

Appendix J – Drainage Strategy Addendum (Part 2)



Appendix D REFH2 Greenfield Runoff Rates

DOCUMENT VERIFICATION RECORD	
Project:	Sperberry Hill Solar
Client:	Axis P.E.D Ltd
Report Title:	Drainage Strategy Addendum- Resubmission Scheme
Date:	18/10/2024

DOCUMENT REVIEW & APPROVAL	
Author:	Jessica Joy BSc (Hons) MCIWEM
Checker:	Aled Williams BSc (Hons) MCIWEM C.WEM
Approver:	Nigel Jones BEng (Hons) CEng MICE

ReFH2 RUNOFF RATES*	
Return Period (Years)	As-rural Peak Flow (l/s)
1	0.316465
2	0.375336
5	0.563337
10	0.694902
30	0.907205
50	1.013055
75	1.103333
100	1.172343
200	1.364552
1000	2.184445

*Runoff Rates printed from the ReFH Flood Modelling software package

Appendix E MicroDrainage Simulation

Waterco Ltd				Page 1		
Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ		14855-Sperberry Hill Solar 1 in 100 Year + 40% CC				
Date 26/09/2024 File 1 in 100 Year + 40% CC-...		Designed by JJ Checked by AW				
XP Solutions		Source Control 2020.1.3				
Summary of Results for 100 year Return Period (+40%)						
Storm Event		Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer		9.341	0.341	0.8	174.1	0 K
30 min Summer		9.443	0.443	0.8	225.9	0 K
60 min Summer		9.547	0.547	0.8	279.2	0 K
120 min Summer		9.688	0.688	0.8	350.7	0 K
180 min Summer		9.769	0.769	0.9	392.3	Flood Risk
240 min Summer		9.823	0.823	0.9	419.9	Flood Risk
360 min Summer		9.889	0.889	0.9	453.4	Flood Risk
480 min Summer		9.926	0.926	1.0	472.4	Flood Risk
600 min Summer		9.949	0.949	1.0	484.1	Flood Risk
720 min Summer		9.964	0.964	1.0	491.6	Flood Risk
960 min Summer		9.979	0.979	1.0	499.1	Flood Risk
1440 min Summer		9.983	0.983	1.0	501.5	Flood Risk
2160 min Summer		9.971	0.971	1.0	495.1	Flood Risk
2880 min Summer		9.952	0.952	1.0	485.3	Flood Risk
4320 min Summer		9.918	0.918	1.0	468.3	Flood Risk
5760 min Summer		9.903	0.903	1.0	460.4	Flood Risk
7200 min Summer		9.901	0.901	1.0	459.5	Flood Risk
8640 min Summer		9.908	0.908	1.0	462.8	Flood Risk
10080 min Summer		9.920	0.920	1.0	469.2	Flood Risk
Storm Event		Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Summer		139.709	0.0	69.3	16	
30 min Summer		90.815	0.0	62.6	31	
60 min Summer		56.298	0.0	126.6	62	
120 min Summer		35.564	0.0	132.8	122	
180 min Summer		26.666	0.0	140.1	182	
240 min Summer		21.520	0.0	144.6	242	
360 min Summer		15.653	0.0	149.5	362	
480 min Summer		12.357	0.0	151.8	482	
600 min Summer		10.234	0.0	152.9	602	
720 min Summer		8.748	0.0	153.3	722	
960 min Summer		6.797	0.0	152.9	962	
