Cefn Solar Farm

Surface Water Management Plan

Novus Renewable Services Ltd

REPORT REF: 321/SP11 (v1)

October 2021

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1 Introduction

1.1 Background

This is a Surface Water Management Plan (SWMP) to support the Planning Application for a solar farm on land at Cefn Road, east of Wrexham (Cefn Road, Abenbury, Pentre Maelor, Wrexham, Wales, LL13 0PX). A Flood Consequence Assessment has also been prepared for the development.

Corylus Planning and Environmental Ltd (Corylus) has been instructed by Novus Renewable Services Ltd to undertake this assessment.

1.2 Sources of Information for the Report

This Report has been informed by the following:

- Scoping Assessment in April 2020;
- Site visit on 8th June 2021 including infiltration testing at four locations on the Site;
- Flood modelling undertaken for the River Clywedog in support of related planning applications;
- Access to maps and other relevant information on publicly available internet sites.

It has been prepared in response to the Welsh Government's Sustainable Drainage (SuDS) Statutory Guidance published in 2019.

1.3 Structure of this Report

This Report comprises the following Sections:

- Section 2 provides the Site Context and SuDS Selection Review;
- Section 3 describes the mitigation measures;
- Section 4 provides a Summary of the main findings

The following supporting Appendices are provided:

- Appendix A is the Site Investigation Report for the Site
- Appendix B is the Development Proposal
- Appendix C is the Application Form for the SuDS Approval Board (SAB)
- Appendix D is a Construction and Environment Management Plan (CEMP)

This Report has benefitted from feedback received from NRW and on submissions for related Sites; this has been very helpful in the preparation of this Report.

2 Site Context and Evolution of SuDS Strategy

2.1 Site Context

The location of the Site is shown in Figure 2-1 along with the topography. The Site is on land that slopes gently down to the south-east towards the river Clywedog. The land is currently in agricultural use. An aerial view of the Site given in Figure 2-2 showing how the Site covers just two fields that are bounded, in part, by Cefn Road and warehousing on Clywedog Road South. The Site boundary extends to the south to include a substation. Images of the Site are shown in Figure 2-4 Figure 2-3.

Figure 2-1: Location and topography of Site – outlined in red

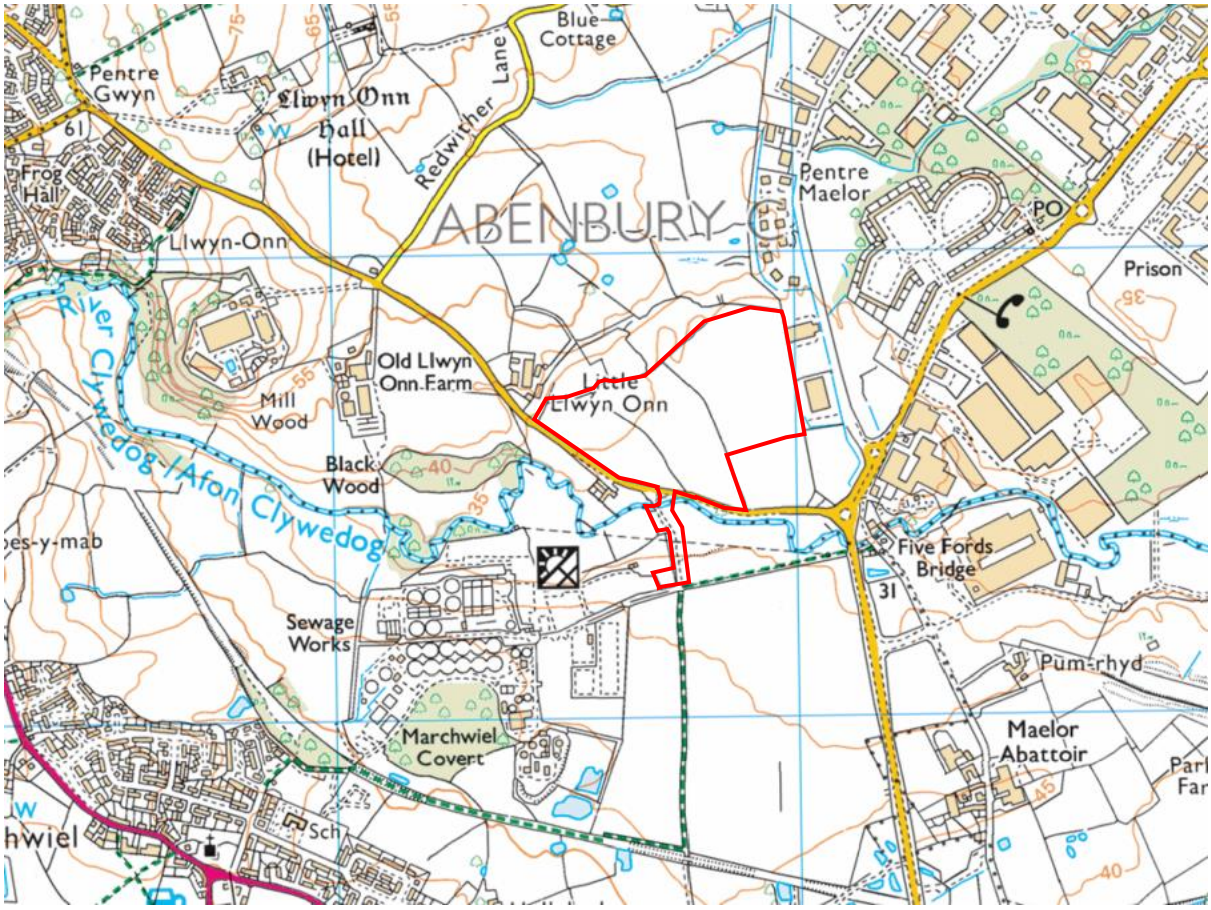


Table 2-1: Map Co-ordinates

Reference	Value
Grid reference	SJ368486
OS X (Eastings)	336822
OS Y (Northings)	348648
Nearest Post Code	LL13 0PX
Lat (WGS84)	53.03
Long (WGS84)	-2.94
What3words	porch.gracing.treaties

Figure 2-2: Existing Site with proposed development outlined in red

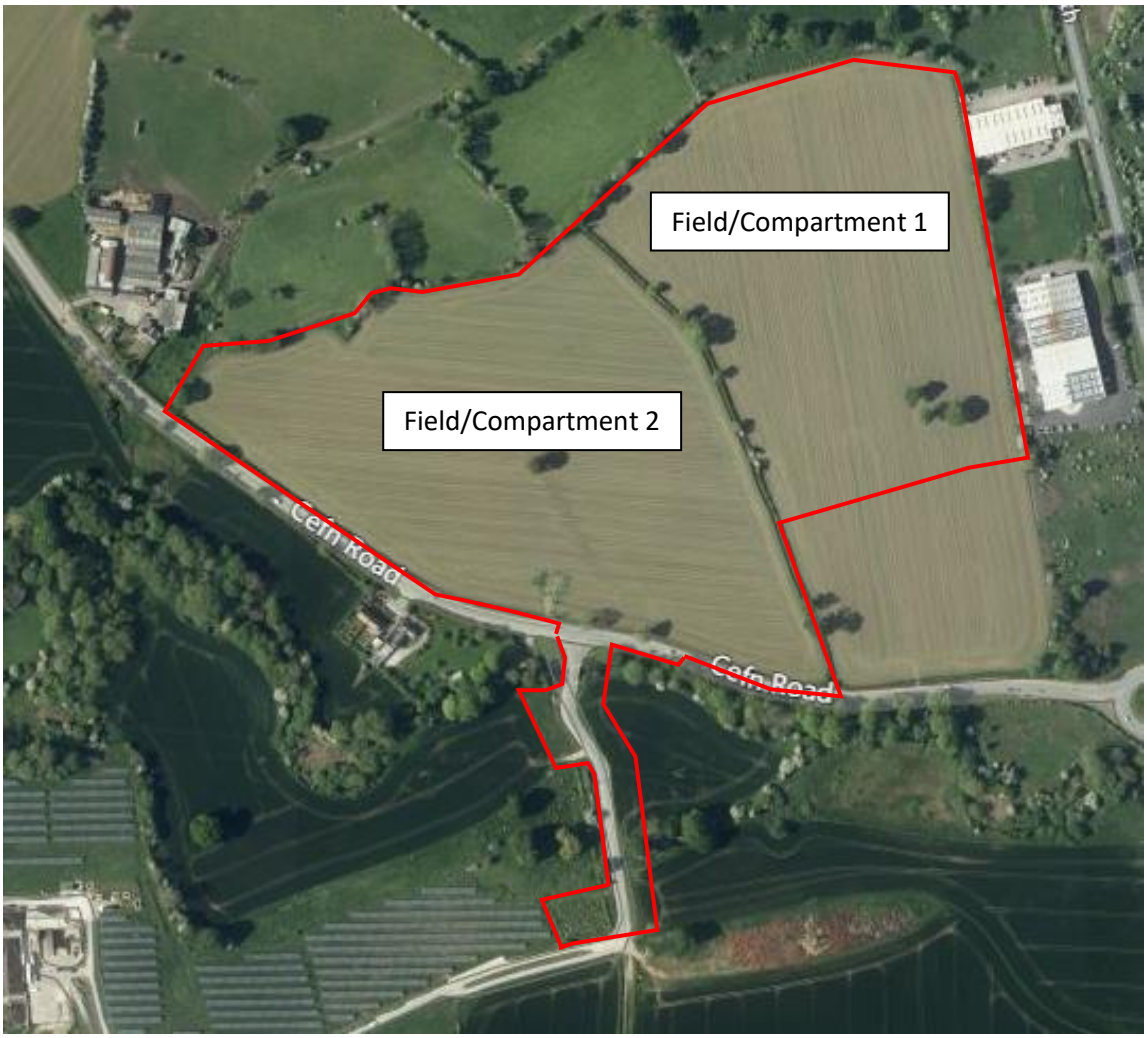


Figure 2-3: Compartment 1 from south-west corner of Field (beyond the red line boundary)

(a) South along line of ditch

(b) East towards Compartment 2 along Cefn Road

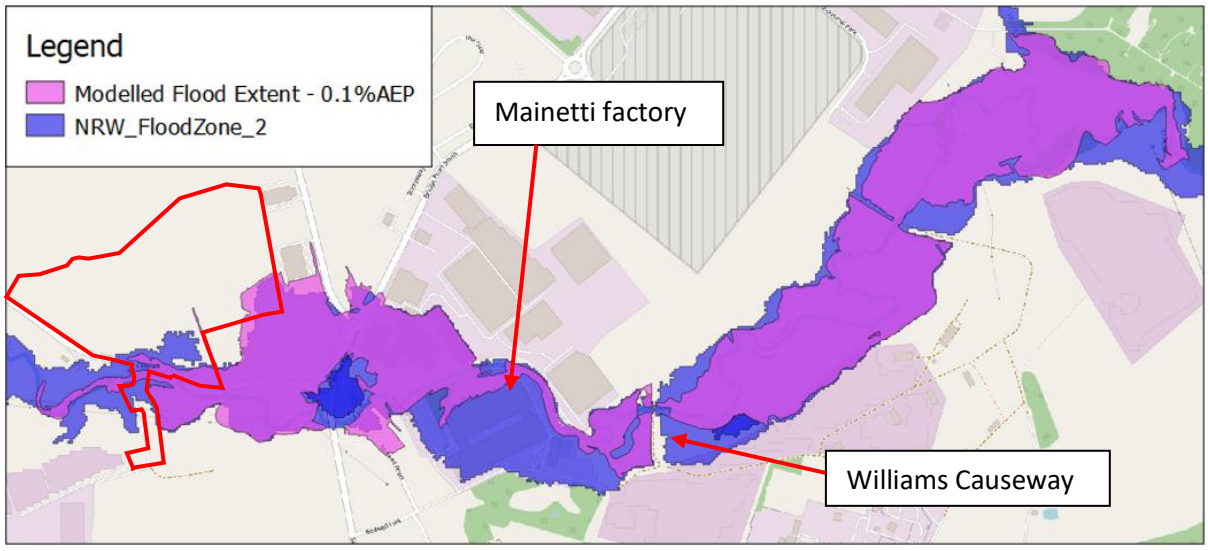
Figure 2-4: Compartment 2 from south-west corner

(a) North along line of ditch **(b) East along Cefn Road**

2.2 Flood Context

As noted previously, a hydraulic model has been developed for the River Clywedog to support planning applications for Sites to the east of the current one. Results from the model suggested that there were minor differences compared with the flood extents on the NRW web site. The flood extents are compared in Figure 2-5 for an earlier version of the model and show that, for the majority of the Site, there is little practical difference between the flood extents. There are substantial differences in extents, such as in Compartment 1; however, this results from the proximity to the upstream boundary of the new model where computed levels are not reliable. If the current model had been extended, it is not expected that there would be any substantial difference with the NRW Flood extents.

