SUDS REPORT FOR 36 REDINGTON ROAD, HAMPSTEAD, LONDON, NW3 7RT

DOCUMENT NUMBER.: C2131-R1-REV-B

PREPARED BY

Nimbus
ENGINEERING CONSULTANTS

Contents

APPENDICES

1. INTRODUCTION

1.1 Appointment

Nimbus Engineering have been appointed by Zolf Aghari to provide solution on the management of Surface Water run off and to ensure that there is no risk of flooding caused by the proposed development at 36 Redington Road, Hampstead, London NW3 7RT.

The London Borough of Camden have imposed the following planning condition, relating to surface water:

> 7 Sustainable urban drainage:
>
> A) Prior to commencement of development details of a sustainable urban drainage system shall be submitted to and approved in writing by the local planning authority. Such system shall be designed to accommodate all storms up to and including a 1:100 year storm with a 30% provision for climate change, and shall demonstrate that greenfield run off rates (5l/s) will be achieved.
>
> B) Prior to occupation of the development, evidence that the sustainable drainage system has been implemented shall be submitted to the Local Authority and approved in writing. The systems shall thereafter be retained and maintained in accordance with the approved maintenance plan.
>
> Reason: To reduce the rate of surface water run-off from the buildings and limit the impact on the storm-water drainage system in accordance with policies CS13 and CS16 of the London Borough of Camden Local Development Framework Core Strategy and policies DP22, DP23 and DP32 of the London Borough of Camden Local Development Framework Development Policies.

1.2 Objectives

This report will address the concerns raised by the Borough and provide details on a suitable Sustainable Urban Drainage System (SuDS) in order to reduce the surface water run off leaving the site and show that the proposed development will not increase Flood Risk at the site or elsewhere.

1.3 Limitations

The general limitations of this report are:

- A number of data and information sources have been used to prepare this report. Whilst Nimbus Engineering believes them to be trustworthy, Nimbus Engineering is unable to guarantee the accuracy of data and information that has been provided by others;

- This report has been prepared using the best data and information that was available at the time of writing. There is the potential for further information or data to become available, leading to changes in the conclusions drawn by this report, for which Nimbus Engineering cannot be held responsible.

2. SUSTAINABLE URBAN DRAINAGE SYSTEMS

Surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the site prior to the proposed development, while reducing the flood risk to the site itself and elsewhere, taking climate change into account.

Reducing the rate of surface water discharge from urban sites is one of the most effective ways of reducing and managing flood risk.

Traditional piped surface water systems work by removing surface water from our developments as quickly as possible, however this can cause various adverse impacts:

- Increased downstream flooding, and sudden rises in flow rates and water levels in local water courses.
- Reduction in groundwater levels and dry weather flows in watercourses.
- Reduce amenity and adversely affect biodiversity due to the surface water run-off containing contaminants such as oil, organic matter and toxic materials.

SuDS are defined as a sequence of management principles and control structures designed to drain surface water in a more sustainable fashion than conventional piped drainage techniques. SuDS should utilise the natural landscape of an area which as well as slowing down the rate of runoff provides a number of environmental, ecological and social benefits.

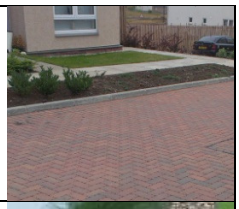
These include:

- Protection and enhancement of water quality. As well as providing on-site attenuation, SuDS treat the water, resulting in an improved quality of water leaving the site. This is achieved when the water passes through fine soils and the roots of specially selected plants. Pollutants washed off the hard landscaping by rainfall will be safely removed before the water reaches the natural receiving water course.

- A sympathetic approach to the environmental setting by providing opportunities to create habitats for flora and fauna in urban watercourses and open spaces.

- Meeting the amenity and social needs of the local community and residents in the creation of attractive green spaces.

The various types of SuDS include:

Permeable paving	
Soakaways;	
Swales and basins;	
Bioretention/ rain gardens;	
Green roofs and rainwater re-use;	

Preferably a combination of these techniques should be used as part of the surface water management train, and it is important for all stakeholders, such as developers, architects, landscape architects and engineers to work in order to determine a feasible solution.

3. PROPOSED SOLUTION

The total site area is 474 m^2, with the impermeable areas at the existing site being 165 m^2. Following the development at this site, the impermeable areas will have increased to 263 m^2.

Pre and post development peak flow rate of run off and peak flow storage calculations were carried out using these pre and post development impermeable area figures in order to determine a suitable surface water management solution, as requested by the London Borough of Camden. All surface water calculations are included in Appendix A.

In order to ensure that the SuDS management train has been considered fully, the proposed solution involve porous surfacing at all proposed hardstanding areas.

One wall mounted rainwater harvesting tank will also be provided in order to recycle the rainwater.

The remaining surface water run off from the proposed development site will be attenuated into a crate system attenuation tank, with restricted flow leaving the site set to 0.325 l/s, which is the existing site's greenfield rate.

Hydrograph storage calculations were carried out for a 1 in 100 year storm event plus 40% climate change allowance, these show that 16.6m^3 of storage is required.

The proposed SuDS solution and details can be found on drawing number C2131-01 and C2131-02 in Appendix B.

We believe the Sustainable Urban Drainage System hierarchy has been considered fully, and the above solution meets the requirements of the London Plan and London Borough of Camden's Local Plans and policies.

4. TIMESCALE AND MAINTENANCE OF WORKS

All drainage works will be completed prior to first occupation and there will be no adoption of any of the drainage works within the site, and the homeowner will be responsible to oversee the long term maintenance their drains.

- Regular inspection and cleaning of catchment, gutters reduce the likelihood of contamination, typically every 3 to 6 months.

- Regular jet-washing of permeable block paving can be used to keep joints and voids clear, this should be carried out every 6 months.

- The catch pit chamber and flow control chamber should be emptied every 3 months, and after every large storm event to ensure that there are no blockages.

- The inlets and outlets to the rainwater harvesting tanks should be checked every 3 months, and after every large storm event to ensure that there are no blockages

5. CONCLUSIONS

The purpose of this report and associated drawings, is to satisfy the planning condition relating to surface water flows arising due to the development at this site.

As requested, SuDS have been incorporated into the design, in the form of one outdoor rainwater harvesters, in order to re-use rainwater.

All hard standing surfaces will be formed of permeable paving, with the driveway and parking areas underlain by a hydrocarbon removing geotextile membrane, to also ensure there is no contamination of the receiving groundwater.

All remaining surface water will then be conveyed into an attenuation tank at the site with a flow restriction leaving the site set to 0.325 l/s.

The timetable of works is to complete all drainage prior to occupation of dwellings, and maintenance requirements are also included in this report, therefore it is considered that all requirements of part a of the planning condition have been met, and therefore can be discharged.

