East Anglia ONE North and East Anglia TWO Offshore Windfarms

Clarification Note

SuDS Infiltration Note

Applicant: East Anglia TWO and East Anglia ONE North Limited
Document Reference: ExA.AS-9.D2.V1
SPR Reference: EA1N_EA2-DWF-ENV-REP-IBR-001131

Date: 17th November 2020
Revision: Version 01
Author: Royal HaskoningDHV

Applicable to East Anglia ONE North and East Anglia TWO

Revision Summary				
Rev	**Date**	**Prepared by**	**Checked by**	**Approved by**
001	17/11/2020	Paolo Pizzolla	Lesley Jamieson / Ian Mackay	Rich Morris

Description of Revisions			
Rev	**Page**	**Section**	**Description**
001	n/a	n/a	Final for Deadline 2

Table of Contents

1 Introduction 5
1.1 Overview 5

2 Legislation and Relevant Guidance 7
2.1 Legislation 7
2.2 Guidance 7

3 Modelling Design Parameters 9

4 Results 10

5 References 12

Appendix 1: Figures 13

Appendix 2: Model Outputs 15

Glossary of Acronyms

CIRIA	Construction Industry Research and Information Association
DCO	Development Consent Order
SCC	Suffolk County Council
SuDS	Sustainable Drainage Systems

Glossary of Terminology

Applicants	East Anglia TWO Limited / East Anglia ONE North Limited
East Anglia ONE North project	The proposed project consisting of up to 67 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia TWO project	The proposed project consisting of up to 75 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
National Grid infrastructure	A National Grid substation, cable sealing end compounds, cable sealing end (with circuit breaker) compound, underground cabling and National Grid overhead line realignment works to facilitate connection to the national electricity grid, all of which will be consented as part of the proposed East Anglia TWO / East Anglia ONE North project Development Consent Order but will be National Grid owned assets.
National Grid substation	The substation (including all of the electrical equipment within it) necessary to connect the electricity generated by the proposed East Anglia TWO project / East Anglia ONE North project to the national electricity grid which will be owned by National Grid but is being consented as part of the proposed East Anglia TWO / East Anglia ONE North project Development Consent Order.
National Grid substation location	The proposed location of the National Grid substation.
Onshore substation	The East Anglia TWO / East Anglia ONE North substation and all of the electrical equipment within the onshore substation and connecting to the National Grid infrastructure.
Onshore substation location	The proposed location of the onshore substations for the proposed East Anglia TWO project and the East Anglia ONE North project.
Order limits	The limits shown on the works plans within which the authorised project may be carried out.
Projects	The East Anglia TWO Offshore Windfarm and the East Anglia ONE North Offshore Windfarm.

1 Introduction

1.1 Overview

1. This technical note accompanies an illustrative infiltration Sustainable Drainage System (SuDS) design in support of the Development Consent Order (DCO) applications (the Applications) for the East Anglia TWO project and the East Anglia ONE North project (the Projects) submitted by East Anglia TWO and East Anglia ONE North Limited (the Applicants).

2. The illustrative design addresses Suffolk County Council's (SCC) request to consider infiltration as part of the drainage design, in accordance with the SuDS drainage hierarchy (SCC, 2018). The Applicants have been asked by SCC to demonstrate that there is sufficient space within the Order limits of the onshore substation location and the National Grid substation location to accommodate infiltration features with a worst case infiltration rate of 10mm/hr and an appropriate factor of safety (LA-005 of the Water Resources and Flood Risk Statement of Common Ground). SCC also requested that the Applicants demonstrate compliance with the SCC guidance for SuDS design (2018).

3. Works to be undertaken within the onshore substation location include (amongst other things) the construction of two co-located onshore substations (a substation for East Anglia TWO and East Anglia ONE North respectively and hereafter referred to collectively as the 'onshore substation') and National Grid infrastructure, at Grove Wood, Friston, and associated landscaping and surface water management infrastructure. It should be noted that the ***draft DCO*** (APP-023) allows for flexibility for either project to use either onshore substation location.

4. It is noted that the basis of the design presented within the Applications is for SuDS attenuation ponds with a discharge connection to the Friston watercourse. This represents a reasonable design for the Projects. Further information on the attenuation design will be set out in the Outline Operational Drainage Management Plan which the Applicants will submit at Deadline 3.

5. This document demonstrates the viability of incorporating infiltration as part of the design during operation of the Projects to manage drainage. The ***Outline Code of Construction Practice*** (APP-578) covers surface water and drainage requirements during construction, including sediment management and pollution prevention.

6. This document is applicable to both of the Projects and the Applications, and therefore is endorsed with the yellow and blue icon used to identify materially

identical documentation in accordance with the Examining Authority's procedural decisions on document management of 23rd December 2019 (PD-004). Whilst this document has been submitted to both Examinations, if it is read for one project submission there is no need to read it for the other project submission.

