

Byers Gill Solar Development

Application by RWE Renewables for an Order granting Development Consent for a proposed solar development on land between Darlington, Stockton-on-Tees and Newton Aycliffe

PINS Ref: EN010139

Landscape & Visual Review

for

Deadline 2 Written Representations

by

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for

Bishopton Villages Action Group

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Appendices

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Appendix CT-A: CT LVIA Criteria

Appendix CT-B: Letter from Gwent Wildlife Trust and Friends of the Gwent Levels

Appendix CT-C: ADAS / Welsh Government Solar Soil Impact Study Report

Appendix CT-D: Examples of CGIs

Summary

- S1 I am a Chartered Member of the Landscape Institute (CMLI), a Fellow of the Royal Society of Arts (FRSA), and a Member of the International Association for Landscape Ecology (MIALE). I specialise in landscape, environmental and colour assessment and planning in the UK and abroad, and have done so for over 40 years.
- S2 My relevant experience is set out in Section 1.2 of my report, but for the last three years, I have been and still am involved with many renewable energy (wind / solar) proposals in the UK, some of which are Nationally Significant Infrastructure Projects (NSIPs), so I am very familiar with the issues associated with developments such as the one proposed here.
- S3 In February 2023, I was approached by a representative of the Bishopton Villages Action Group (BVAG), who asked whether I would be prepared to act as their landscape consultant for the proposed Byers Gill solar development, and advise them throughout the Examination process.
- S4 In order to establish whether I could act / advise, I needed to gain a preliminary understanding of the proposed development and the likely issues, so I carried out a fairly rapid desktop baseline study and review of the proposals. At that time, the scheme was at the pre-application phase, and scoping documents had been submitted. In the light of this exercise and past experience, I concluded that I was prepared to undertake the commission, and was subsequently instructed by BVAG to proceed. I undertook in-depth baseline desktop studies, visited the site and surrounding areas, and spoke to local residents.
- S5 Once it had been submitted, I carried out a full review of the Application, including the Applicant's Landscape and Visual Impact Assessment (LVIA), and undertook my own technical assessment of landscape and visual effects, in accordance with published guidance. This involved carrying out further site visits, research, and informal consultation.
- S6 However, please note that the scope of this commission is somewhat different from that of a 'standard' LVIA, in that it is a 'hybrid' between an assessment and a review, and it also factors in matters discussed / noted during the Examination process to date.
- S7 Also, for conciseness, I decided not to write up the findings of my assessment and review separately and in full; rather, I have summarised the most relevant points in this report, and provided a few detailed examples, to justify my conclusions about the LVIA review, effects, and the matters with which I agree / do not agree.
- S8 If necessary, I will draw on my full notes and hand-drawn plans during the Examination, to inform any questions and / or responses.
- S9 The main aims of my assessment and review were:
- i) to understand the issues of relevance to landscape and visual effects, and establish whether they are a) identified and b) properly addressed in the Applicant's submissions;
 - ii) to determine whether the Applicant's submissions provide sufficient information to ensure that informed judgements about landscape and visual effects can be made, and on which decision-makers can confidently rely; and
 - iii) to establish a) the main areas of agreement and disagreement, and b) the reasons for such agreement / disagreement.
- S10 In summary, I concluded that:
- i) many issues of relevance to landscape and visual effects are not identified or properly addressed in the Applicant's submissions;

- ii) the Applicant's submissions do not provide sufficient information to ensure that informed judgements about landscape and visual effects can be made, and on which decision-makers can confidently rely; and
 - iii) notwithstanding the above, there appear to be many areas of agreement about landscape and visual matters, including effects, as explained below.
- S11 My own assessment concluded that the proposed development would give rise to **significant adverse** landscape and visual effects.
- S12 National Planning Policy Framework (NPPF) paragraph 163 b)¹ says that '*applications for renewable and low carbon development should be approved if its impacts are (or can be made) acceptable*'. In this case, the majority of the significant adverse landscape and visual effects are not, and could not be made, acceptable, and would remain significant for the 40-year duration of the operation – for many, that would be a lifetime.
- S13 Some effects would or could be 'truly' permanent, not just scheme elements such as the proposed Distribution Network Operator (DNO) substation complex, but also, damage to buried heritage assets and soils, and loss of vegetation.
- S14 Not only would some of the levels of adverse landscape and visual effects be at the very highest level, but they would also extend over a vast area. The site covers c. 490ha, and stretches some 12km from west to east, and 2.7km from north to south, in the triangle of land between Darlington, Newton Aycliffe, and Stockton-on-Tees.
- S15 Once the busy urban areas are left behind, the area very quickly becomes deeply rural, characterised by scenically-beautiful, sparsely-settled, working agricultural landscapes of arable and pasture, interspersed with woodland, watercourses, historic features, and historic villages linked by narrow, winding lanes. Here, levels of tranquillity are surprisingly high, with no disturbance, often, the only sounds are skylarks singing and the wind blowing across the fields.
- S16 In fact, it is not easy to fully comprehend the magnitude of size and scale of the proposal, especially relative to its wider context and how much land it would cover. This is best established by travelling around by car / on foot, but by way of comparison, I calculated that the site could accommodate the nearby large urban residential settlement of Newton Aycliffe, which has a population of around 27,000.
- S17 Also, the proposed development must be considered in combination with other existing and proposed solar developments and similar large-scale projects nearby, some of which have already industrialised / urbanised parts of the area, and will no doubt continue to do so.
- S18 Importantly, the increase in such development, which includes housing, results in ever-more pressure being put on ever-decreasing landscape resources, meaning that the resources become even more valuable, and more vulnerable to change.
- S19 My report describes some of the significant landscape, visual and other effects likely to arise in detail, where they have not been identified or adequately explained in the Applicant's submissions. Below is a brief summary of other likely / potentially significant landscape-related effects which were identified in my assessment and review:
 - i) There would be significant and unacceptable harm to social and recreational amenity, especially the enjoyment of well-used and highly-valued public rights of way through a high-quality landscape offering many valuable resources, and performing many valuable / critical functions.
 - ii) There would also be significant and unacceptable harm to residential amenity.

¹ December 2023 version used throughout

- iii) The proposed development would result in high levels of harm to the settings of several designated heritage assets, and potentially, to buried archaeology.
 - iv) The claims that the development would deliver significant biodiversity net gains are doubtful, and the proposals are in fact likely to cause significant harm to habitats and species, including protected species including otters, water vole, and bats.
 - v) There is the potential for significant and probably permanent soil damage / reduction in quality and fertility.
 - vi) There is the potential for significant adverse effects on water quality.
- S20 There are many other matters of concern, especially in terms of potentially significant adverse effects, which are either a) covered in some detail in the Applicant's assessments, but the conclusions are based on flawed methods / assumptions; or b) not covered in sufficient detail (or at all) in the Applicant's submissions, nor in my own assessment: examples are given in Section 4.8.
- S21 Regarding the landscape and visual topic in relation to this Examination, not only did my own assessment conclude that the proposed development would give rise to **significant adverse** landscape and visual effects, but so did the Applicant's.
- S22 Whilst my review concluded that certain aspects of the Applicant's LVIA method and process are flawed, and as a result, the overall levels of landscape and visual effects would be higher than the LVIA predicts, it is hoped that the parties can agree that the adverse landscape and visual effects arising from the proposed development would be 'significant', and thus landscape and visual effects could be scoped out of the Examination, which would save a considerable amount of time.
- S23 Of course, 'landscape' covers / is relevant to a wide range of environmental and other topics, for example heritage, biodiversity, soils, hydrology, transport, and recreation (views are also relevant to some of these), so such agreement should not preclude further discussion about specific landscape and visual effects if necessary.
- S24 Indeed, in my opinion, it is very important to understand the specific cause and nature of the landscape, visual, and other effects likely to arise, as this may be useful for future discussions / queries about associated topics, especially mitigation.
- S25 Notwithstanding any such agreement, it would be helpful if the ExA could ask the Applicant to clarify some of the matters raised in this report where noted, and to supply additional information, if the ExA considers that this would be relevant / useful.
- S26 Naturally, the proposals for the Byers Gill application in particular have caused not only concern, but also great anxiety amongst local residents. My assessment concluded that these concerns and anxieties are not unfounded, or based on speculation: on the contrary, they are based on evidence and fact.
- S27 The government's Planning Practice Guidance (PPG) says, '*The National Planning Policy Framework explains that all communities have a responsibility to help increase the use and supply of green energy, but this does not mean that the need for renewable energy automatically overrides environmental protections and the planning concerns of local communities. As with other types of development, it is important that the planning concerns of local communities are properly heard in matters that directly affect them.*'
- S28 Members of the local communities have clearly expressed their concerns about the proposals, and I hope that this report adequately represents those relating to landscape and visual effects.

1 Introduction

1.1 Background

- 1.1.1 I am an independent chartered landscape architect specialising in landscape planning, with extensive experience in renewable energy developments, some of which are Nationally Significant Infrastructure Projects (NSIPs). My relevant experience is set out in Section 1.2 below.
- 1.1.2 In February 2023, I was approached by a representative of the Bishopton Villages Action Group (BVAG), who asked whether I would be prepared to act as their landscape consultant for the proposed Byers Gill solar development, and advise them throughout the Examination process.
- 1.1.3 In order to establish whether I could act / advise, I needed to gain a preliminary understanding of the proposed development and the likely issues, so I carried out a fairly rapid desktop baseline study and review of the proposals. At that time, the scheme was at the pre-application phase, and scoping documents had been submitted. In the light of this exercise and past experience, I concluded that I was prepared to undertake the commission, and was subsequently instructed by BVAG to proceed.
- 1.1.4 For the next few months, I had little involvement, apart from occasional update meetings with BVAG. In February 2024, when the Application was submitted, I made a start on my assessment and review, which included visiting the site and surrounding area, meeting BVAG, and speaking to local residents and others.
- 1.1.5 I then carried out a full review of the Application, including the Applicant's Landscape and Visual Impact Assessment (LVIA), and undertook my own technical assessment of landscape and visual effects, in accordance with published guidance. I also carried out further site visits, research, and informal consultation. However, please note that the scope of this commission is somewhat different from that of a 'standard' LVIA, in that it is a 'hybrid' between an assessment and a review, and it also factors in matters discussed / noted during the Examination process to date.
- 1.1.6 Also, for conciseness, I decided not to write up the findings of my assessment and review separately and in full; rather, I have summarised the most relevant points in this report, and provided a few detailed examples, to justify my conclusions about the LVIA review, effects, and the matters with which I agree / do not agree. If necessary, I will draw on my full notes and hand-drawn plans during the Examination, to inform any questions and / or responses.
- 1.1.7 The main aims of my assessment and review were as follows:
- i) to understand the issues of relevance to landscape and visual effects, and establish whether they are a) identified and b) properly addressed in the Applicant's submissions;
 - ii) to determine whether the Applicant's submissions provide sufficient information to ensure that informed judgements about landscape and visual effects can be made, and on which decision-makers can confidently rely; and
 - iii) to establish a) the main areas of agreement and disagreement, and b) the reasons for such agreement / disagreement.
- 1.1.8 In summary, I concluded that:
- i) many issues of relevance to landscape and visual effects are not identified or properly addressed in the Applicant's submissions;
 - ii) the Applicant's submissions do not provide sufficient information to ensure that informed judgements about landscape and visual effects can be made, and on which decision-makers can confidently rely;

- iii) notwithstanding the above, there appear to be many areas of agreement about landscape and visual matters, including effects.
- 1.1.9 In fact, both the Applicant's LVIA (set out in Environmental Statement (ES) Chapter 7 Landscape and Visual) and my own assessment concluded that the proposed development would give rise to **significant adverse** landscape and visual effects.
- 1.1.10 Whilst my review concluded that certain aspects of the Applicant's LVIA method and process are flawed, and that as a result, the overall levels of landscape and visual effects would be higher than the LVIA predicts, my thought at that point was that at an early stage in the Examination process, it should be possible for the parties to agree that the adverse landscape and visual effects arising from the proposed development would be 'significant', and thus scope landscape and visual effects out of the Examination, which would save a considerable amount of time.
- 1.1.11 Of course, 'landscape' covers / is relevant to a wide range of environmental and other topics, for example heritage, biodiversity, soils, hydrology, transport, and recreation (views are also relevant to some of these), so such agreement should not preclude further discussion about specific landscape and visual effects if necessary.
- 1.1.12 Indeed, in my opinion, it is very important to understand the specific cause and nature of the landscape, visual, and other effects likely to arise, as this may be useful for future discussions / queries about associated topics, especially mitigation.
- 1.1.13 In fact, in some cases, it appears that the environmental effects arising from certain aspects of the proposals were not considered at all.
- 1.1.14 The proposed access into the western end of the site, Area A, is a good example of many of the issues associated with the Applicant's submission that I identified in my assessment and review; therefore, I decided to go into some detail about the proposed access to this Area; also, the information could help to inform proposals for specific mitigation measures and / or alternative solutions for this part of the scheme, if these are found to be necessary.
- 1.1.15 Very importantly, it must be emphasised that whilst the problems with the proposed access into Area A are highlighted here, the same / similar problems would certainly in some cases, and probably in others, apply to the other Areas (B – F), in terms of lack of baseline survey and analysis, and identification and assessments of effects.
- 1.1.16 However, whilst my own assessment concluded that the majority of adverse landscape and visual effects arising from the scheme as currently proposed could not be adequately mitigated, it also concluded that high levels of some of the adverse effects could possibly be reduced through material adjustments to the scheme, in terms of siting and layout.
- 1.1.17 On the 23rd and 24th of July 2024, I attended, as an online observer, Preliminary Meeting and Issue Specific Hearing 1 (ISH1), and Open Floor Hearings (OFHs) 1 and 2.
- 1.1.18 During the Preliminary Meeting, it was agreed that BVAG would enter into a Statement of Common Ground (SoCG) with the Applicant.
- 1.1.19 On the 25th of July, the Applicant sent to BVAG the *Statement of Common Ground with Bishopton Villages Action Group Draft v1 July 2024* (ExA doc ref AOC-002), explaining that they had '*amended the draft SoCG document we shared with you last week*', which was between the Applicant and Bishopton Parish Council (BPC), '*to ensure that it relates to BVAG only... This document has been prepared based on the contents of your Relevant Representation*'.
- 1.1.20 I reviewed the draft SoCG, focussing on relevant landscape and visual matters, and BVAG sent their comments on the draft to the Applicant on the 9th of August. By the time this report was due to be submitted, BVAG had not received a response from the Applicant about the draft SoCG. It may be appropriate to consider a separate Landscape SoCG.

- 1.1.21 I also reviewed the Examining Authority (ExA)'s first round of written questions and requests for information (ExQ1), which was issued on the 30th of July. This was very helpful in terms of informing my response. Where relevant, I have included references to / comments on ExQ1 in this report.
- 1.1.22 In addition, I read Darlington Borough Council (DBC)'s Local Impact Reports (LIRs) (main LIR, and landscape and visual LIR), which were issued on the 15th of August.
- 1.1.23 Regarding the main LIR, there are a few landscape-related matters that BVAG may wish to augment and / or comment on in due course.
- 1.1.24 Regarding the landscape LIR, which is also helpful, and comprehensive, I found that it a) identified several matters which my own assessment and review had identified, with our assessments reaching similar conclusions; b) identified a few matters which are not included in my own assessment; and c) did not identify / comment on other matters which are raised in my report. To avoid repetition, I decided to focus on the latter (c), and rely on the landscape LIR for the former (a) and b)).
- 1.1.25 Examples of a) include i) the assessment of cumulative landscape and visual effects; ii) the detailed analysis and assessment of effects on the affected settlements, their settings / contextual landscapes, and their communities; iii) the LVIA's selection of viewpoints / analysis / quality of visualisations (but see Appendix CT-D); and iv) unclear rationale behind the design proposals (landscape LIR para. 10.5), and absence of a clearly defined landscape strategy in the Design Approach Document being a key weakness (para. 10.6).
- 1.1.26 However, please note that I do not agree with the landscape LIR's conclusion at para. 8.1, that the baseline material in the Applicant's LVIA is '*adequate and comprehensive*'. Also, whilst the landscape LIR considers that the LVIA's method and criteria '*generally accords with*' the published guidance, there are certain flaws in the LVIA which have resulted in levels of adverse effects being underestimated.

1.2 Relevant Experience

- 1.2.1 I am a Chartered Member of the Landscape Institute (CMLI), a Fellow of the Royal Society of Arts (FRSA), and a Member of the International Association for Landscape Ecology (MIALE). I specialise in landscape, environmental and colour assessment, planning and design, and have done so for over forty years.
- 1.2.2 I am also a Design Council Expert, and an author.
- 1.2.3 I was a contributor to the first edition of *Guidelines for Landscape and Visual Impact Assessment* (GLVIA1), and a reviewer of the current edition (GLVIA3). For many years, I developed and promoted the landscape-led and iterative approach to development, which has now been adopted by the LI, Local Planning Authorities (LPAs), and other bodies.
- 1.2.4 I have been involved in the planning, design, co-ordination, management and implementation of many large-scale, high-profile developments in the UK and overseas, working for governments and NGOs, alongside architects including Richard Rogers and Norman Foster, on schemes which have won competitions and awards.
- 1.2.5 My experience covers a wide range of development types, including residential, commercial, industrial, recreational, historical, agricultural, ecological, and sustainable. For the last three years, I have been involved with many renewable energy (wind / solar) proposals in the UK, some of which are Nationally Significant Infrastructure Projects (NSIPs), for example, Mallard Pass (EN010127), and the on-shore substations for the Norfolk Boreas and Vanguard Offshore Windfarms (EN010079 and EN EN010087 respectively).
- 1.2.6 I am regularly called as an expert witness at planning inquiries, giving evidence on behalf of appellants, defendants, and Rule 6 parties.

- 1.2.7 I advise bodies responsible for National Parks / National Landscapes, and LPAs, producing guidance documents (I advised a National Landscape partnership on recently-published solar development guidance), carrying out character, sensitivity, capacity, and effects assessments, and reviewing planning applications. I also provide specialised in-field LVIA training for LPA and National Landscape officers, landscape practitioners and others.
- 1.2.8 Currently, I am a member of LI and Natural England working groups tasked with updating current landscape and visual assessment guidance; producing other technical guidance and information notes (for example, LI Technical Information Note (TIN) 04/2018 *Environmental Colour Assessment*); assessing the future of local landscape designations; and responding to consultations by government / other bodies (eg revisions to National Policy Statements (NPSs) and the National Planning Policy Framework (NPPF); the LI's Technical Guidance Note (TGN) 02/21 *Assessing landscape value outside national designations*; the Government's *25 Year Environment Plan*; and the *Agriculture Bill*).
- 1.2.9 Today, much of my work is in neighbourhood planning, helping communities develop a more in-depth and informed understanding of landscape and its value.
- 1.2.10 In 2020, I was invited to speak about 'valued landscapes' at the Planning Inspectorate's Annual Training Event.

2 Key Issues

- 2.1 This section summarises the key issues which I identified during the course of my assessment and review. Where relevant, the issues are expanded upon in the following sections.

1: Landscape and visual effects

- 2.2 Evidently, the key issue in terms of both my assessment and review, and this Examination topic, is 'effects on character and appearance'.
- 2.3 In fact, both the Applicant's LVIA and my own assessment concluded that the proposed development would give rise to **significant adverse** landscape and visual effects.
- 2.4 In the ExQ1 table of questions, at QGCT.1.16, the ExA confirms that '*Significant [adverse] effects have been identified by the Applicant, particularly Visual and Landscape effects*'.
- 2.5 However, as explained in the previous section, 'landscape' covers / is relevant to a wide range of environmental and other topics, for example heritage, biodiversity, soils, hydrology, transport, and recreation. Views / visual amenity are also relevant to some of these.
- 2.6 Thus, even if there is agreement between the parties that the adverse landscape and visual effects arising would be significant, it is still important to understand the precise cause and nature of the landscape and visual effects likely to arise, and the reasons for the parties' differences of opinion about these matters, even if just for future reference, or for where there is association between other topics / topic effects, for example in terms of proposed mitigation / enhancement measures.
- 2.7 Also please note that I am acting for BVAG, which represents the views of a large number of people living in the area. Landscape and visual effects are amongst their primary concerns. Their opinions on this topic can be found in BVAG's Relevant Representation report dated the 15th of May 2024 (Examination doc ref RR-548).
- 2.8 Under the heading *The proposal – matters to be investigated*, paras. 2.12 – 2.14 explain how the residents consider that the proposed development would adversely change character, appearance and amenity, and adversely affect their health and well-being:

'2.12 The proposal has raised serious concerns from many local residents who would be significantly and adversely affected if this project were granted consent. The first of these concerns is rather than being perceived as a solar development occupying an area of land within a wider landscape, the Byers Gill solar proposal has the potential to dominate and transform the entire local landscape - to alter it beyond recognition - and thus to create a new landscape altogether.'

'2.13 The transformation of open countryside to an alien, industrial landscape would stretch over 30 miles between Darlington, and Newton Aycliffe, to Stockton, surrounding and dominating communities and villages which have been within their rural settings for centuries, and evolved with deep historical significance. This rural characteristic remains important to people's lives even more today. The application has failed to understand the perception and experience of the local community, and the major adverse impact on the health and wellbeing of the affected communities represented here. This will be further explored in BVAG's WR in due course.'

'2.14 The fragmented, sprawling layout of the proposals, is wasteful and the equivalent to almost 10 major solar farms of 49.9MW which could be consented by local planning authorities. Located amidst and around several settlements and within a historic landscape, it has the potential to impact on local character to such an extent as to completely transform the sense of place, and the place attachment of the residents, of the affected villages and communities. Many residents will experience the adverse visual and perceptual effects of various elements of the solar farm, as part of their daily routines. The visual elements include not only the 1000s of panels and metal frame mountings, but also the battery storage compounds, and general security infrastructure such as fencing, lighting,

mounted CCTV, as well as access roads, inverters, power stations, and the destruction resulting from the construction of such a vast and sprawling industrial complex.'

- 2.9 On completion of my assessment and review, I concluded that none of these concerns are unfounded.

2: LVIA method and process

- 2.10 My assessment and review concluded that certain aspects of the Applicant's LVIA method and process, and certain assumptions, are flawed. Thus, whilst there could potentially be agreement between the parties about the overall levels of adverse landscape and visual effects, or at least that they would be 'significant', there may not be agreement about how those conclusions were reached, what factors were / should have been taken into account, what assumptions were / should have been made, and so on.
- 2.11 As explained above, even if agreement is reached and the landscape and visual topics are scoped out, the findings of my assessment and review may be useful for future discussions / queries about associated topics, especially mitigation.

3: Mitigation / Scheme Design

- 2.12 My assessment concluded that in some cases, the proposed mitigation measures would in themselves give rise to adverse landscape and visual effects.
- 2.13 It also concluded that the majority of landscape and visual effects arising from the scheme as currently proposed could not be adequately or acceptably mitigated.
- 2.14 However, it may be possible to reduce levels of some of the adverse effects on character and appearance by making material adjustments to the scheme layout.

3 LVIA Method and Process

3.1 Introduction

3.1.1 This section sets out matters relating to the Applicant's LVIA method and process.

3.1.2 For my own commission, I carried out a full review of the Application, and undertook a technical assessment of landscape and visual effects, in accordance with published guidance². However, as explained in Section 1, the scope of this work is somewhat different from that of a 'standard' LVIA, in that it is a 'hybrid' between an assessment and a review, and it factors in matters discussed / noted during the Examination process to date.

3.1.3 Also, unlike many practitioners, I do not have a stand-alone method that I append to my reports: I prefer to explain the method at the relevant points in the text, for ease of reference. The only stand-alone generic document I include is for the criteria and matrices I use when making judgements about levels of landscape and visual sensitivity, magnitudes of effect, and overall landscape and visual effects (see Appendix CT-A).

3.1.4 In addition, my surveys and assessments were carried out with the assistance of members of BVAG and people from the local communities. I asked them to do research and fieldwork to help inform / augment the baseline studies and effects assessments, under my professional guidance. I often do this, not just because it helps to keep costs down, but also, in my experience, local people usually know far more about their own 'back yards' than anyone else, and are a mine of information. In addition, involvement in the studies helps engender a sense of responsibility, and a greater understanding of 'value'. Sometimes during these exercises, previously unknown features come to light which turn out to be of regional / national importance.

3.1.5 Furthermore, the knowledge that they are doing something useful can go some way in lessening the stress and anxiety that many of those affected inevitably feel – something that the planning process / policy does not consider, despite new development supposedly being intended to improve people's health and well-being, and the quality of their lives.

3.1.6 The residents used Ordnance Survey (OS) and other maps for their studies, including the hand-drawn landscape and visual baseline plans I had already prepared, based on a 1:25,000 OS map of the study area. The information they gathered during desktop and on-the-ground studies, in accordance with my brief, included:

- Key visitor attractions, recreational / community facilities, schools, shops, places of work etc.
- Important recreational / daily commute connections between the site and the wider area.
- Routes (along roads, byways open to all traffic (BOATs), bridleways, public / permissive footpaths) typically / frequently used by the local community and visitors, i) in cars, ii) on bicycles, iii) on horseback, iv) on foot, and v) by bus.
- Routes used for regular organised sporting events such as cycle and running races.
- Public and residential viewpoints.
- Constraints along the proposed construction route.

² Guidance followed includes the Landscape Institute's Technical Guidance Note (TGN) 1/20 *Reviewing Landscape and Visual Impact Assessments (LVIAs) and Landscape and Visual Appraisals (LVAs); Guidelines for Landscape and Visual Impact Assessment* 3rd Edition (2013); TGN 02/21 *Assessing landscape value outside national designations*; and TGN 2/19 *Residential Visual Amenity Assessment*. Also reference was made to Natural England's publications *An Approach to Landscape Character Assessment* (October 2014); and *An approach to landscape sensitivity assessment – to inform spatial planning and land management* (June 2019).

- 3.1.7 The visual studies were cross-referenced with the landscape studies, which identified the key natural, cultural and recreational / social features in the area, many of which are of relevance to views and effects upon them.
- 3.1.8 The LVIA's viewpoints (VPs) were marked on the plans, along with other VPs and view routes from which the undeveloped site was found to be visible, or it was considered likely / possible that the developed site could be visible.

3.2 Applicant's LVIA

- 3.2.1 The Applicant's LVIA is set out in ES Chapter 7 Landscape and Visual; the assessment method is set out in full in ES Appendix 7.1 LVIA Methodology, and summarised in LVIA Section 7.4.
- 3.2.2 For ease of reference, the matters below are broadly set out in the order in which they occur in the LVIA, using the LVIA's headings (although only relevant headings are included, and I have added some of my own).
- 3.2.3 Some of the matters are summarised here, and explained further in the following sections. For matters relating specifically to mitigation, see Section 5.

Consultation

- 3.2.4 As mentioned above, consultation with local communities is not only important, but also potentially very valuable. Indeed, this is confirmed in GLVIA3, at paras. 3.42 – 45: *'Consultation is an important part of the LVIA process... It can be a valuable tool... can highlight local interests and values which may otherwise be overlooked... can also make a real contribution to scheme design... Well-organised and timely public consultation... can bring benefits to a project, including an improved understanding of what is proposed and access to environmental information that might otherwise not have been available to the assessment. This can be of benefit to LVIA in providing better understanding of the landscape and local attitudes to it... will improve the quality of the information...'*
- 3.2.5 At para. 7.3.5, the Applicant's LVIA explains that *'Engagement in relation to LVIA has been undertaken within a number of stakeholders throughout the EIA process'*. However, the list of stakeholders consulted does not include BVAG. In fact, BVAG have expressed both concern and disappointment in the lack of meaningful engagement and conversation with the Applicant, despite best efforts, especially in terms of discussions about the scheme's siting, layout and design, and potential landscape and visual mitigation and / or enhancement / benefit.
- 3.2.6 This is explained further in BVAG's *Inadequacy of Public Consultation Report* dated the 17th of February 2024 (attached as an Annex to DBC's *Adequacy of Consultation Representation* report dated the 24th of February 2024, which was submitted to PINS (doc ref AOC-002)).
- 3.2.7 Importantly, BVAG's report refers to para. 15 of the Planning Act 2008 (Guidance in the pre-application process) DCLG (March 2015), which states, *'Pre-application consultation is a key requirement for applications for Development Consent Orders for major infrastructure projects. Effective pre-application consultation will lead to applications which are better developed and better understood by the public, and in which the important issues have been articulated and considered as far as possible in advance of submission of the application to the Secretary of State. This in turn will allow for shorter and more efficient examinations'*.
- 3.2.8 In this case, whilst extensive consultation with other stakeholders may have been undertaken, this does not appear to have included meaningful and potentially productive conversations with the affected communities, for example, responding to queries about certain aspects of the scheme.
- 3.2.9 Under LVIA para. 7.3.7, LVIA Table 7-1 Stakeholder engagement relating to LVIA *'provides a summary of engagement with relevant stakeholders which has been undertaken to inform the EIA'*.

The Table sets out *Matters raised in Scoping Opinion and responses*, and is dealt with in this report where relevant.

LVIA Method and Process

3.2.10 The LVIA method is set out in full in ES Appendix 7.1 Methodology, with a summary in LVIA Section 7.4.

3.2.11 As mentioned above, my review concluded that certain aspects of the Applicant's LVIA method and process are flawed. In summary, they relate to:

- i) Insufficient granular baseline study and analysis, which has resulted in several landscape and visual / recreational receptors not being identified.
- ii) Several of the excluded landscape receptors are of high value / sensitivity, and make important contributions to landscape character and visual amenity.
- iii) In particular, the LVIA did not consider the landscape history and historic landscape character of the site and surrounding area, which is a key factor in levels of landscape value and sensitivity having been underestimated.
- iv) The LVIA did not consider sequential visual effects, in that the proposed development would be visible multiple times from different points along the same journey.
- v) The LVIA did not consider the fact that the area's landscapes provide a highly-valued recreational resource which is well-used not only by the local communities, but also visitors.
- vi) As a result of the above, the LVIA underestimated levels of landscape and visual value, and susceptibility to the form of change proposed, and thus, in some cases, levels of receptor sensitivity were under-reported.
- vii) The LVIA did not factor in the cause and nature of many of the effects likely to arise during project construction, operation, and decommissioning.
- viii) Some of the levels of adverse magnitudes of effect were underestimated / under-reported, and some beneficial magnitudes were incorrectly assumed. This is due to errors and flaws in the methods used and assumptions made, including some of those mentioned above, especially lack of granular survey and analysis, and not understanding the cause and nature of effects, along with:
 - a) Inadequate / flawed criteria.
 - b) Erroneous assumptions, for example that direct effects on landscape character can be mitigated when they cannot, and that screen planting which is proposed to mitigate adverse effects on views would also mitigate direct adverse effects on character, which it would not.
 - c) Double-counting mitigation measures as enhancements.
- ix) Other reasons for levels of magnitude of effect having been under-reported include:
 - a) Over-reliance on existing and proposed vegetation to screen views in the future.
 - b) Incorrect assumptions made about plant growth rates, and how screening vegetation would be managed.
 - c) Some of the proposed landscape and visual mitigation measures in themselves giving rise to adverse landscape and visual effects, for example, the disruption of characteristic field patterns through the creation of new field boundaries on arbitrary lines, and double-hedged corridors along public rights of way (PRoWs); and some of the planting not only being uncharacteristic in these landscapes, but also, screening fine, highly-valued open views.

- 3.2.12 Landscape and visual assessment guidance explains that the process for assessing landscape and visual effects entails combining levels of receptor sensitivity with levels of magnitude of effect in order to arrive at overall levels of effect (for example, High + Low = Moderate). Professional judgement must also be applied.
- 3.2.13 Thus, if levels of sensitivity and magnitude are underestimated, then overall levels of effects will be under-reported, as is the case here.
- 3.2.14 Notwithstanding the above, however, there appears to be agreement between the parties that many of the adverse landscape and visual effects arising from the scheme would be 'significant' adverse for the duration of the operation.

Landscape and visual sensitivity

- 3.2.15 LVIA Tables 7-1 and 7-2 are the matrices used to judge levels of landscape and visual receptor sensitivity respectively, combining levels of landscape / visual value, and susceptibility to change (the latter in terms of change of the type proposed here).
- 3.2.16 For a project of this nature and scale, I do not agree with the use of a three-point scale (High, Medium, Low) for levels of value and susceptibility, as it is too blunt an instrument: a five-point scale (from Very High to Very Low) would allow a more forensic interpretation of the results³, (although I note that split categories can be used). The LVIA also combines different point scales, which is problematic. These matters are discussed further below.

Magnitude of Effect

- 3.2.17 Levels of magnitude of effect are set out on a four-point scale (Large, Medium, Small, Negligible).

'Significance'

- 3.2.18 The LVIA has misinterpreted GLVIA3 in relation to establishing whether or not an effect is 'significant'. Whilst this does not affect the results, it is an important technical matter.
- 3.2.19 LVIA para. 7.4.8 states that *'The significance of a landscape or visual effect is assessed through professional judgement, combining the sensitivity of the receptor with the predicted magnitude of change, as summarised in Table 7-4'*.
- 3.2.20 However, 'significance' is not an outcome of the combination of *the sensitivity of the receptor with the predicted magnitude of change*. The correct method is firstly, to state the overall level of effect resulting from the combination of the level of receptor sensitivity with the predicted level of magnitude of change – for example, respectively High and Low levels, which theoretically would result in a Moderate level of overall effect. Then, a judgement is made about whether or not that level is 'significant', based on a pre-stated significance threshold – see below.
- 3.2.21 In fact, this is a fairly common error amongst practitioners: so much so that the LI produced a statement of clarification on the subject (*GLVIA3 Statement of Clarification 1/13 10-06-13*). Under the heading 3 Significance, it says:
- 3.2.22 *'Members may find the following helpful: In simple terms, assume an environment (A). Then assume a proposed development (B). B is placed into A and, as a result, gives rise to impacts which permit the identification of effects of various sorts. The level of, or degree of, effect may then be judged. This may be achieved, for example, by determining magnitude and registering it against sensitivity, each as defined in GLVIA3 in Paras 3.23 to 3.30. Depending on the means of judgement and terminology (which should be explicitly set out), effects of varying degrees of change (or levels*

³ Para. 3(4) of LITGN-2024-01 *Notes and Clarifications on aspects of the 3rd Edition Guidelines on Landscape and Visual Impact Assessment (GLVIA3)* explains that *'Paragraph 3.27 of GLVIA3 states that three or four categories of effect are 'ideal'. The GLVIA Panel acknowledges that more categories may be useful in some instances (such as five or six categories). It is the assessor's responsibility to ensure their methodology is clear and the levels of effects are clearly defined'*.

of change), may be derived. The assessor should then establish (and it is for the assessor to decide and explain) the degree or level of change that is considered to be significant'.

- 3.2.23 LVIA Table 7-4 Significance is the matrix used in the LVIA to establish 'significance', but in fact, it provides the overall level of effects. Table 7-4 is problematic, as it combines different point scales (three for sensitivity, and four for magnitude), which can skew the results – see below.

Matrix 1: Combining 4-point scales

		MAGNITUDE			
		SUBSTANTIAL	MODERATE	SLIGHT	NEGLEGIBLE
SENSITIVITY	HIGH	Major	Major - Moderate	Moderate	Moderate - Minor
	MEDIUM	Major - Moderate	Moderate	Moderate - Minor	Minor
	LOW	Moderate	Moderate - Minor	Minor	Minor - Negligible
	NEGLEGIBLE	Moderate - Minor	Minor	Minor - Negligible	Negligible

Matrix 2: Combining 3- and 4-point scales (Applicant's LVIA Table 7-4 Significance)

		Magnitude of Change			
		Substantial	Moderate	Slight	Negligible
Receptor Sensitivity	High	Major	Major/Moderate	Moderate	Minor
	Medium	Major/Moderate	Moderate	Moderate/Minor	Minor/Negligible
	Low	Moderate	Moderate/Minor	Minor	Negligible

- 3.2.24 LVIA para. 7.4.9 does go on to explain that 'The significance of any identified landscape or visual effect is assessed as Major, Moderate, Minor or Negligible. Where the effect has been classified as Major or Major/Moderate this is considered to be equivalent to likely significant effects referred to in the EIA Regulations'.
- 3.2.25 Notwithstanding the combination of point scales above, I agree that Major or Major/Moderate levels of overall effects should be categorised as 'significant' for the purposes of this project, but in my opinion and experience, consideration should also be given to Moderate levels, as there may be factors which still result in what would normally be categorised as 'significant' effects.
- 3.2.26 Para. 3(5) of the LI's recently-published (August 2024) GLVIA3 statement of clarification for practitioners, to which I contributed (LITGN-2024-01 Notes and Clarifications on aspects of the 3rd Edition Guidelines on Landscape and Visual Impact Assessment (GLVIA3))⁴ explains that 'typically, effects falling below the middle of the range of overall effect are assessed as not significant. For example, if using a scale of minor / moderate / major, then major effects will be significant and minor effects will not be significant. In this example, moderate effects may or may not be significant and justification would be needed in the methodology or receptor assessment as to whether a moderate effect is significant or not'.

Beneficial / Adverse

- 3.2.27 I agree with the LVIA that 'Changes to rural landscapes involving construction of man-made objects of a large scale are generally considered to be adverse' (LVIA para. 7.4.11).

⁴ https://www.landscapeinstitute.org/wp-content/uploads/2024/08/LITGN-2024-01-GLVIA3-NC_Aug-2024.pdf

Cumulative Assessment

- 3.2.28 LVIA para. 7.4.13 explains that '*a cumulative LVIA is provided in the Chapter 13 Cumulative Effects*' – see my summary of cumulative effects in Section 8.

Night-time Assessment

- 3.2.29 LVIA para. 7.4.14 explains that '*The Proposed Development does not include permanent lighting. Infra-red security lighting would be used at night, and lighting would be available for emergencies. As a result, no significant effects are likely to arise at night, and night-time impacts are not assessed further*'.
- 3.2.30 Firstly, the LVIA has not considered the landscape and visual effects arising from lighting during construction; and secondly, there could be floodlighting at the on-site substation.

Residential Amenity

- 3.2.31 Although the heading is 'Residential Amenity', this section only mentions the visual aspects of effects on residential amenity. It explains that the assessment of effects on residential visual amenity is set out in ES Appendix 7.6.
- 3.2.32 I briefly consider certain aspects of residential amenity effects in Section 6.

Study Area

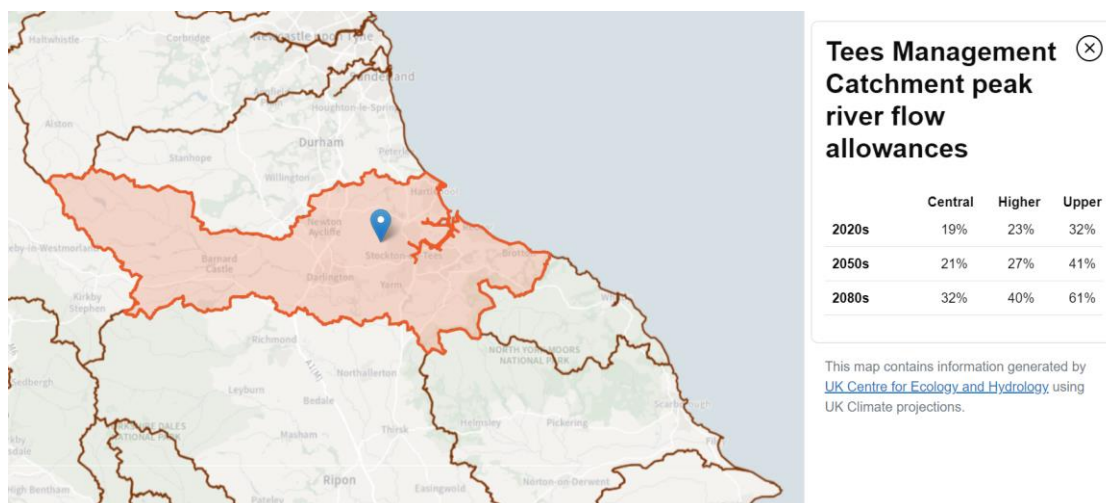
- 3.2.33 LVIA para. 7.6.1 explains that at the start of the LVIA process, the LVIA study area boundary was set at 2km from the panel areas. However, following responses to the scoping exercise, for the PEIR stage the boundary was increased to 5km. Following preliminary stakeholder consultation on the Application (see Principal Areas of Disagreement Statements (PADS) in ES Doc 7.6 *Potential Main Issues for Examination* (PMIE)), the boundary was set to 3km.
- 3.2.34 I **agree** that the 3km LVIA study area boundary is adequate, on the basis that no *significant* adverse landscape or visual effects are likely to arise beyond 3km from the panel areas.
- 3.2.35 But please note that in principle, I do not agree that it is appropriate to use the Zone of Theoretical Visibility (ZTV) plans to establish the study area boundary for assessing effects on landscape character (which includes for example experiential and recreational effects), because development will cause change to / give rise to effects on character, but it may not necessarily cause change to / give rise to effects on views (for example, the development may be able to be camouflaged, or fully-screened, or there may be no visual receptors within the development's zone of visual influence (ZVI)). In other words, as the popular saying goes, "*Just because you can't see something, doesn't mean it's not there*".
- 3.2.36 In fact, although not provided here, a ZVI plan would be helpful in allowing a better understanding the likely extent of visual effects, as it shows the areas from which it is predicted that the proposed development would actually be visible, as opposed to theoretically. Whilst a viewpoint location plan can give an indication of this, it does not give a true reflection, which makes it difficult to draw objective conclusions.
- 3.2.37 Also, I **do not agree** that 100m is sufficient for the Residential Visual Amenity Assessment (RVAA) boundary.

Zone of Theoretical Visibility

- 3.2.38 LVIA para. 7.4.2 explains that a ZTV study was carried out, and ZTV plans were produced (See ES Figures 7.2, 7.3, and 7.8).
- 3.2.39 Firstly, the different colours used on the ZTV plans are helpful in showing the likely visibility of the proposed panel areas and substation (but see below); however, because the 1:25,000 OS map base used is black and white, it is difficult to establish the locations of potential viewpoints / view routes along highways and PRowS. Also, high-value landscape receptors such as local

- landscape designations and heritage assets aren't marked on ZTV plan, so it is very difficult to establish whether visual receptors in those places would have views of the developed site.
- 3.2.40 For my own assessment, I printed out a copy of the Applicant's ZTV Figure 7.2, and marked on roads, PRoWs and the high-value landscape receptors in colour by hand.
- 3.2.41 Secondly, the ZTV exercise is not a bare-earth scenario: it factors in buildings (assumed to be 7.5m tall), and 'principal' woodland (trees assumed to be 10m tall, although that is conservative - mature woodland is likely to be at least 20 – 30m tall – mature oak can get up to 40m).
- 3.2.42 The problem with factoring in screening from woodland at this stage in the process is that over the lifetime of the proposed development (c. 40 years' operation, and probably several years of construction and decommissioning – see Section 4.2 below), it is highly likely that the baseline situation will change considerably, with the loss of some woodlands, and the growth / addition of others.
- 3.2.43 This, combined with uncertainties about how long other vegetation such as hedges and tree belts would retain its current screening properties means that it is impossible to predict what the degree of screening by vegetation would be at any one point in time in the future.
- 3.2.44 In fact, these days, many practitioners including myself do not consider it safe, or best practice, to rely on vegetation to screen views in the longer term, since there is no guarantee that it will remain in place (or in the case of new planting, establish at all). This is explained further in Section 5.
- 3.2.45 Thirdly, the ZTV target height for the panel tops is 3.5m from ground level. However, from the LVIA and ZTV plan, I was unable to ascertain the height above ground level used for the substation target, and whether it is the highest element in the substation, ie the lattice tower – the submitted plan ES Figure 2.14 Typical Substation is not annotated; also, Figure 2.14 has a bar scale, but that appears to be incorrect.
- 3.2.46 However, for now, I have assumed that the description in the ES Non-Technical Summary is correct, ie there would be a 15m communications tower, and electrical equipment up to 8m.
- 3.2.47 Finally, it is not clear whether the height of the ZTV targets (panels and substation complex / elements) were based on existing or proposed ground levels.
- 3.2.48 The Applicant's Flood Risk Assessment and Drainage Strategy (ES Appendix 10.1) states that there is no requirement to raise vulnerable infrastructure or panels, but some of the vulnerable scheme elements may have to be raised above existing ground levels anyway, for example to prevent ingress from surface water runoff.
- 3.2.49 I was unable to ascertain whether the Applicant's designs and studies (hydrological, landscape / visual and others) had factored in the Environment Agency (EA)'s revised (December 2022) Tees Management Catchment peak river flow allowances.
- 3.2.50 On the assumption that the proposed development would become operational by the late 2020s and would operate for 40 years, ie into the late 2060s, then the siting, layout and design of the scheme elements would have to be based on the relevant current peak river flow allowances for the catchment, as shown in the screenshot overleaf from the EA's online Hydrology Data Explorer⁵, ie ranging from 21% to 41% for the 2050s, rising to 32% to 61% for the 2080s.

⁵ <https://environment.data.gov.uk/hydrology/climate-change-allowances/river-flow?mgmtcatid=3093>



- 3.2.51 Regarding flooding, another important point to bear in mind is that whilst solar panels are not categorised as ‘vulnerable’ infrastructure, and in principle may be acceptable development within flood zones, the latter is dependent on there being sufficient freeboard allowed under the panels for flood water to flow through. Whilst that can be calculated and factored in to the scheme design, I have heard of instances where solar panel legs blocked water-borne debris, creating dams across the site and causing flood flows to deflect onto roads and into neighbouring settlements.
- 3.2.52 If the above allowances were not used / assumed, or, if the incorrect assumptions were made about the ground levels at which scheme elements would sit, then the ZTV should be remodelled, as evidently, taller scheme elements would result in a) levels of visual effects being higher for certain receptors, and b) the geographical extent of visual effects being further than assumed / assessed.
- 3.2.53 Clarification of the above points would be helpful.
- 3.2.54 It would also be helpful if the Applicant could provide a bare earth ZTV, ideally either a) on a full-colour 1:25,000 OS map base, or b) with roads, PROWs and high-value landscape receptors such as local landscape designations and heritage assets highlighted in colour on the black-and-white version.

