

Castlefarm Dunboyne Phase 2

Infrastructure Design Report

230143-DBFL-XX-XX-RP-C-0001

INFRASTRUCTURE



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Contents

1	Introduction.....	1
1.1	Background	1
1.2	Objectives	1
1.3	Location.....	1
1.4	Topography and Site Characteristics	2
1.5	Ground Conditions	3
1.6	Proposed Development.....	4
2	Access and Roads	5
2.1	Vehicular Site Access.....	5
2.2	Pedestrian and Cycle Access	5
2.3	Street Layout Design	5
2.4	Vehicle Tracking	6
2.5	Pavement Design Standards	6
2.6	Traffic & Transportation	6
3	Surface Water Drainage.....	7
3.1	Existing Surface Water Drainage Infrastructure.....	7
3.2	Basis of Design.....	8
3.2.1	General Description of Surface Water Design	8
3.2.2	Compliance with Surface Water Policy	10
3.2.3	Allowable Runoff Rate	11
3.2.4	Design Standards.....	12
3.2.5	SUDS	14
3.2.6	Proposed Runoff Coefficients and Factored Impermeable Areas	15
3.2.7	Attenuation Calculation	16



3.2.8	Interception Volume	18
3.2.9	Treatment Volume	18
3.2.10	Maintenance Specification and Schedule for Proposed Drainage System:	18
3.3	Flood Risk	19
3.4	Surface Water Quality Impact	20
4	Foul Drainage	21
4.1	Existing Foul Drainage Infrastructure	21
4.2	Design Strategy	22
4.3	Correspondence with Irish Water	22
4.4	Design Calculations	22
4.5	Foul Drainage – Environmental Impact	23
5	Water Supply	24
5.1	Existing Public Water Mains	24
5.2	Proposed Water Main Layout	25
5.3	Pre-Connection Feedback from Irish Water	25
5.4	Hydrants	25
5.5	Materials	25
5.6	Water Demand	26
Appendix A :	Irish Water Network Plans	A
Appendix B :	Permissible Site Discharge	B
Appendix C :	Attenuation Calculations	C
Appendix D :	Surface Water Drainage Calculation	C
Appendix E :	Foul Drainage Calculations	D
Appendix F :	Site Investigation Report	E
Appendix G :	Irish Water Correspondence	F



Figures

Figure 1-1 Site Layout	2
Figure 1-2 EPA Map – Site Layout (Indicative Site Boundary)	3
Figure 2-1 Proposed Roads Layout	5
Figure 3-1 Existing Surface Water Network in Site (Indicative Site Boundary).....	7
Figure 3-2 Catchment Plan	8
Figure 3-3 Proposed Surface water network	10
Figure 3-4 Climate Change Factors as per GDSDS	13
Figure 4-1 Existing Foul Network in Site (Indicative Site Boundary)	21
Figure 5-1 Existing Watermain Network (Indicative Site Boundary)	24

Tables

Table 3.1 Classification of Soil Type (Soil Index / spr Value Calculated from Flood Studies Report, The classification of Soils from Winter Rainfall Acceptance Rate, Table 4.5)	12
Table 3.2 Factored Area Summary	16
Table 3.3 Surface Water Attenuation Storage and Discharge Limits	17



1 Introduction

1.1 Background

DBFL have been instructed to prepare an Infrastructure Design Report to accompany a planning application for a proposed development at Castlefarm, Station Road, Dunboyne, Co. Meath.

The proposed development, on a site area of c. 2.14 ha, consists of 76 no. dwellings, comprised of 42 no. 1, 2 & 3 bedroom apartments and duplex units, accommodated in 4 no. 2-3 storey buildings, and 34 no. 2, 3 and 4 bedroom, 2 storey, terraced, semi-detached and detached houses. A creche is located on the ground floor of Block L, which will replace the creche permitted (under Ref. RA/180561) in the adjoining phase of the Castle Farm development. Access to the development will be via the constructed access road to Castle Farm directly off Station Road. The proposed development also provides for all associated site development works, above & below ground, public and communal open spaces, including hard & soft landscaping and boundary treatments, car & bicycle parking, bin stores, public lighting etc.

1.2 Objectives

This report provides information regarding the existing site and addresses the infrastructural demands of the proposed development including the following:

- Site Access and Road Layout
- Surface Water Drainage
- Flood Risk
- Foul Drainage
- Water Supply

1.3 Location

The subject site is located at Castlefarm, Station Road, Dunboyne, Co Meath, adjacent to the previously permitted residential development (Planning Ref: RA/180561). Dunboyne is located approximately 16km northwest of Dublin City Centre in the area of Meath County Council. The proposed site is located south of the L2228 Station Road, west of M3 and R147, south-east of Dunboyne Train station and east of Dunboyne Town Centre. Refer to Fig 1.1 below.



Figure 1-1 Site Layout

1.4 Topography and Site Characteristics

The existing topographical survey of the site is shown in the background of DBFL's roads layout drawing (refer to 230143-X-04-Z00-DTM-DR-DBFL-CE-1201).

The site, in general, is relatively flat and has a gradient of approximately 1:200 falling from North to South. Based on the existing topographic information the highest point is 65.805m OD in the Western portion of the site and the low point is 64.578m OD in the southeast corner of the site. Existing surface gradients across the site have been a key factor with regard to the design of road levels, finished floor levels, surface water drainage and foul drainage.

The site is bound by the permitted residential development (Planning Ref: RA/180561) and the L2228 to the north and by greenfield sites to the south, east and west.

The closest river network as identified on the EPA's map viewer is River Tolka (Refer to figure 1-2 below). The nearest EPA designated watercourse is the Loughsallagh stream which runs along the

southern boundary of the site. The Loughsallagh stream discharges to the Dunboyne stream approximately 80m south of the site.

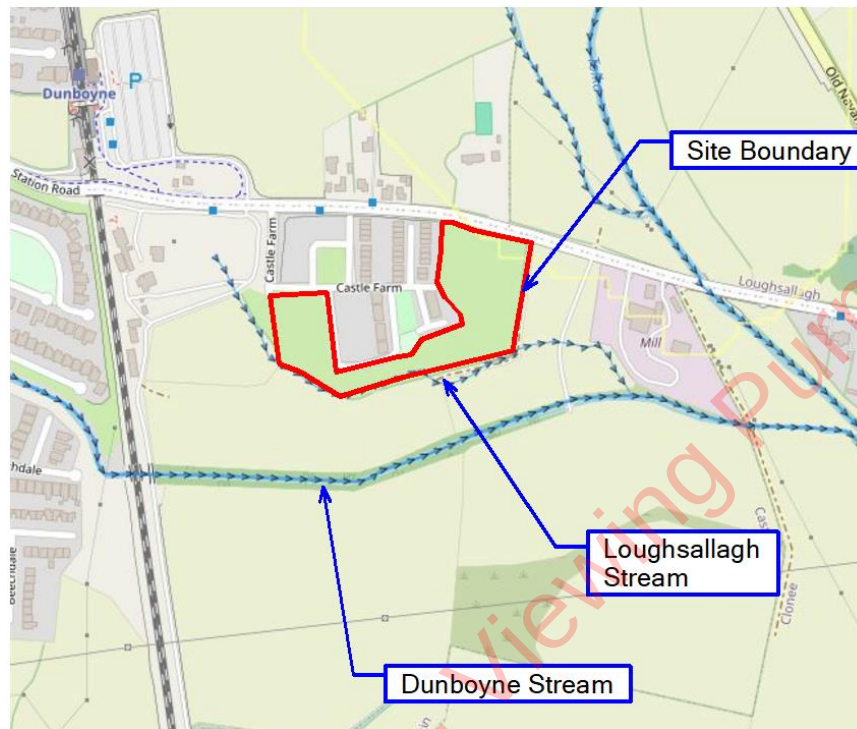


Figure 1-2 EPA Map – Site Layout (Indicative Site Boundary)

1.5 Ground Conditions

Site investigations were carried out by Causeway Geotech at the Castlefarm site. Refer to Appendix F for Site investigation report.

The proposed development site is a greenfield site overlaid by a topsoil layer of up to 100mm. Fluvioglacial deposits were encountered up to a maximum depth of 2.2m. Glacial till encountered overlying the fluvioglacial deposit layer.

Infiltration tests were carried out in three locations (SA01 -SA03) in accordance with BRE Digest 365 - Soakaways (BRE, 2016). SA01 and SA02 recorded a test infiltration rate of 1.490m/h and 0.407m/h respectively, the absence of the outflow from the SA03 precluded calculation of infiltration coefficients.

Groundwater was encountered during trial pit excavation at depths between 1.5m and 2.0m.



1.6 Proposed Development

As noted in Section 1.1, the proposed development comprises of 76 residential dwellings and a creche.

The proposed development will also include the following associated engineering infrastructure:

- Provision of surface water drainage, foul drainage and water supply infrastructure and connections.
- Provision of road infrastructure within the site which comprises of access roads, footpaths, and parking spaces.

2 Access and Roads

2.1 Vehicular Site Access

The primary access point for the proposed development is from the Station Road, through the newly constructed road network installed as part of Phase 1 of the Castle Farm development (Planning Ref: RA/180561).

2.2 Pedestrian and Cycle Access

Pedestrians and Cyclists will access the site at the same location as the aforementioned vehicular access introduced above.

2.3 Street Layout Design

The proposed road layout is shown in drawing 230143-X-04-Z00-DTM-DR-DBFL-CE-1201 and in Fig.2.1 below. The road layout is designed in accordance with the recommendations of the Design Manual for Urban Roads and Streets (DMURS).

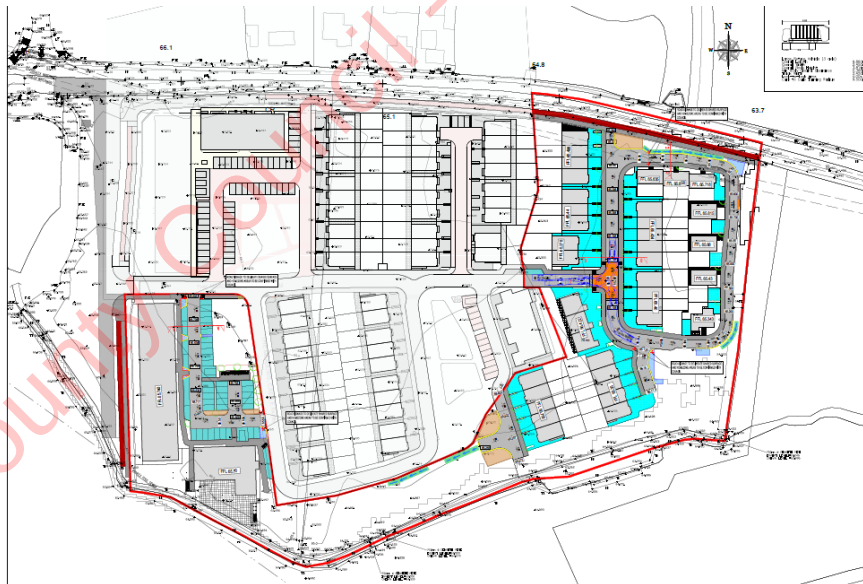


Figure 2-1 Proposed Roads Layout

The standard road cross sections and construction details are shown on drawings 230143-X-04-Z00-DTM-DR-DBFL-CE-5201 and 230143-X-04-Z00-DTM-DR-DBFL-CE-5202.



Typical road widths and gradients are indicated below.

- Home zone – 4.8m wide carriageways
- Internal Local Street – 5.5m wide carriageways
- Internal Local Street (One Way) – 3.5m wide carriageways
- Footpath adjacent to internal street – 2m wide
- Typical Longitudinal Gradient – 1/80 – 1/150
- Road cross fall – 1/40

2.4 Vehicle Tracking

The proposed site layout has been tracked to demonstrate that the site's proposed corner radii and turning heads will accommodate large vehicles such as refuse trucks and fire engines (refer to Drawing 230143-X-04-Z00-DTM-DR-DBFL-CE-1201).

