Cottam Solar Project

Environmental Statement Appendix 10.1:

Flood Risk Assessment and Drainage Strategy

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Cottam
SOLAR PROJECT

Flood Risk Assessment and Drainage Strategy

Cottam Solar Scheme

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Protecting people and planet

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INOGEN ALLIANCE

Reference of Terms

Canal Failure

Canal failure can include a breach or overtopping of a canal system due to the effects of a high intensity rainfall event or structural failure that is not associated with a rainfall event. Such failure can be very dangerous as it can involve the rapid release of large volumes of water at high velocity, however, it is typically limited to reaches of canal that are raised above the surrounding ground level on one or both side and where watercourses or other structures pass beneath the canal. The size and nature of canals themselves can also have a hydraulic control on the mechanisms of flooding associated with a failure, resulting in a rapid peak in flow followed by a gradual reduction as the flow becomes restricted by the capacity of the canal itself to rapidly pass flow to the breach or failure point.

Fluvial Flooding

Fluvial flooding typically occurs when a river's capacity is exceeded, and the excess water overtops the river banks. It can also occur when the watercourse has a high level downstream, perhaps due to structures or blockage, thus limiting conveyance. This creates a back-up of water which can overtop the banks. Typical flooding issues occur when the natural floodplain has been urbanised and the river has been confined.

Groundwater Flooding

Groundwater flooding is caused by the emergence of water from beneath the ground at either point or diffuse locations when the natural level of the water table rises above ground level. This can result in deep and long-lasting flooding of low-lying or below-ground infrastructure such as underpasses and basements. Groundwater flooding can cause significant damage to property, especially in urban areas, and can pose further risks to the environment and ground stability.

Reservoirs Failure

Reservoir failure can be a particularly dangerous form of flooding as it results in the sudden release of large volumes of water that can travel at high velocity. This can result in deep and widespread flooding, potentially resulting in significant damage. The likelihood of reservoir flooding occurring is generally extremely low given that all large reservoirs are managed in accordance with the Reservoirs Act 1975. Under the Reservoirs Act 1975, a large raised reservoir is defined as one that holds over 25,000 cubic metres of water above the level of the surrounding land. The EA's online reservoir inundation map illustrates the maximum flood extents that could potentially occur in the event of a reservoir failure.

Sewer Flooding

Flooding from sewers primarily occurs when flow entering a system exceeds available capacity or if the network capacity has been reduced through blockage or collapse. In the case of surface water sewers that discharge to watercourses, the same effect can be caused as a result of high water levels in the receiving watercourse. As a result, water can begin to surcharge the sewer network, emerging at ground level through gullies and manholes and potentially causing flooding to highways and properties. If this occurs flooding can represent a significant hazard to human health due to the potential for contaminants in flood water.

Surface Water Runoff

Surface water runoff is defined as water flowing over the ground that has not yet entered a drainage channel or similar. It usually occurs as a result of an intense period of rainfall which exceeds the infiltration capacity of the ground. Typically, runoff occurs on sloping land or where the ground surface is relatively impermeable. The ground can be impermeable either naturally due to the soil type or geology, or due to development which places impervious material over the ground surface (e.g. paving and roads).

Tidal Flooding

Tidal flooding is caused by high tides coinciding with a low-pressure storm system which raises sea and tidal water levels, overwhelming coastal and river defences. This may be made worse by gale force winds blowing the raised body of water up tidal river basins some distance from the coast, due to floodwater being forced up the tidal reaches of rivers and estuaries. Such flooding may become more frequent in future years due to rising sea levels.

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1.0 Introduction

1.1 Appointment

1.1.1 Delta-Simons Environmental Consultants Limited ("Delta-Simons") was instructed by Cottam Solar Energy Farm Limited (the "Applicant") to carry out Flood Risk Assessment (FRA) and Drainage Strategy (DS) reports for the Cottam Solar Project (the "Scheme").

1.1.2 The Scheme comprises a number of land parcels (the "Site" or "Sites") described as Cottam 1, 2, 3a and 3b for the solar arrays, grid connection infrastructure and energy storage; and the cable route corridors. For further details of the Scheme, please see Chapter 4 of the Environmental Statement (ES): Scheme Description.

1.1.3 Where a Site has multiple parcels these have been labelled as "Sub-Site [X]" in accordance with field numbering plans that are included within the ES. Cottam 1 is subdivided into three distinct smaller Sites (North, West and South) and therefore, the assessment of each area has been undertaken separately. Furthermore, Cottam 1 North and West are further divided into three Sub-Sites each with Cottam 1 North containing Sub-Sites A, B and C and Cottam 1 West containing Sub-Sites E, F and G.

1.2 Project Understanding

1.2.1 The aim of this report is to assess the potential flood risk to the Scheme, the impact of the proposed Scheme on flood risk elsewhere, and the proposed measures which could be embedded to mitigate the identified risk. The reports have been prepared in accordance with the guidance contained in the National Policy Statement for Energy (NPS), National Planning Policy Framework (NPPF) revised in July 2021, and the National Planning Practice Guidance (NPPG) Flood Risk and Coastal Change.

1.2.2 The aim of the Sustainable Drainage Strategy is to identify water management measures, including Sustainable Drainage Systems (SuDS), to provide surface water runoff reduction and treatment.

