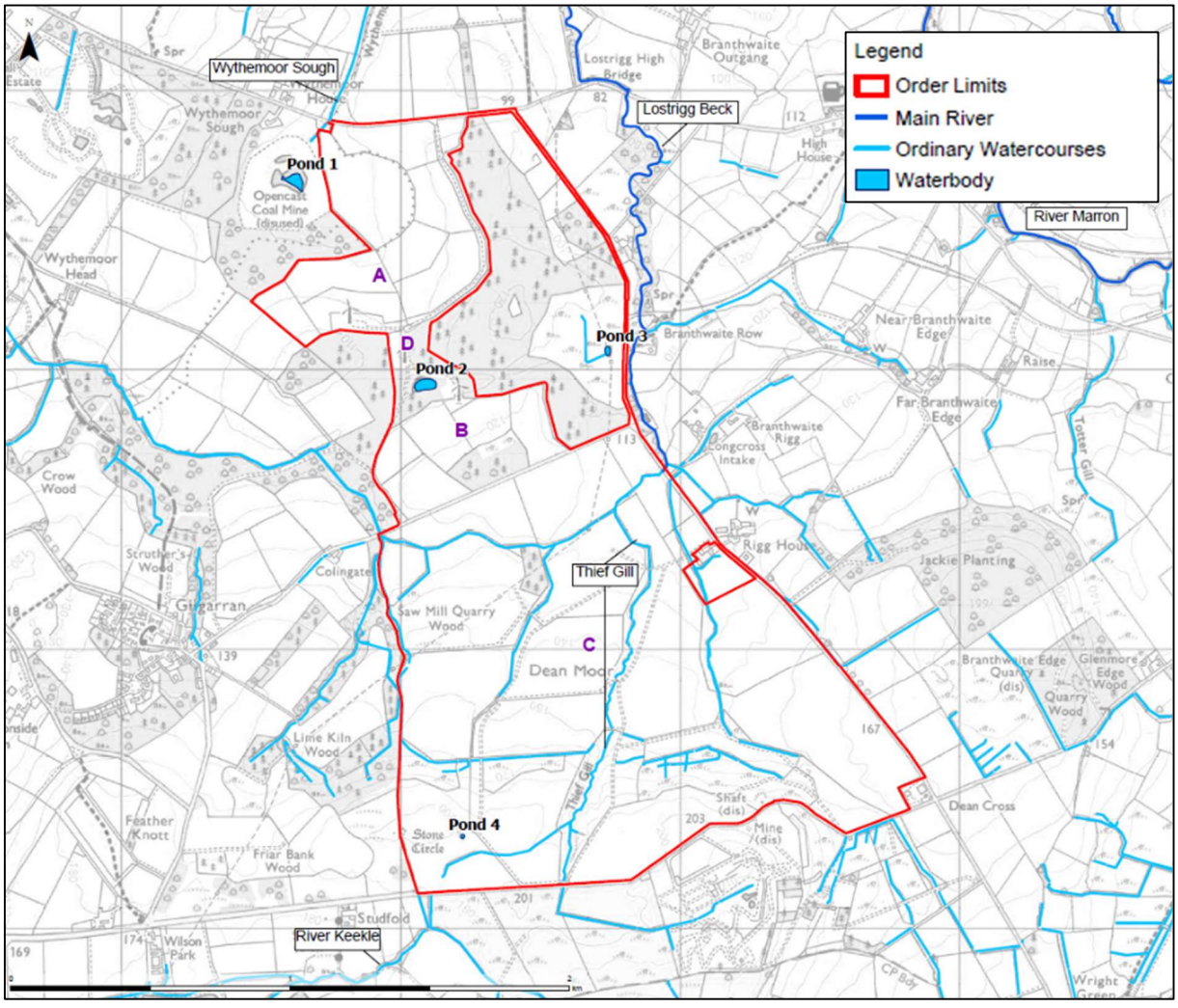
- Policy Objective 1 (P1) *'Reduction in flood risk to the people of Cumbria…the central objective of flood risk management should be to reduce the risk of flooding wherever possible.'* The objective notes that flood management does not always mean construction of flood defence measures; maintenance of existing assets can be cost effective and sustainable, and local communities should be involved in the development of flood risk mitigation;
- Policy Objective 2 (P2) '*Increased knowledge and awareness of the factors affecting flooding across Cumbria'*. Local research of flooding needs to be carried out, to understand the likely impact of flooding, and resultant prioritising of areas and solutions;
- Policy Objective 3 (P3) '*Ensure that flood risk management is integrated within the planning process in Cumbria'*. Flood risk management needs to be unified with planning, to prevent the initial alteration of flood risk, and seek to avoid development in flood risk areas unless justified;
- Policy Objective 4 (P4) *'Facilitate close partnership working between all risk management authorities'*: This emphasises the importance of formal close collaboration between different risk management authorities; and
- Policy Objective 5 (P5) *'Improve Community Resilience through awareness of flood risk'*: Improving the awareness and understanding of communities at risk of flood risk, to enable better communication and coordination.

3 Site Setting

3.1 Surrounding Hydrological Network

3.1.1 Several ordinary watercourses provide land drainage and flow across the southern part of the Site (Area C), the most significant among them being the 'Thief Gill' (see Figure 3.1) (FRA_005 in Appendix A). These flow through the Site from the south and west, combining and flowing towards the northeast corner of Area C.

Figure 3.1: Hydrological Context of Site



3.1.2 After passing beyond the Site and under Branthwaite Edge Road, the combined channel becomes an EA designated 'main river', the Lostrigg Beck, which continues north to eventually outfall into the River Marron, approximately 6.5km northeast of the Site.

3.1.3 There are no ordinary watercourses within Areas A or B, but the land falls towards the northwest corner of the Site where a land drainage channel, the 'Wythemoor Sough' is formed flowing north beyond the Site boundary. This ordinary watercourse flows east, to discharge into the Lostrigg Beck approximately 400m north of the Site. There are no watercourses are present over Area D.

3.1.4 There is a pond located centrally within Area D. Land falls at a shallow gradient west from the pond, indicating that any overflow would discharge in this direction towards the ordinary watercourse within Struther Wood, beyond the western boundary of the Site. Additionally, there is a second pond located outside the Site boundary to the northwest of Area A, which is likely to receive overland flows from Area A as the land falls in that direction. Smaller areas of ponding may be present in localised depressions over the Site. For example, there is an ephemeral (a non-permanent) pond located in Area C. Further information on locations of ponds is available from ES Appendix 8.1 – Preliminary Ecological Appraisal (PEA).

3.1.5 Further details of the ecological status of the watercourses and hydrological features, including baseline habitat assessments (RiverMorph survey), is discussed in the ES Chapter 8 – Biodiversity, Appendix 8.1 PEA, and Appendix 8.8 - Biodiversity Net Gain Report.

3.1.6 There are no flood defences in the vicinity of the Site.

3.2 Topography

3.2.1 A topographic survey of the Site (Appendix B) was undertaken in April 2023 and provides a detailed overview of the ground levels across the Site.

3.2.2 Given the scale of the Site, EA *'Light Detection and Ranging'* (LiDAR) remote sourced survey data has been utilised to provide a graphical representation of the area topography – see Figure 3.2; this is typically accurate within the range of +/- 100mm and therefore is considered

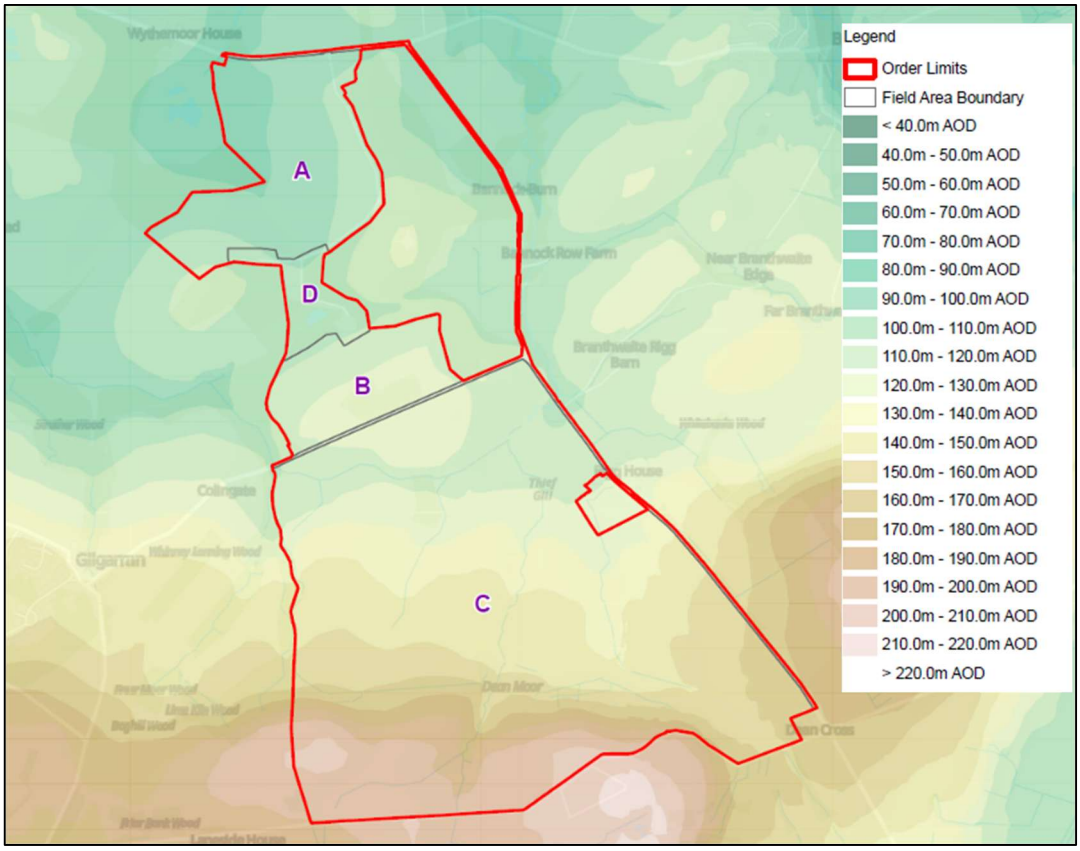
suitable for such purposes for the FRA, given the Site varies in elevation by over 100m.

3.2.3 The detailed topographic survey has been incorporated to consider the detailed impacts at the site level, including for the detailed overland flow route assessment (see Figures 003A to 003D in Appendix A) and at the detailed design stage as necessary to inform area-specific drainage arrangements.

3.2.4 The topography across the key Site areas can be summarised as follows:

- **Area A** – the ground falls from high points of approximately 112m AOD in the south-eastern and south-western corners of the parcel, to 83m AOD in the north-western corner of the northern parcel;
- **Area B** – the ground falls from approximately 128m AOD in the central southern boundary to 107m AOD in the north-eastern border;
- **Area C** – the ground falls from peaks of approximately 206m AOD in the lower south-western boundary of the Site to 107m AOD in the north-western corner of the parcel.
- **Area D** – The ground falls from approximately 108m AOD in the south-western border to 98m AOD in the central north-western border.

Figure 3.2: Topography (LiDAR Overview)



3.3 Geology

3.3.1 The geological information has been provided from the Phase 1 Ground Conditions Assessment (ES Appendix 10.1) [**REF: 6.3**]. This information, taken from the BGS Geology of Britain Viewer, indicates that the superficial and bedrock geology varies across the Site and throughout each parcel, as follows:

Area A

- **Bedrock Geology**: Primarily '*Pennine Middle Coal Measures Formation - Mudstone, siltstone and sandstone'* along the central northern reaches of the parcels with '*Pennine Lower Coal Measures Formation, mudstone, siltstone and sandstone'* over the southern eastern boundaries.
- **Superficial Deposits**: Primarily '*Till, Devensian – Diamicton'* in the north-eastern part of the parcel, with '*Unknown'* (assumed to be topsoil only) prevailing in the western extents.

Area B

- **Bedrock Geology:** Primarily '*Pennine Lower Coal Measures Formation, mudstone, siltstone and sandstone'*, with minor areas of '*Pennine Middle Coal Measures Formation - Mudstone, siltstone and sandstone'* along the southern edge of the parcel.
- **Superficial Deposits:** Primarily '*Unknown'* (assumed to be topsoil only) across the parcel, with '*Till, Devensian – Diamicton'* along the southern and south-eastern borders.

Area C

- **Bedrock Geology**: Area C has the most diverse distributions of bedrock geology, with the parcel primarily comprising '*Pennine Middle Coal Measures Formation - Mudstone, siltstone and sandstone'* along the central area. '*Pennine Lower Coal Measures Formation, mudstone, siltstone and sandstone'* is located along the eastern edge, '*Whitehaven Sandstone Formation – Sandstone'* in the lower south of the Site, and patches of '*Stainmore Formation - Mudstone, siltstone and sandstone'* along the central-eastern border, spreading patchily along a horizontal axis through the centre of the Site.
- **Superficial Deposits**: Area C is the most diverse in geological distributions, with '*Till, Devensian – Diamicton'* prevailing in the north-eastern parts of the parcel, and '*Unknown'* (assumed to be topsoil only) in the south-west corner. However, further within these, accumulations of '*Alluvium - Clay, silt, sand and gravel'* exist along the route of the ordinary watercourses over the central/east area of the Site, and '*Peat - Peat. Sedimentary superficial deposit'* along the west and southern boundaries.

Area D

- **Bedrock Geology:** Primarily '*Pennine Lower Coal Measures Formation, mudstone, siltstone and sandstone'*, with minor areas of '*Pennine Middle Coal Measures Formation - Mudstone, siltstone and sandstone'.*
- **Superficial Deposits**: Primarily '*Unknown'* (assumed to be topsoil only) across the parcel.

3.4 Hydrogeology

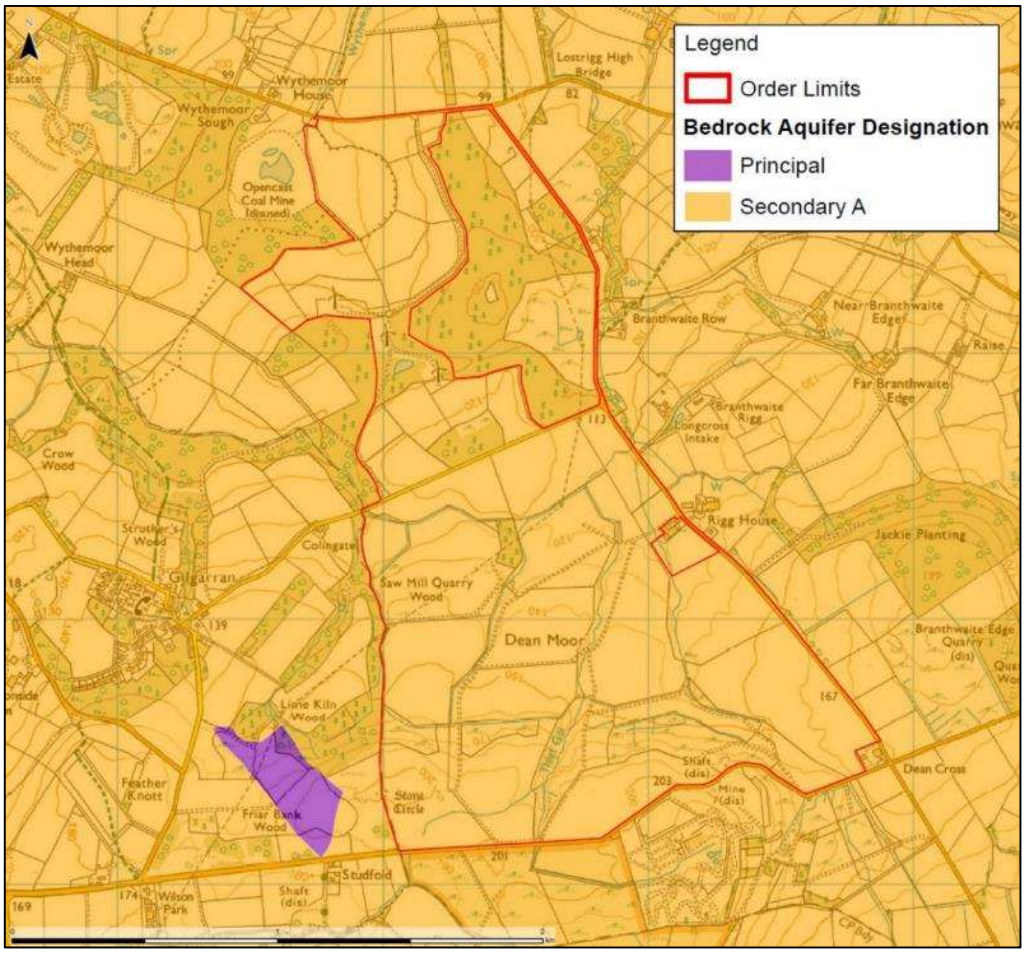
3.4.1 Aquifer designations are put in place to help protect groundwater, as the type of aquifer over a site will affect how vulnerable it is to pollution and how much is available for abstraction.

3.4.2 'Principal' and 'Secondary' aquifers are designated by the EA as hydrogeological features of potentially of strategic importance, which have high permeability and storage potential, and may also support rivers and wetland environments.

3.4.3 The Site fully sits within the 'Secondary A' aquifer designation; these comprise permeable layers which have the potential to support local water supplies and may form an important source of baseflows to rivers (Figure 3.3).

3.4.4 Groundwater 'vulnerability' describes the vulnerability of groundwater to pollution and what, if any, natural protection exists. It is classified as 'Medium – Low' and 'Low' within Areas A and B, north of the Gilgarran Road, and 'Medium – High' and 'High' for Area C south of the Gilgarran Road.