2.5 Pavement Design Standards

Local streets within the site are to be designed in accordance with Meath County councils taken in charge standards.

Proposed road construction materials and thicknesses are to be based on an existing minimum subsoil CBR of 2.0% at road formation level.

Actual CBR values are to be confirmed by site specific investigations prior to road construction.

2.6 Traffic & Transportation

A separate Traffic & Transport Assessment has been prepared as part of this planning application (refer to DBFL Report No. 230143-DBFL-XX-XX-RP-C-0003).

3 Surface Water Drainage

3.1 Existing Surface Water Drainage Infrastructure

As noted in Section 1.4, Topography and Site Characteristics, the site generally falls from North to south. A topographical survey has been incorporated into the background of Road layout 230143-X-04-Z00-DTM-DR-DBFL-CE-1201 and Proposed Surface water Layout drawing 230143-X-91-Z00-DTM-DR-DBFL-CE-1311.

The surface water drainage network constructed as part of the Phase 1 of this development (Planning Ref Reg: RA/180561) crosses the subject site to discharges to the Loughsallagh stream, immediately south of the site which ultimately discharges to the Tolka River. The existing surface water network is shown in the background of 230143-X-91-Z00-DTM-DR-DBFL-CE-1311 and can also be seen in Fig 3-1.

The Loughsallagh stream running along the sites southern boundary is expected to provide a suitable discharge point for the subject site.

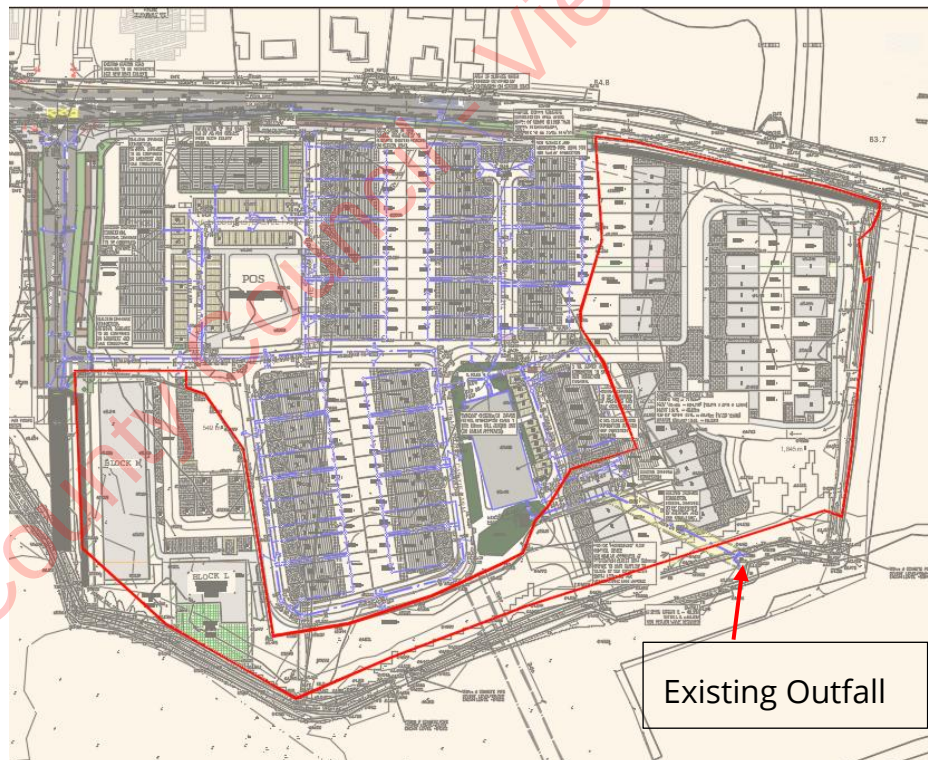


Figure 3-1 Existing Surface Water Network in Site (Indicative Site Boundary)

3.2 Basis of Design

3.2.1 General Description of Surface Water Design

As mentioned above, the Loughsallagh stream (as described above in Section 3.1) is expected to provide a suitable surface water discharge point for the proposed development.

Refer to DBFL Drawing No. 230143-X-93-Z00-DTM-DR-DBFL-CE-1311 for proposed surface water outfall location.

The surface water strategy has been developed to incorporate SuDS features into the proposed surface water network in order to mimics the natural regime of the site, in addition to providing amenity and increasing biodiversity.

The proposed site is split into 2 no. catchments with independent outfalls see Fig 3.2 below and Proposed Catchment Plan drawing (No. 230143-X-05-Z00-DTM-DR-DBFL-CE-1305).

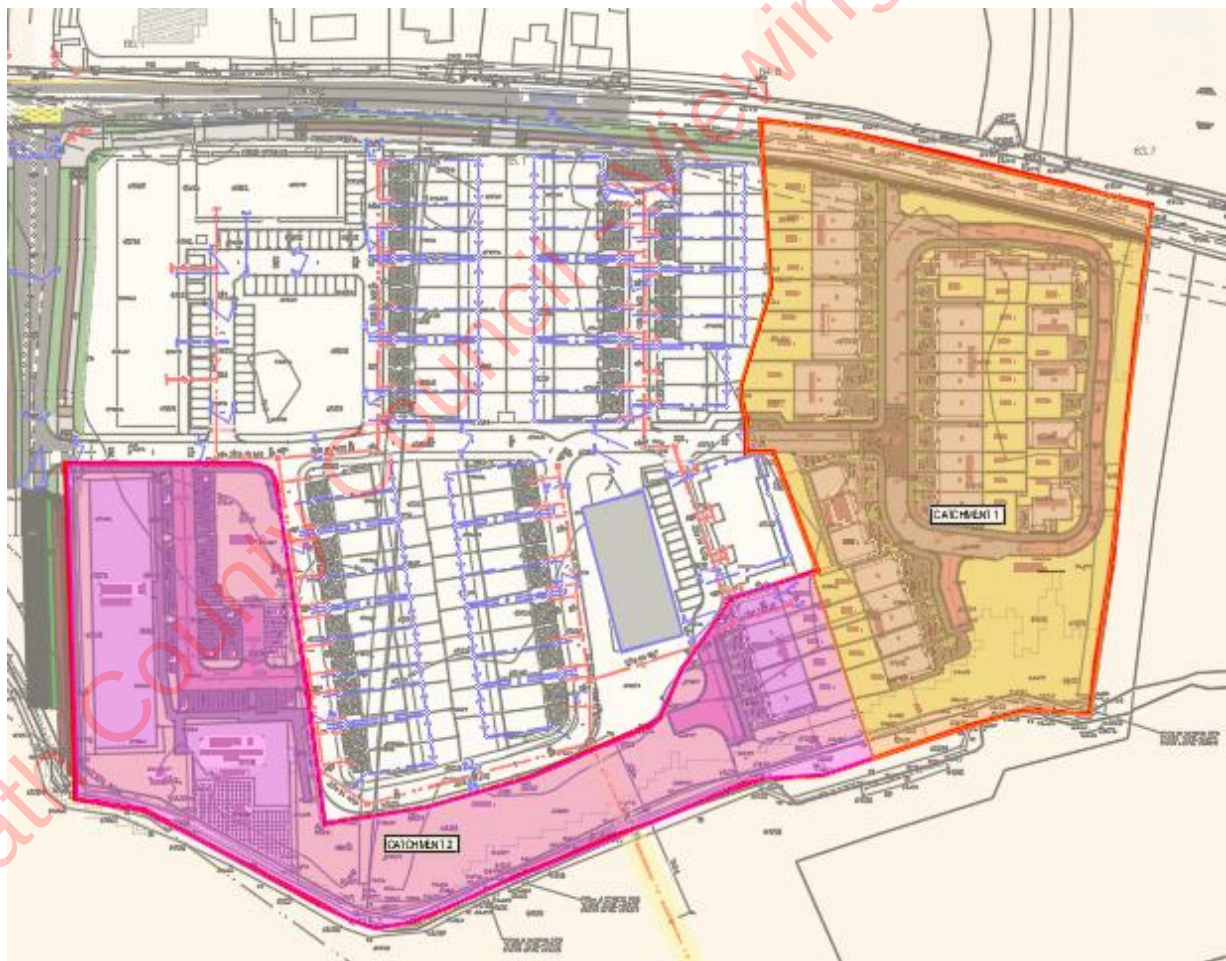


Figure 3-2 Catchment Plan



Catchment 1 will comprise of the units directly to the East of the Phase 1 Development.

Catchment 2 will comprise of the units directly Southwest of the Phase 1 Development.

The surface water runoff from both catchments will be controlled by independent vortex flow control devices (Hydrobrake or equivalent) and associated attenuation systems (underground SC740 Stormtech attenuation system or similar approved).

Attenuation systems will be sized to accommodate the 100-year AEP (+ 20% for Climate change) with a discharge rate set to the greenfield runoff rate (Q_{bar}) in accordance with the Greater Dublin Strategic Study (GDSDS) before discharging to the Loughsallagh Stream south of the site.

The internal surface water network will collect surface water runoff from the site via the features described below prior to discharge.

Surface water runoff from driveways will be captured by permeable paving.

Surface water runoff from the roofs of individual housing units will be routed to the proposed surface water drainage network via filter drains in the rear garden and permeable paving to the front.

Surface water runoff from the road network will be directed towards Raingardens/ Bioretention areas, swales, permeable paving, and tree pits before entering the piped surface water network.

In limited instances, surface water runoff from the site's internal road network and roof areas will drain directly to the surface water network via conventional gullies.

All surface water drainage will pass through a Class 1 Bypass Separator prior to entering the attenuation system and discharging from the site.

The surface water outfall installed as part of phase 1 (Planning Ref Reg: RA/180561) will be required to be diverted to facilitate proposed development.

See figure 3.3 below. Refer DBFL's Surface water Layout drawing 230143-X-91-Z00-DTM-DR-DBFL-CE-1311.

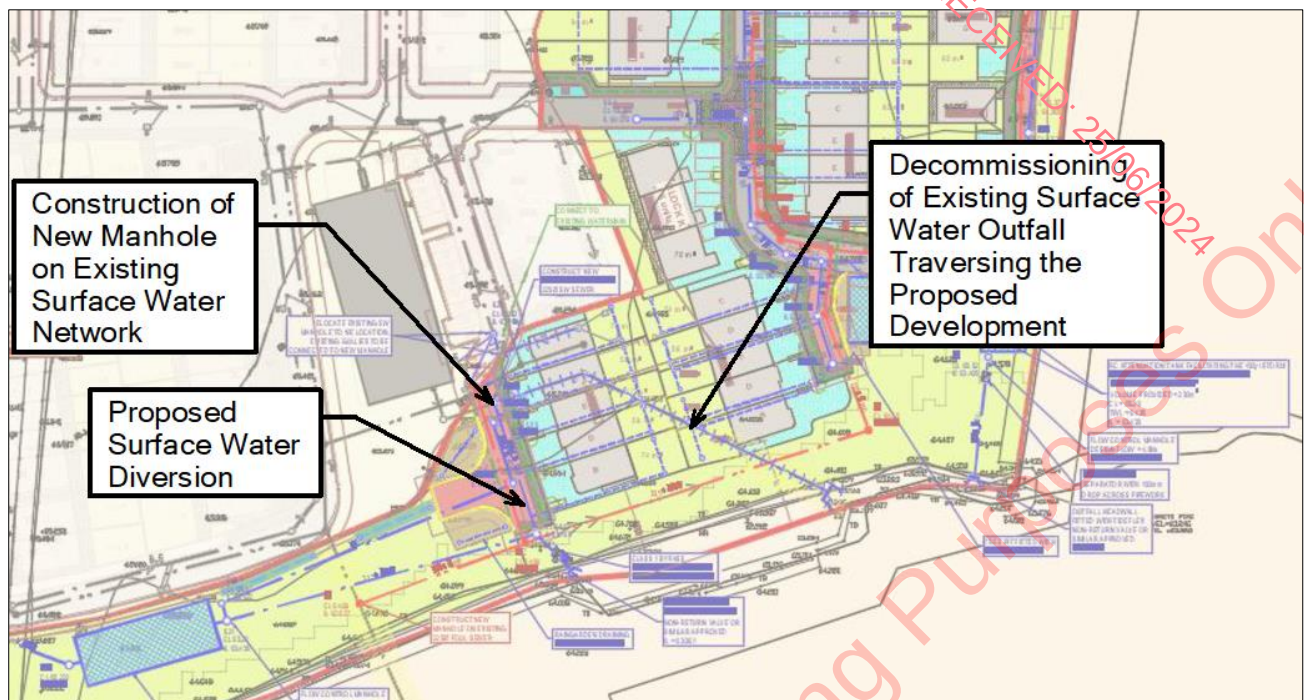


Figure 3-3 Proposed Surface water network.

