



Drainage Design Report

Flow

v6.0

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Network	Storm Network 1
Filename	I:\Projects\066 - Peel Enviromental Management Ltd\006 - Houghton Main Revised\Pds\Flow\HOUGHTON NETWORK 1.PFD
Username	ENZYGO\mark.jarvis
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Rainfall Methodology	FSR
Return Period (years)	2
Additional Flow (%)	0
FSR Region	England and Wales
M5-60 (mm)	20.000
Ratio-R	0.400
CV	0.750
Time of Entry (mins)	5.00
Maximum Time of Concentration (mins)	30.00
Maximum Rainfall (mm/hr)	50.0
Minimum Velocity (m/s)	1.00
Connection Type	Level Soffits
Minimum Backdrop Height (m)	3.000
Preferred Cover Depth (m)	1.200
Enforce best practice design rules	✓

Name	Area (ha)	T of E (mins)	Add Inflow (l/s)	Cover Level (m)	Diameter (mm)	Easting (m)
1	0.077	5.00		33.180	1350	441575.602
2	0.077	5.00		33.164	1350	441538.437
3				33.180	1350	441540.266
4				33.181	1350	441545.486
5	0.068	5.00		33.181	1350	441554.188
6	0.073	5.00		33.200	1200	441597.207
7	0.073	5.00		33.200	1350	441598.668
8				33.207	1350	441601.014
9	0.077	5.00		33.178	1350	441599.079
10				33.150	1350	441646.473
11	0.077	5.00		33.181	1350	441648.286
12	0.146	5.00		33.181	1350	441650.166
13				33.185	1350	441652.251
14				33.132	1350	441627.619
15	0.041	5.00		33.122	1350	441551.586
16	0.131	5.00		33.132	1350	441536.327
17	0.030	5.00		33.153	1350	441538.283
18	0.023	5.00		33.166	1350	441544.466
19	0.178	5.00		33.255	1350	441587.485
20	0.154	5.00		33.084	1350	441608.980
21				33.067	1350	441620.224
22	0.052	5.00		33.102	1200	441636.690
23	0.060	5.00		33.118	1200	441648.358
24	0.094	5.00		33.154	1200	441651.595
26	0.116	5.00		33.154	1200	441654.881
27				33.073	1200	441640.669
28				33.031	1500	441630.572
29				33.100	1500	441642.125
30				33.642	1500	441650.711
31				32.657		441683.528
32				32.149		441715.127
33				31.036	1500	441722.103

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)
1.000	1	2	37.228	0.600	31.830	31.715	0.115	324.0	375	5.62
1.001	2	3	32.428	0.600	31.715	31.615	0.100	324.3	375	6.16
1.002	3	4	17.842	0.600	31.615	31.560	0.055	324.4	375	6.46
1.003	4	5	12.116	0.600	31.560	31.522	0.038	318.8	375	6.66
1.004	5	7	44.548	0.600	31.522	31.384	0.138	322.8	375	7.40
2.000	6	7	22.764	0.600	31.850	31.534	0.316	72.0	225	5.25
1.005	7	8	42.059	0.600	31.384	31.254	0.130	323.5	375	8.10
1.006	8	14	26.899	0.600	31.254	31.171	0.083	324.1	375	8.55
3.000	9	10	47.482	0.600	31.828	31.575	0.253	187.7	375	5.60
3.001	10	11	32.673	0.600	31.575	31.474	0.101	323.5	375	6.14
3.002	11	12	33.888	0.600	31.474	31.369	0.105	322.7	375	6.71
3.003	12	13	37.577	0.600	31.369	31.253	0.116	323.9	375	7.33
3.004	13	14	24.942	0.600	31.253	31.171	0.082	304.2	375	7.73
1.007	14	28	9.015	0.600	31.171	30.574	0.597	15.1	375	8.58
4.000	15	16	15.683	0.600	31.027	30.988	0.039	402.1	450	5.26
4.001	16	17	34.666	0.600	30.988	30.903	0.085	407.8	450	5.84
4.002	17	18	18.803	0.600	30.903	30.856	0.047	400.1	450	6.15
4.003	18	19	58.182	0.600	30.856	30.713	0.143	406.9	450	7.12
4.004	19	20	30.946	0.600	30.713	30.637	0.076	407.2	450	7.63
4.005	20	21	11.294	0.600	30.637	30.609	0.028	403.4	450	7.82
4.006	21	28	10.394	0.600	30.609	30.499	0.110	94.5	450	7.90
5.000	22	23	12.305	0.600	31.752	31.618	0.134	91.8	300	5.12
5.001	23	24	55.445	0.600	31.618	31.391	0.227	244.2	300	6.05
5.002	24	26	56.280	0.600	31.391	30.777	0.614	91.7	300	6.62
5.003	26	27	14.790	0.600	30.777	30.751	0.026	568.8	300	7.00
5.004	27	28	10.508	0.600	30.751	30.733	0.018	583.8	300	7.27
1.008	28	29	17.875	0.600	30.424	30.387	0.037	483.1	525	8.87
1.009	29	30	19.111	0.600	30.312	30.279	0.033	579.1	600	9.19
1.010	30	31	52.598	0.600	30.279	30.188	0.091	578.0	600	10.06
1.011	31	32	49.933	0.600	29.738	29.638	0.100	499.3	1050	10.60
1.012	32	33	25.014	0.600	29.638	28.160	1.478	16.9	525	10.68

