Stephen Fox

Interested Party Reference number: FA3AE8AE5

By email

The Examining Authority

The Planning Inspectorate National Infrastructure Planning

Temple Quay House 2

The Square Bristol,

BS1 6PN

11th September 2025.

Reference: Application by One Earth Solar Farm Ltd for an Order Granting Development Consent for the One Earth Solar Farm (EN010159)

Dear Sirs

Please accept this letter and the attached document, **"A Cost-Benefit Analysis of the One Earth Solar Farm (EN010159): An Assessment of Economic Viability in the Context of Cumulative and Catastrophic Flood Risk,"** as a formal written representation for the examination of the above-referenced Nationally Significant Infrastructure Project (NSIP).

We believe this document is of significant importance to the examination for several key reasons.

First, it directly addresses the fundamental balancing exercise required by Section 104 of the Planning Act 2008. The Act requires that a Development Consent Order (DCO) may be refused if the Secretary of State is satisfied that "the adverse impact of the proposed development would outweigh its benefits." Our analysis moves beyond a conventional appraisal to present a comprehensive, risk-weighted cost-benefit ledger. It concludes that when the full spectrum of costs—including the un-assessed risk of catastrophic flooding, the multi-generational loss of agricultural land, and the inequitable distribution of local disamenity versus national gain—is properly accounted for, the project's adverse impacts do indeed outweigh its stated benefits.

Second, the analysis fills a critical gap in the evidence submitted by the applicant concerning cumulative hydrological impact. As the Local Impact Report from West Lindsey District Council has already highlighted, there are "significant concerns regarding the cumulative impact of the scheme with other NSIP solar generating station projects". Our report substantiates this concern by providing a detailed analysis of the "assessment fragmentation" problem, whereby the systemic, catchment-level flood risk from the unprecedented cluster of major developments around the High Marnham grid connection point has not been holistically evaluated. This is a matter of profound importance for public safety and environmental protection.

Third, the report incorporates the latest hydrological science, including the findings of Baiamonte et al. (2023), to challenge the adequacy of the applicant's Flood Risk Assessment. It demonstrates that the unique hydrological response of large-scale solar farms—particularly the potential for a dramatic increase in peak runoff—may not be sufficiently captured by standard assessment models, thereby underestimating the true flood risk posed by the development itself.

Finally, the document provides a structured examination of the foundational challenges to the applicant's case, including the significant local and institutional opposition, the unproven nature of biodiversity net gain claims, and the fundamental conflict of placing essential infrastructure in an area of inherent flood risk.

We respectfully submit that this analysis constitutes an important and relevant matter for the examination. It provides a robust, evidence-based framework that we hope will assist the Examining Authority in its duty to gather and test all evidence before making a recommendation to the Secretary of State.

Thank you for your time and consideration.

Yours faithfully,

Stephen Fox

A Cost-Benefit Analysis of the One Earth Solar Farm (EN010159): An Assessment of Economic Viability in the Context of Cumulative and Catastrophic Flood Risk

Executive Summary

This report presents a comprehensive cost-benefit analysis (CBA) of the proposed One Earth Solar Farm, a 740MW Nationally Significant Infrastructure Project (NSIP) located on the border of Nottinghamshire and Lincolnshire (Application Reference: EN010159). The analysis rigorously evaluates the proposal within the context of two critical, interconnected risk factors: the potential for catastrophic flooding and the cumulative hydrological impact of extensive regional development.

The stated benefits of the project align with UK national policy. With a projected annual output of 1,000 GWh, the solar farm would power over 200,000 homes, make a significant contribution to the UK's 2035 decarbonisation and 2050 Net Zero targets, and enhance national energy security.[1] [2] Economically, the project's benefits are almost exclusively national, contributing to a rapidly growing renewable energy sector and creating jobs.[3] [4] However, these national gains come at a significant local cost. The project offers a stable significantly enhanced income stream for a very small number of agricultural landowners through land leasing, while the wider local community bears the brunt of the disbenefits.[5] [6]

These benefits must be weighed against a complex and significant cost profile. The direct financial costs are considerable, with an estimated Capital Expenditure (CAPEX) of approximately £845 million and a long-term decommissioning liability potentially exceeding £44 million.[7] [8] Furthermore, the project entails the removal of 1,409 hectares of agricultural land, comprising approximately 170 fields, from production for a 60-year period, contributing to national concerns over food security and the loss of Best and Most Versatile (BMV) farmland.[9] [10] [11] While the developer proposes ecological enhancements, claims of delivering Biodiversity Net Gain (BNG) are hotly contested by the local community, are not supported by a transparent framework or robust evidence, reflecting systemic weaknesses in the BNG policy that allow for loopholes and shortfalls in enforcement.[12] [13]

The central finding of this analysis is that the project's viability is fundamentally challenged by its location and the broader development context. The site is situated within Environment Agency Flood Zones 2 and 3, bisected by the River Trent, and lies within a recognised flood warning area.[14] [15] While the developer's Flood Risk Assessment (FRA) proposes mitigation measures, such as elevating solar panels, this report contends that this approach may be insufficient for three primary reasons derived from an analysis of modern hydrological science and regional planning data:

1. **Altered Hydrological Response:** Large-scale solar farms fundamentally change local hydrology. The impervious surfaces of solar panels concentrate rainfall, significantly increasing the volume and velocity of surface water runoff and elevating the risk of soil erosion.[16] [17] This effect, if not adequately managed across the entire 1,409-hectare site, can increase localised and regional pluvial (surface water) flood risk.

2. **Cumulative Impact of Regional Development:** The One Earth project is one of numerous large-scale solar, grid infrastructure, and transport developments concentrated around the High Marnham grid connection point. The current NSIP planning process assesses these projects individually, creating a systemic failure to evaluate the holistic, catchment-level impact of converting thousands of hectares of permeable agricultural land into semi-impermeable surfaces. The aggregate effect is a likely significant increase in peak runoff into the River Trent system, elevating the baseline risk of fluvial (river) flooding beyond what is considered in isolated project assessments.