1.2.3 The scheme will be located within the administrative boundaries of West Lindsey District Council, Lincolnshire County Council, Bassetlaw District Council and Nottinghamshire County Council. For details of how the Scheme accords with the policies relevant to these Councils, please see section 10.3 (Policy Context) of Chapter 10 (Hydrology, Flood Risk and Drainage) of the ES.

1.2.4 The scheme is not located within one of Natural England's designated nutrient neutrality catchment areas and therefore nutrient loading has not been considered within the assessment.

1.3 Scope of Works

1.3.1 The scope of works has been as follows for this FRA:

- Assess flood risk from all sources using best available information, including review of Environment Agency (EA) data and mapping, topography and historical records;
- Assess previous relevant available third-party studies, local authority plans or strategies;
- Advise on flood mitigation measures and residual risks;
- Assess evacuation routes;
- Advise on availability of flood warnings;
- Identify the requirement for a Sequential Test;
- Prepare FRA report.

1.3.2 Drainage Strategy

- Review existing conditions including sewer plans, British Geological Survey information and topographical information;
- Review Lead Local Flood Authority (LLFA) drainage policies;
- Analyse existing and proposed impermeable areas;
- Calculate existing runoff rates (excluding existing drainage system modelling);
- Assess method of surface water runoff disposal (soakaway / watercourse / sewer);
- Establish surface water discharge rate in consultation with the LLFA / sewerage provider;
- Estimate required attenuation volume using MicroDrainage or similar;
- Assess and advise on suitable forms of SuDS;
- Advise on drainage system maintenance measures;
- Advise on surface water treatment methods;
- Prepare DS report.

1.3.3 This report takes into account the following national and local policies:

- National Policy Statements for Energy (NPS) (2011)[1]
- Draft National Policy Statements for Energy (DNPS) (2021)[2]
- National Planning Policy Framework (NPPF) (2021)[3];
- National Planning Practice Guidance (NPPG) (2022)[4];
- CIRIA Guidance: The SuDS Manual (C753) (2017)[5];
- Nottinghamshire County Council and Bassetlaw District Council Local Development and Planning Policies; and
- Lincolnshire County Council and West Lindsey District Council Local Development and Planning Policies.

1.4 Sources of Information

1.4.1 The following sources of information have been reviewed and assessed for the purpose of this FRA:

- EA Online Flood Maps[6];
- British Geological Society (BGS) Interactive Map[7];
- MAGIC Interactive Map[8];
- West Lindsey District Council Strategic Flood Risk Assessment (2009 SFRA);
- Lincolnshire County Council Preliminary Flood Risk Assessment (2011 PFRA);

1 https://www.gov.uk/government/publications/national-policy-statements-for-energy-infrastructure
2 https://www.gov.uk/government/consultations/planning-for-new-energy-infrastructure-review-of-energy-national-policy-statements
3 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1004408/NPPF_JULY_2021.pdf
4 http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/
5 [redacted]
6 https://flood-map-for-planning.service.gov.uk/
7 [redacted]
8 http://www.magic.gov.uk/

- Nottinghamshire County Council Preliminary Flood Risk Assessment (2011 PFRA);
- Bassetlaw District Council Strategic Flood Risk Assessment (2019 SFRA);

1.5 Project Limitations

1.5.1 The wider Delta-Simons limitations are contained within Annex A.

2.0 Relevant Planning Policy and Guidance

2.1 Introduction

2.1.1 The aim of this section of the report is to discuss the main aspects of the local and national planning policies that are relevant to any proposed development on the Scheme and relevant guidance and legislation.

2.2 Assessment of Flood Risk

2.2.1 The flood risk from fluvial (Main Rivers) and coastal flooding is assessed through the use of the EA Flood Maps (flood risk from rivers or the sea). This map defines three zones of different flood risk, the third of which is subdivided into two categories:

- Zone 1 "Low probability of flooding" – This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%);
- Zone 2 "Medium probability of flooding" – This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% – 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% – 0.1%) in any year;
- Zone 3a "High probability of flooding" – This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year; and
- Zone 3b "Functional floodplain" – A sub-part of Zone 3, this zone comprises land where water has to flow or be stored in times of flood. This zone is not normally included within the national Flood Map for Planning and is calculated where necessary using detailed hydraulic modelling.

2.3 National Policy Statement (NPS) for Energy

2.3.1 The Overarching NPS for Energy (EN-1), adopted by the Department of Energy and Climate Change (DECC) in July 2011, to set objectives for the development of nationally significant infrastructure in a particular sector and to provide the legal framework for planning decisions.

Overarching National Policy Statement for Energy (EN-1)

2.3.2 The Overarching National Policy Statement for Energy (NPS) (EN-1) sets out policy regarding the development of nationally significant energy infrastructure projects.