APPENDIX A - SURFACE WATER RUN OFF CALCULATIONS

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Job No.	C2131
Sheet no.	1
Date	21/05/19

MasterDrain
HY 10.01

Project	By	Checked	Reviewed
36 Redington Road, Hampstead, London NW3 7RT	S.L		
Title: Pre & Post Devt SW Calcs			

Data:-

Hydrology (FSR):-

Location = LONDON (NORTH)		WRAP	= 4
Long reference = 540190		Grid reference	= TQ4090
M5-60 (mm)	= 20	SAAR (mm/yr)	= 610
r	= 0.43	Soil	=0.47
Hyd. area	= 6	Hyd. zone	= 8
Hydrograph	= Winter	Area = England & Wales	

Site values used in design:-

Total site area	= 0.0474 ha	Climate change factor	= 40%
Pre-dev area drained	= 0.0165 ha	Post-dev area drained	= 0.0263 ha
Imperm runoff factor	= 100%	Perm runoff factor	= 20%

Pre-development

Area to soakaways	= 0.0000 ha	Area to other SUDS	= 0.0000 ha
Perv. area to SUDS	= 0.0000 ha	Pre-dev flow to drain	= 0.00 l/s

Post-development

Area to soakaways	= 0.0000 ha	Area to other SUDS	= 0.0000 ha
Perv. area to SUDS	= 0.0000 ha	Post-dev flow to drain	= 0.00 l/s

Calculations:-

Revised Post-dev Imperm. area = 0.026 ha
Equiv. Post-dev Imperm. area = 0.026 ha
Equiv. Post-dev Perm. area = 0.004 ha
Total Pre-dev equiv. area ha = 0.023 ha
Total Post-dev equiv. area ha = 0.031 ha
100 yr 6 hour mean intensity = 10.13mm/hr

Results:-

Pre-dev peakflow runoff (l/s) (m^3/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	5.0	3.3	2.0	1.2	0.8	0.6	0.5	0.4	5.0	N/A	5.0	1
30	12.3	7.9	4.9	2.9	1.7	1.2	1.0	0.8	12.3	N/A	12.3	30
100	15.9	10.3	6.4	3.8	2.2	1.6	1.3	1.1	15.9	N/A	15.9	100

Post-dev peakflow runoff (l/s)

R.P.	15	30	60	120	240	360	480	600	Max	CCF	Final	R.P.
1	6.8	4.4	2.7	1.7	1.0	0.8	0.6	0.5	6.8	40	9.5	1
30	16.5	10.6	6.5	3.9	2.3	1.7	1.3	1.1	16.5	40	23.1	30
100	21.4	13.9	8.6	5.1	3.0	2.1	1.7	1.4	21.4	40	30.0	100

100 year 6 hour (x Climate Change Factor) storm gives:-
Pre-dev runoff volume m^3 = 13.8m^3
Post-dev rainfall volume = 26.0m^3
Post-dev volume m^3 (excess above SUDS) = 26.0m^3
100 yr 6 hour mean intensity = 10.13mm/hr
Pre-dev volume to drain at 0 l/s = 0.0 m^3
Post-dev volume to drain at 0 l/s = 0.0 m^3
Post-dev storage volume = 26.0m^3
Post-dev 5mm imperm volume = 1.3 m^3
Post-dev 5mm perm volume = 1.1 m^3

$Q_{BAR(rural)}$ = 0.195 l/s or 4.110 l/s/ha or 0.000 cumecs - from IoH 124.

The rainfall rates are calculated using the location specific values above in accordance with the Wallingford procedure.

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Job No. C2131			
Sheet no. 2			
Date 21/05/19			
Project 36 Redington Road, Hampstead, London NW3 7RT	By S.L	Checked	Reviewed
Title Pre & Post Devt SW Calcs			

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Data summary.

Use the data below for the SUR1 form

Site areas:-

Total site area =	0.0474 ha ;473.6 m²	[3A]
Pre-development impermeable area =	0.0165 ha	[3B]
Pre-development permeable area =	0.0309 ha	
Post-development impermeable area =	0.0263 ha	[3C]
Post-development permeable area =	0.0211 ha	

Peak runoff:-

Pre-development 1 year storm (15min) =	5.0 l/s	[6A]
Pre-development 100 year storm (15min) =	15.9 l/s	[6C]
Post-development 1 year storm (15min) =	6.8 l/s	[6B]
Post-development 100 year storm (15min)=	21.44 l/s	[6D]

Greenfield runoff:-

$Q_{BAR(rural)}$ = 0.195 l/s or 4.110 l/s/ha or 0.000 cumecs - from IoH 124.

Climate change factor:-

CCF = 40%

Volumes:-

Pre-development 100 yr/6hr storm [12A]= 19.3m³
Post-development 100 yr/6hr storm (add. volume with no SUDS) [12B]= 26.0m³
Post-development 100 yr/6hr storm (add. volume with SUDS) = 26.0m³
Post-development add. predicted volume (No SUDS) [12C] = 6.7m³

You may also require

Data relating to the infiltration test calculations (if applicable)
Evidence to show runoff reduction (if applicable)
Information on calculation methods (if applicable see next sheet)

Note

Numbers in square brackets relate to the
Nov. 2010 v1.1 / issued 11/02/10 copy of SUR1

Definitions and methods

Hydrology

The hydrological constants are derived from the Wallingford maps. They are used to calculate location specific rainfall figures.

Site values and factors

Areas of the site should be entered in hectares (10000 m²). If the Pre-development site is a green field, this box is blank.
Climate Change Factor is initially set at 20% - this may be changed as required.
Greenfield runoff is calculated using the method described in IoH 124.
Runoff factors

The impermeable runoff factor is initially set at 98%
The permeable runoff factor is initially set at 20%

Note: the CCF and the runoff factors may be changed by the user to suit the development
The areas draining to soakaways and other SUDS are entered in the appropriate box (in hectares)

Calculations

The post-development area is reduced by subtracting the areas that drain to soakaways or other SUDS, to give a revised figure.
All areas are then multiplied by the appropriate runoff factor to give an equivalent area with 100% runoff.
These are then summated.
This gives a total pre-development equivalent area, and a similar figure for the post-development area.
The 'Post-dev volume to drain (no SUDS)' gives the total runoff to drain if no SUDS were used.