3. **Risk of Catastrophic Failure:** The combination of the site's inherent flood vulnerability, the altered hydrological response from the solar farm itself, and the cumulative impact of regional development creates a tangible high-consequence risk of a catastrophic flood event that exceeds the project's design tolerances. The potential costs of such an event—including total asset loss, damage to third-party property, and severe environmental contamination from the large-scale Battery Energy Storage System (BESS) and other down—are immense and must be factored into the CBA.

In conclusion, when the cost side of the ledger is adjusted to account for the risk-weighted cost of a catastrophic flood event, the economic case for the One Earth Solar Farm becomes marginal at best, and potentially negative. The analysis suggests that while the project offers clear national benefits, it does so by concentrating a significant and potentially underestimated level of flood risk and local disamenity onto a specific locality and the region it sits in. This report recommends that a decision on the Development Consent Order (DCO) be deferred pending a holistic, catchment-wide cumulative hydrological impact assessment that models the aggregate effect of all major regional developments. Without such an assessment, the project represents a considerable long-term financial and environmental liability.

Section 1: The Case for the Project: A Contested Proposal

This section establishes the foundational case for the One Earth Solar Farm, detailing the project's technical specifications and strategic purpose. It critically examines the benefits presented by the developers, placing them in the context of the significant and foundational challenges that have been raised by local authorities and communities, which contest the project's overall suitability and the adequacy of its assessment.

1.1 Development Overview and Strategic Context

The One Earth Solar Farm is a proposed utility-scale renewable energy project with an associated grid connection and energy storage facility. Its scale and technical capacity place it among the most significant onshore renewable energy developments currently under consideration in the United Kingdom.

1.1.1 Project Specification

The core of the proposal involves the construction, operation, and eventual decommissioning of a ground-mounted solar photovoltaic (PV) array designed to generate and export up to 740 megawatts (MW) of electricity.[1] [9] This is complemented by an integrated Battery Energy Storage System (BESS), designed to enhance grid stability by storing excess energy generated during periods of high solar irradiance and releasing it to the grid during periods of high demand or low generation.[1]

The total land area encompassed by the project's Order Limits is approximately 1,409 hectares (equivalent to 3,482 acres).[9] [18] This extensive site is situated on the border of Nottinghamshire and Lincolnshire, straddling the administrative boundaries of Newark and Sherwood District, Bassetlaw District, and West Lindsey District Council.[18] [19] The landscape is predominantly agricultural, comprising numerous fields that are bisected by the River Trent, which flows from south to north through the project area.[17] Key local settlements in the vicinity include North and South Clifton, Ragnall, Dunham, and Fledborough.[9]

1.1.2 Strategic Rationale and Development Status

The selection of this specific location was not arbitrary but was dictated by a key piece of national infrastructure. The developers state that the "starting point for choosing the location of the solar farm was the availability of the grid connection point at High Marnham"(a clear breach of the Sequential test).[1] This substation has significant available capacity following the decommissioning of the former High Marnham coal-fired power station, making it a prime target for new energy projects seeking to connect to the National Grid.[1] This highlights a critical dynamic in UK renewable energy development, where the legacy infrastructure of the fossil fuel era is now shaping the geography of the green transition. This concentration of new generation capacity around existing grid nodes has profound implications for cumulative environmental impacts, a central theme of this report.

Due to its generating capacity exceeding the 50MW threshold defined in the Planning Act 2008, the One Earth Solar Farm is classified as a Nationally Significant Infrastructure Project (NSIP).[20] [21] This designation means that the decision on whether to grant planning permission is not made by local authorities but at a national level by the Secretary of State for Energy Security and Net Zero. The project must secure a Development Consent Order (DCO) through a rigorous examination process administered by the Planning Inspectorate (PINS). The application for the One Earth project was formally accepted for examination on 27 March 2025, under the reference number EN010159.[9] The examination period commenced in July 2025 and is expected to last six months, with a recommendation from the Examining Authority anticipated by April 2026 and a final decision from the Secretary of State in summer 2026.[21] [22]

1.1.3 The Developers

The developers are shell company formed for the specific purpose of the project.

1.2 The Benefit Case: National Imperatives vs. Local Realities

The developers and proponents of the One Earth Solar Farm case for approval case for its approval centred on contributions to national energy goals. However, this analysis finds that these national benefits are achieved by imposing significant, uncompensated costs on the local and communities.

1.2.1 National Energy and Climate Contributions

The principal benefit of the project is its capacity to generate a vast amount of low-carbon electricity. The 740MW output is projected to be sufficient to supply more than 200,000 UK homes.[1] [14] [22] The project's Preliminary Environmental Information Report (PEIR) further quantifies this, estimating an annual generation of approximately 1,000 GWh.[2] This level of generation directly supports the UK Government's Energy Security and Net Zero Strategy, which includes an ambitious target to increase the nation's solar capacity fivefold by 2035, reaching up to 70GW.[24]

By displacing electricity generated from fossil fuels, the project is calculated to have a significant positive effect on the UK's carbon budget. The PEIR concludes that the operational phase will lead to a substantial reduction in Greenhouse Gas (GHG) emissions, directly contributing to the legally binding target of achieving a net-zero economy by 2050 and decarbonising the power sector by 2035.[2] Government policy documents recognise that large-scale, ground-mounted solar is one of the cheapest and most rapidly deployable forms of new electricity generation available, making projects like One Earth central to this strategy.[24]

Beyond decarbonisation, the project is framed as a key contributor to the UK's energy security. By increasing the supply of domestically generated electricity, it reduces the nation's dependence on imported fossil fuels, which are subject to price volatility and geopolitical instability.[25] The inclusion of a large-scale BESS is a critical component of this benefit. It allows the grid to be more resilient, storing solar power when it is abundant and releasing it during evening peak demand periods, thereby helping to balance supply and demand and ensuring a more stable and reliable power system.[1] [3] It is this alignment with overriding national policy that forms the central justification for the project, a justification that is weighed against significant and contested local and regional impacts.

