Project

Gowans Citywest

Report Title

Surface Water Drainage Report

Client

Gowan Distributor Ltd

INFRASTRUCTURE

DBFL CONSULTING ENGINEERS

Job Title: **Gowans City West**

Job Number: **210091**

Report Title: **Surface Water Drainage Report**

Report Reference: **210091-DBFL-SW-SP-RP-C-0001**

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Date: **November 2021**

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P1	19/11/2021	Issued for Planning	TCA	KJS	DJR

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1.0 INTRODUCTION

1.1 Background

This document relates to the request for additional information from South Dublin City Council in response to a submitted planning application (Ref: SD21A/0240).

The proposed development comprises of changes to the existing development at Units 2007 and 2008, Orchard Avenue, Citywest Business Campus, Dublin 24. The application includes provision of new single storey hand wash valet structure on south elevation, new ramped and stepped access with external terrace to form new entrance area with canopy at existing exit on west elevation, revisions to existing hard and soft landscaping to accommodate the development, and a total of 14no. additional parking spaces are also proposed as part of the proposed development.

1.2 Report Objectives

This report is intended to address the surface water strategy for the new build elements of the proposed development as per Item 4 of the request for further information from South Dublin City Council under planning reference SD21A/0240:

4. *"(a) The application particulars contain no surface water attenuation calculations. The applicant is requested to submit a report showing surface water attenuation calculations for the proposed new-build element of the development. If the development will share an existing attenuation system, the applicant is requested to then also show the surface water attenuation calculations for the existing and proposed development. The calculations shall include, SAAR value, Qbar, Soil factor, areas of buildings, roads, pathways permeable paving and green areas in m2 and their respective run off coefficients. Include the area of site in Hectares".*

   "(b)The applicant is requested to submit a report and drawing to examine what SuDS (Sustainable Drainage System) are proposed. Surface water attenuation shall be carried out using SuDS such as green areas, green roof, permeable paving, filter drains tree pits, grasscrete, bioswales and other such SuDS. Only where SuDS are insufficient to attenuate surface water shall alternate surface water attenuation system be used."

The key areas addressed in this report are:

- The new extension to the south of the existing development
- The new steps and ramped access to the south of the existing development
- Changes to the existing hard and soft landscaping
- New parking spaces

2.0 SURFACE WATER DRAINAGE

2.1 Existing Surface Water Drainage

The existing development is currently served by a private surface water sewer discharging off the site to the west.

There is an existing surface water pipe running beneath the footprint of the proposed extension. The section of the pipe beneath this area is to be diverted around the extension. All other existing surface water drainage is to be maintained in place and unaltered by the proposed works. Refer to drawing 210091-DBFL-CS-SP-DR-C-1300.

It is not intended to discharge surface water generated from the new build elements of the proposed development to the existing network.

2.2 Design Standards

The drainage strategy is designed in accordance with the Greater Dublin Regional Code of Practice for Drainage Works. Surface water pipework and SUDS features were sized using the Microdrainage Windes drainage modelling software. The following parameters apply to the design:

- Return period for attenuation 100 years
- Time of entry 4 minutes
- Assumed Infiltration Rate 3.5 mm/hr
- Standard Average Annual Rainfall 834mm (Met Eireann)
- M5-60 17.3mm (Met Eireann)
- Ratio R 0.300 (Met Eireann)
- Climate Change 20% for rainfall intensities.
- Runoff Factor – Roofs 100%
- Runoff Factor – Paved areas 95%
- Runoff Factor – Paved areas to filter drain 70%
- Runoff Factor – Reinforced Grass 50%

2.3 Surface Water Strategy

In accordance with the GDSDS it is proposed to use Sustainable Urban Drainage systems (SUDS) for managing stormwater for the new built elements of the proposed development. The aim of the SUDS strategy for the site will be to;

- Attenuate additional storm-water runoff.
- Reduce additional storm-water runoff.

