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REPORT



PROJECT No	FR1636
PROJECT TITLE	BARRY – BIOMASS UK Number 2 LTD
CLIENT	GALLIFORD TRY

DISCIPLINE	CIVIL / STRUCTURAL
DOCUMENT TITLE	SURFACE WATER DRAINAGE DESIGN
DOCUMENT NUMBER	BARRY_01_REP_01_20063

A	HA	12/07/17	MS	GB	FOR INFORMATION
ISSUE	CREATED BY	DATE	CHECKED BY	APPROVED BY	REASON FOR ISSUE



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CHANGE TRACKING LOG		
Revision	Date	Description
A	12/07/2017	First issue





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REPORT

PART A – INTRODUCTION

A1- DESCRIPTION

This report covers the design of the surface water drainage network for the Barry EFW project. Drawings are attached in the Appendix D highlighting layouts of the drainage network.

A2- STRUCTURAL FORM

The surface water drainage network utilises a Tubosider attenuation tank for storage capacity and ACO drains.

A restricted discharge for the surface water drainage of 3 l/s has been imposed by PCML.

A3- SURFACE WATER DRAINAGE DESIGN PARAMETERS

Design of the network is carried out using MicroDrainage System 1 to set up the network and Simulation to run the storm events through the network.

The following parameters were used to assess the new surface water drainage network on the site:

- 1:1 year storm event (+20% for future anticipated climate change BS EN 752 Cl. 8.4.3.3) to check the manholes are not surcharged where possible (BS EN 752 NA.4.1.2 & 4.2.3.3).
- Surcharging of individual manholes is considered acceptable, in a 1:1 year storm event, provided that the surcharging does not pose a flood risk. A manhole will pose a flood risk when the surcharge level is within 300mm of the manhole cover level.
- 1:30 year storm event (+20% for future anticipated climate change BS EN 652 Cl. 8.4.3.3) to check the network does not flood (BS EN 752 NA.4.1.2).
- 1:100 year storm event (+20% for future anticipated climate change BS EN 752 Cl. 8.4.3.3) to check that any flood that occurs is contained on site.
- Various storm durations between 15 minutes and 10080 minutes (7 days) are analysed to find the critical storm for design.
- An infiltration rate of 0% was used to all concrete/tarmac hardstanding areas.
- Due to the levels of the site the discharge will be pumped at a restricted discharge rate imposed by PCML (3 l/s).
- Pipes are to be laid generally with a minimum 1:300 fall, with a steeper gradient where required to avoid clashes with other services.
- Surface water from the hardstanding areas and the roof areas are to be laid to gravity falls into a Tubosider Storm Water Retention tank.



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A4- ACO DRAINAGE DESIGN PARAMETERS

ACO drainage design is carried out using ACO's online design programme at www.acodesign.co.uk.

The following parameters were used to design the kerb drains and slot drains on the site:

- 1:30 year storm event to check the system has the required flow capacity.
- An infiltration rate of 0% was used to all concrete/tarmac hardstanding areas.
- All kerb drains and slot drains are assumed to have a level invert, with stepped transitions between different sized sections (where applicable).

A5- DESIGN DECISIONS TAKEN BY OTHERS

- PCML discharge consent flow rate 3 l/s.

A6- DESIGN ASSUMPTIONS

- No allowance has been made for run-off from grass verges or surrounding landscaping. These areas are assumed to have a 100% infiltration rate.
- Pipes in the network are assumed to have a roughness coefficient of 0.6mm.

A7- DESIGN EXCLUSIONS

- Temporary works.
- Foul sewer network.
- Rainwater harvesting tanks.



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A8- REFERENCES

<i>Document Reference</i>	<i>Title</i>
[1] BS EN 752:2008	Drain and sewer systems outside buildings
[2] BARRY_01_DWG_01_20131 to 20136	Site services Gas & schedule
[3] TUB/15257	Storm Water Retention Tank for Barry Biomass





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APPENDIX A – DESIGN RISK ASSESSMENT



DESIGN RISK MANAGEMENT LOG PROJECT: Surface Water Drainage



Rating	Impact
3	Fatality, Major Environmental incident involving threat to Public Health, Criminal Liability
2	Major injury to worker / 1/3 party, Operation likely to cause damage, complaint or nuisance
1	Minor injury to worker, 1/3 party Env impact requiring management response to cover.

Degree of Risk	
3	3
2	4
1	3

Likelihood	
1	1
2	2
3	3

Degree of Risk	Risk level
Low	
3 to 4	Medium
High	

Prepared by:	H ASHRAF
Checked by:	M SPENCER
Authorised by:	G BROUGHTON
Document Ref:	BARRY_01_REP_01_20063
Revision:	A
Documentation Referred to:	BARRY_01_REP_01_20063

THINK ABOUT HOW THE DESIGN IS TO BE BUILT, OPERATED, MAINTAINED, IMPACTS ON THE PUBLIC AND IS LATER DEMOLISHED

CONCEPT AND DEFINITION STAGE

IMPLEMENTATION STAGE

No	Date	Design Lead	Location	Description	Impact	Original Assmnt		Revsd Assmnt		Notes	Status
						3	2	3	1		
Design											
1	Jul-17	H Ashraf	Surface water Drainage	Buried Services	Striking live services during construction.	3	2			SHE Box to be added to drawings.	ACTIVE
2	Jul-17	H Ashraf	Surface water Drainage	Vehicle impact on ACO KerbDrains	Damage to the kerb drainage system	3	2			Notes and construction details to be added to drawings.	ACTIVE
3	Jul-17	H Ashraf	Surface water Drainage	Vehicle loading on ACO Q-Max slot drainage system	Damage to the slot drainage system	3	2			Notes and construction details to be added to drawings.	ACTIVE

Operation / Maintenance Period

Impacts on the Public

Demolition

Designers have to consider ALL HAZARDS and do what is reasonable to eliminate if feasible, or reduce risks where hazards remain. But, when it comes to PASSING ON INFORMATION, Designers do not need to mention every hazard or assumption, but they MUST POINT OUT SIGNIFICANT RISKS. These are not necessarily those that result in greatest risk, but those that are: a) not likely to be obvious to a competent Designer or Contractor, b) unusual, or c) likely to be difficult to manage effectively.

Note 1: The Appointed Temporary Works Coordinator must ensure that any temporary works designs are undertaken by a suitably competent person and be risk assessed.



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APPENDIX B – MICRODRAINAGE OUTPUT





CALCULATIONS

Client GALLAGHER TRAY
Project BARRY C&W
Section PRACTICAL DESIGN

Job no. P1616
Calcs by JY
Checked by

BYO'A
Sheet of
Date 12/07/17
Date

Reference

MICRO PIPES OUTPUT


DESIGN OF THE SURFACE WATER DRAINAGE IS CARRIED OUT USING MICRO PIPES SOFTWARE.

THE DESIGN IS BASED ON DRAINAGE ALDMS LINKED ON A SCHEME TO EFFLUENT D.

THE AHEAD IS RECORDED:


- 1:1 YEAR STORM + 20% CLIMATE CHANGE
- 1:30 YEAR STORM + 20% CLIMATE CHANGE
- 1:100 YEAR STORM + 20% CLIMATE CHANGE

THE STORM DRAINAGE CAPACITY PROVIDED IS 10080 L/S.