1.2.2 National Economic Value vs. Localised Costs

The development of the One Earth Solar Farm would represent a significant investment into the national economy. The One Earth project, with its capital cost approaching £1 billion, is claimed to be driver of this growth, supporting jobs in manufacturing, construction, engineering, and long-term operations and maintenance.

However, these economic benefits are almost exclusively national in scope, while the costs are borne locally and regionally. To address the direct impact on host communities, the developers have established the "One Earth Community Fund".[5] Administered by the local charity Forever Notts, this fund is designed to provide grants of up to £1,000 to registered community groups, local charities, and parish councils within designated priority areas.[5]

This provision stands in stark contrast to a project with a national-level impact and a capital cost in the hundreds of millions. This scale mismatch has been a point of is astounding. The local community is expected to endure the visual intrusion, construction disruption, and long-term industrialisation of their landscape in exchange for a community fund that is disproportionately small. This imbalance undermines the project's social license to operate and highlights a fundamental inequity in how the costs and benefits of this large-scale infrastructure are distributed.

1.2.3 Support for a Minority of Landowners

For the agricultural landowners involved, the project offers a significant opportunity for income diversification. Solar farm leases provide a long-term, stable, and index-linked income stream that is decoupled from the inherent volatility of agricultural commodity markets and weather-dependent crop yields.[24] [25] Across the UK, payments to farmers hosting solar installations were estimated at £61 million in 2024, a figure projected to rise to over £300 million annually by 2035.[3] [4]

However, this direct financial benefit is concentrated among a very small number of individuals or businesses. While the exact number of landowners involved in the One Earth project is not public, the scheme involves the consolidation of approximately 170 agricultural fields but is estimated to be no more than 10[9] It is highly probable that this vast area is controlled by a small number of large landholders. This creates a situation where a few landowners receive substantial financial reward, while the wider community of 13 surrounding villages and numerous other residents experience the negative impacts without comparable compensation.[27] This dynamic concentrates the project's direct financial upside while socialising its disbenefits across the local population.

1.3 Foundational Challenges to the Applicant's Case

The case for the One Earth Solar Farm, while compelling at the national policy level, faces significant and foundational challenges that are central to this cost-benefit analysis. These challenges, raised by local authorities and residents, question the project's suitability, the adequacy of its environmental assessment, and the equity of its impacts.

1.3.1 The Grid-Led Justification and Inherent Site Risk

A primary challenge stems from the project's core justification. The developer's selection of the 1,409-hectare site was driven almost exclusively by the availability of grid connection capacity at the High Marnham substation.[1] This "grid-led" approach is the basis for the applicant's Sequential Test, which argues that no other reasonably available sites exist that could accommodate a project of this scale.[28] [29] However, this singular focus on grid access has resulted in the selection of a site with inherent and severe environmental constraints. A significant portion of the proposed development lies within Environment Agency Flood Zones 2 and 3, areas with a high probability of flooding from the River Trent.[14] [17] This creates a fundamental conflict at the heart of the proposal: the strategic national need for grid connection is pitted directly against the local and regional need for floodplain preservation and flood risk management.

1.3.2 The Unassessed Cumulative Burden

The One Earth Solar Farm is not an isolated development. It is one of several large-scale solar NSIPs concentrated in the same geographical and hydrological catchment area, drawn to the same grid connection points at High Marnham and Cottam.[30] This has created a development cluster of unprecedented scale. West Lindsey District Council (WLDC), in its formal Local Impact Report (LIR), has expressed "significant concerns regarding the cumulative impact of the scheme with other NSIP solar generating station projects," warning of "significant adverse impacts upon the natural environment, character and communities within the West Lindsey District."[31] This report contends that the current regulatory framework, which assesses each project individually, fails to account for the systemic, catchment-level hydrological impact of converting thousands of hectares of permeable farmland to semi-impermeable surfaces. This "assessment fragmentation" represents a core challenge to the validity of the project's environmental claims, as the true, cumulative flood risk has not been holistically evaluated.

1.3.3 Significant Local and Institutional Opposition

The project faces considerable opposition from the communities it would directly affect. The WLDC LIR concludes that the project "on its own merits will also give rise to significant adverse impacts on the natural environment and the amenity and lives of communities living in the near and surrounding area".[31] Newark and Sherwood District Council has also highlighted "likely significant adverse effects" relating to biodiversity, heritage, and a lack of tangible benefits for local residents. Lincoln County Council have lodged a formal objection because the negative impacts outweigh any national beneft.[32] These institutional concerns are echoed by the local population. Councillors have relayed residents' fears over the "destruction of our beautiful countryside" and raised specific, unanswered safety questions, such as the risk of a pollution event from the thousands of lithium-ion batteries in the BESS, which are to be sited near a major water treatment works supplying the city of Lincoln.[19]

Section 2: Baseline Costs and Environmental Liabilities

A credible cost-benefit analysis requires a rigorous accounting of its full lifecycle costs and disbenefits. This section establishes the baseline costs of the project, encompassing direct financial expenditures from construction to decommissioning, as well as the non-flood-related environmental and agricultural liabilities. These elements form the foundational "cost" side of the analytical ledger, prior to the detailed examination of catastrophic flood risk in Section 3.

2.1 Lifecycle Financial Costs

The financial commitment required for a project of this magnitude is substantial, extending from the initial capital investment through decades of operation to the final act of site restoration.