2.3.3 Specific policy relating to Flood Risk is set out in Section 5.7. Paragraph 5.7.9 of this section states 'in determining an application for development consent, the Examining Authority (formerly IPC) should be satisfied that where relevant:

- the application is supported by an appropriate FRA;
- the Sequential Test has been applied as part of site selection;
- a sequential approach has been applied at the site level to minimise risk by directing the most vulnerable uses to areas of lowest flood risk;
- the proposal is in line with any relevant national and local flood risk management strategy
- priority has been given to the use of sustainable drainage systems (SuDs) (as required in the next paragraph on National Standards); and
- in flood risk areas the project is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed over the lifetime of the development. 3.1.3 Paragraph 5.7.12 states that the Secretary of State should not

consent development in Flood Zone 2 in England unless it is satisfied that the Sequential Test requirements have been met and that it 'should not consent development in Flood Zone 3 unless it is satisfied that the Sequential and Exception Test requirements have been met'. For the Sequential Test, it states the following:

- Preference should be given to locating projects in Flood Zone 1 in England or Zone A in Wales. If there is no reasonably available site in Flood Zone 1 or Zone A, then projects can be located in Flood Zone 2 or Zone B. If there is no reasonably available site in Flood Zones 1 or 2 or Zones A & B, then nationally significant energy infrastructure projects can be located in Flood Zone 3 or Zone C subject to the Exception Test. 3.1.4 The overarching objectives of the NPS are addressed within this FRA, however, with regard to the Sequential and Exception Test, the NPS requires the following:
- If, following application of the sequential test, it is not possible, consistent with wider sustainability objectives, for the project to be located in zones of lower probability of flooding than Flood Zone 3 or Zone C, the Exception Test can be applied. The test provides a method of managing flood risk while still allowing necessary development to occur.
- The Exception Test is only appropriate for use where the sequential test alone cannot deliver an acceptable site, taking into account the need for energy infrastructure to remain operational during floods. It may also be appropriate to use it where as a result of the alternative site(s) at lower risk of flooding being subject to national designations such as landscape, heritage and nature conservation designations, for example Areas of Outstanding Natural Beauty (AONBs), Sites of Special Scientific Interest (SSSIs) and World Heritage Sites (WHS) it would not be appropriate to require the development to be located on the alternative site(s).
- All three elements of the test will have to be passed for development to be consented. For the Exception Test to be passed:
  - It must be demonstrated that the project provides wider sustainability benefits to the community that outweigh flood risk;
  - The project should be on developable, previously developed land or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously developed land subject to any exceptions set out in the technology specific NPSs; and
  - A FRA must demonstrate that the project will be safe, without increasing flood risk elsewhere subject to the exception below and, where possible, will reduce flood risk overall.
- Exceptionally, where an increase in flood risk elsewhere cannot be avoided or wholly mitigated, the IPC may grant consent if it is satisfied that the increase in present and future flood risk can be mitigated to an acceptable level and taking account of the benefits of, including the need for, nationally significant energy infrastructure as set out in Part 3 above. In any such case the IPC should make clear how, in reaching its decision, it has weighed up the increased flood risk against the benefits of the project, taking account of the nature and degree of the risk, the future impacts on climate change, and advice provided by the EA and other relevant bodies.

2.3.4 The NPS EN-1 was published in July 2011, prior to the release of the NPPF, and its policies were subsequently developed based on PPS 25 'Development and Flood Risk'. As part of the preparation of the NPPF, the requirements to pass the Sequential and Exception Test listed in PPS 25 were reviewed and updated.

National Policy Statement for Electricity Networks Infrastructure (EN-5)

2.3.5 The NPS for Electricity Networks Infrastructure (EN-5) was published by the DECC in July 2011 and forms part of the suite of energy NPSs and is to be read in conjunction with the Overarching NPS for Energy (EN-1).

2.3.6 NPS EN-5 is relevant to the Proposed Development as the policy recognises electricity networks as "transmission systems (the long distance transfer of electricity through 400kV and 275kV lines), and distribution systems (lower voltage lines from 132kV to 230V from transmission substations to the end-user) which can either be carried on towers/poles or undergrounded" and "associated infrastructure, e.g. substations (the essential link between generation, transmission, and the distribution systems that also allows circuits to be switched or voltage transformed to a useable level for the consumer) and converter stations to convert DC power to AC power and vice versa."

2.3.7 NPS EN-5 sets out further technology-specific considerations, in addition to those impacts covered in NPS EN-1, specifically with regards to Climate Change Adaptation and Resilience and its potential impacts on flooding, particularly for substations that are vital to the network; and especially in light of changes to groundwater levels resulting from climate change.

Draft National Policy Statements

Draft Overarching National Policy Statement for Energy (EN-1)

2.3.8 In contrast to the adopted NPS EN-1 (2011), the Draft NPS EN-1, published in September 2021, makes specific reference to the generation of solar energy and recognises that there is an urgent need for new electricity generating capacity to meet UK objectives.

2.3.9 Paragraph 3.2.1 of the Draft NPS EN-1 sates that: "wind and solar are the lowest cost ways of generating electricity, helping reduce costs and providing a clean and secure source of electricity supply (as they are not reliant on fuel for generation). Our analysis shows that a secure, reliable, affordable, net zero consistent system in 2050 is likely to be composed predominantly of wind and solar." The NPS highlights that Government requires a sustained growth in the capacity of solar in the next decade and recognises that solar development needs to be coupled with technologies which optimise energy generation even when conditions for solar generation are not optimal.

