

Drainage Assessment

Residential Development Hough Lane, Wombwell Barnsley

September 2017

Issue 01



FAIRHURST

CONTROL SHEET

CLIENT: Balmoral Group Holdings Ltd.

PROJECT TITLE: Residential Development, Hough Lane, Wombwell, Barnsley

REPORT TITLE: Drainage Assessment

PROJECT REFERENCE: 117436

DOCUMENT NUMBER: 117436-DA

Issue & Approval Schedule	ISSUE 1		Name		Signature		Date	
	Prepared by		A. Gray				11/09/2017	
	Checked by		K. Thomson				11/09/2017	
	Approved by		A. Scott-Kiddie				11/09/2017	
Revision Record	Rev.	Date	Status	Description	Signature			
	1				By			
					Checked			
					Approved			
	2				By			
					Checked			
					Approved			

This document has been prepared in accordance with procedure OP/P02 of the *Fairhurst Quality and Environmental Management System*

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Drainage Assessment

This drainage assessment is prepared in accordance with the guidance given in the following documents:-

- Water Assessment and Drainage Assessment Guide – Working SUDS Party.
- The SUDS Manual – (CIRIA C753).
- SUDS for Roads.
- Sewers for Adoption, 7th Edition

The Development Proposal

The client, Balmoral Group Holdings, propose to develop a new residential development, at the site of a former industrial site, on Hough lane, Wombwell, Barnsley.

The 1.485 Ha brownfield site is located at OS Ref: SE3907802480, and is bounded to the North by Hough Lane, to the East and West by existing residential developments, and to the South by existing greenfield land.

For details of the site location, and conceptual drainage layout, refer to Appendix B – Drawings 117436/9500 & 2000.

Existing Drainage

Private Drainage

Private drainage currently serving the existing site is to be abandoned/removed as required.

Public Sewers

There are existing surface and foul sewers located within the adjacent residential developments. Further site investigation will be carried out to confirm the location of public drainage within the site. Any public drainage within the site will be re-routed as required.

Foul Drainage

Foul flows from the houses will discharge via the plot drainage to a disconnection chamber, which will drain into the new public gravity sewers. The new sewers will gravitate to a pumping station, which will pump flows via a break-pressure chamber, to the existing combined sewer within Hough Lane.

For details of the conceptual drainage layout, refer to Appendix B – Drawing 117436/2000.

Surface Water Drainage

Referring to The SUDS Manual (CIRIA C753), the surface water run-off will be dealt with as follows:-

Building Roof Area

Surface water run-off from the building roof areas will drain via downpipes to the new plot drainage, which will discharge via a disconnection chamber to the new gravity sewers within the road. The sewers will gravitate to the extended detention basin, which will discharge at a restricted rate via new gravity sewers to existing surface water drainage to the south of the site.

Indicative SUDS Mitigation Indices for Surface Water Runoff from Building roof Areas			
Where mitigation indices exceed pollution indices, the cell is highlighted GREEN			
	Total Suspended solids (TSS)	Metals	Hydrocarbons
<u>Pollution Indices</u>			
Building Roof	0.2	0.2	0.05
<u>Mitigation Indices</u>			
Extended Detention Basin	0.5	0.5	0.6
Total	0.5	0.5	0.6

Driveways/Car Parking

Surface water from the driveways will permeate through the porous surface (in accordance with CIRIA specification), and be drained to ground at source where practicable. Where the subsoils do not permit drainage at source, the porous surface will be contained and flows directed to the surface water sewer.

Indicative SUDS Mitigation Indices for Surface Water Runoff from Driveway/Car Park			
Where mitigation indices exceed pollution indices, the cell is highlighted GREEN			
	Total Suspended solids (TSS)	Metals	Hydrocarbons
<u>Pollution Indices</u>			
Driveway/Car Park	0.5	0.4	0.4
<u>Mitigation Indices</u>			
Permeable Paving	0.7	0.6	0.7
Total	0.7	0.6	0.7

Roads

Surface water run-off from the road areas will shed to gullies, which will drain to the new gravity sewers within the road. The new sewers will gravitate to the extended detention basin, which will discharge at a restricted rate via new gravity sewers to existing surface water drainage to the south of the site.

