From:	Stephen Fox
To:	One Earth Solar
Subject:	Subject: Submission of a Critical Analysis of Flood Risk Assessments for the One Earth, Tillbridge, and Great North Road NSIP Solar Proposals
Date:	19 September 2025 12:20:42
Attachments:	Soil compaction implications.docx An assessment of One Earth, Greatnorth road and Tilbridge flood risk and biodiversity. Accumulative impacts.docx

Dear Sirs

Interested party reference number FA3 AE8AE5

I am submitting the copy letter that I have sent to the Planning Inspectorate and the Chief Executives of Lincolnshire County Council and Nottinghamshire County Council for together with the attached report Submission of a Critical Analysis of Flood Risk Assessments for the One Earth, Tillbridge, and Great North Road NSIP Solar Proposals. It is of critical importance in assessing the cumulative effect of the projects, for which information is readily available local, to the One Earth Project

To The Planning Inspectorate, Lincolnshire County Council, and Nottinghamshire County Council,

Subject: Submission of a Critical Analysis of Flood Risk Assessments for the One Earth, Tilbridge, and Great North Road NSIP Solar Proposals

Dear Sirs and Madams

I am writing to formally submit for your consideration the attached report, which provides a detailed critical analysis of the flood risk assessments (FRAs) for the Nationally Significant Infrastructure Projects (NSIPs) concerning the One Earth, Tilbridge, and Great North Road solar proposals.

The report concludes that the FRAs for these projects are critically deficient. It presents a detailed case, supported by modern hydrological science, that the assessments significantly underestimate the flood risk and long-term environmental impacts of these developments. The core findings highlight that the proposed solar panels act as conduits for rainfall, leading to a dramatic increase in runoff speed and peak discharge rates that are not adequately accounted for in the project's drainage strategies. This poses a serious, unmitigated risk of surface water flooding and soil erosion to the areas for which you are the Lead Local Flood Authorities and examining authorities and, I would submit, requires urgent attention.

It is also critical to note that this report addresses only the projects for which detailed planning documentation is currently available. The problem of regional flood risk will be compounded exponentially as other major solar projects in the same geographic region, such as Cottam Solar Project, West Burton Solar Project, and Steeples Renewables Projects, come forward in the coming years. The cumulative effect of these developments on the area's hydrology presents a profound and unaddressed risk that extends far beyond the scope of any single project's assessment.

I urge you to consider the findings of this report as part of your ongoing scrutiny of these proposals. Given the scale and co-location of these projects, it is imperative that a unified, basin-wide hydrological study be conducted to fully assess the cumulative flood risk to the region.

I trust that you will take this matter into serious consideration. The findings presented in the attached analysis underscore the need for a comprehensive re-evaluation to ensure these projects do not increase flood risk or cause irreversible environmental damage over their sixty-year lifespan.

Sincerely,

Stephen fox

I am also submitting a report on **Soil Compaction threat from the One Earth Solar Project**

Yours faithfully

Stephen Fox

1.0 Summary

1.1 Summary of Key Findings

This analysis concludes that the flood risk assessments (FRAs) submitted as part of the Development Consent Order (DCO) applications for the One Earth, Tillbridge, and Great North Road solar projects are critically deficient. The primary flaw lies in their reliance on an outdated hydrological paradigm that assumes solar photovoltaic (PV) arrays have a negligible impact on surface water runoff. This assumption is directly contradicted by modern, peer-reviewed hydrological science, particularly the findings of Baiamonte et al. (2023). This research demonstrates that solar panels significantly increase runoff speed and peak discharge rates by acting as impermeable conduits, a phenomenon the project assessments fail to model or mitigate. Consequently, the flood risk to the projects and surrounding areas is profoundly underestimated.

Furthermore, the report identifies several systemic weaknesses within the planning and assessment processes for these Nationally Significant Infrastructure Projects (NSIPs). The proposed mitigation strategies, such as vegetation and swales, are designed for pre-development conditions and are likely to be overwhelmed by the concentrated, high-energy runoff from the panels. The immense scale of construction, involving the installation of millions of panels across thousands of hectares, presents an insurmountable challenge in preventing widespread soil compaction. This irreversible change to the soil's structure will permanently reduce its infiltration capacity, creating a chronic, long-term increase in surface runoff that extends beyond the operational lifespan of the projects. Finally, the NSIP process, with its accelerated timetable and siloed approach to assessment, is structurally unequipped to address the cumulative flood risk posed by all three large-scale projects operating within the same regional drainage system. This places an unmanageable burden on under-resourced local authorities, making effective long-term monitoring and enforcement highly improbable.

1.2 Overarching Conclusions

Based on a rigorous review of available documentation and informed by modern hydrological science, the DCO applications, in their current form, do not provide sufficient assurance that the proposed developments will not increase flood risk elsewhere or compromise long-term environmental objectives. The projects pose a significant, unmitigated risk of surface water flooding and soil degradation, which contravenes key tenets of the National Policy Statement for Energy (EN-1) and the Water Framework Directive (WFD). The failure to accurately model the hydrological impacts and to propose credible, long-term mitigation and monitoring plans renders the assessments insufficient for a project of this scale and sensitivity.

1.3 High-Level Recommendations

It is recommended that the Planning Inspectorate and the Secretary of State require a complete re-evaluation of the hydrological impacts for all three projects. This must include a revised drainage strategy based on accurate hydrological modeling that accounts for the effects of the solar panels themselves. A comprehensive, basin-wide cumulative effects study is essential to understand the combined regional flood risk. To address the long-term impacts, a legally binding, independently funded monitoring and enforcement plan must be secured for the lifetime of the projects, with enforceable provisions for post-decommissioning restoration.