Figure 3.3: Bedrock Aquifer Designation

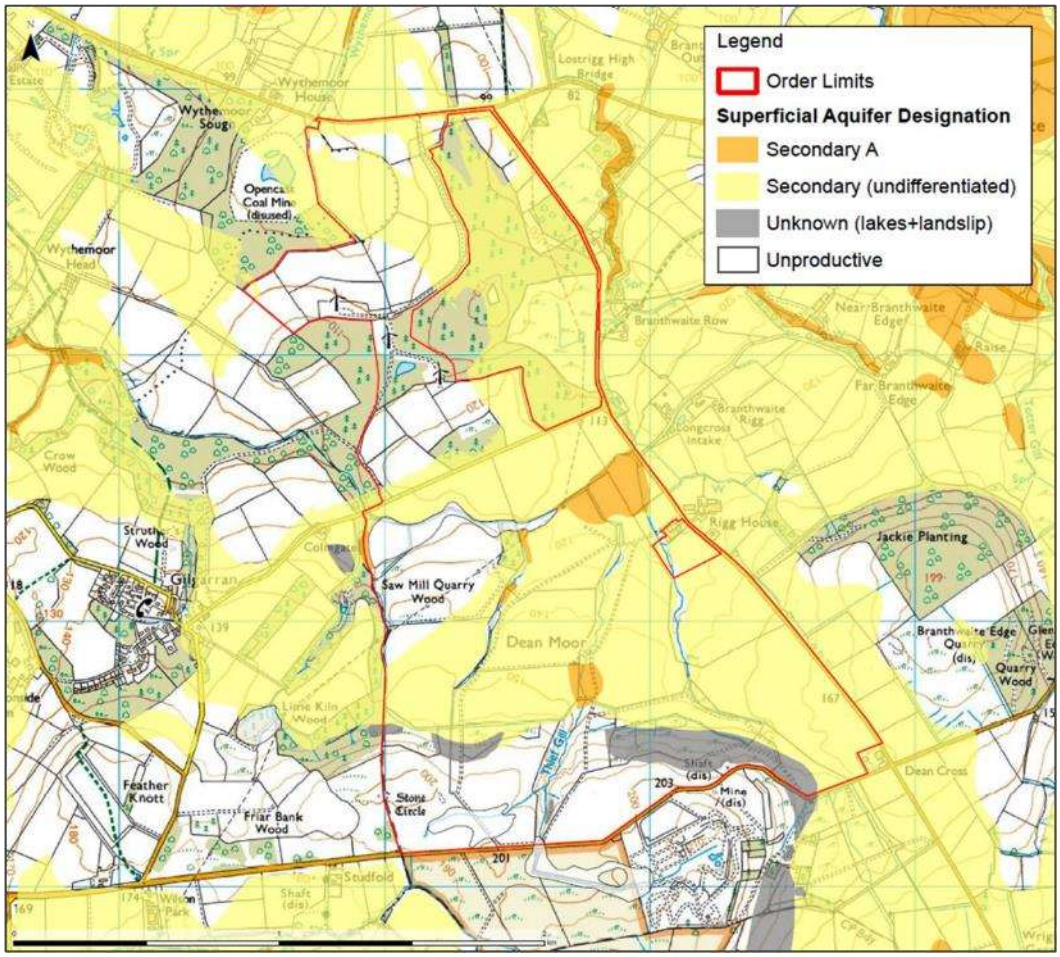


3.4.5 According to the online EA Aquifer Vulnerability Designation Mapping[20], the underlying superficial and bedrock strata have varied classifications over the Site; within the northern aspects of the Site there are low and medium–low vulnerability aquifers, whilst a small area in the lower south-west of the Site comprises medium–high and high, and the south-east comprises medium and medium–high vulnerability.

3.4.6 As shown in Figure 3.4, the EA's Aquifer Designation Mapping indicates a superficial aquifer classified as 'Secondary (undifferentiated)' that extends across over 50% of the Site from the east, partially affecting Area A and Area C and affecting the eastern edge of Area B. The majority of Area B, and all of Area D, is classified as Unproductive.

[20] Magic Maps. Available at: https://magic.defra.gov.uk/MagicMap.aspx Accessed November 2023

Figure 3.4: Superficial Aquifer Designation



3.4.7 EA-defined groundwater Source Protection Zones ('SPZs') are designated zones which show the level of risk to the groundwater source (such as wells, boreholes and springs) from contamination. The Site is not located within an SPZ, nor does it lie within Drinking Water Protected Areas (surface water) or Drinking Water Safeguard Zones (both surface and groundwaters).

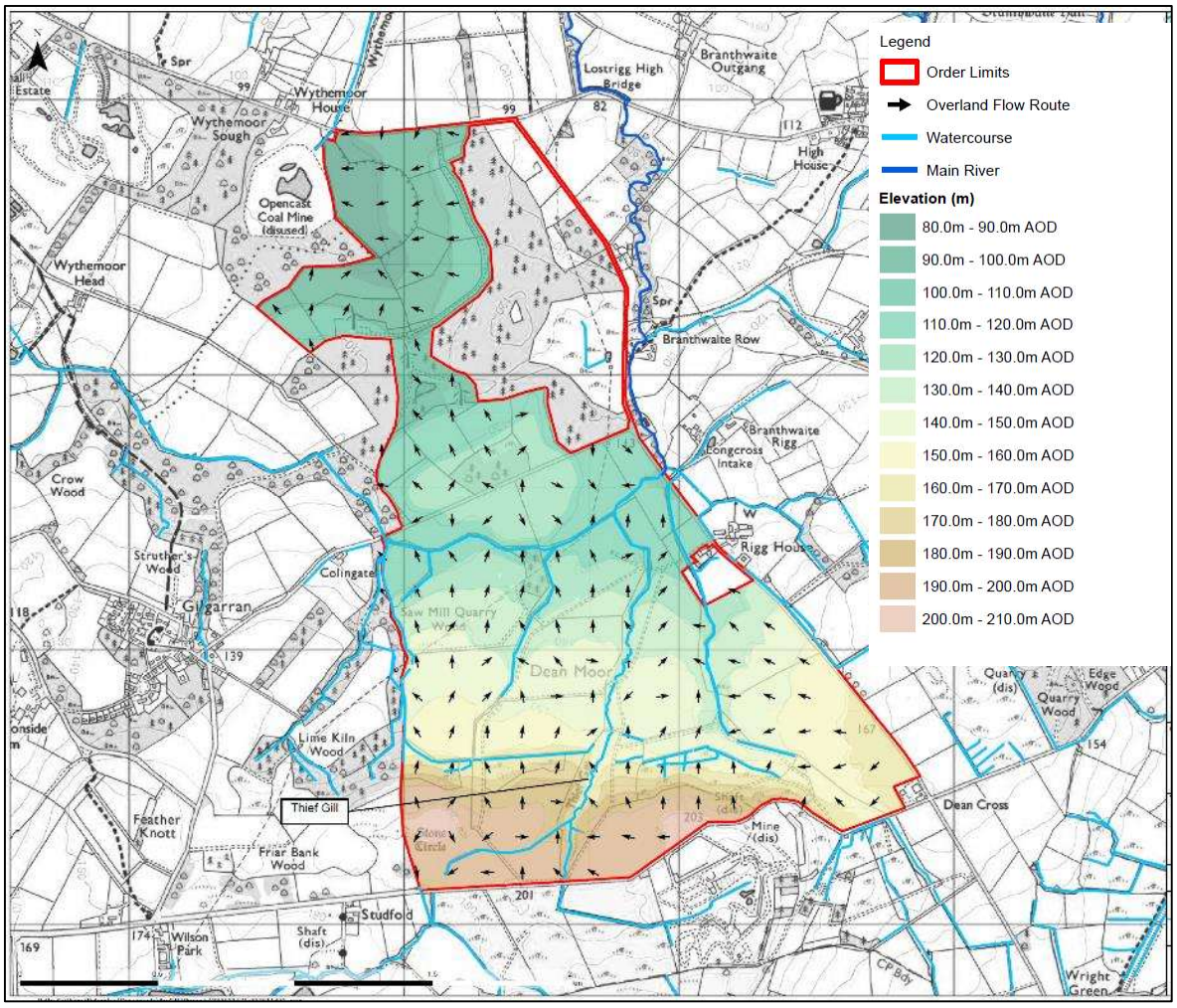
3.5 Existing Drainage Arrangements

3.5.1 As detailed in Sections 3.1 and 3.2, there are a number of ordinary watercourses flowing across the Site which provide a land drainage function, and their location and direction follow the base of the natural land drainage catchments over the Site, mainly routing towards the Lostrigg Beck main river to the north-east.

3.5.2 A high-level flow path analysis is displayed on Figure 3.5 and detailed versions (FRA_003A to 003D) is included in Appendix A, which are based on the Site's detailed topographical survey data. This illustrates the above pattern of the fall across the natural topography towards the land drainage channels, particularly over Area C where the topographical changes are most stark, and the overarching pattern is a routing of surface water towards the Lostrigg Beck in the northeast corner of that Area. The Areas A and D further north show less significant changes in elevation, with a natural fall towards the north-west corner of the Site and the Wythemoor Sough ordinary watercourse, although this also flows east beyond the Site and outfalls into the Lostrigg Beck.

3.5.3 As such, the existing surface water drainage arrangements appear to follow the natural greenfield arrangements with rainfall currently draining either naturally via runoff into the land drainage channels or infiltrating into the ground where geological and hydrogeological conditions allow.

Figure 3.5: Surface Water Overland Flow Routes



3.5.4 There is no record that the Site is served by any 'formalised' existing artificial surface water drainage system, although it is understood there may be some legacy agricultural drainage present which serves to prevent waterlogging and enhance the natural land drainage for grazing use. Such elements – and how they will be addressed, and how these will be dealt with over the Site, are considered as part of section 12 of the OCEMP (Appendix 5.1).

4 Impact of Climate Change

4.1 Climate Change Allowance Guidance

4.1.1 This FRA sets out how the Proposed Development will take account of the projected impacts of climate change, using Government guidance and industry standard benchmarks such as the Climate Change Allowances for Flood Risk Assessments. This guidance provides contingency allowances for potential increases due to climate change in:

- Peak river flow;
- Rainfall intensity; and
- Sea level rise.

4.1.2 Peak river flow is considered further in Section 4.2.

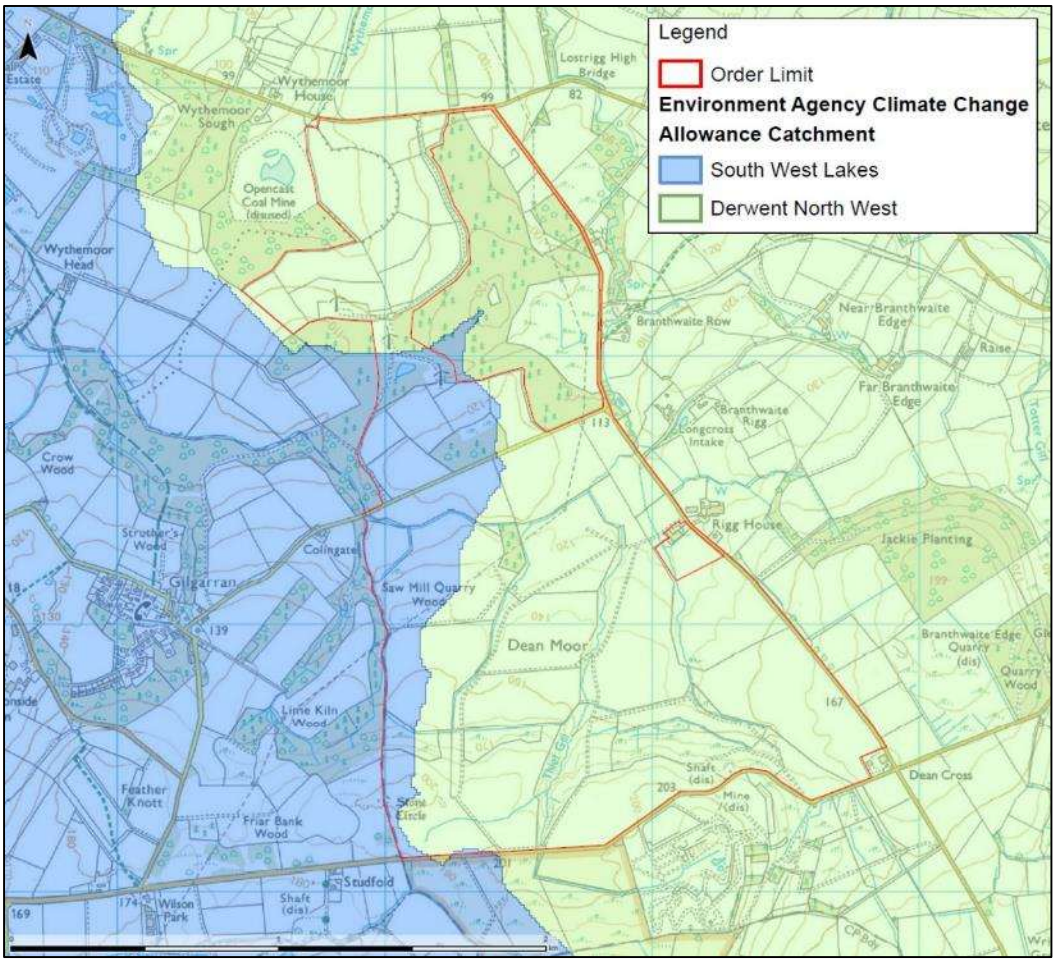
4.1.3 Sea level rise is not applicable given the Site location and elevation.

4.2 Peak River Flow

4.2.1 The peak river flow allowances provide a range of allowances based on percentile (i.e., the degree of certainty of an event occurring, based on the range of climate change scenarios assessed through scientific investigations). The applicable values for a site are dependent on the sub-catchment of river basin district (known as management catchments) in which the site is located, which can be confirmed via the online mapping tool embedded within the guidance.

4.2.2 As shown in Figure 4.1, the majority of the Site is located within the 'Derwent North West' Management Catchment, but portions of Areas B, C, and D lie within the 'South West Lakes' Management Catchment. As such, peak river flow climate change allowances are provided for both catchments.

Figure 4.1: EA Climate Change Allowance Catchments



4.2.3 'Essential Infrastructure' requires application of the 'Higher Central' value as the design standard. Furthermore, the EA have confirmed that the Proposed Development would be considered a 'Nationally Significant Infrastructure Project' ('NSIP') which requires the consideration of the 'Upper End' allowance for sensitivity testing.

4.2.4 The conditions at the Site and consequent peak river flow allowances to be considered as part of the FRA are as detailed in Table 4.1. The Proposed Development is considered to have a design life of approximately 40 years, but as a precautionary approach the 2080s epoch allowances have been considered in the assessment of flood risk (noting the allowances for the Derwent North-West catchment are higher – and therefore more precautionary – than the South West Lakes equivalents).

Table 4.1: Derwent North West - Peak River Flow Climate Change Allowances

Derwent North West Management Catchment Epoch	Applicable Climate Change Allowance *(2000s Epoch – 2040-2069)*		
	Central	Higher Central	Upper End
2020s (2015-2039	+15%	+19%	+28%
2050s (2040-2069)	+23%	+31%	+49%
2080s (2070-2125)	+40%	**+51%**	**+80%**

Table 4.2: South West Lakes - Peak River Flow Climate Change Allowances

South West Lakes Management Catchment Epoch	Applicable Climate Change Allowance *(2000s Epoch – 2040-2069)*		
	Central	Higher Central	Upper End
2020s (2015-2039	+12%	+14%	+22%
2050s (2040-2069)	+17%	+23%	+38%
2080s (2070-2125)	+30%	+39%	+63%

4.2.5 The Site is entirely in FZ1, and the adjacent areas of fluvial flood risk are confined to a narrow corridor of floodplain along the upper reaches of the Lostrigg Beck main river watercourse beyond the eastern boundary of the Site, both for present day and climate change projections (see section 5.2 for further details).

4.2.6 No Site-specific detailed hydraulic modelling is available and given the location at the head of the local drainage catchment the surface water mapping has been used as a proxy for the fluvial flood risk. To verify this assumption, a hydraulic analysis has been undertaken in accordance with a methodology agreed with the EA to verify that the flood risk from the EA 'Risk of Flooding from Surface Water' ('RoFSW') mapping is appropriate – see Appendix D and sections 5.3 and 5.4 of this FRA.

4.2.7 This analysis utilised precautionary flood flows provided by the EA and assessed the impacts over part of the Site for the 'design' 1 in 100 Annual Probability (AP) +51% (Higher Central) climate change allowance scenario

based on the 2080s epoch. A sensitivity test applying the equivalent event with a +80% (Upper End) was also undertaken. This confirmed the approach was robust, with flood extents comparable to the RoFSW mapping utilised in the analysis.

4.2.8 The hydraulic analysis has been reviewed by the EA, and it has been confirmed that the analysis provides confidence that it is appropriate for the application to rely on the RoFSW mapping as a proxy for fluvial flood risk across the Site. How this has enabled the FRA to address issues raised by the EA is discussed further in section 7.3.

4.3 Peak Rainfall

4.3.1 The EA climate change allowances guidance was updated in May 2022 to include a GIS based 'peak rainfall allowances' map showing the anticipated changes in rainfall intensity based on river management catchment. The anticipated changes in peak rainfall intensity in small catchments (less than 5km^2), or urbanised drainage catchments are summarised in Table 4.3 for both the South West Lakes and Derwent North West areas (i.e., the same values apply to both catchments).

4.3.2 The Proposed Development is considered to have an operational life of 40 years. The guidance specifies that for developments with a design lifetime of between 2061 and 2125 (i.e. minimum 50 years lifetime), the 2070s epoch is to be applied for design purposes. The guidance recommends that the 'Upper End' allowances are used.

Table 4.3: Climate Change Allowances for Peak Rainfall Intensity (2070s Epoch)

South West Lakes Management Catchment Plan	**Total potential change anticipated** *(2070s epoch – i.e. 2061 to 2125)*	
	Central	***Upper End***
3.3% (1 in 30-year) rainfall	35%	45%
1% (1 in 100-year) rainfall	35%	50%

4.3.3 The climate change allowances in relation to peak rainfall intensity are considered further in section 8.

5 Assessment of Flood Risk

5.1.1 The assessment of flood risk has been undertaken based on the sources of information listed in section 1.3. The baseline flood maps have been taken from the GIS flood maps report in Appendix A, utilising the EA Open Data datasets available online and reproduced with OS mapping under licence.

5.2 Historic Flooding Records

5.2.1 Details of historic flooding information over the Site are provided below from available sources. There is no further information available from local stakeholders or landowners.

5.2.2 It should be noted that the accuracy of historic mapping is often dependant on the frequency of flooding, and whether the watercourse is in an area with sensitive receptors to flooding (i.e., a watercourse through a highly urbanised area is more likely to have an accurate record of flooding as flooding would have a greater potential impact on receptors than in a sparsely inhabited rural area with fewer receptors impacted by flooding).

Environment Agency

5.2.3 The EA 'Historic Flood Map'[21] is a dataset showing the maximum extent of all individual recorded flood outlines from river, the sea and groundwater and shows areas of land that have previously been subject to flooding. The EA does not hold any records of historical flooding at the Site (see correspondence in Appendix C).

CCC Preliminary Flood Risk Assessment (PFRA) and Strategic Flood Risk Assessment (SFRA)

5.2.4 The Council has confirmed that they do not hold any records of flooding at the Site (see correspondence in Appendix C).

5.2.5 The CCC 'PFRA' was released in 2009 and updated in June 2011, providing a high-level assessment of flood risk issues across the former

[21] https://environment.data.gov.uk/DefraDataDownload/?mapService=EA/HistoricFloodMap&Mode=spatial Accessed January 2024

County. The CCC SFRA does not include any records of flooding over the Site, or the nearest settlement of Branthwaite Edge.

