Appendix B Surface Water Drainage

2no. Greenfield Calculations

Haydn Evans drawing 336-004-D100 – Surface Water Drainage Strategy

Haydn Evans calculations 336-004-CA3 - Network Calculations

Haydn Evans document 336-004-RP3 – SuDS Management & Maintenance Plan

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Tayler Evans
Site name:	Rigifa
Site location:	Rigifa

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	58.62304° N
Longitude:	3.21967° W
Reference:	1389556744
Date:	Aug 07 2024 11:43

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	5.391

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	885	885
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	34.24	34.24
1 in 1 year (l/s):	29.11	29.11
1 in 30 years (l/s):	66.78	66.78
1 in 100 year (l/s):	84.92	84.92
1 in 200 years (l/s):	97.25	97.25

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Tayler Evans
Site name:	Rigifa - Substation Compound
Site location:	Rigifa

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	58.62913° N
Longitude:	3.22025° W
Reference:	1780436318
Date:	Aug 20 2024 10:19

Runoff estimation approach

IH124

Site characteristics

Total site area (ha):	0.1

Methodology

Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	4	4
HOST class:	N/A	N/A
SPR/SPRHOST:	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm):	885	885
Hydrological region:	1	1
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	1.95	1.95
Growth curve factor 100 years:	2.48	2.48
Growth curve factor 200 years:	2.84	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

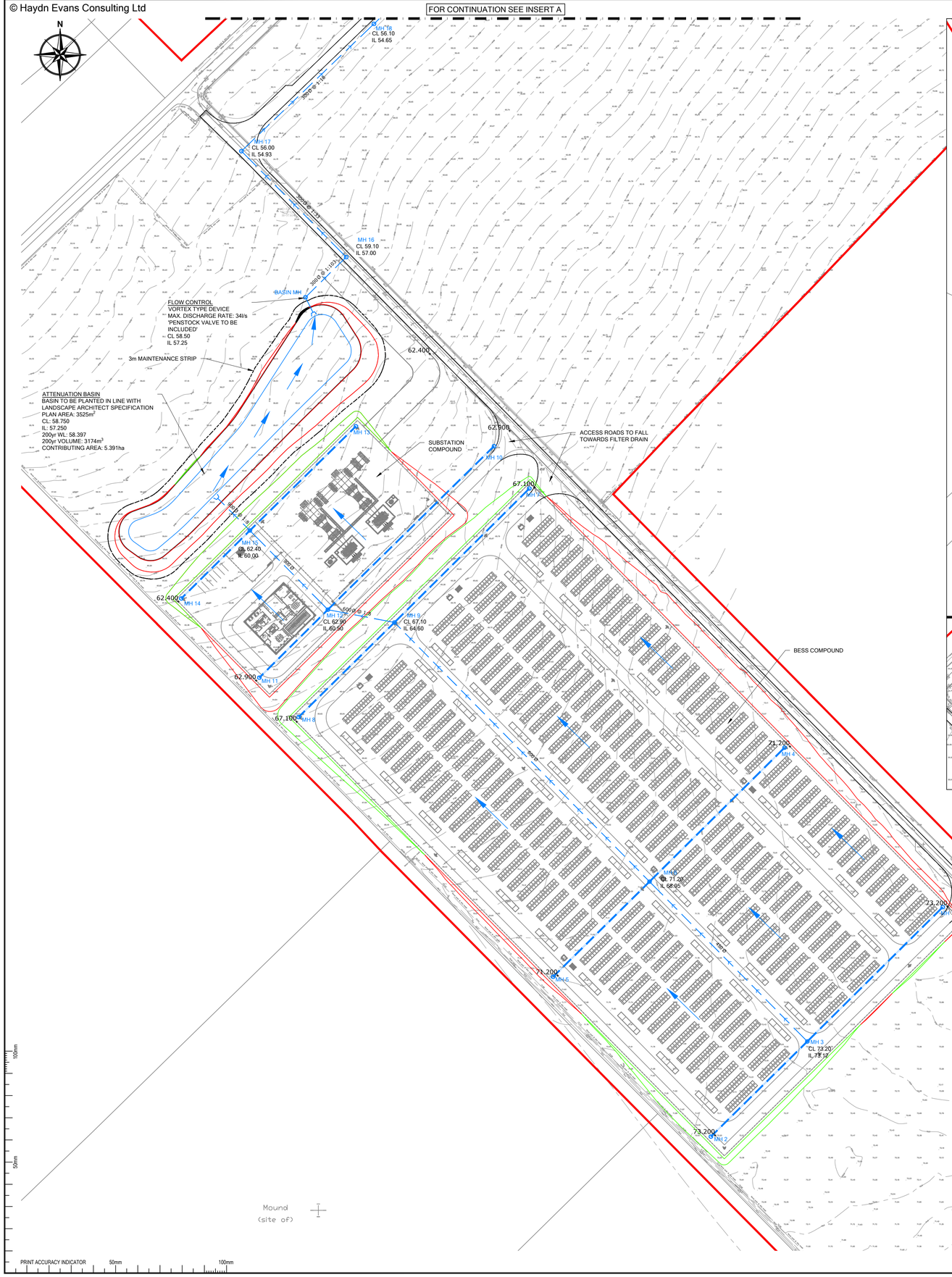
(3) Is SPR/SPRHOST ≤ 0.3?