2.3.10 Paragraph 3.3.24 of the Draft NPS EN-1 recognises that that energy storage is key in achieving net zero and providing flexibility to the energy system, so that high volumes of low carbon power can be integrated and to reduce the costs of the electricity system and increase reliability by storing surplus electricity in times of low demand to provide electricity when demand is higher.

Draft National Policy Statement for Electricity Networks Infrastructure (EN-5)

2.3.11 The Draft NPS EN-5 was published in 2021 and recognises that new electricity networks required for electricity generation, storage and interconnection infrastructure are vital to achieving the nation's transition to net zero.

2.3.12 Draft NPS EN-5 does not include any substantial revisions with regards to Flood Risk and Drainage.

2.4 National Planning Policy Framework

2.4.1 Flood risk in England is normally considered through the planning process in the NPPF, revised in July 2021, produced by Ministry of Housing, Communities and Local Government.

2.4.2 The principal aim of the NPPF assessment of flood risk is that:

"Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere".

2.4.3 The NPPF requires a FRA to be produced where development Sites are:

- Greater than one hectare in size;
- All proposals for new development (including minor development and change of use) in Flood Zones 2 and 3;

- Or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the EA);
- Identified in a Strategic Flood Risk Assessment as being at increased risk in the future; and
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

2.4.4 The NPPF requires that developers consider not just the flood risk to the development but also the impact that the development might have on flood risk elsewhere. As well as Main Rivers and the sea, it is also necessary to consider flood risk from other sources, including surface water, groundwater, Ordinary Watercourses, artificial drainage systems, canals and reservoirs.

Sequential Test

2.4.5 A key part of the NPPF is that a proposed development must first pass a "Sequential Test" to demonstrate that the overall development proposal is appropriate in terms of flood risk. It ensures that a sequential approach is followed to guide new development to areas with the lowest probability of flooding.

Vulnerability Classification

2.4.6 In accordance with Table 2 of the NPPG: Flood Risk and Coastal Change, solar farm developments are considered to be 'Essential Infrastructure'. Table 3 of the NPPG (reproduced below as Table 1), states that 'Essential Infrastructure' development is considered appropriate within Flood Zones 1 and 2. However, the Exception Test must be satisfied for development within Flood Zone 3.

Table 1: Flood Risk Vulnerability Classification (from Table 3 of online Planning Practice Guidance)

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	**Highly Vulnerable**	**More Vulnerable**	**Less Vulnerable**	**Water-Compatible**
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a	Exception Test required	X	Exception Test required	✓	✓
Zone 3b	Exception Test required	X	X	X	✓

✓ development is permitted
X development is not permitted

2.4.7 The latest NPPF guidance now requires that all sources of flood risk pass the Sequential Test depending on the level of risk. This will be broadly assessed as part of the formal assessment included as Annexes B – H.

Exception Test

2.4.8 The Exception Test determines whether the benefits of the proposed development will outweigh the potential flood risk. Within the NPPF, the Exception Test states that:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and
- A Site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

2.4.9 The reports included as Annexes B – H detail the flood risk to the Sites and the mitigation measures which could be carried out to ensure that the developments remain safe for their lifetime. The Sequential and Exception Tests are considered further in Section 3.0.

2.5 Local Policy

2.5.1 Cottam 1, Cottam 2, Cottam 3a and Cottam 3b are located within the Lincolnshire County Council and West Lindsey District Council administrative boundaries.

2.5.2 The Lincolnshire County Council 'Sustainable Drainage Design and Evaluation Guide' was produced to facilitate the best possible SuDS design. It is primarily intended for use by developers, designers and consultants who are seeking guidance on the Lead Local Flood Authority (LLFA) standards for the design of sustainable surface water drainage in Lincolnshire.

2.5.3 The Central Lincolnshire Local Plan was adopted in April 2017 and replaces the Local Plans of the City of Lincoln, West Lindsey, and North Kesteven District Councils. The Local Plan contains the following policies relating to flood risk and drainage:

Policy LP14: Managing Water Resources and Flood Risk

Flood Risk

'All development proposals will be considered against the NPPF, including application of the sequential and, if necessary, the exception test.

Through appropriate consultation and option appraisal, development proposals should demonstrate:

a. that they are informed by and take account of the best available information from all sources of flood risk and by site specific flood risk assessments where appropriate;

b. that there is no unacceptable increased risk of flooding to the development site or to existing properties;

c. that the development will be safe during its lifetime, does not affect the integrity of existing flood defences and any necessary flood mitigation measures have been agreed with the relevant bodies;

d. that the adoption, ongoing maintenance and management of any mitigation measures have been considered and any necessary agreements are in place;

e. how proposals have taken a positive approach to reducing overall flood risk and have considered the potential to contribute towards solutions for the wider area; and

f. that they have incorporated Sustainable Drainage Systems (SuDS) in to the proposals unless they can be shown to be impractical'.

Protecting the Water Environment

'Development proposals that are likely to impact on surface or ground water should consider the requirements of the Water Framework Directive.