2.0 Foundational Principles: Science, Law, and Practice

2.1 The Hydrological Impacts of Solar Panels: A Modern Scientific Paradigm Shift

The flood risk assessments for the One Earth, Tillbridge, and Great North Road proposals appear to be founded on a fundamental misinterpretation of the hydrological function of large-scale solar farms. This misinterpretation is rooted in the long-held assumption that because the land under and between the solar arrays remains "pervious" and unpaved, the overall hydrological response of the site is not significantly altered from its pre-development state. Sources suggest that solar farms are often considered to be as much as 95% permeable, with only the relatively small footprints of substations, access roads, and other compounds considered impermeable. The conclusion drawn from this assumption is that no significant increase in runoff volume or rate will occur, thereby requiring only standard drainage strategies to manage the minor increases from the truly impermeable infrastructure.

However, this paradigm is directly challenged and refuted by recent, detailed hydrological research. A key study by Baiamonte et al. (2023) provides a critical scientific basis for a revised understanding of solar farm hydrology. The research explicitly demonstrates that the panels themselves, while not permanently sealing the ground, act as highly efficient conduits for rainfall. They intercept rainfall that would otherwise be absorbed over a wide, dispersed area and concentrate it, discharging it as a high-velocity, high-volume flow at the lower, down-slope edge of each panel.

The quantitative findings of the Baiamonte et al. study are alarming and have been overlooked in the project assessments. Using a rainfall simulator on a sloped test plot, the research found that solar panels increased the peak discharge by approximately **11 times** compared to a bare soil hillslope. A moderate effect of panel arrangement was also observed, with cross-slope panels resulting in a peak discharge 11.7 times higher and aligned-slope panels 11.5 times higher than the bare soil reference. Crucially, the time for runoff to begin was drastically reduced, from 1.2 hours for bare soil to as low as 0.3 hours for the aligned-slope panels. This reduction in lag time means that a site with solar panels will contribute to flood peaks much more quickly than an agricultural field, compounding the risk to downstream areas.

The kinetic energy of the water is also a significant factor that the developers' assessments fail to consider. The Baiamonte et al. study found that the kinetic energy of the flow draining from the edge of the panels was greater than that of the rainfall itself, which can cause significant erosion at the base of the panels. This accelerated, high-energy flow will scour the soil, leading to the formation of gullies and ruts that concentrate flow even further. The assumption that grass and vegetation alone can manage this concentrated erosive force is a major misjudgement. The failure to incorporate these modern scientific findings means the hydrological models used for these projects are fundamentally inaccurate and provide a false sense of security regarding flood risk.

2.2 The UK Planning Framework for Flood Risk: Statutory Requirements and Guidance

The planning process for NSIPs is governed by the Planning Act 2008, with specific policy guidance provided by the Overarching National Policy Statement for Energy (EN-1) and the National Policy Statement for Renewable Energy Infrastructure (EN-3). These documents mandate a comprehensive approach to flood risk, requiring developers to demonstrate that their projects are resilient to the effects of flooding and will not increase flood risk elsewhere.

The core of this framework is the application of the Sequential and Exception Tests. These tests are designed to steer new development to areas of lower flood risk and, where this is not possible, to ensure that the project will be safe for its lifetime without increasing flood risk to others. The documents for both One Earth and Great North Road reference the application of these tests, claiming compliance and justification for their locations. However, the efficacy of this process is entirely dependent on the accuracy of the underlying flood risk data. If the initial hydrological modeling fails to account for the unique runoff characteristics of the solar panels, then the entire application of the Sequential and Exception Tests becomes a technical formality rather than a substantive assessment of risk. The developers' conclusion that the projects will not increase flood risk elsewhere (a key requirement of EN-1) is therefore unsupported by sound science and renders their application of the planning tests invalid.

EN-1 also stipulates that mitigation measures should make use of natural flood management techniques and that there should be no net loss of floodplain storage. While the project documents mention the use of natural features like swales and the avoidance of flood zones for certain infrastructure, this appears to be based on a flawed premise. The rapid, high-volume flows from the solar panels, as identified in the Baiamonte et al. study, are fundamentally different from the slow, diffuse sheet flows that natural flood management techniques are designed to manage. This disconnect between the proposed solutions and the actual problem further demonstrates the inadequacy of the assessments.

2.3 The Water Framework Directive and its Application to Land-Based Developments

The Water Framework Directive (WFD) is the cornerstone of water protection legislation in Europe, with a core objective of achieving "good ecological and chemical status" for all surface waters and groundwater. A key tenet of the WFD is the requirement for Member States to prevent any deterioration in the status of water bodies. The land-intensive nature of solar farms, combined with the hydrological changes they induce, poses a direct and unaddressed threat to WFD compliance.

The increased runoff and soil erosion resulting from the concentrated water flow off the panels, as detailed by Baiamonte et al. (2023) , have direct and severe implications for water quality. When soil erodes, it carries sediment and other pollutants into local watercourses. This sediment loading can smother aquatic habitats, reduce light penetration for photosynthesis, and alter the physical and chemical composition of the water, thereby degrading its ecological status. The developers' claims of biodiversity net gain for terrestrial habitats are therefore undermined if the hydrological impacts compromise the health of local rivers and streams, which are integral to the wider ecosystem. The absence of a robust, scientifically-sound assessment of these water quality impacts in the flood risk documents suggests a critical failure to comply with the overarching principles of the WFD.