3.2.2 Compliance with Surface Water Policy

The site's surface water management infrastructure has been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS), and the requirements of Meath County Council.

The GDSDS (Vol. 2, Chapter 6.3.4) requires that the following design criteria are applied to all sites:

- Criterion 1: River Water Quality Protection – Satisfied by providing interception storage and treatment of surface water run-off by routing through SUDS features such as permeable paving, tree pits, raingarden, swales, and full retention fuel / oil separators at surface water discharge points.
- Criterion 2: River Regime Protection – Satisfied by attenuating surface water run-off in association with flow control devices prior to discharge off site at greenfield runoff rate. Site critical duration storm used to assess attenuation volume.
- Criterion 3: Level of Service (Flooding) for the Site – Satisfied by reviewing available flood hazard information (e.g. Eastern CFRAM Study) relating to the site's proximity to fluvial flood plains (up to 1 in 100-year flood event).



Also refer to JBA Report No. LVQ-JBAI-XX-XX-RP-HO-0001-S3-P01-Castlefarm_FRA Flood Risk Assessment.

- Criterion 4: River Flood Protection – Satisfied by attenuating surface water discharge to greenfield runoff rates, addressing pluvial flood risk associated with the 1 in 100-year storm and avoiding development in flood plains.

3.2.3 Allowable Runoff Rate

Qbar has been assessed based on GDSDS requirements (Section 6.6.1.2/ IHR 124)

i.e. $Qbar(m^3/s) = 0.00108 \times (Area) 0.89(SAAR) 1.17(SOIL) 2.17$

Catchment 1

- Area – 0.926 Ha (areas positively draining to the piped network)
- SAAR – 802mm
- SOIL – Type 4
- Qbar – 4.8l/sec

Please refer assessment of Soil type below. Please refer to Appendix B for Catchment 1 permissible site discharge calculations.

Catchment 2

- Area – 0.706 Ha (areas positively draining to the piped network)
- SAAR – 802mm
- SOIL – Type 4
- Qbar – 3.6l/sec

Please refer assessment of Soil type below. Please refer to Appendix B for Catchment 2 permissible site discharge calculations.

Soil Type Determination

SOIL is the soil index, Reference GDSDS Section 6.3.1.2.2 Soil Type 4 (as determined below) equates to an SPR value of 0.47.

Assessment of Soil Type (see Table 3.1)

- Drainage Group: 2
- Depth to Impermeable Layer: 3 (>40 cm)
- Permeability Group: 3 (Slow)
- Slope: 1 (0-2deg)

Table 4.5 The classification of soils by winter rain acceptance rate from soil survey data.

Drainage class Group	Depth to impermeable layer (cm)	Slope classes									
		0 - 2°			2 - 8°			>8°			
		Permeability rates above impermeable layers									
		Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)	Rapid (1)	Medium (2)	Slow (3)	
1	>80	1			1	2			1	2	3
	40 - 80	1			2			3			4
	<40	—	—	—	—	—	—	—	—	—	
2	>80	2	3			4			—		
	40 - 80	2	3			4					
	<40	3	4			5					
3	>80	5			6			7			
	40 - 80	5			6			7			
	<40	5			6			7			

Winter rain acceptance indices: 1, very high; 2, high; 3, moderate; 4, low; 5, very low. Upland peat and peaty soils are in Class 5. Urban areas are unclassified.

Table 3.1 Classification of Soil Type (Soil Index / spr Value Calculated from Flood Studies Report, The classification of Soils from Winter Rainfall Acceptance Rate, Table 4.5)

3.2.4 Design Standards

Proposed surface water drains have been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS), the Department of the Environment's Recommendations for Site Development Works for Housing Areas, the Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Wastewater Disposal" and BS EN 752: 2008 Drain and Sewer Systems Outside Buildings.



Design Criteria:

- Return period for pipe work design 5 years
- Return period for attenuation design 100 years
- Allowable Outflow for Catchment 1 4.8 l/sec
- Allowable Outflow for Catchment 2 3.6 l/sec
- Time of entry 4 minutes
- M5 - 60 (based on site specific rainfall data) 15.3 mm
- Ratio "r" (based on site specific rainfall data) 0.271
- Pipe Friction (Ks) 0.6 mm
- Minimum Velocity (based on pipe flowing full) 1.0 m/s
- Rainfall Depth Factored for Climate Change 20%
- Rainfall Runoff from Roads and footpath (draining via SuDs features) 70%
- Rainfall Runoff from Roads and footpath (draining to SW network via gullies) 95%
- Rainfall Runoff from Roof (draining to SW network) 95%
- Rainfall Runoff from Roof (draining via filter drains) 80%
- Rainfall Runoff from Permeable Paving 50%
- Rainfall Runoff from Green landscape areas 47%

(in accordance with GDSDS Volume 2, Chapter 6, Table 6.2 – See below)

Climate Change Category	Characteristics
River flows	20% increase in flows for all return periods up to 100 years
Sea level	400+mm rise (see Climate Change policy document for sea levels as a function of return period)
Rainfall	10% increase in depth (factor all intensities by 1.1) Modify time series rainfall in accordance with the GDSDS climate change policy document

Table 6.2 Climate Change Factors to be Applied to Drainage Design

Figure 3-4 Climate Change Factors as per GDSDS



Typical drainage details as outlined on DBFL Drawings 230143-X-05-Z00-DTM-DR-DBFL-CE-5301 and 230143-X-05-Z00-DTM-DR-DBFL-CE-5302, are in accordance with Greater Dublin Regional Code of Practice for Drainage Works.

The Surface water drainage network including the surface water storage system has been designed and simulated for all critical storms events (including 1 in 5, 1 in 30 and 1 in 100-year storm events) using the Network module of Microdrainage. This is based on the Modified Rational Method. The surface water drainage network is designed in accordance with IS EN 752, BS8301:1985 and the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS).

The minimum pipe diameter proposed is 225mm. Private drains within the proposed development will be 100mm diameter and filter drains will be 150mm diameter.

Refer to Appendix C for Attenuation Design Calculations and Appendix D for Surface Water Network Design Calculations which have been carried out using Microdrainage WinDes analysis software.

3.2.5 SUDS

The following methodologies are being implemented as part of a SuDS treatment Train approach.

- Permeable paving is provided for parking areas. The permeable paving does not rely on the infiltration.
- Swales will collect surface water runoff from the adjacent areas which will reduce initial flow on the network, as well as provide an additional element of attenuation and support biodiversity.
- Tree pits and Rain gardens will collect runoff from the adjacent roads and will reduce initial flow on the network as well as provide an additional element of attenuation.
- Filter Drain at the back of the houses are typically trenches with permeable material and a perforated collection pipe at the invert with an optional permeable 'Sandy' topsoil at surface. They can treat, convey, and attenuate runoff at source and can infiltrate to the ground where the subgrade is suitable. The systems will allow some form of storage for small rainfall events and can result in water evaporation and adsorption in small quantities, therefore there will be less runoff from these areas in small rainfall events thus mimicking the natural response for this catchment. These will be located in the back-



gardens of each unit and will result in an improvement in the quality of surface water draining from roofs of houses.

- Installation of a vortex flow control device (Hydrobrake or equivalent), limiting surface water discharge from the site.
- Surface water discharge will also pass via a Class 1 full retention fuel/oil separator (sized in accordance with catchment area flowing through it).

3.2.6 Proposed Runoff Coefficients and Factored Impermeable Areas

Noted below are the proposed runoff coefficient for the proposed development.

- **Roof / Footpath/ Roads draining directly to SW network - Runoff Coefficient 0.95**

A 5% reduction of the surface area is applied to take account of surface water run-off collected and stored within the micro and macro texture of the surfacing.

- **Roads/Footpath Draining via SuDS – Runoff Coefficient 0.70**

Surface water runoff from the road/footpath will be routed to the main surface water network via tree pits, swales and raingarden which slows the runoff at source ultimately reducing the peak inflow for attenuation calculations.

- **Roof draining via SuDS – Runoff Coefficient 0.80**

Surface water runoff from roofs will be routed to the proposed surface water pipe network via filter drains in the back gardens. This will provide an additional element of storage. Reduction of velocity as the filler material used in the SuDS feature slows the runoff at source ultimately reducing the peak inflow for attenuation calculations.

- **Permeable Paving – Runoff Coefficient 0.50**

Reduction of velocity as the aggregate /filter material used in the SuDS feature (permeable paving) slows the run-off at source ultimately reduce the peak inflow for attenuation calculations.

- **Soft Landscaped/Grassed Areas – Runoff Coefficient 0.47**

Grassed/Landscaped areas slows the run-off at source ultimately reducing the peak inflow for attenuation calculations. Pedestrian / green links to drain to surrounding landscape for reduction and treatment of run-off.

The incorporation of the above SuDS elements will discharge surface water in a sustainable manner from the site, encourage groundwater recharge and provide treatment of run-off and subsequent improvement of discharge quality.



The proposed surface water drainage layout is detailed in DBFL drawing 230143-X-93-Z00-DTM-DR-DBFL-CE-1311.

Factored Impermeable Areas

Proposed Runoff Co-efficient and Factored Impermeable Areas for Catchment 1 and Catchment 2 are noted below in table 3.2.

Area Summary		
Catchment	Gross Area (Ha)	Factored Area (Ha)
1	0.926	0.574
2	0.706	0.431

Table 3.2 Factored Area Summary

3.2.7 Attenuation Calculation

The proposed site is split into 2 separate catchments. It is proposed to have separate outfall locations for each of these catchments.

As mentioned above, the proposed housing units and duplex units, east of the site along with any associated infrastructure will form Catchment 1. The apartment blocks, 5 no. housing units and any associated infrastructure west of the proposed development site will form catchment 2.

Surface water runoff from the overall development will be attenuated to an allowable greenfield runoff rate (Q_{bar}). Attenuation volumes have been calculated based on an allowable greenfield runoff rate of 4.8 l/s for Catchment 1 and 3.6 l/s for Catchment 2. (Refer to section 3.2.3 above).

Runoff from the proposed development will be controlled / attenuated using vortex type flow control devices (Hydrobrake or equivalent).

The designed attenuation volumes, discharge limits, storage types and storage volumes for each catchment are summarised in Table 3.3 below. The locations of the proposed attenuation systems are shown on DBFL drawing 230143-X-91-Z00-DTM-DR-DBFL-CE-1311.