Results

The pre- and post-development areas are subjected to 1,30 and 100 year return period storms with a duration of 15 to 600 minutes.
The Revised Post-dev Imperm. area is the area (in ha) that is not going to SUDS x impervious runoff factor.
The runoff rates are calculated for the chosen hydrograph (Summer or Winter) as l/s. Figures in red indicate m³/s
The peak value is measured, multiplied by the CCF and the total maximum rate is shown.
The pre- and post-development volumes for a 100 year / 6 hour storm are calculated from the area under the hydrograph curve.
Post-dev volume (i.e. excess above SUDS) is that volume produced by the drained area that does not go to SUDS.
Qbar(rural) is calculated in accordance with the procedure laid down in IoH 124

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Job No.	C2131
Sheet no.	1
Date	21/05/19

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Project	By	Checked	Reviewed
36 Redington Road, Hampstead, London NW3 7RT	S.L		

Title: IoH 124 (Qbar(urban))Runoff calcs

Hydrological Data:-

FSR Hydrology:-

Location = LONDON (NORTH) Grid reference = TQ4090
M5-60 (mm) = 20 r = 0.43
Soil runoff = 0.45 SAAR (mm/yr) = 610
WRAP = 4 Area = England & Wales
Hydrological area = 6 Hydrological zone = 8

Soil classification for WRAP type 4
Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Design data:-

Area = 0.000474 Km² - 0.047 Ha - 474 m² % Urbanisation = 35.00%

Calculation method:-

Runoff is calculated from:-

$$Q_{BAR(urban);} = Q_{BAR(rural)} (1 + URBAN)^{2NC}[1 + URBAN\{(21/CIND) - 0.3\}]$$

where:-

NC varies with the value of SAAR:-
for 500<SAAR<1100 mm then NC = 0.92 - 0.00024SAAR
for 1100<SAAR<3000 mm then NC = 0.74 - 0.000082SAAR

CIND = 102.4SOIL + 0.28(CWI - 125) CWI = Catchment Wetness Index

so

CIND =28.528 CWI =62.313 NC =0.774

For areas less than 50Ha, a modified calculation which multiplies the 50Ha runoff value by the ratio of the site area to 50Ha is used
Reducing factor used for these calculations is 0.001

$Q_{BAR(rural)}$ = 0.177 (l/s)

$Q_{BAR(urban)}$ = 0.325 (l/s)

$Q_{BAR(urban)}$ is then multiplied by a growth factor - GC(T) - for different storm return periods derived from EA publication W5-074/A.

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Job No.	C2131
Sheet no.	2
Date	21/05/19
Project	36 Redington Road, Hampstead, London NW3 7RT
Title	IoH 124 (Qbar(urban))Runoff calcs
By	S.L
Checked	
Reviewed	

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Calculated data:-

Mean Annual Peak Flow $Q_{BAR(urban)}$ = 0.32 l/s

Values for $Q_{BAR(urban)}$

Ret. per.	m³/hr	l/s	l/s/ha	Ret. per.	m³/hr	l/s	l/s/ha
1yr	0.000	0.276	5.829	100yr	0.001	1.023	21.602
2yr	0.000	0.286	6.035	100yr+20%	0.001	1.228	25.923
5yr	0.000	0.416	8.778	100yr+30%	0.001	1.330	28.083
10yr	0.001	0.526	11.110	200yr	0.001	1.202	25.374
30yr	0.001	0.724	15.293	200yr + 30%	0.002	1.562	32.987
50yr	0.001	0.851	17.968	500yr	0.001	1.458	30.792
				1000yr	0.002	1.676	35.387

Growth factors -

1yr	2yr	5yr	10yr	30yr	50yr	100yr	200yr	500yr	1000yr
0.85	0.88	1.28	1.62	2.23	2.62	3.15	3.70	4.49	5.16

The above is based on the Institute of Hydrology Report 124 to which you are referred for further details (see Sect 7). Note that the 200 year growth curve was taken from W5-074/A.

For WRAP type 1 soils, CIND can become negative for lower values of SAAR. In this case the CIND value is multiplied by -1 to return a positive value (CIND is very small at this point).

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Job No.	Sheet no.	Date	By	Checked	Reviewed
C2131	1	21/05/19	S.L		

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Project: 36 Redington Road

Title: Hydrograph storage calcs with Qbar discharge

Data:-

Location = LONDON (NORTH)
M5-60 (mm) = 20
Soil index = 0.45
Return period = 100
UCWI = 0.0

Grid reference = TQ4090
r = 0.43
SAAR (mm/yr) = 610
WRAP = 4
Climate change = 40%

Clayey, or loamy over clayey soils with an impermeable layer at shallow depth.

Pipeline storage = 0.0 m³
Offline storage = 0.0 m³

Available MH storage = 0.0 m³

Percentage runoff = 100.0% (manual setting)

Imperv. area = 263 m²
Total area = 263 m²
Total runoff = 20.7 m³

Pervious area = 0 m²
Equiv area = 263 m² (Tot. area x % runoff).
Discharge rate = 0.325 l/s

Storage (m³) = 16.6 m³ (Sum of all balance quantities)

Total rainfall depth = 78.6 mm

Calculations :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
0.040	20.0	3.9	0.041	0.047	0.000	0.000
0.080	20.0	3.9	0.041	0.047	0.000	0.000
0.120	21.0	4.1	0.043	0.047	0.000	0.000
0.160	21.0	4.1	0.043	0.047	0.000	0.000
0.200	22.0	4.3	0.045	0.047	0.000	0.000
0.240	23.0	4.5	0.048	0.047	0.001	0.001
0.280	24.0	4.7	0.050	0.047	0.003	0.004
0.320	26.0	5.1	0.054	0.047	0.007	0.011
0.360	27.0	5.3	0.056	0.047	0.009	0.020
0.400	29.0	5.7	0.060	0.047	0.013	0.033
0.440	31.0	6.1	0.064	0.047	0.017	0.050
0.480	32.0	6.3	0.066	0.047	0.019	0.069
0.520	33.0	6.5	0.068	0.047	0.021	0.091
0.560	34.0	6.7	0.070	0.047	0.024	0.114
0.600	36.0	7.1	0.074	0.047	0.028	0.142
0.640	38.0	7.5	0.079	0.047	0.032	0.174
0.680	39.0	7.7	0.081	0.047	0.034	0.208
0.720	40.0	7.9	0.083	0.047	0.036	0.244
0.760	42.0	8.3	0.087	0.047	0.040	0.284
0.800	45.0	8.8	0.093	0.047	0.046	0.330
0.840	49.0	9.6	0.101	0.047	0.055	0.384
0.880	53.0	10.4	0.110	0.047	0.063	0.447
0.920	57.0	11.2	0.118	0.047	0.071	0.518
0.960	62.0	12.2	0.128	0.047	0.081	0.600
1.000	66.0	13.0	0.136	0.047	0.090	0.689
1.040	71.0	14.0	0.147	0.047	0.100	0.789
1.080	77.0	15.1	0.159	0.047	0.112	0.902
1.120	84.0	16.5	0.174	0.047	0.127	1.029
1.160	91.0	17.9	0.188	0.047	0.141	1.170
1.200	98.0	19.3	0.203	0.047	0.156	1.326
1.240	105.0	20.6	0.217	0.047	0.170	1.496
1.280	114.0	22.4	0.236	0.047	0.189	1.685
1.320	125.0	24.6	0.258	0.047	0.212	1.897
1.360	135.0	26.5	0.279	0.047	0.232	2.129
1.400	143.0	28.1	0.296	0.047	0.249	2.378
1.440	154.0	30.3	0.318	0.047	0.272	2.650
1.480	164.0	32.2	0.339	0.047	0.292	2.942
1.520	173.0	34.0	0.358	0.047	0.311	3.253
1.560	183.0	36.0	0.378	0.047	0.332	3.584
1.600	194.0	38.1	0.401	0.047	0.354	3.939

