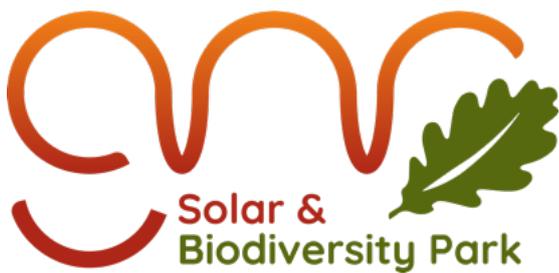


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## [Great North Road Solar and Biodiversity Park](#)

[Environmental Statement](#)

[Volume 4 – Technical Appendices](#)

[Technical Appendix A9.1 – Flood Risk Assessment](#)

[Document reference – EN010162/APP/6.4.9.1C](#)

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## A9.1.1 INTRODUCTION

### A9.1.1.1 BACKGROUND

- 1 This Technical Appendix (TA) presents the assessment of Flood Risk and surface water run-off management. This Flood Risk Assessment has been prepared as part of an Environmental Statement for a solar PV (the Development) located on land to the northwest of Newark, in the Newark and Sherwood district, Nottinghamshire, East Midlands, which comprise the Order Limits.
- 2 The Order Limits form the Core Study Area (CSA) for this assessment.
- 3 The areas within the CSA are described in ES Chapter 5, Development Description, [EN010162/APP/6.2.5] as being one of the following areas:
  - Work Area 1: Solar PV;
  - Work Area 2: Cables;
  - Work Area 3: Mitigation/enhancement;
  - Work Area 4: Intermediate substations;
  - Work Area 5a: BESS;
  - Work Area 5b: 400 kV Substation;
  - Work Area 6: National Grid Staythorpe Substation and connection point;
  - Work Area 7: Consented Staythorpe BESS and Connection; and
  - Work Area 8: Access Works.
- 4 The layout of the above areas, including field numbers, is shown on ES Figure 5.1 [EN010162/APP/6.3.5.1].
- 5 Following consultee feedback, the following changes to the Development layout have occurred:
  - Removal of Work Area 1 in Fields 16, 19, 20 - 30, 45 and 58;
  - Reduction in extent of Work Area 1 in Fields 0, 7, 13, 31, 35, 36, 38, 40, 42-47, 49, 51 - 53, 55 - 57 and 59;
  - Removal of sections of Work Area 2;
  - Removal of one substation in Work Area 4; and
  - Reduction in the Order Limits.
- 6 The Order Limits are located wholly within the administrative area of Newark and Sherwood District Council (NSDC).
- 7 Due to the rural setting in which the Order Limits are located, flooding from artificial sources (e.g., highways drainage) has been scoped out of the assessment, as set out at the PEIR stage.

### A9.1.1.2 CONSULTATION

- 8 As set out in Appendix E, the Development has been subject to consultation with the relevant authorities; namely the Environment Agency (EA), Nottingham County Council (as the Lead Local Flood Authority (LLFA)) and the Trent Valley Internal Drainage Board (Trent Valley IDB).
- 9 The LLFA confirmed in their response to the FRA presented in the PEIR that "*The Flood Risk Management Team has reviewed the Flood Risk Assessment (Technical Appendix A9.1) and is broadly satisfied with its content*". The EA and Trent Valley IDB have made a number of detailed



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comments in respect of hydrology, and have not commented on the methodology used.

- 10 Feedback received by those parties has been considered in the preparation of this assessment and it is understood that the approach and methodology to the assessment has been substantially agreed. Statements of Common Ground are being progressed with the EA and NCC and will seek to confirm agreement with each relevant party.

#### A9.1.1.3 METHODOLOGY

- 11 This FRA has been prepared with reference to data, documents and guidance published by the EA, the Lead Local Flood Authority (LLFA) (Nottinghamshire County Council) and the Local Planning Authority (NSDC).
- 12 Flood risk will be classed as Negligible (where little or no risk is identified), Low (where theoretical risk is identified but mitigating factors may influence flood levels) or Moderate to High (where modelled levels or historical events show risk to the Work Areas)).
- 13 Several factors will be considered when attributing the residual risk of flooding to the Development, including:
  - The depth of flooding;
  - The hazard to life during flood water ingress;
  - The velocity of floodwater;
  - Flooding extent / ingress;
  - Type of infrastructure affected; and
  - Intervening structures / flood protection.
- 14 The conclusion section of this FRA provides justification for the risk category using professional judgement and experience of assessing similar types of projects / scenarios. This approach is consistent with the Flood Risk Assessments prepared in support of a number of made DCOs including the Cleve Hill Solar Park DCO and the Mallard Pass Solar Park DCO, in which both the Examining Authority and Secretary of State were content with the approach adopted in the assessment methodology.

##### A9.1.1.3.1 Study Area

- 15 The Core Study Area is defined by the Order Limits. The Wider Study Area (WSA) is defined as a 5 km buffer of the Order Limits.
- 16 Where figures within this FRA show the CSA, this also refers to the Order Limits.

##### A9.1.1.3.2 Climate Change Allowances

###### A9.1.1.3.2.1 Fluvial

- 17 As the Development is Essential Infrastructure in Annex 3: Flood risk vulnerability classification - Guidance to the NPPF<sup>1</sup> and will have a lifespan of 40 years (anticipated to be decommissioned from 2069) the Development is required by the Environment Agency (EA) Flood risk assessments: climate

<sup>1</sup><https://www.gov.uk/guidance/national-planning-policy-framework/annex-3-flood-risk-vulnerability-classification>

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change allowances guidance<sup>2</sup> to account for a 23 % climate change (CC) allowance (Higher Central) for the 2050s epoch (2040-2069) for the Lower Trent and Erewash Management Catchment<sup>3</sup>.

- 18 Where fluvial modelling indicates that the required 23 % CC allowance is not available, then a higher proxy value will be used.
- 19 The Development has also been assessed against the Higher CC allowance of 38 % for the 2050s epoch as a validation check.

#### A9.1.1.3.2.2 Tidal

- 20 A 39 % CC (2050s epoch) allowance has been used to assess tidal flooding, while a 62 % CC allowance (2080s epoch) has been used as a validation check.

#### A9.1.1.3.2.3 Pluvial

- 21 The Lower Trent and Erewash Management Catchment peak rainfall Central Allowance of 25 % for the 2070s epoch will be used to assess pluvial flooding.

#### A9.1.1.3.2.4 SuDS

- 22 Whilst the Lower Trent and Erewash Management Catchment peak rainfall Central Allowance of 25 % for the 2070s epoch is required by the EA, consultation with the Lead Local Flood Authority (LLFA) highlighted that a 40 % CC allowance should be used where possible.
- 23 As such, a 40 % CC allowance will be used for Sustainable Drainage Systems (SuDS) structures such as those which will serve Work Area 5a, BESS, and 5b, 400 kV Compound.

#### A9.1.1.4 GUIDANCE AND LEGISLATION

- 24 This document is intended to meet the requirements of:
  - The EA<sup>4</sup>;
  - National Policy Statement (NPS) for Energy EN-1<sup>5</sup>;
  - NPS for Renewable Energy EN-3<sup>6</sup>;
  - NPS for Electricity Networks Infrastructure EN-5<sup>7</sup>;
  - Nottinghamshire Local Flood Risk Management Strategy (LFRMS) 2021-2027<sup>8</sup>;
  - NSDC Strategic Flood Risk Assessment (SFRA) Update (2016)<sup>9</sup>;

<sup>2</sup> <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

<sup>3</sup> <https://environment-test.data.gov.uk/hydrology/climate-change-allowances/river-flow?mgmtcatid=3052>

<sup>4</sup> <https://www.gov.uk/guidance/flood-risk-assessment-standing-advice>

<sup>5</sup> <https://www.gov.uk/government/publications/overarching-national-policy-statement-for-energy-en-1>

<sup>6</sup> <https://www.gov.uk/government/publications/national-policy-statement-for-renewable-energy-infrastructure-en-3>

<sup>7</sup> <https://www.gov.uk/government/publications/national-policy-statement-for-electricity-networks-infrastructure-en-5>

<sup>8</sup> <https://www.nottinghamshire.gov.uk/media/4346719/nottinghamshire-local-flood-risk-mangement-strategy-2021-27.pdf>

<sup>9</sup> <https://www.newark-sherwooddc.gov.uk/sfraupdate/>

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- The NSDC ENV 13 SFRA Level 1 Refresh (September 2023)<sup>10</sup>;
  - National Fire Chiefs Council (NFCC) – Grid Scale Battery Energy Storage System planning – Guidance for FRS;
  - NFCC – Grid Scale Battery Energy Storage System planning – Guidance for FRS – July 2024 Update<sup>11</sup>;
  - The National Fire Protection Association (NFPA) 855 Standard for the Installation of Stationary Energy Storage Systems<sup>12</sup>; and
  - The revised National Planning Policy Framework 2024 ('NPPF')<sup>13</sup>.
- 25 As outlined in NPS EN-1 (paragraph 5.8.15) the minimum requirements for FRAs are that they should be proportionate to the risk and appropriate to the scale, nature and location of the project. Importantly, this FRA should identify and secure opportunities to reduce the causes and impacts of flooding overall during the period of construction.
- 26 Throughout the early stages of the Development, design opportunities to identify existing pluvial flow pathways and extensive consultation with communities affected by pluvial flooding has been undertaken, with a view to identifying positive interventions to reduce the existing impacts of prolonged or intense rainfall events.

#### A9.1.1.5 SITE CHARACTERISTICS

- 27 The Order Limits are shown on ES Figure 5.1 [EN010162/APP/6.3.5.1] as being to the west of the A1, north of the A617, east of Eakring, south of Eganton, and to the north and north-west of Staythorpe. The Development essentially consists of discrete land parcels proposed to be occupied by solar PV panels and connected by cable route areas. The eastern side of the Development runs from the north of North Muskham to Eganton in the north. The western side of the Development runs north-west from National Grid Staythorpe Substation and then splits at Maplebeck, with spurs running to Eakring in the north-west and Kneesall to the north-northeast, then connecting with the eastern side of the Development.
- 28 The CSA is generally in arable use, interspersed with woodland and some minor areas of pastoral use, as shown in Plate A9.1.1.

<sup>10</sup> [https://www.newark-sherwooddc.gov.uk/media/nsdc-redesign/documents-and-images/your-council/planning-policy/local-development-framework/amended-allocations-and-development-management-dpd/SFRA\\_Level\\_1\\_P04.pdf](https://www.newark-sherwooddc.gov.uk/media/nsdc-redesign/documents-and-images/your-council/planning-policy/local-development-framework/amended-allocations-and-development-management-dpd/SFRA_Level_1_P04.pdf)

<sup>11</sup> <https://nfcc.org.uk/>

<sup>12</sup> <https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=855>

<sup>13</sup> <https://www.gov.uk/government/publications/national-planning-policy-framework--2>

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**Plate A9.1.1: Greenfield areas - arable conditions west of Maplebeck**



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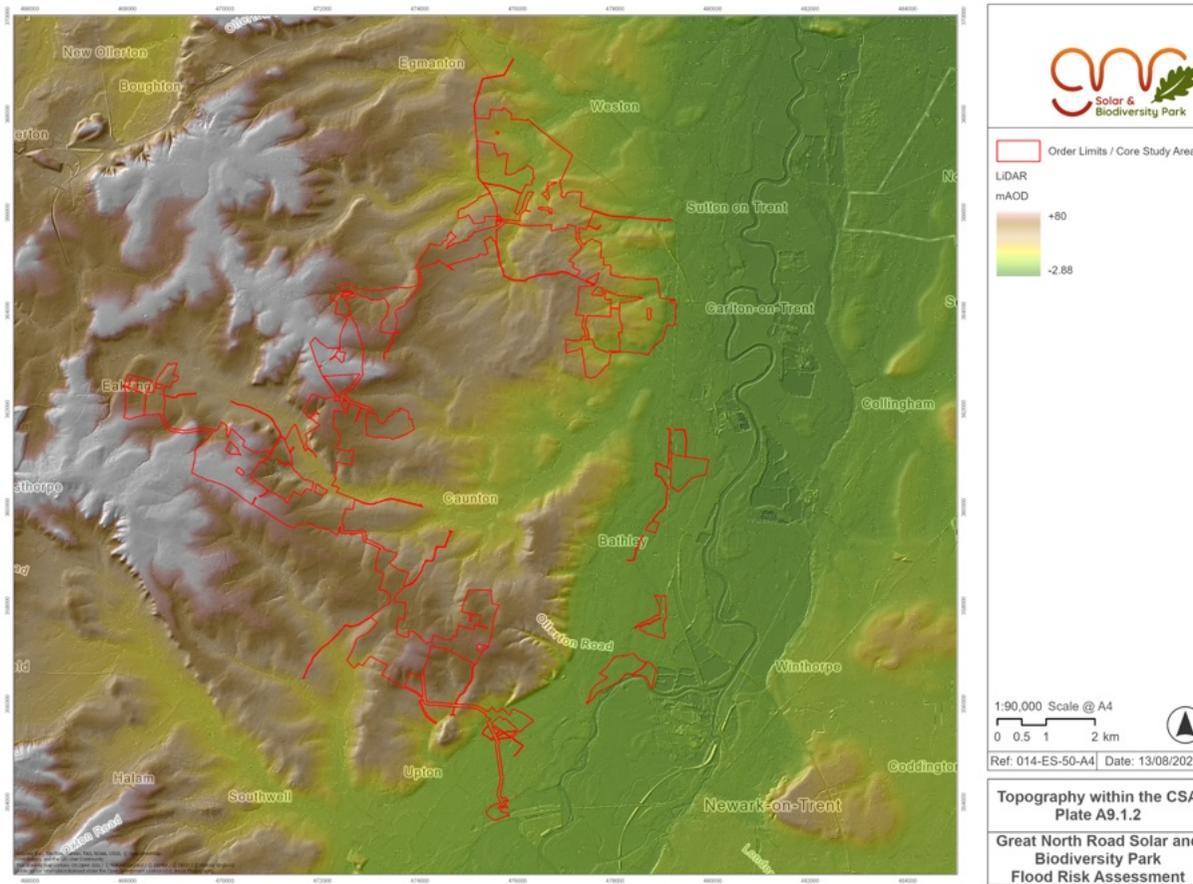
1 m resolution Lidar data<sup>14</sup> shows that land within the CSA is generally gently sloping, with elevations from 6.85 m AOD in the west to 92.43 m AOD in the east, as shown in Plate A9.1.2.

<sup>14</sup> <https://environment.data.gov.uk/survey>

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#### A9.1.1.6 FLOOD CLASSIFICATION

- 29 The EA Flood Map for Planning (2025)<sup>15</sup> shows that the CSA is mostly located in Flood Zone (FZ) 1 (89.81 %), while 10.19 % lies in FZ 2 and FZ 3, as shown in Figure A9.1 in Appendix D, which assumes all watercourses are flooded at the same time and is represented by the EA's NaFRA2 data. The following Work Areas are located outside FZ 2, FZ 3 and the future floodplain:
- Work Area 1: Solar PV (based on illustrative design, [with the exception of Field E8](#));
  - Work Area 4: Intermediate Substations;
  - Work Area 5a: BESS; and
  - Work Area 5b: 400 kV substation.
- 30 As identified in the SFRA, minor areas of the CSA are located within the functional floodplain (Flood Zone 3b), specifically Work Area 3: Mitigation, Work Area 6: National Grid Staythorpe Substation and connection point, Work Area 7: Consented Staythorpe BESS and Connection and Work Area 8: Access, as shown in Figure A9.2 in Appendix C.
- 31 The NaFRA2 dataset<sup>16</sup> includes the 3.33 % AEP Defended CCP1 outline as the future functional floodplain, with the extents being very similar to the SFRA functional floodplain and is shown in Figure A9.3 in Appendix C.
- 32 No Solar PV or new aboveground ancillary infrastructure will be located in the functional or future floodplain.

#### A9.1.1.7 FLOOD DEFENCES

- 33 Existing flood defences are located adjacent to the River Trent and River Greet and are shown on Figure A9.4 in Appendix C and in Appendix A (EA Consultation).
- 34 The left (west) bank of the River Trent is flanked by embankments and naturally high ground which have a Standard of Protection between 1:2 and 1:10 (50 % annual exceedance probability (AEP) and 10 % AEP)<sup>17</sup>.
- 35 The operational National Grid Staythorpe Substation (Work Area 6) has a private flood defence scheme, which comprises 'hard' engineered walls and 'soft' spoil embankments to a level of 13.10 m AOD, as part of NSDC planning application 14/00091/ELE<sup>18</sup>.
- 36 The EA Asset Management Database<sup>19</sup> shows that the defences adjacent to the River Trent have not been accounted for in the Flood Map for Planning.

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<sup>15</sup> <https://flood-map-for-planning.service.gov.uk/>

<sup>16</sup> <https://www.gov.uk/guidance/updates-to-national-flood-and-coastal-erosion-risk-information>

<sup>17</sup> <https://environment.data.gov.uk/asset-management/index.html>

<sup>18</sup> <https://publicaccess.newark-sherwooddc.gov.uk/online-applications/applicationDetails.do?activeTab=documents&keyVal=MZPFEZLB08200>

<sup>19</sup> <https://environment.data.gov.uk/asset-management/index.html>

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### A9.1.1.8 PLUVIAL FLOODING

- 37 The Flood Risk Assessments: Climate Change Allowances Guidance (Environment Agency 2022)<sup>20</sup> state that ‘for modelling large areas (larger than 5 square kilometres) with rural land use, direct rainfall modelling is unlikely to be appropriate’. As such, the initial constraints process used the best available dataset, which is the EA pluvial flood depth datasets (Risk of Flooding from Surface Water 2025), which do not apply a CC allowance, as shown in Figure A9.5 in Appendix C.
- 38 Depths are shown on Figure A9.6 in Appendix C for specific areas of the CSA.
- 39 Pluvial flood depths and flow routes at Calton-on-Trent (amongst other locations) have been verified by direct rainfall method (DRM) 2D pluvial flood modelling in Flood Modeller Pro using the parameters outlined in Table A9.1.1.

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**Table A9.1.1: 2D Pluvial Flood Model Parameters – Carlton-on-Trent**

<b>Return Period</b>	1 % AEP
<b>Storm Duration</b>	3 hours
<b>Season</b>	Summer
<b>FEH Rainfall Design Depth</b>	55.314 mm
<b>Rural runoff</b>	55 %
<b>CC Allowance – Central 2070s<sup>21</sup></b>	25 %
<b>Drainage / Infiltration Allowance (0 or 12 mm)</b>	0 mm <sup>22</sup>
<b>Manning’s n Values</b>	<ul style="list-style-type: none"> <li>• Floodplain - mature row crops<sup>23</sup>: 0.035;</li> <li>• Roads: 0.01;</li> <li>• Buildings: 0.01; and</li> <li>• Woodland: 0.1.</li> </ul>
<b>Model Timestep</b>	0.5 second
<b>Grid Resolution</b>	2 m
<b>Height Data</b>	1 m LiDAR, 2022
<b>Data Stamping (OS MasterMap)</b>	<ul style="list-style-type: none"> <li>• Buildings – Raise +2 m; and</li> <li>• Roads – Depress -0.1 m.</li> </ul>
<b>Mass Error</b>	0.0 %
<b>Largest Courant (Cr) Value</b>	3.5

<sup>20</sup> <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>

<sup>21</sup> <https://environment-test.data.gov.uk/hydrology/climate-change-allowances/rainfall?mgmtcatid=3052>

<sup>22</sup> Monte Carlo approach used to derive the national default 12 mm per hour drainage rate value disappplied due to rural catchment

<sup>23</sup> Manning’s n for Channels (Chow, 1959)

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- 40 Storm durations used in modelling reflect the nature of the catchment assessed. As the CSA is predominantly rural, the peak 1 % AEP event has been assessed in accordance with the parameters outlined within the Table in Section 4.2.1 of the EA's *What is the Risk of Flooding from Surface Water map? Report* (version 2.0 April 2019).
- 41 An Active area for the 2D domain was chosen based on the area of interest, i.e., areas modelled to flood on the EA's pluvial flood depth datasets (Risk of Flooding from Surface Water Depth).
- 42 Outputs from Flood Modeller, using the Alternating Direction Implicit (ADI) solver on a 2 m grid resolution, show a good correlation with the EA's modelling (also see Figure A9.6) for the area upslope of Carlton-on-Trent, as shown in Figure A9.7 in Appendix C.

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**A9.1.1.9 RESERVOIR FLOODING**

- 43 The eastern section of the CSA is modelled to flood should there be a breach in the retaining walls of the reservoirs outlined upstream of the CSA, specifically those identified in Table A9.1.2.

**Table A9.1.2: Reservoirs which could affect the CSA in a breach event**

Reservoir name	Approx. Distance to CSA
Blithfield	75 km south west
Carsington	45 km west
Derwent	59 km north west
Foremark	51 km south west
Howden	59 km north west
Ladybower	48 km north west

- 44 The extent of reservoir flooding which interacts with the CSA largely follows the corridor of the River Trent. The Fluvial Contribution and Wet Day scenarios are shown in Figure A9.8 in Appendix C.
- 45 Should there be a breach of reservoir retaining walls when river levels are within normal range, then only a very minor area of the CSA, in proximity to Work Area 7, Consented Staythorpe BESS and Connection, is modelled to be within the flood extent, as shown in Figure A9.9 in Appendix C.
- 46 The SFRA identifies reservoirs within the administrative area of the LLFA and these are noted to be downstream of the CSA, and are listed in Table A9.1.3.

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**Table A9.1.3: Reservoirs downstream of the CSA**

Reservoir name	Approx. distance to CSA	Catchment
Ash Buffer Lagoon, Besthorpe	3.1 km east	River Trent
Rufford Lake	4.1 km west	River Maun
Sherwood Forest Lake	4.8 km west	River Maun

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South Farm Reservoir 1	10.2 km north west	River Maun
South Farm Reservoir 2	10.2 km north west	River Maun
Thoresby Lake (Upper)	11.2 km north west	River Maun
Thoresby Lake	11.1 km north west	River Maun

**A9.1.1.10 FLOOD HISTORY**

- 47 Anecdotal evidence suggests that the eastern section of the CSA has previously flooded from fluvial sources, principally the River Trent.
- 48 The EA historic flood outline dataset also indicates that the CSA has previously flooded, as shown in Figure A9.10 in Appendix C.
- 49 Only minor areas of the CSA, and no areas of Work Area 1 – PV Arrays or the substations or BESS areas, have flooded since 2000, as shown in Figure A9.11 in Appendix C.
- 50 From public feedback, attendance at Parish Council meetings and NCC’s Section 19 reports (reports which investigate significant flood events), it is evident that areas surrounding the CSA have previously flooded from pluvial sources, with the following communities affected:
  - Maplebeck<sup>24</sup>;
  - Sutton-on-Trent<sup>25,26</sup>;
  - Carlton-on-Trent<sup>27</sup>;
  - Weston; and
  - Caunton<sup>28</sup>.
- 51 2D direct rainfall modelling has been undertaken for this FRA in Flood Modeller to verify surface water flow pathways and predict flood depths during a range of storm return periods for several communities in proximity to the CSA.
- 52 The area around Maplebeck was initially investigated as an area of concern following feedback from the Parish Council regarding the existing pluvial flood risk and the effects of Storm Babet (October 2023).  
 The Flood Modelling exercise for Maplebeck is discussed in Section A9.1.3.2 of this FRA.

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**A9.1.1.11 FLOOD STUDIES**

- 53 Following feedback received from the EA during the Scoping stage, outputs from a number of flood studies within the Wider Study Area were obtained, including:
  - Tidal Trent, Jacobs, (2023);
  - Trent and Tributaries at Newark SFRM2 (2011), Halcrow, July 2011 plus the EA climate change (2020 rerun);

<sup>24</sup> <https://www.nottinghamshire.gov.uk/media/fbznep5u/maplebeck-s19-storm-babet-oct-2023.pdf>  
<sup>25</sup> <https://www.nottinghamshire.gov.uk/media/vvhcdwlc/sutton-on-trent-s19-storm-babet-oct-2023.pdf>  
<sup>26</sup> <https://www.nottinghamshire.gov.uk/media/1529265/suttonontrentsection19flooding.pdf>  
<sup>27</sup> <https://www.nottinghamshire.gov.uk/media/1494226/carlton-on-trent-section-19-report.pdf>  
<sup>28</sup> <https://www.nottinghamshire.gov.uk/media/yqjcq1z/caunton-s19-storm-babet-oct-2023.pdf>

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- Mill Dam Dyke, Tidal Trent Tributaries, Jeremy Benn Associates (JBA) (2022);
- River Greet, Nottingham Tributaries SFRM, JBA (2014);
- River Maun at Mansfield, HR Wallingford (2021); and
- Slough Dyke, Tidal Trent Tributaries, JBA (2022).

54 Outputs from the River Maun, Slough Dyke and Mill Dam Dyke do not encroach on the CSA and are therefore not discussed further within this FRA.

55 Catchments for each of the flood studies is shown on Figure A9.12 in Appendix C.

56 Where the Development is located in Flood Zone 1 and is sufficiently distant from a watercourse e.g. not in proximity to The Beck and Moorhouse Beck, national scale modelling has been utilised and validated against the EA's CCP1 climate change dataset (23 % CC uplift) [or Flood Zone 2 \(0.1 % AEP\)](#) to assess the risk of flooding in those areas.

57 Watercourses which interact with the Order Limits are not close enough to be influenced by other watercourses during a flood event, either in isolation or if they were to flood at the same time. It should also be noted that the River Trent is not a rapid response catchment due to the wide area which it drains, meaning the smaller tributaries which are located within and close to the Order Limits will transfer water downstream more rapidly than the River Trent and therefore [its](#) influence on water levels within the tributaries is limited. Structures, such as the A1, East Coast Mainline Railway embankments and culverts / bridges also limit the influence and flood extent of the River Trent.

#### A9.1.1.12 TIDAL TRENT

58 Outputs from the Tidal Trent, Jacobs, (2023) Flood Study show that the extents for the tidally dominated 0.5 % AEP 2021 (Upper End) scenario do not encroach upon the CSA, as shown in Figure A9.13 in Appendix C.

59 The fluvially dominated 1 % AEP + 39 % CC (2050s epoch) and 62 % CC (for the 2080s epoch (2070 – 2125)) defended scenario outputs show that a minor section of Work Area 3, Mitigation / Enhancement, shown to be diverse grassland on the Sitewide Plan of the LEMP, would flood to a depth of 0.6 m, as shown in Figure A9.14 in Appendix C.

60 No other work areas are located in the fluvially dominated 1 % AEP + 62 % CC defended scenario extent.

61 The Combined Breach of defences outline shows that whilst several breach scenarios marginally encroach upon the eastern section of the CSA, no flood outline extends into any of Work Area other than Work Area 3, Mitigation / Enhancement, proposed to be diverse grassland, as shown in Figure A9.15 in Appendix C.

#### A9.1.1.13 FLUVIAL TRENT

62 Outputs from the Trent and tributaries at Newark SFRM2 Flood Study show that the extents of the 1 % AEP event do not encroach upon the Solar PV area (Work Area 1) and marginally encroaches on the Consented Staythorpe

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BESS and Connection (Work Area 7) and National Grid Substation Connection Point (Work Area 6) as shown on Figure A9.16 in Appendix D.

- 63 As the Development will have an operational life of 40 years the Development is required to be assessed against the 1 % AEP + 23 % CC allowance in accordance with 2050s Higher Central allowance for the Lower Trent and Erewash Management Catchment. In the absence of a modelling study incorporating a 23 % CC allowance the 1 % AEP + 30 % CC event has been used as a proxy and the extents encroach further into the eastern section of the CSA and specifically into Work Area 3, Mitigation / Enhancement, Work Area 6, National Grid Staythorpe Substation, and Work Area 7, Consented Staythorpe BESS and Connection compared to the 1 % AEP as shown in Figure A9.17 in Appendix C.

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- 64 Work Area 1 (Solar PV Area) has been designed to avoid the 1 % AEP + 30 % CC and 39 % CC extent, based on the illustrative design.

- 65 Figure 9.18 in Appendix C, shows that new above ground development in Work Areas 1 and 4 (e.g. Solar PV, substations etc.) have been located outside the 1 % AEP 2036-2069 flood extent.

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- 66 The Canal and River Trust are currently in the process of building two variable height weir structures at points along the River Trent, with these being used to generate hydroelectric power. Hydroelectric schemes will have a failsafe whereby the weir can be lowered during flooding events, and therefore the schemes should have no impact on flooding to the Development. This failsafe mechanism means the weirs pose no flood risk to the Development and are not considered further within this FRA.

#### A9.1.1.14 RIVER GREET

- 67 The Flood Map for Planning shows that the eastern access track to the BESS/400 kV Compound (Work Area 5a and 5b) borders Flood Zone 2 and 3, as shown in Plate A9.1.39.

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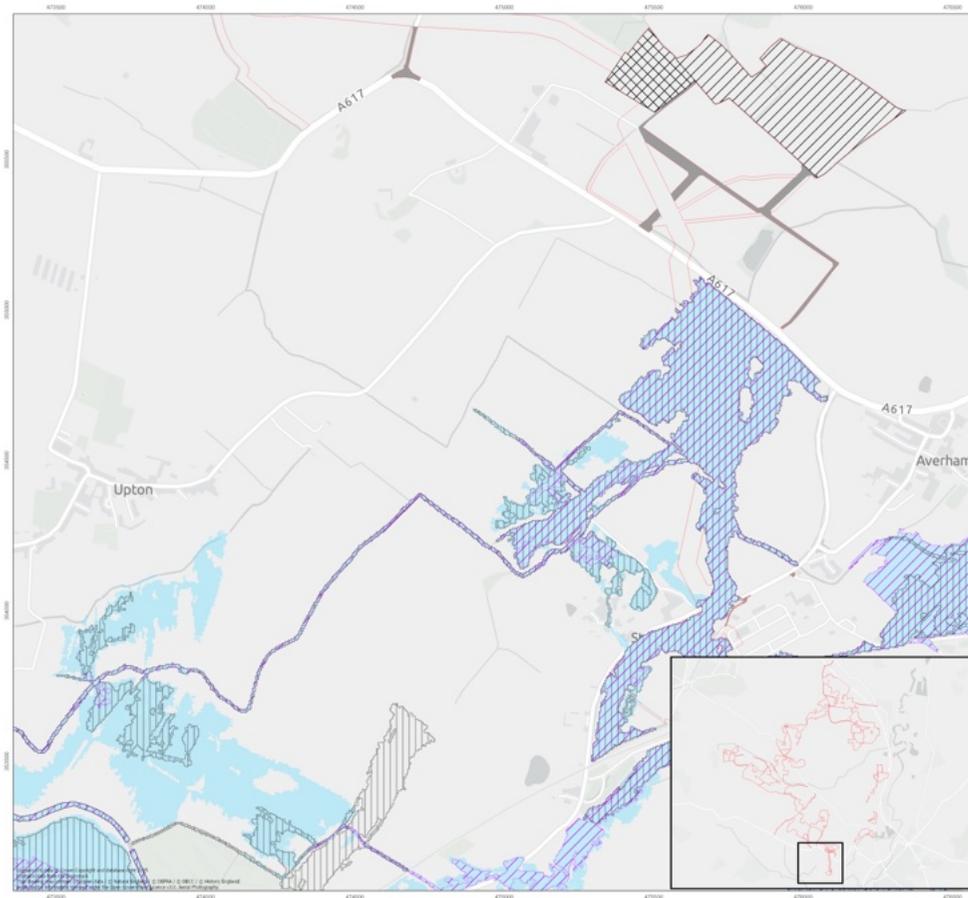
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- 68 Outputs from the River Greet Flood Study (JBA 2014) and the River Greet Climate Change Scenarios, (EA 2021) show that the 1 % AEP, 1 % AEP + 50 % CC and the 0.1 % AEP events only encroach upon the southern section of the CSA, specifically the Consented Staythorpe BESS (Work Area 6) and National Grid Substation Point of Connection (Work Area 7), but does not encroach upon the Solar PV Arrays (Work Area 1), Intermediate Substations (Work Area 4) and BESS (Work Area 5a), as shown in Plate A9.1.4.

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-  Order Limits / Core Study Area
-  Works Area 5a: BESS
-  Works Area 5b: 400kV Substation
-  Works Area 8: Access
-  1% AEP
-  1% AEP + 50% cc
-  0.1% AEP

1:15,000 Scale @ A4  
 0 100 200 400 m   
 Ref: 014-ES-030b-A4 | Date: 13/08/2025

**Modelled River Greet Flood Extents - JBA 2014 and EA 2021 Plate A9.1.4**  
**Great North Road Solar and Biodiversity Park Flood Risk Assessment**

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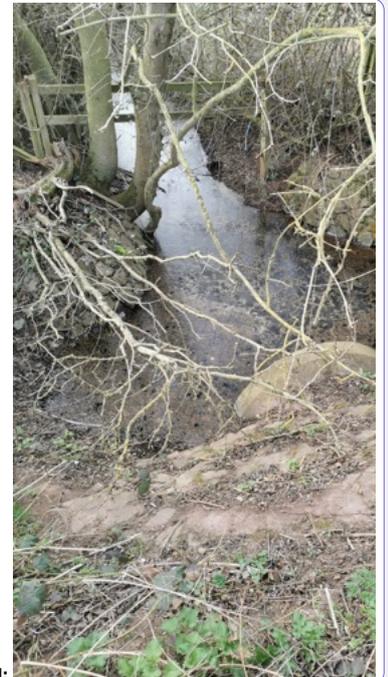
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- 69 As such the discrepancy between the pre-NaFRA2 Flood Map for Planning and the outputs from the River Greet flood studies was queried with the EA who responded stating *"We are sorry that we cannot explain why Flood Zone 3 is of a lesser extent than the 2004 1 % AEP JFLOW outline to the north west of Averham. Flood Zone 3 in the wider area has utilised part of the River Greet 2008 model but this is of a smaller extent than the current Flood Zone 3 as shown below (Flood Zone 3 in darker blue and the 1% AEP 2008 River Greet model in lighter blue). The Flood Zone outline does not align to a modelled outline or recorded flood outline. The Flood Zones in this area were last updated in 2014 and unfortunately our records do not answer your question."* (see Appendix A).
- 70 Following a meeting with the EA, it was suggested that whilst the source of the discrepancy could not be fully ascertained, the source of flooding could possibly be attributed to flood waters from Car Dyke / Pingley Dyke. To verify this Raincloud undertook a 1D-2D linked hydrological model of the watercourse in 2024, derived from LiDAR. The model was updated in March 2025 to include a culvert carrying the A617, following consultation comments on the Preliminary Environmental Information Report (PEIR) from the EA.
- 71 The culvert was surveyed on 28<sup>th</sup> March 2025 by Greenhatch Group and is shown in Plate A9.1.5.