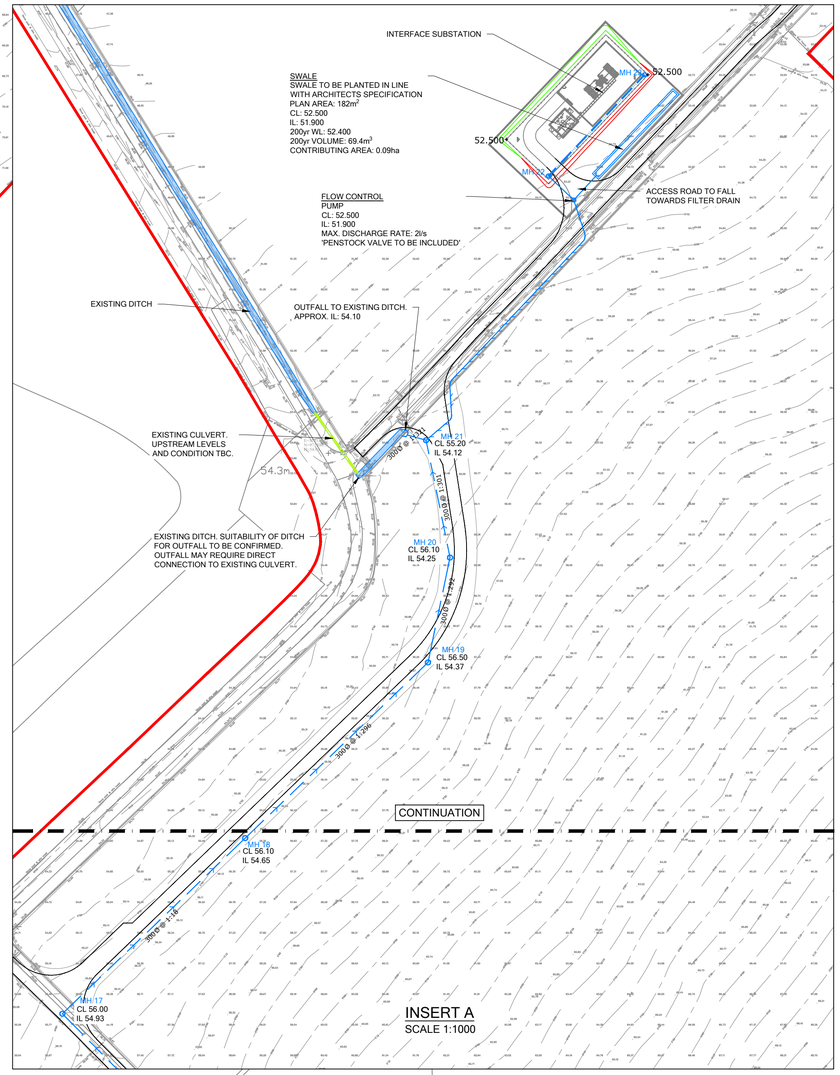
Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):	0.64	0.64
1 in 1 year (l/s):	0.54	0.54
1 in 30 years (l/s):	1.24	1.24
1 in 100 year (l/s):	1.58	1.58
1 in 200 years (l/s):	1.8	1.8





