Cottam Solar Project

Environmental Statement Appendix 10.1:

Annex H – 10.1.7

Flood Risk Assessment and Drainage Strategy – Cottam 3B

Prepared by: Delta-Simons

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Cottam
SOLAR PROJECT

Flood Risk Assessment and Drainage Strategy

Annex H - Cottam 3B

Presented to: Cottam Solar Energy Farm Limited

Issued: December 2022

Delta-Simons Project No: 22-1088.03

Protecting people and planet

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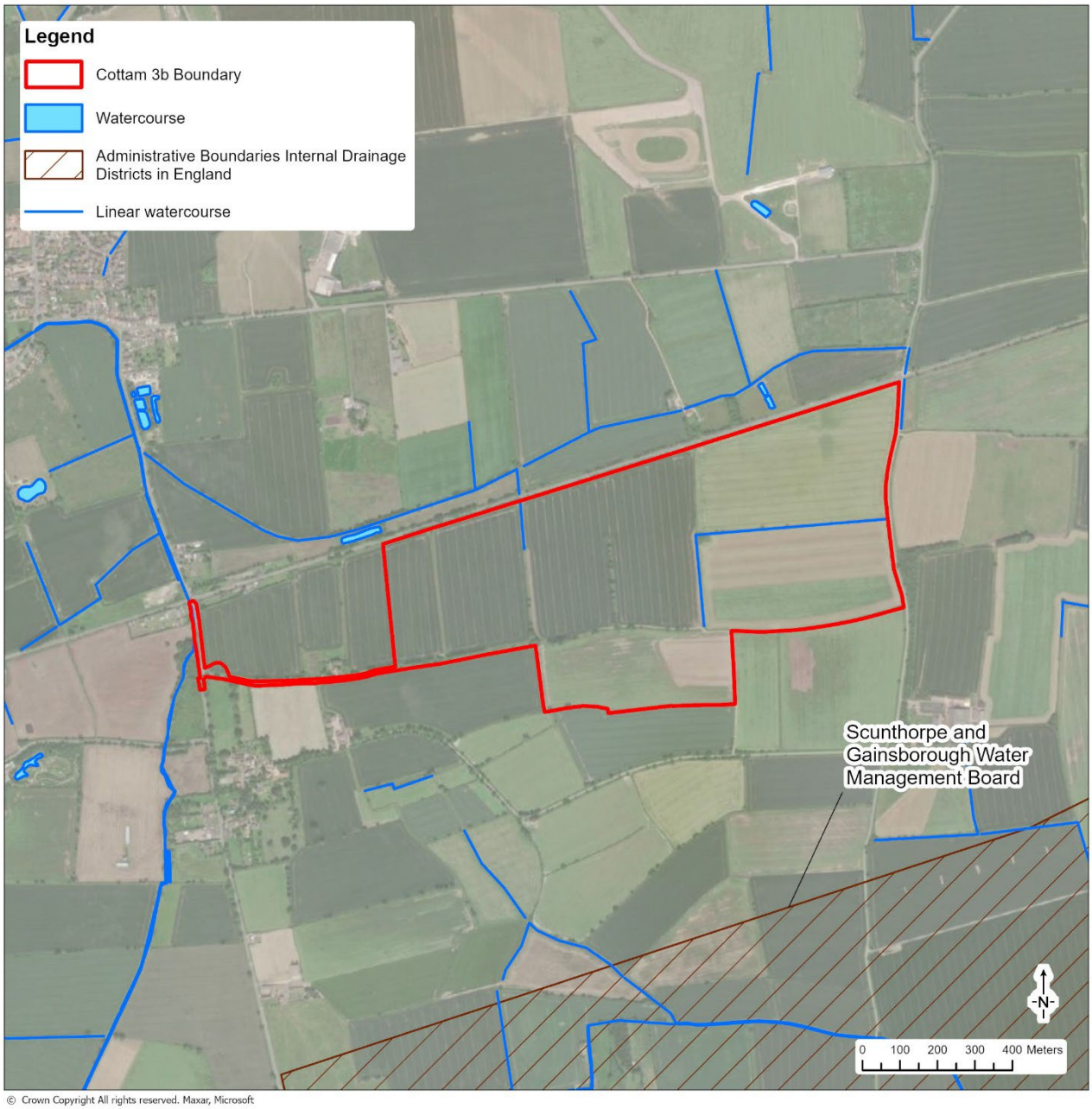
Annexes

1.0 Site Description

1.1.1 The aim of this section of the report is to outline key environmental information associated with the baseline environment.



