Green Hill Solar Farm
EN010170

Environmental Statement
Appendix 10.4: Flood Risk Assessment and Drainage Strategy Annex C: Green Hill A.2

Prepared by: Arthian

Date: May 2025

Document Reference: APP/GH6.3.10.4

APFP Regulation 5(2)(e)

Appendix 10.4: Annex C - Flood Risk Assessment and Drainage Strategy – Green Hill A.2

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For: Green Hill Solar Farm Ltd

Site: Green Hill A.2

Date: 20/05/2025

Document Ref: 313532

Issue-04

Quality Assurance

Issue Record

Revision	Description	Date	Author	Reviewer	Approver
1.0	First Issue	04/09/2024	GH	LA	JR
2.0	Second Issue	24/10/2024	GH	LA	JR
3.0	Third Issue	11/04/2025	GH	LA	JR
4.0	Fourth Issue for submission of ES Chapter	20/05/2025	GH	IR	JR

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Figures

Annexes

1. Site Details

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

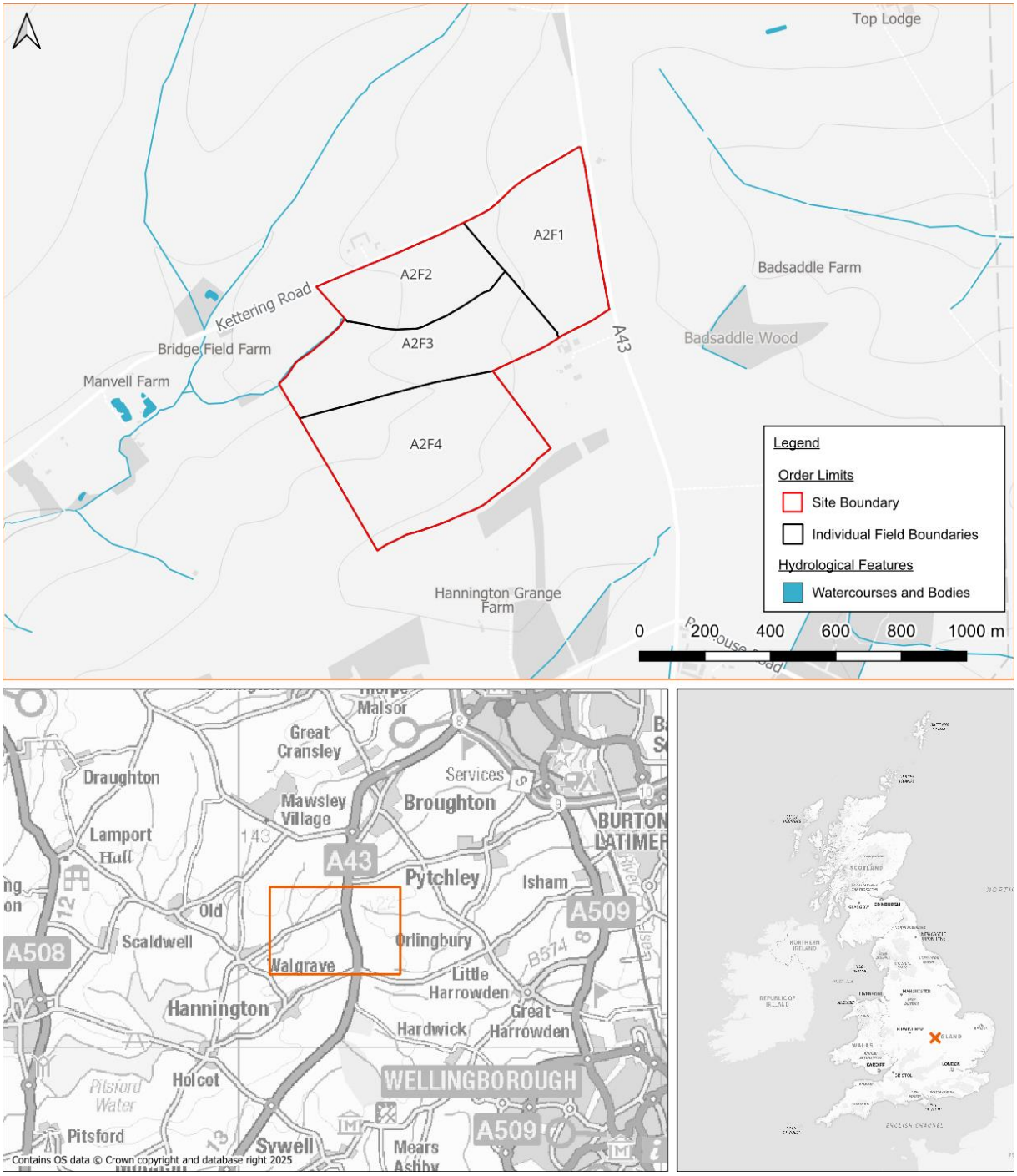


Figure 1: Site Location Plan

1.2 Site Location

1.2.1 Green Hill A.2 is located just east of Walgrave in West Northamptonshire, approximately 6.2km

southwest of Kettering train station, and directly adjacent to the west side of the A43 road. The National Grid Reference for Green Hill A.2 is approximately 482490, 273360 in the northeast to 481870, 272190 in the southwest.

1.3 Existing Site Conditions

1.3.1 Online mapping (including Google Maps / Google Streetview imagery, accessed March 2025)[i] shows that Green Hill A.2 is greenfield, comprising agricultural / arable fields.

1.4 Topography

1.4.1 Topographic levels to metres Above Ordnance Datum (m AOD) have been derived from a 1m 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 134m AOD in the north-east to approximately 110m AOD in the west (Figure 2).

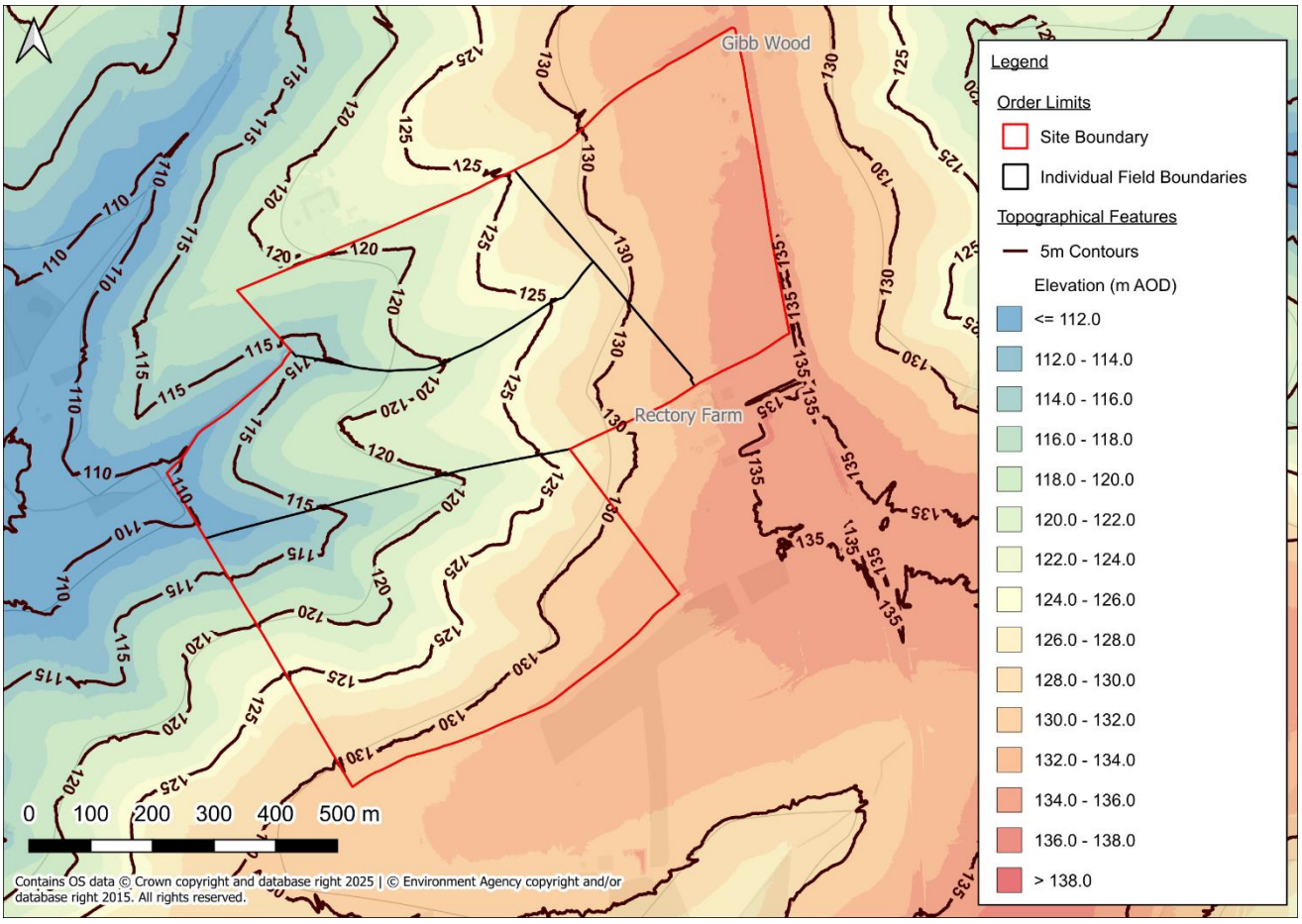


Figure 2: LiDAR Plan

1.5 Hydrology

1.5.1 The nearest EA Main River, which is unnamed, is located approximately 3.5km to the northwest of the Site. Main Rivers are within the jurisdiction of the EA.

1.5.2 There are no watercourses or land drains present within the Green Hill A.2 Site boundary. There is

however a series of land drains in the Green Hill A.2's vicinity with the closest drain positioned adjacent to the north-western border of the Site, connecting to Pittsford Water Reservoir.