INSERT A
SCALE 1:1000

PRINT ACCURACY INDICATOR 50mm 100mm

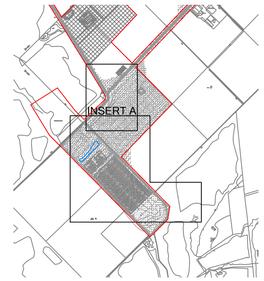
NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS, ARCHITECTS AND SPECIALISTS DRAWINGS AND THE SPECIFICATION.
2. THIS DRAINAGE STRATEGY DRAWING SHOWS HOW SURFACE WATER RUN-OFF COULD BE MANAGED ON SITE WITH A RESTRICTED OFF-SITE DISCHARGE, FOR ALL RAINFALL EVENTS UP TO AND INCLUDING THE 200 YEAR RETURN PERIOD EVENT TO ENSURE NO INCREASED FLOOD RISK TO OTHERS AS A RESULT OF THE PROPOSED DEVELOPMENT.

   THIS IS NOT INTENDED TO BE A DETAILED DESIGN AT THIS STAGE. PLEASE NOTE THAT THE FINAL LAYOUT MAY BE SUBJECT TO REFINEMENT TO MEET CERTAIN TECHNICAL CRITERIA.
3. SITE LAYOUT BASED ON FIELD ENERGY SITE LAYOUT PLAN, DRAWING REF. BTGBRIG01-001.1 REV. 5, DATED 05/08/2024 . TOPOGRAPHICAL SURVEY FROM HIGHLAND SURVEYORS LTD, DRAWING REF. 23066, UNDERTAKEN NOVEMBER 2023
4. DRAINAGE LEVELS ARE BASED ON COMPOUND LEVELS PROVIDED BY FIELD.

KEY

- xx.xxx+ PROPOSED LEVEL
- PROPOSED ATTENUATION BASIN
- CUT GRADING
- FILL GRADING
- SURFACE WATER MANHOLE
- SURFACE WATER DRAIN
- FILTER DRAIN
- PLANNING BOUNDARY
- OVERLAND FLOW ARROWS
- EXISTING DITCH
- EXISTING CULVERT
- IMPERMEABLE CATCHMENT AREAS
- SWALE
- SURFACE WATER RISING MAIN



Rev'n	Date	Description	Drawn	Chk'd	App'd
P05	16.09.2024	AMENDED TO SUIT LATEST SITE LAYOUT	THW	BP	JRC
P04	02.09.2024	LEVELS AND PIPE GRADIENTS ADJUSTED	TE	BH	JRC
P03	30.08.2024	INTERFACE SUBSTATION DRAINAGE REVISED	TE	BP	*
P02	22.08.2024	DRAINAGE AMENDED TO SUIT UPDATED SITE LAYOUT	TE	BH	JRC
P01	26.04.2024	DRAFT ISSUE	BP	BH	*

Status: PRELIMINARY

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Client: FIELD

Project: RIGIFA

Drawing title: SURFACE WATER DRAINAGE STRATEGY

Scale	Drawn	Checked	Approved	Date
1:1000 @ A1	BP	BH	JC	APRIL 2024

Drawing no.: 336-004-D100

Revision: P05

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
Maximum Rainfall (mm/hr)	50.0		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Basin	0.000	5.00	58.500	1800	329284.905	971248.466	1.250
MH 1	0.058	5.00	73.200	1200	329572.044	970973.619	1.500
MH 2	0.058	5.00	73.200	1200	329467.621	970870.237	1.500
MH 3	0.058	5.00	73.200	1500	329511.049	970913.099	2.080
MH 4	0.508	5.00	71.200	1350	329500.789	971045.492	1.650
MH 5	0.508	5.00	71.200	1350	329396.513	970942.253	1.650
MH 6	0.508	5.00	71.200	1500	329439.953	970985.126	2.250
MH 7	0.834	5.00	67.100	1350	329385.781	971162.271	1.650
MH 8	0.834	5.00	67.100	1350	329281.833	971059.304	1.650
MH 9	0.834	5.00	67.100	1500	329325.014	971101.927	2.500
MH 10	0.035	5.00	62.900	1350	329369.860	971181.348	1.650
MH 11	0.035	5.00	62.900	1350	329264.127	971077.046	1.650
MH 12	0.035	5.00	62.900	1800	329294.989	971107.684	2.400
MH 13	0.194	5.00	62.400	1350	329307.621	971190.299	1.650
MH 14	0.194	5.00	62.400	1350	329228.968	971112.732	1.650
MH 15	0.194	5.00	62.400	1800	329259.849	971143.352	2.400
MH16	0.000	5.00	59.100	1200	329303.248	971266.557	2.100
MH17	0.000	5.00	56.000	1200	329256.064	971314.323	1.070
MH18	0.000		56.100	1200	329315.742	971371.657	1.450
MH19	0.000		56.500	1200	329375.421	971428.991	2.130
MH20	0.000		56.100	1200	329382.612	971463.229	1.850
MH21	0.000		55.200	1200	329374.790	971501.520	1.080
MH22	0.045	5.00	52.500	1200	329414.764	971587.790	0.500
MH23	0.045	5.00	52.500	1200	329446.114	971620.792	0.450
Outfall	0.000		55.200	1200	329368.128	971505.049	1.100
Swale	0.000	5.00	52.500	1800	329422.965	971579.957	0.600