- Reduce additional pollution impact.
- Replicate the natural characteristics of rainfall runoff for the site.
- Recharge the groundwater profile

The Surface Water Strategy is to discharge run-off from the new build elements to a new separate drainage system discharging via infiltration into the underlying soils and avoid discharging to the existing drainage network.

It is not intended to discharge surface water generated from the existing development to the proposed surface water network serving the new build elements. Various SUDS features are incorporated into the design for the subject site, these include:

1. Bioretention Areas - Where possible Bioretention areas have been implemented into the design. Surface water generated from the adjacent structures and footpaths will discharge directly to these SUDS features
2. Infiltration– The proposed design includes reinforced grass finishes on the new parking spaces proposed.

The proposed new build elements of this development are spaced across the site. The new build elements have therefore been separated into 3 catchments each discharging to separate SUDS features as shown in Figure 2-1 below.

Figure 2-1 - Surface Water Catchments

2.4 SUDS Features

As stated previously it is intended to discharge surface water run-off from the site via infiltration into the underlying soils. It is intended to achieve this by using Bio-retention and reinforced grass paving as detailed below. The underlying soil of the site is predominately clay deposits;

therefore, SUDS features have been designed using a conservative approach with an assumed infiltration rate of 3mm/hr. SUDS storage calculations are contained in Appendix B of this report.

The proposed drainage layout is shown on drawing 210091-DBFL-CS-SP-DR-C-1300 with SUDS features detailed on drawing 210091-DBFL-CS-SP-DR-C-5300

2.4.1 *Catchment 1*

Contributing areas to the catchment 1 drainage network include an extension to the existing building, concrete footpaths and terraced area with surrounding landscaping. It is proposed to collect surface water generated on this portion of the development in filter drains that discharge to a Bio-retention Area, to the south of the building as shown in Figure 2-2 below, with a total volume of 36.41m³. Contributing areas for calculations for are contained in Appendix A.

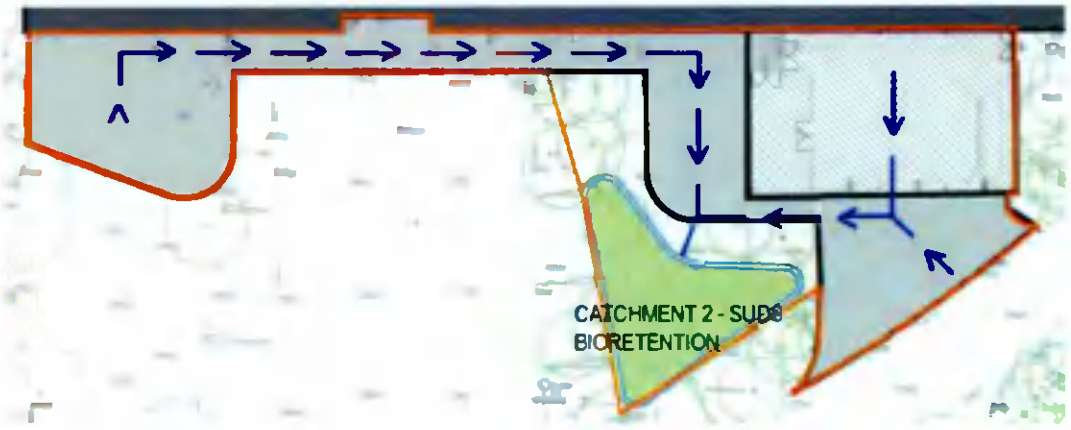

Figure 2-2 Catchment 1 - Contributing Areas

2.4.2 *Catchment 2*

New build elements contributing to the catchment 2 drainage consist of a pedestrian/wheelchair access and terraced area with canopy above entrance to the west of the existing building. It is proposed to collect surface water generated on this portion of the development in filter drains that discharge to a Bio-retention Area to the north of the building with a total volume of 11.37m³. Contributing areas for calculations for are contained in Appendix A.