1440 min Summer		4.740	0.0	149.7	1442	
2160 min Summer		3.310	0.0	293.3	2160	
2880 min Summer		2.580	0.0	289.6	2880	
4320 min Summer		1.848	0.0	278.7	3848	
5760 min Summer		1.481	0.0	539.6	4560	
7200 min Summer		1.265	0.0	536.8	5336	
8640 min Summer		1.123	0.0	533.7	6144	
10080 min Summer		1.024	0.0	525.9	7056	
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XP Solutions		Source Control 2020.1.3			
Summary of Results for 100 year Return Period (+40%)					
Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	9.341	0.341	0.8	174.1	0 K
30 min Winter	9.443	0.443	0.8	225.9	0 K
60 min Winter	9.547	0.547	0.8	279.2	0 K
120 min Winter	9.688	0.688	0.8	350.7	0 K
180 min Winter	9.769	0.769	0.9	392.4	Flood Risk
240 min Winter	9.824	0.824	0.9	420.1	Flood Risk
360 min Winter	9.890	0.890	0.9	453.7	Flood Risk
480 min Winter	9.927	0.927	1.0	472.8	Flood Risk
600 min Winter	9.950	0.950	1.0	484.7	Flood Risk
720 min Winter	9.965	0.965	1.0	492.4	Flood Risk
960 min Winter	9.981	0.981	1.0	500.2	Flood Risk
1440 min Winter	9.987	0.987	1.0	503.3	Flood Risk
2160 min Winter	9.977	0.977	1.0	498.1	Flood Risk
2880 min Winter	9.960	0.960	1.0	489.8	Flood Risk
4320 min Winter	9.930	0.930	1.0	474.5	Flood Risk
5760 min Winter	9.908	0.908	1.0	462.9	Flood Risk
7200 min Winter	9.903	0.903	1.0	460.6	Flood Risk
8640 min Winter	9.905	0.905	1.0	461.5	Flood Risk
10080 min Winter	9.912	0.912	1.0	465.0	Flood Risk
Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)	
15 min Winter	139.709	0.0	69.3	16	
30 min Winter	90.815	0.0	62.6	31	
60 min Winter	56.298	0.0	126.6	62	
120 min Winter	35.564	0.0	132.8	122	
180 min Winter	26.666	0.0	140.0	180	
240 min Winter	21.520	0.0	144.5	240	
360 min Winter	15.653	0.0	149.3	358	
480 min Winter	12.357	0.0	151.6	478	
600 min Winter	10.234	0.0	152.6	596	
720 min Winter	8.748	0.0	152.9	714	
960 min Winter	6.797	0.0	152.3	950	
1440 min Winter	4.740	0.0	148.8	1414	
2160 min Winter	3.310	0.0	292.2	2100	
2880 min Winter	2.580	0.0	288.2	2772	
4320 min Winter	1.848	0.0	276.8	4064	
5760 min Winter	1.481	0.0	537.9	4672	
7200 min Winter	1.265	0.0	535.5	5552	
8640 min Winter	1.123	0.0	532.6	6488	
10080 min Winter	1.024	0.0	525.1	7464	
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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	14855-Sperberry Hill Solar 1 in 100 Year + 40% CC	
Date 26/09/2024 File 1 in 100 Year + 40% CC-...	Designed by JJ Checked by AW	
XP Solutions Source Control 2020.1.3		