Development proposals should demonstrate:

g. that water is available to support the development proposed;

h. that development contributes positively to the water environment and its ecology where possible and does not adversely affect surface and ground water quality in line with the requirements of the Water Framework Directive;

i. that development with the potential to pose a risk to groundwater resources is not located in sensitive locations to meet the requirements of the Water Framework Directive;

j. they meet the Building Regulation water efficiency standard of 110 litres per occupier per day;

k. how Sustainable Drainage Systems (SuDS) to deliver improvements to water quality, the water environment and where possible to improve amenity and biodiversity have been incorporated into the proposal unless they can be shown to be impractical;

l. that relevant site investigations, risk assessments and necessary mitigation measures for source protection zones around boreholes, wells, springs and water courses have been agreed with the relevant bodies (e.g. the Environment Agency and relevant water companies);

m. that adequate foul water treatment and disposal already exists or can be provided in time to serve the development;

n. that no surface water connections are made to the foul system;

o. that surface water connections to the combined or surface water system are only made in exceptional circumstances where it can be demonstrated that there are no feasible alternatives (this applies to new developments and redevelopments) and where there is no detriment to existing users;

p. that no combined sewer overflows are created in areas served by combined sewers, and that foul and surface water flows are separated;

q. that suitable access is safeguarded for the maintenance of water resources, flood defences and drainage infrastructure; and

r. that adequate provision is made to safeguard the future maintenance of water bodies to which surface water is discharged, preferably by an appropriate authority (e.g. Environment Agency, Internal Drainage Board, Water Company, the Canal and River Trust or local council)'.

2.5.4 The cable route is located across the Lincolnshire County Council, West Lindsey District Council, Nottinghamshire County Council and Bassetlaw District Council administrative boundaries. Nottinghamshire County Council does not have any relevant policies relating to flood risk and / or drainage. The Basset Law Local Plan 2020 – 2037, (Publication Version) published August 2021, is currently undergoing examination and is therefore not yet adopted however, it contains the following policies relating to flood risk and drainage:

Policy ST52: Flood Risk and Drainage

1. All proposals are required to consider and, where necessary, mitigate the impacts of the proposed development on flood risk, on-site and off-site, commensurate with the scale and impact of the development. Proposals, including change of use applications, must be accompanied by a Flood Risk Assessment (where appropriate), which demonstrates that the development, including the access and egress, will be safe for its lifetime, without increasing or exacerbating flood risk elsewhere and where possible will reduce flood risk overall.

2. Where relevant, proposals must demonstrate that they pass the Sequential Test and if necessary the Exceptions Test in Flood Zones 2 and 3 and ensure that where land is required to manage flood risk, it is safeguarded from development.

River Ryton Flood Management Impact Zone

3. All development within the River Ryton Flood Management Impact Zone, as identified on the Policies Map, will need to demonstrate through a Design and Access Statement that they will not prejudice the delivery of a future flood management scheme for the River Ryton catchment through prior agreement with the Environment Agency.

Surface Water Flood Risk

4. All development (where appropriate) should incorporate sustainable drainage systems (SuDS) in line with national standards. These should:

a) be informed by the Lead Local Flood Authority, sewerage company and relevant drainage board;

b) have appropriate minimum operational standards;

c) be managed in line with the Government's water strategy;

d) have maintenance arrangements in place to ensure an acceptable standard of operation and management for the development's lifetime;

e) prevent surface water discharge into the sewerage system;

f) maximise environmental gain through enhancing the green/blue infrastructure network, including urban greening measures, contributing to biodiversity net gain where possible, and securing amenity benefits along with flood storage volumes;

g) seek to reduce runoff rates in areas at risk from surface water flooding, and that any surface water is directed to sustainable outfalls.

POLICY ST53: Protecting Water Quality and Management

1. In line with the objectives of the Water Framework Directive17, the quantity and quality of surface and groundwater bodies will be protected and where possible enhanced in accordance with the Humber River Basin Management Plan21. Development adjacent to, over or in, a main river or ordinary watercourse will be supported where proposals consider opportunities to improve the river environment and water quality by:

a) actively contributing to enhancing the status of the waterbody through positive actions or ongoing projects;

b) naturalising watercourse channels;

c) improving the biodiversity and ecological connectivity of watercourses;

d) safeguarding and enlarging river buffers with appropriate habitat in accordance with Policy ST39; and

e) mitigating diffuse agricultural and urban pollution.

2. Proposals within a Source Protection Zone will need to demonstrate that any risk to the Sherwood Sandstone Principle Aquifer and its groundwater resources and groundwater quality will be protected throughout the construction and operational phase of development.

3. All proposals must ensure that appropriate infrastructure for water supply, sewerage and sewage treatment, is available or can be made available at the right time to meet the needs of the development. Proposals should:

a) utilise the following drainage hierarchy:

i. connection to a public sewer; then

ii. package sewage treatment plant (which can be offered to the Sewerage Undertaker for adoption); then

iii. septic tank, which will only be considered if it can be clearly demonstrated by the applicant that discharging into a public sewer is not feasible.

b) ensure that development that discharges water into a watercourse incorporates appropriate water pollution control measures;

c) ensure that drainage design take into account an appropriate climate change allowance as agreed with the relevant authority(s);

d) ensure that infiltration based SuDS incorporate appropriate water pollution control measures;

e) consider use of water recycling, rainwater and storm water harvesting, wherever feasible, to reduce demand on mains water supply.

