HELIOS RENEWABLE ENERGY PROJECT

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Written Summary of the Applicant's Oral Submissions – Issue Specific Hearing 1

December 2024

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Prepared on behalf of Enso Green Holdings D Limited

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1. Introduction

1.1. Overview

1.1.1. This Post Hearing Note summarises the submissions made by Enso Green Holdings D Limited (the "**Applicant**") at the Issue Specific Hearing ("**ISH1**") on 4 December 2024. This document does not purport to summarise the oral submission of parties other than the Applicant. Summaries of submissions made by other parties are only included where necessary in order to give context to the Applicant's submissions.

1.1.2. This document follows the order of the agenda published by the Examining Authority on Friday 15 November 2024. It covers agenda items 4, 5 and 6.

1.2. Agenda Items

1. Welcome and logistics
2. Purpose of the Issue Specific Hearing
3. Introductions
4. The Principal and Scope of the Proposed Development
5. Socio-economic and Environmental Matters
6. The draft Development Consent Order (and related control documents)
7. Next Steps
8. Closing

2. The Principal and Scope of the Proposed Development

2.1. Scale of the Proposed Development and generating capacity

2.1.1. The Applicant was asked by the Examining Authority ("**ExA**") to clarify the scale and generating capacity of the Proposed Development as well as the reason for any overplanting.

2.1.2. The Applicant confirmed that the Proposed Development has an export capacity of 190MW for the solar element and 190MW for the Battery Energy Storage System ("**BESS**") element. However, the Applicant clarified that the maximum generating capacity is 235MW, but this allows for degradation throughout the 40-year lifespan of the project with these being no-more than 2% in the first year and then dropping to around 0.45% in subsequent years.

2.1.3. The Applicant confirmed that there is an element of overplanting, which is accepted in the National Policy Statement for Renewable Energy Infrastructure (EN-3) ("**EN-3**") and the Proposed Development is within the range for this type of development.

2.1.4. **Action: The Applicant was asked to provide a calculation on generating capacity over the lifetime of the generating station, how degradation in panels is accounted for, showing initial generation once built and generation at the end of its 40-year lifespan.**

2.1.5. *Post Hearing Note: Over the lifetime of the development the solar panels will reduce in output. Panel power degradation for the first year will be no more than 2% followed by no more than 0.45 % in subsequent years. This equates to a worst-case scenario of 19.55% over the operational lifetime. When applying the 19.55% degradation factor to the installed capacity of 235.17 MW the output is reduced to 189.2 MW, aligning with the Bilateral Connection Agreement with National Electricity System Operator (NESO) for a 190 MW connection.*

2.1.6. *Post Hearing Note: The Applicant refers the ExA to paragraph 2.10.17 of EN-3 which notes that along with associated infrastructure, a solar farm requires between 2 and 4 acres of each MW of output which will vary depending on the site and evolve as technology becomes more efficient with the scale of development inevitably having impacts particularly in rural areas. The area covered by the panels ("Solar Farm Zone") is 294.11ha (726.76 acres). The installed capacity of the solar farm is 235.17*

MW. Accordingly, the scheme requires approximately 3.09 acres per MW of power generated, in line with EN-3.

2.1.7. The Applicant confirmed that once the Proposed Development has been built and is operational, there will be no wholesale replacement of the panels. Instead, if a panel fails, it will be repaired or replaced, but this is part of routine maintenance of the development. The Applicant reiterated that there is no repowering provided for in the dDCO, so subject to other planning permissions outside of this dDCO, the Proposed Development would be decommissioned at the end of the 40yr operational life of the Proposed Development.

2.1.8. A concerned resident noted that the proposed tracker panels had not been used in the UK and concerns over whether they had been safety tested. The Applicant confirmed that these were used on a solar farm outside Cirencester but agreed to respond with examples of this type of tracker technology being used in the UK in writing.

2.1.9. The ExA said that any safety issues would be addressed later on in the Examination.

2.1.10. *Post Hearing Note: Single Axis Trackers ("SAT") are a mounting system for solar panels that have only been deployed in the UK in the past few years. A few examples of the installed technology in the UK are provided in Appendix A.*

2.2. BESS

2.2.1. The ExA invited the Applicant to confirm the Battery Energy System Storage ("**BESS**") capacity, its relationship to the solar panels and connection to the national grid.

2.2.2. The Applicant confirmed that the BESS has a 190MW capacity and that releases that energy over a period of 4-hours, so in that 4 hours, it can store 760MWh. The BESS shares the same grid connection to the solar farm with the availability to import and export electricity from the National Grid network to help balance the demand and supply of energy.

2.2.3. After questioning from a concerned resident as well as the North Yorkshire Council, the Applicant confirmed that whilst they have indicative plans for the number of units that will be in operation, it is difficult to confirm exact numbers and size of the units as technology may improve, allowing the batteries to be smaller in size. The

Applicant confirmed that what is in the indicative plans is the maximum area which will be occupied by the BESS.

2.2.4. **Action: The Applicant will provide an explanation as to how the battery system will work, the scale of the site and that the batteries won't increase in size.**

2.2.5. *Post hearing Note: Figure 3.3 Indicative Design **[APP-041]** shows 76 battery container units, 38 inverter/transformers, one control room and one switch room within the Battery Energy Storage System (BESS) compound. The maximum battery container dimensions are up to 12.2m in length x 2.4m in width x 3.5 in height, including supports 600mm in height. These are the dimensions which have been assessed in the Environmental Statement and the dDCO ensures that detailed design is approved by the LPA (Requirement 3 of the dDCO).*

2.3. Operational lifetime of the Proposed Development

2.3.1. The ExA invited the Applicant to discuss potential technology changes over time, how this may impact the drafting in the dDCO and whether the dDCO will be drafted to include provisions for change.

2.3.2. The Applicant confirmed that this application is for one construction phase, one operational phase and then one decommissioning phase. The wholesale replacement of panels and repowering of the Proposed Development would be tantamount to another construction phase. Further, the Applicant stated that if, during operation, technology improvements were made, it is likely that a different wattage of panel would be a different shape and size to those already installed. The Applicant agreed to reflect on whether changes to panels are expressly prohibited.

2.3.3. **Action: The Applicant was asked to confirm in writing how they consider that the dDCO would prevent the wholesale repowering of the generating station. In doing so, please make specific reference to the definition of 'maintain' in Article 2 of the dDCO and any other Articles/Schedules in the dDCO and any measures in the control documents.**

2.3.4. *Post Hearing Note: The definition of maintain at Article 2 of the DCO states the permitted activities that are authorised under the dDCO under Article 4 Maintenance of authorised development which sets out the scope within which the undertaker may maintain the authorised development (subject to other provisions in the order and any related agreements made under the order).*

2.3.5. *The definition of maintain is included below for clarity, and it should be noted that the wording which has been underlined (for emphasis) strictly prohibits the undertaker from any wholesale powering under dDCO.*

2.3.6. *"maintain" includes inspect, repair, adjust, alter, remove, refurbish, reconstruct, replace and improve any part of, but not remove, reconstruct or replace the whole of, the authorised development, and any derivative of "maintain" must be construed accordingly;*

2.3.7. *A further discussion of Articles 2 and 4 can be found in 4.1.2-4 and 4.2.4 -4.2.5 of the Explanatory Memorandum* ***[APP-007].***

2.3.8. *The requirement for replacement could be due to accidental damage during routine maintenance or individual panel failure. It is assumed that there will be an annual replacement rate of 0.0375% which would equate to approximately 145 panels per year for a project of this scale. Replacement solar panels are transported on pallets of 36. Spare panels are either kept within a storage container onsite or brought onto site as required as part of the routine ongoing maintenance. On an average year approximately 4 pallets of panels will be required and a container can accommodate up to 720 panels. Figure 2.1 below shows an example image of pallets of solar panels.*

Figure 2.1: Solar panel pallets
Source: Cero Generation

2.4. Decommissioning

2.4.1. The Applicant stated that decommissioning is secured by Requirement 5 and will require the Applicant to provide a Decommissioning Environmental Management Plan ("**DEMP**") in advance and then to carry out the decommissioning with it. The DEMP would be agreed with the Local Planning Authority ("**LPA**") and be accompanied by a traffic management plan ("**TMP**").

2.4.2. The ExA then questioned the Applicant on the funding of the decommissioning as it is a time limited project. The Applicant confirmed that decommissioning at the end of the 40-year lifespan is provided for in the dDCO. The Applicant will ensure that there is sufficient funding in place to pay for the decommissioning. The Applicant stated that in the very unlikely event that the Applicant becomes insolvent during the operational phase, the Proposed Development is an income generating asset, so would likely be sold as an asset to another party. In this event, there would still be funds available from the operator of the Proposed Development to pay for the decommissioning.

2.4.3. *Post Hearing Note: Other DCOs with similar structures with a 40-year life time limitation are Oaklands Farm Solar Park, Byers Gill Solar Development (both in examination), East Yorkshire Solar Farm, Heckington Fen Solar Farm (both awaiting determination, and Long Field Solar Farm and Sunnica Energy Farm (both made DCOs).*

3. Socio-Economic and environmental matters

3.1. Water environment

3.1.1. It was agreed in the hearing that agenda item 5d Water Environment would be dealt with before the other items in the agenda for ISH1.

3.1.2. In accordance with the agenda here the ExA discussed the Applicant's approach to flood risk and drainage including surveys, effects and mitigation.

3.1.3. NYC were invited to provide comments in relation to clarity or amended wording within the dDCO and the related control documents relating to the water environment and the ExA confirmed they were happy for this to inform the Council's Local Impact Report to be submitted at Deadline 2.

3.1.4. The Environment Agency ("**EA**") provided an overview of their discussions with the Applicant and commented that these had been good long discussions whereby the EA were happy with the Applicant's hydraulic modelling from both the river Ouse and the river Foss.

3.1.5. The EA noted the Applicant's draft Statement of Common Ground ("**SoCG**") **[submitted at Procedural Deadline A]** and that in accordance with this SoCG, there were still areas of disagreement between the parties. The ExA asked the EA to summarise the outstanding points between the parties as outlined in the EA's Procedural Areas of Disagreement **[also submitted at Procedural Deadline A]** as well as the SoCG. These points are outlined below.

Volumetric Assessment

3.1.6. Calculation of the impact of physical structures placed in the flood zone, solar array support structures and potential impact of flooding offsite. The EA noted that they required a volumetric assessment of this impact in order to confirm that the risk of such impact was negligible.

3.1.7. The Applicant noted that the BESS will be at least 0.3m – 0.6m above ground level with the maximum being assessed and the compound 0.3m above the design flood.

3.1.8. **Action: The Applicant was asked to provide volumetric calculation on flood risk which could be caused by the physical solar farm infrastructure, such as the**

piling/mounting infrastructure (water displaced by panel infrastructure).

3.1.9. *Post hearing note – As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

Flood Risk Assessment

3.1.10. A concern in relation to the potential for flooding in relation to the compound that houses the BESS and that an approved Flood Risk Assessment would demonstrate a flood compensation scheme that would compensate for any flood storage lost and take this forward into design. Ongoing discussions were happening with the Applicant in relation to whether this was required at the decommissioning stage.

Finished Floor Levels

3.1.11. The EA discussed the compound and the BESS storage and noted that they would like to see that these are set about design flood level as opposed to ground level. The ExA wanted clarification as to whether this was in the any of dDCO control documents. The Applicant confirmed that it was shown in the supporting plans.

3.1.12. **Action: The ExA asked the Applicant to provide clarity (with reasoning) of the finished floor levels for the buildings/structures in the BESS. In particular, provide clarity as to whether this would be 300mm above ground level or above the predicted design flood level.**

3.1.13. *Post Hearing Note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

Tilt Failure

3.1.14. The EA questioned what would happen with the remote operation of the solar panels and particularly wanted to understand the impact on flooding in the worst-case scenario if the solar panels were stuck in the down position and whether there was a maintenance plan to control this. It was suggested that such a maintenance plan could address the debris clearance which would have a detrimental impact on movement of water and remaining panels.

3.1.15. The Applicant confirmed that this was addressed in the outline Operational Environment Management Plan ("**oOEMP**").

3.1.16. **Action: The Applicant was asked to provide a comment on the following: in the event of a failure of the panel tracking system, resulting in a significant portion of the panels being stuck in the downward position, provide evidence relating to the impact on flood water flow and if the lower portions of the panels would have an effect on this, what measures could/should be put in place (within the dDCO/control documents) to prevent undue impacts on flood water flow.**

3.1.17. *Post Hearing Note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

3.1.18. **Action: The Applicant was asked to provide clarity on how operational pollution control measures are secured in the OEMP (and any other relevant documents).**

3.1.19. *Post Hearing Note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

Definition of "commence" and Site Preparation

3.1.20. A further concern of the EA was that whilst Schedule 2 Requirement 4 of dDCO states that there should no phase of Authorised Development may commence until a Construction Environmental Management Plan ("**CEMP**") for that phase has been approved by the Local Planning Authority ("**LPA**"), the definition of commence in the dDCO at Part 1 Article 2 (Interpretation) excludes site preparation works and it therefore does not benefit from a CEMP. The trigger needs to be activated earlier.

3.1.21. **Action: The Applicant was asked to provide clarification to the Environment Agency (and submit for the Examination) as to what activities could occur as site preparation works. In doing so, please make reference to Article 2 of the dDCO, the CEMP and any other relevant control document.**

3.1.22. *Post Hearing Note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

Protection of Ground Water

3.1.23. The EA outlined their concerns regarding trenchless techniques whereby the Authorised Development is connected to the National Grid and requested that a hydrogeological risk assessment was secured through a requirement.

3.1.24. The EA also voiced their preference for the need to secure a piling risk assessment

through a requirement to ensure the protection of ground water and safeguard against contamination.

3.1.25. The Applicant confirmed they were amenable to adding such requirements to the dDCO and would provide drafts to the EA for discussion.

3.1.26. **Action: The Applicant was asked to provide an update in respect of the drafting of Requirements for flood compensation strategy and piling assessment, including updates on the liaison with the Environment Agency.**

3.1.27. *Post Hearing Note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

Water Abstraction

3.1.28. The EA noted that during construction it was likely that there would be dust wheel washing and therefore water would need to be gained through extraction which would require a licence from the EA. The Applicant confirmed that it was not seeking to include consent for this licence in the DCO and therefore a permit application would be made in the usual way. This was set out in the Consents and Licences Position Statement

3.1.29. **Action: The Applicant was asked to provide clarity in respect of how the water abstraction licensing will be managed (which will not be secured within the DCO).**

3.1.30. *Post Hearing Note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

LLFA

3.1.31. The Lead Local Flood Authority ("**LLFA**") stated generally that solar farms were fairly benign and that whilst solar panels increase the impermeable area they are designed with gaps, the panels are still impermeable themselves and the Applicant has taken this into account. Whilst impact is fairly negligible the Applicant has again acknowledged this and suggested swales (depressions in the ground) which is something not always seen by developers. Further concerns have been picked up by the EA and therefore there are no continuous flow paths from one end of a field to the other, neither are there significant slopes for water to flow down. Whilst the

details need to be reviewed further by the LLFA the Applicant does seem to be mitigating the negligible impacts.

3.1.32. The ExA asked the LLFA to put this in writing as the burden of discharging requirements sits with the Council and the LLFA and NYC confirmed that this was something they would be responding to in their LIR. The ExA confirmed that either a Post Hearing Note or in the LIR would suffice and this was to include the LLFA's comments on the BESS in line with those previously outlined by the EA.

3.1.33. **Action: The Applicant was asked to Provide update on the use of swales to the Environment Agency.**

3.1.34. *Post Hearing Note: It is the understanding of the Applicant that this update should be provided to the LLFA rather than the EA, given that the LLFA raised the phased delivery of interception swales at ISH1. As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2 with a response to be provided by the EA (or the LLFA if more appropriate) by Deadline 3.*

3.1.35. In regards to the sequential test, the ExA confirmed they would wait until the LIR is received and then add any further queries to written questions.

3.1.36. **Action: The Applicant committed to updating the SoCG with the LLFA (as part of NYC) for D2.**

3.1.37. The LLFA required clarity in relation to the impact of the swales on the ground during construction and the CEMP noted that this was at the discretion of the site manager.

3.1.38. The Applicant noted that the effects of construction is the same as any development, physically excavating and can be provided at the outset or at the end. The Applicant did however commit to reviewing the wording and ExA encouraged the LLFA to provide their preferred wording either in a Post Hearing Note for D2 or in their LIR. An update can be outlined in the SoCG should this not be agreed.

Protective Provisions

3.1.39. The Applicant noted that they were liaising with the EA regarding protective provisions and stated that they would provide a further update on progress at D2.

3.2. Socio-economic matters

BMV

3.2.1. The ExA asked the Applicant about their general approach to the land and in particular, the fact that the site is based on land that is predominantly on Best and Most Versatile ("**BMV**") land. The Applicant referred the ExA to the Agricultural Land Classification ("**ALC**") plan at page 42 of 6.3 Environmental Statement Appendix 14.1 - ALC of the Site **[APP-171]** which illustrates the BMV classifications at the site and within 5km of it.

3.2.2. In relation to site selection, the Applicant confirmed that they used the grid connection point at Drax Power Station, to create a search radius of 5km of surrounding land. The 5km search area is all Grade 1 –3 of agricultural land, meaning that wherever the Proposed Development was sited, it would likely be on BMV land.

3.2.3. The Applicant clarified that the map in the planning statement at Figure 2.7 of 7.1 Planning Statement Appendix 2: Alternative Site Assessment **[APP-227]** shows the ALC's grading of land (established in the 1970's) being between 1 and 5, however, the Ministry of Agriculture made changes to the grading system whereby there are sub-categories within the 1 to 5 gradings in the 1980's to include categories 3a and 3b.

3.2.4. *Post Hearing Note: EN-2.10.33 states that the ALC is the only approved system for grading agricultural quality in England and Wales.*

3.2.5. The Applicant explained the Agricultural Land Classification (ALC) survey. It was explained that the soil was sampled on a regular 100 metre grid (hence one sample per hectare) using a hand-held soil auger, augering down to 120 cm where possible. This is explained in the ALC report **[APP-171]**. The area originally surveyed was larger, which explains why the numbering reported in the ES is no longer sequential

3.2.6. It was mentioned by the Applicant that Natural England (NE) required clarity regarding the **APP-171** plan as the numbers were not sequential and this was because a larger search area was reviewed than the final site boundary. The ExA asked the Applicant to address this point in a Post Hearing Note.

3.2.7. **Action: the Applicant was asked to provide clarity in respect of the points**

raised by Natural England on soil sampling data and the sequencing of numbers.