Baseline Conditions / Landscape Character

- 3.2.55 Given the localised variations within the site and its contextual landscapes, I found the LVIA’s baseline landscape character survey and analysis very limited.
- 3.2.56 I **agree** with the LVIA’s references to the published national and local landscape character area descriptions, although the LVIA does not appear to consider which of the character areas’ key characteristics are present in the study area, nor whether those which are present are typical or good representations of the host. That information should be factored into value judgements and the effects assessments.
- 3.2.57 However, there should have been more extensive and granular fieldwork to justify the LVIA’s conclusions. There is minimal description or analysis of the site and its contextual landscapes, only broad-brush descriptions of key landscape elements and features, suggesting that little fieldwork was undertaken beyond the site and its immediate environs.
- 3.2.58 As GLVIA3 makes clear (see for example paras. 5.15 to 18), LVIA should not just rely on published character assessments, especially as most are high-level, and cover large geographical areas within which – as is the case here – there may be distinctive and important localised variations. It is necessary to dig deeper, especially for the more in-depth assessments required to assess the extensive and often complex effects of large-scale industrial developments such as this.
- 3.2.59 Here, the main descriptions are in a few short paragraphs.

- 3.2.60 LVIA para. 7.7.1 describes the site and its contextual landscapes as '*an area of undulating mixed farmland with a network of local roads and rights of way and a mix of dispersed settlement, small villages and hamlets*'.
- 3.2.61 LVIA para. 7.7.10 sets out the local character areas within which the different parts of the site lie, with very brief, generic descriptions, for example '*Woodland, hedgerows and hedgerow trees are relatively frequent in the Great Stainton Farmland which along with the undulating landform serves to constrain visibility, though there are some more elevated and open locations with wider views*'.
- 3.2.62 LVIA para. 7.10.7 provides additional description of the site's landscapes – which cover c. 490ha, and stretch some 12km from west to east – as follows: '*The landscape fabric of the Panel Areas and substation site consists of a mix of arable and pasture fields, typically of medium scale and separated by hedgerows. In places those hedgerows are sparse, and in others they also include trees. For the cable routes, the site area is a mix of farmland and road surfaces and verges*'.
- 3.2.63 Again, this is very generic. This section should have been augmented with information about the site and surrounding area's physical landscapes (geology, soils, hydrology etc); their quality and condition; cultural heritage / historic landscape character; aesthetic and perceptual qualities (these are not mentioned at all, apart from one reference to 'tranquillity'); landscape and visual functions; local materials; plant and animal species; and other details which would provide a better understanding of what could be affected, and what the implications would be.
- 3.2.64 My own assessment found a multitude of important variations within the site itself as well as within its contextual landscapes, a wide range of highly-valued assets, and many important positive attributes, characteristics, qualities, and functions, including the following:
- i) Leaving the large urban settlements and travelling into the heart of the triangle of land between Darlington, Newton Aycliffe, and Stockton-on-Tees, the area very quickly becomes deeply rural, characterised by scenically-beautiful, sparsely-settled, working agricultural landscapes of arable and pasture, interspersed with woodland, watercourses, historic features, and historic villages linked by narrow, winding lanes. Here, levels of tranquillity are surprisingly high, with no disturbance: often the only sounds are skylarks singing and the wind blowing across the fields. 'Tranquillity' is explained further in Section 4.3.
 - ii) Despite erosion at the edges of the larger settlements, and the presence of a few detractors such as gappy hedges, intensive horsiculture, new solar developments (including ongoing construction damage to roads and roadside vegetation), pylons and wind turbines, in many parts, the landscapes are in very good condition, well-managed and of high quality. The tall pylons and turbines occur infrequently, are absent in many views, and are not visually prominent within the wider landscape.
 - iii) The variations in these landscapes allow enjoyment of several different types of visual and other sensory experiences throughout the seasons.
 - iv) There are many places from which excellent, extensive, uninterrupted, panoramic vistas can be enjoyed across the open countryside, towards high hills and moors forming the distant skyline.
 - v) To the south east, the distinctive profile of the hills in the North York Moors National Park are a highly distinctive feature, and from some viewpoints in the study area, it is possible to see the whole range, from Guisborough in the north (c. 25km from the site), to Kirby Knowle in the south (c. 32km from the site).
 - vi) Similarly, to the west and south west (and sometimes, from the same viewpoints), the undulating, upstanding profiles of the North Pennines National Landscape (c. 23km from the site); and the Yorkshire Dales National Park (c. 25km from the site) draw the eye.
 - vii) In these views, the urban settlements and modern detractors are relatively well-absorbed into the intervening landscape, so there is a sense of remoteness, and 'borrowed' wildness.

- viii) In terms of both character and views, these landscapes also borrow from the very lovely Areas of High Landscape Value (AHLVs) in County Durham, close by to the north.
 - ix) In other areas, views are enclosed, resulting in a sense of timelessness and privacy, allowing escape from the bustle and 'hard' landscapes of the urban areas.
 - x) There is a great deal of visible time-depth, with designated and undesignated heritage assets, and historical landscape features including ridge-and-furrow, in many locations (historic landscape character and features are explained further below).
 - xi) There is an abundance of wildlife, some often visible, especially birds and larger mammals, others more secretive but leaving visible signs, such as otter and water vole (see below).
 - xii) The landscapes provide an excellent recreational resource, as well as making highly important contributions to visual, social, and residential amenity (see below).
 - xiii) Many of the above are highly important Green Infrastructure (GI) assets, especially in combination, and they perform most if not all of the key GI functions. They are also important ecosystem services, and valuable natural capital.
 - xiv) As a whole, at least until recently, the area's landscapes have helped to prevent urban sprawl / coalescence.
 - xv) Today, the above assets, attributes, characteristics, qualities, and the multitude of functions that the landscapes perform, are increasingly under pressure due to the ongoing expansion of Darlington and Stockton, with more and more people relying on smaller areas of land and fewer resources to fulfil their needs and desires, in terms of access to open countryside.
 - xvi) Thus, what remains becomes even more precious.
 - xvii) Unfortunately, a lot of what remains either will, or may soon be, a vast expanse of sterile, industrial solar development.
- 3.2.65 The Applicant's LVIA did not properly consider cultural heritage, in terms of the landscape history and historic landscape character of the site and surrounding areas, despite this being an integral part of the LVIA process. For example, GLVIA3 paras. 5.7 to 11 emphasise that '*the relationship between landscape and historic landscape matters is close*', and that '*Landscape professionals should make good use of existing historic landscape information, and collaborate with historic environment specialists*'; and paras. 5.20 to 24, which deal with landscape value, give examples of heritage-related landscape receptors that should be considered in the assessment.
- 3.2.66 Whilst doing the fieldwork for the assessments, I noticed many very visible man-made features in the landscape which in my opinion are highly likely to be medieval in origin, especially as several are associated with both designated and non-designated medieval heritage assets, including the scheduled motte and bailey castle at Bishopton.
- 3.2.67 I suggest that some are considered during the ExA's site visits.
- 3.2.68 For example, just west of Bishopton, a lane called Folly Bank runs north – south, c. 400m west of the castle (scheduled area). In the field east of the lane, ridge-and-furrow is visible (it can be seen on Google Earth as well as LIDAR, the latter showing other ridge-and-furrow close by), along with what appear to be man-made level changes.
- 3.2.69 On the west side of the lane there is a deep ditch with a steep bank rising to the field (the south-western part of Area F, where panels are proposed). To me, this looks like a typical medieval deer park boundary. It would be interesting to know if that is the case.
- 3.2.70 Other medieval landscape features abound at Area A: these are described in more detail in Section 4.2.
- 3.2.71 In the Applicant's LVIA, para. 7.7.15 states that '*Landscape designations within the study area and scope of assessment include locally designated historic parklands within Darlington... Those within the 3km study area are shown on Figure 7.1 and identified in Table 7-5*'; however, there is very

little description or analysis of this receptor to explain any contribution it makes to the area's character (and visual amenity), and how such qualities may be affected.

- 3.2.72 In addition, nor did the LVIA consider natural heritage, or biodiversity. However, loss or erosion of habitats can lead to adverse effects on character and appearance. As noted at GLVIA3 para. 3.22, development may result in *'alterations to a drainage regime which might change the vegetation downstream with consequences for the landscape'*. Changes to landscape features, elements and landcover can also result in changes to these habitats and the species of flora and fauna they support. Thus, landscape and ecological consultants should also work in close collaboration. The baseline information which needs to be gathered and considered in landscape assessments is set out in the guidance; the list includes 'literature on wildlife' such as relevant NCA profiles, Biodiversity Action Plans, management plans, and habitat / other surveys.
- 3.2.73 In fact, I visited several residential properties adjacent to the site at which there are ponds. The residents advised me that the Applicant had not asked to visit the properties to carry out ecological surveys, but many stated that they regularly saw newts in the ponds (although none were certain whether or not they were great-crested). Some of the ponds and surrounding areas appear to be good great-crested newt habitats.
- 3.2.74 One of the properties with a pond in the garden where large numbers of newts are frequently sighted is adjacent to the south-eastern boundary of Area C. The pond itself is c. 12m from the site boundary. It is quite large, and both the aquatic and adjacent terrestrial habitats (which include shallow margins, reedbeds, marsh, tussocky grass, hedgerow, and various hibernacula) evidently offer excellent great-crested newt territory.
- 3.2.75 ES Chapter 6 Biodiversity para. 6.4.8 states that *'The Order Limits do not overlap with any red risk zone. Therefore, the approach adopted to mitigate any potential impact on great crested newts (Triturus cristatus) (GCN) will be through the process of a District Level Licensing (DLL) application for GCN. This approach, therefore, removes the requirement for baseline surveys'*. Para. 6.7.38 states, *'In the absence of survey information, there is potential for GCN to be present within these waterbodies and they are therefore assumed to be present'*, but para. 6.7.39 goes on to say that *'Given the results of the BDS, suitable ponds for GCN within and adjacent to the Proposed Development, it is therefore considered that the Order Limits is of Local value only for GCN'*.
- 3.2.76 I assume that the above approach is acceptable to the ExA.
- 3.2.77 Also, at the large pond mentioned above, the residents reported sightings and signs of water voles and otters.
- 3.2.78 ES Chapter 6 para. 6.7.55 states that *'Given the limited habitat present for Water Vole and the absence of signs to indicate presence such as burrows or droppings, it is considered that the Order Limits is of Local value for water vole'*, and para. 6.7.57 states, *'Given the limited habitat present for otter and the absence of holts, couches or resting sites, it is considered that the Order Limits is of Local value for otter'*.
- 3.2.79 However, in the light of the above information, these assumptions may not be correct, and may need to be reconsidered.
- 3.2.80 In addition, the large pond adjacent to the site mentioned above, where newts, water voles and otters are understood to be present, lies at the foot of the slope on which panels would be located. It is important to note that no formal infiltration sustainable drainage systems (SuDS) are proposed be installed as part of the drainage strategy for this development (see for example item 1 in Table 10-1 of the Applicant's Hydrology and Flood Risk report (ES Chapter 10)).
- 3.2.81 Evidently, without robust measures in place (the various effects of which would need to be assessed), it is highly likely that during construction, interim and decommissioning works, runoff from this part of the site (which is a large arable field) could give rise to significant adverse effects on the pond and associated species and habitats, bringing large quantities of silt and a

wide variety of potentially polluting substances. There is also concern about runoff from panels during operation – see Section 4.2.

- 3.2.82 As well as heritage and biodiversity, the LVIA did not adequately consider recreation: the area's landscapes provide a highly-valued recreational resource which is well-used not only by the local communities, but also visitors. This is due to factors such as high levels of aesthetic and perceptual qualities, including scenic beauty, tranquillity, time depth, small, sleepy villages, and the network of lightly-trafficked lanes and public rights of way that connect them.
- 3.2.83 Some of the excluded landscape features / qualities / receptors such as those mentioned above are highly-valued, and make important contributions to landscape character, visual, and recreational amenity (parts of the proposed construction routes to Area A, on the west side of the site, coincide with the route of 'one of the best walks in Britain' – see Section 6).
- 3.2.84 Most importantly, the LVIA did not consider the effects of the proposed development on the health, well-being, and quality of life of the people who use and value this resource. All are integral to 'landscape', as well as to assessments of landscape and visual effects.
- 3.2.85 Where relevant, these matters are augmented in the following sections.

Visual Receptors

- 3.2.86 My assessment considered several viewpoints and view routes which were not included in the LVIA, and also considered sequential visual effects, which the LVIA did not appear to factor in.

Landscape Designations

- 3.2.87 I **agree** with the LVIA's inclusion of locally-designated historic parklands within Darlington, and also AHLVs within Durham (the Elstob AHLV is located c. 30m north of the Panel Area B, and the Bradbury, Preston and Mordon Carrs AHLV c. 1.1km north of Panel Area A).
- 3.2.88 However, there is very little information about / analysis of these receptors. Importantly, the Durham AHLVs are 'valued landscapes' in the context of NPPF para. 180 a)⁶ – see receptor sensitivity below.

Receptor Baseline

- 3.2.89 This section of the LVIA summarises the landscape and visual receptors identified at the baseline study stage, in Table 7-5.
- 3.2.90 LVIA para. 7.7.17 explains that '*Baseline description for receptors is provided within section 7.10 for ease of reference by setting out firstly the baseline and then the effects for each receptor*'.
- 3.2.91 However, the LVIA does not explain the next stage in the LVIA process, which is that once the baseline studies are complete, the findings are analysed, then judgements are made about the levels of sensitivity of the landscape and visual receptors (sensitivity levels being a combination of levels of a) value, and b) susceptibility). For ease of reference, this is normally set out in a table, showing each receptor's level of value, susceptibility to change, and sensitivity, with justification provided in the LVIA text, but here, the LVIA tables only set out levels of sensitivity. This makes it difficult to establish the justification for the conclusions.
- 3.2.92 A full tabulated summary would have been helpful, especially as not only is the relevant information difficult to find in the LVIA report, but also, other relevant information is contained in other documents, for example ES Appendix 7.3 Landscape and Settlement Sensitivity Assessment, and Appendix 7.5 Non-significant effects.
- 3.2.93 It is important to know on what basis sensitivity judgements were made, as there is a big difference between landscapes of High value and Low susceptibility, and those of Moderate

⁶ December 2023 version used throughout

- value and Moderate susceptibility, both of which would normally be categorised as Moderate sensitivity.
- 3.2.94 Another issue is that levels of value and susceptibility are set out on a three-point scale (High, Medium, Low). As mentioned above, for a project of this nature and scale, I do not agree with the use of a three-point scale.
- 3.2.95 Three-point scales are often used for high-level / strategic assessments, especially where the geographical extent of the study area is large, but the High – Medium – Low range does not allow enough granular differentiation between landscapes. For example, if the High level is reserved for nationally- / regionally-designated landscapes, and Low for very poor-quality landscapes, then Medium must cover the majority of the landscapes in the country. Of course, categories can be split (eg High – Medium), but the LVIA's value criteria are very limited, so not very helpful for making value judgements (for comparison, see Tables 1 and 2 in Appendix CT-A; I use a five-point scale ranging from Very High to Very Low, with Moderate in the middle).
- 3.2.96 Also, to me, it was not clear how the site had been treated as a landscape receptor.
- 3.2.97 Table 7-5 sets out *Receptors grouped by distance from nearest Panel Area*, within a) 1km of the panels areas, and b) 3km.
- 3.2.98 The table notes that landscape character areas Darlington 6: Great Stainton Farmland and Darlington 7: Bishopston Vale are the 'host areas', ie some parts of the Application site lie within one, and some parts in another (see LVIA para. 7.7.10 and ES Figure 7.5 Landscape Receptors). However, the site itself is not identified as a separate receptor.
- 3.2.99 Then, in Section 7.10 Assessment of likely significant effects, the LVIA sets out effects on the '*The landscape fabric of the Panel Areas and substation site*'.
- 3.2.100 Para. 7.10.1 explains that the site's landscape fabric '*consists of a mix of arable and pasture fields, typically of medium scale and separated by hedgerows. In places those hedgerows are sparse, and in others they also include trees*'. In other words, what the LVIA calls 'landscape fabric' is essentially 'landscape elements'. The GLVIA3 glossary defines elements as '*Individual parts which make up the landscape, such as, for example, trees, hedges and buildings*'. The LVIA did not note 'landscape features', which in a baseline context are defined in the GLVIA3 glossary as '*Particularly prominent or eye-catching elements in the landscape, such as tree clumps, church towers or wooded skyline*'. The site and its contextual landscapes contain and display several prominent and eye-catching landscape features.
- 3.2.101 Para. 7.10.5 states that '*effects on landscape fabric inform the consideration of effects on landscape character*': that is true, but as mentioned above, there are many other factors which inform such consideration (geology, soils, hydrology, quality, condition, aesthetic / perceptual qualities, landscape and visual functions, plant species and so on).
- 3.2.102 Furthermore, the LVIA appears only to have assessed effects on a) the landscape fabric of the site, and b) the landscape character areas beyond the site boundaries, but not on the overall character and qualities of the site. This is very important because most of the effects on the character of the site (and the construction route if not within the site boundary / order limits) would be **direct**, whereas effects on character beyond the site are almost always **indirect**.
- 3.2.103 The above and other matters relating to the LVIA method are discussed further in the following sections where relevant.

Landscape and Visual Receptor Sensitivity

Landscape Receptor Sensitivity

- 3.2.104 The LVIA concludes (in ES Appendix 7.5 Non-significant effects) that the sensitivity of the National Character Area (NCA) within which the site lies (NCA 23 Tees Lowlands) is **Low to Medium**.

- 3.2.105 However, firstly, there is no explanation of which of the NCA's key characteristics are displayed / found on the site and within the study area, nor whether those which are present are typical, or good representations. Clearly, if they are good representations, the level of sensitivity will be higher. Secondly, as the local character areas which lie within NCA 23 will have similar characteristics / qualities to the NCA, it follows that in theory, the NCA's level of sensitivity should reflect that of the host local character areas (in my opinion, Medium to High – see below).
- 3.2.106 The LVIA concludes that the sensitivity of Elstob AHLV is **between Medium and High** (Table 7-13). It appears that this is based on High value, and Moderate susceptibility, although that is not clear, but this does highlight the problem with using three-point scales mentioned above. In my opinion, the AHLV's susceptibility is also High, so the level of sensitivity should be **High**.
- 3.2.107 Regarding the Application site, at para. 7.10.30, the LVIA concludes that the level of sensitivity of local character area '*Darlington: 6 Great Stainton Farmland (includes Panel Areas A-D and substation)*' is **Medium**, so I assume that is also the level applied to the site. This is based on value being 'Community' level, ie Low, and susceptibility being Medium to High.
- 3.2.108 Notwithstanding the comments above about the use of a three-point scale, and the fact that the LVIA's value and susceptibility criteria are minimal, I **agree** that susceptibility is Medium – High, but I **do not agree** that the site is of Low value, it is at least Medium.
- 3.2.109 This is partly because the site is so large, its scale is more 'Regional' than 'Community', but also, as noted above, the LVIA relies on the published character assessments, as opposed to having surveyed and analysed the important localised variations in character that occur across the site, which are atypical of the host. In fact, the site displays many positive landscape qualities, and performs several important landscape functions (recreational resource, setting of heritage assets and so on).
- 3.2.110 At para. 7.10.39, the LVIA concludes that the level of sensitivity of '*Darlington: 7 Bishopton Vale (includes Panel Areas E and F)*' is **Low to Medium**, and I assume that is the level applied to the site. This is based on value being 'Community' level, ie Low, and susceptibility being Medium.
- 3.2.111 The comments above about criteria, scale, variations, qualities and functions apply here, but due to Areas E and F's close proximity to Bishopton, the value of the some of the functions it performs is higher, in terms of a) the recreational resource, and b) i) the contribution that the heritage assets (Scheduled Monument, Conservation Area, listed buildings) make to both historic landscape character and the present-day landscapes, and also visual amenity; and ii) the contribution that the contextual landscapes make to the settings of the heritage assets.
- 3.2.112 Thus, value is at least Medium, and susceptibility is at least Medium – High.
- 3.2.113 Using the LVIA's criteria, my assessment concluded that the whole site's level of sensitivity is **at least between Medium and High**.

Visual Receptor Sensitivity

- 3.2.114 LVIA para. 7.10.81 explains that '*The highest sensitivity [visual] receptors within the study area would be local residents and users of local recreational routes (who would have high susceptibility) where views would be of at most Regional value (within locally designated landscapes), indicating High/medium sensitivity*'.
- 3.2.115 I **agree** with this judgement – indeed, it is consistent with my conclusion that the site's level of sensitivity is between Medium and High, albeit for different reasons (I did not factor in the locally-designated landscapes). In fact, the LVIA uses Medium to High sensitivity for many of the visual receptors.
- 3.2.116 However, the LVIA judges the sensitivity of visual receptors travelling along 'rural roads' as being of Medium sensitivity, based on Regional (ie Medium) value, and Medium susceptibility (see LVIA Table 7-13). I **agree** with Medium value, but **do not agree** with Medium susceptibility.

- 3.2.117 In the LVIA Method (ES Appendix 7.1), the criteria for a Medium level of visual receptor susceptibility are *'Local road users and travellers on trains. People engaged in outdoor recreation with some appreciation of the landscape e.g. road cycling, nature conservation, golf and water based recreation'*.
- 3.2.118 I agree that many of these receptors would not necessarily be *'focussed on the appreciation of views'*, which is a criterion for High susceptibility receptors, since they would be driving / on trains / road cyclists. However, some people travelling in cars / other vehicles may be passengers who are unable to walk along the local roads due to illness or disability, for example, but for whom the experience of being out and about makes a highly important contribution to their mental and physical health and well-being, and quality of life: their attention is highly likely to be *'focussed on the appreciation of views'*.
- 3.2.119 Also, the LVIA has not factored in the regular use and high value of the 'rural roads' / lanes as a recreational resource (for walking, running, horse-riding, and leisure cycling in particular, especially with young children), not just for local residents, but also for communities within the wider area, and visitors from all around the country.
- 3.2.120 Many come specifically to enjoy the landscapes' high levels of aesthetic and perceptual qualities described above: parts of the local road network are very lightly-trafficked, so offer good recreational opportunities for people of all ages and abilities. For local residents, the recreational resource also makes an extremely important contribution to their health and well-being, and the quality of their lives.
- 3.2.121 Thus, I **disagree** that all users of the rural lanes should be categorised as Medium sensitivity visual receptors: in accordance with the LVIA's criteria, and adopting the worst-case scenario, they should be **between Medium and High**.

Future Baseline

- 3.2.122 As well as the mention of Ash dieback, this section relates to *'consented developments that are likely to be operational either before or during the construction and operation of the Proposed Development'*, although as mentioned previously, cumulative effects are reported in ES Chapter 13.

4 Cause and Nature of Effects

4.1 Potential Impacts

- 4.1.1 In Section 7.8, the LVIA sets out the 'potential impacts' that would arise from the scheme during construction, operation, and decommissioning, which are of relevance, and were factored in, to the assessments of landscape and visual effects.
- 4.1.2 Whilst I agree with the impacts which the LVIA identified, the information provided is extremely limited, and does not fully explain or describe the cause and nature of the effects likely to occur / be experienced.
- 4.1.3 This is important, because without a clear understanding of how the proposals would affect each of the landscape and visual receptors, it is not possible to predict levels of magnitude of effect with any certainty, nor to propose effective mitigation.
- 4.1.4 As explained previously, for conciseness, I decided not to write up the findings of my assessment and review separately and in full; rather, I summarised the most relevant points in this report, and provided a few detailed examples, to justify my conclusions about the LVIA review, effects, and matters agreed / not agreed. If necessary, I will draw on my full notes during the Examination, to inform any questions and / or responses.
- 4.1.5 However, even if there is agreement between the parties that the adverse landscape and visual effects arising from the proposed development would be significant, it is still important to understand the cause and nature of the landscape and visual effects likely to arise, as this may be useful for queries / discussions about associated topics.

4.2 Construction / Decommissioning Impacts / Nature of Effects

- 4.2.1 The nature of the construction and decommissioning effects likely to arise and their causes are summarised below (see also previous and following sections for additional information):
 - i. Temporary features during construction / decommissioning phases including compound/s and security fencing.
 - ii. Extensive ground / engineering works.
 - iii. Direct / indirect loss of / damage to existing landscape elements, features and landcover: many found on and around the site are good representations of both the national and local landscapes' key characteristics. Some features are of high heritage and ecological value.
 - iv. Uncharacteristic, modern, highly industrialising features and activities inserted into / occurring within deeply rural landscapes displaying high levels of aesthetic and perceptual qualities, including scenic beauty, tranquillity, time depth, small, sleepy villages, and the network of lightly-trafficked lanes and public rights of way that connect them.
 - v. Disturbance / activity / movement / noise (vehicular, mechanical and human); odour; clutter and paraphernalia associated with activities on site; security fencing; bright / contrasting colours; glint / glare from reflective surfaces; and lighting (see note on tranquillity in operational impacts / nature of effects section below).
 - vi. Changes to / loss of landscape function and contribution to landscape character and settings of heritage assets made by site.
 - vii. Changes to / loss of visual functions / views resulting from the above.
 - viii. Adverse effects of noise, light, glint and glare, pollution, traffic etc. on people's residential and social amenity, mental / physical health and well-being, and quality of life.

- ix. Pollution of soil, air and / or water - residues and emissions, odour and dust (also nuisances) – see below.
 - x. Long-term adverse effects on soil structure and microbiology.
 - xi. Loss of / disturbance to wildlife.
 - xii. Construction / interim works / decommissioning routes along narrow tracks and lanes with several constraints, including high levels of recreational use along PRoWs by local residents and visitors: potential for conflict / highway safety implications.
 - xiii. Some of the direct effects arising from construction and other traffic using the proposed construction routes (for example loss of / damage to verges, hedges and trees, and damage to structures such as bridges and walls) could be truly permanent.
 - xiv. During decommissioning and / or interim maintenance / panel and BESS unit replacement / repair works, if / where vegetation along the construction route had recovered, and / or features / structures had been repaired, similar damage / loss would occur again.
- 4.2.2 In some cases, it appears that the effects arising from certain aspects of the proposals have not been considered at all, for example, access into Area A.
- 4.2.3 As this is a good example of some of the problems with the Applicant's submission that I identified in my assessment and review, I decided to go into some detail about the access to this Area – see below; also, the information could help to inform proposals for mitigation measures and / or alternative solutions, if these are found to be necessary.
- 4.2.4 However, as mentioned previously, it must be emphasised that whilst the problems with the proposed access into Area A are highlighted here, the same / similar problems would certainly in some cases, and probably in others, apply to the other Areas (B – F), in terms of lack of baseline survey and analysis, and identification and assessments of effects.

Access to Area A

- 4.2.5 Area A lies at the western end of the site, just east of Brafferton village (location plans and photos are provided below).
- 4.2.6 The majority of Area A lies south of High House Lane: this is a residential road that runs through the centre of Brafferton, which, at the eastern end of the village, becomes a narrow, winding, unsurfaced rural track and public footpath leading north east.
- 4.2.7 The smaller part of Area A lies north of the track.

Area A North

- 4.2.8 Area A North is divided into two sections, separated by fields, and joined by the High House Lane track.
- 4.2.9 The south-western section comprises two square arable fields and half of a rectangular one (an example of an arbitrary boundary resulting in the disruption of characteristic field patterns, giving rise to adverse landscape and visual effects), and is covered by Works 1A, 2, 3, and 8. Work 8 is for the access into this part of the area, which would be off the south-western end of the track, just beyond the eastern end of Brafferton.

High House Lane at eastern end of Brafferton where street becomes track, looking north east



South-western end of High House Lane track, looking north east



South-western end of High House Lane track, looking south west towards Brafferton



Just beyond south-western end of High House Lane track, looking south west



- 4.2.10 The north-eastern section of Area A North lies c. 600m north east of the south-western section as the crow flies. This section is covered by Works 1A, 2, and 3, the latter being the access into this part of the area.
- 4.2.11 It comprises a long (c. 1.1km) narrow swathe of four fields of what appears to be permanent pasture. The south-westernmost field is a small area lying between the well-wooded watercourse which runs through this part of Area A North, and the track.

- 4.2.12 The topography in these landscapes is complex, undulating, and some of the slopes are steep, with deeply-incised valleys to the small watercourses which flow through the local area (most of which discharge into the River Skerne, which here is c. 250m south of Brafferton). This adds considerably to the area's 'charm'.
- 4.2.13 From the proposed access to the south-western section of Area A North, High House Lane track / public footpath continues north-eastwards for c. 1km then the track ends, and the public footpath splits into two, going a) north, crossing the north-eastern part of Area A North, and b) south east, crossing fields and running past the eastern end of Area A South.
- 4.2.14 The surfaced section of the track ends at the access into Lovesome Hill Farm, c. 500m north east of the proposed access to the south-western section of Area A North.

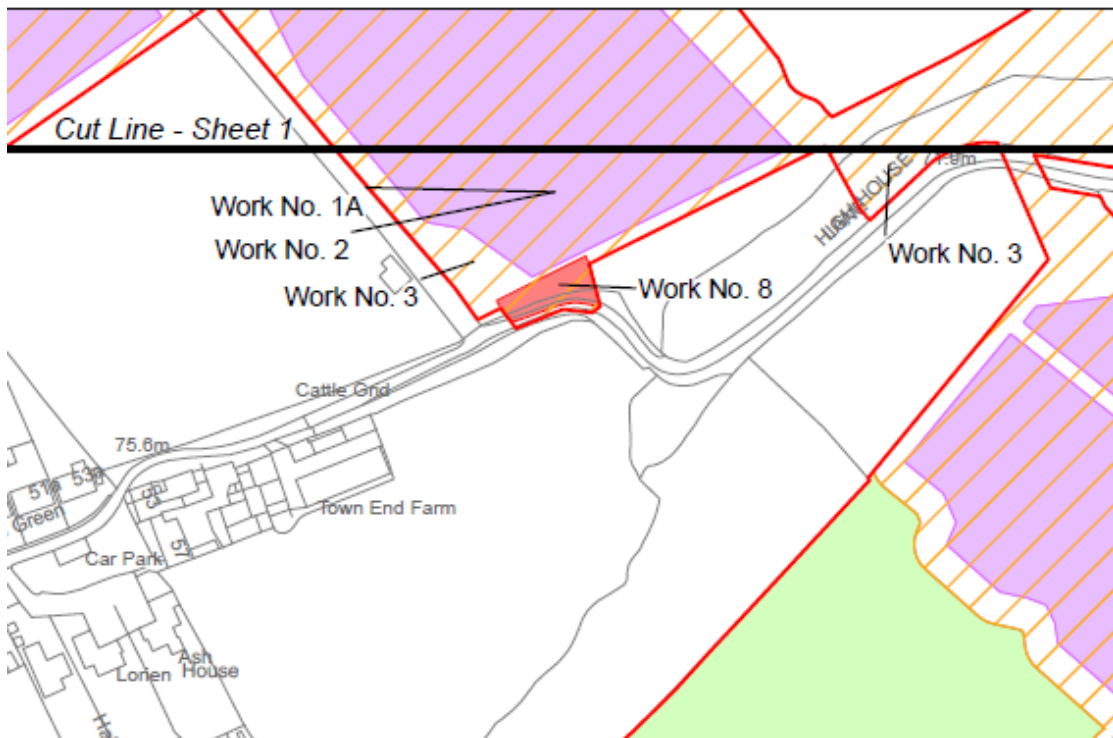
Surfaced section of High House Lane, looking north east



Unsurfured section of High House Lane, looking north east



- 4.2.15 The relevant Works Plans (Drawing No. 2.2, Sheets 1 and 2 of 13) show that the access to the north-eastern section of Area A North would be taken from the south-eastern corner of the south-western section of Area A North (see extract from Works Plan Drawing No. 2.2 Sheet 3 of 13 below).

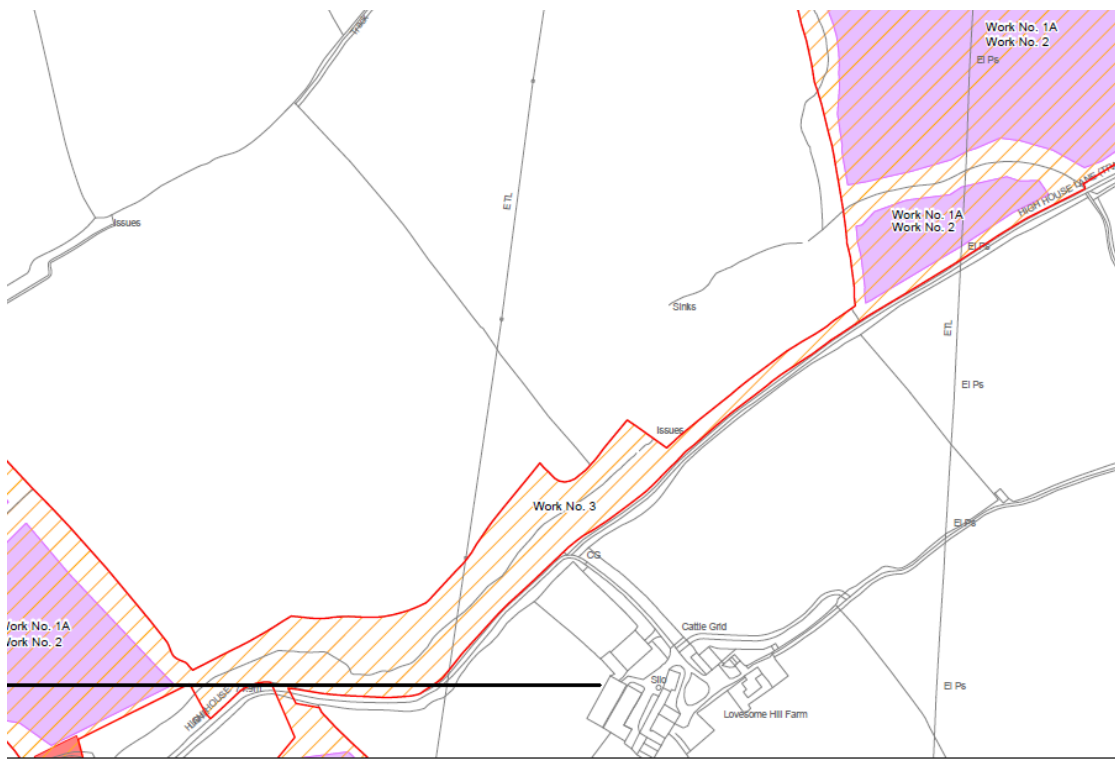
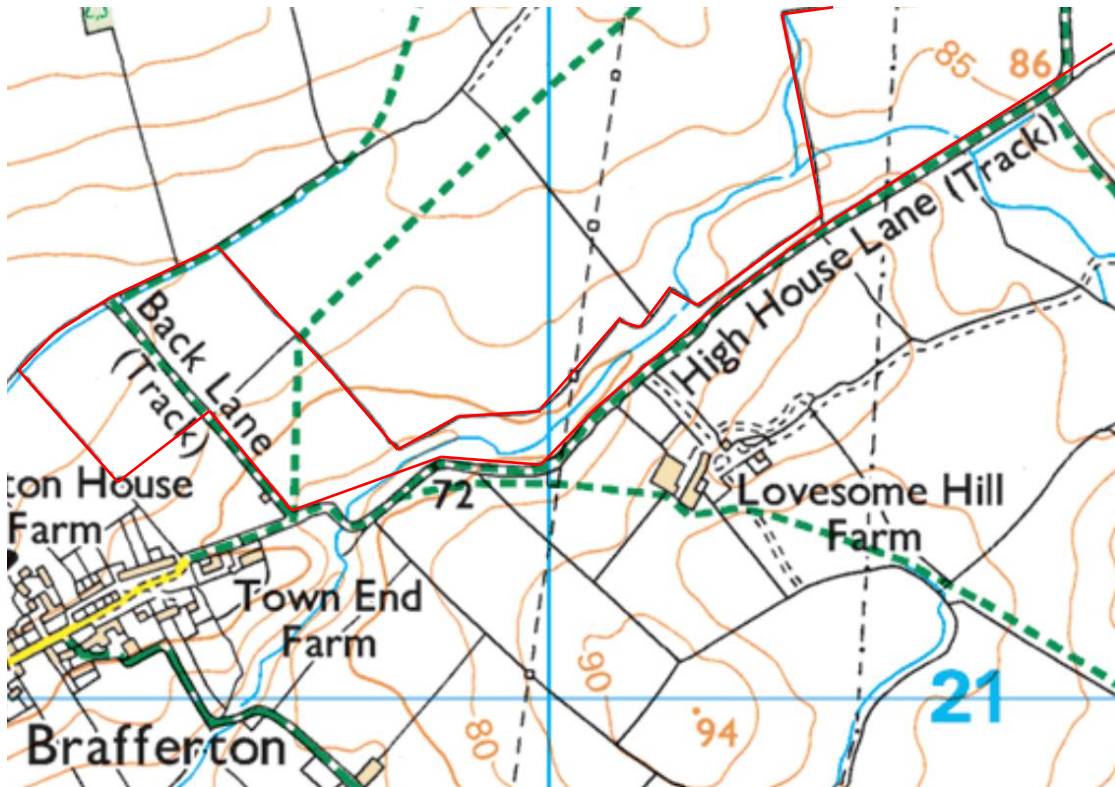


- 4.2.16 However, it is not clear to me how the access between the two parts of Area A North could be achieved without extensive engineering works and the removal of many mature hedges and trees.
- 4.2.17 The plans show that construction access between the south-western and north-eastern sections of Area A North would not be via the track: instead, it would follow the line of the track, on its

northern side, through a swathe of wooded pasture, c. 50m wide at the south-western end, and c. 6m wide (between mature hedges) at the north-eastern end, where the proposed access would enter the north-eastern section of Area A North.

- 4.2.18 The watercourse mentioned above runs through the centre of this pasture, in a steeply-incised, well-wooded valley (marked with an arrow on the photos below; also, below the photos, there is a) a 1:25,000 OS map extract (own licence) showing the line of the watercourse and the contours; b) an extract from Works Plan Drawing No. 2.2 Sheet 1 of 13 showing the proposed route between the two parts of Area A North; and c) an extract from Google Earth (imagery ©2024 Airbus) of the same area, showing field patterns and landcover. The site area is marked on all of them.

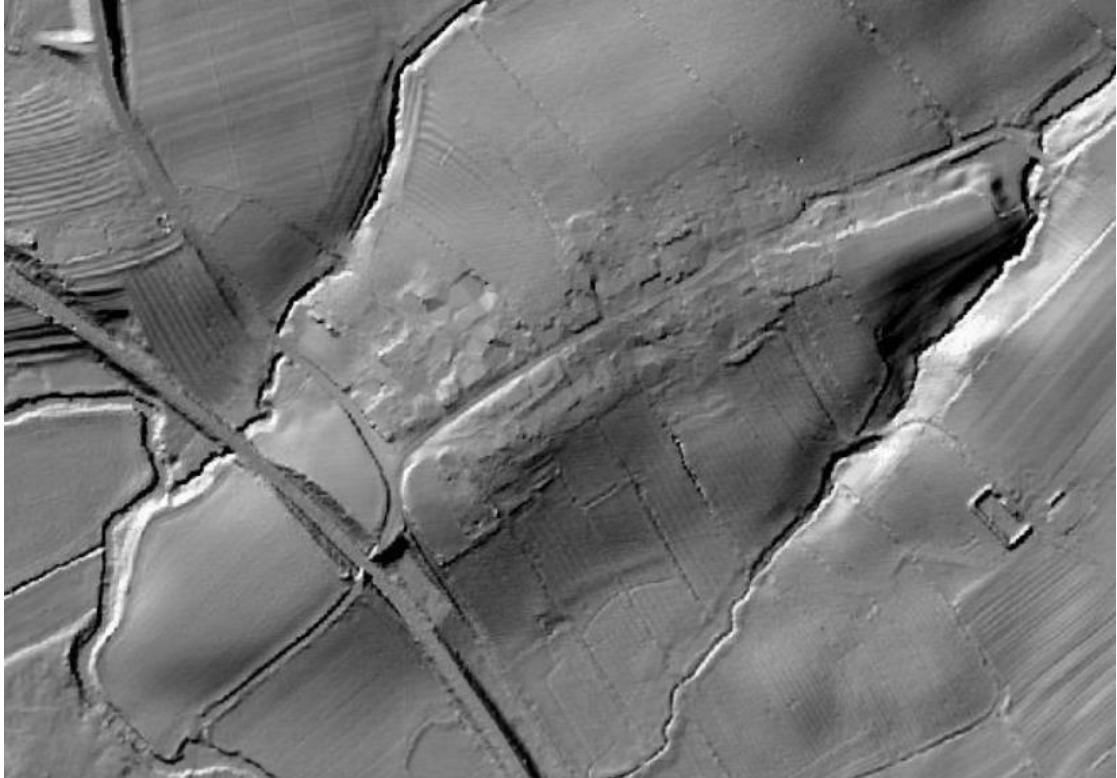






- 4.2.19 As well as having high landscape, visual, and recreational value, given its antiquity, and intactness / good condition, the track and its associated landscape features are likely to be of high biodiversity value, and potentially, high heritage value as well.
- 4.2.20 Whilst on site, I noticed what appeared to be medieval ridge-and-furrow in several fields around Brafferton, including adjacent to the western end of Area A North; later this was confirmed by LIDAR – see image overleaf. I also noticed what appear to be man-made landforms on the south side of High House Lane, at the eastern end of the village, which are also visible on the LIDAR extract (top right), and in the photo below the extract.
- 4.2.21 Also, para. 8.7.21 of ES Chapter 8 Cultural Heritage and Archaeology states that '*Analysis of LIDAR data and aerial photography have revealed evidence for approximately 28 deserted medieval settlements (DMV) throughout the study area, and immediately beyond... The outskirts of these medieval settlements, and the rural areas surrounding them, are characterised by ridge and furrow earthworks and field systems, suggesting a dominant agricultural presence in this area during the medieval period*', and para. 8.10.5 states that there are '*8.10.5. Large areas of post-medieval ridge and furrow throughout the Order Limits... The Proposed Development would remove or disturb archaeological remains associated with the asset*'.

Possible ridge-and-furrow / other medieval features around Brafferton (Environment Agency 2022)



Landforms south of High House Lane, opposite Area A North



4.2.22 I could not find any specific reference to the proposals for the proposed access to Area A North / effects arising from its construction in the LVIA (the LVIA did not include any viewpoints along High House Lane), nor in the Applicant's ecological or heritage assessments. Many of the trees which could potentially be lost are categorised as A and B (A being most valuable in arboricultural terms) in the Applicant's Arboricultural Impact Assessment (AIA) (ES Appendix 7.7).

- 4.2.23 The works would not only result in damage to / loss of high-value landscape elements and features, they would also urbanise / industrialise this deeply rural, tranquil, and probably ancient, trackway.
- 4.2.24 Furthermore, as the public footpath along the track is well-used for recreational purposes, there is likely to be conflict between construction traffic / activities and footpath users: given the narrowness of the track, and blind bends / summits along it, there should be concerns for the users' safety.

Area A South

- 4.2.25 There also appear to be problems with achieving the proposed access into Area A South, without extensive and potentially highly damaging engineering and other works, and loss of mature, healthy and highly characteristic vegetation which is certainly of high landscape and visual value, and is likely to be of high biodiversity, and possibly, heritage value as well.
- 4.2.26 Again, I was unable to find any detailed information about the proposed access, and neither consideration nor assessment of the specific effects likely to arise: as noted above, the LVIA did not include any viewpoints along High House Lane.
- 4.2.27 The Works Plans show three proposed points of access and construction routes into Area A South (see also the OS map extract in the third access point description below):
- i) The first is off High House Lane track, at the northern end of Area A South (Work 3: on right-hand side of extract from Works Plan Drawing No. 2.2 Sheet 3 of 13 above).
 - a) As the crow flies, this access point would be c. 200m north east of the proposed access into the south-western section of Area A North, described above.
 - b) Arriving from the west, construction traffic would travel along the swathe of wooded pasture where the watercourse flows through, then turn east up the wooded bank to High House Lane track. As noted above, this is likely to require extensive engineering works, and the removal of characteristic and valuable mature hedges and trees.
 - c) Traffic would cross the track / public footpath somewhere in the vicinity of the section of the track shown in the photo below (looking west), and enter this part of Area A South – a sloping field south of the track (in which panels are proposed, albeit here, the land has a north west-facing aspect, not south).



- d) It is not clear whether any existing field access points would be utilised, or whether one or more new ones would have to be created, which would entail engineering (due to the bank / slope) and removal of mature hedges and trees (the AIA shows several category B trees here, one of which is Ancient / Veteran).
- e) In my opinion, a swept path analysis should be carried out to ascertain (if they can even get this far) whether very large vehicles (potentially including Abnormal Indivisible Loads (AILs) – see illustrations below) would be able to enter the site without loss of vegetation on the north side of the track as well.

Photograph from Western Power Distribution's 'Guide to the production of legal plans' showing substation plant on HGV



AIL vehicle carrying electricity transformer



- f) Having entered the sloping field / Area A South, construction traffic would immediately have to cross another public footpath which runs eastwards from High House Lane across the northern part of the field.
- ii) The second proposed point of access and construction route into Area A South is via a track / public bridleway leading south from High House Lane where it runs through the centre of Brafferton village.

- a) The photos below show this part of High House Lane.

High House Lane at western end of Brafferton looking north east



High House Lane near centre of Brafferton looking south west



- b) From High House Lane, construction traffic would turn south east down a surfaced track, which is a bridleway, between residential properties / farm buildings – see photo overleaf.