Indicative SUDS Mitigation Indices for Surface Water Runoff from Road Areas			
Where mitigation indices exceed pollution indices, the cell is highlighted GREEN			
	Total Suspended solids (TSS)	Metals	Hydrocarbons
<u>Pollution Indices</u>			
Roads	0.5	0.4	0.4
<u>Mitigation Indices</u>			
Extended Detention Basin	0.5	0.5	0.6
Total	0.5	0.5	0.6

For details of the conceptual drainage layout, refer to Appendix B – Drawing 117436/2000.

Hydraulic Control

In accordance with the Water Assessment and Drainage Assessment guide, the rate and volume of surface water run-off from the post development situation should not exceed the surface water run-off from the existing brownfield site.

Attenuation volume for the site will be provided within the extended detention basin. The basin will contain the run-off volumes generated by the critical 100 year rainfall event (plus 30% climate change) within the site, detailed as follows:

The total development area that will drain to the basin is 0.835 Ha. We have calculated that the current unrestricted discharge from this area is 90.5 l/sec. We therefore propose a restricted discharge rate of 18.1 l/sec, based on 20% of the existing brownfield discharge rate.

As part of the detailed drainage design for the development area, sensitivity tests to assess flood risk from the drainage system will be carried out for rainfall events up to and including the 100 year, plus climate change, rainfall return event. Site levels will be set in order to prevent water entering buildings or restricting access for emergency vehicles.

Soakaways or infiltration trenches will be designed in accordance with BRE Digest 365 and will contain the run-off volume generated by the critical 30 year return period rainfall event.

For details of the conceptual drainage layout, refer to Appendix B – Drawing 117436/2000.

For details of the attenuation calculations, refer to Appendix C.

Maintenance

- Drainage within the house plots, including pipes and disconnection chambers, will remain private and will be owned and maintained by the individual house owners.
- The public drainage, including sewers, gullies and the basin will be adopted by Barnsley Council.
- The developer will own the drainage system until it is adopted. The developer will also remain responsible for maintenance of the drainage system until Barnsley Council issue a Completion Certificate for the drainage system, at which time they will assume responsibility for maintenance of the elements they are to adopt.

Construction Phase SUDS

A method statement, detailing how surface water arising during construction will be dealt with, will be prepared by the contractor for approval prior to commencement of works on site.

During the development of the site a surface water management strategy will be prepared for each individual construction phase. This strategy will be submitted to the Planning Authority for their approval prior to the commencement of works.

The surface water management strategy will be based on the Contractor's Method Statement and will incorporate the following measures to prevent the surface water run-off from the construction works discharging direct to the watercourses.

- Localised interception of surface water run-off. Temporary ditches or channels around the area of works would provide this. Check dams or silt traps can be provided to encourage the settlement of silt.
- Surface water settlement and filtration. Temporary settlement ponds will be formed and water intercepted at the construction area will be directed to these where it will be retained to allow silt suspended in the run-off to settle. A high level outlet will be formed from the settlement pond to allow treated run-off to discharge to the watercourse. Additional protection could be provided by placing straw bales in the high level outlet so that all flows pass through these before entering the watercourse.
- Protection of permanent drainage system. Surface water run-off from construction areas will, where practicable, not be drained to the permanent drainage system. This will prevent silt and other construction debris from building up in the system. Where the use of the permanent system cannot be avoided then the system will need to be thoroughly cleaned on the completion of the construction phase.

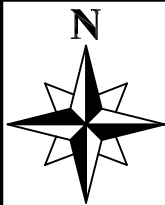
Appendix A – Simple Index Approach

Pollution Indices for Different Land Use Classifications				
Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roof	Very Low	0.2	0.2	0.05
Other Roof (Typically Commercial/Industrial Roof)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual Property Driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, homezones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. <300 traffic movements/day	Low	0.5	0.4	0.4
Commercial Yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail) all roads except low traffic roads and trunk roads/motorways	Medium	0.7	0.6	0.7
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