Site Location Plan	
Co-ordinates	Centred approximately at National Grid Reference (NGR) 487330, 394490.
Site Location	The Cottam 3B site is located approximately 500 m north-east of Pilham, Lincolnshire, 6.5 km north-east of Gainsborough railway station and 7.15 km south-west of Kirton Lindsey railway station.

Existing Site Conditions	Online mapping (including Google Maps / Google Streetview imagery, accessed May 2022) shows that the Site is greenfield comprising agricultural / arable fields. The Site is bordered by a railway line to the north and the B1205 road to the east, with greenfield land lying beyond from all orientations. Access to the Site is provided from Station Road to the west.
Topography	Topographic levels to metres Above Ordnance Datum (m AOD) have been derived from a 1 m resolution Environment Agency (EA) composite 'Light Detecting and Ranging' (LiDAR) Digital Terrain Model (DTM). A review of LiDAR ground elevation data shows that the Site slopes from approximately 25 m AOD in the south-east to approximately 15 m AOD in the north-west. A LiDAR extract is included in Annex B.
Hydrology	The nearest watercourse are the two land drainage ditches located within the Site, located within the northern and eastern extents. There are also land drains along the northern and eastern periphery. Other watercourses in the area include an Ordinary Watercourse approximately 90 m north of the Site which flows east to west. All watercourses mentioned are the responsibility of the Lead Local Flood Authority (LLFA) to maintain.
Water Framework Directive	The Site is located in both the Laughton Drain Catchment (trib of Trent) and Eau from Source to Northorpe Beck Catchment. Both catchments have a Cycle 3 2019 Ecological status of Moderate and a Failing chemical status. A summary of the Water Body Classification for both catchments are included as Annexes C and D.
Geology	Reference to the British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the Site is underlain by superficial deposits of Mid-Pleistocene Till. The superficial deposits are identified as being underlain by Scunthorpe Mudstone Formation consisting of interbedded mudstone and limestone. The geological mapping is available at a scale of 1:50,000 and as such may not be accurate on a Site-specific basis. The closest historical BGS borehole records (BGS Ref: SK89SE14 – 15) available to view are located within the eastern extents of the Site. The borehole records indicate that the area is underlain by clay up to 3.05 and 6.71 m below ground level (bgl) underlain by bands of shale, sand and limestone. The borehole records indicate that groundwater was not encountered during the borehole sampling.
Hydrogeology	According to the EA's Aquifer Designation data, obtained from MAGIC Map's online mapping [accessed 23/05/22], the superficial deposit is classified as a Secondary Undifferentiated Aquifer. Secondary Undifferentiated Aquifers are assigned in 'cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type'. The underlying bedrock deposit is described as a Secondary B Aquifer. Secondary B Aquifers are 'predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such

	as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers'. The EA's 'Source Protection Zones' data, obtained from MAGIC Map's online mapping [accessed 23/05/22], indicates that the Site is not located within a Groundwater Source Protection Zone. The Soilscapes mapping obtained from MAGIC Map's online mapping [accessed 23/05/22] shows the Site to be located in 'slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils'.
Proposed Site Conditions	The proposed development at Cottam 3B is for a ground mounted solar photo-voltaic plant and associated power stations and access roads. An Illustrative Site Layout Plan is included as Annex E.

2.0 Assessment of Flood Risk

2.1 Tidal Flood Risk

2.1.1 The Site is situated inland at a minimum elevation of 15 m AOD. Therefore, the risk from tidal flooding is considered to be **Negligible**.