3.0 Project-Specific Analysis and Critique

Project	Hydrological Assumption	Proposed Mitigation Measures	Explicit Claims/Partnerships
One Earth	Land is permeable; focus on small impermeable areas.	Low ground pressure vehicles, post-construction soil amelioration with farm equipment, regular soil inspections.	Acknowledges "inevitable" damage but proposes standard remediation; claims compliance with EN-1.
Tilbridge	Land is permeable; focuses on small impermeable areas.	Swales, piped drainage, and a Construction Environment Management Plan.	Collaboration with other projects to "minimise land take and environmental impacts"; references a PEIR with a chapter on flood risk and drainage.
Great North Road	Assumes vegetation and other passive measures are sufficient; no mention of panel-specific runoff effects.	Sward, swales, constructed wetlands, and a piped drainage network.	Collaboration with Trent Rivers Trust on "Natural Flood Management" and biodiversity enhancements; claims to have moved electrical infrastructure out of flood zones.

3.1 One Earth Solar Farm: Assessment of Flood Risk and Drainage Strategy

The DCO application for the One Earth Solar Farm is currently in the examination phase, having been accepted by the Planning Inspectorate in March 2025. The available documentation includes an Outline Soil Management Plan (OSMP) and a Flood Risk Assessment (FRA). The FRA correctly references the requirements of the National Policy Statement for Energy (EN-1) and outlines the application of the Sequential and Exception Tests. However, a detailed critique of the OSMP reveals a critical vulnerability in the project's long-term hydrological planning.

The OSMP for the One Earth project acknowledges that a key potential impact on the land will be trafficking by construction vehicles, which "has the potential to compact and damage soils". While the document proposes mitigation methods such as using low ground pressure vehicles and avoiding work in unsuitable conditions, it candidly admits that "some damage or compaction is inevitable". This is a crucial admission. Given the sheer scale of the project, which is designed to produce 740MW of energy , the installation of millions of solar panels and associated infrastructure will necessitate extensive and dispersed vehicle movements across the site. The aggregation of this "inevitable" localized damage will lead to a widespread and permanent reduction in the land's infiltration capacity. The proposed remedy—the use of "standard farm cultivation equipment" and periodic inspections by a soil scientist —is a short-term, reactive approach that is fundamentally insufficient to reverse a permanent, large-scale change to the land's hydrological function. This leaves the site with a lasting legacy of increased surface runoff potential that extends beyond the project's operational phase and is not adequately accounted for in the FRA.

3.2 Tillbridge Solar Farm: Critique of Preliminary Environmental Information

The Tillbridge Solar project, which was accepted for examination in May 2024, has produced a Preliminary Environmental Information Report (PEIR) that includes a chapter on Flood Risk, Drainage, and Surface Water. The documentation references an Outline Drainage Strategy that includes "Micro Drainage Quick Storage Estimates for Swales". This reliance on generic drainage software and passive systems highlights a significant deficiency in the project's hydrological assessment.

As established by the Baiamonte et al. (2023) research, the concentrated discharge from the solar panels creates an entirely new set of hydrological conditions that traditional drainage models are not designed to simulate. The proposed use of swales and other passive measures, which rely on the land's natural infiltration capacity, is likely to be ineffective against a peak discharge that can be over 11 times higher than an unpanelled hillslope. The high-energy, channelized flow from the panels will likely scour and overwhelm these systems, rendering them incapable of mitigating flood risk during high-intensity rainfall events. Furthermore, while the project documents mention "opportunities for collaborative working" with neighbouring solar projects to minimize land take and environmental impacts , this collaboration is explicitly stated as being for grid connection and cable routes, not for a unified, basin-wide hydrological assessment. This demonstrates a siloed approach to environmental impact that fails to address the very real cumulative risk of these co-located projects.

3.3 Great North Road Solar Park: Scrutiny of Hydrological and Cumulative Effects

The Great North Road Solar Park, accepted for examination in July 2025, has produced documentation that attempts to present a progressive and environmentally sensitive approach to flood risk. The developer claims to have collaborated with conservation partners, including the Trent Rivers Trust, to develop and implement "Natural Flood Management (NFM) interventions" such as "sward, swales and constructed wetlands". The project also claims to have moved all above-ground electrical infrastructure out of areas with a higher flood risk, demonstrating a positive application of the Sequential Test.

However, a closer look at these proposals reveals a profound disconnect between the claimed solutions and the actual hydrological problem. Natural Flood Management is a valid and effective approach for managing slow, diffuse flows across a catchment area. It is, however, fundamentally mismatched with the high-velocity, high-energy, and concentrated runoff generated by solar panels. A simple sward of grass is unlikely to withstand an 11-fold increase in peak discharge, and the proposed swales and wetlands will be quickly overwhelmed by a flow regime they were not designed to manage. This suggests that while the developer has correctly identified the need for a more environmentally conscious approach, the proposed mitigation measures are based on a flawed hydrological understanding and will not be sufficient to manage the actual flood risk. The relocation of above-ground infrastructure, while a welcome move, does not address the surface water runoff from the vast majority of the site, which remains a primary and unmitigated risk factor.

4.0 Systemic Challenges and Unaddressed Impacts

4.1 The Problem of Soil Compaction and Permanent Hydrological Change

The process of installing ground-mounted solar farms on a massive scale presents a significant and often unaddressed risk of permanent hydrological change due to soil compaction. Best practice guidelines for solar construction emphasize the need for careful management to prevent soil damage, including the use of low ground pressure vehicles and the avoidance of work on wet soil. The One Earth project's Outline Soil Management Plan acknowledges these measures but also admits that "some damage or compaction is inevitable."

Given the scale of the Great North Road project, which will occupy approximately 1,025 hectares for solar array development, the logistical challenge of installing millions of panels and associated cabling without causing widespread soil compaction is practically insurmountable. The distributed, but extensive, ground disturbance from vehicles and machinery will inevitably alter the soil's structure, reducing its porosity and ability to infiltrate water. This is not a temporary effect that can be fully reversed with short-term "amelioration measures". The permanent alteration of the land's capacity to absorb rainfall will lead to a chronic increase in surface runoff, creating a long-term flood risk that the assessments fail to acknowledge. This permanent hydrological legacy directly contradicts the principle of ensuring projects do not increase flood risk over their lifetime, a core requirement of EN-1.