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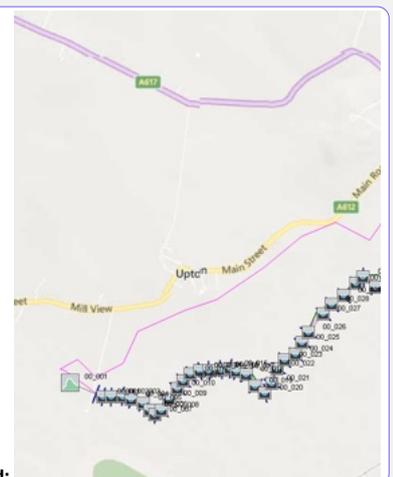
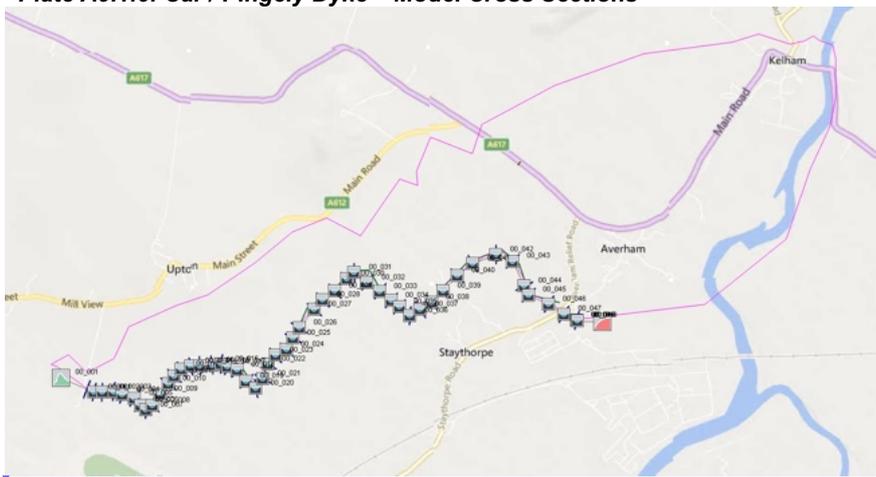
**Plate A9.1.5: Culvert under A617 (southern side)**



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72 Cross sections and the active model area (pink outline) are shown in Plate A9.1.6, while the model parameters are provided in Table A9.1.4.

**Plate A9.1.6: Car / Pingely Dyke – Model Cross Sections**



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73 The culvert has been modelled using the following parameters which are derived from survey:

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Id	Name	Node 1	Node 2	Structure Type	Sub-type	Length	Include bend	Invert drop	Edit	Distribution Factor
0	CulvertMar25_FromSur...	0.ci	0.cond.DS	Culvert	Circular	30	<input type="checkbox"/>	0.240		1

CONDUIT CIRCULAR: 0.cond.US

**Node Label**  
 0.cond.US

**Comment :**

**Geometry**  
 Distance to Next Conduit:  Elevation Of Invert:  Diameter:

**Friction**  
 Equation:  Value Below Axis:  Value Above Axis:

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Id	Name	Node 1	Node 2	Structure T
0	CulvertMar25_FromSur...	0.ci	0.cond.DS	Culvert

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 0.cond.US

**Comment :**

**Geometry**  
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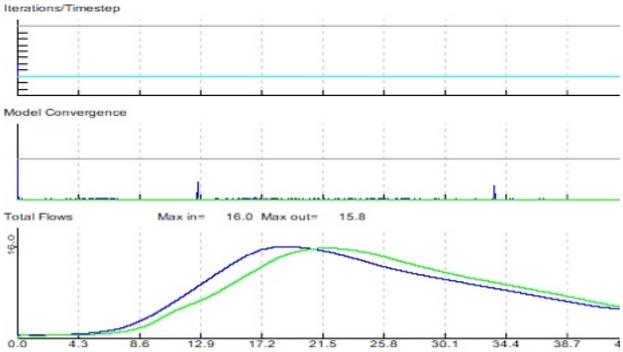
**Friction**  
 Equation:  Value Below Axis:  Value Above Axis:

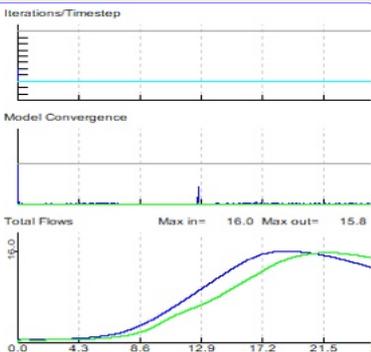
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**Table A9.1.4: 1D-2D modelling parameters**

<b>Return Period</b>	1 % AEP
<b>Storm Duration</b>	43 hours
<b>Season</b>	Summer
<b>FEH Hydrograph</b>	 <p>Iterations/Timestep</p> <p>Model Convergence</p> <p>Total Flows Max in= 16.0 Max out= 15.8</p> <p>Datafile: ...014_GNR\FM\CARDYKE\NETWORK\CARDYKE_1AEP.DAT              Results: ...FM\CarDyke\1D\1D_CARD_UNSTEADY_1AEP.zzi              Ran at 21:02:40 on 30/08/2024              Ended at 21:03:48 on 30/08/2024              Start Time: 0.000 hrs              End Time: 43.000 hrs              Timestep: 1.0 secs</p> <p>Current Model Time: 43.00 hrs              Percent Complete: 100 %</p> <p>Simulation time elapsed (s): 40</p> <p>run completed</p> <p>Number of unconverged timesteps: 0              Proportion of simulation unconverged: 0.00%</p> <p>***** Mass balance summary *****              Mass balance calculated every 300.0s</p> <p>Initial volume: 5495.73 m3              Final volume: 26133.9 m3</p> <p>-----              Total boundary inflow : 0.131259E+07m3              Total boundary outflow : 0.129184E+07m3              Total lat. link inflow : 0.00000 m3              Total lat. link outflow: 0.00000 m3</p> <p>-----              Max. system volume: 108661. m3              Max. [volume] increase: 103165. m3              Max. boundary inflow: 16.0460 m3/s              Max. boundary outflow: 15.7780 m3/s</p> <p>-----              Net increase in volume: 20638.2 m3              Net inflow volume: 20754.2 m3              Volume discrepancy: 116.078 m3              Mass balance error: -0.11% (of peak system volume)              Mass balance error [2]: -0.01% (of boundary inflow volume)</p> <p>***** End mass balance summary *****</p> <p>Writing binary results to D:\Raincloud\Projects\014_GNR\FM\CarDyke\1D\1D_CARD_UNSTEADY_1AEP.zzn              outputting max/min/means to D:\Raincloud\Projects\014_GNR\FM\CarDyke\1D\1D_CARD_UNSTEADY_1AEP.mmm              Convergence plot saved to D:\Raincloud\Projects\014_GNR\FM\CarDyke\1D\1D_CARD_UNSTEADY_1AEP_005.bmp</p> <p>Peak flow: 16.046 m<sup>3</sup>/s</p>



Iterations/Timestep

Model Convergence

Total Flows Max in= 16.0 Max out= 15.8

Datafile: ...014\_GNR\FM\CARDYKE\NETWORK\CARDYKE\_1AEP.DAT  
 Results: ...FM\CarDyke\1D\1D\_CARD\_UNSTEADY\_1AEP.zzi  
 Ran at 21:02:40 on 30/08/2024  
 Ended at 21:03:48 on 30/08/2024  
 Start Time: 0.000 hrs  
 End Time: 43.000 hrs  
 Timestep: 1.0 secs

Current Model Time: 43.00 hrs  
 Percent Complete: 100 %

Simulation time elapsed (s): 40

run completed

Number of unconverged timesteps: 0  
 Proportion of simulation unconverged: 0.00%

\*\*\*\*\* Mass balance summary \*\*\*\*\*  
 Mass balance calculated every 300.0s

Initial volume: 5495.73 m3  
 Final volume: 26133.9 m3

-----  
 Total boundary inflow : 0.131259E+07m3  
 Total boundary outflow : 0.129184E+07m3  
 Total lat. link inflow : 0.00000 m3  
 Total lat. link outflow: 0.00000 m3

-----  
 Max. system volume: 108661. m3  
 Max. [volume] increase: 103165. m3  
 Max. boundary inflow: 16.0460 m3/s  
 Max. boundary outflow: 15.7780 m3/s

-----  
 Net increase in volume: 20638.2 m3  
 Net inflow volume: 20754.2 m3  
 Volume discrepancy: 116.078 m3  
 Mass balance error: -0.11% (of peak system volume)  
 Mass balance error [2]: -0.01% (of boundary inflow volume)

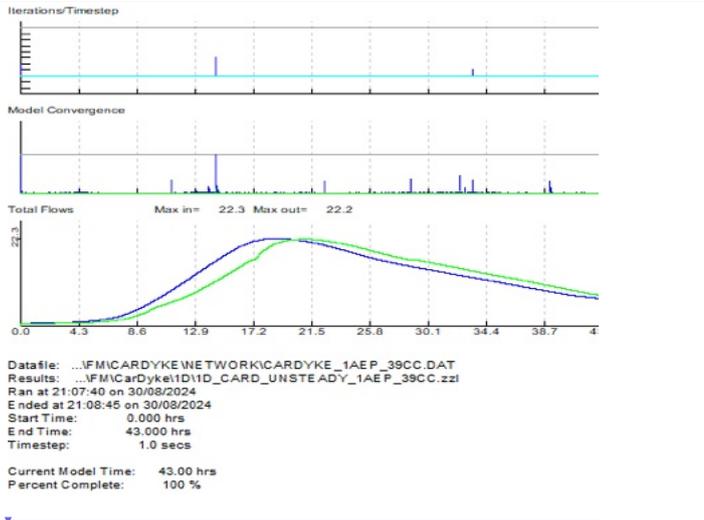
\*\*\*\*\* End mass balance summary \*\*\*\*\*

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 Convergence plot saved to D:\Raincloud\Projects\014\_GNR\FM\Ca