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C2131	2	21/05/19	S.L		

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Project: 36 Redington Road

Title: Hydrograph storage calcs with Qbar discharge

Calculations (cont.) :-

Time (hrs)	%Mean intens	Rain mm/hr	Inflow (m3)	Outflow (m3)	Balance (m3)	Cumulative (m3)
1.640	204.0	40.1	0.422	0.047	0.375	4.314
1.680	212.0	41.7	0.438	0.047	0.392	4.705
1.720	219.0	43.0	0.453	0.047	0.406	5.111
1.760	226.0	44.4	0.467	0.047	0.421	5.532
1.800	233.0	45.8	0.482	0.047	0.435	5.967
1.840	239.0	47.0	0.494	0.047	0.447	6.414
1.880	244.0	48.0	0.505	0.047	0.458	6.872
1.920	248.0	48.7	0.513	0.047	0.466	7.338
1.960	249.0	48.9	0.515	0.047	0.468	7.806
2.000	250.0	49.1	0.517	0.047	0.470	8.276
2.040	250.0	49.1	0.517	0.047	0.470	8.746
2.080	249.0	48.9	0.515	0.047	0.468	9.214
2.120	248.0	48.7	0.513	0.047	0.466	9.680
2.160	244.0	48.0	0.505	0.047	0.458	10.138
2.200	239.0	47.0	0.494	0.047	0.447	10.586
2.240	233.0	45.8	0.482	0.047	0.435	11.021
2.280	226.0	44.4	0.467	0.047	0.421	11.441
2.320	219.0	43.0	0.453	0.047	0.406	11.847
2.360	212.0	41.7	0.438	0.047	0.392	12.239
2.400	204.0	40.1	0.422	0.047	0.375	12.614
2.440	194.0	38.1	0.401	0.047	0.354	12.968
2.480	183.0	36.0	0.378	0.047	0.332	13.300
2.520	173.0	34.0	0.358	0.047	0.311	13.611
2.560	164.0	32.2	0.339	0.047	0.292	13.903
2.600	154.0	30.3	0.318	0.047	0.272	14.175
2.640	143.0	28.1	0.296	0.047	0.249	14.423
2.680	135.0	26.5	0.279	0.047	0.232	14.656
2.720	125.0	24.6	0.258	0.047	0.212	14.868
2.760	114.0	22.4	0.236	0.047	0.189	15.056
2.800	105.0	20.6	0.217	0.047	0.170	15.227
2.840	98.0	19.3	0.203	0.047	0.156	15.383
2.880	91.0	17.9	0.188	0.047	0.141	15.524
2.920	84.0	16.5	0.174	0.047	0.127	15.651
2.960	77.0	15.1	0.159	0.047	0.112	15.763
3.000	71.0	14.0	0.147	0.047	0.100	15.863
3.040	66.0	13.0	0.136	0.047	0.090	15.953
3.080	62.0	12.2	0.128	0.047	0.081	16.034
3.120	57.0	11.2	0.118	0.047	0.071	16.105
3.160	53.0	10.4	0.110	0.047	0.063	16.168
3.200	49.0	9.6	0.101	0.047	0.055	16.223
3.240	45.0	8.8	0.093	0.047	0.046	16.269
3.280	42.0	8.3	0.087	0.047	0.040	16.309
3.320	40.0	7.9	0.083	0.047	0.036	16.345
3.360	39.0	7.7	0.081	0.047	0.034	16.379
3.400	38.0	7.5	0.079	0.047	0.032	16.411
3.440	36.0	7.1	0.074	0.047	0.028	16.438
3.480	34.0	6.7	0.070	0.047	0.024	16.462
3.520	33.0	6.5	0.068	0.047	0.021	16.483
3.560	32.0	6.3	0.066	0.047	0.019	16.503
3.600	31.0	6.1	0.064	0.047	0.017	16.520
3.640	29.0	5.7	0.060	0.047	0.013	16.533
3.680	27.0	5.3	0.056	0.047	0.009	16.542
3.720	26.0	5.1	0.054	0.047	0.007	16.549
3.760	24.0	4.7	0.050	0.047	0.003	16.552
3.800	23.0	4.5	0.048	0.047	0.001	16.553
3.840	22.0	4.3	0.045	0.047	0.000	16.551
3.880	21.0	4.1	0.043	0.047	0.000	16.548
3.920	21.0	4.1	0.043	0.047	0.000	16.544
3.960	20.0	3.9	0.041	0.047	0.000	16.539
4.000	20.0	3.9	0.041	0.047	0.000	16.534

Storage volume (m^3) = 16.6 m^3 (Sum of all balance quantities)