Figure 2-5: Comparison of NRW and model extents (0.1% AEP)



2.3 Soil Context

The bedrock geology is shown in Figure 2-6; this shows that the site is underlain by the Salop formation, a sedimentary formation comprising mudstone, sandstone and conglomerate. The superficial geology is shown in Figure 2-7; most of the Site is underlain by river terrace deposits comprising sand and gravel – likely from former courses of the River Clywedog.

The soil properties for the Site are illustrated in Figure 2-8 from the NSRI Soilscape web site. This shows that the soils over virtually the entire Site are described as being "Naturally wet". Site specific testing has been undertaken with the results presented in Appendix A. The tests have confirmed that the soils are indeed suitable for some SuDS infiltration measures to be adopted.

Figure 2-6: Bedrock Geology (BGS Website)

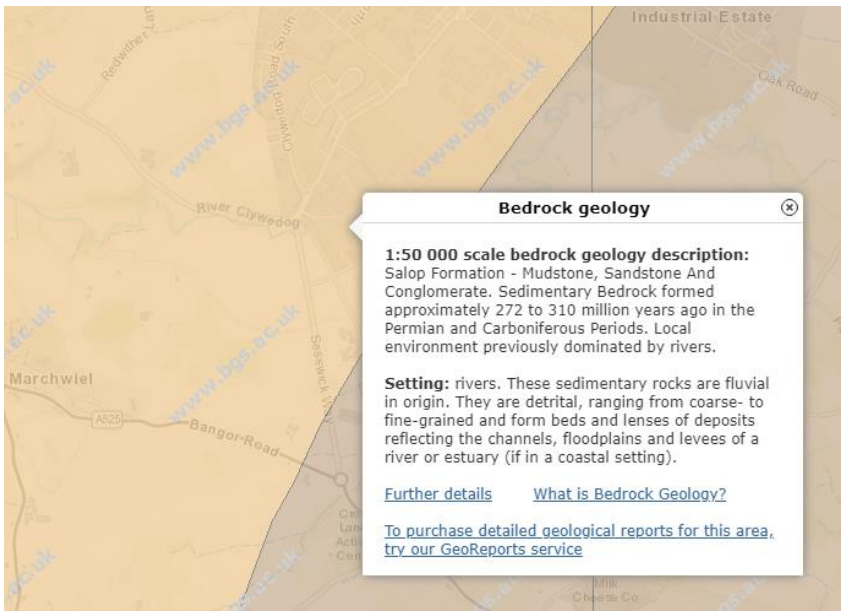


Figure 2-7: Superficial Geology (BGS Website)

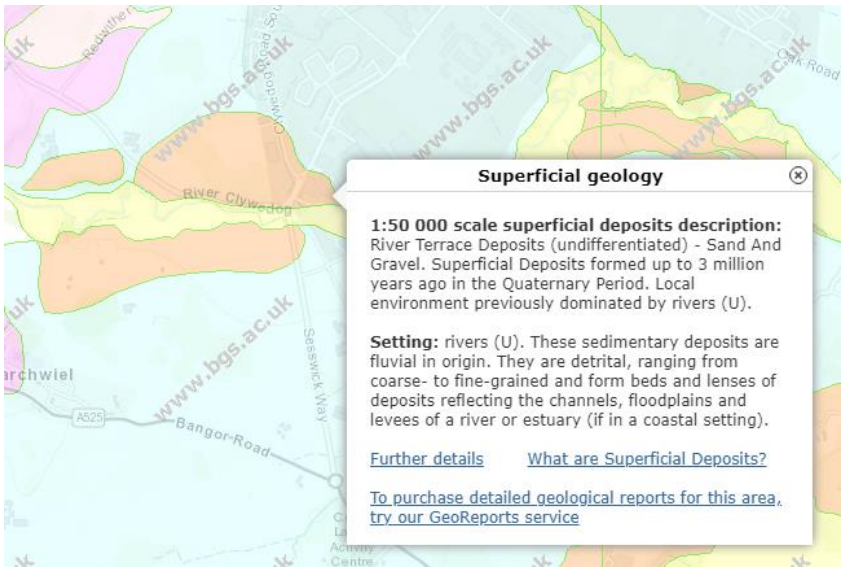
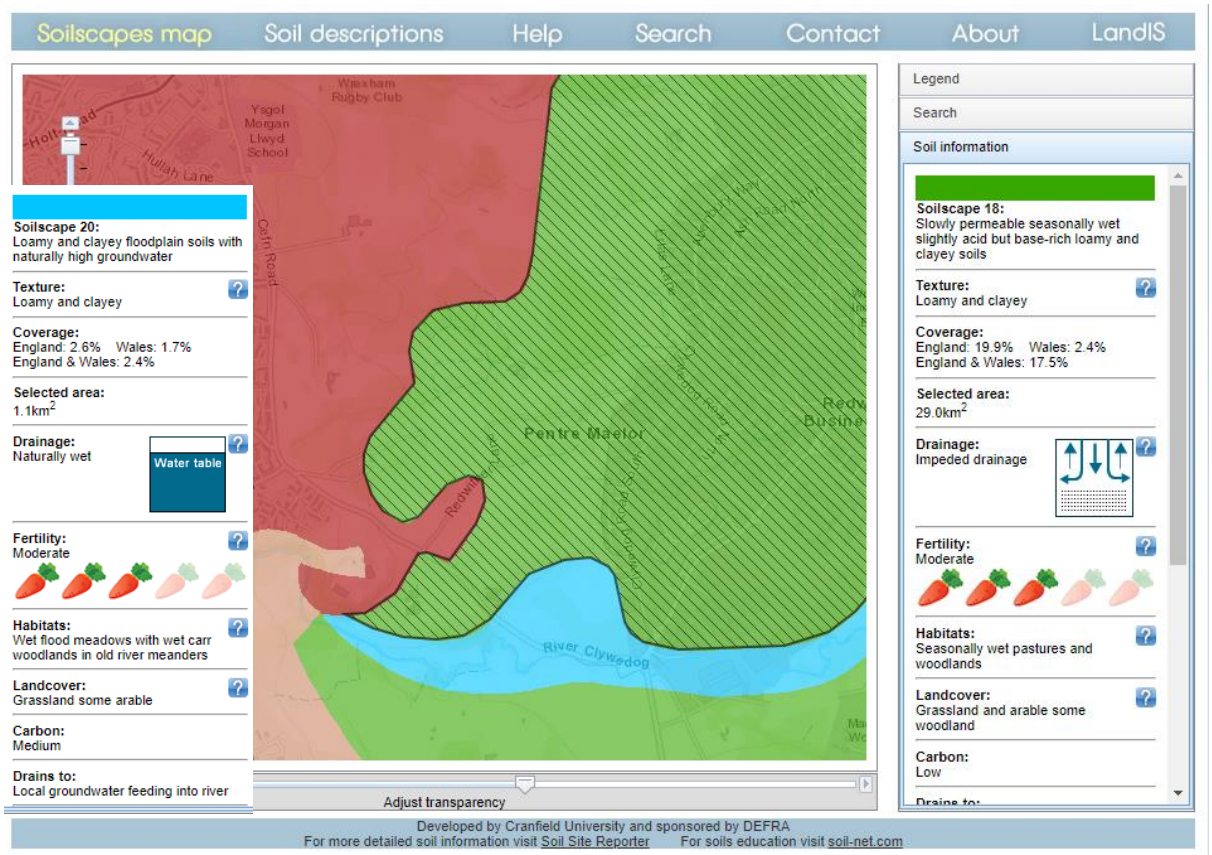


Figure 2-8: Soil Properties (NSRI Soilscape Website)



Infiltration testing was undertaken at the proposed locations of isolated infrastructure on the proposed Solar Farm. The results of these investigations are presented in Appendix A with the results of the testing are shown in Table 2-2. The results confirm that the soils are freely draining across the Site. Values for Pits A, B and D are similar; the relatively low result at Pit C is thought to be due to the Trial Pit being affected by compaction due to tractor movements.

In the analyses described later in this Report, the lowest value from the tests has been used, namely from Pit C at **3.04 E-05 m/s** – equivalent to 110 mm/h.

Table 2-2: Summary of Infiltration Test results in m/s

Pit	Proposed development	Test 1	Test 2	Test 3
A	Battery	1.89E-05	9.25E-05	**9.58E-05**
B	Transformer (Compartment 2)	1.78E-05	2.22E-04	**1.05E-04**
C	Transformer (Compartment 1)	1.62E-05	1.66E-05	**3.04E-05**
D	Transformer (Compartment 1 nr Cefn Road)	1.65E-05	1.78E-05	**1.04E-04**

2.4 SuDS Selection Review

The SuDS selection Review demonstrates the way in which SuDS measures are to be provided to mitigate the impacts of the development.

The components of the development are shown in Appendix B (Drawing by Corylus, ref CE/321/4-2 Rev A, dated August 2021) and comprise the following:

- Temporary construction compound in Compartment 2 with a smaller construction compound likely to be east of the proposed substation and within the existing red line boundary
- Installation of solar panels
- Gravel tracks to provide internal access and around the batteries and transformers;
- Impermeable surfaces comprising the rooves and concrete pads for the batteries and transformers; and
- Shallow soil berms for storage of top soil removed for creation of roads and other infrastructure.

Our general experience relating to the **installation of solar panels** over many years is that there is no increase in runoff, except in specific circumstances. In general, and especially on flat sites (such as this one) runoff from solar panels is able to infiltrate into the soil either beneath the panels, or under adjacent panels. This is aided by the rainwater gap between the panels as shown in Figure 2-9. On sites with steep slopes, especially where the panels align down the gradient, increased rates of runoff may occur and require mitigation. Since this is not the case for this site, **there is no requirement for any mitigation of runoff from solar panels.** This is supported by the observations on a neighbouring solar site with similar setting where there was no evidence of increased runoff or waterlogging under the panels (Figure 2-10).

Figure 2-9: Typical section through solar array showing rainwater gap between adjacent panels

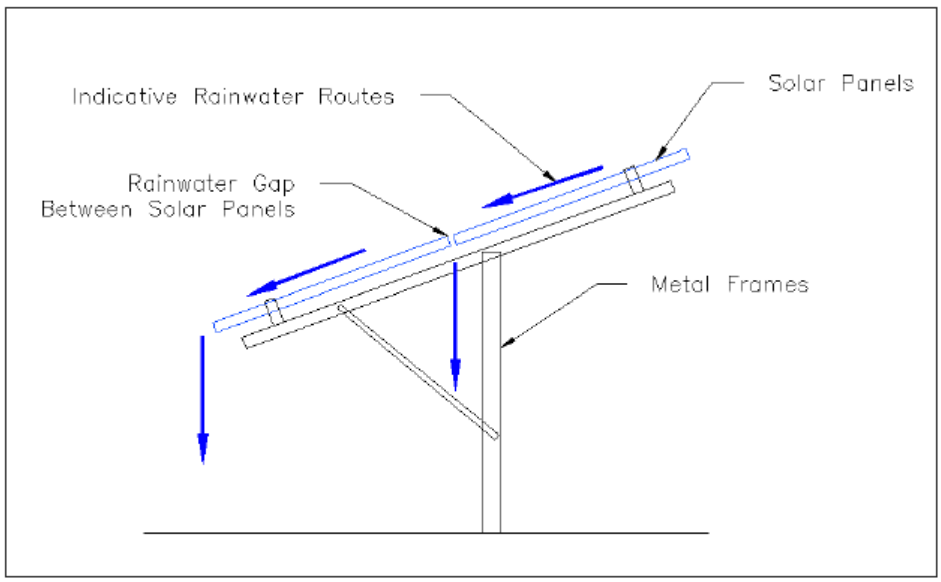


Figure 2-10: Ground conditions on an adjacent solar site in similar setting

The use of **gravel chippings** for areas around the infrastructure and for the internal access tracks is commonplace on solar farms; a typical arrangement is shown in Figure 2-11. The chippings provide a permeable surface, through which rainfall may penetrate and infiltrate into the underlying soils. **No further mitigation is required for these "permeable" areas of gravel chippings.** This would also apply to the Construction compound which is to be made of permeable materials laid on a geotextile layer.