3.2.8. *Post Hearing Note: AMET Property Ltd, who conducted the ALC, surveyed a total of 532 ha of agricultural land in March 2022. Their survey involved 549 auger samples, on a regular 100 metre grid (ie 1 per hectare), plus 15 soil pits dug to 120 cm. The location of the sample point is shown on attached plans Map 1a and Map 1b (some land east of Draft Power Station) within Appendix B.*

3.2.9. *As the project design progressed the land to be included within the Proposed Development was refined. As a result, the ALC results being reported were amended to provide the results only for the areas within the Proposed Development. The ALC Report* ***[APP-171]*** *is Issue 3-12th June 2023. The agricultural land surveyed, as reported in Issue 3, was 394 ha, therefore a reduction of 138 ha.*

3.2.10. *It is very difficult, and is subject to a risk of error, to renumber auger points. It requires the plan and the tables to be amended very carefully. In this case the report was edited to exclude all auger points no longer within the site of the proposed development. For that reason the numbering is no longer sequential. The following comparison of the north west corner shows the consequence.*

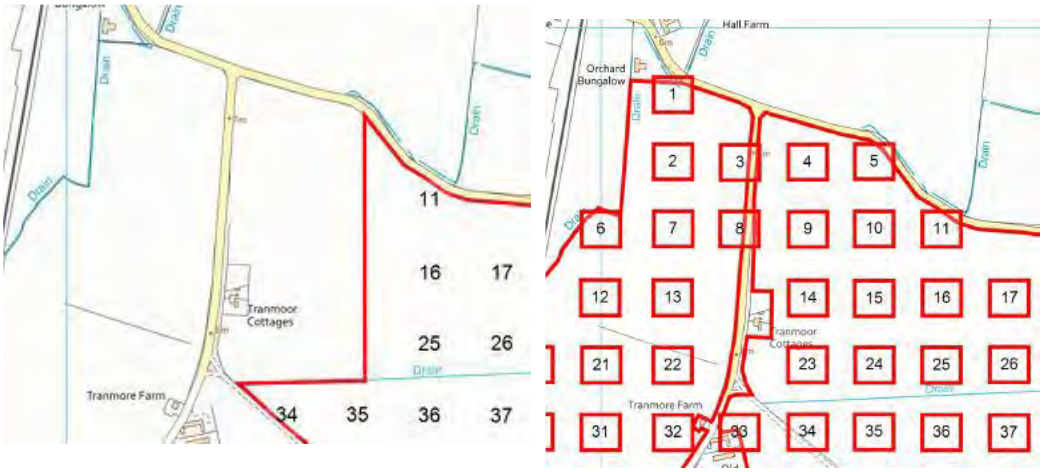


Figure 3.1: Auger Point Numbering System
Source: Kernon Countryside Consultants

3.2.11. The ExA questioned why this site had been chosen for the Proposed Development if the vast majority is BMV land. In response, the Applicant acknowledged that while there is policy that states that poorer quality land should be preferred be used for developments such as this, there is no absolute requirement or sequential test approach requiring the avoidance of BMV land .

3.2.12. *Post Hearing Note: EN-3 at paragraph 2.10.29 states that whilst land type should not*

be a predominating factor in determining the suitability of site location application, where it is necessary that it is agricultural the use of poorer quality land should be preferred and the use of BMV (defined as ALC grades 1,2 and 3a) should be avoided where possible. Development is not prohibited on BMV but the impacts of this should be considered as per paragraph 2.10.27-92 and 2.10.107 – 2.10.126 of EN-3 (paragraph 2.10.30), and that it is likely that developments will use BMV land, and in such cases, applicant should explain their choice of site and why it has not been possible to use suitable brownfield, industrial and low and medium grade agricultural land. Finally, paragraph 2.10.32 notes that consideration of whether Proposed Development allows for continued agricultural use and co-location with other functions.

3.2.13. *The Cable Route Corridor will be available for continued farming use. The cable connection between the Solar PV Array areas, the Cable Route Corridor, is a wide area but the actual installation within that reserved area, will be narrow. Typically a 20 metre working width will be needed, and the topsoil may be removed from this width or running boards will be used. This will be stored at one edge of the working width. The trench will be dug and the subsoil placed to the same side, but separate from, the topsoil. Once the cable has been installed the subsoils will be returned in the same order, the topsoil respread, the area cultivated and returned to the farmer. Thereafter there will be no restrictions on farming use.*

3.2.14. Further, the Applicant has designed the scheme to ensure that the best quality land is not being impacted from the farmers perspective. In addition to this, the Applicant confirmed that they have multiple land agreements with other sites around the country which are also likely to be developed. This site that has been chosen for the reasons set out in the Planning Statement (and reiterated in the Statement of Reasons).

3.2.15. The ExA questioned whether the cable corridor had been surveyed yet. The Applicant confirmed that the cable route has not yet been surveyed as it is currently a large area of land and it is yet to be decided where exactly the cable will go as it would likely be a trench of 1 to 1.5 metres depending on the construction technique and a working strip of up to 20m so there would only be a narrow amount of disturbance. It would be disproportionate to survey the whole corridor at this stage. The Applicant reiterated that this is the usual approach to cabling and can be seen in the Cottam Solar Project made DCO, where only once the cable route had been decided, the soil

resource management plan ("**SRMP**") and survey can be conducted. The Applicant also stated that there will be as little disturbance to the soil as possible.

3.2.16. The ExA further clarified that they are not looking for the whole area's soil to be surveyed and that they understand the rationale for only surveying the section that will be used, however the ExA requested that it is made clear what the impact on agricultural land will be once the soil has been put back and how this is controlled. The Applicant is to liaise with NE regarding the SRMP.

3.2.17. **Action: The Applicant was asked to provide written information to set out how the final interconnecting cable corridor will be confirmed as a smaller area to that indicated in Works No: 4A and then how soil sampling will be secured (in the dDCO and control documents) and used to inform soil management for these works.**

3.2.18. *Post Hearing Note: Currently the cable route corridor is a wide area, of the order of 300 m wide. The cable works will require a working width of circa 20m across which the topsoil may be stripped (or running boards may be used), to enable the digging of a trench expected to be 1.5 m wide.*

3.2.19. *The working width will normally reduce to pass through limitations, such as hedgerows.*

3.2.20. *The works will be temporary and reversible. Typically, construction practice is to strip the topsoil off the working width and place that in a bund at the edge of the working width. The trench will then be dug by machinery working on one side, placing the subsoil adjacent to the topsoil on the other side. Once the cable is installed, the subsoil is placed back in the trench, and the topsoil spread back across the working width. The area is cultivated and rolled and returned to the farmers.*

3.2.21. *Topsoil disturbance is short term and limited. The same soils, having been stored adjacent to the trench, is replaced in the same order and to the same depth. This does not affect soil structure or land quality, although soil movement should take place only when soils are suitably dry.*

3.2.22. *The subsoil removed from the trench is replaced in the same order, and settles rapidly.*

3.2.23. *For these reasons land quality is not affected. A Soil Resource and Management*

Plan (SRMP) is secured by requirement 8 of the DCO. This will start with a soil survey of the proposed route, following a line as close as possible to the likely trench, and advising on soil handling and timing once the soil results have been collected.

3.2.24. *Once the cable has been installed, the land will return to the landowners and will be farmed as normal, with no limitations to use except for in common with other buried services, an obligation not to use diggers over the cable area for obvious safety reasons.*

3.2.25. The Applicant suggested that the farming use of the land should not be impacted once the cable has been installed and that it will at a depth which would not affect the usual use of farming machinery and that any impacts would therefore be limited a temporary construction disturbance. In relation to decommissioning, the Applicant confirmed that in the worst-case scenario is that upon decommissioning of the site, the cable is removed. However, this will be carried out according to the Decommissioning Environmental Management plan ("**DEMP**") .

3.2.26. The ExA stated that they wanted to understand the potential cumulative impacts on BMV land. The Applicant confirmed that table 14.7 of the Environmental Statement ("**ES**") estimates that the amount of soil disturbance will add up to 10 hectares of land. However, the Applicant has confirmed that the land that is disturbed will be restored upon decommissioning.

3.2.27. A concerned resident suggested concern over a number of points including food security and the loss of 4 tonnes of corn being taken out of food supply *[Post Hearing Note***:** *It is accepted that the installation of solar panels will take place on arable farmland. Therefore the impacts of using BMV agricultural land, rather than poorer quality land (subgrade 3b or below) is the incremental difference between what yield the BMV land produces versus the yield of poorer quality land . This is set out in Chapter 14 of the ES* ***[APP-034]****. The annual effect, based on the assumptions explained in the ES (14.5.91 – 14.5.97) is of the order of 500 tonnes of cereals (wheat) per annum across the Site. This is compared to annual UK production of circa 22 million tonnes.]*, the cumulative impact of the Proposed Development on the area, that wind turbines were a preferred source of renewable energy for the area, and whether grazing animals could co-exist alongside the tracking panels.

3.2.28. The Applicant emphasised that the only agricultural land to be taken out of use was 10 hectares temporarily which would be disturbed and then restored and that there

was a limited impact following decommissioning.

3.2.29. In relation to the concerned resident's comments regarding food supply the Applicant noted the figures for agricultural food production for last year being 22 million tonnes of cereals for England only and that the 2024 figures which weren't out yet would be lower. The Applicant also pointed to paragraphs 14.5.777-96 of the Environmental Statement **[APP-033]** for further discussion of this point.

3.2.30. The Applicant reiterated that in this case there was a separation between loss of BMV and land use as the land could still be used by farmers for example for BNG, or grazing livestock. It was confirmed that the tracking panels would be above the height of any likely grazing animals and that the Applicant was not aware that this been found to be a problem in other applications.

3.2.31. A discussion was had between the ExA and the Applicant regarding a requirement for grazing in the DCO and give that such a requirement is difficult to secure due to the availability of the relevant animals (sheep in particular) it may be a point to consider adding to the oLEMP outline Landscape Environmental Management Plan.

3.2.32. The Applicant stated they could provide, for the application site, the areas available for grazing and biodiversity and then compare these to the arable areas .

3.2.33. **Action: The Applicant was asked to Provide a figure for how much land is taken out of agricultural use - in addition to 10ha impermeable surfaces, specifically including areas for the solar array and mitigation areas.**

3.2.34. *Post Hearing Note: The Examining Authority asked for a breakdown of land uses between areas under and around panels where there is agricultural use potential, and areas for biodiversity enhancement, and areas for other works. These areas are shown on the ES Figure 3.2 Parameter Plan **[APP-040]**. An extract is provided below showing solar farm zone areas (blue) and green infrastructure (green).*

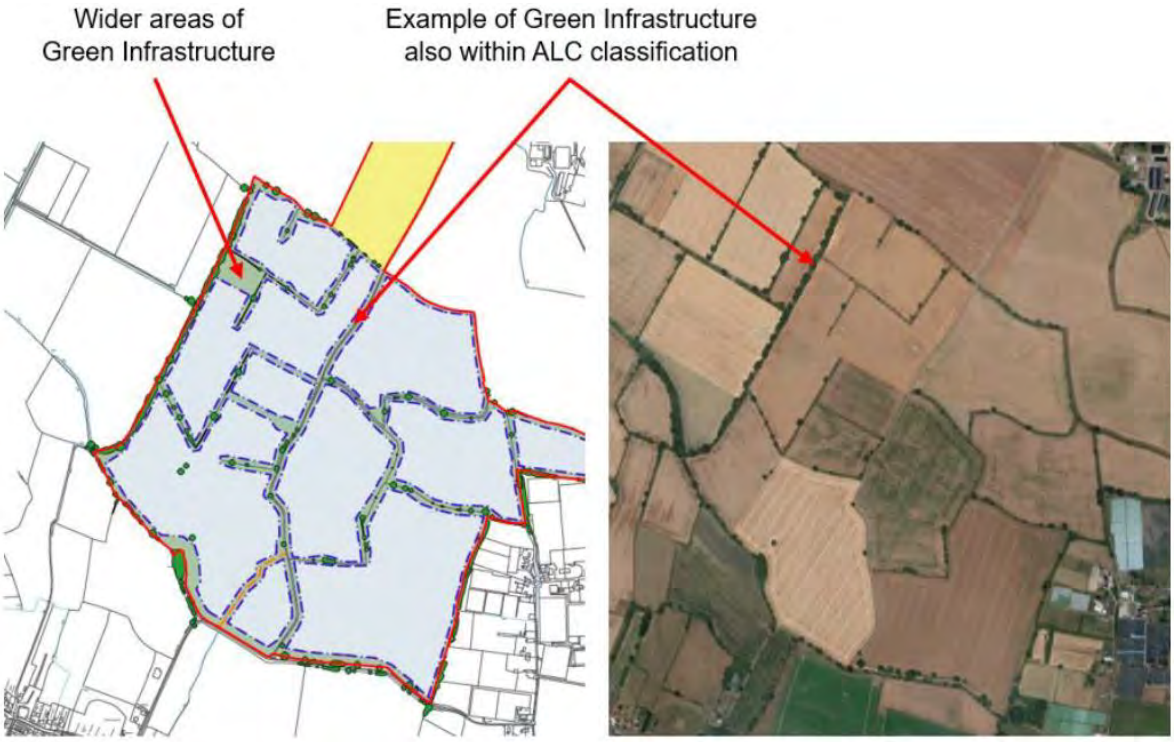


Figure 3.2: Green Infrastructure Maps
Source: Kernon Countryside Consultants

3.2.35. *The Parameter Plan shows the following areas:*

i) solar farm zone, being land for the solar PV modules, access tracks, inverters/transformers etc. This extends to about 295 ha and excludes the areas of hedgerow, ditches etc, as labelled below. It includes about 4 ha of tracks and field stations (ES, Chapter 14, Table 14.7 ***[APP-034]****);*

ii) green infrastructure areas, which include hedges and ditches (all areas classified as agricultural land within the ALC grading), as well as wider areas as indicated on the extract below;

iii) the substation;

iv) the area within which the underground cable corridor will run, once the route is determined;

v) the National Grid Substation and Access.

3.2.36. *The Examining Authority's question in relation to the first two, the solar farm zone and the green infrastructure areas, and was raised in connection with understanding how much agricultural land will no longer be available for agricultural use.*

3.2.37. *Quantifying this figure is difficult. Whilst the green infrastructure adds up to about 89ha, this includes areas such as the one shown below, which falls within the ALC total area, and within the green infrastructure area.*

Figure 3.3: Green Infrastructure on Site
Source: Kernon Countryside Consultants

3.2.38. *Therefore not all the ALC areas within the total is changing from agriculture to green infrastructure, because much of it is already green infrastructure.*

3.2.39. The Applicant referred to 5.1 of the Planning Statement **[APP-228]** and that the environmental assessment was undertaken for the worst case i.e. the land being taken out of use completely for 40 years and its bearing on the planning balance.

3.2.40. The Applicant also noted government figures for Agricultural Land Use in England from 1 June 2024 whereby the area of uncropped arable land was over 300,000 thousand hectares for BNG and therefore it is clear the government is not concerned with food production and security rather on BNG.

3.2.41. **Action: The Applicant committed to providing updated figures for this.**

3.2.42. *Post Hearing Note: The latest 'Agricultural Land Use in England at 1 June 2024' (Defra, 26 September 2024) is included as Appendix C. They show that at 1st June 2024:*

- *the area of uncropped arable land was 581,000 ha;*
- *of this 276,000 ha were left as bare fallow;*
- *the other 305,000 ha were used for environmental benefit;*
- *the area of solar panels was 7,300 ha, of which 3,600 ha was also used for*

agricultural purposes.".

3.2.43. The ExA asked the Council for comment and they confirmed that their responses would be provided in the LIR.

3.2.44. A concerned resident outlined further concerns regarding tracking panels and grazing movements as well as what would happen after decommissioning and piling damage and gave an example of the Selby coal field development which despite planning condition was not reinstated to agricultural use.

3.2.45. The Applicant confirmed that tracking panes don't affect grazing sheep who can graze comfortably and the ExA asked for examples of other solar farms where tracking panels are used and where grazing animals are present in the same location.

3.2.46. **Action: Provide examples of currently installed tracking panels and any evidence as to the effect of the movement on grazing livestock (particularly sheep).**

3.2.47. *Post Hearing Note: Examples of the installed technology in the UK are provided in Appendix A. Sheep can be grazed under SAT panels as:*

1. *The minimum height of panels is 900mm above existing ground level, so would allow free movement of sheep around and beneath the panels.*
2. *The noise and movement of the SAT would not disturb the sheep given that noise impacts would be insignificant and that the panels move slowly throughout the day.*

3.2.48. *Whilst it is not possible to specify which SAT sites are currently grazing livestock (due to the availability of data from the operators), it is important to note that many installed SAT sites are likely to have not reached grassland establishment phase (i.e. ~ 2 years after grassland seeding), given the relevantly recent introduction of SAT technology in the UK. It is therefore likely that they would have limited grazing until newly seeded grasslands have established.*

3.2.49. In relation to the damage after decommissioning the Applicant confirmed that compaction was minor and that the tracking panels were light weight and that in fact after 40 years land quality can improve due to long grass improvement.

3.2.50. Regarding permitted use after decommissioning the oDEMP which will be converted into a DEMP will ensure that following the removal of the structures and panels the land is returned to the landowners in a condition which allows arable agricultural use

to continue. Any future planning applications would have to be considered on their own merits.

3.3. Biodiversity and Ecology

3.3.1. The ExA noted that there were areas of disagreement between the Applicant and Natural England ("**NE**") however whilst invited NE has not attended the hearing. The Applicant was then invited to take the ExA through these remaining areas of disagreement with NE.

3.3.2. The Applicant flagged that the ecological impact of the scheme was outlined in Chapter 8 of the Environmental Statement. One of the main areas of disagreement between the parties as per NE's RR-268 related to wintering birds and those species which are located on designated sites and whether the Site is functionally linked to the designated sites as per the meaning in the Conservation of Habitats and Species Regulations 2017 . The Applicant confirmed it was updating the HRA in relation to this, as well as the Sites of Special Scientific Importance ("**SSSI**") assessment and conducting a further data gathering exercise (exclusive of BMV and air quality) and was working towards a further update at Deadline 2 but did not feel there were any points that weren't able to be resolved.

3.3.3. The ExA asked about deer fencing surrounding the panels and whether this may have an impact on the movement of animal across the site. The Applicant stated that it is common practice for solar farms to be secured by fencing for security reasons, but that the Applicant has addressed the potential impacts by creating "badger gates" and will place them on known animal tracks, which will help to mitigate any potential impacts. Additionally, the Applicant noted that such fencing is largely compartmentalised and therefore there are number of areas available to moving animals such as deer who are subject to behavioural changes altering the biodiversity of site.