Catchment	Catchment Area (Ha)	Factored Area (Ha)	Storage System Types	Calculated Allowable Outflow (l/s)	Storage Volume Required	Storage Volume Provided
1	0.926	0.574	Underground SC740 Stormtech Attenuation System or similar approved	4.8	297.8	315.5
2	0.706	0.431	Underground SC740 Stormtech Attenuation System or similar approved	3.6	224.4	232.8

Table 3.3 Surface Water Attenuation Storage and Discharge Limits

We note that the M5-60 and "r-value" (as noted in section 3.2.4 above) are sourced from Met Eireann. The inflow hydrograph for each storm is then calculated using Microdrainage software using the Flood Studies report method as recommended by Section 6.4 of the GDSDS.

Attenuation Volumes have been calculated using Microdrainage WinDes Analysis software. Refer to Appendix C for Source control calculations.

In total 548.3 m³ of storm water storage is provided within the attenuation facilities for the subject site.



3.2.8 Interception Volume

The GDSDS (Vol.2, Table 6.3) requires interception storage to be incorporated into surface water drainage design in order to limit discharge of sediment and pollutants into the downstream surface water drainage network and receiving water courses.

The interception storage is designed to capture surface water run-off from rainfall depths of 5mm (and up to 10mm if possible).

The SuDS features included in the development (refer to Section 3.2.4) will provide the necessary interception volume required by the GDSDS (within stone reservoirs beneath permeable paved driveways and surface water runoff from roads being intercepted by tree pits, swales, and raingardens).

3.2.9 Treatment Volume

The GDSDS requires that a "treatment volume" (V_t) to be provided to prevent any pollutants or sediments entering river systems. Additionally, a 'treatment train' stormwater runoff management is required, according to CIRIA document C697 the following treatment train approach is necessary:

- Surface water runoff from Roofs – 1 Treatment Stage.
- Surface water runoff from Roads – 2 Treatment Stage.
- Surface water runoff from other Paved areas excluding Roads – 1 treatment Stage.

The treatment volume is based on treatment 15mm of rainfall depth from 80% of the runoff from impermeable areas as defined in GDSDS.

3.2.10 Maintenance Specification and Schedule for Proposed Drainage System.

The stormwater network should be maintained regularly by the developer and then by Meath County Council when taken in charge. Regular maintenance of the storm network reduces the chance of flooding, ponding and contamination of surrounding water courses.

Chapter 32 of the CIRIA SuDS Manual (C753:2015) will be used as the general overarching guideline for the implementation of maintenance guidelines for the following elements which are to be inspected regularly as part of the maintenance routine. Guidelines referenced within the SuDS



manual are not intended to be exhaustive, Therefore, additional maintenance outside the scope identified below may be required in the future,

The following elements will be inspected regularly as part of the Maintenance Routine

- Gullies,
- Flow Control Manholes
- Inspection Chamber (Ciria C753: Section 20.14)
- Tree Pits (Ciria C753: Section 19.12)
- Swale (Ciria C753: Section 17.12)
- Permeable Paving (Ciria C753: Section 20.14)
- Interceptors (Ciria C753: Section 14.12)

Common practice for maintenance procedure for all elements should provide at minimum maintenance schedules that include routine inspection procedures for the following events:

- After every major storm event
- End of winter (April): Typically involving the collection of winter debris (leaves, branches, etc)
- Mid-summer (July/August): Typically involving the collection of dust, flower, and grass-type deposits.
- End of Autumn (November): Collection of leaves from Fall.

Typical quarterly inspections of all catchpits and interceptors should make allowances for structural elements to be emptied regularly to prevent them from becoming full. Amendment of the frequency of necessary maintenance procedures will be determined on the basis of regular inspections.

3.3 Flood Risk

A separate Site-Specific Flood Risk Assessment has been prepared as part of this planning application (refer to JBA Report No. DBFL Report No. LVQ-JBAI-XX-XX-RP-HO-0001-S3-P01-Castlefarm_FRA).

This flood risk assessment has been undertaken by reviewing information from the Office of Public Works (OPW) National Flood Hazard Mapping (www.floodmaps.ie) and the Eastern CFRAM Study and has been carried out in accordance with the OPW's Guidelines for Planning Authorities – The Planning System and Flood Risk Management (November 2009).



3.4 Surface Water Quality Impact

Run-off rates from the site are controlled by flow control devices.

Surface water management proposals for the development also incorporate the following impact reduction measures.

- Designed in accordance with GDSDS requirements.
- Incorporates SuDS features e.g. permeable paving (i.e. treatment/filtration provided within the stone reservoir beneath permeable paved driveway), filter drain at the back of the houses, swales, raingardens, tree-pits with overflow to conventional road gullies.
- A bypass petrol interceptor in conjunction with the attenuation system prior to discharge to the Loughsallagh stream.

4 Foul Drainage

4.1 Existing Foul Drainage Infrastructure

An existing 225mm diameter foul sewer is located south of the site. This foul network was installed during phase 1 of the development (Planning Ref RA/180561) discharging south of the site to a public network.

See Appendix A for existing Irish water record drawings.

The existing foul layout described above is shown on DBFL Drawing 230143-X-92-Z00-DTM-DR-DBFL-CE-1321 Foul Layout. The location of the existing public foul sewer is shown below in Fig 4.1.

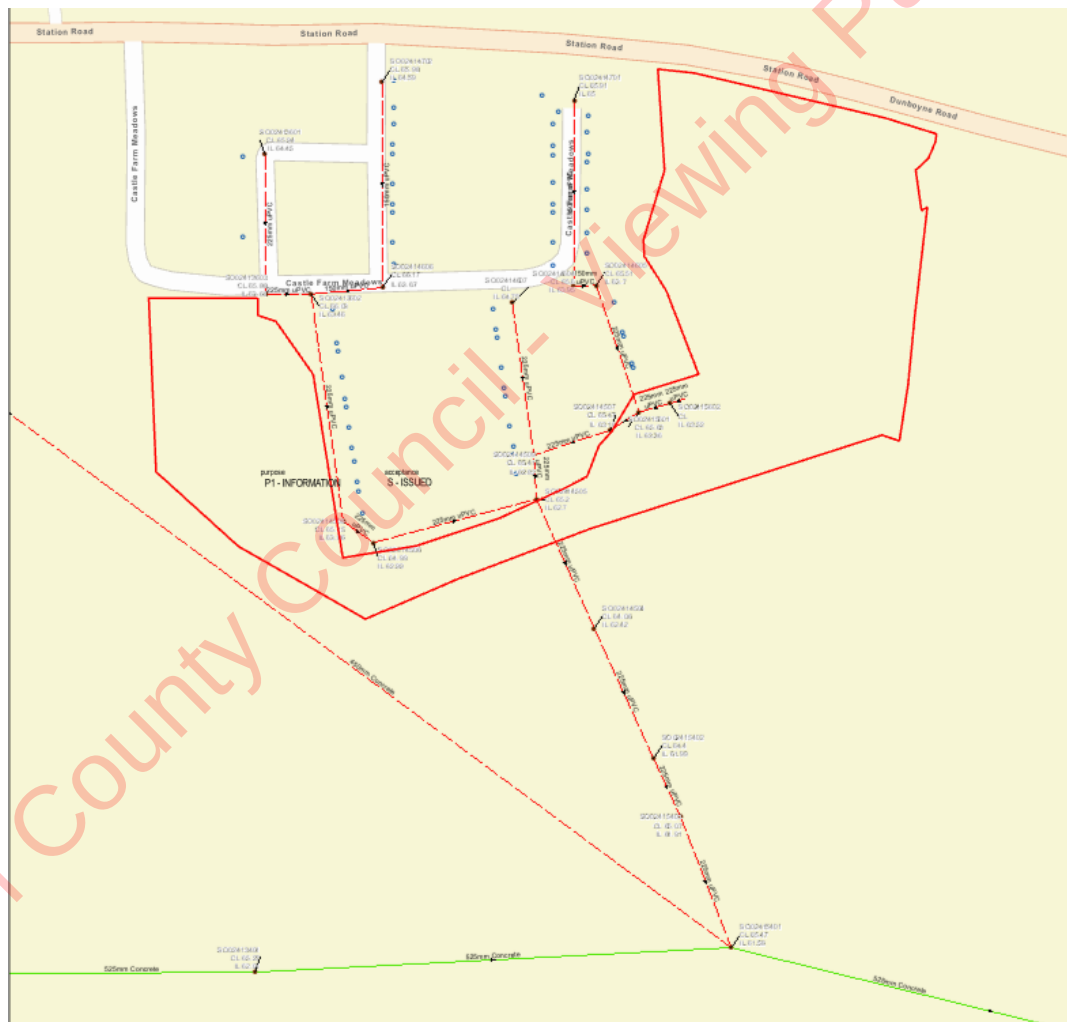


Figure 4-1 Existing Foul Network in Site (Indicative Site Boundary)



4.2 Design Strategy

It is proposed for the foul flow from the proposed development to utilise the existing foul outfall constructed for Phase 1 of the development. This will require additional manholes to be constructed on the foul drainage network which will serve as discharge points for the units to the east and west.

It is proposed to discharge the foul drainage flows from the development to the 225mm diameter outfall, discharging south of the site.

All new foul sewer installed within the network will be 225mm diameter pipes. Individual residential connections will be served by individual 100mm diameter connections.

Refer to DBFL drawing 230143-X-92-Z00-DTM-DR-DBFL-CE-1321 Foul Layout.

4.3 Correspondence with Irish Water

A Confirmation of Feasibility was received for the proposed development on the 17th of April 2024 (Ref: CDS24001654). Refer to Appendix G.

COF confirmed that a wastewater connection is "Feasible without infrastructure upgrade by Irish Water".

4.4 Design Calculations

The foul drainage network for the proposed development has been designed in accordance with the following guidelines:

- Irish Water Code of Practice for Wastewater infrastructure and standard details
- Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Wastewater Disposal".
- Department of the Environment's recommendations for site development works for housing areas.
- BS EN 752:2008 Drain and Sewer Systems outside Buildings.
- IS EN 12056: Part 2 (2000) Gravity Drainage Systems inside Buildings

Foul drainage network design has been carried out using Microdrainage Windes Analysis Software.

Refer to Appendix E for foul drainage calculations.



Design Criteria:

Demand	446 l/dwelling/day
Discharge Units	14 units per house (BS8301)
Pipe Friction (Ks)	1.5 mm.
Minimum Velocity	0.75 m/s (self-cleansing velocity)
Maximum Velocity	3.0 m/s (1:18 maximum pipe gradient)
Frequency Factor	0.5 for domestic use.
Manhole Depths	< 5.0m

4.5 Foul Drainage – Environmental Impact

Wastewater Discharge has been calculated in accordance with the guidelines outlined in Irish Water's Code of Practice for Wastewater Infrastructure

Type of Use: Domestic

No. of Dwellings: 76

Dry Weather Flow (DWF) = 446 l/Dwelling/Day

DWF = 76×446 = 33,896 L/Day

Average Discharge (DWF) = $(33,896) / (24 \times 60 \times 60)$ = 0.392 l/s

Peak Discharge = $6 \times \text{DWF}$ = 2.352 l/s

Creche

Creche Occupancy / staff no's = 30

Per Capita Consumption = 50L (Irish Wastewater Code of Practice Appendix D)

Average Daily Demand (based on 12hr day) = $(30 \times 50) / (12 \times 60 \times 60)$ = 0.035 l/s

Post Development peak Discharge = Peak Factor x Average Daily Demand

Peak Factor = 4.5 (Irish Wastewater Code of Practice Appendix C) = 4.5×0.035 = 0.16 l/s

5 Water Supply

5.1 Existing Public Water Mains

An existing 200mm uPVC watermain and 100mm uPVC watermain runs along Station Road (adjacent to the site's northern boundary). A 150mm diameter looped watermain was installed as part of Phase 1 of the development (Planning Ref RA/180561).

See Appendix A for existing Irish water record drawings.