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location GB 520762 226234 TL 20762 26234	
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	1.000
Cv (Winter)	1.000
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.500

Time (mins)	Area
From:	To: (ha)
0	1 0.500

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XP Solutions	Source Control 2020.1.3	

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	510.0	1.000	510.0

Hydro-Brake® Optimum Outflow Control

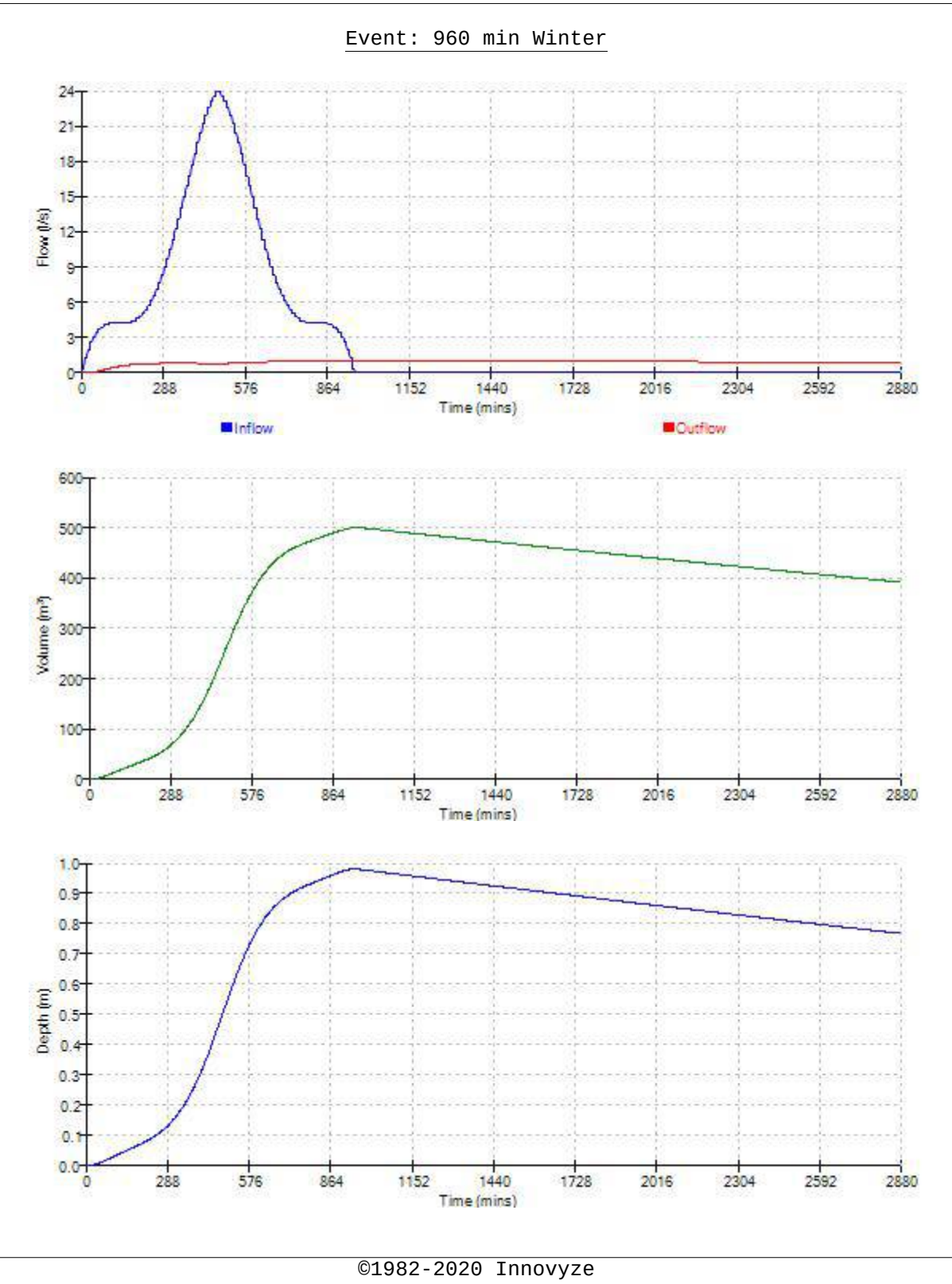
Unit Reference	MD-SHE-0047-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.0
Flush-Flo™	0.205	0.8
Kick-Flo®	0.415	0.7
Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