1.6 Water Framework Directive Status

1.6.1 Green Hill A.2 is located within the Nene Catchment, specifically the Pitsford Arm of Brampton Branch Water Body and the Pytchley Brook Water Body Catchment[ii]. The Pitsford Arm of Brampton Branch Water Body catchment has a Cycle 3 Ecological status of Good in 2019 and 2022 and Failing chemical status in 2019 (no data in 2022). The Pytchley Branch Water Body Catchment has a Cycle 3 Ecological status of Moderate in 2022 and Failing chemical status in 2022.

1.6.2 A summary of the Water Body Classifications for the catchment is included as Annex A.

1.7 Geology

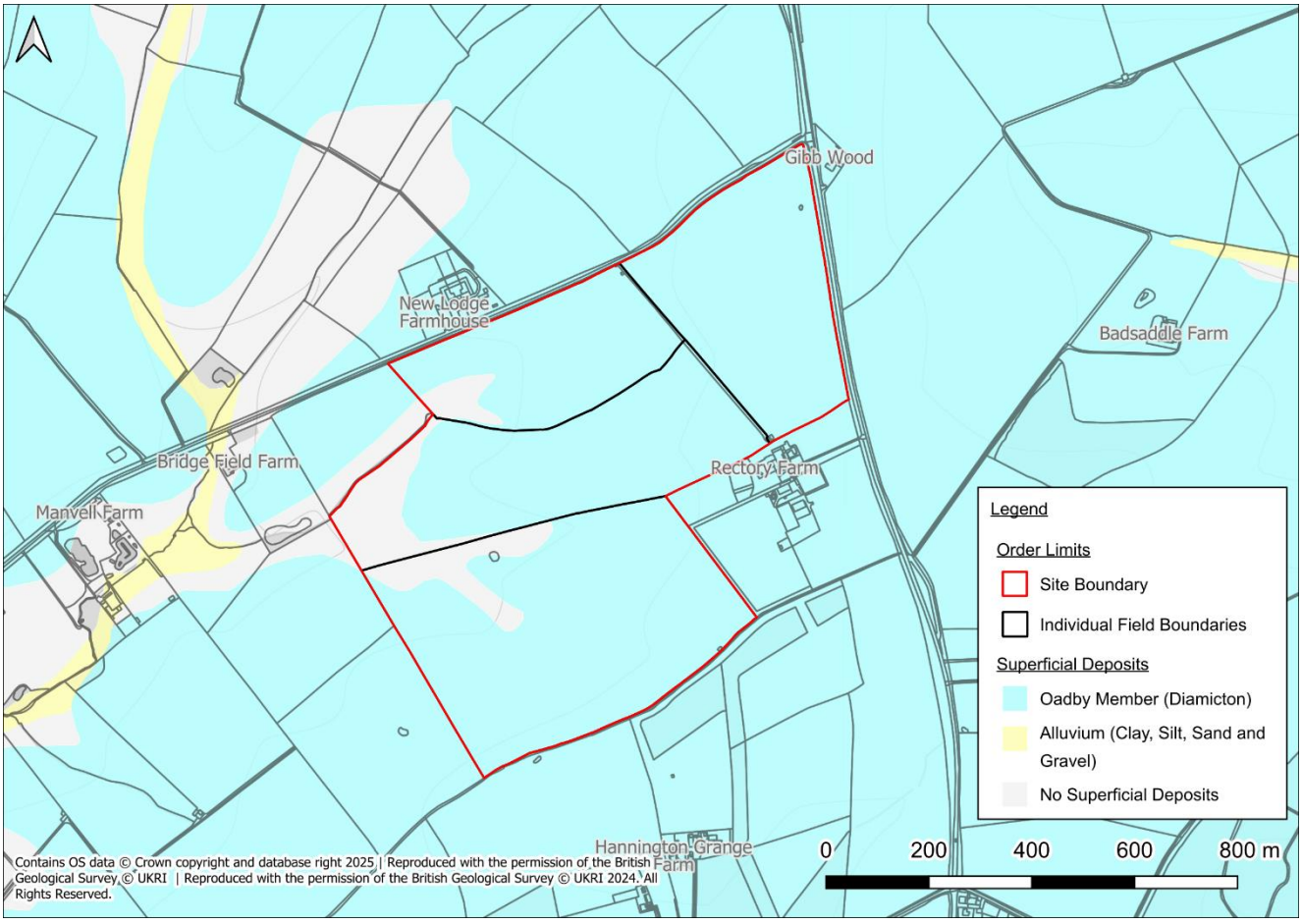


Figure 3: Superficial Deposits

1.7.1 Reference to the British Geological Survey (BGS) online mapping[iii] (1:50,000 scale) indicates that Green Hill A.2 is underlain by the following superficial deposits (see Figure 3 for the locations of the varying deposit):

- Oadby Member generally comprising Diamicton; and
- There are also areas on-Site identified as not being underlain by any superficial deposits.

1.7.2 Green Hill A.2 is identified as being underlain by the following bedrock deposits (see Figure 4 for the locations of the varying deposits):

- Wellingborough Limestone Member generally comprising Limestone and Mudstone;
- Rutland Formation generally comprising Mudstone; and
- Stamford Member generally comprising Sandstone and Siltstone.

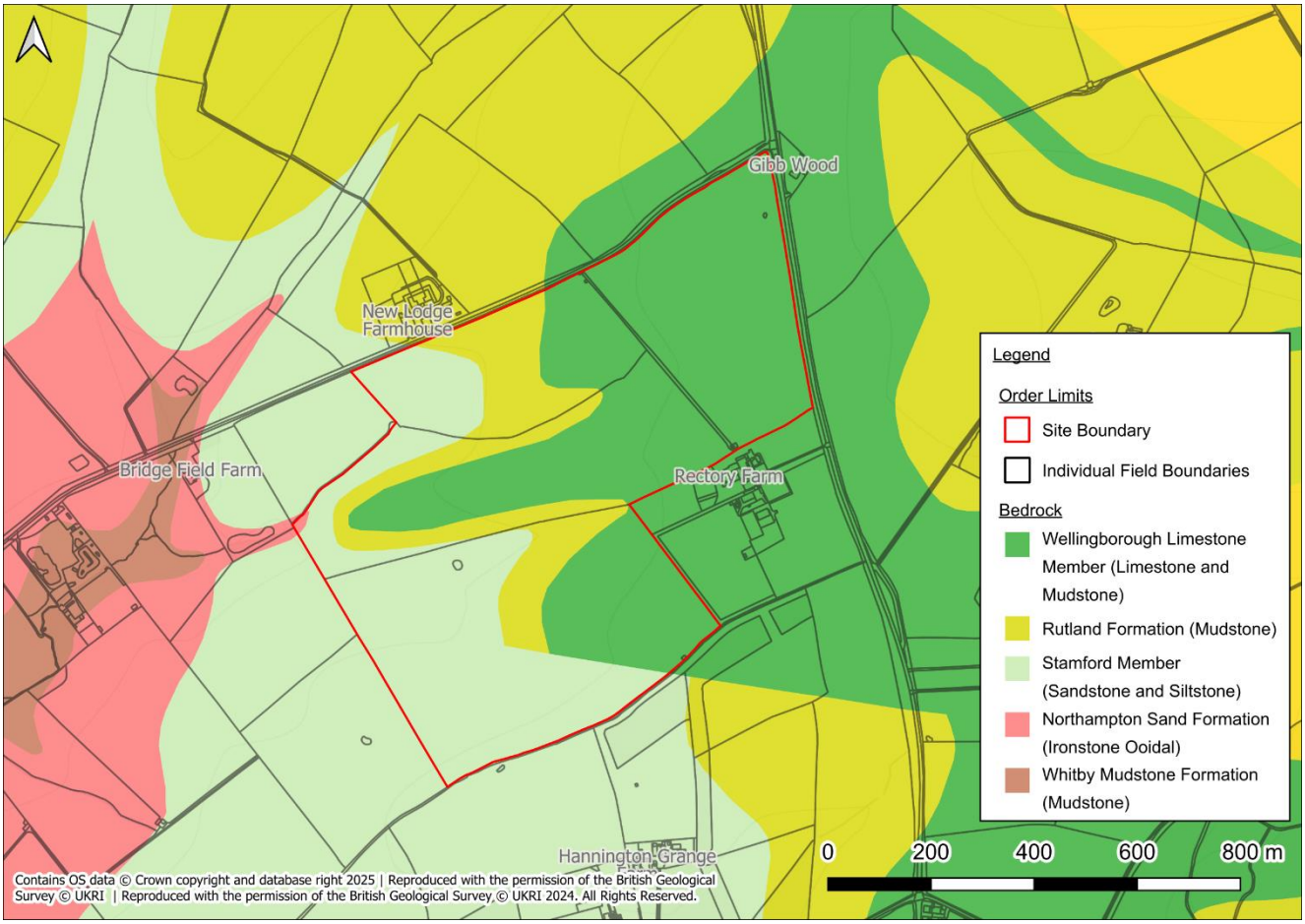


Figure 4: Bedrock Deposits

1.7.3 The geological mapping is available at a scale of 1:50,000 and as such may not be accurate on a Site-specific basis.

1.7.4 The closest historical BGS borehole record (BGS Ref: SP87SW69) is located along the north Site boundary towards the east (NGR 482150, 273110). The borehole record indicates that the following geology was encountered:

- Clay to 1.52m below ground level (bgl);
- Blue Clay from 1.52m to 12.19m (bgl);
- Rock and Clay from 12.19m to 15.24m (bgl);
- Hard Blue Clay from 15.24m to 21.33m (bgl);
- Hard rock from 21.22m to 26.21m (bgl); and

- Sandy Clay and Rock from 26.21m to 28.04m.

1.7.5 A water strike was recorded in this borehole record at a depth of approximately 24.9m bgl.

1.7.6 BGS borehole (Ref: SP87SW69) is located to the north of the Site. Due to the size of the Site the BGS borehole is unlikely to be representative for the Site as a whole.