Figure 2-11: Typical layout showing gravel chippings around infrastructure on concrete pads

The **electrical infrastructure** comprises a Battery Storage containers, paired transformers plus customer/DNO substation. These units are all mounted on concrete pads which are impermeable and will require mitigation.

The **soil storage bunds** will be required so that topsoil can be retained within the Site, ultimately for restoration of the Site. The soil bunds are expected to have reasonable infiltration properties – given that they are to be made from topsoil, placed without compaction and will likely promote a good sward. Furthermore, they are located some distance from any downslope external site boundaries. **No further mitigation is thus required for the soil storage mound.**

A SuDS Selection Review is presented in Table 2-3 by way of a summary of the proposed approach to mitigating runoff from the development surfaces. This confirms that some form of infiltration based SuDS are appropriate for mitigating any increase in runoff from impermeable surfaces.

Table 2-3: SuDS Selection Review

SuDS Component	**Appropriate**	**Comment**
Rainwater Harvesting Systems	No	Not appropriate for nature of development.
Green Roofs	No	Not appropriate for nature of development
Infiltration Systems	**Yes**	**Site investigation shows that soils are suitable for infiltration over the Site.**
Proprietary Treatment Systems	No	Runoff from building rooves has low levels of contamination.
Filter Strips	**Potential**	**If required.**
Filter Drains	No	Not deemed necessary.
Swales	**Potential**	**If required.**
Bioretention Systems	No	Not necessary.
Trees	**Yes**	**Existing trees around field boundaries to be retained.**
Pervious Pavements	**Yes**	**Site investigation shows that soils are suitable for infiltration over the Site.**
Attenuation Tanks	No	Not required
Detention Basins	No	Not required
Pond/Wetlands	No	Not required

Based on Table 1.1 (CIRIA, 2015)

3 Mitigation Measures

3.1 Impermeable Surfaces

The SuDS selection review presented in Section 2.4 has shown that the only aspects of the development that require mitigation are the impermeable surfaces associated with the electrical infrastructure. The relevant areas are shown in Table 3-1.

Table 3-1: Impermeable surfaces

Item	Unit area	Nr.	Gross area	Unit	Comment
Battery	128.3	2	256.5	m2	To soakaway
ISO	9.9	1	9.9	m2	To soakaway
Substation comprising:					
Customer sub-station	29.6	1	29.6	m2	To soakaway
DNO sub-station	29.6	1	29.6	m2	To soakaway
DNO Transformers	39.6	2	79.1	m2	To soakaway
Transformer (pair)	73.5	2	147.0	m2	To soakaway
Transformer (pair)/ISO	92.4	2	184.7	m2	To soakaway
Sub-total: Impermeable			**736.4**	**m2**	
Compound			4016	m2	
Gravel around transformers etc			1956	m2	
Tracks			1200	m2	c400 m x 3m
Soil mounds			1500	m2	Approximate
Sub-total: Permeable			**8672.0**	**m2**	
Gross development			**9408.4**	**m2**	

3.2 Greenfield runoff

It is not necessary to compute rates of greenfield runoff since all excess water will be disposed of within the Site.

3.3 Sizing of SuDS Components

Infiltration testing on the adjacent site (see Appendix A) confirmed the suitability of soils for shallow infiltration close to the location of the isolated infrastructure. The typical arrangement for the different types of infrastructure is shown in Figure 3-1. The generous gravel margins, with gravel depths of 0.30 m minimum, provide the nominal areas for the proposed soakaways. Each type of infrastructure has been analysed using a standard soakaway spreadsheet to demonstrate the adequacy of the proposed areas.

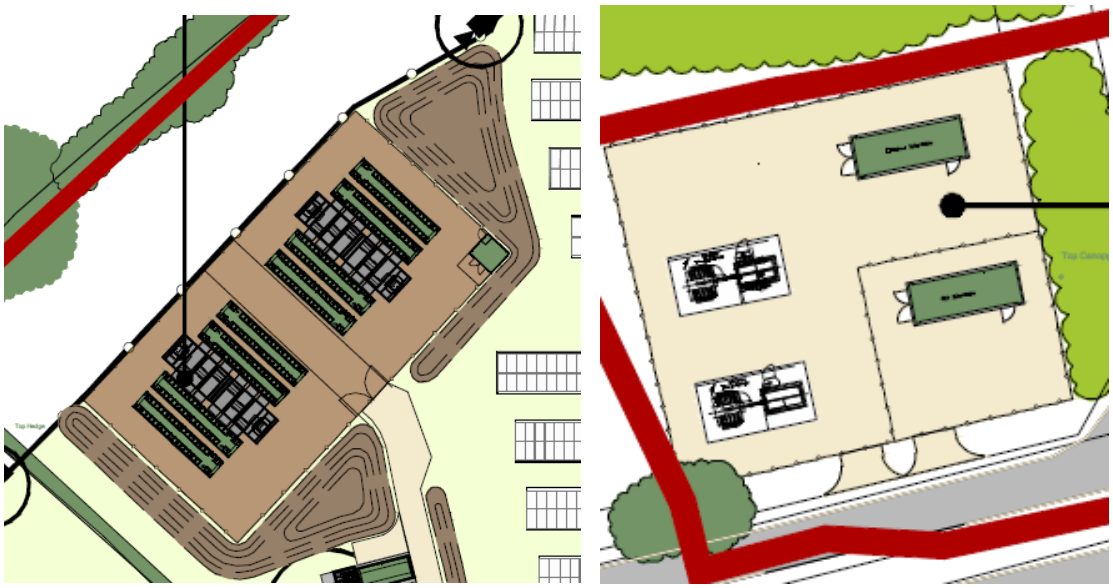
The infiltration areas have been sized by reference to the site-specific infiltration rates and the appropriate impermeable area. The sizing makes use of a generalised spreadsheet that is based on the SuDS Manual (CIRIA, 2015). The analysis uses the following assumptions:

- Point rainfall, based on FEH2013 data with an AEP of 1% (1 in 100)
- Infiltration rate based on that from the site-specific testing

- Factor of Safety of 2.0 – consistent with the small area and limited impacts from any surcharge but higher than the recommended value of 1.5;
- Runoff coefficient of 100% with all incident rainfall assumed to runoff;
- Climate change adjustment of +20%.

Figure 3-1: Isolated infrastructure components

(a) Battery/ISO **(b) Substation**



(c) Transformer pair **(d) Transformer pair with ISO**

The results are presented in Figure 3-2 and summarised in Table 3-2 showing the available size of infiltration areas for mitigating the effects of surface water runoff. The infiltration rate of the soils is sufficiently high that "null" results were obtained for all impermeable areas – in other words, no depths could be computed nor half-drain down times. The available areas are thus sufficient for all of the proposed impermeable areas. Indicative cross-sections through the soakaways, as envisaged for the Transformer pairs are shown in Figure 3-3.

Figure 3-2: Sizing of Infiltration Areas for Isolated Infrastructure

SOAKAWAY DESIGN - 3D INFILTRATION (v2)

Project name: Cefn Solar Farm: Battery/ISO

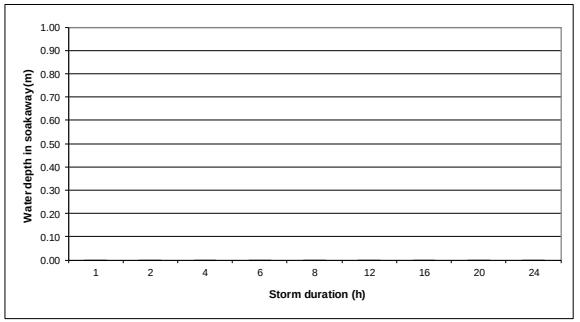
Input data	Term	Value	Unit	
Area to be drained	Ad	293.04	m^2	Includes creep
Porosity of fill	n	0.35		
Infiltration coefficient	q	3.04E-05	m/s	
Climate change factor	cc	1.20		
Factor of Safety		1.5		

Size of soakaway			
Length	L	88.4	m
Width	W	10	m

Design parameters			
Infiltration coefficient	q	0.1096	m/h
Effective infiltration coeff.	qe	0.0730	m/h
Surface Area	Ab	884.0	m^2
Perimeter	P	196.8	m
Volume	V	-140.1	m^3
Effective volume	Veff	-49.0	m^3
Maximum depth	**hmax**	**-0.16**	**m**
Time to reach half vol	**t1/2**	**-0.39**	**h**

Critical duration analysis

Storm duration (h)	Depth (mm) 1%	Intensity * cc (mm/h)	b	a	h max (m)	$t_{1/2}$ (h)
1	40.9	49.1	0.0465	3.4913	-0.16	-0.39
2	48.7	29.2	0.0465	3.8959	-0.35	-0.88
4	57.5	17.2	0.0465	4.1405	-0.70	-1.91
6	62.6	12.5	0.0465	4.2366	-1.03	-2.99
8	66.3	9.9	0.0465	4.2892	-1.33	-4.11
12	71.4	7.1	0.0465	4.3463	-1.86	-6.50
16	75.0	5.6	0.0465	4.3772	-2.30	-9.05
20	77.8	4.7	0.0465	4.3967	-2.66	-11.75
24	80.2	4.0	0.0465	4.4101	-2.96	-14.59



Note: Based on the CIRIA SuDS Manual C753 & Report 156 - Infiltration drainage - Manual of good practice

SOAKAWAY DESIGN - 3D INFILTRATION (v2)

Project name: Cefn Solar Farm: Substation

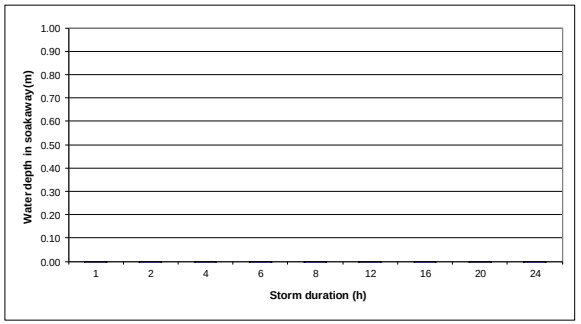
Input data	Term	Value	Unit	
Area to be drained	Ad	152.13	m^2	Includes creep
Porosity of fill	n	0.35		
Infiltration coefficient	q	3.04E-05	m/s	
Climate change factor	cc	1.20		
Factor of Safety		1.5		

Size of soakaway			
Length	L	30	m
Width	W	24	m

Design parameters			
Infiltration coefficient	q	0.1096	m/h
Effective infiltration coeff.	qe	0.0730	m/h
Surface Area	Ab	720.0	m^2
Perimeter	P	108.0	m
Volume	V	-126.9	m^3
Effective volume	Veff	-44.4	m^3
Maximum depth	**hmax**	**-0.18**	**m**
Time to reach half vol	**t1/2**	**-0.43**	**h**

Critical duration analysis

Storm duration (h)	Depth (mm) 1%	Intensity * cc (mm/h)	b	a	h max (m)	$t_{1/2}$ (h)
1	40.9	49.1	0.0313	5.7201	-0.18	-0.43
2	48.7	29.2	0.0313	6.1029	-0.37	-0.93
4	57.5	17.2	0.0313	6.3342	-0.75	-1.95
6	62.6	12.5	0.0313	6.4251	-1.10	-3.01
8	66.3	9.9	0.0313	6.4750	-1.43	-4.10
12	71.4	7.1	0.0313	6.5290	-2.04	-6.38
16	75.0	5.6	0.0313	6.5582	-2.58	-8.78
20	77.8	4.7	0.0313	6.5766	-3.06	-11.30
24	80.2	4.0	0.0313	6.5893	-3.48	-13.92



Note: Based on the CIRIA SuDS Manual C753 & Report 156 - Infiltration drainage - Manual of good practice

SOAKAWAY DESIGN - 3D INFILTRATION (v2)