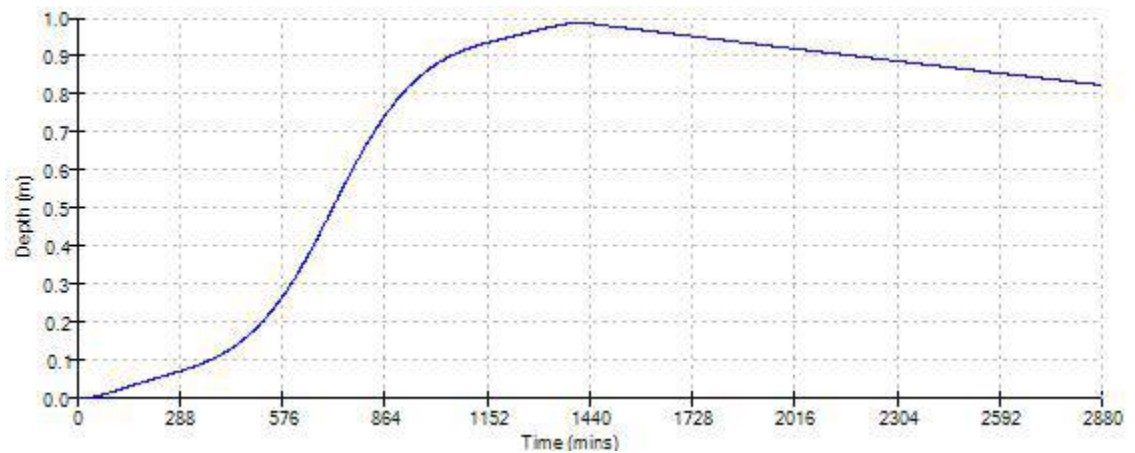
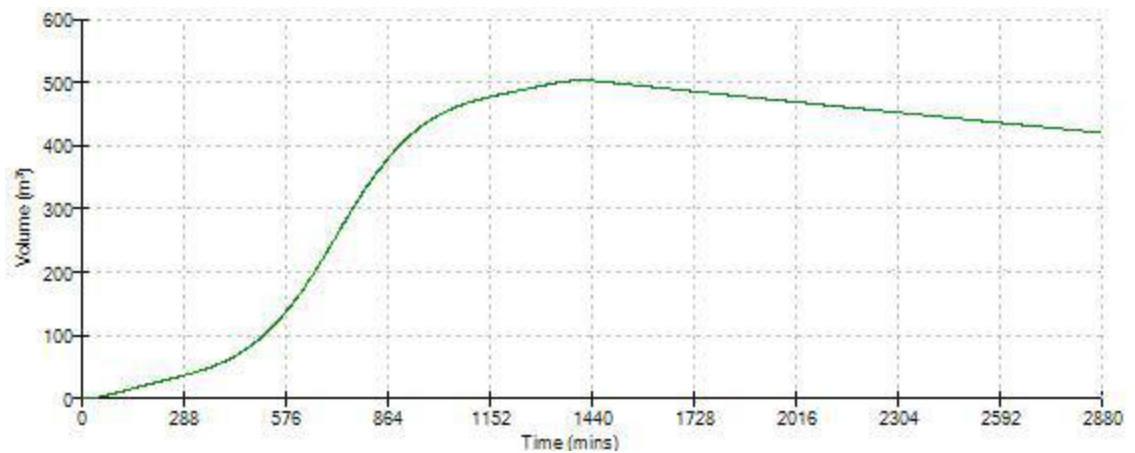
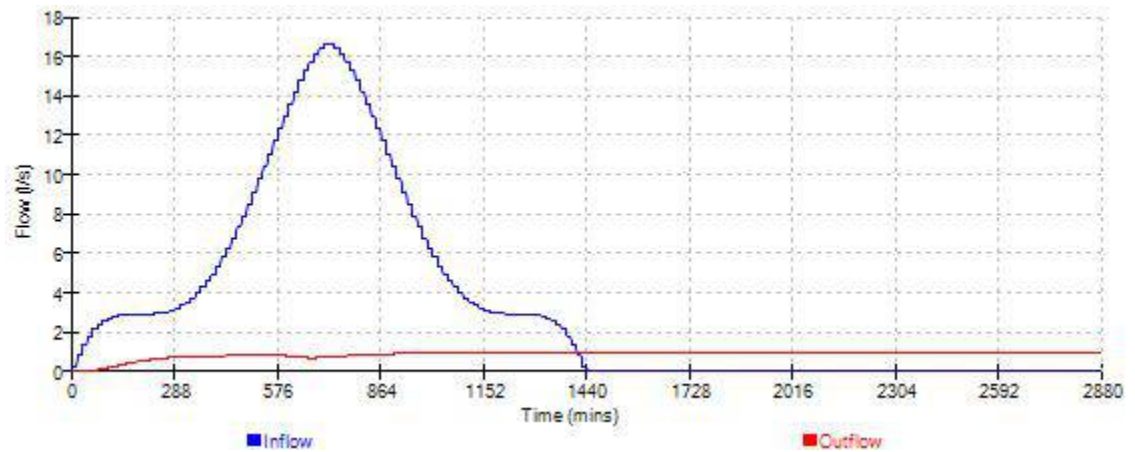
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.600	1.2	5.000	2.1
0.200	0.8	1.800	1.3	5.500	2.2
0.300	0.8	2.000	1.4	6.000	2.3
0.400	0.7	2.200	1.4	6.500	2.3
0.500	0.7	2.400	1.5	7.000	2.4
0.600	0.8	2.600	1.5	7.500	2.5
0.800	0.9	3.000	1.6	8.000	2.6
1.000	1.0	3.500	1.8	8.500	2.7
1.200	1.1	4.000	1.9	9.000	2.7
1.400	1.2	4.500	2.0	9.500	2.8