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The Studio 51 Brookfield Road Cheadle SK8 1ES	BARRY EFW SURFACE DRAINAGE	
Date 06/07/2017 File MODEL HA1.SUM	Designed By HA Checked By [REDACTED]	
Micro Drainage	Simulation W.11.2	

On-Line Controls (Pump)

US/PN	Volume (m ³)	Ctrl MH Name	Invert (m)	Headloss (m)	Flow (l/s)
1.006	606.202	20	5.300	0.2	3.0
				0.4	3.0
				0.6	3.0
				0.8	3.0
				1.0	3.0
				1.4	3.0
				1.8	3.0
				2.2	3.0
				2.6	3.0
				3.0	3.0
				3.4	3.0
				3.8	3.0
				4.2	3.0

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Network Details

* - Indicates pipe has been modified outside of WinDes's Storm/Foul & Schedules

PN	Length (m)	Fall (m)	Slope (1:x)	Area (ha)	T.E. (mins)	Rain Pro	k (mm)	Hyd Sect	Dia (mm)
1.000	31.10	0.104	299.0	0.124	5.00	1	0.600	o	225
1.001	16.20	0.054	300.0	0.064	0.00	1	0.600	o	300
1.002	28.15	0.094	299.5	0.058	0.00	1	0.600	o	300
2.000	29.20	0.097	301.0	0.058	5.00	1	0.600	o	225
2.001	18.58	0.062	299.7	0.016	0.00	1	0.600	o	225
1.003	9.61	0.048	200.2	0.000	0.00	1	0.600	o	300
3.000	12.88	0.043	299.5	0.008	5.00	1	0.600	o	150
3.001	19.00	0.063	301.6	0.000	0.00	1	0.600	o	150
3.002	10.92	0.037	295.1	0.036	0.00	1	0.600	o	225
3.003	11.06	0.037	298.9	0.027	0.00	1	0.600	o	300
3.004	29.60	0.100	296.0	0.058	0.00	1	0.600	o	300
3.005	25.46	0.090	282.9	0.047	0.00	1	0.600	o	300
4.000	19.26	0.064	300.9	0.052	5.00	1	0.600	o	225
3.006	27.21	0.091	299.0	0.000	0.00	1	0.600	o	300
3.007	11.08	0.939	11.8	0.035	0.00	1	0.600	o	300
1.004	31.60	0.131	240.5	0.116	0.00	1	0.600	o	600
5.000	8.79	0.051	171.0	0.036	5.00	1	0.600	o	225
1.005	10.00	0.239	41.9	0.000	0.00	1	0.600	o	600
1.006	140.00	0.050	2800.0	0.000	0.00	1	0.600	o	2400
1.007	5.00	0.300	16.7	0.000	0.00	1	0.600	o	150


PN	USMH No.	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl No.	US/MH (mm)
1.000	SW06	8.350	6.660	1.465	8.440	6.556	1.659		1200
1.001	SW05	8.440	6.556	1.584	8.477	6.502	1.675		1200
1.002	SW04	8.477	6.502	1.675	8.911	6.408	2.203		1200
2.000	SW09	8.667	7.100	1.342	8.580	7.003	1.352		1200
2.001	SW08	8.580	7.003	1.352	8.911	6.941	1.745		1200
1.003	SW03	8.911	6.408	2.203	8.990	6.360	2.330		1200
3.000	SW17	8.530	7.760	0.620	8.530	7.717	0.663		1200
3.001	SW16	8.530	7.717	0.663	8.675	7.654	0.871		1200
3.002	SW15	8.675	7.654	0.796	8.675	7.617	0.833		1200
3.003	SW14	8.675	7.617	0.758	8.640	7.580	0.760		1200
3.004	SW13	8.640	7.580	0.760	8.640	7.480	0.860		1200
3.005	SW12	8.640	7.480	0.860	9.300	7.390	1.610		1200
4.000	SW10	9.300	7.450	1.625	9.300	7.386	1.689		1800
3.006	SW11	9.300	7.390	1.610	8.900	7.299	1.301		1800
3.007	SW07	8.900	7.299	1.301	8.990	6.360	2.330		1200
1.004	SW02	8.990	6.360	2.030	9.000	6.229	2.171		1800
5.000	SW18	9.000	6.280	2.495	9.000	6.229	2.546		1800
1.005	SW01	9.000	6.229	2.171	9.000	5.990	2.410		1800
1.006	tubosider tank	9.000	5.400	1.200	9.000	5.350	1.250		10500
1.007	20	9.000	5.300	3.550	9.300	5.000	4.150	5	1500

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Micro Drainage		Simulation W.11.2



MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam., L*W (mm)	Pipes Out			Pipes In		
				PN	IL. (m)	D (mm)	PN	IL. (m)	D (mm)
SW06	8.350	1.690	1200	1.000	6.660	225			
SW05	8.440	1.884	1200	1.001	6.556	300	1.000	6.556	225
SW04	8.477	1.975	1200	1.002	6.502	300	1.001	6.502	300
SW09	8.667	1.567	1200	2.000	7.100	225			
SW08	8.580	1.577	1200	2.001	7.003	225	2.000	7.003	225
SW03	8.911	2.503	1200	1.003	6.408	300	1.002 2.001	6.408 6.941	300 225
SW17	8.530	0.770	1200	3.000	7.760	150			
SW16	8.530	0.813	1200	3.001	7.717	150	3.000	7.717	150
SW15	8.675	1.021	1200	3.002	7.654	225	3.001	7.654	150
SW14	8.675	1.058	1200	3.003	7.617	300	3.002	7.617	225
SW13	8.640	1.060	1200	3.004	7.580	300	3.003	7.580	300
SW12	8.640	1.160	1200	3.005	7.480	300	3.004	7.480	300
SW10	9.300	1.850	1800	4.000	7.450	225			
SW11	9.300	1.910	1800	3.006	7.390	300	3.005 4.000	7.390 7.386	300 225
SW07	8.900	1.601	1200	3.007	7.299	300	3.006	7.299	300
SW02	8.990	2.630	1800	1.004	6.360	600	1.003 3.007	6.360 6.360	300 300
SW18	9.000	2.720	1800	5.000	6.280	225			
SW01	9.000	2.771	1800	1.005	6.229	600	1.004 5.000	6.229 6.229	600 225
tubosider tank	9.000	3.600	10500	1.006	5.400	2400	1.005	5.990	600
20	9.000	3.700	1500	1.007	5.300	150	1.006	5.350	2400
Road	9.300	4.300	1200		OUTFALL		1.007	5.000	150

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Summary Wizard of "CRITICAL BY RETURN PERIOD" (Rank 1 by Max Level)
Results for Design Storms

Margin for Flood Risk warning (mm) 300 Inertia Status OFF
 DTS Status ON Analysis Time Step Fine
 DVD Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440, 2160,
 2880, 4320, 5760, 7200, 8640, 10080
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 20, 20, 20

PN	Storm	Return Period	Climate Change	Rank	First X SurchARGE	First Y Flood	First Z Overflow	O/F Act
1.000	15 Winter	1	20%	1	30/15 Summer			
1.001	15 Winter	1	20%	1	30/15 Summer			
1.002	15 Winter	1	20%	1	30/15 Summer			
2.000	15 Winter	1	20%	1				
2.001	15 Winter	1	20%	1				
1.003	15 Winter	1	20%	1	30/15 Summer			
3.000	15 Winter	1	20%	1	100/15 Summer			
3.001	15 Winter	1	20%	1	100/15 Summer			
3.002	15 Winter	1	20%	1	100/15 Summer			
3.003	15 Winter	1	20%	1	100/15 Winter			
3.004	15 Winter	1	20%	1	100/15 Summer			
3.005	15 Winter	1	20%	1	100/15 Summer			
4.000	15 Winter	1	20%	1	30/15 Summer			
3.006	15 Winter	1	20%	1	100/15 Summer			
3.007	15 Winter	1	20%	1				
1.004	15 Winter	1	20%	1				
5.000	15 Winter	1	20%	1	30/15 Winter			
1.005	15 Winter	1	20%	1	100/960 Winter			
1.006	960 Winter	1	20%	1				
1.007	960 Winter	1	20%	1	1/15 Summer			

Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
	1.000	6.786	-0.099	0.000	0.58	0.0	16.2	O K
	1.001	6.699	-0.157	0.000	0.42	0.0	22.6	O K
	1.002	6.653	-0.149	0.000	0.50	0.0	28.6	O K
	2.000	7.181	-0.144	0.000	0.27	0.0	7.6	O K
	2.001	7.094	-0.134	0.000	0.35	0.0	9.3	O K
	1.003	6.579	-0.129	0.000	0.61	0.0	37.2	O K
	3.000	7.794	-0.116	0.000	0.11	0.0	1.1	O K
	3.001	7.752	-0.115	0.000	0.11	0.0	1.0	O K
	3.002	7.729	-0.150	0.000	0.19	0.0	4.9	O K
	3.003	7.705	-0.212	0.000	0.15	0.0	7.9	O K
	3.004	7.681	-0.199	0.000	0.24	0.0	14.1	O K
	3.005	7.597	-0.183	0.000	0.32	0.0	18.7	O K
	4.000	7.543	-0.132	0.000	0.24	0.0	6.5	O K
	3.006	7.526	-0.164	0.000	0.42	0.0	24.1	O K
	3.007	7.366	-0.233	0.000	0.11	0.0	27.2	O K
	1.004	6.546	-0.414	0.000	0.21	0.0	75.3	O K
	5.000	6.392	-0.113	0.000	0.13	0.0	4.1	O K
	1.005	6.388	-0.441	0.000	0.16	0.0	78.2	O K
	1.006	5.983	-1.817	0.000	0.00	0.0	8.0	O K
	1.007	5.984	0.534	0.000	0.09	0.0	3.0	SURCH'ED

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Summary Wizard of "CRITICAL BY RETURN PERIOD" (Rank 1 by Max Level)
Results for Design Storms

Margin for Flood Risk warning (mm) 300 Inertia Status OFF
 DTS Status ON Analysis Time Step Fine
 DVD Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440, 2160,
 2880, 4320, 5760, 7200, 8640, 10080
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 20, 20, 20

PN	Storm	Return Period	Climate Change	Rank	First X Surcharge	First Y Flood	First Z Overflow	O/F Act
1.000	15 Winter	30	20%	1	30/15 Summer			
1.001	15 Winter	30	20%	1	30/15 Summer			
1.002	15 Winter	30	20%	1	30/15 Summer			
2.000	15 Winter	30	20%	1				
2.001	15 Winter	30	20%	1				
3.000	15 Winter	30	20%	1	100/15 Summer			
3.001	15 Winter	30	20%	1	100/15 Summer			
3.002	15 Winter	30	20%	1	100/15 Summer			
3.003	15 Winter	30	20%	1	100/15 Winter			
3.004	15 Winter	30	20%	1	100/15 Summer			
3.005	15 Winter	30	20%	1	100/15 Summer			
4.000	15 Winter	30	20%	1	30/15 Summer			
3.006	15 Winter	30	20%	1	100/15 Summer			
3.007	15 Winter	30	20%	1				
1.004	15 Winter	30	20%	1				
5.000	960 Winter	30	20%	1	30/15 Winter			
1.005	960 Winter	30	20%	1	100/960 Winter			
1.006	960 Winter	30	20%	1				
1.007	960 Winter	30	20%	1	1/15 Summer			

Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000		6.998	-0.142	0.000	0.98	0.0	52.9	SURCH'ED
1.001		6.998	-0.142	0.000	0.98	0.0	52.9	SURCH'ED
2.000		7.238	-0.087	0.000	0.67	0.0	18.5	O K
2.001		7.165	-0.063	0.000	0.86	0.0	23.1	O K
3.000		7.836	-0.074	0.000	0.27	0.0	2.5	O K
3.001		7.828	-0.039	0.000	0.31	0.0	3.0	O K
3.002		7.819	-0.060	0.000	0.54	0.0	13.6	O K
3.003		7.803	-0.114	0.000	0.44	0.0	22.3	O K
3.004		7.790	-0.090	0.000	0.68	0.0	39.7	O K
3.005		7.748	-0.032	0.000	0.85	0.0	50.0	O K
4.000		7.719	0.044	0.000	0.53	0.0	14.3	SURCH'ED
3.006		7.407	-0.192	0.000	0.28	0.0	67.0	O K
1.004		6.670	-0.290	0.000	0.51	0.0	186.6	O K
5.000		6.573	0.068	0.000	0.03	0.0	1.1	SURCH'ED
1.005		6.574	-0.255	0.000	0.04	0.0	21.9	O K
1.006		6.573	-1.227	0.000	0.00	0.0	17.2	O K
1.007		6.573	1.123	0.000	0.09	0.0	3.0	SURCH'ED

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PN	Storm	Return Period	Climate Change	Rank	First X Surcharge	First Y Flood	First Z Overflow	O/F Act
1.000	15 Winter	100	20%	1	30/15 Summer			
1.001	15 Winter	100	20%	1	30/15 Summer			
1.002	15 Winter	100	20%	1	30/15 Summer			
2.000	15 Winter	100	20%	1				
3.000	15 Winter	100	20%	1	30/15 Summer			
3.001	15 Winter	100	20%	1	100/15 Summer			
3.002	15 Winter	100	20%	1	100/15 Summer			
3.003	15 Winter	100	20%	1	100/15 Summer			
3.004	15 Winter	100	20%	1	100/15 Winter			
3.005	15 Winter	100	20%	1	100/15 Summer			
4.000	15 Winter	100	20%	1	30/15 Summer			
3.007	15 Winter	100	20%	1	100/15 Summer			
1.004	960 Winter	100	20%	1				
5.000	960 Winter	100	20%	1	30/15 Winter			
1.005	960 Winter	100	20%	1	100/960 Winter			
1.006	960 Winter	100	20%	1				
1.007	960 Winter	100	20%	1	1/15 Summer			

Lvl Ex.	PN	Water Lvl. (m)	Surcharged Depth (m)	Flooded Vol (m³)	Flow/Capacity	Overflow (l/s)	Pipe Flow (l/s)	Status
1.000		7.296	0.000	0.000	0.00	0.0	48.0	OK
1.001		7.296	0.000	0.000	0.00	0.0	48.0	OK
1.002		7.296	0.000	0.000	0.00	0.0	48.0	OK
2.000		7.296	-0.029	0.000	0.83	0.0	23.1	OK
3.000		7.964	0.054	0.000	0.34	0.0	3.2	SURCH'ED
3.001		7.954	0.087	0.000	0.51	0.0	4.8	SURCH'ED
3.002		7.946	0.067	0.000	0.58	0.0	14.7	SURCH'ED
3.003		7.925	0.008	0.000	0.48	0.0	24.2	SURCH'ED
3.004		7.908	0.028	0.000	0.78	0.0	45.4	SURCH'ED
3.005		7.881	0.000	0.000	0.00	0.0	48.0	OK
4.000		7.795	0.120	0.000	0.72	0.0	19.2	SURCH'ED
3.007		7.424	-0.175	0.000	0.36	0.0	87.1	OK
1.004		6.856	-0.104	0.000	0.07	0.0	26.3	OK
5.000		6.856	0.351	0.000	0.04	0.0	1.3	SURCH'ED
1.005		6.857	0.028	0.000	0.06	0.0	27.4	SURCH'ED
1.006		6.856	-0.944	0.000	0.00	0.0	21.6	OK
1.007		6.856	1.406	0.000	0.09	0.0	3.0	SURCH'ED



BARRY_01_REP_01_20063

REPORT

APPENDIX C – ACO DRAINAGE DESIGN OUTPUT





ACO Design
Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Haroon Ashraf

Date: 11-07-2017

Run No.: 3 Option No.: A

RAINFALL INTENSITY

 RETURN PERIOD 30 years
 R 0.34
 M5-60 19.0 (mm/h)

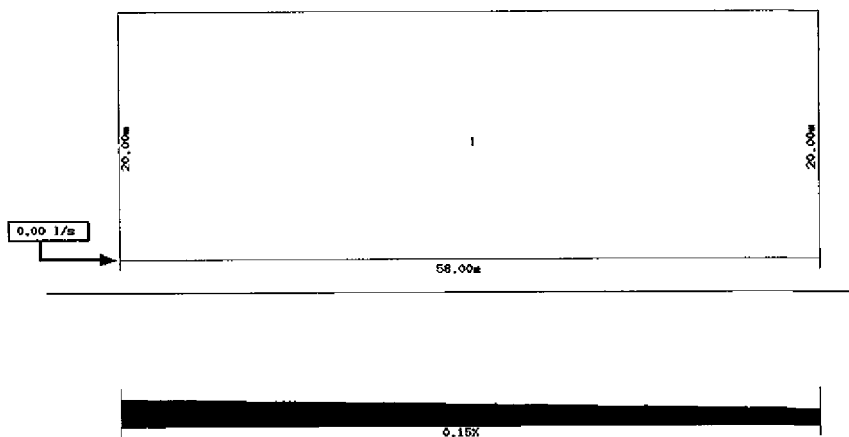
RAINFALL DATA

Duration	Intensity (mm/h)
10 mins	82.54
15 mins	71.62
30 mins	47.43
1 hour	29.91
2 hours	18.59
4 hours	11.08
6 hours	8.13
10 hours	5.57
24 hours	2.87
48 hours	1.63