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**CC Allowance – Central 2080s**  
**39 %**



```
Simulation time elapsed (s):      39
run completed

Number of unconverged timesteps: 0
Proportion of simulation unconverged: 0.00%

***** Mass balance summary *****
Mass balance calculated every 300.0s

Initial volume:      5495.73 m3
Final volume:        38922.9 m3
-----
Total boundary inflow : 0.182412E+07m3
Total boundary outflow : 0.179063E+07m3
Total lat. link inflow : 0.00000 m3
Total lat. link outflow: 0.00000 m3
-----
Max. system volume:  156777. m3
Max. [volume] increase: 151282. m3
Max. boundary inflow: 22.3040 m3/s
Max. boundary outflow: 22.1705 m3/s
-----
Net increase in volume: 33427.2 m3
Net inflow volume:      33491.1 m3
Volume discrepancy:     63.9531 m3
Mass balance error:     -0.04% (of peak system volume)
Mass balance error [2]: -0.00% (of boundary inflow volume)

***** End mass balance summary *****

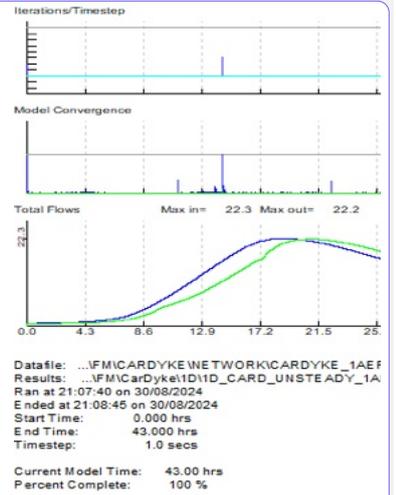
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outputting max/min/means to D:\Raincloud\Projects\014_GNR\FM\CarDyke\1D\1D_CARD_UNSTEADY_1AEP_39CC.mmm
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Peak flow: 22.304 m<sup>3</sup>/s

**Boundaries**

Upstream: QT  
 Downstream: Normal Depth

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```
Simulation time elapsed (s):      39
run completed

Number of unconverged timesteps: 0
Proportion of simulation unconverged: 0.00%

***** Mass balance summary *****
Mass balance calculated every 300.0s

Initial volume:      5495.73 m3
Final volume:        38922.9 m3
-----
Total boundary inflow : 0.182412E+07m3
Total boundary outflow : 0.179063E+07m3
Total lat. link inflow : 0.00000 m3
Total lat. link outflow: 0.00000 m3
-----
Max. system volume:  156777. m3
Max. [volume] increase: 151282. m3
Max. boundary inflow: 22.3040 m3/s
Max. boundary outflow: 22.1705 m3/s
-----
Net increase in volume: 33427.2 m3
Net inflow volume:      33491.1 m3
Volume discrepancy:     63.9531 m3
Mass balance error:     -0.04% (of peak system volume)
Mass balance error [2]: -0.00% (of boundary inflow volume)

***** End mass balance summary *****

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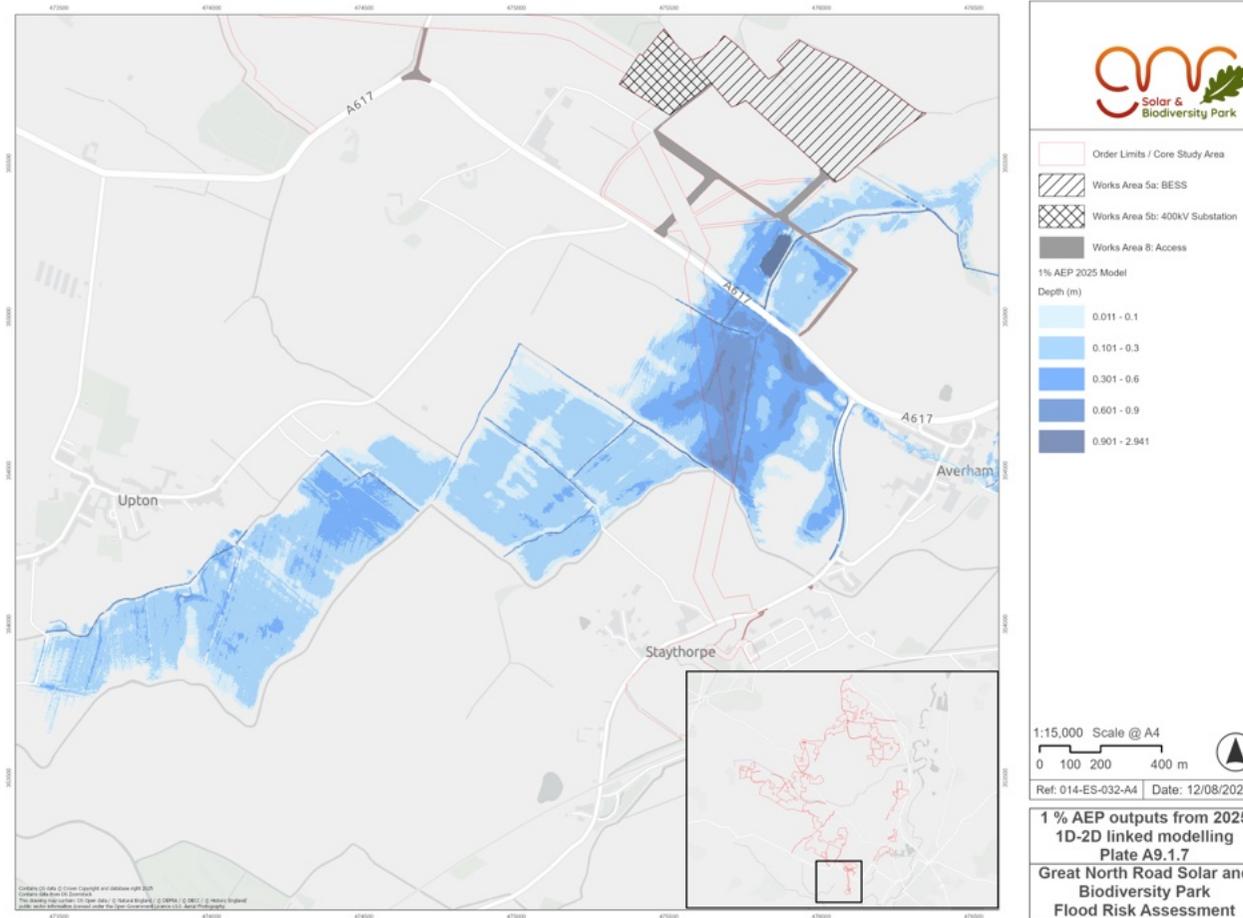
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<b>Drainage / Infiltration Allowance (0 or 12 mm)</b>	0 mm <sup>29</sup> (Green-Ampt not applied)
<b>Manning's n Values</b>	<ul style="list-style-type: none"> <li>Floodplain - mature row crops<sup>30</sup>: 0.035</li> <li>Channel - clean, straight, full stage, no rifts or deep pools: 0.03</li> </ul>
<b>Model Timestep</b>	1 second
<b>Grid Resolution</b>	2 m
<b>Height Data</b>	1 m LiDAR, 2022
<b>Data Stamping (OS MasterMap)</b>	None
<b>1D Mass Error</b>	0.11 %
<b>Largest Courant (Cr) Value</b>	2.4

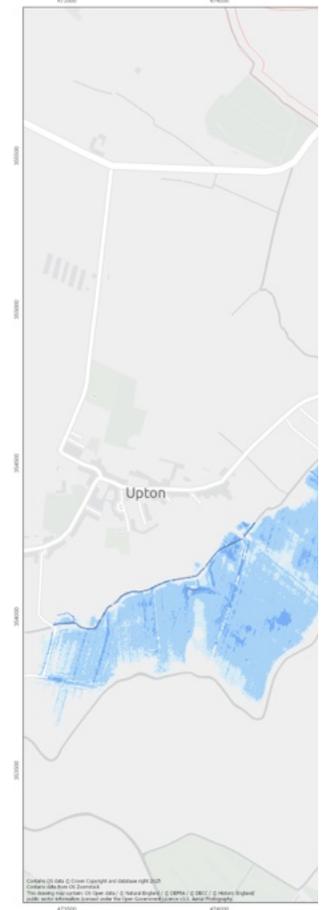
- 74 Flood extents from the initial analysis show a good correlation with the outputs from the NaFRA2 data (see Plate A9.1.19), whereby the embankment on the south side of A617 Road acts as a topographical barrier to flood flows, with flows constricted north via the culvert under the A617, as shown in Plates A9.1.7 and A9.1.8.
- 75 Flood extents for the 1 % AEP and 1 % AEP +39 % CC do not encroach into Work Areas 5a or 5b.

<sup>29</sup> Monte Carlo approach used to derive the national default 12 mm per hour drainage rate value disappplied due to rural catchment  
<sup>30</sup> Manning's n for Channels (Chow, 1959)

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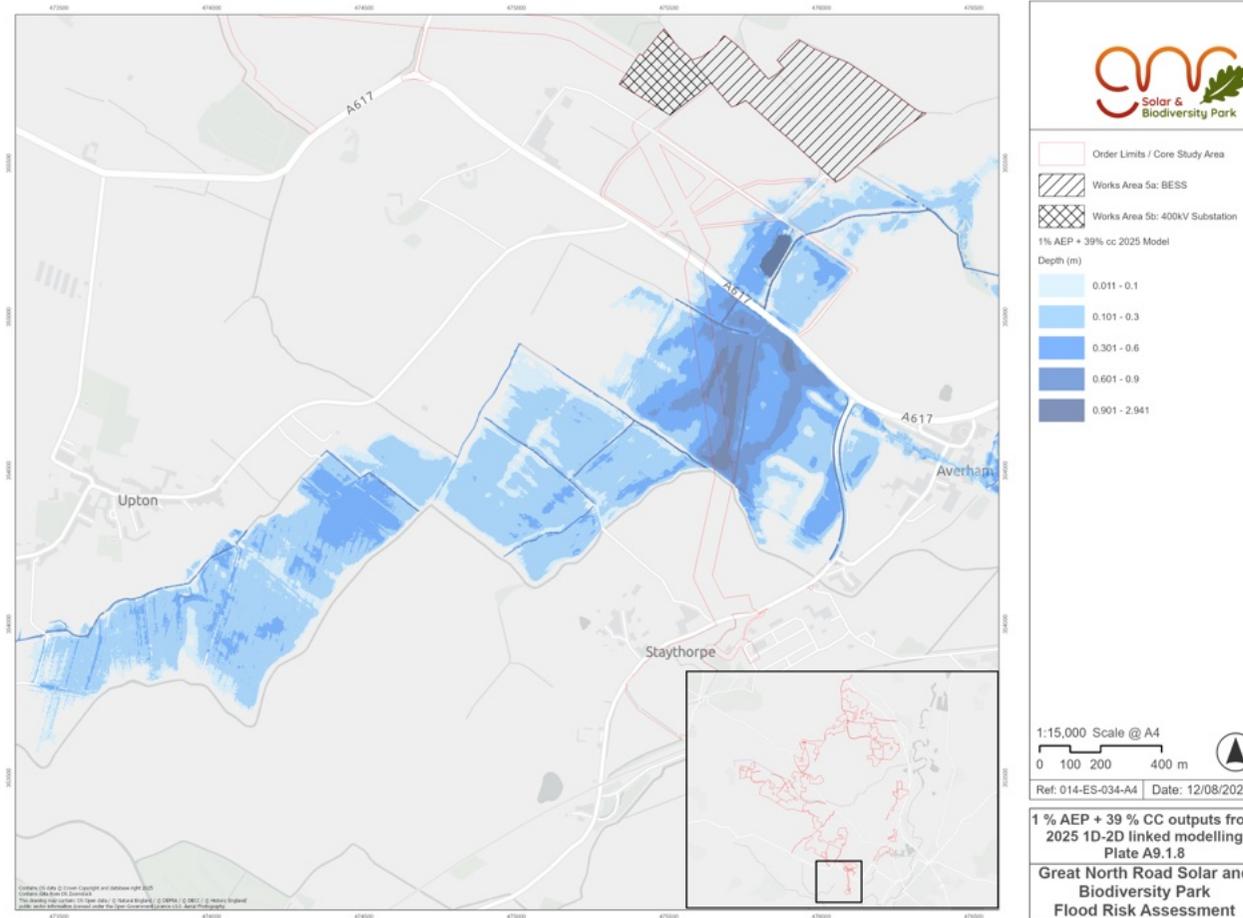


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## A9.1.2 FLOOD RISK ASSESSMENT

### A9.1.2.1 TIDAL

- 76 Outputs from the Tidal Trent 2023 flood model (see section 1.10) show that the CSA would not flood during both the 0.5 % AEP (2121 UE scenario) with defences in place and 0.5 % AEP flood defence breach scenarios, ensuring the Development would be safe for its lifetime (40 years, through to 2067 from the assumed commission date of 2027).
- 77 The fluvially dominated 1 % AEP + 62 % CC defended scenario outputs show that a minor section of Work Area 3, Mitigation/Enhancement (Fields 18 and 390) would flood to a depth of 0.6 m.
- 78 Works Area 3, Mitigation/Enhancement, will comprise grassland in the affected area. As such, the minor area located in the tidal flood extent is compatible with the EA's "Working with natural processes to reduce flood risk 2024" Flood and Coastal Erosion Risk Management (FCERM) research report<sup>31</sup>.
- 79 No other Work Area is located within the tidal flood extents of the River Trent.
- 80 As such, the risk of the Development flooding from tidal sources is Negligible.

### A9.1.2.2 FLUVIAL

- 81 The majority of Work Area 1: Solar PV, based on the illustrative layout, is located outside Flood Zones 2 and 3, with the exception of Field E8, which is in Flood Zone 2, as of 28<sup>th</sup> November 2025.
- 82 Regardless, flood zones do not account for CC and as such, each source of flooding is assessed in the following sections in accordance with the NPPF and NPS documents.
- 83 As the Development is Essential Infrastructure and will have a lifespan of 40 years (anticipated to be decommissioned from the end of 2069) the Development is required to account for a 23 % CC allowance for the 2050s epoch (2040-2069) for the Lower Trent and Erewash Management Catchment.

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#### A9.1.2.2.1 River Trent (Fluvial)

- 84 As shown in Plate A9.1.4, the only aspect of the Development located within the 1 % AEP flood extents of the River Trent is Work Area 3, Mitigation / Enhancement, which will comprise grassland, scrub, scattered trees and an orchard. As such, this is compatible with the EA's "Working with natural processes to reduce flood risk 2024" FCERM report.
- 85 The 1 % AEP extent also marginally encroaches into Work Area 6: National Grid Staythorpe Substation, which has private flood defences, and Work Area 7: Consented Staythorpe BESS and Connection, which included flood

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<sup>31</sup> [https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/working-with-natural-processes-to-reduce-flood-risk-2024?utm\\_medium=email&utm\\_campaign=govuk-notifications-topic&utm\\_source=a06ab0c7-b939-430c-a4b4-14734d0c1c23&utm\\_content=weekly](https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/working-with-natural-processes-to-reduce-flood-risk-2024?utm_medium=email&utm_campaign=govuk-notifications-topic&utm_source=a06ab0c7-b939-430c-a4b4-14734d0c1c23&utm_content=weekly)



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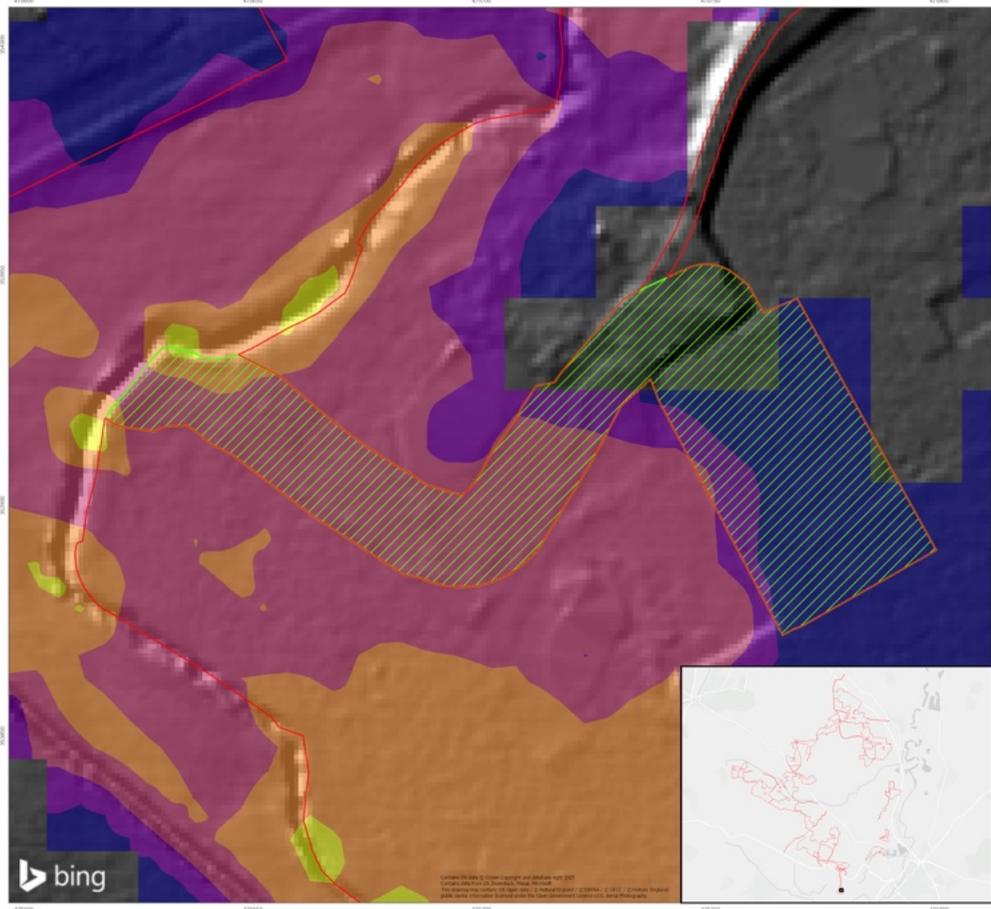
resilient design as part of NSDC planning application reference numbers 22/01840/FULM and 24/01261/FULM).

#### **A9.1.221.1 Climate change scenarios**

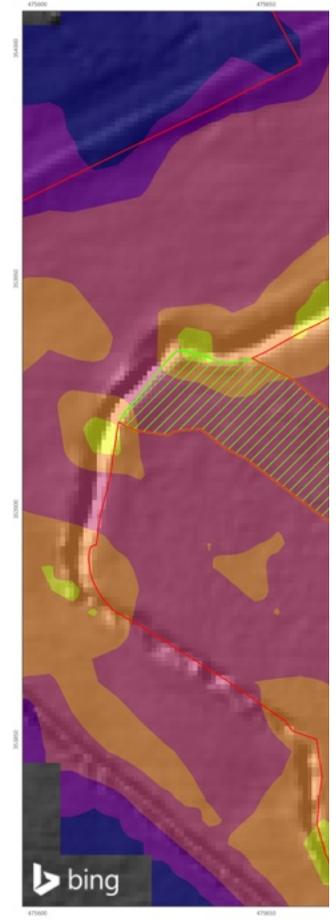
- 86 The A46 upgrade DCO application to the east of the CSA has modelled the 1 % AEP + 39 % CC (2080s epoch Central Allowance) flood scenario for the fluvial River Trent. Outputs from the model, made available by Skanska, show that there is a marginal increase in the extent of flooding (within the CSA) during the 1 % AEP + 39 % CC (2080's epoch Central Allowance) flood scenario compared to the 30 % CC scenario, as shown in Figure A9.19 in Appendix C.
- 87 Compared to the 30 % CC scenario, the 39 % CC allowance leads to a marginal increase in the extent of areas modelled to flood within Work Area 6: National Grid Staythorpe Substation, as shown in Plate A9.1.9.

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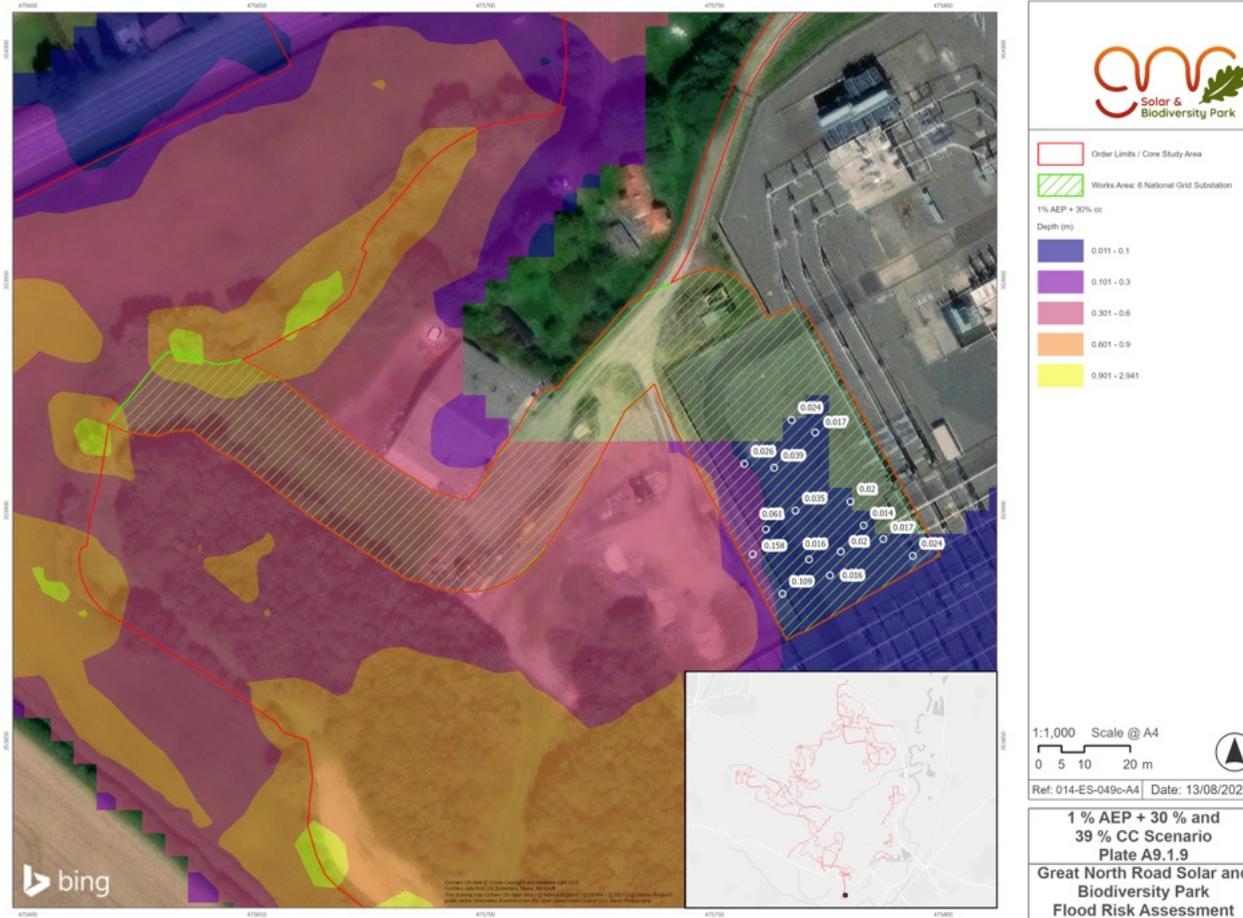
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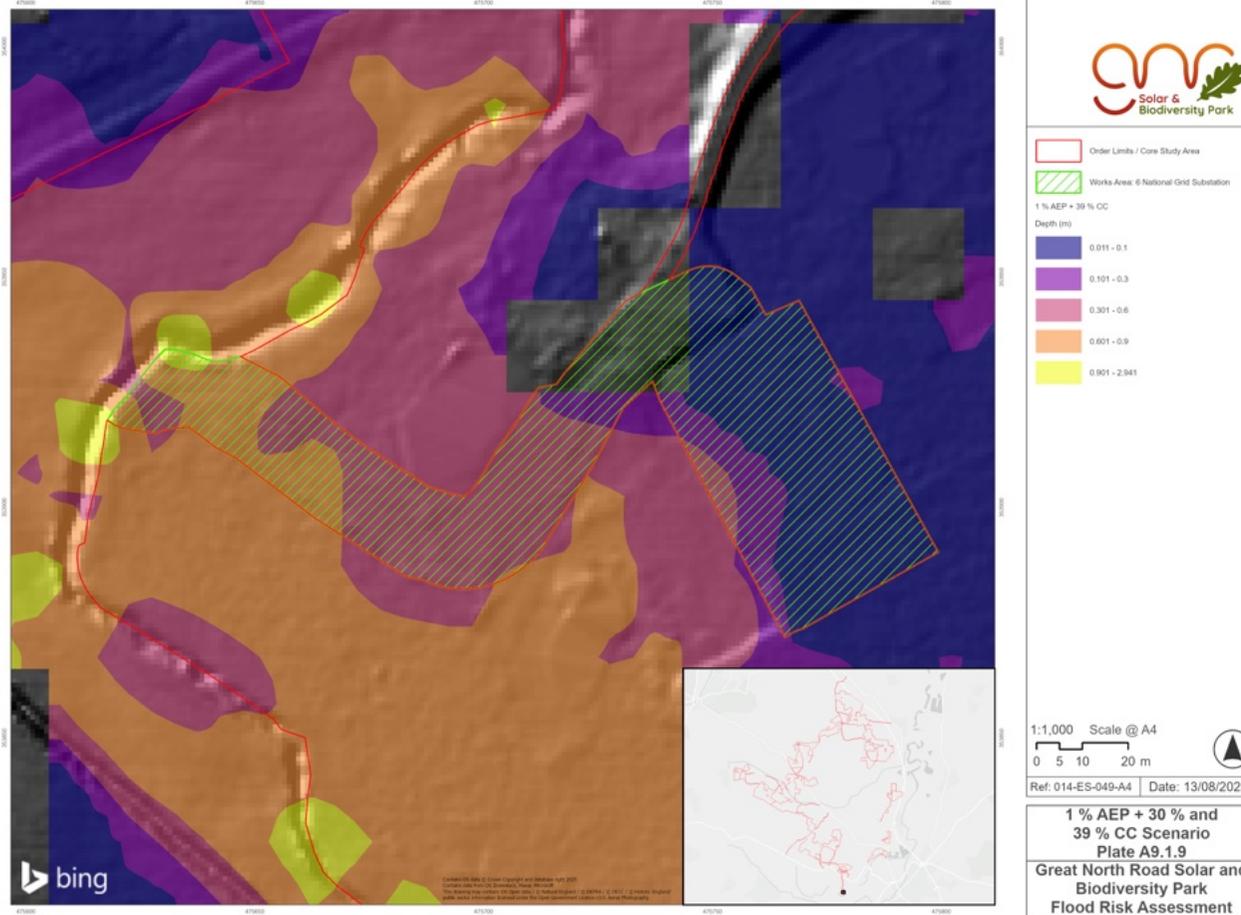


1 % AEP + 30 % and  
 39 % CC Scenario  
 Plate A9.1.9  
 Great North Road Solar and  
 Biodiversity Park  
 Flood Risk Assessment

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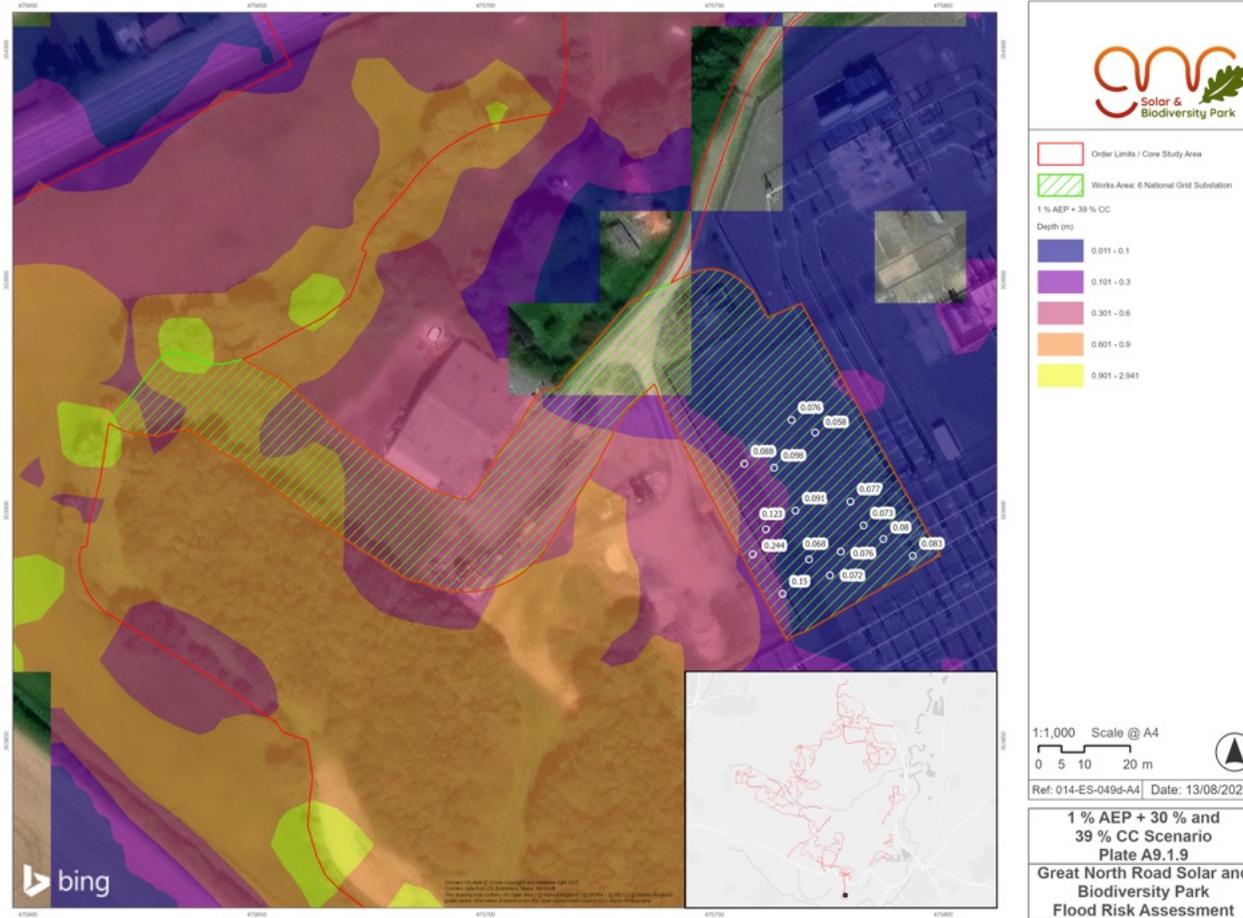
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- 88 The EA 1 % AEP undefended CCP1 dataset ([Central allowance for 2080s epoch32](#)) has been used as a validation tool and shows Work Area 6 is almost entirely located outside the flood extent (i.e. the main platform area), as shown in Figure A9.20 in Appendix C.
- 89 Given the time-limited nature of the operational phase of the Development, the conservative approach of applying 30 % CC allowance, in the absence of the 23 % CC allowance for the 2050s epoch, is acceptable and should there be a delay in the completion of the construction of the Development, resulting in the operational phase extending into the 2080s epoch, then the design of the Development will ensure compliance with the 39 % CC allowance i.e., no electrically sensitive equipment flush to ground, as shown in Plate A9.1.10 which illustrates a typical arrangement within substations.

**Plate A9.1.10: Typical substation connection arrangement**



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- 90 All new aboveground infrastructure i.e. solar PV (Works Area 1), substations (Work Area 4), BESS and substation compound (Work Area 5a and 5b), are located outside the 1 % AEP + 39 % CC extent from the River Trent.
- 91 Work Area 2, Cables, (including jointing bays) will be below ground and will therefore not influence conveyance or displace floodwater.
- 92 Work Area 3, Mitigation/Enhancement areas located within the flood extent of the River Trent 1 % AEP + 30 % CC, will comprise grassland, scrub, orchard, scattered trees and arable fields. As such, this is compatible with the EA's "Working with natural processes to reduce flood risk 2024" FCERM research report. No dense planting (woodland or orchards will be planted in Flood Zone 3).
- 93 Work Area 6: National Grid Staythorpe Substation is located within the 1 % AEP + 23 % CC extent (30 % CC used as proxy) and is mostly modelled to flood to depths of less than 0.1 m (i.e. within the main platform area), as shown in Plate A9.1.26.
- 94 Similarly, using the 39 % CC allowance as a sense check, Work Area 6 could flood to a nominal depth of less than 0.1 m (i.e. within the main platform area).

32 <https://ckan.publishing.service.gov.uk/dataset/rivers-and-sea-defended-and-undefended-flood-risk-extents-climate-change#:~:text=Climate%20change%20scenarios,flooding%20from%20rivers>

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- 95 The National Grid Staythorpe Substation has private hard (walls) and soft (embankments) defences to a level of 13.10 m AOD. As such, Work Area 6 is unlikely to be inundated during the 1 % AEP + 30 % CC and 39 % CC events, should the Development operate marginally into the 2080s epoch.
- 96 Work Area 7, Consented Staythorpe BESS and Connection, will utilise the existing infrastructure associated with the Staythorpe BESS (construction due to commence at the time of writing). The Staythorpe BESS design included flood resilience measures and the critical aspects of the scheme are located outside the 1 % AEP + 30 % CC and 39 % CC extents. As such, connecting the Development in Work Area 7 to the existing 400 kV infrastructure will be within an area not modelled to flood during the 1 % AEP + 30 % CC and 39 % CC event.
- 97 Work Area 8, Access, will utilise existing roads or be flush to the existing ground level and will therefore not influence conveyance or displace floodwater.
- 98 The commitment in the oEMP is that should the Development lifetime be anticipated to extend into the 2080s epoch, as a result of delays to the construction programme for example, then modelling will be undertaken in year 2069 using the appropriate climate change allowances at the time, in consultation with the EA (and other regulators). Should modelling results show that the Development has the potential to interact with flood depths then the Development design will be altered accordingly to ensure that flood storage and conveyance is maintained for the River Trent. This could involve raising the PV Arrays (subject to negligible loss of storage and conveyance), the removal of the first row of panels on a PV table or removing the mounting system and associated infrastructure from the modelled extent.
- 99 As such, the risk of flooding from the River Trent (fluvial) is Low.

#### A9.1.2.2.2 Moorhouse Beck

- 100 Only Work Area 2, Cables, i.e., below-ground structures and Work Area 3: Mitigation / Enhancement are located within the 1 % AEP flood extents of Moorhouse Beck.
- 101 Work Area 1 and 4 have been located outside of Flood Zones 2 and 3 and the future floodplain ([2080's central allowance](#)) associated with Moorhouse Beck, as shown in Figure A9.21 in Appendix C.
- 102 Wrack marks, as shown in Plate A9.1.11, were observed along the stretch of Moorhouse Beck adjacent to Fields 0 and 57 to be at less than 50 % channel depth following a persistent rainfall event (week commencing 30th September 2024), where the area received 175 % of the 1991-2020 average rainfall in September 2024<sup>33</sup>, suggesting a capacity to convey substantial flows without becoming bankful.

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<sup>33</sup> [https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/summaries/mwr\\_2024\\_09\\_for\\_print\\_v1.pdf](https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/summaries/mwr_2024_09_for_print_v1.pdf)

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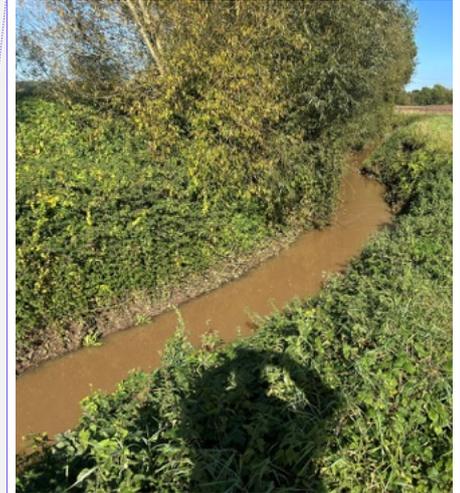
**Plate A9.1.11: Wrack marks on Moorhouse Beck following persistent rainfall**



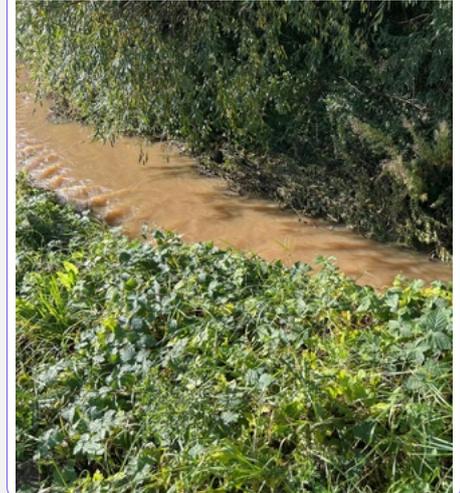
103 Plate A9.1.12 shows a cross section through the floodplain suggesting that should Moorhouse Beck overtop its banks then floodwater will spread over a wide flat area to shallow depths, and not interact with electrically sensitive infrastructure in Work Area 1, Solar PV.

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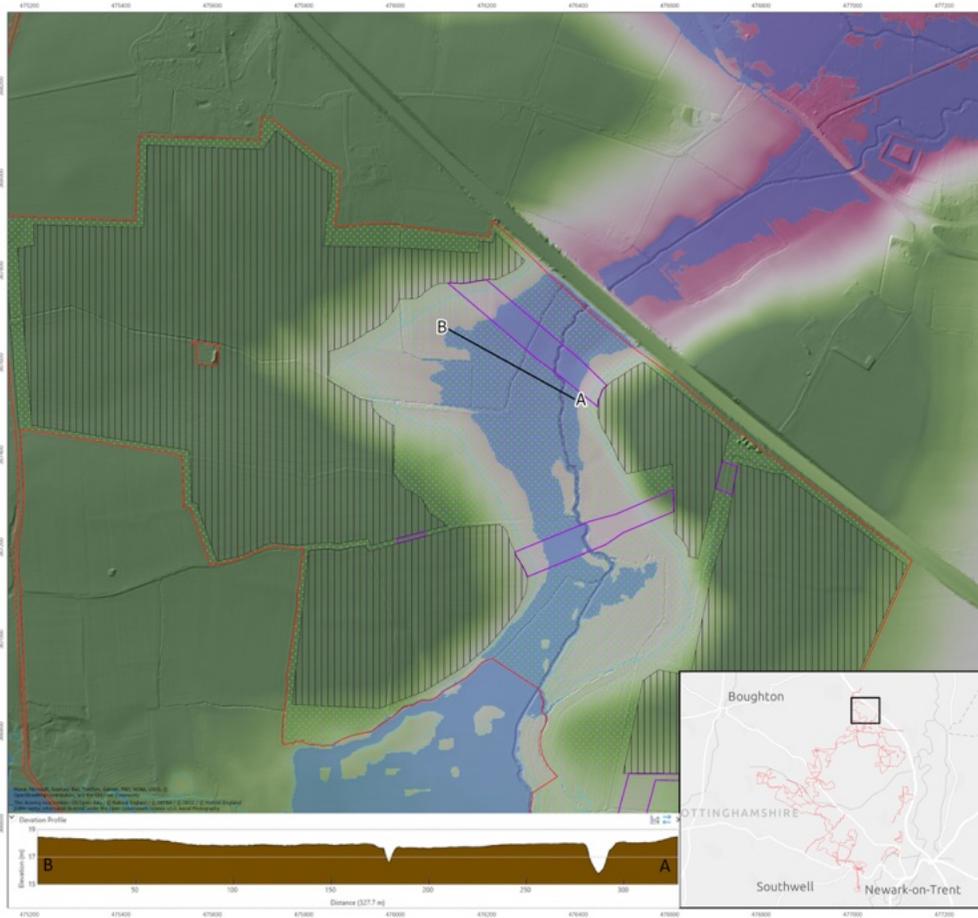
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105 Whilst Work Area 3, Mitigation/Enhancement, is located within the floodplain of Moorhouse Beck. Work Area 3 will comprise grassland, scrub and scattered trees. No blocks of woodland are located in Flood Zone 3. As such, this is compatible with the EA's "Working with natural processes to reduce flood risk 2024" FCERM research report.

106 As such, the risk of flooding from Moorhouse Beck is Negligible.

#### **A9.1.2.2.3 River Greet, Pingley / Car Dyke**

107 As outlined in Section A9.1.1.13, the A617 Road acts as a topographical barrier which restricts floodwater from the River Greet and Pingley Dyke from propagating north via a culvert towards Work Area 5a, BESS, and 5b, 400 kV Compound.

108 1D-2D modelling shows that no aspect of Work Area 5a or 5b are located within the extents of the 1 % AEP + 39 % CC event.

109 Similarly, Work Area 6 (excluding potential underground cable area) is located outside the extents of the 1 % AEP + 30 % CC and 50 % CC extents.

110 One of the two access routes (Work Area 8) to Work Area 5a is located within the 1 % AEP + 39 % CC extent and has a maximum depth of 0.14 m. Velocities are mostly below 0.1 m/s.

111 As such, the risk of flooding at Work Area 5a is Low.

112 The risk to the Development from the River Greet / Pingley Dyke is therefore Low.

#### **A9.1.2.2.4 Ordinary Watercourses**

113 The ordinary watercourses which border Work Area 5a and 5b are flanked by a raised earth banks on the southern side of the channel which provide a bank top level of 1.35 m from the base of the agricultural ditches, while the top width ranges from 3 m to 3.5 m (3 m avalanche probe for reference), as shown in Plate C9.1.

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**Plate C9.1: Ordinary Watercourses and embankments – Work Area 5**



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114 Whilst the ordinary watercourses contained water following 23 mm<sup>34</sup> of rainfall in the preceding 24 hours before the site walkover, flow was very slow suggesting they do not respond rapidly. Additionally, no standing water was observed within Work Area 5.

115 Observations and measurements of the ordinary watercourse to the north of Work Area 5a show a relatively uniform channel profile and depth for the entire length of the watercourse.

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1 [34 Calverton Rain Gauge](#)

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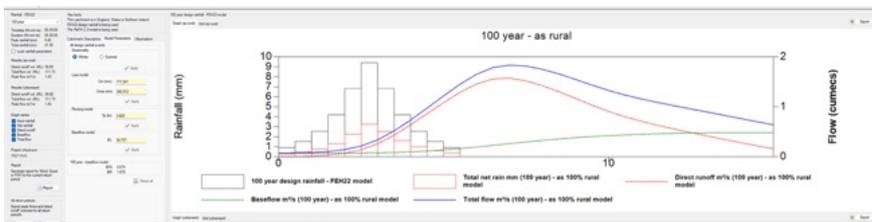
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116 Based on the Manning's equation for open channels, the top bank height is above the 1 in 100 year plus 39 % CC peak water level as shown in Table A9.1.5, based on a peak flow of 2.54 m<sup>3</sup> (1.83 m<sup>3</sup> + 39 %) derived from the ReFH2 method using 2022 FEH data, shown in Plate C9.2 and a catchment of 2.7 km<sup>2</sup>, which is likely to provide a conservative estimate of flow.

**Table A9.1.5: 1 % AEP + 39 % CC Peak level ordinary watercourses at BESS – Manning Equation for Open Channel**

<b>Mannings Formula for Open Channel Flow</b>				
Watercourse Gradient 1 in	100			
Bed Width	0.75	m	So	0.01
			A	1.529707
Water Depth	0.859	m	P	3.433602
Bank Slope 1 in	1.2		m	0.445511
			V	1.666624
Roughness (n)	0.035		Q	2.549446

**Plate C9.2: 1 % AEP peak flow – ReFH2.3 method**



117 As such, the ordinary watercourses at the BESS have sufficient capacity to convey flows without overtopping towards Work Area 5a during the 1% AEP + 39 % CC design event and the risk to and from the Development is Low.

**A9.1.2.3 PLUVIAL**

- 118 The majority (89.3 %) of the CSA is located outside areas classified as at risk of pluvial flooding for the 1 % AEP event, based on the EA Risk of Flooding from Surface Water (RoFSW) mapping.
- 119 Electrically sensitive infrastructure, such as inverters, will be located outside the 3.3 %, 1 % and 1 % AEP surface water flooding extent, as shown in Plate A9.1.7 of this FRA.
- 120 The CSA is in agricultural (arable and pastoral) use, however it is known that some areas are prone to generating substantial surface water run-off during extreme or prolonged rainfall events, which has been evidenced by properties downslope of the CSA being flooded.

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**A9.1.2.3.1 Work Area 1: Solar PV**

The majority of Work Area 1 has been sited to avoid pluvial flood pathways and areas of pooling. Table A9.1.5 identifies fields in Work Area 1, Solar PV, Area are identified by the EA as being at risk of pluvial flooding, to depths of more than 0.3 m (filters out isolated modelled cells).

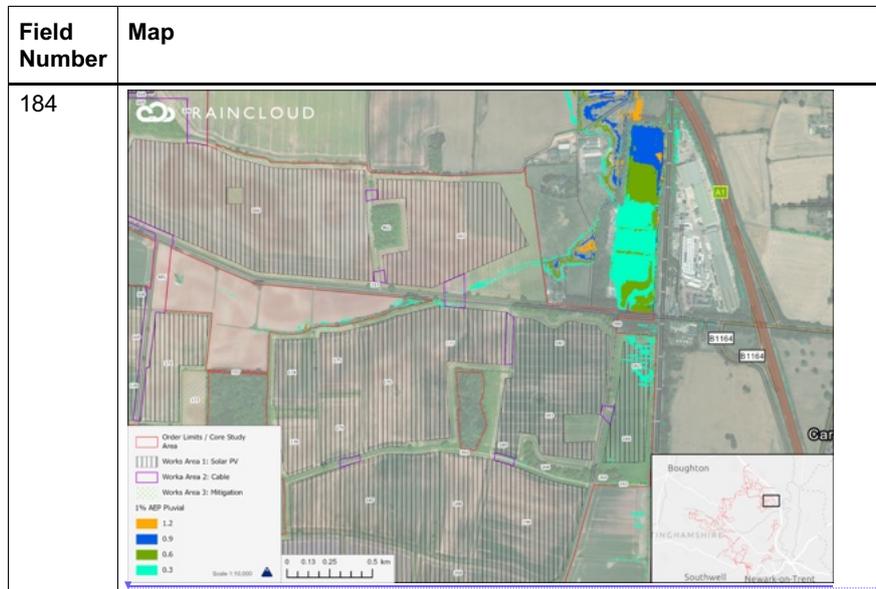
**Table A9.1.5: Work Area 1 over 0.3 m pluvial depth**

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96 and 104	

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121 PV arrays will have a leading edge (bottom edge of panels) raised off ground level by approximately 0.5 m, with the exception of areas modelled to flood to a depth of 0.5 m or higher for the 1 % AEP + 25 % CC event (in accordance with Lower Trent and Erewash Management Catchment peak rainfall allowances (2070s)), whereby the leading edge will be higher, to allow for 300 mm freeboard to account for residual uncertainty in the modelling.

122 Pluvial flood depths have been verified by 2D direct rainfall modelling, as shown on Figure A9.7a in Appendix C: 1 % AEP Flood Depths – Raincloud 2D Modelling and Figure A9.7b in Appendix C: 1 % AEP + 25 % CC Flood Depths – Raincloud 2D Modelling of this FRA.

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123 As such, the impact of pluvial flooding on Work Area 1, Solar PV, will be Negligible.

#### A9.1.2.3.2 Work Area 2: Cables

124 Cables will be located underground in waterproof ducting. Areas of cable trench excavations will not be left open for considerable periods of time therefore limiting the potential interaction with surface water.

125 As such the risk of pluvial flooding is Negligible.

#### A9.1.2.3.3 Work area 3: Mitigation/Enhancement

126 Work Area 3 is reserved for enhancement measures and these will be cognisant of existing flood risk from pluvial sources, and grassland upslope of these areas within these areas will serve to improve the downstream effects of run off.

127 As such, the risk of flooding to Work Area 3 is Negligible.

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128 The beneficial impacts of enhancement on pluvial flooding are discussed in Section A9.1.3.

#### **A9.1.2.3.4 Work Area 4: Intermediate Substations**

129 No areas of Work Area 4: Substations are located within the modelled 0.1 % AEP pluvial outline.

130 As such the risk of pluvial flooding is Negligible.

#### **A9.1.2.3.5 Work Area 5a BESS**

131 As outlined in Section A9.1.1.7, sections of Work Area 5a, BESS, is located within an area modelled to be at risk of pluvial flooding, as shown on the EA long term flood risk map.