2.1.1 Capital and Operational Expenditure (CAPEX/OPEX)

The Capital Expenditure (CAPEX) for the One Earth project, is estimated by One Earth to be between £950million and £1.05 Billion.
Operational Expenditure (OPEX) represents the ongoing annual costs required to run and maintain the facility. A common industry estimate for OPEX is approximately 1% of the initial CAPEX per year.[34] Based on the CAPEX estimate above, the One Earth project would incur annual running costs in the range of **£9.50 million to £10.5 million**. These costs cover routine maintenance, panel cleaning (£4 to £15 per panel), vegetation management, security, insurance, and administrative overheads.[34]

2.1.2 Decommissioning and Restoration Liability

A critical, and often underestimated, component of the project's lifecycle cost is the liability associated with its decommissioning at the end of its operational life, which is stated to be 60 years.[19] The Development Consent Order (DCO) will legally require the developer to remove all above-ground infrastructure—including millions of solar panels, thousands of tonnes of steel racking, and all electrical equipment—and restore the land to its former condition.[14 35]

Estimating these costs is challenging, but data from smaller projects provides a baseline. For a standard 2MW installation, decommissioning costs are estimated to range from $60,000 to $150,000 (£48,000 to £120,000).[8] A simple linear scaling of this figure to the 740MW One Earth project would suggest a total decommissioning cost between **£17.7 million and £44.4 million**. This process is labour- and equipment-intensive, involving the dismantling of the racking system, removal of electrical equipment and cables, breaking up and removing concrete pads for substations and inverters, removing perimeter fencing, and regrading and reseeding the entire 1,409-hectare site.[8 36]
A significant financial risk is associated with this long-term liability. The project is being developed by "One Earth Solar Farm Limited," a Private Limited Company incorporated in 2020 as a special purpose vehicle (SPV).[37] Over a 60-year timeframe, there is a tangible risk that the operating company could be sold, restructured, or become insolvent, potentially leaving the landowner or the public to bear the substantial clean-up costs. To mitigate this, legal experts and planning authorities typically require the inclusion of a decommissioning bond or fund in the land lease agreement.[35 38] This financial instrument is intended to ring-fence sufficient funds to cover the full cost of restoration, regardless of the financial health of the operator in the future. The valuation, inflation-proofing, and legal enforceability of this bond are therefore not minor administrative details but a core element of the project's long-term cost profile. An underfunded or poorly structured bond represents a significant future liability being transferred from the developer to the public.

2.2 Agricultural and Environmental Disbenefits (Non-Flood Related)

Beyond the direct financial costs, the project imposes significant non-monetised or difficult-to-monetise costs on the environment and the agricultural sector.

2.2.1 Impact on Agricultural Land and Food Security

The most direct environmental cost is the removal of 1,409 hectares (3,482 acres) of land from agricultural production for the project's 60-year operational life.[9 19] While the land use is technically temporary and reversible, it represents a multi-generational suspension of food production on a very large scale.[24]

This land take occurs within a context of growing national concern over food security and the cumulative loss of productive farmland. A 2025 report by the countryside charity CPRE revealed that 59% of England's largest solar farms are located on productive agricultural land, with nearly a third (31%) of their total area classified as the nation's 'Best and Most Versatile' (BMV) land (Grades 1, 2, and 3a).[10 39] This trend is seen as a direct threat to the UK's ability to produce its own food, with some analyses warning that the UK could lose up to 23% of its total farmland by 2050 due to competing demands from energy, housing, and nature restoration projects.[11 40]

The One Earth project is a clear manifestation of this policy conflict between national energy goals and national food security. The specific classification of the 1,409 hectares in the project's Environmental Statement is therefore a matter of critical importance. The loss of significant quantities of BMV land would represent a substantial and long-term cost to the nation's agricultural capacity and resilience. This concern has been explicitly raised by local authorities in relation to similar nearby projects; West Lindsey District Council, for example, expressed deep disappointment that for the consented Gate Burton solar NSIP, the "loss of prime agricultural land has been put to one side and not given due regard".[41]

2.2.2 Local Ecological Impacts and Unproven Biodiversity Claims

The construction and operation of the solar farm will have direct impacts on the local ecosystem. While developers often highlight the potential for biodiversity net gain through measures like planting wildflower meadows, these claims lack transparency and are not supported by a robust evidence base.[42 43] The system of Biodiversity Net Gain (BNG) itself is subject to criticism for significant loopholes, enforcement shortfalls, and a lack of ambition that undermines its effectiveness.[12 13] There is a lack of robust, empirical evidence that BNG works in practice, and with declining financial support for local authorities, it is unclear how the auditing of any claimed gains would be effectively and independently managed.[13 14]

Independent scientific research has shown that the microclimate and soil conditions under solar panels are significantly altered. The ground is subject to increased compaction from construction machinery and reduced sunlight, which can lead to lower levels of soil organic carbon and particulate organic matter.[44] These changes are detrimental to soil health and can impair crucial ecosystem services, including the soil's ability to store carbon and infiltrate water—a factor with direct relevance to the flood risk analysis in the next section. Furthermore, while some species may thrive, others can be negatively affected. Studies have noted that some bat species find it harder to forage in and around solar farms, and local councillors have registered specific concerns about the potential for "catastrophic losses" of bird species in the One Earth project area.[19 42] For local communities, the disbenefits include significant impacts on amenity. Residents and councillors have voiced fears over the "destruction of our beautiful countryside" due to the profound visual change to the landscape.[19] There are also practical concerns about operational noise from the numerous inverters required to convert the DC electricity to AC, and the potential for pollution from the BESS units. A particularly acute concern has been raised regarding the siting of thousands of lithium-ion batteries within close proximity of a large water treatment facility that supplies drinking water to the city of Lincoln, with fears that a fire or leak could lead to hazardous pollutants entering the water supply.[19]

Section 3: Catastrophic Flood Risk: A Multi-Factor Cost Analysis

This section forms the analytical core of the report, a detailed assessment of catastrophic flood risk. The analysis moves beyond a standard review of the developer's submissions to incorporate findings from modern hydrological science and, critically, to model the cumulative impact of the unprecedented cluster of major developments in the region. This multi-factor approach is essential for understanding the true, systemic flood risk posed by the One Earth Solar Farm, which represents the most significant potential cost in this analysis.

3.1 Site-Level Flood Vulnerability: A Critical Review of the Developer's Flood Risk Assessment (FRA)

The project's own consultants correctly identify that "Flood is a key constraint for the project".[14] The site's inherent vulnerability to flooding is undeniable and provides the baseline upon which all other risk factors are layered.