2 Legislation and Relevant Guidance

2.1 Legislation

2.1.1 Flood and Water Management Act 2010

7. Under the Flood and Water Management Act 2010, Lead Local Flood Authorities (LLFAs) have responsibility for managing the risk of flooding from surface water, groundwater and ordinary watercourses. SCC is the LLFA covering the onshore development area and is required to deliver a strategy for local flood risk management in its area, to investigate flooding and to maintain a register of flood risk assets.

2.2 Guidance

2.2.1 Suffolk County Council SuDS Guidance

8. SCC's SuDS design guidance (2018) has informed the illustrative infiltration design. Section 5 of the guidance (Suffolk Design Principles) indicates that "*soakage rates need to be above 5-10mm/hr for infiltration to be the sole means of drainage*" (i.e. the first option within the surface water drainage hierarchy).

9. SCC guidance also states that the aim of a SuDS design "*should be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable:*

   i) into the ground (infiltration);

   ii) to a surface water body (attenuation);

   iii) to a surface water sewer, highway drain or another drainage system; or

   iv) to a combined sewer".

10. As agreed in Table 13 in the draft Statement of Common Ground with the Councils, the Applicants have therefore tested the SuDS design at an infiltration rate of 10mm/hr which is deemed to be a reasonable worst-case feasible infiltration rate.

2.2.2 Construction Industry Research and Information Association

11. The Construction Industry Research and Information Association (CIRIA) SuDS Manual (2015) states that "*Where components are designed to manage the 1:10 year or 1:30 year event, it is usual to specify that half emptying occurs within 24 hours. If components are designed to infiltrate events greater than the 1:30 year event, designing to half empty in 24 hours can result in very large storage requirements and, with agreement from the drainage approving body, it may be appropriate to allow longer half emptying times*".

12. On this basis, a 24hr and a 48hr half drain time has been included in the illustrative SuDS design for the 10mm/hr infiltration rate.

2.2.3 Sustainable Drainage Principles

13. 'Infiltration' refers to allowing or encouraging water to soak into the ground, through the natural hydrologic processes. This is normally the most desirable solution for the disposal of surface water from rainfall as it does not create additional runoff and contributes directly to the recharge of the underlying groundwater.

14. Ground investigations at the location of the onshore substations and National Grid infrastructure will be undertaken and will inform the final Operational Drainage Management Plan. Percolation tests will be undertaken as part of the detailed design process to determine the underlying permeability and the feasibility to dispose of surface water directly to ground or other engineered filtration systems, and to what degree.

3 Modelling Design Parameters

15. In order to demonstrate that sufficient space is available within the Order limits at the onshore substation location and the National Grid substation location to accommodate infiltration features, the following parameters have been modelled:

- Infiltration rate of 10mm/hr;
- 50% impermeable surface area for the onshore substations and National Grid infrastructure areas of hardstanding;
- 100% impermeable area for the permanent operational access road; and
- Attenuation of water during the 1 in 100 year plus 40% climate change scenario.

16. The modelling has considered both a 24hr and a 48hr half drain time and has used FEH2013 rainfall data.

17. The design parameters of the onshore substation and National Grid infrastructure are summarised in ***Table 3.1***.

Table 3.1 Onshore Substation Location Area Infiltration Design Parameters

Equipment	East Anglia TWO (m^2)	East Anglia ONE North (m^2)	National Grid Infrastructure (m^2)
Overall substation operational footprint	36,100 *(50% impermeable)*	36,100 *(50% impermeable)*	44,950 *(50% impermeable)*
Operational access road	13,600 *(100% impermeable)*		N/A
Overal cable sealing end compounds and cable sealing end with circuit breaker compound operational footprint	N/A		10,000 *(50% impermeable)*
Permanent access road to sealing end compound	N/A		1,850 *(100% impermeable)*
Total impermeable area	**49,700**		**29,325**

4 Results

18. Drawing ED11892-C-SK10 (***Appendix 1***: Figures) shows the indicative sizing of the infiltration basins based on a 10mm/hr infiltration rate, for both the 24hr and 48hr half drain times. The figure demonstrates that, based on the parameters modelled and described in section 3, for both a 24hr half drain time and a 48hr half drain time, the infiltration basins can be comfortably accommodated within the Order limits whilst accommodating the planning presented within the ***Outline Landscape Mitigation Plan General Arrangement*** shown in ***Figure 29.11a*** (APP-401).

19. Drawing ED11892-C-SK10 (***Appendix 1***) shows total depth of basin and respective maximum water level based on 1:100yr storms with 40% climate change. The Freeboard is the total depth of basin minus the total depth to maximum water level. For further information on depths and structure refer to page 4 (infiltration basin structure) of the modelling outputs for the 24hr and 48hr drain times for the onshore substation and National Grid infrastructure respectively (***Appendix 2***: Model Outputs).

20. Infiltration basin options are indicative only, and detailed design of the basins would be required to confirm exact elevations, shapes and locations for each option as required.

21. The development of the final drainage design will be in line with best practice and guidance applicable to the Projects, recognising their classification as Nationally Significant Infrastructure Projects. It will include a combination of infiltration measures and a connection to the Friston watercourse in the vicinity of Church Road. Further information will be detailed in the final Operational Drainage Management Plan secured under the DCO.