132 The EA pluvial flood map depths have been verified through 2D direct rainfall analysis for the 1 % AEP and 1 % AEP + 25 % CC, 3-hour event using FEH data, as shown in Plates A9.1.13 and A9.1.14.

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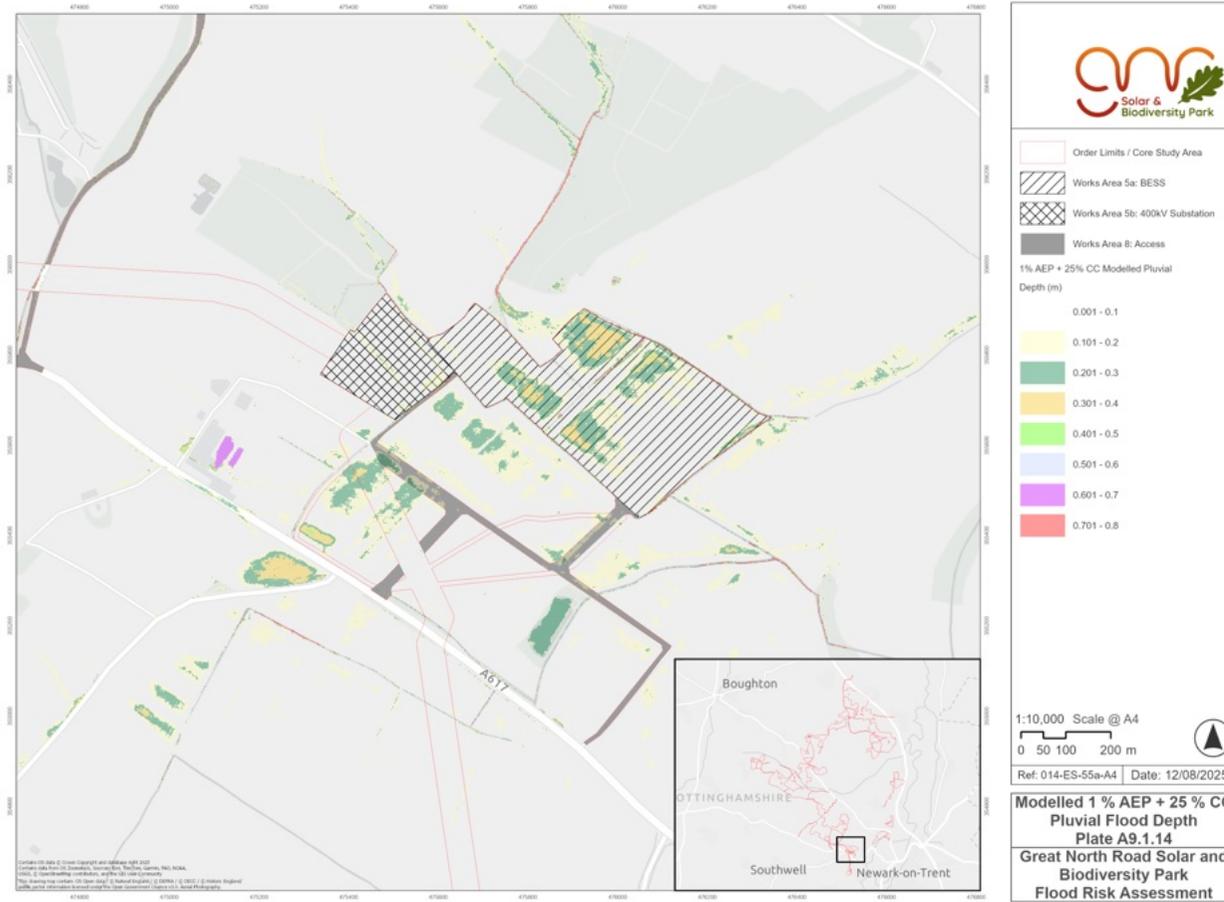


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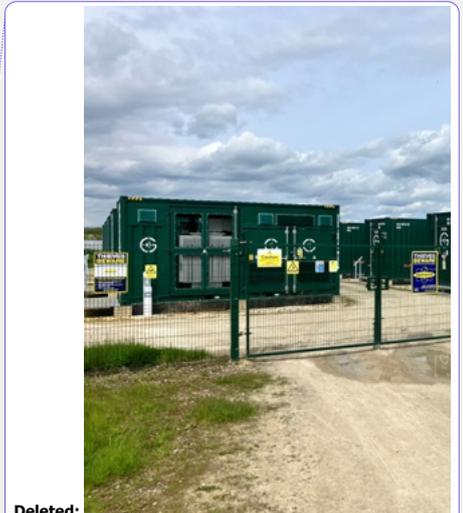
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133 It should be noted that the pluvial flood extents match topographical low points in the baseline landscape, which is unlikely to represent the finished level of Work Area 5a. Additionally, Work Area will be served by a SuDS system designed to accommodate the 1 % AEP event plus a 40 % allowance for climate change. As such, the designed event should not surcharge and place BESS units at risk of surface water flooding.

134 The placement of above ground infrastructure will avoid areas for flooding greater than 0.4 m, with the exception of a very small area in the north of Work Area 5a. BESS units are generally not located flush to the existing ground and are elevated on corner blocks or a racking frame elevated from the ground, as shown in Plate A9.1.15.

**Plate A9.1.15: Typical Corner Pads and racking on BESS units**



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135 As such, pluvial flooding should not pose a risk to the electrically sensitive aspects of the BESS units.

136 Management of surface water runoff from the Development is outlined in [ES TA A9.3 Outline Drainage Strategy \[EN010162/app/6.4.93\]](#), meaning a formal drainage system will have capacity to accept and convey rainfall to [SuDS structures](#) during the 1 % AEP + 40 % CC event.

137 Based on the design of the Development to avoid placing larger above ground structures (e.g. substations) within the flow paths of surface water

and the land management measures described in Section A9.1.3, the risk of pluvial flooding to and from the Development is Low.

#### **A9.1.2.3.6 Work Area 5b: 400 kV Substation**

138 As shown on Figure A9.6, 2D pluvial modelling shows that the 400 kV substation is not at risk of flooding from pluvial sources.

139 As such, the risk of pluvial flooding at Work Area 5b is Negligible.

#### **A9.1.2.3.7 Work Areas 6 and 7**

140 The existing or consented infrastructure within Work Areas 6 and 7 are shown not to be at risk of pluvial flooding on the EA flood map. Additionally, the infrastructure in these areas will be served by a formal drainage system designed to accommodate intense rainfall.

141 As such, the risk of pluvial flooding in Work Areas 6 and 7 is Negligible.

#### **A9.1.2.3.8 Work Area 8: Access Works**

142 Work Area 8 is principally within existing highways on the road network and is mostly free of pluvial flood risk, principally as a result of highways drainage.

143 The areas of Work Area 8 which are outside the existing highways are not shown to be at risk of pluvial flooding.

144 As such, the risk of pluvial flooding to Work Area 8 is Negligible.

#### **A9.1.2.4 GROUNDWATER**

145 Work Area 4, Intermediate Substations, Work Area 5a, BESS, and Work Area 5b, 400 kV Compound, are the main aspects of Development which have the potential to be affected should groundwater emerge at the surface, given that the PV arrays in Work Area 1 are elevated from the ground by at least 0.5 m, and Work Area 2, cables, are in waterproof ducting.

146 The EA Long Term Flood Risk service<sup>35</sup> reports "Flooding from groundwater is unlikely in this area".

147 BGS borehole records<sup>36, 37, 38</sup> approximately 30 m southeast of Work Area 5a show groundwater was struck at 3.0 m, 2.7 m and 1.8 m BGL, associated with sand and gravel layers at corresponding depths which overlay mudstone, indicating that the mudstone acts as a low transmissivity rock layer limiting infiltration at shallow depth, rather than the gravels being an extensive groundwater unit.

148 Table 4a of the SFRA identifies that Staythorpe Road, near to Work Area 6 and 7, has previously flooded from groundwater sources, however no records of groundwater flooding in the area surrounding Work Area 5a and 5b exist.

149 The PV arrays in Work Area 1 will be raised off the ground by at least 0.5 m on a racking system and therefore will not be affected in the event that groundwater emerges at the surface.

<sup>35</sup> <https://check-long-term-flood-risk.service.gov.uk/risk>

<sup>36</sup> <https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/19366580>

<sup>37</sup> <https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/239130>

<sup>38</sup> <https://api.bgs.ac.uk/sobi-scans/v1/borehole/scans/items/238970>



- 150 Cabling in Work Area 2 will be within waterproof ducting. The entry point of any cable or ducting into chambers should also be sealed to prevent water ingress.
- 151 Infrastructure in Work Area 5a and 5b will not be flush to ground level, e.g. by concrete feet, elevating the BESS units by approximately 0.3 m AGL, as outlined in the Pluvial Flooding assessment in Section A9.1.2.4. Should groundwater emanate at ground level within Work Area 5, it is likely to spread over a wide area at shallow depth. As such the risk of groundwater interacting with infrastructure within Work Area 5a and 5b is unlikely.
- 152 Infrastructure within Work Area 6 and Work Area 7 consented / operational and will have built in resilience, such as hard standing and impermeable membranes to prevent the upward movement of groundwater interacting with infrastructure within these areas.
- 153 As such the risk of groundwater flooding is Negligible.

#### A9.1.2.5 RESERVOIRS

- 154 The risk of flooding from [reservoirs](#) is reduced through regular maintenance by the operating authority and owner (identified in Table A9.1.2), with reservoirs in the UK having an extremely good safety record with no incidents resulting in the loss of life since 1925.
- 155 Whilst the consequences of flooding from dam failure are potentially high within the eastern and southern sections of the CSA, the Reservoirs Act 1975 requires all large reservoirs to be regularly inspected and supervised by reservoir panel engineers, making the risk of failure low.
- 156 Regarding Work Area 1: Solar PV, the extents would only encroach into one field (Field [E8](#)) and the leading edge of the panels would be above ground level by at least 0.5 m. As such, the potential for interaction with the electrically sensitive aspects of Work Area 1 is low.
- 157 The flood resilience measure in Work Areas 6 and 7 for fluvial flooding would minimise any potential impact under a reservoir breach scenario.
- 158 As such, the residual risk of flooding associated with reservoirs is Low.

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**CONSTRUCTION PHASE**  
**Pollution Prevention**  
 Given the relatively short construction phase and gently sloping land within the OL, it is not anticipated that significant amounts of sediment will be generated. The Development will adhere to a Construction Environmental Management Plan (CEMP), to be secured by DCO Requirement and based on the Outline CEMP provided in ES TA A5.3 [EN010162/APP/6.4.5.3], which will ensure compliance with the relevant guidance.

**Run-off Rates**  
 Rural Sustainable Drainage Systems (RSuDS) are not a new concept, but they are not widespread in the rural environment and can present many opportunities for improving the management of water at source. They are a collection of physical structures used to mimic natural processes. In rural environments, it is an approach for managing the detrimental impact of rainfall on fields where run-off is a major threat to the flora, fauna and chemical status of our surface waters.  
 RSuDS slow down or prevent the transport of pollutants to watercourses by breaking the delivery pathway between the pollutant source and the receptor. By intercepting run-off and trapping sediment before it leaves the field they help maintain and manage the provision of good water quality by preventing the loss of soil, chemicals, nutrients, and faecal organisms. A further benefit is their ability to temporarily capture water and slow down flow. This can reduce localised flooding and provide valuable aquatic habitats in the form of micro-wetlands for farmland wildlife and will encourage the downward movement of water to recharge aquifers.  
 Research in the United States by Cook & McCuen (2013) meta-analysis outlines that solar panels do not have a significant effect on runoff volumes or peak flows, however where ground beneath panels is bare there may be an increase in peak discharge.  
 Milazzo et al. (2023)<sup>39</sup> reviews the role of grassland for erosion and flood mitigation in Europe and provides quantification that permanent grassland mitigates better runoff than arable land.  
 Whilst the Natural England Technical Information Note 101 (TIN101) "Solar Parks: maximising environmental benefits" has been archived, the principles relating to solar parks, their siting, their potential impacts and mitigation requirements for the safeguarding of the natural environment are still relevant.  
 TIN101 states:  
*"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".*  
 As such, a suitable grassland sward will be developed in areas underneath the PV arrays before the construction phase.

**PV Array Installation**  
 Whilst the PV arrays and racking system does not involve the installation of hardstanding, the installation methods could lead to soil compaction if not managed properly. Installation of the racking system (mounting frame) should only occur when soil conditions are suitable, e.g., dry enough that tyre imprints are not deeper than a specified depth when tracking across land. The Construction Contractor will be responsible for monitoring conditions, in consultation with the Ecological Clerk of Works, in accordance with a Soil Management Plan (an outline ... [4])

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### A9.1.3 CONCLUSIONS & RECOMMENDATIONS

- 159 The Order Limits are mostly located in Flood Zone 1 (89.99 %).
- 160 All new aboveground infrastructure within Work Areas 1, 4 and 5 are located in Flood Zone 1, with the exception of Field E8 which is located in Flood Zone 2 [due to changes in the Flood Map for Planning](#) as of 28<sup>th</sup> November 2025. [By their nature, PV Arrays are raised from ground level and will account for the 1 % AEP + 25 % CC pluvial event in this area.](#)
- 161 Infrastructure within all Work Areas will be located outside the 2076 and 2098 0.5 % AEP River Trent tidal breach event.
- 162 No built aspects in Work Area 1: Solar PV, Work Area 4: Substations, Work Area 5a: BESS or Work Area 5b: 400 kV substation are located within the extent of the 1 % AEP + 23 % CC (30 % CC used as a proxy) or 1 % AEP + 39 % CC events.
- 163 Work Area 6: National Grid Staythorpe Substation is located within the 1 % AEP + 23 % CC extent (30 % CC used as proxy) and is modelled to flood to depths of less than 0.1 m (i.e. within the main platform area).
- 164 Similarly, using the 39 % CC allowance as a sense check, Work Area 6 could flood to a nominal depth of less than 0.1 m (i.e. within the main platform area).
- 165 The National Grid Staythorpe Substation has private hard (walls) and soft (embankments) defences to a level of 13.10 m AOD. As such, Work Area 6 is unlikely to be inundated during the 1 % AEP + 30 % CC and 39 % CC events, should the Development operate marginally into the 2080s epoch.
- 166 Work Area 7 will utilise the existing infrastructure associated with the Staythorpe BESS (currently under construction). The Staythorpe BESS design included flood resilience measures and the critical aspects of the scheme are located outside the 1 % AEP + 30 % CC and 39 % CC extents. As such, connecting the Development in Work Area 7 to the existing 400 kV infrastructure will be within an area not modelled to flood during the 1 % AEP + 30 % CC and 39 % CC event.
- 167 All electrically sensitive infrastructure associated with the Development will be located above the modelled depths for the 1 % AEP + climate change pluvial flood event.
- 168 The extent of reservoir flooding (Wet Day scenario) which interacts with the Development largely follows the corridor of the River Trent and presents a residual risk to the Development.
- 169 The Development is classified as Essential Infrastructure and is therefore compatible with Flood Zones 1, 2 and 3.
- 170 Groundwater levels are likely to be variable across the CSA, and were struck at 1.8 to 3 m BGL within Work Area 5a: BESS. BESS units will not be flush to the ground and will be elevated from the ground by approximately 300 mm. As such the Development will remain safe and operational should groundwater emerge at ground level.

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**Deleted:** Surface water run off from Work Area 1: Solar PV will be managed through RSuDS techniques such as grassland / wildflower, which will act to bind soils, slow surface water and increase water quality compared to the baseline scenario. Where Solar PV in Work Area 1 is located on slopes of 6 % or greater, then additional measures to slow runoff, such as filter drains and berms, will be implemented.

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172 In respect of flood risk matters, the Development is compliant with the NPS EN-1, EN-3, EN-5, NPPF and local planning policy, including Core Policy 10 Climate Change of the Amended core strategy DPD.

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## APPENDIX A: EA CORRESPONDENCE

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Liam Nevins  
Via Email

**Our Ref:** EMD-331357

**Previous Ref:** EMD-307955

**Date:** 30 November 2023

Dear Liam,

**Enquiry regarding - Product 6- Missing data near Averham.**

Thank you for your enquiry which was received on 24 October 2023.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

The JFLOW has been used to create flood zone 3 in this area, along with the older version of the River Greet model from 2008.

You can download the JFLOW model results using the link below and will need to look at grid square SK75:

[Defra Data Services Platform](#)

Please refer to [Open Government Licence](#) which explains the permitted use of this information.

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Yours sincerely

  
Customers & Engagement Officer  
East Midlands

For further information please contact the Customers & Engagement Team on 02084 747770

Direct e-mail:- [EMDenquiries@environment-agency.gov.uk](mailto:EMDenquiries@environment-agency.gov.uk)

Liam Nevins  
Via Email

**Our Ref:** EMD-339002

**Your Ref:**

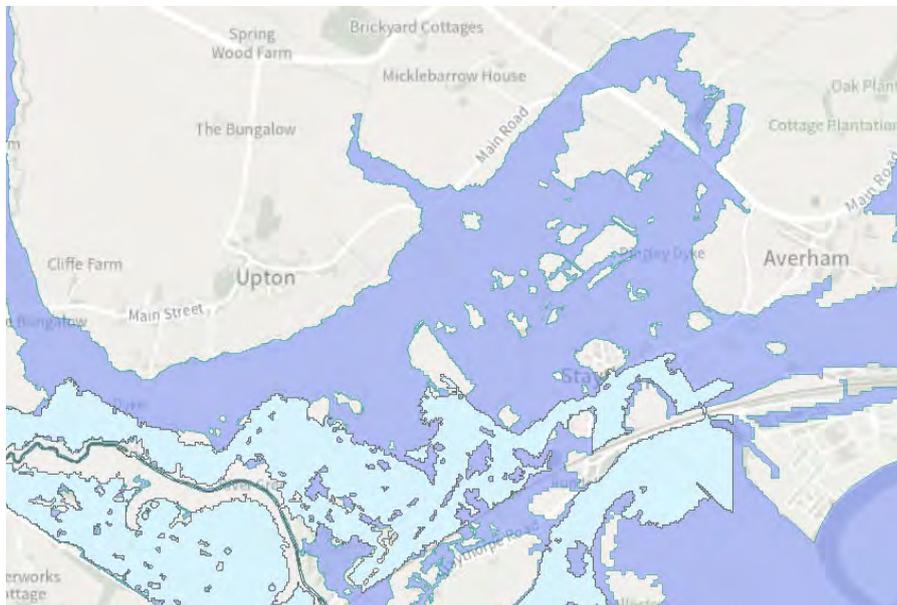
**Date:** 16 January 2024

Dear Liam

**Enquiry regarding – flood data around Averham**

Thank you for your enquiry which was received on 14 December 2023. Please see the response from our technical team below:

*We are sorry that we cannot explain why Flood Zone 3 is of a lesser extent than the 2004 1 % AEP JFLOW outline to the north west of Averham. Flood Zone 3 in the wider area has utilised part of the River Greet 2008 model but this is of a smaller extent than the current Flood Zone 3 as shown below (Flood Zone 3 in darker blue and the 1% AEP 2008 River Greet model in lighter blue). The Flood Zone outline does not align to a modelled outline or recorded flood outline. The Flood Zones in this area were last updated in 2014 and unfortunately our records do not answer your question.*



*We will be updating our flood risk map products: Flood Zones (on Flood Map for Planning), Risk of Flooding from Rivers & Sea (RoFRS) and Risk of Flooding from Surface Water (RoFSW) in 2024/5 as part of the new National Flood Risk Assessment (NaFRA2). This should result in improvements to our mapping products, especially where we do not currently have any detailed local modelling. This may address the query you have with our flood risk products. Our new National Flood Risk Assessment*

*will bring many improvements to our flood risk information, including updated national modelling (which uses a better representation of topography and finer level of detail) as well as incorporating local detailed modelling where we have it. Therefore, we would advise waiting until after these are published to check our new flood risk information. In preparation for these changes, there is currently a pause on updates to these mapping products until NaFRA2 is released.*

Our technical team are also happy to speak with you further on this matter, if you'd like to schedule a call.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

Please refer to [Open Government Licence](#) which explains the permitted use of this information.

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

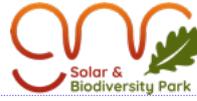
Yours sincerely



Customers & Engagement Officer  
East Midlands

For further information please contact the Customers & Engagement Team on 02084 747770

Direct e-mail:- [EMDenquiries@environment-agency.gov.uk](mailto:EMDenquiries@environment-agency.gov.uk)



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## APPENDIX B: INFILTRATION TESTING

Deleted: December 2025

Environmental  
Geotechnical  
Specialists



# SOAKAWAY LETTER REPORT

< ENVIRONMENTAL > < GEOTECHNICAL >

job number	date
site address	
written by	checked by
issued by	

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**Rogers Geotechnical Services Ltd**  
Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU  
☎ 01484 604354      Company No. 5130864

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## Appendices

1.	Site Plan
2.	Trial Pit Records
3.	Trial Pit Photographs
4.	Soakaway Results





## Report on Soakaway Testing

Location:	Land off Caunton Road Newark, Nottinghamshire, NG22 0BH		
For:	Elements Green Trent Ltd		
Report No.	C4946/25/E/7542	Report Date:	May 2025

For and on behalf of **Rogers Geotechnical Services Ltd**

<b>Steven Hale</b> BSc FGS Geo-environmental Technician	<b>Imran Sakoor</b> BEng FGS Geo-environmental Engineer

### Report Summary<sup>1</sup>

Item	Comments	Section
Geology	Superficial Geology – none. Solid Geology – Mercia Mudstone Group.	4.
Strata Conditions	Nominal thickness of topsoil overlaying clay representative	5.
Groundwater	No water strikes noted during investigation.	5.
Suitability of Soakaways	Not recommended.	7.

<sup>1</sup> This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

## 1. Introduction

---

- i. We thank you for your request to undertake percolation testing at the above-mentioned site and take pleasure in enclosing the results of this work. The investigation was undertaken on the 8<sup>th</sup> April 2025 in accordance with your instruction to proceed. The site is centred on grid reference 472060, 362046. This report describes the work undertaken, presents the data obtained and discusses the results of the tests

## 2. Limitations

---

- ii. The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between trial pit positions, these are for guidance only and no liability can be accepted for their accuracy.
- iii. This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

## 3. Fieldworks

---

- iv. Three trial pits were excavated in order to undertake soakaway testing, the positions of which are shown in Appendix 1. The soakaway tests were undertaken at the base of the pit at depths rational to the construction of soakaways. The soils exposed in the trial pits were logged on site in general accordance with BS5930: 2015 +A1: 2020, and full descriptions are given on the trial pit records which are presented in Appendix 2. Photographs of the trial pits are included within Appendix 3.
- v. Once excavations were completed, the trial pits were carefully re-instated with the arisings. Whilst every care was taken during the infilling process, including compacting of the infill at regular intervals with the arm of the excavator, it should be appreciated that some mounding of the surface may have resulted. Moreover, the infilled soils may be subjected to settlement over time, such that a depression in the surface may also occur. Therefore, the locations of any pits undertaken in this investigation should be conveyed to the current site user, as the mounds or depressions associated with the pits may present a risk to current site operations. Furthermore, it must be realised that the infilled pits represent an area of disturbance within the site soils, thus the soils at the pit locations may vary characteristically compared to the undisturbed ground.

## 4. Geology

- vi. The available published geological data for the site has been examined and the following table presents the anticipated geology.

Strata Type	Strata Name <sup>2</sup>	Previous Name <sup>3</sup>	Description <sup>3</sup>
Superficial Geology	-	-	None indicated beneath the site.