3.1.1 Baseline Fluvial and Pluvial Risk

The proposed 1,409-hectare site is located in an area with a well-documented history of flood risk. The land is bisected by the River Trent, a major English river, and much of the proposed development area lies within the Environment Agency's designated Flood Zones 2 and 3.[14] Flood Zone 2 is defined as land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), while Flood Zone 3 is land having a 1 in 100 or greater annual probability of river flooding (>1%).[45] [46] The site is specifically located within the "River Trent at High Marnham and Low Marnham" flood warning area.[15] [47] This area has been subject to multiple flood warnings in recent years, including during Storm Henk in January 2024 and Storm Babet in October 2023, where high river levels on the Trent posed a direct threat to property and farmland in the Marnham area.[48] This establishes a clear baseline of existing fluvial (river) flood risk. The risk of pluvial (surface water) flooding is also present, as indicated by Environment Agency mapping which models runoff from heavy rainfall.[17] [49]

3.1.2 Developer's FRA and Mitigation Strategy

In accordance with the requirements for an NSIP, the DCO application (EN010159) is supported by a detailed Flood Risk Assessment (FRA) and an Outline Drainage Strategy (submitted as Appendix 7.2 of the Environmental Statement, Document Reference: EN010159/APP/6.21).[17] This document acknowledges the site's location in Flood Zones 2 and 3 and outlines the developer's strategy to mitigate this risk.

The primary mitigation measure proposed is structural: the base height of the solar panels and associated electrical infrastructure will be elevated to varying levels above the ground.[14] [50] This approach, which the developer states has been "agreed with the Environment Agency," is designed to keep the critical electrical components above predicted flood levels, thereby ensuring the project can remain safe and operational during a flood event.[14] The FRA models various flood scenarios, including the design flood event of a 1-in-100-year return period, with an added allowance of 39% for the impacts of climate change on peak river flows.[17]

The developers have also undertaken a Sequential Test, as required by national planning policy.[28] This test requires developers to demonstrate that there are no reasonably available alternative sites at a lower risk of flooding. The justification for proceeding with the High Marnham site, despite the flood risk, is predicated on the unique availability of a 740MW grid connection point, arguing that alternative sites without this connection capacity are not viable for a project of this scale.[28] [29]

3.1.3 Analysis of Adequacy

While the developer's FRA follows the procedural requirements, its adequacy in the face of catastrophic risk is questionable. A critical analysis reveals potential shortcomings. The climate change allowance for peak river flow (+39%) must be scrutinised against the latest government guidance, which recommends applying higher allowances for "essential infrastructure" with a design life of 100 years (the project's stated life is 60 years, but residential developments are considered to have a 100-year life for planning purposes).[19] [51] For such infrastructure in Flood Zone 3, the "higher central" or even "upper end" allowances may be more appropriate, which could be significantly greater than 39%.[51]

More fundamentally, the strategy of simply elevating infrastructure on stilts fails to address the wider hydraulic consequences. This approach prevents the assets from being damaged but does nothing to mitigate the project's impact on floodwater displacement. By occupying 1,409 hectares of the floodplain, the infrastructure, even when elevated, will obstruct and displace floodwater, potentially increasing flood risk in downstream or adjacent areas. The FRA must demonstrate "no net loss of floodplain storage" and that any constriction of flood flow routes is safely managed.[17] [28] This will not be achieved by simply raising panels on posts without comprehensive compensatory flood storage measures.

3.2 The Hydrological Impact of Utility-Scale Solar Development: Applying Modern Science

A key deficiency in many standard FRAs for solar farms is the failure to account for the fundamental way in which such developments alter the local hydrological cycle. Recent scientific research provides a much clearer picture of these impacts, which must be incorporated into a comprehensive cost-benefit analysis.

3.2.1 Altering the Hydrological Response

Large-scale solar farms transform the landscape from a predominantly permeable, vegetated surface to a hybrid one characterised by vast areas of impervious panels over a pervious ground layer.[16] [52] This has profound consequences for how the land responds to rainfall. In a natural or agricultural setting, a significant portion of rainfall is intercepted by vegetation and infiltrates slowly into the soil. On a solar farm, rainfall that hits the panels is not intercepted or infiltrated; instead, it sheets off rapidly and is concentrated along the lower edge of the panel, known as the "dripline".[52] [53]

3.2.2 Increased Runoff Velocity, Volume, and Erosion

This process of concentration dramatically increases both the volume and velocity of surface water runoff compared to the pre-development state. Hydrological modelling and field studies have shown that this can lead to a significant increase in peak discharge rates from the site.[17, 52] One study noted a potential for a 100% increase in peak runoff in scenarios where land cover is altered after construction.[52] More recent research underscores the potential severity of this effect; a 2023 hydrological modelling study by Baiamonte et al. found that under certain conditions, solar panels could increase the peak discharge from a hillslope by as much as eleven times compared to the pre-development state.[76]

This highlights a critical flaw in conventional flood risk modelling. While some stormwater permits treat solar farms as entirely impervious surfaces, this approach can be overly simplistic and lead to an overestimation of total runoff, as it ignores the infiltration that occurs in the pervious ground between and under the panels.[77] The reality is more complex: solar farms create a "disconnected impervious" landscape where concentrated runoff from panels creates intense localised saturation and erosion at the "dripline," fundamentally altering the site's hydrological response in ways that standard models may fail to capture accurately.[77]

Furthermore, the kinetic energy of the water flowing off the panels can be substantially greater than that of direct rainfall, creating a high potential for soil erosion at the panel base.[16, 17, 54] This erosion can lead to the loss of topsoil, the creation of gullies, and the transport of sediment into local watercourses, degrading water quality and reducing downstream channel capacity.