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Eden Court Lon Parcwr Business Park Denbighshire LL15 1NJ	14855-Sperberry Hill Solar	
	1 in 100 Year + 40% CC	
Date 26/09/2024	Designed by JJ	
File 1 in 100 Year + 40% CC-...	Checked by AW	
XP Solutions	Source Control 2020.1.3	



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Date 26/09/2024 File 1 in 100 Year + 40% CC-...	Designed by JJ Checked by AW	
XP Solutions	Source Control 2020.1.3	

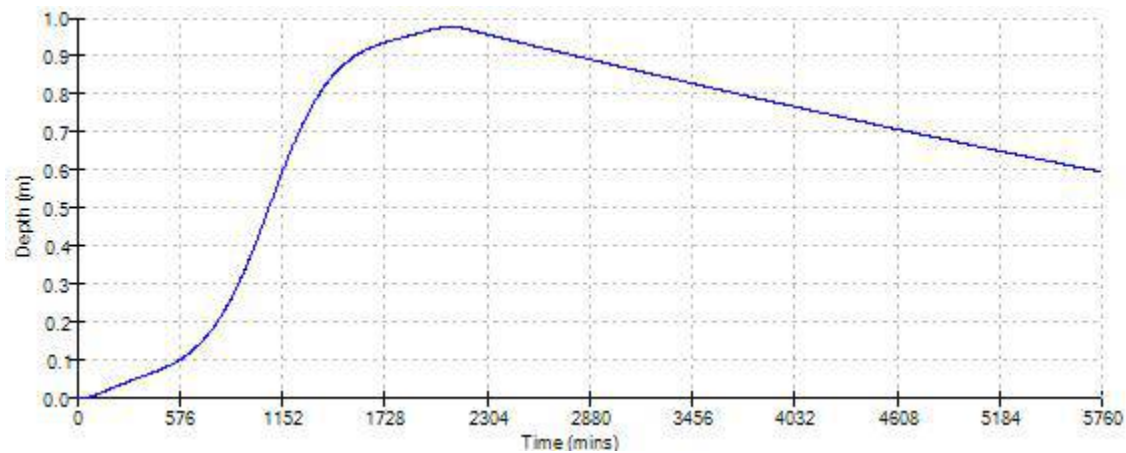
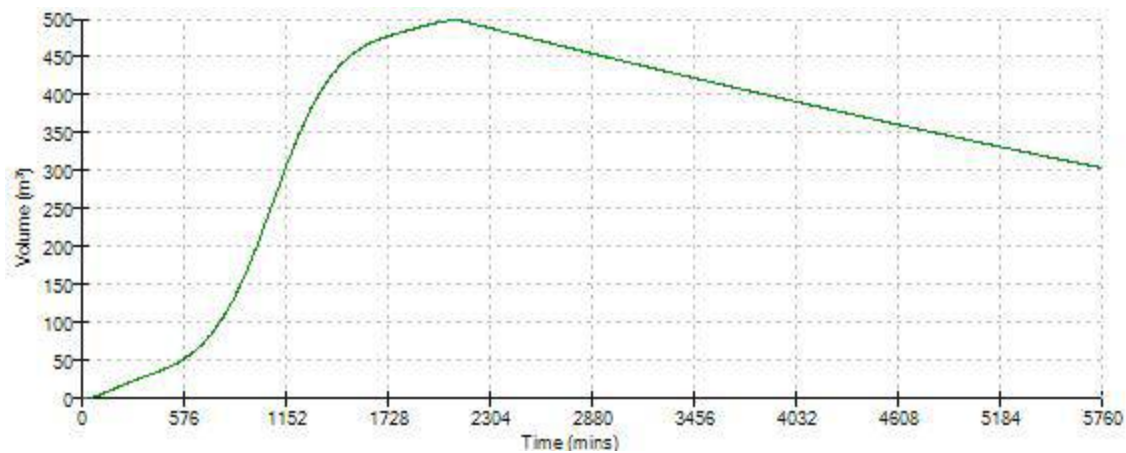
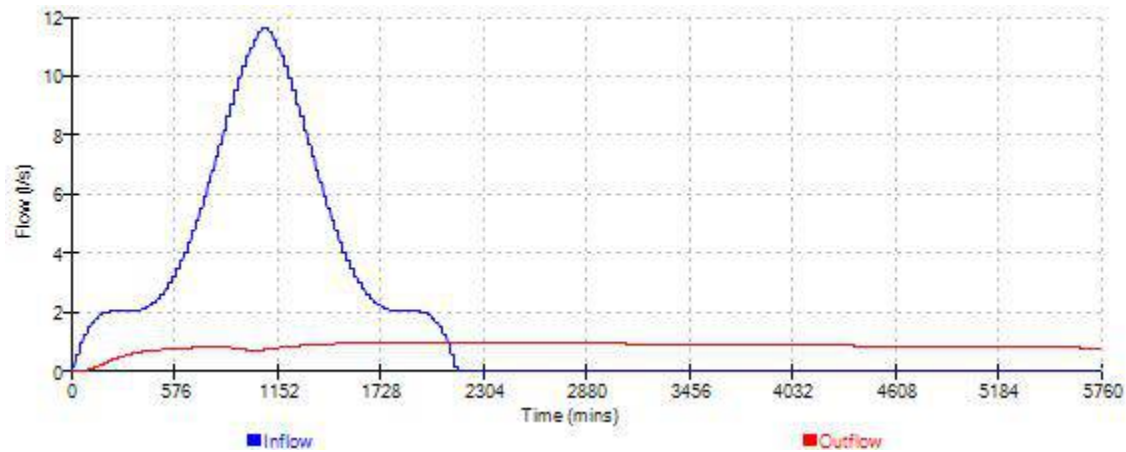
Event: 1440 min Winter