Figure 2-3 Catchment 2 - Contributing Areas

2.4.3 *Catchment 3*

Catchment 3 consists entirely of the 14no. new parking spaces to the north of the existing development. It is proposed to pave these spaces with grass reinforcement with a 200mm

granular base providing 21m³. There are no new impermeable hardstanding areas within this catchment so surface water generated will infiltrate directly through finished surface.. Refer to drawings 162119-DBFL-CS-SP-DR-C-1300 & 5300 for details.

2.5 Pluvial Flooding Provision

The surface water network, SUDS storage and site levels are designed to accommodate a 100 year storm event and includes climate change provision. The minimum finished floor level of the proposed development is 108.650m. The highest water level for the 100 year storm is 107.929m which is over 0.5m below the proposed building levels.

For storms in excess of the 100 year event, it is intended for surface ponding to occur within the proposed SUDS features. Each feature is over 5m away from the proposed and existing building with a maximum top of system level of 108.000m, which is 0.65m below the finished floor level of the development.

3.0 CONCLUSION

We trust the information included in this report satisfies Item 4 of the request for additional information from South Dublin City Council in response to planning application reference SD21A/0240.

4. *"(a) The application particulars contain no surface water attenuation calculations. The applicant is requested to submit a report showing surface water attenuation calculations for the proposed new-build element of the development. If the development will share an existing attenuation system, the applicant is requested to then also show the surface water attenuation calculations for the existing and proposed development. The calculations shall include, SAAR value, Qbar, Soil factor, areas of buildings, roads, pathways permeable paving and green areas in m2 and their respective run off coefficients. Include the area of site in Hectares".*

   "(b)The applicant is requested to submit a report and drawing to examine what SuDS (Sustainable Drainage System) are proposed. Surface water attenuation shall be carried out using SuDS such as green areas, green roof, permeable paving, filter drains tree pits, grasscrete, bioswales and other such SuDS. Only where SuDS are insufficient to attenuate surface water shall alternate surface water attenuation system be used."

APPENDIX A

CONTRIBUTIBUTING CATCHMENT AREA CALCULATIONS

PROJECT			JOB REF.
Gowens City West			210091
SUBJECT			Calc. Sheet No.
Catchment 1			1
Drawing ref.	Calculations by	Checked by	Date
	TC	KJS	16-Nov-21

CATCHMENT CONTRIBUTING AREA CALCULATIONS

Site Area

What is the overall site area? **2.35** Hectares (ha) Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? **No**

Catchment	This refers to the entire site area	0.06	
Area	0.06	Hectares (ha)
Drainage Group	2	Class
Depth to Impermeable Layers	1	Class
Permeability Group above Impermeable Layers	2	Class
Slope [6]	1	Class
SOIL Type	2	From FSR Table
[1]SOIL Index	0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? **No**

What is the overall site area for catchment? **0.18** Hectares (ha)

Catchment 1	Area (m^2)	Runoff Coeff	Effective Area (m^2)
Roofs - Type 1 (Draining to gullies)	146.0	1.00	146.0
Roofs - Type 2 (Draining to SUDS features)	0.0	0.70	0.0
Roads and Footpaths - Type 1 (Draining to gullies)	75.0	0.95	71.3
Roads and Footpaths (Draining to Suds features)	230.0	0.70	161.0
Permeable Paving (Reinforced Grass)	0.0	0.50	0.0
Grassed Areas	173.0	0.15	26.0
Total	624.0		404.2

Include Public Open Space in Effective Catchment Area? **No**

Effective Catchment Area **404.2** m^2

Effective Catchment Runoff Coefficient **0.65**

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? **834.0** mm From Met Eireann, Co-ordinates 32000 , 226000

Is the overall site area less than 50 hectares? **Yes**

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site **0.1** Litres/sec

[7]Site Discharge = **2.0** Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5)
2. SPR value calculated from GDSDS - Table 6.7
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change
4. Long-term storage Vol_{ls} (m^3) = Rainfall Area 10.[(PIMP/100)(0.8 x)+(1-PIMP/100)(β SPR)-SPR] (GDSDS Section 6.7.3)
   Where long-term storage cannot be provided on-site due to ground conditions Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6), i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2}$ For catchments greater than 50 hectares in area Flow rates are linearly interpolated for areas smaller than 50hectares
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable use 2.0 l/s or closest value possible
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2.