Solid Geology	Mercia Mudstone Group	Red Marl	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas.

## 5. Strata Conditions

- vii. In accordance with the geology of the area, the succession has been shown to include the following:

Depth m below ground level to underside of layer	Strata Type	Positions Layer Revealed	Groundwater Strikes m below ground level
0.30 – 0.35	TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, clayey SILT)	All	None
0.75 – +1.60	Firm, reddish brown, slightly gravelly, silty CLAY [WEATHERED MERCIA MUDSTONE GROUP]	All	None
+1.25	Firm, grey occasionally mottled reddish brown, very gravelly, silty CLAY. [WEATHERED MERCIA MUDSTONE GROUP]	SA01	None

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

## 6. Insitu Testing

### 6.1 Soakaway Test

- viii. On reaching the elected soakaway test depth, the pit was trimmed and squared as much as practicable. Water was then introduced into the pit at a controlled rate to prevent collapse of the sides and the level monitored at time intervals relative to a reference bar at ground level. The results obtained from the soakaway tests are presented at Appendix 4 and are summarised below:

<sup>2</sup> Sources: British Geological Survey (NERC) Map Sheets 113; Ollerton; Solid and Drift Edition, and Onshore Geindex [online resource from [www.bgs.ac.uk](http://www.bgs.ac.uk)]

<sup>3</sup> Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [online resource from [www.bgs.ac.uk](http://www.bgs.ac.uk)]

**Table 3: Soakaway Test Results**

Location	Soakage Area Dimensions (average) (m)	Depths of soaked strata (m)	Soil Description (of soaked strata)	Infiltration Rate (m/s)	*Drainage Characteristics
SA01	0.30 x 1.60	0.97 to 1.25	Side – Very gravelly, silty CLAY Base – Presumed MUDSTONE bedrock	-	Practically impermeable
SA02	0.30 x 1.60	0.91 to 1.60	Side – Slightly gravelly, silty CLAY Base – As above	-	Practically impermeable
SA03	0.30 x 1.70	0.99 to 1.60	Side – Slightly gravelly, silty CLAY Base – As above	-	Practically impermeable

- ix. During the soakaway tests the water level did not achieve a fall from 75% to 25% of the effective depth of the storage volume in all three trial pits. In all tests, the water level did not move, as such, the tests could not be completed within the scope of the method provided in BRE Digest 365 due to the poor soakage rate of the exposed soils. Due to the negligible water movement it was not possible to extrapolate the results obtained in order to obtain a soil infiltration rate.

## 7. Discussion

---

- x. The soils encountered beneath the topsoil were found to be typical of the weathered fraction of the underlying Mercia Mudstone Group. The strata conditions and subsequent drainage characteristics appear to be comparable across the site. In this instance, the infiltration testing has revealed that the soils have practically impermeable drainage characteristics. Therefore, soakaways cannot be recommended at this site and an alternative form of drainage should be adopted.

## 8. References

---

- Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.
- British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations*, B.S.I., London.
- Barnes, G. (2000). *Soil Mechanics Principle and Practice*. 2nd ed. London: Macmillan Press Ltd, p.47.



---

## Appendix 1

### Site Plan

---

Notes:



**Rogers Geotechnical Services Ltd**

Offices 1 & 2, Barncliffe  
Business Park,  
Near Bank,  
Shelley,  
Huddersfield,  
HD8 8LU

**Telephone:** 0843 50 66 87  
**www.rogersgeotech.co.uk**

**Client:**

Elements Green Trust Ltd

**Job Number:**

C4946/25/E/7542

**Project Details:**

Land off Cauntton Road, Newark,  
Nottinghamshire, NG23 6BA

**Scale:** Not to scale - reference only





---

## Appendix 2

### Trial Pit Records

---



# Trial Pit Log

Trialpit No  
**SA01**  
Sheet 1 of 1

Project Name: Land off Caunton Road      Project No. C4946/25/E/7542      Co-ords: -      Date 08/04/2025  
Level:      Level:

Location: Newark, Nottinghamshire, NG23 6BA      Dimensions (m): 1.6      Scale 1:25

Client: Elements Green Trent Ltd      Depth 1.25      Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			TOPSOIL (Soft, brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is sub-angular to rounded and fine to coarse of various lithologies).
				0.75			Firm, reddish brown, slightly gravelly, silty CLAY. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
				1.25			Firm, grey occasionally mottled reddish brown, very gravelly, silty CLAY. Gravel is tabular, sub-angular and fine to coarse of mudstone. [WEATHERED MERCIA MUDSTONE GROUP]
				1.26			Extremely weak, weathered, grey MUDSTONE recovered as gravel. [MERCIA MUDSTONE GROUP] End of pit at 1.25 m

Remarks: 1. Position scanned for services using CAT and Genny. 2. Trial pit refused on presumed bedrock.

Stability: Stable





# Trial Pit Log

Trialpit No  
**SA02**  
Sheet 1 of 1

Project Name: Land off Caunton Road      Project No. C4946/25/E/7542      Co-ords: -      Date 08/04/2025  
Level:      Level:

Location: Newark, Nottinghamshire, NG23 6BA      Dimensions (m):      1.6  
Depth 1.60      0.3

Client: Elements Green Trent Ltd      Scale 1:25  
Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.35			TOPSOIL (Soft, brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is sub-angular to rounded and fine to coarse of various lithologies).
				1.60			Firm, reddish brown, slightly gravelly, silty CLAY. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
							End of pit at 1.60 m

Remarks: 1. Position scanned for services using CAT and Genny.

Stability: Stable





# Trial Pit Log

Trialpit No  
**SA03**  
Sheet 1 of 1

Project Name: Land off Caunton Road

Project No.  
C4946/25/E/7542

Co-ords: -  
Level:

Date  
08/04/2025

Location: Newark, Nottinghamshire, NG23 6BA

Dimensions (m): 1.7  
Depth 1.60

Scale  
1:25  
Logged  
SH

Client: Elements Green Trent Ltd

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.35			TOPSOIL (Soft, brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is sub-angular to rounded and fine to coarse of various lithologies).
				1.60			Firm, reddish brown, slightly gravelly, silty CLAY. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
							End of pit at 1.60 m



Remarks: 1. Position scanned for services using CAT and Genny.

Stability: Stable





---

## Appendix 3

### Trial Pit Photographs

---



Photo 1: SA01



Photo 2: SA01 backfilled



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Geotechnical  
Specialists

Site Name:

**Land off Cauntun Road**

Job No:

**C4946/25/E/7542**

**t. 0843 50 666 87**

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Photo 1: SA02



Photo 2: SA02 backfilled



Site Name:  
**Land off Caunton Road**

Job No:  
**C4946/25/E/7542**

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Photo 1: SA03



Photo 2: SA03 backfilled



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Site Name:

**Land off Cauntun Road**

Job No:

**C4946/25/E/7542**

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## Appendix 4

### Soakaway Results

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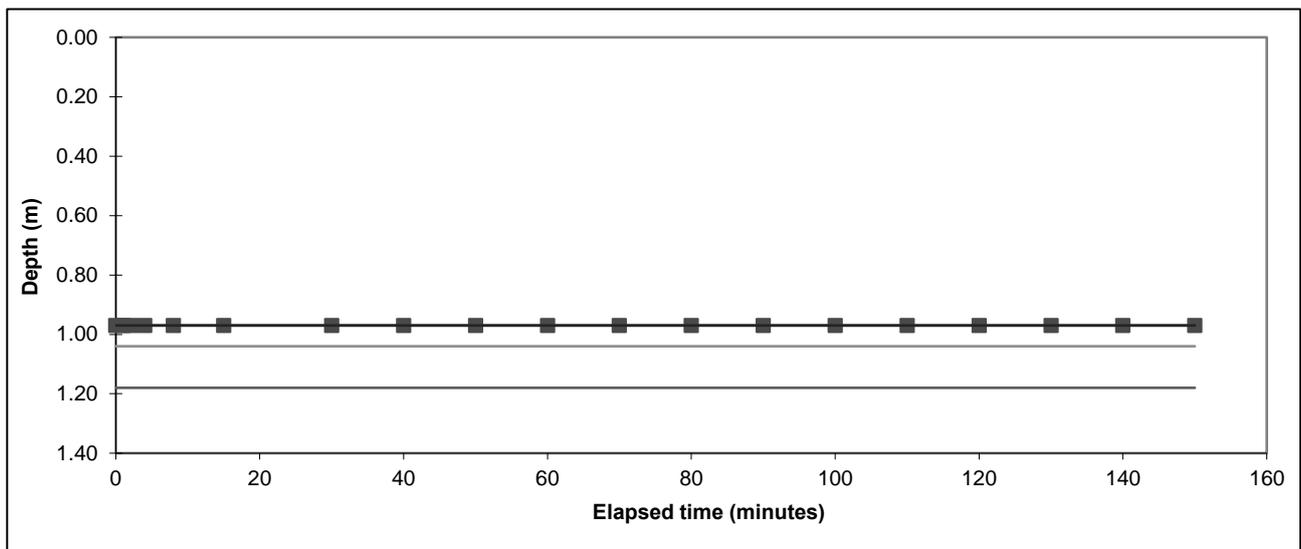
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA01	Test No:	1	Date:	08.04.2025
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.25	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.970	110	0.970
1	0.970	120	0.970
2	0.970	130	0.970
4	0.970	140	0.970
8	0.970	150	0.970
15	0.970		
30	0.970		
40	0.970		
50	0.970		
60	0.970		
70	0.970		
80	0.970		
90	0.970		
100	0.970		



Start water depth for analysis (mbgl):	0.97	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.04	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.11	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.18	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.25		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):		1.01	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007). Soil appears to be practically impermeable.
----------------	--

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Caunton Road, Kersall, Newark, Nottinghamshire, NG23 6BA		C4946/25/E/7542

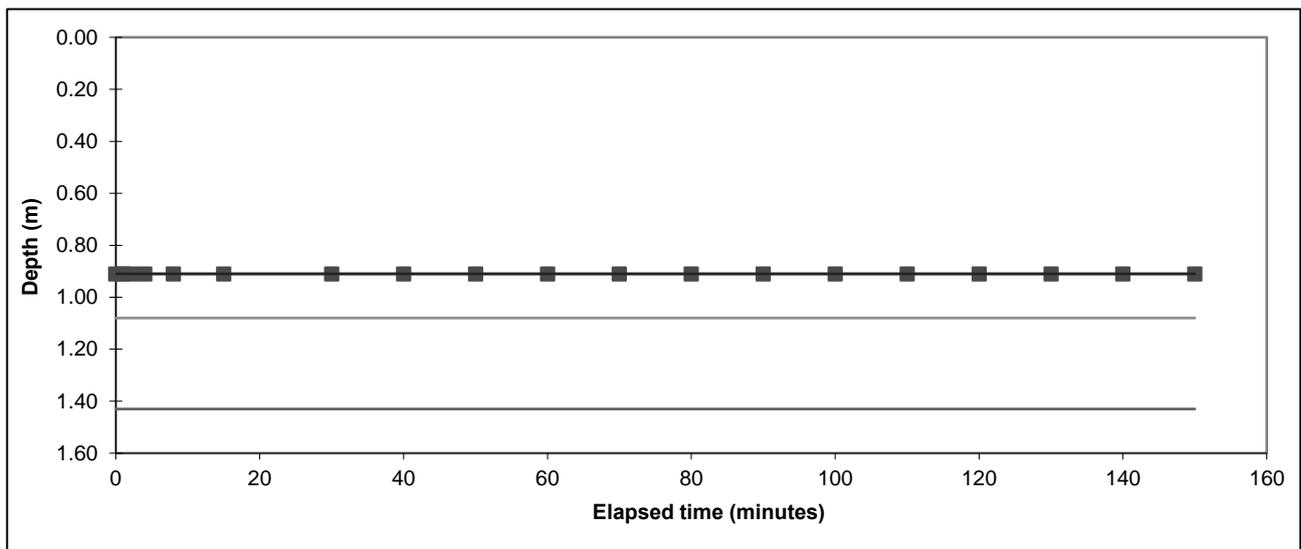
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA02	Test No:	1	Date:	08.04.2025
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.60	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.910	110	0.910
1	0.910	120	0.910
2	0.910	130	0.910
4	0.910	140	0.910
8	0.910	150	0.910
15	0.910		
30	0.910		
40	0.910		
50	0.910		
60	0.910		
70	0.910		
80	0.910		
90	0.910		
100	0.910		



Start water depth for analysis (mbgl):	0.91	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.08	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.26	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.43	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.60		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):			1.77
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007). Soil appears to be practically impermeable.
----------------	--

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Caunton Road, Kersall, Newark, Nottinghamshire, NG23 6BA		C4946/25/E/7542

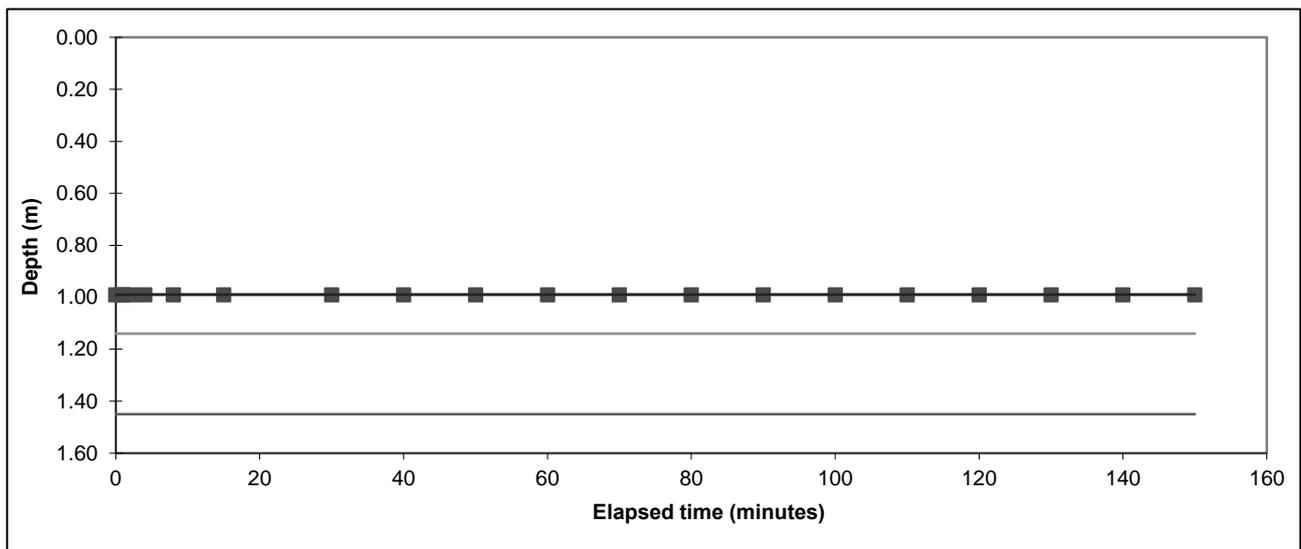
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA03	Test No:	1	Date:	08.04.2025
Length (m):	1.700	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.60	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.990	110	0.990
1	0.990	120	0.990
2	0.990	130	0.990
4	0.990	140	0.990
8	0.990	150	0.990
15	0.990		
30	0.990		
40	0.990		
50	0.990		
60	0.990		
70	0.990		
80	0.990		
90	0.990		
100	0.990		



Start water depth for analysis (mbgl):	0.99	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.14	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.30		
25% effective depth (mbgl):	1.45	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.60		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):		1.71	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007). Soil appears to be practically impermeable.
----------------	--

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Caunton Road, Kersall, Newark, Nottinghamshire, NG23 6BA		C4946/25/E/7542

## **APPENDIX B: INFILTRATION TESTING - Soakaway Testing 2: Land Adjacent Ossington Lane**

Environmental  
Geotechnical  
Specialists



# SOAKAWAY LETTER REPORT

< ENVIRONMENTAL > < GEOTECHNICAL >

job number	date
site address	
written by	checked by
issued by	

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**Rogers Geotechnical Services Ltd**  
Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU  
☎ 01484 604354      Company No. 5130864

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## Appendices

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2.	Trial Pit Records
3.	Trial Pit Photographs
4.	Soakaway Results





## Report on Soakaway Testing

**Location:** Land Adjacent Ossington Lane  
Ossington Lane, Newark, Nottinghamshire, NG23 6NY

**For:** Elements Green Trent Ltd

**Report No.** C4947/25/E/7544

**Report Date:** May 2025

For and on behalf of **Rogers Geotechnical Services Ltd**

**Steven Hale** BSc FGS  
Geo-environmental Technician

**Rob Palmer** MSc FGS ACIEH  
Engineering Director

### Report Summary<sup>1</sup>

Item	Comments	Section
Geology	Superficial Geology – none. Solid Geology – Mercia Mudstone Group.	4.
Strata Conditions	Nominal thickness of topsoil overlaying clay representative of the weathered Mercia Mudstone	5.
Groundwater	No water strikes noted during investigation.	5.
Suitability of Soakaways	Not recommended.	7.

<sup>1</sup> This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

## 1. Introduction

---

- i. We thank you for your request to undertake percolation testing at the above-mentioned site and take pleasure in enclosing the results of this work. The investigation was undertaken on the 28<sup>th</sup> April 2025 in accordance with your instruction to proceed. The site is centred on grid reference 477350, 364723. This report describes the work undertaken, presents the data obtained and discusses the results of the tests.

## 2. Limitations

---

- ii. The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between trial pit positions, these are for guidance only and no liability can be accepted for their accuracy.
- iii. This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

## 3. Fieldworks

---

- iv. Three trial pits were excavated in order to undertake soakaway testing, the positions of which are shown in Appendix 1. The soakaway tests were undertaken at the base of the pit at depths rational to the construction of soakaways. The soils exposed in the trial pits were logged on site in general accordance with BS5930: 2015 +A1: 2020, and full descriptions are given on the trial pit records which are presented in Appendix 2. Photographs of the trial pits are included within Appendix 3.
- v. Once excavations were completed, the trial pits were carefully re-instated with the arisings. Whilst every care was taken during the infilling process, including compacting of the infill at regular intervals with the arm of the excavator, it should be appreciated that some mounding of the surface may have resulted. Moreover, the infilled soils may be subjected to settlement over time, such that a depression in the surface may also occur. Therefore, the locations of any pits undertaken in this investigation should be conveyed to the current site user, as the mounds or depressions associated with the pits may present a risk to current site operations. Furthermore, it must be realised that the infilled pits represent an area of disturbance within the site soils, thus the soils at the pit locations may vary characteristically compared to the undisturbed ground.

## 4. Geology

- vi. The available published geological data for the site has been examined and the following table presents the anticipated geology.

Table 1: Geological Data for the Site			
Strata Type	Strata Name <sup>2</sup>	Previous Name <sup>3</sup>	Description <sup>3</sup>
Superficial Geology	-	-	None indicated beneath the site.
Solid Geology	Mercia Mudstone Group	Red Marl	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas.

## 5. Strata Conditions

- vii. In accordance with the geology of the area, the succession has been shown to include the following:

Table 2: Generalised Strata Profile			
Depth m below ground level to underside of layer	Strata Type	Positions Layer Revealed	Groundwater Strikes m below ground level
0.25 – 0.30	TOPSOIL (Soft, dark brown, sandy, slightly gravelly, silty CLAY)	All	None
+1.60 – +1.65	Firm, reddish brown, slightly sandy, slightly gravelly, silty CLAY. [WEATHERED MERCIA MUDSTONE GROUP]	All	None

'+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

## 6. Insitu Testing

### 6.1 Soakaway Test

- viii. On reaching the elected soakaway test depth, the pit was trimmed and squared as much as practicable. Water was then introduced into the pit at a controlled rate to prevent collapse of the sides and the level monitored at time intervals relative to a reference bar at ground level. The results obtained from the soakaway tests are presented at Appendix 4 and are summarised below:

<sup>2</sup> Sources: British Geological Survey (NERC) Map Sheets 113; Ollerton; Solid and Drift Edition, and Onshore Geindex [online resource from [www.bgs.ac.uk](http://www.bgs.ac.uk)]

<sup>3</sup> Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [online resource from [www.bgs.ac.uk](http://www.bgs.ac.uk)]

**Table 3: Soakaway Test Results**

Location	Soakage Area Dimensions (average) (m)	Depths of soaked strata (m)	Soil Description (of soaked strata)	Infiltration Rate (m/s)	*Drainage Characteristics
SA01	0.30 x 1.60	1.01 to 1.60	Side – Slightly sandy, slightly gravelly, silty CLAY Base – As above	-	Practically impermeable
SA02	0.30 x 1.55	0.92 to 1.60	Side – Slightly sandy, slightly gravelly, silty CLAY Base – As above	-	Practically impermeable
SA03	0.30 x 1.55	0.99 to 1.65	Side – Slightly sandy, slightly gravelly, silty CLAY Base – As above	-	Practically impermeable

- ix. During the soakaway tests the water level did not achieve a fall from 75% to 25% of the effective depth of the storage volume in all three trial pits. In all tests, the water level did not move, as such, the tests could not be completed within the scope of the method provided in BRE Digest 365 due to the poor soakage rate of the exposed soils. Due to the negligible water movement it was not possible to extrapolate the results obtained in order to obtain a soil infiltration rate.

## 7. Discussion

---

- x. The soils encountered beneath the topsoil were found to be typical of the weathered fraction of the underlying Mercia Mudstone Group. The strata conditions and subsequent drainage characteristics appear to be comparable across the site. In this instance, the infiltration testing has revealed that the soils have practically impermeable drainage characteristics. Therefore, soakaways cannot be recommended at this site and an alternative form of drainage should be adopted.

## 8. References

---

- Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.
- British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations*, B.S.I., London.
- Barnes, G. (2000). *Soil Mechanics Principle and Practice*. 2nd ed. London: Macmillan Press Ltd, p.47.



---

## Appendix 1

### Site Plan

---

Notes:



**Rogers Geotechnical Services Ltd**

Offices 1 & 2, Barncliffe  
Business Park,  
Near Bank,  
Shelley,  
Huddersfield,  
HD8 8LU

**Telephone:** 0843 50 66 87  
**www.rogersgeotech.co.uk**

**Client:**

Elements Green Trust Ltd

**Job Number:**

C4946/25/E/7542

**Project Details:**

Land off Cauntton Road, Newark,  
Nottinghamshire, NG23 6BA

**Scale:** Not to scale - reference only





---

## Appendix 2

### Trial Pit Records

---



# Trial Pit Log

Trialpit No  
**SA01**  
Sheet 1 of 1

Project Name: Land off Caunton Road      Project No. C4946/25/E/7542      Co-ords: -      Date 08/04/2025  
Level:      Level:

Location: Newark, Nottinghamshire, NG23 6BA      Dimensions (m): 1.6      Scale 1:25

Client: Elements Green Trent Ltd      Depth 1.25      Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			TOPSOIL (Soft, brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is sub-angular to rounded and fine to coarse of various lithologies).
				0.75			Firm, reddish brown, slightly gravelly, silty CLAY. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
				1.25			Firm, grey occasionally mottled reddish brown, very gravelly, silty CLAY. Gravel is tabular, sub-angular and fine to coarse of mudstone. [WEATHERED MERCIA MUDSTONE GROUP]
				1.26			Extremely weak, weathered, grey MUDSTONE recovered as gravel. [MERCIA MUDSTONE GROUP] End of pit at 1.25 m

Remarks: 1. Position scanned for services using CAT and Genny. 2. Trial pit refused on presumed bedrock.

Stability: Stable





# Trial Pit Log

Trialpit No  
**SA02**  
Sheet 1 of 1

Project Name: Land off Caunton Road      Project No. C4946/25/E/7542      Co-ords: -      Date 08/04/2025  
Level:

Location: Newark, Nottinghamshire, NG23 6BA      Dimensions (m): 1.6

Client: Elements Green Trent Ltd      Depth 1.60      Scale 1:25      Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.35			TOPSOIL (Soft, brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is sub-angular to rounded and fine to coarse of various lithologies).
				1.60			Firm, reddish brown, slightly gravelly, silty CLAY. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
							End of pit at 1.60 m

Remarks: 1. Position scanned for services using CAT and Genny.

Stability: Stable





# Trial Pit Log

Trialpit No  
**SA03**  
Sheet 1 of 1

Project Name: Land off Caunton Road

Project No.  
C4946/25/E/7542

Co-ords: -  
Level:

Date  
08/04/2025

Location: Newark, Nottinghamshire, NG23 6BA

Dimensions (m): 1.7  
Depth 1.60

Scale  
1:25  
Logged  
SH

Client: Elements Green Trent Ltd

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.35			TOPSOIL (Soft, brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is sub-angular to rounded and fine to coarse of various lithologies).
							Firm, reddish brown, slightly gravelly, silty CLAY. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
				1.60			End of pit at 1.60 m



Remarks: 1. Position scanned for services using CAT and Genny.

Stability: Stable





---

## Appendix 3

### Trial Pit Photographs

---



Photo 1: SA01



Photo 2: SA01 backfilled



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Site Name:

**Land off Caunton Road**

Job No:

**C4946/25/E/7542**

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Photo 1: SA02



Photo 2: SA02 backfilled



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Photo 1: SA03



Photo 2: SA03 backfilled



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---

## Appendix 4

### Soakaway Results

---

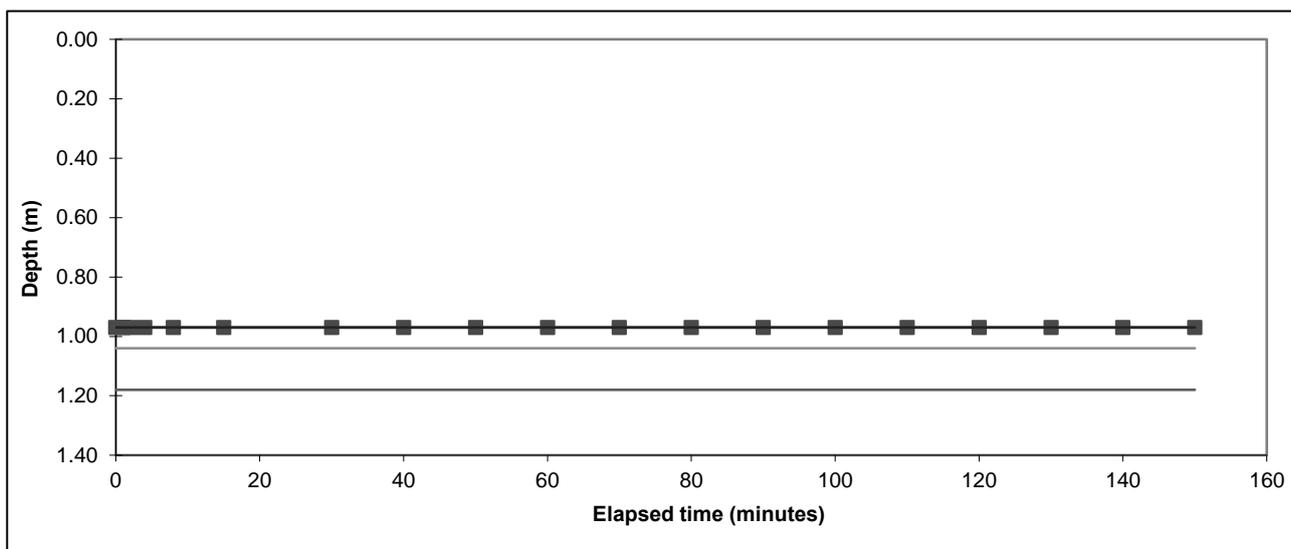
