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2023

**Civil Engineering Planning Report  
Serviced Sites Castlepollard**

**Civil Engineering Planning Report**  
**Proposed Serviced Sites, Deerpark, Castlepollard, Co. Westmeath**

**Document Control Sheet**

<b>Client:</b>	Westmeath County Council
<b>Document No:</b>	230845-ORS-Z1-XX-RP-C-13a-001

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## 1. Introduction

This report outlines the Civil Engineering deliverables completed for the part 8 planning application associated with the proposed residential housing development in Deerpark, Castlepollard, Co. Westmeath.

- a) The development of 9 individual plots under the Ready to Build scheme, for the building of a property for occupation as the principal private residence of the purchaser.
- b) Associated site development works including internal road, paths, paving, parking, drainage, landscaped public open space, street lighting and associated boundary treatments.
- c) Providing a foul sewer with a separate storm sewer to connect to existing drainage infrastructure, and all associated site development works to complete the development.

A general outline of the proposed works is provided in Figure 1.1 below.



Figure 1.1 – Proposed Architectural Site Layout

## 2. Design Codes & Standards

The civil engineering works presented in this report and the accompanying drawings have been designed in accordance with the following codes of practice and standards:

- “Irish Building Regulations Technical Guidance Documents” Department of the Environment and Local Government
- “Greater Dublin Strategic Drainage Study” published under the National Development Plan
- CIRIA Report “C697 – Sustainable Drainage Systems”
- EPA - Wastewater Treatment Manuals – Treatment Systems for Small Communities, Business, Leisure Centres and Hotels
- EPA – Guidance on the Authorisation of Discharges to Groundwater (EPA, 2011)
- Irish Water Water Code of Practice
- Irish Water Wastewater Code of Practice
- Design Manual for Urban Roads and Streets



## 3. Site Location and Description

The site of the proposed residential housing development is an undeveloped site with a total site area of 0.88ha, situated in Deerpark, south-east of Castlepollard town in Co. Westmeath. The site is located 0.6km outside the town on the Dublin Road (R395). It is bounded to the north and west by residential properties, to the south by agricultural lands and to the east by the R395 which is the main road between Castlepollard and Collinstown. The site is currently a greenfield site with a line of trees and shrubs boarding the site along the west boundary with a stone wall bordering against the residential houses along the north and a wooden fence along the south and east boundary.

The development will have 1 No. vehicular entrance located to the east of the site, off the existing R395 Road.

The location of the site is shown in Figure 3.1 below.

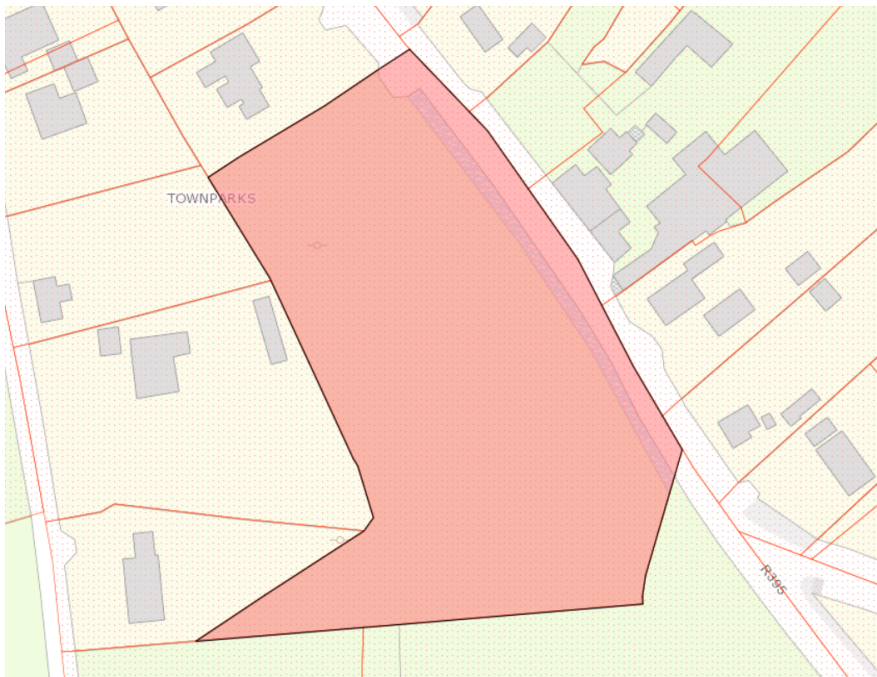


Figure 3.1 – Site Location (courtesy of Land Direct)