4.2 The Limitations of Proposed Mitigation: Beyond Vegetation and Swales

A central theme in the project documents is the reliance on passive, vegetation-based mitigation measures to manage surface water runoff. While the concept of using grass and swales to slow and infiltrate water is sound in traditional contexts, it is critically insufficient when applied to the unique hydrological conditions created by solar panels. The Baiamonte et al. (2023) research found that the concentrated flow from the panels' drip edge possesses higher kinetic energy than the original rainfall. This high-energy flow will inevitably lead to soil erosion and gully formation, undermining the very vegetation and soil structure that the mitigation strategies depend on.

The assumption that the proposed systems will be able to manage a peak discharge that is **11 times higher** than a pre-development hillslope is deeply flawed. The passive, nature-based solutions proposed are designed for a gradual, dispersed flow, not a rapid, concentrated torrent. In a high-intensity rainfall event, it is highly probable that the swales and vegetated areas would be quickly overwhelmed and scoured, leading to an uncontrolled increase in downstream flood risk. The failure of the developers' assessments to model for these specific, scientifically validated effects indicates a fundamental disconnect between their proposed solutions and the actual, on-site hydrological problem.

5.0 Cumulative Effects and Oversight Capacity

Hydrological Principle (Baiamonte et al. 2023)	Project-Specific Deficiency	Potential Outcome
Solar panels increase peak discharge by up to 11x.	One Earth FRA assumes standard runoff coefficients; fails to model panel-induced discharge.	Catastrophic underestimation of peak runoff and flood risk, rendering the FRA invalid.
Time to runoff is significantly reduced (down to 0.3 hours).	Tilbridge PEIR relies on generic drainage models and systems not designed for accelerated runoff.	Swales and other passive mitigation measures are overwhelmed and fail during high-intensity rainfall.
Concentrated runoff has higher kinetic energy, leading to soil erosion.	Great North Road proposes vegetation and NFM, which are ill-equipped to manage high-energy flows.	Widespread soil erosion, gully formation, and sediment loading of local watercourses, contravening WFD objectives.
Construction inevitably leads to soil compaction and reduced infiltration.	All three projects' assessments fail to model the permanent, long-term hydrological change caused by widespread compaction.	Chronic increase in surface water runoff potential for the projects' lifetime and beyond, increasing regional flood risk.
The NSIP process is siloed, and assessments are project-specific.	No comprehensive, basin-wide hydrological study for the cumulative effects of One Earth, Tilbridge, and Great North Road.	A single, large rainfall event could lead to a catastrophic regional flood as the combined runoff from all three projects overwhelms shared watercourses and drainage infrastructure.

5.1 Cumulative Flood Risk: Overwhelming Regional Drainage Systems

The DCO process, by design, evaluates each project on its own merits, and the available documentation for One Earth, Tillbridge, and Great North Road reflects this siloed approach. While the Tillbridge project mentions a collaborative effort with neighbouring schemes , this collaboration is explicitly limited to grid connection and land take, not a unified environmental or hydrological assessment. The absence of a single, comprehensive, basin-wide hydrological study for the regional drainage system that will bear the cumulative impact of these projects is a critical oversight.

Each of these solar farms is a Nationally Significant Infrastructure Project due to its immense scale—One Earth at 740 MW and Great North Road at 800 MW. When the cumulative effect of an 11-fold increase in peak discharge from thousands of hectares across all three projects is considered, the potential for a catastrophic flood event becomes a profound and unaddressed risk. The aggregate increase in runoff volume and peak discharge, compounded by the reduced time to peak, could overwhelm existing watercourses and drainage infrastructure that were not designed to handle such a rapid influx of water. This creates a regional-scale flood risk that has been entirely ignored by the project-specific assessments, which focus narrowly on their individual sites.

5.2 The Long-Term Monitoring Challenge: Local Authority Resource Constraints

The successful implementation of any mitigation strategy, particularly for large-scale, long-term projects, is contingent on effective monitoring and enforcement. However, the NSIP regime, with its accelerated timetable and national-level determination, creates a fundamental power and resource imbalance that leaves local authorities ill-equipped to provide this critical oversight.

The process is structured to be fast, with a six-month examination period and a recommendation delivered to the Secretary of State within a tight timeframe. In stark contrast, a 2023 survey of local authority planning departments in England found that over 90% had difficulty recruiting, and over 70% had difficulty retaining staff. Local authorities are required to prepare a Local Impact Report (LIR), but as acknowledged in the documents, these are often a "broad overview" rather than a "precise technical document". The immense volume and technical complexity of the developer-submitted DCO applications and Environmental Statements mean that under-resourced local councils are given an impossible task of providing detailed, technically rigorous scrutiny in a short period. This structural weakness means that the hydrological and environmental flaws identified in this report are likely to go unnoticed in the formal review process, leaving the public and environment vulnerable to the long-term consequences of inadequate planning and a lack of effective, post-consent monitoring.

6.0 Conclusions and Recommendations

6.1 Summary of Critical Findings

The flood risk assessments for the One Earth, Tilllbridge, and Great North Road NSIPs are demonstrably flawed and do not provide a credible basis for development consent. The core of the issue is a fundamental failure to incorporate modern hydrological science into the assessments, leading to a severe underestimation of flood and soil erosion risks. The proposed mitigation measures are mismatched to the problem they are intended to solve, and the long-term impacts of soil compaction and cumulative regional flood risk are either ignored or unmitigated. The NSIP process, as currently applied, exacerbates these problems by placing an unmanageable burden on local authorities and failing to mandate comprehensive, basin-wide studies for co-located projects.

