DRAINAGE ASSESSMENT

PROPOSED DEVELOPMENT AT

Carrowreagh Road, Dundonald

May 2025

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Foreword

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This document has 19 pages including the cover.

Document Ref: P673 - CARROWREAGH RD DA REV D

Revision	Date	Details	Author	Checked By	Issued to
-	11/2024	For Planning	JS	MH	Bell rolston
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Introduction

Marrac Design has been commissioned to undertake this Drainage Assessment (DA) for a proposed Industrial Building at a site at Carrowreagh Road, Dundonald. It has been prepared in accordance with the requirements of Lisburn and Castlereagh City Council (LCCC) Local Development Plan (LDP) 2032.

LCCC LDP Plan Strategy Flooding Policy Requirements

The LDP Plan Strategy's objective is to minimise flood risk to people, property and the environment by adopting a precautionary approach to decision making where flooding is a material consideration in determining planning applications. It embodies the Government's commitment to sustainable development and conservation of biodiversity and places responsibility on the applicant to address flood risk and drainage issues to allow proper consideration of an application.

The LDP Plan Strategy Flooding Policy is divided into five sub-policies:

- FLD1 – Development in Fluvial Flood Plains – Development will not be permitted in the flood plain (plus climate change allowance), with some exceptions;
- FLD2 – Protection of Flood Defence and Drainage Infrastructure – Development will not be permitted that impedes the operational effectiveness of flood defence and drainage infrastructure or hinder access for maintenance, including building over the line of a culvert;
- FLD3 – Development and Surface Water (Pluvial) Flood Risk Outside Flood Plains – Residual risk of flooding from drainage systems;
- FLD4 – Artificial Modification of Watercourses – Artificial modification of a watercourse, including culverting or canalisation, will only be permitted in exceptional circumstances;
- FLD5 – Development in Proximity to Reservoirs – Development within the potential flood inundation area of a controlled reservoir.

A Drainage Assessment (DA) will be required for development proposals that exceed any of the following thresholds:

- The development comprises of 10 or more residential units;
- The development site exceeds one hectare;
- Changes of use involving new buildings and/or hard surfacing which exceed 1,000m^2 in area;
- The proposed development is in an area where there is evidence of a history of surface water flooding;
- Surface water run-off from the development may adversely impact upon other development or features of importance to nature conservation, archaeology or the built heritage.

To comply with the LCCC LDP requirements, Marrac Design has undertaken the following:

- Reviewed the development proposals
- Reviewed information available online
- Undertaken calculations of pre-and post-development run-off from the development
- Assessed the proposals for control of surface run-off, including discharge consents
- Compiled and concluded on the findings.

Description of Site

Site Location

The site is located immediately south of Carrowreagh Road, Dundonald. The development area within the planning boundary is approx. 0.9ha in size and greenfield in nature.



Figure 1 - Location Plan (https://www.google.co.uk/maps/)

Further details of the site location are shown in **Appendix A**.

Data Collection

Development Proposals

It is proposed to construct industrial building with associated access and landscaping provisions.

Details of the proposed development layout are shown in **Appendix B**.

Topographical Survey

A topographic survey was procured by the Project Team which captured existing levels and features on site. The survey shows that the site ranges from approximately 55.9mOD to 44.20mOD with the land falling generally from north east to south west.

Further details of the topographical survey are shown in **Appendix C**.

NI Flood Hazard Maps

Marrac Design reviewed the DfI Mapping Portal and the NI Flood Hazard Maps for an indication of potential flood mechanisms associated with the site.

The NI Flood Hazard Maps identify potential flood risk from a variety of sources including:

- Fluvial (Rivers)
- Pluvial (Surface Water)
- Coastal
- Historic

Reservoir Flood Mapping for Emergency Planning is also available.

The NI Flood Maps do not indicate any fluvial, pluvial or tidal flooding affecting the site.

There are no recorded historic flooding events, and the site is not estimated to be within the inundation zone of a reservoir.

The relevant flood maps are shown in **Appendix D.**

Correspondence

DfI Rivers

It is proposed to discharge surface water runoff to the adjacent sheugh via an attenuated storm drainage network. The storm drainage catchment has been limited to the area comprising new hardstanding areas, i.e. a total area of 0.9ha.

A Schedule 6 application has been consented to by DfI Rivers to obtain consent to discharge at a rate equivalent to greenfield runoff of 9.0l/s (10l/s/ha).

Further details of this correspondence are shown in **Appendix E.**

Drainage Assessment

It is proposed to develop a site with more than 1000m2 of new hardstanding. Therefore, a DA is required to assess the impacts of the proposed development on the local drainage system in accordance with LCCC LDP FLD3.

Existing Run-off

The existing site extents comprise a greenfield area of 0.9ha. Therefore, utilising the accepted greenfield runoff rate of 10l/s/ha, the existing site generates 9.0l/s of surface water runoff.

Post Development Run-off

Based on the new site layout proposals, and by assessment using the Modified Rational Method (MRM) as a traditional peak flow calculation used for storm sewer sizing, post-development surface water flows are summarised as follows:

Table 1 – Post-Development Run-off Rates

Return Period	Flow (l/s)
100	142.7
30	111.6
2	59.4

Further details of the runoff calculations are shown in **Appendix F**.

Control of Surface Run-off

It is proposed to construct new storm sewers to serve the development. Details of the proposed sewer layout are shown in **Appendix G**.

Using MicroDrainage modelling software, Marrac Design has simulated the proposed storm sewer network and tested it to the requirements of Sewers for Adoption NI However the storm network will be privately maintained. Details of the storm simulation calculations are shown in **Appendix H**.

It is proposed to limit the discharge to a maximum of 9.0l/s from the proposed storm network which is equivalent to greenfield rate of 10l/s/ha. This rate is achieved through use of a flow control device with approximately 407.8m^3 of storage provided within oversized drainage infrastructure.

The drainage networks serving the development site are presented on the following basis:

- The storm sewer network will privately be maintained however has been designed to comply with the requirements of Sewers for Adoption NI 1st edition. A maintenance schedule is shown in **Appendix I**.
- Hydraulic simulations have been undertaken to demonstrate performance of the storm sewer network.
- The storm drainage network has been designed to not surcharge during the 1 in 2-year return period (except where manholes/pipework are immediately upstream of a flow control).
- The storm drainage network has been designed to not surcharge within 300mm of cover levels during the 1 in 30-year return period (shown as flood risk in simulation results).

- The storm drainage network has been designed for no out of sewer flooding to occur during the 1 in 100-year return period (1% AEP), whilst ensuring compliance with consented discharge rates
- Restricting the storm discharge to equivalent greenfield runoff rate has been achieved via the specification of a vortex flow control device and attenuation storage in the form of oversized infrastructure.
- Exceedance checks have been undertaken which demonstrate that no out of sewer flooding will occur during the 1 in 100-year return period (+ 20%) event, to ensure adequate flood protection is given to properties.

Conclusions

It is proposed to construct development with associated access and landscaping provisions. Therefore, a DA is required to assess the impacts of the proposed development on the local drainage system in accordance with LCCC LDP FLD3.

The NI Flood Maps do not indicate any fluvial, pluvial or tidal flooding affecting the site.