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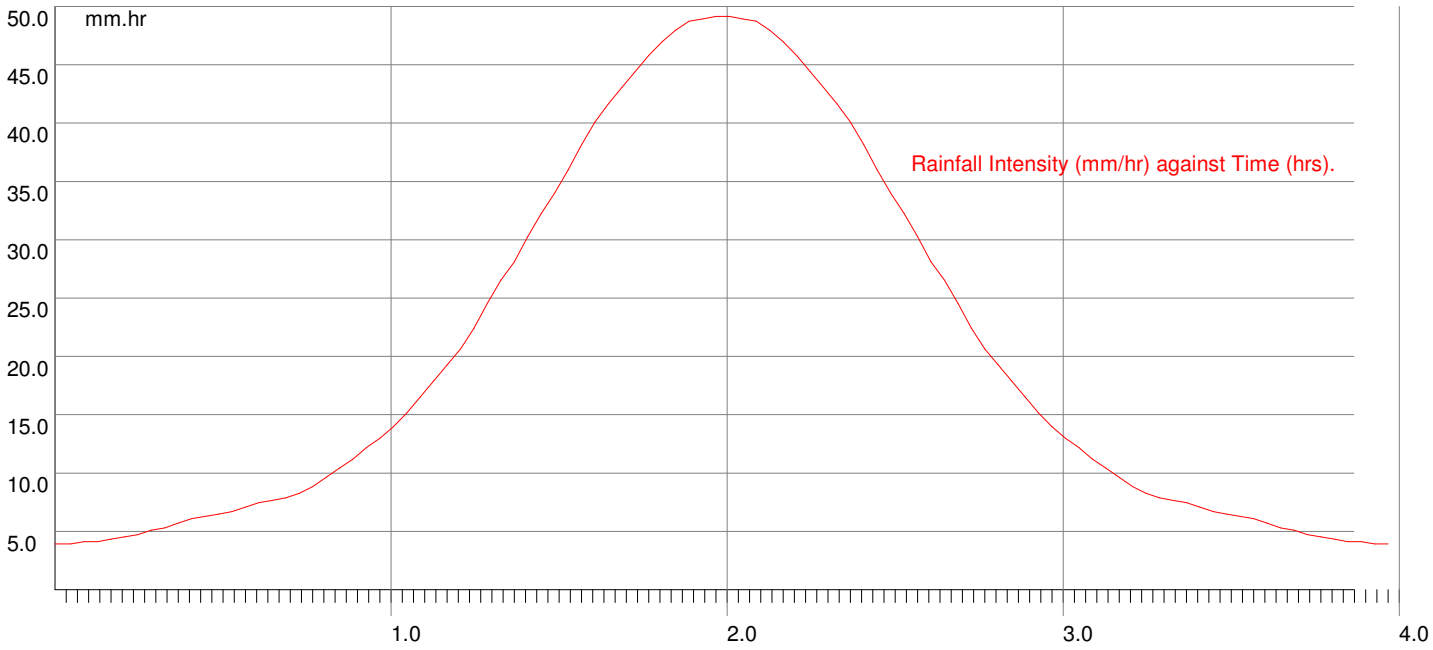
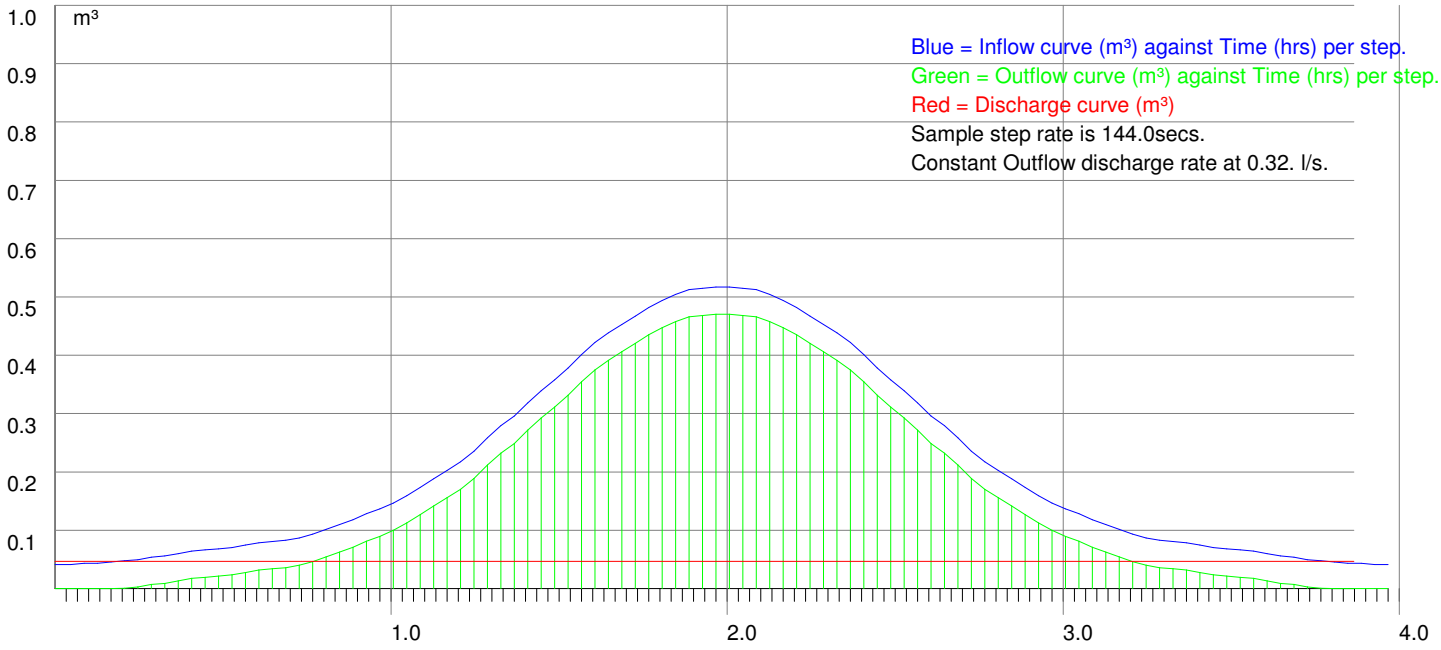
MasterDrain SW

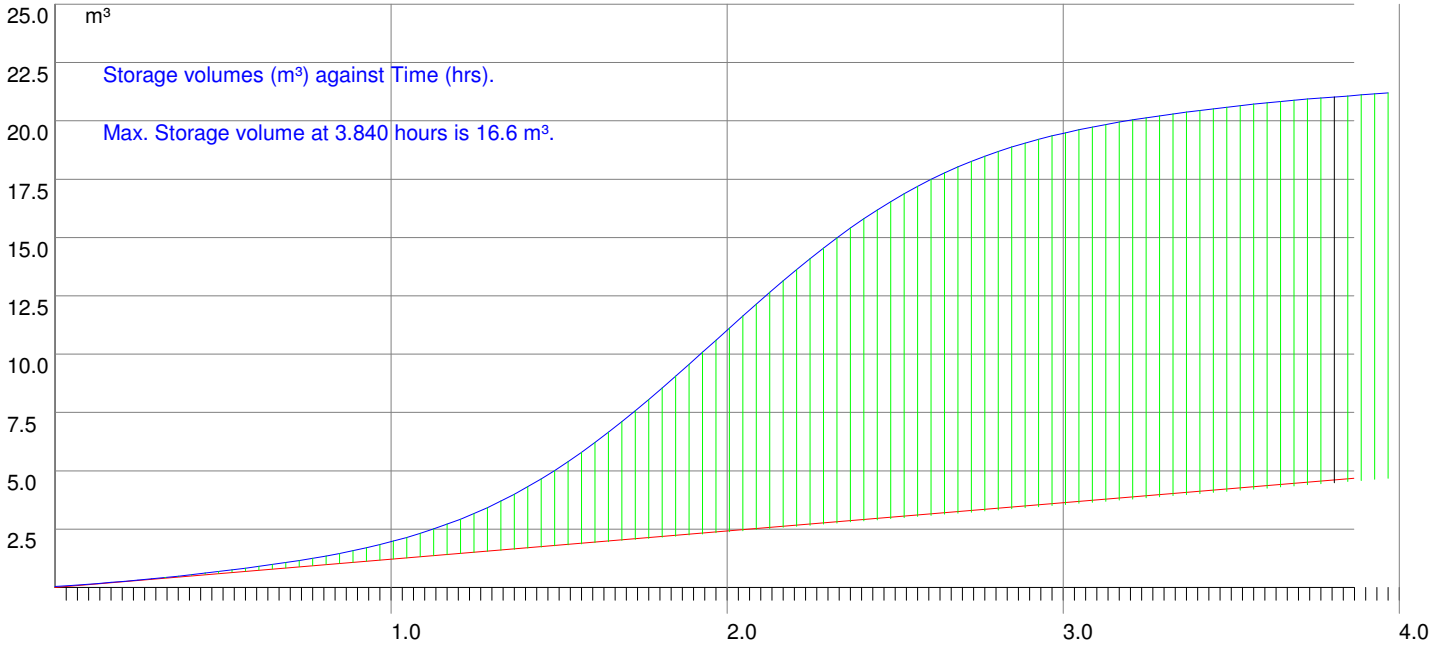
Job No.	C2131
Sheet no.	3
Date	21/05/19
By	S.L
Checked	
Reviewed	

Project 36 Redington Road

Title Hydrograph storage calcs with Qbar discharge







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Job No.	C2131
Sheet no.	4
Date	21/05/19

Project	By	Checked	Reviewed
36 Redington Road	S.L		

Title: **Hydrograph storage calcs with Qbar discharge**

Maximum storage volumes for varying duration storms.