3.3.4. Further the Applicant stated that research by Solar UK has found that deer still manage to get into the sites regardless of these fences and explained that the UK is not conserving deer due to the non-native species but that largely the evidence in the report was that there is no detriment. The ExA asked the Applicant to provide the Solar UK report and sign post the relevant sections regarding deer accessing solar farms.

3.3.5. **Action: The Applicant was asked to provide the Solar UK report relating to evidence of biodiversity within existing solar farms, with relevant sections signposted.**

3.3.6. *Post hearing note: A copy of the report 'Solar Habitat 2024: Ecological trends on solar farms in the UK' is provided at Appendix D. This report summarises on-going annual monitoring of biodiversity at operational solar farms in the UK, and is a joint publication between Solar Energy UK, Lancaster University, and two other professional parties.*

3.3.7. *With regards to deer, the Inspector is directed to page 6 of the report, which notes the presence of two non-native species of deer (fallow deer and muntjac), in addition to one native deer species (roe deer). Page 28 of the report (the 'Mammals' section) repeats this observation, and also notes the wider range of British mammal species recorded, including brown hare, badger, fox and smaller mammal species.*

3.3.8. *The same report also includes some information on skylarks, noting on page 24 that the species was seen at more operational solar farms than any other species (71%), which is represented in a graph on page 25. Additional context on ground-nesting birds (principally skylarks) is included on page 27 of the report. This notes that skylarks were regularly observed gathering food for young (nest provisioning) in an operational solar farm and therefore highlights that skylarks are not fully displaced from solar farms (i.e. they can continue to provide a foraging resource).*

3.3.9. The ExA asked NYC for their comments and they raised a concern in relation to ground nesting birds and the impact that solar sites can have on them. They questioned how this would be managed as there is general consensus that there will be a level of displacement for the birds. The Applicant confirmed that they are able to deliver the mitigation plots for skylarks within the order limits and that there is sufficient space to ensure that the mitigation programme and the taking of rights for the Proposed Development do not conflict. Further, the Applicant stated that the timing of the mitigation would be set out in the Landscape and Ecological Management Plan ("**LEMP**") and that they would provide further comment on this once they had read the Council's LIR.

3.3.10. NYC queried that some of the mitigation land seemed to be outside of the order limits based on the plans annexed to the LEMP at 3.8,3.12. The Applicant confirmed that they would clarify their position in writing with plans annexed.

3.3.11. **Action: The Applicant was asked to provide confirmation that all mitigation for ground nesting birds is proposed to be sited within the Order Limits and provide evidence that this land would be sufficient.**

3.3.12. *Post Hearing Note: Table 3.1 summarises the indicative number of skylark plots which can be accommodated in each suitable field located within the Order Limits. Field numbers are shown in Appendix E: Ground Nesting Bird Mitigation and Compensation Area Maps 1 – 3. This demonstrates that the Order Limits is able to accommodate at least 50 skylark plots, which is the required number.*

3.3.13. *The Applicant will discuss and seek to agree the oLEMP which is secured by Requirement 10 in the dDCO, with the LPA.*

Table 3.1: The available number of skylark plots per field located within the order Limits.

Field Number	Total Area (ha)	Area minus precautionary 50m buffer (ha)	Indicative number of skylark plots (x2 plots per ha)
2a	6.67	3.48	6
7a	5.01	1.86	3
11	5.93	2.00	3
17	19.63	9.63	19
19a	17.46	9.56	19
Total		26.53	50

3.3.14. The ExA suggested that the Applicant and NYC liaise and try to agree wording for the LEMP through the Statement of Common Ground ("**SoCG**") process. The ExA confirmed that a point needed to be reached where the Applicant and NYC were in agreement about the wording, but if this could not be reached, then each party could make a statement to confirm their respective positions. The Applicant agreed to work with NYC on their SoCG.

3.3.15. **Action: the Applicant will engage with NYC through the SoCG process and an update on this would be given at D2.**

3.3.16. In terms of monitoring the Applicant pointed out that it is a known quantity that sky lark plots are effective therefore an annual drone survey or similar could be helpful to show they are physically using the plots.

BNG

3.3.17. The ExA questioned the Applicant on their Biodiversity Net Gain ("**BNG**") position,

however the Applicant confirmed that whilst they are committed to providing gains, the statutory BNG regime does not currently apply to Nationally Significant Infrastructure Projects ("**NSIPs**") and that they are providing it on a voluntary basis.

3.3.18. The Council further iterated that the various ecological and biodiversity commitments are not represented in the LEMP and that it currently does not provide for monitoring and that they would arrange for an ecologist to review the LEMP to assist with adding the required detail. The Applicant reiterated that what the various parties have seen so far is an oLEMP and that the dDCO secures the LEMP.

3.3.19. The Applicant noted that the ES 16.1 **[APP-177]** is a useful document which would help parties to navigate the various control documents on a topic specific basis.

3.3.20. **Action: Review the dDCO and relevant control documents including the oLEMP, oCEMP in respect of the implications of 'site preparation' being outside the triggering of ecological mitigation controls. Liaise with the Council and Natural England of this matter through the SoCG process and provide an update to the Examination.**

3.3.21. *Post hearing note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

3.4. Transport and Access

3.4.1. The Applicant stated that the SoCG with National Highways is in a positive place and that they are expecting to be able to reach an early agreement with them.

3.4.2. In relation to the construction phase, the Applicant confirmed that various documents, including a Construction Transport Management Plan ("**CTMP**") had been prepared and secured as requirements (requirements 2 and 6 in particular) in the dDCO to manage any transport issues throughout the construction phase inclusive of consultation with the Local Planning Authority and Highways Authority ("**HA**") in relation to vehicular and pedestrian access, parking and circulation areas as being part of the detailed design process.

3.4.3. NYC stated that they wish to be involved in the drafting of the CTMP and as has been shown in in similar dDCO applications, it is important to set out all of the detail at an early point. The Applicant reiterated that impacts on the road networks would be minimal, the impact on the minor roads would be measure on the CTMP and

alongside this management measures for controls will be used to manage vehicle flow.

3.4.4. The HA noted that if a road is improved such as with passing places, the HA are going to look to the Applicant for commuted sums in terms of maintenance and any additional highway.

3.4.5. The Applicant agreed to liaise with NYC offline regarding this point and to provide the ExA with an update in the SoCG.

3.4.6. **Action: The Applicant was asked to continue to progress discussions in respect of the provision/upgrading of vehicular accesses and matters relating to securing adequate controls for the crossing of highways during construction. Indicate the position in respect of any commuted sums which may be necessary and provide an update at D2.**

3.4.7. *Post Hearing Note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

3.4.8. The HA also noted that during operation HGVs will not visit the site, and light vehicles or cars will be used and therefore unless this is not the case Applicant is managing the numbers of vehicles appropriately and it is therefore mainly the construction phase they are concerned with.

3.4.9. In relation to the operational life of the development, the Applicant reiterated that the definition of "maintain" under Article 2 of the dDCO does not include repowering, so it is highly unlikely that any HGVs would visit the site after the construction phase. The Applicant confirmed it would be cars and smaller vans needed for maintenance, which wouldn't disrupt any local transport routes.

3.4.10. In relation to decommissioning, the Applicant stated that it is essentially construction in reverse but with less disruption. Further, Requirement 5 requires a DEMP and a decommissioning transport management plan to be agreed and it is likely that this will follow the same route set out in the CTMP, but as decommissioning is after 40 years, an exact route cannot be confirmed at this point.

3.4.11. The HA commented that at this point decommissioning is an unknown factor and that at present the HA might suggest the existing or the, the proposed route to take the solar panels and the batteries away. Defining a route at this stage is very difficult, it

would likely be the current route but parties should wait to the time of decommissioning to confirm.

4. The draft dDCO and related control documents

4.1. Articles and Schedules in the dDCO

4.1.1. The ExA asked the Applicant to comment on any potential alterations, additions or updates to the articles in the dDCO arising from this hearing or as a result of engagement with IPs (ie arising from the SoCG process). The Applicant confirmed that save for the requirements and amendments discussed earlier in relation to Water Environment, there may potentially be some future amendments to some of the control documents such as the oLEMP and oSRMP.

4.1.2. The Applicant suggested that there may be some amendments to Schedule 9 of the dDCO, which sets out the Protective Provisions ("**PPs**") with various parties as bespoke PPs are being negotiated with some Statutory Undertakers.

Article 7

4.1.3. The ExA questioned the Applicant about the implications of Article 7 of the dDCO and whether it could or would obviate a change to the DCO, which would normally be done through s153 of the Planning Act 2008 ("**PA 2008**") and how this functioned.

4.1.4. The Applicant confirmed that Article doesn't obligate a variation to DCO- it affects the NSIP part of the only proposed development only, the authorised development, rather than the associated development. If, for example a landowner applied for planning permission for a barn on cable corridor this would require separate planning permission from the LPA in the usual way. Any variation to the NSIP must go through the variation process under the PA 2008 in the normal way. The ExA confirmed they would review the wording of this article and would come back with any further queries in written questions.

4.1.5. The Applicant concluded that this wording appears in a number of confirmed Orders.

4.1.6. *Post Hearing Note: The wording in Article 7 Planning Permission is the same as confirmed DCO's M3 Junction 9, and M20 Junction 10a. Byers Gill and Oaklands DCOs (not yet made) have proposed amended the wording to address issues arising from the Hillside case (regarding overlapping planning permissions). The Applicant will review and update as necessary.*

Flexibility

Schedule 2 Requirement 17

4.1.7. When asked about degree of flexibility in the dDCO, the Applicant stated that this level of flexibility is normal in dDCO applications. Schedule 2 requirement 17 is built in to ensure that any approved plans can be amended as necessary and sets out the process for doing so. Further, the Applicant stated that all works and plans are constrained by the ES and any parameter plans and therefore wider flexibility is not being sought.

Schedule 1 - Work No9

4.1.8. The Applicant noted that underneath Work No. 9 in a separate paragraph (albeit unnumbered) the elements listed a)-n), include a number of ancillary works which are required to facilitate the development and are not included in the Works descriptions because of the ancilliary nature of them. Without this provision the Applicant highlighted that the Works plans would become illegible due to the level of detail. All the works are constrained by what is outlined on the parameter plans and the environmental assessment.

Authorised Development

4.1.9. When asked to explain definition of "authorised development" in Article 2, the Applicant noted that this explains what is permitted by the dDCO, the authorised development (the NSIP over 50 MW of generation) as per Schedule 1 and its associated development (the other works needed to make the NSIP work).

Control Documents

4.1.10. The Applicant confirmed that Appendix 16.1 of the Environmental Statement sets out the mitigation committed to in the ES and where this is secured in the various control documents. All the control documents are secured by requirements in the DCO.

4.1.11. NYC questioned how many phases there will be in the Proposed Development. The Applicant responded that the solar farm is going to be built all at once, so only one phase, save for site preparation and decommissioning.

4.1.12. The ExA and NYC questioned about how the various documents sit together. In response, the Applicant clarified that the documents have a flat hierarchy, meaning that they all have their own requirements and all need to be signed off. In relation to

securing the requirements, the Applicant confirmed that the procedure for discharge is set out in Part 2 of Schedule 2 of the dDCO and at Requirement 16

Time requirements for NYC to approve plans

4.1.13. The Council objected to the 10-day requirement due to resourcing issues and the number of plans on numerous projects that they receive and have to sign off. The Applicant and NYC agreed to take this forward in their SoCG.

4.1.14. The Applicant highlighted that Requirement 18 (Consultation) puts the onus on the Applicant to liaise with the necessary parties ahead of submitting the plans for approval, so essentially all of the required consultation will be completed prior to the plans reaching the council for approval. This should mean it is not a lengthy exercise for them to approve plans.

4.1.15. **Action point: the Applicant and NYC will discuss the time limit for providing approval of plans and provide an update in their next SoCG. The NYC will provide relevant wording to amend the dDCO in this respect.**

4.1.16. *Post Hearing Note: As per the Actions List published by the ExA on 9 December this action point is to be provided at Deadline 2.*

Appendix A: Examples of currently installed Single Axis Tracker panels

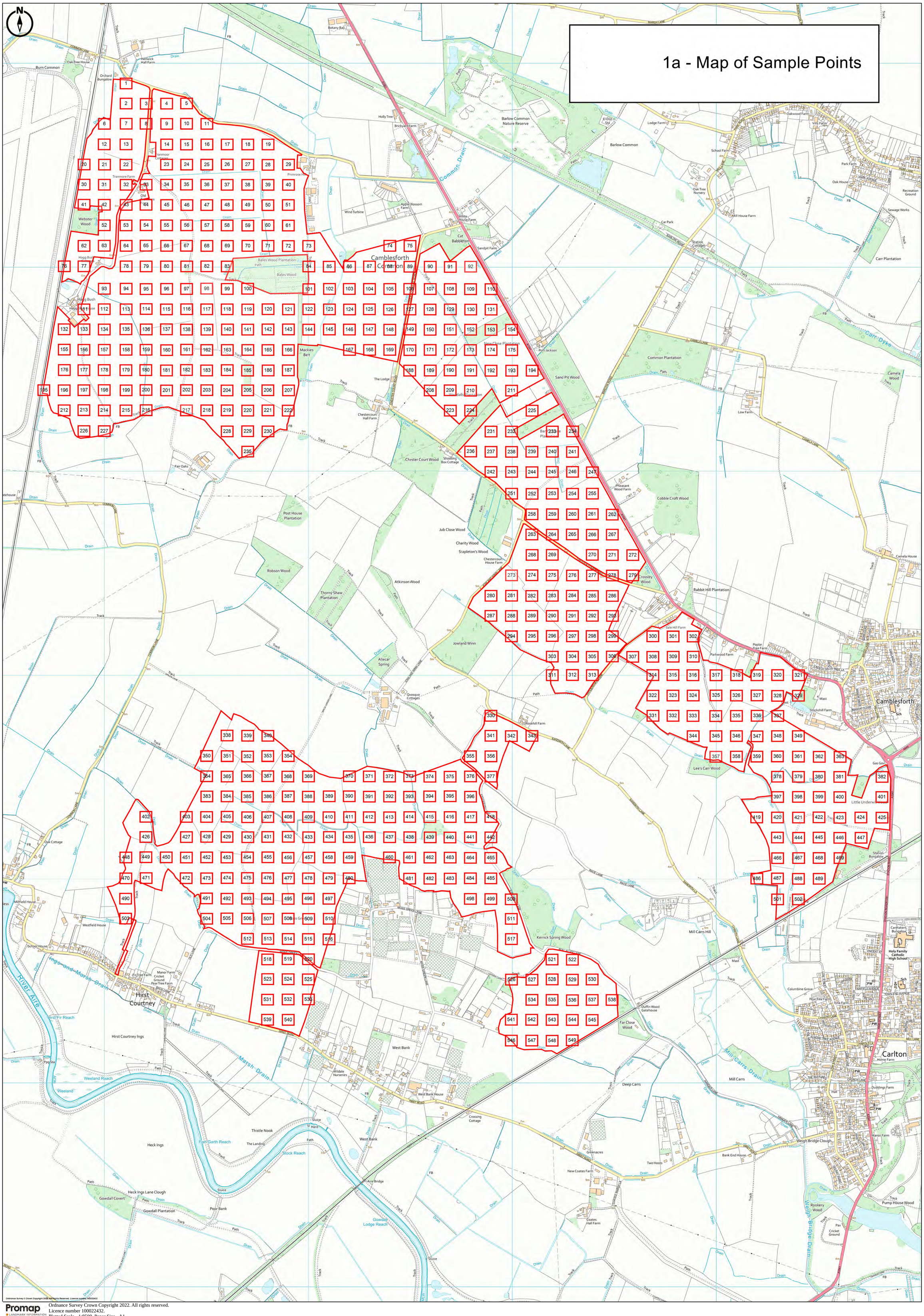
Details	Figure
Cirencester Location: Witpit Lane, Cirencester, Gloucestershire Planning Ref: 15/01923/FUL (as amended). Local Planning Authority: Cotswold District Council Status: Operational Grazed: Unknown	 *Cirencester.* *Source: Enso Energy*

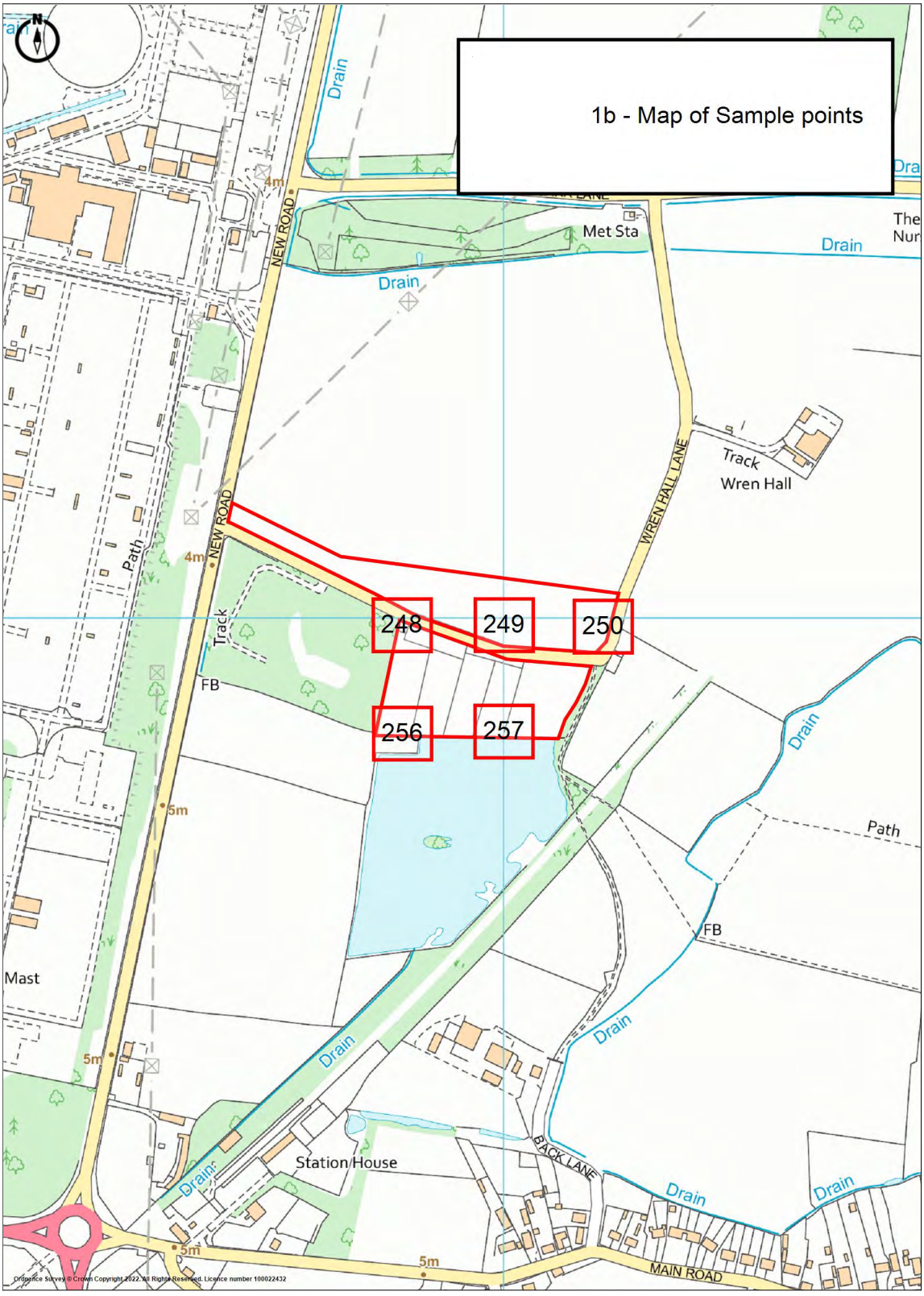
York Location: Boscar Grange Farm, Easingwold, North Yorkshire Planning Ref: 15/01268/FUL (as amended) Local Planning Authority: North Yorkshire Council Status: Operational Grazed: Unknown	 *Boscar Grange Farm.* *Source: Google Earth*

Hull Location: Land South Of Main Road, Bilton, East Riding Of Yorkshire Planning Ref: 15/01752/STPLF (as amended) Local Planning Authority: East Riding of Yorkshire Council Status: Operational Grazed: Unknown	 *Bilton.* *Source: Google Earth*

Appendix B: Maps of Sample ALC Points

1a - Map of Sample Points





Promap
LANDMARK INFORMATION

Appendix C: 'Agricultural Land Use in England at 1 June 2024' (Defra, 26 September 2024)

GOV.UK

Department
for Environment,
Food & Rural Affairs

Accredited official statistics

Agricultural land use in England at 1 June 2024

Updated 26 September 2024

Applies to England

Contents

This publication is available at https://www.gov.uk/government/statistics/agricultural-land-use-in-england/agricultural-land-use-in-england-at-1-june-2024

This release contains the estimates of crop areas, land use and land ownership on commercial agricultural holdings in England on 1 June 2024 from the June Survey of Agriculture. Cereal and oilseed areas were published on 29 August. They are included here for completeness and remain unchanged.