2.6 Climate Change

2.6.1 The EA 'Flood Risk Assessments: Climate Change Allowances' Guidance (February 2016; last updated May 2022) details how development should consider climate change with regards to flood risk. Climate change allowances are predictions of anticipated change for:

- peak river flow
- peak rainfall intensity
- sea level rise
- offshore wind speed and extreme wave height

2.6.2 To increase resilience to flooding and coastal change, competent consultants should make allowances for climate change within flood risk assessments. There are allowances for different climate scenarios over different epochs, or periods of time, over the coming century. They include figures for extreme climate change scenarios.

2.6.3 Peak river flow allowances show the anticipated changes to peak flow by management catchment. Management catchments are sub-catchments of river basin districts. The range of allowances is based on percentiles. A percentile describes the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flow fall below it, and half fall above it.

The:

- central allowance is based on the 50th percentile
- higher central allowance is based on the 70th percentile
- upper end allowance is based on the 95th percentile

2.6.4 An allowance based on the 50th percentile is exceeded by 50% of the projections in the range. At the 70th percentile it is exceeded by 30%. At the 95th percentile it is exceeded by 5%.

2.6.5 The EA 'Flood Risk Assessments: Climate Change Allowances' Guidance states that Essential Infrastructure Developments (see paragraph 2.4.6) should utilise the Higher Central Allowance.

2.6.6 Table 2 indicates the Higher Central Allowances for the Management Catchments which the Sites are located across.

2.6.7 Cottam 1 North, South and West are located in the Anglian District within Witham Management Catchment.

2.6.8 Cottam 2, Cottam 3a and Cottam 3b are located in the Humber District within the Lower Trent and Erewash Management Catchment.

Table 2: Higher Central Allowances (2050s epoch)

District	Management Catchment	Higher Central Allowance
Anglian	Witham	15%
Humber	Lower Trent & Erewash	23%

3.0 Assessment of Flood Risk

3.1.1 The aim of this report is to assess the potential flood risk to the Scheme, the impact of the proposed development on flood risk elsewhere, and the proposed measures which could be embedded to mitigate the identified risk.

3.1.2 Site and Sub-Site specific assessments of Flood Risk have been provided in Annexes B-H

3.1.3 A summary of the assessed flood risk to the Sites is provided as table 3 below:

Site	**Summary of Flood Risk**
Cable Route	The risk to the Site from all sources of flooding is **Negligible to Low**.
Cottam 1 North	The risk to the Site from all sources of flooding is **Negligible to Low**.
Cottam 1 West	The risk to the Site from all sources of flooding is **Negligible to Low**.
Cottam 1 South	The risk to the Site from all sources of flooding is **Negligible to Low**.
Cottam 2	The risk to the Site from all sources of flooding is **Negligible to Low**.
Cottam 3a	The risk to the Site from all sources of flooding is **Negligible to Low**.
Cottam 3b	The risk to the Site from all sources of flooding is **Negligible to Low**.

3.2 Embedded Mitigation

3.2.1 Where Site specific mitigation is required this is specified in the annexes.

3.2.2 In general the following mitigations have been embedded into the masterplanning process.

- 8m easements have been established around all watercourses, including Main Rivers and Ordinary Watercourses and 9 m from IDB assets.
- Either fixed or tracker panels will be utilised throughout the Sites.
- The minimum height of the lowest part of the fixed solar panel units will be 0.6 m above ground level.
- The tracker solar panel units will be mounted on raised frames (usually raised a minimum of 0.4 m) when on maximum rotation angle) and will therefore be raised above surrounding ground levels and fitted with a tracking system. During times of flooding, solar panels may be stowed by the tracking system algorithm onto a horizontal plane, to the minimum post height of 2.3 m above ground level. This ensures that all sensitive and electrical equipment on the solar panel is raised to a minimum of 2.3 m above ground level in the horizontal position.
- Fixed panels should be located within areas of the Site which are located in Flood Zone 1 whereas tracker panels can be located in areas that are within Flood Zones 2 and 3 on the basis of the additional flood protection offered by their potential to be stowed horizontally.
- Electrical infrastructure associated with the panels can be adequately waterproofed to withstand the effect of flooding. Where possible the sensitive electrical equipment has been located in parts of the Site that are within Flood Zone 1. Where this hasn't been possible, equipment will be raised 0.6 m above the 0.1% Annual Exceedance Probability (AEP) flood level or where this is not possible as high as practicable.

4.0 Soil Management

4.1.1 The management of soil is essential to ensure the natural drainage of the Site is maintained and to avoid an increase in surface water flooding. The following applies to The Scheme.

4.1.2 The nature of the development means that precipitation is intercepted by the solar panels. If the Site is inappropriately manged, there is potential for the local hydrology to be impacted, which could lead to an increase in surface water flow.

4.1.3 In the absence of Site management, integrated drainage systems could develop within the Site. An unmanaged drainage network could lead to the rate of infiltration being compromised and ultimately being bypassed, resulting in increased surface water flows passing to the wider fluvial network.

4.1.4 There is no UK environmental managing runoff from solar panel installations. Research undertaken in the United States (US) by Cook and McCuen[9] recommend that the vegetation cover beneath the panels is well maintained or that a buffer strip be placed after the most down gradient row of panels.