United Utilities Water

5.2.6 UUW has confirmed that they have no record of any incidence of flooding from sewers within a 200m radius of the Site (see correspondence in Appendix C).

5.3 Fluvial Flood Risk

5.3.1 Fluvial flooding occurs when the capacity of river channels is exceeded by the volume of water draining from the surrounding land as a result of sustained or intense rainfall. The resulting increase in water level causes the river to rise above its banks and/or retaining structures, and flow across land.

5.3.2 The EA Flood Map for Planning ('Flood Zone Map') is the starting point for assessing the probability of flooding from rivers (and the sea). This provides an initial indication of the extent of the FZs, which can be refined using more detailed site-specific level survey and modelled flood levels. The FZs are defined in Table 1 of the 'Flood Risk and Coastal Change' PPG[3] as follows:

- **FZ 1 'Low Probability'** – Land at less than 1 in 1000 (0.1%) annual probability (AP) of river or sea flooding;
- **FZ2 'Medium Probability'** – Land between 1 in 100 (1.0%) and 1 in 1000 (0.1%) AP of river flooding, or between 1 in 200 (0.5%) and 1 in 1000 (0.1%) AP of sea flooding; and
- **FZ3 'High Probability'** – Land at 1 in 100 (1.0%) or greater AP of river flooding, or 1 in 200 (0.5%) or greater AP of sea flooding.

5.3.3 The EA provided a comprehensive update to the online 'Flood Map for Planning' mapping service in March 2025[22] which utilises outputs from the updated National Flood Risk Assessment ('NaFRA2') outputs. This national scale modelling exercise utilises improved national data and higher resolution mapping than previous iterations, providing an enhanced

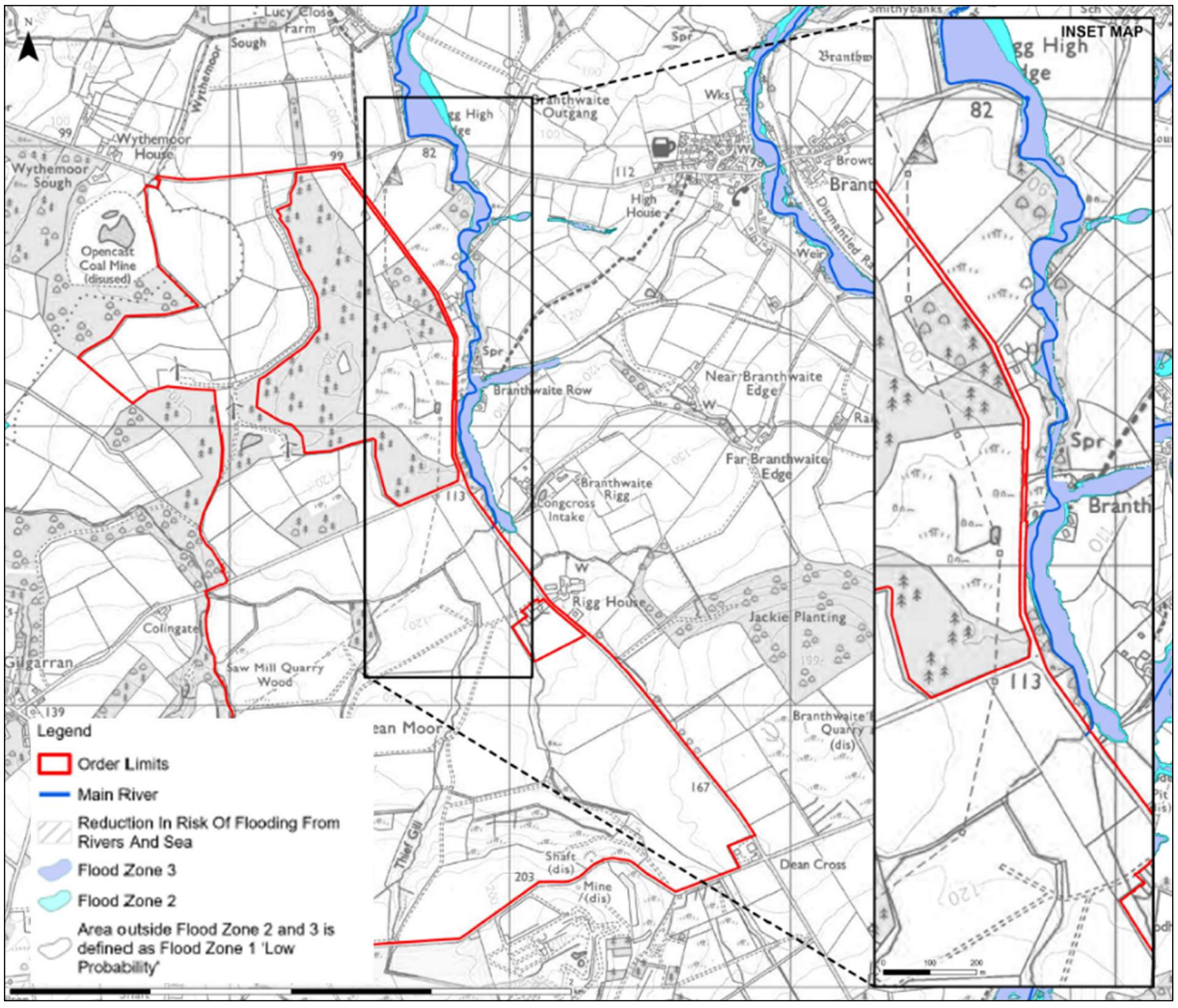
[22] UK Government (2025). Flood Map for Planning. Available at: https://flood-map-for-planning.service.gov.uk/ Accessed June 2025

level of information where no local ‘detailed’ hydraulic modelling is available.

5.3.4 The updated Flood Zone map is shown in Figure 5.1 and FRA_001 in Appendix A, and confirms that the Site is located fully within FZ 1.

5.3.5 The nearest areas of FZ 2 ‘Medium Probability’ and FZ 3 ‘High Probability’ to the Site are associated with the Lostrigg Beck, alongside the main river channel approximately 50m to the north-east of Area C.

Figure 5.1: Environment Agency Flood Zone Map and Order Limits



5.3.6 The Flood Map for Planning also includes new datasets for the Flood Risk From Rivers and Sea (‘RoFRS’). This includes both ‘defended’ and ‘undefended’ scenarios (note these are identical at the Site, as no flood defences are present), and both ‘present day’ and ‘climate change’ conditions, with the climate change scenario based on a ‘central’

allowance 2080s epoch (i.e. the applicable projection for peak river flows/sea level rise to the year 2125).

5.3.7 The Proposed Development is considered to have an operational life of approximately 40 years, but as a precautionary approach the 2080s epoch allowances have been considered in the assessment of flood risk (see section 4.2).

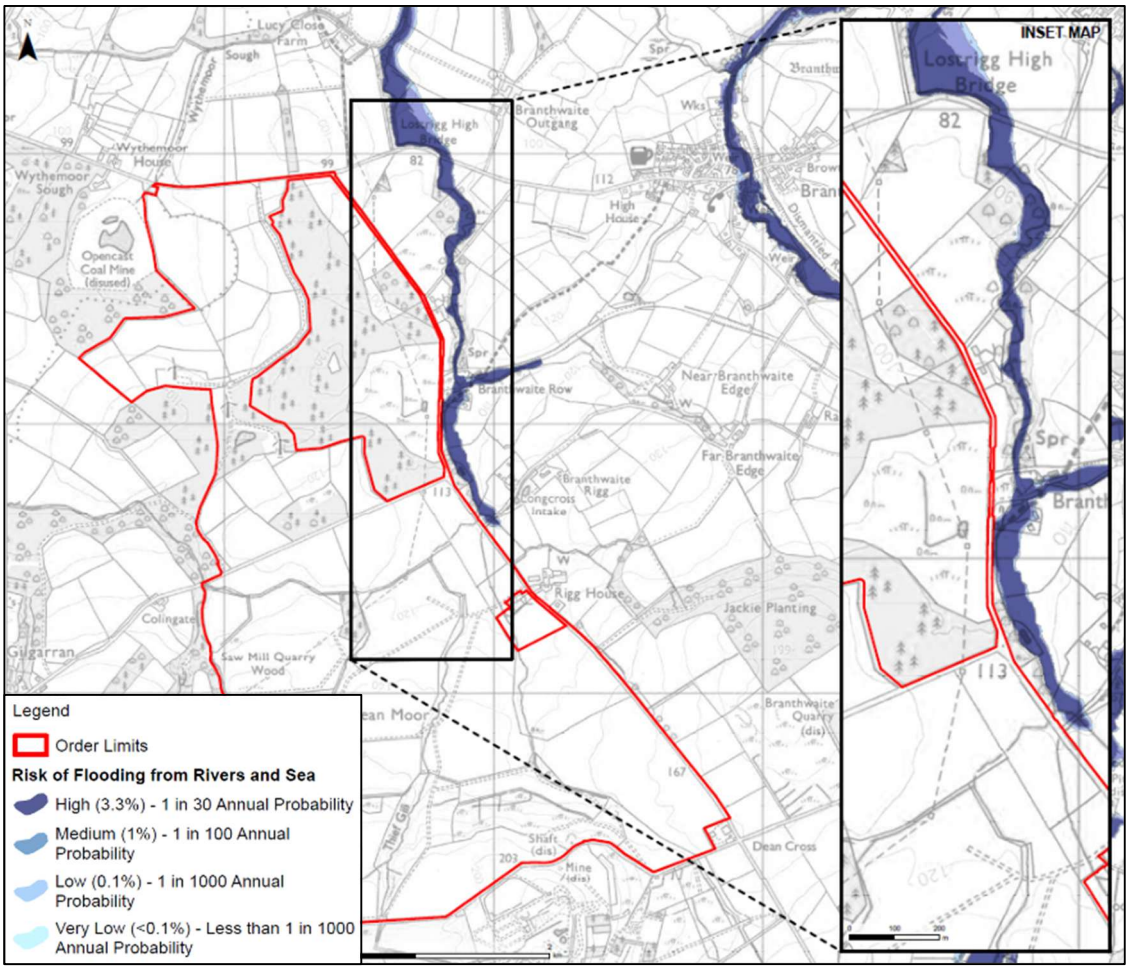
5.3.8 The RoFRS mapping provides the following scenarios, consistent with the Flood Zones:

- 1 in 30 annual probability (AP) of river or sea flooding
- 1 in 100 (1.0%) AP of river flooding/ 1 in 200 (0.5%) AP of sea flooding;
- 1 in 1000 (0.1%) AP of river or sea flooding.

5.3.9 The RoFRS Map shows a corridor of 'High' flood risk along the Lostrigg Beck beyond the eastern boundary of the Site, with flooding extending up to approximately 20m either side of the river channel and extending further south than the FZ 3 shown on the Flood Zone map (Figure 5.12 shows the most extensive climate change scenario).

5.3.10 The present day and climate change flood extents are almost identical (see FRA_006 (present day) and FRA_006cc (climate change) in Appendix A). The whole Site has a less than 1 in 1000 (0.1%) annual probability of flooding, consistent with the Flood Zone 1 designation (now and in the future).

Figure 5.2: Fluvial Flood Risk Map (incl. climate change)



5.3.11 In conclusion, the EA RoFRS fluvial mapping indicates the Site is located outside the fluvial floodplain, including when accounting for climate change impacts.

5.3.12 Within the Site, the flood risk is primarily from surface water flooding draining via ordinary watercourses, as discussed in section 5.4. However, the EA raised concerns that there is a potential gap in information where the ordinary watercourses combine and transition to a fluvial flood risk within the Site, shortly upstream of the upstream limit of the Lostrigg Beck (see details of consultation in section 1.5).

5.3.13 To address these concerns, it was agreed with the EA that a hydraulic analysis would be undertaken – see Appendix D. This verifies that the assessment of flood risk using the EA RoFSW mapping is appropriate and the significant majority of the Site will not be impacted by, or have any

impact on, fluvial flood risk other than along existing watercourses with some limited exceptions in the north east of Area C.

5.4 Surface Water (Pluvial) Flood Risk

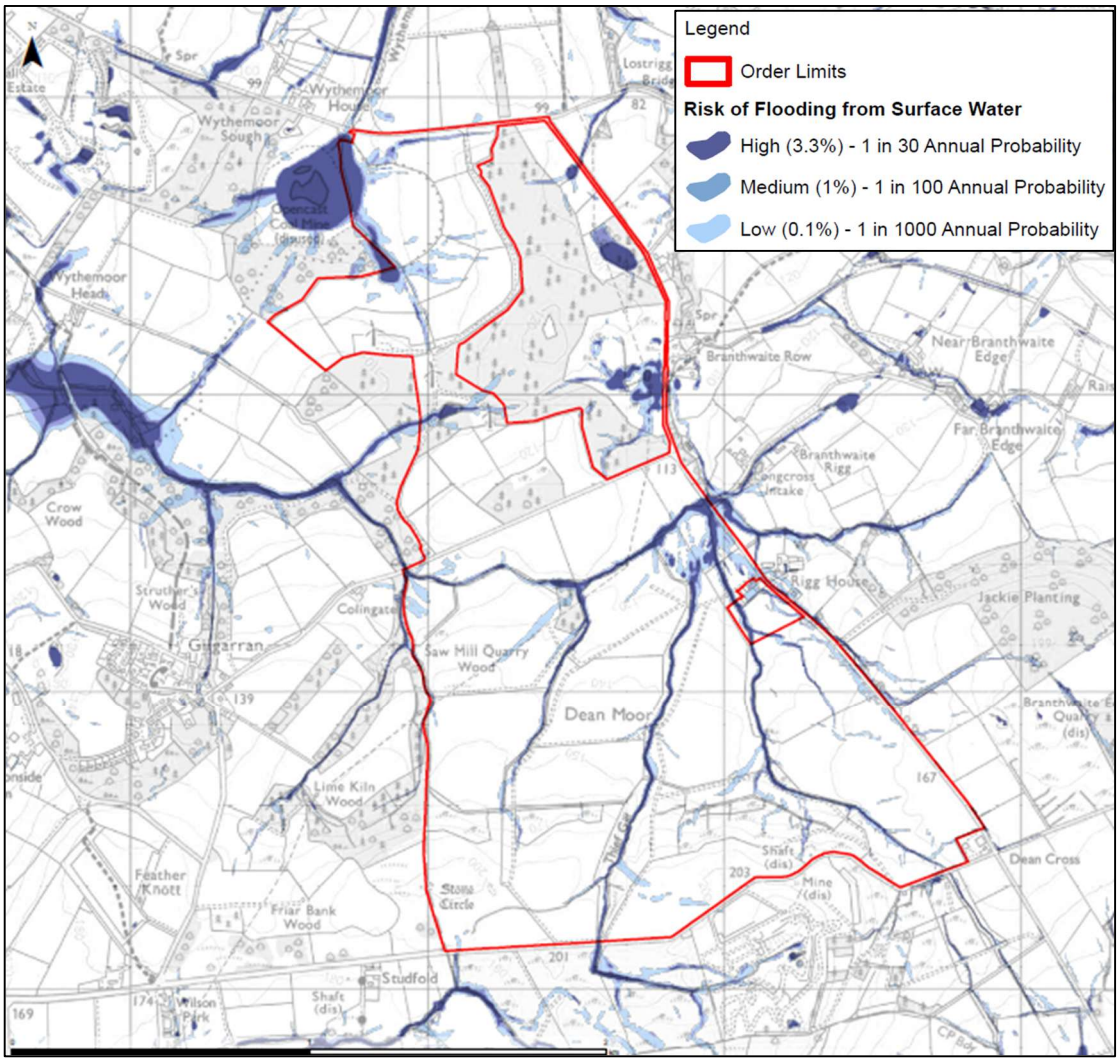
5.4.1 The EA 'Risk of Flooding from Surface Water' ('RoFSW') map identifies areas that could be susceptible to surface water flooding in various rainfall events. This dataset was updated in January 2025 following release of the new NaFRA2 information (see section 5.3). The latest mapping identifies flooding resulting from severe rainfall events based on the following scenarios:

- **'High' Risk:** 1 in 30 (3.3%) or greater AP rainfall event;
- **'Medium' Risk**: Between a 1 in 100 (1.0%) and 1 in 30 (3.3%) AP rainfall event;
- **'Low' Risk**: Between 1 in 1000 (0.1%) and 1 in 100 (1.0%) AP rainfall event; and
- **'Very Low' Risk**: Lower than 1 in 1000 (0.1%) AP rainfall event.

5.4.2 As part of the NaFRA2 update, the dataset now provides mapping for both present day and future climate change conditions (based on an 'intermediate' '2040 to 2060' scenario).

5.4.3 The RoFSW mapping for the present-day scenario indicates most of the Site has a 'Very Low' risk of surface water flooding, with areas of 'Low' to 'High' surface water flood risk present along the route of the Thief Gill, the other ordinary watercourses, and around the pond within the Site, consistent with the depressions in the local topography. The climate change scenario impacts are almost identical to the present-day map, with some nominal increases in the low' risk areas, particularly where the Thief Gill converges with other ordinary watercourses within the Site. Figure 5.3 provides the (worst case) climate change scenario, and both present day and climate change maps are provided as FRA_002 and FRA_002cc respectively in Appendix A.

Figure 5.3: Pluvial (Surface Water) Flood Risk Map (incl. Climate Change)



5.4.4 In addition to the EA surface water mapping, a high-level flow route assessment has been carried out (see Figure 3.5), confirming the identified surface water flow routes are consistent with the lowest areas across the topography as flows are directed towards watercourses.

5.4.5 Discussions with the LLFA in June 2024 confirmed it would be acceptable and appropriate to rely on the Open Data datasets (Appendix A) without further detailed hydraulic modelling, which is not considered warranted due to the low risk nature of both the existing Site conditions, the retention of the existing landform and the form of the Proposed Development (see LLFA meeting minutes in Appendix C). This is further reinforced since the new NaFRA datasets released in January 2025 now provide higher resolution outputs and climate change scenarios.

5.4.6 As noted in sections 4.2 and 5.3, the EA sought further reassurance that the flood risk through the Site – and specifically where ordinary watercourses converge upstream of the Lostrigg Beck – was accurately represented by the RoFSW mapping.