1.8 Hydrogeology

1.8.1 According to the EA's Aquifer Designation data, obtained from MAGIC Map's online mapping[iv] [accessed 18/10/2024], the Oadby Member is classified as a Secondary (Undifferentiated) Aquifer.

1.8.2 The underlying Wellingborough Limestone Member and Rutland Formation is described as a Secondary A Aquifer; however, the underlying Stamford Member is described as a Secondary B Aquifer.

1.8.3 The EA's 'Source Protection Zones' data, obtained from MAGIC Map's online mapping [accessed 18/10/2024], indicates that the Site is not located within a Groundwater Source Protection Zone.

1.9 Proposed Site Conditions

1.9.1 Green Hill A.2 proposes a ground mounted solar photo-voltaic plant and associated electrical infrastructure and access.

1.9.2 An Outline Landscape and Ecological Management Plan (OLEMP) [EN010170/APP/GH7.4] has been developed to support the DCO application, and details that the vast majority of the Site is proposed to be utilised for solar panels, supporting infrastructure, internal access and peripheral areas will comprise landscaped buffers in line with the embedded mitigation described throughout the ES.

2. Assessment of Flood Risk

The aim of this section of the report is to assess and summarise the existing flood risk at Green Hill A.2.

2.1 Fluvial Flood Risk

2.1.1 There are no watercourses or land drains present within the Green Hill A.2 Site boundary. There is however a series of land drains in the Green Hill A.2's vicinity with the closest drain positioned adjacent to the north-western border of the Site. Based on the local topography, flows within these ditches are expected to move in a south-westerly direction.

2.1.2 Additionally, the Site is located approximately 3.5km south-west of the nearest main river, a distance considered sufficient not to pose a fluvial flood risk to the Site.

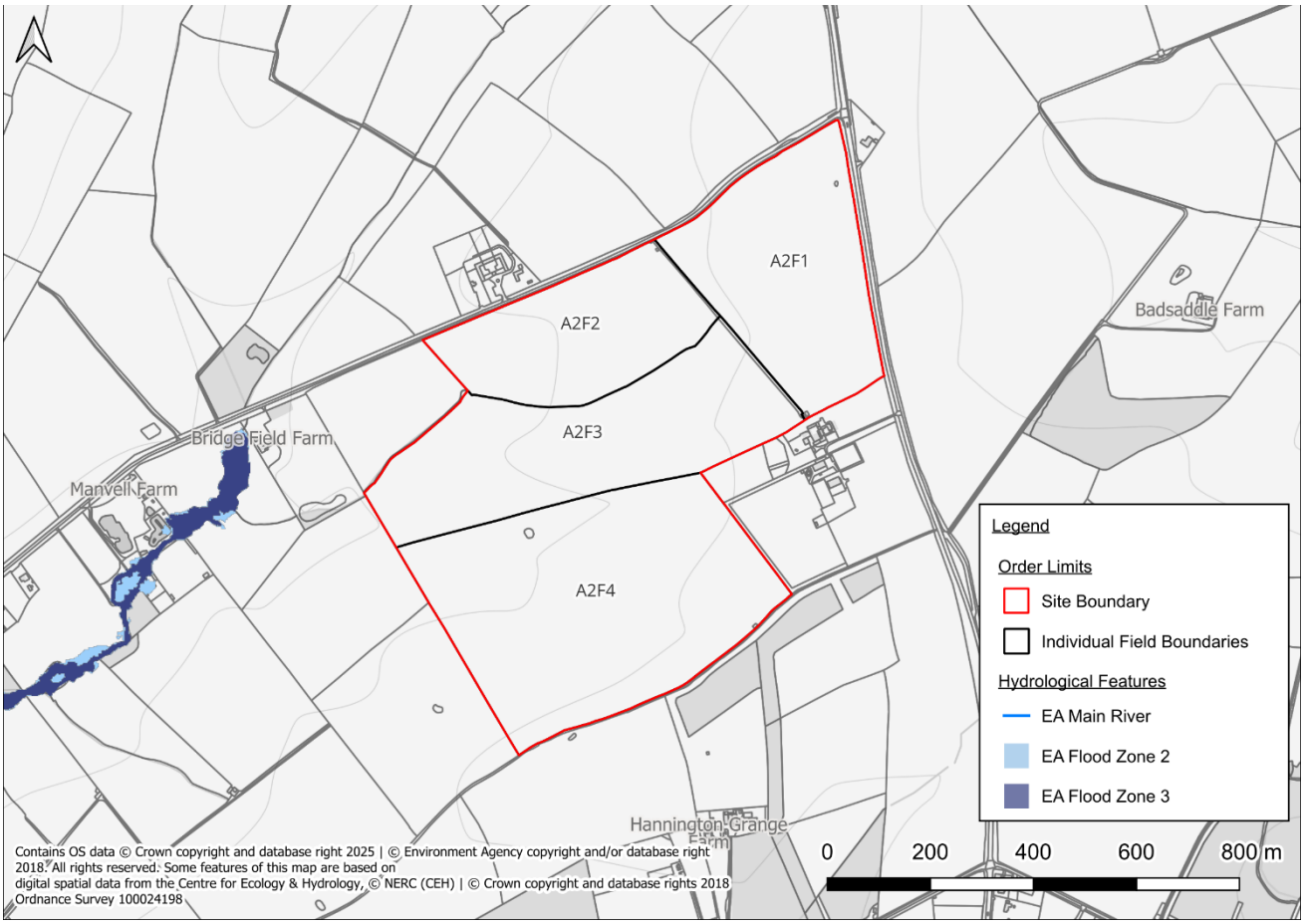


Figure 5: EA's Flood Map for Planning

2.1.3 According to the EA's Flood Map for Planning[v] (updated March 2025), the entirety of the Green Hill A.2 is situated in Flood Zone 1 (has less than a 1 in 1,000 annual probability of river or sea flooding).

2.1.4 It is essential to note that the EA Flood Maps do not cover the Site, and due to the Site being in a rural setting, its classification as Flood Zone 1 may not be entirely accurate.

2.1.5 The EA 'Historical Flood Map' indicates that Green Hill A.2 has no recorded history of flooding either on the Site or in the immediate vicinity. However, this does not necessarily mean that the Site has never flooded, only that there is no documented record of such events.

2.1.6 In the absence of modelled flood data, the 0.1% annual probability surface water flood scenario can be used as a proxy for the 0.1% AEP + Climate Change (CC) fluvial event. In addition, the Manning's open channel flow formula has been used to demonstrate and quantify potential fluvial flood risk to the Site during a 1% AEP +36%CC fluvial event. Cross-sections of existing watercourses and the wider floodplain have been extracted from EA LiDAR data (flown Q1 2020) and used to inform the calculations. More detail on these calculations is provided in Annex B. The flood levels estimated by the calculations suggest that the flood extent is low and that flood extents on Site would be similar to or smaller than the EA surface water flood extents, which could therefore be used as a conservative proxy for fluvial flood risk.

2.1.7 There is no indication within relevant third-party reports (listed in 'Sources of Information' on the Covering Report) to suggest that Green Hill A.2 has historically experienced fluvial flooding.

2.1.8 Green Hill A.2 is also not located within a Flood Warning Area.

Consultation

2.1.9 Given that Green Hill A.2 is located within Flood Zone 1, the EA will not provide any Product Data, therefore Product Data was not requested from the EA.

2.1.10 The West Northamptonshire Council LLFA was contacted in January 2024. A response was received in June 2024 and is included as Annex C. The LLFA stated that there have been two historic reports of flooding within the Site boundary: Sywell Road in December 2012 and on Holcot Lane in November 2012. However, the two locations stated are in fact located outside of the Site boundary.

2.1.11 Further to this, the EA and LLFA were consulted with throughout the pre-application process, with guidance complied with where required. Green Hill A.2 is not located within an IDB.

Summary

2.1.12 Green Hill A.2 is therefore considered to be at **Low** risk of fluvial flooding, the proposed solar panels will be raised above surrounding ground levels with associated power infrastructure appropriately located out of the flood zone and protected.

2.2 Surface Water Flood Risk

2.2.1 The EA's National Flood Risk Assessment Mapping (NaFRA), known as the Long Term Flood Risk Map (Surface Water)[vi] was updated in January 2025. The NaFRA mapping provides an updated view of surface water flooding across the Site, however it should be noted that at the time of writing, the NaFRA mapping only delivers climate change insight up to the year 2060.

2.2.2 The previous EA Risk of Flooding from Surface Water (RoFSW) mapping indicates that Green Hill A.2 is largely at Very Low risk of surface water flooding, meaning it has a less than 0.1% annual probability of flooding. There are areas in the vicinity of the land drains on-Site where surface water risk ranges from

Low risk (between a 1% and 0.1% annual probability) to Medium (between a 3.3% and 1% annual probability) with isolated areas of High risk (a greater than 3.3% annual probability of flooding).