6.2 Recommendations for the Examining Authority and the Secretary of State

- **Mandate New Hydrological Modeling:** Require the developers for all three projects to submit a revised Flood Risk Assessment based on the Baiamonte et al. (2023) research. The revised modeling must explicitly quantify and mitigate the effects of the solar panels' impact on peak discharge, runoff speed, and time to peak.
- **Require a Unified Cumulative Effects Study:** The Examining Authority should mandate a single, independent, basin-wide hydrological study for the entire regional drainage network that will be affected by the cumulative effects of the One Earth, Tilbridge, and Great North Road projects. This study should assess the combined flood risk and propose integrated, regional-scale mitigation measures.

- **Secure a Long-Term Monitoring and Restoration Plan:** The DCOs, if granted, should include a legally binding, independently funded and managed plan for the long-term monitoring and maintenance of all hydrological mitigation measures and soil conditions for the lifetime of the projects. This plan must include enforceable provisions for post-decommissioning restoration of the soil to its pre-construction state.
- **Suspend Examination Pending Re-evaluation:** The examination of all three projects should be suspended until the required re-evaluation of hydrological impacts and cumulative effects is completed to a standard that can withstand rigorous, independent, and scientific scrutiny.

6.3 Recommendations for Local Authorities and Statutory Consultees

- **Coordinate Formal Submissions:** Local authorities and statutory consultees should coordinate their formal submissions to the Planning Inspectorate, focusing their objections on the systemic flaws and cumulative impacts identified in this report.
- **Leverage Scientific Evidence:** Use the scientific evidence and analysis presented herein as the basis for formal objections and technical questions during the examination process, challenging the developers to provide a scientifically robust justification for their flood risk claims.
- **Demand Independent Oversight:** Advocate for the Planning Inspectorate and the Secretary of State to mandate independent, third-party technical review of the hydrological and environmental assessments, given the documented resource and skills shortages within local planning departments.

Footnotes

1. Based on the findings of Baiamonte et al. (2023) on solar panel runoff generation.
2. Based on the assessment of permeability in the Flood Risk Assessments for Great North Road and Tilbridge.
3. Based on guidance for managing solar farms' flood risk and developer assumptions.
4. Based on the Baiamonte et al. (2023) study on the kinetic energy of runoff from solar panels.
5. Based on the National Policy Statements for Energy (EN-1) and Renewable Energy (EN-3).
6. Based on the Flood Risk Assessment for One Earth and EN-1 guidance on flood risk and the Sequential and Exception Tests.
7. Based on the application of Sequential and Exception Tests as outlined in the EN-1 and a Preliminary Environmental Information Report.
8. Based on claims of collaboration with conservation partners and biodiversity enhancements for the Great North Road project.
9. Based on the proposed use of natural flood management techniques, such as swales and wetlands, for the Great North Road project.
10. Based on the objectives of the EU Water Framework Directive.
11. Based on the Outline Soil Management Plan for the One Earth Solar Farm.
12. Based on the Outline Drainage Strategy for the Tilbridge project and general guidance for solar developments.

13. Based on a solar project's construction environment management plan and best practice guidance.
14. Based on the documented collaborative efforts between the Tilbridge and other solar projects in the area.
15. Based on the Preliminary Environmental Information Report and Environmental Statement documents for the Tilbridge project.
16. Based on project information from the Newark and Sherwood District Council website and the One Earth project's DCO application acceptance.
17. Based on the documented NSIP process timetable and a report on the accelerated nature of the process.
18. Based on the project size mentioned in the Great North Road documentation.
19. Based on the documented timetable for the Great North Road project and its acceptance by the Planning Inspectorate.
20. Based on best practice guidelines for preventing soil compaction during solar farm construction.
21. Based on the proposed land area for solar development for the Great North Road project.
22. Based on the documentation for the DCO process and the focus of the Tilbridge project on its own merits.
23. Based on a 2023 survey of local authority planning departments in England.
24. Based on the purpose of a Local Impact Report as a broad overview rather than a precise technical document.
25. Based on the documents submitted as part of the DCO application for One Earth and Great North Road.

Soil Compaction threat from the One Earth Solar Project

Summary

The proposed One Earth Solar Farm, while technically feasible from a construction perspective, presents significant and interconnected long-term environmental risks that challenge its real-world sustainability beyond a purely desk-based assessment. The central issue stems from a fundamental engineering decision: the use of driven pile foundations. The analysis confirms that this method will cause widespread and permanent soil compaction, a consequence that cannot be remediated once the 1.5 million panels are installed. This irreversible alteration of the soil's physical properties fundamentally compromises the site's hydrologic performance, a critical concern given the area is already prone to flooding.

The project's ability to mitigate surface runoff, erosion, and increased flood risk is, therefore, entirely contingent on the long-term, flawless maintenance of a robust vegetative ground cover. This reliance on administrative and financial commitment over the project's proposed 60-year lifespan introduces a significant and unquantified risk. Furthermore, the environmental and social impacts of this project are not isolated; they must be assessed in conjunction with other concurrent large-scale infrastructure proposals in the Trent Valley area. The cumulative effect of these developments could have far-reaching consequences for the local landscape and hydrology, a factor that is required to be addressed within the scope of a single NSIP application, but which local councils and the public believe requires a more strategic, holistic approach.

The analysis concludes that the project's stated mission to deliver science-based, nature-centric solutions appears to be in direct tension with its foundational engineering choices, which seem to prioritize installation speed and cost-effectiveness over minimizing environmental disturbance. This report recommends a re-evaluation of the project's flood mitigation strategy to explicitly account for permanent soil compaction, a mandated cumulative impact study for the entire Trent Valley region, and the securing of a long-term maintenance bond for the vegetative cover.