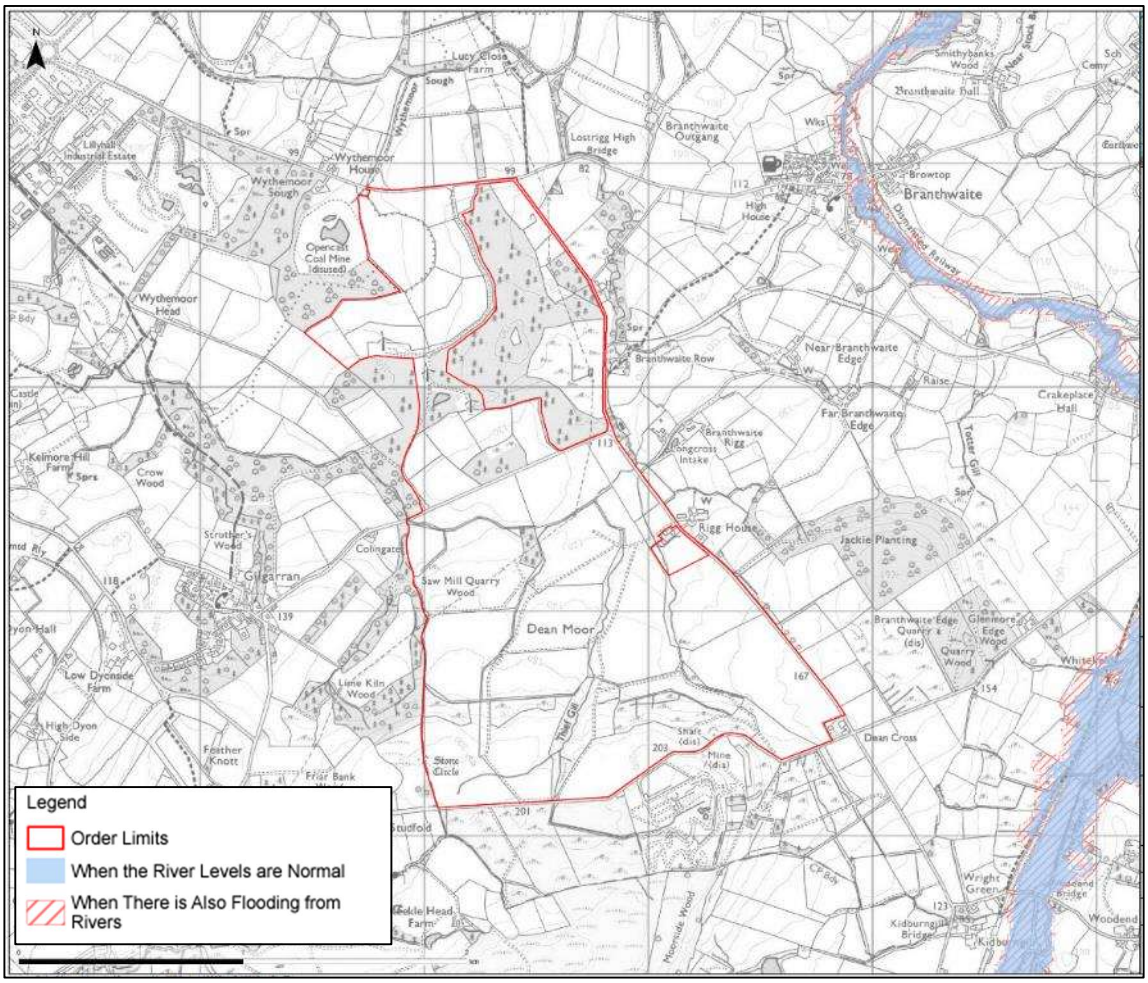
5.4.7 The analysis detailed in Appendix D applies an EA accepted methodology to generate flood extents within the area of concern, based on precautionary 2080s +51% (Higher Central) and +80% (Upper End) climate change allowances to verify the extent of flooding from the RoFSW mapping.

5.4.8 Channel cross sections were extracted through the area of concern and rating curves (i.e. a graph of the flow-water level relationship) were produced, utilising the EA-advised precautionary flows. The analysis confirmed the approach taken is robust, with flood extents comparable to the RoFSW mapping, therefore allowing this mapping to serve as a proxy for fluvial flood risk for the purposes of this FRA and ODS.

5.5 Flood Risk from Reservoirs and Artificial Sources

5.5.1 The EA provides maps showing the risk of flooding in the event of a reservoir failure. The reservoir breach extents are shown (Figure 5.4 below) and FRA_004 in Appendix A.

Figure 5.4: Risk of Flooding from Reservoirs Map



5.5.2 The mapping confirms the Site is not at risk of reservoir breach during either a ‘dry-day’ or a ‘wet-day’ scenario (a dry day being the scenario where reservoir breach occurs when rivers are at normal levels, and a wet day when the reservoir breach occurs concurrent with a severe fluvial flood event). The Council’s SFRA mapping for reservoir flooding also indicates that the Site is not within an area at risk of flooding from reservoirs.

5.5.3 There are no other artificial structures, such as canals, in the area that would impact on flood risk to the Site.

5.5.4 The risk of flooding from reservoirs and artificial sources is therefore considered to be ‘low’.

5.6 Groundwater Flood Risk

5.6.1 The Council SFRA holds no data on groundwater flooding at the Site and specifies reference to the PFRA. The PFRA acknowledges the occurrence of groundwater flooding in the county but indicates there be *'no 'Significant Flood Risk Areas' in Cumbria'.* Furthermore, no recorded groundwater flooding incidents are identified at or near the Site.

5.6.2 Based on the general topography of the Site, the underlying geology and lack of historic record, flood risk from groundwater is considered low.

5.6.3 Published BGS data (Table in Section 3.5 of ES Appendix 10.1) indicates the risk of groundwater flooding to be negligible to low. Therefore, this has been scoped out as per the Scoping Opinion (ES Appendix 2.2) and in agreement with the EA and LLFA.

5.7 Sewer Flooding

5.7.1 The PFRA states the following on sewer flooding across Cumbria:

'An initial data collection exercise revealed over 250 past flood incidents across the area from local authority records. In addition, interrogation of the United Utilities Sewer Incident Record System (WIRS / SIRS) database uncovered a further 250 incidents of flooding due to the sewer system capacity being exceeded. The majority of these incidents related to flooding of minor roads or single properties.'

5.7.2 There is no Site-specific information related to sewer flooding provided within the PFRA – or in the SFRA - in relation to the Site or for Branthwaite Edge, the settlement in closest proximity to the Site.

5.7.3 Utility information obtained for the Site is shown in the 'Utilities within the Site' plan provided in ES Figure 2.2; this confirms that the Site is largely devoid of sewerage infrastructure other than a UUW clean water sewer running just within the Site boundary along the south-eastern edge of the Site. Additionally, UUW confirmed that there is no current record of sewer flooding or flood-related incidents associated with their assets within the vicinity of the Proposed Development. The risk of sewer flooding at the Site is therefore considered to be 'Low'.

5.8 Tidal Flood Risk

5.8.1 Given the location and elevation of the Site, tidal flood risk is not a concern, and this topic will not be considered further.

5.9 Other Potential Sources of Flooding

5.9.1 A review of the PFRA, SFRA and EA flood maps indicates that there are no other known records of flooding associated with any other sources of flooding. The residual flood risk is therefore considered to be 'Low'.

5.10 Summary of Flood Risk

5.10.1 An overview of flood risk to and from the Site is provided in Table 5.1, based on the information obtained and detailed in this section.

5.10.2 The assessment concludes that the Site is at low risk of flooding from all sources, notwithstanding the limited areas of 'High' surface water flood risk denoting the route of ordinary watercourses or other hydrological features across the Site. As such, the requirements of the sequential test have been met and the exception test is not required, and the use of the Site for the proposed 'Essential Infrastructure' land use is appropriate.

5.10.3 Nevertheless, a sequential approach has been undertaken in establishing the design parameters (including Works Plans and constraints/obligations in control documents secured by DCO Requirements) to account for flood risk. Design commitments include the following, with further details provided in the relevant sub-section of section 8. It should be noted that where there are references to consideration of surface water flood risk extents, this is also a reference to fluvial extents for which pluvial extents are confirmed as a proxy:

- A minimum 8-metre development buffer from the top of the bank of all ordinary watercourses within the Site.
- Grid Connection Infrastructure (Work No. 2) [**REF: 2.3**] elements which have the potential to represent new impermeable area will be located outside areas with 'Medium' to 'High' surface water flood risk areas.
- The potentially sensitive or vulnerable elements of the Work No. 2 Grid Connection Infrastructure such as buildings or structures will be located outside areas defined as the 1 in 100 AP plus climate change

fluvial floodplain, based on the hydraulic analysis in Appendix D. Additionally, all access tracks will be of a permeable construction and all PCS units (within Work No. 1), Grid Connection Infrastructure (Work No. 2) and Associated Works (Work No. 3), will benefit from targeted SuDS to avoid their introduction changing existing greenfield runoff rates across the largely low-risk Site.

Table 5.1: Site Flood Risk Summary

Source of Flood Risk	Flood Risk Impact to the Site	Flood Risk Impact from the Site	Comment
Fluvial			The EA Flood Zone map indicates the Site is located within FZ1 'Low Probability'. The Site is located a significant distance from areas of FZs 2 and 3, and outside the 1 in 1000 annual probability floodplain on the EA 'Flooding from Rivers and Sea' map (in present day and climate change scenarios) - and therefore there is a very low risk of fluvial flooding. A hydraulic analysis has been undertaken that demonstrates the RoFSW mapping within the Site is a suitable proxy for the fluvial flood risk, allowing for climate change to the 2080s epoch.
Pluvial (Surface Water)			EA surface water flood mapping indicates that most of the Site has a 'Very Low' risk of surface water flooding (in present day and climate change scenarios), with areas of higher risk focussed along Site ordinary watercourses, consistent with the depressions in the local topography.
Ground-water			No record of groundwater flooding in the SFRA or the PFRA at or near the Site. Based on pattern of topography, presence of land drainage channels and the underlying geology it is considered that the groundwater flood risk is 'Low'.
Reservoir or Canals			The EA map for flood risk from reservoirs confirms the Site is not at risk in the event of a reservoir failure. No canals in vicinity of the Site.
Sewers and Water Mains			Limited sewerage infrastructure over the Site. No information on flood risk associated with water utilities (mains or sewers) is included within the PFRA or SFRA, and engagement with UUW has not identified any flood risk to or from these sources.
Tidal			The Site is located a significant distance away from, and elevation above, tidal influences and therefore there is no tidal flood risk at the Site.

Key:		
		Low/Negligible Risk – No noticeable impact to or from the Site and not considered to be a constraint to development.
		Medium Risk – Issue requires consideration but not a significant constraint to development.
		High Risk – Major constraint to development requiring active consideration in mitigation proposals.

6 Flood Vulnerability and the Sequential Test

6.1 Flood Risk Vulnerability

6.1.1 NPPF Annex 3[23] confirms the *'Flood risk vulnerability classification'* of a Site, depending upon the proposed usage. This classification is subsequently applied to PPG 'Flood Risk and Coastal Change' Table 2 (reproduced as Table 6.1 below) to determine whether:

- The Site is suitable for the FZ in which it is located, and
- Whether an Exception Test is required for the Site.

Table 6.1: Flood Risk Vulnerability and Flood Zone 'Incompatibility'

	Flood Risk Vulnerability Class (PPG Table 2)	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone (PPG Table 1	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test Required	✓	✓	✓
	Zone 3a	Exception Test Required	x	Exception Test Required	✓	✓
	Zone 3b	Exception Test Required	x	x	x	✓
Key:	✓ Development is appropriate			x Development should not be permitted		

6.1.2 As a solar energy generating station, the Proposed Development is classed as '*Essential Infrastructure*' under the NPPF Annex 3. The Site is located within FZ1 'Low Probability' and this form of development is appropriate in this FZ.

6.2 NPPF Sequential Test and Sequential Approach

6.2.1 Paragraphs 172 and 173 of the NPPF encourage the application of the 'sequential approach' in the master-planning process for new development, i.e., locating the more sensitive/vulnerable elements of new development in the areas which lie at lowest probability of flooding and,

[23] HM Government (2012). MHCLG. National Planning Policy Framework - Annex 3: Flood risk vulnerability classification

conversely, reserve areas of a site at greatest risk of flooding for the least vulnerable elements of the development (or, preferably, leave such areas undeveloped or as soft landscaping).

6.2.2 As the Site is located within FZ1 'Low Probability' and mainly within areas of 'Very Low' surface water flood risk, the Sequential Test is de facto passed. Notably, the latest update of the PPG[24] (September 2025) clarifies the approach to the Sequential Test in relation to surface water flood risk, stating (paragraph 027): "*Where a site-specific flood risk assessment demonstrates clearly that the proposed layout, design, and mitigation measures would ensure that occupiers and users would remain safe from current and future surface water flood risk for the lifetime of the development (therefore addressing the risks identified e.g. by Environment Agency flood risk mapping), without increasing flood risk elsewhere, then the sequential test need not be applied*".

6.2.3 Furthermore, a sequential approach has been applied throughout the design development of the scheme to focus development within those areas at lowest flood risk, with any encroachment into higher risk areas limited to elements that have no impact on flood risk or on surface runoff, or where there is a reasonable prospect of appropriate mitigation being available which would be secured through the provisions associated with DCO Requirement 8.

6.2.4 The Hydraulic analysis provided at Appendix D has enabled the application to rely on the RoFSW mapping as a proxy for fluvial flood risk. Relying on this proxy results in the Work Plans [**2.3**] for Work No. 2 Grid Connection Infrastructure including land which is in - or in the vicinity of - areas of medium-high fluvial flood risk. However, there is ample space within Work Area 2 for Work No. 2 development which could affect or be affected by flood risk conditions to avoid being sited in such locations as the Work No 2. area is 8.95ha, and the Work No. 2 facility will occupy an area not larger than 1.2ha as per the Design Parameters Document (DPD)

[24] GOV.UK. 2025. Flood Risk and Coastal Change. Available from: https://www.gov.uk/guidance/flood-risk-and-coastal-change . Accessed October 2025.

[**5.7**]. Furthermore, this infrastructure will be largely designed for adoption by the DNO, Electricity North West Limited (ENW), and will therefore comply with electricity undertaker design standards which would not allow their infrastructure to be vulnerable to flood risk.

6.2.5 In summary, the proposed Grid Connection Infrastructure (Work No. 2) in the vicinity of this fluvial flood risk will be located outside areas defined as the 1 in 100 AP plus climate change fluvial floodplain to address the flood risk to such elements. This commitment is secured via inclusion in the ODS with which the final DS must comply in accordance with DCO Requirement 8.

6.2.6 The PCS Units and other such containerised ancillary buildings associated with Work No. 1 or Work No. 3, which could have potential to represent new hardstanding, are to be sited in developable areas that have either a 'Very low' or 'Low' risk of surface water flooding. If there is any reason why avoidance is not possible, such elements would only be sited in locations with flood risk if it can be demonstrated as part of the final DS that suitable mitigation is available such as elevating flood levels above flood levels This commitment will be taken forward into the final design and is secured by the ODS with which the final DS must comply in accordance with DCO Requirement 8.

6.2.7 As such, the proposals meet the requirements of the Sequential Test and a sequential approach to the final design is secured through DCO Requirements.

7 Mitigation Measures

7.1 Overview

7.1.1 There is potential for flood risk impacts both during the construction phase of the Proposed Development, and during the operational phase of the Proposed Development.

7.1.2 The FRA provides consideration of both aspects, as detailed below.

7.2 Construction Phase

7.2.1 The assessment undertaken within section 5 of the FRA confirms that the Site is primarily at low risk of flooding from all sources, with the main areas of high flood risk consistent with the routes of ordinary watercourses providing a land drainage function across the Site. However, construction activities have the potential to alter the pattern of surface water runoff over the Site, through the presence of above ground obstructions such as construction materials/compounds and through compaction of ground resulting from vehicular activity.

7.2.2 Best practice construction measures will be undertaken to ensure that no adverse impacts on surface water or groundwater quality occur during the construction phase – i.e. to demonstrate that the water quality – and the rate of runoff – is not adversely affected by the construction operations. Full details will be set out in the CEMP, which will be secured by a DCO Requirement, and a detailed Soil Management Plan ('SMP') which will be part of, or sit alongside, the CEMP. The OCEMP and OSMP (ES Appendices 5.1 and 5.3) respectively, provide a framework for these measures, specifying protocols for pollution prevention, sediment control, and soil management.

7.2.3 Specific requirements for managing water quality and sediment during construction are outlined in OCEMP, which outlines sediment and erosion control practices designed to prevent contamination of water bodies.

7.2.4 To minimise damage to the soil structure within the Site, the areas in which primary and secondary construction compounds may be located

(Work No 4) are immediately adjoining existing accesses into the site from the public highway . As a general principle, HGVs will be unloaded within these compounds, with the vehicles accessing the rest of the Site typically smaller vehicles, carrying smaller loads. Where possible vehicles moving within the Site will use existing access tracks, and standard deliveries within the Site beyond the construction compounds will be made by tracked or low ground pressure machines (i.e., with large tyres) to impose low pressures on the soil, similar to farming machinery. A delivery sequence by vehicles will be devised to minimise repeat journeys over the field, reducing rutting and damage to the vegetation and soil structure. This approach aligns with the OSMP (Appendix 5.3) which recommends the use of low ground pressure equipment to protect soil integrity.

7.2.5 During the construction phase, HGVs will not typically be using the internal access tracks around the Site except from the highway into the temporary construction compounds. HGVs making deliveries to the Site for construction will drop off in temporary construction compounds (which will be located with areas as defined by Work No. 4) close to the highway access points. Materials will then be delivered around the Site by tractor-trailer type vehicles. This will mitigate structural damage to the soil on the Site which in turn will enable the Site to infiltrate and drain water at its baseline rate. Further information is also available from the OSMP (Appendix 5.3).

7.2.6 The PCS Units (central inverter-transformers or standalone transformers) must be off-loaded directly from HGVs and therefore will be located in places where internal access routing supports them. The Construction Traffic Management Plan (‘CTMP’) will control traffic onto the Site from the highway, while the CEMP will manage traffic within the Site, thereby ensuring minimal disruption and overlap between external and internal traffic controls. There is also the possibility that vehicles delivering aggregate (typically 10ft tippers) would enter the Site as part of the access track construction. Further information is available from the Outline Construction Traffic Management Plan (‘OCTMP’) (ES Appendix 5.2) and OCEMP (ES Appendix 5.1).

7.2.7 These measures are informed by the Agricultural Land Classification ('ALC') Report (ES Appendix 2.8), which provides the basis of the OSMP (ES Appendix 5.3). The Site is predominantly classified as poorer quality agricultural land, with some areas potentially classified as Grade 3b, which is not considered 'Best and Most Versatile' ('BMV') land. The OSMP focuses on managing soil resources to maintain their quality and structure throughout the construction phase, rather than preserving higher-quality agricultural land.

