Burston Solar, Burston Mill, Mill Road, Burston, IP22 5TJ

Flood Risk Assessment and Drainage Strategy

For Zestec Asset Management
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Burston Solar

Project	Flood Risk Assessment and Drainage Strategy
Client	Zestec Asset Management
Status	Final
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EXECUTIVE SUMMARY

The Site would be expected to remain dry in all but the most extreme conditions. The consequences of flooding are acceptable, and the development would be in accordance with the requirements of the National Planning Policy Framework (NPPF). The Proposed Development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The Proposed Development will considerably reduce the flood risk posed to the Site and to off-site locations due to the adoption of a Sustainable Drainage Systems (SuDS) Strategy.

The Proposed Development should not therefore be precluded on the grounds of flood risk or drainage.

1.0 INTRODUCTION

1.1 Background

This Flood Risk and Drainage Strategy (FRA) has been prepared by KRS Enviro at the request of Zestec Asset Management to support a planning application for the development of a solar farm ("the Proposed Development") on land to the rear of the For Farmers industrial unit/ manufacturing plant, Burston Mill, Mill Road, Burston, IP22 5TH ("the Site").

This FRA has been carried out in accordance with guidance contained in the National Planning Policy Framework (NPPF)[1], associated Planning Practice Guidance on flood risk and coastal change[2] (PPG) and the PPG 'Site-specific flood risk assessment checklist (para 068 Reference ID: 7-068-20140306). This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

It is recognised that developments which are designed without regard to flood risk may endanger lives, damage property, cause disruption to the wider community, damage the environment, be difficult to insure and require additional expense on remedial works. The development design should be such that future users will not have difficulty obtaining insurance or mortgage finance, or in selling all or part of the development, as a result of flood risk issues.

1.2 National Planning Policy Framework (NPPF)

One of the key aims of the NPPF is to ensure that flood risk is taken into account at all stages of the planning process; to avoid inappropriate development in areas at risk of flooding and to direct development away from areas of highest risk.

It advises that where new development is exceptionally necessary in areas of higher risk, this should be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall. A risk-based approach is adopted at stages of the planning process, applying a source pathway receptor model to planning and flood risk. To demonstrate this, an FRA is required and should include:

- whether a Proposed Development is likely to be affected by current or future flooding from all sources;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- if necessary, provide the evidence to the Local Planning Authority (LPA) that the Sequential Test can be applied; and
- whether the development will be safe and pass part c) of the Exception Test if this is appropriate.

The report findings are based upon professional judgement and are summarised below with detailed recommendations provided at the end of the report. The report includes rainfall data

[1] Ministry for Housing, Communities and Local Government (2021) National Planning Policy Framework: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1005759/NPPF_July_2021.pdf

[2] Communities and Local Government (2014) Planning Practice Guidance - Flood Risk and Coastal Change: https://www.gov.uk/guidance/flood-risk-and-coastal-change

from the Flood Estimation Handbook (FEH) and hydrogeological information from the British Geological Survey (BGS). The assessment will summarise and refer to these datasets in the text.

1.3 Report Structure

This FRA has the following report structure:

- Section 2 describes the location and the existing and Proposed Development;
- Section 3 outlines the flood risk to the existing and Proposed Development;
- Section 4 details the proposed surface water drainage for the Site and assesses the potential impacts of the Proposed Development on surface water drainage;
- Section 5 details the Sequential and Exception Tests; and
- Section 6 presents a summary and conclusions.

2.0 LOCATION & DEVELOPMENT DESCRIPTION

2.1 Site Location

The Site is located on land to the rear of the For Farmers industrial unit/ manufacturing plant Burston Mill, Mill Road, Burston, IP22 (see Figure 1). The National Grid Reference (NGR) of the Site is 613657, 283829.