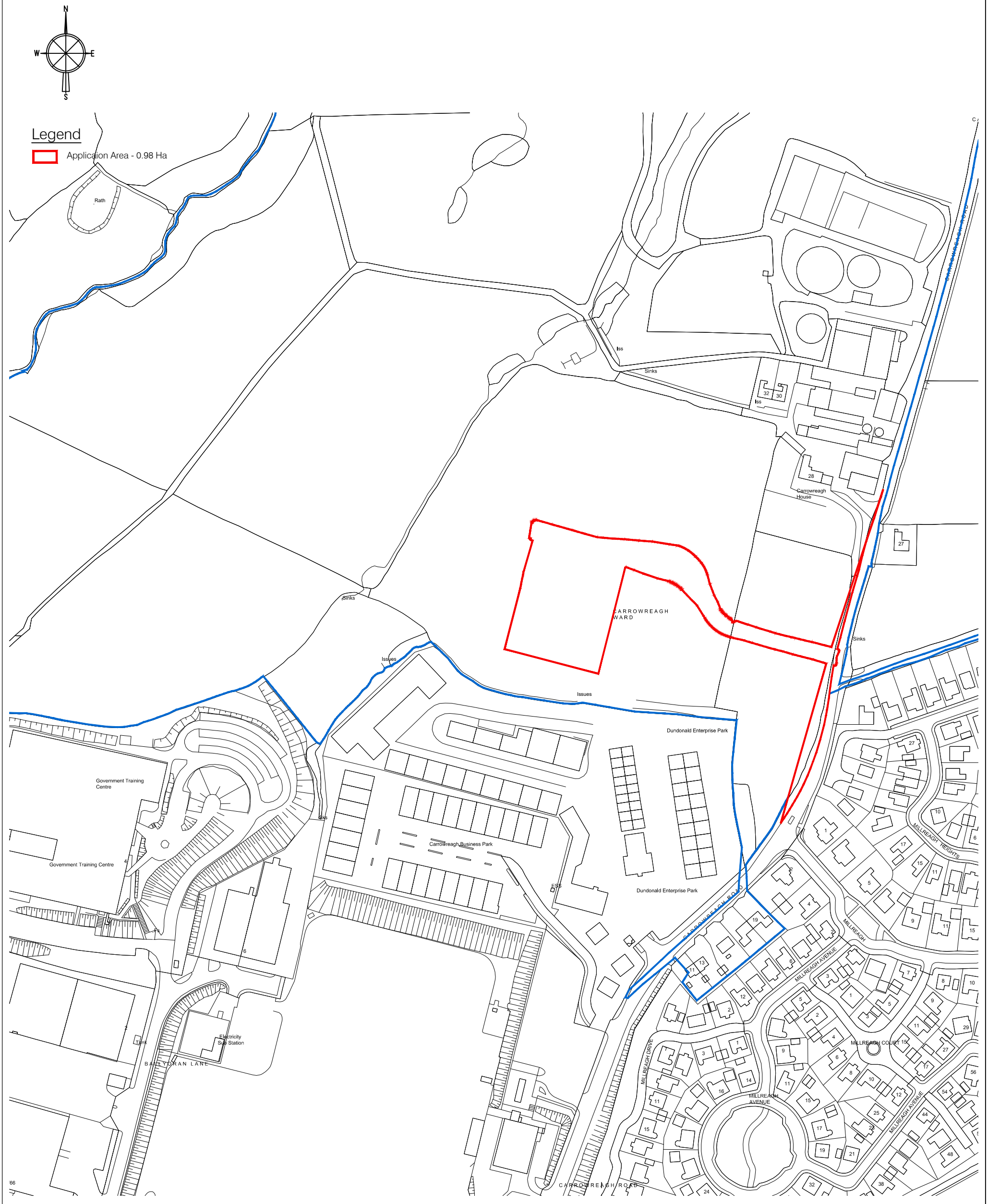
There are no recorded historic flooding events, and the site is not estimated to be within the inundation zone of a reservoir.

It is proposed to discharge surface water runoff to the adjacent ditch via an attenuated storm drainage network. A Schedule 6 application has been consented to by DfI Rivers to discharge at equivalent greenfield runoff rate of 9.0l/s (10l/s/ha). Details of the Sch 6 consent has been included within this report.

The storm sewer network will be privately maintained; however, the design has been undertaken in accordance with the requirements of Sewers for Adoption NI 1st edition. Using MicroDrainage modelling software, Marrac Design has simulated the proposed storm sewer network and tested it to the requirements of Sewers for Adoption NI 1st edition.

Based on the above conclusions, it is considered that this DA conforms with the requirements of LCCC LDP FLD3.

APPENDIX A: Site Location



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4. All dimensions are in mm unless stated otherwise

A3 paper size

BH Estates

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Carrowreagh Road, Dundonald, Co.Down, BT16 1TS

Proposed Industrial Building

Site Location Plan

4108 - PL01

Revision	Drawn By	Chkd By	Date	Comments
-	SD	-	-	

Scale 1:2500

Date May 2025

APPENDIX B: Proposed Site Layout

Existing Vegetation

- existing hedge to be retained
- existing trees to be retained
- existing hedge to be removed
- existing trees to be removed

Planting Specification

native species woodland planting

feathered trees

Species	Size	Height	Spec	Key	Qty
Alnus glutinosa	BR	200-250cm	Feathered	t1	4
Betula pendula	BR	200-250cm	Feathered	t2	4
Quercus petraea	BR	200-250cm	Feathered	t3	4
Sorbus aucuparia	BR	200-250cm	Feathered	t4	3

native species hedge

Species	Size	Height	Spec	Density	%
Crataegus monogyna	BR	40-60cm	2 + 1	7/lin m	50
Prunus spinosa	BR	40-60cm	2 + 1	7/lin m	10
Corylus avellana	BR	40-60cm	2 + 1	7/lin m	10
Ilex aquifolium	C	30-40cm	Bushy	7/lin m	10
Betula pendula	BR	40-60cm	2 + 1	7/lin m	10
Alnus glutinous	BR	40-60cm	2 + 1	7/lin m	10

grass planting

proposed banking

Areas of broken hedging to Southern boundary to be filled in as per Ecologist's Preliminary Ecological Appraisal. Please see PEA for details

Proposed Site Layout Plan
Scale 1:500

N

NOTES

A0
Drawn at size

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LEGEND

- application area
- land under applicants control
- items to be removed / demolished
- 4.5x120m sight visibility splays
- Roller door locations
- floodlight type 1 - mounted at 6m high. See drawing No SK04
- main entrance

Hardscape:

- ashphalt hard surfacing
- concrete hardstanding
- Boundary Type 1 - reinforced concrete retaining wall and paladin fence - wall various heights
- Paladin wire mesh fencing - 2.1m high
- Three bat boxes deployed on mature trees at:
  1. 54.600167, -5.782925
  2. 54.599365, -5.783761
  3. 54.598278, -5.782423
  Elisa bat boxes or similar design installed at least 3m above the ground on the NE side of the tree

53.00 + GFL proposed levels

Key to symbols: 1

1. Proposed access road
2. Pedestrian gate
3. Entrance gate
4. Exit gate
5. Proposed yard area
6. Proposed 8No car parking spaces
7. Proposed building

Proposed Levels

Refer to Civil Engineers layout/s for all proposed levels.

REVISION	DESCRIPTION			INITIALS	DATE
-	SD		-		
Revision	Drawn By	Chkd By	Date	Comments	