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (ha)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1	2	1.001	110.5	10.4	0.975	1.074	0.077	0.0	77	0.636
1.001	2	3	1.000	110.5	20.9	1.074	1.190	0.154	0.0	109	0.773
1.002	3	4	1.000	110.5	20.9	1.190	1.246	0.154	0.0	109	0.773
1.003	4	5	1.009	111.4	20.9	1.246	1.284	0.154	0.0	109	0.779
1.004	5	7	1.003	110.7	30.1	1.284	1.441	0.222	0.0	133	0.857
2.000	6	7	1.542	61.3	9.9	1.125	1.441	0.073	0.0	61	1.142
1.005	7	8	1.002	110.6	49.9	1.441	1.578	0.368	0.0	176	0.976
1.006	8	14	1.001	110.5	49.9	1.578	1.586	0.368	0.0	176	0.975
3.000	9	10	1.319	145.7	10.4	0.975	1.200	0.077	0.0	67	0.772
3.001	10	11	1.002	110.6	10.4	1.200	1.332	0.077	0.0	77	0.637
3.002	11	12	1.003	110.8	20.9	1.332	1.437	0.154	0.0	109	0.775
3.003	12	13	1.001	110.6	40.7	1.437	1.557	0.300	0.0	157	0.927
3.004	13	14	1.033	114.1	40.7	1.557	1.586	0.300	0.0	154	0.949
1.007	14	28	4.682	517.1	90.5	1.586	2.082	0.668	0.0	105	3.549
4.000	15	16	1.007	160.2	5.6	1.645	1.694	0.041	0.0	57	0.478
4.001	16	17	1.000	159.1	23.3	1.694	1.800	0.172	0.0	116	0.722
4.002	17	18	1.010	160.6	27.4	1.800	1.860	0.202	0.0	125	0.761
4.003	18	19	1.001	159.3	30.5	1.860	2.092	0.225	0.0	132	0.777
4.004	19	20	1.001	159.2	54.6	2.092	1.997	0.403	0.0	181	0.911
4.005	20	21	1.006	160.0	75.5	1.997	2.008	0.557	0.0	218	0.992
4.006	21	28	2.091	332.6	75.5	2.008	2.082	0.557	0.0	145	1.703
5.000	22	23	1.641	116.0	7.0	1.050	1.200	0.052	0.0	50	0.914
5.001	23	24	1.001	70.8	15.2	1.200	1.463	0.112	0.0	94	0.802
5.002	24	26	1.642	116.1	27.9	1.463	2.077	0.206	0.0	100	1.359
5.003	26	27	0.652	46.1	43.6	2.077	2.022	0.322	0.0	233	0.738
5.004	27	28	0.643	45.5	43.6	2.022	1.998	0.322	0.0	236	0.729
1.008	28	29	1.012	219.1	209.7	2.082	2.188	1.547	0.0	414	1.144
1.009	29	30	1.004	284.0	209.7	2.188	2.763	1.547	0.0	385	1.094
1.010	30	31	1.005	284.3	209.7	2.763	1.869	1.547	0.0	385	1.095
1.011	31	32	1.535	1329.2	204.3	1.869	1.461	1.547	0.0	275	1.129
1.012	32	33	5.463	1182.5	0.0	1.986	2.351	1.547	0.0	0	0.000

Rainfall Methodology	FSR		Return Period (years)	Climate Change (%)
FSR Region	England and Wales		100	30
M5-60 (mm)	20.000			
Ratio-R	0.400			
Summer CV	0.750			
Winter CV	0.840			
Analysis Speed	Detailed			
Drain Down Time (mins)	2880			
Additional Storage (m³/ha)	20.0			
Storm Durations (mins)	15			
	30			
	60			
	120			
	180			
	240			
	360			
	480			
	600			
	720			
	960			
	1440			
Check Discharge Rate(s)	✓			
1 year (l/s)	286.0			
30 year (l/s)	286.0			
100 year (l/s)	286.0			
Check Discharge Volume	✓			
100 year 360 minute (m³)				