Three new questions were introduced to the survey this year to gather information on how land use is changing. First estimates are now available on the area of arable land used for environmental benefit but not in production and the area of agricultural land used for solar panels (including and excluding land also used for grazing or production).

All results tables are available in the datasets at

Agricultural land use in England at 1 June (https://www.gov.uk/government/statistics/agricultural-land-use-in-england)

Agricultural land ownership and tenure structure in England at 1 June (https://www.gov.uk/government/statistical-data-sets/agricultural-land-ownership-in-england)

Key points

Agricultural land use

- The utilised agricultural area (UAA) is 8.7 million hectares in 2024, a 1.0% decrease since 2023 and accounts for 67% of the total area of England.
- The total croppable area accounts for just over half (57%) of UAA whilst permanent grassland accounts for an additional 38%.

Crops

- The total area of arable crops saw a 6.4% decrease between 2023 and 2024, falling to 3.5 million hectares. This was primarily due to flooding and difficult weather conditions which resulted in failed crops and a partial switch to spring plantings.
- The area of uncropped arable land increased by 107% to 581 thousand hectares. Of this area, 276 thousand hectares were left as bare fallow

and the remaining 305 thousand hectares were used for environmental benefit.

- The area of wheat decreased by 11% to 1.4 million hectares, whilst barley increased by 6.2% to 849 thousand hectares.
- The area of oilseed crops decreased by 26% to 274 thousand hectares in 2024. Oilseed rape accounts for 91% of this area and fell by 27% to 250 thousand hectares in 2024.
- Potatoes increased by 1.2%, rising to 83 thousand hectares in 2024.
- The area of horticultural crops covers 113 thousand hectares of land, a decrease of 3.2% compared to 2023.

Land ownership

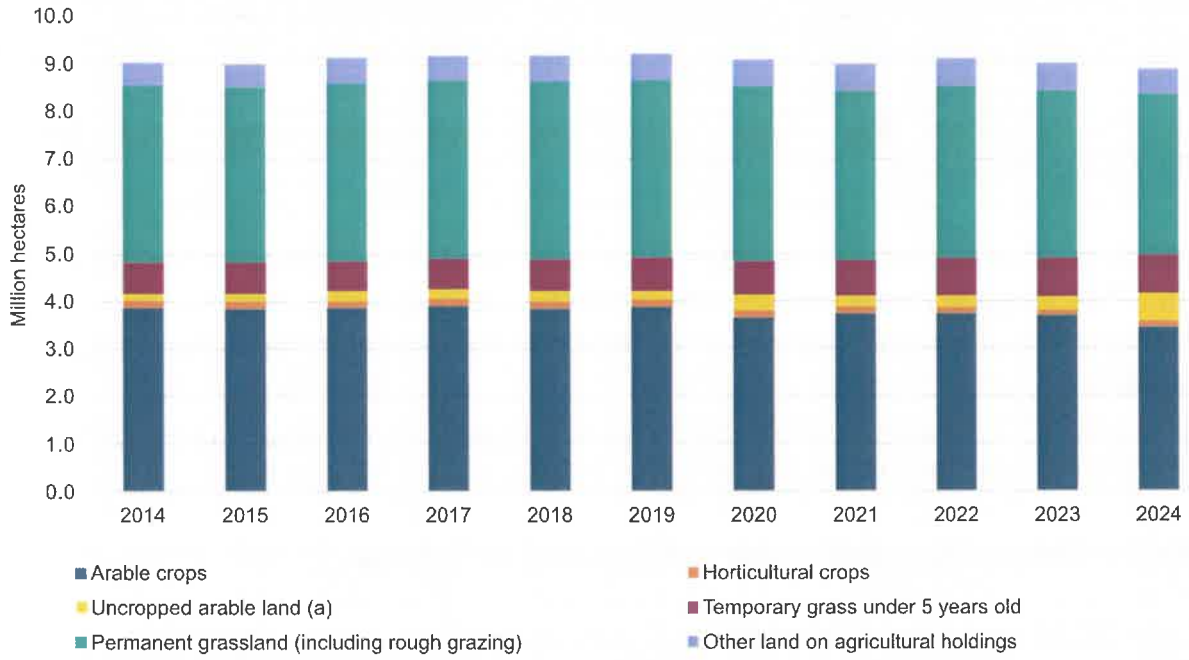
- The area of agricultural land owned in England decreased by 1.0% to 6.1 million hectares in 2024. Land rented in for a year or more remained at 2.9 million hectares.

Section 1 Detailed results

1.1 Utilised agricultural area

The utilised agricultural area in England is 8.7 million hectares in 2024 and accounts for 67% of the total England area. This area includes all arable and horticultural crops, uncropped arable land including bare fallow and arable land used for environmental benefit, land used for outdoor pigs, temporary and permanent grassland and common rough grazing (Figure1).

Figure 1 - Agricultural land use areas in England at 1 June



(a) From 2024 uncropped arable land was collected as two separate categories: bare fallow and arable land used for environmental benefit but not in production. Areas for both are available in the agricultural land use dataset that accompanies this publication.

The amount of land used for solar panels was collected separately for the first time in 2024 via two categories to differentiate between land used only for solar and that also used for grazing or agricultural production. The data only covers land use and therefore excludes rooftop panels.

Land used for solar panels and also grazed or used for agricultural production covered 3.6 thousand hectares in 2024 and is included in the permanent grassland area. Solar panels on land not used for agricultural production accounted for 3.7 thousand hectares and is included in the other land on agriculture holdings area (Figure 1). Detailed breakdowns are available in the accompanying dataset. (https://www.gov.uk/government/statistics/agricultural-land-use-in-england)

1.2 Croppable area

The area of land available for cropping increased by 1.6% to 5.0 million hectares and accounts for 57% of UAA. The croppable area consists of cereals, oilseeds, potatoes, other arable crops, horticultural crops, uncropped arable land and temporary grassland.

Figure 2 shows that in the years prior to 2024, the proportion of croppable land used for each purpose remained similar; however, in 2024 some

categories did see changes. In particular, cereal and oilseed crops saw decreases in area as a result of bad weather causing difficult planting conditions. Consequently, the area of uncropped arable land increased by 107% to 581 thousand hectares. Of this area, 276 thousand hectares were left as bare fallow and the remaining 305 thousand hectares were used for environmental benefit.

This additional detail about uncropped arable land was collected for the first time in 2024 to give more insight into how the land is used. Arable land used for environmental benefit but not in production includes pollen and nectar flower mixes, winter bird food, buffer strips on arable land, flower rich margins and in field strips. This area would previously have been recorded as uncropped arable land along with bare fallow as a single item.

Figure 2 - Total croppable area in England at 1 June

(a) From 2024 uncropped arable land was collected as two separate categories: bare fallow and arable land used for environmental benefit but not in production. Areas for both are available in the agricultural land use dataset that accompanies this publication.

1.3 Arable crops

The total area of arable crops saw a 6.4% decrease between 2023 and 2024, falling to 3.5 million hectares. This was largely due to a decrease in the cereals area, which accounts for 71% of arable crops. Difficult weather conditions in the autumn and restricted opportunities for spring drilling affected cereal plantings and led to the decreased area.

The wheat area decreased by 11% to 1.4 million hectares in 2024. This is the lowest wheat area since 2020 when crop plantings were last affected by very wet weather in the autumn. Barley increased by 6.2%, from 799 thousand hectares in 2023 to 849 thousand hectares in 2024. A 17% decrease in winter sown barley was more than offset by a 28% increase in spring sown area as a result of a partial switch to spring planting (Figure 3).

The total area of oilseed rape decreased by 27%, from 342 thousand hectares in 2023 to 250 thousand hectares in 2024. This was due to a 28% fall in winter sown oilseed rape, which accounts for 98% of the total oilseed rape area.

For more detailed information please go to the full Cereal and oilseed areas in England release (https://www.gov.uk/government/collections/crops).

Figure 3 - Area of wheat, barley and oilseed rape in England at 1 June (thousand hectares)

The total potato area increased by 1.2% to 83 thousand hectares in 2024, the first increase in area since 2019. This rise was driven by a 7.2% increase in early crop potatoes, with the area of main crop potatoes remaining stable.

Other arable crops covered 648 thousand hectares in 2024, a decrease of 3.4% since 2023. Field beans saw the largest area change, decreasing by 37% to 132 thousand hectares. Maize accounts for over a third of the other arable crops area and increased by 8.8% to 237 thousand hectares in 2024.

1.4 Horticultural crops

Horticultural crops covered 113 thousand hectares in June 2024, falling by 3.2% since 2023. This area is mostly used to grow fruit and vegetables, which covers 90% of the total horticultural area.

The total area of orchards and small fruit decreased by 5.0% between 2023 and 2024 to 28 thousand hectares, with orchards covering 18 thousand hectares in 2024 and small fruit grown on the remaining 10 thousand hectares. Figure 4 shows the breakdown of small fruit areas and highlights the increase in area used to grow wine grapes seen in recent years.

Figure 4 - Breakdown of small fruit areas in England at 1 June

The area used to grow vegetables and salad for human consumption decreased by 5.2%, to 73 thousand hectares in 2024. This was largely due to lower areas of carrots, onions and other vegetables and salad. Carrots saw the largest proportional decrease, falling by 27% as a result of difficult weather conditions (Figure 5).

Figure 5 - Breakdown of vegetable and salad areas in England at 1 June

1.5 Land ownership

The total area of land owned in 2024 was 6.1 million hectares, a decrease of 1.0% compared to 2023.

Land rented in for a year or more remained almost unchanged at 2.9 million hectares in 2024. Farm Business Tenancies account for 44% of this area and remained broadly stable at 1.3 million hectares. Land under Full Agricultural Tenancies has continued to decline, falling by 2.1% to 1.1

million hectares. Land covered by other agreements of a year or more increased by 1.1% in 2024 (Figure 6).

Figure 6 - Breakdown of area of land rented in for a year or more in England at 1 June (hectares)

Section 2 About these statistics

2.1 Survey methodology

Full details of the survey methodology are available on the Structure of the agricultural industry guidance web page (https://www.gov.uk/structure-of-the-agricultural-industry-survey-notes-and-guidance).

The June Survey of Agriculture and Horticulture has been run predominantly online since 2011, with an option for farmers to complete a paper form if they prefer. The survey is annual and samples around 30,000 holdings most years, with a full census run once a decade. The last census was run in 2021.

The June 2024 survey was sent to a sample of 56,000 commercial holdings and responses were received from 30,000 holdings, representing a response rate of 53%. This is a larger sample than usual which will enable us to provide detailed geographical breakdowns later in the year and help to understand changes currently happening within the farming sector, e.g. changes in land use following the introduction of ELM schemes. Commercial holdings are defined as those with more than five hectares of agricultural land, one hectare of orchards, 0.5 hectares of vegetables or 0.1 hectares of protected crops, or more than 10 cows, 50 pigs, 20 sheep, 20 goats or 1,000 poultry.

Table 1 provides details of the sample survey population broken down by farm size. The size of a farm is determined by its Standard Labour Requirement (SLR) which is the typical number of full-time workers required on the holding based on its activity.

Table 1: June 2024 population size and sampling rate

Stratum	Description	Sampling rate (%)	Population size
1	SLR < 0.5	30%	50,264

Stratum	Description	Sampling rate (%)	Population size
2	SLR >= 0.5 and < 1	51%	15,271
3	SLR >= 1 and < 2	71%	13,527
4	SLR >= 2 and < 3	80%	6,773
5	SLR >= 3 and < 5	80%	6,675
6	SLR >= 5	80%	7,182
10	SLR unknown	97%	5,649
	All	**52%**	**105,341**

For pig and poultry sectors, an additional data collection exercise was run to collect data from a central point for some of the largest companies. Cattle results are sourced from the Cattle Tracing System (CTS). The data include returns from all holdings with cattle so are not subject to survey error.

2.2 Changes to June Survey design

Three new questions were introduced to the survey this year to gather information on how land use is changing. First estimates are now available on the area of arable land used for environmental benefit but not in production and the area of agricultural land used for solar panels (including and excluding land also used for grazing or production).

Arable land used for environmental benefit but not in production includes pollen and nectar flower mixes, winter bird food, buffer strips on arable land, flower rich margins and in field strips. It would previously have been recorded as uncropped arable land along with bare fallow as a single item.

2.3 Data analysis

The data are subject to rigorous validation checks which identify inconsistencies within the data or large year-on-year changes. Any records that have not been cleaned by the results production stage are excluded from the analysis.

Population totals are estimated for each question on the survey to account for the non-sampled and non-responding holdings. This survey uses the technique known as ratio raising, in which the trend between the sample data and base data (previous year s data) is calculated for each stratum. The calculated ratio is then applied to the previous year s population data to give England level estimates. For holdings where we do not have base data (new holdings or long-term non-responders) the sample estimates are raised according to the inverse sampling fraction.

2.4 Confidence indicators

Confidence intervals and tick based indicators are shown alongside all of our estimated figures and can be found in the data tables within the dataset (https://www.gov.uk/government/statistics/agricultural-land-use-in-england). These both help to show where there is more variability around results and highlight whether year-on-year changes are statistically significant or not. Whilst these are a useful indicator, they do not take into account any other sources of survey errors, such as non-response bias or administrative data errors.

2.5 Data notes

- All figures relate to commercial holdings.
- All percentage changes are based on unrounded figures.
- Totals may not necessarily agree with the sum of their components due to rounding.
- Proportional breakdown rounding may be adjusted to add up to 100%.

2.6 Data uses and users

Results from the June Survey of Agriculture and Horticulture have a wide range of uses and users with requests for data being made on a frequent basis. A document providing information of specific uses and users can be found on our guidance and notes (https://www.gov.uk/guidance/structure-of-the-agricultural-industry-survey-notes-and-guidance).

2.7 Other survey results and publications

The next releases from the June Survey will be UK results and are expected to be in December. The definitive publication date will be announced on the research and statistics (https://www.gov.uk/search/research-and-statistics) webpage on gov.uk.

More detailed results from the June Survey can be found on our Structure of the agricultural industry in England and the UK at June web page (https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june). This includes various time series of crop areas and livestock numbers dating back as early as 1866 and detailed geographical breakdowns of the results.

2.8 Feedback

We welcome feedback and any thoughts to improve the publication further. Please send any feedback to: farming-statistics@defra.gov.uk.

Section 3 - What you need to know about this release

3.1 Contact details

Responsible statistician: [redacted]

Team: Farming Statistics - Department for Environment, Food and Rural Affairs

Email: farming-statistics@defra.gov.uk

Tel: 0300 060 0170

3.2 Accredited official statistics

Accredited official statistics are called National Statistics in the Statistics and Registration Service Act 2007. An explanation can be found on the Office for Statistics Regulation website (https://osr.statisticsauthority.gov.uk/accredited-official-statistics/).

Our statistical practice is regulated by the Office for Statistics Regulation (OSR). OSR sets the standards of trustworthiness, quality and value in the Code of Practice for Statistics that all producers of official statistics should adhere to.