22. The Applicants will submit an Outline Operational Drainage Management Plan at Deadline 3. A new requirement will be included in the ***draft DCO*** (APP-023) which requires the Operational Drainage Management Plan to be submitted to and approved by the relevant planning authority. This requirement will also provide that the Operational Drainage Management Plan must accord with the Outline Operational Drainage Management Plan and be implemented as approved. This is separate to the ***Outline Landscape and Ecological Management Strategy*** (APP-584).

23. The final design of the SuDS will be developed to reflect the final detailed design of the onshore substation and National Grid infrastructure and will be informed by pre-construction ground investigations (including infiltration testing). It will incorporate infiltration measures, where appropriate, but will retain a discharge

connection to the Friston watercourse. The Applicants have committed to ensuring that the final design of the SuDS will not increase the rate of discharge to the Friston watercourse over that currently experienced during storm events. The connection to the Friston watercourse remains an integral part of the Projects.

24. Influencing factors for the final SuDS design will include:

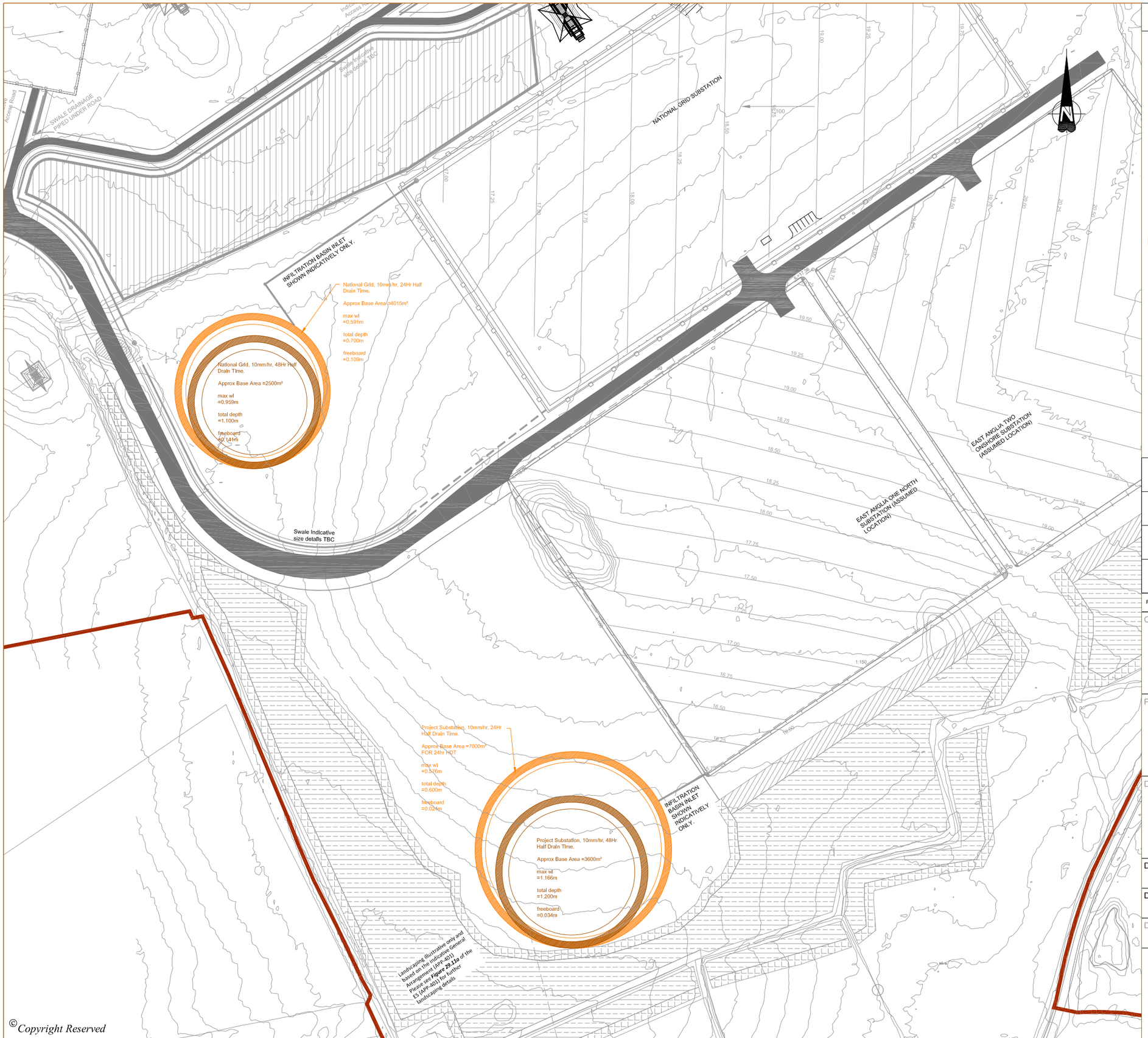
- Final sizing of onshore substation and National Grid infrastructure;
- Final percentage of impermeable areas within the onshore substations and National Grid infrastructure;
- Masterplanning considerations, including access road routing and landscaping;
- Pre-construction ground investigation results, including infiltration test results; and
- Discharge rate to the Friston watercourse which will not exceed the current discharge rate during storm events.