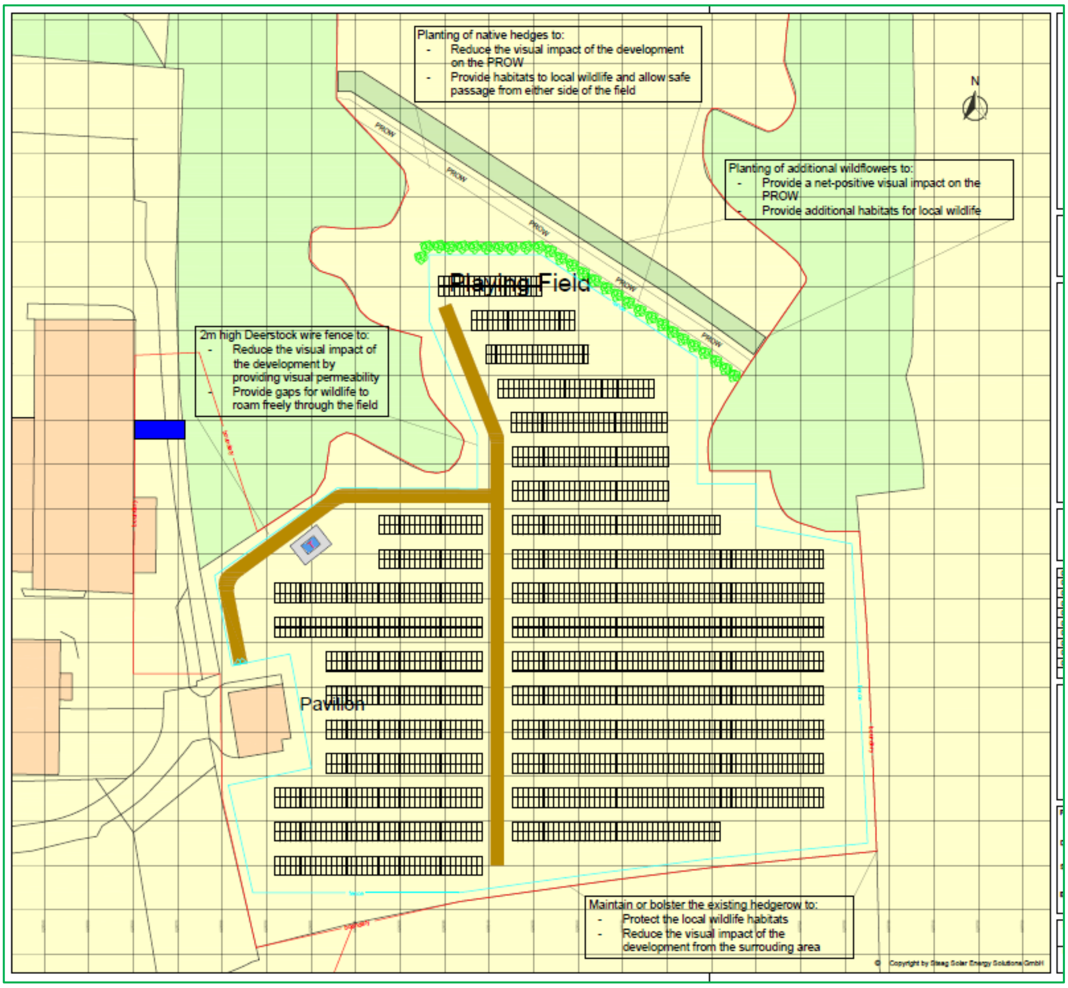

Figure 1 - Site Location

2.2 Existing Development

The existing Site is currently recreational land.

2.3 Proposed Development

The Proposed Development is for a solar farm and associated infrastructure (see Appendix 2). Further details with regard to the Proposed Development can be found in the accompanying information submitted with the planning application.

2.4 Ground Levels

The Site is relatively flat with an approximate ground level of 40 metres Above Ordnance Datum (mAOD).

2.5 Catchment Hydrology / Drainage

There is a watercourse located approximately 400m to the south west of the Site. There are no other watercourses located in the vicinity of the Site.

2.6 Ground Conditions

The British Geological Survey (BGS) map shows that the bedrock deposits consist of Lewes Nodular Chalk, Seaford Chalk, Newhaven Chalk, Culver Chalk and Portsdown Chalk Formations - chalk. Sedimentary bedrock formed between 93.9 and 72.1 million years ago during the Cretaceous period. The superficial deposits underlaying the Site consist of Lowestoft Formation - diamicton. Sedimentary superficial deposit formed between 480 and 423 thousand years ago during the Quaternary period.

Information from the National Soil Resources Institute details the Site area as being situated on slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils.

2.7 Source Protection Zone

The Site is not located within a Source Protection Zone (SPZ). SPZ's have been defined by the Environment Agency around major public water supplies with the intent to show the risk of contamination from any activities that might cause pollution in the area. Three zones are defined: SPZ 1 is the Inner Zone (highest risk); SPZ 2 is the Outer Zone (average risk); and SPZ 3 is the Total Catchment (least risk).

2.8 Contaminated Land

We are not aware of any historical industrial land use. Further investigation would be required to confirm this. The client has not provided information to suggest the potential for contamination within the Site boundary from past land uses.

3.0 FLOOD RISK

3.1 Sources of Flooding

All sources of flooding have been considered, these are; fluvial (river) flooding, tidal (coastal) flooding, groundwater flooding, surface water (pluvial) flooding, sewer flooding and flooding from artificial drainage systems/infrastructure failure.

3.2 Historic Flooding

Environment Agency data shows that the Site has not historically flooded. There are no records of anecdotal information of flooding at the Site including within the British Hydrological Society "Chronology of British Hydrological Events". No other historical records of flooding for the Site have been recorded. Therefore, it has been concluded that the Site has not flooded within the recent past.

3.3 Existing and Planned Flood Defence Measures

Environment Agency data confirms that the Site is not protected against flooding by existing flood defence measures.

3.4 Environment Agency Flood Zones

A review of the Environment Agency's Flood Zones indicates that the Site is located within Flood Zone 1 and therefore has a 'low probability' of flooding as shown in Figure 2, with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). Th

The Flood Zones are the current best information on the extent of the extremes of flooding from rivers or the sea that would occur without the presence of flood defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development. They show the worst-case scenario.

The Environment Agency Flood Zones and acceptable development types are explained in Table 1. Table 1 shows that all development types are generally acceptable in Flood Zone 1.