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA01	Test No:	1	Date:	08.04.2025
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.25	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.970	110	0.970
1	0.970	120	0.970
2	0.970	130	0.970
4	0.970	140	0.970
8	0.970	150	0.970
15	0.970		
30	0.970		
40	0.970		
50	0.970		
60	0.970		
70	0.970		
80	0.970		
90	0.970		
100	0.970		



Start water depth for analysis (mbgl):	0.97	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.04	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.11	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.18	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.25		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):			1.01
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007). Soil appears to be practically impermeable.
----------------	--

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Caunton Road, Kersall, Newark, Nottinghamshire, NG23 6BA		C4946/25/E/7542

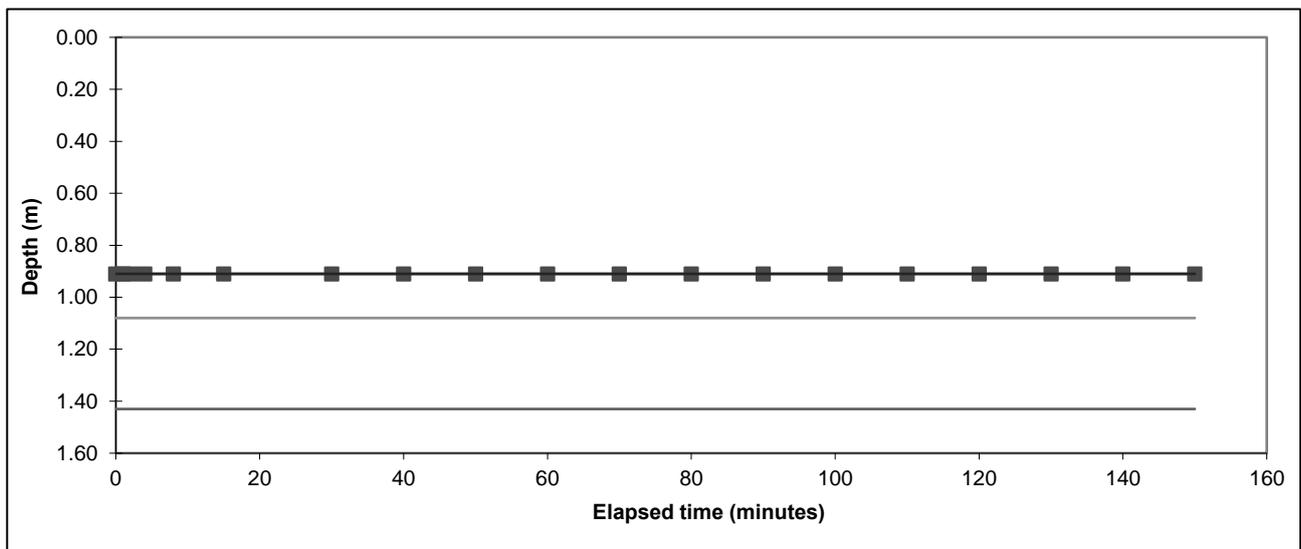
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA02	Test No:	1	Date:	08.04.2025
Length (m):	1.600	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.60	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.910	110	0.910
1	0.910	120	0.910
2	0.910	130	0.910
4	0.910	140	0.910
8	0.910	150	0.910
15	0.910		
30	0.910		
40	0.910		
50	0.910		
60	0.910		
70	0.910		
80	0.910		
90	0.910		
100	0.910		



Start water depth for analysis (mbgl):	0.91	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.08	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.26		
25% effective depth (mbgl):	1.43	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.60		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):		1.77	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007). Soil appears to be practically impermeable.
----------------	--

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Caunton Road, Kersall, Newark, Nottinghamshire, NG23 6BA		C4946/25/E/7542

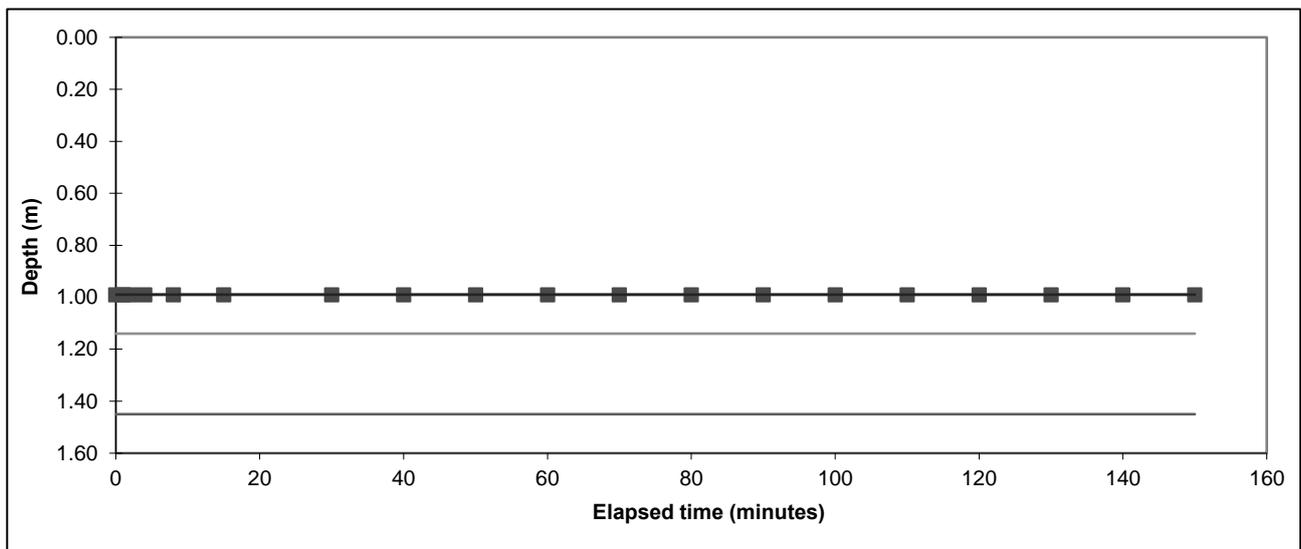
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA03	Test No:	1	Date:	08.04.2025
Length (m):	1.700	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.60	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.990	110	0.990
1	0.990	120	0.990
2	0.990	130	0.990
4	0.990	140	0.990
8	0.990	150	0.990
15	0.990		
30	0.990		
40	0.990		
50	0.990		
60	0.990		
70	0.990		
80	0.990		
90	0.990		
100	0.990		



Start water depth for analysis (mbgl):	0.99	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.14	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.30	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.45	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.60		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):		1.71	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007). Soil appears to be practically impermeable.
----------------	--

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Caunton Road, Kersall, Newark, Nottinghamshire, NG23 6BA		C4946/25/E/7542

## **APPENDIX B: INFILTRATION TESTING - Soakaway Testing 3: Land at Maplebeck Road**

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# SOAKAWAY LETTER REPORT

< ENVIRONMENTAL > < GEOTECHNICAL >

job number	date
site address	
written by	checked by
issued by	

 Please consider the environment before printing this report.



**Rogers Geotechnical Services Ltd**  
Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU  
☎ 01484 604354      Company No. 5130864

## Contents

	Page
1. Introduction	2
2. Limitations	2
3. Fieldworks	2
4. Geology	3
5. Strata Conditions	3
6. Insitu Testing	3
6.1 Soakaway Test	3
7. Discussion	4
8. References	4

## Appendices

1. Site Plan
2. Trial Pit Records
3. Trial Pit Photographs
4. Soakaway Results





## Report on Soakaway Testing

Location: **Land at Maplebeck Road**  
Maplebeck, Newark, Nottinghamshire, NG22 0BS

For: Elements Green Trent Ltd

Report No. C4948/25/E/7546

Report Date: May 2025

For and on behalf of **Rogers Geotechnical Services Ltd**

<b>Steven Hale</b> BSc FGS Geo-environmental Technician	<b>Rob Palmer</b> MSc FGS ACIEH Engineering Director

### Report Summary<sup>1</sup>

Item	Comments	Section
Geology	Solid Geology – Mercia Mudstone Group.	4.
Strata Conditions	Significant thickness of cohesive and granular made ground overlying silty clay (weathered fraction of the underlying rock).	5.
Groundwater	No water strikes noted during investigation.	5.
Suitability of Soakaways	Not recommended.	7.

<sup>1</sup> This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

## 1. Introduction

---

- i. We thank you for your request to undertake percolation testing at the above-mentioned site and take pleasure in enclosing the results of this work. The investigation was undertaken on the 26<sup>th</sup> March 2025 in accordance with your instruction to proceed. The site is centred on grid reference 471807, 359946. This report describes the work undertaken, presents the data obtained and discusses the results of the tests.

## 2. Limitations

---

- ii. The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between trial pit positions, these are for guidance only and no liability can be accepted for their accuracy.
- iii. This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

## 3. Fieldworks

---

- iv. Three trial pits were excavated in order to undertake soakaway testing, the positions of which are shown in Appendix 1. The soakaway tests were undertaken at the base of the pit at depths rational to the construction of soakaways. The soils exposed in the trial pits were logged on site in general accordance with BS5930: 2015 +A1: 2020, and full descriptions are given on the trial pit records which are presented in Appendix 2. Photographs of the trial pits are included within Appendix 3.
- v. Once excavations were completed, the trial pits were carefully re-instated with the arisings. Whilst every care was taken during the infilling process, including compacting of the infill at regular intervals with the arm of the excavator, it should be appreciated that some mounding of the surface may have resulted. Moreover, the infilled soils may be subjected to settlement over time, such that a depression in the surface may also occur. Therefore, the locations of any pits undertaken in this investigation should be conveyed to the current site user, as the mounds or depressions associated with the pits may present a risk to current site operations. Furthermore, it must be realised that the infilled pits represent an area of disturbance within the site soils, thus the soils at the pit locations may vary characteristically compared to the undisturbed ground.

## 4. Geology

- vi. The available published geological data for the site has been examined and the following table presents the anticipated geology.

Strata Type	Strata Name <sup>2</sup>	Previous Name <sup>3</sup>	Description <sup>3</sup>
Superficial Geology	-	-	None indicated beneath the site.
Solid Geology	Mercia Mudstone Group	Red Marl	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas.

## 5. Strata Conditions

- vii. In accordance with the geology of the area, the succession has been shown to include the following:

Depth m below ground level to underside of layer	Strata Type	Positions Layer Revealed	Groundwater Strikes m below ground level
0.25 – 0.30	TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, silty CLAY)	All	None
+1.50	Firm, reddish brown mottled greenish, slightly gravelly, silty CLAY [WEATHERED MERCIA MUDSTONE GROUP]	SA01	None
0.70	Firm, greenish grey mottled reddish brown, gravelly, silty CLAY [WEATHERED MERCIA MUDSTONE GROUP]	SA02	None
+1.30 – +1.40	Firm to stiff, reddish brown, slightly gravelly, silty CLAY [WEATHERED MERCIA MUDSTONE GROUP]	SA02 & SA03	None

<sup>1</sup> '+' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

## 6. Insitu Testing

### 6.1 Soakaway Test

- viii. On reaching the elected soakaway test depth, the pit was trimmed and squared as much as practicable. Water was then introduced into the pit at a controlled rate to prevent collapse of the sides and the level monitored at time intervals relative to a

<sup>2</sup> Sources: British Geological Survey (NERC) Map Sheets 113; Ollerton; Solid and Drift Edition, and Onshore Geindex [online resource from [www.bgs.ac.uk](http://www.bgs.ac.uk)]

<sup>3</sup> Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [online resource from [www.bgs.ac.uk](http://www.bgs.ac.uk)]

reference bar at ground level. The results obtained from the soakaway tests are presented at Appendix 4 and are summarised below:

Location	Soakage Area Dimensions (average) (m)	Depths of soaked strata (m)	Soil Description (of soaked strata)	Infiltration Rate (m/sec)	*Drainage Characteristics
SA01	0.30 x 1.30	0.94 to 1.50	Side – Slightly gravelly, silty CLAY Base – As above	-	Practically impermeable
SA02	0.30 x 1.00	0.86 to 1.30	Side – Slightly gravelly, silty CLAY Base – As above	-	Practically impermeable
SA03	0.30 x 1.20	0.94 to 1.40	Side – Slightly gravelly, silty CLAY Base – As above	-	Practically impermeable

\*Based on the most onerous results for each test.

- ix. During the soakaway tests the water level did not achieve a fall from 75% to 25% of the effective depth of the storage volume in all three trial pits. In all tests, the water level either did not move or moved at a negligible rate. It is considered that the initial movement was observed as water filled any gaps and fissures within the ground at the sides of the pits. On this basis, the tests could not be completed within the scope of the method provided in BRE Digest 365 due to the poor soakage rate of the exposed soils. Due to the negligible water movement it was not possible to extrapolate the results obtained in order to obtain a soil infiltration rate.

## 7. Discussion

- x. The soils encountered beneath the topsoil were found to be typical of the weathered fraction of the underlying Mercia Mudstone Group. The strata conditions and subsequent drainage characteristics appear to be comparable across the site. In this instance, the infiltration testing has revealed that the soils have practically impermeable drainage characteristics. Therefore, soakaways cannot be recommended at this site and an alternative form of drainage should be adopted.

## 8. References

- Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.
- British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations*, B.S.I., London.
- Barnes, G. (2000). *Soil Mechanics Principle and Practice*. 2nd ed. London: Macmillan Press Ltd, p.47.



---

## Appendix 1

### Site Plan

---

Notes:



Rogers **Geotechnical** Services Ltd

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HD8 8LU

**Telephone:** 0843 50 66 87  
**www.rogersgeotech.co.uk**

**Client:**  
Elements Green Trent Ltd

**Job Number:**  
C4948/25/E/7545

**Project Details:**  
Land at Maplebeck Road, Newark

**Scale:** Not to scale - reference only





---

## Appendix 2

### Trial Pit Records

---



# Trial Pit Log

Trialpit No  
**SA01**  
Sheet 1 of 1

Project Name: Land at Maplebeck Road      Project No. C4948/25/E/7545      Co-ords: -      Date 26/03/2025  
Level:      Dimensions (m): 1.3

Location: Maplebeck Road, Maplebeck, Nottinghamshire, NG22 0BS      Depth 1.50      Scale 1:25  
Client: Elements Green Trent Ltd      Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.25			TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to medium. Gravel is sub-angular to sub-rounded and fine to coarse mudstone and siltstone).
				1.50			Firm, reddish brown mottled greenish grey, slightly gravelly, silty CLAY. Gravel is sub-angular and fine to medium mudstone. [WEATHERED MERCIA MUDSTONE GROUP]
							End of pit at 1.50 m

Remarks: 1. Position cleared of services using CAT and Genny.

Stability: Stable





# Trial Pit Log

Trialpit No  
**SA02**  
Sheet 1 of 1

Project Name: Land at Maplebeck Road      Project No. C4948/25/E/7545      Co-ords: -      Date 26/03/2025  
Level:

Location: Maplebeck Road, Maplebeck, Nottinghamshire, NG22 0BS      Dimensions (m): 1      Scale 1:25

Client: Elements Green Trent Ltd      Depth 1.30      Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to medium. Gravel is sub-angular to sub-rounded and fine to coarse mudstone and siltstone).
				0.70			Firm, greenish grey mottled reddish brown, gravelly, silty CLAY. Gravel is sub-angular and fine to coarse mudstone. [WEATHERED MERCIA MUDSTONE GROUP]
				1.30			Stiff, reddish brown, slightly gravelly, silty CLAY. Gravel is sub-angular and fine to medium of mudstone. [WEATHERED MERCIA MUDSTOEN GROUP]
							End of pit at 1.30 m

Remarks: 1. Position cleared of services using CAT and Genny.

Stability: Stable





# Trial Pit Log

Trialpit No  
**SA03**  
Sheet 1 of 1

Project Name: Land at Maplebeck Road      Project No. C4948/25/E/7545      Co-ords: -      Date 26/03/2025  
Level:

Location: Maplebeck Road, Maplebeck, Nottinghamshire, NG22 0BS      Dimensions (m): 1.2  
Depth 1.40      Scale 1:25  
Client: Elements Green Trent Ltd      Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, silty CLAY. Sand is fine to medium. Gravel is sub-angular to sub-rounded and fine to coarse mudstone and siltstone).
				1.40			Stiff, reddish brown, slightly gravelly, silty CLAY. Gravel is sub-angular and fine to medium of mudstone. [WEATHERED MERCIA MUDSTONE GROUP]
							End of pit at 1.40 m

Remarks: 1. Position cleared of services using CAT and Genny.

Stability: Stable





---

## Appendix 3

### Trial Pit Photographs

---



Photo 1: SA01



Photo 2: SA01 backfilled



Environmental  
Geotechnical  
Specialists

Site Name:

**Land at Maplebeck Road**

Job No:

**C4948/25/E/7545**

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Photo 3: SA02



Photo 4: SA02 backfilled



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Specialists

Site Name:

**Land at Maplebeck Road**

Job No:

**C4948/25/E/7545**

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Photo 5: SA03



Photo 6: SA03 backfilled



Site Name:  
**Land at Maplebeck Road**

Job No:  
**C4948/25/E/7545**

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---

## Appendix 4

### Soakaway Results

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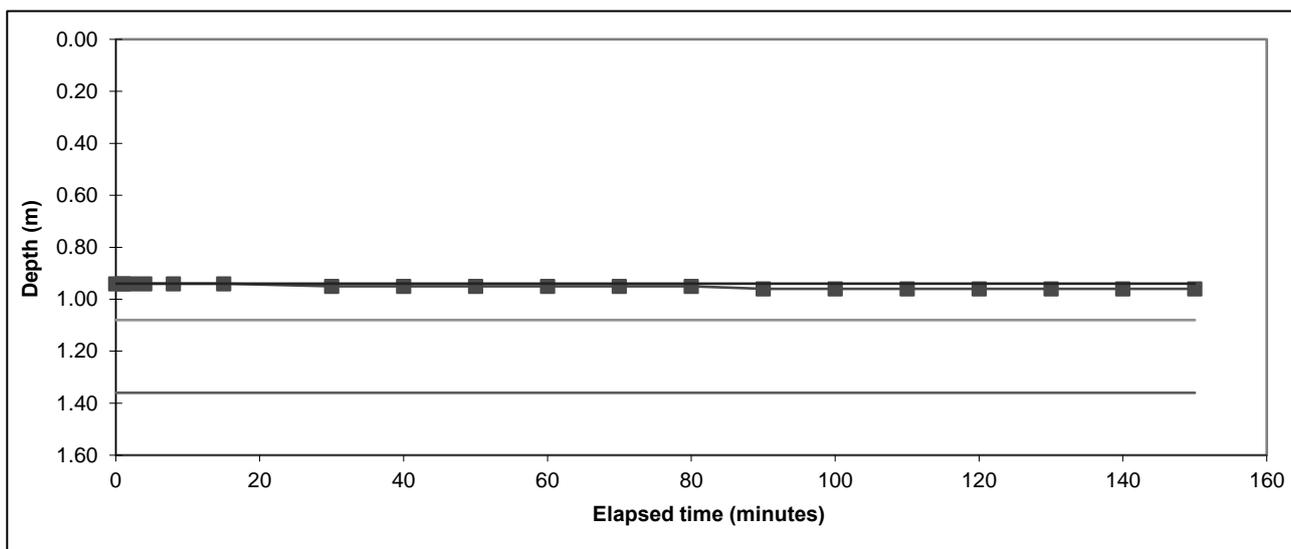
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA01	Test No:	1	Date:	26.03.2025
Length (m):	1.300	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.50	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.940	110	0.960
1	0.940	120	0.960
2	0.940	130	0.960
4	0.940	140	0.960
8	0.940	150	0.960
15	0.940		
30	0.950		
40	0.950		
50	0.950		
60	0.950		
70	0.950		
80	0.950		
90	0.960		
100	0.960		



Start water depth for analysis (mbgl):	0.94	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.08	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.22	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.36	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.50		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):		1.29	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007).
----------------	---

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	C4948/25/E/7545
<b>Site:</b>	Land at Maplebeck Road		

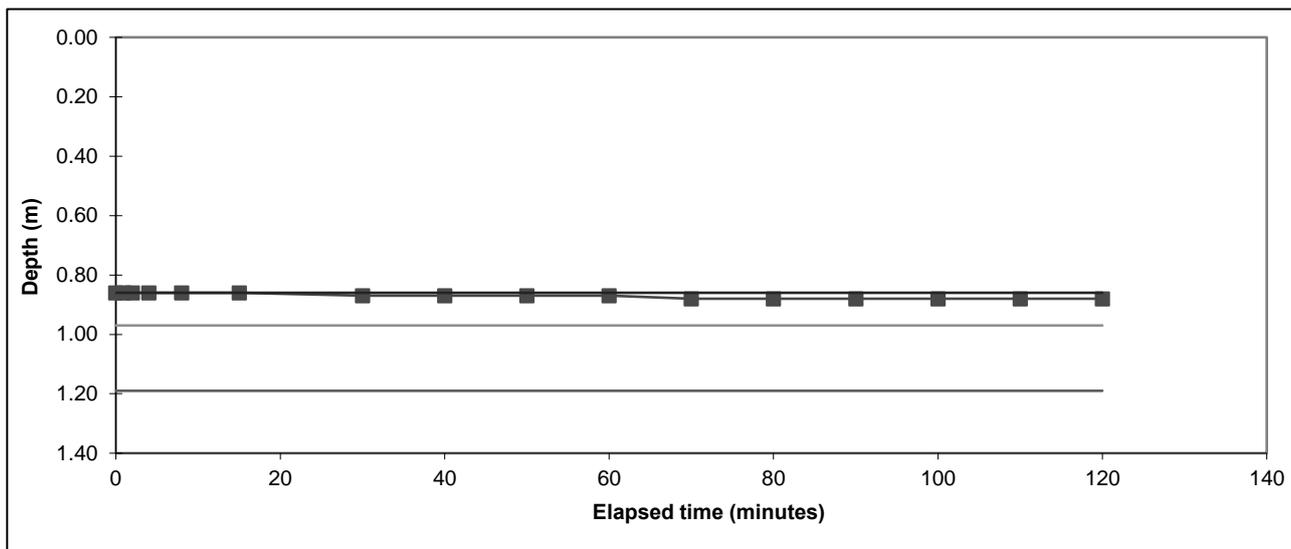
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA02	Test No:	1	Date:	26.03.2025
Length (m):	1.000	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.30	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.860	110	0.880
1	0.860	120	0.880
2	0.860		
4	0.860		
8	0.860		
15	0.860		
30	0.870		
40	0.870		
50	0.870		
60	0.870		
70	0.880		
80	0.880		
90	0.880		
100	0.880		



Start water depth for analysis (mbgl):	0.86	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	0.97	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.08		
25% effective depth (mbgl):	1.19	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.30		

Volume outflow between 75% and 25% effective depth (m<sup>3</sup>):

Mean surface area of outflow (m<sup>2</sup>): 0.87

(side area at 50% effective depth + base area)

Time for outflow between 75% and 25% effective depth (mins):

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

**Remarks** Results processed following BRE 365 (2007).

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	C4948/25/E/7545
<b>Site:</b>	Land at Maplebeck Road		

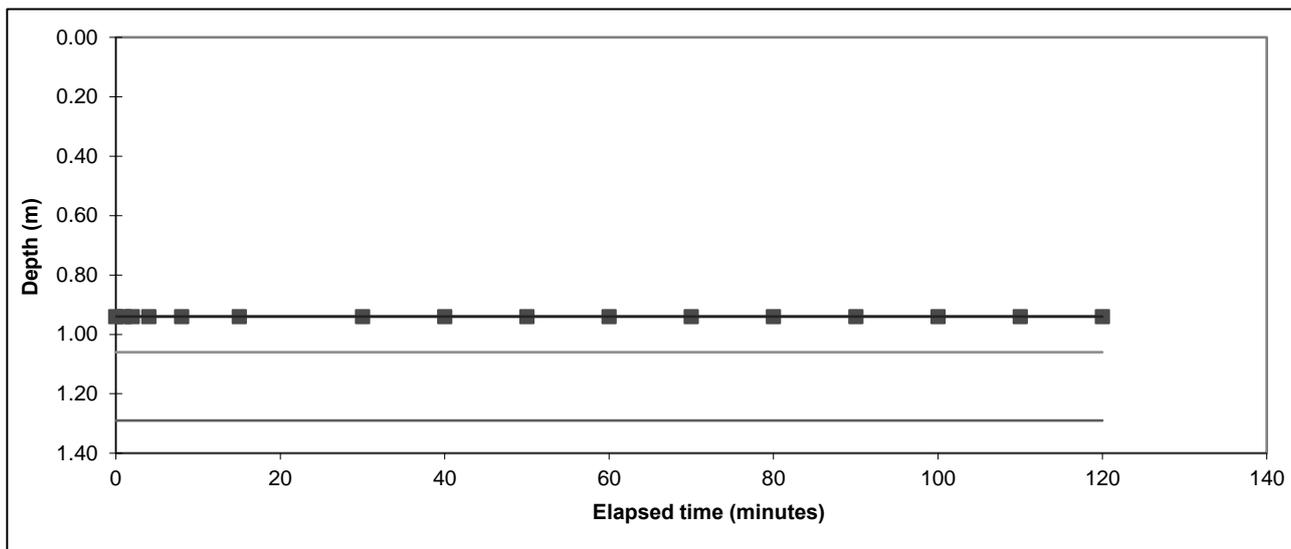
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA01	Test No:	1	Date:	26.03.2025
Length (m):	1.200	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.40	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.940	110	0.940
1	0.940	120	0.940
2	0.940		
4	0.940		
8	0.940		
15	0.940		
30	0.940		
40	0.940		
50	0.940		
60	0.940		
70	0.940		
80	0.940		
90	0.940		
100	0.940		



Start water depth for analysis (mbgl):	0.94	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.06	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.17	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.29	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.40		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):			1.05
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007).
----------------	---

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	C4948/25/E/7545
<b>Site:</b>	Land at Maplebeck Road		

## **APPENDIX B: INFILTRATION TESTING - Soakaway Testing 4: Land off Mill Lane**

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Geotechnical  
Specialists



# SOAKAWAY LETTER REPORT

< ENVIRONMENTAL > < GEOTECHNICAL >

job number	date
site address	
written by	checked by
issued by	

 Please consider the environment before printing this report.



**Rogers Geotechnical Services Ltd**  
Offices 1 & 2 Barncliffe Business Park, Near Bank, Shelley, Huddersfield, HD8 8LU  
☎ 01484 604354      Company No. 5130864

## Contents

		Page
1.	Introduction	2
2.	Limitations	2
3.	Fieldworks	2
4.	Geology	3
5.	Strata Conditions	3
6.	Insitu Testing	3
6.1	Soakaway Test	3
7.	Discussion	4
8.	References	4

## Appendices

1.	Site Plan
2.	Trial Pit Records
3.	Trial Pit Photographs
4.	Soakaway Results





## Report on Soakaway Testing

Location: **Land off Mill Lane**  
Kersall, Newark, Nottinghamshire, NG22 0BH

For: Elements Green Trent Ltd

Report No. C4949/25/E/7546

Report Date: May 2025

For and on behalf of **Rogers Geotechnical Services Ltd**

<b>Steven Hale</b> BSc FGS Geo-environmental Technician	<b>Scott Alexander</b> BSc FGS Senior Geo-environmental Engineer

### Report Summary<sup>1</sup>

Item	Comments	Section
Geology	Superficial Geology – none. Solid Geology – Mercia Mudstone Group.	4.
Strata Conditions	Nominal thickness of topsoil overlaying clay representative	5.
Groundwater	No water strikes noted during investigation.	5.
Suitability of Soakaways	Not recommended.	7.

<sup>1</sup> This summary should not be relied upon to provide a comprehensive review. All of the information contained in this document should be considered.

## 1. Introduction

---

- i. We thank you for your request to undertake percolation testing at the above-mentioned site and take pleasure in enclosing the results of this work. The investigation was undertaken on the 7<sup>th</sup> April 2025 in accordance with your instruction to proceed. The site is centred on grid reference 472200, 362150. This report describes the work undertaken, presents the data obtained and discusses the results of the tests

## 2. Limitations

---

- ii. The recommendations made and opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between trial pit positions, these are for guidance only and no liability can be accepted for their accuracy.
- iii. This report has been prepared in accordance with our understanding of current best practice. However, new information or legislation, or changes to best practice may necessitate revision of the report after the date of issue.

## 3. Fieldworks

---

- iv. Three trial pits were excavated in order to undertake soakaway testing, the positions of which are shown in Appendix 1. The soakaway tests were undertaken at the base of the pit at depths rational to the construction of soakaways. The soils exposed in the trial pits were logged on site in general accordance with BS5930: 2015 +A1: 2020, and full descriptions are given on the trial pit records which are presented in Appendix 2. Photographs of the trial pits are included within Appendix 3.
- v. Once excavations were completed, the trial pits were carefully re-instated with the arisings. Whilst every care was taken during the infilling process, including compacting of the infill at regular intervals with the arm of the excavator, it should be appreciated that some mounding of the surface may have resulted. Moreover, the infilled soils may be subjected to settlement over time, such that a depression in the surface may also occur. Therefore, the locations of any pits undertaken in this investigation should be conveyed to the current site user, as the mounds or depressions associated with the pits may present a risk to current site operations. Furthermore, it must be realised that the infilled pits represent an area of disturbance within the site soils, thus the soils at the pit locations may vary characteristically compared to the undisturbed ground.