Storm length (hrs)	Max. Vol (m^3)	Max. Vol time	Mean intens (mm/hr)	Step time. (mins)	Peak found
0.25	9.26	0.25	141.69	0.2	
0.5	11.80	0.50	91.88	0.3	
1	14.12	1.00	56.71	0.6	
2	15.90	2.00	33.84	1.2	
3	16.47	3.00	24.70	1.8	
4	16.55	4.00	19.66	2.4	Peak found
5	16.44	---	16.41	3.0	
6	16.27	---	14.18	3.6	
7	16.06	---	12.52	4.2	
8	15.83	---	11.25	4.8	
9	15.59	---	10.23	5.4	
10	15.32	---	9.39	6.0	
12	14.75	---	8.10	7.2	
15	13.82	---	6.76	9.0	
18	12.87	---	5.83	10.8	
20	12.24	---	5.35	12.0	
24	10.97	---	4.61	14.4	
30	9.15	---	3.84	18.0	
36	7.41	---	3.31	21.6	
42	5.81	---	2.91	25.2	
48	4.35	---	2.61	28.8	
54	3.05	---	2.37	32.4	
60	1.90	---	2.17	36.0	
66	0.97	---	2.01	39.6	
72	0.28	---	1.87	43.2	
84	0.00	---	1.65	50.4	
96	0.00	---	1.47	57.6	
120	0.00	---	1.22	72.0	
150	0.00	---	1.02	90.0	
175	0.00	---	0.89	105.0	
200	0.00	---	0.80	120.0	
250	0.00	---	0.66	150.0	
300	0.00	---	0.57	180.0	
375	0.00	---	0.47	225.0	
500	0.00	---	0.37	300.0	
750	0.00	---	0.27	450.0	
1000	0.00	---	0.21	600.0	
1250	0.00	---	0.17	750.0	
1500	0.00	---	0.15	900.0	
1570	0.00	---	0.14	942.0	
2000	0.00	---	0.12	1200.0	
2500	0.00	---	0.10	1500.0	
3000	0.00	---	0.08	1800.0	
3500	0.00	---	0.07	2100.0	
4000	0.00	---	0.07	2400.0	

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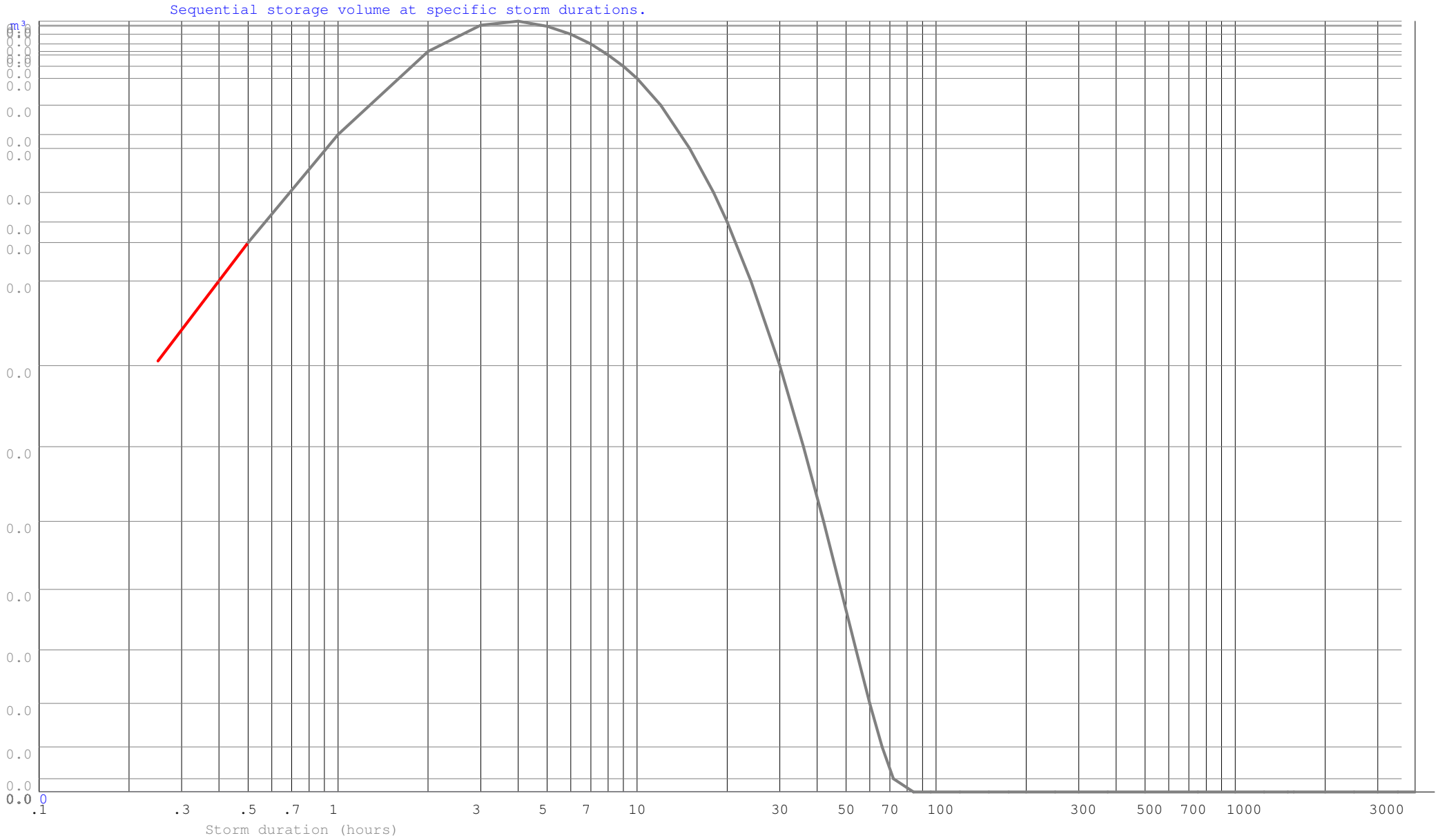
Job No. C2131			
Sheet no. 5			
Date 21/05/19			
Project 36 Redington Road	By S.L	Checked	Reviewed
Title Hydrograph storage calcs with Qbar discharge			



Explanatory notes for Peak Flow Storage

1) This system uses the rainfall intensity/ duration curve calculated using either the Wallingford or FEH method as selected.
2) The balance is calculated from the inflow minus the outflow.
3) The storage volume is the maximum value of the balance curve.
4) This method was described by Davis (1963) - see Butler & Davies, 2nd edition, p294
5) References to 'storm duration' relate only to the hydrograph method (qv).
6) There are always 600 steps in the calculation process, thus a 'run' time of 10 hours will be sampled every minute,

Explanatory notes for Hydrograph Storage

1) The user has the choice of Summer or Winter curves
2) The mean intensity varies with the duration of the storm curve
3) There are always 120 steps in the calculation process, irrespective of storm duration.
4) The balance is calculated from the inflow minus the outflow.
5) The storage volume is the sum of the balance values for each step.
6) Varying durations should be tried to find the maximum storage value - this can be narrowed down very closely.