4.1.5 The Maryland Department for the Environment Storm water Design Guidance for solar panel installations[10] recommends 'non-structural techniques like disconnecting impervious cover' to reduce runoff by promoting overland filtering and infiltration. The following must also be considered:

- Runoff must sheet flow onto and across vegetated areas to maintain the disconnection.
- Disconnecting impervious surfaces works best in undisturbed soils. To minimise disturbance and compaction, construction vehicles and equipment should avoid areas used for disconnection during installation of the solar panels. Where disturbance is unavoidable, post construction soil treatment (deep ploughing) to restore soil condition may be required.
- Groundcover vegetation must be maintained in good condition in those areas receiving disconnected runoff. Typically this maintenance is no different than other lawn or landscaped areas. However, areas receiving runoff should be protected (e.g. planting shrubs or trees along the perimeter) from future compaction.

4.1.6 To minimise the potential impacts from soil compaction and changes in flow pathways a number of mitigation techniques have been suggested as follows. To meet soil protection guidance, DEFRA objectives of Construction Code of Practice for the Sustainable Use of Soils on Construction Sites are recommended.

4.1.7 Soil compaction will be limited during the construction phase by a number of measures;

- Using only light machinery to install the solar panels and low ground pressure vehicles to be used during extreme rainfall events.
- Where construction has resulted in soil compaction, the areas between panel rows would be tilled / scarified to an appropriate depth and then re-seeded with an appropriate vegetation cover.
- During the first few years there should be frequent inspections of the planting and soil to ensure it is growing properly, isn't bare and isn't compacted. Any remedial work should occur as soon as possible.
- During operation, maintenance of infrastructure will be limited and only require light machinery, therefore no change in the existing permeability of the soil would be caused.

[redacted]

[redacted]

4.1.8 The presence of appropriately maintained vegetation at all times across the site will mitigate potential increases in runoff and soil erosion, which can be a contributing factor to greater runoff.

4.1.9 Any existing field or tile drainage system would be restored where affected by construction.

4.1.10 All access tracks will be made out of granular material and will therefore be permeable, reducing the potential increase in surface runoff.

5.0 Drainage Strategy

5.1 Introduction

5.1.1 In general The Scheme currently comprises undeveloped, agricultural land with no formal, positive drainage network. Surface water runoff generated within the existing Site is anticipated to discharge into the surrounding land drainage network at an uncontrolled rate.

5.1.2 The Scheme measures in excess of 1 ha in size and therefore a Sustainable Drainage Strategy is required to support the Development Consent Order (DCO) application in line National Policy Statement (NPS) for Energy. To provide context to the level of detail required for an effective SuDS strategy, the BRE Planning Guidance for the development of large scale ground mounted solar PV systems states:

5.1.3 *"The Environment Agency has advised that, due to the size of solar PV farms, planning applications will be expected to be accompanied by a Flood Risk Assessment. This will need to consider the impact of drainage. As solar PV panels will drain to the existing ground, the impact will not in general be significant and therefore this should not be an onerous requirement".*

5.1.4 All of the Sites which make up The Scheme will comprise natural ground cover post development albeit with the introduction of solar panels on raised frames and limited areas of hardstanding associate with substations and inverters. The Scheme will remain wholly largely permeable following development. The below assessment, therefore, forms the Drainage Strategy for the vast majority of The Scheme with the proposed battery storage and substation within Cottam 1 West being assessed separately within Annex D.

5.2 Drainage Hierarchy

5.2.1 The recommended surface water drainage hierarchy (Paragraph 5.7.19 of the NPS EN-1 and Paragraph 080 of the NPPG: Flood Risk and Coastal Change) is to utilise soakaway systems or infiltration as the preferred option, followed by discharging to an appropriate watercourse. If this is not feasible, the final option is to discharge to an existing public sewer.

Surface Water Discharge to Soakaway / Permeable Surfaces

5.2.2 The first consideration for the disposal of surface water is infiltration (soakaways and permeable surfaces). The Scheme is undeveloped agricultural land and wholly permeable, informally draining to ground and in exceedance events in excess of the infiltration capacity, into the surrounding Land Drains. The vast majority of The Scheme will comprise natural ground cover post development albeit with the introduction of solar panels on raised frames and limited areas of hardstanding associate with substations and inverters. Any proposed access or surfacing will be permeable. The Scheme will therefore remain wholly largely permeable following development, as per the existing situation.

5.2.3 Cottam 1 West includes for battery storage and a substation this Site has been assessed separately within Annex D.

Surface Water Discharge to Watercourse

5.2.4 Where soakaways are not suitable a connection to watercourse is the next consideration. The nearest watercourses are the land drains which flow through the Scheme.

5.2.5 Any surface water runoff in excess of the infiltration capacity of the ground may naturally drain into the surrounding land drains as per the existing scenario. As no new connections will be required, formal discharge consents will not be necessary from the LLFA or IDB.

Surface Water Discharge to Sewer

5.2.6 As described above, draining to ground is feasible as per the existing scenario and therefore a connection to the public surface water sewer is not required

5.3 Surface Water Discharge

5.3.1 The Scheme will be free draining through perimeter gaps around all panels, there will be minimal increase in impermeable area meaning the proposals will not increase surface water risk elsewhere.

5.3.2 As a result of the construction of the solar panels, some rainfall will be intercepted by the surface of the solar panels before reaching ground level. Intercepted rainfall will either run down the face of the panels, due to the angle at which they are positioned, and drip onto the ground below or will be lost due to evaporation from the face of the panels.