Project name: Cefn Solar Farm: Transformer pair/ISO

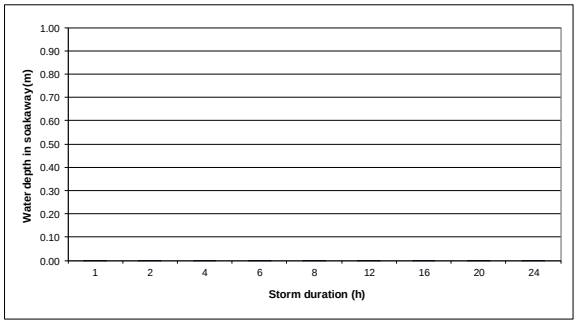
Input data	Term	Value	Unit	
Area to be drained	Ad	101.6	m^2	Includes creep
Porosity of fill	n	0.35		
Infiltration coefficient	q	3.04E-05	m/s	
Climate change factor	cc	1.20		
Factor of Safety		1.5		

Size of soakaway			
Length	L	11	m
Width	W	8	m

Design parameters			
Infiltration coefficient	q	0.1096	m/h
Effective infiltration coeff.	qe	0.0730	m/h
Surface Area	Ab	88.0	m^2
Perimeter	P	38.0	m
Volume	V	-3.9	m^3
Effective volume	Veff	-1.4	m^3
Maximum depth	**hmax**	**-0.04**	**m**
Time to reach half vol	**t1/2**	**-0.11**	**h**

Critical duration analysis

Storm duration (h)	Depth (mm) 1%	Intensity * cc (mm/h)	b	a	h max (m)	$t_{1/2}$ (h)
1	40.9	49.1	0.0901	0.5187	-0.04	-0.11
2	48.7	29.2	0.0901	1.2454	-0.21	-0.53
4	57.5	17.2	0.0901	1.6846	-0.51	-1.47
6	62.6	12.5	0.0901	1.8572	-0.78	-2.49
8	66.3	9.9	0.0901	1.9518	-1.00	-3.59
12	71.4	7.1	0.0901	2.0544	-1.36	-5.94
16	75.0	5.6	0.0901	2.1098	-1.61	-8.46
20	77.8	4.7	0.0901	2.1448	-1.79	-11.05
24	80.2	4.0	0.0901	2.1690	-1.92	-13.65



Note: Based on the CIRIA SuDS Manual C753 & Report 156 - Infiltration drainage - Manual of good practice

Figure 3-3: Cross Section through proposed soakaway for Transformer Pair

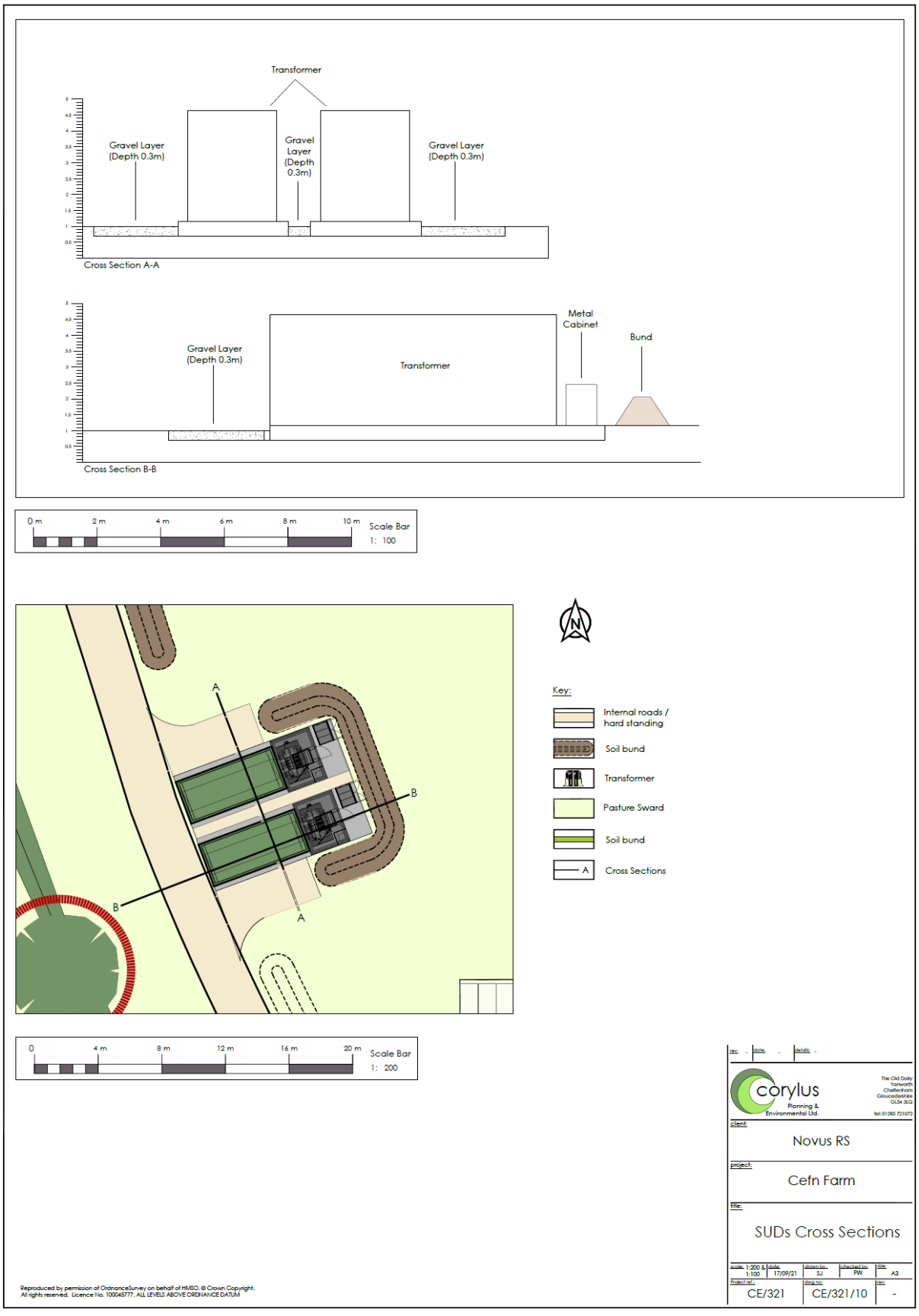


Table 3-2: Sizing of infiltration areas for isolated infrastructure

Component	Impermeable area (m^2)	Infiltration area (m^2)	Max depth (m)	Half drain time (h)
Battery	293	884	n/a	n/a
Sub-station	152	720	n/a	n/a
Transformer pair with ISO	102	88	n/a	n/a

3.4 Treatment stages

The new impermeable surfaces comprise rooves and adjacent concrete hard standing from which runoff should require limited treatment. The runoff will be able to infiltrate freely to the surrounding gravel areas which should provide the required treatment. In view of this, no additional treatment stages are required.

3.5 Maintenance and Residual Risk

The maintenance requirements for the SuDS components are shown in Table 3-3 for soakaways. All solar sites are subject to a strict monthly maintenance schedule for operational reasons. The SuDS maintenance requirements can thus be included within this broader operational maintenance schedule.

The residual risks arise from failure to undertake the required maintenance and from storms in excess of those for which the scheme has been designed. For the reasons stated above, there is a high probability that maintenance will be undertaken on a regular basis and be effective in ensuring the operability of the SuDS devices.

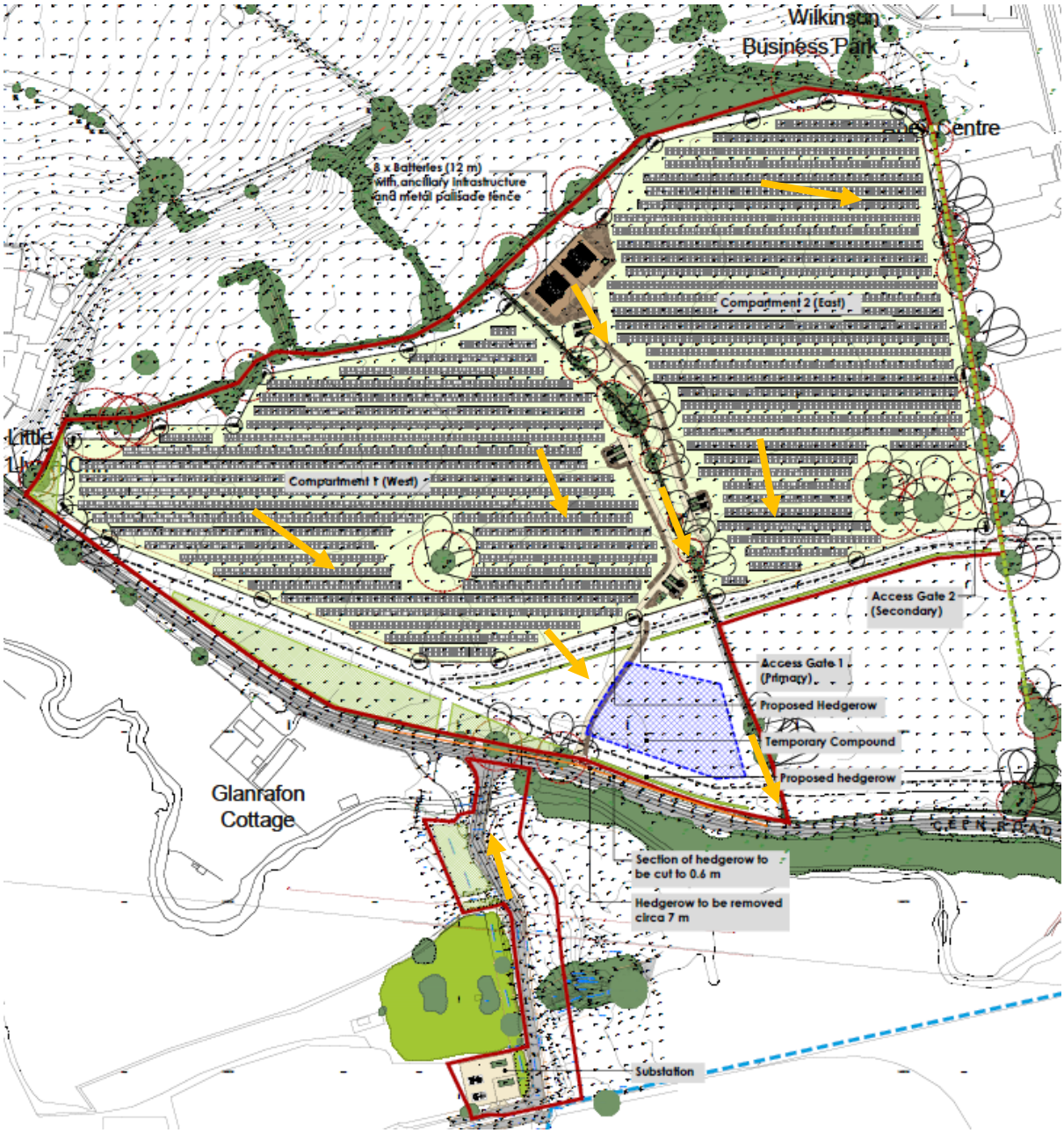
Should storms in excess of the design storm occur, then the impacts on others are likely to be negligible. This is due to the favourable infiltration properties of the soils and the opportunity for infiltration within the Site. Potential flow paths have been sketched on Figure 3-4 which reflect the general topography which slopes down to the south-east.

Table 3-3: Operation and maintenance requirements for soakaways

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Inspect for sediment and debris in pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	Annually
	Cleaning of gutters and any filters on downpipes	Annually (or as required based on inspections)
	Trimming any roots that may be causing blockages	Annually (or as required)
Occasional maintenance	Remove sediment and debris from pre-treatment components and floor of inspection tube or chamber and inside of concrete manhole rings	As required, based on inspections
Remedial actions	Reconstruct soakaway and/or replace or clean void fill, if performance deteriorates or failure occurs	As required
	Replacement of clogged geotextile (will require reconstruction of soakaway)	As required
Monitoring	Inspect silt traps and note rate of sediment accumulation	Monthly in the first year and then annually
	Check soakaway to ensure emptying is occurring	Annually

Table 13.1 from the SuDS Manual (CIRIA, 2015)

Figure 3-4: Exceedance flow routes



3.6 Flood and drainage issues during construction

The principal risk during construction relates to ground conditions, which is referenced within the CEMP, provided as Appendix D.