### 3.1 Site Topography

A topographical survey was carried out on the entire site. The subject site is generally flat. There is no history of flooding on the site.

## 4. Water and Wastewater Services

### 4.1 Irish Water Correspondence

A pre-connection enquiry was lodged with Irish Water in August 2023 for both water and wastewater. A letter of response dated 30<sup>th</sup> August 2023 confirmed the feasibility of water and wastewater connections for the development without infrastructure upgrade by Irish Water. A copy of the response letter from Irish Water is attached in Appendix A.

Existing water, wastewater and surface water infrastructure maps in the locality of the site have been sourced from the public infrastructure maps available in QGIS software and are attached in Appendix B.

### 4.2 Water Supply

The proposed development will connect to the existing watermain located to the east on R395 Road. The anticipated water demand for the development has been calculated in accordance with Irish Water – Code of Practice for Water Infrastructure. Given that the proposal is for a residential housing development, the water usage per person has been taken as 150 litres per day, the ultimate number of new units is 9 and the average occupancy has been taken at 4 per dwelling (conservative). As calculated in **Appendix C** the water demand will be 5.4m<sup>3</sup>/day with a peak demand of 0.31l/s.

The watermain shall have a minimum cover of 900mm and shall be overlain with tape containing a tracer wire. The watermain shall also be located a minimum of 3m away from any structure as per Irish Water Code of Practice requirements. Air valves to BS5159 and sluice valves to BS5163 where required shall be installed on site. Where a main is terminating in a cul-de-sac, it will be terminated in loops in accordance with the requirements of Irish Water Code of Practice for Water Infrastructure. The proposed watermain network incorporates sufficient fire hydrants to ensure that all buildings are within 46m of same as per BS750.

All watermain infrastructure shall be designed and constructed in accordance with Irish Water documents “Code of Practice for Water Infrastructure” and “Water Infrastructure Standard Details”. Please refer to ORS drawing no. 230894-ORS-Z1-00-DR-CE-400 for details of the proposed water supply infrastructure.

### 4.3 Wastewater Network

The COF letter received from Irish Water on 30<sup>th</sup> August 2023 confirmed that there is sufficient capacity in the existing wastewater network to service the proposed development. The proposed gravity wastewater network to serve the site will fall by gravity and connect into the existing 300mm diameter wastewater sewer which runs through the south of the site.

The anticipated wastewater volume generated from the entire subject development has been calculated in accordance with Irish Water – Code of Practice for Wastewater Infrastructure. The water usage per person has been taken as 150 litres per day. The proposed number of new units is 9 and the average occupancy has been taken at 4 per dwelling (conservative). Therefore, as calculated in **Appendix D**, the anticipated total daily flow for the development will be approximately 5.4 m<sup>3</sup>/day. This translates to a Dry Weather Flow of 0.06l/s or Peak

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Dry Weather Flow (6.0DWF) of 0.38l/s.

The proposed internal wastewater sewer will consist of a series of 225mm diameter sewers falling in 1:200. 100mm diameter pipes will be provided between access junctions falling at a minimum grade of 1 in 60. All internal wastewater drainage will be separate to surface water drainage infrastructure in accordance with Irish Water standards. Proposed wastewater sewer loading calculations are attached in **Appendix D**.

All wastewater infrastructure shall be designed and constructed in accordance with Irish Water documents "Code of Practice for Wastewater Infrastructure" and "Wastewater Infrastructure Standard Details".