2.2 Fluvial Flood Risk

Online EA Maps

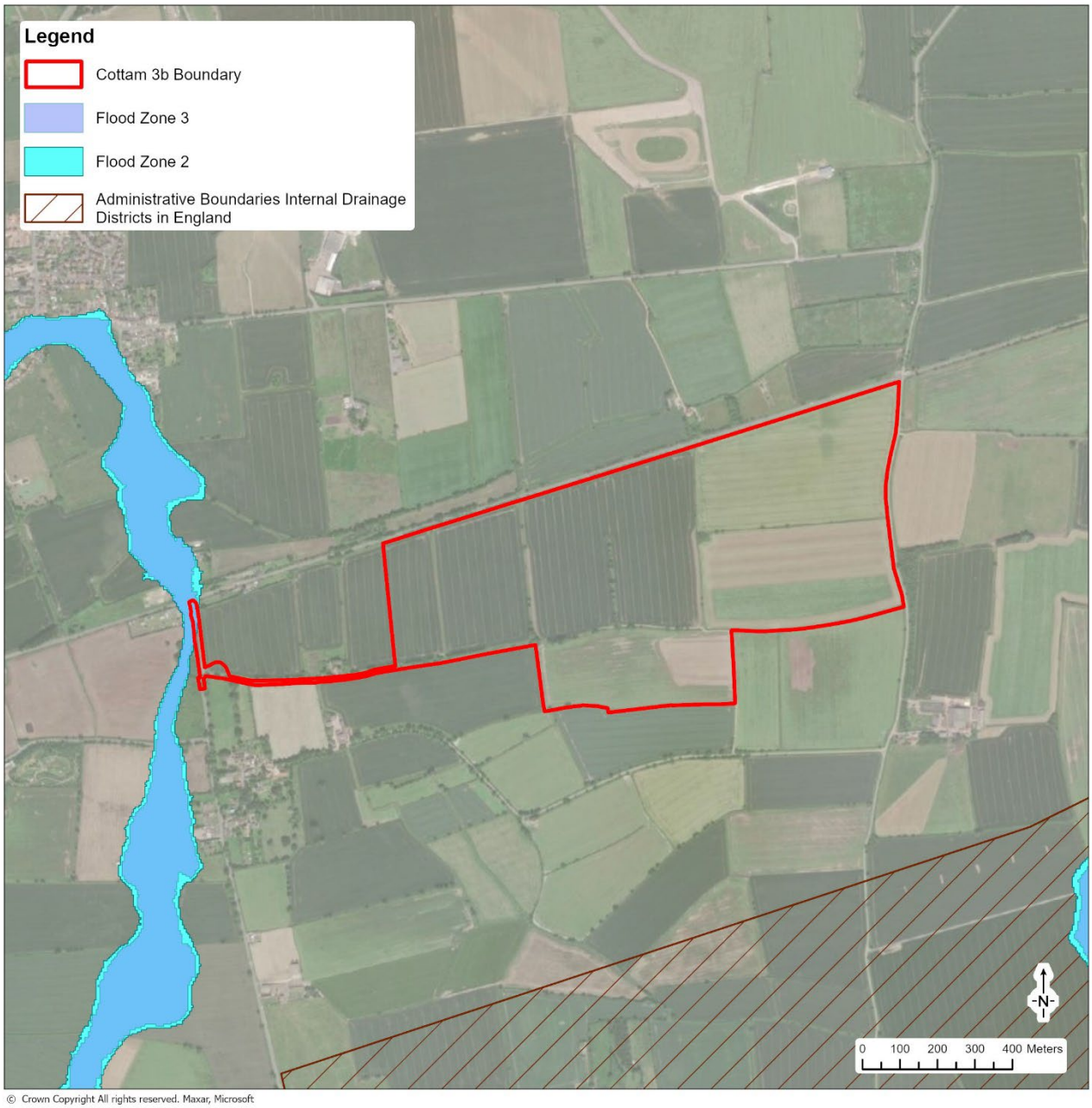


Figure 1: EA's Flood Map for Planning

2.2.1 The nearest watercourse are the two land drainage ditches located within the Site, located within the northern and eastern extents. There are also land drains along the northern and eastern periphery. Other watercourses in the area include an Ordinary Watercourse approximately 90 m north of the Site which flows east to west. All watercourses mentioned are the responsibility of the LLFA to maintain; it is important to note that the Site is not within the Scunthorpe and Gainsborough Water Management Board (an Internal Drainage Board) which is located within close proximity to the Site.