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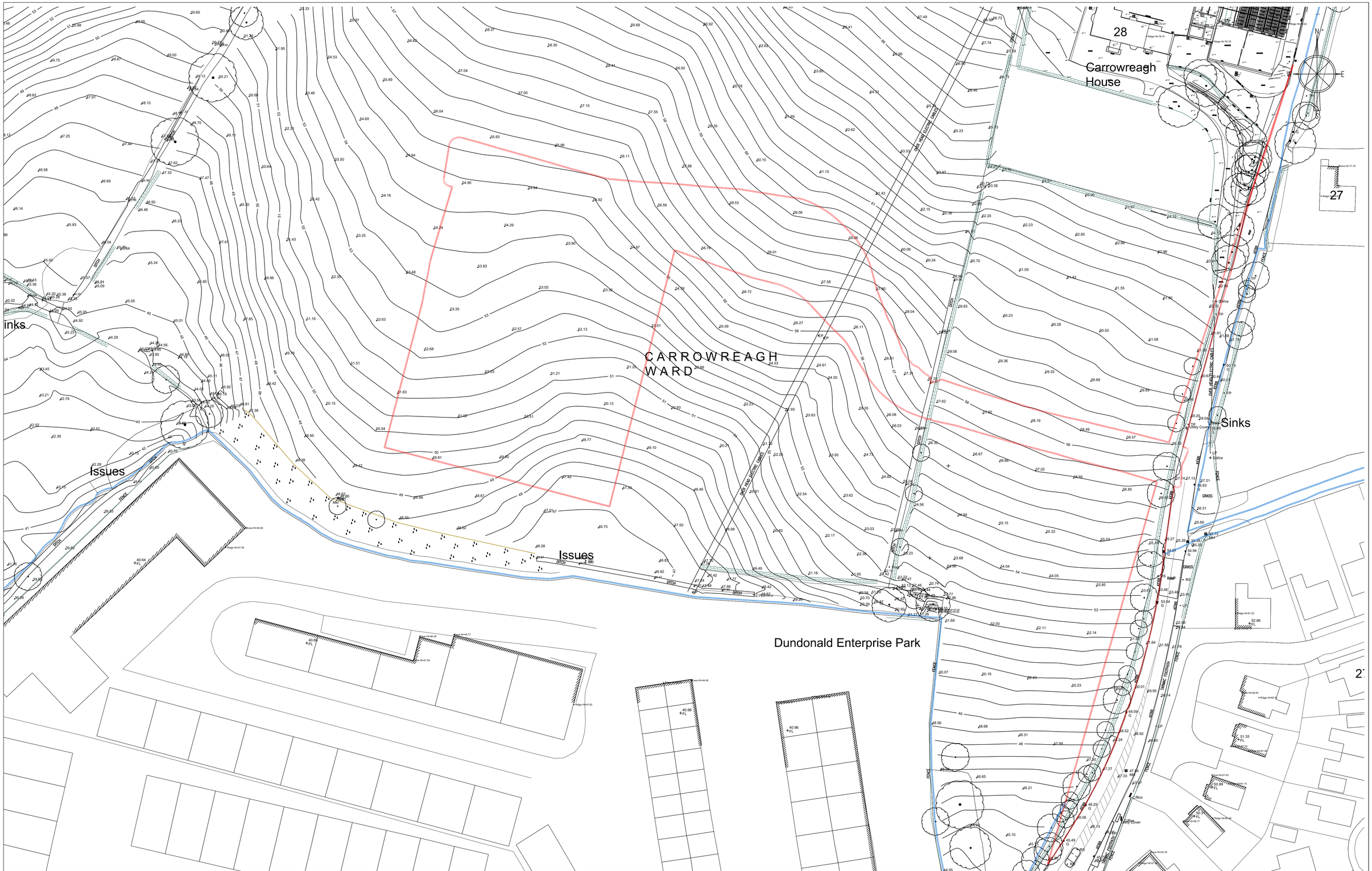
Proposed Industrial Building

Proposed Site Layout Plan

4108 - PL03

Scale	Date
1:500	May 2025

APPENDIX C: Topographical Survey



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3. Contractors to carry out their own due diligence and report any errors to this office.
4. All dimensions are in mm unless stated otherwise

A1 paper size

LEGEND

application area

land under applicants control

1:500 A1 — 0 10 20 30 50 m

Amendments Date

BH Estates

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Carrowreagh Road, Dundonald, Co.Down, BT16 1TS

Proposed Industrial Building

Revision	Drawn By	Chkd By	Date	Comments
-	SD	-	-	

Existing Site Layout Plan

4108 - PL02

Scale 1:500

Date May 2025

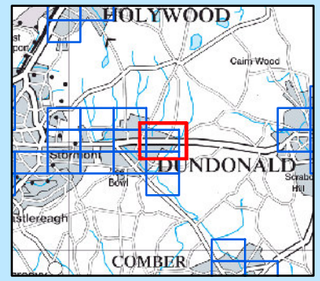
APPENDIX D: NI Flood Maps

Flood Hazard Depth

Medium Probability

1% chance that a flood of this magnitude or greater will occur in any given year.

Map Type: FLOOD HAZARD
Source: RIVER
Epoch: CLIMATE CHANGE 2080



Scale 1:5,000 when plotted at A3

River Model Status
- Modelled in Detail
- Modelled Strategically
- Unmodelled
- Flow Direction

"Detailed" Hazard Data
*"Detailed" Climate Change Hazard Data (1 in 100yrs)
- Depth < 0.3m
- Depth 0.3m - 1.0m
- Depth > 1.0m
- 12.23 River Level (m)
- V=1.2 Velocity (m/s)
- Q=3.4 Discharge (m3/s)

Flood Defence Structures
Present Day Standard of Protection (SoP)
- SoP < 50 yrs
- 50yrs <= SoP < 75 yrs
- 75yrs <= SoP < 100 yrs
- 100yrs <= SoP

"Indicative" Hazard Data
*"Indicative" Climate Change Floodplain (1 in 100yrs)

* Estimated using strategic flood models and therefore should only be used to identify general areas prone to flooding and not to determine the hazard to individual properties.

Coordinate System: Irish Grid.
Coordinates in metres.
Heights in metres above MSL Belfast.

Users of this map should refer to the guidance and conditions of use available at the DfI Rivers website.

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www.infrastructure-ni.gov.uk

Map Sheet : 13113SE
Drawing Number : FDMCC_13113SE
Publication Date: 1st December 2018

342800 344000 374400 373600

DUNLADY · KILLARN · BALLYBEEN · CARROWREAGH · GREENGRAVES · BALLYORAN

LAMBERT RISE · LAMBERT AVENUE · DUNLADY ROAD · LAMBERT PARK · LAMBERT GLEN · UPPER NEWTOWNARDS ROAD · BALLYORAN LANE · CARROWREAGH ROAD · BELFAST ROAD · REGENT COURT · KEMPE STONES ROAD · BROOKLANDS AVENUE · BROOKLANDS ROAD · BROOKLANDS DRIVE · BROOKLANDS GARDENS · BROOKLANDS PARK · BUTE PARK · DUNGOYNE PARK · BALLYBEEN PARK · DRUMADOON DRIVE · RANK ROAD · CRAIGLEITH DRIVE · CARNSMORE AVENUE · ROSNEATH GARDENS · STRONE PARK · CARROWREAGH PARK · CARROWREAGH GARDENS · CULROSS DRIVE · KILBERRY PARK · LISMORE DRIVE · LISMORE WAY · ARDMORE AVENUE · CLAGGAN PARK · OLD MILL GROVE · OLD MILL RISE · OLD MILL HEIGHTS · OLD MILL PARK · OLD MILL MEADOWS · OLD MILL DALE · MILLMOUNT LANE

36.83 · 36.43 · V=1.5 Q=14.8 · 35.38 · 33.26 · 32.48

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ORDNANCE SURVEY OF NORTHERN IRELAND

N W E S

0 50 100 200 300 400 500 Metres

1:5,000

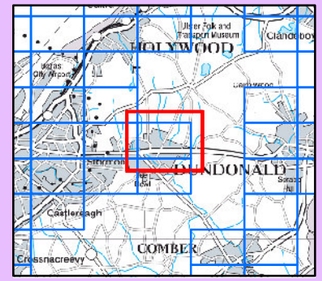
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Surface Water Depth

Medium Probability

0.5% chance that a flood of this magnitude or greater will occur in any given year

Map Type: FLOOD HAZARD
Source: SURFACE WATER
Epoch: CLIMATE CHANGE 2080



Scale 1:10,000 when plotted at A3

*** Surface Water Hazard Data**

- Depth < 0.3m
- Depth 0.3m - 1.0m
- Depth > 1.0m

* Estimated using strategic flood models and therefore should only be used to identify general areas prone to flooding and not to determine the hazard to individual properties.