**Please refer to ORS drawing no. 230894-ORS-Z1-00-DR-CE-400 for details of the proposed wastewater drainage infrastructure.**



## 5. Surface Water Drainage

### 5.1 Drainage Strategy

The proposed site will be served via below ground gravity pipework which will predominantly run below the proposed internal roads within the development. The surface water network will be fed via on-road gullies and an outlet pipe from each site to cater for the runoff from building roofs via guttering and downpipes. The surface water network will be attenuated within one of the public open spaces on the site and flow controlled to greenfield runoff rates prior to outfalling into a dedicated surface water drainage sewer which will ultimately outfall to the adjacent surface water network to the southeast.

There is an existing surface water network located to the southeast of the site. This network runs parallel to the R395 road and the outlet from the developed site which will be flow controlled to greenfield runoff rates will be connected to this sewer.

In developing the surface water design for the site, a range of SuDS measures were reviewed. Measures which were deemed suitable in controlling the quality and quantity of water discharged from the development include:

- Collection of excess roof rainwater and run-off from impermeable surfaces and attenuating this run-off prior to discharge to outfall locations,
- The use of trapped gullies throughout the development,
- The use of an oil interceptor.

It is proposed to collect run-off generated from impermeable areas of the site and attenuate the runoff in the attenuation storage located in the public open space to the southeast of the site. The discharge from the tank will be flow controlled to greenfield runoff rates and discharge to a Local Authority surface water line parallel to the R395. This approach will also allow storm water to drain in the direction it currently drains due to the topography of the area. Discharge rates will be limited to greenfield run-off rates.

The following design criteria has been incorporated into the design:

- Pipes are designed for small catchment areas as defined in GDSDS, based on the Modified Rational Method and a rainfall intensity of 50mm/hour onto impermeable surfaces.
- All surface water pipes have been designed to achieve a minimum self-cleansing velocity of 0.75m/s.
- Surface water pipework will be laid to a gradient no flatter than 1:500.
- The GDSDS requirements with respect to interception volume, long-term storage volume and treatment volume have been considered.
- Minimum surface water pipe size of 225mm
- Minimum depth of cover to pipework of 1.2m below roads without appropriate protection
- Maximum depth of pipework 5m
- Roughness value for surface water pipework,  $k_s$  0.6mm

## 5.2 Catchment and SuDS Systems

The proposed site layout has been designed as one surface water catchment. The catchment will have a gravity surface water drainage network which will outfall into a attenuation system in the Public Open Space. The attenuation system has been sized to store the runoff from a 1:100-year storm of critical duration plus a 20% climate change allowance.

**Conservatively no allowance has been made for infiltration on the site. A geotechnical site investigation is intended to be undertaken in the coming weeks on the site and BRE 365 infiltration tests will be undertaken as part of the works. Should the site be deemed suitable for infiltration, the attenuation system will be adjusted to cater for this and reduce further the offsite discharge of surface water.**

A breakdown of the different land uses across the site is included below in Table 5.1 below.

**Table 5.1 – Catchment Land Uses/Area**

<b>Catchment Area</b>	<b>Areas (Hectares)</b>
Roof Areas – Future Estimated (95% impermeable)	0.12
Road/Paving Areas (90% impermeable)	0.21
Landscaped Green Space (10% impermeable)	0.55
<b>Catchment: Total Area</b>	<b>0.88</b>

Refer to ORS drawing nos. 230894-ORS-Z1-XX-DR-CE-421 for typical SuDS details.

## 5.3 Flow Controls

A flow control device will be fitted to the outlet manhole from the site. This will be fitted to a 225mm diameter outlet pipe and will have a pull chord bypass. To allow maintenance, a penstock valve (or similar approved) will be installed on the inlet to the flow control manhole.

## 5.4 Bypass Interceptors

As surface water is to be collected from the roads and car parking areas with a low risk of spillage, a Class 1 Petrol/Oil Bypass Interceptor will be installed prior to discharge into the attenuation tank. All surface water shall be drained from impermeable areas through precast lockable gully traps.