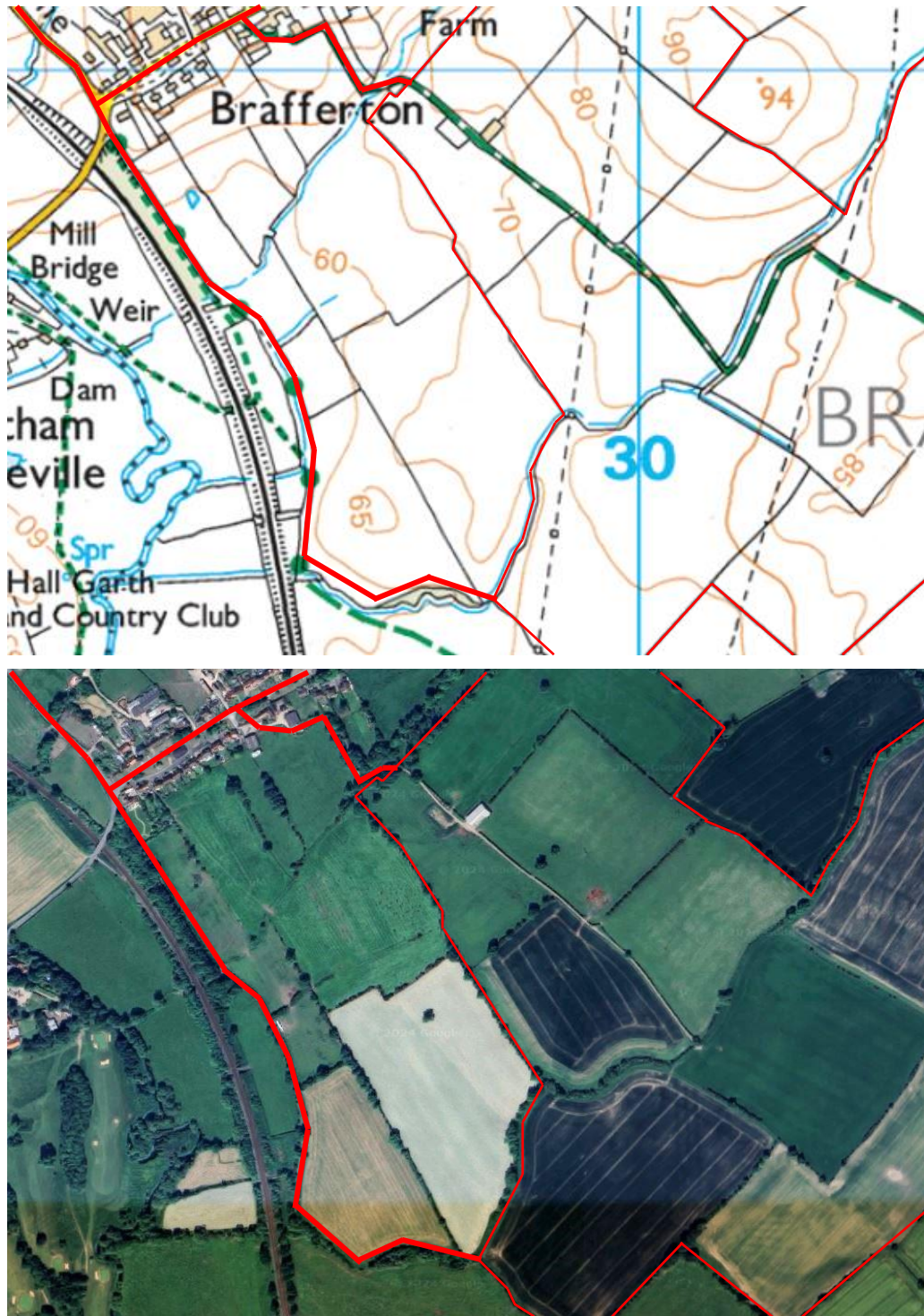
- c) Past the buildings, the track is unsurfaced. There are tight bends along it. Large construction vehicles may have difficulty navigating the bends: a swept path analysis should be carried out to determine whether any / how much vegetation removal would be required.



- d) The bridleway is well-used by the local community, and there are fine views from the track, in an arc from south west to south east, over the unsettled open rural landscapes beyond, some of which would be occupied by panel areas. The field in the foreground of the photo overleaf appears to be ridge-and-furrow – see LIDAR extract above.



- e) The LVIA assessed effects on views from the bridleway, at LVIA VP 2 (at the north-western end where it joins High House Lane); and VP8 (where the bridleway enters the site on the western side of Area A South). Wirelines and photomontages are also provided (see ES Figure 7.9 Visualisations Viewpoints).
 - f) I could not find assessments of other effects arising from this proposal (highways and ecology, for example) in the Applicant's submissions.
- iii) The third proposed point of access and construction route into Area A South is via a track off the south side of Brafferton Lane, at the west end of the village, just before the lane crosses the railway.
- a) The LVIA did not specifically assess views along this route, and I could not find assessments of other effects arising from this proposal (highways and ecology, for example) in the Applicant's submissions.
 - b) Overleaf are a 1:25,000 OS map extract, and a Google Earth extract of the same area. The site area is marked on both, along with the construction routes in a heavier line.



- c) Overleaf is a photo taken from a Brafferton resident's upstairs window, looking south west, showing the line of the proposed access track (wooded track and railway on right-hand side of photo), and the site / wider landscape context to the east.



- d) The proposed access point, off Brafferton Lane, is Work 8.
- e) Presumably, the existing access to the track would have to be altered to accommodate construction vehicles, which would urbanise / industrialise the current rustic charm of the track – see photo below.



- f) The northern section of the track is part-public footpath, part-BOAT, and is well-used for recreational purposes. It is heavily-wooded, and also, quite steep in parts.
- g) It is not certain that the track would be wide enough for the larger construction vehicles to travel down without damage to / loss of mature vegetation (and disruption to / conflict with recreational users, especially those on horse-back).
- h) The southern section of the track is a continuation of the BOAT, with the public footpath running further west. There is no woodland cover, but the track is flanked on both sides by native hedges with escaped mature trees (at the time of writing, for various reasons, no photos of the southern section of the track were available, but these can be supplied if needs be).

- i) The OS map extract above shows that a small watercourse runs along the centre-line of the BOAT / track / construction route, then discharges into the River Skerne which lies c. 150m to the west.
- j) At its southern end, the BOAT crosses another watercourse, this one flowing into the River Skerne from the east, through the centre / along the boundaries of Area A South.
- k) From the southern end of the BOAT, the track continues south-eastwards as a public bridleway, across fields. Just north of this point, the proposed construction route would leave the BOAT and travel east, along the southern end of an arable field (which is not part of the site), north of the watercourse. The route then crosses the watercourse, and enters the south-western part of Area A South.
- l) The total length of the construction route, from Brafferton Lane to the point where it enters Area A South, is c. 1km.
- m) Even it is feasible to bring large construction vehicles / AILs along this route, there would almost certainly have to be extensive engineering works and removal of mature vegetation to accommodate them, with all the associated adverse effects.
- n) The track would have to be surfaced, otherwise it would be impossible for construction vehicles to travel up and down the slope when wet and muddy, and this would cause significant damage to the surfaces and edges.
- o) Where the route has to cross open watercourses (or possibly, follow their route), presumably culverting would be required.
- p) Construction (and operational) effects on water quality arising from the scheme as a whole are a concern (see below), but here, where feasible at least, extensive mitigating measures would almost certainly be required.

Access to Area A: Summary

- 4.2.28 At para. 7.13.5, the LVIA concludes that '*Significant [adverse] visual effects would arise for users of public rights of way within 1km of the Panel Areas during the construction and operational stages, with the exception of changes to views from [other viewpoints / view routes, not the Brafferton ones].*
- 4.2.29 I **agree**: my assessment also concluded that for users of PROWs, visual effects arising from the proposed access points and construction routes to Areas A North and South would be **significant adverse**, and not only during construction and operation, but during interim and decommissioning works as well.
- 4.2.30 Evidently, these significant adverse visual effects are the result of **significant adverse** effects on landscape character, arising from loss of / damage to vegetation, and urbanisation / industrialisation.
- 4.2.31 The works required to construct the access points and routes into Area A would not only result in damage to / loss of high-value landscape elements and features, they would also urbanise / industrialise deeply rural, tranquil, and probably ancient, trackways, which make such important contributions to these landscapes' positive aesthetic and perceptual qualities, which are enjoyed by so many.
- 4.2.32 In addition, the construction traffic would be highly disruptive, and would cause conflict with regular road users especially along High House Lane where it runs through the centre of Brafferton.
- 4.2.33 As shown in the photos above, residents park their cars along both sides of the street. Also, people tend to walk along, and children play in, the middle of the street. The Village Hall on the green relies on on-street parking, and it is regularly used, with classes on most nights of week, and village events held throughout the year. Four times a year, between April and August, sheep

are driven into Brafferton and along High House Lane from fields to the south the BOAT / proposed access into the western part of Area A South.

Sheep drive through Brafferton



- 4.2.34 Furthermore, the works would give rise to **significant adverse** effects on recreational / social amenity.
- 4.2.35 Importantly, the PRoWs are well-used by the local communities and visitors for recreational purposes, so there is likely to be conflict between construction traffic / activities and PRoW users. Given the narrowness of some of the tracks, there should be concerns for the users' safety.
- 4.2.36 As mentioned previously, sections of the proposed Area A construction routes coincide with the route of 'one of the best walks in Britain' – see Section 6.
- 4.2.37 I could not find assessments of other effects arising from these works in the Applicant's submissions; however, my own assessment concluded that they could potentially give rise to significant adverse effects on water quality (see below), biodiversity, and heritage.

Construction / Decommissioning Routes and Site Accesses

- 4.2.38 During site visits, it is possible that the ExA has already noted and experienced the existing conditions along the proposed construction routes, and at the other places where access into the site is proposed – in particular, the very poor condition of the highway surface and the erosion and damage to roadside vegetation along Lime Lane, where a solar development (at Whinfield House, ref 21/00958/FUL) has been under construction for some time.
- 4.2.39 The same lack of detailed survey, analysis, consideration of cause and nature of effects, and assessment of effects noted for Area A above applies to the rest of the construction routes and access points.
- 4.2.40 Some of the proposed routes are along narrow, winding country lanes which are lightly-trafficked: as a result, they are enjoyed by local people and visitors alike, whether walking, running, cycling, riding, or driving, both for informal recreation and for getting to and from work,

school, the shops, church family and friends, and so on. For many, these quiet lanes make an important contribution to their health and well-being, and the quality of their lives.

- 4.2.41 Certainly, large amounts of traffic would be generated during construction and decommissioning, for long periods of time. In fact, in my opinion, the Applicant's estimate of 'up to two years' for construction is over-optimistic.
- 4.2.42 I note that for the Whinfield House solar development it was stated (in the DAS) that '*The construction phase of the Development is expected to have a duration of approximately 6 months*'. However, according to local residents, construction on site began in July 2023. When I last visited the site, in mid-August 2024, the works were still ongoing, so already, the works have lasted twice as long as predicted. According to an online source⁷, the scheme '*is expected to enter into commercial operation in 2025*'.
- 4.2.43 Crucially, the export capacity of the Whinfield House scheme is only c. 31MW on a site of 42.3ha, whereas the Byers Gill proposal's export capacity is up to 180MW on a site of c. 490ha. Thus, the Byers Gill site is almost twelve times as large as Whinfield House, and the export capacity six times as large (which raises questions about whether the size of the Byers Gill site is commensurate to the export capacity, as noted in ExAQ1, and is a matter on which BVAG seeks clarity).
- 4.2.44 At a 30MW solar site under construction in Worcestershire, the construction period was stated as being three months. Construction began in August 2022, and in April 2024, the works were still ongoing (I do not know if they are completed yet, but can find out), ie 20 months after construction commenced, almost seven times longer than expected. In part this was no doubt due to the fact that not many utility-scale solar sites are yet operational, so there are many unknown factors, but there were also delays due to repeated theft of equipment at the site (see Section 4.7).
- 4.2.45 It is quite possible, therefore, that the construction period for Byers Gill could last for many years.
- 4.2.46 Importantly, as the effects assessments assumed that the construction period would be of shorter duration than was actually the case, then levels of adverse construction effects will have been underestimated.
- 4.2.47 Prolonged periods of heavy / intensive construction traffic along the quiet rural lanes in particular would not only give rise to significant adverse effects on landscape character and visual amenity, but also, to social, recreational, and potentially, residential amenity.
- 4.2.48 Most importantly, there is highly likely to be conflict between construction traffic and regular users, which could result in accidents.

Construction / Interim/ Decommissioning Effects on Water and Soil

- 4.2.49 Regarding adverse effects on soil and water quality, in a letter from Gwent Wildlife Trust and Friends of the Gwent Levels, to Julie James, Minister for Climate Change dated the 14th of October 2022 (see Appendix CT-B), the authors set out the devastating adverse effects which arose during and / or soon after the construction of a solar development, especially on soil and water quality.
- 4.2.50 The effects on water quality are especially relevant here, as a) watercourses cross the site; b) there are several ponds adjacent / in close proximity to the site (as noted in Section 3.2, no SuDS are proposed, but runoff from the site during construction, interim works, and decommissioning could give rise to significant adverse effects on species and habitats, due to silt and a wide variety of potentially polluting substances); c) parts of the construction route, and parts of the site are prone to flooding / seasonally wet.

⁷ <https://www.power-technology.com/marketdata/power-plant-profile-whinfield-solar-pv-park-uk/>

- 4.2.51 According to the above letter, levels of one waterborne pollutant arising from the constructed solar development *'were over 14 times higher than pre-construction'*; very high levels of total petroleum hydrocarbons which adversely affect aquatic fauna *'were recorded inside the solar farm site, at 230 µg / litre, compared with a pre-construction level on the site of less than 10 µg / litre'*; and *'Nitrite as N and Nitrite as NO₂, were recorded at very much higher levels postconstruction compared with pre-construction'*.
- 4.2.52 The letter goes on to say that *'The flora on the site has been severely damaged by the construction process and there is no evidence of any attempts to mitigate against this. The ground appears compacted and the panels have large areas of bare earth under and around them, with brambles starting to take over the area, in stark contrast to the grazing marsh habitat of the site before construction. It should be stressed that this is merely a snapshot of the damage caused to the SSSI, and that further damage is likely to manifest itself as the years go by'*.
- 4.2.53 It also notes that following construction, *'The diversity of bat species decreased markedly, and for the majority of locations, abundance of species has dropped dramatically (95- 100%)'*.
- 4.2.54 Incidentally, regarding the effects of solar development on bats, recent research by the University of Bristol⁸ found that the activity level of common pipistrelle, noctule, myotis species, serotine, soprano pipistrelle, and long-eared bat species, is substantially lower at solar sites, compared with paired control sites. Lead researcher Elizabeth Tinsley said, *"Further research is required to assess bat behaviour at solar farms, and why it is causing the significant decrease of certain species at the site. Is it the loss of suitable habitat that reduces activity? Are there fewer insect prey available, and are bats at risk of collisions with panels?"*.
- 4.2.55 Some experts say that moonlight glint / glare on panels is an issue.
- 4.2.56 Regarding soils, according to a recent (March 2023) report by ADAS for the Welsh Government called *The impact of solar photovoltaic (PV) sites on agricultural soils and land quality*⁹ (see Appendix CT-C), construction works *'can negatively impact the flexibility of agricultural land, potentially lowering quality and ALC grade'* (my emphasis).
- 4.2.57 Indeed, the evidence demonstrates that solar development can and does cause considerable damage to soils, for example through compaction, disturbance and turbation (the mixing of soils / sediments) during construction, interim works, and decommissioning, and increased runoff and pollution during construction, operation and decommissioning. Some of the damage is likely to be irreversible – or at least, may take decades to recover from.
- 4.2.58 The Institute of Environmental Management and Assessment (IEMA) guide *A New Perspective on Land and Soil in Environmental Impact Assessment* (February 2022) defines soil impacts for EIA purposes as *'permanent, irreversible loss of one or more soil functions or soil volumes (including permanent sealing or land quality downgrading)...'* (Table 3, page 49). It also notes that this can include *'effects from temporary developments'*, which it explains *'can result in a permanent impact if resulting disturbance or land use change causes permanent damage to soils'*.
- 4.2.59 According to page 9 of the European Union's September 2020 report *Potential impacts of solar, geothermal and ocean energy on habitats and species protected under the birds and habitats directives*, *'Habitats transformed into solar farms will suffer from a wide range of impacts such as reduced vegetative cover, compaction of soil, reduced infiltration, increased runoff, decreased soil activity, decreased soil organic matter, and impaired water quality (New Jersey Department of Environmental Protection, 2017)'*.
- 4.2.60 Most importantly, both the short- and medium-term effects arising from the construction of utility-scale ground-mounted solar developments in the UK are only just becoming evident, due to there being relatively few large sites where construction is complete.

⁸ https://research-information.bris.ac.uk/ws/portalfiles/portal/390922178/Tinsley_et_al_Journal_of_Applied_Ecology_-_2023.pdf

⁹ <https://www.gov.wales/impact-solar-photovoltaic-sites-agricultural-soils-and-land-quality-summary>

- 4.2.61 I do not know whether any such solar developments in the UK have been decommissioned, but as far as I am aware, the first 'large-scale' solar development to be granted planning permission was the Wheal Jane site in Cornwall, which became operational in 2011: the application was for a generating capacity of 1.55MW, the site is c. 4ha.
- 4.2.62 The ADAS / Welsh Government soils report mentioned above confirms that *'There have been few studies of solar PV sites which have a focus on the impacts on agricultural land and soils. This is largely because solar PV sites are recent developments but also because in the early years sites were located on brownfield land or poorer quality agricultural land. The importance of achieving successful restoration of solar PV sites has increased in significance as the number, size and operational time frame of solar PV sites on BMV agricultural land has increased'*.
- 4.2.63 In one of its responses (March 2023) to a proposed solar development (Mallard Pass NSIP EN010127), Natural England explains that regarding solar development generally, *'there could be a disbenefit to the soil resource due to unknowns as a result of the solar development infrastructure. **It is currently unclear as to what impact the solar panels may have on the soil properties such as carbon storage, structure and biodiversity.** For example, as a result of changes in shading; temperature changes; preferential flow pathways; micro-climate; and vegetation growth caused by the panels. Therefore, **it is unknown what the overall impact of a temporary solar development will have on soil health'*** (my emphases).
- 4.2.64 Some experts now believe that the electromagnetic radiation which emanates from solar installations can give rise to adverse effects on soils / associated ecology / microbiology.
- 4.2.65 Adverse effects on soils are very likely to result in adverse effects on landscape character, views / visual amenity, biodiversity, and water quality.
- 4.2.66 In my opinion, all consented utility-scale ground-mounted solar developments should be monitored by independent experts for the lifetime of the development.

Compaction / Disturbance / Turbation

- 4.2.67 One of the main causes of soil damage / degradation is compaction, which farmers and land managers know reduces soil health / quality, and therefore try to avoid, or mitigate.
- 4.2.68 As the ADAS / Welsh Government report explains, *'The impact of soil compaction is well documented (Batey, 2009) and crop growth, yield and quality may be adversely affected. There are also wider environmental implications relating to water and air quality'*.
- 4.2.69 The report goes on to explain that *'the main cause of compaction is the compressive forces applied to the soil from the wheels or tracks of machinery. Hakansson (1985) found that an axle load of 10 tonnes increased soil bulk density to a depth of 50 cm. Compaction may be very persistent in the subsoil and **possibly permanent** (Hakansson et al 1988). Where there is 'industrial compaction' the depth of compaction can extend to depths of 1m (Spoor, 2006) and **may persist for up to 30 years** (Batey, 2009)'* (my emphases).
- 4.2.70 During decommissioning of solar developments specifically, the report explains that *'Access roads and tracks may require reinforcing to be of a standard suitable for heavy machinery. Trafficking will again occur across the site on and off the site tracks as panels, frames and inverter cabins and substations are removed... which can result in soil compaction... The extraction of the piles is likely to be more problematical than the initial installation...'*.
- 4.2.71 Natural England (and other organisations) recommend that *'in order to minimise the potential detrimental impact of construction activities on the soil resource, it should be ensured that the grass sward is fully established (ie no bare ground), prior to the installation of the panels and associated infrastructure'*.
- 4.2.72 Unfortunately:

- i) The presence of a grass / other thick sward on the soil surface does not protect against compaction (however, it can help to protect against the adverse effects of superficial soil disturbance and turbation (and runoff – see below)).
 - ii) If the sward being established was the proposed operational species-rich mixture, it would not establish successfully on arable soil – see below.
 - iii) Even if a temporary grass ley was established prior to construction, it would take at least two growing seasons to develop a sward dense enough to withstand at least some of the construction damage.
 - iv) Even if a temporary grass ley was established, and the soil fertility problems were resolved, once the panels and other infrastructure were in place it would be impractical, and perhaps impossible, to replace the ley with a species-rich mixture, as this would involve removal and resowing, or over-sowing, or plug-planting, either mechanically, or by hand, over a very large area, most of which would be covered by panels.
- 4.2.73 Furthermore, it is difficult to remedy damage such as compaction using normal agricultural equipment, as the panels, once installed, prevent ease of cultivation, such that compaction and structural damage can remain until panels are removed or even beyond. The compaction can cause long term drainage issues that affect both soil quality and the ability of the soil to absorb water, leading to increased run-off and localised flooding.
- 4.2.74 The nature of the soil is also an important factor in the way in which it will be affected during construction / other works, and by changes in use.
- 4.2.75 Here, according to the Applicant's Agricultural Land Classification and Soil Resources report (ES Appendix 9.1), almost all of the site is under arable cultivation, apart from small areas of permanent grassland 'in the western part of Area A'; north of Byers' Gill Wood in Area C; and in the northern part of Area D. The soils are clay based, predominantly clay, or heavy clay loam, with some medium clay loam, and small areas of sandy clay loam. It confirms that some of the land is seasonally-wet / prone to flooding.
- 4.2.76 Evidently, carrying out construction activities on arable land which is characterised by such soils and conditions is very likely to give rise to high levels of adverse effects on soil structure and microbiology.
- 4.2.77 The following photographs show the effects of agricultural vehicles travelling across arable land of a similar nature to that of many parts of the site, and a dried-out area of soil in the same field.

Photographs of soil damage in arable field





- 4.2.78 Generally, on heavier, less freely-draining soils, it is more difficult to avoid compaction, but turbation is a problem on most soil types.
- 4.2.79 Turbation can occur during many construction activities, such as tracking and turning of vehicles; and engineering works / excavations for access tracks, structures, foundations, infiltration basins, and trenches for cables and drains which are backfilled with foreign material – all of which would be required in this case.

Soil Pollution

- 4.2.80 There is always a risk of pollution incidents happening during all types of construction (and interim / decommissioning) works, which may be localised and / or widespread, temporary and / or permanent. It is important that all the possible risks are identified at an early stage, and robust measures are put in place to avoid such incidents happening in the first place, and / or to reduce the likely levels of adverse effects.
- 4.2.81 The ADAS / Welsh Government report states that during construction, pollution incidents can result in longer-term detriment to soils. However, as mentioned above, one of the problems of this being a relatively new industry in the UK – at least, at this scale – is that currently, the cause and nature of many of the effects arising from construction are not properly understood, and to date, very little monitoring of effects during and / or post-construction has taken place; also, it is likely to be many years before certain effects are experienced / realised.
- 4.2.82 In terms of the effects of pollution on soils in particular, according to the letter from Gwent Wildlife Trust and Friends of the Gwent Levels:
- a) *Levels of several waterborne pollutants arising from the constructed solar farm have risen hugely since construction. For example, [regarding] levels of suspended solids (silt) inside the development site... the levels of this damaging pollutant produced by the solar farm were over 14 times higher than pre-construction.*
 - b) *Very high levels of total petroleum hydrocarbons TPHCWG (a very damaging pollutant adversely affecting the aquatic invertebrate and plant citation interest of the SSSI) were recorded inside the solar farm site, at 230 µg / litre, compared with a pre-construction level on the site of less than 10 µg / litre.*

- c) *Even these very high levels of pollutants caused by the solar farm may be underestimates, because other pollutants, for example Nitrite as N and Nitrite as NO₂, were recorded at very much higher levels postconstruction compared with pre-construction.*

4.2.83 See also Pollution Risk in Section 4.3 below.

Soil Erosion

- 4.2.84 During construction and decommissioning works, bare soil on sloping ground can quickly erode away due to surface water runoff, and potentially, be lost, ending up where it is not wanted, for example in other fields, watercourses, and on roads. The risks can and should be anticipated, and robust prevention / mitigation measures put in place to ensure that the soil is preserved.
- 4.2.85 During operation, there would be runoff from the solar panels. As explained above, the effects of runoff depend greatly upon the nature of the landcover under and in between the arrays: if a good, dense sward exists when the panels are erected, and it remains in place, then soil erosion is less likely than if the soil was bare.
- 4.2.86 Section 2.2.4 of the ADAS / Welsh Government report explains (and illustrates, at Figure 6) that *'There is likely to be some instances of run-off from the solar panels, which could result in the compaction of soils at the base of the panels (Choi et al, 2020). Over time rivulets can form along the trailing edge of the panel with potential risk of soil erosion creating rills and gullies across the site. The sand bed could act as a drain, especially on heavy textured soils, leading to drainage discharges or wet patches at the down slope end of each trench'.*
- 4.2.87 At the Gwent Levels solar site, the monitors found that ***'The ground appears compacted and the panels have large areas of bare earth under and around them, with brambles starting to take over the area'*** (my emphasis).
- 4.2.88 Also, see the photos overleaf (evidence from appeal ref APP/D3315/A/13/2203242), showing how rain falling off the lower edges of the panels onto bare soil forms rivulets and increases runoff.



4.3 Operational Impacts / Nature of Effects: Summary

4.3.1 The operational effects likely to arise / their causes are summarised below. These and others are explained in more detail in previous and the following sections, where relevant.

- i) Modern, highly industrialising features and activities inserted into / occurring within landscapes with high levels of aesthetic and perceptual qualities, including scenic beauty, tranquillity, time depth, small, sleepy villages, and the network of lightly-trafficked lanes and public rights of way that connect them.
- ii) The landscape pattern of the wider landscape would be disrupted; there would be bright / contrasting colours, and glint / glare from the solar panels' and other reflective surfaces.

- iii) What is rarely if ever considered in solar development effects assessments, on not just character and views, but also heritage, are the important qualities brought by seasonal changes in the landscape.
- iv) Best practice guidance on assessing setting (Historic England's publication *The Setting of Heritage Assets Historic Environment Good Practice Advice in Planning Note 3 (Second Edition)*) highlights the need to consider diurnal and seasonal changes. Often, seasonal changes manifest with views being more or less prominent in winter and summer (respectively), as trees and hedges in the landscape come into and out of leaf.
- v) In this instance, considering the agricultural context of heritage assets at a landscape scale, particularly where the fields are largely arable, there is an obvious expectation for agricultural land to change with the seasons as fields are ploughed, sown, tended, and harvested throughout the course of the year. Indeed, in rural areas, such changes are often celebrated with seasonal festivals and events, as has been the tradition been for many hundreds of years.
- vi) Solar development of this type and at this scale not only obscures views of the land itself, and introduces alien, modern built form across a wide area, but also, establishes a static, sterile year-round appearance which is very different from the character of a dynamic agricultural landscape with its seasonal changes.
- vii) This in turn will have notable adverse impacts on the settings of heritage assets which have their significance contributed to by an agricultural context in which they can be experienced and understood. This would extend as much to the brief periods of intense activity and noise associated with harvest as to the non-visual aspects – some perhaps much changed from traditional practice, but still an unmistakable part of the farming year.
- viii) Although levels of some effects would normally be lower during operation than construction, there would still be regular activities on site, with disturbance / activity / movement / noise (human and mechanical), glint and glare, contrasting / bright colours, clutter and paraphernalia, lighting, security fencing, signage, and so on. See also pollution risk below.
- ix) Changes to / loss of landscape function and contribution to wider landscape character, and heritage assets, made by site.
- x) Some of the proposed features / activities have a high degree of permanence, others would be 'truly' permanent, for example the Distribution Network Operator (DNO) substation proposed in Area C, and its associated infrastructure, access, cabling etc, would remain after the solar plant was decommissioned.
- xi) Loss of characteristic vegetation.
- xii) The site's historical landscape patterns would be disrupted by the proposed creation of new boundaries on arbitrary lines.
- xiii) It is likely that panels / other equipment such as battery storage units would need to be replaced from time to time (see below), meaning that many construction effects would be experienced again during the operational phase.
- xiv) There would be substantial adverse changes to / loss of views and visual amenity resulting from the above, including to highly-valued and important heritage assets.
- xv) In fact, there may not be any intervisibility between assets / landscapes / features, but a) there could be high levels of interinfluence / association between assets / landscapes / features which are not related to visibility, but to physical / cultural aspects / qualities; b) lack of intervisibility may be a modern phenomenon, with once-intended intervisibility now screened by vegetation; and c) screening vegetation may not be permanent.
- xvi) Regarding heritage assets and their settings specifically, 'Setting' is defined in the NPPF as *'the surroundings in which a heritage asset is **experienced**'* (my emphasis). This is similar to the difference between character and views in LVIA, especially in that in many heritage

assessments (including, it would appear, the Applicant's) assume that by screening the proposed development in views to and from heritage assets, all harm disappears, when of course, that is not the case.

- xvii) Historic England's Planning Note 3 explains that *'The extent and importance of setting is often expressed by reference to visual considerations. Although views of or from an asset will play an important part, the way in which we experience an asset in its setting is also influenced by other environmental factors such as noise, dust and vibration from other land uses in the vicinity, and by our understanding of the historic relationship between places. For example, buildings that are in close proximity but are not visible from each other may have a historic or aesthetic connection that amplifies the experience of the significance of each'*.
- xviii) There would be substantial adverse changes to the highly-valued and valuable recreational resource, from which local economic benefits are derived.
- xix) Tranquillity is a relevant consideration here, because the site and parts of the contextual landscapes benefit from this landscape quality, along with local residents and visitors.
 - a) Tranquillity is defined in the glossary of GLVIA3 as *'a state of calm and quietude associated with peace, considered to be a significant asset of landscape'*.
 - b) Tranquillity is often assumed to be synonymous with 'lack of sound'; however, in landscape and visual assessment, that is not the case. 'Tranquil areas' should not be confused with 'quiet areas', which are defined by the European Environmental Noise Directive (END; 2002/49/EC) as *'those areas delimited by national authorities that are undisturbed by noise from traffic, industry or recreational activities'*.
 - c) In Wales, the definition of tranquillity that has been adopted by both Welsh Government (Welsh Government 2012) and Natural Resources Wales (NRW 2016a) is *'An untroubled state, which is peaceful, calm and free from unwanted disturbances. This can refer to a state of mind or a particular environment. Tranquillity can be measured in terms of the absence of unwanted intrusions, or by a balancing of positive and negative factors. These include **the presence of nature, feeling safe, visually pleasing surroundings and a relaxing atmosphere**'* (my emphasis).
 - d) The LI's technical information note (TIN) 01/2017 on the subject¹⁰ (revised March 2017) was *'prepared for the purposes of providing an overview of what is understood by the term 'tranquillity' within the landscape profession and to inform any future discussions and actions on the topic'*. The TIN – which was not referenced in the Applicant's LVIA – explains that *'There are clear links between landscape and tranquillity... the interpretation of tranquillity is often linked to an association or engagement with the natural environment and it is this interpretation that places the term within the realms of landscape related study and research'*.
 - e) The TIN goes on to say that *'tranquillity cannot readily be defined as an environmental characteristic or quality as it is a state of mind that is being described and thus human perceptions as well as factual evidence must be considered in any studies relating to the term. Tranquillity is, in effect, an umbrella term used to refer to the effect of a range of environmental factors on our senses and our perception of a place'*.
 - f) Natural England lists 'relative tranquillity' as one of six factors that contribute to natural beauty.
 - g) A 2001 survey commissioned by Defra cited tranquillity as the most commonly-mentioned reason why people visit the countryside.

¹⁰ <https://landscapewpstorage01.blob.core.windows.net/www-landscapeinstitute-org/2017/02/Tranquillity-An-Overview-1-DH.pdf>

- h) Tranquillity is an important factor in why people visit certain places, and why they choose to live and / or work in them.
- i) One of the most commonly-reported benefits of tranquillity is its ability to enhance a positive peaceful, state of mind: generally considered to contribute to enhancing people's quality of life.
- j) Thus, even during the operational phase, when the site would not be as active / noisy as it would be during construction / decommissioning, there is no doubt that the proposed development would give rise to high levels of adverse effects on tranquillity.

4.4 Pollution Risk / BESS

- 4.4.1 During operation, it may be assumed that solar power stations pose a low level of pollution risk; however, there is evidence that the chemicals used in panel-cleaning products also contribute to soil and water pollution (see reference to Gwent Wildlife Trust and Friends of the Gwent Levels above). Also, whilst levels of polluting substances may be lower than during arable cultivation (unless organic), there may have to be widespread use of herbicides and pesticides (eg endectocides which are used on sheep¹¹).
- 4.4.2 The Application includes a battery energy storage system (BESS). Whilst the risk of an accident occurring may not be 'significant', the fact that there is a risk at all is important, because in the event of an accident or incident which results in the batteries catching fire / igniting / exploding, there is the potential for significant widespread adverse effects on environmental and human health.
- 4.4.3 ES Appendix 2.13 Outline Battery Fire Safety Management Plan (oBFSMP) para. 2.3.3 explains that *'the proposed siting of the BESS has been decided through engagement with the local fire and rescue service to ensure that proper access can be maintained throughout, whilst also reducing fire risk across the Order Limits. In addition, the BESS has been placed at least 300m from residential properties in the majority of cases, to reduce the visual and noise impact of the infrastructure'*.
- 4.4.4 Notwithstanding the above and other measures proposed in the oBFSMP, in my opinion, it is still important to understand more about the cause and nature of the environmental effects that can potentially arise from BESS.
- 4.4.5 I was unable to ascertain the exact numbers and locations of the BESS units. The General Arrangement Panel Area plans for Areas A – F (ES Figures 2.3 – 2.8) show pink rectangles where 'Battery Energy Storage Systems, inverters, switchgear, and spare containers' would be sited, but does not differentiate between them. ES Figure 2.11 Typical Access and Supporting Infrastructure Layout does differentiate between the different types of containers, but as it says, it is simply a 'typical' / indicative layout, which could be in any part of the site.
- 4.4.6 Clarification of the above would be helpful (I note that these questions are also asked in ExAQ1, at PPD.1.11, and WFR.1.13).
- 4.4.7 Normally, BESS units are housed in modified shipping containers, each c. 12m wide x 2.5m wide x 3m high, either white, grey or green (the choice of colour makes a material difference to levels of visual effects).
- 4.4.8 The purpose of BESS is to store surplus / excess solar power that would otherwise be wasted.
- 4.4.9 Usually, lithium-ion solar batteries are used for this purpose, being a rechargeable energy storage solution which can be paired with the solar energy system to store surplus power (lithium-ion batteries are commonly used in rechargeable electronic devices such as mobile

¹¹ Endectocides are drugs often administered to sheep, which are effective against both endoparasites and ectoparasites, but they are environmentally toxic. Ivermectin, for example, has become notorious because of lethal and sublethal effects on beneficial coprophagous *Coleoptera* (eg dung beetles) and other invertebrates, disrupting biodiversity and ecosystem services. See [eg https://bit.ly/iverimpact](https://bit.ly/iverimpact).

- phones, and in electric vehicles (EVs)). Lithium is toxic, as are the other metals they contain, such as cobalt, nickel, and manganese.
- 4.4.10 Lithium-ion batteries can be extremely dangerous. Sometimes, they short-circuit, resulting in fire. They are also prone to 'thermal runaway', which means that if the internal circuitry is compromised, an increase in internal temperature can occur. At a certain temperature, the battery cells begin to vent hot gases, in turn increasing the temperature in neighbouring cells.
- 4.4.11 Ultimately, this will lead to ignition, and fire. Even a relatively small incident can lead to an uncontrollable fire. As such, large quantities of batteries pose a significant safety risk, which is why lithium batteries are considered hazardous materials / dangerous goods, and must be handled, stored and transported accordingly (for transportation purposes, the UN categorises all lithium batteries as Class 9 — miscellaneous dangerous substances and articles).
- 4.4.12 It is now well-known¹² that **lithium-ion battery incidents which occur at scale can be catastrophic**, resulting in the combustion of nearby structures, explosion, and the release of highly toxic clouds / plumes containing gases such as Hydrogen Fluoride (HF) and highly inflammable gases including Hydrogen (H₂), Methane (CH₄), Ethylene (C₂H₄) and Carbon Monoxide (CO). These in turn may cause further explosions or fires upon ignition. The chemical energy then released can be up to twenty times the stored electrochemical energy.
- 4.4.13 Recent examples of such fires at BESS installations are in Liverpool¹³, and Germany¹⁴.
- 4.4.14 In fact, BESS thermal runaway events are not 'fires' in the traditional sense of the word, but self-sustaining chemical reactions that have gone out of control. They pose a unique threat to firefighters: because the fires are chemically-driven, requiring no external oxygen, they cannot be extinguished by traditional methods. Vast amounts of water are needed over many days due to the risk of reignition. The water used to extinguish a fire inevitably becomes contaminated with toxic chemicals (such as highly corrosive hydrofluoric acid, and copper oxide), which may drain into surrounding areas / watercourses.
- 4.4.15 Such incidents are therefore highly likely to cause **widespread, major damage to health, life, property and the environment**.
- 4.4.16 In recognition of the above problems and risks, in November 2022, the National Fire Chiefs Council (NFCC) published *Grid Scale Battery Energy Storage System planning – Guidance for FRS* [Fire and Rescue Services]¹⁵. The guidance is '*based on trying to help reduce the risk as far as reasonably practicable, whilst recognising that ultimate responsibility for the safe design and running of these facilities rests with the operator*'.
- 4.4.17 In response to an application which included BESS (W/23/00270/FUL, response dated 31st July 2023), Hereford and Worcester Fire and Rescue (HWFR) Service referred to the NFCC guidance.
- 4.4.18 They stated that '*If we were to let [a fire] burn, there would be a significant impact on the surrounding communities which would all be significantly impacted from the vapour / smoke plume for at least 24-48 hours, and therefore recommend that the Planning Authority consider this potential impact*'.
- 4.4.19 As a result, '*a comprehensive risk management process must be undertaken by operators to identify hazards and risks specific to the facility and develop, implement, maintain and review risk*

¹² See for example *Safety of Grid Scale Lithium-ion Battery Energy Storage Systems* (5th June 2021) by Eurling Dr Edmund Fordham MA PhD CPhys CEng FInstP, Fellow of the Institute of Physics; Dr Wade Allison MA DPhil Professor of Physics, Fellow of Keble College, Oxford University; and Professor Sir David Melville CBE FInstP Professor of Physics, former Vice-Chancellor, University of Kent

¹³ <https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010106/EN010106-004089-DL2%20-%20Edmund%20Fordham%20EF14.pdf>

¹⁴ <https://www.ess-news.com/2024/08/12/third-battery-fire-at-the-same-site-in-germany/#:~:text=This%20is%20the%20third%20fire,in%20flames%20on%20June%2030th.>

¹⁵ <https://nfcc.org.uk/wp-content/uploads/2023/10/Grid-Scale-Battery-Energy-Storage-System-planning-Guidance-for-FRS.pdf>

controls'. This should include 'impact on surrounding communities, buildings, and infrastructure'. Also, 'water run-off and potential impact on the environment, along with mitigation measures, should be considered and detailed'.

- 4.4.20 In addition, *'the Environment Agency and Severn Trent may need to consider the impact of run-off in to local water courses'.*
- 4.4.21 I note that very recently (the 22nd of August 2024), the Environment Agency responded to a planning application in Wiltshire for a c. 24MW solar development with BESS (Wiltshire Council ref PL/2023/01914).
- 4.4.22 The response explains that *'Since our last response dated 30 March 2023 the Environment Agency's position has changed with regards Battery Energy Storage Systems (BESS) and ensuring sealed drainage in the event that a fire breaks out',* and that the Agency now **objects** to the proposals. It says that *'the proposed development may pose an unacceptable risk of causing a detrimental impact to groundwater quality because the applicant has failed to indicate the means of disposal of surface water and the applicant has failed to provide a method statement detailing how contaminated surface water run-off will be dealt with in the unfortunate event that a fire breaks out at the site in particular a battery fire'.*
- 4.4.23 It then states that in order to overcome the objection, *'The applicant should provide a detailed drainage plan for the BESS portion of the site',* with measures which include *'drainage features, suitable for containing contaminated surface water run-off in the event of a fire'.*
- 4.4.24 Clearly, if this was to be a requirement here, it would exacerbate levels of adverse landscape, visual, and other effects due to the need for extensive engineering works likely to adversely affect soil and water quality.
- 4.4.25 Another important point to note is that as far as I am aware, currently, lithium-ion battery units of the type that are likely to be used at the Application site have a lifetime of about eight years. Therefore, the units proposed at the Application site could need replacing up to five times during the 40-year operational period. Each container weighs around 19 tons. Thus the proposed development would generate around 22,800 tons of heavy-duty industrial waste, including 5,000 tons of toxic lithium chemicals.

4.5 Soil Fertility

- 4.5.1 As explained above, the damage caused to soils during construction, operation and decommissioning of solar developments can be irreversible, and the ADAS / Welsh Government report states that construction works *'can negatively impact the flexibility of agricultural land, potentially lowering quality and ALC grade'.*
- 4.5.2 This section briefly explains the problems associated with the Applicant's proposal to replace the existing arable crops with different types of grass swards.
- 4.5.3 According to Table 6-6 of ES Chapter 6 Biodiversity, *'Area underneath panels [is] to be sown with a low maintenance grassland while between panels and to margins they will be sown with legume rich herbal ley/wildflora mixes'.*
- 4.5.4 Para. 3.3.4 of ES Appendix 6.6 Biodiversity Net Gain Assessment sets out the proposals for the establishment of the different swards. The locations of these areas are shown on the Environmental Masterplan (ES Volume 2 Plans Drawings & Designations 2.5 Environmental Masterplan).
- 4.5.5 In summary:
 - i) *A low maintenance grass rich sward will be under the PV panels.*
 - ii) *Around the PV panels... there would be legume rich herbal ley / temporary grass and clover leys.*

- iii) *The Biodiversity Enhancement/ Wildflower Meadow area will be seeded with a wildflower seed mix.*
- 4.5.6 The Outline Landscape and Ecology Management Plan (LEMP) (ES Appendix 2.14) provides further details about the proposed grass / 'species-rich wildflower meadow grassland' / other swards and their proposed establishment and management.
- 4.5.7 Para. 3.2.5 explains that the proposed '*low maintenance grassland beneath solar PV panel and legume rich herbal ley/wildflower mixes to margins and between solar PV panel rows*' would be '*managed with a late summer / autumn hay cut... followed by grazing if required*'. How hay-cutting could be achieved beneath the panels is not stated. Re grazing, see below.
- 4.5.8 Sections 5.7 – 5.12 provide details of the proposed management objectives, management operations, and species mixes.
- 4.5.9 Para. 5.9.2 explains that '*Wildflowers will be selected to tolerate still relatively high nutrient soil conditions of formerly improved agricultural land*'.
- 4.5.10 However:
 - i) The arable land on the site is characterised by **high fertility / nutrient-rich soils** (para. 3.6 of the Applicant's Agricultural Land Classification and Soil Resources report (ES Appendix 9.1) states that across the majority of the site, the Agricultural Land Classification (ALC) is 3b, with small areas of 2 and 3a (the latter are categorised as Best and Most Versatile (BMV) land); however, this is disputed by BVAG and others, who consider that the ALC is likely to be higher than stated in some parts of the site).
 - ii) In order to establish successfully, **wildflower meadows and species-rich grassland require low fertility / nutrient-poor soils.**
 - iii) It is not clear to me how this would be achieved. Would the topsoil be stripped and stored, or sold?
 - iv) Even if the fertility of the soils was reduced, it would take many, many years for a good, species-rich sward to develop, and that assumes regular, careful maintenance and management.
 - v) Furthermore, **it is now recognised that successful establishment of species-rich wildflower meadow does not occur under / around solar arrays.** This is mainly due to shading, runoff, and form of use / management (if not grazed by sheep, herbicides are customarily used).
 - vi) For example, ecological consultants working on the proposed Mallard Pass solar development mentioned previously **did not propose species-rich wildflower meadow / pasture within the solar array areas**, as they recognised the problems of establishment. Instead, a standard six-species grass ley is proposed. The mixtures proposed to be sown on this Application site contain many more species, increasing biodiversity.
 - vii) Para. 2.3.3 of the Outline Decommissioning Environmental Management Plan (ES Appendix 2.7) states that '*Land within the Order Limits would be returned to its original use as far as possible and practical with areas of established mitigation left in situ where possible and in agreement with the landowner*'.
 - viii) Thus, after operation has ceased, it is possible, perhaps even likely, that the landowner would expect to be able to grow high-yielding arable crops, on land which is still partly BMV, with high-quality, productive soil (although of course, some of the scheme elements would be 'truly' permanent, for example the on-site DNO substation and associated access, cabling and other elements).
 - ix) But the Applicant does not explain how this would be achieved either. Would the stripped, stored topsoil be returned, or would new topsoil be imported?

- 4.5.11 Although I am not certain whether the matter has been mentioned in the Applicant's submissions, many applications for utility-scale solar development state that the proposals would benefit soils in fields which are currently in arable use because they would be 'rested' for forty years.
- 4.5.12 The concept of soil recovery, or 'resting', has been practiced for millennia: in summary, it involves cessation of intensive / depletory agricultural activities for a period of time, and either allowing plants to establish naturally, or sowing / planting a cover crop such as a grass ley or legumes, which helps the soil replenish its depleted resources.
- 4.5.13 Importantly, **the benefits of resting are only temporary**, and do not increase exponentially: recent studies show that the optimum resting period is around three years¹⁶. 'Resting' specifically relates to cultivated land which would be re-cultivated following the 'resting' period (as is likely to be the case here), as opposed to 'restoring' land to its pre-cultivated state (also 'rewilding'). In principle, the long-term ecological benefits of 'restoration' are greater than those of 'resting'.
- 4.5.14 Furthermore, it has been demonstrated that the most effective method of improving and maintaining good soil health (physical, chemical, and biological) for food production is through regular and diverse crop rotation interspersed with resting, as opposed to semi-permanent leys and / or grazing.
- 4.5.15 In this case, of course, during construction, the soil would have suffered significant damage, and therefore would take far longer to 'recover' than the baseline agricultural soil would.