5 References

Construction Industry and Research Information Association (2015) The SuDS Manual (C753).

Suffolk County Council (2018) Sustainable Drainage Systems (SuDS): a Local Design Guide, Appendix A to the Suffolk Flood Risk Management Strategy.

Appendix 1: Figures



DO NOT SCALE FROM THIS DRAWING

NOTES:

INFILTRATION BASIN OPTIONS ARE SHOWN INDICATIVELY AS CIRCULAR FOR ILLUSTRATION PURPOSES ONLY. DETAILED DESIGN OF BASIN WOULD BE REQUIRED TO CONFIRM EXACT ELEVATIONS, SHAPES AND LOCATION OF EACH OPTION AS APPROPRIATE AND AS PART OF THE MASTERPLANNING PROCESS.

LEGEND

DENOTES PROPOSED EXTENT OF INFILTRATION BASIN OPTION FOR 24 HOUR HALF DRAIN TIME.

DENOTES PROPOSED EXTENT OF INFILTRATION BASIN OPTION FOR 48 HOUR HALF DRAIN TIME.

DENOTES DCO ORDER LIMITS

REVISION	DETAILS	DATE	DR'N	CHK'D	APP'D
D	DRAWING UPDATED RO ADDRESS SPR COMMENTS.	17.11.20	SH	SH	SH
C	DRAWING UPDATED FOR CLARITY	06.10.20	JN	JN	SH
B	INFILTRATION BASINS UPDATED.	17.09.20	JN	CS	SH
A	FIRST ISSUE	10.09.20	JN	CS	SH

CLIENT

HASKONING DHV UK LIMITED

PROJECT

EAST ANGLIA OFFSHORE WIND
EA1N & EA2

SKETCH

DRAWING TITLE

INFILTRATION BASIN
10mm PER HOUR
OPTIONS SKETCH

DRG No.	REV
ED11892-C-SK10	D

DRG SIZE	SCALE	DATE
A3		SEPT'20

DRAWN BY	CHECKED BY	APPROVED BY
JN	CS	SH

wardell armstrong
STOKE ON TRENT | TEL 01782 276700
WWW.WARDELL-ARMSTRONG.COM
BIRMINGHAM, BOLTON, CARDIFF, CARLISLE, EDINBURGH, GLASGOW, LEEDS, LONDON, MANCHESTER, NEWCASTLE UPON TYNE

N:\ED\ED11892 - EAST ANGLIA OFFSHORE WIND EA 1\03 - DESIGN\AUTOCAD\ED11892-C-SK05-SK10 D -INFILTRATION BASIN.DWG

SHOLMES

Appendix 2: Model Outputs

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1581 minutes.

Note the status column provides an indication of the worst case scenario and should be reviewed alongside the maximum volumes. This is then used to identify the critical storm duration and volume of storage required.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	14.812	0.162	12.0	662.4	O K
30 min Summer	14.866	0.216	12.3	889.6	O K
60 min Summer	14.920	0.270	12.6	1117.1	O K
120 min Summer	14.983	0.333	12.9	1386.3	O K
180 min Summer	15.024	0.374	13.1	1567.0	O K
240 min Summer	15.055	0.405	13.3	1702.9	Flood Risk
360 min Summer	15.099	0.449	13.5	1896.5	Flood Risk
480 min Summer	15.128	0.478	13.6	2025.5	Flood Risk
600 min Summer	15.147	0.497	13.7	2108.3	Flood Risk
720 min Summer	15.158	0.508	13.8	2159.6	Flood Risk
960 min Summer	15.167	0.517	13.9	2196.0	Flood Risk
1440 min Summer	15.154	0.504	13.8	2141.3	Flood Risk
2160 min Summer	15.121	0.471	13.6	1990.6	Flood Risk
2880 min Summer	15.086	0.436	13.4	1837.1	Flood Risk
4320 min Summer	15.022	0.372	13.1	1555.9	O K
5760 min Summer	14.968	0.318	12.8	1324.2	O K
7200 min Summer	14.650	0.000	0.0	0.0	O K
8640 min Summer	14.650	0.000	0.0	0.0	O K
10080 min Summer	14.650	0.000	0.0	0.0	O K
15 min Winter	14.831	0.181	12.1	742.7	O K
30 min Winter	14.892	0.242	12.4	998.0	O K
60 min Winter	14.952	0.302	12.7	1254.4	O K
120 min Winter	15.023	0.373	13.1	1560.7	O K
180 min Winter	15.070	0.420	13.3	1767.7	Flood Risk
240 min Winter	15.106	0.456	13.5	1924.2	Flood Risk
360 min Winter	15.156	0.506	13.8	2150.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	122.248	0.0	19
30 min Summer	82.572	0.0	34
60 min Summer	52.458	0.0	64
120 min Summer	33.215	0.0	124
180 min Summer	25.480	0.0	182
240 min Summer	21.109	0.0	242
360 min Summer	16.158	0.0	362
480 min Summer	13.321	0.0	482
600 min Summer	11.410	0.0	602
720 min Summer	10.016	0.0	722
960 min Summer	8.080	0.0	960
1440 min Summer	5.860	0.0	1254
2160 min Summer	4.154	0.0	1620
2880 min Summer	3.224	0.0	1992
4320 min Summer	2.228	0.0	2808
5760 min Summer	1.712	0.0	3624
7200 min Summer	-0.012	0.0	0
8640 min Summer	-0.010	0.0	0
10080 min Summer	-0.008	0.0	0
15 min Winter	122.248	0.0	19
30 min Winter	82.572	0.0	33
60 min Winter	52.458	0.0	62
120 min Winter	33.215	0.0	122
180 min Winter	25.480	0.0	180
240 min Winter	21.109	0.0	240
360 min Winter	16.158	0.0	356