4 Summary

This is a Surface Water Management Plan (SWMP) to support the Outline Planning Application for a solar farm at Cefn Road, east of Wrexham (Cefn Road, Abenbury, Pentre Maelor, Wrexham, Wales, LL13 0PX). The development comprises:

- Stripping of soil in areas where infrastructure will be placed and where gravel access roads will be laid;
- Storing soil in soil storage mounds
- Installation of solar arrays in two fields,
- Installation of electrical infrastructure including batteries and transformers.

The main findings of this Report are as follows:

i. The only features of the development that require mitigation are the new impermeable surfaces associated with the electrical infrastructure.
ii. The SuDS selection review leads to the recommendation of infiltration for mitigating the effects of runoff from new impermeable surfaces – this being due to the good infiltration properties of the soils over most of the Site.
iii. The soakaways are comprised of gravelled areas and access roads adjacent to the proposed infrastructure. The gravel depth of 0.3 m is sufficient as a soakaway for events up to and beyond the 1% with allowance for climate change.
iv. The SuDS components will be subject to routine maintenance, likely as part of the regular maintenance schedules for the solar farm itself.
v. There are unlikely to be water quality problems associated with the runoff from the new surfaces particularly since all runoff is directed to the soakaways.
vi. Exceedance of design events may lead to surcharging of the soakaways. However, there is ample opportunity for any excess to be attenuated or infiltrated within the Site.
vii. The principal construction risk relates to the risk of waterlogging. Construction work should thus be avoided during and following prolonged rainfall.
viii. A Construction and Environment Management Plan (CEMP) has been provided in Appendix D; this references the proximity to the River Dee and Bala Lake SAC (Special Area of Conservation) and outlines the proposed mitigation measures.

5 References

Author	Date	Title/Description
Centre for Ecology and Hydrology.	2020	The Flood Estimation Handbook Web Service. Available from: https://fehweb.ceh.ac.uk/
CIRIA	2015	C753, The SuDS Manual.
Welsh Government	2019	Sustainable Drainage (SuDS) Statutory Guidance

Appendix A Infiltration Testing

A.1 Introduction

This Appendix describes the infiltration testing that was carried out on 8th June 2021 at the Cefn Farm Site in support of the SuDS design. The testing was undertaken by Dr Paul Webster at four locations shown in Figure A-1; these locations coincide with the proposed impermeable infrastructure locations.

A.2 Methodology

Infiltration testing was undertaken using a small trial pit with nominal dimensions of 0.3 m x 0.3 m x 0.3 m and were dug by hand. The pit walls were comparatively stable so there was no need to introduce any gravel for stabilisation.

The sequence of activities was as follows:

- Pits were dug on the afternoon of 8th June 2021;
- They were filled with water and measurements were made of the changing depth over time
- All Pits drained rapidly and were refilled.
- The pits were filled for the third time on the afternoon of 8th June with formal measurements made of the changing depth over time.

Tests were undertaken in accordance with the BRE365 Procedure i.e. with infiltration based on the results from the third filling of the trial pits at all four locations.

Water levels were recorded by "dipping" down from a reference point roughly in the middle of each pit. Photographs of each pit prior to and during testing are shown in Figure A-3.

The determination of infiltration rates requires the time taken for the pit to drain from 75% to 25% full. Since the pits drained rapidly, testing was undertaken in series. Linear interpolation has been used to estimate these thresholds from time-adjacent measurements.

A.3 The results

The results from the first and second tests on 8th June are shown for all pits in Table A-2 and Table A-3. The infiltration test results are summarised in Table A-1. The tabulated values for Tests 1 and 2 are of limited use since the Pits were visited well after they had drained. This means that the drain down times were subject to over-estimation. This was not a problem for Test 3 since measurements were taken up to the point when the Pits reached 25% full.

Table A-1: Summary of infiltration test results in units of m/s

Pit	Proposed development	Test 1	Test 2	Test 3
A	Battery	1.89E-05	9.25E-05	**9.58E-05**
B	Transformer (Compartment 1)	1.78E-05	2.22E-04	**1.05E-04**
C	Transformer (Compartment 2)	1.62E-05	1.66E-05	**3.04E-05**
D	Transformer (Compartment 2 nr Cefn Road)	1.65E-05	1.78E-05	**1.04E-04**

Figure A-1: Location of infiltration test sites

The depth to groundwater was investigated by hand augering adjacent to Pits B and D (Figure A-2). The auger refused at around 1 m at Pit B; at this depth, damp clay was encountered. The auger refused at around 0.6 m in Pit D at which point damp gravelly soils were encountered. Accordingly, there is no practical risk from groundwater affecting proposed soakaways.

Figure A-2: Hand augering

(a) Pit B

(b) Pit D

Figure A-3: The infiltration test pits

Pit A (dry)

Pit A (filled)

Pit B (dry)

Pit B (filled)

Pit C (dry)

Pit C (filled)

Pit D (dry)

Pit D (filled)

Table A-2: Infiltration test results (Tests 1 and 2 on 8th June 2021)

Pit & Trial	**A1**		**B1**		**C1**		**D1**		**A2**		**B2**		**C2**		**D2**	
Length (mm)	270		260		280		260		270		260		280		260	
Width (mm)	300		270		280		290		300		270		280		290	
Start (0%)	90		80		60		30		55		50		40		0	
Base (100%)	270		300		290		260		270		300		290		260	
Range (mm)	180		220		230		230		215		250		250		260	
Volume (m3)	0.01458		0.015444		0.018032		0.017342		0.017415		0.01755		0.0196		0.019604	
Readings in mm below dip point																
1	90	13:29	80	13:54	60	14:12	30	14:49	55	15:09	50	15:23	40	15:32	0.1	15:56
2	170	13:30	160	13:55	290	15:31	90	14:50	110	15:10	155	15:24	75	15:33	50	15:57
3	210	13:32	210	13:56			120	14:51	180	15:12	200	15:25	100	15:34	90	15:58
4	270	15:08	300	15:21			260	15:55	200	15:14	230	15:26	120	15:35	120	15:59
5									220	15:17	240	15:27	140	15:36	150	16:00
6									270	16:16	245	15:28	150	15:37	165	16:01
7											300	16:31	165	15:38	260	17:58
8													290	16:54		
9																
10																
Interpolation																
	90	13:29:00	80	13:54:00	60	14:12:00	30	14:49:00	55	15:09	50	15:23:00	100	15:34:00	50	15:57
	170	13:30:00	160	13:55:00	290	15:31:00	90	14:50:00	110	15:10	155	15:24:00	120	15:35:00	90	15:58:00
75% full (interp.)	135	13:29:34	135	13:54:41	117.5	14:31:45	87.5	14:49:58	108.75	15:09:59	112.5	15:23:36	102.5	15:34:08	65	15:57:22
	210	13:32:00	210	13:56:00	60	14:12:00	120	14:51:00	200	15:14:00	230	15:26:00	165	15:38:00	165	16:01
	270	15:08:00	300	15:21:00	290	15:31:00	260	15:55:00	220	15:17:00	240	15:27:00	290	16:54:00	260	17:58:00
25% full (interp.)	225	13:56:00	245	14:29:03	232.5	15:11:15	202.5	15:28:43	216.25	15:16:26	237.5	15:26:45	227.5	16:16:00	195	16:37:57
Calculation																
Level diff for 75% and 25% (mm)	90		110		115		115		107.5		125		125		130	
Time diff (s)	1586.3		2062.1		2370.0		2325.4		387.6		189.3		2512.5		2434.3	
Vp (s) for 1 mm fall in WL	17.6		18.7		20.6		20.2		3.6		1.5		20.1		18.7	
f (m/s)	**1.89E-05**		**1.78E-05**		**1.62E-05**		**1.65E-05**		**9.24E-05**		**0.00022**		**1.66E-05**		**1.78E-05**	
f (mm/h)	**68.1**		**64.0**		**58.2**		**59.3**		**332.8**		**792.5**		**59.7**		**64.1**	

Figure A-4: Infiltration test results (Tests 1 and 2 on 8th June 2021)

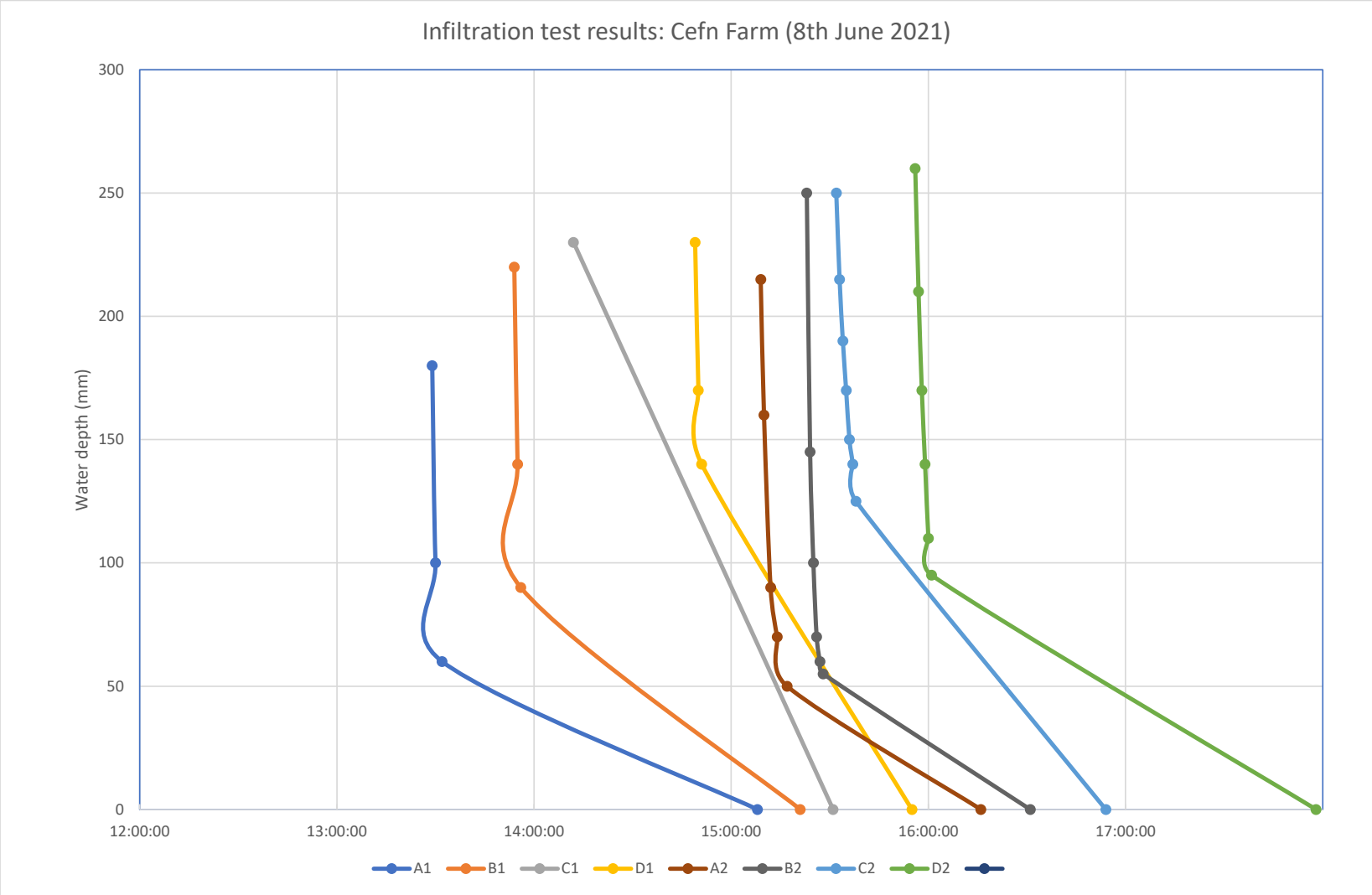
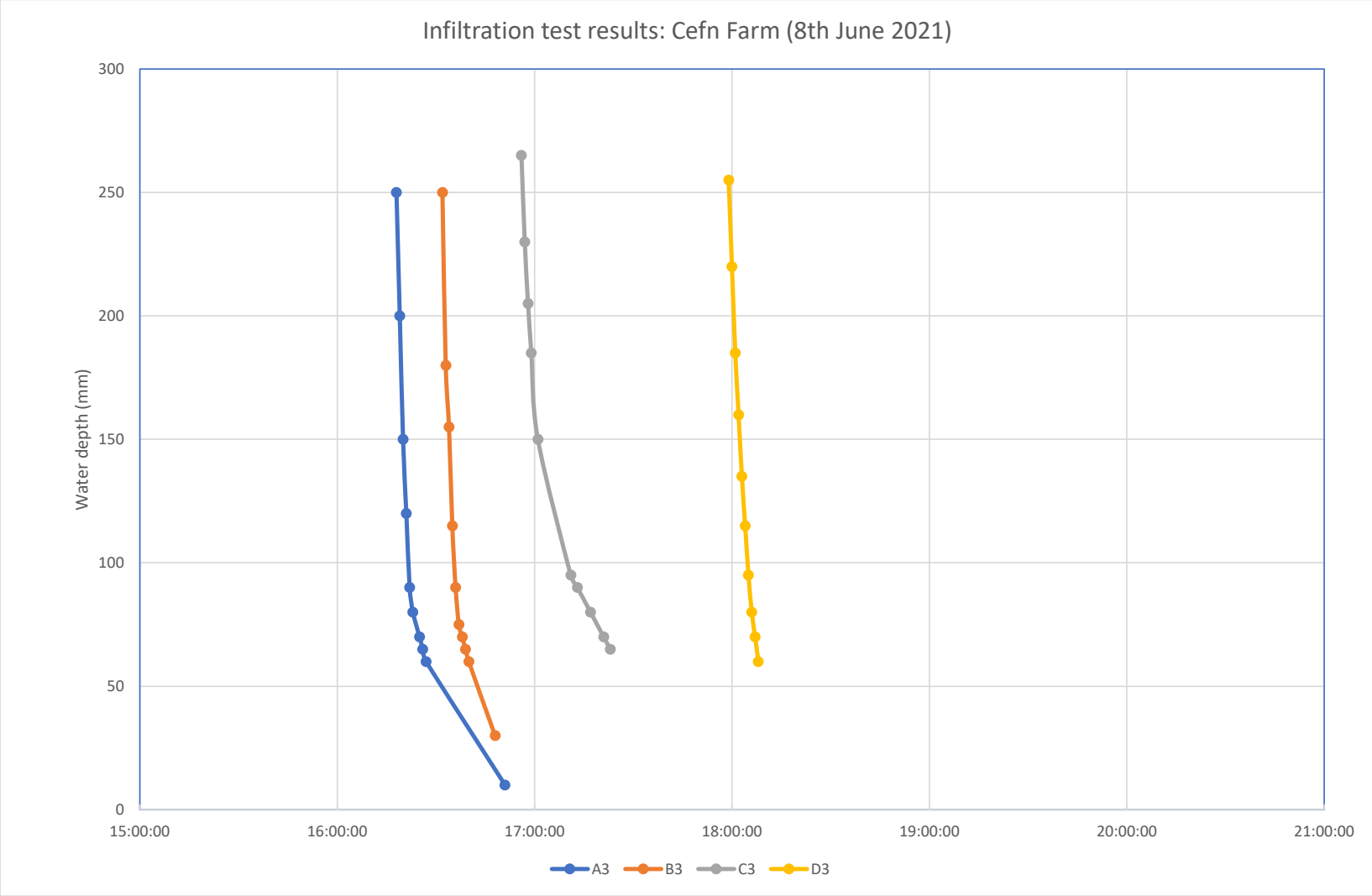