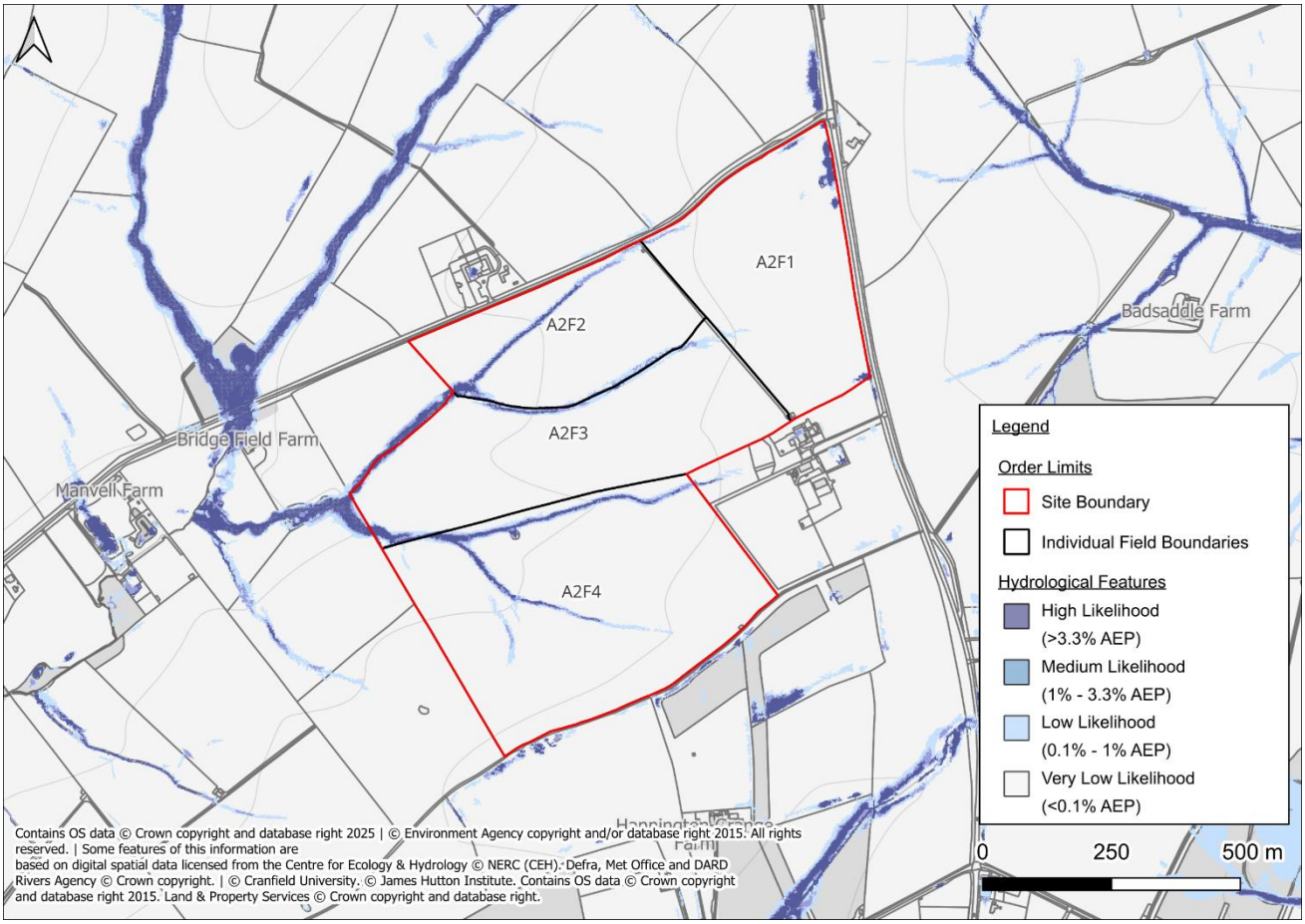


Figure 6: EA's Long-Term Flood Risk Map (Flood Risk from Surface Water)

2.2.3 The updated NaFRA mapping (Figure 6) has been assessed and indicates that there is no visible change in surface water risk across Green Hill A.2.

2.2.4 NaFRA surface water mapping indicates that the majority of Green Hill A.2 is subject to flood depths of below 0.3m. Surface water depths of less than 0.3m are typically passable by both vehicles and pedestrians. There are isolated areas of flood depths above 0.3m along the northern boundary of A2F4 and A2F3, along the western boundary of A2F3, and along the southern boundary of A2F2.

2.2.5 The surface water flooding extents largely match the courses of the land drainage ditches which flow adjacent to Green Hill A.2.

2.2.6 It is worth noting that the EA Flood Map does not accurately take into account local drainage and is likely to be overexaggerating the surface water risk.

2.2.7 Any potential surface water flooding arising at or near to the Site would be directed west, away from the Site, following the local topography.

2.2.8 There is no indication within relevant third-party reports (listed in 'Sources of Information' on the Covering Report) to suggest that Green Hill A.2 has historically experienced surface water flooding.

2.2.9 Based on the above and considering the embedded mitigation as part of the design of the solar panels, the overall risk of surface water flooding at Green Hill A.2 is considered to be **Low**. The proposed solar panels will be raised above surrounding ground levels and will be appropriately located out of the flood zone and waterproofed thereby reducing the potential to be impacted in the event of surface water flooding.

2.2.10 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.

2.3 Groundwater Flood Risk

2.3.1 A description of the Sites geology is included in section 1.0.

2.3.2 There is no information within relevant third-party reports (listed 'Sources of Information' on the Covering Report) to suggest that Green Hill A.2 has experienced historical groundwater flooding.

2.3.3 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.

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

2.4 Sewer Flooding

2.4.1 No Site-specific incidents of sewer flooding have been identified from relevant third-party reports. On the basis of the Site's rural setting the presence of sewerage infrastructure is unlikely. Utility records have been checked and no sewers are identified within the Site. There is a water main located across Fields A2F1 and A2F3, however these have been respected in the Scheme design. It can therefore be concluded that the risk of sewer flooding is Low.

2.5 Reservoir and Canal Flooding

2.5.1 There are no canals within the vicinity of Green Hill A.2, therefore there is negligible associated flood risk.

2.5.2 The EA 'Flood Risk from Reservoirs' map shows that Green Hill A.2 is not at risk of flooding from reservoirs.

2.5.3 It can therefore be concluded that there is a **Negligible** risk of flooding from artificial sources.

2.6 Residual Flood Risks

2.6.1 A residual risk is an exceedance event, such as greater than the 1 in 1000 year (<0.1% AEP) flood event that would overtop the land drains and potentially impact the Site. As the probability of a greater than 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.

2.6.2 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.

2.7 Summary of Flood Risk and Mitigation

2.7.1 It can be concluded that the risk to Green Hill A.2 from all sources of flooding is **Negligible to Low**, however, it would be prudent to include the below mitigation measures.

2.8 Embedded Mitigation

2.8.1 Embedded Mitigation is detailed in section 3.2 of the covering report.

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. Therefore, there will be no loss of floodplain volume as a result of the Scheme and no increase in flood risk elsewhere.

2.9.2 The supporting infrastructure is insignificant in size and will not increase flood risk elsewhere.

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

3. Conclusions and Recommendations

3.1 Conclusions

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

Flood Risk

3.1.2 Green Hill A.2 is located within Flood Zone 1 on the Environment Agency (EA) 'Flood Map for Planning (Rivers and Sea)' – an area considered to have the lowest probability of fluvial and tidal flooding.

3.1.3 The risk of flooding from all sources has been assessed and the flood risk 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 Scheme.

3.2 Recommendations

3.2.1 Embedded Mitigation is detailed in section 3.2 of the covering report.

Annex A – Water Body Catchment Classification Summaries

Pitsford Arm of the Brampton Branch Water Body Catchment Classification Summary

Classification Item	2019 Classification		2022 Classification	Cycle 3 Objectives		
	Cycle 2	Cycle 3	Cycle 3	Status	Year	Reasons
Ecological	Good	Good	Good	Good	2015	
Biological Quality Elements	Poor	Poor	Moderate	Good	2015	
Invertebrates	Poor	Poor	Moderate	Good	2015	
Macrophytes and Phytobenthos Combined	N/A	N/A	N/A	N/A	2015	Disproportionately expensive: Disproportionate burdens; Technically infeasible: No known technical solution is available
Physio-Chemical Quality Elements	High	High	Good	Good	2015	
Acid Neutralising Capacity	N/A	N/A	High	N/A		
Ammonia (Phys-Chem)	N/A	N/A	High	Good	2015	
Dissolved Oxygen	N/A	N/A	Good	Good	2015	
Phosphate	N/A	N/A	Good	Good	2015	
Temperature	N/A	N/A	High	Good	2015	
pH	High	High	High	Good	2015	
Hydromorphological Supporting Elements	N/A	N/A	N/A	N/A	2015	
Supporting Elements (surface Water)	Good	Good	Good	Good	2015	
Mitigation Measures Assessment	Good	Good	Good	Good	2015	
Specific Pollutants	High	High	High	High	2015	
Iron	High	High	High	High	2015	
Maganese	High	High	High	High	2015	
Chemical	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time; Technically infeasible: No known technical solution is available
Priority Hazardous Substances	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time; Technically infeasible: No known technical solution is available
Benzo(a)pyrene	Good	Good	N/A	Good	2015	
Dioxins and dioxin-like compounds	Good	Good	N/A	Good	2015	
Heptachlor and cis-Heptachlor Epoxide	Good	Good	N/A	Good	2015	
Hexachlorobenzene	Good	Good	N/A	Good	2015	
Hexachlorobutadiene	Good	Good	N/A	Good	2015	
Mercury and Its Compounds	Fail	Fail	N/A	Good	2040	Natural conditions: Chemical status recovery time
Perfluorooctane sulphonate (PFOS)	Fail	Fail	N/A	Good	2039	Technically infeasible: No known technical solution is available
Polybrominated diphenyl ethers (PBDE)	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Priority substances	Good	Good	N/A	Good	2015	
Cypermethrin (Priority)	Good	Good	N/A	Good	2015	
Fluoranthene	Good	Good	N/A	Good	2015	
Other Pollutants	N/A	N/A	N/A	N/A	2015	