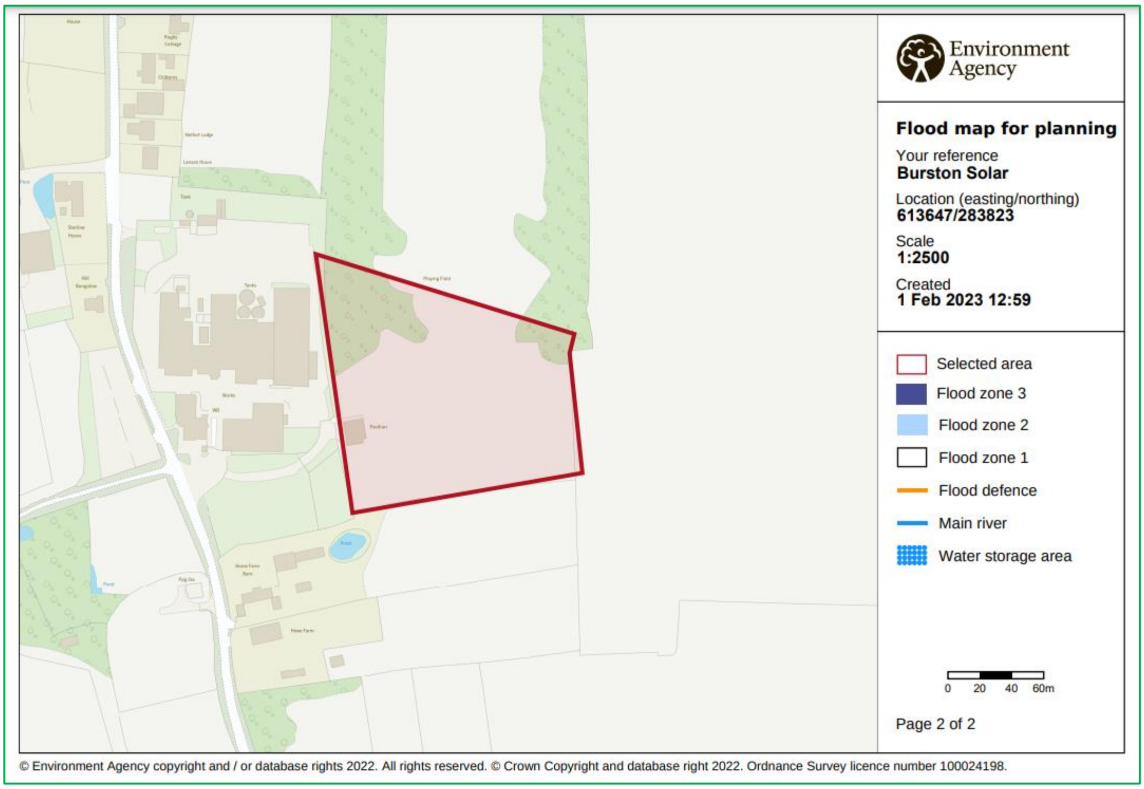

Figure 2 - Environment Agency Flood Zones

Table 1 - Environment Agency Flood Zones and Appropriate Land Use

Flood Zone	Probability	Explanation	Appropriate Land Use
Zone 1	Low	Less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%)	All development types generally acceptable
Zone 2	Medium	Between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% 0.1%) in any year	Most development type are generally acceptable
Zone 3a	High	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	Some development types not acceptable
Zone 3b	'Functional Floodplain'	Land where water has to be flow or be stored in times of flood. SFRAs should identify this zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1% flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes)	Some development types not acceptable

3.5 Flood Vulnerability

In the Planning Practice Guidance to the NPPF, appropriate uses have been identified for the Flood Zones. Applying the Flood Risk Vulnerability Classification in the Planning Practice Guidance to the NPPF, the proposed use is classified as 'essential infrastructure'. Table 2 of this report and the Planning Practice Guidance to the NPPF states that 'essential infrastructure' uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA.

Table 2 - Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	×	Exception test required	✓
Zone 3b 'Functional Floodplain'	Exception test required	✓	×	×	×

***Key:** ✓: Development is appropriate, ×: Development should not be permitted.*

3.6 Climate Change

Projections of future climate change, in the UK, indicate more frequent, short-duration, high intensity rainfall and more frequent periods of long duration rainfall. Guidance included within the NPPF recommends that the effects of climate change are incorporated into FRA's. Recommended precautionary sensitivity ranges for peak rainfall intensities and peak river flows are outlined in the flood risk assessments: climate change allowances guidance[3]. As per Environment Agency guidance, the anticipated lifetime of the development is deemed to be 60 years. Table 3 shows peak river flow allowances by river catchment.

The flood risk assessments: climate change allowances guidance recommends that for 'essential infrastructure' uses in Flood Zone 1 that the central allowances are used. Therefore, the design flood level for the Site is the 1 in 100 year (+11%) event.

Table 3 - Peak River Flow Allowances

Catchment	Allowance Category	2020s	2050s	2080s
Broadland Rivers Management Catchment	Upper	+27%	+27%	+44%
	Higher	+14%	+10%	+20%
	Central	+8%	+3%	+11%

3.7 Fluvial (River) Flooding

The Site will not be inundated with floodwater for all events up to and including the 1 in 100 year (+11%) and 1 in 1000 year events. The Site will be flood free during the 1 in 100 year (+11%)

[3] https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances#high-allowances

and 1 in 1000 year events. The Site is not located within the vicinity of fluvial flooding sources and the risk of fluvial flooding is considered to be not significant.

3.8 Tidal (Coastal) Flooding

The Site is not located within the vicinity of tidal flooding sources and the risk of tidal flooding is considered to be not significant.

3.9 Groundwater Flooding

Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

Groundwater flooding tends to occur sporadically in both location and time. When groundwater flooding does occur, it tends to mostly affect low-lying areas, below surface infrastructure and buildings (for example, tunnels, basements and car parks) underlain by permeable rocks (aquifers). Site ground conditions suggest a low potential for groundwater flooding. The risk of flooding from groundwater flooding is considered to be not significant.

3.10 Surface Water (Pluvial) Flooding

The Environment Agency Surface Water flood map shows that the Site has a very low to high risk of surface water flooding (see Figure 6) with a chance of flooding of less than 1 in 1000 years (0.1%) to greater than 1 in 30 years (3.3%). This may result in water depths of less than 300mm and due to a low topographical area through the Site. These areas are located on the north western edge of the Site and would not impact Site infrastructure which would be raised approximately 650mm above ground level.

Given the scale and nature of the Proposed Development and the size and location of the surface water flooding sources it has been concluded that surface water flooding poses a low flood risk to the Site and the risk of surface water flooding is considered to be of low significance.