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
480 min Winter	15.191	0.541	14.0	2304.0	Flood Risk
600 min Winter	15.213	0.563	14.1	2406.5	Flood Risk
720 min Winter	15.228	0.578	14.2	2473.7	Flood Risk
960 min Winter	15.241	0.591	14.2	2534.2	Flood Risk
1440 min Winter	15.234	0.584	14.2	2499.4	Flood Risk
2160 min Winter	15.192	0.542	14.0	2308.9	Flood Risk
2880 min Winter	15.149	0.499	13.8	2116.7	Flood Risk
4320 min Winter	15.063	0.413	13.3	1736.8	Flood Risk
5760 min Winter	14.988	0.338	12.9	1411.1	O K
7200 min Winter	14.650	0.000	0.0	0.0	O K
8640 min Winter	14.650	0.000	0.0	0.0	O K
10080 min Winter	14.650	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
480 min Winter	13.321	0.0	474
600 min Winter	11.410	0.0	590
720 min Winter	10.016	0.0	704
960 min Winter	8.080	0.0	932
1440 min Winter	5.860	0.0	1368
2160 min Winter	4.154	0.0	1712
2880 min Winter	3.223	0.0	2164
4320 min Winter	2.228	0.0	3068
5760 min Winter	1.712	0.0	3912
7200 min Winter	-0.012	0.0	0
8640 min Winter	-0.010	0.0	0
10080 min Winter	-0.008	0.0	0

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.930

Time From:	(mins) To:	Area (ha)
0	4	2.930

Note: This output relates to the National Grid infrastructure and is inclusive of the cable sealing end compounds and permanent access road. Micro drainage area expressed in hectares. Area footprints and impermeability are summarised in the table below:

Equipment	National Grid Infrastructure (m²)
Overall substation operational footprint	44,950 *(50% impermeable)*
Operational access road	N/A
Overal cable sealing end compounds and cable sealing end with circuit breaker compound operational footprint	10,000 *(50% impermeable)*
Permanent access road to sealing end compound	1,850 *(100% impermeable)*
Total impermeable area	**29,325 (2.93ha)**

Model Details

Storage is Online Cover Level (m) 15.350

Infiltration Basin Structure

Invert Level (m) 14.650 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.01000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.01000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4015.0	0.600	4572.0	0.700	5450.0

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 2281 minutes.