PROJECT			JOB REF.
Gowens City West			210091
SUBJECT			Calc. Sheet No.
Catchment 2			1
Drawing ref.	Calculations by	Checked by	Date
	TC	KJS	16-Nov-21

CATCHMENT CONTRIBUTING AREA CALCULATIONS

Site Area

What is the overall site area? **2.35** Hectares (ha) Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? **No**

Catchment (This refers to the entire site area)	0.02	
Area	0.02	Hectares (ha)
Drainage Group	2	Class
Depth to Impermeable Layers	1	Class
Permeability Group above Impermeable Layers	2	Class
Slope [6]	1	Class
SOIL Type	2	From FSR Table
SOIL Index	0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? **No**

What is the overall site area for catchment? **0.18** Hectares (ha)

Catchment 1	Area (m^2)	Runoff Coeff	Effective Area (m^2)
Roofs - Type 1 (Draining to gullies)	0.0	1.00	0.0
Roofs - Type 2 (Draining to SUDS features)	0.0	0.70	0.0
Roads and Footpaths - Type 1 (Draining to gullies)	65.0	0.95	61.8
Roads and Footpaths (Draining to Suds features)	67.0	0.70	46.9
Permeable Paving (Reinforced Grass)	0.0	0.50	0.0
Grassed Areas	38.0	0.30	11.4
Total	170.0		120.1

Include Public Open Space in Effective Catchment Area? **No**

Effective Catchment Area **120.1** m^2

Effective Catchment Runoff Coefficient **0.71**

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? **834.0** mm From Met Eireann Co-ordinates 32000 226000

Is the overall site area less than 50 hectares? **Yes**

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site **0.0** Litres/sec

[7]Site Discharge = **2.0** Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5).
2. SPR value calculated from GDSDS - Table 6.7
3. Rainfall depth for 100 year return period 6 hour duration with additional 10% for climate change
4. Long-term storage Vol_{lts} (m^3) = Rainfall Area 10 [(PIMP/100)(0.8 $_{SPR}$)+(1-PIMP/100)(1 SPR)-SPR]. (GDSDS Section 6.7.3)
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$.
5. Total Permissible Outflow - $QBAR_{Rural}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6) i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas smaller than 50hectares
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2

PROJECT			JOB REF.
Gowens City West			210091
SUBJECT			Calc. Sheet No.
Catchment 3			1
Drawing ref.	Calculations by	Checked by	Date
	TC	KJS	16-Nov-21

CATCHMENT CONTRIBUTING AREA CALCULATIONS

Site Area

What is the overall site area? **2.35** Hectares (ha) Site is Less than 50 Hectares

Pre-Development Catchment Soil Characteristics

Are there different soil types present on the pre-developed site? **No**

Catchment This refers to the entire site area	0.04	
Area	0.03	Hectares (ha)
Drainage Group	2	Class
Depth to Impermeable Layers	1	Class
Permeability Group above Impermeable Layers	2	Class
Slope [6]	1	Class
SOIL Type	2	From FSR Table
[1]SOIL Index	0.30	

SOIL	SOIL Value	SPR
1	0.15	0.10
2	0.30	0.30
3	0.40	0.37
4	0.45	0.47
5	0.50	0.53

Site SOIL Index Value **0.30**

Site SPR Value **0.30**

Post-Development Catchment Characteristics

Is the development divided into sub-catchments? **No**

What is the overall site area for catchment? **0.18** Hectares (ha)

Catchment 1	Area (m^2)	Runoff Coeff	Effective Area (m^2)
Roofs - Type 1 (Draining to gullies)	0.0	1.00	0.0
Roofs - Type 2 (Draining to SUDS features)	0.0	0.70	0.0
Roads and Footpaths - Type 1 (Draining to gullies)	0.0	0.95	0.0
Roads and Footpaths (Draining to Suds features)	0.0	0.70	0.0
Permeable Paving (Reinforced Grass)	347.0	0.50	173.5
Grassed Areas	0.0	0.30	0.0
Total	347.0		173.5