Site Makeup	Greenfield
Greenfield Method	IH124
Positively Drained Area (ha)	
SAAR (mm)	
Soil Index	1
SPR	0.10
Region	1
Growth Factor 1 year	0.85
Growth Factor 30 years	1.95
Growth Factor 100 years	2.48
Betterment (%)	0
QBar	
Q 1 year (l/s)	
Q 30 year (l/s)	
Q 100 year (l/s)	

Hydro-Brake®												
Node	Flap Valve	Online / Offline	Replaces Downstream Link	Loop to Node	Invert Level (m)	Design Depth (m)	Design Flow (l/s)	Objective	Sump Available	Product Number	Min Outlet Diameter (m)	Min Node Diameter (mm)
32	x	Online	x		29.638	1.000	286.0	(HE) Minimise upstream storage	✓	CTL-CHE-0515-2860-1000-2860		

<u>Depth/Area/Inf Area</u>									
Node	Base Inf Coefficient (m/hr)	Side Inf Coefficient (m/hr)	Safety Factor	Porosity	Invert Level (m)	Time to half empty (mins)	Depth (m)	Area (m ²)	Inf. Area (m ²)
32	0.00000	0.00000	2.0	1.00	29.638	16	0.000	299.9	0.0
							1.000	299.9	0.0
							1.001	0.0	0.0

Results for 100 year +30% Critical Storm Duration. Lowest mass balance: 99.33%									
Event	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status	Outflow (l/s)	Discharge Vol (m³)
15 minute winter	13	32.629	0.799	44.9	2.0561	0.0000	SURCHARGED	43.1	
15 minute winter	13	32.635	0.920	88.0	2.2943	0.0000	SURCHARGED	72.4	
15 minute winter	13	32.604	0.989	72.4	1.4149	0.0000	SURCHARGED	69.5	
15 minute winter	13	32.584	1.024	69.5	1.4651	0.0000	SURCHARGED	78.4	
15 minute winter	13	32.569	1.047	90.9	2.3570	0.0000	SURCHARGED	96.7	
15 minute winter	13	32.553	0.703	42.6	1.5548	0.0000	SURCHARGED	39.9	
15 minute winter	13	32.491	1.107	150.0	2.4750	0.0000	SURCHARGED	132.4	
15 minute winter	13	32.274	1.020	132.4	1.4598	0.0000	SURCHARGED	133.7	
15 minute winter	13	32.435	0.607	44.9	1.5601	0.0000	SURCHARGED	44.4	
15 minute winter	13	32.421	0.846	44.4	1.2108	0.0000	SURCHARGED	62.5	
15 minute winter	13	32.376	0.902	70.3	2.1043	0.0000	SURCHARGED	77.5	
15 minute winter	13	32.336	0.967	133.3	2.9438	0.0000	SURCHARGED	120.3	
15 minute winter	13	32.208	0.955	120.3	1.3665	0.0000	SURCHARGED	113.7	
15 minute winter	13	32.114	0.943	243.8	1.3488	0.0000	SURCHARGED	248.2	
15 minute winter	12	32.360	1.333	58.4	2.4295	0.0000	SURCHARGED	-34.5	
15 minute winter	12	32.361	1.373	91.5	3.6422	0.0000	SURCHARGED	86.9	
15 minute winter	12	32.345	1.442	109.2	2.4485	0.0000	SURCHARGED	102.0	
15 minute winter	12	32.312	1.456	112.5	2.3748	0.0000	SURCHARGED	102.1	
15 minute winter	12	32.235	1.522	188.1	4.3099	0.0000	SURCHARGED	187.9	
15 minute winter	12	32.099	1.462	272.5	3.9314	0.0000	SURCHARGED	263.2	
15 minute winter	12	31.964	1.355	263.2	1.9394	0.0000	SURCHARGED	257.5	
15 minute winter	12	32.908	1.156	30.4	2.1967	0.0000	FLOOD RISK	28.4	
15 minute winter	12	32.884	1.266	63.4	2.4440	0.0000	FLOOD RISK	55.7	
15 minute winter	12	32.785	1.394	107.2	3.0630	0.0000	SURCHARGED	84.2	
15 minute winter	12	32.408	1.631	139.6	3.4368	0.0000	SURCHARGED	134.4	
15 minute winter	13	32.091	1.340	134.4	1.5157	0.0000	SURCHARGED	133.7	
15 minute winter	13	31.856	1.432	597.4	2.5312	0.0000	SURCHARGED	599.9	
15 minute winter	13	31.390	1.078	599.9	1.9040	0.0000	SURCHARGED	601.4	
15 minute winter	13	31.131	0.852	601.4	1.5049	0.0000	SURCHARGED	604.7	
30 minute winter	30	30.529	0.791	538.5	0.0000	0.0000	OK	521.2	
30 minute winter	30	30.532	0.894	521.2	267.9787	0.0000	SURCHARGED	268.9	544.6
30 minute winter	30	28.327	0.167	268.9	0.0000	0.0000	OK		