5.3.3 Where rainwater drips onto the ground below, the energy of the flow from the surface of the panels is likely to be greater than that of the rainfall (especially where rainwater collects at the bottom edge of the solar array before dripping onto the ground below) which could result in the erosion of ground without appropriate mitigation. The erosion of the ground could then result in the formation of rivulets which could increase the speed of runoff throughout the Site.

5.3.4 In order to mitigate against potential erosion, the existing intensively managed agricultural land will be replaced by planted wildflower and grassland below the solar panels. The planted surface will act as a level spread / energy dissipater to promote low erosivity sheet flow during the operation of the solar farm. The vegetation will be managed organically and will either be mowed or used for light grazing.

5.3.5 The panels forming the solar array will not be tightly compacted and will not form one continuous surface. Small gaps will exist between each panel, which will allow water to drip onto the ground below from several locations rather than as concentrated runoff from the bottom edge. This spread of water dripping will reduce the potential for erosion to occur.

5.3.6 The access track will be designed to be permeable, thereby allowing surface water runoff to percolate into the ground below.

5.3.7 Electrical infrastructure associated with the panels will be sited on concrete pads. The concrete bases will be surrounded by gravel filled filter trenches, constructed to limit the lateral flow of water away from the equipment and replace the loss of natural infiltration caused by the concrete bases themselves. Surface water would be stored within the gravel sub- base prior to infiltrating into the ground as per the existing situation.

5.3.8 Based on the above, the proposed development is likely to provide betterment over the existing surface water runoff regime.

5.3.9 During construction of the proposed Scheme temporary construction lay-down areas will be provided.

5.3.10 It is recommended that temporary drainage measures are implemented within the lay-down areas to ensure there is no increase in surface water runoff as a result of the construction compound.

5.3.11 In addition, construction of the proposed development has the potential to result in the compaction of soils thereby reducing the soil's ability to accept surface water runoff. It is recommended that the movement of large vehicles is limited where possible to proposed access tracks in order to reduce the potential for soil compaction to occur. Vehicles should be fitted with low pressure tyres to further reduce the impact on the underlying soil.

5.3.12 The aforementioned techniques will discourage soil erosion within the scheme, whilst maintaining the existing overland flow paths.

5.4 Event Exceedance

5.4.1 Any surface water runoff in excess of the infiltration capacity of the ground may naturally drain into the surrounding land drains as per the existing scenario.

5.5 Foul Water

5.5.1 Welfare at the Sites is limited to the substations. Given the remote nature of the Scheme and the substations within it, no readily accessible public sewers are understood to be available. Waste water associated with welfare facilities at the substations will be contained in a septic tank to be emptied as and when required by tanker. No direct connection to public sewers is proposed.

6.0 Sequential and Exception Test

6.1 Sequential Test

6.1.1 The solar panels will be mounted on raised frames above surrounding ground level allowing flood water to flow freely underneath. Therefore, there will be no loss of floodplain volume as a result of the proposed development

6.1.2 The proposed development is free draining through perimeter gaps around all panels, allowing for infiltration as existing within the grassland/vegetation surrounding and beneath the panels. There will be minimal increase in impermeable area meaning the proposals will not increase surface water flood risk elsewhere.

6.1.3 Where sensitive electrical equipment such as substations and conversion units have been proposed within the Sites and Sub-Sites, it has been recommended that the structures are sequentially located outside of the 1% AEP + Climate Change extent and/or the 0.1% Annual Probability Surface Water proxy extent. Where this is not possible, the sensitive equipment will be raised 600 mm above the design flood level and designed to be flood resilient in line with best practice guidance.

6.1.4 Associated infrastructure will also be designed to be flood resilient.

6.1.5 Given the above it is considered that the proposals pass the Sequential Test.

6.2 Exception Test

6.2.1 Paragraphs 5.7.12, 5.7.14, 5.7.15, and 5.7.16 of the NPS EN-1 states that the Infrastructure Planning Commission should only consent to development in Flood Zone 3 that has satisfied the exceptions to the application of the Sequential Test.

6.2.2 In accordance with Table 2 of the NPPG: Flood Risk and Coastal Change, 'Essential Infrastructure' developments are considered appropriate in Flood Zones 1, 2 and appropriate in Flood Zone 3 following the appropriate application of the Exception Test.

6.2.3 The Exception Test aims to ensure that more vulnerable property types are not allocated to areas at high risk of flooding. For the Exception Test to be passed it must be demonstrated that:

A. the development would provide wider sustainability benefits to the community that outweigh flood risk, and

B. the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

6.2.4 With reference to point (a) above, the proposed development will positively contribute to wider sustainability benefits. The UK is legally bound through the Climate Change Act (2008) to cut greenhouse gas emissions by 100% by 2050, compared to 1990 levels..

6.2.5 With reference to point (b) above, this Flood Risk Assessment demonstrates that the Scheme will not increase flood risk elsewhere and the ground beneath the panels will remain entirely permeable, draining as existing. The development may reduce existing greenfield run-off rates by replacing intensive agricultural surfaces with a landcover comprising a mixture of wildflowers and grassland

Annex A – Limitations

Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

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