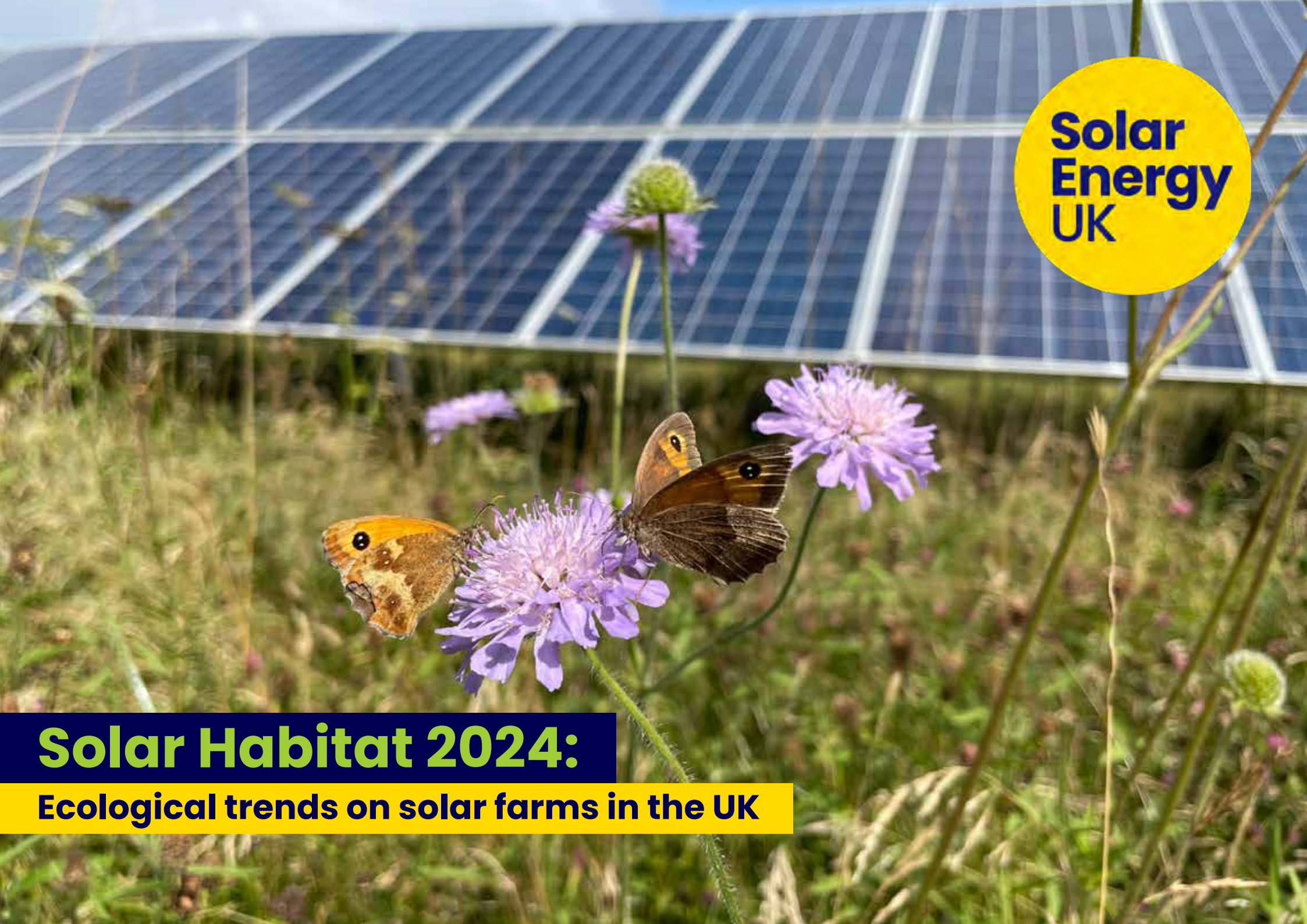
These accredited official statistics were independently reviewed by the Office for Statistics Regulation in 2014. They comply with the standards of trustworthiness, quality and value in the Code of Practice for Statistics and should be labelled accredited official statistics .

You are welcome to contact us directly with any comments about how we meet these standards (see contact details). Alternatively, you can contact OSR by emailing regulation@statistics.gov.uk or via the OSR website.

Since the latest review by the Office for Statistics Regulation, we have continued to comply with the Code of Practice for Statistics, and have made the following improvements:

- Reviewed and amended the validation checks carried out on response data including validation against new administrative data sources to better assure ourselves of the quality of the statistics.
- Enhanced trustworthiness by removing pre-release access.

Appendix D: Solar Habitat 2024: Ecological trends on solar farms in the UK (Solar Energy UK)



Solar Habitat 2024:

Ecological trends on solar farms in the UK

Solar Energy UK

is an established trade association working for and representing the entire solar and energy storage value chain. Solar Energy UK represents a thriving member-led community of almost 400 businesses and associates, including installers, manufacturers, distributors, large-scale developers, investors and law firms. Our underlying ethos has remained the same since our foundation in 1978 - to be a powerful voice for our members by catalysing their collective strengths to build a clean energy system for everyone's benefit. Our mission is to empower the UK's solar transformation.

Clarkson & Woods

provide a full range of ecological survey and consultancy services in respect to planning and land management. We are a leading consultancy in the survey, assessment and design of proposed and existing photovoltaic solar developments of all scales, from community owned to nationally significant projects.

We provide a range of services including survey and ecological assessment of solar and battery projects, development of bespoke management plans for solar farms and ecological monitoring of operational solar farms. We have a particular interest in furthering our understanding of the interactions between solar farms and ecology and have co-developed guidance in this area as well as embarking on pioneering research and collaboration with academic institutions.

Lancaster University

is a northern powerhouse of research excellence nested within a context of social and environmental sustainability. In the 2021 Research Excellence Framework, 91% of our research was independently rated as 'internationally excellent' or 'world leading'. We are ranked 7th in the UK for social and environmental sustainability.

The Energy Environment Interactions team focus on improving understanding of the implications of the energy transition on the environment, and how land use change for energy can be done in a way that delivers ecological, as well as climate, benefits. They sit within Lancaster Environment Centre, a 400-strong community of high-achieving students, world-class environmental researchers, government scientists and enterprises working together to address today's biggest environmental challenges, cutting across the physical and social sciences.

Wychwood Biodiversity

works with solar asset owners and managers to improve biodiversity on their land. Our team of ecologists is passionate about biodiversity and our core strengths lie in the planning, creation and management of bespoke wildlife habitats.

We've developed a range of services to support organisations at all stages of the project cycle, from pre-planning through to the long-term management of solar farms. We provide technical services to support planning applications, development of site management plans and ecological monitoring. We offer tried and tested means to achieve biodiversity gains for single sites or entire portfolios. We've worked with our project partners to produce guidance on biodiversity management for the entire solar industry.

Pyramidal Orchid, Harry Knight-Smith, British Solar Renewables

Contents

Front cover: Gatekeeper and Meadow Brown butterflies, Hollie Blaydes, Lancaster University

Glossary

Amber Listed – bird species with an unfavourable conservation status in Europe, whose population/range has declined moderately in recent times or has a historically declining population but has made a recent substantial recovery, rare breeders and species for which the UK holds internationally important populations, as categorised by the British Trust for Ornithology[1].

Arisings – vegetation cuttings often left in situ after management.

Birds of Conservation Concern – British Trust for Ornithology Amber or Red Listed species[1].

Biodiversity Net Gain (BNG) – an approach to development that aims to deliver measurable improvements for biodiversity by creating or enhancing habitats.

Botany – relating to plants.

Broadleaf – plant species with relatively broad, flat leaves.

BTO – British Trust for Ornithology.

Climber (plant) - a group of plants that use twining stems, tendrils or sticky pads to cling to surfaces.

Deciduous – plants which lose their leaves during the winter.

eDNA – Environmental DNA.

ESG – Environmental, Social and Governance.

Evergreen – plants that retain their leaves through the winter.

Ferns - a group of vascular plants that reproduce using spores and do not have seeds or flowers.

Graminoid – grasses, sedges and rushes.

Incidental (observations) - biodiversity sightings outside of structured surveys.

Injurious weed – a plant that can damage crops, habitats or ecosystems, as prescribed in the Weeds Act 1959.

Natural England – A non-departmental public body which advises on the natural environment in England, sponsored by the Department for Environment, Food & Rural Affairs.

NERC Act – Natural Environment and Rural Communities Act 2006.

NSIP - Energy projects over a specified generating capacity (50 MWac and above in England and 350MWac and above in Wales) which are of national significance and are determined at a national level.

Open mosaic habitat – habitat which establishes on previously developed land usually comprising sparse, patchy vegetation including stress tolerant plants.

Quadrat – a square plot of land marked out for botanical assessment.

Red Listed – bird species that are globally threatened, whose population/range has declined rapidly in recent times or that have declined historically and not shown recovery, as categorised by the British Trust for Ornithology[1].

Standard error (of the mean) - an indication of how different the population mean is likely to be from a sample mean.

Strings (of panels) – a row of panels that are wired together.

Sward – a grassland area.

Transect – a straight line through a habitat used to make measurements or observations.

Woody plants – plant species whose stems/roots are reinforced with wood (typically trees and shrubs).

Summary & highlighted findings

Until recently, monitoring of solar farms has not been applied consistently across the UK, making comparisons between sites difficult. In response, Solar Energy UK, in collaboration with Lancaster University, Clarkson & Woods and Wychwood Biodiversity introduced the standardised approach to monitoring biodiversity on solar farms. This standard enables the collection of comparable data, providing a clearer understanding of ecological trends on solar farms.

In May 2023, the first Solar Habitat report was released which highlighted ecological trends across 37 sites in the UK monitored in 2022 using the standardised methodology. This report continues that work, collating data from 87 sites monitored throughout 2023. The more than doubling of data in this year's report means trends between management approaches and biodiversity on solar farms can be identified with greater confidence.

This report provides a summary of botany, invertebrates, birds and mammals found on solar farms as part of structured surveys and incidental observations. The analysis indicates a positive relationship between specific management with greater biodiversity focus for biodiversity and plant and animal abundance. It also shows that the presence of diverse plant and invertebrate species has a positive impact on the abundance of bird species.

A direct comparison of the findings from 2022 to those from 2023 is not possible as only 17 sites were monitored in both years. However, over time, as data is accumulated from the same sites year on year, enabling the exploration of temporal trends, impacts of management practices over time and changes in biodiversity as sites mature. The standardised methodology will be reviewed periodically to incorporate feedback and make improvements.

The results of the standardised ecological monitoring set out in this and future annual publications of the Solar Habitat reports will help guide site managers, policymakers, ecologists, and local authorities and inform the effective management of operational sites.

The 87 sites surveyed in 2023 represent only a small proportion (6%) of the more than 1,400 solar farms operating in the UK[1]. It is anticipated that both the number of sites and contributing ecological consultancies will continue to grow year-on-year as the demand for monitoring and number of active sites continue to grow. With a greater data set and understanding of ecological trends, an ever-clearer picture of biodiversity on solar farms will emerge

Wheatear, Conor Mackenzie, Wychwood Biodiversity

Botany

- A total of 298 plant species were recorded across grasslands within 87 solar farms. On average, 27 species were recorded on each site, with a maximum of 52 found on one site.
- Within solar farms, species richness was generally greater in margin areas and those set aside for biodiversity.
- Across all monitored solar farms, on average more plant species were recorded at sites managed with a greater focus on biodiversity.

Invertebrates

- At least 47 invertebrate species and more than 3,000 individuals were recorded as part of structured surveys, including bumblebees, butterflies, moths, dragonflies and damselflies. On average, six species were recorded at each site, with a maximum of 15 observed at one site.
- Along transects, butterflies were five times more abundant than bumblebees. The most frequently recorded species was the meadow brown butterfly.
- The abundance and species richness of bumblebees and butterflies was greater along transects walked in solar farm margins and areas managed for biodiversity than between the rows of panels.

Birds

- A total of 99 bird species and almost 8,000 individuals were recorded across solar farms as part of structured surveys. On average, 25 species were recorded at each site, with a maximum of 47 found at one solar farm.
- Species recorded included 21 British Trust for Ornithology (BTO) Red Listed Species of Conservation Concern, as well as 25 BTO Amber Listed species.
- Higher numbers of bird species were associated with higher numbers of plant species across solar farms. Bird abundance was also greater with higher invertebrate abundance.

Mammals

- Incidental observations from 33 sites reported ten species of mammal present on solar farms, including rabbit, brown hare, weasel, field vole, common shrew, fox and badger. Fallow deer, muntjac deer and roe deer were also sighted.
- Brown hare were the most frequently recorded species, making up 40% of all observations.
- Targeted surveys would increase our understanding of mammals and solar farms.

Flower rich grassland, Hollie Blaydes, Lancaster University

Introduction

In May 2023 Solar Energy UK, in collaboration with Clarkson & Woods, Lancaster University and Wychwood Biodiversity, published the pilot Solar Habitat report highlighting ecological trends on solar farms in the UK.

Using the guidance set out in The Standardised Approach to Monitoring Biodiversity on Solar Farms, published in 2022, the pilot report summarised the results of ecological monitoring conducted at 37 operational solar farms in the UK. It looked at trends and observations to highlight how solar farms and their management can interact with local biodiversity.

This report continues that effort and collates the results of monitoring data from 87 solar farms undertaken by Clarkson & Woods and Wychwood Biodiversity throughout 2023. The report focuses on botany, invertebrates, birds and mammals found at solar farms and presents additional case studies looking at: growing shade tolerant grasses and wildflowers beneath panels, growing chamomile between panels and the use of environmental DNA (eDNA) to identify invertebrates. The report also revisits the application of Biodiversity Net Gain (BNG) on solar farms.

Solar Habitat has taken inspiration from Clarkson & Woods annual Solarview reports (2018 - 2020) which presented the results of ecological monitoring on solar farms undertaken by Clarkson & Woods solely. It is the intention of the authors to continue to report on the ecological monitoring on solar farms each year, encompassing data collected by ecological consultancies active across the UK, to build an ever-clearer picture of biodiversity on solar farms.

Monitoring ecology

Solar farms can contribute towards addressing the twin crises of climate change and biodiversity loss by reducing emissions and, with good management, encouraging biodiversity. While the first claim is widely accepted, it is important that claims about biodiversity are substantiated by ongoing observations.

Monitoring ecology is important for assessing the influence of solar farms on biodiversity. These include changes in the climate, growth in the scale and number of solar farms, changes in technology and changes in management practices, not to mention changes in policy and planning requirements.

The Standardised Approach to Monitoring Biodiversity on Solar Farms was published in 2022 by the authors of this report in order to be able to build a comparable data set across solar farms. The data will allow for a greater understanding of the influence solar farms can have on biodiversity and help to identify the impacts of management approaches.

The standardised methodology has been used for two consecutive years to monitor 37 sites in 2022 and 87 sites in 2023, beginning the process of building a credible evidence base, which will paint a representative picture of ecological trends on solar farms. Management styles vary greatly across operational solar farms. Though the trends identified from the analysis of data collected in 2022 and 2023 may be comparable, the data itself cannot be directly compared. This is because many sites go more than one year between monitoring and because the standardised methodology is designed to be achievable within a single day meaning that the time of year or weather on the day can impact results. However, over time, the accumulation of data collected from the same sites over multiple years, will enable the exploration of temporal trends, impacts of management practices over time and changes in biodiversity as solar farms age.

The results of the ecological monitoring set out in this, and future annual publications of the Solar Habitat reports, will help to guide policy, help ecologists and local authorities to appraise solar farm impacts and inform the management of operational sites. It is anticipated that the number of sites as well as the number of contributing ecological consultancies will continue to grow year on year as the demand for monitoring and number of active sites to continue growing.

Brown argus butterfly, Conor Mackenzie, Wychwood Biodiversity

Overview of solar farms

A total of 87 solar farms were monitored in 2023, with sites spread across England and a number located in Wales and Northern Ireland (Figure 1).

Most sites were located in England, with many in the south-west (30%), east (23%) and south-east (18%), which broadly matches the distribution of solar farms across the UK (Figure 1). Although the sample is generally representative of solar farms in England, it did not include any sites in the regions of London or the north-west. Just 3% of sites were located in Wales, compared to 11% at the national level. One site was located in Northern Ireland, and this was broadly similar to the distribution across the UK (1% vs. 2%). No solar farms in Scotland submitted monitoring data to this report in 2023, although 1% of sites across the UK are located there.

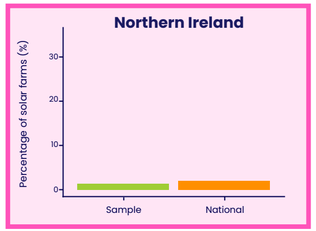
The age and size of solar farms in the Solar Habitat sample were generally representative of sites across the UK. The average age (years since grid connection) of sites in the sample was eight years but ranged from one to ten years old (nationally, the average age of operational solar farms is eight years, ranging from one to twelve years).

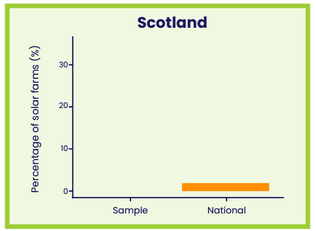
The generation capacity of solar farms included within the Solar Habitat sample based on megawatt (MW) output ranged from 1 MW to 70 MW, with an average of 10 MW. Again, this reflects the profile of operational sites nationally, which range from < 1 MW to 75 MW, with an average of 8 MW, based on solar farms that were operational as of October 2023[3].

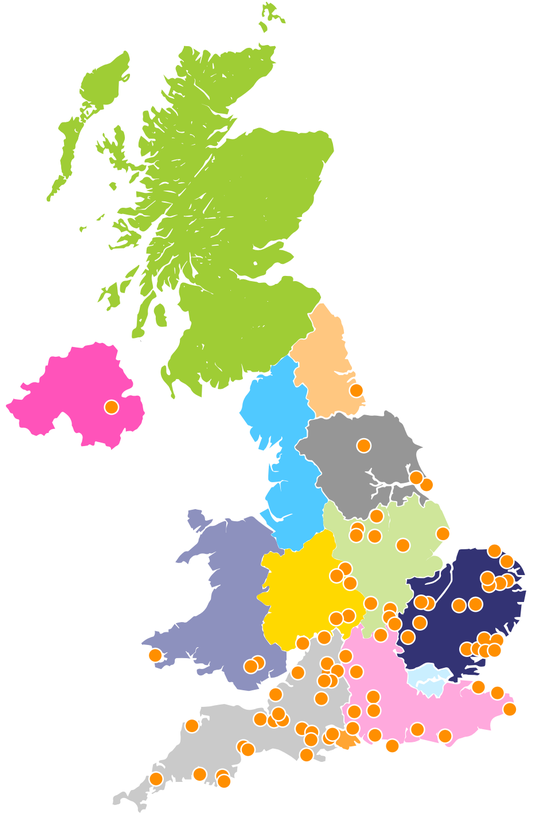
Figure 1: A map of the UK where England is split into regions and Wales, Scotland and Northern Ireland are represented at the country level. Orange points represent solar farms monitored in 2023. For each region/country, a bar graph shows the percentage of solar farms in (i) the Solar Habitat sample (n = 87) and (ii) at the national level (excluding sample sites; n = 1,004). National data were taken from the Renewable Energy Planning Database quarterly for October 2023.