Please refer to ORS drawing nos. 230894-ORS-Z1-00-DR-CE-400, 230894-ORS-Z1-00-

## 6. Flood Risk Identification

The Floodinfo.ie website was consulted for high level information on any potential flood risk on the site. The site is not in an area of defined flood risk under the OPW mapping and there is no indication of any likely past or future flood incidences in the vicinity of the site. Refer to figure 6.1 below.

The development will present no significant increase in risk of flooding either within the site or downstream of the site. Surface water runoff will be limited to greenfield runoff rates via flow control measures.

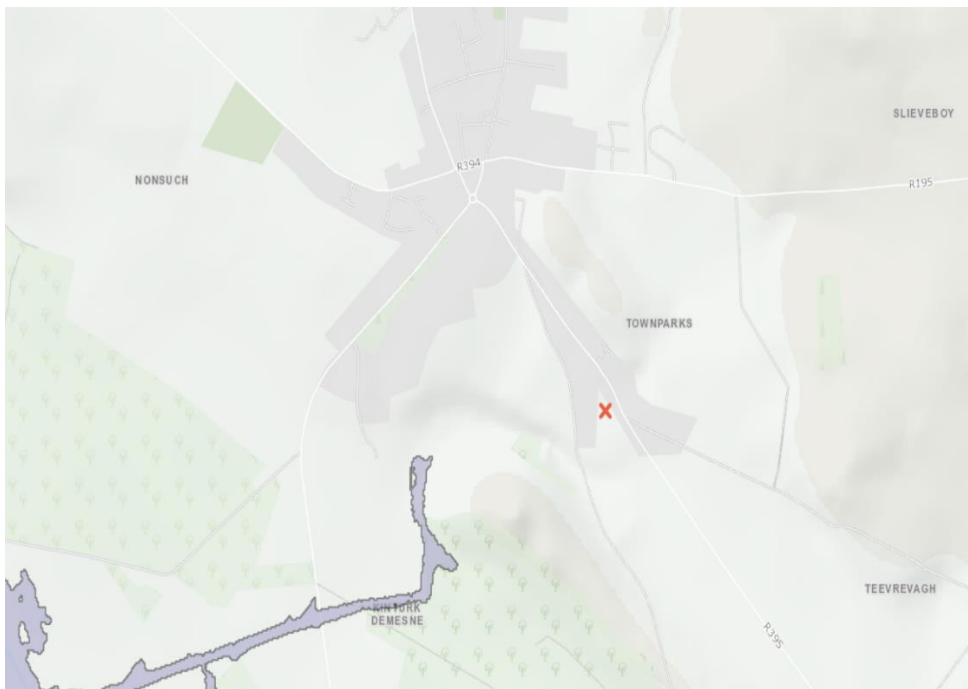


Figure 6.1 – Floodinfo Map – approximate site location marked with red X.

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## **7. Health and Safety**

ORS understand their health and safety responsibilities as set out in the Health and Safety at Work (Construction) Regulations 2013.

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## **Appendix A – Irish Water Correspondence**

## CONFIRMATION OF FEASIBILITY

Karine Mamikonjana  
Block A  
Marlinstown Office Park  
Mullingar  
Westmeath  
N91W5NN

30 August 2023

**Uisce Éireann**  
Bosca OP 448  
Oifig Sheachadta na  
Cathrach Theas  
Cathair Chorcaí

**Irish Water**  
PO Box 448,  
South City  
Delivery Office,  
Cork City.

[www.water.ie](http://www.water.ie)

**Our Ref: CDS23005962 Pre-Connection Enquiry  
Deerpark, Castlepollard, Westmeath**

Dear Applicant/Agent,

### We have completed the review of the Pre-Connection Enquiry.

Irish Water has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Housing Development of 9 unit(s) at Deerpark, Castlepollard, Westmeath, (the **Development**).