RAINFALL SPECIFIED

ALLOWANCE FOR CLIMATE CHANGE	20.0	%
DESIGN RAINFALL INTENSITY	126.78	(mm/h)
	0.0352	l/s m ²

CHANNEL LAYOUT





ACO Design
Hydraulic Calculation:

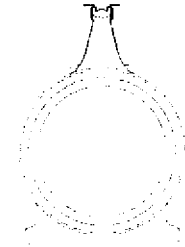
+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Haroon Ashraf
Date: 11-07-2017

+ INPUT

Channel System: Qmax



	1	2	3	4	5	6	7	8	9	10
System	Qmax 150	Qmax 225	Qmax 350							
W – Width (mm)	150	225	350							
H – Invert (mm)	350	425	550							
Length (m)	8	34	16							

Kinematic Viscosity (m ² /s)	1.14x10 ⁻⁶	Area Drained (m ²)	1160.00
Rainfall Intensity (l/s x m)	0.0352 (= 126.78mm/h)	Impermeability	1.00
		Channel Length (m)	58.00

+ RESULTS

Outflow (l/s):	40.893
Max. Velocity (m/s):	1.06
Min. Freeboard (m):	0.000
Percentage Capacity (%):	99.97%
Max. Valid Length (m):	58.00 (Full Length)

Notes:

CX03



ACO Design

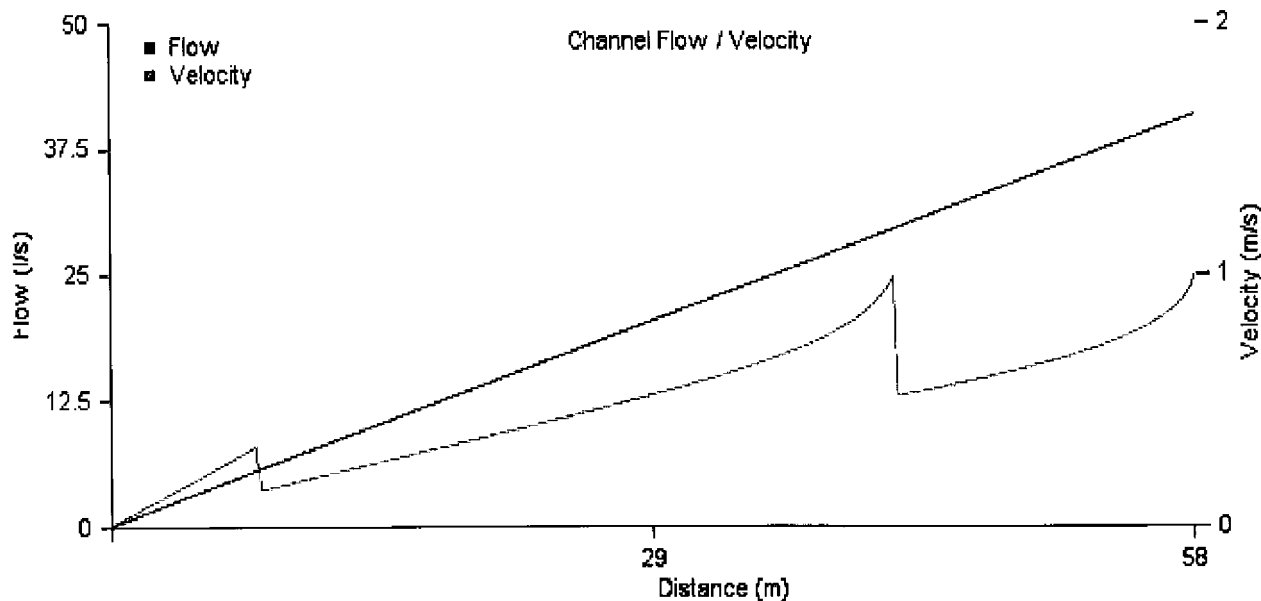
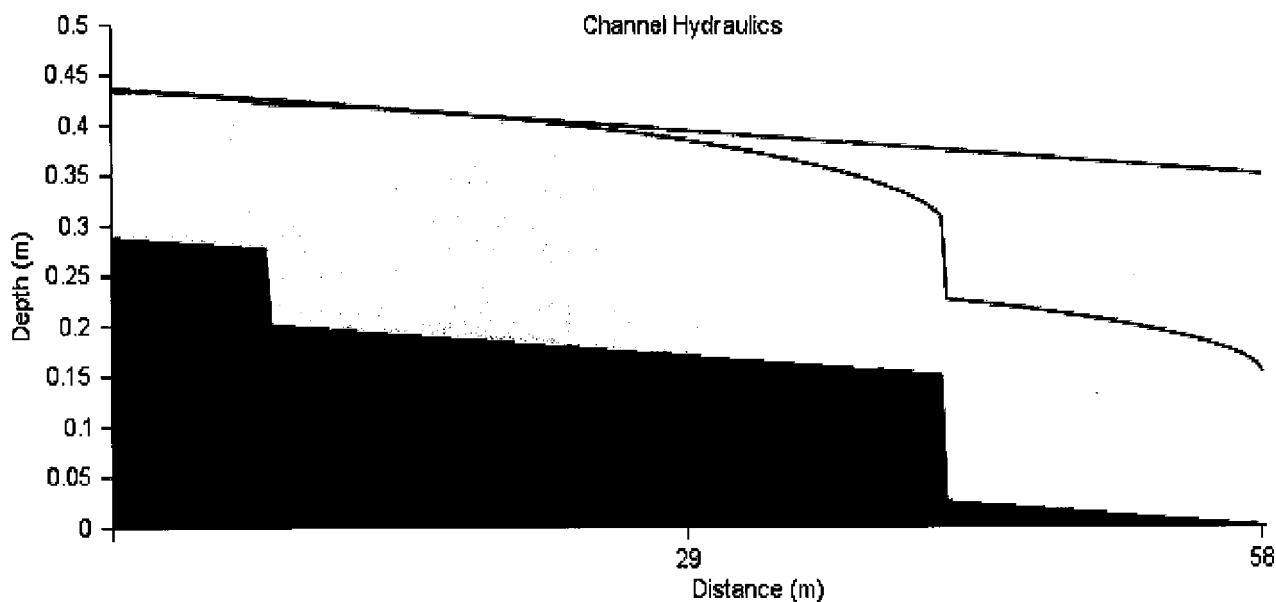
Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Haroon Ashraf

Date: 11-07-2017





ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Haroon Ashraf

Date: 11-07-2017

DISCLAIMER

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INPUT

CATCHMENT AREA

(m²)

MAX PERMITTED
OUTFLOW

l/s

RESULT

OUTPUT

R

l/s

STORAGE VOLUME OF
CURRENT CHANNEL

m³

M5-60

mm/h

RETURN PERIOD

CLIMATE CHANGE

%

DURATION

INTENSITY
mm/h

REQUIRED
STORAGE
VOLUME (m³)

No Attenuation Calculation Performed.