341600 344000 375200 373600

BALLYMISCAW DUNLADY KILLARN BALLYREGAN CARROWREAGH GREENGRAVES CHURCH QUARTER BALLYBEEN BALLYORAN BALLYLISBREDAN

DUNLADY ROAD · BALLYREGAN ROAD · CARROWREAGH ROAD · BELFAST ROAD · STONEY ROAD · UPPER NEWTOWNARDS ROAD · KEMPE STONES ROAD · COMBER ROAD · GREENGRAVES ROAD · OLD DUNDONALD ROAD · MILLARS LANE

0 100 200 400 600 800 1,000 Metres

1:10,000

Coordinate System: Irish Grid.
Coordinates in metres.
Heights in metres above MSL Belfast.

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Map Sheet : 13113
Drawing Number : PDMCC_13113
Publication Date: 1st December 2018

APPENDIX E: DFI Rivers Correspondence

Dfl Rivers - Greater Belfast

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An Roinn Bonneagair
www.infrastructure-ni.gov.uk

Mark Hardy
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BT20 5BB

Ravarnet House
36 Altona Road
Lisburn
BT27 5QB
Tel: 028 9260 6197

Your reference: P673
Our reference: IN1-20-14555
Date: 8 December 2024

Dear Mark

RE: SCHEDULE 6 - LANDS TO THE SOUTH OF 28 CARROWREAGH RD, DUNDONALD

Thank you for your correspondence received 30 November 2024 and for subsequent additional information received 8 December 2024 regarding the above. From a drainage aspect my comments are as follows.

The Department for Infrastructure has assessed your proposals to discharge the greenfield runoff figure of a total maximum of 9 l/s to the undesignated watercourse as detailed in Drawing Nos. GF-01 and KN-HW-S and are satisfied that your proposals will not render the watercourse less effective for drainage purposes. This watercourse is undesignated under the terms of the Drainage (NI) Order 1973.

The Department would stress that it is your responsibility to ensure:

- That the proposed works do not result in any obstruction to flow arising from a blockage, structural failure, poor workmanship, or any other reason.

- There is no restriction or reduction to the watercourse's capacity either during or upon completion of the works.

- That your proposed headwall is of a suitable scale to the outfall pipe and that erosion protection is provided at the outfall location where required.

Please note that failure to adhere to the above conditions is a contravention of the Drainage (NI) Order 1973 and may result in legal proceedings. This appraisal is valid for a period of 24 months from the date of this letter. If the proposals are not substantially completed and any approved discharge not

substantially commenced within this 24-month period, they should be resubmitted for further appraisal. The applicant should note that future changes in policy may affect the outcome of any subsequent appraisal.

Applicants should note that in accordance with Paragraph 11 of Schedule 6 of the Drainage (Northern Ireland) Order 1973 the applicant must comply with all other relevant legislation. The Department's appraisal is from a drainage and flood risk aspect only. It is the applicant's responsibility to contact other parties which may have an interest in your proposals e.g. NIEA, Landowners, Fisheries etc.

You are requested to notify DfI Rivers of the commencement date of your works so that an inspection may take place during construction.

Please see the below link for guidance on pollution prevention when working in or near water.

https://www.netregs.org.uk/media/1418/gpp-5-works-and-maintenance-in-or-near-water.pdf?utm_source=website&utm_medium=social&utm_campaign=GPP5%2027112017

Should you require any further information or clarification, please contact me at the above address, by email or by telephone, quoting the above reference number.

Yours faithfully

[redacted]

Peter Neish
Engineering Section

APPENDIX F: MRM Run-off Calculations

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Project	
P673 - Carrowreagh Road, Dundonald	
Check by	Date
MH	30/11/2024

Ref	Calculations		
	The Modified Rational Method		
		0.75	Input
	Wallingford Procedure - Vol 4 - The Modified Rational method		Calc
	The Rational Formula **Qp = C i A**		Linked
	Qp = Peak Discharge (l/s)		
	C = Dimensionless Coefficient		
	i = Average Rainfall Intensity during time of Concentration (mm/hour)		
	A = Contributing Catchment Area (ha)		
	If the Area (A) is expressed in Hectares and the rainfall intensity (i) in mm/ hr the equation becomes		
	Qp = 2.78 C i A		
C	**$C = C_v C_R$** C_v = proportion of rainfall on catchment which appears as surface runoff in storm drainage system = average 0.75 (0.6 in rapidly draining soils & 0.9 in heavy soils)		
	C_R = constant value of 1.30		
	C_v = 0.75		
	C_R = 1.3		
	C = 0.975		
	Applying the dimensionless coefficient using the parameters above gives a revised equation of:		
	Qp = 2.71 i A		

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Check by	Date
MH	30/11/2024

Ref	Calculations

tc

Time of Concentration (Tc)

$t_c = t_e + t_f$

t_c = Time of Concentration

t_e = Time of Entry - represents delay & attenuation of flow over ground surface

t_f = Time of Flow through pipe system to point under consideration

The Wallingford Procedure would recommend the following t_e values:

Return Period	t_e (mins)
5 yrs	3 - 6
2 yrs	4 - 7
1 yr	4 - 8
1 mth	5 - 10

Use longer times of entry at each return period for large flat subcatchments (area > 400m^2, slope <1:50)

Use smaller values for small steep subcatchments (area <200m^2, slope >1:30)

t_e =	5	mins
t_f =	10	mins
t_c =	15	mins

assume 15min event is appropriate design event - see pg 5

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Ref	Calculations

1 **Assessment of Rainfall Intensity**

Determine M5-60 min rainfall and the coefficient r for the site from the mapping included in the Wallingford Procedure

M5 - 60mins = 5 year return period and 60 minute duration rainfall depth - Use M5-60 Map

M5-60 min Rainfall 17.3 (mm - Total rainfall)

r = ratio of 5yr - 60min duration and 5 yr - 2 day duration rainfall depth - Use r map

r = 0.3

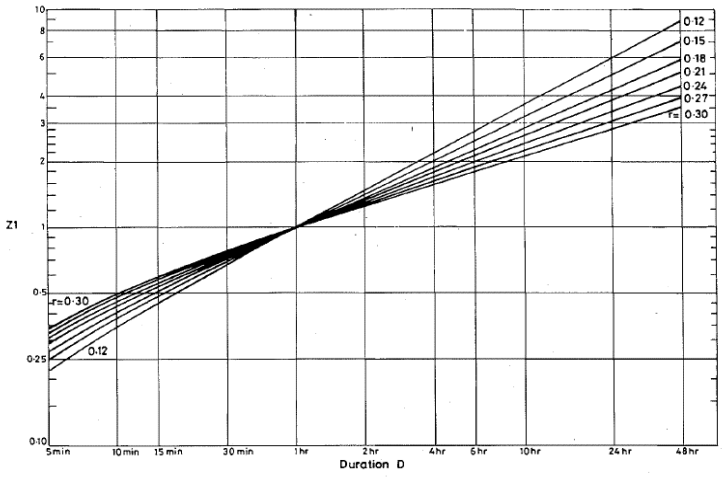
2 Determine rainfall depths for 5 year return period for all required return periods, D = M5 - D

Using the r value above establishing the Z1 value from the graph in the Wallingford procedure (Fig A.3a)

r = 0.3

Return Period	Duration (D)		Z1	M5-D (mm total)
M5	5	Min	0.35	6.06
M5	10	Min	0.49	8.48
M5	15	Min	0.58	10.03
M5	30	Min	0.77	13.32
M5	1	Hour	1.00	17.30
M5	2	Hour	1.20	20.76
M5	4	Hour	1.60	27.68
M5	6	Hour	1.80	31.14
M5	10	Hour	2.10	36.33
M5	24	Hour	2.80	48.44
M5	48	Hour	3.50	60.55

M5-D values are calculated by factoring the M5-60 value by Z1



Relation between Z1 and D for different values of r. (0·12 ≤ r ≤ 0·30)