Based upon the details provided we can advise the following regarding connecting to the networks;

<b>Water Connection</b>	Feasible without infrastructure upgrade by Irish Water
<b>Wastewater Connection</b>	Feasible without infrastructure upgrade by Irish Water
<b>SITE SPECIFIC COMMENTS</b>	
Water Connection	There is sufficient capacity in the water treatment facility to cater for the proposed development. Please note, while flows in excess of your required demand may be achieved in the Uisce Éireann network and could be utilised in the event of a fire, Uisce Éireann cannot guarantee a flow rate to meet your fire flow requirement. To guarantee a flow to meet the Fire Authority requirements you should provide adequate fire storage capacity within your development.
Wastewater Connection	We can confirm that there is sufficient capacity in the wastewater treatment facility to cater for this development.



Please note that according to our records there is sewer pipes running through this site (see drawing attached).

Any structures or works over or in close proximity to Uisce Éireann infrastructure that will inhibit access for maintenance or endanger structural or functional integrity of the infrastructure are not allowed.

The layout of the development must ensure that this pipe is protected and adequate separation distances are provided between Uisce Éireann infrastructure and any structures on site. Alternatively you may enter into a diversion agreement with Uisce Éireann and divert the pipe to accommodate your development. If you wish to proceed with this option please contact Uisce Éireann at [Diversions@water.ie](mailto:Diversions@water.ie) and submit detailed design drawings before submitting your planning application.

It will be necessary to provide a wayleave over this pipe to the benefit of Uisce Éireann and ensure that it is accessible for maintenance. For more information, please see go to the link below: <https://www.water.ie/connections/developer-services/diversions/>

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before the Development can be connected to our network(s) you must submit a connection application and be granted and sign a connection agreement with Irish Water.

As the network capacity changes constantly, this review is only valid at the time of its completion. As soon as planning permission has been granted for the Development, a completed connection application should be submitted. The connection application is available at [www.water.ie/connections/get-connected/](http://www.water.ie/connections/get-connected/)

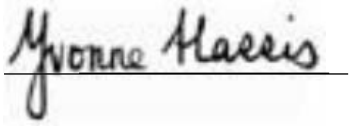
### Where can you find more information?

- **Section A** - What is important to know?
- **Section B** - Details of Irish Water's Network(s)

**This letter is issued to provide information about the current feasibility of the proposed connection(s) to Irish Water's network(s). This is not a connection offer and capacity in Irish Water's network(s) may only be secured by entering into a connection agreement with Irish Water.**

For any further information, visit [www.water.ie/connections](http://www.water.ie/connections), email [newconnections@water.ie](mailto:newconnections@water.ie) or contact 1800 278 278.

Yours sincerely,

A handwritten signature in black ink that reads "Yvonne Harris". The signature is written in a cursive style and is positioned above a thin horizontal line.

**Yvonne Harris**  
**Head of Customer Operations**

## Section A - What is important to know?

What is important to know?	Why is this important?
<b>Do you need a contract to connect?</b>	<ul style="list-style-type: none"> <li>• Yes, a contract is required to connect. This letter does not constitute a contract or an offer in whole or in part to provide a connection to Irish Water's network(s).</li> <li>• Before the Development can connect to Irish Water's network(s), you must submit a connection application <u>and be granted and sign</u> a connection agreement with Irish Water.</li> </ul>
<b>When should I submit a Connection Application?</b>	<ul style="list-style-type: none"> <li>• A connection application should only be submitted after planning permission has been granted.</li> </ul>
<b>Where can I find information on connection charges?</b>	<ul style="list-style-type: none"> <li>• Irish Water connection charges can be found at: <a href="https://www.water.ie/connections/information/charges/">https://www.water.ie/connections/information/charges/</a></li> </ul>
<b>Who will carry out the connection work?</b>	<ul style="list-style-type: none"> <li>• All works to Irish Water's network(s), including works in the public space, must be carried out by Irish Water*.</li> </ul> <p>*Where a Developer has been granted specific permission and has been issued a connection offer for Self-Lay in the Public Road/Area, they may complete the relevant connection works</p>
<b>Fire flow Requirements</b>	<ul style="list-style-type: none"> <li>• The Confirmation of Feasibility does not extend to fire flow requirements for the Development. Fire flow requirements are a matter for the Developer to determine.</li> <li>• <b>What to do?</b> - Contact the relevant Local Fire Authority</li> </ul>
<b>Plan for disposal of storm water</b>	<ul style="list-style-type: none"> <li>• The Confirmation of Feasibility does not extend to the management or disposal of storm water or ground waters.</li> <li>• <b>What to do?</b> - Contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges.</li> </ul>
<b>Where do I find details of Irish Water's network(s)?</b>	<ul style="list-style-type: none"> <li>• Requests for maps showing Irish Water's network(s) can be submitted to: <a href="mailto:datarequests@water.ie">datarequests@water.ie</a></li> </ul>