3.2.3 The Critical Role of Ground Cover and Compaction

The severity of these hydrological impacts is heavily dependent on the management of the ground beneath and between the panels. The risk of increased runoff and erosion is significantly exacerbated if the ground cover is degraded to bare earth or replaced with gravel.[16, 17] Maintaining a dense, healthy vegetation sward is critical for slowing runoff and promoting infiltration.[53]

Equally important is the issue of soil compaction. The use of heavy machinery during the construction phase can compact the soil, drastically reducing its permeability and infiltration capacity.[54] This means that even areas not directly covered by panels may generate significantly more runoff than they did pre-development.

3.2.4 Implications for One Earth

Applying these scientific principles to the 1,409-hectare One Earth site raises serious concerns. The project will introduce millions of square metres of new impervious surfaces into the Trent floodplain. This will inevitably lead to a faster and more concentrated runoff response during rainfall events. The developer's Outline Drainage Strategy must be robust enough to manage not just the existing flood risk, but this fundamentally altered hydrological regime. Standard drainage solutions may be insufficient. The strategy should incorporate specific measures to manage dripline erosion (e.g., gravel-filled filter drains or swales) and a comprehensive soil management plan to de-compact the ground following construction to restore its infiltration capacity.[55] Even with these measures, the project itself could become a significant source of localised surface water flooding.

3.3 Cumulative Hydrological Impact Assessment (CIA): The Core of the Risk Analysis

The most critical and complex aspect of the flood risk analysis is the cumulative impact of the One Earth project in combination with the unprecedented concentration of other major developments in the surrounding 30-mile radius.

3.3.1 The Development "Cluster"

The area surrounding the High Marnham substation has become a focal point for NSIPs and other large-scale infrastructure projects, driven by the availability of grid capacity. A systematic review identifies a dense cluster of recent and proposed developments that share the same hydrological catchment. This concentration of development is a direct result of the "grid-led" development pattern, where the existence of a high-capacity connection point acts as a powerful magnet, attracting numerous large projects to a single geographical area. This process, while efficient from a grid-planning perspective, externalises the environmental risk by failing to account for the aggregate impact on the local landscape and water systems. The table below provides a schedule of the most significant projects contributing to this cumulative burden.

Table 1: Schedule of Major Developments for Cumulative Impact Assessment (30-Mile Radius of High Marnham)

Project Name	PINS Reference	Development Type	Scale	Status	Distance from One Earth (km)	Overlapping Hydrological Catchment
One Earth Solar Farm	**EN010159**	**Solar & BESS**	**740 MW / 1,409 ha**	**Examination**	**0**	**Yes**
Cottam Solar Project	EN010133	Solar & BESS	600 MW / 1,150 ha	Consented	~6	Yes
West Burton Solar Project	EN010134	Solar & BESS	480 MW / 1,050 ha	Consented	~8	Yes
Gate Burton Energy Park	EN010131	Solar & BESS	500 MW / 834 ha	Consented	~10	Yes

Project Name	PINS Reference	Development Type	Scale	Status	Distance from One Earth (km)	Overlapping Hydrological Catchment
Great North Road Solar Park	EN010162	Solar & BESS	>50 MW	Pre-application	~12	Yes
Tillbridge Solar Project	EN010118	Solar & BESS	>50 MW	Examination	~18	Yes
Tuxford Road Solar Farm	-	Solar & BESS	120 ha	Consented	~5	Yes
Grassthorpe Beck Solar Farm	-	Solar & BESS	52 ha	Pre-application	~4	Yes
Brinsworth to High Marnham Uprating	-	Grid Infrastructure	New Substation (~10.8 ha)	Pre-application	0	Yes
A46 Newark Bypass	TR010065	Transport Infrastructure	6.5 km widening	Examination	~18	Yes
Newark Southern Link Road	-	Transport Infrastructure	~6.4 km new road	Under Construction	~19	Yes

Project Name	PINS Reference	Development Type	Scale	Status	Distance from One Earth (km)	Overlapping Hydrological Catchment
A614/A6097 Corridor Improvements	-	Transport Infrastructure	5 junction upgrades	Under Construction	~25	Yes
Land South of Newark	10/01586/OUTM	Residential/Mixed-Use	3,150 dwellings	Approved	~19	Yes

Note: This table is illustrative and not exhaustive. Data compiled from sources.[56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68]

3.3.2 The "Assessment Fragmentation" Problem

Under the current NSIP framework, each project is required to conduct its own cumulative effects assessment.[69] [70] [56] [71] However, this process is fundamentally flawed when dealing with systemic, catchment-level impacts like hydrology. The Environmental Statement Addendum for the nearby Cottam Solar Project, for example, explicitly considered the cumulative impact with One Earth and other solar farms and concluded that "no significant additional cumulative effects on hydrology, flood risk, or drainage have been identified".[72]

This conclusion, while potentially logical from the narrow perspective of a single project's EIA, illustrates a critical analytical failure. These assessments tend to focus on the interaction of *mitigated outputs* (e.g., controlled drainage from one site flowing past another) rather than the aggregate impact of the *fundamental land-use change*. They often rely on distance or the assumption that each individual project's mitigation will be 100% effective, thereby concluding that their own incremental contribution is not significant. This approach creates a systemic blind spot. The sum of numerous individually "insignificant" hydrological changes across a single river catchment does not necessarily result in an insignificant cumulative impact; it can result in a significant, un-assessed, and un-mitigated change to the entire catchment's response to rainfall. This "death by a thousand cuts" scenario for regional flood resilience is a direct consequence of this fragmented assessment process.

3.3.3 Quantifying the Cumulative Effect

A true assessment requires a holistic analysis. The projects listed in Table 1 represent the conversion of well over 4,500 hectares (more than 11,000 acres) of predominantly permeable agricultural land within the same hydrological system. Each of these developments will increase the rate and volume of surface water runoff. The cumulative effect is a likely increase in the peak flow of the River Trent during storm events, raising the baseline flood risk for the entire region. This report contends that without a single, integrated hydrological study that models the aggregate impact of all these developments, the true flood risk to the One Earth site and the surrounding communities cannot be accurately determined.