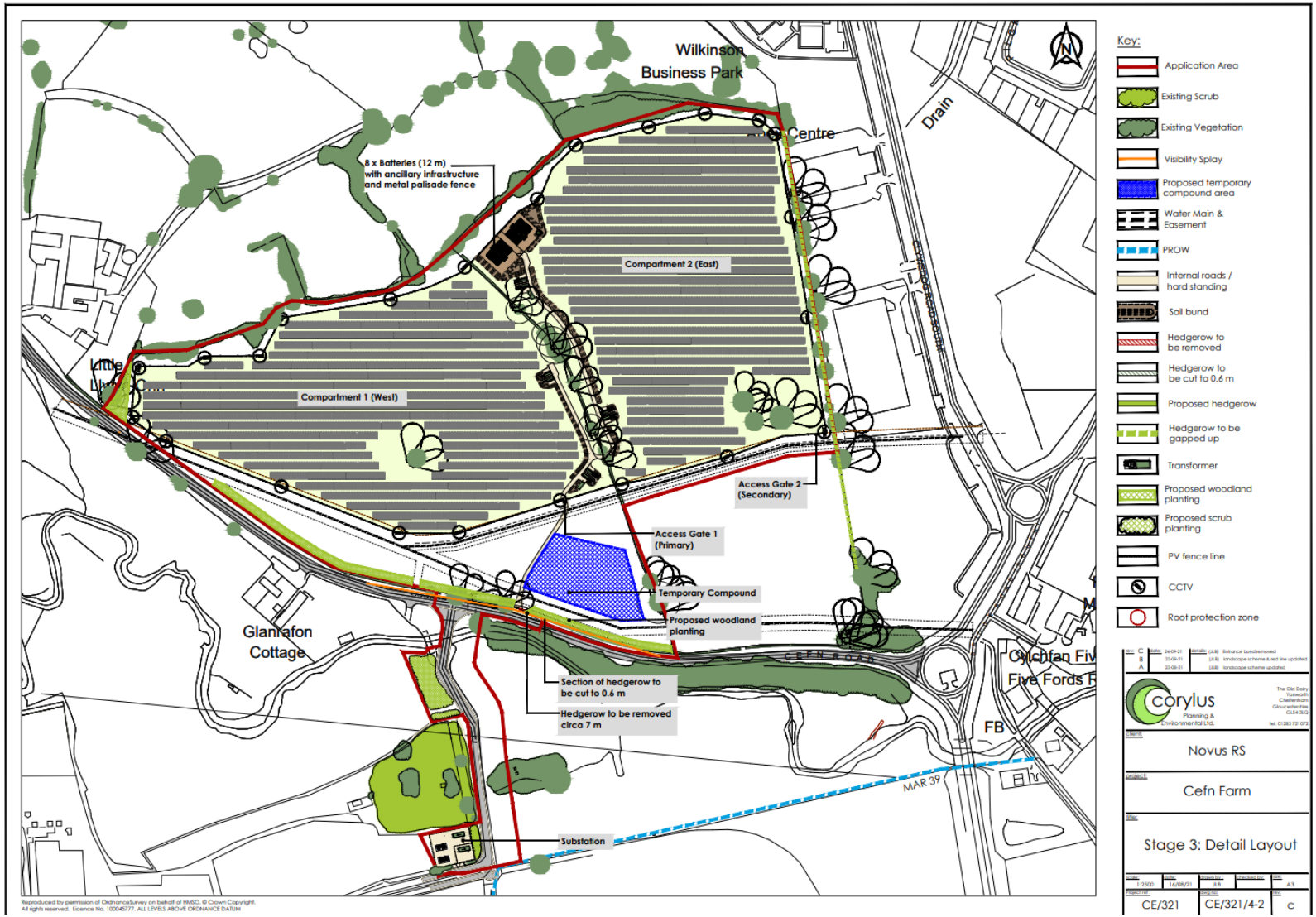
Table A-3: Infiltration test results (Test 3 on 8th June 2021)

Pit & Trial	**A3**		**B3**		**C3**		**D3**	
Length (mm)	270		260		280		260	
Width (mm)	300		270		280		290	
Start (0%)	20		50		25		5	
Base (100%)	270		300		290		260	
Range (mm)	250		250		265		255	
Volume (m3)	0.02025		0.01755		0.020776		0.019227	
Readings in mm below dip point								
1	20	16:18	50	16:32	25	16:56	5	17:59
2	70	16:19	120	16:33	60	16:57	40	18:00
3	120	16:20	145	16:34	85	16:58	75	18:01
4	150	16:21	185	16:35	105	16:59	*100*	18:02
5	180	16:22	210	16:36	140	17:01	125	18:03
6	190	16:23	225	16:37	195	17:11	145	18:04
7	200	16:25	230	16:38	200	17:13	165	18:05
8	205	16:26	235	16:39	210	17:17	180	18:06
9	210	16:27	240	16:40	220	17:21	190	18:07
10	260	16:51	270	16:48	225	17:23	200	18:08
Interpolation								
	70	16:19:00	50	16:32:00	85	16:58:00	40	18:00:00
	120	16:20:00	120	16:33:00	105	16:59:00	75	18:01:00
75% full (interp.)	82.5	16:19:15	112.5	16:32:54	91.25	16:58:19	68.75	18:00:49
	205	16:26:00	235	16:39:00	220	17:21:00	190	18:07:00
	210	16:27:00	240	16:40:00	225	17:23:00	200	18:08:00
25% full (interp.)	207.5	16:26:30	237.5	16:39:30	223.75	17:22:30	196.25	18:07:38
Calculation								
Level diff for 75% and 25% (mm)	125		125		132.5		127.5	
Time diff (s)	435.0		396.4		1451.3		408.2	
Vp (s) for 1 mm fall in WL	3.5		3.2		11.0		3.2	
f (m/s)	**9.58E-05**		**0.000105**		**3.04E-05**		**0.000104**	
f (mm/h)	**344.8**		**378.4**		**109.6**		**374.8**	

Figure A-5: Infiltration test results (Test on 8th June 2021)



Appendix B The Proposed Development (Drawing CE/321/4-2 Rev C, dated September 2021)



Appendix C Full Application Form

1. Applicant Details

Applicant Name and Address

Title and Name		
Company		Novus Renewable Services Limited
Suffix (unit/name/number)		
Address line 1		Craven House
Address line 2		16 Northumberland Avenue
Address line 3		
Town		London
County		
Postcode		WC2N 5AP
Phone number	**Mobile**	
	Works	
	Home	
e-mail address		

Agent Name and Address

Title and Name		Dr Paul Webster
Company		Corylus Planning and Environmental Ltd
Suffix (unit/name/number)		
Address line 1		The Old Dairy
Address line 2		Yanworth
Address line 3		
Town		Cheltenham
County		Gloucestershire
Postcode		GL54 3LQ
Phone number	**Mobile**	07748 187 110

	Works	01285 721 072
	Home	
e-mail address		

Preferred contact	~~Applicant~~	Agent

2. Site Details

A general description of site location supported by a plan specifying the construction area and the extent of the drainage system for which approval is sought MUST be submitted. Plans shall be at a scale of 1:2500. All plans MUST show the direction of North.

Name of proposed development	Solar Farm at Cefn Road

Grid Reference (E/N)	336822	348648
Suffix (unit/name/number)		
Address line 1		
Address line 2		
Address line 3		
Town		
County		
Postcode		

Description of proposed development	Installation of a solar park and battery storage facility with associated infrastructure
Total application site area (Ha)	14.5 ha
Is the existing site currently developed i.e. Brownfield or is it currently undeveloped i.e. Greenfield?	Undeveloped.
Existing use	Agricultural

Proposed use	Solar farm	
Does the site cross more than one SAB area?	Yes ☐	No ☒
If "Yes", please confirm the proportionate area in each SAB below: **(The main contact will be the SAB that has most of the surface water drainage system within its boundary.)**		
SAB	**% of Site Area**	

3. Interest in the Land

What interest do you have in the land?		
Owner	Yes ☐	No ☒
Prospective Owner	Yes ☐	No ☒
Other (please provide details)	Enabling planning approval	

4. Application

Has any prior advice been sought from the SAB about this application?			Yes ☐		No ☒
If Yes, please complete the following information about the advice you were given. This will help the SAB to deal with this application more efficiently.					
Officer Name					
Reference number	n/a	**Date**			

Details of pre-application advice received	

Does this application relate to any other SAB application already made?	Yes ☐	No ☒
If "Yes", please provide SAB Reference number		

Is this application part of a phased approach to development of the site, or one of multiple applications for the same site?	Yes ☐	No ☒
If "Yes", please provide brief details		

Is this application one of two or more applications made at the same time, each setting out an alternative proposal for construction of a drainage system	Yes ☐	No ☒
If "Yes", please provide details of other applications made at the same time (include SAB Reference number if available)		

5. Application Fee

It is recommended you contact the SAB directly to ensure the correct fee is paid with the application.