2.2.2 The Site is situated wholly within Flood Zone 1 (Low Probability).

2.2.3 The Site is not included as a study area in the 2009 SFRA and is not considered to be an area at significant risk within the West Lindsey District Council boundary. In addition, the EA could not provide product data for the Site as the Site is not in the vicinity of any Main Rivers, confirming that the Site is in Flood Zone 1.

2.2.4 The Site is also not within a Flood Warning or Flood Alert area. Flood Warnings / Alerts are available for fluvial and tidal events but not from Ordinary Watercourses / surface water / land drains. However, using the EA Long Term Flood Risk Map shown in Figure 2 as a proxy for risk from Ordinary Watercourses / surface water / land drains, flood risk is not shown to affect the Site. Any surface water shown to arise on Site is expected to flow north and south-west, away from the Site and the depth of any ponding is discussed in Section 2.3.2 below.

Summary

2.2.5 It can therefore be concluded that the Site is at **Low** risk of fluvial flooding, therefore no specific mitigation is considered necessary.

2.3 Surface Water Flood Risk

2.3.1 The EA 'Flood Risk from Surface Water' map (Figure 2) indicates that the Site is largely at Very Low risk (<0.1% annual probability) of surface water flooding. However, there are some small areas throughout the Site which are at Low to High risk (0.1 - ≥ 3.3% annual probability) of surface water flooding; these areas are generally confined to the north-east and south-western extents.

Figure 2: EA's Long-Term Flood Risk Map (Flood Risk from Surface Water)

2.3.2 Flood depths are expected to remain below 0.3 during the High and Medium Risk scenarios in all areas excluding the north-eastern extents of the Site, which is expected to reach depths between 0.3 and 0.9 m which appears to be as a result of ponding behind the railway which forms the northern boundary of the Site.

2.3.3 Flooding could potentially occur from a blockage at the inlet of the culvert located at the northern Site boundary where the land drainage ditch is culverted beneath the railway line. However, using the EA Long Term Flood Risk Map as a proxy for the risk of flooding associated with the Land Drain within the Site, the culvert is not indicated to increase the risk of flooding at the Site.

2.3.4 According to Figure 2, there are no distinct flow routes in the area which would direct any potential surface water flooding towards the Site. Flow routes that are associated with the Site direct potential surface flooding south-west, away from the Site. Any shallow depth surface water flooding is predicted to drain naturally into the permeable sands underlying parts of the Site or run off into the surrounding Land Drainage Ditch network as detailed in Section 1.0. There is no information within relevant third party reports to suggest that the Site has experienced historical flooding..

2.3.5 Based on the above and considering the embedded mitigation as part of the inherent design of the solar panels, the overall risk of surface water flooding is considered to be **Low**. The proposed solar panels will be raised above surrounding ground levels and will be appropriately waterproofed thereby reducing the potential to be impacted in the event of surface water flooding.

2.3.6 The impact of the development on surface water risk is covered in Section 5.0 of the Covering Report to ensure that surface water risk is not exacerbated through appropriate SuDS measures.

2.4 Groundwater Flood Risk

2.4.1 As detailed above in Section 1.0, the Site is underlain by superficial deposits of Till. The superficial deposits are shown to be underlain by bedrock deposits of interbedded mudstone and limestone deposits from the Scunthorpe Mudstone Formation.

2.4.2 There is no information within relevant third party reports to suggest that the Site has experienced historical groundwater flooding.

2.4.3 No buildings other than the supporting unstaffed infrastructure and no basement levels are identified on plans which may otherwise be at increased risk from groundwater seepage.

2.4.4 It can therefore be concluded that the risk of groundwater flooding is **Low** and no specific mitigation measures are required.