Pytchley Brook Water Body Catchment Classification Summary

Classification Item	2019 Classification		2022 Classification	Cycle 3 Objectives		
	Cycle 2	Cycle 3	Cycle 3	Status	Year	Reasons
Ecological	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Biological Quality Elements	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Invertebrates	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	
Macrophytes and Phytobenthos Combined	Moderate	Moderate	Moderate	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Physio-Chemical Quality Elements	Moderate	Moderate	N/A	Good	2027 - Low Confidence	Disproportionately expensive: Disproportionate burdens
Acid Neutralising Capacity	High	High	N/A	Good	2015	
Ammonia (Phys-Chem)	High	High	N/A	Good	2015	
Dissolved Oxygen	Moderate	Moderate	N/A	Good	2015	
Phosphate	Moderate	Moderate	N/A	Good	2027	Disproportionately expensive: Disproportionate burdens
Temperature	Good	Good	N/A	Good	2015	
pH	High	High	N/A	Good	2015	
Hydromorphological Supporting Elements	Supports Good	Supports Good	Supports Good	Supports Good	2015	
Supporting Elements (surface Water)	N/A	N/A	N/A	N/A	N/A	
Mitigation Measures Assessment	N/A	N/A	N/A	N/A	N/A	
Specific Pollutants	N/A	N/A	N/A	N/A	N/A	
Iron	N/A	N/A	N/A	N/A	N/A	
Maganese	N/A	N/A	N/A	N/A	N/A	
Chemical	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Priority Hazardous Substances	Fail	Fail	N/A	Good	2063	Natural conditions: Chemical status recovery time
Benzo(a)pyrene	Good	N/A	N/A	Good	205	
Dioxins and dioxin-like compounds	N/A	N/A	N/A	Good	2015	
Heptachlor and cis-Heptachlor Epoxide	Good	N/A	N/A	Good	2015	
Hexabromocyclododecane	Good	N/A	N/A	Good	2015	
Hexachlorobenzene	Good	N/A	N/A	Good	2015	
Hexachlorobutadiene	Good	N/A	N/A	Good	2015	
Mercury and Its Compounds	Fail	N/A	N/A	Good	2040	Natural conditions: Chemical status recovery time
Perfluorooctane sulphonate (PFOS)	Good	N/A	N/A	Good	2015	
Polybrominated diphenyl ethers (PBDE)	Fail	N/A	N/A	Good	2063	Natural conditions: Chemical status recovery time
Priority substances	Good	N/A	N/A	Good	2015	
Cypermethrin (Priority)	Good	N/A	N/A	Good	2015	
Fluoranthene	Good	N/A	N/A	Good	2015	
Other Pollutants	N/A	N/A	N/A	N/A	2015	Did not require assessment

Annex B – Manning's Open Channel Flow Mapping

313532 Green Hill Solar Farm

Manning's Open Channel Flow Calculation - Option Area A2

Methodology

Cross-sections of the channel and floodplain were extracted from Environment Agency (EA) LiDAR DTM data (flown Q1 2020) at the locations shown in Figure 1. These cross-sections can be considered representative of the channel and general floodplain adjacent to the site and at the location of the proposed development. Due to the nature of LiDAR, volume and conveyance of the main channels will likely be underestimated, providing a conservative assessment of fluvial flood risk.

The cross-sections were imported into Flood Modeller and the "tabulate cross section properties" tool was utilised to establish the level-flow relationship for the channel and wider floodplain. This tool utilises the Manning's open channel flow equation. Manning's 'n' roughness was set to 0.03s/m$^{1/3}$ for the channel and 0.04s/m$^{1/3}$ for the floodplain based on aerial imagery. The bed slope was set for each cross-section based on underlying LiDAR. Catchment descriptors for the catchments upstream of the outlet locations shown in Figure 1 were imported into ReFH2 and used to provide an estimate of flows within the channel during the 1% AEP +36%CC event. These flows were scaled by area as required.

Within this excel workbook, the xlookup function has been used along with the Flood Modeller level-flow relationship for the cross-sections to determine the equivalent water level for the calculated flow, rounding up where a direct match is not found. To provide additional confidence in the assessment, a second xlookup has been used to determine the estimated flood level should an additional 50% flow be applied.

Cross-sections have been located at suitable locations throughout the proposed development. Whilst it is acknowledged that the Manning's open channel flow equation used to determine the level-flow relationship does not constitute detailed hydraulic modelling, the calculation can still be considered suitable to demonstrate the scale of the changes in water level that can be expected when considering a +36% uplift in flows (Nene Catchment, 2080's higher allowance).

Cross-Section Locations

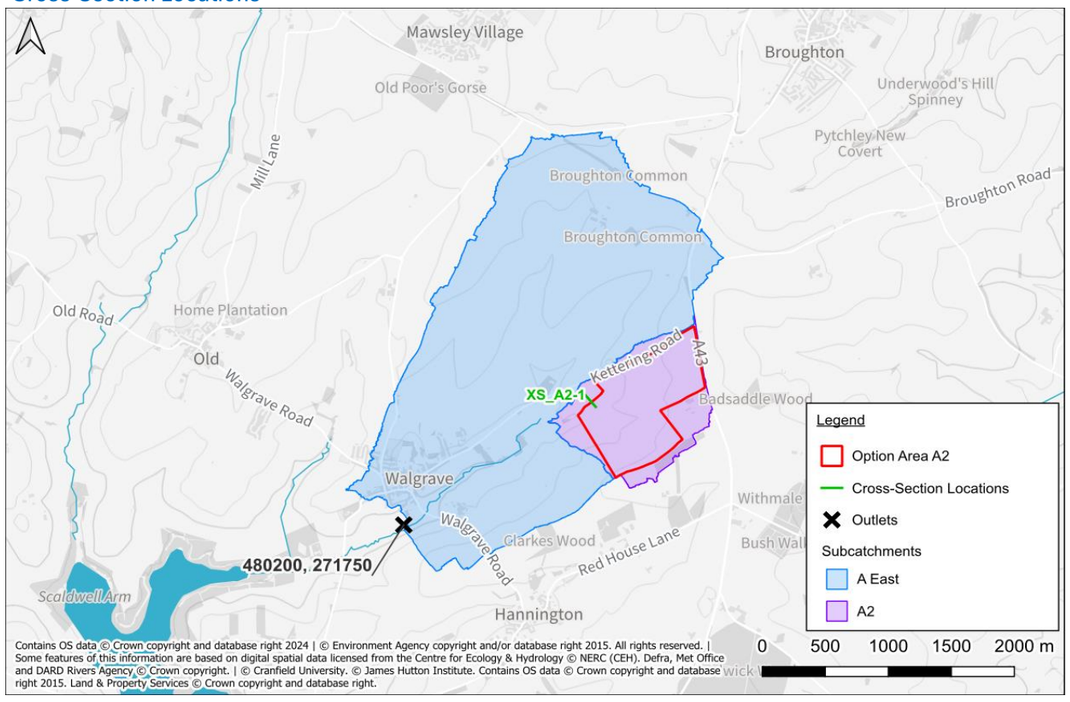


Figure 1: Cross-section locations

Calculated Flows and Levels

Cross-Section	ReFH2 Peak Flow - 1% AEP +36%CC (m^3/s)	Equivalent Flood Level (m AOD)	Sensitivity Flow - ReFH2 +50% (m^3/s)	Equivalent Flood Level (m AOD)
A2-1	2.94	112.22	4.41	112.29 (+73mm)

Tabulated Cross-Section Properties | A2-1

(Calculated by Flood Modeller)

Node	Flow (m^3/s)	Stage (m AOD)	Depth (m)	Velocity (m/s)	Froude no.	Area (m^2)	Conveyance (m^3/s)	Width (m)	W Perim. (m)	Slope
A2-1	0.000	111.631	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0182
A2-1	0.021	111.706	0.076	0.503	0.827	0.042	0.155	1.102	1.113	0.0182
A2-1	0.133	111.782	0.151	0.799	0.928	0.166	0.985	2.205	2.226	0.0182
A2-1	0.389	111.855	0.224	1.115	1.006	0.348	2.878	2.781	2.825	0.0182
A2-1	0.800	111.928	0.297	1.424	1.064	0.562	5.921	3.077	3.156	0.0182
A2-1	1.339	112.001	0.370	1.682	1.105	0.796	9.917	3.374	3.486	0.0182
A2-1	2.007	112.073	0.442	1.907	1.137	1.052	14.863	3.670	3.816	0.0182
A2-1	2.806	112.146	0.515	2.109	1.163	1.330	20.779	3.967	4.147	0.0182
A2-1	3.739	112.219	0.588	2.295	1.185	1.630	27.693	4.264	4.477	0.0182
A2-1	4.812	112.291	0.660	2.467	1.204	1.951	35.635	4.560	4.808	0.0182
A2-1	6.028	112.364	0.733	2.629	1.221	2.293	44.642	4.857	5.138	0.0182
A2-1	7.393	112.437	0.806	2.782	1.237	2.657	54.748	5.153	5.468	0.0182
A2-1	7.973	112.493	0.862	2.681	1.230	2.973	59.047	6.137	6.466	0.0182
A2-1	8.328	112.522	0.891	2.636	1.227	3.160	61.678	6.718	7.051	0.0182
A2-1	7.911	112.530	0.899	2.459	1.209	3.217	58.590	7.632	7.967	0.0182
A2-1	7.747	112.534	0.903	2.382	1.323	3.252	57.372	9.845	10.180	0.0182
A2-1	6.734	112.542	0.911	2.019	1.158	3.335	49.871	10.760	11.095	0.0182
A2-1	7.343	112.573	0.942	1.990	1.156	3.691	54.384	12.217	12.557	0.0182
A2-1	9.248	112.631	1.000	2.080	1.170	4.445	68.488	13.798	14.145	0.0182
A2-1	10.911	112.677	1.046	2.133	1.179	5.115	80.807	15.324	15.677	0.0182
A2-1	12.169	112.711	1.080	2.150	1.182	5.661	90.118	16.795	17.152	0.0182
A2-1	13.424	112.742	1.111	2.164	1.185	6.204	99.417	18.253	18.614	0.0182
A2-1	15.454	112.782	1.151	2.219	1.193	6.964	114.452	19.751	20.117	0.0182
A2-1	15.513	112.783	1.152	2.221	1.193	6.984	114.884	19.780	20.146	0.0182
A2-1	15.556	112.794	1.163	2.157	1.186	7.210	115.205	21.360	21.727	0.0182
A2-1	18.029	112.837	1.206	2.206	1.193	8.174	133.522	23.458	23.827	0.0182
A2-1	18.708	112.847	1.216	2.224	1.196	8.410	138.547	23.840	24.209	0.0182
A2-1	24.896	112.925	1.294	2.403	1.220	10.362	184.373	26.195	26.569	0.0182
A2-1	25.448	112.936	1.305	2.388	1.218	10.655	188.465	27.193	27.567	0.0182
A2-1	25.770	112.942	1.311	2.382	1.217	10.820	190.849	27.736	28.111	0.0182
A2-1	27.387	112.965	1.334	2.386	1.218	11.477	202.822	29.353	29.729	0.0182
A2-1	34.934	113.037	1.406	2.555	1.240	13.670	258.710	31.574	31.955	0.0182
A2-1	35.157	113.039	1.408	2.560	1.241	13.733	260.365	31.637	32.018	0.0182
A2-1	39.770	113.078	1.448	2.650	1.252	15.007	294.527	32.832	33.215	0.0182
A2-1	44.703	113.118	1.487	2.738	1.262	16.327	331.062	34.027	34.413	0.0182
A2-1	46.861	113.134	1.503	2.777	1.267	16.875	347.044	34.434	34.821	0.0182
A2-1	55.476	113.197	1.566	2.903	1.281	19.109	410.843	36.498	36.890	0.0182
A2-1	60.314	113.229	1.598	2.972	1.289	20.292	446.674	37.418	37.812	0.0182
A2-1	67.768	113.275	1.644	3.075	1.300	22.041	501.872	38.644	39.041	0.0182
A2-1	76.468	113.328	1.697	3.168	1.310	24.138	566.305	40.478	40.879	0.0182
A2-1	82.673	113.364	1.733	3.227	1.316	25.619	612.260	41.797	42.200	0.0182
A2-1	84.951	113.377	1.746	3.247	1.318	26.166	629.128	42.306	42.710	0.0182
A2-1	98.910	113.448	1.817	3.382	1.332	29.247	732.506	44.497	44.906	0.0182
A2-1	103.757	113.471	1.840	3.427	1.336	30.278	768.399	45.168	45.579	0.0182
A2-1	115.845	113.526	1.895	3.531	1.347	32.807	857.920	46.800	47.215	0.0182