3.4 The Cost of Catastrophic Failure: Monetising the Unthinkable

The final stage of the risk analysis is to consider the potential costs of a catastrophic flood event—defined as a flood that exceeds the design capacity of the project's mitigation measures and the absorption capacity of the local drainage network. Such an event could be triggered by a fluvial flood on the Trent greater than the 1-in-100-year + climate change scenario, a severe pluvial event, or a combination of both, with the severity amplified by the cumulative runoff from the regional development cluster.

3.4.1 Direct Costs

- **Asset Loss:** The most immediate cost would be the partial or total loss of the solar farm itself. The developer's mitigation strategy of elevating equipment is designed to prevent this, but a flood exceeding the design height could submerge panels, inverters, switchgear, and the BESS units. Submersion of this sensitive electrical equipment would likely result in a total loss, representing a write-off of the circa **£1billion** investment.[73]
- **Third-Party Damage:** Displaced floodwater and increased peak flows from the catchment could cause extensive damage to downstream and adjacent properties, including homes, businesses, and critical public infrastructure such as roads (including the A1 and A46) and the East Coast Main Line.
- **Environmental Contamination:** This represents the most severe potential cost. As highlighted by local councillors, the BESS component involves thousands of large lithium-ion battery units.[19] In the event of a major flood, there is a significant risk of these units being damaged, leading to fire or the leakage of toxic and hazardous materials. Given the project's proximity to a water treatment works serving Lincoln, such a contamination event could have catastrophic consequences for the public water supply, requiring an extremely costly and long-term remediation effort.[19]

3.4.2 Indirect Costs

- **Business Interruption:** A catastrophic flood would lead to a prolonged or permanent cessation of electricity generation, resulting in a total loss of revenue for the operator.
- **Emergency Response and Recovery:** The costs associated with emergency services, potential evacuations, clean-up operations, and the long-term repair of public infrastructure would be substantial.
- **Long-Term Economic and Social Damage:** Such an event would have lasting negative impacts, including depressed property values in the affected area, a permanent loss of agricultural productivity, and potential long-term public health consequences arising from environmental contamination.[74] The reputational damage to the developers and the wider solar industry would also be immense.

Section 4: Synthesis and Final Cost-Benefit Ledger

This section synthesises the preceding analyses into a final, integrated cost-benefit ledger. The objective is to provide a clear and comprehensive comparison of the project's stated benefits against its full spectrum of costs, with a particular emphasis on incorporating the high-impact, risk of catastrophic flooding. This approach moves beyond a simple accounting of direct costs and benefits to provide a risk-weighted perspective on the project's overall viability.

4.1 Integrated Analysis and Ledger

The following table consolidates the monetised and non-monetised factors discussed throughout this report. The benefits are primarily national in scale, focusing on energy generation and decarbonisation. The costs include direct project expenditures, the loss of agricultural capacity, and, most critically, a risk-weighted valuation of potential catastrophic flood damage.

A key element of this ledger is the "Risk-Weighted Cost of Catastrophic Flooding." This is not an accounting of a definite cost but an economic method for representing the potential impact of a high-consequence, low-probability event. It is calculated by estimating the total cost of such an event (as detailed in Section 3.4) and multiplying it by an assumed probability of occurrence over the project's 60-year lifetime. Given the uncertainty, a sensitivity analysis is presented using three different lifetime probability scenarios (1%, 5%, and 10%) to illustrate how the valuation of this risk profoundly affects the overall cost-benefit balance.

Table 2: Final Cost-Benefit Analysis Ledger for the One Earth Solar Farm

Benefits	Costs
Monetised Benefits	**Monetised Costs**
Annual Revenue from Energy Generation (estimated)	Capital Expenditure (CAPEX): **£950M - £1.05 billion**
Lifetime Gross Value Added (GVA) Contribution (project share of national projections)	Lifetime Operational Expenditure (OPEX) (60 years): **£444M - £534M**
Job Creation (Construction & Operation) A notional benefit	Decommissioning & Restoration Liability: **£18M - £45M**
Annual Lease Payments to a Minority of Landowners	Value of Lost Agricultural Output (60 years, site-specific)
Non-Monetised Benefits	**Risk-Weighted Cost of Catastrophic Flooding (Sensitivity Analysis over 60-year lifetime)**

Benefits	Costs
Contribution to UK Net Zero 2050 Target	*Scenario 1 (1% probability):* **~£10M**
Enhanced National Energy Security & Grid Stability	*Scenario 2 (5% probability):* **~£50M**
Local Community Fund Contributions (Nominal)	*Scenario 3 (10% probability):* **~£100M**
	Non-Monetised Costs
	Permanent Loss of 1,409 ha of Agricultural Land (including potential BMV land)
	Contribution to National Food Security Risk
	Systemic Increase in Catchment-Level Flood Risk
	Risk of Catastrophic Water Contamination from BESS Failure
	Significant and Long-Term Negative Visual Amenity Impact
	Unproven and Non-Transparent Biodiversity Net Gain Claims
	Disproportionate burden of local disamenity (visual, noise, disruption)

Note: Monetised benefit values are highly dependent on future wholesale electricity prices and economic modelling. The Risk-Weighted Cost is based on an estimated catastrophic event cost of ~£1 billion (asset loss + third-party/environmental damage).

4.2 Risk-Weighted Conclusion

The final cost-benefit ledger demonstrates that the stated benefits of the One Earth Solar Farm, while aligned with national energy policy, are fundamentally challenged when weighed against the full spectrum of its costs, liabilities, and the inequitable distribution of its impacts. The project's viability is not merely a matter of balancing direct financial inputs and outputs; it is contingent on a series of severe, localised, and potentially catastrophic risks that are currently underestimated.

The central argument of this report is that the project's cost profile is dominated by the risk of a catastrophic flood event. This is not a static, baseline risk but a dynamic one, significantly amplified by the hydrological changes induced by the solar farm itself and, most critically, by the un-assessed cumulative impact of massive regional development. As demonstrated in the sensitivity analysis (Table 2), accounting for even a modest probability of such a high-consequence event adds a risk-weighted cost of between £10 million and £100 million to the ledger, substantially eroding the project's net benefit.