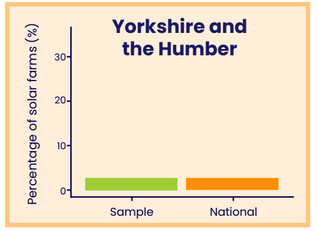
Region	Sample	National
South West	26	339
South East	16	158
East Midlands	11	126
East of England	20	111
Wales	5	110
West Midlands	4	56
North West	0	37
Yorkshire and the Humber	3	22
Northern Ireland	1	19
Scotland	0	14
North East	1	11
London	0	2

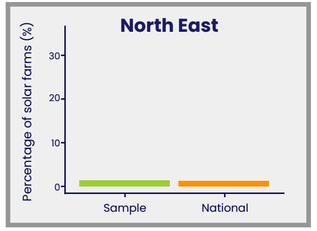
Table 1: Count of solar farms in the Solar Habitat sample and nationally, by region

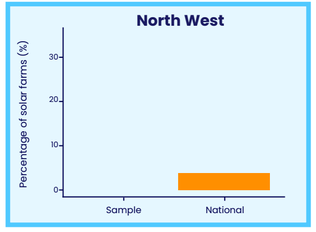


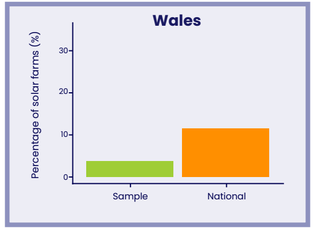


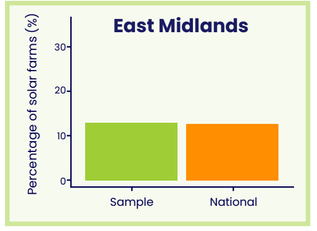


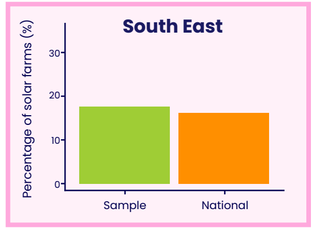


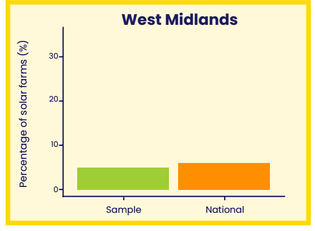


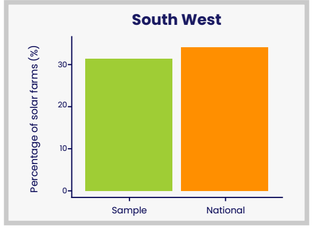


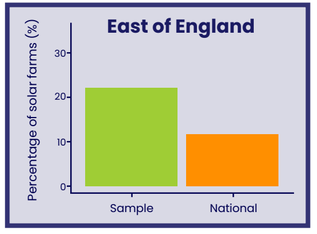


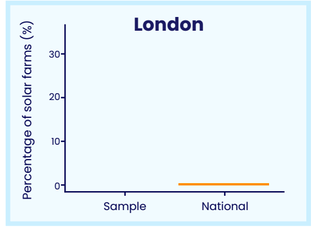












The solar farms monitored in 2023 were graded from one to five, depending on the sites focus on biodiversity (Table 2). Due to the lack of a national database management, it is not known if sites included in the Solar Habitat sample are representative of how sites are managed across the UK. Most sites in the sample were placed in Categories 2 (41%) or 3 (45%), indicating some consideration of biodiversity. Two sites in the sample were assigned to Category 1 (2%), suggesting management practices are aligned with optimal biodiversity enhancement and eight sites were assigned to Category 4 (9%), indicating less optimal management for biodiversity. Two sites were placed in Category 5 (2%); this encompassed a newly constructed site without any kind of management established as yet and an old coal storage site which comprised open mosaic habitat and so standard grassland management did not apply.

The lack of sites in Category 1 is likely linked to the current difficulties in cutting and collecting grass arisings related to both the requirement for specialist machinery and the issue of disposing arisings once collected. In contrast, very few sites fell into Category 4, as in most cases there will be a requirement for screening through woody planting as part of the planning application. In addition, field margins are often difficult to access for management and may become tussocky through lack of access rather than as an intentional biodiversity enhancement. Difficulties were encountered with some sites as they did not readily fit into a specific category. This is something being addressed in the revised standardised methodology.

Table 2: Site management categories as defined in the Standardised approach to monitoring biodiversity on solar farms

1	**Optimal management for biodiversity with conservation cutting/grazing and no herbicide use. Arisings are removed from the site. A range of habitats (e.g. meadows, tussocky grassland, woodland planting, hedgerow planting) are present.**
2	**Conservation cutting/grazing. Arisings are left on the site with signs of a thatch of vegetation in places. A range of habitats are present. Herbicides may be used, but spot treatment only.**
3	**Site cut or grazed throughout the season leading to short sward in the summer months. However, some other habitats present such as tussocky margins or planted hedgerows/woodland. Use of herbicides apparent (i.e. blanket spraying beneath panels).**
4	**Site cut or grazed throughout the season leading to short sward in the summer months. No other habitats (tussocky margins, new hedgerows/woodland). Use of herbicides apparent (i.e. blanket spraying of fields or beneath panels).**
5	**Site unmanaged or "other".**

Bee orchid, Hannah Montag, Clarkson & Woods

Botany

Botanical quadrats

A total of 1,504 botanical quadrats were assessed across the 87 solar farms. A mixture of 1 m x 1 m (75%) and 2 m x 2 m (25%) quadrats were used across sites, but as a statistical analysis showed no impact on survey results, it is thus possible to compare data collected from both quadrat sizes.

At most sites, five quadrats were assessed directly beneath the solar panels ("Under"; a total of 503 quadrats), five were assessed between the rows of solar panels ("Between"; 506 quadrats) and five were assessed outside the main footprint of the solar panels, in field margins or other areas within the security fencing ("Outside"; 387 quadrats). At some sites, additional quadrats were assessed in areas managed especially for biodiversity ("Biodiversity"; 94 quadrats). These locations were within an adjacent field to the solar farms. They were also managed in the same way as the solar farm sites, prior to construction ("Control", 15 quadrats). However, quadrats in control areas were excluded from analyses as they were outside of the solar farm itself and thus managed differently.

On average, 17 quadrats were assessed at each site (encompassing "Under", "Between", "Outside" and "Biodiversity" areas), ranging from 14 to 33. More quadrats tended to be surveyed at larger sites and those with more variation in habitat types.

Botanical species richness

Across all solar farms monitored in 2023, a total of 298 plant species were recorded, including 59 species of graminoid (grass, sedge or rush), 211 broadleaf plants and 28 other species including woody plants, climbers, ferns and agricultural species.

Yorkshire fog (*Holcus lanatus*) was the most frequently recorded graminoid species, present in more than half of all quadrats assessed (52%), followed by common bent (*Agrostis capillaris*) which was present in 35% of quadrats and red fescue (*Festuca rubra*), found in almost a third of quadrats (32%). Interestingly, these grasses are less associated with agricultural grassland which tends to comprise a monoculture dominated by ryegrasses, indicating that these solar farms are moving towards a more diverse grassland more typical of low intensity management[3].

Botany

The most frequently recorded broadleaf species were cut-leaved crane's-bill (*Geranium dissectum*), common dandelion (*Taraxacum officinale*) and creeping buttercup (*Ranunculus repens*), each present in 15% of quadrats. White clover (*Trifolium repens*) and cleavers (*Galium aparine*) were also common within solar farms, recorded in more than 10% of all quadrats. These species (apart from the cranes bill) are indicative of high nutrient levels and may be prevalent due to residual fertilizers which remain present in the soil. Soil nutrient levels are expected to reduce over time, which may result in a greater diversity of species.

The number of species recorded inside quadrats varied, ranging from one to 24, but with an average of five species (including all plant types). When considering the two main plant types (graminoid and broadleaf), species richness was greatest in "Biodiversity" areas (Figure 2). Interestingly, on average, more broadleaf plant species were recorded in "Biodiversity" and "Outside" quadrats, compared to graminoid species, whereas in "Between" and "Under" quadrats, there were more species of graminoids..

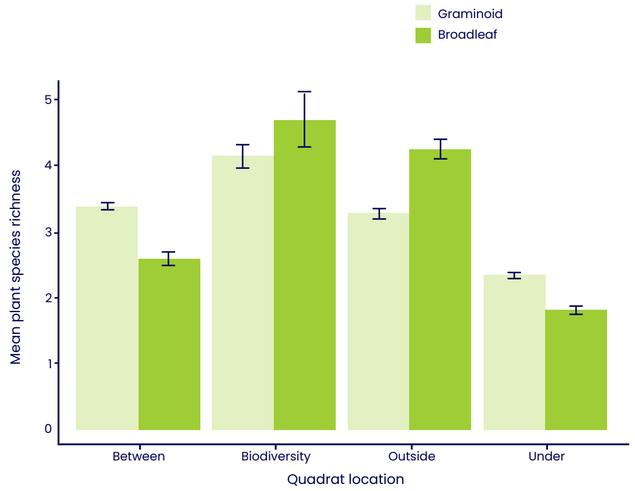


Figure 2: Mean species richness of graminoid and broadleaf plant species inside quadrats surveyed in different areas of the solar farm (n = 1,489, all quadrats excluding those in "Control" areas). Error bars represent standard error.

There was also variation in plant species richness at the site level. On average, a total of 27 plant species were recorded across each site, ranging from nine to 52. Variation in plant species richness is likely due to a combination of factors but solar farm management will be influential. Figure 3 shows how the number of plant species recorded on a site, on average, increases with solar park biodiversity management score. The two sites in Category 5 showed a high diversity of plant species due to the open mosaic habitat on one of the sites; this is a habitat that can be particularly ecologically important often with a wide variety of plant species present.

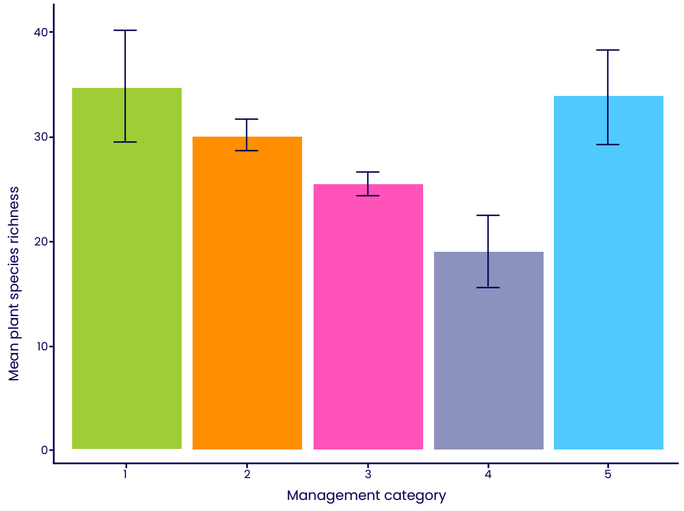


Figure 3: Mean plant species richness by management category (n = 87, all solar farms). Most sites were in management Category 3 (n = 39) or 2 (n = 36), with fewer in Categories 4 (n = 8), 1 (n = 2) and 5 (n = 2). Error bars represent standard error.

Under panel wildflower planting, Guy Parker, Wychwood Biodiversity

Case Study

Sowing shade tolerant grasses and wildflowers beneath panels – results of a trial on NextEnergy solar farms

Shading by solar panels, both from rain and sunlight, can create an environment that does not suit many grassland species, often resulting in bare ground that allows problem species, such as curled dock (*Rumex crispus*) and common nettle (*Urtica dioica*), to establish. As such, NextEnergy Solar Fund commissioned Wychwood Biodiversity to undertake trials into suitable vegetation to grow beneath solar panels with the intention of suppressing problematic weed species such as common nettle and creeping thistle, while encouraging biodiversity.

Trials were established to create a low growing sward comprised of species native to UK woodland and hedgerows, tolerant of both shade and drought. The sward aimed to provide ground cover sufficiently dense to prevent the establishment of problem species, while increasing biodiversity value. The trials were undertaken at two solar farms, Emberton Solar Park and Temple Normanton Solar Limited, and used different approaches.

Seeding beneath panels

The first trial was undertaken at Emberton solar farm beneath three solar panel rows. Two shade tolerant fine grass mixes were sown (*Emorsgate EG9 and EG29*), with common vetch (*Vicia sativa*), selfheal (*Prunella vulgaris*), bird's foot trefoil (*Lotus corniculatus*), bluebell (*Hyacinthoides non-scripta*), primrose (*Primula vulgaris*) and hedge bedstraw (*Galium mollugo*) added. Seed was sown into a clean seed bed as per the supplier's instructions.

The site was monitored annually during the growing season for three years. Several sown grass and herb species, mainly red fescue (*Festuca rubra*) and hedge bedstraw (*Galium mollugo*), established and covered nearly half of the trial area in Year 1, but in Year 2 they were overgrown by agricultural grasses, mainly cock's foot (*Dactylis glomerata*) and Yorkshire fog (*Holcus lanatus*), encroaching from the wider solar farm. By Year 3 the seeded grasses and herbs had all but disappeared and the agricultural grasses dominated.

The trial suggested that the fine grass and wildflowers were not fast growing and robust enough to establish ground cover and were consequently swamped by agricultural grasses. This is a common problem where soil nutrient levels are relatively high (the site was formerly an arable field) and agricultural grasses are present.

Planting plugs and bulbs beneath panels

The second trial took place at Temple Normanton solar farm and was designed using more vigorous wildflowers that were planted as plugs and pot-grown plants, rather than seeds. In total, 1,000 bulbs of four species of wildflower and 1,050 wildflower plugs of seven species were planted beneath four panel rows. In addition, 150 native ferns were planted, most of which were evergreen.

The trial has been monitored for 2 years during the growing season to date. Establishment of pot-grown plants after Year 1 was positive, with approximately 80% of all plants surviving. Of the four bulb species that were planted, wild garlic (*Allium ursinum*) and bluebell (*Hyacinthoides non-scripta*) established well, whilst lesser celandine (*Ficaria verna*) and wood anemone (*Anemone nemorosa*) appeared to have been less successful.

Most of the plugs of all seven species survived, except in two areas where the topsoil was very shallow (only two or three centimetres deep). Two cranesbill species, herb robert (*Geranium robertianum*) and hedge cranesbill (*Geranium pyrenaicum*), as well as red campion (*Silene dioica*) established most successfully and formed a dense ground cover. Five species of fern were planted (a mixture of evergreen and deciduous species) and wherever there was sufficient soil depth, established well.

The outcomes of both trials indicated that the planting of potted plants and plugs was more successful than seeding, with most species establishing well, and several species forming a dense ground cover. The results indicate that a number of wildflower species can establish in under-panel conditions, but the ability to cover ground effectively may be influenced by a site's soil conditions. The next steps include selecting the most successful species for wider trials and trialling seeding and planting at larger scales.

Ferns growing beneath solar panels, Guy Parker, Wychwood Biodiversity

Case Study

Growing chamomile between rows of solar panels – results of a trial on a NextEnergy solar farm

Emberton Solar Park Limited, which is an asset owned by NextEnergy Solar Fund, commissioned Wychwood Biodiversity to undertake a trial to investigate the feasibility of growing chamomile as a cash crop within a solar farm. This was supported by WiseEnergy, TWIG and the NEC Biodiversity team. The scale of this trial was intentionally small to enable management of the crop by hand rather than by mechanical means wherever possible. NEC recognised that this trial was unlikely to be financially viable at this scale, but it would nonetheless help to define logistical processes and constraints.

Annual or German chamomile (*Matricaria recutita*) was selected as the most suitable variety for this study. The crop was sown into a clean seed bed (as per seed supplier's instructions) approximately 50 m long by 2 m wide between the rows of solar panels in the northern field of the solar farm. The seed was sown in September 2020, weeded in April the following year and harvested in two sessions in June and July. Once harvesting was complete, the crop was recultivated and resown for harvesting the following year.

The trial suggested that it is possible to grow annual chamomile between the rows of solar panels in the southern United Kingdom and to attain commercial yields when grown in small plots. No irrigation was required, and the initial harvest equalled 3.7 kg of wet flower heads, equivalent to 370 kg per hectare which is within the commercial yield range for chamomile in Northern Europe[4]. Wet heads were air dried and placed into glass jars for use as chamomile tea called 'Meadow Sweet.'

Whilst the trial was successful at this scale, manual weeding and harvesting were labour intensive, where 0.25 person days were needed for weeding (equivalent to 25 days per hectare) and 0.75 person days were required for harvesting (equivalent to 75 days per hectare). If chamomile were to be planted at a larger scale, this would be uneconomical and mechanical options would need to be identified. There are also costs associated with ground preparation (mechanical clearance of grasses, cultivation, sowing) which are higher compared to an open field, as compact equipment must fit between the panel rows. Next steps should therefore focus on identifying the best options for scaling up production using mechanised means.

Chamomile between the rows of solar panels, Guy Parker, Wychwood Biodiversity

Injurious weeds

Particular attention is paid to plant species categorised as "injurious weeds" under the Weeds Act 1959. Common ragwort (*Jacobaea vulgaris*), broad-leaved dock (*Rumex obtusifolius*), curled dock (*Rumex crispus*), creeping thistle (*Cirsium arvense*) and spear thistle (*Cirsium vulgare*) are all injurious weeds. These species are generally more aggressive colonisers that can lead to a reduction in species richness within a grassland sward. In agricultural land, these species can also damage crops or may be harmful to grazing animals, if allowed to proliferate. However, injurious weed species provide important food sources for invertebrates and are highly attractive to many bees, butterflies and moths.

Injurious weeds were recorded on the majority of solar farms (82%) and within 22% of all quadrats. The most frequently recorded injurious weed species were creeping thistle, recorded in 13% of quadrats, followed by broad-leaved dock (6% of quadrats), common ragwort (4% of quadrats), curled dock and spear thistle (each in 2% of quadrats).

Under the Weeds Act 1959, if injurious weeds are spreading to adjacent agricultural land, they need to be managed. However, injurious weeds do not require active control if they are not spreading or causing maintenance issues. As such, injurious weeds that are at lower density and considered to be under control may be left within a solar farm to benefit invertebrates and birds. By undertaking regular monitoring of sites, it is possible to detect emerging problems and identify specific areas within a solar farm which may require management.

Six spot burnet moth on common ragwort, Hollie Blaydes, Lancaster University.

Invertebrates

Common blue butterfly, Hannah Montag, Clarkson & Woods

Transect walks

Transects focusing on bumblebees and butterflies were walked on 73 solar farms (84% of sites). A total of 794 transects were walked across all sites, either between the rows of solar panels (“Between”; 382 transects) or in margins, open areas or areas managed for biodiversity (“Outside”; 371 transects). The locations of the remaining 41 transects were not specified (“Unknown”). Transects were 100 m in length and on average, eleven were walked on each solar farm, ranging from five to 19.