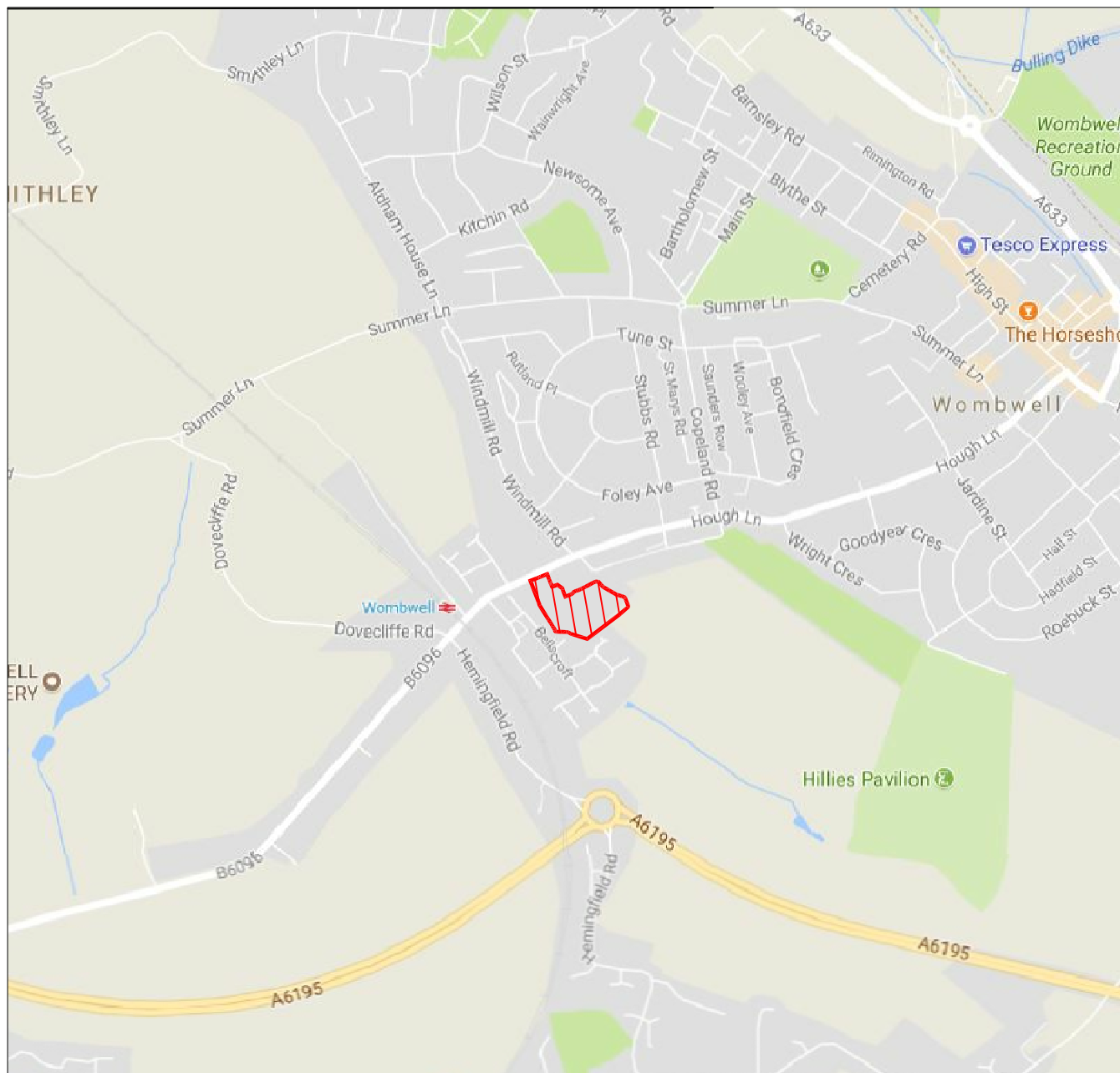
Table 1 – Pollution Hazard Indices (CIRIA C753 – The SUDS Manual)

Appendix B - Drawings

- 117436/9500 Site Location Plan
- 117436/2000 Conceptual Drainage Layout



Do not scale from this drawing.