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Figure 3 - Environment Agency Surface Water Flood Map

3.11 Sewer Flooding

Sewer flooding occurs when urban drainage networks become overwhelmed and maximum capacity is reached. This can occur if there is a blockage in the network causing water to back up behind it or if the sheer volume of water draining into the system is too great to be handled. Sewer flooding tends to occur sporadically in both location and time such flood flows would tend to be confined to the streets around the development. Flood flows could also be generated by burst water mains, but these would tend to be of a restricted and much lower volume than weather generated events and so can be discounted for the purposes of this assessment. There are no public sewers located within the vicinity of the Site therefore, the risk of flooding from sewer flooding is considered to be not significant.

3.12 Flooding from Artificial Drainage Systems/Infrastructure Failure

There are no other nearby artificial water bodies, reservoirs, water channels and artificial drainage systems that could be considered a flood risk to the Site. The Environment Agency Reservoir flood map shows that the Site is not at risk of flooding from reservoir failure (see Figure 4). This map shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. The risk of flooding from artificial drainage systems/infrastructure failure is considered to be not significant.

Figure 4 - Environment Agency Reservoir Flood Map

3.13 The Effect of the Development on Flood Risk

The Site is located within Flood Zone 1 therefore, the Proposed Development will have no impact on flood risk and the overall direction of the movement of water will be maintained within the developed Site and surrounding area. There will no net loss in flood storage capacity. The conveyance routes (flow paths) will not be blocked or obstructed. The topography of the Site will not be altered; therefore, the overland flow routes will not be altered.

3.14 Summary of Site Specific Flood Risk

A summary of the sources of flooding and a review of the risk posed by each source at the Site is shown in Table 4.

The Site is not at risk of flooding from a major source (e.g. fluvial and/or tidal). The Site has a 'low probability' of fluvial/tidal flooding as the Site is located within Flood Zone 1 with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). A secondary flooding source has been identified which may pose a low significant risk to the Site. This is:

- Surface Water Flooding

The flooding source will only inundate the Site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the Proposed Development Site.

There will no net loss in flood storage capacity or impact on movement of floodwater across the Site. The overall direction of the movement of water will be maintained within the developed Site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed.

The proposed use of the Site is 'essential infrastructure', 'essential infrastructure' uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA. In conclusion, the flood risk to the Site can be considered to be limited; the Site is situated in Flood Zone 1, with a low or less annual probability of flooding and from all sources. The Site is unlikely to flood except in very extreme conditions.

Table 4 - Risk Posed by Flooding Sources

Sources of Flooding	Potential Flood Risk	Potential Source	Probability/Significance
Fluvial Flooding	No	None Reported	None
Tidal Flooding	No	None Reported	None
Groundwater Flooding	No	None Reported	None
Surface Water Flooding	Yes	Low Spots	Low
Sewer Flooding	No	None Reported	None
Flooding from Artificial Drainage Systems/Infrastructure Failure	No	None Reported	None

4.0 SURFACE WATER DRAINAGE

4.1 Surface Water Management Overview

It is recognised that consideration of flood issues should not be confined to the floodplain. The alteration of natural surface water flow patterns through developments can lead to problems elsewhere in the catchment, particularly flooding downstream. For example, replacing vegetated areas with roofs, roads and other paved areas can increase both the total and the peak flow of surface water runoff from the Site. Changes of land use on previously developed land can also have significant downstream impacts where the existing drainage system may not have sufficient capacity for the additional drainage.

An assessment of the surface water runoff rates has been undertaken, in order to determine the surface water options and attenuation requirements for the Site. The assessment considers the impact of the proposals compared to current conditions. Therefore, the surface water attenuation requirement for the developed Site can be determined and reviewed against existing arrangements.

The requirement for managing surface water runoff from developments depends on the pre-developed nature of the Site. If it is an undeveloped greenfield site, then the impact of the proposals will need to be mitigated so that the runoff from the Site replicates the natural drainage characteristics of the pre-developed Site. The surface water drainage arrangements for any site should be such that the volumes and peak flow rates of surface water leaving a site are no greater than the rates prior to the Proposed Development unless specific off-site arrangements are made and result in the same net effect.

It should be acknowledged that the satisfactory collection, control and discharge of surface water runoff are now a principle planning and design consideration. This is reflected in recently implemented guidance and the National Sustainable Drainage Systems (SuDS) Standards. It is necessary to demonstrate that the surface water from the proposals can be discharged safety and sustainably.

4.2 Surface Water Runoff Rate/Volume

The proposed PV modules will consist of an aluminium frame, with stainless steel supports and concrete shoes. Greenfield conditions will be retained as alluded to in the BRE Planning Guidance for the Development of Large Scale Ground Mounted Solar PV Systems[4]. Although the solar panels will divert the downward path of falling rain, being raised off the ground on frames, they will not reduce the permeable area where they are sited. Any rainfall that does fall onto the Site will, as now, infiltrates into the soil substrate. The flow path over the PV modules is shown in Figure 5.

It is anticipated that rain falling on each of the solar PV modules will fall underneath the down-slope of the panels. A gap of approximately 20mm will allow water to drain off each PV module (the 20mm gap surrounds all sides of the panels) (see Figure 6). Tussock grasses will dominate around and beneath the photovoltaic panels to limit soil erosion caused by runoff from the panels.