Along all transects, a total of 3,088 individual invertebrates were counted and there were around five times more butterflies recorded than bumblebees overall (2,589 individual butterflies compared to 499 individual bumblebees). A total of 25 butterfly species were observed; the meadow brown (*Maniola jurtina*) was by far the most abundant (a total of 1,386 observations), followed by the gatekeeper (*Pyronia tithonus*, 248 observations) and marbled white (*Melanargia galathea*, 243 observations). In comparison, at least six bumblebee species were recorded, where the red-tailed bumblebee (*Bombus lapidarius*; 186 observations) and white-tailed bumblebee (*Bombus lucorom*; 94 observations) were observed most frequently. The majority of bumblebee and butterfly species recorded along transects were relatively common, although the small heath butterfly (*Coenonympha pamphilus*), a Species of Principal Importance under the NERC Act, was observed along transects on ten sites.

On average, one bumblebee or butterfly species and four individuals were recorded along a transect (per 100 m). However, this differed depending on where the transect was located. For example, species richness in “Outside” areas was approximately double that of “Between” areas, on average (Figure 4). Moreover, three times as many bumblebees and butterflies were counted in “Outside” areas, compared to between the panel strings (“Between”; Figure 4). This is likely because “Outside” areas tend to be managed less intensively and may offer more feeding resources to invertebrates. The “Outside” areas are also often on the outskirts of solar farms and may also be closer to other habitats such as hedgerows, which provide resources and shelter to many species.

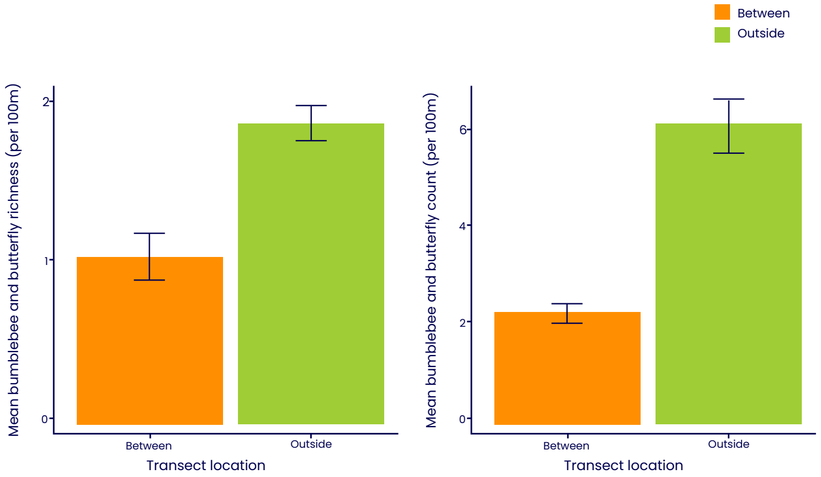


Figure 4: Mean bumblebee and butterfly species richness per 100 m (left) and mean count per 100 m (right) along transects walked between the panel strings (“Between”; n = 382) and in areas away from solar panels (“Outside”; n = 371). Error bars represent standard error.

Invertebrates

Scarce chaser dragonfly, Conor MacKenzie, Wychwood Biodiversity

Other invertebrate groups were also recorded along transects, including moths (six species), odonates (damselflies and dragonflies; five species), other bee species (three species), hoverflies (one species) and hornets (one species). Considering all groups, species richness varied across solar farms, ranging from zero to 15 species, with an average of six. Variation is likely due to a combination of factors, including site management, and it was found that species richness was greatest on solar farms that had a high biodiversity management score (those placed in Category 1; Figure 5). There was also a positive relationship between plant and invertebrate species richness, indicating that solar farms with more plant species can support a greater diversity of invertebrates (Figure 6).

It is also important to note that the conditions in which transects were walked are likely to have a large impact on the invertebrates recorded. Surveys should be undertaken in warm, dry and still weather when invertebrates are most active and transects walked in suboptimal conditions may underestimate invertebrate abundance or species richness. However, due to inflexibility in survey schedules it is not always possible to walk transects in optimal conditions and therefore biodiversity could be underestimated in some cases.

Incidental observations

Alongside transect walks, 2,809 invertebrates were counted as part of incidental observations on solar farms, where ecologists recorded invertebrates they saw whilst undertaking other surveys. At least 83 species were identified, including six bumblebee species, 24 butterfly species, nine moth species, 17 odonates (dragonflies or damselflies) and various grasshoppers, crickets, beetles, flies, hornets, ladybirds and spiders. Notable species included the Norfolk hawker dragonfly (*Aeshna isoceles*), which is a protected species listed as Endangered, and scarce chaser dragonfly (*Libellula fulva*) which is listed as Near Threatened.

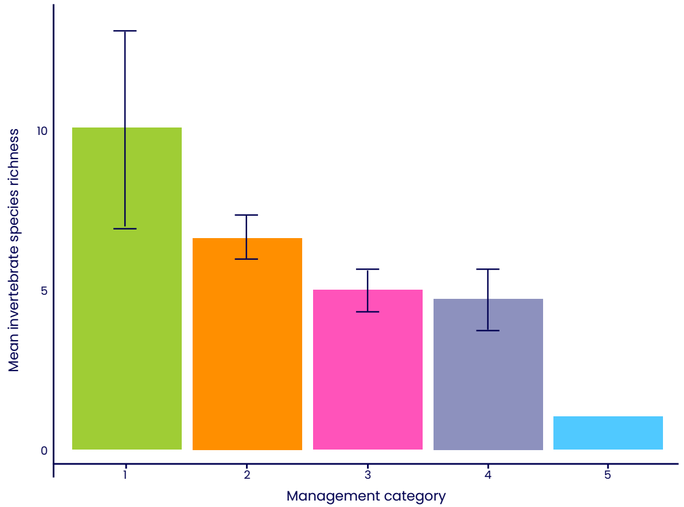


Figure 5: Mean invertebrate species richness by management category (n = 73, including only solar farms where invertebrates were recorded along transects). Most sites were in management category 3 (n = 34) or 2 (n = 27), with less in categories 4 (n = 8), 1 (n = 2) and 5 (n = 2). Error bars represent standard error.

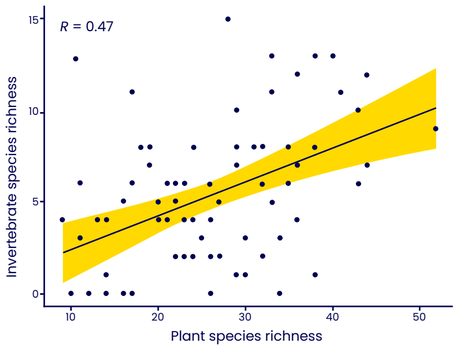


Figure 6: The relationship between plant and invertebrate species richness on solar farms (n = 73, including only solar farms where invertebrates were recorded along transects). The black line represents the trend line and shaded areas represent 95% confidence intervals. The R value is the Pearson correlation coefficient.

Birds

Common buzzard, Harry Knight-Smith, British Solar Renewables

Bird surveys

A total of 67 structured bird surveys were undertaken across solar farms. Bird surveys were conducted on 59 solar farms, where most sites had one survey undertaken (86%), but others had two (undertaken during different months; 14%). The survey methodology included a walked transect across the site so that all habitats were accessed within 50 m; all birds heard and seen were recorded with notes on their behaviour (including singing, foraging and flying over).

A total of 99 bird species were recorded during structured surveys, of which the majority were BTO Green Listed (47%), but a notable proportion were Amber (25%) or Red (21%) Listed Species of Conservation Concern. Six species had no status, representing those not categorised by the BTO as they are non-native (such as game birds: 6%). In terms of abundance, 7,886 individual birds were counted as part of structured bird surveys. On average, 134 individual birds were counted on a solar farm, but there was much variation, with counts ranging from 1 to 389 individuals.

The most abundant species was the wood pigeon (*Columba palumbus*, 974 individuals), an Amber Listed Species, recorded on almost all solar farms where bird surveys were undertaken (56 sites; Figure 7). The most abundant Red Listed Species was the starling (*Sturnus vulgaris*, 658 individuals), recorded at 18 sites (Figure 7). Skylarks (*Alauda arvensis*) were the Red Listed Species recorded across the highest number of sites (71%), with 279 individuals observed across all bird surveys (Figure 7). Whilst not assessed in terms of conservation status, a notable species recorded at one solar farm was the common rosefinch (*Carpodacus erythrinus*). This species is a scarce visitor to the UK, with very few breeding records, and is a Schedule 1 Protected Bird under the Wildlife and Countryside Act 1981.

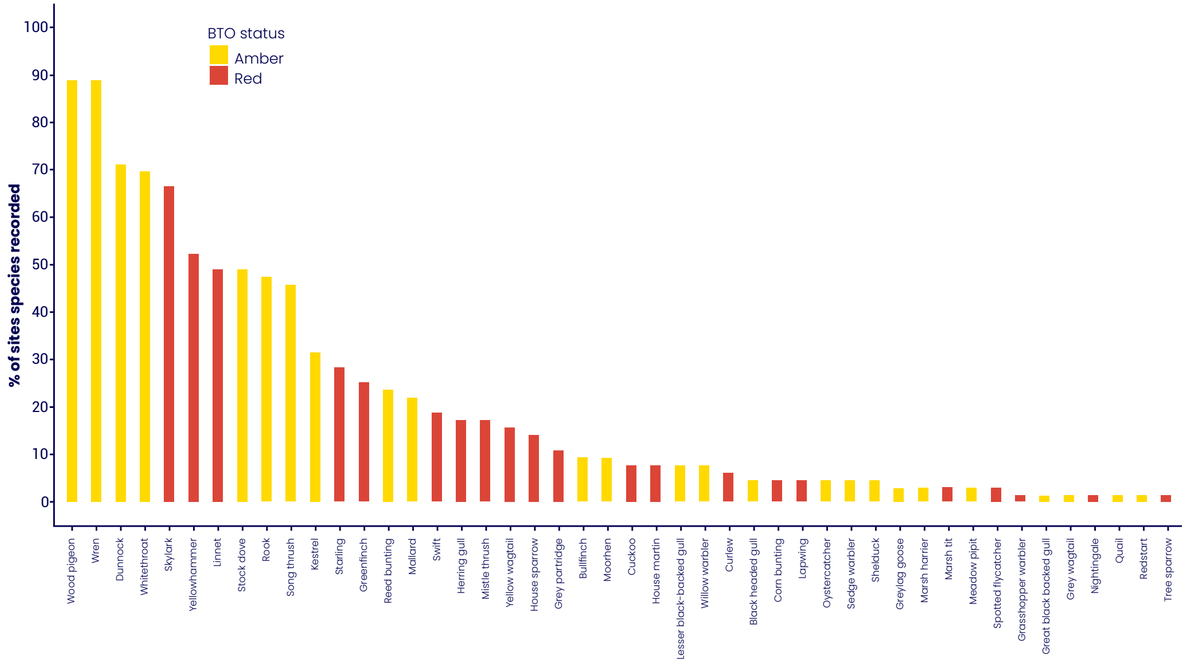


Figure 7: The percentage of sites each BTO Amber or Red Listed bird species was recorded (n = 59, including only solar farms where structured bird surveys were undertaken), arranged by most to least frequently recorded.

On average, 25 bird species were recorded during surveys at each solar farm, but this varied from one to 47. As with invertebrate biodiversity, variation in bird species richness is likely due to several factors including characteristics of the solar farm itself, the location of the site and weather conditions. Whilst no clear patterns between bird biodiversity and site management was directly found, there were positive relationships between bird species richness and plant species richness, as well as a positive relationship between bird abundance and invertebrate abundance across solar farms (Figure 8).

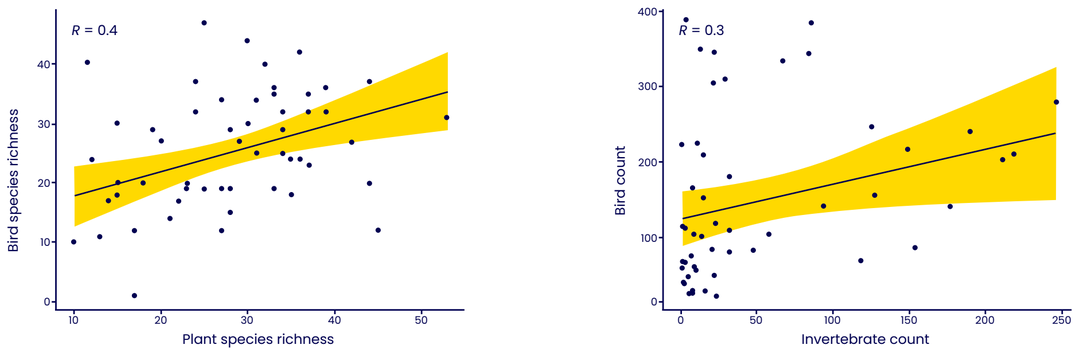


Figure 8: On the left, the relationship between plant and bird species richness. On the right, the relationship between invertebrate and bird count (abundance; n = 59, including only solar farms where structured bird surveys were undertaken). The black line represents the trend line and shaded areas represent 95% confidence intervals. The R value is the Pearson correlation coefficient.

Ground nesting birds

Skylarks continue to be recorded regularly on solar farms, however, no records of nesting on solar farms have been observed yet[5]. One bird survey conducted in 2023 focussed on nest searching on a site where skylarks were observed. No nests were found, however, a bird was observed regularly collecting food from within the solar farm then flying to an adjacent arable field, indicating that the solar farm offered a preferred resource for foraging by skylarks.

Other ground nesting bird species recorded included oystercatcher (*Haematopus ostralegus*) on three sites, where individuals were observed foraging or flying over the solar farm. Meadow pipit (*Anthus pratensis*) were also observed on two sites and breeding behaviour was observed at one solar farm.

Incidental observations

Incidental observations of birds also took place at 41 solar farms (sometimes alongside structured bird surveys, but also at sites without bird surveys). As part of incidental observations, 1,621 individual birds made up of 65 species were recorded across all solar farms. In total, twelve Red Listed Species of Conservation Concern and 17 Amber Listed species were observed. Birds of Conservation Concern recorded as part of incidental observations, but not structured surveys, included Dartford warbler (*Curruca undata*; Amber Listed) and tree pipit (*Anthus trivialis*; Red Listed).

Skylark, Conor MacKenzie, Wychwood Biodiversity

Brown hare, Harry Knight-Smith , British Solar Renewables

Mammal observations

While conducting other surveys, ecologists also noted down any mammals they observed on solar farms, or saw signs of (such as scat, footprints and feeding remains). Mammal observations were made on 33 sites (38%), with ten species observed or signs of their presence recorded. These included badger (*Meles meles*), fox (*Vulpes vulpes*), brown hare (*Lepus europaeus*), rabbit (*Oryctolagus cuniculus*) and weasel (*Mustela nivalis*), along with small mammals including common shrew (*Sorex araneus*) and field vole (*Microtus agrestis*). Fallow deer (*Dama dama*), muntjac deer (*Muntiacus reevesi*) and roe deer (*Capreolus capreolus*) were also sighted.

The most frequently observed species was the brown hare, making up 40% of observations. This is a Species of Conservation Concern which thrives on solar farms; on one site visited large groups of brown hares were recorded, with the site effectively being grazed by this species.

On sites where mammals were observed, their presence has likely been underestimated given that some species are less active during the daytime, many small mammal species are less visible and targeted surveys were not conducted. Future surveys may include more targeted approaches such as small mammal trapping, camera traps and eDNA.

Bats and solar farms

Recently published research has shown solar farms may influence bat activity, although the reasons are not understood. More information and research is needed on how bats interact with solar farms and this will, hopefully, become a focus of future monitoring and management of operational sites.

Case Study

Using eDNA to identify vertebrates on solar farms – results of a trial on a Gridserve solar farm

eDNA has been used in the past to detect the presence of individual species such as the great crested newt (*Triturus cristatus*) in ponds. However, it has recently become possible to extract eDNA for multiple species and other biodiversity groups from water and even soil and air samples including mammals, birds and reptiles.

Gridserve commissioned Wychwood Biodiversity to undertake biodiversity assessments of four solar farms and at one site, requested the sampling of a pond to assess the technique.

eDNA was collected in the field and the samples were analysed in the laboratory for the presence of all vertebrates. The results provided the following details:

- Number of species: 12 (three amphibians and seven birds)
- Identity of species: 100% of species were identified to taxonomic Order; 58% of species were identified to Genus.
- Taxonomic relatedness was displayed as a dendrogram (Figure 9)
- Number of threatened species: none
- Presence of invasive species: none

Information provided by eDNA is valuable as it allows the detection of cryptic species (species which are hard to detect conventionally), such as polecat (*Mustela putorius*), harvest mouse (*Micromys minutus*) and otter (*Lutra lutra*). This technology will also be useful in identifying invasive species and Red Listed species, both of which are relevant to Environmental, Social and Corporate Governance (ESG) reporting and the ongoing management of solar farms.

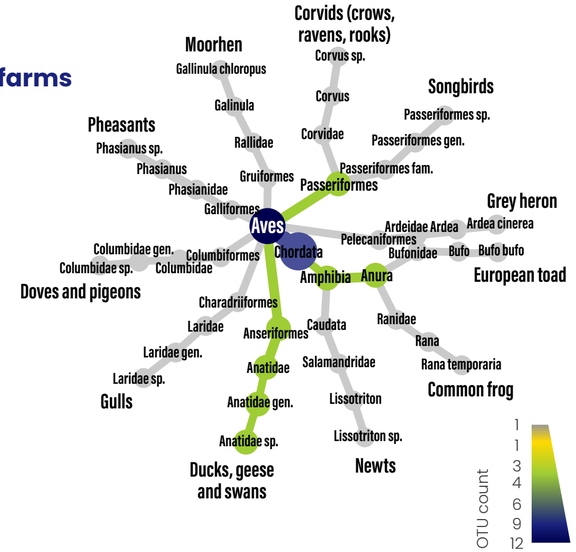


Figure 9: A dendrogram providing a tree-of-life view of the vertebrate species detected using eDNA and their taxonomic relationship. Names on the same branch are more similar than those on different branches and the dendrogram is structured with the highest taxonomic rank in the centre. Branch colour indicates the number of species along a scale, from grey which represents very few species to blue, representing many species.