OS GRID REFERENCE - SE3907802480

Rev.	Date	Description	Drawn	Checked	Approved
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Project Title:

PROPOSED RESIDENTIAL
DEVELOPMENT AT HOUGH LANE
WOMBWELL, BARNSELY

Drawing Title:

LOCATION PLAN

FAIRHURST

88 Queens Road,
ABERDEEN, AB15 4YQ
Tel: 01224 321 222 Fax: 01224 323 201

Scale at A4:
NTS

Status:
For Information

Drawn:
AG

Checked:
KT

Approved:
ASK

Date:
08/09/17

Date:
08/09/17

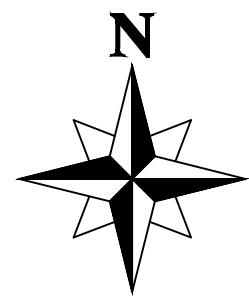
Date:
08/09/17

Drawing No.:

117436/9500

Revision:

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Do not scale from this drawing.	
SAFETY HEALTH AND ENVIRONMENTAL INFORMATION	
IN ADDITION TO THE HAZARD/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING RISKS AND INFORMATION.	
RISKS LISTED HERE ARE NOT EXHAUSTIVE. REFER TO DESIGN ASSESSMENT FORM NO.	
CONSTRUCTION	
DEMOLITION	
FOR INFORMATION RELATING TO USE, CLEANING AND MAINTENANCE SEE THE HEALTH AND SAFETY FILE	
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT.	

POST CONSTRUCTION CCTV SURVEYS OF NEW PRIVATE DRAINAGE AND ADOPTED SEWER TO BE CARRIED OUT BY CONTRACTOR.

LOCATION, DEPTH, SIZE & CONDITION OF EXISTING SEWER TO BE CONFIRMED BY CONTRACTOR AS PART OF THE DETAILED DRAINAGE DESIGN.

SURFACE WATER DISCHARGE TO BE RESTRICTED TO 18.1 l/sec DURING THE CRITICAL 30 YR RAINFALL EVENT BY A HYDROBRAKE WITHIN THE OUTLET CONTROL MANHOLE (OCMH).

SURFACE WATER OUTFALL TO BE INVESTIGATED

LEGEND	
	FOUL SEWER
	SURFACE WATER SEWER
	RISING MAIN
	EX. FOUL SEWER
	EX. SURFACE WATER SEWER
	FREE DRAINING POROUS DRIVEWAY
	DETENTION BASIN
	BASIN STONE TRENCH

Rev.	Date	Description	Drawn	Checked	Approved

Notes:	

Client:



www.balmoral-group.com

Project Title:	
PROPOSED RESIDENTIAL DEVELOPMENT AT HOUGH LANE WOMBWELL, BARNSELY	
Drawing Title:	
CONCEPTUAL DRAINAGE LAYOUT	

Scale at A1:	
1:500	
Status:	
For Information	
Drawn:	Checked:
AG	KT
Date:	Date:
01/09/17	01/09/17
Drawn No.:	Revision:
117436/2000	—

Appendix C - Calculations

- Extended Detention Basin 10 Yr
- Extended Detention Basin 30 Yr
- Extended Detention Basin 100 Yr

FAIRHURST		Page 1
88 Queens Road Aberdeen AB15 4YQ	WOMBWELL BARNESLEY	
Date 08/09/2017 File 117436 - BASIN.SRCX	Designed by AG Checked by KT	
Micro Drainage	Source Control 2017.1.2	

Summary of Results for 10 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	93.268	0.868	18.1	0.0	18.1	113.0	O K
30 min Winter	93.384	0.984	18.1	0.0	18.1	139.2	O K
60 min Winter	93.453	1.053	18.1	0.0	18.1	155.9	O K
120 min Winter	93.449	1.049	18.1	0.0	18.1	155.0	O K
180 min Winter	93.421	1.021	18.1	0.0	18.1	148.0	O K
240 min Winter	93.382	0.982	18.1	0.0	18.1	138.7	O K
360 min Winter	93.283	0.883	18.1	0.0	18.1	116.4	O K
480 min Winter	93.150	0.750	18.1	0.0	18.1	89.3	O K
600 min Winter	93.012	0.612	18.1	0.0	18.1	65.0	O K
720 min Winter	92.876	0.476	18.1	0.0	18.1	44.9	O K
960 min Winter	92.641	0.241	17.9	0.0	17.9	18.2	O K
1440 min Winter	92.479	0.079	14.9	0.0	14.9	5.0	O K
2160 min Winter	92.440	0.040	11.1	0.0	11.1	2.4	O K
2880 min Winter	92.422	0.022	8.9	0.0	8.9	1.3	O K
4320 min Winter	92.401	0.001	6.6	0.0	6.6	0.1	O K
5760 min Winter	92.400	0.000	5.3	0.0	5.3	0.0	O K
7200 min Winter	92.400	0.000	4.6	0.0	4.6	0.0	O K
8640 min Winter	92.400	0.000	4.0	0.0	4.0	0.0	O K
10080 min Winter	92.400	0.000	3.6	0.0	3.6	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	73.840	0.0	128.7	0.0	22
30 min Winter	48.185	0.0	168.3	0.0	36
60 min Winter	30.332	0.0	211.6	0.0	64
120 min Winter	18.676	0.0	260.8	0.0	106
180 min Winter	13.977	0.0	292.3	0.0	142
240 min Winter	11.353	0.0	317.3	0.0	182
360 min Winter	8.446	0.0	353.5	0.0	258
480 min Winter	6.846	0.0	382.3	0.0	324
600 min Winter	5.814	0.0	405.8	0.0	384
720 min Winter	5.086	0.0	426.0	0.0	438
960 min Winter	4.114	0.0	459.4	0.0	536
1440 min Winter	3.043	0.0	509.8	0.0	740
2160 min Winter	2.249	0.0	565.1	0.0	1100
2880 min Winter	1.816	0.0	608.3	0.0	1448
4320 min Winter	1.345	0.0	675.9	0.0	2204
5760 min Winter	1.090	0.0	730.7	0.0	0
7200 min Winter	0.930	0.0	778.9	0.0	0
8640 min Winter	0.819	0.0	822.8	0.0	0
10080 min Winter	0.737	0.0	863.8	0.0	0