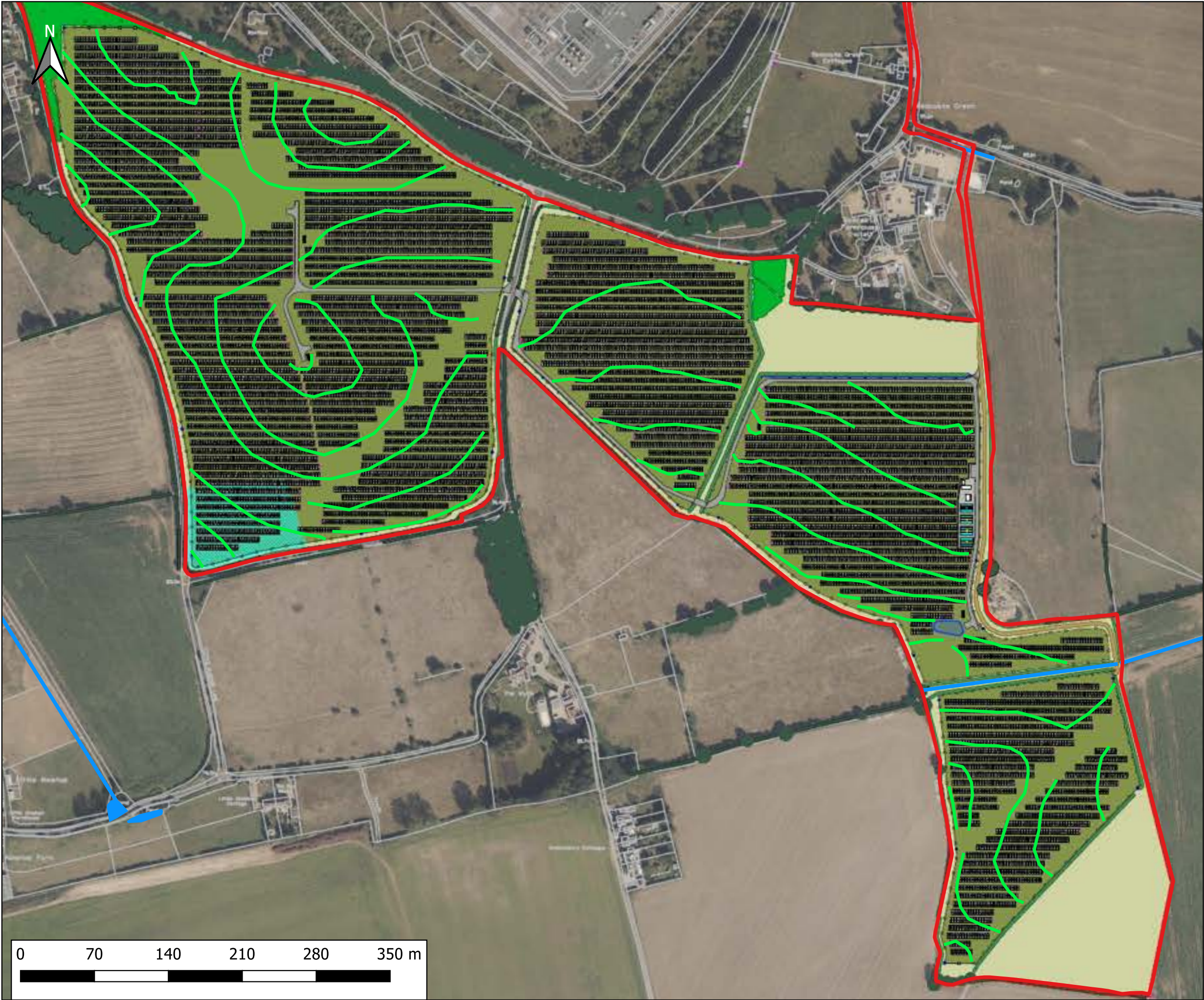
Waterco Ltd		Page 7
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Date 26/09/2024 File 1 in 100 Year + 40% CC-...		Designed by JJ Checked by AW
XP Solutions		Source Control 2020.1.3