<p><b>What are the design requirements for the connection(s)?</b></p>	<ul style="list-style-type: none"> <li>The design and construction of the Water &amp; Wastewater pipes and related infrastructure to be installed in this Development shall comply with <b><i>the Irish Water Connections and Developer Services Standard Details and Codes of Practice</i></b>, available at <a href="http://www.water.ie/connections">www.water.ie/connections</a></li> </ul>
<p><b>Trade Effluent Licensing</b></p>	<ul style="list-style-type: none"> <li>Any person discharging trade effluent** to a sewer, must have a Trade Effluent Licence issued pursuant to section 16 of the Local Government (Water Pollution) Act, 1977 (as amended).</li> <li>More information and an application form for a Trade Effluent License can be found at the following link: <a href="https://www.water.ie/business/trade-effluent/about/">https://www.water.ie/business/trade-effluent/about/</a></li> </ul> <p>**trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended)</p>

## Section B – Details of Irish Water’s Network(s)

The map included below outlines the current Irish Water infrastructure adjacent the Development: To access Irish Water Maps email

[datarequests@water.ie](mailto:datarequests@water.ie)



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**Note:** The information provided on the included maps as to the position of Irish Water’s underground network(s) is provided as a general guide only. The information is based on the best available information provided by each Local Authority in Ireland to Irish Water.

Whilst every care has been taken in respect of the information on Irish Water’s network(s), Irish Water assumes no responsibility for and gives no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided, nor does it accept any liability whatsoever arising from or out of any errors or omissions. This information should not be solely relied upon in the event of excavations or any other works being carried out in the vicinity of Irish Water’s underground network(s). The onus is on the parties carrying out excavations or any other works to ensure the exact location of Irish Water’s underground network(s) is identified prior to

excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.



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## **Appendix B – Existing Services Infrastructure Maps**



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## **Appendix C – Water Demand Calculation**



**PROPOSED WATER DEMAND CALCULATIONS**

ORS Ref:

230894

CLIENT: **Westmeath County Council**

PROJECT DESCRIPTION: **Proposed Residential Development at Deerpark, Castlepollard, Co. Westmeath**

DRAWING REFERENCE: **230894-ORS-Z1-00-DR-CE-400**

Unit Type:	Number of:	Flow (l/day/person):	Persons per Dwelling:	Total Flow (l/day)
Residential	9	150	4	5400
Residential				
	<b>Total Flow (l/day):</b>	<b>5400</b>	<b>Total Flow (m<sup>3</sup>/day):</b>	<b>5.4</b>
	<b>Average Hour Water Demand</b>	0.06	l/s	
	<b>Peak Hour Water Demand (Average Hour Water Demand x 5)</b>	0.31	l/s	

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## **Appendix D – Wastewater Demand Calculation**

**PROPOSED FOUL SEWER DESIGN CALCULATIONS**



**ORS Ref:**

**230894**

**CLIENT:** Westmeath County Council

**PROJECT DESCRIPTION:** Proposed Residential Development at Deerpark, Castlepollard, Co. Westmeath

**DRAWING REFERENCE:** 230894-ORS-Z1-00-DR-CE-400

Unit Type:	Number of:	Flow (l/day/person):	BOD (g/day/person)	Persons	Total Flow (l/day)	BOD (g/day/person)	P.E.
Residential	9	150	60	4	5400	240	4
				<b>Total</b>	5400	240	4
<b>Residential Total Flow per day</b>						5400	litres/day
<b>Residential Dry Weather Flow (DWF)</b>						0.06	litres/second
<b>Peak Dry Weather Flow</b>						0.38	l/s @ 6 x DWF