Sheep-grazing

- 4.5.16 Para. 9.8.10 of ES Chapter 9 Land use and Socioeconomics states that *'During construction, agricultural uses will cease within each of the panel areas and for laying the underground cables. Subject to demand, agricultural uses including sheep grazing may resume within the panel areas once construction is complete, other than in the areas proposed for the on-site substation, operational access tracks and other infrastructure such as BESS, inverters, switchgear and spare containers'*.
- 4.5.17 However, this is the only reference to sheep-grazing that I could find in the Applicant's submission documents: as noted above, elsewhere, for example in the LEMP, there is mention of the potential for some form of 'grazing', but this does not appear to have been assumed for the purposes of this exercise.
- 4.5.18 Interestingly, this is the only proposed solar development I have been involved with where sheep-grazing is not specifically proposed. That could possibly be due to applicants taking account of the growing evidence which indicates that in practice, grazing sheep within solar developments is not only highly impractical, but unwise.
- 4.5.19 Most solar developers / promoters show photographs of sheep grazing in solar array areas. Interestingly, the vast majority are stock images which are available online, and most are from the same sites. One of the sites is in Eastern Europe (Kosovo? The stock photo shows goats as well as sheep), and I am advised that another belongs to a UK solar developer / operator and is on their farm, although I do not know if sheep are still being grazed there.
- 4.5.20 In fact, there appear to be very few if any solar developments in England where *currently*, sheep are being grazed (I believe there may be one or two in Wales). At some solar inquiries, Inspectors have asked applicants to provide examples, but to date, not a single one has been provided.
- 4.5.21 Many solar site operators simply use herbicides (and fertilisers), even though the ecological assessments in particular may have assumed that sheep would be grazed, and therefore,

¹⁶ See for example <https://www.low-impact-farming.info/sites/default/files/2020-05/rotations-and-their-impact-on-soil-health-2019-ffc-merfield.pdf>

damaging chemicals would not be used (although they may not have been aware of the use of environmentally-toxic chemicals on sheep, such as endectocides).

- 4.5.22 At one solar appeal hearing I was involved with, a local resident spoke, who is a life-long, expert sheep farmer. He said that in his opinion, it would not only be extremely difficult, but also cruel to keep sheep in solar array areas.
- 4.5.23 The farmer explained that the reason is mainly because sheep need to be kept in open spaces, where the shepherd can easily observe and monitor the flock. Daily inspections are critical for good animal husbandry, so that animals which are injured / lame / ill can be isolated from the herd and treated quickly (sheep are particularly prone to getting cast and dying if not righted within hours).
- 4.5.24 However, within the confines of solar arrays, due to the configuration of the panels, all but near-distance views are completely blocked.

Eye-level view within solar array in UK (sourced online, photographer / location unknown)



- 4.5.25 Also, the farmer said that it would be very difficult for sheepdogs to round up / separate sheep in that situation (other farmers said that the use of quad bikes would be virtually impossible).
- 4.5.26 In addition, he explained that due to the amount of shading from the panels, a healthy sward does not develop; thus, the grass does not provide the necessary amount of sugar and other nutrition that the sheep require for fattening-up. A poor sward can also adversely affect sheep's health.
- 4.5.27 A 2016 study at the operational Westmill solar site in the UK¹⁷ found that *panels reduce temperatures beneath them in summer by up to 5.2°C, and the ground under them is also dryer. It also found that both species diversity and biomass were lower under panels, attributed to differences in micro-climate and vegetation management. Under the panels there were significantly fewer species, dominated by grasses, with only one broadleaved flowering plant present, being yarrow (Achillea millefolium), which is both shade-and drought-tolerant*.
- 4.5.28 As noted above, at the Gwent Levels solar site, the monitors found that *'The ground appears compacted and the panels have large areas of bare earth under and around them, with brambles starting to take over the area'*.

¹⁷ A. Armstrong, N. J. Ostle, and J. Whitaker (2016) *Solar park microclimate and vegetation management effects on grassland carbon cycling*. Environ. Res. Lett. 11 074016

Grassland management at solar site in UK (sourced online, photographer / location unknown)



Weeds, left unmanaged, could become a problem for the panels

4.5.29 Furthermore, I have been advised that at one operational site, "a large array had to be completely recabled after sheep were given access".

4.5.30 Below is an extract from an email I received earlier this year, from a shepherd, about sheep-grazing on solar sites:

'Re solar, most solar farms are not grazed, for many reasons. Additional cost of putting piping round all wires and everything sheep can chew. Raising solar panels up on higher metal poles so sheep don't damage expensive panels. Why go to all these additional costs to get an extra £50 per acre sheep grazing rent when you are renting the land to the solar company for £1,000 per acre? (It's £200 per acre roughly rented for arable, as you know). Why risk a few sheep in millions of £ worth of investment? The Orston solar farm, 56 acres I believe, cost £12-13 million to build in 2013. When you are getting a guaranteed income of £56,000 a year for 25 years, why bother with £2,800 a year for a few sheep?

'On the estate where I work, lambing mid Feb to Mid March, have approx a 100 acre solar farm, and lamb 750 ewes a year, but they do not graze the solar farm at all, and have no intention of doing so. Not worth the time or effort. They have another application going in for another approx 250 acres of solar farm. They'd make far more money renting it all to solar than lots of hard work with sheep.

'If you do graze solar, you need good dog to round up the sheep to get them out, or in a pen to work on them. How do you check easily each day for poorly sheep or lambs? Most shepherds wouldn't want to graze a solar farm. A few owners might on their own doorstep with a few pet sheep that run to a bucket of food. How often do you see sheep in a solar farm?!

'Sheep wool is effectively worthless the last couple of years. It costs more to shear the sheep than the wool is worth. I can give you some figures another day.

'Lamb has been a good price the last few years, mainly more demand for our lamb from places like Japan, that lifted the BSE ban on UK beef and lamb after 25 years or so.'

- 4.5.31 It must also be borne in mind that whilst for the above and other reasons¹⁸, sheep-grazing is not the ideal form of management to achieve the Applicant's stated mitigation / management objectives for the proposed grass / 'species-rich wildflower meadow grassland' / other swards, if the swards are not grazed, the habitats will degrade. This is mainly due to grazing maintaining a variable sward height, which is essential for much of the community (plant, invertebrate, bird and reptile) dependent on the habitat. Fertilisers increase the dominance and density of grass, and the sward height, which is likely to result in a reduction in the value of the habitat.

4.6 Glint and Glare

- 4.6.1 Despite the subject being of great relevance to the assessment of effects on landscape character and visual / other forms of amenity, the LVIA appears not to have considered the effects of glint and glare at all.
- 4.6.2 This section a) provides more information about the nature and magnitude of the effects which arise from glint and glare; and b) sets out my summary review of the Applicant's Solar Photovoltaic Glint and Glare Study (GGS) (ES Appendix 2.2), where relevant to landscape and visual effects.

Overview of glint and glare effects

- 4.6.3 Glint and glare are sometimes grouped under the term 'solar reflection', which is what causes them. Glint is a momentary flash caused when sunlight hits a smooth, glassy surface such as water, or a solar panel. Glare is diffused light caused by the reflection of the sky on such surfaces; it is less intense than glint, but the effect may be experienced continuously for long periods throughout the day.
- 4.6.4 According to a study called *Understanding Emerging Impacts and Requirements Related to Utility-Scale Solar Development* (September 2016) by Argonne National Laboratory¹⁹, the glint and glare arising from solar panels is '**of unusual intensity and unique appearance**' (my emphasis).
- 4.6.5 Both phenomena are unpleasant / cause visual discomfort when viewed from relatively long distances, and are highly disturbing / disorientating when experienced at close quarters, especially when experienced regularly / for long periods of time. The effects can negatively affect the quality of people's lives, and their well-being. Furthermore, in very close proximity, there is the potential for eye-damage (see below).
- 4.6.6 The images overleaf show examples of glint (1 and 2), and glare (3), arising from solar panels.

¹⁸ See for example <https://howtorewild.co.uk/guide/neutral-grassland/>

¹⁹ <https://publications.anl.gov/anlpubs/2016/10/130700.pdf>

1) *Glint*



2) *Glint from Wheal Jane solar site, Cornwall (imagery ©2024 Airbus, Google Earth)*



3) Glare



- 4.6.7 Glint in particular can give rise to very high levels of adverse effects on visual, recreational and residential amenity, and landscape character. The phenomena are also known to at best distract, and at worst, cause brief loss of vision – also known as flash-blindness – in motorists and other road-users, train drivers, and pilots, which can cause serious road, rail and air accidents.
- 4.6.8 According to the *Understanding Emerging Impacts and Requirements Related to Utility-Scale Solar Development* study, 'the health and safety impacts of glare from solar facilities have been documented extensively', and cites several references.
- 4.6.9 On page 18, the study explains that '**Ocular damage from glare viewed at very short distances is possible**' (my emphasis), although it goes on to say that this is '*primarily a concern for workers because public access to facilities is controlled*'. However, in this case, PRoWs cross the site, and there are several other PRoWs, roads, and residential properties on the boundary of, and close to, the site.

Applicant's GGS method

- 4.6.10 It must be noted that currently, there is no formal guidance for carrying out glint and glare assessments, only high-level guidelines from the Civil Aviation Authority (CAA) (the USA's Federal Aviation Administration (FAA) also has guidance on the assessment of effects of solar developments near aerodromes). However, most experts in the field seem to use the informal guidance published by Pager Power, the company which carried out the Applicant's glint and glare study (*Independent Solar Photovoltaic & Building Development – Glint & Glare Guidance*, currently 4th Edition (September 2022), Pager Power²⁰).
- 4.6.11 Indeed, Pager Power appears to carry out glint and glare assessments for the majority of the solar developments proposed in the UK.
- 4.6.12 On page 6, the informal guidance states that '*Glint and glare can significantly affect nearby receptors under particular conditions. The key receptors with respect to glint and glare are residents in surrounding dwellings, road users, train infrastructure (including train drivers), and aviation infrastructure (including pilots and air traffic controllers)*'.
- 4.6.13 Para. 6.1 states, '*Local residents are a key stakeholder within the local environment when proposing a solar PV development. This is because residents will be living in close proximity to the*

²⁰ <https://www.pagerpower.com/wp-content/uploads/2022/09/Solar-Photovoltaic-Glint-and-Glare-Guidance-Fourth-Edition.pdf>

solar PV development whilst also potentially having views of the solar panels for its lifetime. Where a view of the solar panel exists, a solar reflection may be possible which may impact upon residential amenity'.

- 4.6.14 In the informal guidance, the recommended distances from the site for receptor assessment are given as follows:
- Dwellings and national / major roads: 1km
 - Train drivers: 500m
 - Pilots / air traffic controllers: 30km.
- 4.6.15 However, **no distances for users of PRowS and minor roads are provided, and effects on these receptors are not assessed.**
- 4.6.16 With regard to the 1km study area for receptors in dwellings in particular, in my opinion, it is not only arbitrary, but also highly unsatisfactory. Furthermore, neither the informal guidance nor the Applicant's glint and glare study justify the reason for it being limited to 1km.
- 4.6.17 Section 5.1.1 of the Applicant's glint and glare study simply explains that *'There is no formal guidance with regard to the maximum distance at which glint and glare should be assessed. From a technical perspective, there is no maximum distance for potential reflections. The significance of a reflection, however, decreases with distance because the proportion of an observer's field of vision that is taken up by the reflecting area diminishes as the separation distance increases. Terrain and shielding by vegetation are also more likely to obstruct an observer's view at longer distances. The above parameters and extensive experience over a significant number of glint and glare assessments undertaken show that consideration of receptors within 1km of panel areas is appropriate for glint and glare effects on roads and dwellings'.*
- 4.6.18 It is also very important to note that the 1km boundary does not factor in i) the size of the proposed development, nor ii) the elevation of the viewpoint.
- 4.6.19 As part of my research into this matter, I spoke to a few experts in glint and glare assessment in the USA and Australia. I was advised by one that **"the size of the solar farm has a direct effect on the glare impact.** *We use different study boundaries based on the size of the array (e.g., 500 m for small rooftop arrays, 2 km for small utility, 3-5 km for large utility), rather than a fixed limit for any size"* (my emphasis). This confirms my opinion that 'size matters'.
- 4.6.20 The informal guidance also notes – and my experience confirms – that depending on factors such as topography, and angle and elevation of the target and viewpoint, the adverse effects of glint and glare at public and private viewpoints can be experienced over long distances (note pilots are potentially affected at distances of up to **30km** from sites).
- 4.6.21 The informal guidance does not appear to state whether elevation and angle of view should be considered in the assessments, but that is a highly relevant factor. North Somerset Council's revised Solar Voltaic Arrays Supplementary Planning Document (SPD) states that *'Particular consideration should be given to the glint and glare impact on properties that are higher up a slope than the solar development, as the angles involved mean that these are most likely to experience any glint and glare effects created'.*
- 4.6.22 A study called *Visibility and Visual Characteristics of the Ivanpah Solar Electric Generating System Power Tower Facility* (March 2015), by Argonne National Laboratory²¹, assessed the visual effects of glint and glare arising from a large-scale complex comprising three 12m tall receiver towers, and multiple heliostats: *'Each heliostat consists of two mirrors that are 7.2 ft (2.1 m) wide by 10.5 ft (3.2 m) high, mounted on pylons inserted directly into the ground'* – a little taller than the solar panels proposed here. I note that in Appendix B of the Applicant's glint and glare study, on page 45, it is stated that *'A specular reflection [those made by most solar panels] has **a reflection characteristic similar to that of a mirror**'* (my emphasis).

²¹ https://blmwyomingvisual.anl.gov/docs/IvanpahVisibilityReport_Final.pdf

- 4.6.23 The *Visibility and Visual Characteristics* study Abstract states that 'Glare from individual heliostats was frequently visible, and often brighter than the reflected light from the receivers. **Helio­stat glare caused discomfort for one or more viewers at distances up to 20 mi [miles]** [c. 32km]' (my emphasis).
- 4.6.24 The image overleaf is extracted from a presentation called *Understanding and Mitigating Visual Glare Impacts and Hazards from Solar Energy Systems* Clifford K. Ho, Sandia National Laboratories, Concentrating Solar Technologies Dept., Albuquerque, New Mexico, which is from a viewpoint between 4 – 5 miles (6.5 and 8km) from the reflective elements (albeit the glint and glare characteristics of these technologies are different from those of solar arrays).

Looking north, 8:35 AM (PDT), March 23, 2015, ~4 - 5 miles away



- 4.6.25 Para. 6.14 of the informal glint and glare guidance notes that 'Solar panels produce solar reflections of similar intensity to those from still water or glass'.
- 4.6.26 In a GGS carried out for another solar development, Pager Power notes that 'The reflective properties of solar PV panels vary from different manufacturers. Whilst solar panels vary in their reflectivity with some claiming 'anti-glare' properties, **no solar panel absorbs 100% of the incoming light. Therefore, any solar PV panel has the potential to produce a solar reflection.** The relative absorptive properties of a solar panel should be considered on a case-by-case basis' (my emphasis).

Project-specific effects

- 4.6.27 In summary, the Applicant's GGS concluded (with my brief comments which are augmented below where relevant) that:
- i) 'A moderate [adverse] impact (considering the baseline scenario) is predicted on three sections of road due to the location of the reflecting panels relative to a road user's primary field of view, and the lack of sufficient mitigating factors.'
- However:
- a) The study only considers the effects of glint and glare along roads which are within 1km of the site, whereas the adverse effects of glint and glare are likely to extend much further than that.

- b) It only considers *major national, national, and regional roads* not local B and C-class / unclassified roads and lanes / BOATs.
 - c) The GGS only considers properties from which there is '*a potential view of the panels*'; '*Receptors are excluded if it is clear from the outset that no visibility would be possible*'; however, the GGS's judgements about potential visibility factor in existing and proposed screening vegetation which a) may not remain in place in future; b) may filter, but is unlikely to screen views all year round; and c) in the case of proposed planting, may not establish successfully.
 - ii) For dwellings (residential receptors), '*A moderate [adverse] impact is predicted on ten dwellings... due to the duration of effects, and the lack of sufficient mitigating factors. Assuming that the height of proposed hedgerow/tree planting along reflecting panel boundaries for these dwellings will be managed so that relevant reflecting areas are obscured from view, so that the impact would be reduced to low/none, no further mitigation is recommended*'.
 - a) The 1km study area boundary is also applied to residential receptors, but again, effects are likely to extent much further than that.
 - b) The GGS only considers properties from which there is '*a potential view of the panels*'; however, again, judgements about potential visibility factor in existing and proposed screening vegetation – see comments above.
 - iii) For railway receptors, '*a low [adverse] impact is therefore predicted, and mitigation is not recommended*'.
 - iv) For aviation receptors, '*No impacts are not predicted [sic] on aviation activity associated with Teesside International Airport because solar reflections are not geometrically possible towards [the identified targets]*'.
- 4.6.28 I cannot comment on effects on railway or aviation receptors, but assume the findings are correct. However, my own assessment concluded that there is the potential for glint and glare arising from the proposed development to give rise to significant adverse effects on visual, recreational, and residential amenity, and landscape character.
- 4.6.29 The 6th bullet point at para. 6.2 of the informal glint and glare guidance explains that '*In general, the geometry of the relationship between typical ground mounted solar panels and the movement of the Sun in the northern hemisphere means that dwellings due east and west of the panels are most likely to view a solar reflection for south facing arrays panels*'.
- 4.6.30 As explained above, the GGS did not assess effects on receptors in such locations using local B and C-class / unclassified roads and lanes, BOATs. This is problematic, because not only do people regularly drive along the local roads – they also walk, ride and cycle.
- 4.6.31 Given the proximity of road users to the site, and the fact that the existing screening vegetation cannot be guaranteed to remain in place (nor proposed screening to become effective), the receptors could experience **significant adverse** visual effects.
- 4.6.32 Nor did the GGS assess effects on people travelling along PRowS which cross the site / run in close proximity.
- 4.6.33 As a matter of fact, this matter is indirectly addressed on page 150 (paragraph numbering would have been helpful). Unfortunately, the GGS refers to an out-of-date version of NPS EN-3 (the March 2023 draft version): in November 2023, an updated draft was published, and the November 2023 version came into force (unchanged) in January 2024. The GGS is dated February 2024.
- 4.6.34 The GGS states that '*The [March 2023] EN-3 does not state which receptors should be considered as part of a quantitative glint and glare assessment. Based on Pager Power's extensive project experience, typical receptors include residential dwellings, road users, aviation infrastructure, and railway infrastructure*'. **That is incorrect:** draft EN-3 para. 3.10.149 stated that '*the potential impact*

*of glint and glare on nearby homes, **motorists, public rights of way**, and aviation infrastructure (including aircraft departure and arrival flight paths)' (my emphasis) should be assessed.*

- 4.6.35 Note that the above includes i) **all** motorists, not just those using '*major national, national, and regional roads*', and ii) PRoWs, along which receptors would be walking / riding / cycling. Ironically, that paragraph was included in the GGS (on page 151), but for some reason, in the context of '*mitigation strategies*'.
- 4.6.36 In the now-adopted January 2024 version of EN-3, the wording is exactly the same, but the paragraph number is 2.10.158.
- 4.6.37 Of course, had the study included receptors using PRoWs and the local roads / lanes, it would no doubt have assumed – as it has with residential receptors – that existing vegetation that currently screens views would remain in place for the duration of the operation, which of course, is highly unlikely. As noted above, even if proposed screening eventually became effective for some receptors (which would take many years and cannot be guaranteed), it would not be effective for all receptors partly due to it filtering as opposed to fully screening, and partly due to the elevation of the viewpoint.
- 4.6.38 Evidently, the problems associated with the proposed screen planting also apply to the GGS. Thus, many receptors are likely to experience far higher levels of adverse glint and glare effects than the study predicts.
- 4.6.39 Also as mentioned above, according to the *Understanding Emerging Impacts and Requirements Related to Utility-Scale Solar Development* study, '**Ocular damage from glare viewed at very short distances is possible**' (my emphasis), although it goes on to say that this is '*primarily a concern for workers because public access to facilities is controlled*'. However, in this case, some people would be walking adjacent / very close to the arrays. Evidently, for these and other near-distance receptors, the adverse glint and glare effects could be devastating.
- 4.6.40 Another important matter is that the glint and glare study does not mention heritage assets, and does not consider effects upon them; nor do glint and glare effects appear to have been factored in to the heritage assessment.
- 4.6.41 Again ironically, they are mentioned in the informal glint and glare guidance (para. 3.3), albeit only in the context of an extract from UK Planning Practice Guidance, 2015 Renewable and low carbon energy - *What are the particular planning considerations that relate to large scale ground-mounted solar photovoltaic Farms?*
- 4.6.42 This states, '*As the significance of a heritage asset derives not only from its physical presence, but also from its setting, careful consideration should be given to the impact of large scale solar farms on such assets. Depending on their scale, design and prominence, **a large scale solar farm within the setting of a heritage asset may cause substantial harm to the significance of the asset***' (my emphasis).
- 4.6.43 Furthermore, page 19 of the *Understanding Emerging Impacts and Requirements Related to Utility-Scale Solar Development* study report explains that '*with solar facility glare, there can be effects on... **historic sites***' (my emphasis).

4.7 Security Fencing

- 4.7.1 The Application includes security fencing.
- 4.7.2 High-security palisade fencing would be required to protect the proposed DNO substation complex. The substation is a 'truly' permanent feature, so the fencing would be a permanent fixture.
- 4.7.3 I could not find an illustration of this fencing in the Applicant's submission, but a typical example is illustrated in the photo overleaf.

Typical DNO substation complex fencing



- 4.7.4 Elsewhere – around the perimeter of the site, and the proposed buffer zones, and along public footpaths and bridleways – deer-proof security fencing is proposed.
- 4.7.5 Paras. 7.2.18 – 19 of ES 7.2 Design Approach Document state:
- 'Primarily required for safety and security purposes, the Applicant has proposed a perimeter security fence to be installed to safely enclose the operational areas of the Proposed Development.'*
- 'It is anticipated at this stage of the design that the proposed perimeter fencing would be a deer fence, with a maximum height of 2m. The maximum height of the proposed fencing has been determined partly due a reduction in the proposed height of the fixed solar panels now at a maximum of 3.5m, but also so that the proposed planting can adequately screen the perimeter fencing, reducing the visual impact of this element of the proposed Development.'*
- 4.7.6 The security fencing would remain in place for the lifetime of the scheme, albeit probably with repair / replacement at times, as required.
- 4.7.7 The Applicant's LVIA was carried out based on these assumptions, as was my own.
- 4.7.8 However, in my experience, it is highly likely that the fencing would have to be far more robust than post-and-wire in order to deter thieves and satisfy insurance requirements.
- 4.7.9 Currently, the matter of deer-proof vs high-security fencing at solar development sites is the subject of much debate, especially at inquiries and NSIP hearings. Therefore, I have carried out a great deal of independent research in order to inform my evidence, speaking to and / or communicating with a wide variety of organisations and individuals, from Police crime commissioners, DOCOs, and the National Rural Crime Network (NRCN), to planning officers, developers, consultants, contractors, landowners / managers, insurance companies, and people who have been affected by solar developments, especially in relation to matters such as solar fencing and crime, during both construction and operation.
- 4.7.10 I have also read several documents produced by, and letters / consultation responses to solar development applications from, DOCOs, and have communicated with / spoken to some of them, about the issues faced by the Police due to solar crime.

- 4.7.11 The crimes are apparently mainly solar panel theft (the deer-proof wire fencing is easy and quick to cut, with no specialist tools required – “*As useful as a chocolate fireguard*”, according to one DOCO), but also cable theft (for the copper), and occasionally, just wanton vandalism – some people try to break as many panels as they can by throwing stones at them. It is much more predominant in rural areas, as the activity often goes unnoticed, or the Police’s reaction to the automatic security alert takes a while, giving thieves more time to take what they want / vandals to cause damage.
- 4.7.12 In recent responses to planning applications for solar development, many DOCOs have said that the use of deer-proof fencing should be avoided, and have recommended the use of high-security fencing to a minimum of LPS 1175 level 3²².
- 4.7.13 This matter goes back some time. In an email dated 9th December 2022, the Northumbria Police DOCO was amongst the first DOCOs to comment on a solar development proposed in Northumberland (application ref. 22/03978/FUL) as follows:
- ‘Northumbria Police support the drive toward renewable energy sources but nationally there has been an increase in serious attacks directed at solar arrays, only last week there were three attacks on sites in four days in Nottinghamshire and Cambridgeshire, and in the former a security guard on a solar farm under construction was violently attacked. The National Infrastructure Crime Reduction Partnership (NICRP) and Opal, the national taskforce set up to combat Serious Organised Acquisitive Crime called on solar farm operators to review their security arrangements^[23], so it is worrying that this application doesn’t consider the crime risks.*
- ‘We have considered the risk profile of a number of solar arrays planned for the Northumbria Police Area and have determined that remote sites should be protected by perimeter security fencing specified to LPS 1175 issue 8.1 D15 fencing [explained further in the DOCO’s email, but see below].*
- ‘The rationale for this, particularly important for remoter sites, is that a standard fence may deter the casual more opportunistic criminal, but not an organised attacker, and detection by remote CCTV or Perimeter Intrusion Detection Systems might inform a monitoring station that an attack is in progress, but a response still has to travel to the site, so we need to delay an attack as long as possible’.*
- 4.7.14 I was not familiar with the ‘D-15’ security fencing specified by the DOCO, and couldn’t find much information about it online, so called a few security fencing manufacturers and suppliers, who told me that this type of fence was not yet manufactured or supplied in the UK. When I mentioned this to the DOCO, he said he was aware, but in his opinion, that level of security was necessary for solar developments, and therefore eventually, demand would be created (in fact, in subsequent responses, the DOCO has reduced the requirement to LPS 1175 issue 8.1:D10).
- 4.7.15 However, I did discover that the number in the D-rating (10, 15 etc) relates to the number of minutes it would take someone to cut through the fence (with the right equipment). Therefore,

²² LPS 1175 Level / Security Rating (SR) 3 is for ‘low commercial risk’, and can withstand up to 5 minutes’ attack; Level / SR4 is for ‘medium commercial risk’, with 10 minutes’ maximum attack time; and Level / SR5 is also 10 minutes but ‘based on a high commercial and mission-critical risk’. The Police argue that because solar crime is now highly organised, the higher levels should be used. It is a known fact that solar developments with deer-proof fencing are seen as ‘easy targets’. Some criminal gangs monitor planning applications, and find out when construction and operation are due to start on site (apparently, in some cases, workers are bussed in from cities, many of them being from Eastern Europe, which apparently, is where many panels and cables end up. The increase in this form of crime is thought to be due mainly to a) limited availability of such equipment in that part of the world due to the Russian invasion of Ukraine, and b) Brexit, which has made it harder to track such things). Thieves will sometimes strike when the construction plant and materials have been delivered to site, then wait for a while, go in again during construction, wait until operational, and go in once more. Another problem experienced by DOCOs is that vandals compete by throwing stones / bricks at the panels to see how many they can break, often pulling or cutting down the deer-proof fence if too tall to throw objects over.

²³ See for example <https://www.nicrp.org/news/2023/2/solar-farm-crime/>

if necessary, one could achieve the D15 security rating by putting a D10 and a D5 fence together (ie with the D10 as outer defence, and the D5 as inner).

- 4.7.16 In February 2023, a document called *Theft From Solar Farms* was published. It was written by Crime Intelligence, and Opal, the latter being the organisation mentioned in the DOCO's response above ie the 'Police unit for the United Kingdom developing intelligence to disrupt organised networks involved in acquisitive crime in partnership with the public / private sector'²⁴. A company called DeterTech was responsible for the production of the document²⁵.
- 4.7.17 The report explains that '*In recent years, solar cable has been the item that has been targeted most frequently, and in the last year the rate of cable thefts has shown an increase of 48% from 2021 to 2022 (though remains lower than the reported rate in 2020.) However, **thefts of solar panels have quadrupled from 2021 to 2022**. This increase in the last year has been driven in particular by the Worcestershire area, which has been heavily targeted by panel thieves. Given the context of the cost of living crisis, projected copper prices (which drives the rate of cable thefts) and an ambition of the UK government to potentially triple solar capacity by 2030, **it is highly likely that thefts from solar farms will become increasingly frequent**. It is therefore imperative that our understanding of crime on solar farms improves'* (my emphases).
- 4.7.18 It is interesting to note, however, that the report does not recommend – nor even mention – the use of high-security fencing, despite it being the most obvious solution to the problems (amongst other things, the report recommends '*regular (daily if possible) walks of the perimeter fence line to identify holes cut that could be a precursor to an upcoming theft*'. Where there are several kilometres' length of fencing on a site, as is the case here, that would surely be highly impractical).
- 4.7.19 In their response to an Examiner's question about the *Theft From Solar Farms* report at the Mallard Pass NSIP hearing, the applicant noted that '*DeterTech are a security consultancy business*' which '*will have an interest in the provision of security services*'.
- 4.7.20 Indeed, that is considered (for example, by DOCOs I have spoken to) to be one of the reasons why the report doesn't recommend high-security fencing. Another reason is likely to be the solar industry balking at the very large difference in cost between deer-proof and high-security fencing: on average, deer-proof fencing is c. £15 per linear metre supplied and installed, whereas 'moderate-level' LPS 1175 Level 3 fencing (as opposed to the D10 / D15 fences recommended by several DOCOs) is at least c. £300 per linear metre supplied and installed.
- 4.7.21 I have not yet been able to ascertain whether the local DOCO was consulted about, or responded to, this Application (I believe it would be Durham Constabulary), and if they have not been contacted, then perhaps they should be (I was unable to get through when I tried).
- 4.7.22 However, these days, DOCOs' responses to applications for utility-scale solar in rural areas are relatively standard. Typical examples include:
- '*I would strongly advise to **avoid the use of** what is described as '**Deer Fencing**', which is referred to in the DAS on this planning submission, as this does not provide any difficulty or deterrent to the criminal'* (author's emphases).
 - '*I would recommend that the boundary fence is to a minimum of LPS 1175 level 3 and to a height of 2.4 metres or to the current UK Government standard, SEAP (Security Equipment Approval Panel) class 1-3.'*
 - '*Landscaping techniques such as ditches and berms (bunds) may also be appropriate in some instances. To be effective in stopping vehicles these need to be designed carefully.'*

²⁴ <https://nbcc.police.uk/business-support/urban-dictionary/opal>

²⁵ DeterTech market the Smartwater 'traceable liquid' marking system, which is applied to equipment at risk of theft and which, according to their website, '*provides a legally irrefutable way to deter crime, identify assets and prosecute criminals*'. See <https://detertech.com/>

- 4.7.23 Regarding the latter point about bunds, the effects of such works / features should be assessed, as they could adversely affect biodiversity, character, views, and hydrology.
- 4.7.24 Both DOCOs and the *Theft From Solar Farms* report recommend extensive use of CCTV cameras; however, according to DOCOs I have spoken to, in some cases, monitored CCTV cameras end up being switched off due to the high running costs.
- 4.7.25 In addition to the above, I also discovered that some of the insurance companies which cover solar developments are now stating that they will not accept stock-proof fencing any more. One of the larger commercial insurers, Marsh Commercial²⁶, now has the following on its forms for solar development insurance applications (with my emphasis):

Security

• Ground Mount - Fencing in place of at least 1.8 m to 2m in height: Yes / No

Type of fence installed? (**Note stock fence is not adequate**).

Security Standard BS EN 1722?

- 4.7.26 Last year, a colleague spoke to a 'leading renewable energy insurance broker', and in an email, which I was forwarded later, said they were told that *"unless a new insurer is willing to risk deer fencing so as to gain market share, the trend now is for a deer fencing solar site to be refused insurance, or to be hit with an excess such as £100,000 if the deer fencing is breached by criminals. Instead of deer fencing, **most insurers now request the security fencing the DOCO recommends** because of the increasing crime risk. The bigger and more 'porous' the site, the bigger the risk, she said"* (my emphasis).
- 4.7.27 My colleague then spoke to a different insurance company, and in an email said, *"He confirmed that there are a decreasing number of companies who are willing to insure sites and no one will be allowed to just use deer fencing - even a small domestic site with a few ground mounted panels. They will need secure locked gates with bollards that sink into the ground. 24/7/365 CCTV monitoring... He was telling me about a theft from a site he dealt with where the whole infrastructure was found in the Ukraine"* (my emphasis).
- 4.7.28 I also spoke to several solar insurance companies, and finally, to the British Insurance Brokers Association (BIBA).
- 4.7.29 In summary, this time last year, the situation appeared to be that BIBA and many of their members are aware of the solar crime and security fencing problems, and there are moves in the industry to address them. However, their opinion is that progress is likely to be fairly slow.
- 4.7.30 In the meantime, some insurance companies would almost certainly continue to insure solar developments with deer-proof security fencing, although for how long is uncertain. My inquiries suggest that the smaller companies currently would, but the larger ones either would not, or may not.
- 4.7.31 This is a very important matter, not least because certainly, in terms of levels of landscape and visual effects, there is a significant difference between deer-proof fencing and high-security fencing, as shown in the following photographs. For example, as well as the industrialising / urbanising nature of the high-security fences, and their lack of transparency, they are also higher (the height of the proposed timber post and wire netting fencing would be 2m, whereas the minimum height of D10 fences is 2.8m).
- 4.7.32 Regarding transparency, some DOCOs recommend that *'where appropriate, security fencing systems are transparent to facilitate observation from outside the site'*²⁷. However, Nottinghamshire Police's response to this Application states: *"The development will need to have regard in both its design layout, and future maintenance plans for the retention of growth of*

²⁶ <https://www.marshcommercial.co.uk/for-business/renewable-energy-insurance/solar-panel-and-projects>

²⁷ Planning application ref DC/21/00060

vegetation on these important boundaries, including the opportunity for trees within the boundaries to grow on to maturity. The use of natural vegetation as a feature should not compromise the benefit of clear and unobstructed natural and formal (CCTV System) surveillance'.

- 4.7.33 The problem is that planting along fencelines, as in some cases is proposed here to screen views of the development / avoid the effects of glint and glare, would not allow the required transparency (although as shown in the following photos, the high-security fencing isn't particularly transparent, especially when viewed from oblique angles).

Deer-proof post-and-wire fencing at solar site in Worcestershire



Example of LPS 1175 level 3 security fencing from catalogue



Examples of D10 – D15 security fencing from catalogues



Example of SEAP Class 2 fence from catalogue



- 4.7.34 In my opinion, there is no doubt that if this type of security fencing was installed, it would give rise to very high levels of landscape and visual effects, which could not be satisfactorily mitigated.
- 4.7.35 As mentioned above, both the LVIA and my own assessment assessed the effects arising from deer-proof timber post and wire, not high-security fencing (apart from around the DNO substation). However, overleaf are computer-generated images (CGIs) which were produced for a group opposing a proposed solar development in Worcestershire.
- 4.7.36 The images show the proposed development with the recommended LPS 1175 Level 3 fencing in place (the images show the situation during Year 1 of operation, before mitigating measures such as planting had become effective).

CGIs of fenced public footpath corridors at proposed solar development



- 4.7.37 In addition, the change from deer-proof to high-security fencing would have adverse implications for wildlife.
- 4.7.38 Para. 7.2.20 of ES 7.2 Design Approach Document explains that *'the fencing would be installed in such a way that small animals and mammals such as badgers and hares would be able to navigate between and through the panel areas, and to allow the movement of large mammals such as deer through the landscape along the retained hedgerow margins between the fencing and the highway.'*
- 4.7.39 However, according to the manufacturers, suppliers and contractors I contacted, a) the high-security fences are concreted in and cannot have gaps along the bottom edge; and b) not only

would it be very difficult, time-consuming and costly to create mammal passes in the high-security fences, it also would almost certainly render the security rating invalid.

- 4.7.40 Furthermore, here, in some places, the proposed fencing would have to cross hedges and watercourses. Deer-proof fencing is quite flexible, in that at hedgerow crossings, to avoid removal of vegetation, a gap in the wire netting can be cut out to accommodate the hedge, or a section omitted, and watercourses can easily be 'bridged' by the fence without damage by using a wider span between upright posts. High-security fence panels are not flexible: they cannot be cut, and require excavation for concrete foundations.
- 4.7.41 Evidently, this work would adversely affect many ecological receptors, and the soil. Also, all the concrete would have to be removed during decommissioning.
- 4.7.42 Finally, another concern is that should the proposed development be granted consent, it would be approved on the basis of deer-proof fencing; however, potentially, an application could be made to change the specification to high-security fencing at a later stage.
- 4.7.43 This has already happened in the case of at least one scheme (albeit not an NSIP). In 2022, at a BESS development approved by Babergh and Mid Suffolk District Councils (BMSDC), and under construction (DC/19/01601), an application was made to BMSDC for '*a Non Material Amendment relating to DC/19/01601 - to amend the fence type from deer fence to V-mesh*' (DC/22/05018).
- 4.7.44 The reason for the upgrade was '*to increase security on site and protect the equipment*', and it was handled as a non-material change under delegated officer powers. According to local residents, no consultation was carried out. Unfortunately, it was only when the fencing was erected that it was realised that the V-mesh fence resulted in higher levels of adverse landscape and visual effects (see photograph of installed fence below). However, the type of fencing used has a lower security rating than is recommended by the Police for solar developments. It is not known whether mammal passes were a proposed ecological mitigation measure, and if so, whether / how they were created in the high-security fence.

LLPS 17 fencing at BESS site



- 4.7.45 I raised this specific matter at a solar appeal inquiry last year, and as a result, the parties drew up a condition to deal with the eventuality of a change in specification post-approval. The draft condition was worded as follows:

*'Notwithstanding any details submitted, no development (excluding demolition, tree protection works, groundworks/investigations) shall take place until details (including layout, materials, colour and finish) of [inter alia] fencing, boundary treatments and gates... shall have been submitted to and approved in writing by the Local Planning Authority... **The details submitted shall be accompanied by an assessment of landscape, visual and ecological effects**' (my emphasis).*

- 4.7.46 The emboldened part of the above draft condition was essential due to the very high levels of landscape, visual and other effects arising from high-security fencing.

4.8 Other Considerations

- 4.8.1 As well as those set out above, there are many other matters relating to the cause and nature of effects which are of concern, especially in terms of potentially significant adverse landscape, visual, and other landscape-related effects, and which are either a) covered in some detail in the Applicant's assessments, but the conclusions are based on flawed methods / assumptions; or b) not covered in sufficient detail (or at all) in the Applicant's submissions, nor in my own assessment.

- 4.8.2 Examples include (in no particular order):

- i) Both the means of connection from the proposed DNO substation in Area C to the main cable run that would connect the site to the main substation in Stockton, and the means of access from the highway to the Area C substation. The plans show what appears to be cabling and access along the same route between Bishopton Lane to the east and the substation, via an access track, along a field boundary, and then – peculiarly, but probably due to land-ownership constraints – all the way around the periphery of Square Wood to the substation. The DNO substation, cables and access points / routes are 'truly' permanent features, in that they would remain post-decommissioning. Is there a requirement for new pylons or poles to carry overhead cables at any point?
- ii) Effects arising along the proposed construction routes and at the proposed access points, on landscape and views, biodiversity, recreational and residential amenity, and other topics if relevant. Swept path analysis plans, and plans showing the required visibility plays showing where removal of trees and hedges, are required. Also, need to establish whether effective mitigation is possible to deal with the issue of potentially dangerous conflict between construction traffic and regular road users, which include people with children, the elderly, cyclists, and equestrians (some with horses which are highly-strung, unpredictable, and extremely sensitive to sudden 'surprises').
- iii) The fact that several visual receptors which my assessment concluded would be significantly adversely affected by the proposals were either not identified / included in the LVIA, or, in the case of residential receptors, the LVIA concluded that they would not be adversely affected by the proposals, for example, assuming that they did not have views over the site, when in fact, they would. A few residents hope that the ExA will consider views from their properties (and also, features such as ponds) during the accompanied site visit.
- iv) Various adverse effects on Bishopton Redmarshall Primary School pupils and staff arising from the very close proximity of the site to the school: not only during construction, interim works, and decommissioning, but also during operation, if there is a BESS thermal runaway event. Concern about the new school car park proposed as part of the proposed development, in terms of location and effects arising.
- v) The poor quality of the Applicant's visualisations / computer-generated images (CGIs), which do not provide an accurate indication of what the panels in particular would actually look like when factoring in light conditions and glare – see Appendix CT-D.
- vi) Bird hazard management:

- a) I am not certain whether Teesside International Airport has responded to the Application in this regard.
- b) It relates to the requirement (under the Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage Areas) Direction 2002) to consider the effects of proposed developments on aviation safety, where such development could attract birds.
- c) Consideration must be given to sites within a range of 13km from civil or military aerodromes; in this case, Teesside International Airport lies c. 6.5km from the site.
- d) Mitigation measures may include bird-scaring systems eg cannons, and regularly cutting back berrying hedges which attract birds (an example of a Bird Hazard Management Plan (BHMP) produced for a solar development in Nottinghamshire that proposes such measures can be found at the link in the footnote below²⁸).
- e) Evidently, this can have significant implications in terms of effects on ecology (and BNG calculations), visual amenity (especially where hedges are required for visual screening); and residential amenity (noise).
- f) I note that in its consultation response to the Whinfield House solar development application, Teesside International Airport raised aerodrome safeguarding objections, and requested the production and implementation of a BHMP to overcome them.
- g) The Whinfield House site lies c. 10.5km from the airport, 4km further than Byers Gill at its closest point, so it is likely that planes would be flying lower over Byers Gill as they depart from / arrive at the airport, so here, birds could pose a greater risk to aviation.

²⁸ https://planningon-line.rushcliffe.gov.uk/online-applications/files/5E4E1070D53B61C9E993FC03B438A779/pdf/22_02241_FUL-APPENDIX_2.3_BIRD_HAZARD_MANAGEMENT-1682939.pdf

5 Mitigation

- 5.1 LVIA para. 7.9.2 explains that *'effects of the Proposed Development are assessed considering embedded mitigation is in place'* – in other words, the layout of the proposed scheme was based on a preliminary assessment of landscape and visual effects, which resulted in primary mitigation measures such as buffer zones and screen planting being included in the plans.
- 5.2 Para. 7.9.3 states that *'Where further mitigation is deemed to be required as a result of potentially significant effects, this is termed essential mitigation and is set out as part of the assessment of effects in Section 7.10'* ('essential' mitigation is more often referred to as 'secondary' mitigation – see for example GLVIA3 para. 4.21). However, as far as I could ascertain, Section 7.10 concludes that no 'essential' mitigation is either 'required' or 'available' for any of the landscape and visual receptors identified, therefore levels of *'residual effects remain as outlined'*.
- 5.3 As explained in Section 3.2 above, the LVIA made several erroneous assumptions about mitigation and enhancement / benefit, which contributed to levels of magnitude of effect being underestimated / under-reported. An example is provided below, but in summary, the LVIA assumes that:
- i) Direct effects on landscape character resulting from the change from a greenfield site (in this case, rural / agricultural) to a developed site (in this case, for industrial use) can be mitigated: they cannot.
 - ii) Levels of effects on character are determined by the degree of visibility of those changes: that is not the case. Development / change affects character even if there are no public or private viewpoints from which the development / change is visible.
 - iii) Levels of adverse effects on landscape character can be reduced by screening views: they cannot. Screening only reduces levels of adverse effects on views. Levels of adverse visual effects can be reduced through measures such as screening / camouflage / visual / perceptual integration into the contextual landscape through appropriate planting etc.
 - iv) Measures which are proposed to mitigate adverse landscape and / or visual effects such as planting can be double-counted as landscape and / or visual enhancement / beneficial effect: they cannot (see below).
 - v) The planting proposed to screen views would be mature within 15 years of planting: that is not the case for woodland, and for hedges, depends on management regimes and other factors – see below.
 - vi) The existing and proposed planting would screen views all year round. However, in this part of the country, deciduous vegetation is leafless for at least half of the year, and unless very dense / containing a high percentage of evergreens, views are more likely to be filtered than screened.
 - vii) Once it had become effective, the existing and proposed planting would screen views for the duration of the operation: that is extremely unlikely – see below.
 - viii) The proposed landscape and visual mitigating measures would be characteristic / appropriate, and would not in themselves give rise to adverse landscape and visual effects. However, my own assessment found to the contrary: for example, there would be disruption of characteristic field patterns through the creation of new field boundaries on arbitrary lines, and double-hedged corridors along PROWs / new permissive paths; and not only would some of the planting be uncharacteristic in these landscapes, but also, it would screen, and thus result in the loss of, highly-valued views.

- 5.4 Effectively, because the LVIA has erroneously assumed that landscape / visual mitigating measures can be double-counted as landscape / visual enhancements, it has overestimated levels of beneficial effects, and underestimated levels of adverse effects.
- 5.5 LVIA para. 7.10.33 is one example of where some of the above problems occur, in particular, a) the erroneous assumption that levels of effects on landscape character can be reduced through visual screening, and b) that screen planting proposed to mitigate adverse effects on views can also be counted as enhancement / benefit (explained further below).
- 5.6 The paragraph is in the *Landscape and settlement character* section, under the heading *Effects during operation*. It states, '*... there would be frequent, close views resulting in a sense of proximity and ubiquity of the Proposed Development when travelling through the area, except within the southernmost part of the character area where visibility would be largely screened. The solar farm would become one of the key characteristics of this area, and would markedly alter the undeveloped character and be seen in most of the more open and elevated views, giving rise to Large and Medium scale changes to character within a Wide extent of the character area. These effects would be widespread but not ubiquitous, and in the lower-lying and more vegetated valleys and hedge-lined lanes, visibility of the solar panels would mostly be screened by hedges, trees or terrain and the character would be unaffected. Mitigation planting in this character area would include reinforcement, reinstatement and the addition of hedgerows and tree lines, which would be both in keeping with the character and a minor improvement to the landscape condition. Over time they would also reduce visibility of the solar PV modules in views across the character area, reducing effects to an Intermediate extent of the character area...*'.