The existing watermain infrastructure described above is shown on DBFL Watermain Layout Drawing 230143-X-93-Z00-DTM-DR-DBFL-CE-1331 and in Figure 5-1 below.

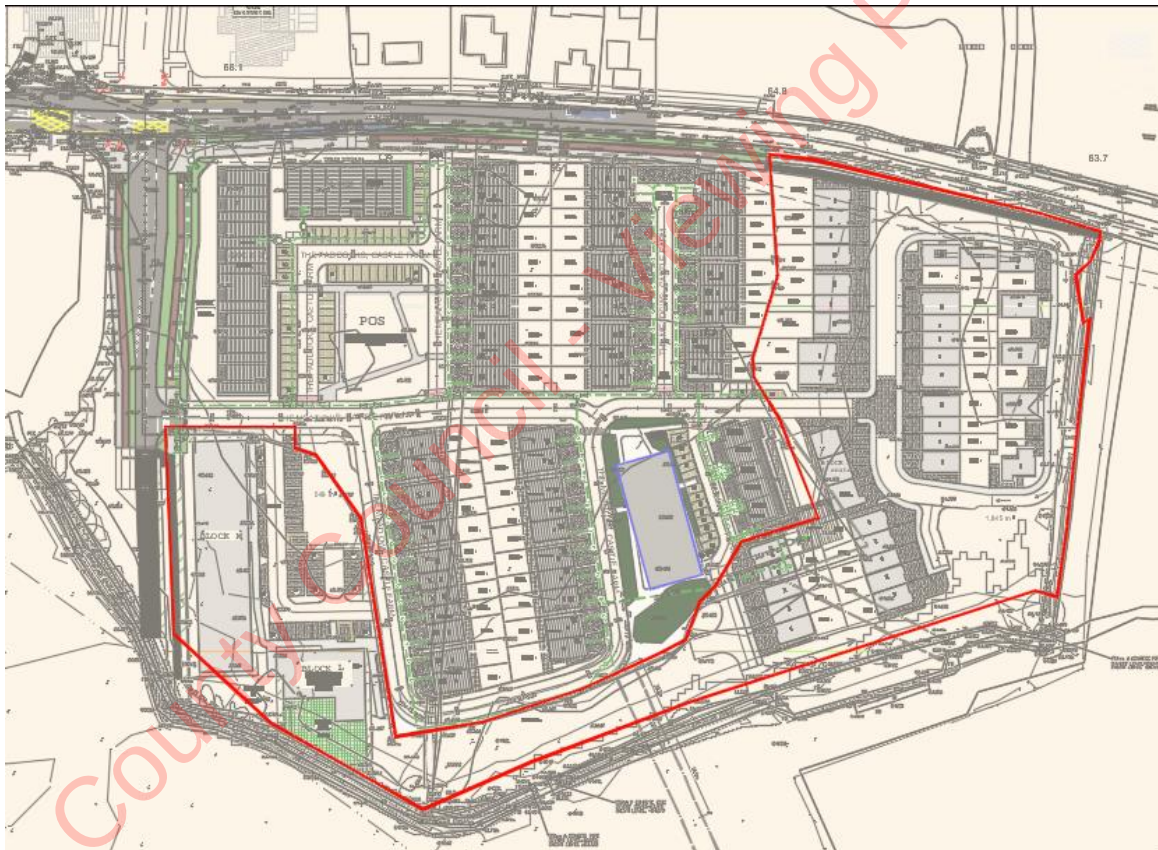


Figure 5-1 Existing Watermain Network (Indicative Site Boundary)



5.2 Proposed Water Main Layout

In order to service the proposed development, it is proposed to connect the watermain to the existing 150mm watermain network constructed as a part of Phase 1 (Planning Ref RA/180561).

Units will have individual watermain connections via service connections and boundary boxes.

The proposed watermain has been designed in accordance with the Irish water code of practice and Standard details for Water Infrastructure.

The development's proposed watermain distribution system is indicated on drawing 230143-X-93-Z00-DTM-DR-DBFL-CE-1331 Proposed Watermain Layout.

5.3 Pre-Connection Feedback from Irish Water

A Confirmation of Feasibility (COF) was received for the proposed development on the 17th of April 2024 (Ref: CDS24001654). Refer to Appendix G.

COF confirmed that a wastewater connection is "Feasible Subject to upgrades". Upgrade works required are as follows:

"Approximately 155m of existing 200mm ID watermain is required to be upsized to 400mm ID watermain"

5.4 Hydrants

The proposed water main layout is arranged such that all buildings are a maximum of 46.0m from a hydrant in accordance with the Department of the Environment's Building Regulations "Technical Guidance Document Part B Fire Safety".

Hydrants shall comply with the requirements of BS 750:2012 and shall be installed in accordance with Irish Water's Code of Practice and Standard Details.

5.5 Materials

Proposed water mains and connections are to be HDPE 100 SDR17 in accordance with Irish Water Code of Practice.



5.6 Water Demand

Water demand has been calculated in accordance with the guidelines outlined in Irish Water's Code of Practice for Water Infrastructure.

Type of Use: Domestic

Total no of Dwellings: 76

Average Usage(l/person/day): 150 litres/person/day

Average Occupancy Ratio: 2.7 person

Total Occupancy: $2.7 \times 76 = 205.2$

Average Daily Demand = Total Occupancy x Per-Capita Consumption
 $= 205.2 \times 150 = 30,780 \text{ l/day} = 0.356 \text{ l/s}$

Average Day/Week Demand factor is 1.25 as per Irish Water Code of Practice – (3.7.2)

Average Day/Peak Week Demand = Average Daily Demand X Average Day/Week Demand Factor
 $= 0.356 \times 1.25 = 0.445 \text{ l/s}$

Peak Demand Factor is 5 as per Irish Water Code of Practice – (3.7.2)

Peak Hour Water Demand = Average Day / Week Demand x Peak Demand Factor
 $= 0.445 \times 5 = 2.227 \text{ l/s}$

Creche

Creche Occupancy / Staff No's = 30

Per Capita Consumption = 50L (Irish Wastewater Code of Practice Appendix D)

Average Daily Demand (based on 12hr day) = $(30 \times 50) / (12 \times 60 \times 60) = 0.035 \text{ l/s}$

Average Day / Peak Week Demand = $0.035 \times 1.25 = 0.043 \text{ l/s}$

Peak Hour Water Demand = $0.043 \times 5 = 0.22 \text{ l/s}$



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Appendix A : Irish Water Network Plans



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DBFL Consulting Engineers
Civil, Structural & Transportation Engineering
www.dbfl.ie

DUBLIN OFFICE: Ormond House, Upper Ormond Quay, Dublin 7, D07 W704
PHONE +353 1 408 4000

CORK OFFICE: 14 South Mall, Cork, T12 CT91
PHONE +353 21 2024536

WATERFORD OFFICE: Suite 8b The Atrium, Marlana Gate, Canada Street, Waterford, X91 W028
PHONE +353 51 309 500

GALWAY OFFICE: Odeon House, 7 Eyre Square, Galway, H91 YNC8
PHONE +353 91 33 55 99

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Appendix B : Permissible Site Discharge

PROJECT

Dunboyne

SUBJECT

Surface Water Calculations - Permissible Site Discharge

Drawing ref.

230143

Calculations by

IPR

Checked by

EJD

JOB REF.

230143

Calc. Sheet No.

1

Date



PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Site Area

What is the overall site area?

0.926

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		
Area	0.926	Hectares (ha)
Drainage Group	3	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	3	Class
Slope ⁽⁶⁾	1	Class
SOIL Type	4	From FSR Table
¹ SOIL Index	0.45	

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

0.45

Site SPR Value

0.47

Post-Development Catchment Characteristics

Long-Term Storage

Is long-term Storage provided?

No

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)?

802.0

mm

From Met Eireann, Co-ordinates xxxxxxxx, xxxxxxxx

Is the overall site area less than 50 hectares?

Yes

⁵QBAR_{Rural} calculated for 50 ha and linearly interpolated for area of site

4.8

Litres/sec

⁷Site Discharge =

4.8

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_{LT} (m³) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(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 samiler 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

Dunboyne

SUBJECT

Surface Water Calculations - Permissible Site Discharge-Catchment 2

Drawing ref.

230143

Calculations by

IPR

Checked by

EJD

JOB REF.

230143

Calc. Sheet No.

1

Date

06/12/2023



PERMISSIBLE SURFACE WATER DISCHARGE CALCULATIONS

Site Area

What is the overall site area?

0.706

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		
Area	0.71	Hectares (ha)
Drainage Group	3	Class
Depth to Impermeable Layers	2	Class
Permeability Group above Impermeable Layers	3	Class
Slope ⁽⁶⁾	1	Class
SOIL Type	4	From FSR Table
¹ SOIL Index	0.45	

Site SOIL Index Value

0.45

Site SPR Value

0.47

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

Long-Term Storage

Is long-term Storage provided?

No

Permissible Site Discharge

What is the Standard Average Annual Rainfall (SAAR)?

802.0

mm

From Met Eireann, Co-ordinates xxxxxxxx, xxxxxxxx

Is the overall site area less than 50 hectares?

Yes

⁵QBAR_{Rural} calculated for 50 ha and linearly interpolated for area of site

3.6

Litres/sec

⁷Site Discharge =

3.6

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_{LT} (m³) = Rainfall.Area.10.[(PIMP/100)(0.8.α)+(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.

230143-Permissible Site Discharge-Phase 2 Catchment 2

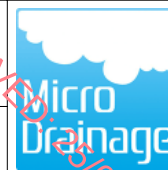


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Appendix C : Attenuation Calculations

Date 03/05/2024 10:00
File Phase 2 - Catchment 1-1...

Designed by rajavadiveluip
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Innovyze

Source Control 2020.1

Summary of Results for 5 year Return Period (+20%)

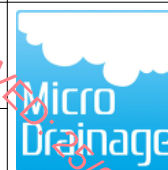
Half Drain Time : 233 minutes.

Storm Event			Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min	Summer		63.676	0.346	0.0	4.8	4.8	56.0	OK
30 min	Summer		63.735	0.405	0.0	4.8	4.8	74.8	OK
60 min	Summer		63.796	0.466	0.0	4.8	4.8	94.5	OK
120 min	Summer		63.853	0.523	0.0	4.8	4.8	112.8	OK
180 min	Summer		63.879	0.549	0.0	4.8	4.8	121.1	OK
240 min	Summer		63.892	0.562	0.0	4.8	4.8	125.3	OK
360 min	Summer		63.906	0.576	0.0	4.8	4.8	129.7	OK
480 min	Summer		63.910	0.580	0.0	4.8	4.8	131.2	OK
600 min	Summer		63.911	0.581	0.0	4.8	4.8	131.2	OK
720 min	Summer		63.908	0.578	0.0	4.8	4.8	130.4	OK
960 min	Summer		63.898	0.568	0.0	4.8	4.8	127.1	OK
1440 min	Summer		63.869	0.539	0.0	4.8	4.8	117.8	OK
2160 min	Summer		63.818	0.488	0.0	4.8	4.8	101.6	OK
2880 min	Summer		63.768	0.438	0.0	4.8	4.8	85.6	OK
4320 min	Summer		63.686	0.356	0.0	4.8	4.8	59.0	OK
5760 min	Summer		63.627	0.297	0.0	4.7	4.7	40.8	OK
7200 min	Summer		63.548	0.218	0.0	4.5	4.5	29.9	OK
8640 min	Summer		63.498	0.168	0.0	4.2	4.2	23.0	OK
10080 min	Summer		63.468	0.138	0.0	4.0	4.0	18.9	OK
15 min	Winter		63.676	0.346	0.0	4.8	4.8	56.0	OK