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	MH 1	MH 3	85.925	0.600	71.700	71.270	0.430	200.0	300	6.29	33.6
2.000	MH 2	MH 3	61.018	0.600	71.700	71.270	0.430	141.9	300	5.77	34.6
1.001	MH 3	MH 6	101.205	0.600	71.120	69.100	2.020	50.1	450	6.88	32.5
3.000	MH 4	MH 6	85.703	0.600	69.550	69.100	0.450	190.5	450	5.97	34.3
4.000	MH 5	MH 6	61.034	0.600	69.550	69.100	0.450	135.6	450	5.58	35.0
1.002	MH 6	MH 9	163.870	0.600	68.950	64.600	4.350	37.7	600	7.57	31.2
5.000	MH 7	MH 9	85.639	0.600	65.450	64.750	0.700	122.3	450	5.78	34.6

Links (Input)

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
6.000	MH 8	MH 9	60.674	0.600	65.450	64.750	0.700	86.7	450	5.46	35.2
1.003	MH 9	MH 12	30.572	0.600	64.600	60.800	3.800	8.0	600	7.63	31.1
7.000	MH 10	MH 12	105.034	0.600	61.250	60.950	0.300	350.1	450	6.62	33.0
8.000	MH 11	MH 12	43.487	0.600	61.250	60.950	0.300	145.0	450	5.43	35.2
1.004	MH 12	MH 15	50.070	0.600	60.500	60.000	0.500	100.1	900	7.89	30.6
9.000	MH 13	MH 15	66.979	0.600	60.750	60.450	0.300	223.3	450	5.82	34.5
10.000	MH 14	MH 15	43.488	0.600	60.750	60.450	0.300	145.0	450	5.43	35.2
1.005	MH 15	Basin	108.059	0.600	60.000	57.250	2.750	39.3	900	8.25	30.0
1.006	Basin	MH16	25.763	0.600	57.250	57.000	0.250	103.1	300	8.53	29.6
11.000	MH16	MH17	67.141	0.600	57.000	54.930	2.070	32.4	300	8.93	29.0
11.001	MH17	MH18	5.000	0.600	54.930	54.650	0.280	17.9	300	8.96	28.9
1.009	MH18	MH19	82.757	0.600	54.650	54.370	0.280	295.6	300	10.47	26.8
1.010	MH19	MH20	34.985	0.600	54.370	54.250	0.120	291.5	300	11.11	26.0
1.011	MH20	MH21	39.082	0.600	54.250	54.120	0.130	300.6	300	11.83	25.2
1.012	MH21	Outfall	6.416	0.600	54.120	54.100	0.020	320.8	300	11.95	25.1
11.000_1	MH23	MH22	42.530	0.600	52.050	52.000	0.050	850.6	300	6.33	33.5
11.001_1	MH22	Swale	6.426	0.600	52.000	51.900	0.100	64.3	300	6.39	33.4
11.002	Swale	MH21	100.310	0.600	51.900	54.120	-2.220	-45.2	300	8.06	30.3

Node Basin Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	x	Sump Available	✓
Invert Level (m)	57.250	Product Number	CTL-SHE-0248-3400-1200-3400
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.300
Design Flow (l/s)	34.0	Min Node Diameter (mm)	1800