Double-counting mitigation measures as enhancements

- 5.7 In LVIA / LVA, it is very important to understand the difference between mitigation and enhancement / benefit. If they are confused / conflated, there are likely to be adverse implications for judgements made about levels of landscape and / or visual effects.
- 5.8 GLVIA3 defines mitigation as '*measures which are proposed to prevent, reduce and where possible offset any significant adverse effects (or to avoid, reduce and if possible remedy identified effects)*', including landscape and visual effects' (para. 3.37).
- 5.9 It defines enhancement as measures which are '*not specifically related to mitigation of adverse landscape and visual effects but means any proposals that seek to improve the landscape and/or visual amenity of the proposed development site and its wider setting beyond its baseline condition*' (para. 3.39).
- 5.10 Unfortunately, the LVIA assumes that enhancements to landscape character would be derived from the screen planting which is proposed to reduce levels of adverse visual effects. In other words, it has double-counted visual mitigation measures as landscape enhancement measures. Yet it confirms throughout that the planting and management proposals are mitigation which is required to help screen views.
- 5.11 Also unfortunately, this is a common error in LVIA / LVA, as GLVIA3 para. 3.39 explains: '*Enhancement... is often referred to incorrectly as an outcome of proposed mitigation measures – for example where planting is proposed to mitigate landscape and/or visual effects but will also achieve an enhancement of the baseline condition of the landscape*'.
- 5.12 Indeed, in the recently-published LITGN-2024-01 *Notes and Clarifications on aspects of the 3rd Edition Guidelines on Landscape and Visual Impact Assessment* (GLVIA3, para. 4(2) states, '*Care should be taken to ensure landscape and visual mitigation is not confused. For example, it does not necessarily follow that screening a development from view would reduce its landscape effects, such as those on character*'.
- 5.13 Here, I would like to point out that **these errors appear in EN-1 and EN-3.**

- 5.14 EN-1 para. 5.10.5 states, '*Virtually all nationally significant energy infrastructure projects will have adverse effects on the landscape, but there may also be beneficial landscape character impacts arising from mitigation*'.
- 5.15 EN-3 para. 2.10.131 states, '*Applicants should consider the potential to mitigate landscape and visual impacts through, for example, screening with native hedges, trees and woodlands*'.
- 5.16 This was pointed out at the consultation stage but not addressed: I understand that the LI is looking into it.
- 5.17 Also very importantly, as explained above, it is not possible to mitigate the direct effects on character arising from the replacement of a greenfield site with a developed one.
- 5.18 Levels of other / indirect adverse effects on landscape character can be reduced by planting if it is appropriate / characteristic, for example to assist with the perception of integration into the receiving landscape. Landscape mitigation measures may also act as visual mitigation in the form of screening, for example, but either way, they are mitigation, not enhancement. Also, I understand that certain landscape and visual mitigation measures such as planting can be counted as biodiversity benefits, if appropriate.
- 5.19 This matter is important in decision-making, because it may be erroneously assumed that the benefits outweigh the harm.

Over-reliance on Vegetation to Screen Views

- 5.20 As explained previously, the problem with factoring in screening from existing and proposed vegetation at an early stage in the planning process is that over the lifetime of the proposed development (40 years' operation), it is highly likely that the baseline situation will change, with the loss of some vegetation, including mature woodlands, and the addition of other woods, trees and hedges.
- 5.21 This, combined with uncertainties about how long other vegetation such as hedges and tree belts would retain its current screening properties means that it is impossible to predict what the degree of screening by vegetation would be at any one point in time in the future.
- 5.22 In fact, these days, many practitioners including myself do not consider it safe, or best practice, to rely on vegetation to screen views in the longer term, since there is no guarantee that it will remain in place (or in the case of new planting, establish at all).
- 5.23 There are many reasons for this, including: soil type; temperature / climate change; water and nutrient availability; competition; maintenance and management regimes / quality of care; deliberate removal (authorised, for example forestry plantations, or unauthorised); accident; erosion, decline and death from intensive landuse / pollution; inappropriate species selection for situation; wrong planting specification / inadequate soil preparation; and pests / diseases / pathogens (Ash dieback is prevalent in this area, as confirmed at LVIA para. 7.7.19 and noted during my fieldwork, and Ash is a key existing screening element in this case, both on and off the site).
- 5.24 Notwithstanding the above, it is still necessary to factor existing vegetation in to visual assessments, but it is important to note the nature of the vegetation – for example, is it a large block of ancient woodland with an assumed high degree of permanence (subject of course to the above factors), or a dense coniferous forestry plantation which is mature and ready for felling, or a thin, overgrown hedge which may be cut back or removed at any time?
- 5.25 Another matter to factor in is plant growth rates. The LVIA assumes that by year 15, the proposed screen planting would be 'mature'; however, whilst it is possible that new hedges would have developed a degree of maturity by then (but see photos below), that does not apply to trees, which are also proposed to screen views.

- 5.26 The photographs below show screen planting at two different solar development sites, respectively c. five and eight years after planting. Also, here, the proposal is for hedges to be cut back regularly, to promote bushy growth (and potentially, to remove berrying material – see BHMP above).



- 5.27 Over-reliance on vegetation to screen views is likely to result in levels of adverse visual effects being underestimated.

Scheme Design

- 5.28 As well as the matters relating to mitigation above, there is also the question of whether additional mitigation, beyond that currently proposed could reduce levels of landscape and visual effects to more acceptable levels.
- 5.29 My assessment concluded that the majority of landscape and visual effects arising from the scheme as currently proposed could not be adequately mitigated, and as noted previously, the LVIA concludes that no 'essential' mitigation is either 'required' or 'available' for any of the landscape and visual receptors identified, therefore levels of *'residual effects remain as outlined'*.
- 5.30 In the ExQ1 table of questions, there are a few occasions where the ExA refers to mitigation and scheme design, in relation to landscape and visual effects.
- 5.31 For example, QLSV.1.7 notes the fact that LVIA 'Section 7.10 [para. 7.10.11] states that "no essential mitigation is available, beyond that already embedded in the Proposed Development". As a result, no essential mitigation measures have been proposed to reduce residual effects'. The ExA goes on to ask, 'Can the Applicant explain in more detail why no essential mitigation is available to reduce significant adverse effects on landscape and visual receptors...?'.
"no essential mitigation is available, beyond that already embedded in the Proposed Development". As a result, no essential mitigation measures have been proposed to reduce residual effects'. The ExA goes on to ask, 'Can the Applicant explain in more detail why no essential mitigation is available to reduce significant adverse effects on landscape and visual receptors...?'.
- 5.32 At QGCT.1.16, the ExA notes that 'Significant [adverse] effects have been identified by the Applicant, particularly Visual and Landscape effects', and asks, 'Considering the number of significant visual effects identified, can the Applicant please explain its design approach to the proposed development, why more detailed information than that provided in Chapter 3 of the ES was not submitted and if the Applicant believes that a separate Design Approach document might be of use in order to better inform the ExA in relation to the Applicant's approach on Design?' (this matter is also raised in the Landscape LIR, as noted above).
- 5.33 QDES.1.4 relates to consultation about the proposed scheme design. The ExA asks, 'Would the Applicant confirm if the Design Council or similar professional bodies have been consulted in terms of the review of the design of this development?'.
- 5.34 A Design Panel Review would be a very interesting exercise to carry out for this project; however, in my experience, it would be highly unusual for an applicant to consult professional design bodies about solar development proposals (such an exercise is not mentioned in the Applicant's Design Approach report (ES 7.2)), mainly because there is little or no opportunity to influence or change the design of the scheme elements themselves (panels, inverters, substations and so on), as they are supplied ready-made at scale, to industry standards.
- 5.35 Indeed, this is recognised at para. 4.7.6 of NPS EN-1, which states, 'Whilst the applicant may not have any or very limited choice in the physical appearance of some energy infrastructure, there may be opportunities for the applicant to demonstrate good design in terms of siting relative to existing landscape character, land form and vegetation'.
- 5.36 EN-1 para. 4.7.6 goes on to say, 'Furthermore, the design and sensitive use of materials in any associated development such as electricity substations will assist in ensuring that such development contributes to the quality of the area'; however, in the case of DNO substations and associated infrastructure / elements, there is usually even less potential for design flexibility, as normally, DNO substations are designed and built by Independent Connection Providers (IPCs) on behalf of the DNO, to their specification.
- 5.37 In the case of the Boreas Vanguard wind farm on-shore substation NSIP, the buildings were very large and difficult to screen. As the buildings' forms were use-driven, so flexibility in that regard was limited, the visual mitigation proposals focussed mainly on trying to reduce the perception of scale, and visually integrating the buildings into the landscape, for example through reprofiling the flat roofs; the introduction of design-breaks; selection of materials and colours; landform modelling; and planting.
- 5.38 In terms of this proposed development, in my opinion, the issue is not so much about design quality as about mitigation.

- 5.39 Here, it is very important to reiterate that it is not possible to mitigate the direct effects on landscape character that occur with the replacement of an undeveloped site with development – in this case, from rural / agricultural to industrial.
- 5.40 Also, that levels of adverse effects on character cannot be reduced through screen planting, only levels of visual effects.
- 5.41 Also importantly, the direct effects of the proposed development on character are not limited to the places where the required access tracks, built infrastructure, panels and other elements would be located / sited.
- 5.42 In fact, this matter was dealt with by Fordham J. in what has become known as ‘the Galloway Judgement’²⁹. He said, *‘In one sense, if you add up the widths of all the rows of panels, half of this one-acre field is “occupied” by solar panels. In another sense, the whole one-acre field is “occupied” by solar panels. The whole field is what the solar farm “requires”. If you looked at this field, in the countryside, it would look like a field full of solar panels. On a straightforward reading, it seems that Draft EN-3 §2.47.2 (§15 above) was speaking of this as an acre of solar panels, because it was describing the acreage which the solar farm “requires” for the solar panels’.*
- 5.43 It may be possible to reduce levels of some of the adverse effects on character and visual / recreational / residential amenity by adjusting the siting and layout of the scheme. I assume that any such adjustments would have to be within the Order limits, but consideration could be given to measures such as removing and / or relocating certain fields / panel areas.
- 5.44 However, a) I doubt that making material adjustments to siting / layout (and potentially, design), would be a straightforward or rapid exercise, and b) it is unlikely that this exercise would result in levels of all effects being made ‘acceptable’: many would remain significant adverse.
- 5.45 Whilst stakeholder / public consultation may result in one or more preferred options being put forward (in my opinion, given their intimate knowledge of the area, it is very important that local residents were fully involved in the process), there would inevitably be a difference in approach between options which entail a) the removal of certain parts of the site currently proposed for development, thus reducing the amount of land covered by panels and associated infrastructure; and b) maintaining the amount of land covered by panels / infrastructure, but relocating the panels / infrastructure to parts of the site where they are not currently proposed.
- 5.46 It seems likely that for some receptors at least, removal of parts of the panel-covered land should result in a reduction in levels of adverse effects. However, if panel-covered areas were to be relocated elsewhere on the site, the Applicant would need to factor in the technical requirements / constraints relating to the location of the infrastructure, panels, cables, access and so on, and potentially, assess the environmental effects arising from the proposed adjustment, and / or update other studies / assessments.

²⁹ The King (on the application of Ian Galloway) Claimant and Durham County Council Defendant and Lightsource SPV 215 Limited Interested Party [2024] EWHC 367 (Admin) Case Nos: AC-2023-LDS-000229 and AC-2023-LDS-000290.

6 Effects on Landscape Character

- 6.1 As mentioned previously, it is hoped that agreement can be reached between the parties about levels of effects on landscape character being 'significant' throughout the project's lifetime, and that there is no need to analyse / interrogate this conclusion further; therefore, for conciseness, I have not written up the findings of my review and assessment relating to effects on character in full; rather, I have summarised the most relevant points in this report, to justify my conclusions about the LVIA review, effects, and matters agreed / not agreed. If necessary, I will draw on my full notes and hand-drawn plans during the Examination, to inform any questions and / or responses.
- 6.2 GLVIA3 explains that the process for establishing overall levels of effects on character (and views) is to combine the level of receptor sensitivity and the level of magnitude of effect (so for example, High sensitivity + Low magnitude = Moderate overall level of effect). As mentioned in Section 3.2, the LVIA should then go on to state whether or not the overall level of effect is 'significant', based on a given significance threshold.
- 6.3 The reasons and justifications for my judgements and conclusions about the overall levels of effects on character are set out in the previous sections.
- 6.4 Before reporting overall levels of effects, there is one part of the LVIA's character effects assessment (LVIA Section 10) which I am not clear about, relating to how levels of effects on the character of the site were assessed.
- 6.5 Firstly, the LVIA reports effects on the 'landscape fabric' of the site (explained further in Section 3.2 above). Para. 7.10.7 states that *'The landscape fabric of the Panel Areas and substation site consists of a mix of arable and pasture fields, typically of medium scale and separated by hedgerows'*.
- 6.6 Para. 7.10.10 concludes that the loss of fabric during construction *'would result in some localised adverse effects which would not be significant'*.
- 6.7 Para. 7.10.12 concludes that during operation, *'Effects on landscape fabric... would not be significant. They would consist of the continued presence of the solar farm, increasing maturity of the proposed hedgerow and tree planting, along with the continued maintenance of the grassland within the panel areas'*. Para. 7.10.12 goes on to say that *'There would be localised non-significant positive effects on the landscape fabric as a result of the hedgerow and tree planting'*.
- 6.8 The first point to make is that the latter part of 7.10.12 is an example of the LVIA having double-counted mitigation as enhancement: the hedgerow and tree planting are mitigating measures proposed to screen views, so do not result in beneficial effects on character.
- 6.9 The second is that the first part of para. 7.10.12 seems to suggest that effects on the overall character and qualities of the site are being considered here, as opposed to just the very limited range of elements (or 'fabric') identified in the LVIA. Yet there is no analysis of the aspects of character which should be factored in (GLVIA3 para. 5.4 includes physical influences such as geology, soils, and hydrology; different types of vegetation; landscape patterns; historic landuses; aesthetic and perceptual aspects; and overall character – ie how all these combine).
- 6.10 The direct effects of the development on the site are not assessed in the LVIA, in terms of the change from rural / agricultural to industrial which, as explained in previous sections, cannot be mitigated. Nor are indirect effects on the site assessed.
- 6.11 Under the heading *Landscape and Settlement Character*, LVIA para. 7.10.27 explains that this section sets out *'Effects for receptors which would be significantly affected at any stage of the Proposed Development, effects for host landscape character areas, and effects on the character of the three settlements requested by Darlington Borough Council (Brafferton, Great Stainton and Bishopston)'*.

- 6.12 However, effects are reported for the whole character area, not the site. For example, para. 7.10 33 notes that during operation, *'Panel Areas A, B, C and D would physically occupy an Intermediate extent of [host character area Darlington: 6 Great Stainton Farmland], and there would be frequent, close views resulting in a sense of proximity and ubiquity of the Proposed Development when travelling through the area, except within the southernmost part of the character area where visibility would be largely screened. The solar farm would become one of the key characteristics of this area, and would markedly alter the undeveloped character and be seen in most of the more open and elevated views, giving rise to Large and Medium scale changes to character within a Wide extent of the character area'*.
- 6.13 Note the erroneous assumption that effects on landscape character are reduced through visual screening, which, as explained previously, is not the case.
- 6.14 LVIA para. 7.13.1 concludes that *'Significant [adverse] effects would arise during operation on Darlington LCA 6 Great Stainton Farmland which would host Panel Areas A to D'*.
- 6.15 Therefore, there would be **direct significant adverse effects on the character of the site**.
- 6.16 It must also be assumed that the overall level of direct effect on the site is higher than the level of indirect effect on the host character area beyond the site. The LVIA concludes that levels of indirect operational effects on Darlington: 6 Great Stainton Farmland would be **Major – Moderate Adverse** (significant). Therefore, the level of direct effect on this part of the site would be **at least between Major – Moderate and Major Adverse**.
- 6.17 In fact, this aligns with the findings of my own assessment.
- 6.18 I concluded that the site's level of landscape sensitivity is at least between Medium and High (based on the LVIA's criteria) (see Section 3.2).
- 6.19 Using the LVIA's criteria for levels of magnitude of effect in Plate 7-1 under para. 7.4.6 (which I found to be unsatisfactory – see those I normally use in Table 5, Appendix CT-A) I concluded that the level of magnitude would be Substantial.
- 6.20 According to the matrix in LVIA Table 7-4, the combination of a Medium – High sensitivity receptor and a Substantial level of magnitude results in a level of direct effect of **between Major – Moderate and Major Adverse**.
- 6.21 Normally, levels of indirect landscape effects reduce gradually with distance, to the point where there is no further influence / association between the site and the wider landscape, although there may be abrupt drops in levels where interinfluence / association ceases, for example, at a mountain range, or an estuary.

Effects On Other Aspects of Landscape Character

- 6.22 Many LVIAs only consider effects on the landscape's physical elements and features, its key landscape characteristics, and views.
- 6.23 Very few consider landscape and visual function, or social, recreational and residential amenity. None that I have reviewed have ever considered that some visual receptors may be blind. Thus, unfortunately, effects on the other senses tend to be excluded.
- 6.24 My own assessments consider function and amenity in the landscape character sections. They also consider what are called 'experiential' landscape qualities / aspects, and how they may be affected (see for example GLVIA3 Box 5.1, which explains that 'scenic quality' *'is a term used to describe landscapes that appeal primarily to the senses (primarily, but not wholly the visual senses)'*, and various references in LI TGN 02/21).
- 6.25 That includes sounds, noise / lack of it, tranquillity, sense of remoteness, smells, and other experiences, along with a general awareness of what is going on in terms of existing and proposed developments, their nature, and their scale. Journeys can be adversely affected, for example whilst travelling around during construction.

- 6.26 Regarding amenity, my understanding is that *'When planning permission is rejected on the grounds of loss of amenity, it means the proposed development will harm the amenity of another property, through the noise, overlooking, overshadowing, smells, light pollution, loss of daylight, loss of privacy, dust, vibration or late night activities. The planning authorities **must** support sustainable development. For this reason, **when a proposed development poses a risk of loss of amenity of any type, the application is likely to be rejected**'* (my emphases)³⁰.
- 6.27 EN-1 para. 5.6.3 states that *'For energy NSIPs of the type covered by this NPS, some impact on amenity for local communities is likely to be unavoidable. The aim should be to keep impacts to a minimum, and at a level that is acceptable'*.
- 6.28 NPPF paragraph 163 b) says that *'applications for renewable and low carbon development should be approved if its impacts are (or can be made) acceptable'*.
- 6.29 In this case, the majority of the significant adverse landscape and visual effects are not, and could not be made, acceptable, and would remain significant for the 40-year duration of the operation – for many, that would be a lifetime.
- 6.30 Some effects would or could be 'truly' permanent, not just scheme elements such as the proposed DNO substation complex, but also, damage to buried heritage assets and soils, and loss of vegetation.
- 6.31 A dictionary definition of 'amenity' generally, which is helpful in the context of planning / assessment, is *'The quality or character of an area and elements that contribute to the overall enjoyment of an area'*.
- 6.32 Visual amenity is defined in GLVIA3 as *'the overall pleasantness of the views [people] enjoy of their surroundings'*.
- 6.33 Residential amenity is not defined in law, but can be defined as *'Elements that are particularly relevant to the living conditions of a dwelling'*.
- 6.34 *'Residential amenity has a significant and valuable impact on the way in which people use their homes. The health and well-being of residents is often directly related to the level of residential amenity occupants can enjoy. It is a duty of the planning system to support sustainable development. Sustainable development incorporates a social role which seeks to secure well-designed, strong, vibrant and healthy communities'*³¹.
- 6.35 Matters to be considered when assessing effects on residential amenity include loss of privacy, overlooking, overshadowing, loss of daylight, lighting, late-night / early-morning activities, movement, disturbance, disruption, noise, vibration, odours, dust, flooding, pollution, and a general awareness of what is going on.
- 6.36 Visual amenity is a component of residential amenity, usually called Residential Visual Amenity. This means *'the overall quality, experience and nature of views and outlook available to occupants of residential properties, including views from gardens and domestic curtilage'*³². Residential Visual Amenity Assessments (RVAA) are 'objective tests', often carried out alongside LVIA's / LVAs, and one has been carried out for the proposed development (see ES Appendix 7.6).
- 6.37 In the Applicant's LVIA, para. 7.4.15 explains that *'As set out within Landscape Institute Technical Guidance Note 02/19 Residential Visual Amenity Assessment (RVAA) [24]: "Changes in views and visual amenity are considered in the planning process. In respect of private views and visual amenity, it is widely known that, no one has 'a right to a view.'"*
- 6.38 In fact, 'no right to a view' is a principle in English law, that was first recorded in 1610. However, planning policy can and does protect certain views.

³⁰ www.nortontaylornunn.co.uk/faq-items/what-is-amenity-in-planning-terms

³¹ Technical Advice Note: Assessing Residential Amenity June 2016 South Gloucestershire Council

³² Landscape Institute Residential Visual Amenity Assessment (RVAA) TGN 2/19 15 March 2019

- 6.39 Para. 7.4.15 goes on to say that *'It is not uncommon for significant adverse effects on views and visual amenity to be experienced by people at their place of residence as a result of introducing a new development into the landscape. In itself this does not necessarily cause particular planning concern. However, there are situations where the effect on the outlook / visual amenity of a residential property is so great that it is not generally considered to be in the public interest to permit such conditions to occur where they did not exist before.'*
- 6.40 Indeed, *'There comes a point when, **by virtue of the proximity, size and scale of a given development, a residential property would be rendered so unattractive a place to live that planning permission should be refused.** The test of what would be unacceptably unattractive should be an objective test'* (my emphasis).³³
- 6.41 Glint and glare effects are dealt with in Section 4.6, but of relevance here is that para. 6.1 of the (informal) glint and glare guidance used by the Applicant states that *'Local residents are a key stakeholder within the local environment when proposing a solar PV development. This is because residents will be living in close proximity to the solar PV development whilst also potentially having views of the solar panels for its lifetime. **Where a view of the solar panel exists, a solar reflection may be possible which may impact upon residential amenity**'* (my emphases).
- 6.42 I visited several residential properties, and their gardens / grounds, which are adjacent to or in proximity to the site, at various locations. There is no doubt that for many, significant adverse effects on their residential amenity would be experienced throughout the project's lifetime.
- 6.43 My assessments also consider effects on people's health and well-being generally (which occasionally includes safety, for example along construction routes), and the quality of their lives.
- 6.44 As noted above, effects on the health, well-being and quality of life of residents in their homes / gardens is an important consideration in planning and assessment, but so is the health, well-being and quality of life of people who use the landscapes beyond their homes as a valuable resource for recreational and social amenity. In this case, effects on the landscape and visual resource, and its functions, are a major concern for the affected communities, and those who visit them to enjoy their special qualities.
- 6.45 In fact, health, well-being and quality of life are integral to 'landscape', as well as to assessments of landscape and visual effects. EN-1 mentions the importance of schemes, such as the one proposed, protecting and enhancing human health, well-being, and the quality of people's lives. GLVIA3 Figure 1 shows examples of LVIA 'discussion areas', which under the heading 'human beings', includes *social impacts*.
- 6.46 Furthermore, the importance of the above issues is made abundantly clear in the LI's policy on public health³⁴, and associated position statement *Public Health and Landscape: creating healthy places*.
- 6.47 The policy states, *'We want public health professionals, planners and landscape architects to promote and act upon the idea that high quality landscape increases wellbeing'*.
- 6.48 Both the policy and the position statement are derived from the European Landscape Convention (ELC), which states (my emphases):

*'Signatories acknowledge that **the landscape is an important part of the quality of life for people everywhere:** in urban areas and in the countryside, in degraded areas as well as in areas of high quality, in areas recognised as being of outstanding beauty as well as everyday areas' and that **'the landscape is a key element of individual and social well-being.'***

*'The landscape also bears within it a system of **social values**, which sometimes have to be highlighted through awareness-raising activities. **The landscape's social values are tied to its importance for quality of life, health, and to its contribution to the creation of local cultures.***

³³ Burnthouse Farm Windfarm, SoS Decision (APP/D0515/A/10/2123739) 6th July 2011

³⁴ <https://www.landscapeinstitute.org/policy/health/>

Landscape identification, characterisation and assessment underlie landscape quality objectives. This is why such assessment should be done with the interested parties and population concerned, and not just with specialists in landscape appraisal and operations'.

- 6.49 NPPF para. 191 requires decisions to a) '*... avoid noise giving rise to significant adverse impacts on **health and the quality of life**; [and] b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are **prized for their recreational and amenity value** for this reason'* (my emphases).
- 6.50 Other references to 'amenity' and well-being in the NPPF (with my emphases) include:
- '*protect **local amenity** or **the well-being of the area***' (para. 53 b), re Article 4 direction);
 - '*developments should create places that are safe, inclusive and accessible and which promote health and well-being, with a high standard of amenity for existing and future users*' (para. 135 f));
 - '**Amenity value**' of land (para. 181);
 - '*Open space... can act as a **visual amenity***' (Annex 2: Glossary).
- 6.51 My assessment concluded that as well as visual amenity, the proposed development would give rise to **significant adverse** effects on recreational, social, and residential amenity.
- 6.52 There are many general and specific aspects of the scheme that give rise to concern in terms of these amenities above, but examples include a) the proposed long-term closure / diversion of PRoWs, and the creation of permissive paths, which would disrupt long-used historical routes for a generation or more; and b) effects on the very active equestrian community in the area, which uses the PRoWs, lanes, and other open spaces, to exercise horses and participate in organised / informal equestrian events.
- 6.53 Regarding the latter, I understand that there are eleven liveries in Bishopton alone, along with many private stables there and elsewhere. Many types of horseculture are evident, from high-class dressage to horse-rescue centres, and there are opportunities for riders of all abilities and ages to participate, from beginners to experts.
- 6.54 Adverse effects on equestrian amenity resulting from the proposed development, at all stages of its lifetime, could potentially have knock-on adverse economic effects on these and other local businesses to which the high-quality landscape resource makes an important contribution.
- 6.55 As mentioned previously, it is not just local residents who enjoy using the various recreational resources: the area also attracts many visitors. For example, as noted in Section 4, parts of the proposed construction routes to Area A coincide with the route of 'one of the best walks in Britain', featured in the Ordnance Survey's publication *The Best Walks in Britain*.
- 6.56 The walking route is called 'Brafferton to Ketton Country'. It is a c. 12km-long loop walk through open countryside east of Brafferton, visiting historic features such as Grade II listed Ketton Hall, which according to the listing entry, is '*The home of renowned cattle breeder Charles Colling the Younger (1750-1836) who bred the famous "Ketton Ox" (1796-1807)*'.
- 6.57 If starting in Brafferton and heading east, one walks along High House Lane, which is the proposed construction route leading to access to the south-western part of Area A North (see Section 4.2), and continues along High House Lane track, between Areas A North and South.
- 6.58 One then follows various PRoWs through and along the edges of fields, zig-zagging south east and south west before turning north along the BOAT that leads back to Brafferton. Along the way, the route runs along the eastern end of Area A South; crosses the proposed cable route (twice); runs along part of the western edge of Area C; and the south-western end of Area A South.
- 6.59 Evidently, people walking along sections of the Brafferton to Ketton Country Walk would experience significant adverse visual and sensory effects throughout the project's lifetime, and sequentially along the whole route.

- 6.60 As well as the above, I would like to highlight another critical aspect of the proposals relating to the use of PRoWs and permissive paths which could potentially be overlooked.
- 6.61 Parts of the site where panels and infrastructure are proposed are crossed by PRoWs. Where these are to be retained, the corridors would be fenced and hedged, many on both sides. Notwithstanding the adverse effects of this on character, views, and recreational amenity generally, there is also great concern about conflict between / the safety of people using bridleways, at all stages of the scheme.
- 6.62 Bridleways are used by pedestrians, equestrians, and cyclists. On solar sites, they are sometimes used by deer and other large creatures which can't / don't want to use the mammal passes created in the fence.
- 6.63 Whilst cyclists can cause accidents along bridleways by going too fast and colliding with other users, who may not have heard them coming (some may be deaf / hard of hearing), the main problem is horses, which are highly unpredictable.
- 6.64 Horses can be reluctant to go along enclosed, narrow corridors, or may get part way along and refuse to go further. Even during operation when there is no activity on the site, they may be spooked by the noise of inverters / substations; glint / glare; other animals (eg rabbits, sheep, deer, and dogs); people walking / cycling along the path; and / or other horses. If the horse is spooked, or bolts, there is very little room for other path users to move out of the way.
- 6.65 Finally, it is important to consider the risks of the enclosed fenced corridors to personal safety and security.
- 6.66 I was advising a group objecting to a proposed solar development in Worcestershire³⁵. In a letter dated the 10th of November 2021, the Parish Clerk wrote to the LPA on behalf of '*three parishioners who have asked for anonymous representation in responding to this planning application*'. The letter went on to say that '*As Parish Clerk I have brought these residents together in this response so that they can share their experiences and material concerns with District Councillors*'.
- 6.67 The letter explained that the three parishioners used the local footpaths on a daily basis, and all had specific and very sound reasons for not wishing to find themselves trapped within a fenced corridor along the footpaths, for example, due to the threat of pursuit / violence from known parties.
- 6.68 The Clerk explained that the parishioners' opinion is that there was a '*lack of any consideration of public safety and well being in the sense that this application creates an **inescapable corridor** along an existing right of way that was previously open to the wider countryside. The route as it currently exists provides users under threat with numerous options for escape and means of drawing attention in the event of an emergency. This is not the case if the current solar farm layout and design is carried out*' (my emphasis).
- 6.69 It is not clear how such risks could be designed out.

³⁵ LPA ref 21/01846/FUL (refused), PINS ref APP/J1860/W/23/3325112 (appeal dismissed)

7 Effects on Views & Visual Amenity

- 7.1 Both the Applicant's LVIA and my own assessment concluded that for many visual receptors, levels of visual effects would be 'significant' adverse throughout the project lifetime (see LVIA Table 7-12 Landscape and Visual impact assessment summary – Receptors receiving significant effects).
- 7.2 As with landscape effects, it is hoped that the parties can agree about this at an early stage, thus reducing the amount of work involved.
- 7.3 Given this project's nature and very large scale, the visual effects assessment process is complex, involving numerous viewpoints and view routes; consideration of each receptor and establishing the level of visual value and their susceptibility; making judgements about levels of magnitude of effect for each receptor at each viewpoint, factoring in mitigation and other matters; and, once the overall level of effect has been established, deciding whether or not the effect is 'significant'. Also, the assessment has to consider levels of visual effects during construction, operation, interim works, and decommissioning.
- 7.4 Thus, whilst there may not be agreement between the parties about the specifics in terms of levels of visual value, susceptibility, magnitude, and overall level of residual effect at each viewpoint (and it is probably unlikely that there would be agreement on all of them), it would surely save a great deal of Examination time if early on, agreement could be reached that on-site receptors and those within a certain distance would experience significant adverse residual visual effects for the lifetime of the project, and that broadly, levels of visual effects would reduce gradually with distance, unless intervisibility between the developed site and the wider landscape ceased abruptly, for example, along an upstanding ridgeline.
- 7.5 If it is not possible to reach agreement, then if necessary, I can provide the detailed findings of my visual effects assessment and that part of my LVIA review. Perhaps a Scott schedule could be produced and completed by all stakeholders who have expressed opinions about visual effects.
- 7.6 Also, it must be borne in mind that effects on their visual and other amenity are amongst the local communities' main concerns, and therefore they may wish to discuss / respond to these matters during the Examination, and some may appreciate it if, during the Accompanied Site Inspection (ASI), the ExA could visit a few private properties and look at the views of the site.

8 Cumulative Effects

- 8.1 As with landscape and visual effects, it is hoped that the parties can agree about this matter at an early stage, therefore I have not written up my cumulative assessment and review findings.
- 8.2 Given that on its own, the proposed development would give rise to extensive significant adverse landscape, visual and other effects, in my opinion there can be no doubt that in combination with all the other existing and proposed solar developments within the rural parts of the study area, along with proposed projects of a similar industrialising nature and scale, the inter-project cumulative landscape, visual, and many other effects would be significant adverse, and extensive / widespread.
- 8.3 One of the most important matters to consider here are the adverse cumulative effects on the landscape's multitude of highly-valued functions.
- 8.4 For example, taking an overview of the potential situation in the wider landscape context, it becomes clear that the green rural open gap between Darlington, Newton Aycliffe and Stockton is under threat of partial coalescence resulting from the insertion of an industrial corridor through its heart.
- 8.5 Para. 2.13 of BVAG's May 2024 Relevant Representation report is as relevant to cumulative effects as it is to the effects arising from the proposed development in isolation:
- 'The transformation of open countryside to an alien, industrial landscape would stretch over 30 miles between Darlington, and Newton Aycliffe, to Stockton, surrounding and dominating communities and villages which have been within their rural settings for centuries, and evolved with deep historical significance. This rural characteristic remains important to people's lives even more today. The application has failed to understand the perception and experience of the local community, and the major adverse impact on the health and wellbeing of the affected communities represented here.'*
- 8.6 Another important matter for consideration is intra-project cumulative effects.
- 8.7 In particular, on their own, some effects may not be categorised as 'significant'; however, if such effects accumulate, in combination they may well become 'significant'.

9 Conclusions

- 9.1 My assessment and review concluded that the proposed Byers Gill solar development would give rise to **significant adverse** landscape and visual effects, the majority of which could not be adequately mitigated.
- 9.2 NPPF paragraph 163 b) says that '*applications for renewable and low carbon development should be approved if its impacts are (or can be made) acceptable*'.
- 9.3 In this case, the majority of the significant adverse landscape and visual effects are not, and could not be made, acceptable, and would remain significant adverse for the 40-year duration of the operation – for many, that would be a lifetime.
- 9.4 Some effects would or could be 'truly' permanent, not just scheme elements such as the proposed DNO substation complex, but also, damage to buried heritage assets and soils, and loss of vegetation.
- 9.5 Not only would some of the levels of adverse landscape and visual effects be at the very highest level and permanent, but they would also extend over a vast area.
- 9.6 The site covers c. 490ha, and stretches some 12km from west to east, and 2.7km from north to south, in the triangle of land between Darlington, Newton Aycliffe, and Stockton-on-Tees.
- 9.7 Once the busy urban areas are left behind, the area very quickly becomes deeply rural, characterised by scenically-beautiful, sparsely-settled, working agricultural landscapes of arable and pasture, interspersed with woodland, watercourses, historic features, and historic villages linked by narrow, winding lanes. Here, levels of tranquillity are surprisingly high, with no disturbance: often, the only sounds are skylarks singing and the wind blowing across the fields.
- 9.8 In fact, it is not easy to fully comprehend the magnitude of size and scale of the proposal, especially relative to its wider context, and how much land it would cover. This is best established by travelling around by car / on foot, but by way of comparison, I calculated that the site could accommodate the nearby large urban residential settlement of Newton Aycliffe, which has a population of around 27,000.
- 9.9 Also, the proposed development must be considered in combination with other existing and proposed solar developments and similar large-scale projects nearby, some of which have already industrialised / urbanised parts of the area, and will no doubt continue to do so.
- 9.10 Importantly, the increase in such development, which includes housing, results in ever-more pressure being put on ever-decreasing landscape resources, meaning that the resources become even more valuable, and more vulnerable to change.
- 9.11 Naturally, the proposals for the Byers Gill application in particular have caused not only concern, but also great anxiety amongst local residents. My assessment concluded that these concerns and anxieties are not unfounded, or based on speculation: on the contrary, they are based on evidence and fact.
- 9.12 The government's Planning Practice Guidance (PPG) says, '*The National Planning Policy Framework explains that all communities have a responsibility to help increase the use and supply of green energy, but this does not mean that the need for renewable energy automatically overrides environmental protections and the planning concerns of local communities. As with other types of development, it is important that the planning concerns of local communities are properly heard in matters that directly affect them.*'
- 9.13 Members of the local communities have clearly expressed their concerns about the proposals, and I hope that this report adequately represents those relating to landscape and visual effects, which are summarised in Section 2.

- 9.14 The extant Written Ministerial Statement (WMS) dated the 25th of March 2015 states, *'The National Planning Policy Framework includes strong protections for the natural and historic environment and is quite clear that local councils when considering development proposals should take into account the economic and other benefits of the best and most versatile agricultural land. Yet, some local communities have genuine concerns that when it comes to solar farms insufficient weight has been given to these protections and the benefits of high quality agricultural land. As the solar strategy noted, public acceptability for solar energy is being eroded by the public response to large-scale solar farms which have sometimes been sited insensitively'*³⁶.
- 9.15 There are many reasons for 'insensitive' siting, including commercial, but one is certainly that when very large sites such as this are being selected, the preliminary surveys and assessments are carried out rapidly and at a high level, based mainly on national designations. Thus, many highly-sensitive environmental and human receptors are not identified. In addition, the cause and nature of many of the effects likely to arise are not factored in, or are not understood. As a result, levels of adverse effects are underestimated.
- 9.16 This report describes in detail some of the significant landscape, visual and other effects likely to arise, where they have not been identified or adequately explained in the Applicant's submissions. A good example is the proposed access to Area A (see Section 4.2).
- 9.17 In my opinion, even if an application for solar development had been made on just the northern part of Area A, it would have been the subject of far greater scrutiny than was the case here.
- 9.18 And, it must be emphasised that whilst the problems with the proposed access into Area A have been highlighted, the same / similar problems would certainly in some cases, and probably in others, apply to the other Areas (B – F), in terms of lack of baseline survey and analysis, and identification and assessments of effects.
- 9.19 It may be argued that due to the very large size of the site, and complexity of the proposals, it would not be 'reasonable' or 'proportionate' to carry out such detailed surveys and assessments across the entire site; however, as my study shows, it is absolutely essential. Without such scrutiny, many critical matters are missed, which can have devastating consequences which are not realised until it is too late.
- 9.20 Below is a brief summary of other likely / potentially significant landscape-related effects which were identified in my assessment and review:
- i) There would be significant and unacceptable harm to social and recreational amenity, especially the enjoyment of well-used and highly-valued public rights of way through a high-quality landscape offering many valuable resources, and performing many valuable / critical functions.
 - ii) There would also be significant and unacceptable harm to residential amenity.
 - iii) The proposed development would result in high levels of harm to the settings of several designated heritage assets, and potentially, to buried archaeology.
 - iv) The claims that the development would deliver significant biodiversity net gains are doubtful, and the proposals are in fact likely to cause significant harm to habitats and species, including protected species including otters, water vole, and bats.
 - v) There is the potential for significant and probably permanent soil damage / reduction in quality and fertility.
 - vi) There is the potential for significant adverse effects on water quality.
- 9.21 There are many other matters of concern, especially in terms of potentially significant adverse effects, which are either a) covered in some detail in the Applicant's assessments, but the conclusions are based on flawed methods / assumptions; or b) not covered in sufficient detail

³⁶ <https://questions-statements.parliament.uk/written-statements/detail/2015-03-25/HCWS488>

(or at all) in the Applicant's submissions, nor in my own assessment: examples are given in Section 4.8.

- 9.22 Regarding the landscape and visual topic in relation to this Examination, not only did my own assessment conclude that the proposed development would give rise to **significant adverse** landscape and visual effects, but so did the Applicant's.
- 9.23 Whilst my review concluded that certain aspects of the Applicant's LVIA method and process are flawed, and that as a result, the overall levels of landscape and visual effects would be higher than the LVIA predicts, it is hoped that the parties can agree that the adverse landscape and visual effects arising from the proposed development would be 'significant', and thus landscape and visual effects could be scoped out of the Examination, which would save a considerable amount of time.
- 9.24 Of course, 'landscape' covers / is relevant to a wide range of environmental and other topics, for example heritage, biodiversity, soils, hydrology, transport, and recreation (views are also relevant to some of these), so such agreement should not preclude further discussion about specific landscape and visual effects if necessary.
- 9.25 Indeed, in my opinion, it is very important to understand the specific cause and nature of the landscape, visual, and other effects likely to arise, as this may be useful for future discussions / queries about associated topics, especially mitigation.
- 9.26 Notwithstanding any such agreement, it would be helpful if the ExA could ask the Applicant to clarify some of the matters raised in this report where noted, and to supply additional information, if the ExA considers that this would be relevant / useful.

Carly Tinkler BA CMLI FRSA MIALE 29th August 2024

APPENDICES

Note that only Appendices CT-A and CT-D are bound in this document: the others are available as separate documents

Appendix CT-A

Tables of Criteria & Matrices for Landscape & Visual Assessment

Landscape

Table 1: Criteria for Judging Levels of Landscape Quality

Table 2: Criteria for Judging Levels of Landscape Value

Table 3: Criteria for Judging Levels of Landscape Susceptibility to Change

Table 4: Matrix for Evaluating Levels of Landscape Sensitivity

Table 5: Criteria for Judging Levels of Magnitude of Effect (Landscape Character)

Table 6: Matrix for Evaluating Overall Level of Landscape Effects

Visual

Table 7: Criteria for Judging Levels of Visual Value

Table 8: Criteria for Judging Levels of a Landscape's Visual Susceptibility to Change

Table 9: Criteria for Judging Levels of Visual Receptors' Susceptibility to Change

Table 10: Matrix for Evaluating Levels of Visual and Visual Receptor Sensitivity

Table 11: Criteria for Judging Levels of Magnitude of Effect (Views and Visual Amenity)

Table 12: Matrix for Determining Overall Levels of Visual Effects

Table 1: Criteria for Judging Levels of Landscape Quality

Level of Quality	Definition
Very High	• Landscapes of an 'awe-inspiring' or 'sublime' nature and which are important and valued on an international and national level (DMRB) • Unspoilt areas comprising a strong, clear and highly aesthetically-pleasing composition of highly characteristic landscape elements and features in excellent condition and health, intact and distinctive • Excellent representation of the landscape area / type • Very high level of management, or care, or pristine natural / semi-natural environment • Exceptional scenic integrity • Very strong sense of place • Negligible or no atypical or incongruous features or detractors
High	• Very attractive landscapes which are of high value nationally and can be defined as highly scenic (DMRB) • Areas with components combined in an aesthetically pleasing composition, in very good condition and health • Very good representation of the landscape area / type • High level of management, or care, or natural / semi-natural environment in very good form and health • Very good scenic integrity • Strong sense of place • Few atypical or incongruous features or detractors
Moderate	• Good landscape containing areas that, although still attractive, have less significant and more common landscape features (DMRB) • Areas of some value for their landscapes, components combined in an aesthetically pleasing composition but showing signs of erosion and loss, in good to fair condition and health • Good to fair representation of the landscape area / type • Good to fair level of management, environment in good to fair form and health • Good to fair scenic integrity • Some loss of, or change to, intrinsic sense of place • Some atypical or incongruous features or detractors
Low	• Ordinary landscape containing areas that have only common landscape features and some intrusive elements such as conspicuous infrastructure with scope for improvement in management (DMRB) • Areas of limited landscape value, disturbed and lacking coherence and structure. Limited aesthetically-pleasing composition. Signs of urbanisation and / or erosion, characteristic landscape elements and features degraded and / or lost. Poor condition / health • Limited representation of the landscape area / type

Level of Quality	Definition
	• Limited management, or care, environment in fair to poor form and health • Poor scenic integrity • Little if any sense of place • Several atypical or incongruous features or detractors
Very Low	• Poor landscape with areas that contain frequent detracting aspects and/or lack of management which results in a degraded landscape with very few valued features (DMRB) • Areas with few or no valued landscape components or comprising degraded and / or lost characteristic elements and features, making negative contribution to aesthetic composition • Poor or no representation of the landscape area / type • Little or no management, or care, environment in very poor form and health • Little or no scenic integrity • Negative sense of place • Widespread atypical or incongruous features or detractors

Table 2: Criteria for Judging Levels of Landscape Value

Level of Value	Definition
Very High	• 'Outstanding' landscapes (ELC) • Internationally and / or nationally-designated landscapes e.g. World Heritage Sites, National Parks, AONBs • Presence of internationally and / or nationally-designated areas / features of landscape, nature conservation, archaeological, historic, geological and / or other importance e.g. SACs, SSSIs, Scheduled Monuments, Grade I and / or II* listed buildings, Registered Historic Parks and Gardens, Local Geodiversity Sites • Significant wider landscape / visual function e.g. Green Belt, context / setting of heritage asset, contribution to character of settlement of international or national importance • Landscapes in excellent condition and / or of very high quality as defined by appropriate criteria • Significant cultural associations • Exceptional representation of landscape area / type / characteristics and / or rare • Exceptional aesthetic and perceptual attributes and qualities e.g. significant scenic beauty, iconic views, very distinctive sense of place, very high degree of wildness / remoteness, tranquillity • No detractors present • The quality / qualities of, and / or features in, the landscape are likely to be the primary purpose of the visit • Significant contribution to wider public amenity, access and recreation e.g. national trails, Open Access Land • Significant Green Infrastructure assets
High	• Landscapes between 'Outstanding' and 'Everyday' (ELC) • Regionally / locally-designated landscapes e.g. Areas of Great Landscape Value (AGLV) which may be subject of strategy and / or guidance • Presence of regionally / countywide-level designated areas / features of landscape, nature conservation, archaeological, historic, geological and / or other importance e.g. Country Parks, TPOs, National Forest Inventory, Priority Habitat Inventory sites, Local Wildlife Sites / Local Nature Reserves, Grade II Listed Buildings, Conservation Areas, Unregistered Historic Parks and Gardens, SMR / HER. Also National Trust land • Important wider, or significant local, landscape / visual function e.g. context / setting of heritage asset, contribution to character of settlement of regional importance, green gap, buffer zone etc. • Landscapes in very good condition and / or of high quality as defined by appropriate criteria • Important cultural associations • Very good representation of landscape area / type / characteristics and / or uncommon

Level of Value	Definition
	• Very good aesthetic and perceptual attributes and qualities e.g. high degree of scenic beauty, fine / key views, distinctive sense of place, high degree of wildness / remoteness, tranquillity • Negligible / few detractors present • The quality / qualities of, and / or features in, the landscape are likely to be one of the main reasons for the visit • Important contribution to wider public amenity, access and recreation e.g. long-distance / themed trails, well-used public rights of way, Heritage Coast, Public Open Space / Local Green Space. May be protected by / subject of planning policy • Important wider, or significant local Green Infrastructure assets
Moderate	• 'Everyday' landscapes (ELC) • Undesignated landscapes although may be subject of strategy and / or guidance • Presence of undesignated, 'informally' designated and / or locally-important areas / features of landscape, nature conservation, archaeological, historic, geological and / or other interest • Important local landscape / visual function e.g. context / setting of heritage asset, contribution to character of settlement, green gap, buffer zone etc. • Landscapes in good to fair condition and / or of moderate quality as defined by appropriate criteria but good potential for improvement • Important local cultural associations • Good to fair representation of landscape area / type / characteristics but common • Good to fair aesthetic and perceptual attributes and qualities e.g. moderate degree of scenic beauty, local key views, moderate sense of place, moderate degree of wildness / remoteness, tranquillity • Some detractors present • The quality / qualities of, and / or features in, the landscape are unlikely to be one of the main reasons for the visit, but make a positive contribution to the experience • Important contribution to local public amenity, access and recreation e.g. well-used public rights of way, green open spaces, common land • Good local Green Infrastructure assets
Low	• Landscapes between 'Everyday' and 'Degraded' (ELC) • Undesignated landscapes unlikely to be subject of strategy and / or guidance (unless for restoration) • Few if any areas / features of landscape, nature conservation, archaeological, historic, geological and / or other interest • Little or no local landscape / visual function • Landscapes in fair to poor condition and / or of low quality as defined by appropriate criteria but some potential for improvement • Few if any cultural associations • Fair to poor representation of landscape area / type / characteristics and common