Event: 2160 min Winter



Appendix F Concept Drainage Sketch

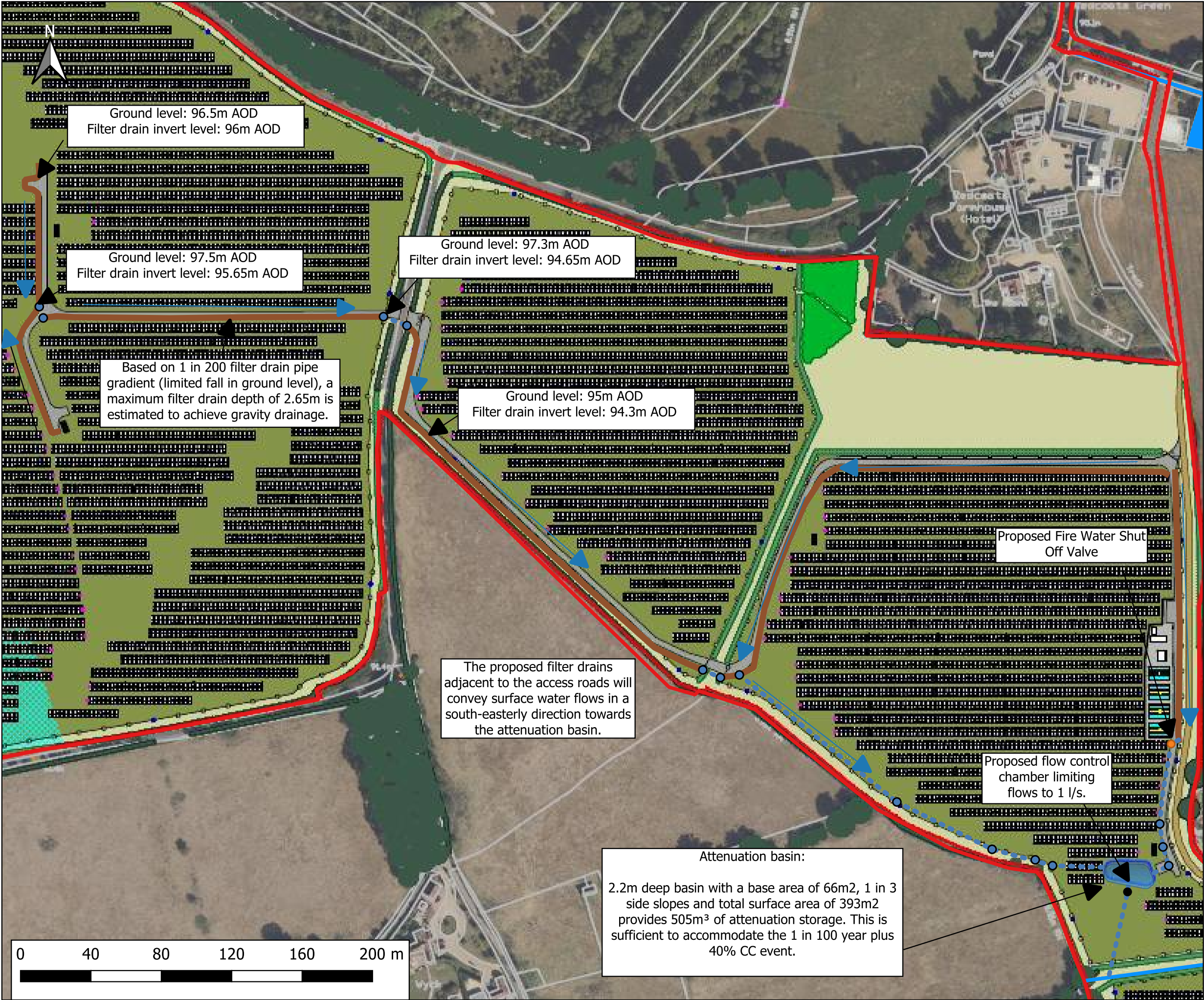


Notes:
1) This sketch has not been subject to formal checks or approvals. Its validity and use must therefore be limited to discussion and information purposes only.
2) Unless otherwise noted the risks associated with this proposal are not considered to be extra ordinary and within the remit of an experienced and competent contractor.
3) All dimensions in millimetres and all levels in metres above ordnance datum unless shown otherwise.
4) This drawing is an ammendment of the 'Landscape Masterplan' by 'Axis P.E.D'. This drawing provides a concept only and is not intended for detailed design.

LEGEND

- ▮ Site boundary
- ▮ Existing Waterbodies
- ▮ Existing Watercourses
- ▮ Filter Drains to be placed at frequent intervals along contours and around transformer substations (approx 300mm deep x 500mm wide).

CLIENT:				Axis P.E.D Ltd	
				 www.waterco.co.uk	
SCHEME:				Sperberry Hill Solar	
PLOT TITLE:				Surface Water Erosion Control Measures	
PLOT STATUS:		SKETCH		DATE:	17-10-2024
DRAWN:	JJ	CHECKED:	AW	APPROVED:	MW
				PLOT SCALE AT A3:	1:3500
PLOT NAME:					REVISION:
14855_Concept_Drainage_Sketch					01



Notes:
1) This sketch has not been subject to formal checks or approvals. Its validity and use must therefore be limited to discussion and information purposes only.
2) Unless otherwise noted the risks associated with this proposal are not considered to be extra ordinary and within the remit of an experienced and competent contractor.
3) All dimensions in millimetres and all levels in metres above ordnance datum unless shown otherwise.
4) This drawing is an ammendment of the 'Landscape Masterplan' by 'Axis P.E.D'. This drawing provides a concept only and is not intended for detailed design.