Biodiversity Net Gain on solar farms

Diverse easement, Hannah Montag, Clarkson & Woods

Biodiversity Net Gain (BNG) is a policy mechanism to stimulate the creation and improvement of natural habitats and biodiversity. BNG enforces a measurably positive impact ('net gain') of all new developments on biodiversity, with a focus on on-site benefits, although credit trading will enable off-site improvements. From 12 February 2024, BNG is mandatory for new planning applications, including solar farms, which will need to deliver at least a 10% increase in relation to the pre-development biodiversity value of the development granted permission. Implementation for Nationally Significant Infrastructure Projects is planned for November 2025.

Solar farms offer the potential to manage land for BNG well above the 10% requirement, particularly as most developments are sited on previously intensively managed agricultural land. During the construction and operational phases of the solar farm, there can be minor habitat loss due to the creation of access tracks, substations and mounting frames. However, the overall infrastructure footprint of a solar farm can be as little as 2% of the total land area, with the panels oversailing around 40% of land within the fenced boundary, on average.

BNG can be calculated by an ecological consultant by comparing the baseline Biodiversity Units (derived from the UK Habitat Classification and taking into account habitat size, condition, distinctiveness, and location) measured in the pre-development state, with results that would be expected once the project is operational, along with any ecological enhancements included. Previous use of the metric for BNG on solar farms has proven challenging due to poorly understood impacts of panel structures on the habitats below.

Research relating botanical datasets to the BNG metric and UK Habitat definitions in different areas of solar farms is ongoing, led by Clarkson and Woods, Natural Power and Wychwood Biodiversity. The outcomes from this research will provide an evidence base and insight relevant to solar farm planning applications, including highlighting some of the wider factors that influence vegetation establishment. Natural England is using the outcomes of this research to produce a case study for applying BNG to solar farm developments, which will be published in 2024.

Several asset owners are now using the BNG metric to assess their "biodiversity stock" in a standard, measurable way; a calculation can be made based on an existing solar farm to assess its current ecological value and explore ways in which this can be increased.

Wildflowers, Hannah Montag, Clarkson & Woods

Tree planting on solar farm, Henry Sturgess, Clarkson & Woods

Case Study

Foresight JLEN Environmental Assets Group portfolio - biodiversity study

Foresight JLEN Environmental Assets Group, a sustainability-led investment fund, commissioned Clarkson and Woods to undertake a biodiversity assessment of ten of their ground-mounted solar farm assets in 2023. The aim was to use the Biodiversity Net Gain (BNG) metric to measure the baseline units on these sites, consider potential options for ecological enhancements and calculate their potential BNG uplift.

It was found that measures could be introduced to significantly increase the habitat value on all ten sites. The anticipated biodiversity increase ranged from 8 to 110%, with significant delivery of both Habitat and Hedgerow Units – the "currency" of the BNG system, which can be utilised in trading or habitat banking.

Figure 10 shows one of the sites within the study, Pylle solar farm, where the habitat survey revealed 60.54 Habitat Units and 26.22 Hedgerow Units within the site. Recommendations that could potentially increase the number of units included enhancement of existing Modified Grassland to a higher condition, new pond and wetland area creation within a low-lying part of the field, tree planting with locally appropriate species, enhancement of existing hedgerows and new hedgerow planting. The calculations resulting from these enhancements showed a potential uplift of 13.97 Habitat Units and 10.65 Hedgerow Units; a total net gain of 23% for habitats and 41% for hedgerows.

If such recommendations are accepted, a legal agreement would need to be secured and a finalised Habitat Management and Monitoring Plan prepared and submitted to the relevant authority to secure the BNG units and to trade them. The site would also need to be registered with Natural England.

Figure 10: Habitat enhancements proposed at Pylle solar farm.

Looking ahead

Walnut orb weaver, Hannah Montag, Clarkson & Woods

The Solar Habitat report will be issued annually, presenting findings from ecological monitoring conducted in the preceding year.

It's not possible to directly compare findings from 2022 to those from 2023, as only 17 sites were monitored in both years. One of the reasons for this is that monitoring doesn't always happen annually. Another is that the key components of the current methodology are designed to be achievable within a single day, so the time of year or even the weather on the day can have a marked impact on the results. However, the accumulation of data collected from the same sites over multiple years will enable the exploration of the trends and impacts of management practices over time.

While the number of solar farms monitored using the standardised approach increased by 50 sites from 2022 to 2023, the sites surveyed remain only a small number of those operational across the UK. It is anticipated that the methodology will be used by more ecological consultancies and applied across more solar farms in future years as demand for monitoring grows and the solar sector expands.

The standardised methodology has been revised in line with feedback and evolving approaches, as well as the experience of its use in the field over two years. Alongside the partners on the project, environmental NGOs and ecological consultancies have been involved in updating the standardised methodology and in line with feedback an update will be will be released in 2024

In an effort to improve the methodology, authors of the report have been looking at how the industry can better collaborate with voluntary citizen science projects monitoring biodiversity on operational solar farms. This may include multi-day bird and butterfly surveys carried out by the volunteers of environmental NGOs.

A survey form for collecting monitoring data using the standardised approach has also been produced. This was still in development at the time of publication.

To access the latest information, including The Standardised Approach to Ecological Monitoring on Solar Farms and monitoring form please scan the QR code or go to solarenergyuk.org.

Please visit solarenergyuk.org/resource/solar-energy-uk-guidance-a-standarised-approach-to-monitoring-biodiversity/

Or scan the QR code to access this guidance.

Case Study

Using Wild Power's Solar Biodiversity Scorecard to assess and improve solar farm biodiversity

Wild Power is an independent third-party certification standard for biodiversity and natural capital enhancements on solar farms. It is built around a 23-point scorecard and accompanying technical notes on biodiversity management.

Wild Power's scorecard combines on-site and desktop activities to provide a holistic assessment of biodiversity on solar farms. It incorporates assessment of site and surrounding areas, species, habitat and guild management, connectivity and management systems in place for biodiversity, the degree of site monitoring, photo documentation, fulfilment of obligatory and voluntary biodiversity commitments, ecosystem services and research contributions (Figure 11).

The scorecard can be used to align site design, construction, and management with best practise in natural capital, and scores allow comparison and benchmarking across projects, offering a way to set and communicate standards via a score-based gold/silver/bronze certification scheme (Figure 12).

Wild Power's scorecard has been used to identify, scope and prioritise both on- site and desktop-based opportunities for biodiversity enhancement on solar farms. Actionable options for improving biodiversity and Wild Power scores include creation and management of valuable native habitats, and strengthening ecological connectivity. Such measures typically require material investment of time and capital and are most easily addressed at site design/planning/construction stages. Further actionable areas for improving site Wild Power scores include site documentation, microhabitat provision such as log piles, bat and bird boxes (often the simplest post-construction on-site action for biodiversity enhancement), fulfilment of obligatory planning commitments and voluntary actions to improve habitat,

online assessment of ecosystem service potential, data submission for research and comprehensive photo documentation.

Wild Power certification provides a basis for benchmarking and communicating investment in solar farm biodiversity. Wild Power certification is a way to demonstrate commitment to biodiversity, creating value in stakeholder management, fund raising, and compliance, and providing monetisation opportunities for projects which comply with Wild Power standards via the development of biodiversity-rich consumer electricity products.

Wild Power completed its beta testing phase in 2023, during which time the scorecard was used to assess 39 sites in the UK from community- to commercial-scale solar farms (Figure 11). Wild Power's certification scheme is due to launch in 2024, with sites currently working towards achieving the UK's first Wild Power certification.

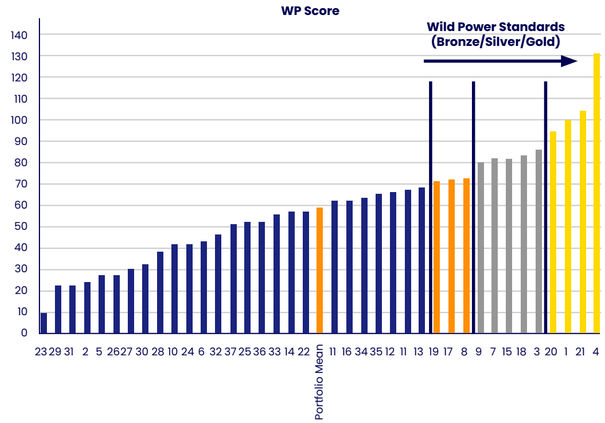
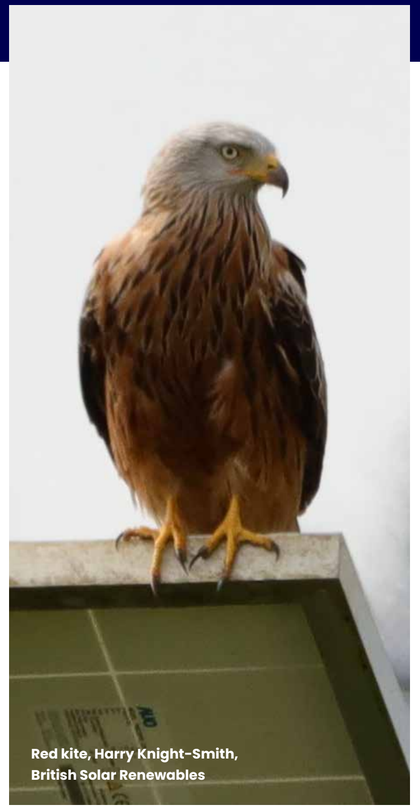


Figure 11: The score distribution for 39 solar farms assessed using the Wild Power scorecard during the beta testing phase.

Category	WP Scorecard item(s)	Notes	Possible uplift		
			Site X	Site Y	Site Z
Score at survey			X	Y	Z
Delta to WP status			+ ●	+ ●	+ ●
Site documentation	1–7	Max 19 pts	+ ●	+ ●	+ ●
Microhabitat provision	11	1/2 pt per microhabitat, max 10 pts	+ ●	+ ●	+ ●
Current penalty for missed planning commitments	15	-2pts per missed commitment	+ ●	+ ●	+ ●
Online assessment of ecosystem service potential	18	+5 pts	+ ●	+ ●	+ ●
Photo documentation	19–20	Max 14 pts, subject to site details	+ ●	+ ●	+ ●
Data submission for research	23	+3pts	+ ●	+ ●	+ ●
TOTAL ACHEIVABLE UPLIFT			+ ●	+ ●	+ ●
ACHEIVABLE SCORE AND WILD POWER STANDARD			+ ●	+ ●	+ ●

Figure 12: Example scorecard results provided by Wild Power that includes an action plan that identifies opportunities to improve biodiversity. Opportunities range in scope, investment and time requirement and can be used to produce workable and costed biodiversity action plans.



Red kite, Harry Knight-Smith, British Solar Renewables

Contributors

We would like to thank the following companies for contributing monitoring data and case studies:

NEXTENERGY CAPITAL

bluefield Solar Income Fund

res power for good

GRIDSERVE SUSTAINABLE ENERGY

Foresight

EDEN RENEWABLES

JLEN

octopus energy generation investing for impact

References

1. bto.org/sites/default/files/publications/bocc-5-a5-4pp-single-pages.pdf
2. Based on data provide by Solar Media Market Research.
3. National level data came from the Renewable Energy Planning Database which lists renewable energy projects in the UK, including ground mounted solar farms, allowing comparison between our sample and those across England, Wales, Scotland and Northern Ireland.
4. Yield of commercial chamomile ranges from 300-500lb per acre / 337-561 kg per Ha in Northern Europe (Foster, S. 1993. Herbal Renaissance. Gibbs-Smith Publishers, Salt Lake City, UT).
5. clarksonwoods.co.uk/wp-content/uploads/PDF/HF%20from%20InPractice117_Sep2022-9.pdf

Brown hare, Hannah Montag, Clarkson & Woods

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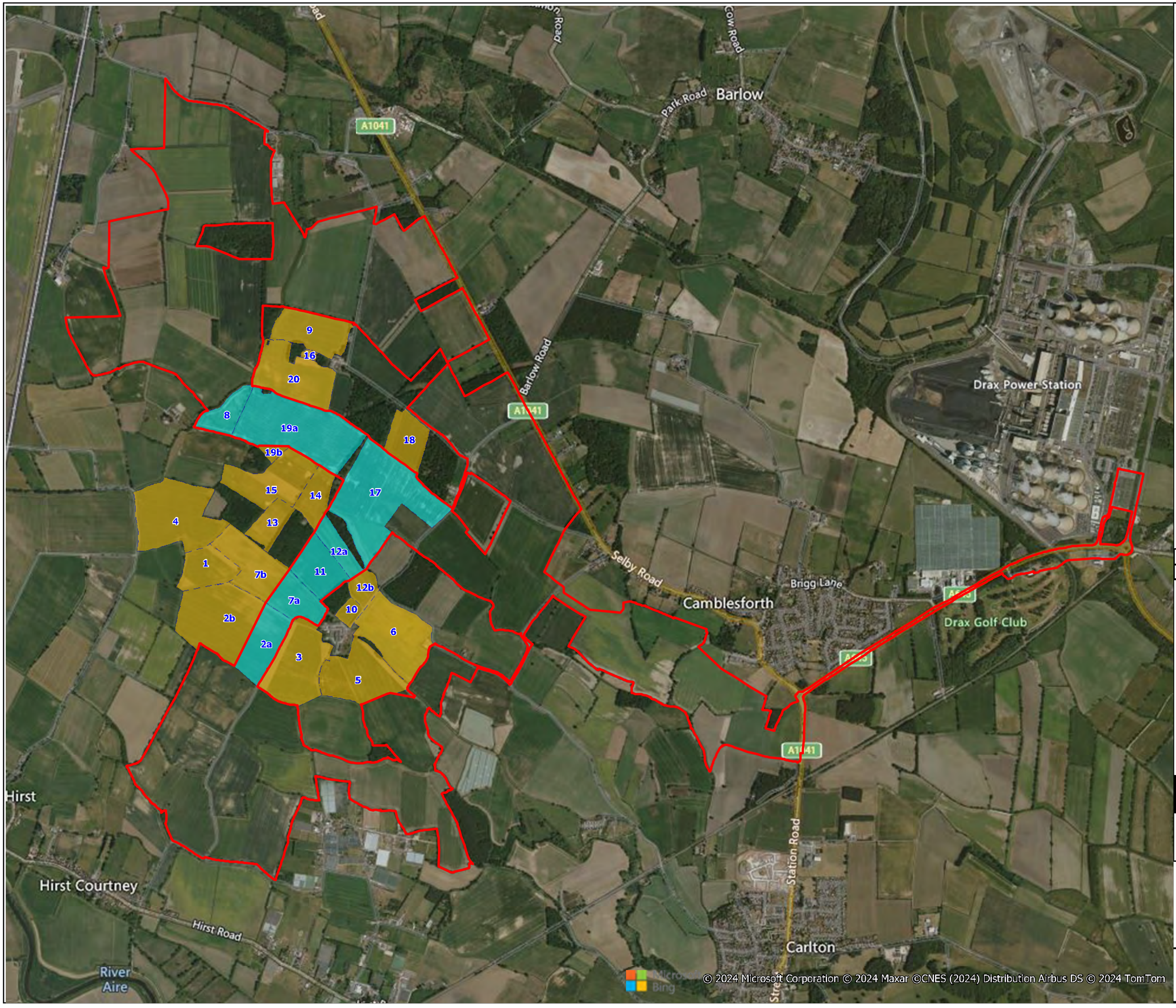
Appendix E: Ground Nesting Bird Mitigation and Compensation Area Maps 1-3



Legend

Order Limits

Ground Nesting Bird Mitigation and Compensation Are

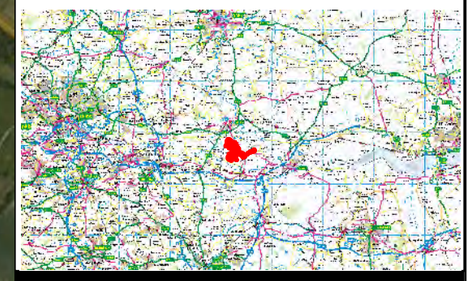
Inside Order Limits

Outside Order Limits

Rev	Date	Description	De	App
00	09/12/2024		HD	HD

This map contains data from the following sources:
Ordnance Survey (2024)

Co-ordinate System : British National Grid
Projection: Traverse Mercator
Datum: OSGB 1936
Units: Metres



HELIOS

GROUND NESTING BIRD MITIGATION AND COMPENSATION AREA

avian ecology

Avian Ecology, Suite 3c Walnut Tree Farm, Northwich Road, Lower Stretton
WA4 4PG
Tel: 0843 506 5116
www.avianecology.co.uk

0 750

metres

N W E S

Field 9: 4 skylark plots
Field 16: not suitable
Field 20: 7 skylark plots
Field 8: not suitable
Field 19a: 19 skylark plots
Field 18: 3 skylark plots
Field 19b: 0 skylark plots
Field 15: not suitable
Field 14: 1 skylark plot
Field 17: 19 skylark plots
Field 4: 13 skylark plots
Field 13: not suitable
Field 12a: not suitable
Field 11: 3 skylark plots
Field 1: 3 skylark plots
Field 7b: 6 skylark plots
Field 12b: not suitable
Field 7a: 3 skylark plots
Field 10: not suitable
Field 2b: 17 skylark plots
Field 6: 10 skylark plots
Field 2a: 6 skylark plots
Field 3: 10 skylark plots
Field 5: 8 skylark plots

Legend

Order Limits

Ground Nesting Bird Mitigation and Compensation Area

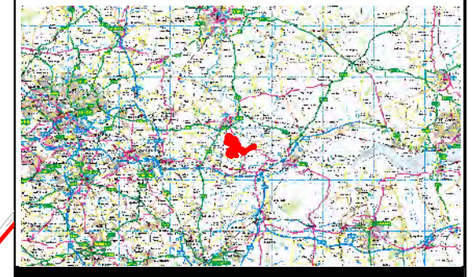
- Inside Order Limits
- Outside Order Limits

Land Avaliable for Skylark Plots

- Suitable
- Not Suitable

Rev	Date	Description	De	App
00	09/12/2024		HD	HD

Co-ordinate System : British National Grid
Projection: Traverse Mercator
Datum: OSGB 1936
Units: Metres



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0 300
metres

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Field 3: 10 skylark plots
Field 5: 8 skylark plots

Legend

Order Limits

Ground Nesting Bird Mitigation and Compensation Area

Inside Order Limits

Outside Order Limits

Land Avaliable for Skylark Plots

Suitable

Not Suitable

50m Field Buffer

Rev	Date	Description	De	App
00	09/12/2024		HD	HD

Co-ordinate System : British National Grid
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