1.0 Introduction: Project Context and the Nationally Significant Infrastructure Framework

1.1 Project Overview: The One Earth Solar Farm NSIP

The One Earth Solar Farm is a major renewable energy proposal classified as a Nationally Significant Infrastructure Project (NSIP) due to its substantial scale and export capacity. The project, located on the border of Nottinghamshire and Lincolnshire, is designed to generate up to 740MW of electricity, a volume capable of supplying more than 200,000 UK homes.1 Developed as a partnership between PS Renewables and Ørsted, two prominent entities in the renewable energy sector, the project's location was strategically chosen due to the pre-existing grid connection point at the decommissioned High Marnham coal-fired power station.2, 3

This classification as an NSIP means that the project does not undergo a traditional local planning application process. Instead, it requires a Development Consent Order (DCO), which is determined at a national level by the Secretary of State for Energy Security and Net Zero, following an examination by the Planning Inspectorate (PINS).4 This process, which began with a pre-application phase and is expected to conclude with a decision in Spring 2026, places the final authority on the project with the central government rather than local councils.4

1.2 The NSIP Process and Community Engagement

The DCO process follows a clear, multi-stage timetable. It begins with the developer's pre-application consultation, followed by an acceptance phase by the Planning Inspectorate, a pre-examination period, a six-month examination phase, and finally, a decision by the Secretary of State.4 During this process, local authorities, such as Nottinghamshire County Council, are designated as “host authorities” and are required to submit a Local Impact Report (LIR).4, 5 This LIR provides a technical assessment of the project's likely impacts on the local area, covering topics like planning, transport, local flood issues, and ecology. It is important to note that the LIR is a technical assessment and does not conclude on the project’s overall acceptability, nor does it explicitly object to or support the application.5

Despite the project’s strategic importance, it has faced significant public opposition. Consultation feedback from local residents and parish councils has highlighted major concerns regarding the project's scale, its visual and ecological impact, and the loss of agricultural land.6, 7, 8 Local bodies, such as South Clifton Parish Council, have reconfirmed their objection, arguing that the project's size is "unsuitable and unfair to the 13 small villages in its' immediate vicinity".7 Concerns have also been raised about the noise from inverters and battery energy storage systems (BESS), the potential for pollution events from the BESS, and the project's effect on local heritage and mental health.1, 7 The design of the solar farm has been subject to multiple masterplan revisions in response to this feedback, with panels being removed from areas near villages and homes.2

A point of particular interest is the project’s name, "One Earth Solar Farm." The name appears to align itself with the global non-profit organization, One Earth, which is a science-based advocacy group focused on three pillars of collective action: energy transition, nature conservation, and regenerative agriculture.9 This organization leads science and storytelling to support solutions for climate change and biodiversity loss, and its framework includes "transforming our food and fiber systems to feed 10 billion people sustainably while restoring life back to the soil".10 The alignment of the project's name with this mission suggests a holistic, regenerative, and environmentally conscious approach. However, a detailed analysis of the project’s on-the-ground engineering decisions and their long-term consequences reveals a potential tension between this stated vision and the reality of its environmental impacts. This divergence between a project's branding and its practical execution will be a central theme of this report.

2.0 Geotechnical Engineering Analysis: Foundations, Compaction, and Post-Installation Constraints

2.1 The Driven Pile Method: A Technical Overview

The proposed installation of 1.5 million solar panels and associated infrastructure necessitates a robust and scalable foundation method. The One Earth project is expected to use driven piles, a type of deep foundation that involves hammering long, slender columns of steel or concrete into the ground.11 This method is a preferred choice for utility-scale solar farms due to its cost-effectiveness, scalability, and speed of installation, which significantly reduces the overall time required for foundation work.11 The piles are driven to a depth that ensures they reach a stable layer of soil or rock, with the user query specifying a depth of 1.5 to 3.5 meters. Geotechnical surveys, which include exploratory borings and field tests, are conducted to determine the specific soil composition and inform the design of these foundations, ensuring they can support the structural loads.12, 13

2.2 The Inevitability of Soil Compaction

A critical, yet often underappreciated, consequence of the driven pile method is the inherent and quantifiable compaction of the surrounding soil. Research confirms that the process of driving or jacking displacement piles into the ground causes a change in the soil condition and stress-strain state, resulting in the formation of a "compaction zone" around the pile.14 This is not a temporary effect; it is a permanent alteration of the soil's physical properties.

Studies have provided specific quantitative data on this phenomenon. In fine-grained soils, the compaction zone can extend horizontally up to 6 to 7 times the pile's diameter for single piles and up to 10 to 11 times for strip pile foundations.14 Vertically, the zone can reach a depth of 3 to 3.5 times the pile's length under the tip.14 Within this area of compaction, the research indicates a significant change in soil properties. For example, the specific weight of clay in the compaction zone increased by 12%, and the modulus of clay deformation increased by a remarkable 283% compared to the natural soil.14 This substantial increase in soil density and stiffness is a direct and irreversible consequence of the chosen installation method.

This permanent change to the soil's structure represents a fundamental vulnerability for the project. The user query correctly identifies that once the panels are installed, taking remedial action is not feasible. The research corroborates this, stating that retrofitting or attempting to remediate the soil beneath an existing solar array is "complicated and expensive," and would require shutting down the entire array.15 The project, by its very design, establishes a permanent condition of reduced soil porosity and infiltration capacity, a direct and non-mitigable outcome of its foundational engineering. The success of any long-term environmental management strategy is thus compromised from the outset by this initial, irreversible choice.