The erection of the solar panels will require the use of light machinery. Care will be taken during the construction to limit the cultivation and disturbance of the ground by plant movement and exposure of soil. However, it is anticipated that this would not lead to irreversible compaction of soils on the Site. However, no work will be undertaken until a perimeter wide cross-contour vegetated swale is constructed around the downstream boundary of the Site

[4] BRE (2013) Planning Guidance for the development of large-scale ground mounted solar PV systems.

which will be along the south and south eastern boundaries of the Site. Therefore, infiltration should not be limited by compaction of soils swales are constructed to intercept flows and will limit the impacts to the nearby watercourse and surrounding agricultural land. The land on the Site can continue to be used for agricultural purposes (sheep grazing or similar) or for biodiversity enhancement following installation of the panels.

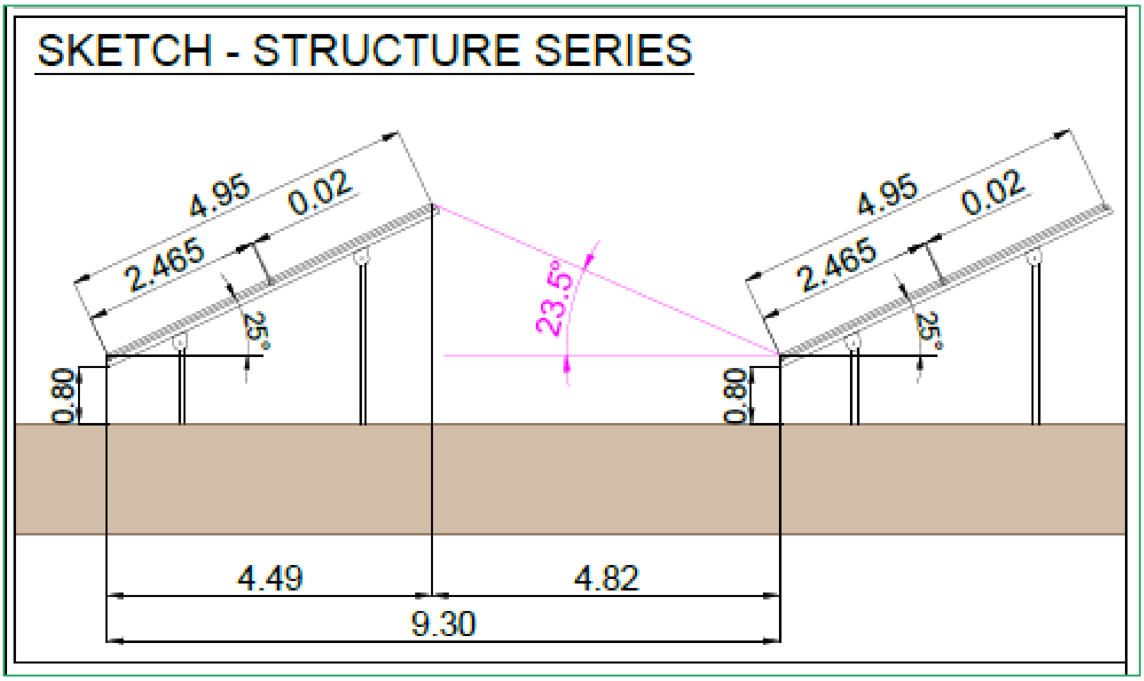


Figure 5 - Flow Paths over PV modules

The proposed inverter/transformers, grid connection and substation structures will be constructed from impermeable surfaces however, these will stand on an area of permeable surfaces. The inverter are positioned on legs raised above the base. The cabin plinths will be founded on concrete pads surrounded by permeable surfaces. Filter strips will be constructed to surround the concrete bases of these ancillary buildings/structures to capture any runoff from the roofs, which in turn will be conveyed to the wide cross-contour perimeter swale around the downstream boundary of the Site.

The proposed access tracks that will be used to service the inverter units will be constructed from permeable material. This will ensure that the access tracks remain permeable allowing surface water to infiltrate into the soil substrate therefore, the access tracks will not result in an increase in the impermeable area. In order to manage any surface water exceedance from the permeable tracks, swales will be incorporated to convey the water to the cross-contour perimeter swale at the downstream boundary of the Site in order to maintain downstream/downslope water quality.

There should, therefore, be no perceivable changes to the upstream or downstream hydrology and to flood risk as a result of the proposals. In terms of surface water runoff, the proposals will not increase the impermeable area on the Site, as the size of the inverter house and PV modules are considered to be negligible in the context of the Site areas. Therefore, there will be no perceivable changes to the upstream or downstream hydrology and flood risk as a result of the Proposed Development.

Figure 6 - Typical View of Arrays with Joints which Distribute Runoff

It is generally accepted that the presence of solar panels on a site may slightly change the pattern of runoff with the potential for minor erosion at the base of the panels. There is empirical evidence of the effect of solar development, a recent research paper[5] found that, with well-maintained grass underneath the panels, the solar panels themselves did not have a significant impact on the runoff volumes, peaks or time to peak. Their analysis did find that, with bare ground or gravel cover beneath the panels as a result of design decisions or lack of maintenance, peak discharge may increase resulting in the need for stormwater management.

Natural England has provided guidance on solar parks in the form of Technical Information Note (TIN) 101, although TIN101, it provides useful information. This guidance provides an overview of the potential effects and possible mitigation measures for soil erosion and increased runoff, amongst others. TIN101 states that *"The key to avoiding increased run-off and soil into watercourses is to maintain soil permeability and vegetative cover. Permeable land surfaces underneath and between panels should be able to absorb rainfall as long as they are not compacted and there is some vegetation to bind the soil surface."*

TIN101 concludes that *"the risks of run-off and soil erosion are lowest on low gradient land with cohesive soils and highest on dry, sandy and steeply sloping soil surfaces";* this highlights the effect of slope on runoff rates and soil erosion. Furthermore, the slope aspect of the land can also have an effect on runoff rates and soil erosion. The aspect of the solar panels will always be south-facing (in the UK) and, therefore, north or south facing slopes will result in runoff flowing in a parallel direction to that of the runoff from the panels thereby remaining relatively diffuse and unlikely to result in concentrated flows that could cause soil erosion, apart from where very steep slopes occur.