Note the status column provides an indication of the worst case scenario and should be reviewed alongside the maximum volumes. This is then used to identify the critical storm duration and volume of storage required.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	14.907	0.257	8.0	665.2	O K
30 min Summer	14.991	0.341	8.4	894.6	O K
60 min Summer	15.075	0.425	8.7	1127.1	O K
120 min Summer	15.173	0.523	9.1	1406.8	O K
180 min Summer	15.239	0.589	9.4	1598.2	O K
240 min Summer	15.288	0.638	9.6	1744.5	O K
360 min Summer	15.360	0.710	9.9	1959.8	O K
480 min Summer	15.410	0.760	10.2	2110.1	O K
600 min Summer	15.443	0.793	10.3	2214.1	O K
720 min Summer	15.467	0.817	10.4	2286.2	Flood Risk
960 min Summer	15.491	0.841	10.5	2362.8	Flood Risk
1440 min Summer	15.494	0.844	10.5	2370.8	Flood Risk
2160 min Summer	15.453	0.803	10.4	2245.4	Flood Risk
2880 min Summer	15.409	0.759	10.2	2108.0	O K
4320 min Summer	15.326	0.676	9.8	1856.2	O K
5760 min Summer	15.259	0.609	9.5	1656.5	O K
7200 min Summer	14.650	0.000	0.0	0.0	O K
8640 min Summer	14.650	0.000	0.0	0.0	O K
10080 min Summer	14.650	0.000	0.0	0.0	O K
15 min Winter	14.936	0.286	8.1	745.6	O K
30 min Winter	15.030	0.380	8.5	1003.2	O K
60 min Winter	15.124	0.474	8.9	1264.9	O K
120 min Winter	15.233	0.583	9.4	1581.5	O K
180 min Winter	15.307	0.657	9.7	1798.9	O K
240 min Winter	15.362	0.712	10.0	1966.3	O K
360 min Winter	15.443	0.793	10.3	2213.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	122.248	0.0	19
30 min Summer	82.572	0.0	34
60 min Summer	52.458	0.0	64
120 min Summer	33.215	0.0	124
180 min Summer	25.480	0.0	184
240 min Summer	21.109	0.0	244
360 min Summer	16.158	0.0	362
480 min Summer	13.321	0.0	482
600 min Summer	11.410	0.0	602
720 min Summer	10.016	0.0	722
960 min Summer	8.080	0.0	962
1440 min Summer	5.860	0.0	1440
2160 min Summer	4.154	0.0	1836
2880 min Summer	3.224	0.0	2188
4320 min Summer	2.228	0.0	2944
5760 min Summer	1.712	0.0	3752
7200 min Summer	-0.012	0.0	0
8640 min Summer	-0.010	0.0	0
10080 min Summer	-0.008	0.0	0
15 min Winter	122.248	0.0	19
30 min Winter	82.572	0.0	34
60 min Winter	52.458	0.0	64
120 min Winter	33.215	0.0	122
180 min Winter	25.480	0.0	182
240 min Winter	21.109	0.0	240
360 min Winter	16.158	0.0	358

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
480 min Winter	15.499	0.849	10.6	2388.8	Flood Risk
600 min Winter	15.538	0.888	10.7	2512.0	Flood Risk
720 min Winter	15.566	0.916	10.8	2599.7	Flood Risk
960 min Winter	15.597	0.947	11.0	2699.6	Flood Risk
1440 min Winter	15.609	0.959	11.0	2737.5	Flood Risk
2160 min Winter	15.571	0.921	10.9	2616.2	Flood Risk
2880 min Winter	15.518	0.868	10.6	2446.7	Flood Risk
4320 min Winter	15.418	0.768	10.2	2136.9	O K
5760 min Winter	15.331	0.681	9.8	1870.8	O K
7200 min Winter	14.650	0.000	0.0	0.0	O K
8640 min Winter	14.650	0.000	0.0	0.0	O K
10080 min Winter	14.650	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
480 min Winter	13.321	0.0	476
600 min Winter	11.410	0.0	592
720 min Winter	10.016	0.0	708
960 min Winter	8.080	0.0	940
1440 min Winter	5.860	0.0	1386
2160 min Winter	4.154	0.0	2032
2880 min Winter	3.223	0.0	2304
4320 min Winter	2.228	0.0	3200
5760 min Winter	1.712	0.0	4096
7200 min Winter	-0.012	0.0	0
8640 min Winter	-0.010	0.0	0
10080 min Winter	-0.008	0.0	0

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.930

Time From:	(mins) To:	Area (ha)
0	4	2.930

Note: This output relates to the National Grid infrastructure and is inclusive of the cable sealing end compounds and permanent access road. Micro drainage area expressed in hectares. Area footprints and impermeability are summarised in the table below:

Equipment	National Grid Infrastructure (m^2)
Overall substation operational footprint	44,950 *(50% impermeable)*
Operational access road	N/A
Overal cable sealing end compounds and cable sealing end with circuit breaker compound operational footprint	10,000 *(50% impermeable)*
Permanent access road to sealing end compound	1,850 *(100% impermeable)*
Total impermeable area	**29,325 (2.93ha)**

Model Details

Storage is Online Cover Level (m) 15.750

Infiltration Basin Structure

Invert Level (m) 14.650 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.01000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.01000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2500.0	1.000	3257.0	1.100	4004.0

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 1449 minutes.