Include Public Open Space in Effective Catchment Area? **No**

Effective Catchment Area **173.5** m^2

Effective Catchment Runoff Coefficient **0.50**

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)? **834.0** mm From Met Eireann Co-ordinates 32000 226000

Is the overall site area less than 50 hectares? **Yes**

[5]$QBAR_{Rural}$ calculated for 50 ha and linearly interpolated for area of site **0.1** Litres/sec

[7]Site Discharge = **2.0** Litres/sec

Notes and Formulae

1. SOIL index value calculated from Flood Studies Report - The Classification of Soils from Winter Rainfall Acceptance Rate (Table 4.5)
2. SPR value calculated from GDSDS - Table 6.7
3. Rainfall depth for 100 year return period, 6 hour duration with additional 10% for climate change
4. Long-term storage Vol_{ls} (m^3) = Rainfall,Area 10 [(PIMP/100)(0.8 x)+(1 PIMP/100)(β SPR)-SPR]. (GDSDS Section 6.7.3)
   Where long-term storage cannot be provided on-site due to ground conditions, Total Permissible Outflow is to be kept to $QBAR_{(Rural)}$
5. Total Permissible Outflow - $QBAR_{(Rural)}$ calculated in accordance with GDSDS - Regional Drainage Policies
   (Volume 2 - Chapter 6) i.e. $QBAR(m3/s)=0.00108x(Area)^{0.89}(SAAR)^{1.17}(SOIL)^{2.17}$ - For catchments greater than 50 hectares in area. Flow rates are linearly interpolated for areas samller than 50hectares
6. Where Total Permissible Outflow is less than 2.0l/s and not achievable, use 2.0 l/s or closest value possible
7. QBAR multiplied by growth factors of 0.85 for 1 year, 2.1 for 30 year and 2.6 for 100 year return period events, from GDSDS Figure C2

APPENDIX B

SUDS STORAGE CALCULATIONS

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7	Gowans City West Catchment 1 Bio Retention Area	
Date 11/11/2021 File Catchment 1.SRCX	Designed by TCA Checked by JPC	
Innovyze	Source Control 2020.1	

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 4981 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	106.635	0.335	0.0	6.9	O K
30 min Summer	106.756	0.456	0.0	9.3	O K
60 min Summer	106.879	0.579	0.0	11.9	O K
120 min Summer	107.016	0.716	0.0	14.7	O K
180 min Summer	107.102	0.802	0.0	16.4	O K
240 min Summer	107.166	0.866	0.0	17.8	O K
360 min Summer	107.260	0.960	0.1	19.7	O K
480 min Summer	107.329	1.029	0.1	21.1	O K
600 min Summer	107.383	1.083	0.1	22.2	O K
720 min Summer	107.426	1.126	0.1	23.1	O K
960 min Summer	107.494	1.194	0.1	24.5	O K
1440 min Summer	107.583	1.283	0.1	26.3	O K
2160 min Summer	107.656	1.356	0.1	27.8	O K
2880 min Summer	107.690	1.390	0.1	28.5	O K
4320 min Summer	107.704	1.404	0.1	28.8	O K
5760 min Summer	107.700	1.400	0.1	28.7	O K
7200 min Summer	107.687	1.387	0.1	28.4	O K
8640 min Summer	107.670	1.370	0.1	28.1	O K
10080 min Summer	107.650	1.350	0.1	27.7	O K
15 min Winter	106.675	0.375	0.0	7.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	91.990	0.0	19
30 min Summer	62.658	0.0	34
60 min Summer	39.995	0.0	64
120 min Summer	24.904	0.0	124
180 min Summer	18.717	0.0	184
240 min Summer	15.262	0.0	244
360 min Summer	11.412	0.0	364
480 min Summer	9.274	0.0	484
600 min Summer	7.890	0.0	602
720 min Summer	6.913	0.0	722
960 min Summer	5.608	0.0	962
1440 min Summer	4.175	0.0	1442
2160 min Summer	3.107	0.0	2160
2880 min Summer	2.518	0.0	2880
4320 min Summer	1.870	0.0	3764
5760 min Summer	1.512	0.0	4552
7200 min Summer	1.283	0.0	5328
8640 min Summer	1.121	0.0	6136
10080 min Summer	1.000	0.0	6960
15 min Winter	91.990	0.0	19