2.5 Artificial Sources Flood Risk

Sewer Flooding

2.5.1 As the Site is located in a rural location with no nearby developments, it is unlikely that there is a public sewer system present at the Site. However, if there are any local public sewers, any potential flooding arising from them would be directed west away from the Site following local topography. There are no distinct flow routes in the area which would direct any potential flooding towards the Site.

2.5.2 It can therefore be concluded that the risk of sewer flooding is **Low**.

Reservoir and Canal Flooding

2.5.3 There are no canals within the vicinity of the Site. Therefore, the risk from canal flooding is considered to be **Negligible**.

2.5.4 The EA 'Flood Risk from Reservoirs' map shows that the Site is not within the extents of a reservoir breach. The EA states within their Preliminary Flood Risk Assessment for England (dated October 2018) that 'reservoir flooding is extremely unlikely to happen'. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, the EA ensure that reservoirs are inspected regularly, and essential safety work is carried out. It can therefore be concluded that the risk from reservoir flooding is considered to be **Negligible.**

2.6 Summary of Flood Risk

2.6.1 It can be concluded that the risk to the Site from all sources of flooding is **Negligible to Low**, and therefore mitigation is not required in this instance. However, protective measures are proposed to be incorporated as part of the Scheme, which are set out below.

2.7 Embedded Mitigation

2.7.1 8m easements have been established around all watercourses, including Main Rivers and Ordinary Watercourses and 9 m from IDB assets.

2.7.2 Either fixed or tracker panels will be utilised throughout the Sites.

2.7.3 The minimum height of the lowest part of the fixed solar panel units will be 0.6 m above ground level.

2.7.4 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.

2.7.5 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.

2.7.6 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% AEP flood level or where this is not possible as high as practicable.

Flood Warnings and Evacuation

2.7.7 Flood Warnings / Flood Alerts do not cover this area. However, access to the Site will be required relatively infrequently, typically by technicians for maintenance and inspection works or Site management. Such works can be scheduled as to avoid the site during times of flood.

2.8 Residual Risks

2.8.1 A residual risk is an exceedance event, such as the 1 in 1000 year (0.1% AEP) flood event that would overtop the land drains or nearby Ordinary Watercourse and potentially impact the Site. As the probability of a 1 in 1000 year flood event occurring is 0.1% in any given year, the probability is low and, therefore, no further mitigation beyond what is proposed is required.

2.8.2 In the event of the defences failing or an exceedance event occurring, the residual risk to people working within the Site can be managed through the implementation of an appropriate Site management plan, which recognises the residual risks and details what action is to be taken by staff in the event of a flood to put occupants in a place of safety.

2.9 Impact on Off-Site Flood Risk

2.9.1 The solar panels will be mounted on frames and raised above ground level allowing flood water to flow freely underneath. The Site is located in Flood Zone 1; therefore, there will be no loss of floodplain storage or flood flow routes as a result of the proposed development.

2.9.2 Supporting infrastructure including the conversion units are insignificant in size and should not increase flood risk elsewhere.

2.9.3 Surface water management has been considered in Section 5.0 of the Covering Report.

3.0 Conclusions and Recommendations

3.1 Conclusions

3.1.1 The proposed development is for a ground mounted solar farm and associated infrastructure and access roads.

Flood Risk

3.1.2 The EA 'Flood Map for Planning' map shows that the Site is located wholly within Flood Zone 1.

3.1.3 The risk of flooding from all sources has been assessed and the flood risk to the Site is considered to be **Negligible to Low** and therefore does not require Site-specific mitigation measures.

3.1.4 The solar panels will be mounted on raised frames and therefore raised 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.

Drainage Strategy

3.1.5 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.

3.1.6 Any surface water exceeding the infiltration capacity of the surrounding strata will naturally drain to the surrounding Land Drains in line with the existing scenario.

3.1.7 The heavily managed agricultural land will be replaced with grassland. This will help to reduce run off rates by increasing the roughness of the ground, help to increase infiltration by reducing compaction, and improve water quality by reducing erosion and mobilisation of pollutants. As a result, runoff rates may be reduced following development when compared to the existing greenfield scenario.