Source Control 2017.1.2

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	10	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 439103 402488	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.831

Time (mins) Area			Time (mins) Area		
From:	To:	(ha)	From:	To:	(ha)
0	4	0.000	4	8	0.831

FAIRHURST		Page 3
88 Queens Road Aberdeen AB15 4YQ	WOMBWELL BARNSELEY	
Date 08/09/2017	Designed by AG	
File 117436 - BASIN.SRCX	Checked by KT	
Micro Drainage	Source Control 2017.1.2	

Model Details

Storage is Online Cover Level (m) 94.000

Tank or Pond Structure

Invert Level (m) 92.400

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	58.0	1.200	284.0	2.400	380.0	3.600	380.0	4.800	380.0
0.200	88.0	1.400	330.0	2.600	380.0	3.800	380.0	5.000	380.0
0.400	120.0	1.600	380.0	2.800	380.0	4.000	380.0		
0.600	160.0	1.800	380.0	3.000	380.0	4.200	380.0		
0.800	200.0	2.000	380.0	3.200	380.0	4.400	380.0		
1.000	240.0	2.200	380.0	3.400	380.0	4.600	380.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0184-1810-1424-1810
Design Head (m) 1.424
Design Flow (l/s) 18.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 184
Invert Level (m) 92.300
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.424	18.1	Kick-Flo®	0.932	14.8
Flush-Flo™	0.426	18.1	Mean Flow over Head Range	-	15.6

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	0.800	16.7	2.000	21.3	4.000	29.7	7.000	38.8
0.200	16.5	1.000	15.3	2.200	22.3	4.500	31.4	7.500	40.2
0.300	17.7	1.200	16.7	2.400	23.2	5.000	33.0	8.000	41.4
0.400	18.1	1.400	18.0	2.600	24.1	5.500	34.6	8.500	42.7
0.500	18.0	1.600	19.1	3.000	25.8	6.000	36.1	9.000	43.9
0.600	17.7	1.800	20.2	3.500	27.8	6.500	37.5	9.500	45.0

Orifice Overflow Control

Diameter (m) 0.140 Discharge Coefficient 0.600 Invert Level (m) 93.800

FAIRHURST		Page 1
88 Queens Road Aberdeen AB15 4YQ	WOMBWELL BARNSELEY	
Date 08/09/2017 File 117436 - BASIN.SRCX	Designed by AG Checked by KT	
Micro Drainage	Source Control 2017.1.2	