7.2.8 Construction vehicles will be properly maintained to reduce the risk of hydrocarbon contamination and will only be active when required. Gravel material will be used, as opposed to tarmac, to allow a level of infiltration through the tracks, better simulating the baseline soil conditions. If scour or siltation could occur on steeper sections of the Site, silt traps, soil bunds, and grass filter strips will be used to capture any sediment, preventing polluted runoff from entering any watercourses draining the Site. Construction materials will be stored, handled, and managed with due regard to the sensitivity of the local aquatic environment, thus minimising the risk of accidental spillage or release. These practices are in line with the pollution prevention and hydrological management strategies outlined in the OCEMP (ES Appendix 5.1), which addresses vehicle maintenance, spill prevention, and sediment capture measures.

7.2.9 Underground cable routes will be designed and installed to ensure a low risk of pollution from this construction activity. Excavations required for cable installation will be undertaken in a manner that minimises the time during which subsoil layers are exposed. Soil stockpiles will be managed to contain sediment within the locality, preventing pollution of watercourses. Additionally, the ground will be restored as quickly as possible following construction, with vegetation reinstated. These measures are set out in the OCEMP (ES Appendix 5.1), which includes guidelines for excavation practices, sediment control, and restoration to minimise soil and water disturbance.

7.2.10 During construction, it is recommended that vegetation disturbance be minimised as much as possible, and any bare ground resulting from construction will be re-seeded as part of targeted measures set out in the OSMP (ES Appendix 5.3). For example, areas impacted by activities such as cable trenching or sections worn out during construction will be promptly seeded to reduce long periods of bare earth, supporting soil structure and drainage.

7.2.11 On completion of the construction phase, the fields will be restored using light farming machines and prepared appropriately for seeding to encourage early native vegetation growth, restoration of the soil structure, and the natural creation of an environment conducive to native meadow plants. This comprehensive restoration will be governed by the final Landscape Ecological Management Plan ('LEMP'), which will be in accordance with the OLEMP (ES Appendix 7.7), which outlines long-term restoration and re-seeding practices to maintain ecological balance and soil health.

7.2.12 A Method Statement will be submitted as part of the Ordinary Watercourse Consent ('OWC') application to the LLFA for any works affecting a watercourse, including any surface water discharges to ordinary watercourses during the construction phase, primarily for measures required as part of the final design to be approved by DCO Requirement (see section 8.12). While additional temporary drainage arrangements for only construction are not anticipated, the CEMP will provide measures to address such needs if required. The procedures for water management, including any temporary measures (such as infiltration swales) are provided by the OCEMP (Appendix 5.1) and will be updated and fully detailed based on the final design.

7.3 Operational Phase

7.3.1 The assessment of flood risk confirms that the Site is a low risk of flooding outside the main route of ordinary watercourses providing land drainage through the Site.

7.3.2 The application of the sequential approach to design (locating the more sensitive/vulnerable elements of new development in the areas which lie at lowest probability of flooding) is the most effective form of mitigation to minimise flood risk to receptors. As noted in section 6.2, a sequential approach has been applied throughout the design of the Proposed Development to focus development within those areas at lowest flood risk, with any encroachment into higher risk areas limited to elements that have no impact on flood risk or on surface runoff.

PCS Units, Ancillary Buildings, and Grid Connection Infrastructure

7.3.3 The PCS Units of Work No. 1, and other such containerised ancillary buildings such as Work No 3 storage containers are to be sited in areas that have either a 'Very low' or 'Low' risk of surface water flooding.

7.3.4 As the Proposed Development is located outside the fluvial floodplain (confirmed by both the EA mapping, and by the hydraulic analysis in Appendix D), there is no impact on fluvial floodplain capacity or fluvial flow routes. Whilst the area of proposed Grid Connection Infrastructure (Work No. 2) [**REF: 2.3**] is located alongside the ordinary watercourse to the north east of Area C, the elements of Work No 2 will be located outside the area defined as the 1 in 100 AP plus climate change fluvial floodplain from the hydraulic analysis (Appendix D).

Solar Arrays

7.3.5 The design of the solar arrays is such that the ground level impact is negligible and will not impact on surface water flow routes (see further details in section 8.5).

7.3.6 The Applicant considers that the solar arrays will not be vulnerable to flood risk, even if located within areas of surface water flooding. Section 8.5 demonstrates that flood risk can be effectively mitigated, even in areas of increased flooding, and that such matters would be given further consideration as part of the post-consent detailed design phase.

Access Arrangements

7.3.7 Continuous safe and dry access is available to the Site, although this is of limited concern due to the nature of the Proposed Development – the Site is unmanned, and during the operational phase there would be a limited number of visits per week for maintenance (typically comprising 1-2 visits per week by van or 4x4 type vehicle).

Surface Water

7.3.8 The main aspect of mitigation relates to the proposed drainage arrangements over the Site. As outlined in section 7.2, the effects of works activities over the Site have the potential to alter surface water runoff characteristics and resulting runoff from the Site. During the operational phase this is mitigated through the principles established within the ODS (which will form the basis of the DS), in section 8.

7.3.9 The ODS for the Proposed Development prioritises nature-based solutions for flood risk mitigation and demonstrates there will be no increased runoff from the Site. This approach will aid in managing surface water flows, whilst ensuring that vegetated ground cover, and existing and new boundary vegetation, receive suitable hydration.

8 Outline Drainage Strategy

8.1 Introduction

8.1.1 No part of the Proposed Development may commence until the Applicant produces a Drainage Strategy ('DS') for that part of the Proposed Development that must be substantially in accordance with this ODS. Preparation and implementation of the DS is secured by a DCO Requirement and will be submitted for approval by the Council (and LLFA where applicable), following consultation by the Applicant with the EA..

8.1.2 The figures provided in the ODS are provided as examples only and do not represent drawings of solar generating equipment that the future DS must be in accordance with.

8.2 Planning Policy

8.2.1 The LLFA is the statutory consultee on planning applications for surface water management. The Council, as LLFA, is therefore responsible for the approval of surface water drainage systems within new major development.

8.2.2 The current form of drainage over the existing Site is via natural infiltration into ground, or to drain via overland flow towards the existing watercourses.

8.2.3 The PPG requires that the proposed drainage solution should maintain the existing runoff rates, mimicking the surface water flows arising from the Site prior to the introduction of new development. Drainage proposals should also consider the effects of climate change and, wherever appropriate, provide a degree of betterment.

8.2.4 In the case of an undeveloped site, the requirements of the NPPF are therefore to mimic existing greenfield runoff rates, necessitating attenuation measures to mitigate runoff from new impermeable surfaces, considering rainfall events up to and including the 1 in 100 (1.0%) annual probability rainfall event, and allowing for the potential impacts of climate change.

8.2.5 The Proposed Development utilises SuDS whenever possible, and the ODS focusses on the use of natural 'rural' drainage features in preference to more 'engineered' SuDS measures typically employed in urban locations. In accordance with section 3.2.3 of the SuDS Manual[10], the aim should be to discharge surface water runoff in accordance with the following hierarchy of drainage options:

- Infiltration (preferred approach);
- To a surface water body;
- To a surface water sewer, highway drain or another drainage system; and
- To a combined sewer (least preferred).

8.2.6 This ODS has been developed with regard for the DEFRA '*Non-statutory technical standards for sustainable drainage systems*'[25] to demonstrate that the Proposed Development does not increase flood risk to the Site or elsewhere.

8.3 Solar Farms and Surface Water Runoff Dynamics

8.3.1 The ODS has been developed based on the research report 'Hydrologic Response of Solar Farms'[26] which advises that, '*this study, along with design recommendations, can be used as a guide for the future design of solar farms'.*

8.3.2 This research provides robust evidence to demonstrate that extensive drainage measures are not required to manage solar farm surface water runoff, provided that the land use and ground cover is effectively managed.

8.3.3 Well-managed solar farms provide full year-round vegetated ground cover, which is more effective at slowing runoff and providing a source for infiltration than land subjected to intensive arable or livestock grazing uses. Cook and McCuen (2013, p. 5) found that, providing full vegetation cover beneath the solar panels is maintained—*'the change in runoff*

[25] HM Government (2015). DEFRA. Guidance Sustainable drainage systems: non-statutory technical standards

[26] Cook, L. and McCuen, R. (2013). "Hydrological response of solar farms." Journal of Hydrologic Engineering, volume 18, issue 5.

characteristics from solar farm sites is likely to be insignificant and that ground cover has a highly significant control over runoff.'

8.3.4 The study also noted that *'the addition of solar panels over a grassy field does not have much of an effect on the volume of runoff, the peak discharge, nor the time to peak'* if grass cover is located underneath panels and between rows, concluding that this is true for a range of return periods and storm durations (Cook and McCuen, 2013, p. 6).

8.3.5 On this basis, the Cook and McCuen study concludes that solar farms only significantly change the hydrologic response under a scenario where gravel is placed under panels, or if patchy or bare ground is created under/between arrays.

8.3.6 In order to provide the most appropriate surface treatment (and wider landscape management) consistent with that advised in the Cook and McCuen study, appropriate seeded vegetation will be provided below and between rows of the solar panels to act as a level spreader/energy dissipater and to promote low erosivity sheet flow for the Proposed Development.

8.3.7 The vegetation will be managed in accordance with a LEMP as outlined in the OLEMP (ES Appendix 7.7) and will be managed through mowing or light grazing. The grassland will not only grow between array gaps; it will also extend to all ground under the arrays. This means that - excluding the access tracks and ancillary buildings - the majority of the Site will be a fully vegetated species-rich grassland as specified in the OLEMP.

8.3.8 During operation, the intensity of grazing within the Site will be reduced, which will allow an improvement of grassland and boundary vegetation habitat quality and diversity relative to the existing baseline conditions. In addition, this is likely to provide further enhancement to watercourses within the Site and downstream, through a reduction in nutrients generated through agricultural activity entering these watercourses.

8.3.9 The watercourses will also benefit from enhancement through the exclusion of livestock over the land and the implementation of

supplementary planting to reduce the erosion of banks and sediment input. Further information is available within the Grazing Management Plan (OGMP, which is included within the OLEMP, ES Appendix 7.7).

8.4 Design Approach

8.4.1 Notwithstanding the natural approach advocated in the findings of the Cook and McCuen study discussed in section 8.2, the Proposed Development will include targeted mitigation measures to address specific areas of potential new impermeable surfacing, notably the access tracks, Grid Connection Infrastructure (Work No. 2) and PCS Units and other ancillary buildings (Work Nos. 1 and 3).

8.4.2 The ODS for the Proposed Development is consistent with the mitigation measures discussed with the LLFA in the meeting of October 2023 (meeting minutes provided in Appendix C), and the Site will incorporate a minimum 8m buffer zone from all watercourses, alongside appropriate mitigation for each specified land use to mimic the existing greenfield runoff mechanism. On this basis, further attenuation measures are not considered necessary.

8.4.3 The ODS will be split depending on the type of component proposed as follows:

- Solar PV Arrays (see section 8.4);
- Power Conversion System (PCS) Units (see section 8.6);
- Grid Connection Infrastructure (see section 8.7); and,
- Access Tracks (see section 8.8).

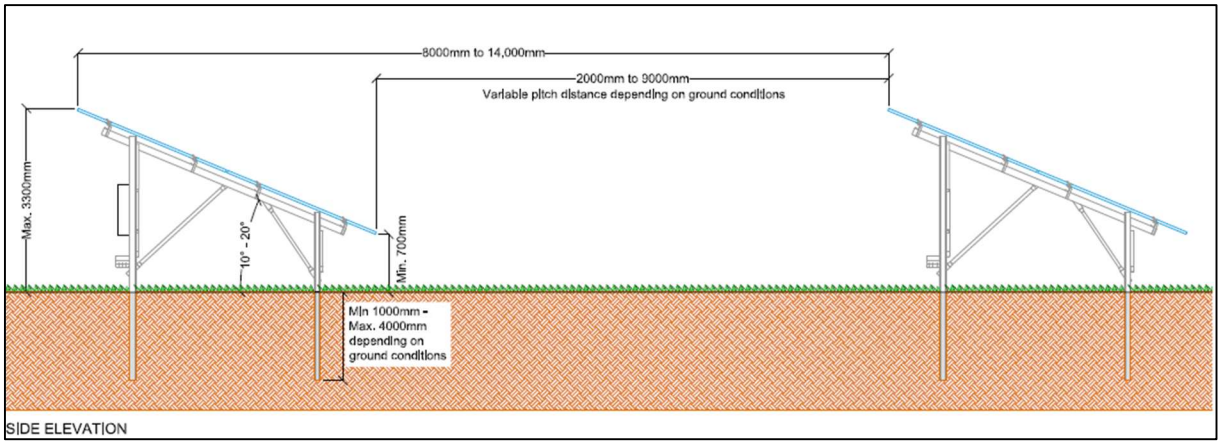
8.4.4 For all aspects of the final design and its DS the mitigation hierarchy will be followed which reflects a sequential approach to design. This means avoidance of areas of flood risk must be prioritised, and if avoidance is not possible mitigation must be designed-in and evidenced as appropriate in the final DS. This will particularly influence the locations for the siting of equipment within the Site to ensure that any vulnerable infrastructure is located outside of the areas with surface water flood risk. If for engineering reasons this is not possible, such elements would only be included if

unless design mitigation is able to avoid risks by for example, elevating vulnerable elements above the freeboard flood level.

8.5 Solar PV Arrays

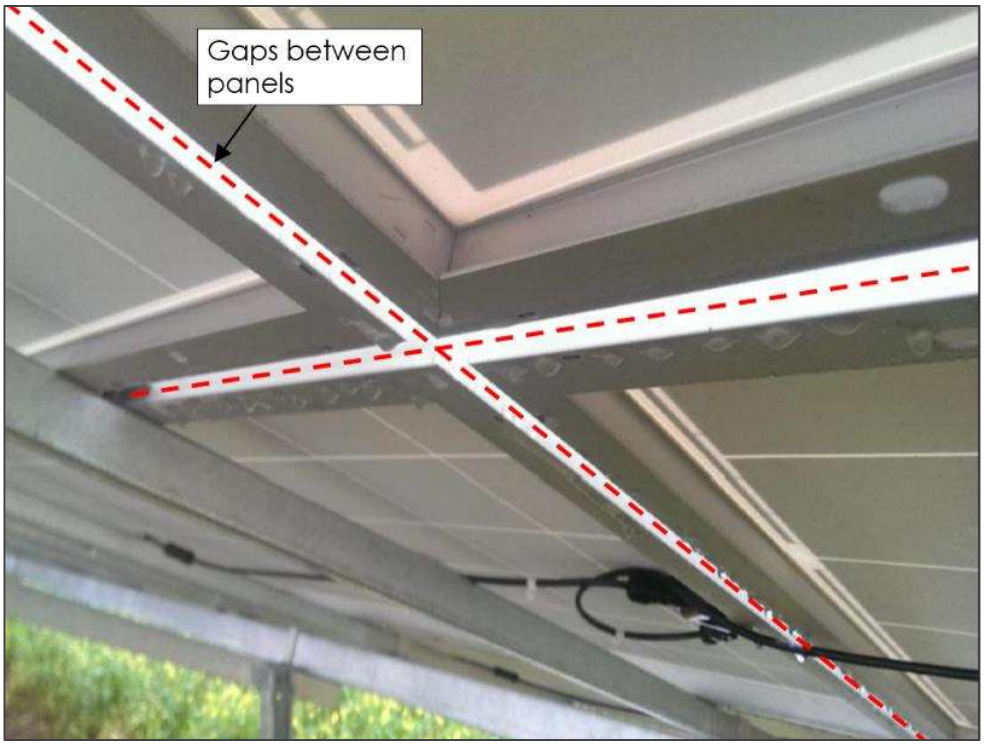
8.5.1 The majority of the generating station is made up of Solar PV Arrays (Work No. 1). These are rows of PV modules attached to a metal framework structure, supported by slim posts that are typically pile-driven into the ground with no earth moving, ground levelling, or permanent foundations required. The lower edge of the solar panels will be a minimum of 700mm above the ground, ascending to a maximum height of up to 3.3m. A typical cross section through the Solar PV Arrays is shown in Figure 8.1.

Figure 8.1: Array Framework Structure Cross Section (Standard)



8.5.2 The PV array installation will not require hardstanding at ground level, so the ground cover in the Work No. 1 (as shown on Figure 1.2) will remain as existing. The PV arrays will include space between panels as rainwater gaps to prevent a solid façade, as shown in Figure 8.2, to mitigate the risk of water accumulating along a single drip line.

Figure 8.2: Typical PV Rainwater Gaps



8.5.3 The solar array facades will intercept some rainfall before it reaches the ground. The intercepted rainfall will either run down the face of the panels and drip onto the ground below via multiple gaps across the arrays or will be lost due to evaporation from the face of the panels.

8.5.4 Figure 8.3 shows an image of solar arrays, demonstrating that grass grows effectively under and between rows, with the gaps between rows (aisles) providing natural filter strips (a minimum of over 2m) that slow overland flows and provide sources of evaporation/transpiration.

Figure 8.3: Example Side view of PV Arrays

8.5.5 The runoff created by rainwater on the solar façade area will fall between the gaps of each panel, allowing water to fall off in many locations mimicking the baseline conditions. The gentle array tilt (typically 10-15 degrees from horizontal, but up to 20 degrees) means water runs down at a low velocity which reduces the likelihood of 'jumping' the gaps. On this basis, water will not regularly sheet down in one area at the lower edge of the arrays, which could introduce the risk of risk of soil erosion (especially in bare ground conditions).

8.5.6 Based on the above, the impact of typical solar arrays is negligible, with the only intrusion from the piled framework posts. Alternative forms of construction include a no-dig (on-ground) ballasted mounting solution which may or may not be fully permeable. While not anticipated at this time, they can be specified in a final layout, although typically only in limited locations such as an archaeology sensitive area. If these are specified in final engineering studies, they would require dedicated consideration in a DS if a ballasted solution were proposed that would introduce additional impermeable surfaces.

8.5.7 The framework posts of standard in-ground arrays can be delivered by different manufacturers but generally have a '[' shape and each post has an effective ground level footprint between the range of 0.0012m^2 and 0.0014m^2. Solar array mounting frameworks can be either dual post or single post. Of these, a dual post system would represent the 'worst case' with respect to ground intrusion. Assuming a dual-post system and based on other comparable schemes, this would represent an estimated 75-100,000 posts.

8.5.8 Assuming the upper end 100,000 posts for assessment purposes and using the highest typical post footprint (0.0014m²), the total area of all array posts across Work No. 1 (168ha) would be 140m². This figure represents 0.008% of the total Work No. 1 area and 0.005% of the total Site area (276.5 ha), confirming that the impact would be negligible.

8.5.9 The provision of fully vegetated ground cover beneath and in-between the rows of solar panels will maintain the current hydrological response of the

Site and will not interfere with existing runoff characteristics or infiltration rates in a way that might otherwise increase flood risk elsewhere.