Node Swale Online Pump Control

Flap Valve	x	Design Depth (m)	0.475	Switch off depth (m)	0.100
Replaces Downstream Link	✓	Design Flow (l/s)	2.0		
Invert Level (m)	51.900	Switch on depth (m)	0.500		

Depth (m)	Flow (l/s)
1.000	4.211

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	57.250
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	2295.0	0.0	1.500	3525.0	0.0

Node MH 1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	71.700	Slope (1:X)	200.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	6	Depth (m)	
Safety Factor	2.0	Width (m)	0.600	Inf Depth (m)	
Porosity	0.30	Length (m)	85.925		

Node MH 2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	71.700	Slope (1:X)	142.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	7	Depth (m)	
Safety Factor	2.0	Width (m)	0.600	Inf Depth (m)	
Porosity	0.30	Length (m)	61.018		

Node MH 4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	69.550	Slope (1:X)	190.5
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	4	Depth (m)	
Safety Factor	2.0	Width (m)	0.600	Inf Depth (m)	
Porosity	0.30	Length (m)	85.703		

Node MH 5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	69.550	Slope (1:X)	135.6
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	5	Depth (m)	
Safety Factor	2.0	Width (m)	0.600	Inf Depth (m)	
Porosity	0.30	Length (m)	61.034		

Node MH 7 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	65.450	Slope (1:X)	122.3
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	4	Depth (m)	
Safety Factor	2.0	Width (m)	0.600	Inf Depth (m)	
Porosity	0.30	Length (m)	85.639		

Node MH 8 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	65.450	Slope (1:X)	86.7
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	3	Depth (m)	
Safety Factor	2.0	Width (m)	0.600	Inf Depth (m)	
Porosity	0.30	Length (m)	60.674		

Node MH 10 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	61.250	Slope (1:X)	350.1
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	7	Depth (m)	
Safety Factor	2.0	Width (m)	0.600	Inf Depth (m)	
Porosity	0.30	Length (m)	105.034		

Node MH 11 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	61.250	Slope (1:X)	145.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	5	Depth (m)	
Safety Factor	2.0	Width (m)	0.750	Inf Depth (m)	
Porosity	0.30	Length (m)	43.487		

Node MH 13 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	60.750	Slope (1:X)	223.3
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	6	Depth (m)	
Safety Factor	2.0	Width (m)	0.750	Inf Depth (m)	
Porosity	0.30	Length (m)	66.979		

Node MH 14 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	60.750	Slope (1:X)	145.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	6	Depth (m)	
Safety Factor	2.0	Width (m)	0.750	Inf Depth (m)	
Porosity	0.30	Length (m)	43.488		

Node MH16 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	57.000	Slope (1:X)	150.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	1380	Depth (m)	
Safety Factor	2.0	Width (m)	0.750	Inf Depth (m)	
Porosity	0.30	Length (m)	42.500		

Node Swale Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	50.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	103.9	0.0	0.600	181.6	0.0