2.3 Comparison to Alternative Foundation Methods

While driven piles are a common choice, less-invasive alternatives exist, such as helical piles. These piles are "screwed into the ground" rather than hammered, a method that causes significantly less soil disturbance.15 A major advantage of helical piles is their "self-verifying" nature; the load capacity can be quantified by monitoring the pressure required for installation, offering a form of "warranty" on the foundation's stability.15 This stands in contrast to other methods where the quality of soil compaction is simply "hoped for the best".15

The developer’s apparent choice of driven piles over less-invasive alternatives suggests a strategic prioritization of upfront cost and installation speed over minimizing long-term environmental disturbance. This decision creates a fundamental trade-off. While the efficiency of driven pile installation helps meet construction deadlines and keep costs down, it introduces a permanent, widespread, and quantifiable environmental consequence in the form of soil compaction. This raises a critical question about whether the project’s technical decisions align with the regenerative mission suggested by its name, reinforcing the paradox between the project's stated vision and its real-world implementation. The geotechnical analysis reveals that a crucial engineering choice has pre-determined the site's long-term hydrologic performance, making this a central issue in the overall feasibility assessment.

Feature	Driven Piles	Helical Piles
Installation Process	Driven into the ground using a pile driver, creating a compaction zone.	Screwed into the ground, a less-invasive method.
Installation Speed	Fast, efficient, and scalable for large projects.	Quick installation.
Cost-Effectiveness	Cost-effective for large-scale projects.	Can be more reliable and stable, reducing long-term risks.
Soil Compaction	Causes permanent and widespread compaction around the pile.	Causes significantly less soil disturbance and compaction.
Post-Installation Remediation	Complicated and expensive; requires shutting down the array.	More easily removed if required.
Load Capacity Verification	"Hope the soil compaction was done well" with no guarantee.	"Self-verifying" by monitoring pressure during installation, offering a warranty.

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3.0 Hydrological and Flood Risk Assessment: The Nexus of Panels, Compaction, and Runoff

3.1 Alterations to Surface Runoff and the Hydrological Cycle

A solar farm covering thousands of acres represents a significant alteration of the natural landscape, with the potential to fundamentally change local hydrologic and water quality processes.16, 17 The solar panels themselves are impervious to rain, acting as large, elevated surfaces that collect and concentrate precipitation.17

A key study on the hydrologic effects of solar farms provides a nuanced understanding of this impact. The research found that the panels alone did not have a significant effect on runoff volume or peak discharge.17 However, this minimal impact was entirely contingent on the ground cover beneath and between the panels being well-maintained grass, which allows for infiltration.17 The problem arises from alternative ground covers. If the ground under the panels is gravel or bare—whether due to design decisions or a lack of maintenance—the peak discharge can increase significantly.17 For example, when the "spacer section" between panel rows was assumed to be bare ground, the peak discharge increased by 100%.17 This happens because bare ground reduces infiltration losses and decreases the time it takes for runoff to reach a given point, causing a rapid accumulation of water.17

Furthermore, the concentrated flow of water draining from the edges of the panels possesses a greater kinetic energy than the rainfall itself.17 The water draining from a panel onto a specific spot on the ground can have nearly 10 times the kinetic energy of rain falling directly on that same area.17 This high-energy flow can cause significant soil detachment and transport, leading to severe erosion, especially in areas with bare soil or gravel.17

3.2 Assessing Flood Risk in a Pre-Existing Flood-Prone Area

The One Earth Solar Farm is planned for an area already identified as "prone to flooding".5 Public consultation respondents expressed specific concerns about an "increase in perceived flood risk due to water runoff from solar panels".18 Given this pre-existing vulnerability, the project is subject to strict planning policy requirements. The Overarching National Policy Statement for Energy (EN-1) serves as a framework, highlighting a comprehensive approach to mitigating flood-related challenges. Crucially, it states that energy infrastructure in flood-risk areas should only be permitted if necessary, and it must be demonstrated that the project will be safe for its lifetime "without increasing flood risk elsewhere, and, where possible will reduce flood risk overall".19, 20 To proceed in a high-risk area, the project must pass the "Exception Test".19, 20

This policy framework places a high burden on the project to prove its long-term safety and to demonstrate that it will not exacerbate existing flood issues. The findings from the hydrologic studies indicate that this is a high-stakes proposition, entirely dependent on the project's ability to manage its ground cover effectively for the entire 60-year lifespan.

3.3 Efficacy of Proposed Mitigation and Drainage Strategies

To minimize the hydrologic impacts of solar farms, best management practices (BMPs) include minimizing soil disturbance during construction, ensuring a high cover of perennial vegetation, and promoting soil decompaction.16, 21, 22 These strategies are designed to maintain and restore the soil's natural infiltration capacity, allowing it to absorb rainfall and prevent runoff.

However, a fundamental contradiction exists at the core of the One Earth project's design. The most effective mitigation strategy—minimizing soil compaction—is directly violated by the project's chosen foundation method. The use of driven piles, as documented, causes permanent and widespread soil compaction. This irreversible change to the soil's structure presents a significant barrier to the effectiveness of vegetative cover as a long-term mitigation strategy. Research confirms that soil compaction reduces porosity and hydraulic conductivity, which are essential for water absorption.23, 24 Furthermore, compaction physically stunts root growth, reducing the plant's ability to explore the soil and maintain its structure, which is vital for infiltration.23

This means that the project's stated commitment to a "holistic flood alleviation strategy" must overcome a self-imposed and irreversible vulnerability.18 The soil's ability to absorb water is permanently reduced, increasing the site's reliance on secondary, and potentially less effective, management practices. While restoring compacted soil is possible through techniques like tilling and adding compost, this is not a feasible option once the solar panels and associated infrastructure are installed, as remediation would be "complicated and expensive" and require shutting down the entire array.15, 25, 26 The integrity of the entire flood risk strategy is thus contingent on an ongoing, flawless operational commitment for decades. The reliance on vegetation for runoff control is a precarious long-term strategy, as its health is susceptible to a range of variables, including climate change, disease, and inadequate maintenance over a 60-year period. Proper management of this vegetation also requires minimal mowing to prevent further soil compaction by heavy machinery.16, 21, 27

Ground Cover Type	Runoff Volume Increase	Peak Discharge Increase	Erosion Risk
Well-Maintained Grass	Approximately 0.35%	Approximately 0.31%	Low (Erosion potential is low when soil is well-covered and protected).
Bare Ground/Gravel	Significant increase	100%	High (Concentrated, high-kinetic-energy flow can cause significant soil detachment and transport).