Level of Value	Definition
	• Few if any aesthetic and perceptual attributes and qualities: little sense of place, little or no sense of wildness / remoteness, tranquillity • Several detractors present • The quality / qualities of, and / or features in, the landscape are unlikely to be a reason for visiting • Little or no contribution to public amenity, access and recreation • Few Green Infrastructure assets
Very Low	• 'Degraded' landscapes (ELC) • Undesignated landscapes, and not subject of strategy and / or guidance (unless for restoration) • No areas / features of landscape, nature conservation, archaeological, historic, geological and / or other interest • Negligible or no landscape / visual function • Landscapes in very poor condition and / or of very low quality as defined by appropriate criteria – may be contaminated land. Situation likely to be permanent, and very little if any potential for improvement • No cultural associations • Poor representation of landscape area / type / characteristics • Negative aesthetic and perceptual attributes and qualities: no sense of place, high levels of landscape and visual disturbance • Widespread detractors present / dominant • The quality / qualities of, and / or features in, the landscape may discourage people from visiting • No contribution to public amenity, access and recreation • Very few or no Green Infrastructure assets

Table 3: Criteria for Judging Levels of Landscape Susceptibility to Change

Level of Susceptibility	Definition
Very High	• The landscape is of a very large scale and / or there is a negligible level of containment, resulting in a significant degree of interaction between landform, topography, vegetation cover, field pattern and built form • There is no existing reference or context within the landscape to the type of change / development proposed • Detracting features are not present in the area • The majority of the existing landscape characteristics / elements / features of value (e.g. ancient woodland, mature / veteran trees, traditional orchards etc.) could not be replaced / substituted and their loss could not be compensated for • Very limited or no opportunities for mitigation • The landscape receptor has a very low level of ability to tolerate the nature / scale of change / development proposed: permanent serious negative consequences in terms of the maintenance of the baseline situation • The proposed change / development would not comply with relevant national planning policies, guidance, and / or strategies
High	• The landscape is of a large scale and / or there is a low level of containment, resulting in a high degree of interaction between landform, topography, vegetation cover, field pattern and built form • There is very limited existing reference or context within the landscape to the type of change / development proposed • Few detracting features in the area and where present, these have little influence on the character and experience of the landscape • Many of the existing landscape characteristics / elements / features of value would not be easy to replace or substitute, and it is unlikely that loss could be compensated for • Some potential for mitigation and enhancement • The landscape receptor has a low level of ability to tolerate the nature / scale of change / development proposed: long-term / permanent consequences of concern in terms of the maintenance of the baseline situation • The proposed change / development is unlikely to comply with relevant national planning policies, guidance, and / or strategies
Moderate	• The landscape is of a medium scale and / or there is a moderate level of containment, resulting in a moderate degree of interaction between landform, topography, vegetation cover, field pattern and built form • There is some existing reference or context within the landscape to the type of change / development proposed • Some detracting features and / or major infrastructure are present in the area, and these have a noticeable influence on the character and experience of the landscape

	- Existing landscape characteristics / elements / features of limited value and could potentially be replaced / substituted, and / or loss satisfactorily compensated for - Good potential for mitigation and enhancement - The landscape receptor has a moderate level of ability to tolerate the nature / scale of change / development proposed: some concern in terms of the maintenance of the baseline situation without mitigation - The proposed change / development may be in conflict with some relevant national planning policies, guidance, and / or strategies, but may comply with others
Low	- The landscape is small scale and / or has a high level of containment, resulting in only a slight degree of interaction between landform, topography, vegetation cover, field pattern and built form - There are many existing references within the landscape to the type of development / change proposed - Several detractors present which have a negative influence on the character and / or experience of the landscape - Few / no landscape characteristics / elements / features of value are present or, where they are present, they can easily be replaced / substituted and / or loss could be satisfactorily compensated for - The landscape receptor has a high level of ability to tolerate the nature / scale of change / development proposed: limited concern in terms of the maintenance of the baseline situation - Very good opportunities for mitigation and enhancement - The proposed change / development is unlikely to be in conflict with relevant national planning policies, guidance, and / or strategies. The site may be allocated for the type of development proposed
Very Low	- The landscape is of such a small scale and / or has such a high level of containment, that there is little or no interaction between landform, topography, vegetation cover, field pattern and built form - The landscape displays the characteristics of the type of development / change proposed - Widespread detractors present which negatively influence the character and / or experience of the landscape - No landscape characteristics / elements / features of value are present - The landscape receptor has a very high level of ability to tolerate the nature / scale of change / development proposed: no concern in terms of the maintenance of the baseline situation - Change / development could result in noticeable improvements to the area - The proposed change / development is likely to comply with relevant national planning policies, guidance, and / or strategies. The site may be allocated for the type of development proposed or for restoration

Table 4: Matrix for Evaluating Levels of Landscape Sensitivity

		Level of Landscape Susceptibility to Change				
		Very High	High	Moderate	Low	Very Low
Level of Landscape Value	Very High	Very High	High to Very High	High	Medium to High	Medium
	High	High to Very High	High	Medium to High	Medium	Low to Medium
	Moderate	High	Medium to High	Medium	Low to Medium	Low
	Low	Medium to High	Medium	Low to Medium	Low	Very Low to Low
	Very Low	Medium	Low to Medium	Low	Very Low to Low	Very Low

Table 5: Criteria for Judging Levels of Magnitude of Effect (Landscape Character)

Level of Magnitude	Definition
Very Large Adverse	• Major alteration to, or complete loss of, key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of change is considered very large due to the extent and proportion of loss of, or change to, existing landscape components • Effects likely to be experienced at a very large scale, influencing several character areas or types • Major alteration to, or complete loss of, key elements, features, characteristics and functions of the baseline condition, and / or the addition of highly uncharacteristic, conspicuous elements, features and / activities, would result in major alteration to, or complete loss of, aesthetic and / or perceptual qualities • The duration of effect would be considered permanent and irreversible
Large Adverse	• Noticeable alteration to, or significant loss of, key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of change is considered large due to the extent and proportion of loss of, or change to, existing landscape components • Effects likely to be experienced at a large scale, influencing the character area and / or type within which the change is proposed • Noticeable alteration to, or loss of, key elements, features, characteristics and functions of the baseline condition, and / or the addition of uncharacteristic, conspicuous elements, features and / activities, would result in noticeable alteration to, or loss of, aesthetic and / or perceptual qualities • The duration of effect would be considered long-term / permanent and probably irreversible
Moderate Adverse	• Partial alteration to, or loss of, key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of change is considered medium due to the extent and proportion of loss of, or change to, existing landscape components • Effects likely to be experienced at a moderate scale, influencing the character type within which the change is proposed but at a local level • Partial alteration to, or loss of, key elements, features, characteristics and functions of the baseline condition, and / or the addition of elements, features and / activities which are not characteristic in the area, would result in partial alteration to, or loss of, aesthetic and / or perceptual qualities • The duration of effect would be considered long-term / permanent and very difficult to reverse in practical terms

Level of Magnitude	Definition
Small Adverse	• Minor alteration to key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of change is considered small due to the extent and proportion of loss of, or change to, existing landscape components • Effects likely to be experienced at a small scale, influencing the landscape within which the change is proposed at a local level • Minor alteration to, or loss of, key elements, features, characteristics and functions of the baseline condition, and / or the addition of elements, features and / activities which are not characteristic in the area, would result in minor alteration to aesthetic and / or perceptual qualities • The duration of effect may be considered long-term / permanent but is potentially reversible
Negligible Adverse	• Barely discernible alterations to key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of change is considered very small due to the extent and proportion of loss of, or change to, existing landscape components • Effects likely to be experienced at a very small scale, with no influence beyond the site and its immediate surroundings on the landscape within which the change is proposed • Barely discernible alterations to key elements, features, characteristics and functions of the baseline condition, and / or the addition of elements, features and / activities which are entirely characteristic in the area, would result in barely discernible alteration to aesthetic and / or perceptual qualities • The duration of effect may be considered temporary (i.e. short- or medium-term); but may also be long-term / permanent. Some effects potentially reversible
Neutral	• No change to the baseline condition, or an equal balance of negative / positive effects
Negligible Beneficial	• Barely discernible improvements to key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of improvement is considered very small due to the extent and proportion of new landscape components • Beneficial effects likely to be experienced at a very small scale, with no influence beyond the site and its immediate surroundings on the landscape within which the improvement is proposed • Barely discernible improvements to existing, or addition of new, key elements, features, characteristics and functions of the baseline condition would result in barely discernible improvements in aesthetic and / or perceptual qualities • Some / all improvements are temporary (i.e. short- or medium-term)

Level of Magnitude	Definition
Small Beneficial	• Small but noticeable improvements to key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of improvement is considered small due to the extent and proportion of new landscape components • Beneficial effects likely to be experienced at a small scale, influencing the local landscape • Small but noticeable improvements to existing, or addition of new, key elements, features, characteristics and functions of the baseline condition would result in discernible improvements in aesthetic and / or perceptual qualities • Improvements are medium- to long-term
Moderate Beneficial	• Noticeable improvements to key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of improvement is considered medium due to the extent and proportion of new landscape components • Beneficial effects likely to be experienced at a moderate scale, influencing the character type within which the change is proposed but at a local level • Noticeable improvements to existing, or addition of new, key elements, features, characteristics and functions of the baseline condition would result in noticeable improvements in aesthetic and / or perceptual qualities • Improvements are long-term / permanent
Large Beneficial	• Major improvements to key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of improvement is considered large due to the extent and proportion of new landscape components • Beneficial effects likely to be experienced at a large scale, influencing the character area and / or type within which the change is proposed • Major improvements to existing, or addition of new, key elements, features, characteristics and functions of the baseline condition would result in considerable improvements in aesthetic and / or perceptual qualities • Improvements are long-term / permanent
Very Large Beneficial	• Substantial improvements to key elements, features, characteristics and functions of the baseline condition • The size, scale and / or geographical extent of improvement is considered very large due to the extent and proportion of new landscape components • Beneficial effects likely to be experienced at a very large scale, influencing several character areas or types • Substantial improvements to existing, or addition of new, key elements, features, characteristics and functions of the baseline condition would result in substantial improvements in aesthetic and / or perceptual qualities • Improvements are permanent

Table 6: Matrix for Evaluating Overall Levels of Landscape Effects

NOTE 1: The level of Magnitude of Effect can be expressed as Adverse or Beneficial, and the overall Level of Effect can be expressed as Negative or Positive.

NOTE 2: If the Magnitude of Effect is Neutral (i.e. 'No Change'), all effects will be Neutral

		Sensitivity of Receptor				
		Very High	High	Medium	Low	Very Low
Level of Magnitude of Effect	Very Large	Substantial	Major to Substantial	Major	Moderate to Major	Moderate
	Large	Major to Substantial	Major	Moderate to Major	Moderate	Moderate to Minor
	Moderate	Major	Moderate to Major	Moderate	Moderate to Minor	Minor
	Small	Moderate to Major	Moderate	Moderate to Minor	Minor	Minor to Negligible
	Negligible	Moderate	Moderate to Minor	Minor	Minor to Negligible	Negligible

Table 7: Criteria for Judging Levels of Visual Value

Level of Visual Value	Criteria
Very High	• Views from, or towards, designated landscapes and / or features of international and national importance (e.g. World Heritage Sites, National Parks, AONBs, Registered Historic Parks and Gardens, Scheduled Monuments, Grade I or II* Listed Buildings etc.) especially where contributing to the significance of an asset / feature • View is of outstanding scenic beauty and very high quality • View makes a highly important contribution to understanding of landscape function / contribution • Likely to be the subject of planning policy and / or guidance / protected views • Views from landscapes / viewpoints within highly popular visitor attractions / tourist destinations, and / or from national trails, used by very large numbers of people • Views with social / cultural / historic associations (e.g. in art and literature, or an historically-important vista over a battlefield) of international / national importance
High	• Views from within, or towards, designated landscapes and / or features of regional or countywide importance (e.g. Areas of Great Landscape Value (AGLV), Country Parks, Conservation Areas, Grade II listed buildings, National Trust land etc.), especially where contributing to the significance of an asset / feature • View is of high scenic beauty and high quality • View makes an important contribution to understanding of landscape function / contribution • Views from well-used and popular visitor attractions / tourist destinations, including long-distance / themed trails, Heritage Coasts, Public Open Spaces / Local Green Spaces, used by relatively large numbers of people • Views with social / cultural / historic associations of countywide importance • Views in which receptors have a proprietary interest, including people living in residential properties
Moderate	• Views from within, or towards, undesignated landscapes and / or features of local importance • View is of moderate scenic beauty and moderate quality • View makes a moderate contribution to understanding of landscape function / contribution • Views from locally-popular recreation areas / green open spaces / public rights of way, but not used by many visitors • Views with social / cultural / historic associations of local importance

Low	• Views from within, or towards, undesignated landscapes and / or features of site-wide importance • View is of low scenic beauty and low quality • View makes a very limited contribution to understanding of landscape function / contribution • Views from landscapes / viewpoints which are not particularly popular or recognised as being destinations in their own right, including infrequently used rights of way • Views with no social / cultural / historic associations
Very Low	• Views from, or towards, undesignated landscapes and / or features of no importance • View is of poor scenic beauty / quality - landscape may be permanently degraded

Table 8: Criteria for Judging Levels of a Landscape's Visual Susceptibility to Change

Level of Visual Sensitivity	Definition
Very High	• Highly visible in wider area • Forms part of exceptional / iconic / very highly valued views • Internationally / nationally important visual function (context, setting, gateway, gap, screen, buffer, transition zone, skyline, panorama, vista, focal point, cultural association etc.) • Very open to public or private views of the countryside or open space which are significant • Development would create unacceptable visual intrusion into the wider landscape that almost certainly could not be mitigated
High	• Visible in wider area • Highly visible in local area • Forms part of wider important / highly valued views • Forms part of views of significant local value • Important wider visual function • Significant local visual function • Very open to public or private views of the countryside or open space which are of wider importance • Development would be uncharacteristically conspicuous in the wider area and mitigation unlikely to reduce adverse effects • Development would create unacceptable visual intrusion into the local landscape that almost certainly could not be mitigated
Moderate	• Not visible from wider area or of no influence • Locally visible but limited influence • Views are of some wider importance but there is scope for mitigating potential adverse visual effects • Locally highly-valued views • Limited wider visual function • Important local visual function • Partially open to public or private views of the countryside or open space which are of wider importance • Open to views public or private views of the countryside or open space which are of local importance • Development likely to be perceptible in the wider area but would not significantly alter the balance of features or elements within the existing view • Development would be uncharacteristically conspicuous in the local area and mitigation unlikely to reduce adverse effects

Level of Visual Sensitivity	Definition
Low	• Not visible from wider area • Limited local visibility • Views of limited importance • Development could be integrated into the land- / town- / villagescape although possibly only with mitigation • Site is fairly well-screened from public and private views • Development may be discernible in the wider area but would not result in loss of, or change to, important views or wider visual amenity • Development likely to be perceptible in the local area but would not significantly alter the balance of features or elements within the existing view
Very Low	• Not visible from wider area • Little or no local visibility • Views of little or no importance • Development would not lead to unacceptable visual intrusion into the landscape, or adverse effects on the settlement, with or without mitigation • Site is very well-screened from public and private views • Development would not be discernible or would enhance views or existing visual amenity

Table 9: Criteria for Judging Levels of Visual Receptors' Susceptibility to Change

Level of Susceptibility	Criteria
Very High	• Receptors (tourists / visitors) within, or looking towards, internationally- or nationally- designated landscapes, areas and features such as World Heritage Sites, National Parks, Areas of Outstanding Natural Beauty, Registered Historic Parks and Gardens, Scheduled Ancient Monuments, Grade I and II* listed buildings and other places where the landscape / feature is the main reason for the visit • People using national trails and other nationally-designated routes where the view is likely to be the focus of attention • People living in residential properties
High	• Receptors (tourists / visitors) within, or looking towards, landscapes, areas and features with regional / countywide designations e.g. Areas of Great Landscape Value (AGLV), Country Parks, Conservation Areas, Grade II listed buildings, National Trust land etc. and other places (such as Open Access Land) where the landscape / feature is part of the reason for the visit • People using long-distance footpaths / scenic routes / themed trails / engaged in outdoor recreation (e.g. walkers, riders, cyclists, boat users, motorists), whose attention may be focused on the landscape and / or particular views, and / or for whom the view is a factor in the enjoyment of the activity • Communities living in areas where the landscape setting makes a highly important contribution to visual amenity
Moderate	• Receptors within, or looking towards, undesignated landscapes, areas and features of local importance, and in places where the landscape / feature is not necessarily part of the reason for the visit • People using local public rights of way / engaged in outdoor recreation whose attention is unlikely to be focused on the landscape and / or particular views, and / or for whom the view is not necessarily a factor in the enjoyment of the activity • People staying in hotels and healthcare institutions who are likely to appreciate and / or benefit from views of their surroundings • People working in premises where the views are likely to make an important contribution to the setting, and / or to the quality of working life
Low	• Receptors in commercial and industrial premises, schools, playing fields etc. where the view is not central to the use • People using main roads, rail corridors, infrequently used / inaccessible public rights of way and likely to be travelling for a purpose other than to enjoy the view
Very Low	• People moving past the view often at high speed (e.g. on motorways and main line railways) and with little or no focus on or interest in the landscape through which they are travelling

Table 10: Matrix for Evaluating Levels of Visual and Visual Receptor Sensitivity

		Level of Visual Susceptibility to Change				
		Very High	High	Moderate	Low	Very Low
Level of Visual Value	Very High	Very High	High to Very High	High	Medium to High	Medium
	High	High to Very High	High	Medium to High	Medium	Low to Medium
	Moderate	High	Medium to High	Medium	Low to Medium	Low
	Low	Medium to High	Medium	Low to Medium	Low	Very Low to Low
	Very Low	Medium	Low to Medium	Low	Very Low to Low	Very Low

Table 11: Criteria for Judging Levels of Magnitude of Effect (Views & Visual Amenity)

Level of Magnitude	Definition
Very Large Adverse	• Significant and substantial deterioration in, or a significant and substantial change to, a very large proportion of the existing view • Complete loss of, or substantial change to, site's visual function / contribution • The change may be noticeable over a large geographical area, or substantial over a more limited area • Development, or a large part of it, would be a dominant new component and / or focus in the view, and would have a strongly-defining influence on it • The duration of effect would be considered permanent and irreversible
Large Adverse	• Development would cause a highly noticeable deterioration in, or a highly noticeable change to, a large proportion of the existing view, or significant deterioration in or a significant change to a smaller proportion of the existing view • Noticeable loss of, or change to, site's visual function / contribution • Development, or a large part of it, would be a significant new component and / or focus in the view, and would have a defining influence on it • The duration of effect would be considered long-term / permanent and probably irreversible
Moderate Adverse	• Development would cause a visible deterioration in, or change to, a large proportion of the existing view, or highly noticeable deterioration in, or change to, a smaller proportion of the existing view • Partial loss of, or change to, site's visual function / contribution • Development appears at odds with local landscape character and would form an apparent element within local views • The duration of effect would be considered long-term / permanent and very difficult to reverse in practical terms
Small Adverse	• Development would cause a small deterioration in, or change to, a large proportion of the existing view, or a visible deterioration in, or change to, a smaller proportion of the existing view • Small change to site's visual function / contribution • Development would form a minor constituent of the view, being partially-visible, or at a sufficient distance to be a limited component of a view • The duration of effect may be considered long-term / permanent but is potentially reversible

Level of Magnitude	Definition
Negligible Adverse	• Development would cause a barely-perceptible deterioration in, or change to, the existing view • Barely-perceptible change to site's visual function / contribution • The duration of effect may be considered temporary (i.e. short- or medium-term); but if long-term / permanent, effects potentially reversible (and may be likely to happen)
Neutral	• No change to the existing view, or equal balance of negative and positive effects
Negligible Beneficial	• Development would result in a barely-discernible improvement in the existing view • Improvements are temporary (i.e. short- or medium-term)
Small Beneficial	• Development would result in a small improvement in a large proportion of the existing view, or a noticeable improvement to a smaller proportion of the existing view • Small improvement to site's visual function / contribution • Development would improve a small part of the view • Improvements are long-term / permanent
Moderate Beneficial	• Development would result in a noticeable improvement to a large proportion of the existing view, or locally-important improvement to a smaller proportion of the existing view • Improvements are long-term / permanent
Large Beneficial	• Development would result in an important improvement to a large proportion of the existing view, or significant improvement to a smaller proportion of the existing view • Improvements are long-term / permanent
Very Large Beneficial	• Development would result in a significant improvement to a large proportion of the existing view • Improvements are permanent

Table 12: Matrix for Determining Overall Levels of Visual Effects

NOTE 1: The level of Magnitude of Effect can be expressed as Adverse or Beneficial, and the overall Level of Effect can be expressed as Negative or Positive.

NOTE 2: If the Magnitude of Effect is Neutral (i.e. 'No Change'), all effects will be Neutral

		Sensitivity of Receptor				
		Very High	High	Medium	Low	Very Low
Level of Magnitude of Effect	Very Large	Substantial	Major to Substantial	Major	Moderate to Major	Moderate
	Large	Major to Substantial	Major	Moderate to Major	Moderate	Moderate to Minor
	Moderate	Major	Moderate to Major	Moderate	Moderate to Minor	Minor
	Small	Moderate to Major	Moderate	Moderate to Minor	Minor	Minor to Negligible
	Negligible	Moderate	Moderate to Minor	Minor	Minor to Negligible	Negligible

Appendix CT-B

Letter from Gwent Wildlife Trust and Friends
of the Gwent Levels

Appendix CT-C

ADAS / Welsh Government Solar Soil Impact
Study Report

Appendix CT-D

Examples of CGIs

- 1) The Applicant's LVIA's photomontages are more helpful than the wireframes in understanding some of the visual effects likely to arise from the proposed development; however:
 - i) Not all of the assessed views are the subject of photomontages: in my opinion, some of the key views of the developed site should be illustrated as photomontages, not wireframes.
 - ii) None of the photomontages show the visual effects of travelling along existing and / or proposed permissive PRowS crossing the site through the proposed panel areas, where levels of adverse visual effects would be extremely high (see examples in Section 4.7 of main report).
 - iii) The photomontages only appear to show the panels, not the other scheme elements (especially containers).
 - iv) The photomontages do not accurately reflect the reality of the future situation, partly because they do not show the correct colour and texture of the panels as they would appear under 'normal' weather / light conditions – the image is too flat and 'dull', and does not account for the effects of glint and glare (see Section 4.6).
- 2) The problem is ensuring that the CGI shows the panels as they would appear in the light conditions as they were when the photograph for the CGI was taken. Ideally, photographs are taken, and CGIs produced, on cloudy and sunny days.
- 3) DBC's landscape and visual LIR also identified this problem, and the report includes good illustrations of the variation of the effects of light on panels at an existing solar development, and I have added a few of my own, along with examples of CGIs produced for solar developments by way of comparison.
- 4) Overleaf are:
 - i) One of the Applicant's LVIA's photomontages of the proposed development.
 - ii) Photographs showing the variation of the effects of light on panels at existing solar developments.
 - iii) An example showing the difference between 1) a photomontage with similar problems produced by an appellant for a proposed development (should have factored in partial cloud-cover), and 2) for the same proposed development, a CGI from a viewpoint in close proximity produced by an expert with experience of working on solar developments (based on photo taken under full cloud-cover).
 - iv) An example of a CGI aerial view for a proposed solar development produced by the same expert.

1) Extract from Applicant's LVIA Viewpoint 11a: Salters Lane Photomontage Year 1



2) Existing solar site (1)



3) Existing solar site (2)



4) Existing solar site (3)



5) Existing solar site (4)



6) An applicant's CGI of a proposed solar development at Year 1



7) *Alternative CGI of the same proposed solar development at Year 1*



8) *CGI of a proposed solar development, aerial view*





Julie James
Minister for Climate Change
14th October 2022

Re: A Temporary Halt on Major Development on the Gwent Levels SSSI

Annwyl Weinidog,

As proposed in FOGL's previous letter of 21st July this year, Friends Of the Gwent Levels (FOGL) and Gwent Wildlife Trust (GWT) are now writing to you to provide you with evidence of a systemic failure to control, mitigate or compensate for serious damage to the Gwent Levels SSSI from development. This evidence consists of the results of post-construction monitoring for the only constructed solar farm on the Gwent Levels SSSI (Llanwern), and a mounting and widespread momentum for further, vastly accelerated deployment of solar on the SSSI. You may recall that our previous letter requested a temporary halt on major development on the SSSI for a period of 2-3 years, for the above reasons, and we are now reiterating that request.

FOGL and GWT's General Approach to Renewable Energy

We fully recognise that climate change is the biggest threat to biodiversity globally, and that concerted action at all levels and in all policy areas, including renewable energy generation, is needed. We further support the Welsh Government's renewable energy generation aspirations as set out in its Net Zero 2 document. However, climate change mitigation through renewable energy generation should not come at the expense of biodiversity, a fact recognised by the Senedd's declaration of a joint Climate and Biodiversity Emergency. There are many thousands of hectares of land and rooftops throughout Wales, (including Gwent) which are eminently suitable for solar generation, and there are many constructed and proposed solar projects in Gwent to which we have not objected. Developments are now approved on the basis that developers promise a benefit for biodiversity but our research shows no benefit and indeed shows further damage to the SSSI.

Results of Post-Construction Monitoring at Llanwern Solar Farm show pollution and biodiversity loss

Pollution:

The post-construction monitoring report for the Llanwern solar farm shows that levels of several **waterborne pollutants** arising from the constructed solar farm have risen hugely since construction. For example, the pre-construction levels of suspended solids (silt) inside the development site were up to 7.4 million µg / litre respectively, compared with pre-construction sample levels of a maximum of 0.53 million µg / litre. Thus, the levels of this damaging pollutant produced by the solar farm were over 14 times higher than pre-construction levels.

Very high levels of total **petroleum hydrocarbons** TPHCWG (a very damaging pollutant adversely affecting the aquatic invertebrate and plant citation interest of the SSSI) were recorded inside the solar farm site, at 230 µg / litre, compared with a pre-construction level on the site of less than 10 µg / litre.

Even these very high levels of pollutants caused by the solar farm may be underestimates, because other pollutants, for example Nitrite as N and Nitrite as NO₂, were recorded at very much higher levels post-construction compared with pre-construction, but no NRW concern trigger level exists. It is important to stress

that the wildlife interest of the SSSI is wholly dependent on a very high quality of water in the reens and ditches.

Biodiversity Loss:

No breeding **lapwings** used the “Lapwing Mitigation (really compensation) Area”. Numbers of breeding lapwings fell from eight pairs pre-construction to two pairs post-construction, with only one nest found on site. Lapwing are a red list species with numbers dropping by 80% in Wales in the last fifty years.

A breeding pair of **cranes** was lost from the site. This is a species which had not bred in Wales for over 400 years. The return of these cranes a few years ago was marked as a success story for the Levels. Cranes as a species are making a slight recovery but the Llanwern development appears to have done the very opposite of assisting their recovery.

The diversity of **bat** species decreased markedly, and for the majority of locations, abundance of species has dropped dramatically (95- 100%).

The **flora** on the site has been severely damaged by the construction process and there is no evidence of any attempts to mitigate against this. The ground appears compacted and the panels have large areas of bare earth under and around them, with brambles starting to take over the area, in stark contrast to the grazing marsh habitat of the site before construction.

It should be stressed that this is merely a snapshot of the damage caused to the SSSI, and that further damage is likely to manifest itself as the years go by.

The Levels as a whole under threat

It is also important to bear in mind that in addition to the damage done directly to the SSSI by solar farms, such as that set out above, indirect damage (both cumulative with other developments and in combination with other damaging activities) would manifest themselves if further solar farms were constructed on the SSSI. The destruction of ecological connectivity and resilience would be inevitable if more and more projects were constructed on this fragile and complex wetland SSSI. This would be completely at odds with the Welsh Government DECCA (Diversity, Extent, Condition, Connectivity, Adaptability) approach to reversing climate change and biodiversity loss.

The catastrophic failure of mitigation measures delivered through planning conditions for the only constructed solar farm on the SSSI (or indeed any wetland SSSI in Wales) shows that mitigation has not remedied damage to the SSSI by development, even though the conditions were approved by the Inspector at the hearing, and by NRW, and set out in the Inspector’s Report and Recommendations. Rather than delivering a measurable benefit, the Llanwern scheme has delivered only measurable losses.

All constructed developments on the Gwent Levels in recent decades will have had “mitigation” commitments attached to their planning permissions, and all of these will have been delivered through planning conditions and/or agreements or similar. Nevertheless, the damage continues and the Levels are acknowledged to be in decline. Ironically, it is the very fact that the Levels have been allowed to reach an unfavourable condition as a result of inappropriate management and damaging development that they are now being seen as ‘fair game’ for development which promises – but has failed to deliver – a net benefit for biodiversity.

There is a very real disconnect between the ambitions of the Welsh Government and the Senedd for the Levels and the reality of the DNS planning process within PEDW. Our experience, drawn from being objectors, and appearing at DNS Hearings is that the big picture of protecting and enhancing this NNRMA does not appear to be shared by all major stakeholders or PEDW. Each application is considered in isolation, with no consideration of cumulative impacts, and there has been no attempt at all to learn from the results of post-construction monitoring in respect of constructed solar development such as the Llanwern example cited above. Without the urgent intervention of Welsh Government in the form of a temporary halt, there is a real possibility that all the excellent work set out in Future Wales in relation to the Gwent Levels NNRMA will come to nothing.

In any event, conditions cannot be significantly adjusted to take account of the damage that results from solar development; realistically, no enforcement action would result in the removal of the development and the reinstatement of the SSSI - once it's gone it's gone.

This is a very grim picture indeed, especially when one takes into account the “shifting baseline” phenomenon. NRW estimates that between 1993 and 2014, 28% of the Rhymney and Peterstone SSSI alone (one of the constituent SSSIs of the composite Gwent Levels SSSI) was destroyed by development.

The situation is now urgent; we are faced with the immediate likelihood that at least another 200 hectares of SSSI would be lost via the Rush Wall and Wentlooge solar applications (using broadly the same mitigation measures and conditions as those for Llanwern) in addition to the 95 hectares of Llanwern solar. Further, another at least 52 hectares are in the consent pipeline (Magor Solar Farm), which would also be lost in due course. Only last week we heard of yet another enormous scheme on the SSSI, near the Newport Wetlands Nature Reserve, which is at the early stages of the consent process.

We are aware that a substantial proportion of all of the Levels’ farming community on the SSSI are regularly approached by developers with a view to promoting major solar development on their land. Every consented solar farm on the SSSI would trigger further waves of approaches to the farming community of the SSSI on the part of developers, and thus further applications.

Every new consent for solar projects would add to the probability that further projects would be consented, in a positive feedback loop due to precedent and momentum. The developers of the Wentlooge resubmission application have included a KC's legal opinion with their application; the opinion states that the previous Inspector's recommendation of approval in respect of the first Wentlooge application, in conjunction with the approval and construction of the Llanwern solar farm, have established a precedent which dictates that any Ministerial decision not to approve the Wentlooge scheme would be vulnerable to legal challenge.

Given the determination of the renewable energy industry to exploit the economic advantages which sites on the Levels offer them, it is therefore not hyperbole to envisage that without some definitive action such as a temporary halt to major development, and under present arrangements, in the next 5-10 years we will see the complete transformation of this extraordinary environment into an energy park. Wales is one of the most nature-depleted countries in the world, and we all want the Gwent Levels to be a place where declines are reversed.

A Positive Future for the Levels:

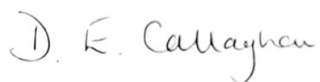
The relentless pressure which the Levels are facing stands in stark contrast to the excellent work you and your Welsh Government and Senedd colleagues have been carrying out over the last few years, in conjunction with the charity sector, the Gwent Levels Working Group and local communities the length and breadth of the Levels. Your Ministerial Statements have had a real and lasting impact on momentum and direction of travel, whilst the Living Levels Partnership is a Wales-wide exemplar of cohesive work to achieve shared aims. The Gwent Levels National Natural Resource Management Area (NNRMA) delineation pursuant to Policy 9 of Future Wales, and your stated intention that a masterplan for the Levels is produced and adopted, are real ground breakers. All this work demonstrates what we in Wales can achieve in pursuit of the sustainable management of natural resources (SMNR) on a landscape scale.

Your Ministerial Statement concerning the results of the Biodiversity Deep Dive released last week is very timely, and we welcome the fact that it highlights the Gwent Levels as being specifically worthy of protection, and commits the Welsh Government to an enhanced level of protection for SSSIs via a review of Planning Policy Wales 11.

We therefore respectfully repeat our call for a halt on major development on the Gwent Levels. The halt we seek would be temporary in nature, but we believe it is necessary for the meaningful completion of the NNRMA work pursuant to Policy 9 of Future Wales, including the spatial masterplan and a comprehensive post-construction monitoring project.

As a result of this halt, we are hopeful that the big picture of a more positive future for the Gwent Levels NNRMA can be shared by all stakeholders working with a common purpose to protect and enhance this unique place in Wales.

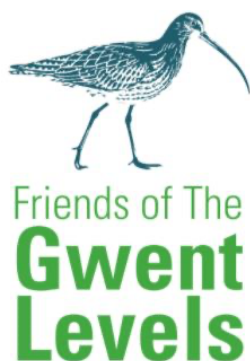
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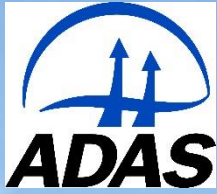


Catherine Linstrum & Diana Callaghan
(Joint chairs, FOGL)



Adam Taylor
(CEO Gwent Wildlife Trust)





Llywodraeth Cymru
Welsh Government

2020/21 Soil Policy Evidence Programme

**The impact of solar photovoltaic (PV)
sites on agricultural soils and land
quality**

Date: March 2023

Report code: Work Package Three SPEP2021-22/03



The impact of solar photovoltaic (PV) sites on agricultural soils and land

Work Package Three: Review of Impacts

March 2023

ADAS GENERAL NOTES

Project No.: 1010857-WP3

Title: The impact of solar photovoltaic (PV) sites on agricultural soils and land. Work Package Three: Review of Impacts

Client: Welsh Government

Date: 31/03/2023

Office: ADAS Rosemaund, Preston Wynne, Herefordshire, HR1 3PG

Status: Final v2

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EXECUTIVE SUMMARY

This report is part of an evidence-based assessment of the impact of solar photovoltaic (PV) sites on agricultural land and soil. The work, under the Welsh Government's Soil Policy Evidence Programme SPEG 2021-22/03, is to inform Welsh Government and Natural England specialists when dealing with solar photovoltaic (PV) planning applications.

The impacts on Best and Most Versatile^{1&2} (BMV) agricultural land from the construction, operational and decommissioning phases are reviewed, based on the findings of the earlier literature review (WP1), best practice and extensive experience of land restoration. The main impact of the three phases of development is deep soil compaction resulting in the loss of versatility of Best and Most Versatile agricultural land and in wetter parts of England and Wales the loss of Best and Most Versatile agricultural land. An assessment is made of the reversibility of the impacts. Soil compaction results mainly from trafficking and alleviation is reported to depths of 45cm. It can take many years for soils to recover from compaction and compaction may be permanent. Runoff from panels can result in rivulets, which can lead to soil loss by erosion.

The benefits of topsoil carbon capture and soil structural improvements are reported for grassland. Research on the impact of solar PV panels on microclimate beneath panels highlights the changes in temperature on vegetation growth.

The decommissioning phase involves the removal of the solar PV site infrastructure. The issues of 'pile pull out' are considered, including corrosion and fracture of the piles.

Good soil handling conditions may mitigate the threats to soil and land. Appropriate planning with a quality soil resource and management plan is essential at the planning application stage to ensure that conditions, as part of the planning process, are relevant and focussed on the restoration of the land to agriculture.

¹ Planning Policy Wales Paragraphs 3.58-3.59 Edition 11 February 2021 and National Planning Policy Framework

² Land classified as Grade 1, 2 and 3a. MAFF Agricultural Land Classification Guidelines. 1988

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1 BACKGROUND

This report is part of an evidence-based assessment of the impact of solar photovoltaic (PV) sites on Best and Most Versatile (BMV) agricultural land and associated soils. The work, under the Welsh Government's Soil Policy Evidence Programme SPEP 2021-22/03, is to inform Welsh Government and Natural England specialists when dealing with solar photovoltaic (PV) planning applications.

A detailed search of published research and industry experience has been undertaken to inform this report. The search concentrated on the impacts of solar PV sites on agricultural land and soils within the UK and internationally. There have been few studies of solar PV sites which have a focus on the impacts on agricultural land and soils. This is largely because solar PV sites are recent developments but also because in the early years sites were located on brownfield land or poorer quality agricultural land. The importance of achieving successful restoration of solar PV sites has increased in significance as the number, size and operational time frame of solar PV sites on BMV agricultural land has increased.

An overview study of the industry has been undertaken and informs this report. The distribution of solar irradiation (Huld et al, 2019) across the UK ranges from approximately 900-1350kWh/m² per year, with the highest resource available in the South West. There has been a trend (BEIS, 2021) towards larger schemes (up to 50 MW and a typical land take of 50ha to 80ha), because of the ceiling for schemes dealt under the Town and Country Planning Act in England. There has also been a move to 'super large' solar PV schemes, generally over 300ha in size. Published sources of guidance for solar developers identified are limited and include several BRE publications (2013, 2014).

Solar Energy UK have prepared a 'best practice guide' (<https://solarenergyuk.org/wp-content/uploads/2022/05/NCBPG-Solar-Energy-UK-Report-web.pdf>), with much focus on the benefits for ecology and biodiversity and little consideration of the impact on soil. A virtual workshop was held on 2nd September 2021 with Welsh Government, Natural England and invited interested parties.

This report reviews the potential impacts to soil and land associated with solar PV site developments at the commissioning and decommissioning phases. The potential effects on soils during the operational phase of the site are considered and the physical reversion from low-maintenance grass to other agricultural uses typically associated with BMV agricultural land and non BMV agricultural land is undertaken.

This report follows the Technical Specification received from Welsh Government and the layout closely follows the points in the brief (Appendix 1).

ADAS gratefully received evidence from the trade body Solar Energy UK to inform this project and details of the evidence provided over December 2021 – January 2022 is provided in Appendix 2.

2 CONSTRUCTION, OPERATION AND DECOMMISSIONING

2.1 Overview of Construction phase

At the time of the submission of the planning application, the solar PV developer will have prepared site outline plans showing details of all aspects of the proposed scheme. Each site is designed taking into account the site's technical assessment, landowner negotiation and grid connection. The solar PV site will typically include some key activities resulting in effects on soil and land, including:

1. Site levelling
2. Construction compound (either for operational life or the temporary during construction phase)
3. Site fencing and security
4. Access road/tracks
5. High voltage cabling
6. Low voltage cabling
7. String cabling
8. Earthing
9. Steel framing mounts and PV panels
10. Piles
11. Inverters and container bases
12. Substation

2.2 Overview of Operational Phase

Solar PV sites are usually unmanned once commissioned. Regular visits may be planned by operations and maintenance staff to undertake monitoring and site maintenance. Typical activities include grass cutting, if grazing does not keep the grass at the optimum height, management of landscaping works and panel washing. The visits will generally require a 4x4 vehicle. Grass on the site is often grazed by sheep, particularly in Wales.

2.3 Overview of Decommissioning Phase

Outline plans stating that decommissioning will be undertaken at the end of the operational life of the development are generally included in the planning application stage. A condition of planning permission is that a more detailed plan, usually about 6 months before the end of the operational life, is submitted to the planning authority. Decommissioning may be

triggered by the end of the operational life of the development or by economic reasons or abandonment (Stantec, 2020).

Typical activities at the decommissioning phase may include:

1. Access roads may need to be reinforced to be able to carry traffic involved in the decommissioning phase
2. De-energise solar arrays
3. Dismantle panels and racking
4. Removal of piles from soil and reinstatement of soil into voids
5. Removal of frames and internal components
6. Removal of structural foundations and backfill sites
7. Removal of inverter stations and foundations
8. Removal of electrical cables and conduits
9. Removal of access and internal roads
10. Removal of substation.

2.4 Impacts on soil and land

2.4.1 Construction phase - overview

The construction of the solar PV site involves operations that necessarily impact on the soil and land. All activities at the construction phase involve trafficking by plant/machinery across the whole site, possibly following access tracks on parts of the site. Examples of the equipment used include excavators and dumper trucks for soil removal and storage, trenching machinery, piling rig and dumper trucks for the transportation of cabling, piles, mounts and panels on site.

The removal of a depth of soil is necessary to prepare the site compound, access roads and site tracks (where aggregate and geo textile membrane are used) and bases for inverters and substations. Site fencing, usually 2m high deer or security fencing, is placed around the site perimeter. Wooden supporting posts are often used, which do not require concrete foundations except at the corners and gateways. With typical spacings of 2.4m to 3m there are approximately 300-416 posts per 1000m run of fencing. The length of fencing varies according to the site layout and each post may be sunk at a depth of up to 1m below ground level. Metal fencing may be used where there is a risk of theft and will require concreting at every footing, which will be spaced at approximately 2m giving 500 posts per 1000m run.

2.4.2 Construction phase - piling

The PV panels are placed on frames which are attached to supporting piles. Most sites use H or I beams, driven into the ground by a piling rig (with a vibrating plate) to a depth of approximately 1.4m to 2m. The beams displace a volume of soil about equal to the volume of the pile. H beam piles are described as 'non-displacement', but soil is displaced as a soil plug forms between the flanges and moves down the pile as it is driven (Ahlvin et al, 1988).

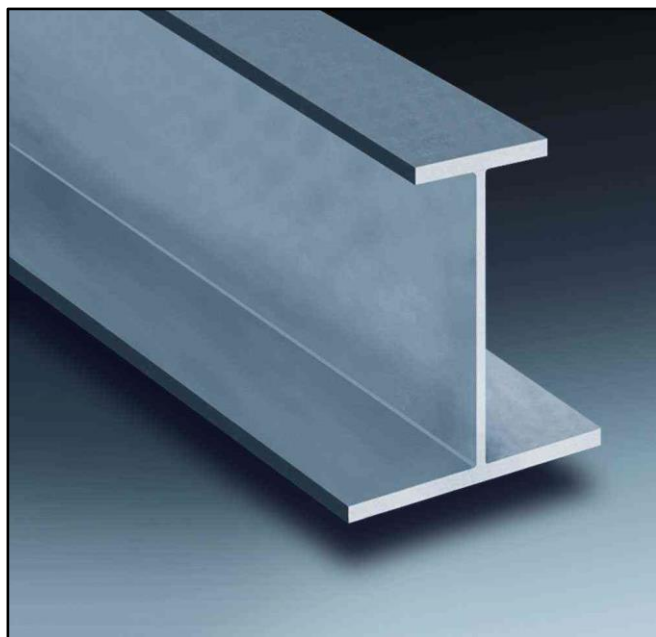


Figure 1: H beam (Sinosources)

H beams have wider flanges than I beams, which have tapered edges. In sandy soils the displaced volume results in compaction of the soil surrounding the pile. In clay soils displacement piles create high stresses in the soil. There is no spoil on the surface.

Helical piles or screws are cylindrical posts with a helix near the bottom of the post and the helix part resists being pulled out by creating a cone of soil above it. Helical piles are installed by digging an initial guiding hole and using a skid steer vehicle with a rotating attachment to spin the pile into place. Helical piles have a smaller surface and will embed with minimal soil disturbance.



Figure 2: Helical beams



Figure 3 Helical piles at depth (Goliathtechpro.com)

H beams are used on larger scale developments as they have a stronger load bearing and require fewer penetrations per rack compared to helical anchors or ground screws.

The number of piles required is determined by the site layout. One case study in WP2 gave the number of piles as 492 piles per ha. Many planning applications for solar PV sites usually include an elevation plan of the solar panel and give the number of PV panels as an illustration, but not the number of piles required.

Ballasted systems provide a non-penetrating foundation to support solar PV frames. The concrete bases can be used on land fill sites or where deep penetration from H beams may damage archaeological features.

2.4.3 Construction phase – soil movement

The development of solar PV sites requires the excavation of soils associated with construction compounds, access roads and trenching for cables. Soil removal is usually undertaken for construction of the site compound and access roads/tracks, where a geotextile membrane may be placed over the subsoil and covered with a surface layer of aggregate. The depth of soil stripped for the compound and for the foundation of bases for inverters and substations should be determined by an assessment of soil resources on site. A review of the case studies (WP 2a) showed removal of soil to depths of up to 30cm i.e. typically topsoil, but excavation to this depth could mix in some subsoil if it is not stripped separately. Trenches created by a trenching machinery will require the removal of soil to a depth of typically up to 1.2m (i.e. a layer of topsoil and subsoil and on some sites overburden) and a width of up to 0.75m. The cables are placed in sand with a suitable backfill placed over. The amount of trenching and cabling is site specific, and one case (Estuary Farm WP2) reported a cabling requirement of approximately 2km on the site.

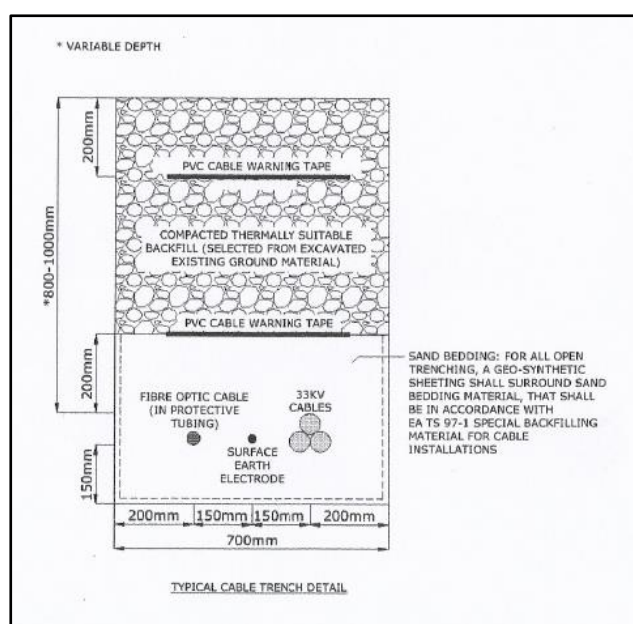


Figure 5: Typical cabling trench details

Site levelling works may be required depending on the site contours and on sites where tilting PV panels are used. Such an engineering operation will disturb the topsoil and it may be that some fill is required on site.