Results for 200 year Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
360 minute winter	Basin	360	58.300	1.050	391.9	2863.8370	0.0000	FLOOD RISK
60 minute summer	MH 1	34	71.822	0.122	27.7	0.5097	0.0000	OK
60 minute summer	MH 2	33	71.813	0.113	27.7	0.3880	0.0000	OK
60 minute summer	MH 3	33	71.246	0.126	81.5	0.2932	0.0000	OK
60 minute summer	MH 4	34	69.940	0.390	242.8	5.5791	0.0000	OK
60 minute summer	MH 5	33	69.893	0.343	242.8	4.0647	0.0000	OK
60 minute summer	MH 6	34	69.311	0.361	797.3	2.2665	0.0000	OK
60 minute summer	MH 7	34	66.278	0.828	398.6	16.9560	0.0000	SURCHARGED
60 minute summer	MH 8	34	66.100	0.650	398.6	10.8376	0.0000	SURCHARGED
60 minute summer	MH 9	34	65.073	0.473	1904.2	3.9942	0.0000	OK
60 minute summer	MH 10	34	61.341	0.091	16.7	0.4399	0.0000	OK
60 minute summer	MH 11	34	61.328	0.078	16.7	0.2514	0.0000	OK
60 minute summer	MH 12	34	61.332	0.832	1954.7	2.3587	0.0000	OK
60 minute summer	MH 13	33	60.959	0.209	92.7	1.9049	0.0000	OK
60 minute summer	MH 14	33	60.939	0.189	92.7	1.3153	0.0000	OK
60 minute summer	MH 15	33	60.608	0.608	2230.1	2.5319	0.0000	OK
7200 minute summer	MH16	4260	57.086	0.086	34.0	0.2305	0.0000	OK
7200 minute summer	MH17	4260	55.010	0.080	34.0	0.0900	0.0000	OK
60 minute summer	MH18	36	54.806	0.156	34.0	0.1761	0.0000	OK
7200 minute summer	MH19	4260	54.531	0.161	34.0	0.1817	0.0000	OK
7200 minute summer	MH20	4260	54.411	0.161	34.0	0.1821	0.0000	OK
8640 minute summer	MH21	5340	54.290	0.170	35.3	0.1924	0.0000	OK
5760 minute winter	MH22	4320	52.399	0.399	1.3	1.1702	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
360 minute winter	Basin	1.006	MH16	34.0	1.558	0.310	0.5642	
60 minute summer	MH 1	1.000	MH 3	26.9	1.014	0.344	2.2802	
60 minute summer	MH 2	2.000	MH 3	27.3	1.148	0.294	1.4548	
60 minute summer	MH 3	1.001	MH 6	80.9	1.798	0.177	5.5232	
60 minute summer	MH 4	3.000	MH 6	235.5	1.707	1.008	11.7886	
60 minute summer	MH 5	4.000	MH 6	241.0	1.944	0.869	7.5848	
60 minute summer	MH 6	1.002	MH 9	790.8	3.783	0.704	34.0368	
60 minute summer	MH 7	5.000	MH 9	359.5	2.271	1.231	13.2419	
60 minute summer	MH 8	6.000	MH 9	376.3	2.488	1.083	9.4273	
60 minute summer	MH 9	1.003	MH 12	1909.5	8.063	0.784	7.6815	
60 minute summer	MH 10	7.000	MH 12	16.1	0.598	0.093	8.7344	
60 minute summer	MH 11	8.000	MH 12	17.9	0.750	0.067	3.5159	
60 minute summer	MH 12	1.004	MH 15	1960.4	3.703	0.984	26.7415	
60 minute summer	MH 13	9.000	MH 15	91.2	1.306	0.423	4.6959	
60 minute summer	MH 14	10.000	MH 15	92.6	1.517	0.345	2.6549	
60 minute summer	MH 15	1.005	Basin	2241.2	5.872	0.704	44.8425	
7200 minute summer	MH16	11.000	MH17	34.0	2.147	0.174	1.0630	
7200 minute summer	MH17	11.001	MH18	34.0	1.329	0.129	0.1294	
60 minute summer	MH18	1.009	MH19	34.0	0.914	0.529	3.1115	
7200 minute summer	MH19	1.010	MH20	34.0	0.884	0.525	1.3450	
7200 minute summer	MH20	1.011	MH21	34.0	0.865	0.533	1.5359	
8640 minute summer	MH21	1.012	Outfall	35.3	0.943	0.572	0.2400	6627.9
5760 minute winter	MH22	11.001_1	Swale	2.4	0.359	0.018	0.4525	

Results for 200 year Critical Storm Duration. Lowest mass balance: 99.92%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
5760 minute winter	MH23	4320	52.399	0.349	0.4	1.0935	0.0000	FLOOD RISK
8640 minute summer	Outfall	5340	54.245	0.145	35.3	0.0000	0.0000	OK
4320 minute winter	Swale	4020	52.399	0.499	2.6	91.8438	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
5760 minute winter	MH23	11.000_1	MH22	0.4	0.149	0.012	2.9949	
4320 minute winter	Swale	Pump	MH21	2.0				

200 MW BESS, Rigifa, Thurso
SuDS Management & Maintenance Plan

1 Introduction

Sustainable Drainage Systems (SuDS) features are utilised to manage rainfall and use landscape features to deal with surface water. SuDS control the flow rate and volume of water leaving the development area and reduce pollution by intercepting silt and cleaning run-off from hard surfaces.

Like all aspects of drainage systems, SuDS components should be regularly inspected and maintained. This ensures efficient operation and reduces the likelihood of failure. The level of inspection and maintenance will vary depending on the type of SuDS component. Further information on maintenance can be found in The SuDS Manual (CIRIA publication C753).