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## **Appendix E – Surface Water Drainage Calculations**

**Design Settings**

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	5	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	Scotland and Ireland	Connection Type	Level Soffits
M5-60 (mm)	15.800	Minimum Backdrop Height (m)	0.200
Ratio-R	0.280	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

**Nodes**

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
9	0.050	5.00	81.400	1200	646848.913	769574.910	1.200
8	0.033	5.00	81.300	1200	646847.634	769614.706	1.000
7	0.089	5.00	82.300	1200	646802.074	769675.586	1.425
6	0.135	5.00	82.050	1200	646821.118	769643.964	1.541
5	0.063	5.00	81.700	1200	646836.921	769609.207	1.460
4	0.074	5.00	81.500	1200	646842.983	769591.586	1.390
3			81.000	1200	646853.098	769594.483	1.600
2	0.009	5.00	80.700	1200	646872.131	769578.154	1.425
1			81.200	1200	646881.215	769581.380	1.965

**Links**

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.003	4	3	10.522	0.600	80.110	80.057	0.053	200.0	300	6.49	50.0
3.000	9	4	17.699	0.600	80.200	80.112	0.088	200.0	225	5.32	50.0
1.002	5	4	18.635	0.600	80.240	80.147	0.093	200.0	300	6.33	50.0
2.000	8	5	12.042	0.600	80.300	80.240	0.060	200.7	225	5.22	50.0
1.001	6	5	38.181	0.600	80.509	80.240	0.269	141.9	225	6.05	50.0
1.000	7	6	36.914	0.600	80.875	80.509	0.366	100.9	225	5.47	50.0
4.000	2	1	9.640	0.600	79.275	79.235	0.040	241.0	225	5.19	50.0

Name	US Node	DS Node	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)
1.003	4	3	1.108	78.3	60.2	1.090	0.643	0.444
3.000	9	4	0.921	36.6	6.8	0.975	1.163	0.050
1.002	5	4	1.108	78.3	43.3	1.160	1.053	0.320
2.000	8	5	0.919	36.5	4.4	0.775	1.235	0.033
1.001	6	5	1.095	43.5	30.4	1.316	1.235	0.224
1.000	7	6	1.302	51.8	12.1	1.200	1.316	0.089
4.000	2	1	0.838	33.3	1.2	1.200	1.740	0.009

**Simulation Settings**

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	Scotland and Ireland	Drain Down Time (mins)	240
M5-60 (mm)	15.800	Additional Storage (m³/ha)	20.0
Ratio-R	0.280	Check Discharge Rate(s)	x
Summer CV	0.750	Check Discharge Volume	x
Analysis Speed	Normal		

**Storm Durations**

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440 | 2160

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	20	0	0
30	20	0	0
100	20	0	0

**Node 2 Online Hydro-Brake® Control**

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	79.275	Product Number	CTL-SHE-0106-5000-1000-5000
Design Depth (m)	1.000	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

**Node 2 Flow through Pond Storage Structure**

Base Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Main Channel Length (m)	25.000
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	79.275	Main Channel Slope (1:X)	200.0
Safety Factor	2.0	Time to half empty (mins)	308	Main Channel n	0.040

**Inlets**

3

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	120.0	0.0	1.000	120.0	0.0	1.001	0.0	0.0