Damage to field drainage systems can occur as piles are driven into the ground, resulting in localised or widespread wet areas within the site.

2.4.4 Operational Phase

During the operational life of a solar PV site there is likely to be minimal disturbance of the site. The wooden posts of deer/security fencing will require replacing through the lifetime of the development due to rot. Frequency of replacement will be greatest in wet or exposed sites. Excavation of the post hole will be required and then re-compaction of the soil leading to localised compaction around the hole and along the access track.

Land between and underneath the PV panels is often grazed by sheep and where there are high numbers of sheep a solid compaction layer 2 cm to 6 cm over a wide area may result (Defra, 2021). There is likely to be some instances of run-off from the solar panels, which could result in the compaction of soils at the base of the panels (Choi et al,2020). Over time rivulets can form along the trailing edge of the panel with potential risk of soil erosion creating rills and gullies across the site. The sand bed could act as a drain, especially on heavy textured soils, leading to drainage discharges or wet patches at the down slope end of each trench.



Figure 6: Channels created by panel runoff within 12 months of site operation commencing

2.4.5 Decommissioning Phase

When the decommissioning phase is triggered at the end of the operational life of the solar PV site, operations to remove the physical infrastructure commence. Access roads and tracks may require reinforcing to be of a standard suitable for heavy machinery. Trafficking will again occur across the site on and off the site tracks as panels, frames and inverter cabins and substations are removed. Cabling may be removed from trenches and string cabling will be dismantled. Access roads, and construction compounds will have aggregate and the geo-textile membranes removed. Where the inverter cabins have been placed on an aggregate base or concrete plinth then this should be removed.

The extraction of the piles is likely to be more problematical than the initial installation (per. comm. P. Woodfield, Technik GS). Pile extraction is undertaken typically with a 13-ton excavator and vibrating pile driver attachment, which removes one beam and then tracks to the next one (per. comm. I. Woolley, Twig Group). A vibrating plate shakes the soil at removal stage, to ensure that the soil stays in place with little disturbance as the H beam is lifted out of the ground, this reduces the risk of soil attaching to the H beam and resulting in a larger area lifting. The volume occupied by the steel beam is the theoretical void. Where there are granular soils e.g. sands and gravel, the soil will fall into the void to occupy the space. The soils do this through a combination of gravity, flow if below the water table and the likely vibration effects while withdrawing the piles (per. comm. M. Wheeler, Binnies).

In clay soils there will be softening and swelling to close the void over time partially or wholly. Plugging can occur in clay soils where the soil may stick to the pile and be withdrawn with the pile, in effect pulling out a solid unit defined by the flanges and width of the pile. The volume of the soil pulled out is greater than in sandy soils and can produce a local ground settlement as soil swells or collapses to fill the void unless measures are taken to fill the void at the time of withdrawal. The clay or soil adhering to the pile can be cleaned off and returned to the hole and then the void is minimal as bulking takes up part of the volume, but this may mix topsoil and subsoil unless carefully managed. Widespread ground settlement is unlikely to occur, although there may be localised ground surface settlement at the point of the pile extraction. It is expected that any localised ground surface settlement would be removed at the time of cultivations on the site. There is no known reported experience of pile pull out within the solar industry in the UK. A study of civil structures in Japan, where the ground is 'soft' and many structures use pile foundations, reported that 'filling' the void was effective in reducing ground subsidence and that the 'filler' must suit the ground conditions (Inazumi et al, 2017). At this stage in the life of the ground-mounted solar PV industry, the impact of pile pull-out on agricultural land and soil is a 'grey' area with few conclusions having been drawn to date.

2.5 Risks to agricultural land quality

During the construction and decommissioning phases there will be soil movement and soil handling on site. During the commissioning, operational and decommissioning phases there will be trafficking by a range of machinery, including dozer, tracked excavator, wheeled backhoe loader, hydraulic hammer rig and rotary bored piling rig, vibrating plates, which can result in soil compaction. The main cause of compaction is the compressive forces applied to the soil from the wheels or tracks of machinery. Hakansson (1985) found that an axle load of 10 tonnes increased soil bulk density to a depth of 50 cm. Compaction may be very persistent in the subsoil and possibly permanent (Hakansson et al 1988). Where there is '*industrial compaction*' the depth of compaction can extend to depths of 1m (Spoor, 2006) and may persist for up to 30 years (Batey, 2009).

Low ground pressure tyres and tracked machinery may reduce the impact of compaction. Tracked vehicles can reduce rut depth by up to 40%, compared to extra wide or soft tyre options (Bygden et al, 2003). The weight on tracked machinery is concentrated beneath the idlers and the bogies (the wheels within the tracks).

Field identification of soil compaction includes evidence of waterlogging on the surface or in subsurface horizons, an increase in soil strength or bulk density, low visible porosity, poor structural conditions, soil colour and rooting pattern (Batey, 2009).

Techniques for loosening compacted soils to depths of about 45cm are established, but at lower depths correcting problems may not be effective and economic and engineering equipment is required.

As well as the forces applied to the soil, the soil water content and bearing capacity are critical at the time the pressure is applied – this is true for both the instance of compaction and the alleviation of compaction.

Soil compaction can occur and be unrelated to mechanical forces, for example finely aggregated soil 'tumbling' down from the surface when cracks are open and wide (Batey, 2009). There is potential for soil falling into the voids created when piles (e.g. H-beams) are removed.

The impact of soil compaction is well documented (Batey, 2009) and crop growth, yield and quality may be adversely affected. There are also wider environmental implications relating to water and air quality.

The extent of trafficking and soil disturbance can cover a substantial proportion of a solar PV site. Satellite imagery of three solar schemes is included in Appendix 3 to this report. This imagery shows:

- 1) Hunstpill Level Solar Farm, Sedgemoor District – pre-construction
- 2) Hunstpill Level Solar Farm, Sedgemoor District – during-construction
- 3) Lamby Way Solar Farm, Cardiff – pre-construction
- 4) Lamby Way Solar Farm, Cardiff – early-construction
- 5) Lamby Way Solar Farm, Cardiff – mid-construction
- 6) Lamby Way Solar Farm, Cardiff – post-construction
- 7) Afon Llan Solar Farm, Swansea – pre-construction
- 8) Afon Llan Solar Farm, Swansea – during construction

The imagery is taken from Google Earth Pro (historical imagery), Google Earth and Bing Aerial.

A number of developers have published videos on the YouTube.com showing phases of solar farm construction in the UK. Some videos appear to show construction during good ground conditions, with suitable access tracks constructed to support the field work.

Other videos, however, appear to show no consideration for topsoil preservation and work proceeding during very wet conditions, resulting in wheel ruts, surface water ponding and slurrified soil in places. Extracts from two of these videos are provided in Appendix 4.

Whilst care must be taken when drawing conclusions from such limited evidence from any given site, the videos give an idea of the soil disturbance that can occur during a solar PV site construction.

On all sites there is the potential impact on soils from the spillage or leakage of fuel and oil. Contaminants only affect agricultural land classification grading where they have or are likely to have a detrimental long-term effect on the physical condition of the soil (MAFF,1988), the yield, cropping and the stocking rates. It is likely that the impact on solar PV sites will be minimal, as bio-oils are widely used and incidents managed through control of contaminants and action.

The supporting information for solar PV sites indicates that galvanised aluminium or steel posts are used to support the frame. Galvanising involves a coating of zinc with thickness ranging from 0.3mm to 3.5mm. The impact on soil and land from the zinc coating is unknown. Defra's code for using sewage sludge (Defra,2018) gives thresholds for zinc in soils of 200 – 300mg/kg; these levels are very unlikely to be achieved from the presence of piles in the soil, although the base level of zinc could influence the threshold. Research on agricultural land has shown that zinc in soils diminishes biological activity (Moffett et al, 2003).

The maintenance of on-site ditches will be key to ensuring that surface water is managed on site. Should maintenance not be undertaken, there is a potential impact of flooding on land. Many solar PV site planning applications consider surface run-off within a management strategy.

3 AGRICULTURAL LAND QUALITY

This section of the report looks specifically at agricultural land, and the risk of residual impacts of solar PV sites on agricultural land quality and Best and Most Versatile (BMV) agricultural land.

The Agricultural Land Classification (ALC) system is used in England and Wales to determine agricultural land quality. The ALC system provides ‘*a framework for classifying land according to the extent to which its physical or chemical characteristics impose long-term limitations on agricultural use*’. The main factors influencing agricultural production and therefore agricultural land quality are climate, site and soil. These three factors and the interactions between them form the basis of classifying agricultural land into one of five grades, as described in Table 1 below.

Table 1: Agricultural Land Classification Grades

Agricultural Land Classification Grades
Grade 1 – excellent quality agricultural land Land with no or very minor limitations to agricultural use. A very wide range of agricultural and horticultural crops can be grown and commonly include top fruit, soft fruit, salad crops and winter harvested vegetable. Yields are high and less variable than on land of lower quality.
Grade 2 – very good quality agricultural land Land with minor limitations which affect crop yield, cultivations or harvesting. A wide range of agricultural and horticultural crops can usually be grown but on some land in the grade there may be reduced flexibility due to difficulties with the production of the more demanding crops such as winter harvested vegetables and arable root crops. The level of yield is generally high but may be lower or more variable than Grade 1.
Subgrade 3a – good quality agricultural land Land capable of consistently producing moderate to high yields of a narrow range of arable crops, especially cereals, or moderate yields of a wide range of crops including cereals, grass, oilseed rape, potatoes, sugar beet and the less demanding horticultural crops.

Agricultural Land Classification Grades (continued)

Subgrade 3b – moderate quality agricultural land

Land capable of producing moderate yields of a narrow range of crops, principally cereals and grass or lower yields of a wider range of crops or high yields of grass which can be grazed or harvested over most of the year.

Grade 4 – poor quality agricultural land

Land with severe limitations which significantly restrict the range of crops and/or level of yields. It is mainly suited to grass with occasional arable crops (e.g. cereals and forage crops) the yields of which are variable. In moist climates, yields of grass may be moderate to high but there may be difficulties in utilisation. The grade also includes very droughty arable land.

Grade 5 – very poor quality agricultural land

Land with very severe limitations which restrict use to permanent pasture or rough grazing, except for occasional pioneer forage crops.

Agricultural land of Grade 1, 2 and Subgrade 3a is considered to be the best and most versatile (BMV) agricultural land in England and Wales.

Two of the principal limitations to agriculture, considered by the ALC system, are soil wetness and soil droughtiness. Soil wetness limits the flexibility of agricultural land by reducing the number of days available for safe cultivations and harvesting. The greater the soil wetness limitation the fewer days available. Soil wetness is influenced by climate (i.e. rainfall v evapotranspiration) and soils (primarily the soil water / drainage regime and topsoil clay content). Soil droughtiness limits the capacity of agricultural land to economically support certain crops. The greater the soil droughtiness limitation the less crop available water there is during the growing season and the less economically viable certain, or in the worst cases all, crops become. Soil droughtiness is influenced by climate (e.g. rainfall v evapotranspiration) and soils (primarily soil structure, soil depth, soil stone content and soil texture).

An assessment of soil wetness and droughtiness can demonstrate the residual impact of solar PV sites on agricultural land quality.

3.1 ‘Disturbed’ and ‘Undisturbed’ Agricultural Soils / Land

In areas of a solar PV site, including the compound, access tracks, bases for inverters/substations, the soil will be stripped during the construction phase, stored and then replaced at the time of decommissioning. In areas of cable trenching the soil will be

stripped, placed close to the trench and then reinstated once the cable is in place. In this report these areas are considered to be '*disturbed*'.

For this report areas in which soils are not stripped or reinstated and remain in situ are considered to be '*undisturbed*' land. These areas of '*undisturbed*', soils may still be impacted during the various construction phases, via trafficking.

The ALC system recognises the classification of '*disturbed*' land, which has different criteria for classifying land from '*undisturbed*' land. Therefore the two are assessed differently:

- the agricultural quality of '*disturbed*' land is assessed with reference only to the soil textural, structural and porosity characteristics.
- the agricultural quality of '*undisturbed*' land is assessed with reference to soil colour (gleying³), textural, structural and porosity characteristics for determining the soil wetness limitation.
- the assessment of soil droughtiness for both '*disturbed*' and '*undisturbed*' land considers the soil texture, structure, organic matter and stone content.

3.2 Agricultural Land Classification Grade Scenarios

In the following sections several scenarios are outlined to indicate the potential residual impacts of solar PV sites on agricultural land quality. The scenarios concentrate on the residual impact of unremediated soil compaction on agricultural land, specifically relating to ALC grade according to soil wetness and soil droughtiness.

The assessment of ALC grade according to soil wetness (MAFF ALC Guidelines Section 3.4 and Appendix 3) considers climate, soil water regime and soil texture. Soil water regime is influenced by climate plus subsoil structure, consistency and porosity – each of which will be impinged by unremediated compaction.

The scenarios assume that unremediated (sub)soil compaction has resulted in a slowly permeable layer (SPL) at a shallower depth in the soil profile than was previously the case. The depth to a SPL is key to assessing soil water regime and ultimately ALC grade according to soil wetness. A SPL prevents the downwards movement of water in the soil profile and can lead to surface water perched at shallow depth for periods of the year, particularly autumn through to spring, and particularly problematic in wetter soil types or wetter areas

³ A greyish, pale and ochreous colouring indicative of waterlogging.

of England and Wales. This can negatively impact the flexibility of agricultural land, potentially lowering quality and ALC grade.

A similar set of scenarios could be made of the potential residual impact of unremediated (sub) soil compaction on ALC grade according to soil droughtiness. The assessment of soil droughtiness considers climate, soil texture and, again, soil structure, consistency and porosity.

Several scenarios have been prepared to demonstrate the impact on soils using Field Capacity Days covering a range of hypothetical climates across England and Wales. Field Capacity Days (FCD) is a theoretical climatic model of the number of days in a typical year that accumulated precipitation exceeds accumulated evapotranspiration. It is based on historical climatic data in England and Wales, and wetter, cooler areas have higher FCD (e.g. >300 FCD in Welsh hills) than warmer, drier areas (e.g. 100 FCD in SE Cambridgeshire). It corresponds with the soil concept of Field Capacity, is the water content of a soil after gravitational drainage over approximately a day.

As is standard with the ALC system, the scenarios assume that soils have or could have an appropriate underdrainage system and the assumption is made that such a system will be in place at the end of the solar PV site decommissioning phase.

Several examples are presented to demonstrate the residual impact of an introduced SPL (caused by unremediated subsoil compaction) and the interaction with the climate variable Field Capacity Day (FCD) on BMV agricultural land. A summary of the scenarios is given below and detailed tables are in Appendix 5.

3.2.1 Scenario 1: Wetness Class I Medium-Textured Soils (Disturbed Land)

Several scenarios for 'disturbed' soils are presented in Appendix 5 (Table A) to demonstrate the residual impact of an introduced SPL (caused by unremediated subsoil compaction) on BMV agricultural land.

The following summary demonstrates the potential impact on land during the lifetime of a solar PV site. The pre-construction soil profile belongs to Wetness Class I⁴ and has a medium-textured topsoil. During the construction phase the soil is stripped and stored in soil bunds.

⁴ Wetness Class (WC) I = freely-draining soil. WC II = moderately freely-draining. WC III = imperfectly-draining. WC IV = poorly-draining. WC V = very poorly-draining. WC VI = permanently waterlogged.

- in an area with a FCD of 230 the impact of an introduced slowly permeable layer at a depth of between 25cm and 60cm would place the reinstated soil profile in Wetness Class IV and the agricultural land classification grade of Subgrade 3b. The agricultural land classification grade before commissioning would be Subgrade 3a, hence there is an impact at decommissioning on BMV land.
- in a drier part of England, with a FCD of 125, with an introduced SPL at a depth of between 35cm and 60cm, the reinstated profile is placed in Wetness Class III and the resultant ALC grade is Subgrade 3a. Prior to commissioning the ALC grade is given as Grade 1, hence there is an impact on the versatility of the BMV land at decommissioning.

3.2.2 Scenario 2: Wetness Class I Medium-Textured Soils ('Undisturbed' Land)

Several scenarios for 'undisturbed' soils are presented in Appendix 5 (Table B) to demonstrate the residual impact of an introduced SPL (caused by unremediated subsoil compaction) on BMV agricultural land. For 'undisturbed' soils reference is made to soil colour (gleying⁵), textural, structural and porosity characteristics for determining the soil wetness limitation.

The scenario is a pre-construction soil profile placed in Wetness Class I, which has a medium-textured topsoil:

- in an area with a FCD of 230, where there is an introduced slowly permeable layer at a depth of between the surface and a depth 80cm with gleying present below a depth of 40cm, the soil at decommissioning is placed in Wetness Class III and an ALC grade of Subgrade 3b. Prior to commissioning the ALC grade is given as Grade 3a, hence there is an impact at decommissioning on the BMV land.
- in an area with a FCD of 230, where an introduced slowly permeable layer is present at a depth of 25cm and gleying is present in the soil profile above 40cm the soil is placed in Wetness Class V and Grade 4. There is an impact at decommissioning on the BMV land.
- in a drier part of England, with an FCD of 125, where there is gleying present below a depth of 40cm and a slowly permeable layer starting between a depth of 35cm to 42cm the soil at decommissioning is placed in Wetness Class III and Subgrade 3a.

⁵ A greyish, pale and ochreous colouring indicative of waterlogging.

Prior to commissioning the ALC grade is given as Grade 1, hence there is an impact on the versatility of the BMV land at decommissioning.

3.2.3 Scenario 3: Wetness Class II Light-Textured Soils (Disturbed Land)

Several scenarios for 'disturbed' soils are presented in Appendix 5 (Table C) to demonstrate the residual impact of an introduced SPL (caused by unremediated subsoil compaction) on BMV agricultural land. The pre-construction soil profile belongs to Wetness Class II⁶ and has a light-textured topsoil. During the construction phase the soil is stripped and stored in soil bunds.

The following summary demonstrates the potential impact on land during the lifetime of a solar PV site:

- in an area with a FCD of 225 the impact of an introduced slowly permeable layer at a depth of between 25cm and 60cm would place the reinstated soil profile in Wetness Class IV and the agricultural land classification grade of Subgrade 3b. The agricultural land classification grade before commissioning would be Grade 2, hence there is an impact at decommissioning on BMV land.
- in a drier part of England, with a FCD of 125, with an introduced SPL at a depth of between 35cm and 60cm, the reinstated profile is placed in Wetness Class III and the resultant ALC grade is Grade 2. Prior to commissioning the ALC grade is given as Grade 1, hence there is an impact on the versatility of the BMV land at decommissioning.

3.2.4 Wetness Class II Light-Textured Soils ('Undisturbed' Land)

Several scenarios for 'undisturbed' soils are presented in Appendix 5 (Table D) to demonstrate the residual impact of an introduced SPL (caused by unremediated subsoil compaction) on BMV agricultural land. The pre-construction soil profile belongs to Wetness Class II and has a light-textured topsoil.

- in an area with a FCD of 225 the impact of an introduced slowly permeable layer at a depth of between 35cm and 61cm and gleying present above 40cm would place the profile in Wetness Class IV and the agricultural land classification grade of

⁶ Wetness Class (WC) I = freely-draining soil. WC II = moderately freely-draining. WC III = imperfectly-draining. WC IV = poorly-draining. WC V = very poorly-draining. WC VI = permanently waterlogged.

Subgrade 3b. The agricultural land classification grade before commissioning would be Grade 2, hence there is an impact at decommissioning on BMV land.

- in a drier part of England, with a FCD of 125, with an introduced SPL at a depth of between 35cm and 61cm and gleying above 40cm, the profile is placed in Wetness Class III and the resultant ALC grade is Grade 2. Prior to commissioning the ALC grade is given as Grade 1, hence there is an impact on the versatility of the BMV land at decommissioning.
- in areas with a FCD of 170 or lower with a light-textured soil changes in the Wetness Class and resultant grade may have minimal impact on BMV land (Appendix 5 Table D). However the introduction of a slowly permeable layer may influence the available water holding capacity of the soil profile and soil droughtiness may have an impact on the BMV land.

3.2.5 Summary

To summarise on both disturbed and undisturbed land, the soil wetness assessment shows the impact of unremediated soil compaction leading to gleying in the soil and the introduction of a slowly permeable layer. The potential loss of BMV agricultural land or its versatility increases in wetter parts of England and Wales.

In slightly drier parts of England and Wales there is loss of BMV agricultural land depending on the starting depth of the slowly permeable layer. Loss of versatility of BMV agricultural land, for the soil textures considered, occurs in slightly drier parts depending on the interaction of the Wetness Class and the FCD of the location.

3.3 Soil Compaction and Soil Droughtiness

Section 3.4 and Appendix 4 of the MAFF ALC Guidelines (1988) outline the methodology for assessing the soil droughtiness. Soil droughtiness indicates the degree to which a shortage of soil water may influence the range of crops grown and the yields achieved. Droughtiness is more likely to be a limitation to crop growth in areas of relatively low rainfall or high evapotranspiration. The interaction of the climate, soil texture, soil stoniness, subsoil structure, subsoil porosity and subsoil consistency influences the degree of the severity.

On solar PV sites both disturbed and undisturbed land at decommissioning may be affected by the introduction of unremediated soil compaction. This could reduce the crop available water of the soil profile, changing the ALC grade in the soil droughtiness assessment and may result in downgrading and /or loss of BMV.

The change in the grade may arise from a change in the soil profile characteristics, particularly soil consistence (the resistance to crushing) leading to changes in the available water holding capacity in the subsoil. The following scenario shows the impact of a change in the available water capacity of a subsoil on BMV land:

- Location – south east England
- Climatic moisture deficit for wheat is 122mm and potatoes 118mm
- **Prior to commissioning:** the profile subsoil has a good structural condition with the resultant crop adjusted water capacity for wheat of 110mm and for potatoes of 89mm.

The moisture balance limits place the profile in Subgrade 3a

- **At decommissioning:** the profile subsoil has a moderate structural condition with the resultant crop adjusted water capacity for wheat of 106mm and for potatoes of 85mm.

The moisture balance limits place the profile in Subgrade 3b.

In more severe cases unremediated soil compaction may prevent root penetration. Occurring at shallow depth this may have a significant impact on crop available water which may result in downgrading by more than one ALC grade. The depth of root penetration can only be assessed by the examination of soil pits.

3.4 Soil Mixing

Soil mixing may occur in the construction and decommissioning phases and is identified in Section 3.3 of the ALC Guidelines (MAFF,1988) as a potential limitation to grade. A study of the effects of golf course development on high quality agricultural land (MAFF,1995) considered the impact of soil mixing on the reversibility of high quality agricultural land. Where mixing of very different soils e.g. sands with clays occurred subsequent agricultural management was potentially difficult. The severity of the impact will depend on the amount of mixing- the ratio of different soil textures and other soil properties such as soil structure, stone content and organic matter content. It is difficult to assess the impact on BMV agricultural land from soil mixing but where it causes significant management problems, post-decommissioning, an independent assessment would be required – both to quantify and to remediate.

3.5 Reversibility or otherwise of the impacts on BMV agricultural land

One of the key impacts on BMV agricultural land is soil compaction, which can vary considerably from very minimal and short term to severe, which possibly cannot be rectified. Compaction in the subsoil below about 45cm is unlikely to be practicable and economic to alleviate (Batey, 2009) and is unlikely to respond quickly to natural recovery through the freeze-thaw cycle. Where compaction is present at depth it is a long-term limitation and it is taken into account in the ALC Guidelines (MAFF, 1988) through reduced permeability in the wetness assessment and crop available water in soil droughtiness assessment. There will be compaction at the time of construction, which may remain for the lifespan of the development. Further compaction may result at the decommissioning phase.

The timescale for reversibility is undefined but is taken in this report as the point at which decommissioning is completed. The time taken for a soil with compaction to recover depends on the severity of the compaction and the soil type. Business Wales (2018) and Froehlich et al (1985) reported that natural recovery of a compacted soil is complex and a slow process. Batey (2009) refers to 30 years for a compacted soil to recover, where 'industrial' compaction extends to depths of 1m or more (Spoor, 2006). Hakansson (1988) reported that compaction may be very persistent in the subsoil and permanent. Nawaz et al (2012) presented a review of research and concluded that soil compaction is rapid and easy to create with agricultural machinery but it can be years before the soil is recovered. Keller et al (2017) noted that knowledge regarding soil compaction rates is 'sketchy' with experimental evidence of recovery periods from a few months to years and decades. Differences in laboratory and field experiments highlight the 'partial and incomplete' knowledge of the key processes involved in soil structure recovery.

Keller et al (2021) undertook research at the Swiss Soil Observatory to quantify and monitor short-term recovery after prescribed compaction. After 2 years it was noted that different soil physical properties follow different recovery paths and rate. Bulk density and air permeability had not fully recovered to pre-compaction values in the topsoil and subsoil. Post compaction recovery rates decreased with soil depth and differed between soil properties.

A study of soil compaction on golf courses (MAFF, 1995) reported that the inappropriate handling of soils resulted in severe compaction and a deterioration of soil structure. In the period 1988 to 1993 construction work, such as soil stripping and trafficking, was undertaken on a number of golf courses during the winter months. A finding of the report was that if soil stripping had been carried out in a more controlled way parts of golf courses might have

been practically reversible to an agricultural land quality closer to the pre-construction quality.

A study undertaken by Defra (2016) considered compaction in grassland on 300 grassland fields. The study considered how grassland management may be used to influence soil compaction and how management can be targeted to alleviate or avoid compaction. The careful management of machinery use in terms of when and how many times soils are trafficked was a key influence on the level of soil compaction.

Current techniques for alleviating compaction above depths of 45cm, particularly in drier parts of England and Wales, indicate that some reversibility of the impact on BMV agricultural land is possible. However not all soils respond and silty soils, where there is structural instability, may be problematic.

Where deep compaction occurs in soil the reversibility of the impacts on BMV agricultural land are given in scenarios (sections 3.2.1 to 3.2.4 and Appendix 5). The impact of compaction on disturbed soils and undisturbed soils are assessed separately. In the case of disturbed soils there may not be any compaction if the soils associated with cable trenching are replaced in an unconsolidated condition. There are many unpredictable factors, such as soil strength and prevailing moisture content, that will affect the level of compaction and the potential to successfully alleviate damage.

In the case of compacted soils and the pre-construction Wetness Class I soil, reversibility involves the removal of the slowly permeable layer within 80 cm at decommissioning. The ALC Guidelines (MAFF,1988) consider that *'where significant compaction occurs below 35cm... it may be difficult or impossible to ameliorate practically or economically. Such compaction is therefore a long-term limitation which is taken into account through reduced permeability and water capacity in the wetness and droughtiness assessments'*.

Batey (2009) reports that techniques for loosening compact soils operating to depths of about 45cm are established. In the case of a soil profile in Wetness Class II it may be that the impact on BMV agricultural land is reversible and some loss of versatility is reversed. For example, in the drier parts of England with a FCD of 125 where there is compaction close to a depth of about 45cm and gleying present below a depth of 40cm, then the impact of compaction on BMV agricultural land is normally reversible, with the Wetness Class moving from Wetness Class III to Wetness Class II.

Any soil mixing may impact on BMV agricultural land but each site will have individual characteristics and it is difficult to prescribe for a potential impact. Small amounts of soil mixing should be reversible as the subsoil and topsoil are mixed by cultivation and soil biota but where significant soil mixing does occur the reversibility of the impact on BMV agricultural land becomes increasingly challenging.

4 POTENTIAL IMPACTS (POSITIVE AND NEGATIVE) ON SOILS DURING THE OPERATIONAL PHASE

4.1 Introduction

During the operational phase of the solar PV site there are minimal activities on site and the site is usually unmanned. Routine maintenance at the site may include grass cutting, if grazing does not keep the grass at the optimum height, landscape management (e.g. hedge trimming) and an annual PV panel wash. The electrical systems may be monitored monthly and a grazier to manage stock grazing may access the site. Access is typically by 4x4 vehicles and it is unlikely that any heavy machinery will be required.

Grazing of grassland by sheep required careful management. Excessive stocking rates and / or grazing on soils susceptible to damage during wet weather, may negatively impact the soil during the operation phase and may pose environmental issues such as increased surface water runoff.

4.2 Claimed benefits of topsoil carbon capture and soil structural improvements

Much guidance (BRE, 2013 and 2014a) and many planning applications promote the benefits to biodiversity of solar PV sites.

Agricultural land use change, often from arable use, on BMV agricultural land to low-maintenance grassland, has been cited by developers in planning applications as a benefit arising from solar PV sites. Soil carbon, mainly derived from carbon fixed by plants, is stored in soils in the form of soil organic matter (SOM). SOM is the cornerstone of soil health; it is beneficial to soil structure, the resistance of the soil to erosion, plant / crop available water, plant / crop available nutrients, earthworm numbers, soil microbiology and biodiversity etc. Furthermore, as a carbon store it is of particular importance today and in the future.

Reports of changes in soil carbon resulting from land reversion are reported by Conant et al (2001). More recently Connant et al (2017) have studied data since 2001 and confirm their earlier conclusions that improved grazing management, fertilization, sowing legumes and improved grass species and conversion from cultivation all tend to lead to increased soil carbon (C).

Defra (2009) reported that the quantity of C that can be stored in any soil is finite. Following a change in management practice levels C can increase (or decrease) towards an equilibrium value at about 100 years depending on the soil type, land use and climate. The relatively

'high' annual rate of C storage reported in the early years following a land use change from arable use to a grassland use does not continue and the rate of accumulation will decline until a new equilibrium is reached. Where the land use change is from long term grasslands it is expected that the initial properties at commissioning of the solar PV site would be different from short term grassland and arable land.

Maintaining an increased SOM level, due to a change in management practice, will be dependent on continuing that practice indefinitely. Only if land is taken permanently out of arable cultivation or rotation will the benefits of C storage be realised over the long-term. Soil organic matter is more rapidly lost than it is accumulated (Freibauer et al, 2004).

A study by Gosling et al (2017) considered the potential for the conversion of arable cropland to grassland to sequester carbon in the short to medium term. The study reported no difference in soil organic carbon stocks in the top 30cm of the soil profile in grassland up to 17 years old and arable cropland at sites across the UK.

The conversion of tillage to grassland resulted in an increased carbon storage in the range 1.1 to 7.0 CO₂e/ha/year (Dawson and Smith, 2006). Conversion of grassland to tillage cropping was estimated to result in carbon losses in the range 2.2 to 6.0 CO₂e/ha/year. It was also reported that converting areas of farmland to grass buffer strips and hedges/shelter belts would enhance soil organic matter and increase C storage on a smaller scale. The baseline soil reference values prior to commissioning are key to understanding any change in SOM over the lifetime of the solar PV site. The land use and factors, such as the changes in management practices e.g. reduced tillage operations, at each site prior to commissioning impact on the baseline soil reference values and potential level of change in SOM.

The relationship between increased SOM and improved soil structure is documented (Cranfield, 2001) and recognised in land management practices with minimum tillage or no tillage operations (Game and Wildlife Conservation Trust, 2020). It is also recognised that reverting arable agricultural land to low-maintenance grassland will improve soil structure. The term soil structure refers to the shape, size, orientation, degree of development, porosity and consistency of aggregates of soil particles. Structure influences the movement of air, water, carbon, nutrients, roots and microorganisms within soil. An improved soil structure is beneficial to many of the key ecosystem services performed by soils, including regulation of air and water, carbon capture and support of plants.

Choi et al (2020) undertook a study in Colorado USA on the effects of revegetation on soil physical and chemical properties in solar PV infrastructure over a 7- year period. The study

found that soils at the solar PV site contained significantly less carbon than the reference soil. This was likely to be caused by the removal of topsoil during the array's construction. The ability of the soil on the site to sequester carbon was diminished relative to reference soils. The study suggested mitigation in the adoption of minimum topsoil disturbance during construction.

Key points from studies on land use changes and soil carbon include:

- The initial increases in the early years do not continue
- To maintain an increase in the level of soil carbon the land has to be taken permanently out of arable cultivation or rotation
- Soil organic matter is more rapidly lost than it is accumulated.

There is limited evidence specifically relating to solar PV sites to confirm the benefits to soil health. Baseline site specific soil reference values are required with long-term monitoring to provide evidence of the changes and legacy in the soil health at a solar PV site over a typical lifetime of 40 years.

Factors such as the disturbance of the soil at the construction phase may impinge the development of benefits through the operation phase. Even in the most successful cases (of soil carbon capture, health and structure improvement), improvements are likely to be only temporary and decrease with disruption at decommissioning and again at the return to arable cropping.

The physical presence of solar PV arrays on land is known to cause seasonal and diurnal variations in air and soil microclimate (Armstrong et al, 2016). The work by Alona Armstrong and her team at Lancaster University, particularly the work of Carvalho et al (2021), is looking at the effect of solar PV sites on soil specific factors, including soil organic carbon, nutrients and pH, bulk density, above ground biomass, soil microbial community etc. The work is in its early stages but managed to survey 35 solar PV sites in England and Wales in 2021 and will survey more sites in 2022. This and further such work could be very instructive.

In summary, further evidence is required to substantiate the benefits of SOM at solar PV sites and the claims cited by developers in planning applications.

4.3 The influence of shading and microclimates beneath panels on soil microbial activity

While the increased levels of SOM are recognised in grassland systems, the full impact of the physical presence of solar PV arrays on grassland management is open for discussion. Armstrong et al (2016) investigated the effects of solar PV arrays on microclimate and the consequences for carbon (C) cycling at Westmill Solar Park. The research found that PV arrays can cause both seasonal and diurnal variation in the ground-level microclimate such that there was an effect on terrestrial C cycling. One of the conclusions of the project is that the effects of solar PV sites on plant–soil processes, which underpin key ecosystem services, is poorly understood.

The microclimatic variability within a solar PV site arises from a lower temperature under the PV arrays. The above ground plant biomass was four times higher in the gap between arrays and the control areas compared to the biomass under the PV arrays. The soil temperature is cooler under the PV arrays and between the PV arrays during the winter due to the interception of shortwave radiation by the solar PV arrays.

The shadow cast by the PV arrays varied from under 2 m in the month of June to just under 11 m in the month of December. The cooling is likely to be significant in terms of ecosystem function with the temperature differences affecting key plant-soil processes from productivity to decomposition (Marrou et al 2013). Thomas et al (2020) expected rising soil temperatures on site would increase soil organic carbon losses due to the increased rates of microbial decomposition.

Recent work in the Netherlands has considered the design of the site layout and the impact on soil (van Aken et al 2021). A comparison of the amount of ground irradiance in terms of intensity and distribution between two south-facing solar park configurations and east-west orientated panels was made. Two variants were made- one with standard solar panels and another with semi-transparent solar panels and bifacial panels. A 77% coverage with semi-transparent and bifacial panels ‘performed better on soil quality’ with a more even distribution of light on the soil than standard panels with a 53% coverage. The study recommended the establishment of criteria for ground radiation under and between panels.

4.4 The influence of solar developments on soil loss and erosion

Soil loss can occur during the construction phase as soil is stripped for the construction of a compound, bases for inverters and substation, and access tracks. Many solar PV site layouts

do not plan space for soil storage bunds and propose to spread the soil in thin layers alongside the access track. This leaves the stripped soil barely visible in the landscape and difficult to reclaim at the restoration phase. This approach is likely to contribute to soil loss, as the soil will not be recovered to its original volume at the decommissioning phase.

Across a solar PV site disturbance can cause the loss of the surface vegetation (see Appendices 3 and 4) and this will leave a site far more vulnerable to soil loss from erosion.

Runoff from solar panels has an influence on soil erosion. Water is known to run along the edge of the panels then fall to the ground at localised points and form rivulets. This has the potential to cause soil erosion, the risk of which is strongly influenced by slope and soil type. Choi (2020) reported erosion and one of the case studies in WP2a (Estuary Farm⁷) considered the possibility of runoff from solar panels causing compaction of soils at the base of the panels and resulting in rivulets forming along the edge of the rows of panels. While there may not be a significant increase in runoff, small channels will have formed with potential of soil loss. This problem is likely to be more severe in erodible soils such as sandy soils on slopes before a vegetation cover establishes. However, the steepness of the slope would be an even stronger influence. The risks are repeated at the construction and decommissioning phases.

4.5 A summary of claimed benefits to soil from previous cases (WP 2a case studies)

The case studies referred to in WP 2a have been reviewed for any claimed benefits to soil within the supporting documentation.

- **Tyddyn Cae Solar Farm Gwynedd**⁸ – there is reference to a reduction in nutrient input to the land as a result of changing from an arable use to grassland. The statement is made that ‘soil health is essential for long term sustainability of farming, and solar farms could play an important role by resting soils through the life of the solar farm, allowing soil nutrients to restore naturally, without the need for regular use of fertilizers.’ and reference is made to BRE (2014a).

⁷ https://www.west-norfolk.gov.uk/planning_and_development Ref: 21/01432/FM

⁸ <https://amg.gwynedd.llyw.cymru/planning/index.html?fa=getApplication&id=24205> Ref: C14/0885/33/LL

- **New Works Solar Farm Telford**⁹ – the site falls outside BMV agricultural land. There is no reference to claimed benefits to soil. Reference is made to the Solar Energy UK’s publication ‘The Natural Capital Value of Solar’.
- **Estuary Solar Farm, King’s Lynn**¹⁰ – there is no reference to claimed benefits to soil. The proposal is to use an ‘under-utilised area of agricultural land’ and enhance the ‘once arable habitat’ with wildflowers and species diverse grassland.

The case studies do not give any site-specific detail on benefits to soil in the supporting documents for the planning application.

⁹ <https://secure.telford.gov.uk/planning/pa-applicationsummary.aspx?applicationnumber=TW/2021/0737>
Ref: TW/2021/0737

¹⁰ https://www.west-norfolk.gov.uk/planning_and_development Ref: 21/01432/FM

5 ARE SOLAR PV SITES REVERSIBLE TO AGRICULTURE WITHOUT RESIDUAL (NEGATIVE) IMPACT?

5.1 Introduction

A brief review and summary of the hypothesis: *‘that solar PV sites are physically reversible to agriculture without residual (negative impact) in the BMV and Non-BMV context’* is presented. The evidence base to support this hypothesis and the main issues influencing reversion to agriculture are identified.

5.2 Evidence Base

The key residual impact on the land is soil compaction. Defra (2016) reported that careful management of machinery use in terms of when and how many times soils are trafficked was a key influence on the level of soil compaction on grassland.

Current techniques on alleviating soil compaction are effective in the topsoil and upper subsoil, generally above a depth of 45cm (Batey, 2009). The depth of the uppermost compacted layer (e.g. after remediation) may be the determining factor in the realisation of potential agricultural use. Keller et al (2021) provide evidence that the recovery of soil from compaction was longer than 2 years. Compaction may be very persistent in the subsoil and possibly permanent (Hakansson et al 1988). Where there is ‘industrial’ compaction the depth of compaction can extend to depths of 1 m (Spoor, 2006) and may persist for up to 30 years (Batey, 2009). A review by Nawaz et al. (2021) refers to time scales of 5 to 18 years for soils to recover from compaction with the aid of agricultural machinery and for soil to recover from compaction naturally (without aid) 100 to 150 years.

At the point of decommissioning there is likely to be a residual impact of soil compaction across solar PV sites. The impact may affect the agricultural use of the land and decisions about cropping and yields.

Soil mixing has been reported by Choi (2020) where there was a greater fraction of coarse particles in the study solar PV site soil than the reference soil. It was considered that the difference arose during the construction phase, when the topsoil was disturbed and fine soil particles were lost by water erosion. Soil mixing has potential to occur at other stages in the life of a solar PV site, such as pile extraction.

5.3 The main issues influencing reversion to agriculture

At decommissioning all materials are expected to be removed including the removal of piles from the soil. Most standard steel products corrode, particularly in the upper part of the pile and this may adversely affect the ability to extract the piles after 40 years. (Non-corrosive materials could be used but have cost implications). It may be that piles fracture and are difficult to extract without additional digging. An engineering solution, where extraction is adversely impacted, would be to partially cut down the piles and provide a capping layer of soil (per comm. P Woodfield, Technik GS). Any residual piles are likely to have a negative impact on whether the land is physically reversible to agriculture unless buried sufficiently deep to enable cultivations and drainage. Where residual piles could not be buried to a depth to allow cultivations the grading of the land would take into account the severity of the limitation. Land with severe or very severe limitations, which restrict the range of crops, is placed into either Grade 4 or Grade 5 in the MAFF Agricultural Land Classification system. To bury the piles to a sufficient depth would mean excavating to a depth of at least 1.0-1.2 metres. This would result in significant soil disturbance if many of the piles were affected in this way.

Where galvanised beams are used zinc is present in the galvanised coating. There are two methods of galvanising used- 'continuous galvanising' and 'batch hot dip galvanising' (per. comm. A Whalley, Milestone Communications). Continuous galvanising (DIN EN 10327) gives a thinner coating, so the expected life is lower. If the beams are batch hot dip galvanised then standard ISO14713-1 applies, which includes reference to exposure to soil. Corrosion in soil is dependent on the soil's mineral content, the nature of the minerals and organic components and the water and oxygen contents. The impact of any interaction between the piles and the soils and potential loss of zinc coating over 40 years and whether there is any residual impact may need to be considered (per. comm J Williams, ADAS). Guidance from Defra (2018) on the use of sewage sludge on land states that the maximum quantity of zinc that can be applied per ha is 150kg over 10 years. Potentially any loss of zinc from piles could be well within this limit, but there is no supporting evidence. There is also evidence that high zinc levels in soils affects the soil biological activity (Moffett et al, 2003).

Handling soil in suitable conditions has an influence on the reversion of land to agriculture. Different soil textural classes have more resilience to structural damage and are more responsive to remediation during soil handling. Light textured soils e.g. sand, loamy sand, sandy loam and sandy silt loam have a higher resilience to structural damage than medium texture soils e.g. soil with 18-27% clay content. Silt loam soils and heavy soils with >27% clay

content have a low resilience to damage. Soil should only be handled or trafficked when as dry and as friable as is practicable. If handled or trafficked in adverse conditions damage to the soil structure can easily occur.

The period available for soil handling and trafficking on a solar PV site can influence the impact on the soil, the resultant structural damage and reversion to agriculture. The Institute of Quarrying (2021) has prepared a map of England and Wales showing climatic zones when vegetated mineral soils may be in a sufficiently dry condition according to their geographic location, depth of soil and clay content. When the clay content is between 10% and 27% in the topsoil in Wales, the South West and North of England the indicative on-average period when soils may be in a sufficiently dry condition for handling is generally late May to early October. For similar soils in central parts of England it is generally late April/early May to early November, while in the East of England it is generally late April to early December. The location of the proposed solar PV site and susceptibility of a soil type to structural damage should be considered at the design stage to ensure timeliness of soil handling and trafficking. A soil in West Wales with a medium clay loam texture and clay content of 24% will have a shorter window for soil handling and trafficking than the same soil in East Anglia. The impact of climate and climatic zones should be built into the design statement at the pre-planning stage of a site.

A research study into end of life decision making for solar farms (Windemer,2021) reported that there may be changes in ownership of the solar PV site with a change in the priorities for the site. The study considered finance for decommissioning, reporting that bonds are not always used in the solar sector as it is 'felt that decommissioning will not present a challenge'. The study found that some developers considered that decommissioning may be self- funding through the resale value of equipment and materials from the site. A sample decommissioning plan (Solar Energy UK, 2022) refers to the provision of a decommissioning fund either through a surety bond, an irrevocable standby letter of credit or other financial security.

Developers may consider that the scrap value of the panels etc on site will cover the costs of decommissioning. There are few contingency plans in place and should operators encounter financial instability and the economics of solar PV change during the project life and trigger early decommissioning then this may influence the reversion of the site to agriculture and other changes of land use may be sought.

Finances available for decommissioning are part of the responsibility of the operator or landowner or both and can influence the reversion to agriculture. It is the responsibility of the planning authority to ensure that the developer or landowner has secure finances or a bond in place to fund decommissioning.

5.4 Summary

There is evidence that soil compaction from machinery can have a residual impact on soil and land. Soil mixing may occur during construction and in the voids left after piles are extracted. Soil compaction and mixing may result in issues for land management. Removal of physical infrastructure on site and re-instatement of soil/land is necessary if the land is to be capable of reversion to a BMV agricultural land quality as well as a non BMV agricultural land quality.

The finance available for the required decommissioning and the timings of these operations may be an influencing factor on the reversion to agriculture. There may be financial constraints, time penalties and contractual performance issues that affect the decommissioning programme and the quality of remediation works.

6 THE PARALLELS BETWEEN MINERAL SITE RESTORATION AND SOLAR PV SITE RESTORATION

There are a few parallels between mineral site restoration and solar PV site restoration. In both situations soil will have been subject to stripping, some form of storage and then spreading over a subsoil. Subsoil compaction is likely to be found in both situations.

There are significant differences in the approach to restoration undertaken.

- Mineral site restoration is detailed as part of the planning application stage, supported by a soil resource management plan and restoration is subject to a statutory aftercare period of 5 years. There is published guidance for solar PV sites (BRE, 2013) recommending that a soil resource management plan be prepared as part of the planning application. Where soil resource plans have been prepared they have usually been undertaken as a condition of planning approval.
- While mineral sites require planned soil storage in the form of bunds many solar PV site layouts do not typically accommodate soil storage in bunds within the site and soil may be spread thinly alongside access tracks on undisturbed land.
- Solar PV site restoration involves the pull out of piles with soil disturbance at the decommissioning phase.
- Only part of a solar PV site generally requires restoration with soil spreading. Most of the area is not disturbed by soil stripping but is subject to trafficking and therefore may be compacted. Mineral site restoration good working practices involve spreading the soil in such a way that trafficking is minimised but all the soil is disturbed leading to a greater disturbance of soil structure and soil biota.

In summary, there are significant differences between mineral site restoration and solar PV site restoration. The main parallel is the need for a soil management plan to protect the soil resource.

7 THE PARALLELS BETWEEN GOLF COURSES OR SIMILAR SOFT USES AND SOLAR PV SITE RESTORATION

There are very limited documented experiences of the reversibility of golf courses to agriculture.

Parallels between golf courses and solar PV sites can be found where there is site levelling and movement of soil. Golf course restoration to agriculture may involve the importation of fill and some land levelling. Fill may also have been imported at the golf course construction stage. Landscaping forms part of both golf course development and solar PV site.