LEGEND

- Site boundary
- Existing Watercourses
- Proposed Filter Drains To Drain Access Roads
- Proposed Inspection Chamber
- Proposed Attenuation Basin
- Proposed Surface Water Drain
- Fire Water Shut Off Valve
- Proposed Flow Control Chamber

CLIENT:		Axis P.E.D Ltd	
		 www.waterco.co.uk	
SCHEME:		Sperberry Hill Solar	
PLOT TITLE:		Concept Drainage Sketch	
PLOT STATUS:		SKETCH	DATE: 22-10-2024
DRAWN:	CHECKED:	APPROVED:	PLOT SCALE AT A3:
JJ	AW	MW	1:2100
PLOT NAME:			REVISION:
14855_Concept_Drainage_Sketch			01

Appendix G Maintenance Schedules

Operation and Maintenance Requirements for Detention Basins

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter and debris	Monthly
	Cut grass-for spillways and access routes	Monthly (during growing season), or as required
	Cut grass - meadow grass in and around basin	Half yearly (spring - before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if required.	Monthly
	Inspect banksides, structures, pipework etc. for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies.	Monthly (for first year), then annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet and forebays	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional maintenance	Reseed- areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years. or as required
	Remove sediment from inlets, outlets, forebays and main basin when required	Every 5 years. or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

Ref. Table 22.1 CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner.

Name :

Position :

Date :

Signed on behalf of the site owner :

Operation and Maintenance Requirements for Filter Drains

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Remove litter (including leaf litter) and debris from filter drain surface, access chambers and pre-treatment devices	Monthly (or as required)
	Inspect filter drain surface, inlet / outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
Occasional maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g. NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

Ref. Table 16.1, CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner.

Name :

Position :

Date :

Signed on behalf of the site owner :

Operation and Maintenance Requirements for Permeable Paving

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and move contributing and adjacent areas	As required
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level or the paving	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Inspect for evidence of poor operation and / or weed growth – if required, take remedial action	Three-monthly, 48hr after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Ref. Table 20.15, CIRIA C753 'The SuDS Manual'

The maintenance requirements detailed above are to be undertaken by the site owner.

Name :

Position :

Date :

Signed on behalf of the site owner :

Appendix H Concept Designers Risk Assessment

Project:

Client:

Report Reference:

Sperberry Hill Solar

Axis P.E.D Ltd

14855-Drainage Strategy Addendum-01

Project No:

14855

Prepared by:

Checked by:

Reviewed by:

Jessica Joy BSc (Hons) MCIWEM

Aled Williams BSc (Hons) MCIWEM C.WEM

Nigel Jones BEng (Hons) CEng MICE

Date:

Date:

Date:

20/09/2024

25/09/2024

27/09/2024

Requirement:
The Construction (Design and Management) Regulations 2015 (CDM 2015) place an obligation on the Designer to take all reasonable steps to provide, with the design, sufficient information about the design, construction or maintenance of the structure, to adequately assist the client, other designers and contractors to comply with their duties under CDM. The Designer has undertaken this assessment to identify any extra-ordinary risks, or those that would not be expected on this particular project by an experienced and competent Contractor. The aim is to avoid needless paperwork and bureaucracy and ensure the assessment is project specific, relevant and proportionate to the risk.

DRA Summary
Each of the following risk areas has been considered using the question below. Is a risk present which is considered to be **extra-ordinary or unexpected** in this instance?

If **YES** - A detailed risk assessment is required at design stage
If **UNKNOWN** - Insufficient information has been provided at concept design stage and the risks are unknown. Further consideration must be given at design stage(s)
If **NO** - No further action is required.

Hazard Ref.	Risk Areas	YES, UNKNOWN or NO	Comments
1	Ground Conditions	Yes	Located within Groundwater Source Protection Zone 3
2	Hazardous Environment	Unknown	To be considered at detailed design stage.
3	Existing Working Environment	Unknown	To be considered at detailed design stage.
4	Existing Services	Unknown	To be considered at detailed design stage.
5	Proximity to Other Structure(s)	Unknown	To be considered at detailed design stage.
6	Near Waterbody / flood risk	Yes	Located within Flood Zone 1 - Watercourse intersects the site
7	Proximity to Other Activities	Unknown	To be considered at detailed design stage.
8	Sequence of Construction	Unknown	To be considered at detailed design stage.
9	Access	Unknown	To be considered at detailed design stage.
10	Interfaces	Unknown	To be considered at detailed design stage.
11	Confined Space Working	Unknown	To be considered at detailed design stage.
12	Maintenance Considerations	Unknown	To be considered at detailed design stage.
13	Working at Height	Unknown	To be considered at detailed design stage.
14	Steep Slopes	Unknown	Site forms sloping hillside - no excessive gradients
15	Demolition / Refurbishment / Repair	Unknown	To be considered at detailed design stage.
16	Welfare	Unknown	To be considered at detailed design stage.
17	Occupational Health	Unknown	To be considered at detailed design stage.
18	Environmental Issues	Unknown	To be considered at detailed design stage.
19	Other Significant Hazards not Identified Above	Unknown	To be considered at detailed design stage.
20	Residual Risk to Future Users	Unknown	To be considered at detailed design stage.