The Proposed Development is considered to have a relatively low gradient, with south- facing slope. A tussock grassed surface will be maintained at the Site to reduce the likelihood of overland flow or soil erosion occurring which, based on this assessment, is considered to be low.

Any local erosion which might result from this trend will be mitigated by the thick sward of tussocky grass germinated both beneath and between the panels and its regime of regular maintenance and therefore, there will be no increase in flood risk off the Site.

As there is no history of surface water flooding at the Site it is likely that the current drainage system is sufficient for the current and proposed use. The surface water runoff will not increase

[5] Cook and McCuen (2013) Hydrologic Response to Solar Farms, pg 536-541, Journal of Hydrologic Engineering, ACSE, May 2013.

post-application compared to pre-application and there will be no increase in surface water flood risk to the Site and off-site locations. No changes to the current surface water network are proposed. Following development, surface water flows from the Site will continue to discharge to the ground.

4.3 Surface Water Management During Construction

The surface water management during construction will include the following measures:

- Soil management practices to reduce runoff
- Erosion and sediment control
- No works undertaken until a wide perimeter cross-contour vegetated swale is constructed around the downstream boundaries of the Site.

The limits of topsoil stripping will be minimised at the Site to reduce Site runoff volumes. Preserving the quantity and quality of the Site topsoil is critical to preserving the Site runoff rates both during and after construction and to promote stabilisation vegetation establishment. Topsoil stripping will be limited to the areas necessary for access road and construction and for the creation of temporary laydown areas, as required. All stripped topsoil must remain on the Site and be reused for landscaping or restoration.

All access tracks and the compound area will be constructed using permeable granular materials. Vehicular movements will be restricted to the access tracks and designated areas where possible to avoid or limit soil compaction, which could have a detrimental impact on infiltration rates.

Erosion and Sediment Control Measures

The various construction activities required to construct the Proposed Development include minor grading activities and general construction traffic. If left unmitigated, these activities will result in impacts ranging from disturbance of soils to potential erosion and sediment transport to off-site locations.

Erosion control will be achieved primarily by:

- Managing disturbed soils using soil conservation practices to reduce runoff and sediment transport during construction.
- Constructing barriers to filter runoff.
- A construction entrance feature ("mud mat") will be provided at the Site entrance to minimise the off-site transport of sediment via construction vehicles.
- The access road will be cleaned of any sediment deposited by Site construction traffic.
- Stabilise topsoil stockpiles expected to be left in place longer than 30 days with vegetative cover (i.e., hydroseeding) or a rolled erosion control product in the event of unfavourable growing conditions (i.e., during the winter).
- Re-vegetate all disturbed areas where construction is not expected for 30 days with a minimum 50mm of topsoil and hydro-seeding or other stabilizing vegetation / erosion protection measures. If vegetation establishment is not possible, given seasonal restriction or other revegetation limiting factors, the disturbed area should be stabilised against erosion impacts by non-vegetated means such as erosion control blankets.

- In the event of inclement weather or unfavourable terrain for construction, construction best practices, such as temporary rig-mats may be used to prevent disruption of surface soils and vegetative cover by construction vehicles and equipment.

The erosion control measures shall be maintained in good repair during the entire construction period and removed as contributing drainage areas are restored and stabilised.

4.4 Surface Water Management Post Construction

The following design features will reduce the risks from surface water runoff from solar panels by promoting dispersion and infiltration:

- The gap between panels will be sufficient (typically 20 mm) to allow drainage to ground rather than onto adjacent panels.
- The ground surface around and between the frames will be maintained as grass to ensure that bare soil areas are minimised.
- The vegetated gap between rows of frames will be of greater width than that of each row of solar panels.
- Groundcover vegetation will be maintained in good condition in those areas receiving runoff from solar panels.
- Regular inspections and maintenance of the Site will be undertaken to ensure that vegetation cover is adequate and no rivulets are generated.

Runoff is expected to remain dispersed and unlikely to form channels. Broad grass strips around the edge of the array will also act to impede drainage of surface water to field margins. The proposed transformers will be sufficiently small so that measures to attenuate surface water will not be required. The runoff will shed onto the surrounding ground where it will naturally disperse.

Post-development, the land will become managed pasture without seasonal ploughing. Runoff will therefore contain lower silt loads than currently and perimeter grass strips around fields will reduce runoff to drainage ditches. Managed grassland will offer equivalent or better runoff management than the current situation. Over the long-term, runoff from the area occupied by the solar array is likely to be an improvement on present conditions

The proposed PV modules will consist of an aluminium frame, with stainless steel supports and concrete shoes. Greenfield conditions will be retained as alluded to in the BRE Planning Guidance for the Development of Large Scale Ground Mounted Solar PV Systems . Although the solar panels will divert the downward path of falling rain, being raised off the ground on frames, they will not reduce the permeable area where they are sited. Any rainfall that does fall onto the Site will, as now, infiltrates into the soil substrate.

It is anticipated that rain falling on each of the solar PV modules will fall underneath the down-slope of the panels. A gap of approximately 20mm will allow water to drain off each PV module (the 20mm gap surrounds all sides of the panels). The land on the Site can continue to be used for agricultural purposes (sheep grazing or similar) or for biodiversity enhancement following installation of the panels.

4.5 Conclusion

There should be no perceivable changes to the upstream or downstream hydrology and to flood risk as a result of the proposals. In terms of surface water runoff, the proposals will not increase the impermeable area on the Site, as the size of the inverter house and PV modules are considered to be negligible in the context of the Site areas.