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	41.811	0.0	59.6	21
30 min Summer	28.524	0.0	81.4	35
60 min Summer	18.805	0.0	107.7	64
120 min Summer	12.158	0.0	139.3	122
180 min Summer	9.371	0.0	161.1	180
240 min Summer	7.779	0.0	178.3	216
360 min Summer	5.974	0.0	205.4	282
480 min Summer	4.950	0.0	226.9	350
600 min Summer	4.277	0.0	245.1	420
720 min Summer	3.794	0.0	261.0	490
960 min Summer	3.141	0.0	288.0	628
1440 min Summer	2.406	0.0	330.9	902
2160 min Summer	1.842	0.0	380.3	1300
2880 min Summer	1.524	0.0	419.4	1676
4320 min Summer	1.166	0.0	481.4	2380
5760 min Summer	0.964	0.0	531.2	3064
7200 min Summer	0.832	0.0	573.0	3752
8640 min Summer	0.738	0.0	609.6	4416
10080 min Summer	0.667	0.0	642.2	5144
15 min Winter	41.811	0.0	59.6	21

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Source Control 2020.1

Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (L/s)	Max Control (L/s)	Max Outflow (L/s)	Max Volume (m³)	Status
30 min Winter	63.735	0.405	0.0	4.8	4.8	74.9	OK
60 min Winter	63.796	0.466	0.0	4.8	4.8	94.6	OK
120 min Winter	63.854	0.524	0.0	4.8	4.8	113.2	OK
180 min Winter	63.881	0.551	0.0	4.8	4.8	121.7	OK
240 min Winter	63.894	0.564	0.0	4.8	4.8	125.9	OK
360 min Winter	63.903	0.573	0.0	4.8	4.8	128.7	OK
480 min Winter	63.903	0.573	0.0	4.8	4.8	128.9	OK
600 min Winter	63.898	0.568	0.0	4.8	4.8	127.1	OK
720 min Winter	63.889	0.559	0.0	4.8	4.8	124.2	OK
960 min Winter	63.864	0.534	0.0	4.8	4.8	116.4	OK
1440 min Winter	63.808	0.478	0.0	4.8	4.8	98.2	OK
2160 min Winter	63.725	0.395	0.0	4.8	4.8	71.5	OK
2880 min Winter	63.657	0.327	0.0	4.8	4.8	49.8	OK
4320 min Winter	63.519	0.189	0.0	4.4	4.4	25.9	OK
5760 min Winter	63.452	0.122	0.0	3.8	3.8	16.6	OK
7200 min Winter	63.434	0.104	0.0	3.3	3.3	14.2	OK
8640 min Winter	63.423	0.093	0.0	3.0	3.0	12.6	OK
10080 min Winter	63.415	0.085	0.0	2.7	2.7	11.5	OK

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	28.524	0.0	81.4	35
60 min Winter	18.805	0.0	107.7	62
120 min Winter	12.158	0.0	139.3	120
180 min Winter	9.371	0.0	161.1	176
240 min Winter	7.779	0.0	178.3	228
360 min Winter	5.974	0.0	205.4	290
480 min Winter	4.950	0.0	226.9	368
600 min Winter	4.277	0.0	245.1	446
720 min Winter	3.794	0.0	261.0	522
960 min Winter	3.141	0.0	288.0	672
1440 min Winter	2.406	0.0	330.9	954
2160 min Winter	1.842	0.0	380.3	1344
2880 min Winter	1.524	0.0	419.4	1700
4320 min Winter	1.166	0.0	481.4	2336
5760 min Winter	0.964	0.0	531.2	2944
7200 min Winter	0.832	0.0	573.0	3672
8640 min Winter	0.738	0.0	609.6	4400
10080 min Winter	0.667	0.0	642.2	5136

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Ormond House Upper Ormond Quay Dublin 7		
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	5	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.271	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.574

Time (mins)		Area	Time (mins)		Area
From:	To:	(ha)	From:	To:	(ha)
0	4	0.331	4	8	0.243

Time Area Diagram

Total Area (ha) 0.000

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

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Date 03/05/2024 10:00 File Phase 2 - Catchment 1-1...	Designed by rajavadiveluip Checked by	
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Model Details

Storage is Online Cover Level (m) 64.890

Complex Structure

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	204.5	204.5	1.061	204.5	204.5
0.300	204.5	204.5	1.360	204.5	204.5
0.301	0.0	204.5	1.361	0.0	204.5
1.060	0.0	204.5			

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	0.0	204.5	1.060	204.5	204.5
0.300	0.0	204.5	1.061	0.0	204.5
0.301	204.5	204.5	1.360	0.0	204.5

Pipe

Diameter (m) 0.600 Length (m) 6.084
Slope (1:X) 600.000 Invert Level (m) 63.330

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	129.5	129.5	1.061	129.5	129.5
0.300	129.5	129.5	1.360	129.5	129.5
0.301	0.0	129.5	1.361	0.0	129.5
1.060	0.0	129.5			

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DBFL Consulting Engineers		Page 5
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 10:00 File Phase 2 - Catchment 1-1...	Designed by rajavadiveluip Checked by	
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Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	0.0	129.5	1.061	0.0	129.5
0.300	0.0	129.5	1.360	0.0	129.5
0.301	129.5	129.5	1.361	0.0	129.5
1.060	129.5	129.5			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0098-4800-1360-4800
 Design Head (m) 1.360
 Design Flow (l/s) 4.8
 Flush-Flo™ Calculated
 Objective Minimise upstream storage
 Application Surface
 Sump Available Yes
 Diameter (mm) 98
 Invert Level (m) 63.330
 Minimum Outlet Pipe Diameter (mm) 150
 Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.360	4.8
Flush-Flo™	0.406	4.8
Kick-Flo®	0.834	3.8
Mean Flow over Head Range	-	4.2

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)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.4
0.200	4.4	1.400	4.9	3.500	7.5	7.500	10.7
0.300	4.7	1.600	5.2	4.000	8.0	8.000	11.1
0.400	4.8	1.800	5.5	4.500	8.4	8.500	11.4
0.500	4.8	2.000	5.7	5.000	8.8	9.000	11.7
0.600	4.6	2.200	6.0	5.500	9.3	9.500	12.0
0.800	4.0	2.400	6.3	6.000	9.6		
1.000	4.2	2.600	6.5	6.500	10.0		

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Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	42.340	0.0	121.0	36
60 min Winter	27.845	0.0	159.5	64
120 min Winter	17.804	0.0	204.1	122
180 min Winter	13.608	0.0	234.0	180
240 min Winter	11.222	0.0	257.3	236
360 min Winter	8.532	0.0	293.4	350
480 min Winter	7.017	0.0	321.7	460
600 min Winter	6.026	0.0	345.4	562
720 min Winter	5.320	0.0	365.9	596
960 min Winter	4.368	0.0	400.6	740
1440 min Winter	3.307	0.0	454.9	1038
2160 min Winter	2.504	0.0	517.0	1452
2880 min Winter	2.054	0.0	565.4	1848
4320 min Winter	1.552	0.0	640.8	2552
5760 min Winter	1.272	0.0	700.3	3168
7200 min Winter	1.089	0.0	749.8	3816
8640 min Winter	0.960	0.0	792.7	4408
10080 min Winter	0.862	0.0	830.7	5136

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	42.340	0.0	121.0	36
60 min Winter	27.845	0.0	159.5	64
120 min Winter	17.804	0.0	204.1	122
180 min Winter	13.608	0.0	234.0	180
240 min Winter	11.222	0.0	257.3	236
360 min Winter	8.532	0.0	293.4	350
480 min Winter	7.017	0.0	321.7	460
600 min Winter	6.026	0.0	345.4	562
720 min Winter	5.320	0.0	365.9	596
960 min Winter	4.368	0.0	400.6	740
1440 min Winter	3.307	0.0	454.9	1038
2160 min Winter	2.504	0.0	517.0	1452
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DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:59 File Phase 2 - Catchment 1-1...	Designed by rajavadiveluip Checked by	
Innovyze	Source Control 2020.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.271	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.574

Time (mins)		Area	Time (mins)		Area
From:	To:	(ha)	From:	To:	(ha)
0	4	0.331	4	8	0.243

Time Area Diagram

Total Area (ha) 0.000

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

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DBFL Consulting Engineers		Page 4
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:59 File Phase 2 - Catchment 1-1...	Designed by rajavadiveluip Checked by	
Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 64.890

Complex Structure

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	204.5	204.5	1.061	204.5	204.5
0.300	204.5	204.5	1.360	204.5	204.5
0.301	0.0	204.5	1.361	0.0	204.5
1.060	0.0	204.5			

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	0.0	204.5	1.060	204.5	204.5
0.300	0.0	204.5	1.061	0.0	204.5
0.301	204.5	204.5	1.360	0.0	204.5

Pipe

Diameter (m) 0.600 Length (m) 6.084
Slope (1:X) 600.000 Invert Level (m) 63.330

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

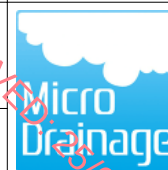
Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	129.5	129.5	1.061	129.5	129.5
0.300	129.5	129.5	1.360	129.5	129.5
0.301	0.0	129.5	1.361	0.0	129.5
1.060	0.0	129.5			

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DBFL Consulting Engineers			Page 5																																																																																																																							
Ormond House Upper Ormond Quay Dublin 7		RECEIVED 03/06/2024 Micro Drainage																																																																																																																								
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Cellular Storage Invert Level (m) 63.330 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>0.0</td><td>129.5</td><td>1.061</td><td>0.0</td><td>129.5</td></tr><tr><td>0.300</td><td>0.0</td><td>129.5</td><td>1.360</td><td>0.0</td><td>129.5</td></tr><tr><td>0.301</td><td>129.5</td><td>129.5</td><td>1.361</td><td>0.0</td><td>129.5</td></tr><tr><td>1.060</td><td>129.5</td><td>129.5</td><td></td><td></td><td></td></tr></table> Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0098-4800-1360-4800 Design Head (m) 1.360 Design Flow (l/s) 4.8 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 98 Invert Level (m) 63.330 Minimum Outlet Pipe Diameter (mm) 150 Suggested Manhole Diameter (mm) 1200 <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.360</td><td>4.8</td></tr><tr><td>Flush-Flo™</td><td>0.406</td><td>4.8</td></tr><tr><td>Kick-Flo®</td><td>0.834</td><td>3.8</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>4.2</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>3.2</td><td>1.200</td><td>4.5</td><td>3.000</td><td>6.9</td><td>7.000</td><td>10.4</td></tr><tr><td>0.200</td><td>4.4</td><td>1.400</td><td>4.9</td><td>3.500</td><td>7.5</td><td>7.500</td><td>10.7</td></tr><tr><td>0.300</td><td>4.7</td><td>1.600</td><td>5.2</td><td>4.000</td><td>8.0</td><td>8.000</td><td>11.1</td></tr><tr><td>0.400</td><td>4.8</td><td>1.800</td><td>5.5</td><td>4.500</td><td>8.4</td><td>8.500</td><td>11.4</td></tr><tr><td>0.500</td><td>4.8</td><td>2.000</td><td>5.7</td><td>5.000</td><td>8.8</td><td>9.000</td><td>11.7</td></tr><tr><td>0.600</td><td>4.6</td><td>2.200</td><td>6.0</td><td>5.500</td><td>9.3</td><td>9.500</td><td>12.0</td></tr><tr><td>0.800</td><td>4.0</td><td>2.400</td><td>6.3</td><td>6.000</td><td>9.6</td><td></td><td></td></tr><tr><td>1.000</td><td>4.2</td><td>2.600</td><td>6.5</td><td>6.500</td><td>10.0</td><td></td><td></td></tr></table>						Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	0.0	129.5	1.061	0.0	129.5	0.300	0.0	129.5	1.360	0.0	129.5	0.301	129.5	129.5	1.361	0.0	129.5	1.060	129.5	129.5				Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.360	4.8	Flush-Flo™	0.406	4.8	Kick-Flo®	0.834	3.8	Mean Flow over Head Range	-	4.2	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.4	0.200	4.4	1.400	4.9	3.500	7.5	7.500	10.7	0.300	4.7	1.600	5.2	4.000	8.0	8.000	11.1	0.400	4.8	1.800	5.5	4.500	8.4	8.500	11.4	0.500	4.8	2.000	5.7	5.000	8.8	9.000	11.7	0.600	4.6	2.200	6.0	5.500	9.3	9.500	12.0	0.800	4.0	2.400	6.3	6.000	9.6			1.000	4.2	2.600	6.5	6.500	10.0		
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																																																																					
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Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	55.208	0.0	157.8	36
60 min Winter	36.249	0.0	207.7	64
120 min Winter	23.005	0.0	263.7	122
180 min Winter	17.485	0.0	300.7	180
240 min Winter	14.355	0.0	329.1	238
360 min Winter	10.841	0.0	372.8	352
480 min Winter	8.870	0.0	406.8	462
600 min Winter	7.587	0.0	434.9	570
720 min Winter	6.675	0.0	459.1	668
960 min Winter	5.452	0.0	499.9	760
1440 min Winter	4.096	0.0	563.1	1074
2160 min Winter	3.077	0.0	635.5	1540
2880 min Winter	2.510	0.0	691.1	1996
4320 min Winter	1.881	0.0	776.6	2724
5760 min Winter	1.531	0.0	843.3	3400
7200 min Winter	1.305	0.0	898.3	3968
8640 min Winter	1.145	0.0	945.7	4584
10080 min Winter	1.025	0.0	987.6	5240