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Ref	Calculations

3 **Determine MT-D**

This is determined from the relationship

MT - D = Z2 (M5-D)

Z2 Values for Rainfall Depths

M5 Rainfall (mm)	M1	M2	M5	M10	M20	M30	M50	M100
5	0.67	0.82	1.02	1.17	1.35	1.49	1.62	1.86
10	0.68	0.82	1.03	1.19	1.39	1.54	1.69	1.97
15	0.69	0.83	1.03	1.2	1.39	1.55	1.7	1.98
20	0.7	0.84	1.02	1.19	1.38	1.52	1.66	1.93
25	0.71	0.84	1.02	1.18	1.37	1.51	1.64	1.89
30	0.72	0.85	1.02	1.18	1.36	1.49	1.61	1.85
40	0.74	0.86	1.02	1.17	1.34	1.45	1.56	1.77
50	0.75	0.87	1.02	1.16	1.3	1.41	1.52	1.72
75	0.77	0.88	1.02	1.14	1.27	1.36	1.45	1.62
100	0.78	0.88	1.02	1.13	1.24	1.32	1.4	1.54
150	0.79	0.89	1.02	1.11	1.2	1.27	1.33	1.45
200	0.8	0.89	1.01	1.1	1.18	1.24	1.3	1.4

Table A2 Relationship between rainfall of return period T(MT) and M5
Wallingford Procedure Vol 4

Table A2: Relationship between rainfall of return period T(MT) and M5 – Scotland and Northern Ireland (ratio Z2)

M5 Rainfall mm	M1	M2	M3	M4	M5	M10	M20	M50	M100
5	0.67	0.82	0.91	0.98	1.02	1.17	1.35	1.62	1.86
10	0.68	0.82	0.91	0.98	1.03	1.19	1.39	1.69	1.97
15	0.69	0.83	0.91	0.97	1.03	1.20	1.39	1.70	1.98
20	0.70	0.84	0.92	0.97	1.02	1.19	1.38	1.66	1.93
25	0.71	0.84	0.92	0.98	1.02	1.18	1.37	1.64	1.89
30	0.72	0.85	0.92	0.98	1.02	1.18	1.36	1.61	1.85
40	0.74	0.86	0.93	0.98	1.02	1.17	1.34	1.56	1.77
50	0.75	0.87	0.93	0.98	1.02	1.16	1.30	1.52	1.72
75	0.77	0.88	0.94	0.98	1.02	1.14	1.27	1.45	1.62
100	0.78	0.88	0.94	0.98	1.02	1.13	1.24	1.40	1.54
150	0.79	0.89	0.94	0.98	1.02	1.11	1.20	1.33	1.45
200	0.80	0.89	0.95	0.99	1.01	1.10	1.18	1.30	1.40

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3 **Determine i, Rainfall Intensity**

100 Year

M5 - D Event		M5-D Total rainfall mm	Z2 values for 100 year event: Lower mm	Lower Z2	Higher mm	Higher Z2	Interpolated Z2	M100 - D Event Total rainfall mm	Intensity mm/hr
5	Min	6.06	5	1.86	10	1.97	1.88	11.40	136.82
10	Min	8.48	5	1.86	10	1.97	1.94	16.41	98.47
15	Min	10.03	10	1.97	15	1.98	1.97	19.77	79.07
30	Min	13.32	10	1.97	15	1.98	1.98	26.34	52.67
1	Hour	17.30	15	1.98	20	1.93	1.96	33.86	33.86
2	Hour	20.76	20	1.93	25	1.89	1.92	39.94	19.97
4	Hour	27.68	25	1.89	30	1.85	1.87	51.73	12.93
6	Hour	31.14	30	1.85	40	1.77	1.84	57.33	9.55
10	Hour	36.33	30	1.85	40	1.77	1.80	65.36	6.54
24	Hour	48.44	40	1.77	50	1.72	1.73	83.70	3.49
48	Hour	60.55	50	1.72	75	1.62	1.68	101.60	2.12

30 Year

M5 - D Event		M5-D Total rainfall mm	Z2 values for 30 year event: Lower mm	Lower Z2	Higher mm	Higher Z2	Interpolated Z2	M30 - D Event Total rainfall mm	Intensity mm/hr
5	Min	6.06	5	1.49	10	1.54	1.50	9.06	108.77
10	Min	8.48	5	1.49	10	1.54	1.52	12.91	77.46
15	Min	10.03	10	1.54	15	1.55	1.54	15.45	61.81
30	Min	13.32	10	1.54	15	1.55	1.54	20.55	41.11
1	Hour	17.30	15	1.55	20	1.52	1.53	26.54	26.54
2	Hour	20.76	20	1.52	25	1.51	1.52	31.51	15.76
4	Hour	27.68	25	1.51	30	1.49	1.49	41.35	10.34
6	Hour	31.14	30	1.49	40	1.45	1.48	46.12	7.69
10	Hour	36.33	30	1.49	40	1.45	1.46	53.15	5.32
24	Hour	48.44	40	1.45	50	1.41	1.42	68.59	2.86
48	Hour	60.55	50	1.41	75	1.36	1.39	84.10	1.75

2 Year

M5 - D Event		M5-D Total rainfall mm	Z2 values for 2 year event: Lower mm	Lower Z2	Higher mm	Higher Z2	Interpolated Z2	M2 - D Event Total rainfall mm	Intensity mm/hr
5	Min	6.06	5	0.82	10	0.82	0.82	4.97	59.58
10	Min	8.48	5	0.82	10	0.82	0.82	6.95	41.71
15	Min	10.03	10	0.82	15	0.83	0.82	8.23	32.91
30	Min	13.32	10	0.82	15	0.83	0.83	11.02	22.03
1	Hour	17.30	15	0.83	20	0.84	0.84	14.45	14.45
2	Hour	20.76	20	0.84	25	0.84	0.84	17.44	8.72
4	Hour	27.68	25	0.84	30	0.85	0.85	23.39	5.85
6	Hour	31.14	30	0.85	40	0.86	0.85	26.50	4.42
10	Hour	36.33	30	0.85	40	0.86	0.86	31.10	3.11
24	Hour	48.44	40	0.86	50	0.87	0.87	42.05	1.75
48	Hour	60.55	50	0.87	75	0.88	0.87	52.92	1.10

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Ref	Calculations

4 **Calculation of Runoff for Proposed Development**

$Qp = 2.78\ C\ i\ A$

$Qp = 2.78\ Cv\ Cr\ i\ A$

C_v	=	0.75		
C_r	=	1.3		
t_c		15		Assume 15min duration event appropriate
i	=	79.07		M100 - 15 appropriate for tc
		61.81		M30 - 15 appropriate for tc
		32.91		M2 - 15 appropriate for tc
A	=	9000	m^2	**Proposed Development Area**
	=	0.9	ha	

Qp	=	**192.9**	**l/s**	100 year
		150.8	**l/s**	30 year
		80.3	**l/s**	2 year

Note the above value considers that the catchment as 100% impermeable. The value needs to be factored by an appropriate value to account for the surface type

McGhee: Water Supply and Sewerage
Table 13-3
Runoff coefficients for different areas

TABLE 13-3
Runoff coefficients for different areas[3]

Description of area	C
Business	
Downtown area	0.70–0.95
Neighborhood area	0.50–0.70
Residential (urban)	
Single-family area	0.30–0.50
Multiunits, detached	0.40–0.60
Multiunits, attached	0.60–0.75
Residential (surburban)	0.25–0.40
Apartment areas	0.50–0.70
Industrial	
Light	0.50–0.80
Heavy	0.60–0.90
Parks, cemeteries	0.10–0.25
Playgrounds	0.20–0.35
Railroad yards	0.20–0.40
Unimproved areas	0.10–0.30

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Ref	Calculations
5	**POST Development**
	Permeable Area = 10.00% Unimproved areas C = 0.2
	Impermeable Area = 90.00% All Run-off C = 0.8
	Runoff Coefficient = permeable area x C + impermeable area x C
	Selected runoff coefficient 0.74
	Factored runoff based on existing site impermeability = 142.7 l/s 100 year
	111.6 l/s 30 year
	59.4 l/s 2 year

APPENDIX G: Proposed Storm Layout

FILTER DRAIN TO BE SIZED ACCORDINGLY AND INSTALLED TO INTERCEPT ADDITIONAL EXISTING LAND FLOW

ORFICE PLATE INSTALLED IN THIS MANHOLE TO MANUFACTURERS RECOMMENDATIONS
ORFICE SIZE: 0.067M

HYDROBRAKE INSTALLED IN THIS MANHOLE TO MANUFACTURERS RECOMMENDATIONS
DESIGN HEAD: 2.30M
FLOW: 9.0 l/s
REF: SHE-0120-9000-2300-9000

HEADWALL CONSTRUCTED AND A RESTRICTED DISCHARGE OF 9.0 l/s TO BE AGREED WITH RIVERS AGENCY.