Item	Unit area	Nr.	Gross area	Unit	Comment
Battery	128.3	2	256.5	m2	To soakaway
ISO	9.9	1	9.9	m2	To soakaway
Substation comprising:					
Customer sub-station	29.6	1	29.6	m2	To soakaway
DNO sub-station	29.6	1	29.6	m2	To soakaway
DNO Transformers	39.6	2	79.1	m2	To soakaway
Transformer (pair)	73.5	2	147.0	m2	To soakaway
Transformer (pair)/ISO	92.4	2	184.7	m2	To soakaway
Sub-total: Impermeable			**736.4**	**m2**	
Compound			4016	m2	
Gravel around transformers etc			1956	m2	
Tracks			1200	m2	c400 m x 3m
Soil mounds			1500	m2	Approximate
Sub-total: Permeable			**8672.0**	**m2**	
Gross development			**9408.4**	**m2**	
Grand total			0.94	ha	
Add 10% contingency			1.03	ha	
Rounded up total			**1.1**	**ha**	

		Area of Land (Ha)	Fraction	Fees
Application fee		N/A	N/A	£350.00
Each 0.1ha or fraction of 0.1ha, for first 0.5ha	**£70.00**	0.5	1	£350.00
Each 0.1ha or fraction of 0.1ha, from 0.5ha up to and including 1ha	**£50.00**	0.5	1	£250.00
Each 0.1ha or fraction of 0.1ha, from 1ha up to and including 5ha	**£20.00**	0.1	.2	£20
Each additional 0.1ha or fraction of 0.1ha above 5Ha.	**£10.00**			
Is the applicant a town/community council?		If yes, application fee is half the amount		No

<u>If applicable</u> – reduction of 50% application fee due to this being an alternative proposal made at the same time.	
<u>If applicable</u> – application fee adjustment due to cross-SAB area approvals needed.	
Total Fees	£970.00

6. Environmental Impact Assessment (EiA) Statement

Does this application relate to a development that is the subject of an EiA application under the Town & Country Planning (Environmental Impact Assessment) (Wales) Regulations 2017(1)?	Yes ☐	No ☒

7. Compliance with Statutory National Standards for Sustainable Drainage Systems (SuDS)

All sustainable drainage systems <u>MUST</u> comply with the Statutory National Standards for Sustainable Drainage Systems (SuDS) for Wales. You are advised to refer to the detailed text in the Standards that relate to the information required below. The Standards are re-produced, in the Guidance to assist in completing this application form.

Standard Principles

The Principles listed below will underpin the design of surface water management schemes to meet the Statutory National Standards. Please provide a brief summary in each of the boxes below relating to each of the bulleted Standard Principles and itemised Standards 1 to 6, showing how your proposed drainage scheme complies with this statutory requirement.

Compliance with Standard Principles
My proposed surface water drainage scheme will comply in the following way/s:
Based on Section 2 (Principles) of the Sustainable Drainage Systems for Wales. • Manage water on or close to the surface and as close to the source of the runoff as possible; **YES**; • Treat rainfall as a valuable natural resource; **n/a** • Ensure pollution is prevented at source, rather than relying on the drainage system to treat or intercept it; **YES** • Manage rainfall to help protect people from increased flood risk, and the environment from morphological and associated ecological damage resulting from changes in flow rates, patterns and sediment movement caused by the development; **YES** • Take account of likely future pressures on flood risk, the environment and water resources such as climate change and urban creep; **YES** • Use the SuDS Management Train, using drainage components in series across a site to

achieve a robust surface water management system (rather than using a single "end of pipe" feature, such as a pond, to serve the whole development); **YES**
- Maximise the delivery of benefits for amenity and biodiversity; **n/a**
- Seek to make the best use of available land through multifunctional usage of public spaces and the public realm; **n/a**
- Perform safely, reliably and effectively over the design life of the development taking into account the need for reasonable levels of maintenance; **YES**
- Avoid the need for pumping where possible; **YES** and
- Be affordable, taking into account both construction and long term maintenance costs and the additional environmental and social benefits afforded by the system. **YES**

Relevant items of supporting information (e.g. evidence, technical documents, plans and drawings etc.), as shown in Table A and Table B of this Guidance **MUST** be listed below, and all relevant material submitted.

1. Surface Water Management Plan which is the main subject of this Report.
2. Appendices to this Report as cross-referenced in this SAB Report Appendix

Standards 1 to 6

Compliance with Standard S1 - Surface water runoff destination

My proposed surface water drainage scheme will comply in the following way/s:

Impermeable surfaces

The only new impermeable surfaces are at 6 locations (battery, substation plus 4 transformer "pairs") as shown in Appendix B. All runoff from these surfaces will be directed to soakaways and provide a "Priority Level 2" compliance. The sizing is shown in Section 3.3 for the soakaways.

The dimensions result from a critical duration analysis using the methodology in the CIRIA 753 UK SuDS Manual and the following assumptions:

- Flood Estimation Handbook point rainfall using FEH 2013.
- Annual probability of exceedance of 1% (1 in 100)
- Climate change allowance of +20% consistent with the 35-year design life
- Factor of Safety of 1.5 , consistent with "no damage or inconvenience" as per Table G1.1 (of Statutory Guidance)

Infiltration rates have been established from site-specific testing on an adjacent Site undertaken in accordance with BRE365 and described in Appendix A.

Runoff from solar panels

Our general experience relating to the **installation of solar panels** over many years is that there is no increase in runoff, except in specific circumstances. In general, and especially on flat sites (such as this one) runoff from solar panels is able to infiltrate into the soil either beneath the

panels, or under adjacent panels. This is aided by the rainwater gap between the panels as shown in Figure 2-9. On sites with steep slopes, especially where the panels align down the gradient, increased rates of runoff may occur and require mitigation. Since this is not the case for this site, **there is no requirement for any mitigation of runoff from solar panels.** This is supported by the observations on the existing solar site where there was no evidence of increased runoff or waterlogging under the panels (Figure 2-10).

Compound, soil mounds and access tracks

The compound and access tracks will be of permeable materials.

Relevant items of supporting information (e.g. evidence, technical documents, plans and drawings etc.), as shown in Table A and Table B of this Guidance **MUST** be listed below, and all relevant material submitted.

1. Drainage Strategy is part of the Surface Water Management Plan in this Report.
2. See Appendix B for locations of SuDS components
3. See Figure 3-2 for sizing of infiltration basins and Figure 3-3 for cross-sections.

Compliance with Standard S2 - Surface water runoff hydraulic control

My proposed surface water drainage scheme will comply in the following way/s:

It is demonstrated that the soakaways can deal with runoff from proposed impermeable surfaces,

Relevant items of supporting information (e.g. evidence, technical documents, plans and drawings etc.), as shown in Table A and Table B of this Guidance **MUST** be listed below, and all relevant material submitted.

1. Descriptions and calculations in Section 3.3 and cross-sections in Figure 3-3.

.

Compliance with Standard S3 – Water Quality

My proposed surface water drainage scheme will comply in the following way/s:

There is a very low pollution hazard level associated with this development. For the solar panels, there is not expected to be any increase in runoff due to the panels with any runoff subject to natural processes.

The impermeable surfaces are distributed across the Site. Runoff from them is expected to pose a very low pollution hazard, consistent with “residential rooves”. In any case, the runoff will be directed to infiltration systems, designed for the 1% annual probability storm, plus allowance for climate change, with very low probability of surcharge.

Relevant items of supporting information (e.g. evidence, technical documents, plans and drawings etc.), as shown in Table A and Table B of this Guidance **MUST** be listed below, and all relevant material submitted.
1. N/a 2. .

Compliance with Standard S4 – Amenity
My proposed surface water drainage scheme will comply in the following way/s:
The proposed soakaways will have limited amenity value, being formed from the proposed road infrastructure (gravel to a depth of 0.3 m).
Relevant items of supporting information (e.g. evidence, technical documents, plans and drawings etc.), as shown in Table A and Table B of this Guidance **MUST** be listed below, and all relevant material submitted.
1. Ecological Impact Assessment for proposed Solar Park and Battery Storage Facility at Cefn Road, east of Wrexham (Cefn Road, Abenbury, Pentre Maelor, Wrexham, Wales, LL13 0PX). (Report in preparation).

Compliance with Standard S5 – Biodiversity
My proposed surface water drainage scheme will comply in the following way/s:
See response on S4 Amenity.
Relevant items of supporting information (e.g. evidence, technical documents, plans and drawings etc.), as shown in Table A and Table B of this Guidance **MUST** be listed below, and all relevant material submitted.
1. See response on S4. Amenity.

Compliance with Standard S6 – Design of drainage for Construction and Maintenance and Structural Integrity
My proposed surface water drainage scheme will comply in the following way/s:
The most important consideration for construction is that the ground conditions are appropriate i.e. not waterlogged. Construction will be programmed to avoid parts of the site where soils may be wet and when working could exacerbate sediment runoff. A Construction and Environment Management Plan has been included as Appendix D.
Relevant items of supporting information (e.g. evidence, technical documents, plans and drawings etc.), as shown Table A and Table B of this Guidance **MUST** be listed below, and all

relevant material submitted.
1. Construction Environmental Management Plan as Appendix D.

8. Assessment of Flood Risk

Is the site within an area at risk of flooding? Refer to Natural Resources Wales Development Advice maps. (Natural Resources Wales / Development and flood risk)	Yes ☒	No ☐
If the proposed development is within the area at risk of flooding, you will need to consider whether it is appropriate to submit a flood consequences assessment. (Refer to Technical Advice Note 15 (TAN15).		

Is the site located within an area susceptible to surface water flooding? Refer to NRW Surface Water Flood Maps.	Yes ☐	No ☒
Is the site located within an area susceptible to groundwater flooding?	Yes ☐	No ☒
Is there a watercourse (as defined under Section 72 Land Drainage Act 1991) **located within 20m of the proposed development?**	Yes ☐	No ☒

9. Surface Water Discharge Hierarchy

Surface water drainage arrangements shall demonstrate the proposed surface water drainage complies with National SuDS Standards. As much of the runoff as possible should be discharged to each hierarchy element before a lower hierarchy element is considered. Collection and infiltration methods of drainage are required to be considered in the first instance. With reference to the hierarchy levels below, please indicate your proposed drainage arrangements.

Level	Yes	No
1. Collect for use	☐	☒
2. Infiltration	☒	☐

3. To watercourse	☐	☒
a. Is it an Ordinary Watercourse?	☐	☐
b. Is it a Main River?	☐	☐
4. To surface water sewer	☐	☒
a. Is it a Highway drain?	☐	☐
b. Is it a public sewer?	☐	☐
c. Is it a private sewer?	☐	☐
d. Other	☐	☐
5. To combined sewer	☐	☒

Has advice been sought from the asset owners?	Yes ☐	No ☒
Has advice been sought from the landowners?	Yes ☒	No ☐

10. Infiltration Assessment

Where infiltration drainage is proposed, testing should be carried out to a methodology agreed with the SAB e.g. Infiltration Drainage - Manual of Good Practice (CIRIA R156) and BRE Soakaway Design (DG 365 – 2016), and be used to inform the design, construction, maintenance, testing and assessment of infiltration systems.

Has infiltration testing been carried out?		Yes ☒	No ☐	
Analysis of development Geology (including both bedrock and superficial deposits where known)		See Section 2.3 and Appendix A		
Depth to groundwater (metres)		None to depth of 1.05 m BGL using hand auger		
Borehole testing	**Reference**			
	Date	18	11	20

Has a Contaminated Land Assessment been undertaken?	Yes ☐	No ☒
Is the infiltration drainage proposed on contaminated land?	Yes ☐	No ☒

Infiltration test result	Tests at 4 locations with results in Section A.3 and 2.3

11. Non-performance Bond, Adoption, Operation & Maintenance

What are your proposals regarding cost of works, adoption and maintenance of the SuDS scheme?

Non-performance Bond – Estimated cost of work	SUDS Scheme will not incur any additional costs.
Adoption (including land agreements etc)	N/a
Funded Maintenance Plan for the lifetime of the development	Maintenance will be undertaken at negligible marginal cost alongside other routine maintenance activity.