8.5.10 The proposed planting as illustrated on the outline Landscape Strategy Plan (ES Figure 7.6.1-7.6.5), which includes grassland ground cover and new and improved boundary vegetation, will reduce runoff, encourage interception, infiltration and evapotranspiration, and provide water quality treatment before surface water enters any watercourses within and surrounding the Site. The proposed planting will also provide effective mitigation against soil erosion.

8.5.11 Grass cover will be inspected and maintained at least twice a year or after periods of significant drought, which is considered an appropriate level of mitigation. It is recommended that, during maintenance, any patchy grass or bare ground is re-seeded. Future landscape management of the Proposed Development will be carried out in accordance with a LEMP, which is substantially in accordance with the OLEMP.

8.5.12 The increased interception, evapotranspiration, and infiltration due to the proposed planting when compared to the existing situation (intensively grazed land which may involve the use of chemical treatments and also include animal waste due to grazing locations being unrestricted) will provide a betterment on the existing runoff rates and quality at the Site and, therefore, will also provide a betterment in any future climate change scenarios.

8.5.13 Figures 8.4 and 8.5 show examples from UK solar farms where grazing is used for groundskeeping (although grounds may also be managed through quarterly mowing), and these show effective ground coverage even under arrays.

Figure 8.4: Ground Coverage Under Arrays – Example 1

Figure 8.5: Ground Coverage Under Arrays – Example 2

8.5.14 As set out within the FRA, there are small areas of surface water flooding outside the excluded extents along watercourses and within Work No. 1 for which the Applicant must have regard as part of the final design and DS. The hydraulic analysis in Appendix D identified a 1 in 100 annual probability plus climate change reference flood level of 109.5m AOD at the most downstream cross section (XS5). A small area in the north-west corner of Area C is shown within the RoFSW mapping with flood depths between 100mm and 500mm identified in association with extreme events. The EA RoFSW mapping also shows that the likelihood of flooding to greater than 600mm (i.e. when the freeboard is at risk) is limited to a very

localised area immediately upstream of the road and centred on the adjacent ordinary watercourse. When considering the area for flooding greater than 900mm, the impact is negligible and centred on the watercourse.

8.5.15 Work No.1 includes an offset from the watercourses and the Site boundary which would mean solar arrays would not be located within areas of the most significant depths. As noted, the arrays are proposed with a freeboard of 700mm above ground as a minimum, with no restriction in the DPD on the potential for this to be raised if, as part of the final design, it is concluded that arrays would be located in areas with risks of depths >700mm such that additional mitigation should be considered.

8.5.16 Various considerations will be weighted into the locations and designs of arrays, including the vulnerability of the infrastructure in a high risk flood event. The Applicant considers that solar arrays themselves are not vulnerable, as the vulnerable junction box on the rear of panels would be >900mm for an array with a lower edge at 700mm, and these are also IP67 or IP68 rated, meaning, meaning they could withstand exposure to flood conditions. Or, in a worst case scenario, the junction box could be replaced without having to replace the panel itself.

8.5.17 Nevertheless, the Applicant will also consider the benefits of design alternatives such as elevating the lower edge of the arrays above the freeboard flood level as per EA advice.[27] The final DS to be provided will demonstrate that if Work No. 1 is included in areas with higher flood risk, a freeboard of 300mm from the design flood level, as identified in the Appendix D Hydraulic Analysis should be provided, based on the information available within the application. The minimum freeboard of 300mm to the lower leading edge of the solar panel will be adopted as part of the final design unless further modelling is provided to satisfactorily

[27] The following advice from the EA is noted and regard must be had in the preparation of the final DS:

Freeboard – A minimum freeboard of 300 mm to the solar panels [should be] *provided within the design flood extent (see Appendix D). In line with EN-1 paragraphs 5.8.7 and 4.10.11, the site must remain operational during flood conditions and demonstrate resilience to the credible maximum flood scenario. The design flood level is 109.50 mAOD, with a credible maximum of 109.59 mAOD* [In a limited part of Area C]. *Given modelling uncertainties, the freeboard is a necessary and proportionate measure to ensure the site's flood resilience and operability during the design flood event.*

demonstrate that risk to electrical infrastructure from flood waters, or other risks (e.g. risks from flood debris), has been appropriately mitigated.

8.6 Ancillary Building Mitigation

8.6.1 This section addresses ancillary buildings across the Site, specifically those located within Work No. 1 and 3. This includes the PCS Units, which will consist of either combined Central Inverter-Transformer Units or Standalone Transformer Units, as well as Operations and Maintenance ('O&M') Units. The drainage for the Grid Connection Infrastructure (Work No. 2) is addressed separately in section 8.8.

8.6.2 A sequential approach will be taken to the design with respect to the locations of ancillary buildings. These will be located outside of areas with high surface water flood risk. In the unlikely event that engineering considerations require a location which does not avoid lower risk area such buildings would only be included with mitigation that elevates the floor levels of buildings above the flood level. This possibility has been embedded into the DPD parameters for all buildings, which include a maximum hight of 1m beyond the max height that would be required for such units without elevation off ground-level, which means potential mitigation options are secured.

8.6.3 Standard requirements for ground floor levels of new development are set out in BS8533:2017 *'Assessing and Managing Flood Risk in New Development – Code of Practice'*[28]. This recommends floor/threshold levels are set a minimum of 300mm above the modelled 1 in 100 (1.0%) annual probability plus allowance for climate change fluvial flood level. The CCC SFRA Level 2 Section 3.5 recommends floor levels be *'above the modelled 1 in 100 plus climate change flood depths'*.

8.6.4 As the Proposed Development is in FZ 1 and a significant distance from any fluvial floodplain, any such freeboard requirements would be significantly exceeded, and the main issue would be in ensuring the risk from surface water is mitigated. All buildings will be located in areas of

[28] BS8533:2017 'Assessing and Managing Flood Risk in New Development – Code of Practice.

very low surface water flood risk and outside of flood flow corridors denoted on the EA surface water flood maps. Aside from locating these units in the lowest risk areas, all ancillary buildings will benefit from targeted SuDS to mitigate the residual flood risk associated with excess surface water runoff in an extreme rainfall event.

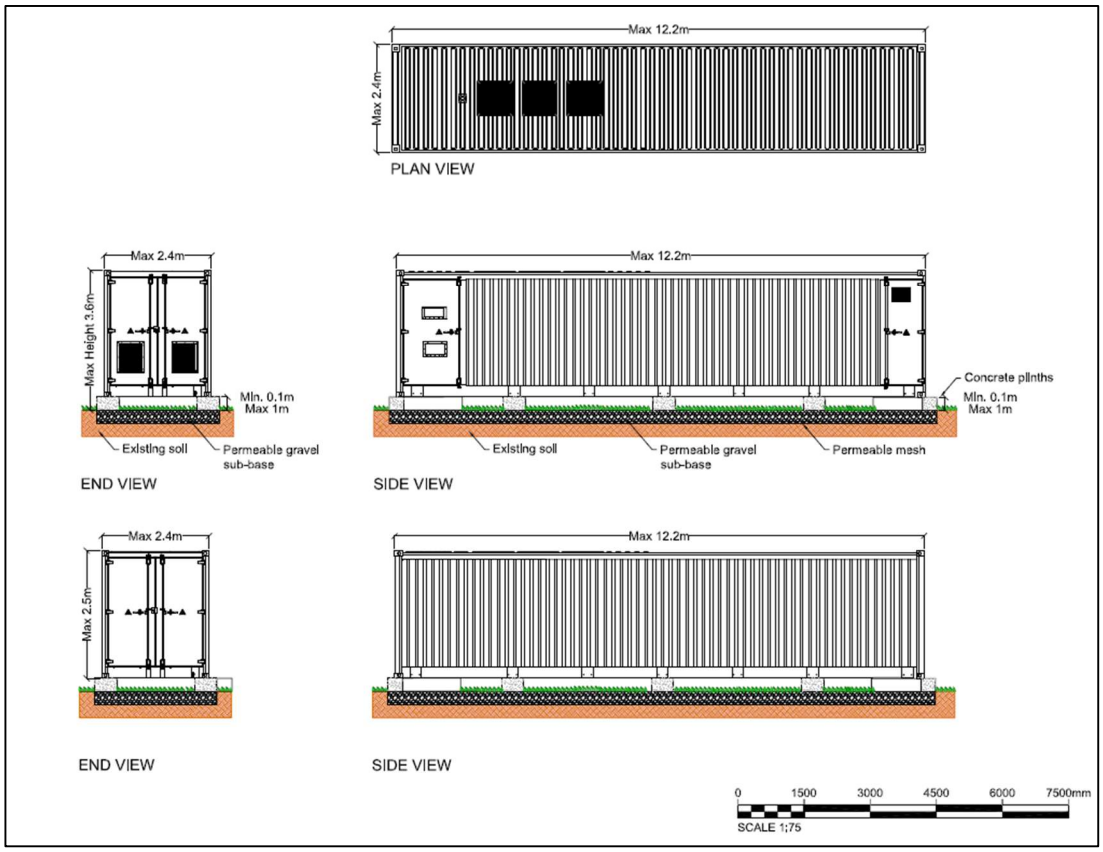
8.7 Power Conversion System (PCS) Units

8.7.1 The PCS Units are critical components within the Site's energy infrastructure, converting the DC electricity generated by the solar PV arrays into AC electricity suitable for grid distribution.

8.7.2 The PCS Units will be strategically located within Work No. 1. Each unit is designed with dimensions up to 12.2m in length, 2.5m in width, and 3.6m in height above ground level ('AGL'), including foundations, which are typically blocks or plinths on ground between the container floor and the ground. The positioning of these units will avoid areas with significant flood risk and high surface water flow, and units are integrated into the Site's topography and infrastructure to allow for ease of maintenance and minimal disturbance to the landscape.

8.7.3 To manage drainage effectively and ensure that surface water runoff does not increase, each unit will benefit from targeted SuDS which will most likely be a granular sub-base drainage system, although other similar options such as gravel filter drains could also be considered. These systems consist of a sub-base lined with a permeable membrane and filled with aggregate (MOT Type 3 or similar), designed to mimic greenfield runoff conditions. This ODS establishes the guiding principles and preliminary approach for drainage management around PCS Units, setting the foundation for more detailed specifications in the DS.

Figure 8.6: Indicative PCS Unit



8.7.4 An aggregate sub-base, with a depth of approximately 300mm, is an option to improve infiltration and runoff characteristics compared to existing conditions. The higher porosity of the aggregate material, as opposed to natural soil, allows it to retain a greater volume of water, enabling more gradual infiltration and reducing runoff. By maintaining these characteristics, the sub-base contributes to preserving the Site's natural hydrological balance, supporting effective drainage while minimising environmental impact.

8.7.5 The DS will adhere to specific standards and principles for effective drainage management. These standards include maintaining greenfield runoff rates, with the drainage system designed to align with pre-development conditions and incorporate measures for attenuation to handle a 1 in 100 annual probability plus climate change rainfall event. This approach is consistent with the requirements outlined by the LLFA during consultation. It should be noted that this ODS will not provide any detailed calculations; all necessary calculations, such as micro-drainage

calculations to confirm specific attenuation volumes, will be completed as part of the DS once the detailed layout is finalised.

8.7.6 The DS will also follow guidance from CIRIA C753[29] by prioritising natural, infiltration-based solutions over engineered systems wherever feasible. Compliance with EN-3 will be ensured in the DS, focusing on flood resilience and encouraging sustainable drainage solutions to manage localised runoff around PCS Units, as advised in Section 2.10 of the NPS for EN-3.

8.7.7 Building upon the principles established in this ODS, the DS will provide precise specifications, calculations, and micro-drainage analysis as part of the detailed design process. By adhering to these standards and principles, the DS will effectively mitigate flood risk, balancing operational needs with environmental stewardship.

8.7.8 Examples of the PCS Units are provided in Figure 8.6. These visuals illustrate typical PCS Unit design, offering a reference for their general structure and appearance with typical SuDS. The principles of targeted SuDS and the nature of these described above in relation to PCS Units will be applied to other containerised ancillary buildings such as O&M Units (Work No. 3).

8.8 Grid Connection Infrastructure

8.8.1 This section addresses the drainage strategy for the Grid Connection Infrastructure within Work No. 2 (and No. 2a), which includes facilities such as the Customer Substation Building, DNO Substation Building, as well as an area housing ancillary electrical equipment within a security fence. Work No. 2 allows for these works to take place within an area of approximately 8.95ha, although the Grid Connection Infrastructure facility therein will only require up to 1.2ha as per the DPD.

8.8.2 These installations will require specific drainage solutions due to the likely inclusion of gravel, concrete bases, and minimal vegetation within the

[29] Construction Industry Research and Information Association. (2015). The SUDS Manual V.6, C753.

fenced area, which could affect water infiltration and runoff characteristics. Given these factors, piped outfalls may be necessary, potentially discharging to a nearby watercourse either north or south of Work No. 2, depending on the final configuration and topography.

8.8.3 Work No. 2 provides the necessary space for both operational infrastructure and associated drainage solutions; the DNO substation has a footprint of up to 140m², the Customer Substation Building a footprint of up to 184m², and the Control Building a footprint of up to 31m^2. This combined footprint area represents a small proportion of the overall area of Work No. 2 leaving ample space to incorporate effective drainage solutions tailored to these impermeable surfaces.

8.8.4 As Work No. 2 primarily serves as a grid connection hub, more than half of the infrastructure here will be DNO-owned and will need to meet specifications set by the electricity undertaker. An Independent Connection Provider ('ICP') will be responsible for implementing this infrastructure, following the drainage requirements dictated by the DNO. Consequently, the drainage design for Work No. 2 must remain flexible, incorporating area-specific elements to align with the DNO's operational standards, which may necessitate an engineered piped drainage solution.

8.8.5 This ODS establishes the guiding principles for drainage within Work No. 2, focusing on natural infiltration and SuDS solutions as a foundation for the DS. The primary approach within Work No. 2 involves the use of filter drains, strategically arranged to create a water quality treatment train and to address all impermeable areas associated with the Grid Connection Infrastructure. These filter drains are intended to manage runoff effectively, providing water quality treatment through multiple stages of filtration.

8.8.6 The filter drains are preliminarily designed to accommodate infiltration across Work No. 2, which would avoid the need for a piped outfall. However, if site investigations reveal that infiltration is not feasible, the filter drains are envisioned to retain sufficient capacity for attenuation, allowing for a controlled connection to the nearest watercourse if needed.

This outfall would be managed to discharge at an agreed rate, likely around the Qbar rate (i.e., mean annual flood), to meet hydrological and regulatory standards.

8.8.7 Where a controlled discharge is required, any necessary approvals from the LLFA will be obtained as secondary consents[30] to enable the DS measures. The DS will be evidence-backed, confirming that hydrological impacts remain within acceptable limits, and will be subject to rigorous scrutiny.

8.8.8 The DS for Work No. 2 will provide clarification on two principal objectives: First, it will distinguish Work No. 2 from other Work Nos. due to its grid connection function, necessitating adherence to DNO standards for drainage. This difference may require a more iterative development process, with certain drainage elements introduced post-consent as DNO requirements are finalised. Second, the DS will establish a phased approach to allow commencement of activities in other Work Nos, such as 1 and 3, if their DS components are approved sooner. This phased approach aims to prevent unnecessary delays, enabling Work No. 1 and 3 to progress independently from Work No. 2 if needed.

8.8.9 In accordance with the design approach to the DS a sequential approach will also be applied to the design of Work No. 2 and 2a infrastructure whereby no sensitive infrastructure will be located in areas of surface water flood risk unless required by DNO engineering requirements in which case it must be demonstrated that inclusion can be appropriately mitigated. A suitably resilient design would be informed by further technical assessments such as geotechnical surveys. It is unlikely that the DNO would design sensitive infrastructure to cross into the flood risk extent. If suitable mitigation cannot be achieved to prevent risks to the infrastructure and impacts on flood risk, the only alternative would be avoidance. The final design will inform the final DS and CEMP, which will have regard to the conclusions of the FRA, Appendix D – Hydraulic

[30] HM Government (1991). Land Drainage Act 1991 c. 59

Analysis, and any further flood risk data that may become available in the interim period.

8.9 Access Tracks

8.9.1 Access tracks are required to facilitate vehicle movement around the Site for construction and maintenance purposes. The majority of access tracks will follow existing farm tracks and will not represent new routes, although any existing routes to be used would be upgraded and will be constructed to meet the same standards required for any new routes.

8.9.2 All tracks, whether new or upgraded existing tracks, will be made in-ground with permeable membrane and rolled ground that will excavate and/or compact topsoil up to approximately 300mm.

8.9.3 Entrances to the Site are likely to entail some upgrades involving bound surfacing where the internal tracks meet the highway, with these bound surfacing extending for a minimum of 5m and up to 20m. To reduce runoff, if possible, a permeable asphalt surface will be used, complete with an appropriate surface course, binder course, granular reservoir, and either a geotextile or geomembrane. This will allow surface water to percolate within the asphalt area.

8.9.4 The indicative section plan in Figure 8.7 shows tracks as being of a fully permeable construction such that there will be no increase in runoff from these areas. Where tracks will be in identified root protection areas, an alternative ‘no-dig’ solution will be employed that is also fully permeable as identified in Figure 8.8.