Research into the impact of solar farm panels on runoff rates and volumes indicates that solar panels do not have a significant impact on runoff volumes, peak rates or time to peak rates when the ground below the panels is vegetated. Therefore, with well-maintained grass underneath the panels, the solar panels themselves will not have a significant impact on the runoff volumes, peaks or time to peak.

5.0 SEQUENTIAL APPROACH

5.1 Sequential and Exception Tests

The risk-based Sequential Test in accordance with the NPPF aims to steer new development to areas at the lowest probability of flooding (i.e. Flood Zone 1). The Site is located within Flood Zone 1 with a 'low probability' of flooding, with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). Therefore, the Sequential and Exception Tests will not need to be undertaken as part of this planning application.

6.0 SUMMARY AND CONCLUSIONS

6.1 Introduction

This report presents a FRA in accordance with the NPPF for the Proposed Development on land to the rear of the For Farmers industrial unit/ manufacturing plant, Burston Mill, Mill Road, Burston, IP22 5TH ("the Site").

This FRA identifies and assesses the risks of all forms of flooding to and from the development and demonstrates how these flood risks will be managed so that the development remains safe throughout the lifetime, taking climate change into account.

6.2 Flood Risk

The Site is not at risk of flooding from a major source (e.g. fluvial and/or tidal). The Site has a 'low probability' of fluvial/tidal flooding as the Site is located within Flood Zone 1 with less than a 1 in 1000 annual probability of river or sea flooding in any year (<0.1%). A secondary flooding source has been identified which may pose a low significant risk to the Site. This is:

- Surface Water Flooding

The flooding source will only inundate the Site to a relatively low water depth and water velocity, will only last a short period of time, in very extreme cases and will not have an impact on the whole of the Proposed Development Site.

There will no net loss in flood storage capacity or impact on movement of floodwater across the Site. The overall direction of the movement of water will be maintained within the developed Site and surrounding area. The conveyance routes (flow paths) will not be blocked or obstructed.

The proposed use of the Site is 'essential infrastructure', 'essential infrastructure' uses are appropriate within Flood Zone 1 after the completion of a satisfactory FRA. In conclusion, the flood risk to the Site can be considered to be limited; the Site is situated in Flood Zone 1, with a low or less annual probability of flooding and from all sources. The Site is unlikely to flood except in very extreme conditions.

6.3 Surface Water Drainage

The proposed PV modules will consist of an aluminium frame, with stainless steel supports and concrete shoes. Greenfield conditions will be retained as alluded to in the BRE Planning Guidance for the Development of Large Scale Ground Mounted Solar PV Systems. Although the solar panels will divert the downward path of falling rain, being raised off the ground on frames, they will not reduce the permeable area where they are sited. Any rainfall that does fall onto the Site will, as now, infiltrates into the soil substrate.

It is anticipated that rain falling on each of the solar PV modules will fall underneath the down-slope of the panels. A gap of approximately 20mm will allow water to drain off each PV module (the 20mm gap surrounds all sides of the panels). Tussock grasses will dominate around and beneath the photovoltaic panels to limit soil erosion caused by runoff from the panels.

The erection of the solar panels will require the use of light machinery. Care will be taken during the construction to limit the cultivation and disturbance of the ground by plant movement and exposure of soil. However, it is anticipated that this would not lead to irreversible compaction of soils on the Site. However, no work will be undertaken until a perimeter wide cross-contour vegetated swale is constructed around the downstream boundary of the Site.

Therefore, infiltration should not be limited by compaction of soils swales are constructed to intercept flows and will limit the impacts to the nearby watercourse and surrounding agricultural land. The land on the Site can continue to be used for agricultural purposes (sheep grazing or similar) or for biodiversity enhancement following installation of the panels.

The proposed inverter/transformers, grid connection and substation structures will be constructed from impermeable surfaces however, these will stand on an area of permeable surfaces. The inverter are positioned on legs raised above the base. The cabin plinths will be founded on concrete pads surrounded by permeable surfaces. Filter strips will be constructed to surround the concrete bases of these ancillary buildings/structures to capture any runoff from the roofs, which in turn will be conveyed to the wide cross-contour perimeter swale around the downstream boundary of the Site.

The proposed access tracks that will be used to service the inverter units will be constructed from permeable material. This will ensure that the access tracks remain permeable allowing surface water to infiltrate into the soil substrate therefore, the access tracks will not result in an increase in the impermeable area. In order to manage any surface water exceedance from the permeable tracks, swales will be incorporated to convey the water to the cross-contour perimeter swale at the downstream boundary of the Site in order to maintain downstream/downslope water quality.

There should, therefore, be no perceivable changes to the upstream or downstream hydrology and to flood risk as a result of the proposals. In terms of surface water runoff, the proposals will not increase the impermeable area on the Site, as the size of the inverter house and PV modules are considered to be negligible in the context of the Site areas. Therefore, there will be no perceivable changes to the upstream or downstream hydrology and flood risk as a result of the Proposed Development.

6.4 Sequential Approach

The Site is located within Flood Zone 1 with a 'low probability' of flooding, with less than a 1 in 1000 annual probability of river flooding in any year (<0.1%). Therefore, the Sequential and Exception Tests will not need to be undertaken as part of this planning application.