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	55.208	0.0	157.8	36
60 min Winter	36.249	0.0	207.7	64
120 min Winter	23.005	0.0	263.7	122
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960 min Winter	5.452	0.0	499.9	760
1440 min Winter	4.096	0.0	563.1	1074
2160 min Winter	3.077	0.0	635.5	1540
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4320 min Winter	1.881	0.0	776.6	2724
5760 min Winter	1.531	0.0	843.3	3400
7200 min Winter	1.305	0.0	898.3	3968
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10080 min Winter	1.025	0.0	987.6	5240

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:59 File Phase 2 - Catchment 1-1...	Designed by rajavadiveluip Checked by	
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.271	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.574

Time (mins)		Area	Time (mins)		Area
From:	To:	(ha)	From:	To:	(ha)
0	4	0.331	4	8	0.243

Time Area Diagram

Total Area (ha) 0.000

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

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DBFL Consulting Engineers		Page 4
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:59 File Phase 2 - Catchment 1-1...	Designed by rajavadiveluip Checked by	
Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 64.890

Complex Structure

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	204.5	204.5	1.061	204.5	204.5
0.300	204.5	204.5	1.360	204.5	204.5
0.301	0.0	204.5	1.361	0.0	204.5
1.060	0.0	204.5			

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	0.0	204.5	1.060	204.5	204.5
0.300	0.0	204.5	1.061	0.0	204.5
0.301	204.5	204.5	1.360	0.0	204.5

Pipe

Diameter (m) 0.600 Length (m) 6.084
Slope (1:X) 600.000 Invert Level (m) 63.330

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	129.5	129.5	1.061	129.5	129.5
0.300	129.5	129.5	1.360	129.5	129.5
0.301	0.0	129.5	1.361	0.0	129.5
1.060	0.0	129.5			

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DBFL Consulting Engineers			Page 5																																																																																																																							
Ormond House Upper Ormond Quay Dublin 7		RECEIVED 03/06/2024 Micro Drainage																																																																																																																								
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Cellular Storage Invert Level (m) 63.330 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><thead><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr></thead><tbody><tr><td>0.000</td><td>0.0</td><td>129.5</td><td>1.061</td><td>0.0</td><td>129.5</td></tr><tr><td>0.300</td><td>0.0</td><td>129.5</td><td>1.360</td><td>0.0</td><td>129.5</td></tr><tr><td>0.301</td><td>129.5</td><td>129.5</td><td>1.361</td><td>0.0</td><td>129.5</td></tr><tr><td>1.060</td><td>129.5</td><td>129.5</td><td></td><td></td><td></td></tr></tbody></table> Hydro-Brake® Optimum Outflow Control Unit Reference MD-SHE-0098-4800-1360-4800 Design Head (m) 1.360 Design Flow (l/s) 4.8 Flush-Flo™ Calculated Objective Minimise upstream storage Application Surface Sump Available Yes Diameter (mm) 98 Invert Level (m) 63.330 Minimum Outlet Pipe Diameter (mm) 150 Suggested Manhole Diameter (mm) 1200 <table><thead><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>Design Point (Calculated)</td><td>1.360</td><td>4.8</td></tr><tr><td>Flush-Flo™</td><td>0.406</td><td>4.8</td></tr><tr><td>Kick-Flo®</td><td>0.834</td><td>3.8</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>4.2</td></tr></tbody></table> 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 <table><thead><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr></thead><tbody><tr><td>0.100</td><td>3.2</td><td>1.200</td><td>4.5</td><td>3.000</td><td>6.9</td><td>7.000</td><td>10.4</td></tr><tr><td>0.200</td><td>4.4</td><td>1.400</td><td>4.9</td><td>3.500</td><td>7.5</td><td>7.500</td><td>10.7</td></tr><tr><td>0.300</td><td>4.7</td><td>1.600</td><td>5.2</td><td>4.000</td><td>8.0</td><td>8.000</td><td>11.1</td></tr><tr><td>0.400</td><td>4.8</td><td>1.800</td><td>5.5</td><td>4.500</td><td>8.4</td><td>8.500</td><td>11.4</td></tr><tr><td>0.500</td><td>4.8</td><td>2.000</td><td>5.7</td><td>5.000</td><td>8.8</td><td>9.000</td><td>11.7</td></tr><tr><td>0.600</td><td>4.6</td><td>2.200</td><td>6.0</td><td>5.500</td><td>9.3</td><td>9.500</td><td>12.0</td></tr><tr><td>0.800</td><td>4.0</td><td>2.400</td><td>6.3</td><td>6.000</td><td>9.6</td><td></td><td></td></tr><tr><td>1.000</td><td>4.2</td><td>2.600</td><td>6.5</td><td>6.500</td><td>10.0</td><td></td><td></td></tr></tbody></table>						Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	0.0	129.5	1.061	0.0	129.5	0.300	0.0	129.5	1.360	0.0	129.5	0.301	129.5	129.5	1.361	0.0	129.5	1.060	129.5	129.5				Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.360	4.8	Flush-Flo™	0.406	4.8	Kick-Flo®	0.834	3.8	Mean Flow over Head Range	-	4.2	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.4	0.200	4.4	1.400	4.9	3.500	7.5	7.500	10.7	0.300	4.7	1.600	5.2	4.000	8.0	8.000	11.1	0.400	4.8	1.800	5.5	4.500	8.4	8.500	11.4	0.500	4.8	2.000	5.7	5.000	8.8	9.000	11.7	0.600	4.6	2.200	6.0	5.500	9.3	9.500	12.0	0.800	4.0	2.400	6.3	6.000	9.6			1.000	4.2	2.600	6.5	6.500	10.0		
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																																																																					
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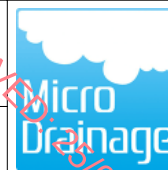
Half Drain Time : 234 minutes.

Storm Event			Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
15 min	Summer	63.472	0.230	0.0	3.5	3.5	42.1	OK	
30 min	Summer	63.520	0.278	0.0	3.6	3.6	56.3	OK	
60 min	Summer	63.571	0.329	0.0	3.6	3.6	71.1	OK	
120 min	Summer	63.617	0.375	0.0	3.6	3.6	84.8	OK	
180 min	Summer	63.639	0.397	0.0	3.6	3.6	91.1	OK	
240 min	Summer	63.650	0.408	0.0	3.6	3.6	94.3	OK	
360 min	Summer	63.661	0.419	0.0	3.6	3.6	97.6	OK	
480 min	Summer	63.665	0.423	0.0	3.6	3.6	98.8	OK	
600 min	Summer	63.665	0.423	0.0	3.6	3.6	98.9	OK	
720 min	Summer	63.663	0.421	0.0	3.6	3.6	98.2	OK	
960 min	Summer	63.655	0.413	0.0	3.6	3.6	95.9	OK	
1440 min	Summer	63.631	0.389	0.0	3.6	3.6	88.9	OK	
2160 min	Summer	63.590	0.348	0.0	3.6	3.6	76.9	OK	
2880 min	Summer	63.550	0.308	0.0	3.6	3.6	65.0	OK	
4320 min	Summer	63.483	0.241	0.0	3.6	3.6	45.3	OK	
5760 min	Summer	63.436	0.194	0.0	3.5	3.5	31.4	OK	
7200 min	Summer	63.405	0.163	0.0	3.3	3.3	22.4	OK	
8640 min	Summer	63.380	0.138	0.0	3.2	3.2	17.1	OK	
10080 min	Summer	63.356	0.114	0.0	3.1	3.1	14.2	OK	
15 min	Winter	63.472	0.230	0.0	3.5	3.5	42.1	OK	

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	41.811	0.0	44.7	21
30 min Summer	28.524	0.0	61.1	36
60 min Summer	18.805	0.0	80.8	64
120 min Summer	12.158	0.0	104.6	122
180 min Summer	9.371	0.0	120.9	180
240 min Summer	7.779	0.0	133.9	214
360 min Summer	5.974	0.0	154.2	282
480 min Summer	4.950	0.0	170.4	350
600 min Summer	4.277	0.0	184.0	420
720 min Summer	3.794	0.0	195.9	490
960 min Summer	3.141	0.0	216.2	628
1440 min Summer	2.406	0.0	248.4	900
2160 min Summer	1.842	0.0	285.5	1300
2880 min Summer	1.524	0.0	314.9	1676
4320 min Summer	1.166	0.0	361.4	2384
5760 min Summer	0.964	0.0	398.9	3104
7200 min Summer	0.832	0.0	430.3	3752
8640 min Summer	0.738	0.0	457.7	4416
10080 min Summer	0.667	0.0	482.2	5144
15 min Winter	41.811	0.0	44.7	21

Date 03/05/2024 09:44
File Phase 2 - Catchment 2-0...