The SuDS and drainage features for the Proposed Development are to be maintained by the site owner/occupant.

This Plan should be updated following any changes to the proposed drainage design at detailed design stage.

2 Managing SuDS

The SuDS features have been designed for easy maintenance and comprise:

- Regular maintenance – litter collection and checking the inlets and outlets where water enters or leaves the SuDS feature.
- Occasional tasks – removing any silt that builds up, cutting back and clearing excessive vegetation growth, inspection of outlets, manholes and flow controls.
- Remedial work – repairing damage where necessary.

3 Contact

In the event of concern over any matter to do with the SuDS, please contact the site owner/occupant.

4 SuDS Maintenance

The surface water drainage system includes filter drains, an attenuation basin, flow control, pipes and manholes.

Surface water is collected by filter drains and directed to the attenuation basin via a piped network. Surface water is then directed to the outfall ditch via a flow control.

Table 1 below provides a breakdown of general maintenance requirements to be undertaken, appropriate to the types of SuDS and surface water drainage systems proposed at this site.

Regular Maintenance		Frequency
1	**Litter Management** Check for and pick up litter around the entire site.	Monthly
2	**Inlets and Outlets** Remove silt and debris from inlets and outlets.	Quarterly
3	**Respond to reported blockages, etc.**	As required
Occasional Maintenance		**Frequency**
4	**Inspection of Control Chamber** Inspection of chambers for silt build up and visually check pipes appear clear and free flowing. Remove silt as required. Jetting as required.	Annually
5	**Inspection of Attenuation** Check for blockages within the connecting pipes.	Quarterly and following heavy storms
Remedial Work		**Frequency**
6	**Inspect SuDS systems to check for damage or failure** Undertake remedial work as required.	Annually
7	**Silt control and removal** Wash or replace filter medium when required.	As required

Table 1: SuDS General Maintenance Requirements

Tables 2 to 6 below provides a breakdown of typical maintenance requirements appropriate to the types of SuDS proposed at this site.

Operation and Maintenance Requirements for Attenuation Basin		
Responsible for Maintenance	**Site Owner/Occupier**	
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular maintenance	Remove litter and debris.	Monthly
	Cut grass - for spillways and access routes.	Monthly (during growing season)
	Cut grass - meadow grass in and around basins.	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
	Check any penstocks and other mechanical devices.	Annually
	Tidy all dead growth before start of growing season.	Annually
	Remove sediment from inlets, outlets and forebay.	Annually
	Manage wetland plants in outlet pool, where provided.	Annually
Occasional maintenance	Reseed areas of poor vegetation growth	To be reviewed every 2 years
	Prune and trim any trees and remove cuttings	Every 2 years
	Remove sediment from inlets, outlets, forebay and main basins when required	Every 5 years (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

Table 2: Site specific maintenance requirements – Attenuation Basins

Operation and Maintenance Requirements for Pipes, Manholes and Gullies		
Responsible for Maintenance	**Site Owner/Occupier**	
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular inspections	Remove cover and inspect, ensuring that water is flowing freely and that the exit route for water is unobstructed. Remove debris and silt.	Annually and after leaf fall in autumn
Remedial action	Repair physical damage if necessary.	As required
Monitoring	Inspect for evidence of poor performance. CCTV survey to investigate poor performance.	As required

Table 3: Site specific maintenance requirements – Pipes, manholes and gullies

Operation and Maintenance Requirements for Flow Control		
Responsible for Maintenance	**Site Owner/Occupier**	
Maintenance Schedule	**Required Action**	**Typical Frequency**
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

Table 4: Site specific maintenance requirements – Flow control

Operation and Maintenance Requirements for Filter Drains		
Responsible for Maintenance	**Site Owner/Occupier**	
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	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 (eg 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

Table 5: Site specific maintenance requirements – Filter drain

Operation and Maintenance requirements for Swales		
Responsible for Maintenance	**Site Owner/Occupier**	
Maintenance Schedule	**Required Action**	**Typical Frequency**
Regular maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – retain grass height within specified design range	Monthly (during growing season), or as required
	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 infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for .48hrs	Monthly, or when required
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, after plant types to better suit conditions, if required.	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Table 6: Site specific maintenance requirements – Swales

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