Summary of Results for 30 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	93.463	1.063	18.1	0.0	18.1	158.5	O K
30 min Winter	93.617	1.217	18.1	0.0	18.1	200.1	O K
60 min Winter	93.721	1.321	18.1	0.0	18.1	231.4	O K
120 min Winter	93.731	1.331	18.1	0.0	18.1	234.5	O K
180 min Winter	93.701	1.301	18.1	0.0	18.1	225.1	O K
240 min Winter	93.670	1.270	18.1	0.0	18.1	215.9	O K
360 min Winter	93.597	1.197	18.1	0.0	18.1	194.5	O K
480 min Winter	93.515	1.115	18.1	0.0	18.1	172.0	O K
600 min Winter	93.426	1.026	18.1	0.0	18.1	149.2	O K
720 min Winter	93.327	0.927	18.1	0.0	18.1	126.1	O K
960 min Winter	93.055	0.655	18.1	0.0	18.1	72.2	O K
1440 min Winter	92.612	0.212	17.8	0.0	17.8	15.6	O K
2160 min Winter	92.469	0.069	14.0	0.0	14.0	4.3	O K
2880 min Winter	92.442	0.042	11.2	0.0	11.2	2.5	O K
4320 min Winter	92.416	0.016	8.2	0.0	8.2	0.9	O K
5760 min Winter	92.402	0.002	6.6	0.0	6.6	0.1	O K
7200 min Winter	92.400	0.000	5.6	0.0	5.6	0.0	O K
8640 min Winter	92.400	0.000	4.9	0.0	4.9	0.0	O K
10080 min Winter	92.400	0.000	4.4	0.0	4.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	100.317	0.0	174.7	0.0	22
30 min Winter	66.101	0.0	230.8	0.0	36
60 min Winter	41.685	0.0	291.2	0.0	64
120 min Winter	25.073	0.0	350.1	0.0	118
180 min Winter	18.583	0.0	389.5	0.0	148
240 min Winter	15.010	0.0	419.2	0.0	186
360 min Winter	11.089	0.0	464.3	0.0	264
480 min Winter	8.946	0.0	499.9	0.0	338
600 min Winter	7.569	0.0	528.0	0.0	412
720 min Winter	6.600	0.0	552.7	0.0	484
960 min Winter	5.307	0.0	592.8	0.0	600
1440 min Winter	3.895	0.0	652.6	0.0	784
2160 min Winter	2.854	0.0	717.1	0.0	1104
2880 min Winter	2.288	0.0	766.5	0.0	1436
4320 min Winter	1.676	0.0	842.1	0.0	2188
5760 min Winter	1.347	0.0	902.5	0.0	2872
7200 min Winter	1.140	0.0	954.7	0.0	0
8640 min Winter	0.997	0.0	1001.9	0.0	0
10080 min Winter	0.892	0.0	1045.6	0.0	0

Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 439103 402488	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.831

Time (mins) Area			Time (mins) Area		
From:	To:	(ha)	From:	To:	(ha)
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Storage is Online Cover Level (m) 94.000

Tank or Pond Structure

Invert Level (m) 92.400

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	58.0	1.200	284.0	2.400	380.0	3.600	380.0	4.800	380.0
0.200	88.0	1.400	330.0	2.600	380.0	3.800	380.0	5.000	380.0
0.400	120.0	1.600	380.0	2.800	380.0	4.000	380.0		
0.600	160.0	1.800	380.0	3.000	380.0	4.200	380.0		
0.800	200.0	2.000	380.0	3.200	380.0	4.400	380.0		
1.000	240.0	2.200	380.0	3.400	380.0	4.600	380.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0184-1810-1424-1810
Design Head (m) 1.424
Design Flow (l/s) 18.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 184
Invert Level (m) 92.300
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.424	18.1	Kick-Flo®	0.932	14.8
Flush-Flo™	0.426	18.1	Mean Flow over Head Range	-	15.6

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	0.800	16.7	2.000	21.3	4.000	29.7	7.000	38.8
0.200	16.5	1.000	15.3	2.200	22.3	4.500	31.4	7.500	40.2
0.300	17.7	1.200	16.7	2.400	23.2	5.000	33.0	8.000	41.4
0.400	18.1	1.400	18.0	2.600	24.1	5.500	34.6	8.500	42.7
0.500	18.0	1.600	19.1	3.000	25.8	6.000	36.1	9.000	43.9
0.600	17.7	1.800	20.2	3.500	27.8	6.500	37.5	9.500	45.0

Orifice Overflow Control

Diameter (m) 0.140 Discharge Coefficient 0.600 Invert Level (m) 93.800

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88 Queens Road Aberdeen AB15 4YQ	WOMBWELL BARNSELY	
Date 08/09/2017 File 117436 - BASIN.SRCX	Designed by AG Checked by KT	
Micro Drainage	Source Control 2017.1.2	