STORAGE PROVIDED THROUGH OVERSIZED PIPEWORK & MANHOLES.

53.00 + GFL

FFL 53.000

50.50 + GFL

FFL 50.500

CARROWREAGH WARD

Carrowreagh House

28 28

Issues

Dundonald Enterprise Park

PLAN 1:500

notes

1. This drawing is to be read in conjunction with other civil engineering drawings including the specific project specification(s) on drawings as well as the architectural drawings.
2. The contractor is responsible for verifying all dimensions on site and ensuring that all dimensions and levels shown on this drawing comply with other relevant drawings.
3. Any discreptancies are to be reported to the originator of the drawings as soon as possible.

Drainage Notes

1. Class S Bedding & Surround to all pipes with cover greater than 1.2m under Roads and 0.9m under other Areas
2. Class Z Concrete Bedding & Surround to pipes with cover less than 1.2m under Roads and 0.9m under other Areas.
3. All work to be carried out in accordance with the WRC Sewers for Adoption 6th Edition
4. The Contractor is responsible for checking the position, Level, and Size of all existing pipework prior to the commencement of the Work.
5. The Contractor is responsible for arranging the necessary permits and site inspections during the construction of the adoptable drainage.
6. Connections from dwellings to the Public Sewer should be contained within the Boundary of each property and not cross through neighbouring properties.
7. Connection to the Public Sewer from the last inspection chamber within the property to be 150mm for storm and 100mm for foul.
8. The maximum allowable distance from the last inspection chamber within a property to the public sewer is 12m.

REV DATE REVISION CHECKED

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PROJECT
Proposed Development at Carrowreagh Road, Dundonald

PROJECT No./Drg No
P673/D-01

DRAWING TITLE
Proposed Road layout & sections

CLIENT
BHE

DATE	SCALE	DRN/CKD BY
Oct'24	1:500@A0	js/mh

APPENDIX H: Storm Sim Results

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
1	57.916	1.300	Open Manhole	1200	1.000	56.616	200				
2	56.404	1.300	Open Manhole	1200	1.001	55.104	200	1.000	55.104	200	
3	54.686	1.300	Open Manhole	1200	1.002	53.386	200	1.001	53.386	200	
4	54.013	1.300	Open Manhole	1200	2.000	52.713	200				
5	54.334	3.634	Open Manhole	2100	1.003	50.700	1200	1.002	52.633	200	933
								2.000	51.896	200	196
6	53.460	2.809	Open Manhole	2700	1.004	50.651	1200	1.003	50.651	1200	
7	53.014	2.424	Open Manhole	2700	1.005	50.590	1200	1.004	50.590	1200	
8	53.758	4.758	Open Manhole	2700	1.006	49.000	750	1.005	50.533	1200	1983
9	51.763	3.817	Open Manhole	2100	3.000	47.945	1200				
10	50.624	2.734	Open Manhole	2400	3.001	47.890	1200	3.000	47.890	1200	
11	50.440	2.564	Open Manhole	2400	3.002	47.876	1200	3.001	47.876	1200	
12	50.353	2.492	Open Manhole	2400	3.003	47.861	1200	3.002	47.861	1200	
13	50.348	2.502	Open Manhole	2700	3.004	47.846	1200	3.003	47.846	1200	
14	50.349	2.518	Open Manhole	2700	3.005	47.831	1200	3.004	47.831	1200	
15	50.350	2.534	Open Manhole	2700	3.006	47.816	1200	3.005	47.816	1200	
16	50.350	2.549	Open Manhole	2700	3.007	47.801	1200	3.006	47.801	1200	
17	50.350	2.564	Open Manhole	2700	3.008	47.786	1200	3.007	47.786	1200	
18	50.473	2.701	Open Manhole	2700	1.007	47.772	375	1.006	48.784	750	1387
								3.008	47.772	1200	
19	50.201	2.486	Open Manhole	1350	1.008	47.714	375	1.007	47.714	375	
	45.324	0.610	Open Manhole	0		OUTFALL		1.008	44.714	375	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
1	343546.785	374511.555	343546.785	374511.555	Required	
2	343483.053	374528.812	343483.053	374528.812	Required	
3	343455.100	374567.097	343455.100	374567.097	Required	
4	343366.011	374589.811	343366.011	374589.811	Required	
5	343413.458	374577.259	343413.458	374577.259	Required	
6	343407.316	374553.294	343407.316	374553.294	Required	
7	343377.824	374561.108	343377.824	374561.108	Required	
8	343350.257	374568.222	343350.257	374568.222	Required	

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Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
9	343400.525	374527.360	343400.525	374527.360	Required	
10	343393.747	374500.817	343393.747	374500.817	Required	
11	343386.529	374502.558	343386.529	374502.558	Required	
12	343379.311	374504.299	343379.311	374504.299	Required	
13	343372.182	374506.174	343372.182	374506.174	Required	
14	343365.054	374508.049	343365.054	374508.049	Required	
15	343357.814	374509.990	343357.814	374509.990	Required	
16	343350.573	374511.851	343350.573	374511.851	Required	
17	343343.332	374513.746	343343.332	374513.746	Required	
18	343336.361	374515.993	343336.361	374515.993	Required	
19	343327.730	374516.539	343327.730	374516.539	Required	
	343285.840	374515.745			No Entry	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	o	200	1	57.916	56.616	1.100	Open Manhole	1200
1.001	o	200	2	56.404	55.104	1.100	Open Manhole	1200
1.002	o	200	3	54.686	53.386	1.100	Open Manhole	1200
2.000	o	200	4	54.013	52.713	1.100	Open Manhole	1200
1.003	o	1200	5	54.334	50.700	2.434	Open Manhole	2100
1.004	o	1200	6	53.460	50.651	1.609	Open Manhole	2700
1.005	o	1200	7	53.014	50.590	1.224	Open Manhole	2700
1.006	o	750	8	53.758	49.000	4.008	Open Manhole	2700
3.000	o	1200	9	51.763	47.945	2.617	Open Manhole	2100
3.001	o	1200	10	50.624	47.890	1.534	Open Manhole	2400
3.002	o	1200	11	50.440	47.876	1.364	Open Manhole	2400
3.003	o	1200	12	50.353	47.861	1.292	Open Manhole	2400
3.004	o	1200	13	50.348	47.846	1.302	Open Manhole	2700
3.005	o	1200	14	50.349	47.831	1.318	Open Manhole	2700
3.006	o	1200	15	50.350	47.816	1.334	Open Manhole	2700
3.007	o	1200	16	50.350	47.801	1.349	Open Manhole	2700
3.008	o	1200	17	50.350	47.786	1.364	Open Manhole	2700
1.007	o	375	18	50.473	47.772	2.326	Open Manhole	2700
1.008	o	375	19	50.201	47.714	2.111	Open Manhole	1350