Node	Flow (m^3/s)	Stage (m AOD)	Depth (m)	Velocity (m/s)	Froude no.	Area (m^2)	Conveyance (m^3/s)	Width (m)	W Perim. (m)	Slope
A2-1	115.268	113.532	1.901	3.483	1.342	33.092	853.649	48.194	48.609	0.0182
A2-1	125.249	113.574	1.943	3.564	1.350	35.143	927.568	49.459	49.876	0.0182
A2-1	133.355	113.608	1.977	3.619	1.355	36.845	987.602	50.679	51.098	0.0182
A2-1	140.281	113.641	2.010	3.639	1.357	38.550	1038.894	52.608	53.029	0.0182
A2-1	141.191	113.645	2.014	3.643	1.358	38.760	1045.627	52.817	53.238	0.0182
A2-1	149.645	113.680	2.049	3.682	1.361	40.638	1108.241	54.495	54.917	0.0182
A2-1	158.587	113.716	2.085	3.720	1.365	42.633	1174.457	56.322	56.746	0.0182
A2-1	164.795	113.738	2.107	3.755	1.368	43.881	1220.439	57.150	57.576	0.0182
A2-1	174.824	113.772	2.141	3.813	1.374	45.845	1294.710	58.361	58.789	0.0182
A2-1	185.997	113.811	2.180	3.862	1.378	48.156	1377.456	60.149	60.579	0.0182
A2-1	198.014	113.847	2.216	3.934	1.385	50.340	1466.450	61.184	61.617	0.0182
A2-1	211.657	113.890	2.259	3.993	1.390	53.010	1567.485	63.012	63.447	0.0182
A2-1	214.277	113.898	2.267	4.004	1.391	53.516	1586.888	63.348	63.783	0.0182
A2-1	241.423	113.972	2.341	4.142	1.403	58.286	1787.922	65.585	66.025	0.0182
A2-1	248.044	113.991	2.360	4.166	1.405	59.540	1836.962	66.423	66.864	0.0182
A2-1	257.085	114.016	2.385	4.200	1.408	61.214	1903.918	67.473	67.916	0.0182
A2-1	274.374	114.058	2.427	4.282	1.415	64.071	2031.951	68.595	69.041	0.0182
A2-1	292.249	114.100	2.469	4.364	1.421	66.976	2164.332	69.717	70.166	0.0182
A2-1	294.805	114.106	2.475	4.374	1.422	67.395	2183.259	69.895	70.344	0.0182
A2-1	314.482	114.155	2.524	4.437	1.427	70.870	2328.983	71.945	72.397	0.0182
A2-1	329.028	114.188	2.557	4.491	1.432	73.263	2436.708	73.051	73.505	0.0182
A2-1	338.545	114.215	2.584	4.498	1.433	75.259	2507.189	74.869	75.324	0.0182
A2-1	343.441	114.226	2.595	4.514	1.434	76.085	2543.448	75.303	75.758	0.0182
A2-1	367.465	114.278	2.647	4.590	1.440	80.052	2721.367	77.268	77.726	0.0182
A2-1	380.075	114.304	2.673	4.631	1.443	82.073	2814.756	78.183	78.642	0.0182
A2-1	403.341	114.350	2.719	4.706	1.449	85.704	2987.052	79.697	80.160	0.0182
A2-1	425.587	114.394	2.763	4.769	1.454	89.247	3151.802	81.376	81.841	0.0182
A2-1	431.656	114.406	2.775	4.784	1.455	90.227	3196.753	81.872	82.337	0.0182
A2-1	461.373	114.463	2.832	4.859	1.461	94.960	3416.827	84.203	84.671	0.0182
A2-1	464.006	114.468	2.837	4.865	1.461	95.382	3436.326	84.419	84.887	0.0182
A2-1	489.401	114.515	2.884	4.924	1.466	99.396	3624.399	86.403	86.873	0.0182
A2-1	501.427	114.541	2.910	4.932	1.466	101.665	3713.461	88.159	88.631	0.0182
A2-1	504.064	114.546	2.915	4.937	1.467	102.107	3732.992	88.421	88.893	0.0182
A2-1	521.238	114.578	2.947	4.966	1.469	104.963	3860.175	90.100	90.574	0.0182
A2-1	545.185	114.620	2.989	5.011	1.472	108.790	4037.521	92.127	92.602	0.0182
A2-1	547.811	114.624	2.993	5.018	1.473	109.159	4056.967	92.242	92.718	0.0182
A2-1	570.476	114.662	3.031	5.062	1.476	112.698	4224.821	94.014	94.492	0.0182
A2-1	603.725	114.713	3.082	5.136	1.482	117.541	4471.054	95.941	96.422	0.0182
A2-1	615.836	114.730	3.099	5.167	1.484	119.177	4560.747	96.399	96.882	0.0182
A2-1	650.727	114.782	3.151	5.238	1.489	124.243	4819.145	98.495	98.980	0.0182
A2-1	663.019	114.801	3.170	5.257	1.490	126.124	4910.178	99.438	99.924	0.0182
A2-1	674.666	114.820	3.189	5.270	1.491	128.024	4996.427	100.568	101.055	0.0182
A2-1	699.291	114.854	3.223	5.319	1.495	131.465	5178.797	101.840	102.328	0.0182
A2-1	754.910	114.925	3.294	5.440	1.503	138.771	5590.701	103.945	104.439	0.0182
A2-1	759.795	114.931	3.300	5.451	1.504	139.394	5626.878	104.106	104.600	0.0182
A2-1	788.846	114.970	3.339	5.498	1.507	143.488	5842.022	105.798	106.294	0.0182
A2-1	855.568	115.048	3.417	5.635	1.517	151.820	6336.151	107.865	108.368	0.0182
A2-1	863.725	115.062	3.431	5.633	1.516	153.338	6396.562	109.024	109.528	0.0182
A2-1	865.338	115.066	3.435	5.627	1.516	153.776	6408.507	109.499	110.003	0.0182
A2-1	882.783	115.091	3.460	5.640	1.517	156.534	6537.696	111.104	111.609	0.0182
A2-1	922.881	115.136	3.505	5.712	1.522	161.564	6834.658	112.500	113.008	0.0182
A2-1	942.035	115.162	3.531	5.726	1.523	164.511	6976.504	114.134	114.643	0.0182
A2-1	976.838	115.199	3.568	5.789	1.527	168.753	7234.251	115.194	115.706	0.0182
A2-1	1014.191	115.242	3.611	5.837	1.530	173.748	7510.876	117.133	117.647	0.0182
A2-1	1016.710	115.245	3.614	5.840	1.530	174.100	7529.532	117.291	117.805	0.0182
A2-1	1063.548	115.297	3.666	5.900	1.534	180.258	7876.402	119.590	120.106	0.0182
A2-1	1076.103	115.310	3.679	5.919	1.536	181.816	7969.382	120.059	120.576	0.0182
A2-1	1147.693	115.380	3.749	6.031	1.543	190.294	8499.563	122.161	122.683	0.0182
A2-1	1155.544	115.394	3.763	6.018	1.542	192.015	8557.710	123.677	124.199	0.0182
A2-1	1165.008	115.403	3.772	6.032	1.543	193.129	8627.792	123.954	124.477	0.0182
A2-1	1239.798	115.473	3.842	6.141	1.550	201.883	9181.673	126.145	126.673	0.0182
A2-1	1263.804	115.493	3.862	6.183	1.553	204.408	9359.456	126.438	126.966	0.0182
A2-1	1313.269	115.534	3.903	6.265	1.558	209.606	9725.781	127.096	127.626	0.0182
A2-1	1363.582	115.575	3.944	6.347	1.563	214.830	10098.389	127.755	128.286	0.0182

Annex C – West Northamptonshire LLFA Response

West Northamptonshire Council
Lead Local Flood Authority

Developer Data and Information Request

LLFA Reference	DR.2024.7
Location	Green Hill Solar – (a) NN69PZ, (b) NN69SN, (c) NN6 0BW, (d) NN6 0DL, (e) NN60TW
Proposal	Request for instances of historic flooding at or near this location, details of flood defences in the area, information regarding maintenance of land drains and management of flood risk in the area, any restrictions in developing near a IDB owned watercourse and specific requirements for discharge rates to land drains
Request By	lantell@mabbett.eu
Request Date	02/01/2024
Response Date	03/06/2024

Dear Lucy,

Thank you for requesting flood risk data for the above site. Please find below and attached our response to your request. The postcodes NN6 0BW, NN6 0DL and NN60TW are not located in West Northamptonshire Council, so we are unable to provide the requested information.