The presence of physical infrastructure on a solar PV site where there may be a high density of piles (e.g. 492 piles per ha) and extensive lengths of trenching for cables are significant differences. The extent of constructed infrastructure on solar PV sites may be greater than on a golf course. The impact of compaction from trafficking would be expected to be greater on a solar PV site than a golf course development, although surface sealing on golf courses can be an issue due to footfall.

A study (MAFF,1995) reviewed the effect of golf course development on Grades 1, 2 and 3a land. The potential adverse effects that impact on high quality agricultural land are from earth moving during construction, soil mixing, sterilisation of land and construction of clubhouses and car parks. The impact of a golf course on land was defined as 'high' (more than 50% of the land irreversibly lost) to 'low' (10 to 25% of the land irreversibly lost). In the study 'irreversible' was defined as the *'ability to restore a site to a similar agricultural land quality which existed prior to development. It is not just the ability to restore land back to agricultural use'*.

The greatest irreversible loss of high quality agricultural land on golf courses resulted from earth shaping and sterilisation of land. Golf courses with the lowest impact used existing landform with little disturbance to the agricultural land. Soil mixing and compaction tended to be localised and the impact on the ALC grade of the land was variable. The study found that golf course constructions on over 30% of the courses took place in the winter period when conditions for soil handling were not suitable. The impact on high quality agricultural land and the reversibility to a similar grade was influenced mainly by the disturbance of the soil through earth moving.

Both golf courses and solar PV sites are presented as being reversible to an agricultural use.

The parallels for restoration between golf courses and solar PV sites include the disturbance of soil, soil mixing, trafficking of the land and unsuitable conditions for soil handling and trafficking during the construction, operation and decommissioning phases.

8 CAN SOIL HANDLING CONDITIONS, AS PART OF THE PLANNING PROCESS, MITIGATE OR REMOVE THREATS TO SOILS AND LAND

8.1 Soil Handling Conditions

Soil is moved through stripping, storage and replacement operations at the construction and de-commissioning phases of a solar PV site. Soil handling will be part of the construction of the site compound, access roads/track, bases for inverters and substations and cabling operations.

A soil resource assessment, undertaken as part of the pre-planning stage, gives a baseline of existing soil conditions on site. The assessment will identify different soil types and soil handling units, which will be required to be stripped, stored and replaced in discrete areas. Planning guidance on large scale ground mounted solar PV sites (BRE, 2013) recommends inclusion of a methodology for stripping, storage and replacement of soil within the developer's planning application. The Institute of Quarrying guidance on soil handling (Institute of Quarrying, 2021), applicable to the civil engineering and the wider construction sectors, refers to the need for a soil resource and management plan (SRMP) at design stage through to site closure. Defra's Code of Practice for the Sustainable Use of Soils on Construction Sites (2009) recommends the inclusion of a soil resource plan as part of pre-construction planning.

From the evidence ADAS has seen, it appears that the preparation of a soil resource and management plan (SRMP) for solar PV sites has usually been a condition of the planning permission granted by the planning authority – i.e. as a condition of permission rather than being prepared to support the planning application. The responsibility for the standard and quality of the SRMP lies with the planning authority.

The SRMP considers the management of soil at the construction phase and is a separate document to a decommissioning plan, which is generally conceived at a much later stage of the project life. From the perspective of protecting the soil resource the two documents should be closely intertwined.

While the preparation of a SRMP may meet a condition of the planning authority, on its own it cannot mitigate or remove the risks of harmful impacts on soil and land or be a guarantee for a successful outcome. The key to mitigation is how the SRMP is implemented, the time of year when construction work is undertaken and the day-to-day management on site during soil handling and trafficking. ADAS experience on infrastructure projects has shown

that the on-site presence of a soil scientist can ensure that soils are stripped at the appropriate depth and in suitable conditions for soil handling. A recording of soil stripping movements and storage locations should be made.

The lifespan of a solar PV site is generally around 40 years. To safeguard the soil resources for this number of years any soil stripped is best placed in planned storage bunds within the site boundary and a record of soil type and volume in each bund made. The physical and chemical conditions of the soil are likely to have changed from the pre-construction (pre-storage) baseline. Storage can cause a reduction in soil porosity and structure. The preparation of a remediation plan with an aftercare programme as a condition of planning permission will give details on soil handling, but the implementation is key to the outcomes.

8.2 Restoration of BMV agricultural land

A research project undertaken in the 1990s considered the quality of agricultural land at the post restoration stage for a number of mineral sites (Defra, 2000). The study included 34 sites with best and most versatile agricultural land quality and of these about half had maintained their pre-working grade at the start of the 5-year aftercare period and the majority had maintained or improved the grade at the end of the 5-year aftercare period. On these sites the soil was worked in phases over a much shorter period than a solar PV site lifespan and therefore was not in long-term storage.

There are many factors that can influence the outcome of restoration of Best and Most Versatile (BMV) agricultural land and these may include:

- The inherent soil properties and variability across the site
- The amount and duration of climatic wetness
- The daily weather conditions and the soil moisture assessment prior to and during soil handling with appropriate soil handling decision making
- Soil resource and management planning at an early stage in the planning process
- Trafficking the land when soils are in suitable conditions
- Recording details (soil type, volume) of stored soils
- Using appropriate machinery in suitable conditions.

Commercial pressures can influence a restoration programme, resulting in work taking place in unsuitable conditions, resulting in damage to the soil and potentially loss of BMV agricultural land.

The condition of the soil after removal from stockpiles will be a key factor in the realistic restoration of sites with BMV agricultural land. A programme of aftercare with finances provided to cover associated costs is essential if there is to be a realistic restoration to BMV agricultural land.

At present the decommissioning of a solar PV site covers the removal of all physical infrastructure. Some developers refer to returning the site to its pre-development condition but give limited details. A detailed decommissioning plan is not required by planning conditions until near the end of the life of the site. The detail of a soil resource and management plan should inform the decommissioning plan.

Many solar PV sites change management over the period of operation and the agreements and responsibility for decommissioning at the granting of planning permission should be taken forward to the site closure.

It is important to note that soil is naturally fragile and restored soils remain particularly vulnerable for a variable period until the new soil structure has stabilised. This means that, even if all the correct plans and procedures are put in place and followed with best practice by all contractors during all phases, restoration of disturbed soil may still fail. This may occur when high rainfall causes prolonged waterlogging before the new soil structure has stabilised and causes the soils to slump.

8.3 BMV v non-BMV agricultural land

It is important to note, despite the risks of the construction, operation and decommissioning phases to BMV agricultural land, that in many instances the soils on BMV agricultural land may potentially be easier to restore after decommissioning than non-BMV. However much depends on the site location and interactions between climate and soil.

Non-BMV agricultural land, i.e. Subgrade 3b, Grade 4 and Grade 5, is described as moderate, poor and very poor quality land respectively. It has physical or chemical limitations ranging from moderate to very severe. On any land with heavier soil types in wetter, cooler climates the soil is likely to be more susceptible to damage during the construction, operation and decommissioning phases. There will be a shorter safe window for construction, decommissioning, aftercare and even sheep grazing through the operational phase. Where droughtiness is the main limitation the characteristics of a sandy soil profile with a moderately stony subsoil may be altered during soil handling and affect the water holding capacity of the soil profile at decommissioning, leading to a change in the ALC grade.

The management history of non-BMV agricultural land will influence the baseline soil reference values and the potential carbon capture benefit of solar PV sites. Land in Subgrade 3b may be used for cereals or grass, while land in Grade 4 may be used for grass with occasional arable crops. Land in Grade 5 is typically limited to permanent pasture or rough grazing.

There may also be greater environmental risks during construction, operation and decommissioning on non-BMV agricultural land. Soils may be at field capacity or have a clayey or silty soil texture with a landform resulting in surface water runoff. In such instances there may be a greater risk of soil erosion and pollution of water courses.

Key to managing the risks at any site is an adequate soil resource and management plan tailored to the individual site which is adhered to by contractors and which flows into an appropriate, and appropriately funded, decommissioning plan, including aftercare as required.

9 TYPICAL PLANNING CONDITIONS FOR RESTORATION OF AGRICULTURAL LAND

Planning conditions may be put in place by the planning authority to address matters of soil handling, storage, replacement and aftercare. An outline soil resource and management plan should be prepared taking into account an overview of the typical planning conditions, with attention to the times of soil handling. A detailed plan should be prepared as required, taking into account typical planning conditions. The potential planning conditions should be considered at the planning stage of the solar PV site and the limitations imposed on soil handling by soil and climate interactions. Welsh Government (2014) give an example of conditions applicable to solar PV development. These conditions are reproduced below and can be linked to the three phases in the life of a solar PV site.

9.1 Whole Lifetime site Condition

General Handling of Soils

All soils shall only be stripped, handled, stored and replaced in accordance with document (*insert ref.*) dated (*insert date*) except as modified by this schedule of conditions or unless otherwise agreed in writing with the Local Planning Authority.

Reason: To prevent loss or damage of soil, or mixing of topsoil with subsoil, or subsoil with aggregate or mixing of dissimilar soil types.

Topsoil shall be stripped to a depth of (*insert ref. / mm*), subsoil shall be stripped to a depth of not less than (*insert ref. / mm*) and they should be stored separately in mounds within the site.

Reason: To prevent loss of soil, and ensure the direct replacement of soil

All topsoil and subsoil shall be permanently retained on site and used in restoration.

Reason: To prevent loss of soil.

In each calendar month, the Local Planning Authority shall be notified in writing at least 7 days before each of the following stages:

- (a) Before each phase of soil stripping is due to commence;
- (b) When soil subsoil has been prepared ready for topsoil replacement to allow inspection of the area before further restoration of this part is carried out; and
- (c) On completion of topsoil replacement

Reason: To ensure that the Local Planning Authority is given opportunity to check that soil operations do not occur under unsuitable conditions and to provide sufficient notice for site inspection.

Soil Stripping

In each calendar year, soil stripping shall not commence on any phase until any standing crop or vegetation has been cut and removed.

Reason: To avoid incorporation of concentrations of decaying vegetation in soil.

Topsoil and subsoil shall only be stripped when they are in a dry and friable condition. The developer shall give 48 hours notice to the Planning Authority of the intention to carry out any soil movement operation and no movement of soils shall occur:

(a) During the months May to October (inclusive), unless otherwise agreed in writing with the Local Planning Authority; and,

(b) Topsoil and subsoil handling for the restoration of land to agriculture, shall cease during rain, applying the following criteria:

(i) If there is light rain or drizzle, handling can proceed for up to four hours unless the soils are already in too moist a state (see tables below);

(ii) If there is light rain, handling will cease if the rain has not stopped in 15 minutes; (iii) If there is heavy rain (as from intense showers, slow-moving depressions) handling shall stop immediately;

(iv) If sustained heavy rainfall (e.g. $\geq 10\text{mm}$ in 24 hours) occurs during soil stripping operations, work must be suspended and not re-started until the ground has had at least a full dry day or agreed moisture criteria (see below) can be met;

(v) Soil shall not be handled or trafficked during or shortly after heavy precipitation (including rain, snow and hail) in a waterlogged condition, and when there are pools of water on the ground surface; and

(vi) After rainfall has ceased, field tests shall be applied to determine when handling may re-start

Reason: To prevent damage to soils.

9.2 Construction Phase

Soil Storage

All topsoil and subsoil shall be stored in accordance with document (*insert ref.*) dated (*insert date*) and in separate mounds which shall:

(a) Not exceed 3 metres in height in the case of topsoil, or exceed 5 metres in height in the case of subsoil unless otherwise agreed in writing with the Local Planning Authority;

(b) Be constructed with only the minimum amount of soil compaction to ensure stability and shaped so as to avoid collection of water in surface undulations;

(c) Not be subsequently moved or added to until required for restoration unless otherwise agreed in writing by the Local Planning Authority;

(d) Have a minimum 3.0 metre standoff, undisturbed around each storage mound;

(e) Comprise topsoils on like texture topsoils and subsoils on like texture subsoils; (f) In the case of continuous mounds, ensure that dissimilar soils are separated by a third material, which shall have previously been agreed in writing by the Local Planning Authority. <i>Reason: To prevent the loss of soil and minimise damage to soil structure during storage.</i>
Prior to soil stripping and formation of storage mounds, a scheme for grass seeding and management of all storage mounds that will remain in situ for more than three months shall be submitted for the written approval of the Local Planning Authority. Seeding and management of the storage mounds shall be carried out in accordance with the approved details. <i>Reason: To protect mounds from soil erosion, prevent build up of weeds in the soil and remove vegetation prior to soil replacement</i>
Within three months of completion of soil handling operations in any calendar year, the Local Planning Authority shall be supplied with a plan showing: (a) The area stripped of topsoil, subsoil and soil making material; (b) The location of each soil storage mound; and (c) The quantity and nature of material therein. <i>Reason: To facilitate soil stock taking and monitoring of soil resources</i>

9.3 Temporary Compound Decommissioning

Soil Replacement

Soil material shall be placed in accordance with the approved scheme. Any alteration to this working method shall only be carried out with prior approval from the Planning Authority. The soil material (topsoil and subsoil) set aside for use in the agricultural restoration shall be spread uniformly and in correct sequence. The soil profile in all areas restored to agricultural after use shall be in accordance with the approved scheme. Any intention to alter this soil depth will require prior approval from the Planning Authority. All operations to move and place soil material shall be carried out only when such material is in dry and friable condition and ground conditions are dry and firm. The developer shall give 48 hours notice to the Planning Authority of the intention to carry out any soil movement operation, and no movement of soils shall occur: (a) During the months May to October (inclusive), unless otherwise agreed in writing with the Local Planning Authority; and, (b) Topsoil and subsoil handling for the restoration of land to agriculture, shall cease during rain, applying the following criteria: (i) If there is light rain or drizzle, handling can proceed for up to four hours unless the soils are already in too moist a state (see tables below);

(ii) If there is light rain, handling will cease if the rain has not stopped in 15 minutes; (iii) If there is heavy rain (as from intense showers, slow-moving depressions) handling shall stop immediately; (iv) If sustained heavy rainfall (e.g. $\geq 10\text{mm}$ in 24 hours) occurs during soil stripping operations, work must be suspended and not re-started until the ground has had at least a full dry day or agreed moisture criteria (see below) can be met; (v) Soil shall not be handled or trafficked during or shortly after heavy precipitation (including rain, snow and hail) in a waterlogged condition, and when there are pools of water on the ground surface; and (vi) After rainfall has ceased, field tests shall be applied to determine when handling may re-start The site shall be restored only in accordance with the approved (<i>insert ref</i>) Plan and all items therein shall be maintained to the satisfaction of the Planning Authority for a period of 5 years. Maintenance shall include the re-seeding of any areas of grassland that are in unsatisfactory condition in the view of the Planning Authority. <i>Reason: To ensure that the site is reclaimed in an orderly manner to a condition capable of maintaining the BMVAL¹¹ status.</i>
All structures, buildings, debris and mounds shall be removed from the site on completion of permission. Compounds and access tracks shall be ripped and any resulting spoil removed from the site and the access removed unless otherwise agreed in writing with the Local Planning Authority.

9.4 Decommissioning Phase End of Life

Soil Replacement

Soil material shall be placed in accordance with the approved scheme. Any alteration to this working method shall only be carried out with prior approval from the Planning Authority. The soil material (topsoil and subsoil) set aside for use in the agricultural restoration shall be spread uniformly and in correct sequence. The soil profile in all areas restored to agricultural after use shall be in accordance with the approved scheme. Any intention to alter this soil depth will require prior approval from the Planning Authority. All operations to move and place soil material shall be carried out only when such material is in dry and friable condition and ground conditions are dry and firm. The developer shall give 48 hours notice to the Planning Authority of the

¹¹ Best and Most Versatile Agricultural Land

intention to carry out any soil movement operation, and no movement of soils shall occur:

(a) During the months May to October (inclusive), unless otherwise agreed in writing with the Local Planning Authority; and,

(b) Topsoil and subsoil handling for the restoration of land to agriculture, shall cease during rain, applying the following criteria:

(i) If there is light rain or drizzle, handling can proceed for up to four hours unless the soils are already in too moist a state (see tables below);

(ii) If there is light rain, handling will cease if the rain has not stopped in 15 minutes; (iii) If there is heavy rain (as from intense showers, slow-moving depressions) handling shall stop immediately;

(iv) If sustained heavy rainfall (e.g. ≥ 10 mm in 24 hours) occurs during soil stripping operations, work must be suspended and not re-started until the ground has had at least a full dry day or agreed moisture criteria (see below) can be met;

(v) Soil shall not be handled or trafficked during or shortly after heavy precipitation (including rain, snow and hail) in a waterlogged condition, and when there are pools of water on the ground surface; and

(vi) After rainfall has ceased, field tests shall be applied to determine when handling may re-start

The site shall be restored only in accordance with the approved (*insert ref*) Plan and all items therein shall be maintained to the satisfaction of the Planning Authority for a period of 5 years. Maintenance shall include the re-seeding of any areas of grassland that are in unsatisfactory condition in the view of the Planning Authority.

Reason: To ensure that the site is reclaimed in an orderly manner to a condition capable of maintaining the BMVAL status.

All structures, buildings, debris and mounds shall be removed from the site on completion of permission. Compounds and access tracks shall be ripped and any resulting spoil removed from the site and the access removed unless otherwise agreed in writing with the Local Planning Authority.

Aftercare

An agricultural aftercare scheme outline strategy shall be submitted for the written approval of the Local Planning Authority at least three months before spreading of subsoil commences. The strategy shall provide for:

- (a) The physical characteristics of the land to be restored, as far as it is practical to do so, to what they were when the land was last used for agriculture;
- (b) A five year period of aftercare, specifying the steps to be taken and the period during which they are to be taken, and who will be responsible for taking those steps. The scheme shall include provision of a field drainage system;
- (c) A detailed annual programme, to be submitted to the Local Planning Authority

Reasons: To ensure the land is capable of retaining its BMVAL status.

Before the start of the calendar *year* and every subsequent year during the aftercare period, the operator shall provide the Local Planning Authority and the landowner/occupier with a detailed annual programme for the approval of the Local Planning Authority including:

- (a) Proposals for managing the land in accordance with the rules of good husbandry including planting, cultivating, seeding, fertilising, draining, watering or otherwise treating the land for the forthcoming 12 months;
- (b) A record of aftercare operations carried out on the land during the previous 12 months.

Reasons: To ensure the productive afteruse of the land.

Before (*insert date*) of every year during the aftercare period, unless otherwise agreed with the Local Planning Authority in writing, a site meeting shall be arranged by the operator, to which the Local Planning Authority and the landowner/occupier (*including the Welsh Government*) shall be invited to monitor previous performance and to discuss and agree future aftercare proposals. The meeting shall also be attended by the person(s) responsible for undertaking the aftercare steps.

Reasons: To ensure the productive afteruse of the land.

Aftercare operations shall be carried out in accordance with the submitted aftercare scheme unless otherwise agreed in writing with the Local Planning Authority.

Reasons: To ensure the productive afteruse of the land.

10 REFERENCES

- Ahlvin R, Smoots VA, Fletcher A. (1988). Construction Guide for Soils and Foundation. Wiley.
- Armstrong A, Ostle NJ and Whittaker J. (2016). Solar park microclimate and vegetation management effects on grassland carbon cycling. Environ. Res. Lett. 11 074016
<https://iopscience.iop.org/article/10.1088/1748-9326/11/7/074016>
- Batey T. (2009). Soil compaction and soil management-a review. Soil Use and Management December 2009 25, 335-345. <https://doi.org/10.1111/j.1475-2743.2009.00236.x>
- Belectric (2015). Time-lapse & drone-lapse construction film of UK's largest solar farm in 2014, Landmead, Oxfordshire. <https://youtu.be/aVPIKsb-f00>
- BEIS (2021). Renewable Energy Planning Database: June 2021 quarterly extract. Department for Business Energy & Industrial Strategy.<https://www.gov.uk/government/publications/renewable-energy-planning-database-monthly-extract>
- Business Wales (2018). Better Soil Management.
<https://businesswales.gov.wales/farmingconnect/news-and-events/technical-articles/better-soil-management-avoiding-soil-compaction>
- BRE (2013). Planning guidance for the development of large-scale ground mounted solar PV systems.
https://www.bre.co.uk/filelibrary/pdf/other_pdfs/KN5524_Planning_Guidance_reduced.pdf
- BRE (2014.) Agricultural Good Practice Guidance for Solar Farms. Ed J Scurlock
https://www.bre.co.uk/filelibrary/nsc/Documents%20Library/NSC%20Publications/NSC_Guide_Agricultural-good-practice-for-SFs_0914.pdf
- BRE (2014a). Biodiversity Guidance for Solar Developments. Eds G E Parker and L Greene.
<https://www.bre.co.uk/filelibrary/pdf/Brochures/NSC-Biodiversity-Guidance.pdf>
- Bygden, Eliasson, L and Wasterlund, I. (2003). Rut depth and soil compaction and rolling resistance when using bogie tracks. Journal of Terra Mechanics, vol 40, issue 3 , July 2003.
- Carvalho F, Montag H, Sharp S, Armstrong A. (2021). The effects of land use change for solar farms on natural capital and ecosystem services. Lancaster University and Clarkson & Woods; poster supplied to ADAS by Solar Energy UK.
- Choi CS, Cagle AE, Macknick J, Bloom DE, Caplan JS, Ravi S. (2020). Effects of Revegetation on Soil Physical and Chemical Properties in Solar Photovoltaic Infrastructure. Brief Research Report Front.Environ.Sci 11 August 2020.
<https://www.frontiersin.org/articles/10.3389/fenvs.2020.00140/full>
- Conant,RT, Paustian,K & Elliott,ET., (2001). Grassland Management and Conversion into Grassland: Effects on Soil Carbon. Ecological Applications 11(2), 343-355.
<https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1890/1051-0761%282001%29011%5B0343%3AGMACIG%5D2.0.CO%3B2>
- Connant RT,Cerri CEP, Osborne BB and Paustian K. (2017). Grassland management impacts on soil carbon stocks. A new synthesis. Ecological Applications Vol 27 Issue 2 pg 662-668.
<https://esajournals.onlinelibrary.wiley.com/doi/10.1002/eap.1473>
- Cranfield University (2001), A Guide to Better Soil Structure 2001.
<http://adlib.eversite.co.uk/adlib/defra/content.aspx?doc=94893&id=1101>

- Dawson, J.J.C & Smith, P (2006). Review of carbon loss from soil and its fate in the environment. Final Technical Review Report for Defra project SP08010.
- Defra (2009). Best Practice for Managing Soil Organic Matter in Agriculture. Defra Project SP8016.
<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=2&ProjectID=15536>
- Defra (2009a). Construction Code of Practice for the Sustainable Use of Soil in Construction. PB13298.
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/716510/pb13298-code-of-practice-090910.pdf
- Defra (2016). Report R&D BD5001: Characterisation of soil structural degradation under grassland and development of measure to ameliorate its impact on biodiversity and other soil functions. Science Search (defra.gov.uk)
<https://randd.defra.gov.uk/ProjectDetails?ProjectID=16827&FromSearch=Y&Publisher=1&SearchText=BD5001&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>
- Defra (2018). Sewage sludge in agriculture: code of practice for England, Wales and Northern Ireland. <https://www.gov.uk/government/publications/sewage-sludge-in-agriculture-code-of-practice/sewage-sludge-in-agriculture-code-of-practice-for-england-wales-and-northern-ireland>.
- Defra (2000). Evaluation of Mineral Sites restored to Agriculture. Project Code LE0206.
<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=3621>
- Defra (2021). Remove Soil Compaction. <https://www.gov.uk/guidance/remove-soil-compaction>
- Freibauer, A., Rounsevell, M. A., Smith, P., & Verhagen, A. (2004). Carbon sequestration in European agricultural soils. *Geoderma*, 122, 1-23.
<https://doi.org/10.1016/j.geoderma.2004.01.021>
- Froehlich H, Miles D, Robbins R. (1985). Soil bulk density recovery on compacted skid trails in central Idaho. *Soil Sci Soc Am J* 49:1015-1017.
<https://doi.org/10.2136/sssaj1985.03615995004900040045x>
- Game and Wildlife Conservation Trust (2020). The Allerton Project.
<https://www.gwct.org.uk/allerton>
- Gosling, P., van der Gast, C. & Bending, G.D. (2017). Converting highly productive arable cropland in Europe to grassland: –a poor candidate for carbon sequestration. *Sci Rep* 7, 10493 (2017). <https://doi.org/10.1038/s41598-017-11083-6>
- Gower Regeneration Ltd (2017). Building a 1MW community owned solar farm - Gower Regeneration Ltd. <https://youtu.be/yUmuyiOXn5M>
- Hakansson I. (1985). Swedish experiments on subsoil compaction by vehicles with high axle load. *Soil Use and Management*, 1, 113-116.
<https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1475-2743.1985.tb00970.x>
- Hakansson I, Voorhees WB and Riley H. (1988). Vehicle and wheel factors influencing soil compaction and crop response in different traffic regimes. *Soil and Tillage Research* 11, 239-282. <https://www.sciencedirect.com/science/article/pii/0167198788900037?via%3Dihub>
- Hive Energy (2015). The UK's largest solar farm constructed in under 2 minutes!
<https://youtu.be/YImpscFsc3k>

- Huld T and Pinedo-Pascua I (2019), Global irradiation and solar electricity potential: Optimally-inclined photovoltaic modules. Institute for Energy and Transport, Renewable Energy Unit; Joint Research Centre; European Commission; <http://re.jrc.ec.europa.eu/pvgis/>
- Inazumi,S, Namikawa,T,Kuwahara,S and Hamaguchi,S. (2017). Influence of pulling out existing piles on the surrounding ground. International Journal of Geomate, July 2017, Vol 13, issue 35
- Keller T, Colombi T, Ruiz S, Manalili M P, Rek J,Stadelmann V, Wunderli H, Breitenstein D, Reiser R, Oberholzer H, Schymanski S, Romero-ruiz A, Linde N, Weisskopf P, Walter A and Or D. (2017) Long-term soil structure observatory for monitoring post-compaction evolution of soil structure. *Vadose Zone Journal*, 16 (4), 1-16. ([doi:10.2136/vzj2016.11.0118](https://doi.org/10.2136/vzj2016.11.0118)).
- Keller T, Colombi T, Ruiz S, Schymanski S J, Weisskopf P, Koestel J, Sommer M, Stadelmann V, Breitenstein D, Kirchgessner N, Walter A and Or D. (2021). Soil Recovery following compaction: Short-term evolution of soil physical properties in a loamy soil. *Soil Science Society of America Journal* vol 85 July/August 2021. <https://doi.org/10.1002/saj2.20240>
- MAFF 1988. Agricultural Land Classification of England and Wales.
- MAFF (1995). Effects of golf course development on Grade 1, 2 and 3a agricultural land in England. Defra Project LE0205. <https://sciencesearch.defra.gov.uk/ProjectDetails?ProjectId=3620>
- Marrou H,Guilioni L,Dufour L (2013).Microclimate under agrivoltaic systems is crop growth rate affected in partial shade of solar panels. *Agricultural and Forest Meteorology* 177:117-132.DOI:10.1016/j.agrformet.2013.04.012
- Moffett BJ, Nicholson FA, Uwakwe N, Chambers BJ, Harris JA, Hill TCJ. (2003). Zinc decreases the bacterial diversity of agricultural soils. *FEMS Microbiol Ecol* Feb 43 (1) <https://pubmed.ncbi.nlm.nih.gov/19719692/>
- Nawaz MF, Bourrie G, Trolard, F. (2012). Soil compaction: impact and modelling. A review. *Agronomy for sustainable development* 33,291-309 (2013). <https://link.springer.com/article/10.1007/s13593-011-0071-8>
- Solar Energy UK (2022) Sample Decommissioning Plan. <https://solarenergyuk.org/wp-content/uploads/2022/05/S...> · DOC file
- Spoor G. (2006). Alleviation of soil compaction: requirements equipment and techniques. *Soil Use and Management*, 22, 113-122
- Stantec (2020). Bellflower Solar Decommissioning Plan Indiana. http://www.henryco.net/attachments/Bellflower%20Solar%20Decom_Plan_20201013.pdf
- The Institute of Quarrying (2021). Good Practice Guide for Handling Soils in Mineral Workings. www.quarrying.org/soils-guidance
- Thomas, A, Cosby BJ, Henrys P, Emmett B. (2020). Patterns and trends of topsoil carbon in the UK: Complex interactions of land use change, climate and pollution. *Science of the Total Environment* 10 August 2020, 138330. <https://doi.org/10.1016/j.scitotenv.2020.138330>
- Voltalia (2022). South Farm - Under construction. <https://youtu.be/NX68KtXei2A>
- Welsh Government (2014). The Use of Planning Conditions for Development Management. <https://gov.wales/sites/default/files/publications/2019-05/the-use-of-planning-conditions-for-development-management-wgc-0162014.pdf>

- Windemer, R. (2021). End-of-life decision making for onshore wind and solar farms in Great Britain. Research findings and recommendations. <https://uwe-repository.worktribe.com/output/8174402>

APPENDIX 1 – Project Brief

Soil Policy Evidence Programme SPEP 2021-22/03

The impact of solar photovoltaic (PV) sites on soil and agricultural land quality.

VERSION 2 (Draft)

Introduction:

Solar photovoltaic (PV) sites started commercial distribution in the UK in 2007. The number of solar photovoltaic sites in the UK has increased from c. 1700 in 2010 to just over one million in 2019 <https://www.statista.com/statistics/418830/number-of-solar-photovoltaic-installations-uk/>.

It appears there has not been any systematic review of the impact of these sites on agricultural land, Best and Most Versatile (BMV) land and associated soils. The SPIES project is useful background though soil does not feature heavily <https://www.lancaster.ac.uk/spies/>. Similarly, the Armstrong *et al* (2016) paper: *Solar park microclimate and vegetation management effects on grassland carbon cycling* <https://iopscience.iop.org/article/10.1088/1748-9326/11/7/074016> is useful background.

Solar PV sites can involve significant soil disturbance in installation, operational phase and decommissioning. A recent proposed 34ha site in Wales involved 70,000 solar panels with 140,000 piles driven into the soil to 1.8 metres, 1.75km of access track and 3.5km Security fencing (boundary measurement), plus associated cabling. Because solar PV energy is relatively new, there are no UK examples of decommissioned sites.

There are questions on the reversibility of these sites back to agriculture and the longer term impact on associated land and soil. There are claimed improvements to some soil properties (e.g. increased carbon storage and improved soil structure). However, are these simply just short term for the period of the scheme?

The impact of mineral sites (e.g. sand and gravel extraction / restoration) is reasonably well understood and with field experience. This is not the case for solar PV sites, partly because the decommissioning timescales are long (c40 years) and the evidence does not yet exist. Can parallels be drawn with other developments such as golf courses, gas pipelines, and pylons. Similarly, are there parallels with horticultural activities such as grubbing out orchards and glasshouse removal? What impacts do these have on soil, how are effects mitigated and how successful are restorations?

This review is to provide an evidence based assessment of the impact of solar PV sites on agricultural land, Best and Most Versatile (BMV) land and associated soils. The scope of the study should be within the UK but look to international experience where possible. The study will inform Welsh Government and Natural England specialists when dealing with solar PV applications.

The review could be used as evidence at planning appeals. Consequently, clarity and accessible is really important, despite the likely complexity of some technical content.

It is anticipated the work will form 4 work packages (WPs):

Work Package 1: Literature review

This work package will:

1. Identify and review any relevant research or experience related to impacts of solar PV developments (published or anecdotal) on land and soil, within the UK or internationally.
2. Identify and review any relevant research or experience, related to (e.g.) golf courses, glasshouse removal, grubbing out of orchards or similar developments / activities (published or anecdotal) on land and soil, within the UK or internationally.
3. Identify and review the key research and experience relating to mineral developments on land and soil, within the UK and internationally.
4. Host a virtual workshop with key soil specialists in the area and record key findings. The key outputs from this need to be recorded as part of the contract.
5. Summarise key findings in a clear and accessible format.

Work Package 2: Description of Solar PV site history and development stages

This work package is intended as a short and simply a statement of facts, rather than in depth interpretation:

1. Provide a summary history of solar PV sites development in the UK. This should include date introduced, number of sites over time and basic explanation of how solar PV sites work. It would be useful to know approximately how many applications there have been (split by UK country), some information on range of site size, preferred types of location, and whether cumulatively large amounts of BMV are likely to be involved. Is the average size of sites increasing?
2. Identify and summarise the main interventions to land and soil with solar PV sites at installation (e.g. pile driving, panel installation, cable laying, track-laying & fencing). Averages (e.g.) of piles / ha or metres of buried cable / tracks / ha would be useful as context. Use of case studies could help. It will be important to summarise the potential levels of disturbance and any differences between different types of site.
3. Identify and summarise the potential benefits and threats to land and soil during the operational phase of the site. Claimed benefits are (for example) topsoil carbon content increases and soil structure improvements.
4. Identify and summarise the main interventions to land and soil when decommissioning sites (e.g. soil disturbance linked with equipment removal).

Work Package 3: Review of Solar PV site impacts on land and soil:

This Work Package is the main review of impacts. It will largely be based on WPs 1 & 2.

1. Review and summarise the main threats to soil and land associated with solar PV site developments. This will need to assess commissioning and decommissioning phases. Assessment of impacts on BMV land - and its reversibility - will be very important.
2. Review and summarise potential effects (positive and negative) on soils during the active phase of the site. Claimed benefits are (for example) topsoil carbon content increases and soil structure improvements. Are such claims realistic and are they only likely to be short term for the duration of the active site? What are the effects of shading and changes in soil microbial activity and microclimates under the panels? Armstrong et al (2016) is useful background: <https://iopscience.iop.org/article/10.1088/1748-9326/11/7/074016>. What effect does 'rilling' have on soil loss / erosion, accelerated run-off and in creating differential areas of soil

wetness? A discussion of short term changes in soil properties vs long term physical limitations (as in ALC) would be useful. A summary of claimed benefits to soil from previous cases would be very helpful.

3. Review and summarise to what extent evidence supports solar PV sites are physically reversible to agriculture in the BMV and non BMV context. What are the main issues and what evidence is there to support this? What factors influence reversibility (e.g. soil handling conditions, monitoring, soil types & climate).
4. Discuss the parallels between mineral site restoration and solar PV site restoration? Are the two comparable or do significant differences exist?
5. Discuss the parallels with golf course or similar type developments or activities and their reversibility. Are these comparable or do significant differences exist? IN Wales, Technical Advice Note 6 “TAN 6” (para 6.2.2) - Planning for Sustainable Rural Communities says, *“once agricultural land is developed, even for ‘soft’ uses such as golf courses, its return to agriculture as best and most versatile agricultural land is seldom practicable”*.
6. Discuss to what extent soil handling conditions, as part of the planning process, can mitigate or remove any threats to soil and land. Can BMV sites realistically be restored to BMV and what factors influence this? Again, differences between sites will be useful to discuss.

Work Package 4: Summary of key issues and recommendations for future work

Based on the above work packages:

- 1 Summarise the key findings from this work. A non-technical executive summary is needed.
- 2 Identify evidence / knowledge / experience gaps.
- 3 Recommend what future work is needed to better understand the impacts of solar PV sites on soil and land.

APPENDIX 2 – Evidence Provided by Solar Energy UK

Project	Details	Wales	Information on Construction Methodology, Mitigation Techniques	Visual evidence of imagery of site impacts during construction	Construction method statements	Soil Management Plans	Evidence of soil quality improving on sites	Evidence of decommissioning requirements and provisions made for existing projects	Any further comments?
Cleve Hill Solar Park	Graveney, Kent	No	> 'Cleve Hill Solar Park - Outline Construction Environmental Management Plan' Access to document https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010085/EN010085-001554-CHSP%20-%20D6%20-%206.4.5.4.pdf Please take specific note to 3.4(64), 4.3(78), 5.5(105), 6.1(107, 108, 109) and Appendices, particularly appendix E which outlines LBMP construction mitigation measures. (Appendix E - LBMP) >'Cleeve Hill - Environment Statement' Access to document - https://drive.google.com/drive/folders/1bKEBKmZv9SqFz4K8DAIElc80Bz-1gDTF Please take specific note to 5.5.4		Updates to existing documents outline construction environmental management plan revision E' Access to document - https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010085/EN010085-001554-CHSP%20-%20D6%20-%206.4.5.4.pdf			> 'Cleve Hill Solar Park - Environmental Statement' 9.5.2.6 Deposition of dust 171. Fugitive dust emissions and track-out dust during construction and decommissioning have the potential to affect ecological receptors. Chapter 16: Air Quality of the ES provides an assessment of the potential effects of the impacts of dust emissions and track-out dust. The assessment concluded that in the absence of mitigation, there was a low risk of dust soiling to ecological receptors as a result of the earthworks and trackout and a negligible risk from the construction works (building of substation, control building, battery storage units, transformers and solar panel installation). Decommissioning effects were assessed to be similar in nature and no greater than those predicted for the construction phase.	Full Preliminary Environmental Information Report can be accessed here. https://drive.google.com/drive/folders/1IE-fACqMIJCzrf9v0dn8DYUed6WY9xU9
Botwnnog Solar Farm	Gwynedd, 5MW	Yes	'Soils and Agricultural Land Classification' Access to document - as		Construction Method Statement - (Proposed)	Soils and Agricultural Land Classification' *Document sent			Landscape and Visual Impact Assessment - Access to document - see zip file.

			attached. Please pay particular reference to 7.3.1, 7.3.2, 7.3.3		Access to document as attached.	as attachment* Please pay particular notice to 2.2.1,			Please pay particular notice to chapter 7 (7.1.1-7.1.5) and chapter 10.
Bypass Solar Farm	Lincolnshire 49.9MW	No	Ecological Impact Assessment Report Access to document http://bypassfarmsolar.com/documents/update110920/12904_r01a_eia_as_mm_210820_compressed.pdf Please pay particular attention to: (4.12, 4.36) No solar panels are proposed adjacent to watercourse WC1, or within the RPA of hedgerows and trees, minimising the potential for impacts to this habitat. However, the ditch and hedgerows within the site could be affected during construction by soil compaction from machinery, which could impact on the root systems, and/or by accidental damage. As such, they will be fenced and protected during construction in accordance with best practise guidance detailed in BS 5837:2012 'Trees in relation to design, demolition and construction' (British Standard, 2012) to reduce potential for impacts and accidental damage., , page 21) Flood Risk Assessment Access to the document http://bypassfarmsolar.com/documents/update110920/14516_hyd_xx_xx_rp_fr_0001_p02_bypass_farm.pdf Please refer to page 9 of the assessment which outlines mitigation techniques			Planning Statement, Proposed Solar farm, land at Bypass Farm, South of A1 Bypass http://bypassfarmsolar.com/documents/update110920/bypass_farm_solar_planning_statement_v3.pdf Please take note to point 2.1.6			Full planning documents can be found here http://bypassfarmsolar.com/downloads/

			regarding to construction and soil compacting/surface run off.						
Low Farm Solar Farm	West Yorkshire, 49.9MW		Construction Traffic Management Plan Access to the document https://www.boom-power.co.uk/wp-content/uploads/2021/10/General_896661-17298-HYD-XX-XX-RP-TP-P004-Construction-traffic-management-plan.pdf Flood Risk Assessment & Drainage Strategy You can access the document here https://www.boom-power.co.uk/wp-content/uploads/2021/10/FloodRiskAssessment_896753.pdf Please refer to point 5.2.2 'Planning Statement' Access Document https://www.boom-power.co.uk/wp-content/uploads/2021/10/General_896701-Planning-Statement.pdf Please take note to pages - 33,34,38, 46			Agricultural Land Classification Access the document https://www.boom-power.co.uk/wp-content/uploads/2021/10/General_896760-AGRICULTURAL-LAND-ASSESSMENT.pdf Please pay particular attention - Page 12		Design and Access Statement Access Document https://www.boom-power.co.uk/wp-content/uploads/2021/10/DesignandAccessStatement_896749.pdf Page 32 Design and Access Statement https://www.boom-power.co.uk/wp-content/uploads/2021/10/DesignandAccessStatement_896749.pdf Pay Particular attention to page 32	
Eveley Farm	Stockbridge, Hampshire		See attachment	See attachment					
Llanwern	Newport, South East Wales	Yes	'Land on Caldicot levels to the south of Llanwern Steelworks site' Full document accessed here https://dns.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/DNS/3213968/DNS-3213968-000525-Report%203213968%20(for		'Local Impact Report' Full document can be accessed here https://dns.planninginspectorate.gov.uk/wp-content/ipc/upl				A full suite of planning documents can be found here https://dns.planninginspectorate.gov.uk/projects/wales/llanwern-solar/?ipcsection=docs&stage=1

			merly%203150137).pdf Please pay attention to points 127, 139, 240		oads/projects/DNS/3213968/DNS-3213968-000525-Report%203213968%20(formerly%203150137).pdf Please pay particular attention to the construction method statement on Page 27				
Outside the UK									
Neoen Solar Farm	Australia	No				Soil and Water Management Plan https://parkessolarfarm.com.au/wp-content/uploads/2020/08/PL-EV-04-Soil-and-Water-Management-Plan-Rev2.pdf			

APPENDIX 3 – Satellite Imagery of Three Solar PV Sites

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APPENDIX 4 – Solar Farm Construction Images

Site A



Figure 1



Figure 2



Figure 3

Site B



Figure 4



Figure 5



Figure 6



Figure 7



Figure 8



Figure 9



Figure 10

APPENDIX 5 – Impact of Soil Wetness Limitation

Table A shows the example of a **medium-textured soil** in **Wetness Class I** before commissioning, classified as BMV land and then **disturbed** during construction, the interaction of climate (FCD) and the depth to an introduced slowly permeable layer.

Where there is evidence of an SPL starting within 60 depth cm reference is made to Figure 7 of the ALC Guidelines (MAFF, 1988) and where there is an SPL starting between 60 cm and 80 cm depth reference is made to Figure 8 of the ALC Guidelines (MAFF, 1988).

Table A Residual Impact of Introduced SPL on ALC Grade- Medium -texture soil

FCD	Pre-construction		Post-decommissioning		
	Wetness Class	ALC Grade	Depth to introduced SPL	Wetness Class	ALC Grade
230	I	3a	0 to 25 cm	V	4
		3a	25 to 60 cm	IV	3b
		3a	60 to 80 cm	III	3b
225	I	2	30 to 60 cm	IV	3b
		2	60 to 80 cm	III	3a
170	I	1	35 to 46 cm	IV	3b
		1	46 to 60 cm	III	3a
		1	60 to 80 cm	II	2
125	I	1	35 to 60 cm	III	3a
		1	60 to 80 cm	II	2

Table B shows the example of a **medium-textured soil** in **Wetness Class I** before commissioning, classified as BMV land and **undisturbed** during construction, the interaction of climate (FCD) and the depth to an introduced slowly permeable layer. Where there is evidence of gleying within 40 cm depth and an SPL within 80 cm depth reference is made to Figure 7 of the ALC Guidelines (MAFF, 1988). Where there is gleying within 70 cm depth and an SPL within 80 cm depth reference is made to Figure 8 of the ALC Guidelines (MAFF, 1988).

Table B Residual Impact of Introduced SPL on ALC Grade- Medium- textured soil

FCD	Pre-construction		Post-decommissioning			
	Wetness Class	ALC Grade	Depth to introduced SPL, with gleying <40 cm	Depth to introduced SPL, with gleying >40 cm	Wetness Class	ALC Grade
230	I	3a	0 to 25 cm		V	4
			25 to 62 cm		IV	3b
			62 to 80 cm		III	3b
				0 to 80 cm	III	3b
225	I	2	25 to 61 cm		IV	3b
			61 to 80 cm		III	3a
				28 to 80 cm	III	3a
170	I	1	35 to 46 cm		IV	3b
			46 to 74 cm		III	3a
			74 to 80 cm		II	2
				35 to 60 cm	III	3a
				60 to 80 cm	II	2
125	I	1	35 to 62 cm		III	3a
			62 to 80 cm		II	2
				35 to 42 cm	III	3a
				42 to 80 cm	II	2

Table C shows the example of a **light-textured soil** in **Wetness Class II** on **disturbed land** and the residual impact of an introduced SPL (caused by unremediated subsoil compaction) on BMV agricultural land.

Where there is evidence of an SPL starting within 60 depth cm reference is made to Figure 7 of the ALC Guidelines (MAFF, 1988) and where there is an SPL starting between 60 cm and 80 cm depth reference is made to Figure 8 of the ALC Guidelines (MAFF, 1988).

Table C Residual Impact of Introduced SPL on ALC Grade- Light- texture soil

FCD	Pre-construction		Post-decommissioning		
	Wetness Class	ALC Grade	Depth to introduced SPL	Wetness Class	ALC Grade
230	II	3a	0 to 25 cm	V	4
		3a	25 to 60 cm	IV	3b
		3a	60 to 80 cm	III	3b
225	II	2	25 to 60 cm	IV	3b
		2	60 to 80 cm	III	3a
170	II	1	35 to 46 cm	IV	3a
		1	46 to 60 cm	III	2
		1	60 to 80 cm	II	1
125	II	1	35 to 60 cm	III	2
		1	60 to 80 cm	II	1

Table D shows the example of a **light-textured soil** in **Wetness Class II** on **undisturbed land** and the residual impact of an introduced SPL (caused by unremediated subsoil compaction) on BMV agricultural land.

Where there is evidence of gleying within 40 cm depth and an SPL within 80 cm depth reference is made to Figure 7 of the ALC Guidelines (MAFF, 1988). Where there is gleying within 70 cm depth and an SPL within 80 cm depth reference is made to Figure 8 of the ALC Guidelines (MAFF, 1988).

Table D Residual Impact of Introduced SPL on ALC Grade- Light-texture soil

FCD	Pre-construction		Post-decommissioning			
	Wetness Class	ALC Grade	Depth to introduced SPL, with gleying <40 cm	Depth to introduced SPL, with gleying >40 cm	Wetness Class	ALC Grade
230	II	3a	0 to -25 cm		V	4
		3a	25 to 62 cm		IV	3b
		3a	62 to 80 cm		III	3b
		3a		0 to 80 cm	III	3b
225	II	2	35 to 61 cm		IV	3b
		2	61 to 80 cm		III	3a
		2		35 to 80 cm	III	3a
170	II	1	35 to 46 cm		IV	3a
		1	46 to 74 cm		III	2
		1	74 to 80 cm		II	1
		1		35 to 60 cm	III	2
		1		60 to 80 cm	II	1
125	II	1	35 to 61 cm		III	2
		1	61 to 80 cm		II	1
		1		35 to 42 cm	III	2
		1		42 to 80 cm	II	1