3.2 Recommendations

3.2.1 The recommendations below have been taken into account in the design of the Illustrative Site Layout:

- 8m easements have been established around all watercourses, including Main Rivers and Ordinary Watercourses and 9 m from IDB assets.
- All service cabling should be designed and installed to be flood resilient / water compatible. This should be achieved in accordance with appropriate design standards and best practise guidance; and
- Locate sensitive electrical equipment in parts of the Site at very low risk of surface water flooding

Annex A – Limitations

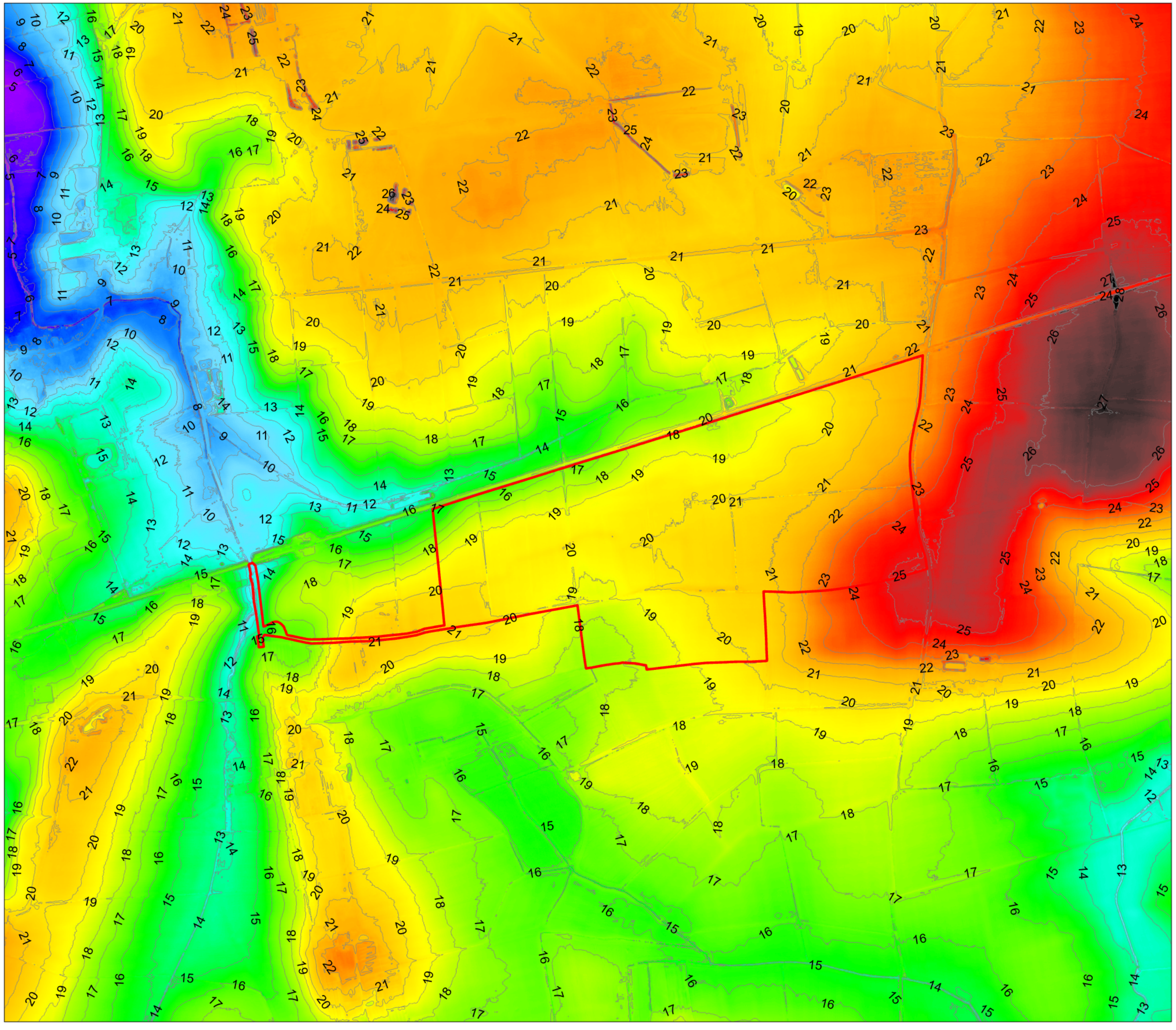
Limitations

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.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