Note the status column provides an indication of the worst case scenario and should be reviewed alongside the maximum volumes. This is then used to identify the critical storm duration and volume of storage required.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	14.408	0.158	20.5	1123.5	O K
30 min Summer	14.462	0.212	20.9	1508.7	O K
60 min Summer	14.515	0.265	21.2	1894.6	O K
120 min Summer	14.577	0.327	21.7	2351.5	Flood Risk
180 min Summer	14.618	0.368	21.9	2658.5	Flood Risk
240 min Summer	14.649	0.399	22.2	2889.4	Flood Risk
360 min Summer	14.693	0.443	22.5	3219.4	Flood Risk
480 min Summer	14.722	0.472	22.7	3439.5	Flood Risk
600 min Summer	14.741	0.491	22.8	3581.8	Flood Risk
720 min Summer	14.753	0.503	23.0	3670.3	Flood Risk
960 min Summer	14.761	0.511	23.5	3731.7	Flood Risk
1440 min Summer	14.749	0.499	22.8	3642.4	Flood Risk
2160 min Summer	14.715	0.465	22.6	3383.4	Flood Risk
2880 min Summer	14.680	0.430	22.4	3120.4	Flood Risk
4320 min Summer	14.616	0.366	21.9	2638.6	Flood Risk
5760 min Summer	14.562	0.312	21.6	2240.6	Flood Risk
7200 min Summer	14.250	0.000	0.0	0.0	O K
8640 min Summer	14.250	0.000	0.0	0.0	O K
10080 min Summer	14.250	0.000	0.0	0.0	O K
15 min Winter	14.427	0.177	20.6	1259.7	O K
30 min Winter	14.487	0.237	21.1	1692.7	O K
60 min Winter	14.546	0.296	21.5	2127.7	O K
120 min Winter	14.617	0.367	21.9	2647.5	Flood Risk
180 min Winter	14.664	0.414	22.3	2999.2	Flood Risk
240 min Winter	14.699	0.449	22.5	3265.3	Flood Risk
360 min Winter	14.750	0.500	22.9	3650.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	122.248	0.0	19
30 min Summer	82.572	0.0	34
60 min Summer	52.458	0.0	64
120 min Summer	33.215	0.0	124
180 min Summer	25.480	0.0	182
240 min Summer	21.109	0.0	242
360 min Summer	16.158	0.0	362
480 min Summer	13.321	0.0	482
600 min Summer	11.410	0.0	602
720 min Summer	10.016	0.0	722
960 min Summer	8.080	0.0	960
1440 min Summer	5.860	0.0	1282
2160 min Summer	4.154	0.0	1624
2880 min Summer	3.224	0.0	2016
4320 min Summer	2.228	0.0	2808
5760 min Summer	1.712	0.0	3624
7200 min Summer	-0.012	0.0	0
8640 min Summer	-0.010	0.0	0
10080 min Summer	-0.008	0.0	0
15 min Winter	122.248	0.0	19
30 min Winter	82.572	0.0	33
60 min Winter	52.458	0.0	62
120 min Winter	33.215	0.0	122
180 min Winter	25.480	0.0	180
240 min Winter	21.109	0.0	240
360 min Winter	16.158	0.0	356

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
480 min Winter	14.783	0.533	24.9	3906.7	Flood Risk
600 min Winter	14.803	0.553	26.1	4070.3	Flood Risk
720 min Winter	14.816	0.566	26.9	4172.9	Flood Risk
960 min Winter	14.826	0.576	27.6	4255.8	Flood Risk
1440 min Winter	14.817	0.567	27.0	4181.2	Flood Risk
2160 min Winter	14.783	0.533	24.9	3906.5	Flood Risk
2880 min Winter	14.743	0.493	22.8	3600.5	Flood Risk
4320 min Winter	14.657	0.407	22.2	2949.0	Flood Risk
5760 min Winter	14.582	0.332	21.7	2387.1	Flood Risk
7200 min Winter	14.250	0.000	0.0	0.0	O K
8640 min Winter	14.250	0.000	0.0	0.0	O K
10080 min Winter	14.250	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
480 min Winter	13.321	0.0	472
600 min Winter	11.410	0.0	588
720 min Winter	10.016	0.0	700
960 min Winter	8.080	0.0	924
1440 min Winter	5.860	0.0	1342
2160 min Winter	4.154	0.0	1688
2880 min Winter	3.223	0.0	2164
4320 min Winter	2.228	0.0	3068
5760 min Winter	1.712	0.0	3920
7200 min Winter	-0.012	0.0	0
8640 min Winter	-0.010	0.0	0
10080 min Winter	-0.008	0.0	0

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.970

Time From:	(mins) To:	Area (ha)
0	4	4.970

Note: This output relates to the Onshore Substations and is inclusive of the operational access road. Micro drainage area expressed in hectares. Area footprints and impermeability are summarised in the table below:

Equipment	East Anglia TWO (m^2)	East Anglia ONE North (m^2)
Overall substation operational footprint	36,100 *(50% impermeable)*	36,100 *(50% impermeable)*
Operational access road	13,600 *(100% impermeable)*	
Overall cable sealing end compounds and cable sealing end with circuit breaker compound operational footprint	N/A	
Permanent access road to sealing end compound	N/A	
Total impermeable area	**49,700 (4.97ha)**	

Model Details

Storage is Online Cover Level (m) 14.850

Infiltration Basin Structure

Invert Level (m) 14.250 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.01000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.01000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	7000.0	0.500	7604.0	0.600	8725.0

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 2568 minutes.