*Modelling using the flow characteristics of the restrictor is available using Vortex Control modelling function. Please be aware that this function needs the full design data file to function.

Why do the two methods give different results?

The rainfall characteristics for each method are very different.

The Peak flow (using the Intensity/Duration/Frequency curve) does not model the actual rainfall. This curve is joined points which represent the mean intensity of a storm at a given duration i.e. a value of 19.5 mm/hr for a 60 minute storm indicates that over the sixty minute period, the mean intensity was 19.5 mm/hr. The calculation method samples the IDF curve for a given location and frequency (Return Period) and calculates the storage for that rate and duration less the outflow volume. The maximum value is displayed as the 'worst case' storage.

The hydrograph method uses a standard curve for either Winter or Summer storms. Traditionally these are symmetrical about the central peak. UK rainfall does not fit into this convenient curve, so the calculations are dealing with a stylised set of data. The mean intensity for the storm is calculated from the IDF curve and applied to the curve data, calculating the storage for that step less the outflow volume. The final storage volume is the sum of the storage for all the steps.

It can be seen that these two methods are very different, and the user may have the choice of which result to use. This is not an exact science, though is often treated as such by those that do not understand the principles of the calculations.

APPENDIX B – DRAWINGS

KEY

SURFACE WATER UPVC PIPES

SURFACE WATER INSPECTION CHAMBERS

PERMEABLE PAVING

SLOT DRAINS

ATTENUATION TANK TO STORE 16.15m3

S5 - CATCHPIT CHAMBER

150mmØ UPVC

S4

150mmØ UPVC

150mmØ UPVC

PUMPING STATION

150mmØ UPVC

S2

S3

S6

100mmØ UPVC

FLOW CONTROL SET TO 0.325 l/s

100mmØ UPVC

150mmØ UPVC

S1

S7

100mmØ UPVC

connect to mains using existing TW connection

ref: L01 GARDEN STORAGE 6.8m² F-C ....m

ref: L01 SUNKEN GARDEN 24.8m²

ref: B01 BEDROOM 4/ GYM 24.4m² F-C ....m

ref: B02 ENSUITE 6.1m² F-C ....m

ref: B11 CUP-D 1.5m² F-C ....m

ref: B10 LOBBY 12.3m² F-C ....m

ref: B03 CLOAK ROOM 3.7m² F-C ....m

ref: B04 TV / GAMES ROOM 46.5m² F-C ....m

ref: B09 BED 5 11.4m² F-C ....m

ref: B08 ENSUITE 3.4m² F-C ....m

ref: L02 LIGHTWELL 12.9m²

ref: L03 LIGHTWELL 7.8m²

ref: B05 LOBBY 2.2m² F-C ....m

ref: B07 UTILITY ROOM 8.2m² F-C ....m

ref: B06 LINEN ROOM 2.8m² F-C ....m

BP-1 D01 BP-1 D02 BP-1 D03 BP-1 D04 BP-1 D07 BP-1 D08 BP-1 D09 BP-1 D11 BP-1 W01 BP-1 W02 BP-1 W03 BP-1 W04 BP-1 W05 BP-1 W06

svp (1 basin)

1x1m prov ceiling adj future lift

vented SVP (2 cloaks)

RWP 2

stub

sump pump

NOTE: LA requirement to protect from Sewer flooding by way of Positive pumped device

MH IL 1.19m

below basement slab

HL connection under GF slab to connect to MH

IMPORTANT

THIS DRAWING IS TO BE CHECKED ON SITE BY THE CONTRACTOR PRIOR TO THE COMMENCEMENT OF THE WORKS. ANY DISCREPANCY MUST BE REPORTED TO THE ENGINEER.

NO DEVIATION MAY BE MADE FROM THE CONTENTS OF THIS DRAWING WITHOUT PRIOR PERMISSION FROM THE ENGINEER.

THIS DRAWING IS TO BE REMOVED FROM CURRENCY IMMEDIATELY AFTER A REVISED EDITION HAS BEEN ISSUED.

REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
A	24-05-19	JR	For Information	SL	SL