Annex B – LiDAR Plan



Legend

Cottam 3b Boundary

Contours

LiDAR

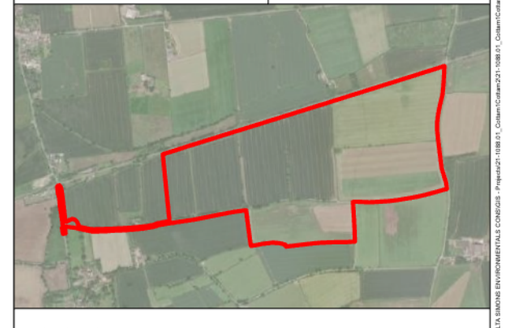
29.45

2.21

0 100 200 300 400 Meters

N

Figure	LIDAR & Contours		
Job	Cottam 3b		
Client	Island Green Power		
Appendix	B	Revision A	Date 03/11/2022
Drawn	BB	Checked EB	Scale 1:10,000 @ A3
Job No.	21-1088.01		Central GR 487082E 394509N



DO NOT SCALE.
NOT FOR CONSTRUCTION.

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Annex C – Laughton Drain Catchment (trib of Trent) EA Water Body Classification Summary

Classification Item	Cycle 2 2016 Classification	Cycle 2 2019 Classification	Cycle 3 2019 Classification	Cycle 3 Objectives		
Ecological	Moderate	Moderate	Ecological	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens; Disproportionately expensive: Unfavourable balance of costs and benefits
Biological quality elements	Moderate	Moderate	Biological quality elements	Moderate	2015	Disproportionately expensive: Disproportionate burdens; Disproportionately expensive: Unfavourable balance of costs and benefits
Invertebrates	Moderate	Moderate	Invertebrates	Moderate	2015	Disproportionately expensive: Unfavourable balance of costs and benefits
Macrophytes and Phytobenthos Combined	Moderate	Moderate	Macrophytes and Phytobenthos Combined	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens

Macrophytes Sub Element	High	High	Physico-chemical quality elements	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Phytobenthos Sub Element	Moderate	Moderate	Acid Neutralising Capacity	Good	2015	
Physico-chemical quality elements	Moderate	Moderate	Ammonia (Phys-Chem)	Good	2015	
Acid Neutralising Capacity	High	High	Dissolved oxygen	Good	2015	
Ammonia (Phys-Chem)	Good	High	N/A	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Biochemical Oxygen Demand (BOD)	High		N/A	Good	2015	
Dissolved oxygen	Moderate	Poor	Phosphate	Good	2015	
Phosphate	Poor	Poor	Temperature	Supports good	2015	
Temperature	High	High	pH	Supports good	2015	
pH	High	High	Hydromorphological Supporting Elements	Good	2015	
Hydromorphological Supporting Elements	Supports good	Supports good	Hydrological Regime	Good	2015	
Hydrological Regime	Supports good	Supports good	Supporting elements (Surface Water)	Not assessed	2015	
Supporting elements (Surface Water)	Good	Good	Mitigation Measures Assessment	Good	2063	Natural conditions: Chemical status recovery time
Mitigation Measures Assessment	Good	Good	Specific pollutants	Good	2063	Natural conditions: Chemical status recovery time