ACO Design Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

Run No.: 4 Option No.: A

RAINFALL INTENSITY

RETURN PERIOD 30 years

R 0.34

M5-60 19.0 (mm/h)

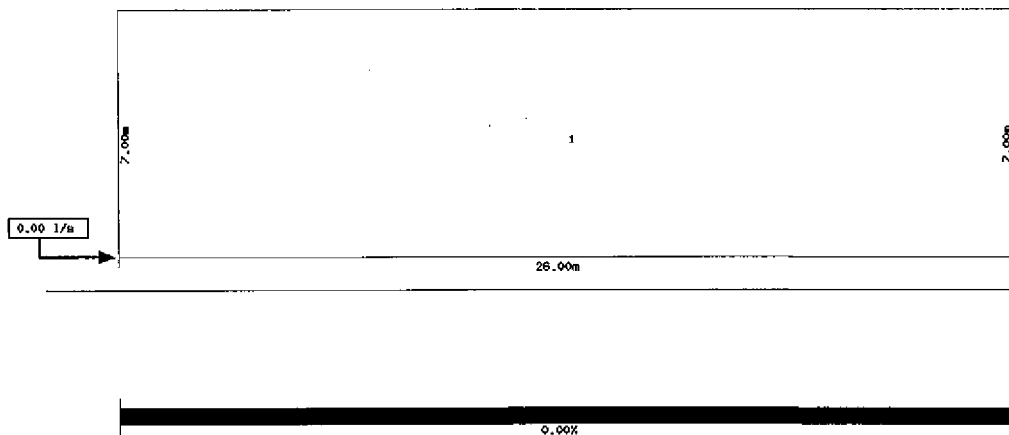
RAINFALL DATA

Duration	Intensity (mm/h)
10 mins	82.54
15 mins	71.62
30 mins	47.43
1 hour	29.91
2 hours	18.59
4 hours	11.08
6 hours	8.13
10 hours	5.57
24 hours	2.87
48 hours	1.63

RAINFALL SPECIFIED

ALLOWANCE FOR CLIMATE CHANGE	20.0	%
DESIGN RAINFALL INTENSITY	126.78	(mm/h)
	0.0352	l/s m ²

CHANNEL LAYOUT





ACO Design
Hydraulic Calculation:

+ PROJECT DETAILS

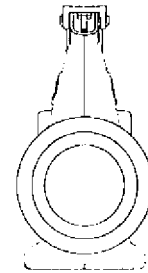
Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

+ INPUT

Channel System: Qmax



	1	2	3	4	5	6	7	8	9	10
System	Qmax 150									
W – Width (mm)	150									
H – Invert (mm)	350									
Length (m)	26.00									

Kinematic Viscosity (m ² /s)	1.14x10 ⁻⁶	Area Drained (m ²)	182.00
Rainfall Intensity (l/s x m)	0.0352 (= 126.78mm/h)	Impermeability	1.00
		Channel Length (m)	26.00

+ RESULTS

Outflow (l/s):	6.416
Max. Velocity (m/s):	0.69
Min. Freeboard (m):	0.022
Percentage Capacity (%):	90.70%
Max. Valid Length (m):	26.00 (Full Length)

Notes:

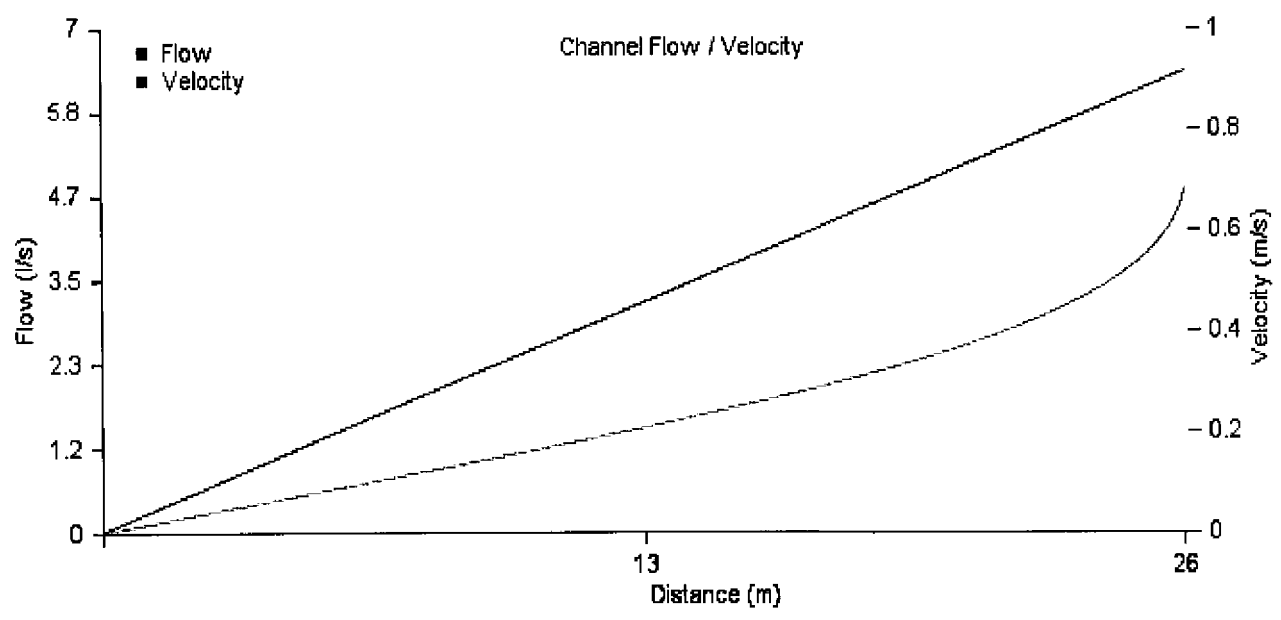
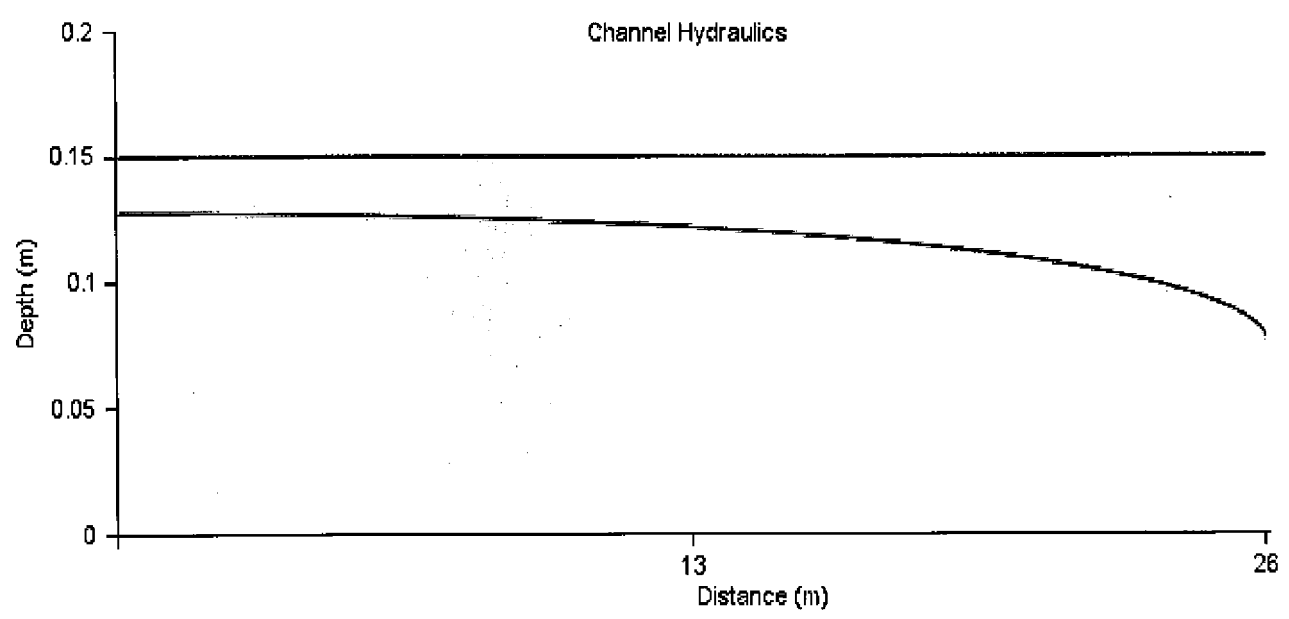


ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name: Barry EFW
Designer: Matthew Spence
Date: 23-08-2016





ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

DISCLAIMER

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INPUT

CATCHMENT AREA

(m²)

MAX PERMITTED
OUTFLOW

l/s

RESULT

OUTPUT

R

l/s

M5-60

mm/h

DURATION

INTENSITY
mm/h

STORAGE VOLUME OF
CURRENT CHANNEL

m³

RETURN PERIOD

CLIMATE CHANGE

%

REQUIRED
STORAGE
VOLUME (m³)

No Attenuation Calculation Performed.



ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

Run No.: 5 Option No.: A

RAINFALL INTENSITY

RETURN PERIOD	30 years
R	0.34
M5-60	19.0 (mm/h)



WARNING - CRITICAL FLOW ENCOUNTERED

The flow in this channel varies between sub-critical and super-critical conditions so the depth / velocity calculation is not precise. However, your selected channel will have sufficient capacity to accommodate the defined flow. Note that optimised solutions will only suggest non-turbulent, sub-critical flow regimes.

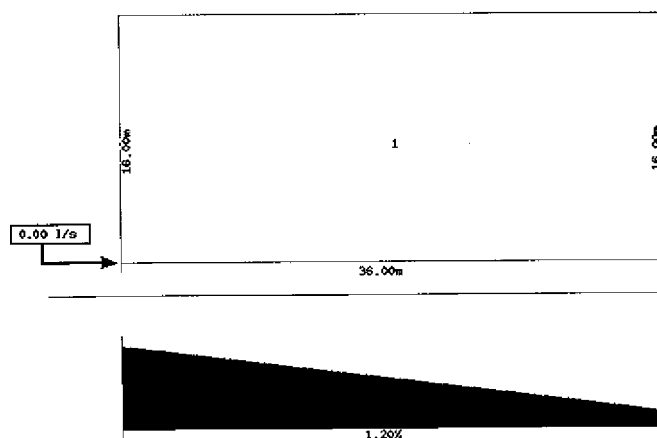
RAINFALL DATA

Duration	Intensity (mm/h)
10 mins	82.54
15 mins	71.62
30 mins	47.43
1 hour	29.91
2 hours	18.59
4 hours	11.08
6 hours	8.13
10 hours	5.57
24 hours	2.87
48 hours	1.63

RAINFALL SPECIFIED

ALLOWANCE FOR CLIMATE CHANGE	20.0	%
DESIGN RAINFALL INTENSITY	126.78	(mm/h)
	0.0352	l/s m ²

CHANNEL LAYOUT





ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

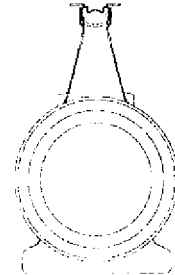
Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

+ INPUT

Channel System: Qmax



	1	2	3	4	5	6	7	8	9	10
System	Qmax 225									
W – Width (mm)	225									
H – Invert (mm)	425									
Length (m)	36.00									

Kinematic Viscosity (m ² /s)	1.14x10 ⁻⁶	Area Drained (m ²)	576.00
Rainfall Intensity (l/s x m)	0.0352 (= 126.78mm/h)	Impermeability	1.00
		Channel Length (m)	36.00

+ RESULTS

Outflow (l/s):	20.305
Max. Velocity (m/s):	0.91
Min. Freeboard (m):	0.102
Percentage Capacity (%):	55.98%
Max. Valid Length (m):	36.00 (Full Length)

Notes:

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ACO Business Park
Hitchin Road, Shefford
Bedfordshire SG17 5TE

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Fax: +44 (0)1462 815895

email: technologies@aco.co.uk
www.aco.co.uk

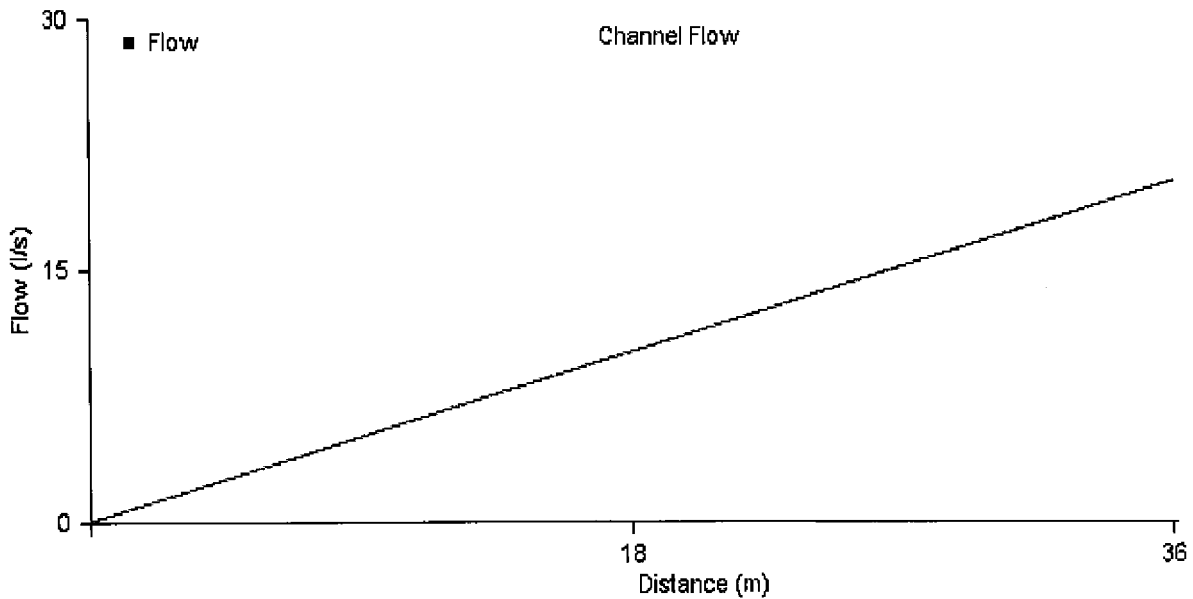
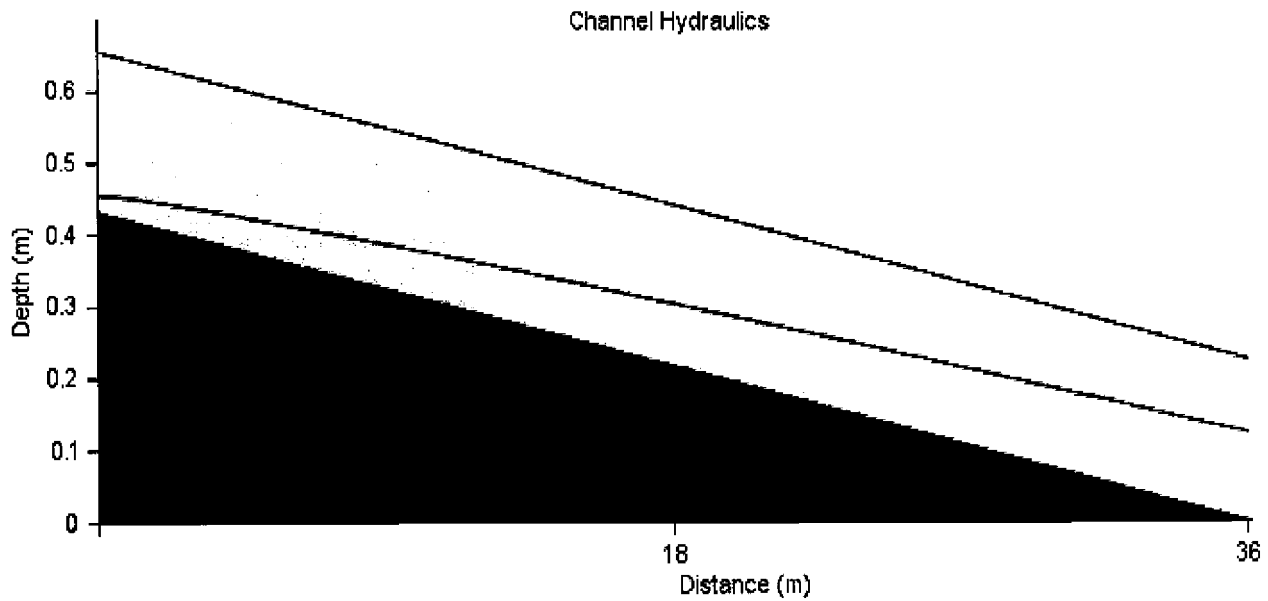


ACO Design
Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Matthew Spencer
Date: 23-08-2016



ACO Design
 Hydraulic Calculation:



+ PROJECT DETAILS

Project Name:
 Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

DISCLAIMER

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INPUT

OUTPUT

CATCHMENT AREA	(m ²)	R	l/s	STORAGE VOLUME OF CURRENT CHANNEL	m ³
MAX PERMITTED OUTFLOW	l/s	M5-60	mm/h	RETURN PERIOD	
RESULT				CLIMATE CHANGE	%
		DURATION	INTENSITY mm/h	REQUIRED STORAGE VOLUME (m ³)	

No Attenuation Calculation Performed.



ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Haroon Ashraf

Date: 11-07-2017

Run No.: 6 Option No.: A

RAINFALL INTENSITY

RETURN PERIOD	30 years
R	0.34
M5-60	19.0 (mm/h)

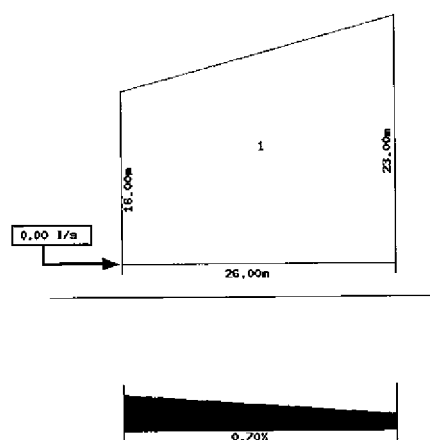
RAINFALL DATA

Duration	Intensity (mm/h)
10 mins	82.54
15 mins	71.62
30 mins	47.43
1 hour	29.91
2 hours	18.59
4 hours	11.08
6 hours	8.13
10 hours	5.57
24 hours	2.87
48 hours	1.63

RAINFALL SPECIFIED

ALLOWANCE FOR CLIMATE CHANGE	20.0	%
DESIGN RAINFALL INTENSITY	126.78	(mm/h)
	0.0352	l/s m ²

CHANNEL LAYOUT



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ACO Business Park
Hitchin Road, Shefford
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email: technologies@aco.co.uk
www.aco.co.uk



ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Haroon Ashraf

Date: 11-07-2017

+ INPUT

Channel System: Qmax



	1	2	3	4	5	6	7	8	9	10
System	Qmax 150	Qmax 225								
W – Width (mm)	150	225								
H – Invert (mm)	350	425								
Length (m)	20	6								

Kinematic Viscosity (m ² /s)	1.14x10 ⁻⁶	Area Drained (m ²)	507.00
Rainfall Intensity (l/s x m)	0.0352 (= 126.78mm/h)	Impermeability	1.00
		Channel Length (m)	26.00

+ RESULTS

Outflow (l/s):	17.876
Max. Velocity (m/s):	0.94
Min. Freeboard (m):	0.010
Percentage Capacity (%):	96.99%
Max. Valid Length (m):	26.00 (Full Length)

Notes:



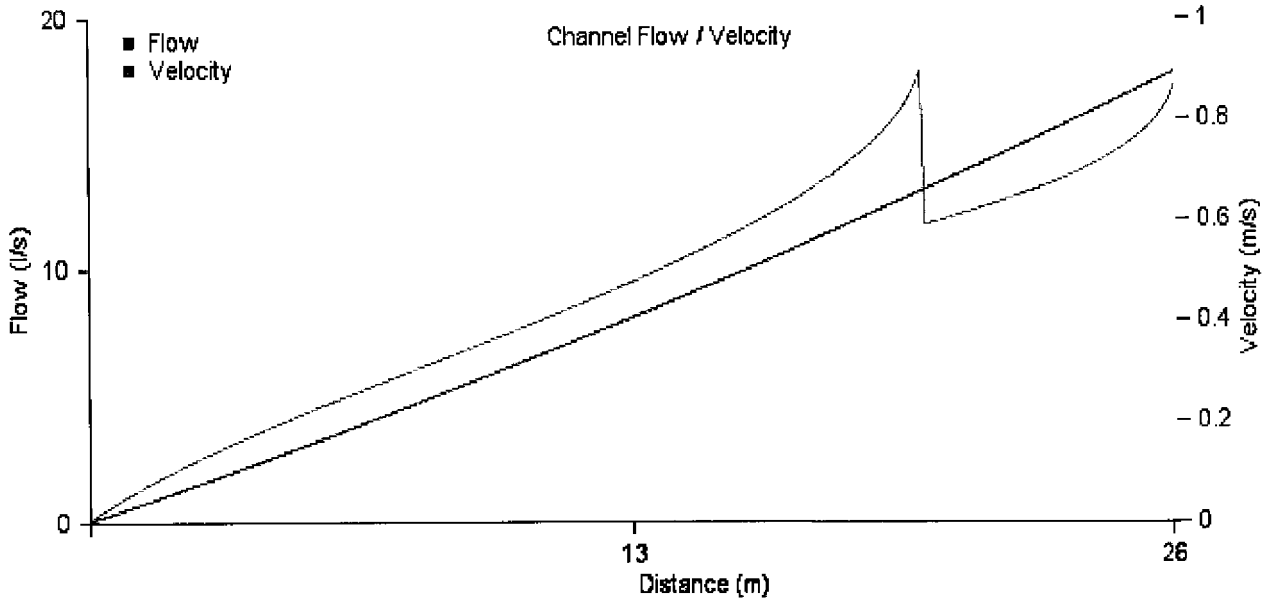
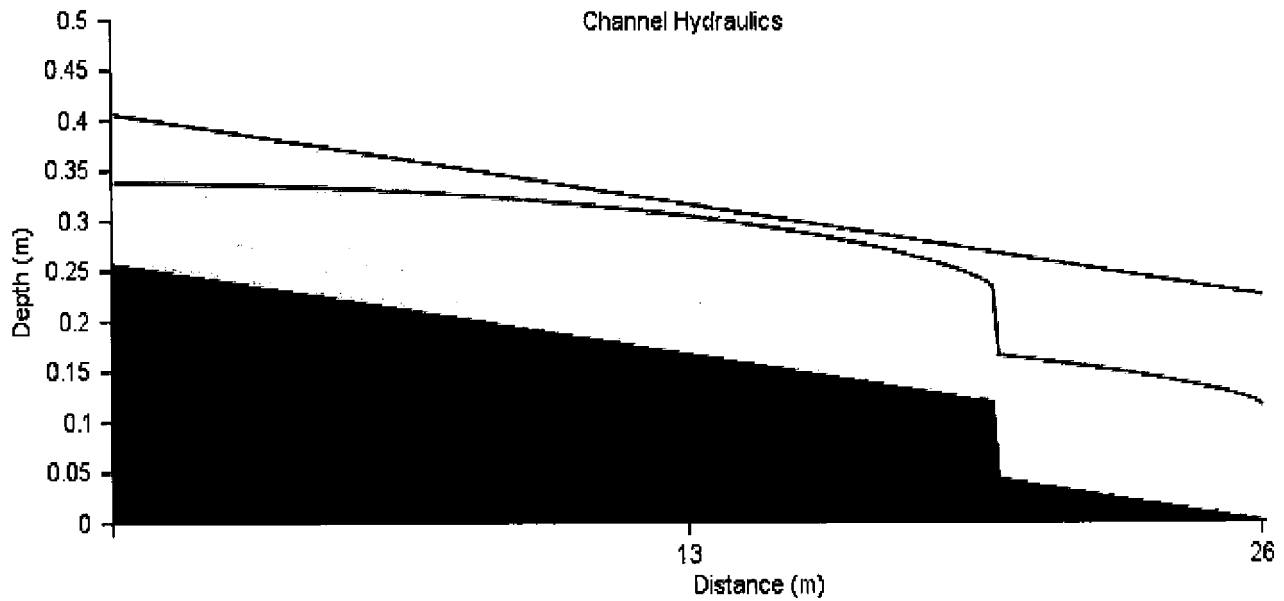
ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Haroon Ashraf
Date: 11-07-2017





ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Haroon Ashraf
Date: 11-07-2017

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INPUT

CATCHMENT AREA

(m²)

MAX PERMITTED
OUTFLOW

l/s

RESULT

OUTPUT

R

l/s

STORAGE VOLUME OF
CURRENT CHANNEL

m³

M5-60

mm/h

RETURN PERIOD

CLIMATE CHANGE

%

DURATION

INTENSITY
mm/h

REQUIRED
STORAGE
VOLUME (m³)

No Attenuation Calculation Performed.



ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

Run No.: 7 Option No.: A

RAINFALL INTENSITY

RETURN PERIOD 30 years

R 0.34

M5-60 19.0 (mm/h)

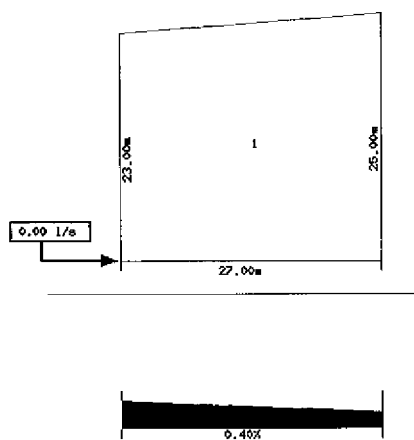
RAINFALL DATA

Duration	Intensity (mm/h)
10 mins	82.54
15 mins	71.62
30 mins	47.43
1 hour	29.91
2 hours	18.59
4 hours	11.08
6 hours	8.13
10 hours	5.57
24 hours	2.87
48 hours	1.63

RAINFALL SPECIFIED

ALLOWANCE FOR CLIMATE CHANGE	20.0	%
DESIGN RAINFALL INTENSITY	126.78	(mm/h)
	0.0352	l/s m ²

CHANNEL LAYOUT



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www.aco.co.uk



ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

+ INPUT

Channel System: Qmax



	1	2	3	4	5	6	7	8	9	10
System	Qmax 225									
W – Width (mm)	225									
H – Invert (mm)	425									
Length (m)	27.00									

Kinematic Viscosity (m ² /s)	1.14x10 ⁻⁶	Area Drained (m ²)	648.00
Rainfall Intensity (l/s x m)	0.0352 (= 126.78mm/h)	Impermeability	1.00
		Channel Length (m)	27.00

+ RESULTS

Outflow (l/s):	0.000
Max. Velocity (m/s):	0.00
Min. Freeboard (m):	0.000
Percentage Capacity (%):	0.00%
Max. Valid Length (m):	27.00 (Full Length)

Notes:



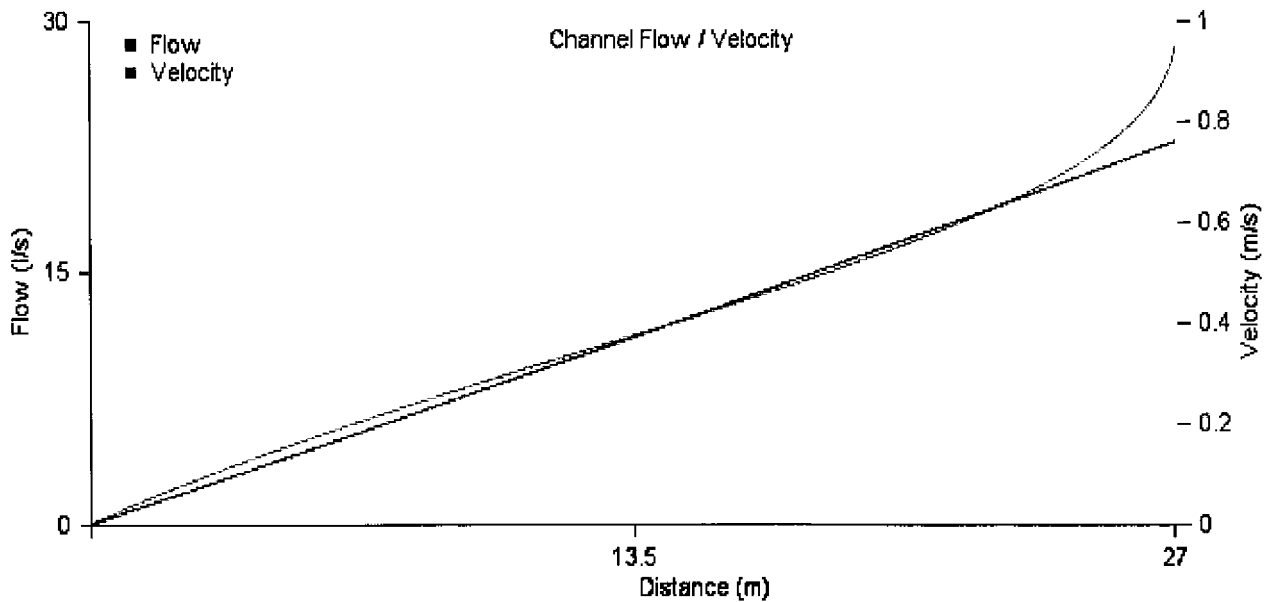
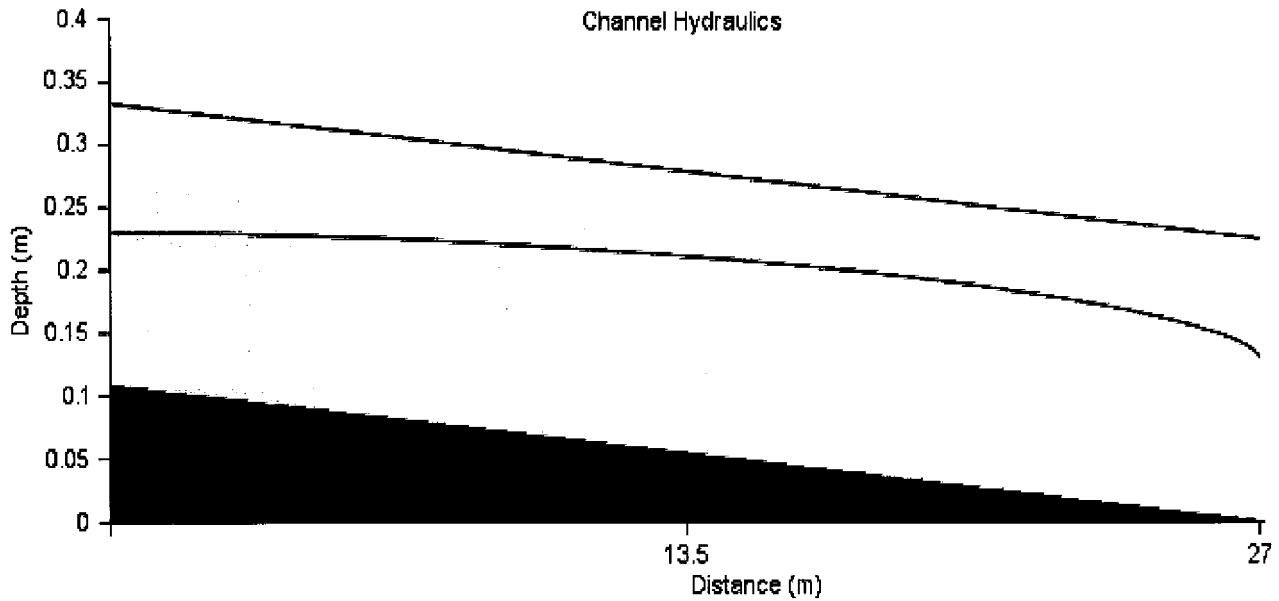
ACO Design
Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016





ACO Design

Hydraulic Calculation:

+ PROJECT DETAILS

Project Name:
Barry EFW

Designer: Matthew Spencer

Date: 23-08-2016

DISCLAIMER

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INPUT

OUTPUT

INPUT		OUTPUT			
CATCHMENT AREA	(m ²)	R	l/s	STORAGE VOLUME OF CURRENT CHANNEL	m ³
MAX PERMITTED OUTFLOW	l/s	M5-60	mm/h	RETURN PERIOD	
RESULT				CLIMATE CHANGE	%
		DURATION	INTENSITY mm/h	REQUIRED STORAGE VOLUME (m ³)	

No Attenuation Calculation Performed.



BARRY_01_REP_01_20063

REPORT

APPENDIX D – REFERENCE DRAWINGS