PROJECT: 36 REDINGTON ROAD

TITLE: SURFACE WATER DRAINAGE & SuDS LAYOUT PLAN

CLIENT: ZOLF AGHARI

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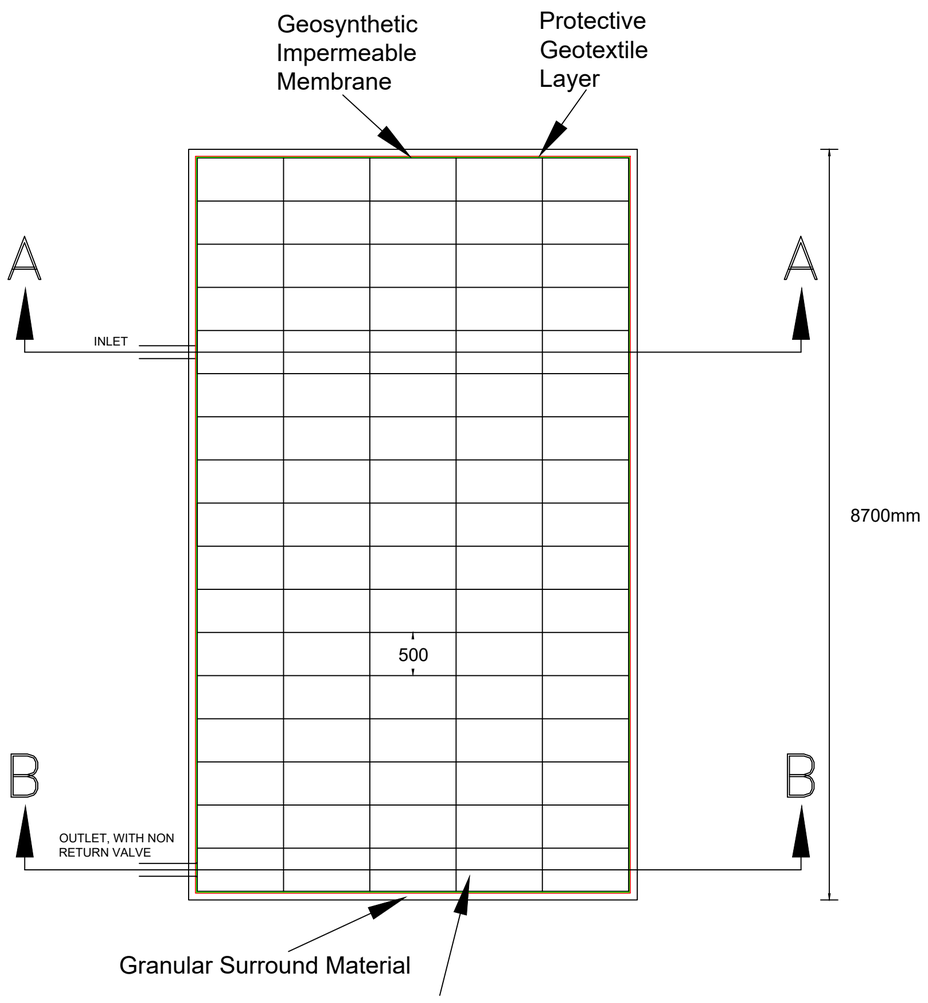
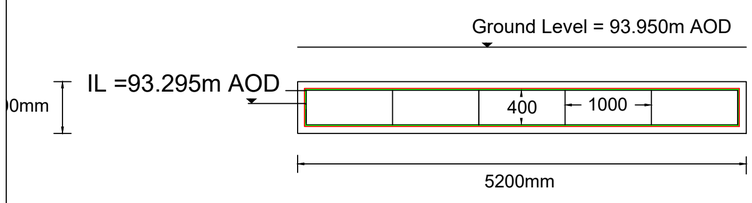
CHECKED BY:	DATE:	APPROVED BY:	DATE:
S.L	24-05-19	S.L	24-05-19
DRN BY: J.R	SCALE: 1:50	DRAWING NUMBER: C2131-02	REV: A
DATE: 24-05-19	SIZE: A1		

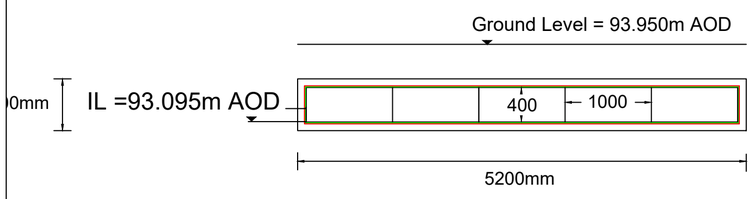
mOVE					
IC	SIZE	COVER LEVEL	INVERT LEVEL	APPROX DEPTH	NOTES
S1	0.45Ø	91.350	90.950	0.400	
S2	0.45Ø	91.350	90.855	0.495	
S3	0.45Ø	T.B.C	93.800	T.B.C	
S4	0.45Ø	T.B.C	93.500	T.B.C	
S5	0.45Ø	93.950	93.350	0.600	
S6	0.45Ø	T.B.C	92.970	T.B.C	
S7	0.45Ø	94.500	92.833	1.667	



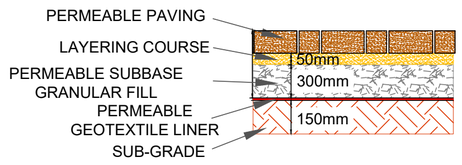
PLAN



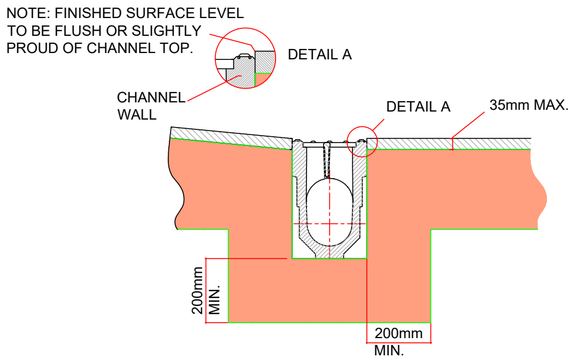
SECTION A-A



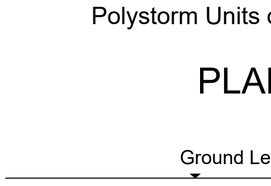
SECTION B-B



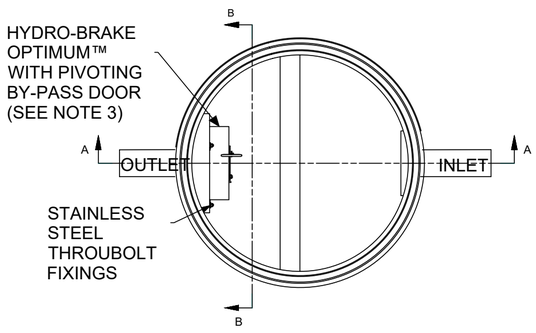
PERMEABLE PAVING CROSS-SECTION

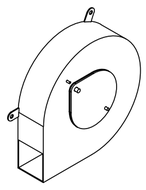


ACO ROAD DRAIN DETAIL



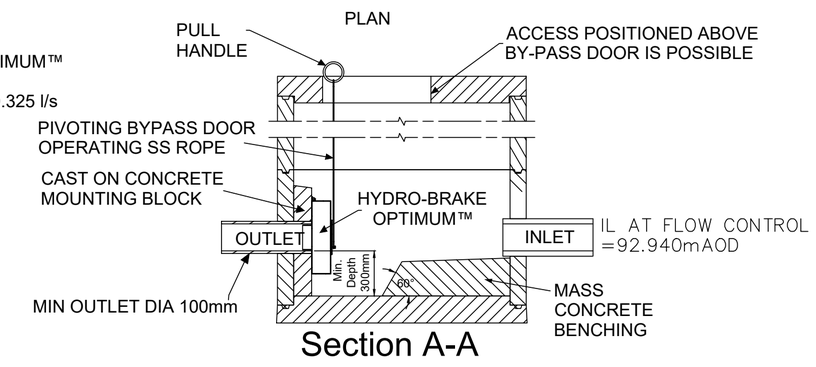
SECTION B-B
(VIEW ON MOUNTING BLOCK)





HYDRO-BRAKE OPTIMUM™ WITH OUTFLOW SET TO 0.325 l/s

Hydrobrake Detail



Section A-A

1200mm dia. Hydrobrake (or similar) Detail

REV	DATE	DRAWN	DESCRIPTION	CHECK	APPR.
A	24-05-19	JR	For Information	SL	SL

PROJECT:
36 REDINGTON ROAD

TITLE:
SuDS DETAILS & MANHOLE SCHEDULE

CLIENT:
ZOLF AGHARI

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S.L	24-05-19	S.L	24-05-19
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