Historic Flood Records

Since the creation of the Lead Local Flood Authority (LLFA) role in 2010, West Northamptonshire Council (WNC) has undertaken to collect as much information as possible relating to historic flood incidents within the district. We have recorded, if known, where actions have been undertaken or are proposed to alleviate the flood risk. The data we have collected is not considered to be exhaustive, and data relating to flood incidents occurring prior to 2010 is limited. For the above postcodes (a) and (b) we have collected the following information:

(a) NN6 9PZ

- Within the site boundary:
  - No historic flooding reports located within the site boundary.
- Within 500m of the site boundary:

Date	Location to street level	Description
14/06/2007	Gold Street, Walgrave	Flooding due to weather conditions
Unknown	Lower Green, Walgrave	Internal flooding to property. Silted culvert.

(b) NN6 9SN

- Within the site boundary:

Date	Location to street level	Description
14/12/2012	Sywell Road, Holcot	Carriageway flooding, out of hours team to clear and make safe. Conways instructure to attend to clear as required.
21/11/2012	Holcot Lane, Sywell	Flooding

- Within 500m of the site boundary:

Date	Location to street level	Description
21/11/2012	Sywell Road, Holcot	Car stuck in flood water.
22/11/2012	Sywell Road, Holcot	Carriageway flooded – approx. 3ft deep
14/12/2012	Sywell Road, Holcot	Carriageway flooded

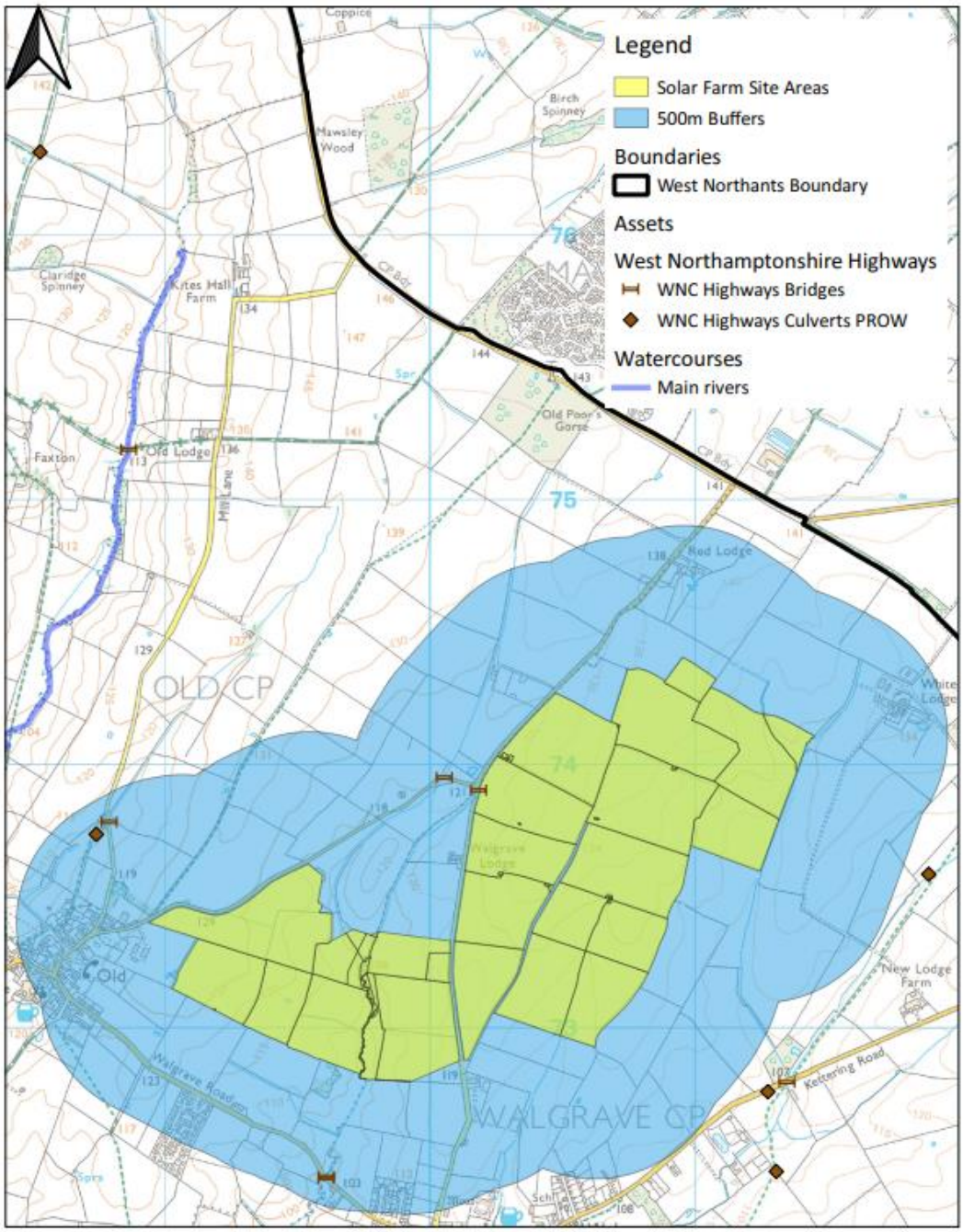
Section 19 Flood Investigations

Under the Flood and Water Management Act 2010 LLFAs have to carry out investigations into flooding incidents if they meet set thresholds. Investigations take place after the flood event has passed and the flood water has receded. We recommend that you have a look at past flood investigations report which are available in our webpage www.westnorthants.gov.uk/am-i-risk/flood-investigation-reports

Asset Register

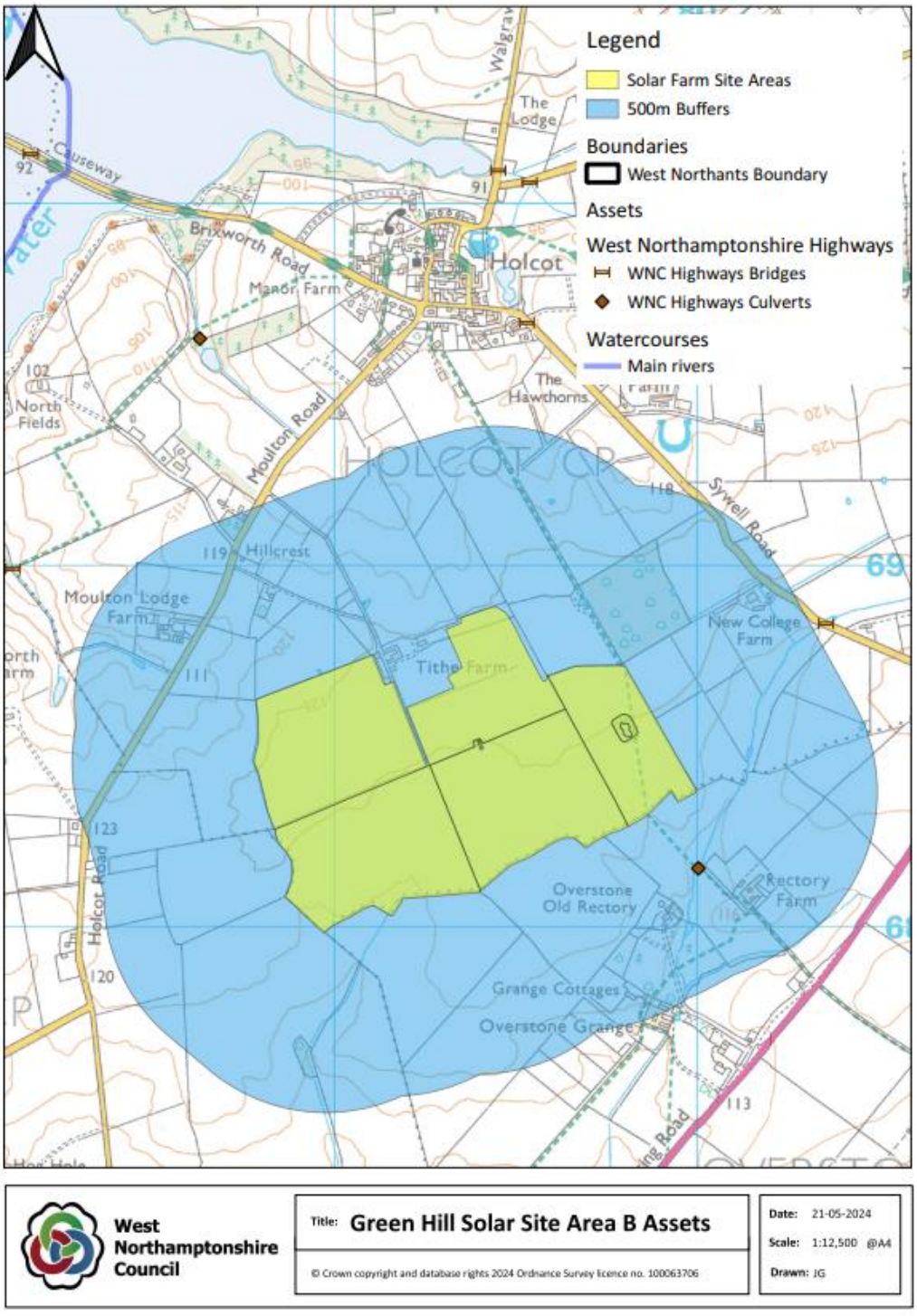
Under the Flood and Water Management Act 2010 we have a duty to maintain a register of assets which have a significant impact on flood risk. We have undertaken a search of our Asset Register, which contains information on all assets relating to flood risk within the county which we have been made aware of. A summary of any assets shown to lie within the site boundary and within a 500m buffer of the site is provided below. Exact details of third party assets should be requested from the relevant risk management authority.