## 4. Geology

- vi. The available published geological data for the site has been examined and the following table presents the anticipated geology.

Strata Type	Strata Name <sup>2</sup>	Previous Name <sup>3</sup>	Description <sup>3</sup>
Superficial Geology	-	-	None indicated beneath the site.
Solid Geology	Mercia Mudstone Group	Red Marl	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas.

## 5. Strata Conditions

- vii. In accordance with the geology of the area, the succession has been shown to include the following:

Depth m below ground level to underside of layer	Strata Type	Positions Layer Revealed	Groundwater Strikes m below ground level
0.20	TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, clayey SILT)	All	None
+1.45 – +1.50	Firm, reddish brown, slightly sandy, slightly gravelly becoming gravelly, silty CLAY [WEATHERED MERCIA MUDSTONE GROUP]	All	None

<sup>1</sup>' denotes that the strata extended below the termination depth of the investigated positions, thus the extent of the deposit is only proven to the depths indicated.

## 6. Insitu Testing

### 6.1 Soakaway Test

- viii. On reaching the elected soakaway test depth, the pit was trimmed and squared as much as practicable. Water was then introduced into the pit at a controlled rate to prevent collapse of the sides and the level monitored at time intervals relative to a reference bar at ground level. The results obtained from the soakaway tests are presented at Appendix 4 and are summarised below:

<sup>2</sup> Sources: British Geological Survey (NERC) Map Sheets 113; Ollerton; Solid and Drift Edition, and Onshore Geindex [online resource from [www.bgs.ac.uk](http://www.bgs.ac.uk)]

<sup>3</sup> Sources: British Geological Survey (NERC) Lexicon of Named Rock Units [online resource from [www.bgs.ac.uk](http://www.bgs.ac.uk)]

**Table 3: Soakaway Test Results**

Location	Soakage Area Dimensions (average) (m)	Depths of soaked strata (m)	Soil Description (of soaked strata)	Infiltration Rate (m/sec)	*Drainage Characteristics
SA01	0.30 x 1.70	0.93 to 1.45	Side – Slightly gravelly, silty CLAY Base – As above	-	Practically impermeable
SA02	0.30 x 1.50	0.95 to 1.50	Side – Slightly gravelly, silty CLAY Base – As above	-	Practically impermeable
SA03	0.30 x 1.70	1.05 to 1.50	Side – Slightly gravelly, silty CLAY Base – As above	-	Practically impermeable

\*Based on the most onerous results for each test.

- ix. During the soakaway tests the water level did not achieve a fall from 75% to 25% of the effective depth of the storage volume in all three trial pits. In all tests, the water level did not move, as such, the tests could not be completed within the scope of the method provided in BRE Digest 365 due to the poor soakage rate of the exposed soils. Due to the negligible water movement it was not possible to extrapolate the results obtained in order to obtain a soil infiltration rate.

## 7. Discussion

- x. The soils encountered beneath the topsoil were found to be typical of the weathered fraction of the underlying Mercia Mudstone Group. The strata conditions and subsequent drainage characteristics appear to be comparable across the site. In this instance, the infiltration testing has revealed that the soils have practically impermeable drainage characteristics. Therefore, soakaways cannot be recommended at this site and an alternative form of drainage should be adopted.

## 8. References

- Building Research Establishment (BRE) Digest 365, *Soakaway Design*, September 1991.
- British Standards Institution (2015 +A1: 2020) BS 5930: *Code of practice for ground investigations*, B.S.I., London.
- Barnes, G. (2000). *Soil Mechanics Principle and Practice*. 2nd ed. London: Macmillan Press Ltd, p.47.



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## Appendix 1

### Site Plan

---

Notes:

A616

SA01

SA02

SA03



Rogers Geotechnical Services Ltd

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Near Bank,  
Shelley,  
Huddersfield,  
HD8 8LU

Telephone: 0843 50 66 87  
[www.rogersgeotech.co.uk](http://www.rogersgeotech.co.uk)

Client:  
Elements Green Trent Ltd

Job Number:  
C4949/25/E/7546

Project Details:  
Land off Mill Lane, Kersall, Newark,  
Nottinghamshire, NG22 0BH

Scale: Not to scale - reference only





---

## Appendix 2

### Trial Pit Records

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# Trial Pit Log

Trialpit No  
**SA01**  
Sheet 1 of 1

Project Name: Land off Mill Lane      Project No. C4949/25/E/7546      Co-ords: -      Date 07/04/2025  
Level:

Location: Kersall, Newark, Nottinghamshire, NG22 0BH      Dimensions (m): 1.7

Client: Elements Green Trent Ltd      Depth 1.45      Scale 1:25      Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is subangular to rounded and fine to coarse of various lithologies).
				1.45			Firm, reddish brown, slightly sandy, slightly gravelly becoming gravelly, silty CLAY. Sand is fine to medium. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
							End of pit at 1.45 m

Remarks: 1. Position scanned for services using CAT and Genny.

Stability: Stable





# Trial Pit Log

Trialpit No  
**SA02**  
Sheet 1 of 1

Project Name: Land off Mill Lane      Project No. C4949/25/E/7546      Co-ords: -      Date 07/04/2025  
Level:

Location: Kersall, Newark, Nottinghamshire, NG22 0BH      Dimensions (m): 1.5

Client: Elements Green Trent Ltd      Depth 1.50      Scale 1:25      Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is subangular to rounded and fine to coarse of various lithologies).
				1.50			Firm, reddish brown, slightly sandy, slightly gravelly becoming gravelly, silty CLAY. Sand is fine to medium. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
							End of pit at 1.50 m

Remarks: 1. Position scanned for services using CAT and Genny.

Stability: Stable





# Trial Pit Log

Trialpit No  
**SA03**  
Sheet 1 of 1

Project Name: Land off Mill Lane      Project No. C4949/25/E/7546      Co-ords: -      Date 07/04/2025  
Level:

Location: Kersall, Newark, Nottinghamshire, NG22 0BH      Dimensions (m): 1.7

Client: Elements Green Trent Ltd      Depth 1.50      0.3      Scale 1:25  
Logged SH

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.20			TOPSOIL (Soft, dark brown, slightly sandy, slightly gravelly, clayey SILT. Sand is fine to medium. Gravel is subangular to rounded and fine to coarse of various lithologies).
				1.50			Firm, reddish brown, slightly sandy, slightly gravelly becoming gravelly, silty CLAY. Sand is fine to medium. Gravel is tabular, sub-angular and fine to coarse of mudstone and siltstone. [WEATHERED MERCIA MUDSTONE GROUP]
							End of pit at 1.50 m

Remarks: 1. Position scanned for services using CAT and Genny.

Stability: Stable





---

## Appendix 3

### Trial Pit Photographs

---



Photo 1: SA01



Photo 2: SA01 backfilled



Site Name:  
**Land off Mill Lane**

Job No:  
**C4949/25/E/7546**

**t. 0843 50 666 87**  
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Photo 1: SA02



Photo 2: SA02 backfilled



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**Land off Mill Lane**

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**C4949/25/E/7546**

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Photo 1: SA03



Photo 2: SA03 backfilled



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**Land off Mill Lane**

Job No:

**C4949/25/E/7546**

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## Appendix 4

### Soakaway Results

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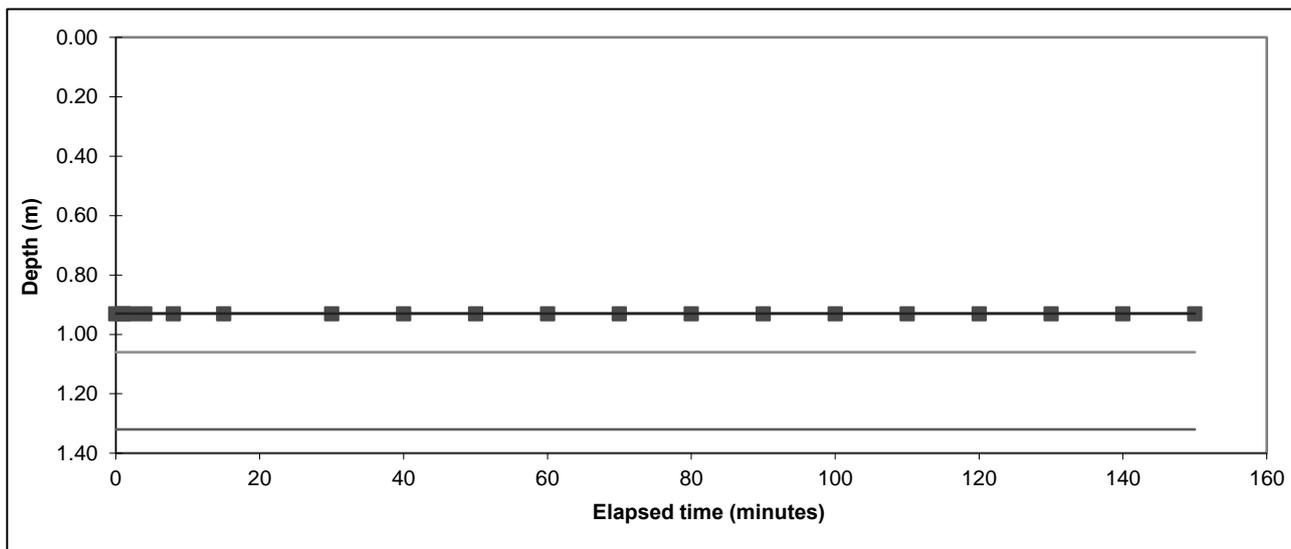
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA01	Test No:	1	Date:	07.04.2025
Length (m):	1.700	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.45	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.930	110	0.930
1	0.930	120	0.930
2	0.930	130	0.930
4	0.930	140	0.930
8	0.930	150	0.930
15	0.930		
30	0.930		
40	0.930		
50	0.930		
60	0.930		
70	0.930		
80	0.930		
90	0.930		
100	0.930		



Start water depth for analysis (mbgl):	0.93	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.06	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.19	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.32	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.45		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):		1.55	
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

<b>Remarks</b>	Results processed following BRE 365 (2007). Soil appears to be practically impermeable.
----------------	--

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Mill Lane, Kersall, Newark, Nottinghamshire, NG22 0BH		C4949/25/E/7546

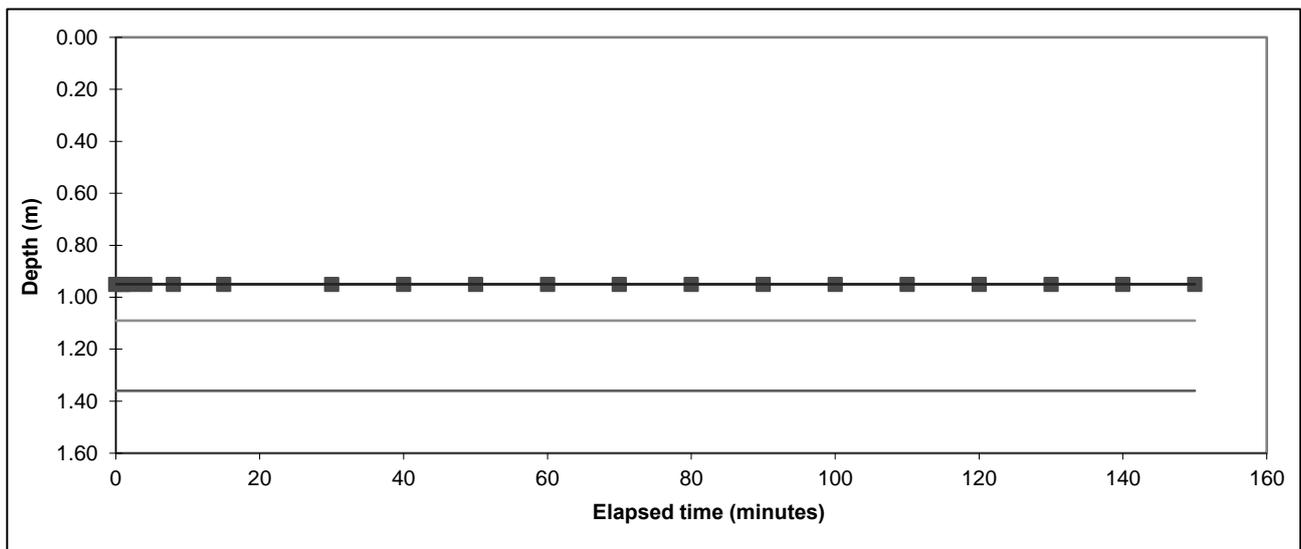
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA02	Test No:	1	Date:	07.04.2025
Length (m):	1.500	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.50	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	0.950	110	0.950
1	0.950	120	0.950
2	0.950	130	0.950
4	0.950	140	0.950
8	0.950	150	0.950
15	0.950		
30	0.950		
40	0.950		
50	0.950		
60	0.950		
70	0.950		
80	0.950		
90	0.950		
100	0.950		



Start water depth for analysis (mbgl):	0.95	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.09	Elapsed time (mins):	#N/A
50% effective depth (mbgl):	1.23	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.36	Elapsed time (mins):	#N/A
Base of soakage zone (mbgl):	1.50		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):			1.42
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

**Remarks** Results processed following BRE 365 (2007).  
Soil appears to be practically impermeable.

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Mill Lane, Kersall, Newark, Nottinghamshire, NG22 0BH		C4949/25/E/7546

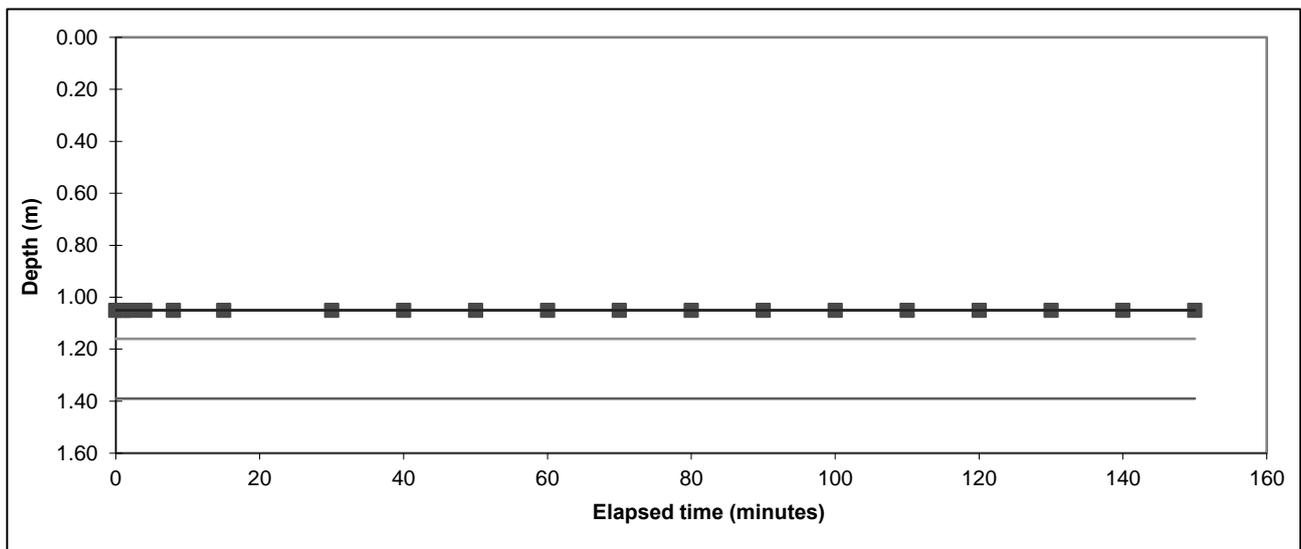
# Rogers Geotechnical Services L

## Soakaway Test

Trial Pit No:	SA03	Test No:	1	Date:	07.04.2025
Length (m):	1.700	Datum Height:			0.00 m agl
Width (m):	0.30	Granular infill:	None		
Depth (m):	1.50	Porosity of infill:	1	(assumed)	

Elapsed time (minutes)	Water Depth (m below datum)	Elapsed time (minutes)	Water Depth (m below datum)
0	1.050	110	1.050
1	1.050	120	1.050
2	1.050	130	1.050
4	1.050	140	1.050
8	1.050	150	1.050
15	1.050		
30	1.050		
40	1.050		
50	1.050		
60	1.050		
70	1.050		
80	1.050		
90	1.050		
100	1.050		



Start water depth for analysis (mbgl):	1.05	Elapsed time (mins):	#N/A
75% effective depth (mbgl):	1.16		
50% effective depth (mbgl):	1.28	Elapsed time (mins):	#N/A
25% effective depth (mbgl):	1.39		
Base of soakage zone (mbgl):	1.50		
Volume outflow between 75% and 25% effective depth (m <sup>3</sup> ):			
Mean surface area of outflow (m <sup>2</sup> ):			1.39
(side area at 50% effective depth + base area)			
Time for outflow between 75% and 25% effective depth (mins):			

<b>Soil infiltration rate (m/s):</b>	<b>Test incomplete as 25% effective depth not achieved. Unable to reliably determine soil infiltration rate.</b>
--------------------------------------	--

**Remarks** Results processed following BRE 365 (2007).  
Soil appears to be practically impermeable.

<b>Client:</b>	Elements Green Trent Ltd	<b>Job No:</b>	
<b>Site:</b>	Land off Mill Lane, Kersall, Newark, Nottinghamshire, NG22 0BH		C4949/25/E/7546



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## APPENDIX C: FIGURES

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<b>Page 33: [1] Deleted</b>	<b>Tiffany Ho</b>	<b>18/02/20</b>
<b>Page 41: [2] Deleted</b>	<b>Tiffany Ho</b>	<b>18/02/20</b>
<b>Page 64: [3] Deleted</b>	<b>Tiffany Ho</b>	<b>18/02/20</b>
<b>Page 68: [4] Deleted</b>	<b>Tiffany Ho</b>	<b>18/02/20</b>



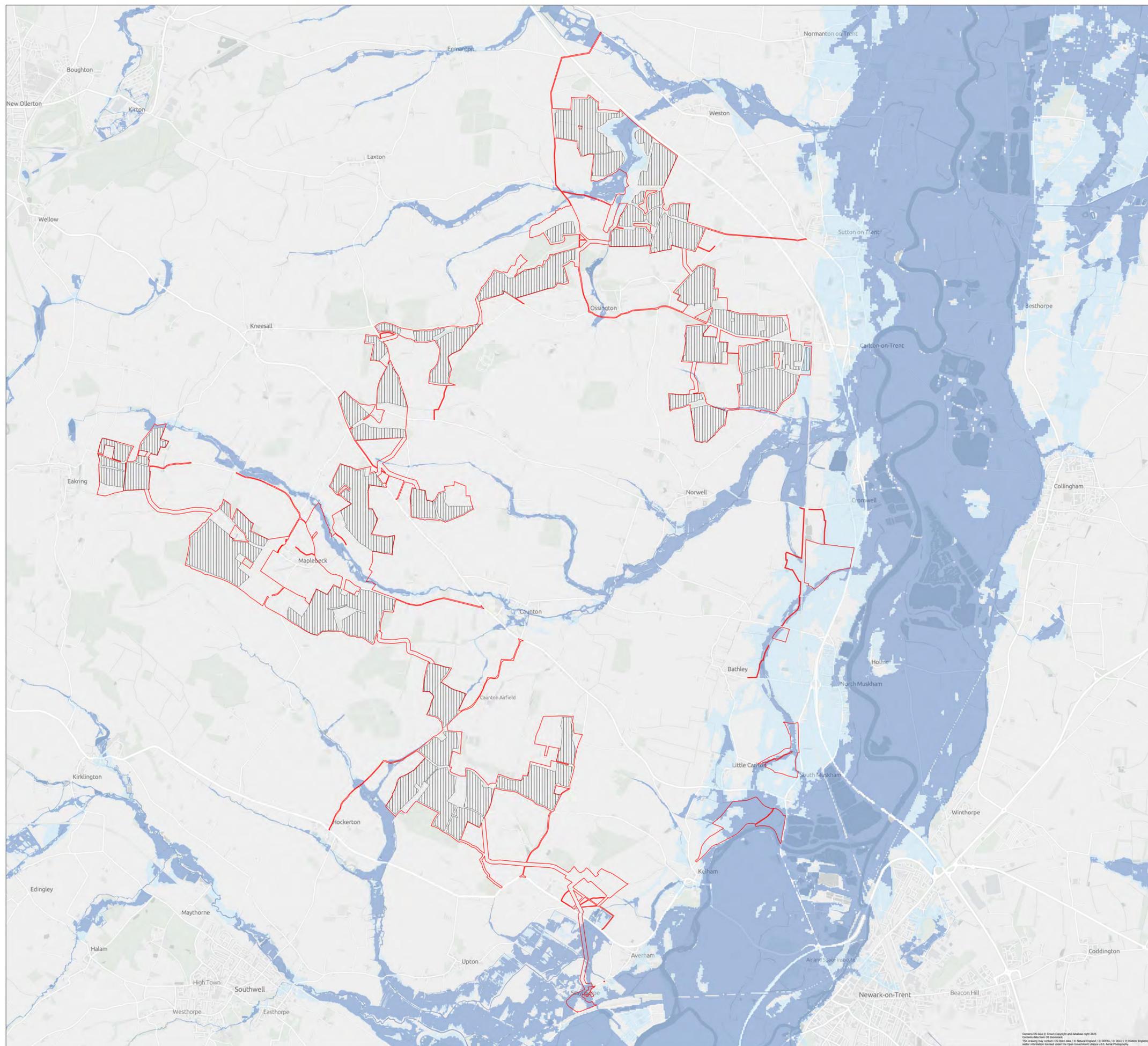
## ENVIRONMENTAL STATEMENT VOLUME 4, TECHNICAL APPENDIX A9.1: FLOOD RISK ASSESSMENT APPENDIX CD

<i>Drawing Number</i>	<i>Revision</i>	<i>Drawing Title</i>	<i>Scale</i>
014-ES-020-Rev02	02	Figure A9.1 Flood Zones 2025	1:30,000 @ A1
014-ES-021-Rev02	02	Figure A9.2 Flood Zone 3b (reproduced from SFRA)	1:20,000@A1
014-ES-021a-Rev02	02	Figure A9.3 3.33% AEP Defended CCP1 Extents	1:20,000@A1
014-ES-008-Rev02	02	Figure A9.4 Existing Flood Defences	1:30,000@A1
014-ES-028-Rev02	02	Figure A9.5 1 % AEP Pluvial Flood Extents	1:30,000@A1
014-ES-022-Rev02	02	Figure A9.6 1 % AEP Flood Depths (EA - RoFSW 2025)	1:30,000@A1
014-ES-029-Rev0 <del>32</del>	0 <del>32</del>	Figure A9.7 <del>A</del> 1 % AEP Flood Depths (Raincloud 2D Modelling)	1:30,000@A1
<u>014-ES-029B</u>	<u>01</u>	<u>Figure A9.7B 1% AEP +25% CC Flood Depths (Raincloud 2D Modelling)</u>	<u>1:30,000@A1</u>
014-ES-007-Rev02	02	Figure A9.8 Reservoir Flood Extents	1:30,000@A1
014-ES-012-Rev02	02	Figure A9.9 Reservoir Flood Extents - Dry Day Scenario	1:20,000@A1
014-ES-009-Rev02	02	Figure A9.10 Historic Flood Outlines	1:30,000@A1
014-ES-010-Rev02	02	Figure A9.11 Recent Flood Outlines	1:30,000@A1
014-ES-065-Rev02	02	Figure A9.12 Flood Studies Catchments	1:30,000@A1
014-ES-014-Rev02	02	Figure A9.13 Tidally Dominated 0.5 % AEP 2121 (Upper End) Scenario	1:30,000@A1
014-ES-013-Rev02	02	Figure A9.14 Fluvially Dominated 1 % AEP + 62 % CC Scenario	1:30,000@A1
014-ES-015-Rev02	02	Figure A9.15 Combined Tidal Breach Outline	1:20,000@A1
014-ES-016-Rev02	02	Figure A9.16 1 % AEP - River Trent	1:20,000@A1
014-ES-017-Rev02	02	Figure A9.17 1 % AEP + 30 % CC - River Trent	1:30,000@A1
014-ES-031a-Rev02	02	Figure A9.18 1 % AEP Defended Extents (CCP1)	1:30,000@A1



<b><i>Drawing Number</i></b>	<b><i>Revision</i></b>	<b><i>Drawing Title</i></b>	<b><i>Scale</i></b>
014-ES-047-Rev02	02	Figure A9.19 1%AEP+30% CC and + 39% CC scenarios	1:30,000@A1
014-ES-049b-Rev02	02	Figure A9.20 1% Undefined CCP1	1:1000@A1
014-ES-048-Rev02	02	Figure A9.21 Moorhouse Beck – Flood Zones	1:10,000@A1
014-ES-059-Rev02	02	Figure A9.22 RSuDS enhancement areas associated with the Development	1:30,000@A1
014-ES-057-Rev02	02	Figure A9.23 Maplebeck 1 % AEP - Baseline	1:5,000@A1
014-ES-058-Rev02	02	Figure A9.24 1 % AEP - Grass Mix under PV Arrays	1:5,000@A1
014-ES-061-Rev02	02	Figure A9.25 Slope within Work Area 1	1:30,000@A1

-  Order Limits / Core Study Area
-  Works Area 1: Solar PV
- Flood Map for Planning December 2025
- Flood Zone
-  FZ2
-  FZ3



1:30,000 Scale @ A1

0 0.5 1 2 km



Ref: 014-ES-020-Rev03

Date: 09/12/2025

**Flood Zones 2025  
Figure A9.1**

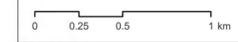
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Biodiversity Park  
Flood Risk Assessment**

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- Order Limits / Core Study Area
- Works Area 1: Solar PV
- Works Area 3: Mitigation
- Works Area 6: National Grid Substation
- Works Area 7: Staythorpe BESS Connection
- Flood Zone 3b (5% AEP from SFRA)



1:20,000 Scale @ A1



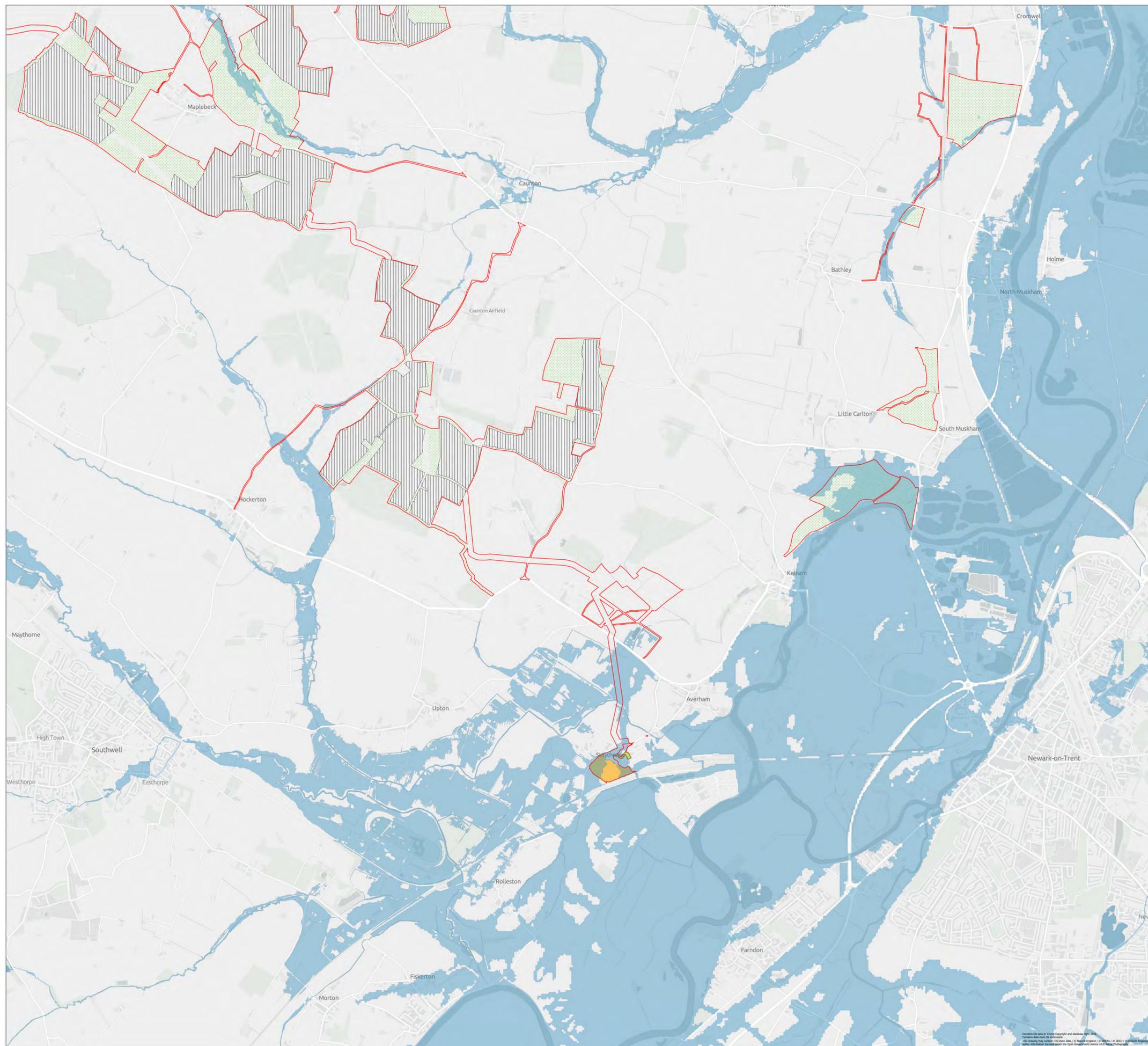
Ref: 014-ES-021-Rev02

Date: 13/08/2025

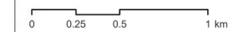
**Flood Zone 3b  
(reproduced from SFRA)  
Figure A9.2**

**Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment**

-  Order Limits / Core Study Area
-  Works Area 1: Solar PV
-  Works Area 3: Mitigation
-  Works Area 6: National Grid Substation
-  Works Area 7: Staythorpe BESS Connection
-  3.33 % AEP Defended CCP1



1:20,000 Scale @ A1



Ref: 014-ES-021a-Rev02

Date: 13/08/2025

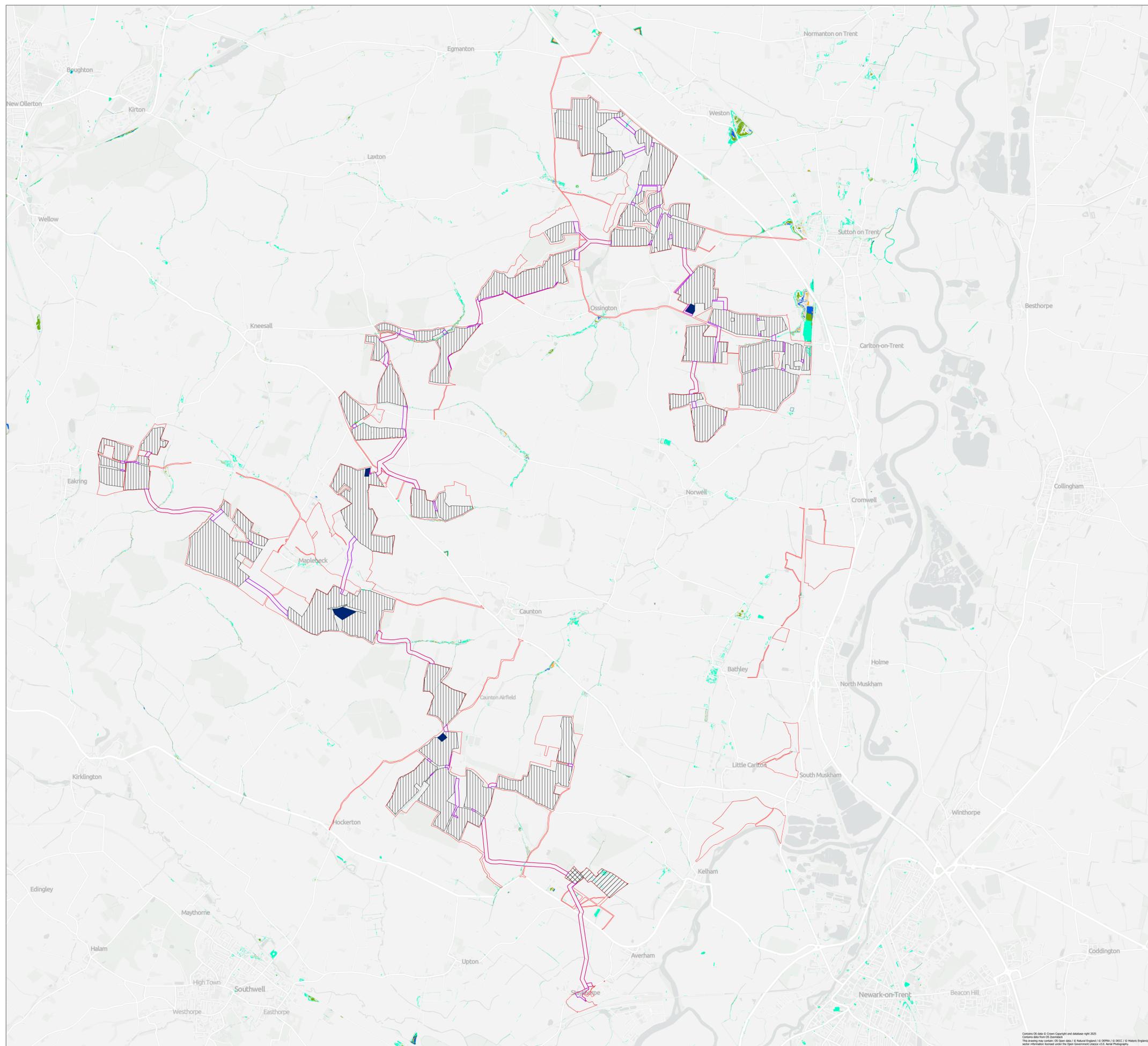
**3.33 % AEP Defended CCP1 Extents  
Figure A9.3**

**Great North Road Solar and  
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Flood Risk Assessment**

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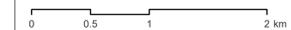






- Order Limits / Core Study Area
  - Works Area 1: Solar PV
  - Works Area 2: Cable
  - Works Area 4: Substations
  - Works Area 5a: BESS
  - Works Area 5b: 400kV Substation
- RoFSW - Medium Risk Depth (m)
- 0-0.2
  - 0.3
  - 0.6
  - 0.9
  - 1.2

1:30,000 Scale @ A1



Ref: 014-ES-022-Rev02

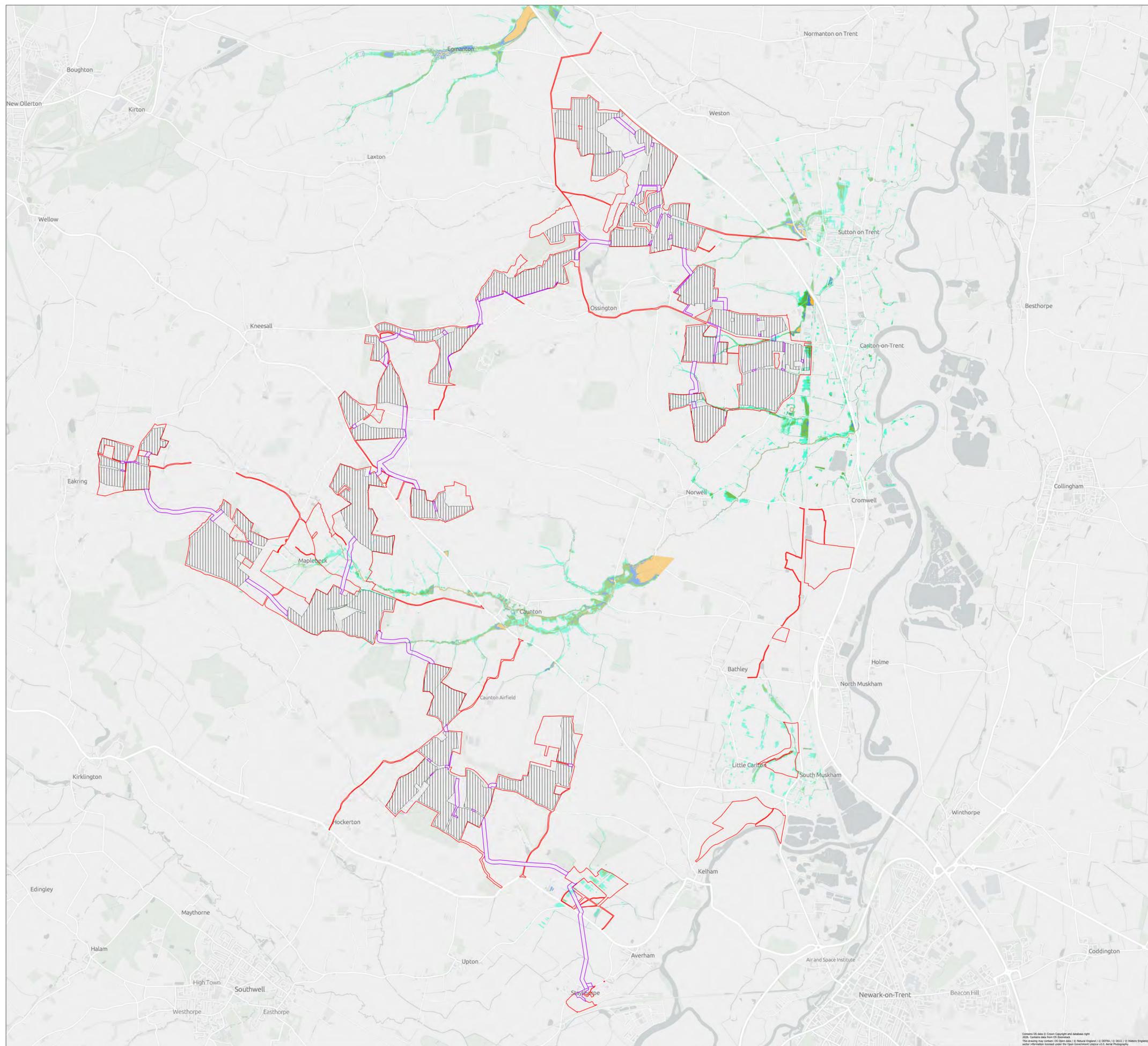
Date: 12/08/2025

**1 % AEP Flood Depths  
(EA - RoFSW 2025)  
Figure A9.6**

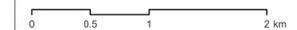
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Flood Risk Assessment**

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- Order Limits / Core Study Area
  - Works Area 1: Solar PV
  - Works Area 2: Cable
- 1% AEP - 2D Model  
Depth (m)
- 0.011 - 0.15
  - 0.151 - 0.3
  - 0.301 - 0.6
  - 0.601 - 0.9
  - 0.901 - 2.941



1:30,000 Scale @ A1



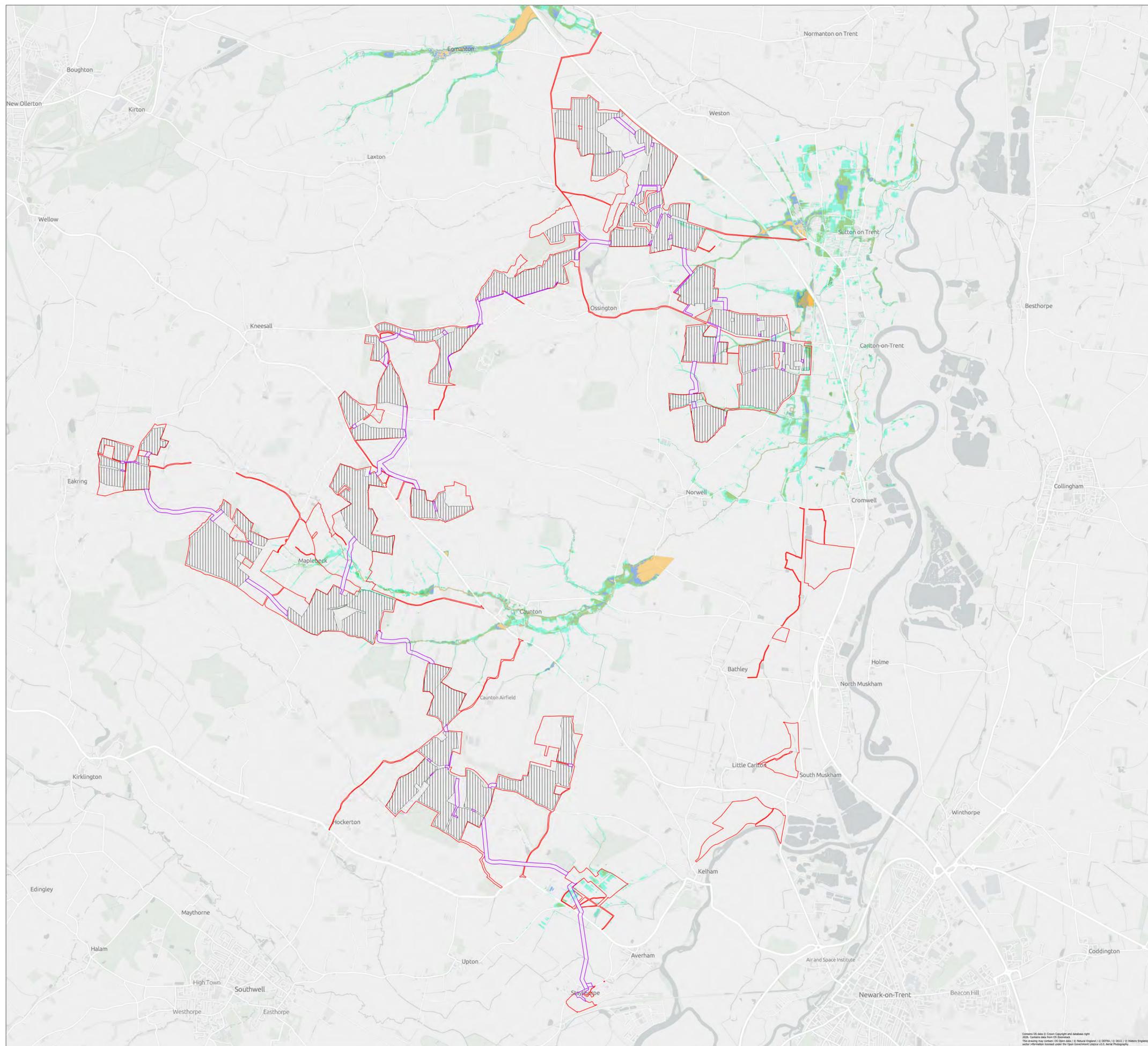
Ref: 014-ES-029-Rev03

Date: 13/02/2026

**1 % AEP Flood Depths  
(Raincloud 2D Modelling)  
Figure A9.7A**

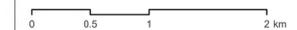
**Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment**

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- Order Limits / Core Study Area
  - Works Area 1: Solar PV
  - Works Area 2: Cable
- 1 % AEP + 25 % CC - 2D Model
- Depth (m)
- 0.011 - 0.15
  - 0.151 - 0.3
  - 0.301 - 0.6
  - 0.601 - 0.9
  - 0.901 - 2.941

1:30,000 Scale @ A1



Ref: 014-ES-029B

Date: 13/02/2026

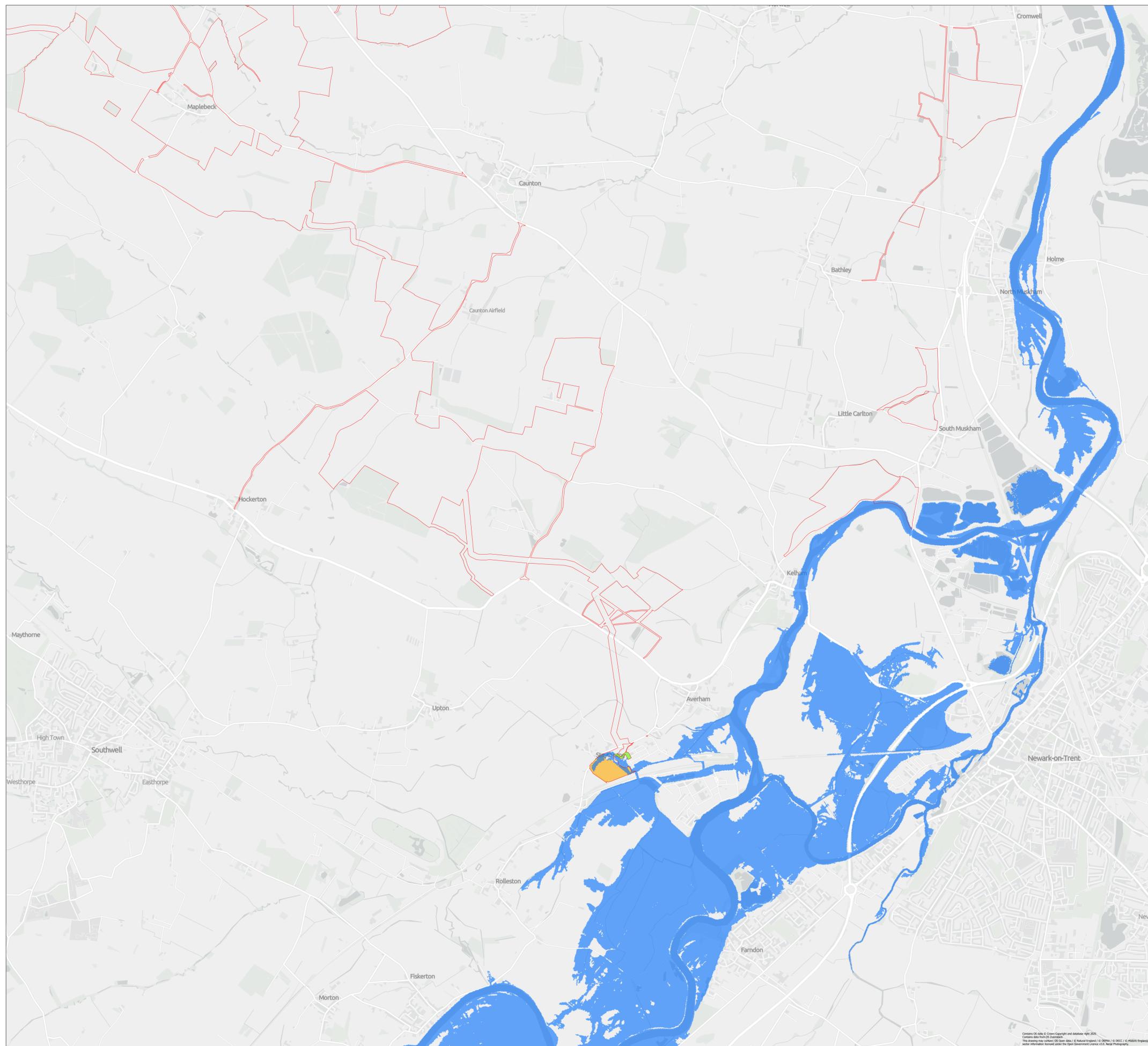
**1 % AEP + 25 % CC Flood Depths  
(Raincloud 2D Modelling)  
Figure A9.7B**

**Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment**

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- Order Limits / Core Study Area
- Works Area 6: National Grid Substation
- Works Area 7: Staythorpe BESS Connection
- Flood Extents - Dry Day



1:20,000 Scale @ A1

0 0.25 0.5 1 km



Ref: 014-ES-012-Rev02

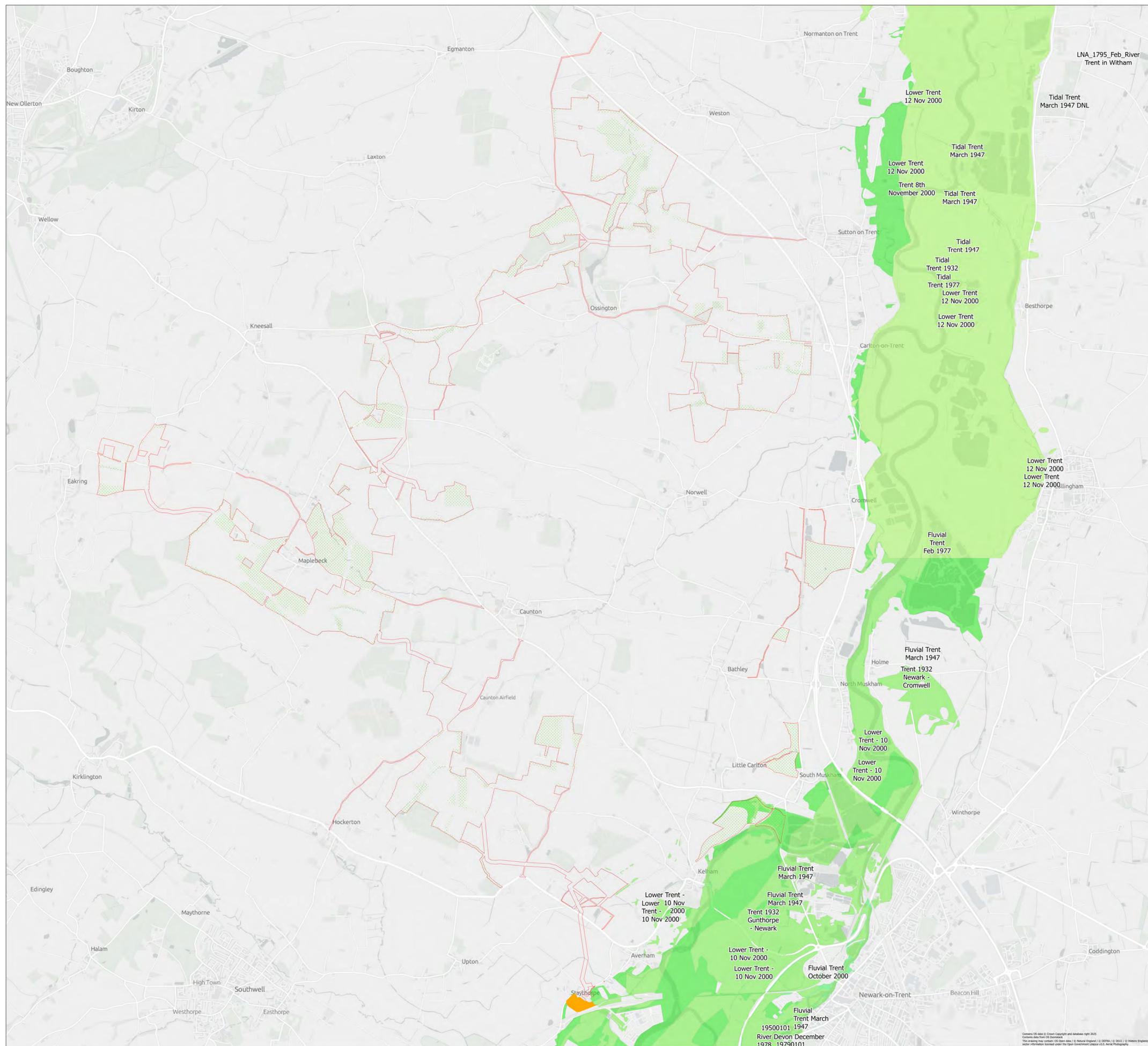
Date: 12/08/2025

**Reservoir Flood Extents -  
Dry Day Scenario  
Figure A9.9**

**Great North Road Solar and  
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Flood Risk Assessment**

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- Order Limits / Core Study Area
  - Works Area 3: Mitigation
  - Works Area 7: Staythorpe BESS Connection
- Recorded Flood Outlines >2000
- Date
- 31/10/2000
  - 08/11/2000
  - 10/11/2000
  - 12/11/2000
  - 22/06/2007
  - 25/06/2007
  - 01/11/2012
  - 16/02/2020
  - 20/10/2023
  - 02/01/2024

1:30,000 Scale @ A1

0 0.5 1 2 km



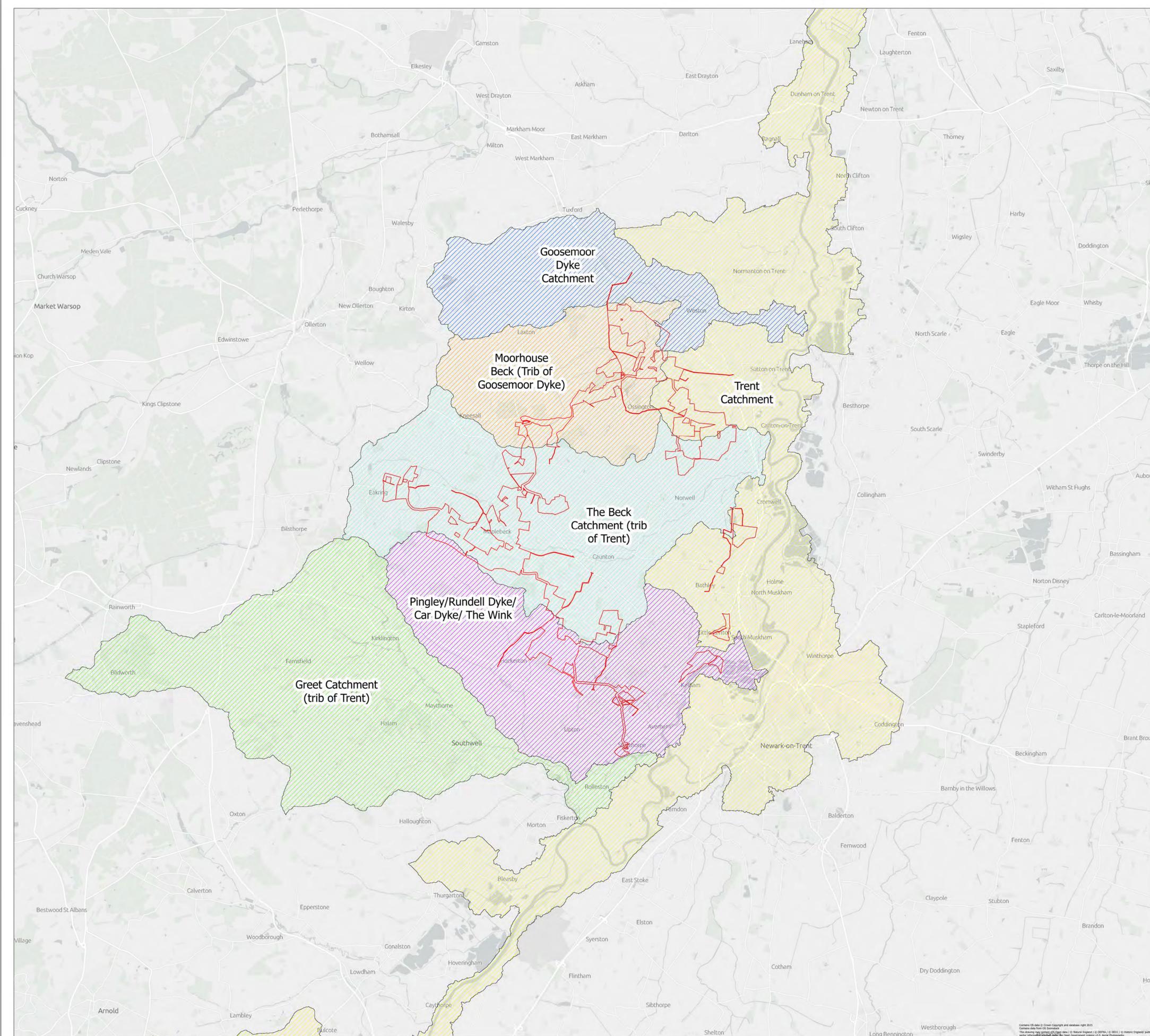
Ref: 014-ES-010-Rev02

Date: 12/08/2025

**Recent Flood Outlines  
Figure A9.11**

**Great North Road Solar and  
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Flood Risk Assessment**

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Order Limits / Core Study Area

Water Body Catchments

wb\_name

-  Goosemoor Dyke Catchment
-  Greet Catchment (trib of Trent)
-  Moorhouse Beck (Trib of Goosemoor Dyke)
-  Pingley/ Rundell Dyke
-  The Beck Catchment (trib of Trent)
-  Trent Catchment

Catchment Name	Flood Study
The Beck Catchment (trib of Trent)	NaFra2 data
Greet Catchment (trib of Trent)	River Greet, Nottingham Tributaries SFRM, JBA (2014)
Moorhouse Beck (Trib of Goosemoor Dyke)	NaFra2 data
Goosemoor Dyke Catchment	NaFra2 data
Trent Catchment	Tidal Trent, Jacobs (2023) Trent and tributaries at Newark SFRM2 (2011) Halcrow July 2011 plus the EA climate change (2020 rerun)
Pingley / Rundell Dyke / Car Dyke / The Wink	Trent and tributaries at Newark SFRM2 (2011) Raincloud (2025)

1:60,000 Scale @ A1

0 1 2 4 km



Ref: 014-ES-065-Rev02

Date: 13/08/2025

**Flood Studies Catchments  
Figure A9.12**

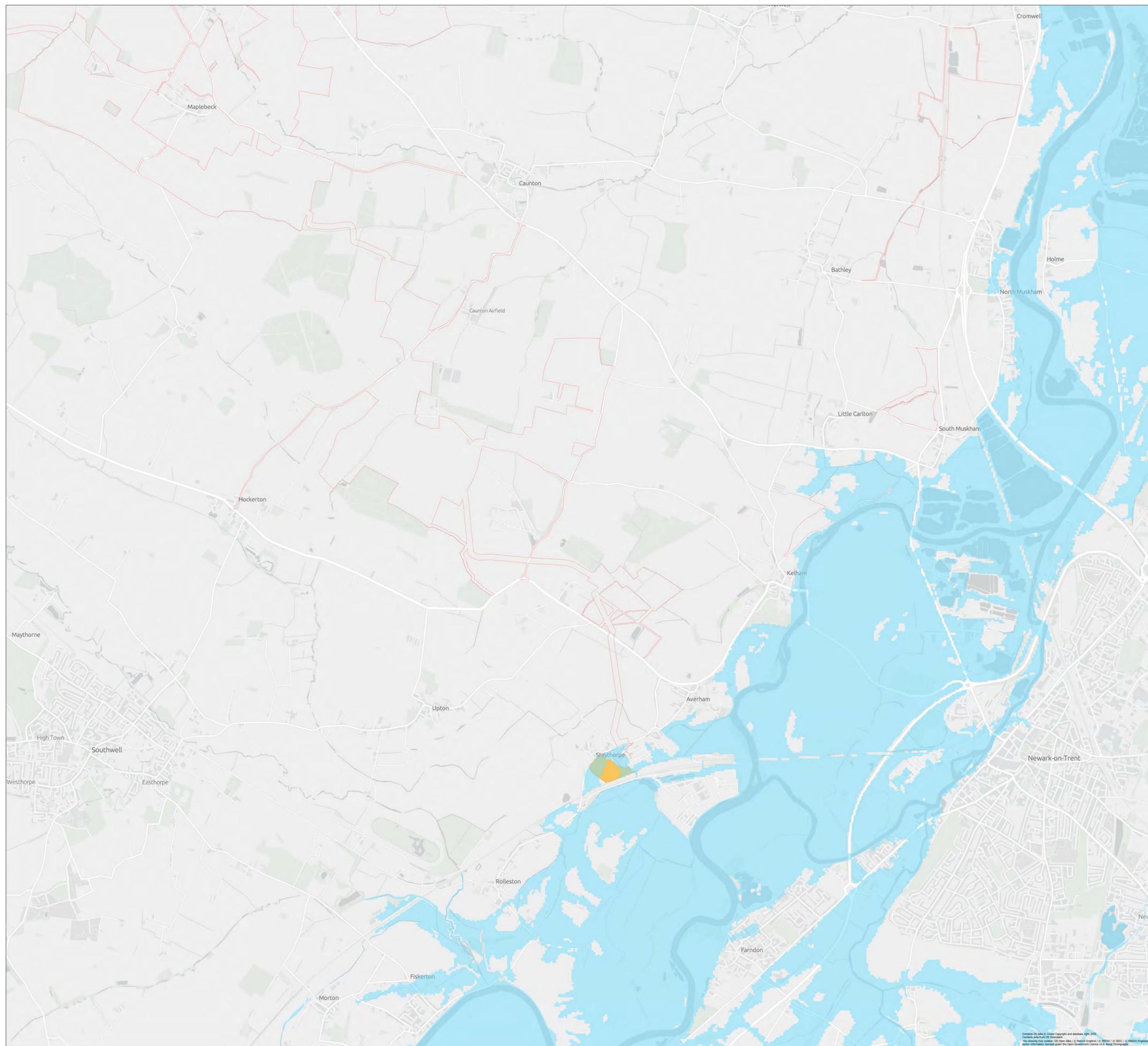
**Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment**







- Order Limits / Core Study Area
- Works Area 7: Staythorpe BESS Connection
- 1% AEP



1:20,000 Scale @ A1

0 0.25 0.5 1 km



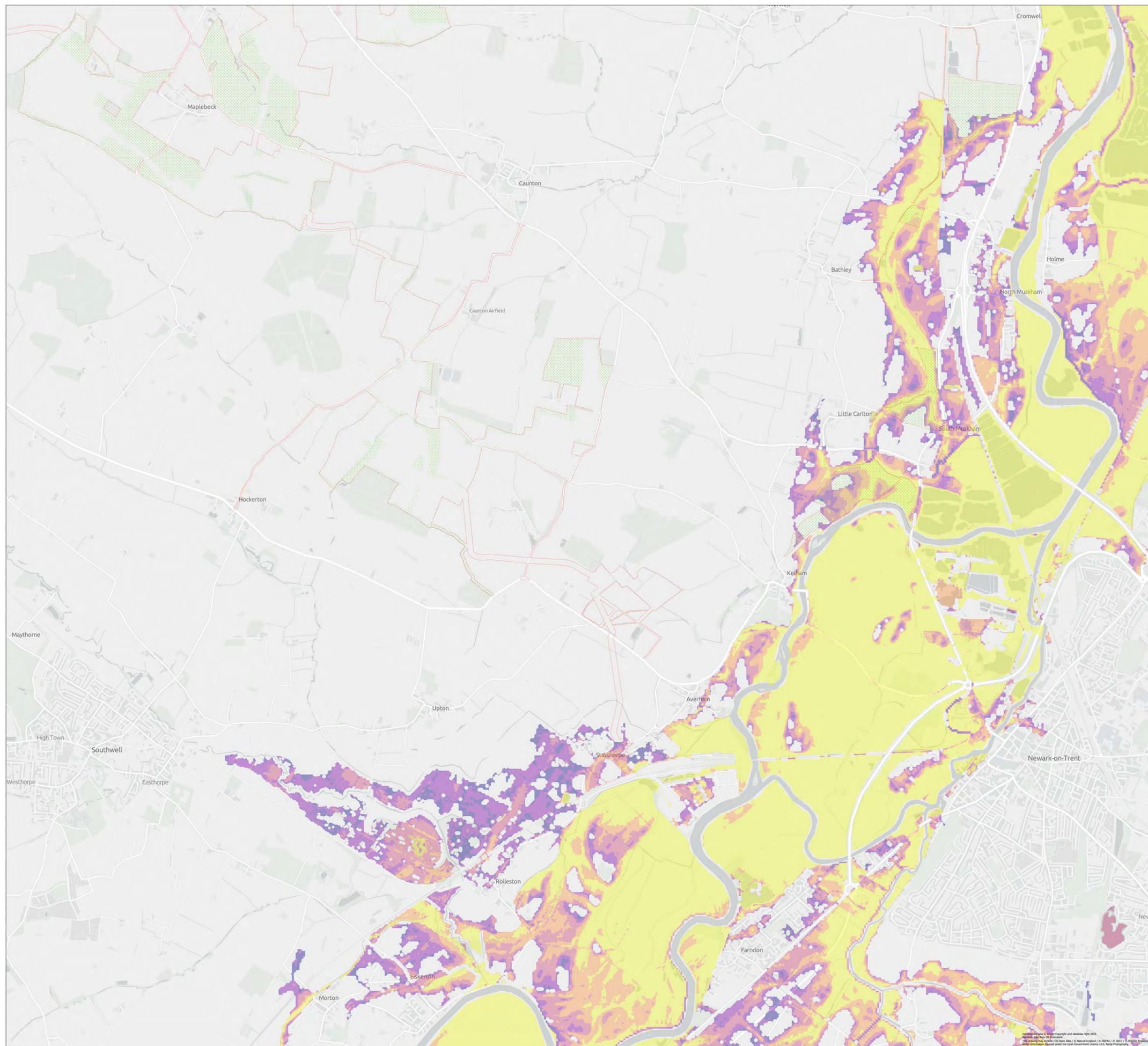
Ref: 014-ES-016-Rev02

Date: 13/08/2025

**1 % AEP - River Trent  
Figure A9.16**

**Great North Road Solar and  
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Flood Risk Assessment**

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- Order Limits / Core Study Area
- Works Area 3: Mitigation
- 1% AEP + 30% cc
- Depth (m)
- 0.011 - 0.1
- 0.101 - 0.3
- 0.301 - 0.6
- 0.601 - 0.9
- 0.901 - 2.941

1:20,000 Scale @ A1

0 0.25 0.5 1 km



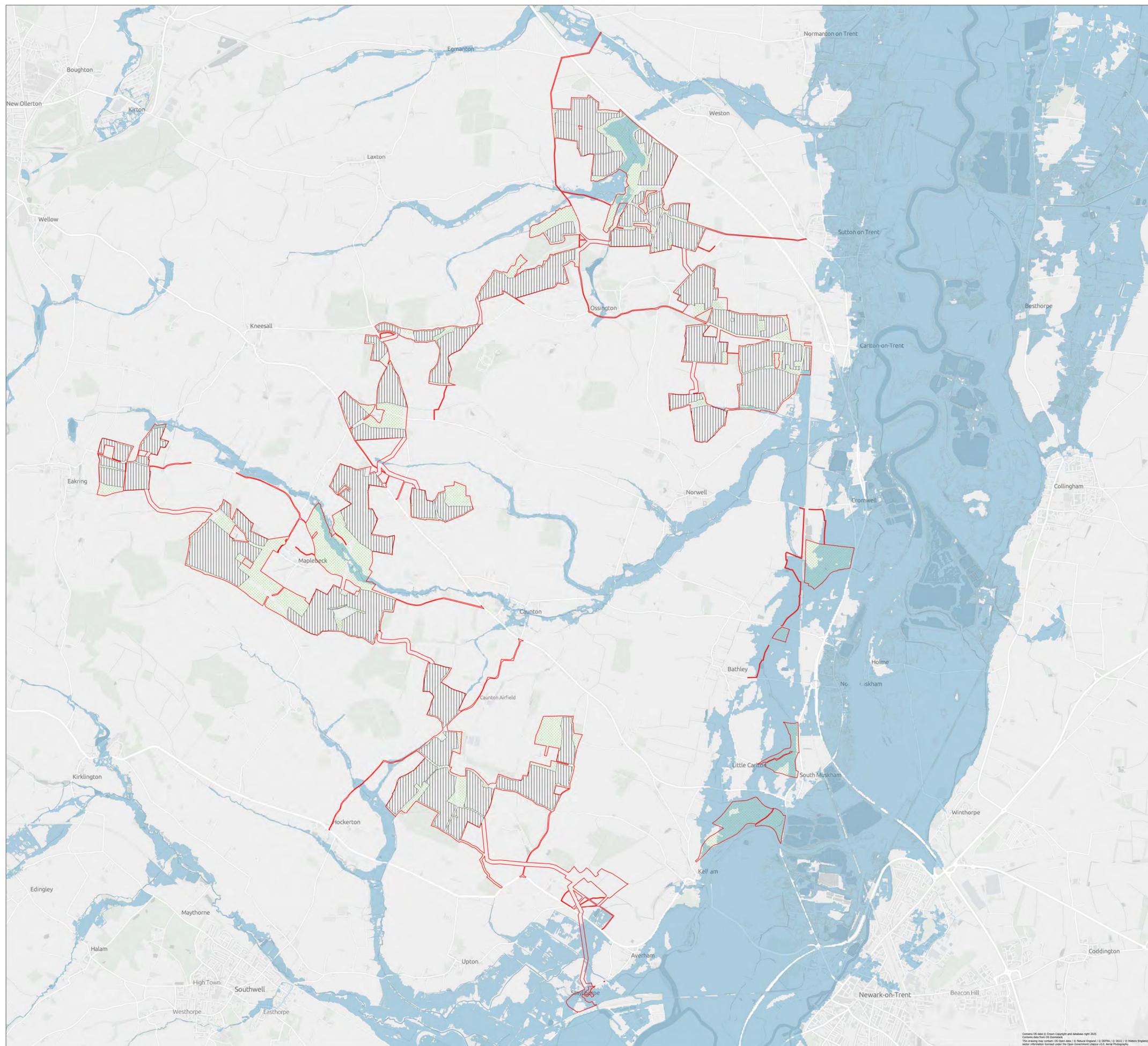
Ref: 014-ES-017-Rev02

Date: 13/08/2025

**1 % AEP + 30 % CC - River Trent  
Figure A9.17**

**Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment**

- Order Limits / Core Study Area
- Works Area 1: Solar PV
- Works Area 3: Mitigation
- 1 % AEP Defended Extents (CCP1)



1:30,000 Scale @ A1

0 0.5 1 2 km



Ref: 014-ES-031a-Rev02

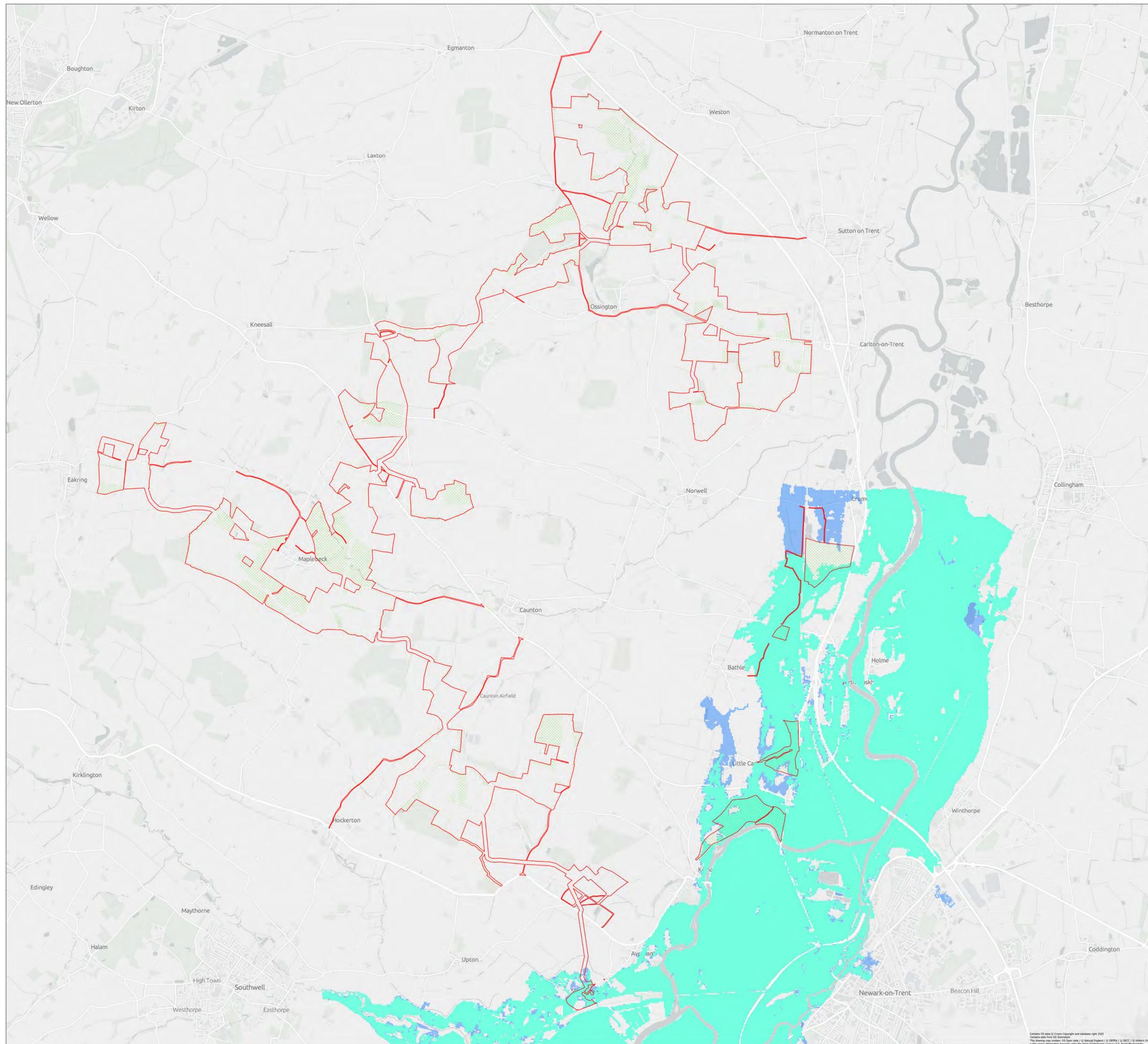
Date: 13/08/2025

**1 % AEP Defended Extents (CCP1)  
Figure A9.18**

**Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment**

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- Order Limits / Core Study Area
- Works Area 3: Mitigation
- 1% AEP + 30% CC
- 1% AEP + 39% CC



1:30,000 Scale @ A1

0 0.5 1 2 km

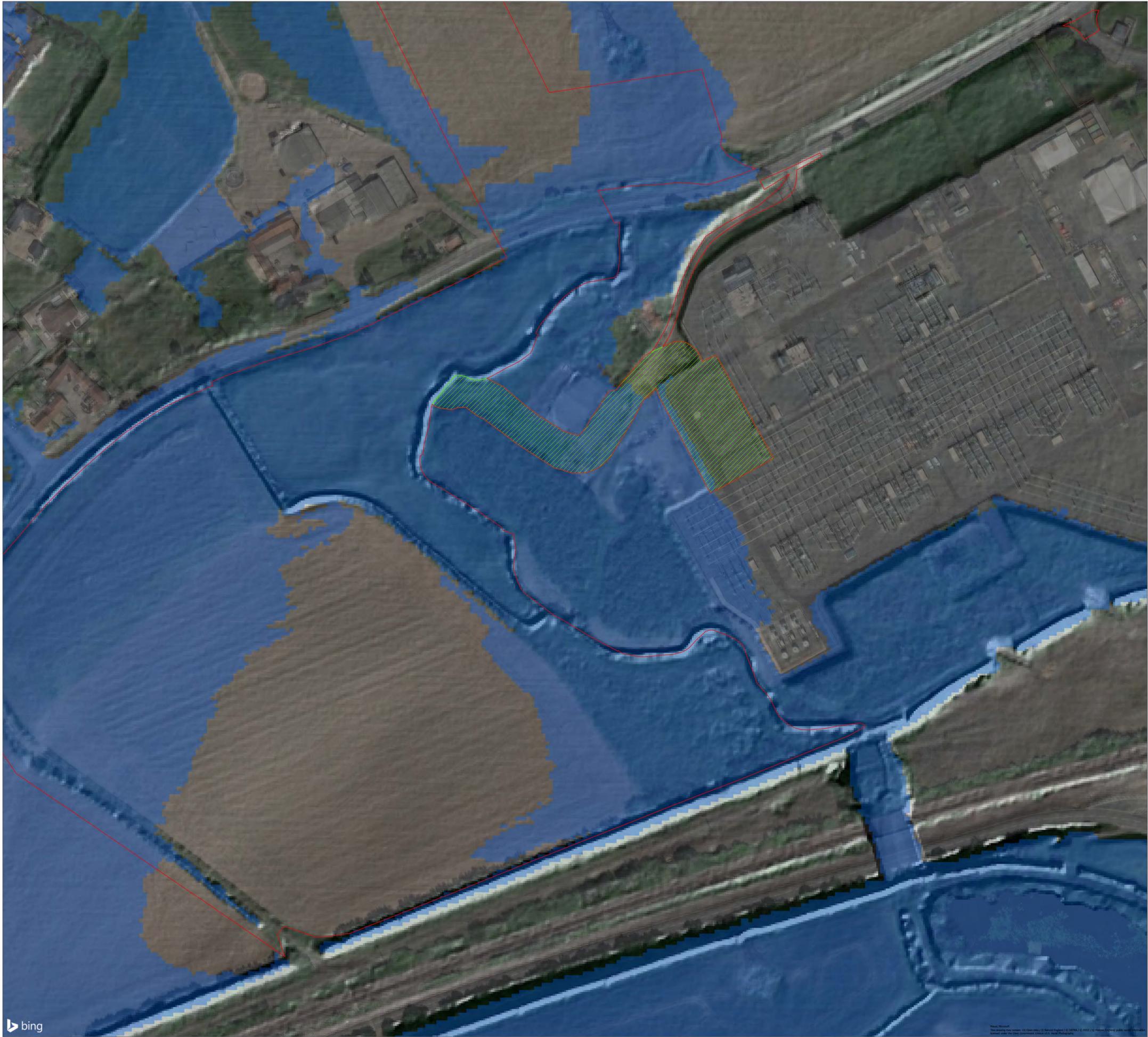


Ref: 014-ES-047-Rev02

Date: 12/08/2025

**1 % AEP + 30 % CC and  
+ 39 % CC scenarios  
Figure A9.19**

**Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment**



- Order Limits / Core Study Area