**Results for 2 year +20% CC Critical Storm Duration. Lowest mass balance: 91.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute summer	9	11	80.341	0.141	7.6	0.2766	0.0000	OK
15 minute summer	8	11	80.427	0.127	5.0	0.2261	0.0000	OK
15 minute summer	7	10	80.952	0.077	13.5	0.1842	0.0000	OK
15 minute summer	6	11	80.658	0.149	33.7	0.4284	0.0000	OK
15 minute summer	5	11	80.425	0.185	47.1	0.3677	0.0000	OK
15 minute summer	4	11	80.337	0.227	64.4	0.4999	0.0000	OK
180 minute summer	3	132	79.710	0.310	26.3	0.3504	0.0000	OK
180 minute summer	2	132	79.710	0.435	15.9	0.5470	0.0000	SURCHARGED
15 minute summer	1	1	79.235	0.000	5.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute summer	9	3.000	4	7.0	0.300	0.192	0.5825	
15 minute summer	8	2.000	5	4.8	0.224	0.130	0.3487	
15 minute summer	7	1.000	6	13.3	0.667	0.257	0.7357	
15 minute summer	6	1.001	5	33.3	1.059	0.765	1.1977	
15 minute summer	5	1.002	4	46.7	1.009	0.596	0.8636	
15 minute summer	4	1.003	3	63.3	1.191	0.808	0.5580	
180 minute summer	3	Flow through pond	2	15.4	0.072	0.004	44.6638	
180 minute summer	2	Hydro-Brake®	1	5.0				79.5

**Results for 30 year +20% CC Critical Storm Duration. Lowest mass balance: 91.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute summer	9	11	80.496	0.296	13.9	0.5828	0.0000	SURCHARGED
15 minute summer	8	11	80.603	0.303	9.1	0.5407	0.0000	SURCHARGED
15 minute summer	7	12	81.093	0.218	24.8	0.5191	0.0000	OK
15 minute summer	6	12	81.023	0.514	59.5	1.4806	0.0000	SURCHARGED
15 minute summer	5	11	80.599	0.359	75.3	0.7131	0.0000	SURCHARGED
15 minute summer	4	11	80.480	0.370	107.9	0.8142	0.0000	SURCHARGED
240 minute summer	3	204	80.150	0.750	39.1	0.8479	0.0000	OK
240 minute summer	2	204	80.150	0.875	22.4	1.1004	0.0000	SURCHARGED
15 minute summer	1	1	79.235	0.000	5.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute summer	9	3.000	4	13.3	0.334	0.363	0.7039	
15 minute summer	8	2.000	5	8.5	0.249	0.232	0.4789	
15 minute summer	7	1.000	6	23.5	0.731	0.454	1.4606	
15 minute summer	6	1.001	5	51.8	1.303	1.190	1.5185	
15 minute summer	5	1.002	4	75.0	1.065	0.958	1.3123	
15 minute summer	4	1.003	3	107.4	1.538	1.372	0.7039	
240 minute summer	3	Flow through pond	2	21.6	0.063	0.005	97.4390	
240 minute summer	2	Hydro-Brake®	1	5.0				120.9

**Results for 100 year +20% CC Critical Storm Duration. Lowest mass balance: 91.55%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute summer	9	11	80.609	0.409	18.0	0.8048	0.0000	SURCHARGED
15 minute summer	8	11	80.775	0.475	11.8	0.8487	0.0000	SURCHARGED
15 minute summer	7	12	81.593	0.718	32.1	1.7105	0.0000	SURCHARGED
15 minute summer	6	12	81.481	0.972	70.0	2.8025	0.0000	SURCHARGED
15 minute summer	5	11	80.769	0.529	94.4	1.0519	0.0000	SURCHARGED
15 minute summer	4	11	80.586	0.476	134.7	1.0465	0.0000	SURCHARGED
720 minute summer	3	450	80.356	0.956	23.3	1.0814	0.0000	OK
240 minute summer	2	184	80.381	1.106	27.6	1.3910	0.0000	SURCHARGED
15 minute summer	1	1	79.235	0.000	5.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute summer	9	3.000	4	16.7	0.419	0.455	0.7039	
15 minute summer	8	2.000	5	10.4	0.267	0.286	0.4789	
15 minute summer	7	1.000	6	26.8	0.746	0.517	1.4681	
15 minute summer	6	1.001	5	65.9	1.657	1.514	1.5185	
15 minute summer	5	1.002	4	95.3	1.353	1.217	1.3123	
15 minute summer	4	1.003	3	133.7	1.899	1.707	0.7249	
720 minute summer	3	Flow through pond	2	100.3	0.047	0.023	117.7196	
240 minute summer	2	Hydro-Brake®	1	5.2				126.9