Note the status column provides an indication of the worst case scenario and should be reviewed alongside the maximum volumes. This is then used to identify the critical storm duration and volume of storage required.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	14.554	0.304	11.3	1129.8	O K
30 min Summer	14.655	0.405	11.8	1520.7	O K
60 min Summer	14.756	0.506	12.2	1918.4	O K
120 min Summer	14.875	0.625	12.8	2400.1	O K
180 min Summer	14.956	0.706	13.1	2732.7	O K
240 min Summer	15.017	0.767	13.4	2989.1	O K
360 min Summer	15.107	0.857	13.8	3370.7	O K
480 min Summer	15.171	0.921	14.1	3642.9	Flood Risk
600 min Summer	15.215	0.965	14.3	3836.6	Flood Risk
720 min Summer	15.247	0.997	14.5	3976.1	Flood Risk
960 min Summer	15.283	1.033	15.3	4136.7	Flood Risk
1440 min Summer	15.298	1.048	15.6	4204.8	Flood Risk
2160 min Summer	15.263	1.013	14.8	4047.2	Flood Risk
2880 min Summer	15.213	0.963	14.3	3825.8	Flood Risk
4320 min Summer	15.115	0.865	13.9	3404.2	O K
5760 min Summer	15.038	0.788	13.5	3075.5	O K
7200 min Summer	14.250	0.000	0.0	0.0	O K
8640 min Summer	14.250	0.000	0.0	0.0	O K
10080 min Summer	14.250	0.000	0.0	0.0	O K
15 min Winter	14.590	0.340	11.5	1266.3	O K
30 min Winter	14.702	0.452	12.0	1704.9	O K
60 min Winter	14.814	0.564	12.5	2152.4	O K
120 min Winter	14.947	0.697	13.1	2696.7	O K
180 min Winter	15.038	0.788	13.5	3073.9	O K
240 min Winter	15.106	0.856	13.8	3366.0	O K
360 min Winter	15.208	0.958	14.3	3803.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	122.248	0.0	19
30 min Summer	82.572	0.0	34
60 min Summer	52.458	0.0	64
120 min Summer	33.215	0.0	124
180 min Summer	25.480	0.0	184
240 min Summer	21.109	0.0	244
360 min Summer	16.158	0.0	362
480 min Summer	13.321	0.0	482
600 min Summer	11.410	0.0	602
720 min Summer	10.016	0.0	722
960 min Summer	8.080	0.0	962
1440 min Summer	5.860	0.0	1440
2160 min Summer	4.154	0.0	2056
2880 min Summer	3.224	0.0	2388
4320 min Summer	2.228	0.0	3112
5760 min Summer	1.712	0.0	3920
7200 min Summer	-0.012	0.0	0
8640 min Summer	-0.010	0.0	0
10080 min Summer	-0.008	0.0	0
15 min Winter	122.248	0.0	19
30 min Winter	82.572	0.0	34
60 min Winter	52.458	0.0	64
120 min Winter	33.215	0.0	122
180 min Winter	25.480	0.0	182
240 min Winter	21.109	0.0	240
360 min Winter	16.158	0.0	358

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
480 min Winter	15.279	1.029	15.1	4116.5	Flood Risk
600 min Winter	15.327	1.077	16.3	4337.1	Flood Risk
720 min Winter	15.360	1.110	17.1	4494.5	Flood Risk
960 min Winter	15.397	1.147	18.0	4679.5	Flood Risk
1440 min Winter	15.416	1.166	18.4	4776.5	Flood Risk
2160 min Winter	15.388	1.138	17.8	4635.9	Flood Risk
2880 min Winter	15.340	1.090	16.6	4402.0	Flood Risk
4320 min Winter	15.243	0.993	14.4	3956.4	Flood Risk
5760 min Winter	15.146	0.896	14.0	3534.5	O K
7200 min Winter	14.250	0.000	0.0	0.0	O K
8640 min Winter	14.250	0.000	0.0	0.0	O K
10080 min Winter	14.250	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
480 min Winter	13.321	0.0	476
600 min Winter	11.410	0.0	594
720 min Winter	10.016	0.0	708
960 min Winter	8.080	0.0	942
1440 min Winter	5.860	0.0	1396
2160 min Winter	4.154	0.0	2036
2880 min Winter	3.223	0.0	2568
4320 min Winter	2.228	0.0	3328
5760 min Winter	1.712	0.0	4216
7200 min Winter	-0.012	0.0	0
8640 min Winter	-0.010	0.0	0
10080 min Winter	-0.008	0.0	0

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 641300 260300 TM 41300 60300	Shortest Storm (mins)	15
Data Type	Catchment	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.970

Time From:	(mins) To:	Area (ha)
0	4	4.970

Note: This output relates to the Onshore Substations and is inclusive of the operational access road. Micro drainage area expressed in hectares. Area footprints and impermeability are summarised in the table below:

Equipment	East Anglia TWO (m^2)	East Anglia ONE North (m^2)
Overall substation operational footprint	36,100 *(50% impermeable)*	36,100 *(50% impermeable)*
Operational access road	13,600 *(100% impermeable)*	
Overall cable sealing end compounds and cable sealing end with circuit breaker compound operational footprint	N/A	
Permanent access road to sealing end compound	N/A	
Total impermeable area	**49,700 (4.97ha)**	

Model Details

Storage is Online Cover Level (m) 15.450

Infiltration Basin Structure

Invert Level (m) 14.250 Safety Factor 1.0
Infiltration Coefficient Base (m/hr) 0.01000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.01000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3600.0	1.000	4389.0	1.200	5250.0