- Works Area: 6 National Grid Substation
- 1% AEP Undefended Extents (CCP1)

1:1,000 Scale @ A1

0 0.01 0.03 0.06 km



Ref: 014-ES-049b

Date: 13/08/2025

**1 % AEP Undefended CCP1  
Figure A9.20**

**Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment**

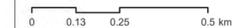
- Order Limits / Core Study Area
- Works Area 1: Solar PV
- Works Area 2: Cables
- Works Area 3: Mitigation
- 1% AEP Defended Extents CCP1

Flood Map for Planning December 2025

- Flood Zone
- FZ2
- FZ3



1:10,000 Scale @ A1



Ref: 014-ES-048-Rev03

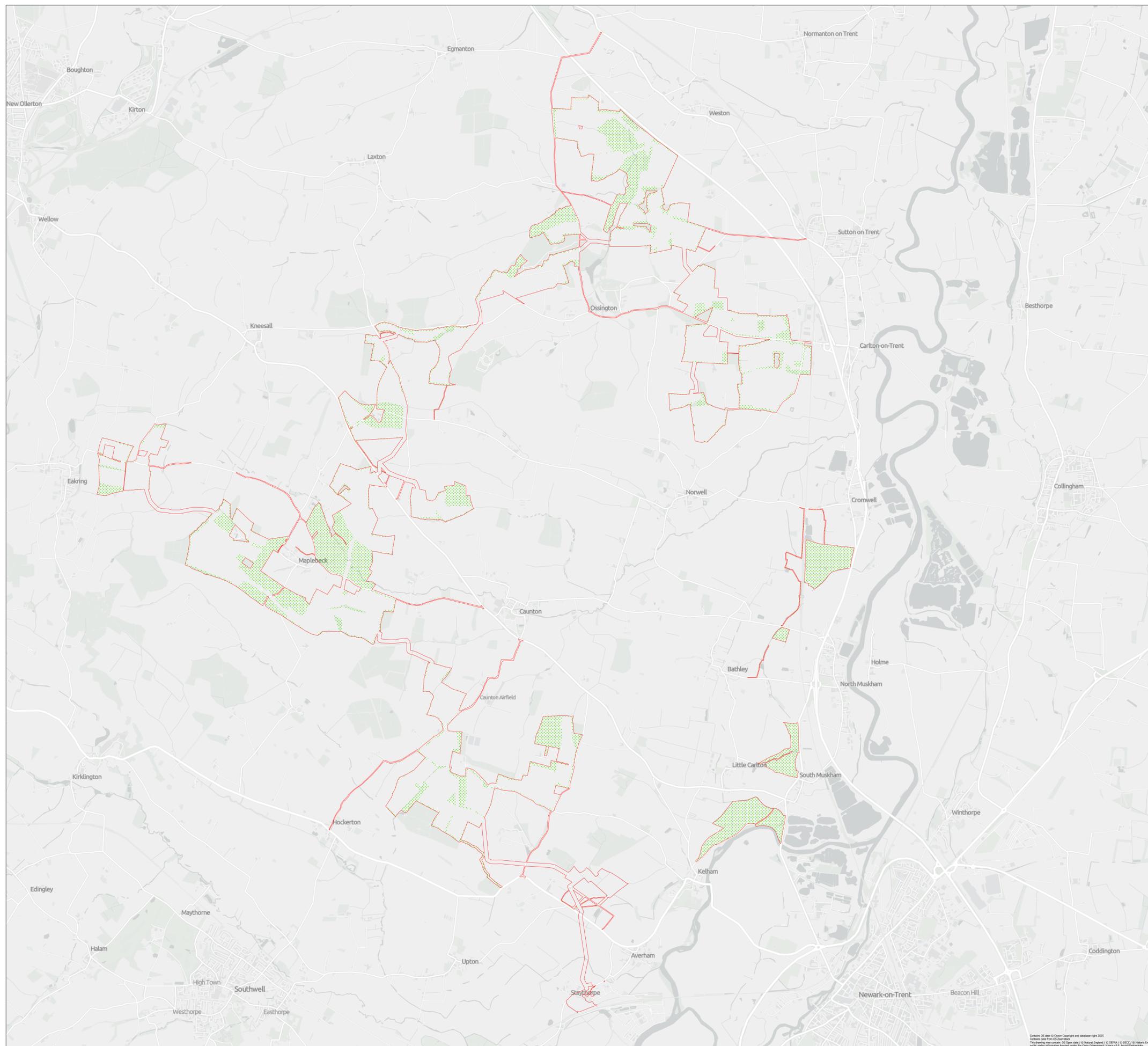
Date: 13/08/2025

**Moorhouse Beck - Flood Zones  
Figure A9.21**

**Great North Road Solar and  
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Flood Risk Assessment**

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Order Limits / Core Study Area  
Works Area 3: Mitigation



1:30,000 Scale @ A1

0 0.5 1 2 km



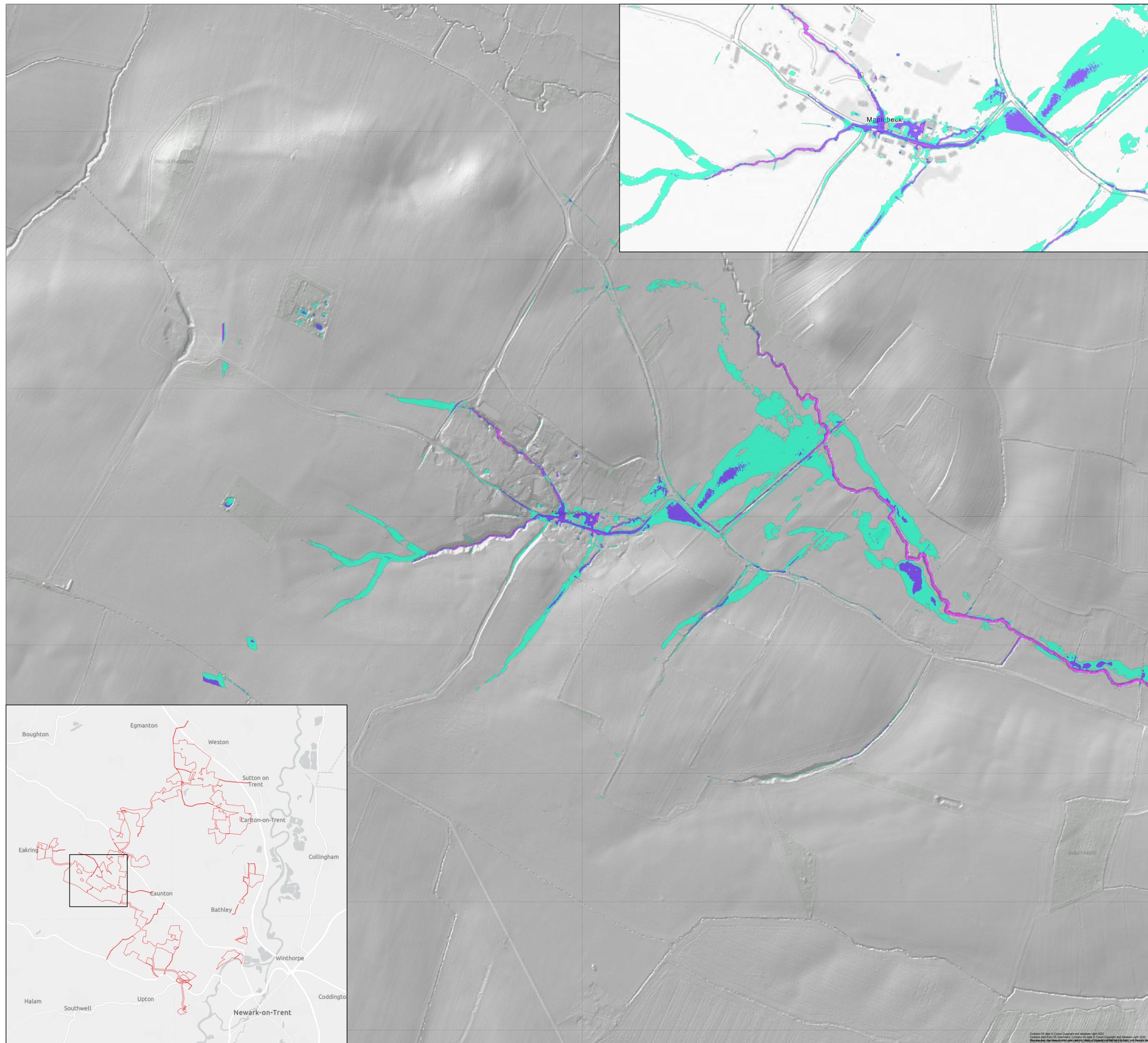
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Date: 12/08/2025

**RSuDS enhancement areas associated with the Development Figure A9.22**

**Great North Road Solar and Biodiversity Park Flood Risk Assessment**

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1% AEP + Wildflower / Grass

Depth (m)

- 0.011 - 0.1
- 0.101 - 0.3
- 0.301 - 0.6
- 0.601 - 0.9
- 0.901 - 2.941
- Work Area 5: BESS



1:5,000 Scale @ A1

Ref: 014-ES-058-Rev02 Date: 12/08/2025

**1 % AEP - Grass Mix under PV Arrays  
Figure A9.24**

**Great North Road Solar and Biodiversity Park  
Flood Risk Assessment**

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Order Limits / Core Study Area

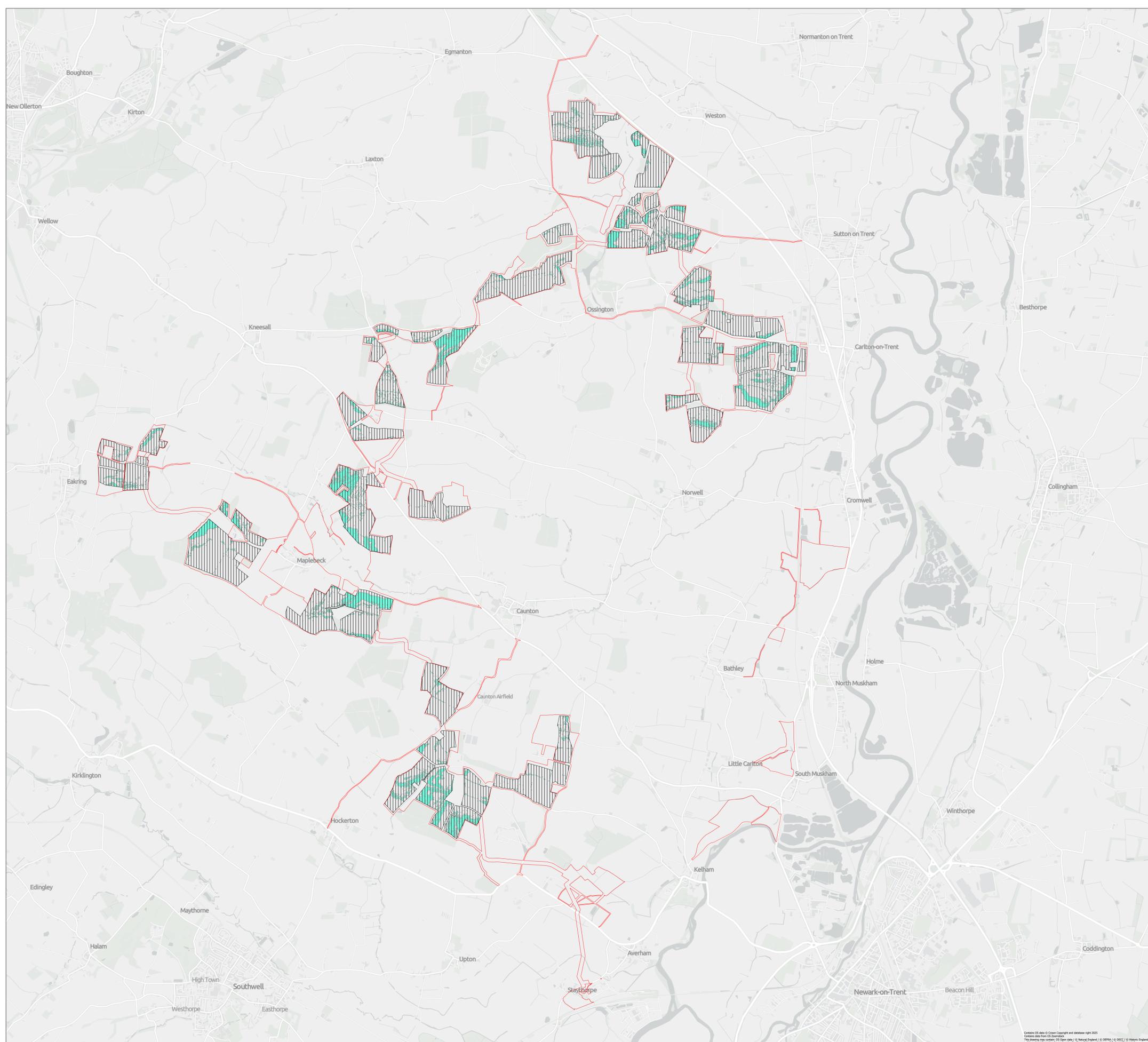
Work Area 1: Solar PV

Slope

%

0.001 - 6

6+



1:30,000 Scale @ A1

0 0.5 1 2 km



Ref: 014-ES-061-Rev02

Date: 12/08/2025

Slope within Work Area 1  
Figure A9.25

Great North Road Solar and  
Biodiversity Park  
Flood Risk Assessment



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## APPENDIX D: FRA CONSULTATION

Extracted from the **Consultation Report** [EN010162/APP/5.1] [APP-296].

February 2026

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Respondent	Comment	Applicant response
Nottinghamshire County Council	The Flood Risk Management Team has reviewed the Flood Risk Assessment (Technical Appendix A9.1) and is broadly satisfied with its content.	Noted.
Nottinghamshire County Council	However, the reference to flood alleviation measures to improve the existing flooding pathways to communities such as Maplebeck is somewhat misleading.	The FRA <b>[EN010162/APP/6.4.9.1]</b> acknowledges the intention to alleviate existing flooding problems through the NG+ fund and that this will be considered as a cumulative development and not part of the Development.
Nottinghamshire County Council	Whilst it is recognised that these schemes may be delivered within the order limits of this proposal, they would be secured separately through applications made to the LPA under the Town and Country Planning Act and will not be delivered directly as part of this development. Therefore, it is not recommended that these measures form part of the FRA for this application.	The FRA <b>[EN010162/APP/6.4.9.1]</b> acknowledges the intention to alleviate existing flooding problems through the NG+ fund and that this will be considered as a cumulative development and not part of the Development.
Environment Agency	Flood risk to the BESS and substation site could be underestimated. The BESS and substation may be at a greater risk of flooding than initially considered. Furthermore, the placement of the BESS and substation could increase flood risk elsewhere if not properly mitigated. The overland flow routes shown in the Risk of Flooding from Surface Water mapping, particularly for the 0.1% (1 in 1000) AEP scenario	Updated 1D-2D modelling has been undertaken to include an existing culvert under the A617, as outlined in the FRA (TA A9.1) <b>[EN010162/APP/6.4.9.1]</b> . Updated results for the 1 % annual exceedance probability (AEP) + 39 % uplift for climate change (CC) shows that Works Area 5a and 5b are located outside the flood extent.

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<p>should be reviewed. It appears the flood risk in this area is not from localised surface water ponding. This could be associated with some of the small ordinary watercourses which run close to the BESS. Any loss of floodplain for the design event should be compensated for on a level for level, and volume for volume basis. The BESS and substation are located in Flood Zone 1. There are small ordinary watercourses which cross the BESS and substation site, these have no associated Flood Zone mapping due to the small size of their respective catchments. The Risk of Flooding from Surface Water (RoFSW) dataset shows the BESS area to be inundated in the 1% (1 in 100) annual exceedance probability scenario (AEP) and the 0.1% (1 in 1000) AEP scenario. In some locations within the BESS area, water depths fall within the 0.30 - 0.60 metre band for the 0.1% (1 in 1000) AEP scenario. Inspection of the RoFSW flow direction dataset, appears to show water flowing south and southeast through the BESS and substation area. It is noted that in section A9.1.2.3 page 41 of Technical Appendix A9.1: Flood Risk Assessment (FRA) that electrically sensitive infrastructure such as inverters will be located outside of the surface water flooding extents. It is also noted that further 2D modelling will be undertaken post-PEIR to confirm the area of pluvial flooding at risk in the 1% AEP plus climate change scenario. This is welcomed.</p>	<p>Updated 2D direct rainfall modelling has also been undertaken for Work Area 5a and 5b. Results correlate well with the updated Risk of Flooding Surface Water (2025) dataset.</p>
--	--

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<p>Environment Agency</p>	<p>This section notes that a sense check for fluvial flows will be undertaken for the credible maximum scenario. There are no details within the FRA, other than the reference to the higher central scenario for the 2080's epoch (plus 39%). It is not clear if the development would remain resilient and operational if upper climate change allowances were to materialise. Provide details within the FRA of the impact of a credible maximum scenario (upper fluvial flows) on the development. It should be demonstrated that the solar panels will remain operational should this scenario materialise. Furthermore, the BESS and substation should remain safe from flooding in this scenario.</p>	<p>Work Area 1: Solar PV is no longer located within the floodplain of the River Trent, including the 1 % AEP plus 39 % CC event.                  Only Work Area 2: Cables, Work Area 3: Mitigation and connections associated with Work Area 6 and Work Area 7 are located within the floodplain, however the works associated are either below ground (cables) or involve the creation of grassland etc which are compatible with the floodplain, will not result in a loss of storage or a perceptible effect on conveyance and will remain operational.</p>
<p>Environment Agency</p>	<p>The PEIR acknowledges the development will be operational between the 2050s and 2080's epochs. However, the design scenario that is proposed to be adopted for the development is the higher central scenario for the 2050's epoch. This reflects an uplift of 23% for the Lower Trent and Erewash management catchment. The FRA describes how the development would be decommissioned from 2069. Section A9.1.2.2.1.2 paragraph 83 of the FRA describes how given the time-limited nature of the application the use of a 30% climate change scenario is considered conservative and acceptable. The FRA notes that should there be a delay in the completion of construction of the development leading to operation into the 2080's the 39% allowance will be considered. The applicant has obtained model output data which includes the 1% (1 in 100) annual exceedance probability plus 39%</p>	<p>Paragraph 10 of the FRA <b>[EN010162/APP/6.4.9.1]</b> stated "the Development is Essential Infrastructure and will have a lifespan of 40 years (decommissioned from 2069)".</p> <p>The Development has been designed to avoid placing above ground infrastructure within the extent of the 1 % AEP + 39 % CC event i.e. the Higher central climate change allowance for the 2080s epoch.                  Given that a conservative approach has been adopted for the majority of the epoch in which the Development will operate in and the potential for climate change allowances to change in future, it is considered that the Development has been designed appropriately.</p> <p>The commitment in the oEMP</p>

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	<p>water levels and depths (2080s higher central scenario). A review of this data confirms that water levels for the solar panels are not substantially increased when compared to the 1% (1 in 100) AEP plus 30% climate change scenario. Some difference mapping is presented in Plate A9.1.29 of the FRA. A review of the water level data for these scenarios confirms that water level differences between the 1% (1 in 100) AEP plus 30% and 1% (1 in 100) AEP plus 39% scenarios is small, with the highest increase being 0.25 m for the largest panel area just to the north of Little Carlton.</p>	<p><b>[EN010162/APP/6.4.5.5]</b> states that should the Development lifetime be anticipated to extend into the 2080s epoch, as a result of delays to the construction programme for example, then modelling will be undertaken in year 2069 using the appropriate climate change allowances at the time, in consultation with the EA (and other regulators). Should modelling results show that the Development has the potential to interact with flood depths then the Development design will be altered accordingly to ensure that flood storage and conveyance is maintained for the River Trent. This could involve raising the PV Arrays (subject to negligible loss of storage and conveyance), the removal of the first row of panels on a PV table or removing the mounting system and associated infrastructure from the modelled extent.</p>
<p>Environment Agency</p>	<p>The FRA has not clarified if the proposed lifetime of the development is the operational lifetime, or if it includes the construction and decommissioning phases. If the lifetime (including construction and decommissioning phase) is longer than proposed in the FRA, the project would extend into the 2080's climate change epoch. This can lead to an inadequate assessment of climate change flood risk. The FRA needs to clarify the timeline of the development and the complete lifetime. Additionally, delays should be factored into this assessment.</p>	<p>Paragraph 10 of the FRA <b>[EN010162/APP/6.4.9.1]</b> submitted with the PEIR stated “the Development is Essential Infrastructure and will have a lifespan of 40 years (decommissioned from 2069)”.</p> <p>The Development has been designed to avoid placing above ground infrastructure within the extent of the 1 % AEP + 39 % CC event i.e. the Higher central climate change allowance for the 2080s epoch.</p> <p>Given that a conservative approach has been adopted for the majority of the epoch in which the Development will operate in and the potential for climate change allowances to change in future, it is considered that the Development has been</p>

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		<p>designed appropriately.</p> <p>The commitment in the oEMP <b>[EN010162/APP/6.4.5.5]</b> states that should the Development lifetime be anticipated to extend into the 2080s epoch, as a result of delays to the construction programme for example, then modelling will be undertaken in year 2069 using the appropriate climate change allowances at the time, in consultation with the EA (and other regulators). Should modelling results show that the Development has the potential to interact with flood depths then the Development design will be altered accordingly to ensure that flood storage and conveyance is maintained for the River Trent. This could involve raising the PV Arrays (subject to negligible loss of storage and conveyance), the removal of the first row of panels on a PV table or removing the mounting system and associated infrastructure from the modelled extent.</p>
<p>Environment Agency</p>	<p>The 1d-2d hydraulic modelling undertaken for the Car and Pingley Dyke suggests the BESS, and substation area, are not at risk from fluvial flooding from these watercourses, and the A617 acts as a barrier to flow. There could be some connectivity underneath the A617 at grid reference 475725, 355050. This could mean flood risk on the northeastern side of the A617, the BESS and substation is underestimated. The Detailed River Network (DRN) dataset suggests there is a small culvert underneath the A617 at grid reference 475725, 355050. Confirmation is required of any</p>	<p>Updated 1D-2D modelling has been undertaken to include the existing culvert under the A617, as outlined in the FRA (TA A9.1) <b>[EN010162/APP/6.4.9.1]</b>.</p> <p>Updated results for the 1 % AEP + 39 % CC shows that Works Area 5a and 5b are located outside the flood extent of Pingley Dyke.</p>

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	<p>flow routes underneath the A617, and if there is a culvert underneath the A617 at grid reference 475725, 355050. If any culverts are present under the A617, these will need to be included within the 1d-2d linked model of the Car and Pingley Dyke. The outcome of this assessment would be prudent to assess whether the flood flows from the River Greet and can pass under the A617.</p>	
Environment Agency	<p>There is no evidence provided to demonstrate there will be no perceptible loss of flood storage or conveyance during times of flooding, from the solar panel metal support frames. The solar panel support frames could potentially increase flood risk due to loss of floodplain storage and impedance to flow. Where solar panel support frames fall within areas of fluvial flood risk, and specifically the design flood, the impact on flood risk to third parties should be quantified. This can be achieved using several different approaches. Firstly, the volume of floodplain lost could be calculated and presented within the Flood Risk Assessment (FRA). Alternatively, the impact of the solar panel mounting structures could be evaluated within the fluvial Trent hydraulic model. This can be completed using a 2d flow constriction layer or increasing the 2d floodplain roughness values.</p>	<p>Work Area 1: Solar PV has been removed from the floodplain and future floodplain (1 % AEP + 39 % CC), as shown on Plate A9.1.17 of the FRA (TA A9.1) <b>[EN010162/APP/6.4.9.1]</b>. As such, there will be no effect on the conveyance of out of channel flows.</p>
Environment Agency	<p>Soffit levels for new crossings are not considered. Potential impediments to flood flows, and therefore increased flood risk elsewhere. Any proposed crossings should be designed so the soffit level of any bridges sits above the design flood level. The design flood level for permanent crossings in this</p>	<p>Crossings will be designed following granting of the DCO and the oCEMP (TA A5.3) <b>[EN010162/APP/6.4.5.3]</b> has been updated at detailed design stage to commit to the soffit level of any bridges to sit above the design flood level. The design flood level for permanent crossings would be</p>

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	<p>case would be the 1% (1 in 100) annual exceedance probability (AEP) plus higher central climate change scenario. The present day (without climate change) 1% (1 in 100) AEP scenario can be used for temporary crossings during the construction phase of the scheme. Careful consideration will need to be given to how the design flood level will be determined for the proposed crossings. Typically, this would be determined by undertaking hydraulic modelling, or referring to existing detailed hydraulic modelling data (where available). The production of the new Risk of Flooding from Rivers and Sea dataset (at the end of January 2025) may provide some useful information which may help inform crossing soffit levels. If a reliance is being placed on existing flood risk products, such as the mapping to inform soffit levels, then clear justification should be provided as to why this is a suitable proxy for representing fluvial flood risk; taking into consideration the effects of climate change. The proposed crossings should be designed to not increase flood risk elsewhere.</p>	<p>the 1% AEP plus Higher central climate change scenario (39 % CC) and will involve the following parameters:</p> <ul style="list-style-type: none"> <li>• Soffit height of the crossing will be a minimum of 600 mm above the 1 % AEP + Climate change allowance flood level.</li> <li>• All abutments must be set back a minimum 1 m from the top of bank and as minimal as possible.</li> <li>• Any loss of floodplain due to abutments and ramps will need to be compensated for.</li> </ul> <p>All parapets and railings need to be permeable and as open as possible with a minimum 100 mm spacing.                  The application is not seeking to disapply the EA's Protective Provisions and, therefore, the design of crossings will need to be approved by the EA prior to the construction phase.</p>
<p>Environment Agency</p>	<p>The development has not assessed the impact it may have on engineered flood defences and assets (engineered high ground). Consideration has not been given for access to maintain the assets and respond to emergency incidents. If assets are adversely impacted, this may lead to degradation and a lower standard of protection. If assets cannot be accessed in times of a flood and/or for</p>	<p>ES Chapter 9, Water Resources [EN010162/APP/6.2.9] assessed the potential effects from the Development on flood defences, including those classed as Engineered High Ground and concluded effects of Negligible magnitude. Work Area 2: Cables has been removed from the Order Limits in proximity to asset ID 55462 (Engineered High Ground) and asset ID 46099</p>

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	<p>maintenance, this can increase flood risk. There must be an assessment of the development's interactions and impacts on all flood defence assets within their site boundary. Additionally, access must be upheld and where possible improved to assets on site</p>	<p>(Natural High Ground) on the left bank of the River Trent. As such, the Development will not directly interact with flood defences and access to the assets will remain unaffected.                  An updated assessment of the potential effects from the Development on flood defences is provided in Section 9.6.1.6 of the ES Chapter.</p>
Trent Valley Internal Drainage Board	<p>The Board will require all watercourses to be crossed by means of an appropriate trenchless method at a depth no less than 2 metres PLUS the safe working distance below the hard bed level of all watercourses (to ODN if EA or IDB maintained). The purpose of this requirement is to allow the IDB to maintain and have the flexibility to improve watercourses in the future due to climate change (works will include deepening &amp; widening of watercourses).</p>	<p>Cable crossings will utilise horizontal directional drilling (HDD) as the default option. Open trench methods will only be utilised on manmade watercourses / ditches and smaller watercourses (less than 2 m width).                  No pipe flumes will be used.                   Regarding culverting, clear span bridge crossings will be used where possible and culverts will only be used where a bridging solution is not feasible i.e. field drains / ditches / smaller watercourses (less than 2 m width).</p>
Trent Valley Internal Drainage Board	<p>Any culverting or other works within the bed of any Board maintained watercourse be they temporary or permanent will require consent. It will usually be assumed that these structures will be temporary measures to accommodate haul roads etc.</p>	<p>Regarding culverting, clear span bridge crossings will be used where possible and culverts will only be used where a bridging solution is not feasible i.e. field drains / ditches / smaller watercourses (less than 2 m width).</p>
Trent Valley Internal Drainage Board	<p>It is anticipated that the above requirements would be covered by SOCGs, MOU, and via Protective Provisions within the DCO. This matter should be discussed further and in more detail as the proposed route is refined.</p>	<p>Noted.</p>

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Trent Valley Internal Drainage Board	Any culverting or other works within the bed of any riparian watercourse within the Board's district or extended area, be they temporary or permanent will also require consent.	Noted.
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