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Overflow (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Winter	93.676	1.276	18.1	0.0	18.1	217.6	O K
30 min Winter	93.867	1.467	18.9	2.4	21.4	279.5	O K
60 min Winter	93.986	1.586	19.6	13.3	32.9	322.3	O K
120 min Winter	93.998	1.598	19.7	14.5	34.2	326.8	O K
180 min Winter	93.988	1.588	19.6	13.5	33.1	323.0	O K
240 min Winter	93.968	1.568	19.5	11.5	31.0	315.7	O K
360 min Winter	93.926	1.526	19.3	7.3	26.6	300.3	O K
480 min Winter	93.880	1.480	19.0	3.7	22.7	284.0	O K
600 min Winter	93.825	1.425	18.7	0.4	19.1	264.9	O K
720 min Winter	93.750	1.350	18.3	0.0	18.3	240.6	O K
960 min Winter	93.593	1.193	18.1	0.0	18.1	193.3	O K
1440 min Winter	93.189	0.789	18.1	0.0	18.1	96.9	O K
2160 min Winter	92.574	0.174	17.5	0.0	17.5	12.2	O K
2880 min Winter	92.474	0.074	14.4	0.0	14.4	4.6	O K
4320 min Winter	92.435	0.035	10.4	0.0	10.4	2.1	O K
5760 min Winter	92.416	0.016	8.3	0.0	8.3	1.0	O K
7200 min Winter	92.405	0.005	7.0	0.0	7.0	0.3	O K
8640 min Winter	92.400	0.000	6.0	0.0	6.0	0.0	O K
10080 min Winter	92.400	0.000	5.3	0.0	5.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Overflow Volume (m³)	Time-Peak (mins)
15 min Winter	134.585	0.0	234.9	0.0	22
30 min Winter	89.520	0.0	312.6	1.6	36
60 min Winter	56.980	0.0	397.6	25.6	64
120 min Winter	34.133	0.0	476.7	45.2	100
180 min Winter	25.265	0.0	529.1	49.5	140
240 min Winter	20.386	0.0	569.5	45.6	178
360 min Winter	15.024	0.0	629.0	29.3	258
480 min Winter	12.067	0.0	674.0	12.3	338
600 min Winter	10.165	0.0	709.8	0.8	422
720 min Winter	8.827	0.0	739.1	0.0	496
960 min Winter	7.053	0.0	787.5	0.0	638
1440 min Winter	5.115	0.0	857.0	0.0	910
2160 min Winter	3.699	0.0	929.5	0.0	1148
2880 min Winter	2.937	0.0	984.1	0.0	1472
4320 min Winter	2.122	0.0	1066.4	0.0	2152
5760 min Winter	1.687	0.0	1130.8	0.0	2848
7200 min Winter	1.415	0.0	1185.2	0.0	3632
8640 min Winter	1.227	0.0	1233.6	0.0	0
10080 min Winter	1.090	0.0	1277.9	0.0	0

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Rainfall Details

Rainfall Model	FEH	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
FEH Rainfall Version	2013	Cv (Winter)	0.840
Site Location	GB 439103 402488	Shortest Storm (mins)	15
Data Type	Point	Longest Storm (mins)	10080
Summer Storms	No	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.831

Time (mins) Area			Time (mins) Area		
From:	To:	(ha)	From:	To:	(ha)
0	4	0.000	4	8	0.831

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Model Details

Storage is Online Cover Level (m) 94.000

Tank or Pond Structure

Invert Level (m) 92.400

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	58.0	1.200	284.0	2.400	380.0	3.600	380.0	4.800	380.0
0.200	88.0	1.400	330.0	2.600	380.0	3.800	380.0	5.000	380.0
0.400	120.0	1.600	380.0	2.800	380.0	4.000	380.0		
0.600	160.0	1.800	380.0	3.000	380.0	4.200	380.0		
0.800	200.0	2.000	380.0	3.200	380.0	4.400	380.0		
1.000	240.0	2.200	380.0	3.400	380.0	4.600	380.0		

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0184-1810-1424-1810
Design Head (m) 1.424
Design Flow (l/s) 18.1
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 184
Invert Level (m) 92.300
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.424	18.1	Kick-Flo®	0.932	14.8
Flush-Flo™	0.426	18.1	Mean Flow over Head Range	-	15.6

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