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
1.000	66.027	43.7	2	56.404	55.104	1.100	Open Manhole	1200
1.001	47.403	27.6	3	54.686	53.386	1.100	Open Manhole	1200
1.002	42.864	56.9	5	54.334	52.633	1.501	Open Manhole	2100
2.000	49.080	60.1	5	54.334	51.896	2.238	Open Manhole	2100
1.003	24.739	500.0	6	53.460	50.651	1.609	Open Manhole	2700
1.004	30.509	500.0	7	53.014	50.590	1.224	Open Manhole	2700
1.005	28.470	500.0	8	53.758	50.533	2.025	Open Manhole	2700
1.006	54.046	250.0	18	50.473	48.784	0.939	Open Manhole	2700
3.000	27.394	500.0	10	50.624	47.890	1.534	Open Manhole	2400
3.001	7.425	500.0	11	50.440	47.876	1.364	Open Manhole	2400
3.002	7.425	500.0	12	50.353	47.861	1.292	Open Manhole	2400
3.003	7.371	500.0	13	50.348	47.846	1.302	Open Manhole	2700
3.004	7.371	500.0	14	50.349	47.831	1.318	Open Manhole	2700
3.005	7.496	500.0	15	50.350	47.816	1.334	Open Manhole	2700
3.006	7.475	500.0	16	50.350	47.801	1.349	Open Manhole	2700
3.007	7.486	500.0	17	50.350	47.786	1.364	Open Manhole	2700
3.008	7.324	500.0	18	50.473	47.772	1.501	Open Manhole	2700
1.007	8.648	150.0	19	50.201	47.714	2.111	Open Manhole	1350
1.008	41.897	14.0		45.324	44.714	0.235	Open Manhole	0

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 2	Number of Storage Structures 0	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	17.300	Storm Duration (mins)	30
Ratio R	0.300		

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Online Controls for Storm

Orifice Manhole: 8, DS/PN: 1.006, Volume (m³): 56.4

Diameter (m) 0.067 Discharge Coefficient 0.600 Invert Level (m) 49.000

Hydro-Brake® Optimum Manhole: 18, DS/PN: 1.007, Volume (m³): 43.4

Unit Reference	MD-SHE-0120-9000-2300-9000
Design Head (m)	2.300
Design Flow (l/s)	9.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	120
Invert Level (m)	47.772
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.300	9.0	Kick-Flo®	1.071	6.3
Flush-Flo™	0.520	7.9	Mean Flow over Head Range	-	7.3

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	4.2	0.800	7.6	2.000	8.4	4.000	11.7	7.000	15.2
0.200	6.9	1.000	6.8	2.200	8.8	4.500	12.3	7.500	15.8
0.300	7.5	1.200	6.6	2.400	9.2	5.000	13.0	8.000	16.3
0.400	7.8	1.400	7.1	2.600	9.5	5.500	13.6	8.500	16.7
0.500	7.9	1.600	7.6	3.000	10.2	6.000	14.2	9.000	17.2
0.600	7.9	1.800	8.0	3.500	11.0	6.500	14.7	9.500	17.7

Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	1	1.470	2.037	0.000	3.507
1.001	2	1.470	1.452	0.000	2.922
1.002	3	1.470	1.295	0.000	2.765
2.000	4	1.470	1.490	0.000	2.960
1.003	5	12.587	25.265	0.000	37.852
1.004	6	16.085	31.452	0.000	47.537
1.005	7	13.879	29.146	0.000	43.025
1.006	8	27.242	22.684	0.000	49.926
3.000	9	13.222	28.438	0.000	41.660
3.001	10	12.368	5.683	0.000	18.051
3.002	11	11.601	5.683	0.000	17.284
3.003	12	11.274	5.453	0.000	16.727
3.004	13	14.327	5.283	0.000	19.610
3.005	14	14.415	5.424	0.000	19.839
3.006	15	14.509	5.401	0.000	19.910
3.007	16	14.592	5.413	0.000	20.005
3.008	17	14.680	5.230	0.000	19.910
1.007	18	15.465	0.731	0.000	16.196
1.008	19	3.559	4.553	0.000	8.112

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Volume Summary (Static)

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
Total		215.687	192.110	0.000	407.797

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm) 17.300 Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R 0.300 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	15 Winter	2	+20%					56.676	-0.139	0.000
1.001	2	15 Winter	2	+20%					55.169	-0.135	0.000
1.002	3	15 Winter	2	+20%	100/15 Summer				53.478	-0.109	0.000
2.000	4	15 Winter	2	+20%					52.767	-0.146	0.000
1.003	5	60 Winter	2	+20%					50.992	-0.908	0.000
1.004	6	60 Winter	2	+20%					50.992	-0.859	0.000
1.005	7	60 Winter	2	+20%					50.992	-0.798	0.000
1.006	8	60 Winter	2	+20%	2/15 Summer				50.992	1.242	0.000
3.000	9	180 Winter	2	+20%	30/180 Winter				48.580	-0.566	0.000
3.001	10	180 Winter	2	+20%	30/120 Winter				48.580	-0.511	0.000
3.002	11	180 Winter	2	+20%	30/120 Winter				48.580	-0.496	0.000
3.003	12	180 Winter	2	+20%	30/120 Winter				48.580	-0.481	0.000
3.004	13	180 Winter	2	+20%	30/120 Winter				48.580	-0.466	0.000
3.005	14	180 Winter	2	+20%	30/120 Winter				48.580	-0.451	0.000
3.006	15	180 Winter	2	+20%	30/120 Winter				48.580	-0.436	0.000
3.007	16	180 Winter	2	+20%	30/120 Winter				48.580	-0.421	0.000
3.008	17	180 Winter	2	+20%	30/120 Winter				48.580	-0.406	0.000
1.007	18	180 Winter	2	+20%	2/15 Summer				48.580	0.433	0.000
1.008	19	30 Summer	2	+20%					47.743	-0.346	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.19			10.9	OK	
1.001	2	0.23			16.1	OK	
1.002	3	0.43			20.7	OK	
2.000	4	0.16			7.7	OK	
1.003	5	0.01			16.1	OK	
1.004	6	0.02			24.1	OK	
1.005	7	0.02			30.2	OK	
1.006	8	0.02			13.1	SURCHARGED	
3.000	9	0.00			1.5	OK	