NN6 9PZ



Our records show that Anglian Water hold assets within the 500m buffer of this site. For details on these assets please contact Anglian Water directly.

NN6 9SN



Our records show that Anglian Water hold assets within the 500m buffer of this site. For details on these assets please contact Anglian Water directly.

Risk of Flooding from Surface Water

By searching a location by postcode, information regarding the risk of surface watter flooding can be found at www.gov.uk/check-long-term-flood-risk

The sequential approach should be taken in considering the site layout in relation to the risk of flooding from surface water runoff. No properties or sensitive development should be located in areas shown to be at risk of flooding.

Risk of Flooding from Groundwater

We have recently completed a detailed study into groundwater flood risk in Northamptonshire. This is available online at www.westnorthants.gov.uk/flooding-and-flood-risk-management/statutory-and-project-documents.

For NN6 9PZ, this map indicates that the majority of site is likely to be negligible risk, there are small vertical bands of very low risk in the west of the location and a small location of very high risk in the north. For NN6 9SN, this map indicates that the majority of site is likely to be negligible risk, the majority of the north east of the site is very low risk and has small locations of moderate and high risk throughout.

Advice on how to consider groundwater flood risk in a Flood Risk Assessment is provided at www.floodtoolkit.com/planning/developers/.

Northamptonshire Local Flood Risk Management Strategy

The Northamptonshire Local Flood Risk Management Strategy was approved in November 2017, and the associated Action Plan was last updated in November 2020. This can be found at www.westnorthants.gov.uk/flooding-and-flood-risk-management/local-flood-risk-management-strategy This document and its related policies and recommendations apply to all development and flood risk management work within the County of Northamptonshire.

The Strategy is currently being updated and initial public consultation is currently taking place, further details will be available on our website.

Upper Nene Catchment

Following the significant flooding to Northampton town centre in Easter 1998 improvements were made to the flood defences along the River Nene. In order to secure the level of protection afforded by the new defence, the Environment Agency agreed with the West Northants Joint Planning Unit that the standards set for new development should also be improved, beyond industry standards.

Therefore all new development in the Upper Nene catchment must be designed for a flood with a 0.5% probability (1 in 200 chance) of occurring in any year, including an appropriate allowance for climate change. This includes design of mitigation for river flooding and any surface water attenuation. This applies across the whole of the Upper Nene catchment including all branches and arms of the Nene, upstream of Billing Aquadrome, and all tributaries such as Wootton Brook, Dallington Brook and Bugbrooke Brook.

This standard relates to the total drainage design, not individual elements such as gullies and swales. The drainage system should be designed to ensure that there is no increased risk of

flooding from the site in the 0.5% event, and that in this event any flooding on the site is limited to designated flood-safe areas such as open space and does not affect any properties, critical infrastructure or access/egress routes within the site.

This policy is outlined within the West Northamptonshire Joint Core Strategy Local Plan (Policy BN7 – Flood Risk, page 129).

Ordinary Watercourse Consent

Ordinary watercourses are riparian owned, i.e. the ownership and maintenance responsibilities are shared by the landowners on either side of the watercourse. It should be noted that any development within 9m of any ordinary watercourse requires the prior consent of the relevant flood risk management authority as outlined in Policy 7 of the Northamptonshire Local Flood Risk Management Strategy.

The Land Drainage consenting service was formally carried out by the Internal Drainage Boards (IDB) and has recently moved back into the Council. For enquries please email: **floodandwater.ncc@westnorthants.gov.uk**. We are currently in the process of building this system which is causing a delay in providing land drainage consents. We apologise for inconveniences this may cause, please be assured we are setting up the system with a matter of urgency. We expect the service to be fully in place in June 2024.

Any works on the site within 9m of the bank of a main river will need prior consent from the Environment Agency through the new Environmental Permitting regime – see www.gov.uk/topic/environmental-management/environmental-permits.

If the watercourse owned by the IDB is within 9m of the site/within the site, a 9m buffer should be maintained between the edge of the watercourse for maintenance access unless demonstrated inappropriate. All buildings and structures should be located outside of the area of flood risk. The developer will need to consult the IDB for consent for all works within 9m of an ordinary watercourse. This consent is separate to the land drainage consent. Further information can be found at [redacted]

SuDS Guidance

Defra has published non statutory technical standards for the design, maintenance and operation of sustainable drainage systems www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards.

We have published local guidance to assist developers in the design of all surface water drainage systems, and to support Local Planning Authorities in considering drainage proposals for new development in Northamptonshire. The guidance sets out the standards that we apply in assessing all surface water drainage proposals and can be found at www.westnorthants.gov.uk/flooding-and-flood-risk-management/statutory-and-project-documents

Local Standards and Guidance for Surface Water Drainage is currently being updated and will be shared on our website once available.

Known Site-Specific Issues and Drainage Constraints

The BGS Infiltration SuDS Map found at [redacted]

provides screening-level data that gives an indication of the suitability of the subsurface for infiltration SuDS features. This dataset indicates that the site may be suitable for the use of infiltration drainage.

Adoption and Maintenance of SuDS

West Northamptonshire Council as Lead Local Flood Authority does not currently adopt SuDS. In due course, the implementation of schedule 3 of the Flood and Water Management Act 2010 may introduce changes regarding the approval and adoption of SuDS if they meet a set of requirements.

If SuDS are designed purely to drain an adoptable highway then Northamptonshire Highways may adopt the SuDS feature. However each case is determined on its own merits and should be discussed with Northamptonshire Highways before any adoption assumptions are made. Please contact Northamptonshire Highways at:

- Section 38 Highway Adoption Queries – highwayadoptions.ncc@westnorthants.gov.uk
- Section 278 Queries – section278.ncc@westnorthants.gov.uk
- General queries pre-planning approval - highwaysdmconsultations@westnorthants.gov.uk

Anglian Water also has a SuDS Adoption Manual, which can be found here:

[redacted]

Developers can apply for Anglian Water to consider the adoption of your proposed SuDS scheme by submitting an expression of interest at:

[redacted]

The responsibility remains with the developer to ensure that adequate long-term maintenance of any drainage system can be delivered. Evidence should be submitted as part of any major planning application to demonstrate that agreements are in place for the entirety of the drainage system to be adopted and maintained in perpetuity.

There are four main options available to developers for the adoption and maintenance of SuDS:

1. The local sewerage undertaker/water company may adopt and maintain certain features;
2. Adoption could be agreed through a Section 106 agreement/ separate agreement with the borough, district, town or parish council and pay the Commuted Sums for the maintenance;
3. Set up or use a service management company; or
4. Adoption and maintenance by private individuals (only where the SuDS serve individual properties).

The adoption and maintenance of all drainage within a development would have to be discussed and agreed directly with the relevant Local Planning Authority.

Maintenance of land drainage

As the LLFA we do not hold information on the maintenance of surface water drainage assets. If you require information on assets held by National Highways, you can contact them here: info@nationalhighways.co.uk. If you require information on assets held by the riparian owner of the watercourse you will need to contact them directly.

Specific requirements for discharge rates for land drainage

It is not clear if the data request is using “land drains” to refer to a means of surface water management though perforated piping collecting drainage from below ground, or if the request is referring to “land drains” as overall land drainage/surface water manamangent. Should a connection to an existing drainage feature be proposed, we would recommend that you undertake suitable investigations to confirm its downstream capacity and condition.
Below outlines the discharge rate expectations for surface water management.

- For a Full planning application we would expect to see full WinDES modelling or similar with the details on proposed discharge rates, simulating storms through the whole drainage system, with results of critical storms, demonstrating that there is no surcharge in the system for the 1 in 1 year, no above ground flooding for the 1 in 30 year, and that any above-ground flooding for 1 in 100 year storm is limited to areas designated and safe to flood, away from sensitive infrastructure or buildings. These storms should also include an allowance for climate change. We may have further comments to make on receipt of this information.
- For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.
- For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event. If this is not possible then the rates should be reduced by at least 40% post-development to account for the impacts of climate change.
- Allowable discharge rates should be based only on the proposed impermeable area excluding public open space. Greenfield runoff rates may be estimated using the tool available [redacted] which requires the total site area, positively drained area and open space.

Should you require any further information, or wish to discuss these matters further, please do not hesitate to contact us.

Yours faithfully,

Patricia Cuervo Uría *MRTPI FCIWEM C.WEM*

For and on behalf of Colin Barrett, Head of Works, West Northamptonshire Council – Lead Local Flood Authority

Disclaimer:
This response is made by the Unitary Council in its capacity as a Lead Local Flood Authority as a statutory consultee. As a Lead Local Flood Authority (LLFA) we respond to Planning Applications considering where development has the greatest ability to affect flood risk. For the avoidance of doubt, we do not comment on

water quality, contaminated land/landfill, wastewater, risk of flooding from ground water, biodiversity and ecological impacts, fisheries, water framework directive, amenity, health & safety, or navigation.
These comments should be taken as general comments on surface water drainage only. A detailed review of any technical assessments, methodology and results has not been undertaken by the LLFA. Liability for such technical work therefore rests with organisation(s) who have undertaken this technical work and the Local Planning Authority responsible for the planning decision.

[i] Google Maps
[ii] England | Catchment Data Explorer
[iii] GeoIndex (onshore) - British Geological Survey
[iv] MAGIC
[v] Get flood risk information for planning in England - Flood map for planning - GOV.UK
[vi] Where do you want to check? - Check your long term flood risk - GOV.UK