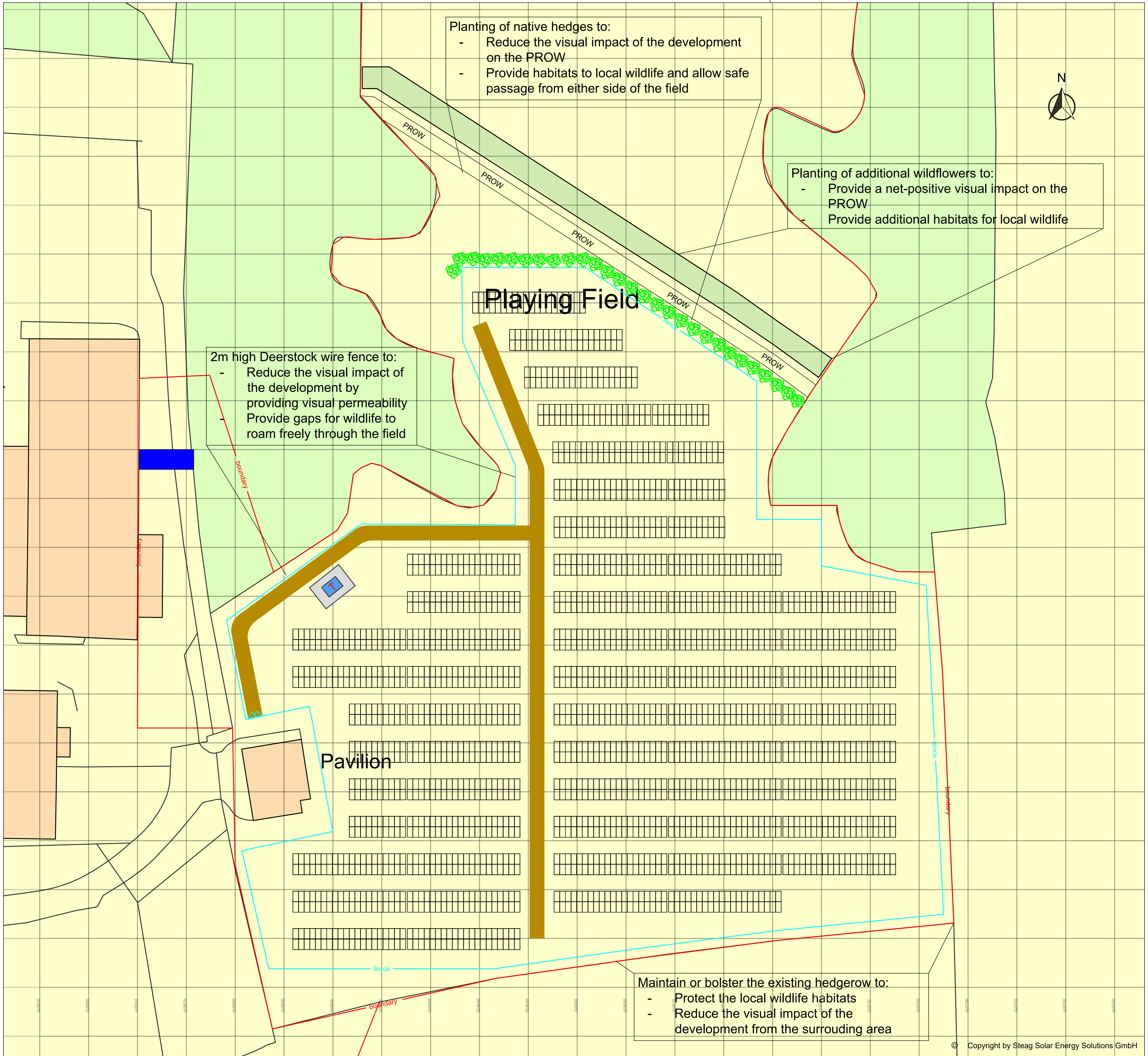
6.5 Conclusion

In conclusion, a solar farm, would be expected to remain dry in all but the most extreme conditions. Providing the recommendations made in this FRA are instigated, flood risk from all sources would be minimised, the consequences of flooding are acceptable and the development would be in accordance with the requirements of the NPPF.

This FRA demonstrates that the Proposed Development would be operated with minimal risk from flooding, would not increase flood risk elsewhere and is compliant with the requirements of the NPPF. The development should not therefore be precluded on the grounds of flood risk.

APPENDICES

APPENDIX 1 – Proposed Site Layout



Legend

- Planning Boundary
- Fence
- Module tables
- LV PVDB Container
- Temporary site road
- Trees/bushes
- Green area
- Gate
- Gantry for AC Cables

Project Notes

Substructure:	TBC
Row distance:	TBC
Inverter:	10no.
PV-Module:	2,200no.
Total PV capacity (DC):	1,199.00 kWp

General Notes

Coordinates:	52°24'38.82"N, 1° 8'23.80"E
Ground level height:	43m
Fence:	approx. 600 m (2m high)
Built-up road, permanent:	N.A
Solar Farm Development Area:	approx. 1.87 ha
Total Lot area:	approx. 8.20 ha

All measurements in metres (m)

Client

Eneco

Project address

Burston Mill,
Mill Road,
Burston,
IP22 5TJ

09			
08			
07			
06			
05			
04			
03			
02			
01	15/12/2022	Updated fence line and TX position	MS/DH
00	09/12/22	First Draft	MS
	Date	Remarks	draw/check

Designed by STEAG Solar Energy Solutions (UK) Limited

SENS
STEAG Solar Energy Solutions
48 Warwick St, City of Westminster
London
W1B 5AW
www.sens-energy.com

Project

ForFarmer Burston

Drawing

Planning Layout

Status

[X] Preliminary [ ] Execution [ ] As-Built

Based

OS MasterMap Topography Layer

Scale	Size	Filename
1:750	A3	221208_BUR_Planning Drawings.dwg
Rev: 01		Plan-ID: LAY-00

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