Figure 8.7: Typical Standard Internal Access Track

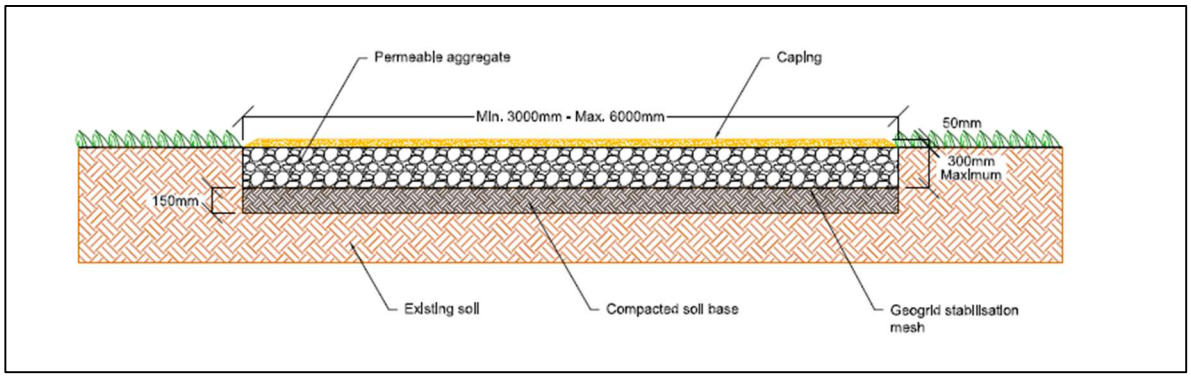
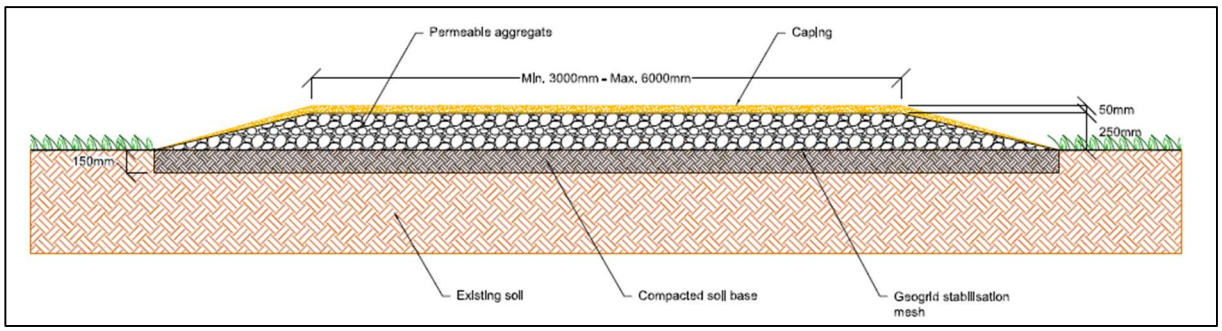


Figure 8.8: Typical No Dig Internal Access Track



8.9.5 The tracks will be formed of MOT type 3 or equivalent material which will provide a permeable surface. Geotextile membrane layers will help to secure the aggregate to prevent it sinking into the soil and this will help prevent ground compaction. This form of construction will mimic the existing greenfield runoff from these areas of the Site.

8.9.6 During the Proposed Development's operational phase there are anticipated to be a limited number of visits per week for maintenance (comprising 1-2 visits per week consisting of 2-4 vehicular movements) as set out in the Transport Statement (ES Appendix 2.5). As such, the impacts of the operational phase on traffic and access are expected to be minimal. This means there is low risk of over-use causing compaction, that could compromise permeability. The maintenance of access tracks - so that they are fit for purpose and are performing as permeable features - will be provided by the Operational Management Plan ('OMP') (as outlined in the Outline Operational Management Plan ('OOMP') (ES Appendix 3.1)) **[REF 6.3]** which is secured by a DCO Requirement and will reflect any recommendations of the DS in relation to these routes.

8.9.7 This ODS establishes the principle that access tracks within the Site should use permeable surfaces wherever feasible to facilitate natural infiltration, thereby reducing runoff and supporting effective Site drainage. However, if further assessments in the DS determine that permeable surfaces are not feasible in certain areas, alternative drainage solutions will be explored to ensure adequate water management.

8.9.8 One potential solution includes the use of roadside infiltration swales or shallow ditches alongside access tracks, which would be designed to provide attenuation by temporarily holding runoff. These ditches would then direct water to the nearest watercourse at or below the existing greenfield runoff rate, helping to maintain the Site's natural hydrology and minimise the impact on surrounding drainage systems.

8.9.9 The DS will provide detailed specifications and evidence to demonstrate that any bound surface areas introduced for access will not pose a risk to drainage within the Site or the adjacent Highway estate.

8.10 Development Runoff Rates

8.10.1 In line with the drainage approach discussed with the Council, any attenuated discharge rate will limit discharge to the existing runoff rate in up to and including the 1 in 100 (1.0%) annual probability plus allowance for climate change rainfall event in accordance with the SuDS Manual[10].

8.11 Pollution Control

8.11.1 Appropriate pollution control measures will be included in the surface water drainage system to minimise the risk of contamination or pollution entering the receiving systems from surface water runoff from the Proposed Development.

8.11.2 Water quality treatment will be provided for surface water runoff from the solar arrays, ancillary buildings, and access tracks. Any change in the pattern of surface water runoff over the Site will be from the relatively small impermeable areas such as buildings/structures dispersed across the area.

8.11.3 The SuDS Manual approach to water quality management of surface water describes risks posed by the surface water runoff to the receiving environment as a function of:

- The pollution hazard at a particular site (i.e. the pollution source).
- The effectiveness of SuDS treatment components in reducing levels of pollutants to environmentally acceptable levels.
- The sensitivity of the receiving environment.

8.11.4 The recommended approaches for water quality risk management are given in Table 26.1 of the SuDS Manual. The 'Simple Index' approach will be applied as the design method for the Site. To deliver adequate treatment, it must be demonstrated that the selected SuDS components have a total 'pollution mitigation index' for each contaminant type that equals or exceeds the 'pollution hazard index' for each contaminant type, as detailed for the Site below.

8.11.5 The DS will prioritise natural infiltration and SuDS solutions wherever feasible, to manage runoff effectively and reduce the potential for pollutants to enter the surrounding environment. The majority of the runoff will come from the grassy landscape, including that located below the Solar PVs, and will therefore be a very low pollution risk (see Table 8.2).

8.11.6 Given the low pollution hazard level anticipated for the Proposed Development, the focus is on incorporating features that support water quality management in line with best practice guidance. By integrating SuDS elements such as granular sub-bases, filter drains, and permeable access tracks, the drainage design aims to meet both water quantity and quality requirements, while aligning with environmental standards.

8.11.7 Mitigation with an index or combined indices of more than 0.3 for Total Suspended Solids (TSS), 0.2 for metals, and 0.05 for hydrocarbons is considered acceptable for the access tracks and ancillary buildings associated with the Proposed Development. These indices align with the guidance provided in the SuDS Manual (Section 26.7 and Table 26.2), which outlines mitigation indices for various SuDS components based on pollution hazard levels for different land uses. Given that the pollution

hazard level for this development is categorised as low, these indices are sufficient to meet the required standards for water quality treatment.

8.11.8 The granular sub-base or filter drains specified for most ancillary buildings and permeable access tracks are designed to meet these water quality requirements effectively. According to the SuDS Manual Section 26.7.3, granular materials in sub-bases can achieve similar treatment levels to permeable paving by capturing and filtering pollutants as runoff infiltrates. This is expected to effectively manage contaminants, including suspended solids and hydrocarbons, under the low pollution hazard conditions anticipated for this Site.

8.11.9 For Work No. 2, where infiltration may not be feasible due to specific conditions, multiple filter drains may be proposed to create a treatment train that enhances pollutant removal before runoff is directed to the nearest watercourse. The SuDS Manual (Section 26.7.4 and Table 26.4) supports the use of filter drains as effective SuDS features for removing pollutants from runoff, particularly TSS and hydrocarbons, in situations where infiltration is not viable. The sequential arrangement of filter drains will provide an added level of water quality treatment, ensuring compliance with environmental standards even in non-infiltration scenarios.

8.11.10 The proposed land uses for the Site, which have been adapted from similar land uses specified in the SuDS Mitigation Indices, fall into the pollution risk categories as defined in Table 8.1.

Table 8.1: Pollution Hazard Indices and Proposed Site Runoff Receptor (CIRIA, C753) Adapted for Solar PV project

Pollution Hazard Indices					
Land Use (Source)	**Destination of Runoff (Receptor)**	**Pollution Hazard Level**	**Total Suspended Solids**	**Metals**	**Hydrocarbons**
Solar PV arrays (Work No. 1)	Mimic natural runoff via infiltration and to watercourse	N/a	N/a	N/a	N/a
PCS Units (Work No. 1) and other associated buildings (Work No. 1 and 3) *(Residential roofing from SuDS Mitigation Index)*	Mimic natural runoff via infiltration and to watercourse	Very Low	0.2	0.2	0.05
Grid Connection Infrastructure (Work No. 2) *(Commercial / Industrial roofing: Medium potential for metal leaching from SuDS Mitigation Index)*	Infiltration and / or to watercourse	Medium	0.3	0.5	0.05
Access Tracks *(low traffic road from SuDS Mitigation Index)*	Mimic natural runoff via infiltration and to watercourse	Low	0.5	0.4	0.4

8.11.11 The proposed strategy outlined herein, which will be further developed in the DS, provides above the required level of pollutant removal as summarised below (see Table 8.2).

Table 8.2: SuDS Mitigation Indices (CIRIA, C753) Adapted for Solar PV project

Mitigation Indices				
Land Use (Source)	**Type of SuDS Component**	**Total Suspended Solids**	**Metals**	**Hydrocarbons**
Solar PV Arrays (Work No. 1)	Natural grass underneath Solar PV	N/a	N/a	N/a
PCS Units and Ancillary Buildings (Work No.1 and 3)	Granular sub-base or filter trenches (Adapted from filter drain in SuDS Mitigation Index)	0.5	0.4	0.4
Grid Connection Infrastructure (Work No. 2)	Minimum x 2 filter strip (or the equivalent level of treatment) - to be determined at detailed stage in the DCO.	0.6	0.6	0.75
Access Tracks	Permeable capping layer over aggregate sub-base (adapted from filter drain in SuDS Mitigation Index)	0.5	0.4	0.4

8.11.12 On this basis, it is considered that the DS will provide the required level of treatment for runoff generated by the Proposed Development.

8.12 Adoption and Management

8.12.1 The ongoing management and maintenance of the proposed surface water management systems will fall under the responsibility of the Applicant as the owners and operators of the Proposed Development.

8.12.2 Long term management of surface water drainage assets, including any SuDS components, is essential to ensure they continue to function to their design standard. As such, a management and maintenance plan will be developed to ensure the systems continue to work effectively.

8.12.3 The detailed design of SuDS and their maintenance will be set out in the DS, the preparation of which is secured by a DCO Requirement.

8.12.4 The DS will sit alongside the LEMP and OMP to provide holistic Site environmental management, including management to prevent flood risks

to/from the Site, to prevent adverse impacts on water quality, and to protect the watercourses as habitats.

8.13 EA and LLFA Consenting Arrangements

8.13.1 Proposed works in, over, under or near a main river require a 'Flood Risk Activity Permit' ('FRAP') application to be made to the EA. This is required to demonstrate any new works in proximity to a main river do not have a detrimental impact on flood risk or prevent maintenance access to the river channel. The Site is almost entirely unaffected by main rivers – however, the upstream limit of the Lostrigg Beck main river runs up to the boundary of the Site in the north-eastern corner of Area C and, as such, any works in this location within 8m proximity of the river channel will be subject to a FRAP application, although there is no expectation of any works being required to the culvert for the main river which runs under the Branthwaite Edge Road, where no street works other than safety signage is proposed by the dDCO.

8.13.2 An Ordinary Watercourse Consent ('OWC') is required for any works within, and adjacent to, an ordinary watercourse, and applications for such works will be made to the Council, as the LLFA and consenting body.

8.13.3 The design and construction methodology of watercourse crossings will be detailed in OWC applications to the LLFA. If this has been applied for and consented in advance of submissions to discharge CEMP and/or DS Requirements, details may be included in these documents as-appropriate. However as a minimum the CEMP and DS will both reflect the final design which will identify all crossing locations, and the CEMP will confirm which crossings may be used as-existing or if structural reinforcement works requiring OWC will be needed. As the EA is named within the dDCO as a consultee for both the DS and CEMP, the EA will be provided with the details of the crossings to be utilised and those for which OWC applications will be made to the LLFA.

8.13.4 The Proposed Development aims to retain and reuse existing crossings of ordinary watercourses. Where necessary, any crossings will be suitably

designed so they do not impede the ordinary watercourses across the Site. i.e., no lesser cross-sectional area than the existing channel.

8.13.5 No upgrade works to the existing culvert of the Lostrigg Beck which is crossed by the Branthwaite Edge Road are proposed (noting that such changes could affect flow rates, which could consequently impact on the flood risk along the Lostrigg Beck main river).

8.13.6 The details to be provided within an OWC application will consider the impact of any design on flow rates, with the objective of demonstrating 'no change', or 'no change that would alter the outcomes of the Appendix D Hydraulic Analysis'. This is also established within Section 12 of the OCEMP. As per the OCEMP (section 12.3), any OWC applications will also include appropriate environmental assessment and RAMS to form part of the implementation methodology under the supervision of the ecological clerk of works (ECoW).

8.13.7 Buffers that align with LLFA and EA requirements are established in the Work Plans [**REF: 2.3**] for the Proposed Development. No development other than approved landscaping or crossings, and works which are subject to additional LLFA consents, will be undertaken in these buffers. The final layout and landscaping plans (including the LEMP) will accord with the LLFA guidance. The OCEMP (ES Appendix 5.1) sets out measures to be implemented to protect against intrusion into these buffers during construction.

8.13.8 The OCEMP outlines the approach considered should any new crossings (including culverts/bridges or other structures) be necessary, and these would be subject to either the OWC process through the LLFA, or a FRAP if within the proximity of a main river.

8.13.9 The Applicant will engage with the LLFA on matters related to its statutory functions in the DS prior to submitting it for approval under the DCO Requirement.

9 Conclusions

9.1.1 This Flood Risk Assessment has been prepared to support an application for a DCO for the Proposed Development on approximately 276.5ha of land located between the villages of Gilgarran and Branthwaite in West Cumbria.

Flood Risk

9.1.2 The Site lies in Flood Zone 1 'Low Probability' (less than a 1 in 1000 (0.1%) annual probability of flooding from rivers or the sea).

9.1.3 The Site is located outside the fluvial floodplain. A hydraulic analysis (see Appendix D) has been undertaken that demonstrates the Environment Agency (EA) RoFSW maps for the Site are a suitable proxy for fluvial flood risk, based on the 2080s epoch climate change allowances, for the location where the ordinary watercourses converge at the head of the Lostrigg Beck. The Site is therefore not considered to be at risk when peak river flows, allowing for climate change impacts, are considered.

9.1.4 The majority of the Site has a 'Very Low' risk of surface water flooding, including when allowing for climate change impacts, with some localised areas of up to 'High' risk denoting the presence of ordinary watercourses, ponds and/or localised depressions.

9.1.5 The remaining sources of flood risk are considered to be a low risk.

Vulnerability and Sequential Test

9.1.6 The Proposed Development is a solar energy generating station, which is classified as '*Essential Infrastructure*' as defined in National Planning Policy Framework (NPPF) Annex 3 'Flood risk vulnerability classification'.

9.1.7 As noted above, the Site is located within the area with the lowest probability of fluvial flooding and, beyond natural land drainage features, the Site has a 'Very Low' risk of surface water flooding, thereby de facto meeting the requirements of the Sequential Test. The Applicant has committed to taking a sequential approach to design in the final layout and

specifications to be provided as a DCO Requirement, with these details to form the basis of the final CEMP and DS.

9.1.8 The Exception Test is not required.

Mitigation Strategy

9.1.9 The main risk of flooding is from surface water runoff in an extreme rainfall event. The solar PV arrays will be raised above any shallow surface water flood levels (the minimum height from the ground level is 700mm with heights higher than 700mm not restricted by the secured DPD parameters) and therefore are not susceptible to flooding.

9.1.10 The Proposed Development has been designed to maintain an 8m minimum buffer from the banks of all watercourses. The ancillary buildings would be located within the Site in areas with very low risk of surface water flooding following a sequential approach to design.

9.1.11 The design of the solar PV arrays is such that they have a negligible impact at ground level due to the nominal effective footprint, and as such they will have no effect on existing overland flow patterns.

9.1.12 The landscape-led mitigation strategy based on planting and targeted Sustainable Drainage Systems (SuDS) has been developed based on the findings of the Cook and McCuen (2013) study, which confirms that effective land management demonstrates that solar PV arrays do not significantly affect runoff volumes, peaks, or time to peak from solar farms provided the grass cover is well maintained under the panels and between the rows. Therefore, the proposed strategy is to apply this landscape-led approach and to maintain grass cover to avoid bare ground and erosion.

9.1.13 Proposed access tracks will be constructed of permeable materials, where possible, so that the runoff from the tracks will mimic greenfield conditions.

9.1.14 Ancillary buildings will benefit from targeted SuDS, which will most likely be a 300mm granular sub-base with a void ratio of at least 30%, providing sufficient attenuation storage for a 1 in 100 (1.0%) annual probability rainfall event plus an appropriate allowance for climate change.

9.1.15 In summary, the DS for the Proposed Development will prioritise nature-based solutions for flood risk mitigation as opposed to over-engineered elements that might compromise the multifunctional benefits of the cessation of widespread sheep grazing and green infrastructure enhancement. Beyond attenuation for ancillary buildings and access tracks, the remainder of the SuDS will be the natural grass buffers between rows, the vegetated ground under arrays, and the existing and new landscape planting boundary treatments.

9.1.16 In conclusion, the proposed infrastructure, and any future users of the Site, will be at a low risk of flooding and the Proposed Development will not increase flood risk elsewhere. It is demonstrated that the Proposed Development complies with the relevant NPS, NPPF, and local planning policy with respect to flood risk and is an appropriate development at this location.