This immense financial and environmental liability is compounded by other significant, non-monetised costs. The project necessitates the multi-generational loss of 1,409 hectares of agricultural land, posing a direct cost to national food security. Furthermore, the developer's claims of delivering Biodiversity Net Gain cannot be taken at face value; they are unproven, lack transparency, and are set against a policy framework with known loopholes and enforcement shortfalls, meaning they are unlikely to serve as a genuine offset for the ecological disruption caused.[12] [13]

Crucially, the analysis reveals a profound imbalance in the distribution of costs and benefits. The project's primary advantages—energy generation, grid stability, and GVA contribution—are almost exclusively national in scope. In contrast, the disbenefits are intensely local: the permanent industrialisation of the landscape, the loss of visual amenity, the disruption from construction, and the bearing of the catastrophic flood risk are all imposed upon the host community. This local sacrifice is made for nominal compensation, with the project's direct financial gains being concentrated in the hands of a very small number of landowners.

Therefore, the ultimate conclusion of this analysis is that the benefits of the One Earth Solar Farm do not outweigh its comprehensive costs. The project achieves its national objectives by externalising a disproportionate and poorly understood level of systemic risk and certain negative impacts onto a single locality and region. This exposure to high-impact tail risk, combined with the certain and inequitable local disbenefits, renders its long-term economic and environmental case untenable.

Section 5: Recommendations

Based on the comprehensive analysis of the One Earth Solar Farm proposal and its wider context, this report puts forward a series of actionable recommendations for key stakeholders. These recommendations are designed to address the critical gaps identified in the assessment of cumulative and catastrophic flood risk, ensuring that any final decision is based on a complete and scientifically robust understanding of the project's true costs and liabilities.

5.1 For the Planning Inspectorate and Secretary of State (during DCO Examination EN010159)

The Examining Authority and the Secretary of State hold the ultimate responsibility for determining whether the project's benefits outweigh its adverse impacts. The evidence presented in this report suggests that the current assessment framework may be inadequate for capturing the systemic risks involved.

1. **Mandate a Holistic Cumulative Hydrological Study:** It is strongly recommended that a final decision on the One Earth DCO (and other pending

solar NSIPs within the Trent catchment, such as the Great North Road Solar Park) be deferred until a single, integrated, and independent hydrological study of the entire affected catchment area is commissioned and completed. This study must move beyond the fragmented, project-by-project approach and model the aggregate hydrological impact of all proposed, consented, and under-construction major developments. The modelling must utilise solar-specific runoff parameters derived from the latest scientific research and apply the upper-end climate change scenarios (UKCP18) appropriate for essential infrastructure with a multi-generational lifespan.[51]
2. **Rigorously Scrutinise Decommissioning Bonds, BESS Safety, and Biodiversity Claims:** The Examining Authority should require the applicant to provide a transparent, legally robust, and independently verified decommissioning bond. This bond must be fully costed to cover a worst-case scenario, be index-linked to account for inflation over the 60-year project life, and be structured to ensure funds are accessible even in the event of the operator's insolvency.[35, 38] Furthermore, a specific and detailed risk assessment and mitigation plan for the Battery Energy Storage System (BESS) in the event of a major flood must be required, explicitly addressing the prevention of fire and the containment of contaminants to protect the local water supply.[19] The applicant's claims of Biodiversity Net Gain must be subject to intense scrutiny, requiring a transparent, independently auditable management and monitoring plan with clear enforcement mechanisms to address the systemic weaknesses in the current BNG framework.[13, 14]

5.2 For the Environment Agency and Lead Local Flood Authorities (LLFAs)

These bodies are responsible for managing flood risk and providing expert advice to the planning process. The rapid proliferation of large-scale solar developments necessitates an urgent update to their strategic approaches and technical guidance.

1. **Update Regional Flood Risk Strategies:** The Environment Agency and the relevant LLFAs (Nottinghamshire and Lincolnshire County Councils) should initiate an immediate review of their Strategic Flood Risk Assessments (SFRAs) for the Trent valley. These assessments must be updated to explicitly account for the systemic change in land use and hydrological response resulting from the cumulative impact of the cluster of approved and proposed NSIPs. Existing flood maps and models, which are based on historical land use patterns, may no longer be fit for purpose in reflecting future flood risk in this heavily impacted region.[75]
2. **Develop and Enforce Solar-Specific Drainage Guidance:** LLFAs should develop clear, prescriptive, and enforceable technical guidance for the surface water drainage design of utility-scale solar farms. This guidance should mandate the use of solar-specific hydrological models and require developers to implement a suite of mitigation measures that go beyond generic standards. This must include measures for managing concentrated dripline runoff, mitigating soil compaction through post-construction remediation, and maximising on-site water retention through techniques like oversized swales and retention basins.[54, 55]

5.3 For the Developer (Ørsted and PS Renewables)

To enhance the project's resilience and reduce its external costs, the developer should proactively adopt a more robust approach to risk mitigation that goes beyond the current proposals.

1. **Adopt a "Whole System" Flood Mitigation Strategy:** The developer should revise the project's drainage and flood mitigation strategy to reflect a "whole system" or "catchment-based" approach. Rather than focusing solely on elevating assets, the revised strategy should incorporate significant on-site and potentially off-site compensatory flood storage to ensure no net increase in flood risk elsewhere. This should prioritise natural flood management techniques, such as the creation of wetlands and upstream water storage areas within the site's extensive land holding, which can provide dual benefits for flood management and biodiversity.[17]
2. **Enhance Transparency on BESS Safety and Decommissioning:** The developer should proactively publish a detailed and public-facing risk assessment for the BESS units, outlining the specific engineering and procedural safeguards that will be in place to prevent and manage a flood-induced failure. Similarly, providing transparent details of the proposed decommissioning fund—including its value, structure, and inflation-proofing mechanism—would build confidence among stakeholders that this long-term liability is being responsibly managed.

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