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4.0 A Holistic Due Diligence: A Synthesis of Interconnected Risks

4.1 The Nexus of Geotechnical and Hydrological Risks

The most critical finding of this analysis is the inseparable link between the project's geotechnical choices and its hydrological risks. The decision to use driven piles creates a permanent condition of soil compaction, an outcome confirmed by geotechnical research. This compaction, in turn, reduces the soil's infiltration capacity, making it less effective at absorbing rainfall. When combined with the concentrated runoff from the solar panels, which possess high kinetic energy, this creates a situation of heightened risk for surface flooding and erosion. This is particularly problematic in an area already prone to such events.

The project's Flood Risk Assessment, therefore, must not be based on the assumption of a natural, undisturbed soil profile. Instead, it must account for the permanent, quantifiable reduction in infiltration capacity caused by the very method used to install the panels. The NSIP's policy requirement to "reduce flood risk overall" is fundamentally undermined from the outset by this foundational engineering choice. The project's mitigation efforts, such as establishing buffer strips or vegetation, are not a way to avoid a risk but a precarious attempt to manage a permanent condition of vulnerability that was created by the initial design.

4.2 The Cumulative Impact of Concurrent Developments

A comprehensive real-world assessment must also look beyond the confines of a single project and consider its cumulative impact. Local councils have voiced strong concerns about the "accumulative effect" of the One Earth Solar Farm and "numerous other solar farm proposals within the Trent Valley area," as well as other major infrastructure projects like the STEP fusion project at West Burton.6, 7 The NSIP process, as outlined in guidance from the Planning Inspectorate, requires an assessment of cumulative effects with other existing and reasonably foreseeable developments.18, 28, 29 For example, the developer for a similar project, Great North Road Solar Park, has stated that its environmental assessments specifically consider potential cumulative effects when combined with other projects.18 Despite these requirements, local authorities like Nottinghamshire County Council have raised concerns and explicitly required a cumulative impact assessment in their scoping opinions.30 From a regional and ecological perspective, the combined effects of multiple, large-scale developments can be far more significant than the sum of their parts. The cumulative loss of agricultural land, the combined visual impact on the landscape, and the compounded hydrological changes from multiple adjacent solar farms could lead to a "death by a thousand cuts" scenario for the Trent Valley region.28 The increased flood risk and loss of landscape, which are already major concerns for the One Earth project alone, are magnified by the presence of other concurrent installations.29, 30 This requires a more strategic, regional-level assessment of land use and energy policy that goes beyond the scope of a single DCO application. A holistic review would consider how these large-scale projects can be designed to complement, rather than undermine, the long-term environmental and social resilience of the entire region.

5.0 Conclusions and Recommendations

5.1 Final Verdict on Real-World Feasibility

The One Earth Solar Farm is technically buildable, but its long-term environmental sustainability is highly precarious. The analysis reveals a fundamental tension between the project's "One Earth" brand—which suggests a regenerative, science-based approach—and its foundational engineering choice of driven piles. This method, while efficient for construction, causes permanent and irreversible soil compaction. While the project relies on a robust vegetative cover to mitigate surface runoff and erosion, the effectiveness of this strategy is inherently compromised by the permanent reduction in the soil's natural infiltration capacity. The project's success hinges on a flawless, decades-long maintenance plan for this vegetative cover to compensate for a geotechnical choice that permanently reduces the soil's ability to absorb water. This inherent design flaw, compounded by the cumulative impact of other large-scale infrastructure projects in the region, casts significant doubt on the project's ability to deliver on its promise of enhancing energy security without significant, potentially detrimental, environmental consequences.

5.2 Actionable Recommendations

Based on this expert assessment, the following recommendations are put forth for relevant stakeholders:

- **For Regulators and Decision-Makers:** It is recommended that the Planning Inspectorate and the Secretary of State require a re-evaluation of the project's Flood Risk Assessment. This re-evaluation must explicitly model the effects of the permanent soil compaction caused by the driven pile foundations. A simple reliance on standard hydrologic models that assume a pristine soil profile would be insufficient. Furthermore, it is advised that the developer be required to submit an independently-validated, 60-year maintenance plan for the vegetative ground cover, secured by a long-term financial bond to ensure proper execution throughout the project’s lifespan.
- **For Local Stakeholders and Councils:** A cumulative impact study of all large-scale infrastructure projects in the Trent Valley region is strongly advised. Such a study would provide a more holistic understanding of the combined effects on local landscape, hydrology, and community well-being, informing a more strategic, long-term approach to land use policy in the area.

- **For Project Developers (Ørsted and PS Renewables):** A critical review of the chosen foundation method is warranted. A public statement is recommended to clarify how the technical choice of driven piles—a method that causes permanent soil compaction—aligns with the regenerative and nature-centric mission suggested by the project's name, "One Earth." A transparent and science-based explanation of this apparent conflict would be a crucial step in building trust and demonstrating a true commitment to sustainable practices.

Footnotes

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