10 Overview of Flood Risk

Aspect of flood risk	Applicable Guidance / Source of Data	Summary	Section of FRA
Site Location	n/a	Branthwaite Edge, Cumberland (nearest postcode CA14 4TB) (approx. NGS locations 304,600 E, 523,150 N).	**3**
Existing Ground Levels	Topographic Survey by AG Surveys Ltd., April 2023 (drawing no. 3539/500/(1-43))	Area A – the ground falls from high points of approximately 112m AOD in the south-eastern and south-western corners of the parcel, to 83m AOD in the north-western corner of the northern parcel; Area B – the ground falls from approximately 128m AOD in the central southern boundary to 107m AOD in the north-eastern border; Area C – the ground falls from peaks of approximately 206m AOD in the lower south-western boundary of the Site to 107m AOD in the north-western corner of the parcel. Area D – The ground falls from approximately 108m AOD in the south-western border to 98m AOD in the central north-western border.	**3.2**
Primary source of flood risk	EA Opendata datasets	Surface water	**5**
Presence of flood defences	EA Opendata datasets	None	**3.1**
Site	Proposals by the Applicant	The Proposed Development will include the following key elements of infrastructure: Solar PV panels; Solar PV array mounting structures; Power Conversion System ('PCS') Units in the form of Inverters and Transformers, and associated infrastructure; Grid Connection Infrastructure comprising Customer and DNO Substation Buildings and external electrical equipment and ancillary infrastructure within a weld mesh Security Fence; Perimeter Fencing, Gates, CCTV cameras, electrical cabling, and other associated infrastructure;	**1.3**

Aspect of flood risk	Applicable Guidance / Source of Data	Summary	Section of FRA
		Access from the highway and internal access tracks; and Green infrastructure including landscape planting and ecological enhancements.	
Planning Aspects			
Flood Risk Vulnerability	Planning Practice Guidance (PPG) 'Flood Risk and Coastal Change'	Essential Infrastructure'	**6.1**
Flood Zone		FZ1 'Low Probability'	**5.2**
Sequential Test		Development is in Flood Zone of lowest risk and in areas of low risk of other sources.	**6.2**
Applicable Climate Change Allowances	EA climate change allowances guidance	South West Lakes Management Catchment Plan +30% (Central), and; Derwent North West Management Catchment +40% (Central)	**4**
Reference Flood Levels	N/A	N/A	**5**
Present Day	N/A	No detailed EA model is available, the Site sits outside area of fluvial flood risk zone and largely at 'Very Low' risk of surface water flooding. Hydraulic analysis has been undertaken to verify the suitability of the RoFSW mapping to assess fluvial flood risk.	**5**
Climate Change		No detailed EA model is available, the Site sits outside area of fluvial flood risk zone and largely at 'Very Low' risk of surface water flooding, in climate change scenarios. Hydraulic analysis has been undertaken to verify the suitability of the RoFSW mapping to assess fluvial flood risk.	**5**

11 Abbreviations

Glossary of Terms	
Term	**Description**
ABI	Association of British Insurers
AP	Annual Probability
BESS	Battery Energy Storage System
BGS	British Geological Survey
BGL	Below Ground Level
CCC	Cumbria County Council
CEMP	Construction Environmental Management Plan
CDA	Critical Drainage Area
CDM	Construction (Design and Management)
CIRIA	Construction Industry Research and Information Association
DEFRA	Department for Environment, Food and Rural Affairs
DCO	Development Consent Order
DNO	Distribution Network Operator
EA	Environment Agency
ES	Environmental Statement
FAS	Flood Alleviation Scheme
FEH	Flood Estimation Handbook
FHR	Flood Hazard Rating
FRA	Flood Risk Assessment
FRAP	Flood Risk Activity Permit
FRMP	Flood Risk Management Plan
FZ	Flood Zone
GIS	Geographic Information System
ICP	Independent Connection Provider
LDC	Land Drainage Consent
LFRMS	Local Flood Risk Management Strategy
LiDAR	Light Detection and Ranging
LEMP	Landscape Ecological Management Plan
LLFA	Lead Local Flood Authority

Glossary of Terms	
Term	**Description**
LPA	Local Planning Authority
m. AOD	Metres Above Ordnance Datum (Newlyn)
MWLP	Minerals and Waste Local Plan
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NSRI	National Soil Resources Institute
OCEMP	Outline Construction Environmental Management Plan
OCTMP	Outline Construction Traffic Management Plan
ODS	Outline Drainage Strategy
OLEMP	Outline Landscape Ecological Management Plan
OMP	Operational Management Plan
OOMP	Outline Operations Management Plan
OSMP	Outline Soil Management Plan
OWC	Ordinary Watercourse Consent
PCS	Power Conversion System
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
PV	Photovoltaic
RoFRS	Risk of Flooding from Rivers and Sea
RoFSW	Risk of Flooding from Surface Water
SFRA	Strategic Flood Risk Assessment
SPZ	Source Protection Zone
SSE	Scottish and Southern Energy
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UUW	United Utilities Water

Figures

N

Wythemoor Sough
Lucy Close Farm
Outgang Farm
Branthwaite Hall
Winscales
Wythemoor House
Branthwaite
Wythemoor Head
Barnscale Burn
Barnock Row Farm
Near Branthwaite Edge
Raise
Far Branthwaite Edge
Crakeplace Hall
Branthwaite Rigg Barn
Totter Gill
Crow Wood
Strutter Wood
Whitelands Wood
Thief Gill
Tithe Barn
Collingate
Gilgarran
Whitney Lonning Wood
Low Dyonside Farm
Rear Moor Wood
Lime Kiln Wood
Boghill Wood
Dean Moor
Dean Cross
Friar Bank Wood
Laneside House
Wilson Park Farm
Oatlands
Keekle Head Farm
Moorside Wood
Quarry Wood
Glenmore
Whitelands
Midburngill House

0 1 2 km

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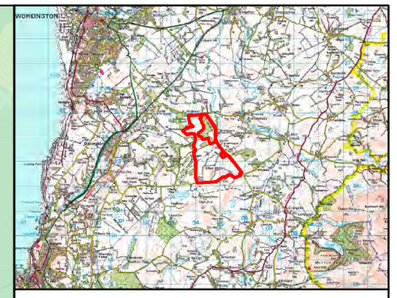

Legend

- Order Limits
- < 40.0m AOD
- 40.0m - 50.0m AOD
- 50.0m - 60.0m AOD
- 60.0m - 70.0m AOD
- 70.0m - 80.0m AOD
- 80.0m - 90.0m AOD
- 90.0m - 100.0m AOD
- 100.0m - 110.0m AOD
- 110.0m - 120.0m AOD
- 120.0m - 130.0m AOD
- 130.0m - 140.0m AOD
- 140.0m - 150.0m AOD
- 150.0m - 160.0m AOD
- 160.0m - 170.0m AOD
- 170.0m - 180.0m AOD
- 180.0m - 190.0m AOD
- 190.0m - 200.0m AOD
- 200.0m - 210.0m AOD
- 210.0m - 220.0m AOD
- > 220.0m AOD

Project Title

Dean Moor Solar Farm

Client

FVS Dean Moor Limited

Title

DEAN MOOR SOLAR FARM
DEVELOPMENT CONSENT ORDER
Topographic LiDAR

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Drawn: TL	Checked: SO	
Figure: 3.2	Sheet 1 of 1	Rev: B

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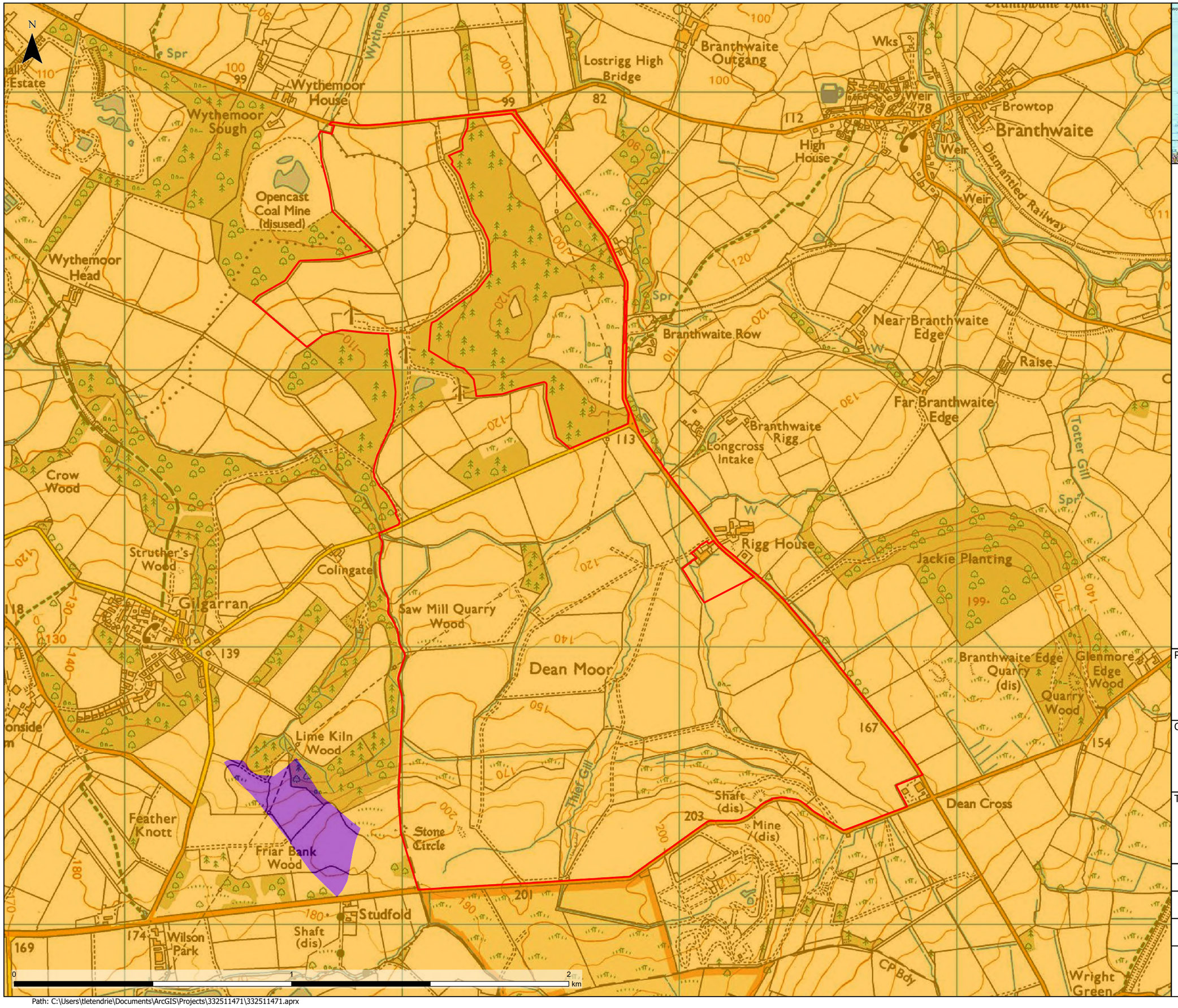

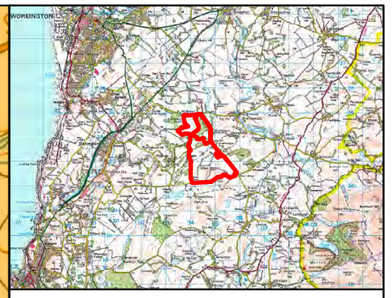

Legend

Order Limits

Bedrock Aquifer Designation

Principal

Secondary A

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Client: FVS Dean Moor Limited

Title: DEAN MOOR SOLAR FARM
DEVELOPMENT CONSENT ORDER

Bedrock Aquifer Designation

Scale: 1:12,500 @ A3	Date: 18/10/2024
Drawn: TL	Checked: SO
Figure: 3.3	Sheet 1 of 1 / Rev: A

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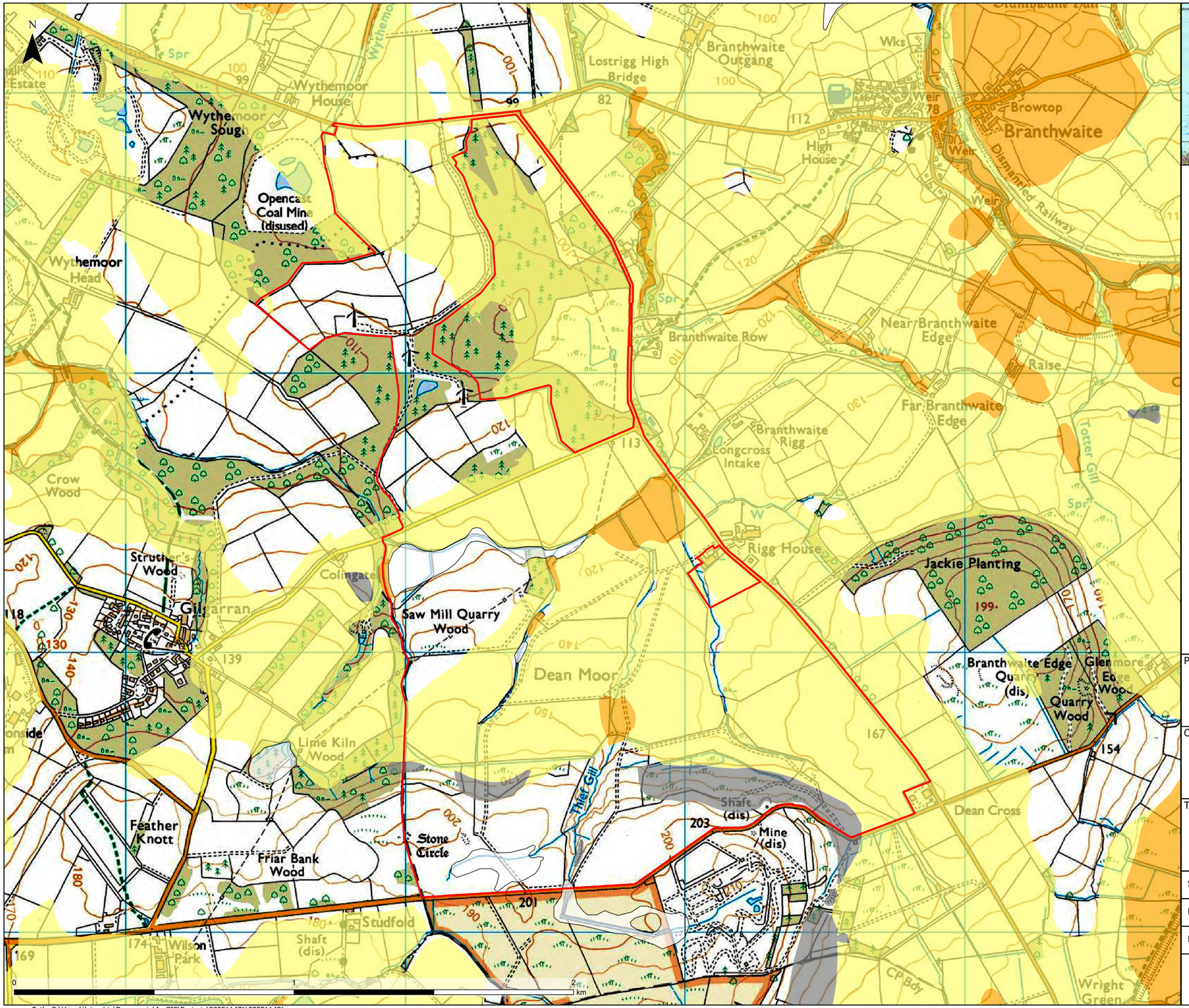

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- Order Limits

Superficial Aquifer Designation

- Secondary A
- Secondary (undifferentiated)
- Unknown (lakes+landslip)
- Unproductive

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Client: FVS Dean Moor Limited

Title: DEAN MOOR SOLAR FARM DEVELOPMENT CONSENT ORDER

Superficial Aquifer Designation

Scale: 1:12,500 @ A3	Date: 18/10/2024
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Figure: 3.4	Sheet 1 of 1 — Rev: A

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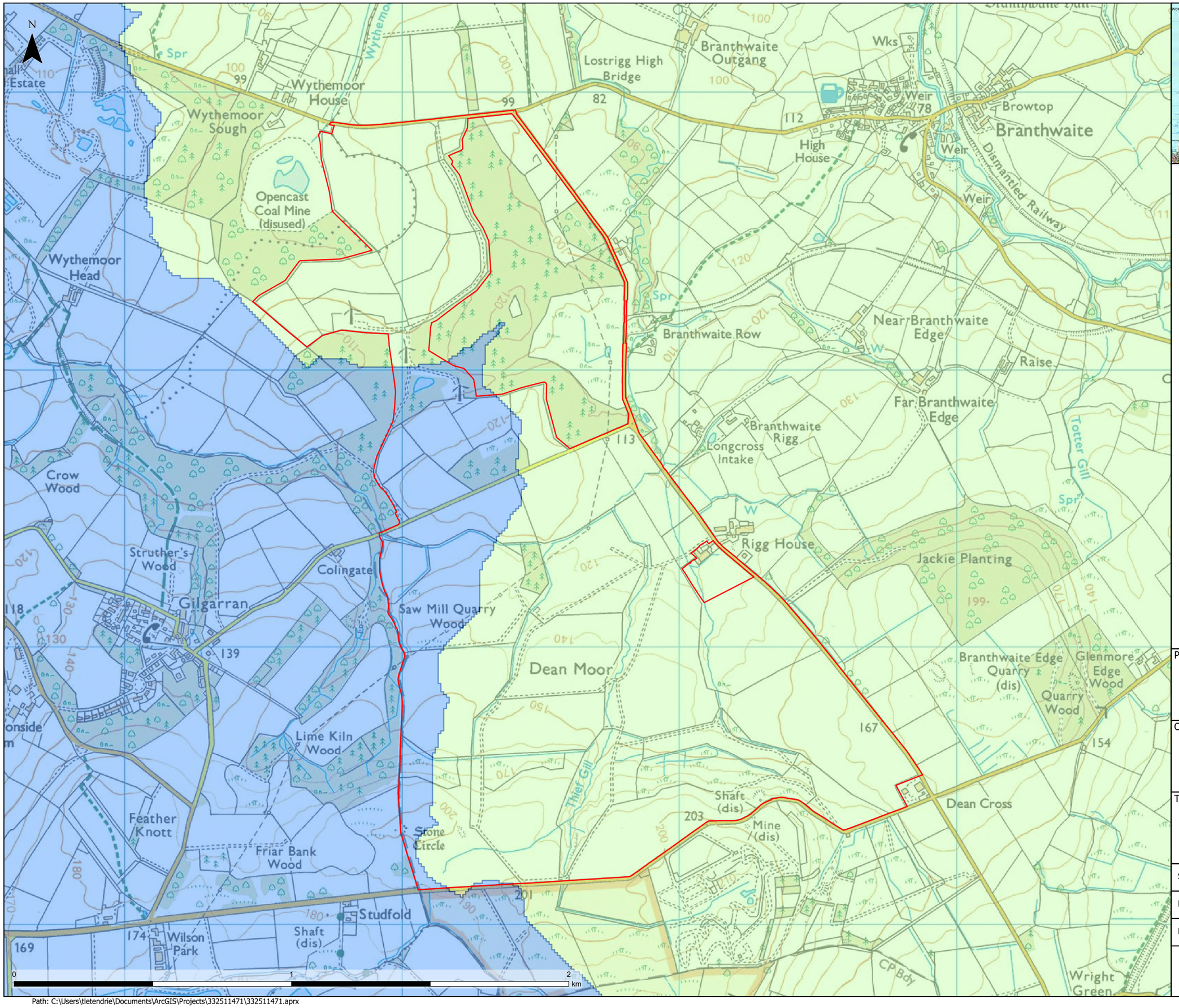

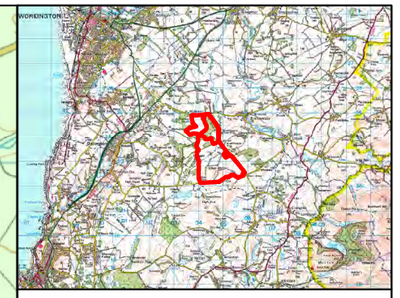

Legend

Order Limits

Environment Agency Climate Change Allowance Catchment

South West Lakes

Derwent North West

Project Title

Dean Moor Solar Farm

Client

FVS Dean Moor Limited

Title

DEAN MOOR SOLAR FARM
DEVELOPMENT CONSENT ORDER

Environment Agency Climate Change Allowance Catchments

Scale: 1:12,500 @ A3	Date: 18/10/2024
Drawn: TL	Checked: PL
Figure: 4.1	Sheet 1 of 1 Rev: A

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