12. SuDS Scheme Application Checklist

Please complete the following checklist and make sure you have read the Guidance on Making SuDS Applications for SAB Approval, the Guidance on completing the Full Application Form, and provided all the necessary information in support of your application:	
Correct Full Application fee.	Yes ☒
Completed, signed and dated Full Application form.	Yes ☒
Plan/s specifying the construction area and the extent of the drainage system for which approval is sought. All plan/s shall be at a scale of 1:2500 and MUST show the direction of North.	Yes ☒
Taken account of SAB Guidance on technical information to be submitted to enable SAB to assess your Full Application.	Yes ☒

13. Declaration

I/ we hereby apply for SuDS Approval as described in this form and the accompanying plans/drawings and additional information. I confirm that I have read and complied with the National SuDS Standards and, to the best of my knowledge, any facts stated are true and accurate and any opinions given are the genuine opinions of the persons giving them.

This form has been completed using evidence from the Flood Consequences Assessment where applicable, surface water drainage strategy and site plans and associated documents.

This form has been completed using accurate information. It can be used as a summary of the detailed surface water drainage proposals on this site, and clearly shows that these drainage proposals conform to the National SuDS Standards for Wales.

Form completed by	Dr P Webster
Signature	*P Webster*
Qualification of person responsible for signing off this application	BSc, DIC, MSc, PhD, FCIWEM, C.WEM
Company	Corylus Planning and Environmental Ltd
On behalf of (Client's details)	Novus Renewables Services Limited
Date	7th October 2021

Disclaimer

Information provided on this form and in supporting documents may be published on the SABs SuDS register and website and be made publicly available.

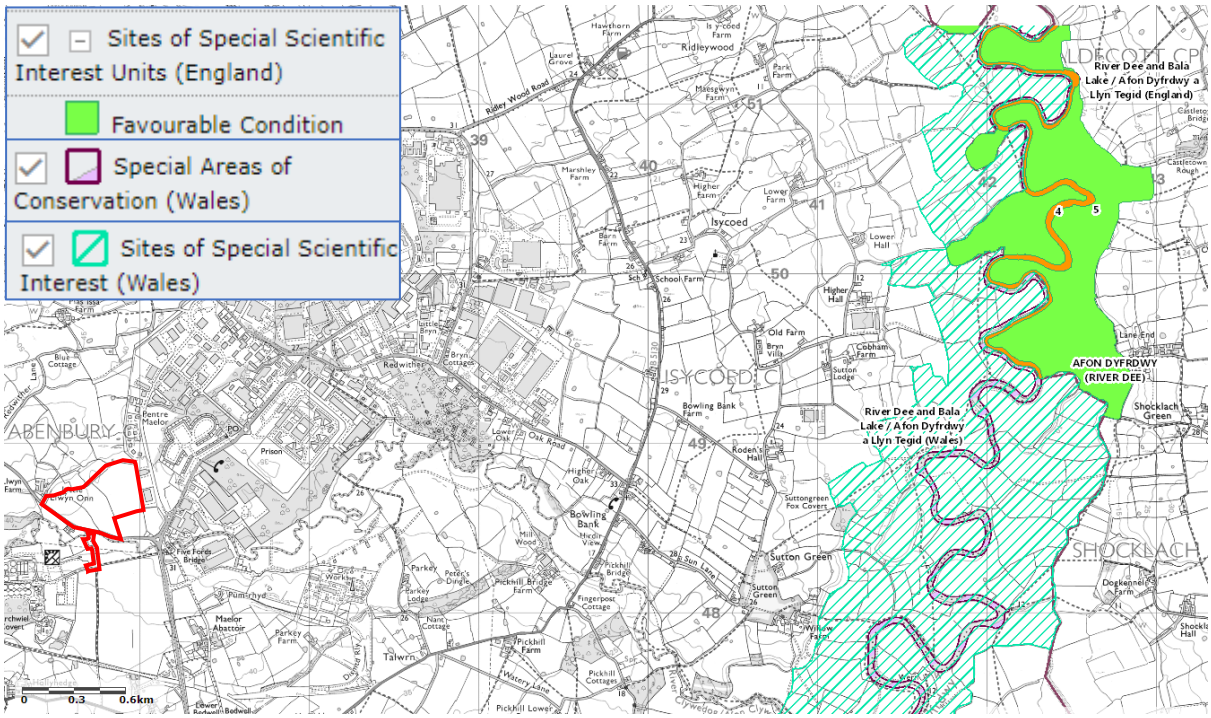
Appendix D Construction and Environment Management Plan

D.1 Introduction

This Appendix provides a CEMP for the proposed solar farm. The specific context for the CEMP follows from the designations in the vicinity of the Site. An approximate site boundary has been superimposed on a MAGIC map extract in Figure D-1. Since the River Clywedog, which flows adjacent to the Site is a tributary of the River Dee, there is a potential pathway from the Site that may impact upon the River Dee and Bala Lake SAC (Special Area of Conservation), and SSSI in England and Wales.

In view of the potential pathways from Site to these areas, consideration is clearly required of the potential impacts and any mitigation.

Figure D-1: Location of SAC &SSSI in relation to Site



https://magic.defra.gov.uk/magicmap.aspx

D.2 Potential Pollution Pathways to Watercourses and Protection

The watercourses relevant to the Site are described in Section 2 and Section 3 of the Main Report. They comprise:

- The River Clywedog flowing broadly eastwards on the southern limit of the Site; and
- A small riparian watercourse (ditch) flowing south through the Site and outfalling to the River Clywedog.

The **Potential Pollution Pathways** have been annotated on Figure 3-4. They have been drawn mainly on the basis of topography and as such, most arrows are orthogonal to the general contours i.e. downslope. The Site investigations, described in Appendix A confirmed that the soils had good infiltration properties. The rates of runoff from the Site are therefore expected to be low, even under wet conditions. The annotated flow paths thus represent an extreme situation; generally, rainfall would be expected to infiltrate at or near where it fell.

The mitigation measures for drainage are outlined in Section 3.3 of the Main Report, comprising soakaways adjacent to all proposed impermeable surfaces. These correspond with gravelled areas with a depth of 0.3 m and which it has been demonstrated can provide highly effective soakaways. It is not considered that any further mitigation is needed for other features of the completed development; this being based on the observations from a nearby solar site which provides a helpful analogue.

The principal risk during construction relates to ground conditions. The physical nature of the construction is considered to be very modest. Specifically, this will entail the installation of pile supports for the solar arrays and the excavation of shallow cable trenches. Such activity can be undertaken with small vehicles. The topography and soils mean that parts of the site may be prone to waterlogging during winter months. The construction should avoid working during or following periods of prolonged rainfall.

The drainage features should be constructed **prior to any other works**. This will both provide the mitigation for storms during the construction period and ensure that there is no possible conflict with the land required for the SuDS components.

The stripped soil should be placed with minimal compaction in the soil storage area. Whilst regrowth of grass is likely, given the source material, reseeding should be undertaken of bare patches to minimise runoff of water and silt from the soil mound. The soil mound is located on a relatively flat part of the Site which will help to mitigate any runoff (water and silt) from the soil mound.

D.3 Construction Method Statement / Construction Health and safety plan

(a) General

Prior to works beginning on site, a Construction Method Statement would be put in place to govern activity on site. Included within this will be information on the proper transportation, handling and storage of all materials, incident response plans and reporting instructions. Construction best practice will be applied and a site-specific environmental checklist will be completed prior to any works commencing on site.

(b) Construction Plant

All machinery comes with a maintenance certificate / condition report showing it is fit for service. There are also daily condition checks to ensure machinery is suitable for use. Any road going vehicle coming on site for deliveries or bringing personnel will have an MoT.

Site personnel will be aware of the Incident response plan for the site. Spill kits are available on site and any incidents will be reported to site management and to the relevant authority if necessary.

The risk of leaks or spill from machinery on site is low. There may, however, be a requirement to have oil or fuel available on site for machinery refuelling, these will be stored in bunded tanks to prevent any spillage into the ground and any refuelling will take place with a drip tray. (See full detail below).

(c) Oil, Fuel and Liquid Chemical Storage

The storage of all oil/fuel containers with a capacity of 200 l or more will comply with the requirements of the Control of Pollution (Oil Storage) regulations. Generally, this means that:

- Oil drums are to be stored on proprietary secondary containment systems that will contain 110% of the contents of the largest container, or 25% of the total, whichever is greater. These are to be protected to minimise the ingress of rainwater and secured against unauthorised discharge.
- All bulk storage tanks are to be integrally bunded proprietary tanks. The tanks are to be located within the compound area of the site, away from general traffic movements and a minimum of 10m from any surface water drain, stream or other water course and secured against unauthorised discharge.
- Only authorised personnel will be issued with a key to the bulk storage tanks for refuelling machinery. When refuelling, the operator must remain in attendance at all times.
- All personnel will be inducted into the Site Incidence Response Plan and the Site Manager is to be notified of all spillages, however minor.
- Spill kit(s) will be available on site and site personnel informed of its location during induction.
- Oils and other chemicals, in containers with a capacity of less than 200ltrs, will be stored within a locked store on either on impervious floor or drip trays. Only authorised personnel will be issued with a key to this store.
- The location of any fuel/oil storage areas and procedures must be agreed with Site Management prior to any deliveries. No storage will be permitted within 10 m of any stream or surface water drains.

D.4 Monitoring of Water Quality

With the limited nature of the construction activity and the precautionary measures that are proposed, it is not considered necessary to undertake any formal monitoring of water quality. However, since the only viable source of pollution would be from surface runoff into adjacent watercourses, then a regular programme of **daily observation** should be undertaken. Since the background water quality is good (i.e. clear water), then the impacts of any pollution should be evident from turbidity and cloudiness in the water being observed.

The key locations where observations would be made would be:

- A – the ditch that flows south through the Site at a location adjacent to the proposed battery store;
- B - the point where the ditch that flows south through the Site, leaves the Site; and

- C – the bridge where the access road to the Sewage Treatment Works crosses the River Clywedog .

A proforma for recording observations is offered in Table D-1. It would be incumbent upon the construction team to immediately identify the source of any pollution and to take such action as necessary to stop it. The incident should also be reported to NRW via the Hotline.

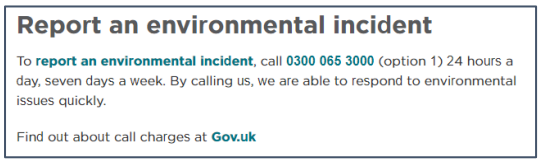


Table D-1: Proforma for recording surface water quality

Date	
Time	
Observer	
Weather Conditions	

A – ditch adjacent to Battery Store	
Observation	**Action**
B – Ditch where it leaves the Site	
Observation	**Action**
C – River Clywedog at road bridge to sewage treatment works	
Observation	**Action**

Signed: ……..

D.5 Operational Considerations

(a) Battery Stores

Li-ion batteries have been proposed, and the chemical makeup and design makes discharge/leak of the electrolyte very low risk. Individual battery cell architecture comprises the anode, cathode and electrolyte all wrapped up in sealed metal casings. Many individual cells are arranged into a module with cooling and management systems all in a further housing. The modules are secured in racking

systems within adapted 40ft metal shipping containers, therefore risk of discharge into the ground is very low.

There is no greater risk anticipated in the installation phase. Battery containers arrive on site with the modules already secured inside ready for connection, so there is no storage or handling of modules.

(b) Cleaning of panels

Panels require occasional cleaning. This is done with de-ionised water with no harmful impact upon the environment.

D.6 Summary

This Appendix provides a CEMP for the proposed construction of a solar farm and associated infrastructure at Cefn Farm, east of Wrexham (Cefn Road, Abenbury, Pentre Maelor, Wrexham, Wales, LL13 0PX). The main findings are as follows:

i. The sensitivity of the scheme is triggered by the proximity to areas designated as SSSI and SAC associated with the River Dee.
ii. There are two hydrological receptors comprising the River Clywedog and a watercourse/agricultural ditch flowing through the Site.
iii. The theoretical pollution pathways follow the topographic gradient within and away from the Site. The mitigation measures for the proposed impermeable areas would mitigate runoff of water and silt from areas of hardstanding.
iv. A Construction Method Statement / Construction Health and safety plan will be prepared, as outlined in Section D.3 and dealing with the Construction plant and the storage of oils and chemicals on the Site.
v. Construction of the required solar arrays requires relatively small vehicles and intervention. However, the construction should avoid periods when the fields may be waterlogged in winter.
vi. Whilst formal monitoring of water quality is not required, a programme of daily inspection at three specific locations will be undertaken.

Planning

Landscape

Architecture

Hydrology

Ecology