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	106.811	0.511	0.0	10.5	O K
60 min Winter	106.949	0.649	0.0	13.3	O K
120 min Winter	107.103	0.803	0.0	16.5	O K
180 min Winter	107.200	0.900	0.0	18.4	O K
240 min Winter	107.273	0.973	0.1	19.9	O K
360 min Winter	107.380	1.080	0.1	22.1	O K
480 min Winter	107.459	1.159	0.1	23.7	O K
600 min Winter	107.520	1.220	0.1	25.0	O K
720 min Winter	107.571	1.271	0.1	26.0	O K
960 min Winter	107.650	1.350	0.1	27.7	O K
1440 min Winter	107.757	1.457	0.1	29.8	O K
2160 min Winter	107.849	1.549	0.1	31.7	O K
2880 min Winter	107.898	1.598	0.1	32.7	O K
4320 min Winter	107.929	1.629	0.1	33.4	O K
5760 min Winter	107.919	1.619	0.1	33.2	O K
7200 min Winter	107.907	1.607	0.1	32.9	O K
8640 min Winter	107.885	1.585	0.1	32.5	O K
10080 min Winter	107.857	1.557	0.1	31.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	62.658	0.0	34
60 min Winter	39.995	0.0	64
120 min Winter	24.904	0.0	122
180 min Winter	18.717	0.0	182
240 min Winter	15.262	0.0	242
360 min Winter	11.412	0.0	360
480 min Winter	9.274	0.0	478
600 min Winter	7.890	0.0	596
720 min Winter	6.913	0.0	714
960 min Winter	5.608	0.0	950
1440 min Winter	4.175	0.0	1414
2160 min Winter	3.107	0.0	2100
2880 min Winter	2.518	0.0	2792
4320 min Winter	1.870	0.0	4068
5760 min Winter	1.512	0.0	4792
7200 min Winter	1.283	0.0	5616
8640 min Winter	1.121	0.0	6568
10080 min Winter	1.000	0.0	7464

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.000	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.040

Time (mins) From:	To:	Area (ha)
0	4	0.040

Model Details

Storage is Online Cover Level (m) 108.400

Cellular Storage Structure

Invert Level (m) 106.300 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00350 Porosity 0.30
Infiltration Coefficient Side (m/hr) 0.00350

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	68.3	68.4	2.100	80.0	133.1
1.700	68.3	133.1			

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 0 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	105.918	0.018	5.4	0.1	O K
30 min Summer	105.917	0.017	5.0	0.1	O K
60 min Summer	105.912	0.012	3.5	0.1	O K
120 min Summer	105.908	0.008	2.4	0.1	O K
180 min Summer	105.906	0.006	1.8	0.0	O K
240 min Summer	105.905	0.005	1.6	0.0	O K
360 min Summer	105.904	0.004	1.1	0.0	O K
480 min Summer	105.903	0.003	1.0	0.0	O K
600 min Summer	105.903	0.003	1.0	0.0	O K
720 min Summer	105.903	0.003	0.8	0.0	O K
960 min Summer	105.902	0.002	0.7	0.0	O K
1440 min Summer	105.902	0.002	0.5	0.0	O K
2160 min Summer	105.901	0.001	0.4	0.0	O K
2880 min Summer	105.901	0.001	0.4	0.0	O K
4320 min Summer	105.901	0.001	0.4	0.0	O K
5760 min Summer	105.901	0.001	0.2	0.0	O K
7200 min Summer	105.901	0.001	0.2	0.0	O K
8640 min Summer	105.900	0.000	0.1	0.0	O K
10080 min Summer	105.900	0.000	0.1	0.0	O K
15 min Winter	105.919	0.019	5.5	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	93.730	0.0	10
30 min Summer	63.708	0.0	17
60 min Summer	40.649	0.0	32
120 min Summer	25.298	0.0	62
180 min Summer	19.019	0.0	92
240 min Summer	15.498	0.0	126
360 min Summer	11.587	0.0	188
480 min Summer	9.415	0.0	240
600 min Summer	8.010	0.0	316
720 min Summer	7.017	0.0	362
960 min Summer	5.693	0.0	488
1440 min Summer	4.238	0.0	750
2160 min Summer	3.154	0.0	1068
2880 min Summer	2.556	0.0	1320
4320 min Summer	1.897	0.0	2252
5760 min Summer	1.535	0.0	2864
7200 min Summer	1.301	0.0	3216
8640 min Summer	1.137	0.0	4608
10080 min Summer	1.015	0.0	5216
15 min Winter	93.730	0.0	10