Chemical	Good	Fail	Chemical	Good	2015	
Priority hazardous substances	Does not require assessment	Fail	Priority hazardous substances	Good	2015	
Benzo(a)pyrene		Good	Benzo(a)pyrene	Good	2015	
Dioxins and dioxin-like compounds		Good	Dioxins and dioxin-like compounds	Good	2015	
Heptachlor and cis-Heptachlor epoxide		Good	Heptachlor and cis-Heptachlor epoxide	Good	2015	
Hexabromocyclododecane (HBCDD)		Good	Hexabromocyclododecane (HBCDD)	Good	2015	
Hexachlorobenzene		Good	Hexachlorobenzene	Good	2040	Natural conditions: Chemical status recovery time
Hexachlorobutadiene		Good	Hexachlorobutadiene	Good	2015	
Mercury and Its Compounds		Fail	Mercury and Its Compounds	Good	2063	Natural conditions: Chemical status recovery time
Perfluorooctane sulphonate (PFOS)		Good	Perfluorooctane sulphonate (PFOS)	Good	2015	
Polybrominated diphenyl ethers (PBDE)		Fail	Polybrominated diphenyl ethers (PBDE)	Good	2015	
Priority substances	Does not require assessment	Good	Priority substances	Good	2015	
Cypermethrin (Priority)		Good	Cypermethrin (Priority)	Does not require assessment	2015	
Fluoranthene		Good	Fluoranthene			
Other Pollutants	Does not require assessment	Does not require assessment	Other Pollutants			

Annex D – Eau from Source to Northorpe Beck EA Water Body Classification Summary

Classification Item	Cycle 2 2016 Classification	Cycle 3 2019 Classification	Cycle 3 Objectives		
Ecological	Moderate	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Biological quality elements	Good	Moderate	Good	2015	
Invertebrates	Good	Good	Good	2015	
Macrophytes and Phytobenthos Combined	Good	Moderate	Good	2015	
Physico-chemical quality elements	Moderate	Moderate	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Ammonia (Phys-Chem)	High	Good	Good	2015	
Dissolved oxygen	High	High	Good	2015	
Phosphate	Poor	Poor	Good	2027 - Low confidence	Disproportionately expensive: Disproportionate burdens
Temperature	High	High	Good	2015	
pH	High	High	Good	2015	
Hydromorphological Supporting Elements	Supports good	Supports good	Supports good	2015	
Hydrological Regime	High	High	Supports good	2015	
Supporting elements (Surface Water)	N/A		Not assessed	2015	
Specific pollutants	N/A		Not assessed	2015	
Chemical	Good	Fail	Good	2063	Natural conditions: Chemical status recovery time
Priority hazardous substances	Does not require assessment	Fail	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene		Good	Good	2015	
Dioxins and dioxin-like compounds		Good	Good	2015	
Heptachlor and cis-Heptachlor epoxide		Good	Good	2015	
Hexabromocyclododecane (HBCDD)		Good	Good	2015	
Hexachlorobenzene		Good	Good	2015	

Hexachlorobutadiene		Good	Good	2015	
Mercury and Its Compounds		Fail	Good	2040	Natural conditions: Chemical status recovery time
Perfluorooctane sulphonate (PFOS)		Good	Good	2015	
Polybrominated diphenyl ethers (PBDE)		Fail	Good	2063	Natural conditions: Chemical status recovery time
Priority substances	Does not require assessment	Good	Good	2015	
Cypermethrin (Priority)		Good	Good	2015	
Fluoranthene		Good	Good	2015	
Other Pollutants	Does not require assessment	Does not require assessment	Does not require assessment	2015	

Annex E - Illustrative Site Layout Plan

General Legend	
(red line)	Option Area
(dashed line)	Security Fence
(orange line)	Development Area
(blue hatched bar)	Mounting structure
(black box)	Power Station
(pink hatched bar)	Electrical Substation
(magenta line)	High Voltage Electrical Cable
(brown bar)	Maintenance Track
(green line)	Gate
(cyan line)	PRoW

Project	Cottam 3B PV Solar Farm
Project Location	Land by Station Rd, Blyton, Gainsborough, Lincolnshire, DN21 3LE, England
Ownership	Cottam Solar Project
Document Title	Cottam 3B Layout
Sheet format	A1 "841 x 594"
Scale	1:2500

Document versions			Comments
v. 1	03/02/2022	A.A	Preliminary layout
v. 2	12/05/2022	A.A	Updated layout
v. 3	25/08/2022	A.A	Final layout
v. 4	15/09/2022	A.A	Updated Red Line
v. 5	14/10/2022	A.A	Updated Application Boundary

Company: Island Green Power UK Limited
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0 25 50 100 200