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2 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	10	0.01			8.0	OK	
3.002	11	0.01			6.6	OK	
3.003	12	0.01			5.3	OK	
3.004	13	0.01			4.5	OK	
3.005	14	0.01			5.1	OK	
3.006	15	0.01			5.8	OK	
3.007	16	0.01			6.5	OK	
3.008	17	0.01			7.2	OK	
1.007	18	0.07			7.9	SURCHARGED	
1.008	19	0.02			7.9	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	17.300
Region	Scotland and Ireland	Ratio R	0.300
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	15 Winter	30	+20%					56.700	-0.116	0.000
1.001	2	15 Winter	30	+20%					55.200	-0.104	0.000
1.002	3	15 Winter	30	+20%	100/15 Summer				53.533	-0.053	0.000
2.000	4	15 Winter	30	+20%					52.788	-0.125	0.000
1.003	5	60 Winter	30	+20%					51.380	-0.520	0.000
1.004	6	60 Winter	30	+20%					51.380	-0.471	0.000
1.005	7	60 Winter	30	+20%					51.380	-0.410	0.000
1.006	8	60 Winter	30	+20%	2/15 Summer				51.379	1.629	0.000
3.000	9	360 Winter	30	+20%	30/180 Winter				49.418	0.273	0.000
3.001	10	360 Winter	30	+20%	30/120 Winter				49.418	0.327	0.000
3.002	11	360 Winter	30	+20%	30/120 Winter				49.418	0.342	0.000
3.003	12	360 Winter	30	+20%	30/120 Winter				49.418	0.357	0.000
3.004	13	360 Winter	30	+20%	30/120 Winter				49.418	0.372	0.000
3.005	14	360 Winter	30	+20%	30/120 Winter				49.418	0.387	0.000
3.006	15	360 Winter	30	+20%	30/120 Winter				49.418	0.402	0.000
3.007	16	360 Winter	30	+20%	30/120 Winter				49.418	0.417	0.000
3.008	17	360 Winter	30	+20%	30/120 Winter				49.419	0.432	0.000
1.007	18	360 Winter	30	+20%	2/15 Summer				49.419	1.272	0.000
1.008	19	2160 Winter	30	+20%					47.743	-0.346	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.36			20.1	OK	
1.001	2	0.45			31.2	OK	
1.002	3	0.87			42.1	OK	
2.000	4	0.30			14.1	OK	
1.003	5	0.02			28.9	OK	
1.004	6	0.03			34.0	OK	
1.005	7	0.02			30.7	OK	
1.006	8	0.02			14.4	SURCHARGED	
3.000	9	0.00			1.7	SURCHARGED	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	10	0.01			8.1	SURCHARGED	
3.002	11	0.01			6.6	SURCHARGED	
3.003	12	0.01			6.3	SURCHARGED	
3.004	13	0.01			7.6	SURCHARGED	
3.005	14	0.01			6.2	SURCHARGED	
3.006	15	0.01			6.2	SURCHARGED	
3.007	16	0.01			6.8	SURCHARGED	
3.008	17	0.01			7.5	SURCHARGED	
1.007	18	0.07			7.9	SURCHARGED	
1.008	19	0.02			7.9	OK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm) 17.300 Cv (Summer)	0.750
Region	Scotland and Ireland	Ratio R 0.300 Cv (Winter)	0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	2, 30, 100
Climate Change (%)	20, 20, 20

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)
1.000	1	15 Winter	100	+20%					56.714	-0.102	0.000
1.001	2	15 Winter	100	+20%					55.216	-0.088	0.000
1.002	3	15 Winter	100	+20%	100/15 Summer				53.706	0.120	0.000
2.000	4	15 Winter	100	+20%					52.800	-0.113	0.000
1.003	5	120 Winter	100	+20%					51.678	-0.222	0.000
1.004	6	120 Winter	100	+20%					51.678	-0.173	0.000
1.005	7	120 Winter	100	+20%					51.677	-0.112	0.000
1.006	8	120 Winter	100	+20%	2/15 Summer				51.676	1.926	0.000
3.000	9	480 Winter	100	+20%	30/180 Winter				50.097	0.952	0.000
3.001	10	480 Winter	100	+20%	30/120 Winter				50.097	1.007	0.000
3.002	11	480 Winter	100	+20%	30/120 Winter				50.097	1.022	0.000
3.003	12	480 Winter	100	+20%	30/120 Winter				50.097	1.037	0.000
3.004	13	480 Winter	100	+20%	30/120 Winter				50.098	1.052	0.000
3.005	14	480 Winter	100	+20%	30/120 Winter				50.098	1.066	0.000
3.006	15	480 Winter	100	+20%	30/120 Winter				50.098	1.081	0.000
3.007	16	480 Winter	100	+20%	30/120 Winter				50.098	1.096	0.000
3.008	17	480 Winter	100	+20%	30/120 Winter				50.098	1.111	0.000
1.007	18	480 Winter	100	+20%	2/15 Summer				50.098	1.951	0.000
1.008	19	480 Winter	100	+20%					47.747	-0.342	0.000

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.47			26.2	OK	
1.001	2	0.58			40.6	OK	
1.002	3	1.07			52.1	SURCHARGED	
2.000	4	0.39			18.4	OK	
1.003	5	0.02			24.0	OK	
1.004	6	0.02			28.6	OK	
1.005	7	0.02			26.7	OK	
1.006	8	0.02			15.2	SURCHARGED	
3.000	9	0.00			1.7	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
3.001	10	0.01			9.5	SURCHARGED	
3.002	11	0.01			9.8	SURCHARGED	
3.003	12	0.01			11.7	FLOOD RISK	
3.004	13	0.02			14.2	FLOOD RISK	
3.005	14	0.02			16.8	FLOOD RISK	
3.006	15	0.02			16.2	FLOOD RISK	
3.007	16	0.02			14.7	FLOOD RISK	
3.008	17	0.02			13.5	FLOOD RISK	
1.007	18	0.08			9.0	SURCHARGED	
1.008	19	0.02			9.0	OK	

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APPENDIX I: Maintenance Schedule

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Our Ref: D:\PJ\P673 - Carrowreagh Rd\Doc\Maintenance Schedule\P673-js-c-24-12-10 - Maintenance Schedule.doc

MAINTENANCE SCHEDULE FOR BELOW GROUND DRAINAGE SYSTEMS.

Introduction
This statement details the drainage maintenance requirements for the proposed surface and foul water systems at the development above. A copy of this statement should be provided to the party responsible for maintaining the drainage system and should also be included within the Maintenance Manuals for the development.

The maintenance detailed in this document must be undertaken throughout the lifetime of the development. Failure to undertake this maintenance may result in the drainage system not operating as designed, increasing the risk of flooding.

Brief Description of the Surface Water Drainage System
The below ground surface water drainage system at the above development comprises a traditional oversized infrastructure system, attenuating flows through oversized pipework and manholes, with a vortex flow control device restricting outflows and discharge to a watercourse.

The system operates entirely by gravity and does not rely on moving parts to remain operational.

Maintenance Requirements
The upstream drainage network will be the sole responsibility of the respective property owner. Whilst the drainage system has been designed to operate with as little maintenance as possible, there are key operations that must regularly be undertaken to ensure that it remains in optimal condition, most of which are general housekeeping tasks that should be undertaken for any drainage system, but with additional attention to the sump upstream of the flow control device. These operations are summarised below together with recommended frequencies:

- Periodic desilting of flow control manhole sump, gully sumps and any surface channel drains. These should be emptied at least as follows (but with an annual inspection and additional cleansing if required): On completion of drainage works, annually for first 3 years, then monitor thereafter for maintenance requirements. The desilting of these items are required to ensure the attenuation and flow control device operate as per the design, and do not become blocked.

- Periodic jetting or rodding of pipework as required to clear blockages.

- Gratings on any gullies and channel drains to be kept clear of debris.

- Periodic clearance of outfall pipe to existing adopted sewer.

Vortex Flow Control
The vortex flow control device provides customised water quantity management for surface water across a wide range of flows and for a variety of applications. The device has no moving parts and no power requirements and provides reliable, low-maintenance, engineered flow management within the proposed network.

- Periodic desilting of the sump as well as checking the emergency drain down mechanism is in good working order. The sump should be emptied/checked at least as follows (but with an annual inspection

and additional cleansing if required): On completion of drainage works, annually for first 3 years, then monitor thereafter for maintenance requirements.

Inspection & Maintenance Frequency

Regular inspection and maintenance are required to ensure the effective long-term operation of below ground drainage systems. The following table details the recommended maintenance frequency.

Maintenance	Required action	Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months then annually.
	Debris removal from catchment surface (where may cause risk to performance).	Monthly or as required.
	Remove sediment from pre-treatment structures (e.g. gullies) and/or connections.	Monthly or as required.
Monitoring	Inspect/check all manholes, pipework and flow controls to ensure that they are in good condition and operating as designed.	Annually.
	Survey attenuation pipework and manholes for sediment build up and remove if necessary.	Annually and after large storms.
Remedial actions	Repair/rehabilitation of pipework, manholes and flow control devices.	Annual inspection or as required.

With implementation of the above maintenance strategy to measures are taken to ensure the drainage network will remain in optimal condition with lower risk of out of sewer flooding.

Please do not hesitate to contact me should you require any further clarification.

Kind Regards,



MARK HARDY

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