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	105.915	0.015	4.4	0.1	O K
60 min Winter	105.910	0.010	2.9	0.1	O K
120 min Winter	105.906	0.006	1.8	0.0	O K
180 min Winter	105.905	0.005	1.4	0.0	O K
240 min Winter	105.904	0.004	1.3	0.0	O K
360 min Winter	105.903	0.003	0.8	0.0	O K
480 min Winter	105.903	0.003	0.8	0.0	O K
600 min Winter	105.902	0.002	0.7	0.0	O K
720 min Winter	105.902	0.002	0.7	0.0	O K
960 min Winter	105.902	0.002	0.5	0.0	O K
1440 min Winter	105.901	0.001	0.4	0.0	O K
2160 min Winter	105.901	0.001	0.4	0.0	O K
2880 min Winter	105.901	0.001	0.2	0.0	O K
4320 min Winter	105.901	0.001	0.2	0.0	O K
5760 min Winter	105.900	0.000	0.1	0.0	O K
7200 min Winter	105.900	0.000	0.1	0.0	O K
8640 min Winter	105.900	0.000	0.1	0.0	O K
10080 min Winter	105.900	0.000	0.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	63.708	0.0	17
60 min Winter	40.649	0.0	32
120 min Winter	25.298	0.0	60
180 min Winter	19.019	0.0	96
240 min Winter	15.498	0.0	112
360 min Winter	11.587	0.0	170
480 min Winter	9.415	0.0	264
600 min Winter	8.010	0.0	294
720 min Winter	7.017	0.0	346
960 min Winter	5.693	0.0	478
1440 min Winter	4.238	0.0	624
2160 min Winter	3.154	0.0	852
2880 min Winter	2.556	0.0	1588
4320 min Winter	1.897	0.0	2772
5760 min Winter	1.535	0.0	2680
7200 min Winter	1.301	0.0	3152
8640 min Winter	1.137	0.0	4256
10080 min Winter	1.015	0.0	0

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.300	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.012

Time (mins) From:	To:	Area (ha)
0	4	0.012

Model Details

Storage is Online Cover Level (m) 107.700

Cellular Storage Structure

Invert Level (m) 105.900 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 5.00000 Porosity 0.30
Infiltration Coefficient Side (m/hr) 0.00350

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	21.3	21.3	1.800	33.0	54.5
1.700	21.3	54.5			

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 429 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	107.430	0.030	0.1	3.1	O K
30 min Summer	107.440	0.040	0.1	4.2	O K
60 min Summer	107.449	0.049	0.2	5.1	O K
120 min Summer	107.459	0.059	0.2	6.1	O K
180 min Summer	107.463	0.063	0.2	6.6	O K
240 min Summer	107.466	0.066	0.2	6.8	O K
360 min Summer	107.468	0.068	0.2	7.1	O K
480 min Summer	107.470	0.070	0.2	7.3	O K
600 min Summer	107.471	0.071	0.2	7.3	O K
720 min Summer	107.471	0.071	0.2	7.4	O K
960 min Summer	107.471	0.071	0.2	7.4	O K
1440 min Summer	107.469	0.069	0.2	7.1	O K
2160 min Summer	107.463	0.063	0.2	6.6	O K
2880 min Summer	107.458	0.058	0.2	6.0	O K
4320 min Summer	107.449	0.049	0.2	5.1	O K
5760 min Summer	107.444	0.044	0.2	4.6	O K
7200 min Summer	107.440	0.040	0.1	4.2	O K
8640 min Summer	107.437	0.037	0.1	3.8	O K
10080 min Summer	107.434	0.034	0.1	3.5	O K
15 min Winter	107.433	0.033	0.1	3.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	93.730	0.0	19
30 min Summer	63.708	0.0	33
60 min Summer	40.649	0.0	62
120 min Summer	25.298	0.0	122
180 min Summer	19.019	0.0	180
240 min Summer	15.498	0.0	240
360 min Summer	11.587	0.0	304
480 min Summer	9.415	0.0	368
600 min Summer	8.010	0.0	432
720 min Summer	7.017	0.0	500
960 min Summer	5.693	0.0	638
1440 min Summer	4.238	0.0	910
2160 min Summer	3.154	0.0	1300
2880 min Summer	2.556	0.0	1696
4320 min Summer	1.897	0.0	2420
5760 min Summer	1.535	0.0	3168
7200 min Summer	1.301	0.0	3888
8640 min Summer	1.137	0.0	4584
10080 min Summer	1.015	0.0	5344
15 min Winter	93.730	0.0	18

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	107.445	0.045	0.2	4.7	O K
60 min Winter	107.456	0.056	0.2	5.8	O K
120 min Winter	107.466	0.066	0.2	6.9	O K
180 min Winter	107.472	0.072	0.2	7.5	O K
240 min Winter	107.475	0.075	0.2	7.8	O K
360 min Winter	107.478	0.078	0.2	8.1	O K
480 min Winter	107.479	0.079	0.2	8.2	O K
600 min Winter	107.480	0.080	0.2	8.3	O K
720 min Winter	107.480	0.080	0.2	8.3	O K
960 min Winter	107.478	0.078	0.2	8.2	O K
1440 min Winter	107.474	0.074	0.2	7.7	O K
2160 min Winter	107.465	0.065	0.2	6.8	O K
2880 min Winter	107.457	0.057	0.2	5.9	O K
4320 min Winter	107.446	0.046	0.2	4.8	O K
5760 min Winter	107.440	0.040	0.1	4.1	O K
7200 min Winter	107.435	0.035	0.1	3.6	O K
8640 min Winter	107.431	0.031	0.1	3.2	O K
10080 min Winter	107.428	0.028	0.1	2.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	63.708	0.0	33
60 min Winter	40.649	0.0	62
120 min Winter	25.298	0.0	120
180 min Winter	19.019	0.0	176
240 min Winter	15.498	0.0	234
360 min Winter	11.587	0.0	340
480 min Winter	9.415	0.0	392
600 min Winter	8.010	0.0	466
720 min Winter	7.017	0.0	542
960 min Winter	5.693	0.0	694
1440 min Winter	4.238	0.0	994
2160 min Winter	3.154	0.0	1404
2880 min Winter	2.556	0.0	1784
4320 min Winter	1.897	0.0	2508
5760 min Winter	1.535	0.0	3232
7200 min Winter	1.301	0.0	3968
8640 min Winter	1.137	0.0	4680
10080 min Winter	1.015	0.0	5448

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.300	Shortest Storm (mins)	15
Ratio R	0.300	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.018

Time (mins) From:	To:	Area (ha)
0	4	0.018

Model Details

Storage is Online Cover Level (m) 108.000

Cellular Storage Structure

Invert Level (m) 107.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00350 Porosity 0.30
Infiltration Coefficient Side (m/hr) 0.00350

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	347.0	347.0	0.600	500.0	420.0
0.200	347.0	420.0			