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Summary of Results for 5 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (L/s)	Max Control (L/s)	Max Outflow (L/s)	Max Volume (m³)	Status
30 min Winter	63.521	0.279	0.0	3.6	3.6	56.3	OK
60 min Winter	63.571	0.329	0.0	3.6	3.6	71.1	OK
120 min Winter	63.618	0.376	0.0	3.6	3.6	85.1	OK
180 min Winter	63.640	0.398	0.0	3.6	3.6	91.6	OK
240 min Winter	63.651	0.409	0.0	3.6	3.6	94.7	OK
360 min Winter	63.659	0.417	0.0	3.6	3.6	97.0	OK
480 min Winter	63.659	0.417	0.0	3.6	3.6	97.2	OK
600 min Winter	63.655	0.413	0.0	3.6	3.6	95.9	OK
720 min Winter	63.647	0.405	0.0	3.6	3.6	93.7	OK
960 min Winter	63.628	0.386	0.0	3.6	3.6	87.9	OK
1440 min Winter	63.582	0.340	0.0	3.6	3.6	74.4	OK
2160 min Winter	63.515	0.273	0.0	3.6	3.6	54.8	OK
2880 min Winter	63.461	0.219	0.0	3.5	3.5	38.7	OK
4320 min Winter	63.393	0.151	0.0	3.3	3.3	18.9	OK
5760 min Winter	63.347	0.105	0.0	2.9	2.9	13.1	OK
7200 min Winter	63.332	0.090	0.0	2.5	2.5	11.2	OK
8640 min Winter	63.323	0.081	0.0	2.2	2.2	10.0	OK
10080 min Winter	63.316	0.074	0.0	2.0	2.0	9.2	OK

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	28.524	0.0	61.1	35
60 min Winter	18.805	0.0	80.8	64
120 min Winter	12.158	0.0	104.6	120
180 min Winter	9.371	0.0	120.9	176
240 min Winter	7.779	0.0	133.9	228
360 min Winter	5.974	0.0	154.2	288
480 min Winter	4.950	0.0	170.4	368
600 min Winter	4.277	0.0	184.0	446
720 min Winter	3.794	0.0	195.9	522
960 min Winter	3.141	0.0	216.3	672
1440 min Winter	2.406	0.0	248.4	954
2160 min Winter	1.842	0.0	285.5	1344
2880 min Winter	1.524	0.0	314.9	1704
4320 min Winter	1.166	0.0	361.4	2336
5760 min Winter	0.964	0.0	398.9	2944
7200 min Winter	0.832	0.0	430.3	3672
8640 min Winter	0.738	0.0	457.7	4408
10080 min Winter	0.667	0.0	482.2	5136

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:44 File Phase 2 - Catchment 2-0...	Designed by rajavadiveluip Checked by	
Innovyze	Source Control 2020.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	5	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.271	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.431

Time (mins)		Area	Time (mins)		Area
From:	To:	(ha)	From:	To:	(ha)
0	4	0.212	4	8	0.219

Time Area Diagram

Total Area (ha) 0.000

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

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DBFL Consulting Engineers		Page 4
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:44 File Phase 2 - Catchment 2-0...	Designed by rajavadiveluip Checked by	
Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 64.752

Complex Structure

Cellular Storage

Invert Level (m) 63.242 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	310.0	310.0	0.911	310.0	310.0
0.150	310.0	310.0	1.060	310.0	310.0
0.151	0.0	310.0	1.061	0.0	310.0
0.910	0.0	310.0			

Cellular Storage

Invert Level (m) 63.242 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	0.0	310.0	0.910	310.0	310.0
0.150	0.0	310.0	0.911	0.0	310.0
0.151	310.0	310.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0089-3600-1060-3600
Design Head (m) 1.060
Design Flow (l/s) 3.6
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 89
Invert Level (m) 63.242
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.060	3.6
Flush-Flo™	0.316	3.6
Kick-Flo®	0.663	2.9
Mean Flow over Head Range	-	3.1

The hydrological calculations have been based on the Head/Discharge relationship for the

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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)
0.100	2.8	1.200	3.8	3.000	5.8	7.000	8.7
0.200	3.5	1.400	4.1	3.500	6.3	7.500	9.0
0.300	3.6	1.600	4.4	4.000	6.7	8.000	9.3
0.400	3.6	1.800	4.6	4.500	7.1	8.500	9.5
0.500	3.5	2.000	4.8	5.000	7.4	9.000	9.8
0.600	3.2	2.200	5.0	5.500	7.8	9.500	10.1
0.800	3.2	2.400	5.3	6.000	8.1		
1.000	3.5	2.600	5.5	6.500	8.4		

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Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	42.340	0.0	90.8	36
60 min Winter	27.845	0.0	119.8	64
120 min Winter	17.804	0.0	153.2	122
180 min Winter	13.608	0.0	175.7	180
240 min Winter	11.222	0.0	193.2	236
360 min Winter	8.532	0.0	220.3	350
480 min Winter	7.017	0.0	241.6	458
600 min Winter	6.026	0.0	259.3	554
720 min Winter	5.320	0.0	274.7	578
960 min Winter	4.368	0.0	300.8	730
1440 min Winter	3.307	0.0	341.5	1028
2160 min Winter	2.504	0.0	388.2	1452
2880 min Winter	2.054	0.0	424.6	1844
4320 min Winter	1.552	0.0	481.2	2552
5760 min Winter	1.272	0.0	525.9	3176
7200 min Winter	1.089	0.0	563.0	3752
8640 min Winter	0.960	0.0	595.2	4408
10080 min Winter	0.862	0.0	623.8	5128

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	42.340	0.0	90.8	36
60 min Winter	27.845	0.0	119.8	64
120 min Winter	17.804	0.0	153.2	122
180 min Winter	13.608	0.0	175.7	180
240 min Winter	11.222	0.0	193.2	236
360 min Winter	8.532	0.0	220.3	350
480 min Winter	7.017	0.0	241.6	458
600 min Winter	6.026	0.0	259.3	554
720 min Winter	5.320	0.0	274.7	578
960 min Winter	4.368	0.0	300.8	730
1440 min Winter	3.307	0.0	341.5	1028
2160 min Winter	2.504	0.0	388.2	1452
2880 min Winter	2.054	0.0	424.6	1844
4320 min Winter	1.552	0.0	481.2	2552
5760 min Winter	1.272	0.0	525.9	3176
7200 min Winter	1.089	0.0	563.0	3752
8640 min Winter	0.960	0.0	595.2	4408
10080 min Winter	0.862	0.0	623.8	5128

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:43 File Phase 2 - Catchment 2-0...	Designed by rajavadiveluip Checked by	
Innovyze	Source Control 2020.1	

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.271	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.431

Time (mins)		Area	Time (mins)		Area
From:	To:	(ha)	From:	To:	(ha)
0	4	0.212	4	8	0.219

Time Area Diagram

Total Area (ha) 0.000

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

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DBFL Consulting Engineers		Page 4
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:43 File Phase 2 - Catchment 2-0...	Designed by rajavadiveluip Checked by	
Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 64.752

Complex Structure

Cellular Storage

Invert Level (m) 63.242 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	310.0	310.0	0.911	310.0	310.0
0.150	310.0	310.0	1.060	310.0	310.0
0.151	0.0	310.0	1.061	0.0	310.0
0.910	0.0	310.0			

Cellular Storage

Invert Level (m) 63.242 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	0.0	310.0	0.910	310.0	310.0
0.150	0.0	310.0	0.911	0.0	310.0
0.151	310.0	310.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0089-3600-1060-3600
Design Head (m) 1.060
Design Flow (l/s) 3.6
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 89
Invert Level (m) 63.242
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.060	3.6
Flush-Flo™	0.316	3.6
Kick-Flo®	0.663	2.9
Mean Flow over Head Range	-	3.1

The hydrological calculations have been based on the Head/Discharge relationship for the

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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)
0.100	2.8	1.200	3.8	3.000	5.8	7.000	8.7
0.200	3.5	1.400	4.1	3.500	6.3	7.500	9.0
0.300	3.6	1.600	4.4	4.000	6.7	8.000	9.3
0.400	3.6	1.800	4.6	4.500	7.1	8.500	9.5
0.500	3.5	2.000	4.8	5.000	7.4	9.000	9.8
0.600	3.2	2.200	5.0	5.500	7.8	9.500	10.1
0.800	3.2	2.400	5.3	6.000	8.1		
1.000	3.5	2.600	5.5	6.500	8.4		

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Source Control 2020.1

[illegible]

Storm Event	Rain (mm/hr)	Flooded Volume (m ³)	Discharge Volume (m ³)	Time-Peak (mins)
30 min Winter	55.208	0.0	118.4	36
60 min Winter	36.249	0.0	156.0	66
120 min Winter	23.005	0.0	198.0	124
180 min Winter	17.485	0.0	225.7	180
240 min Winter	14.355	0.0	247.1	238
360 min Winter	10.841	0.0	279.9	352
480 min Winter	8.870	0.0	305.4	464
600 min Winter	7.587	0.0	326.5	572
720 min Winter	6.675	0.0	344.7	672
960 min Winter	5.452	0.0	375.3	764
1440 min Winter	4.096	0.0	422.8	1082
2160 min Winter	3.077	0.0	477.2	1544
2880 min Winter	2.510	0.0	518.9	1964
4320 min Winter	1.881	0.0	583.1	2720
5760 min Winter	1.531	0.0	633.3	3400
7200 min Winter	1.305	0.0	674.6	4032
8640 min Winter	1.145	0.0	710.1	4584
10080 min Winter	1.025	0.0	741.6	5152

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	55.208	0.0	118.4	36
60 min Winter	36.249	0.0	156.0	66
120 min Winter	23.005	0.0	198.0	124
180 min Winter	17.485	0.0	225.7	180
240 min Winter	14.355	0.0	247.1	238
360 min Winter	10.841	0.0	279.9	352
480 min Winter	8.870	0.0	305.4	464
600 min Winter	7.587	0.0	326.5	572
720 min Winter	6.675	0.0	344.7	672
960 min Winter	5.452	0.0	375.3	764
1440 min Winter	4.096	0.0	422.8	1082
2160 min Winter	3.077	0.0	477.2	1544
2880 min Winter	2.510	0.0	518.9	1964
4320 min Winter	1.881	0.0	583.1	2720
5760 min Winter	1.531	0.0	633.3	3400
7200 min Winter	1.305	0.0	674.6	4032
8640 min Winter	1.145	0.0	710.1	4584
10080 min Winter	1.025	0.0	741.6	5152

DBFL Consulting Engineers		Page 3
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:43 File Phase 2 - Catchment 2-0...	Designed by rajavadiveluip Checked by	
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Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	15.300	Shortest Storm (mins)	15
Ratio R	0.271	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.431

Time (mins)		Area	Time (mins)		Area
From:	To:	(ha)	From:	To:	(ha)
0	4	0.212	4	8	0.219

Time Area Diagram

Total Area (ha) 0.000

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

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DBFL Consulting Engineers		Page 4
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 09:43 File Phase 2 - Catchment 2-0...	Designed by rajavadiveluip Checked by	
Innovyze	Source Control 2020.1	

Model Details

Storage is Online Cover Level (m) 64.752

Complex Structure

Cellular Storage

Invert Level (m) 63.242 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	310.0	310.0	0.911	310.0	310.0
0.150	310.0	310.0	1.060	310.0	310.0
0.151	0.0	310.0	1.061	0.0	310.0
0.910	0.0	310.0			

Cellular Storage

Invert Level (m) 63.242 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	0.0	310.0	0.910	310.0	310.0
0.150	0.0	310.0	0.911	0.0	310.0
0.151	310.0	310.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference MD-SHE-0089-3600-1060-3600
Design Head (m) 1.060
Design Flow (l/s) 3.6
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 89
Invert Level (m) 63.242
Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.060	3.6
Flush-Flo™	0.316	3.6
Kick-Flo®	0.663	2.9
Mean Flow over Head Range	-	3.1

The hydrological calculations have been based on the Head/Discharge relationship for the

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Source Control 2020.1

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)
0.100	2.8	1.200	3.8	3.000	5.8	7.000	8.7
0.200	3.5	1.400	4.1	3.500	6.3	7.500	9.0
0.300	3.6	1.600	4.4	4.000	6.7	8.000	9.3
0.400	3.6	1.800	4.6	4.500	7.1	8.500	9.5
0.500	3.5	2.000	4.8	5.000	7.4	9.000	9.8
0.600	3.2	2.200	5.0	5.500	7.8	9.500	10.1
0.800	3.2	2.400	5.3	6.000	8.1		
1.000	3.5	2.600	5.5	6.500	8.4		



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Appendix D : Surface Water Drainage Calculation

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 10:02	Designed by rajavadiveluip	
File 230143-Network Model Fo...	Checked by	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for SW_1

Pipe Sizes STANDARD Manhole Sizes STANDARD			
FSR Rainfall Model - Scotland and Ireland			
Return Period (years)	100	PIMP (%)	100
M5-60 (mm)	15.300	Add Flow / Climate Change (%)	20
Ratio R	0.271	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	1.000	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for SW_1

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	26.742	0.201	133.0	0.072	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	31.857	0.118	270.0	0.128	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	19.570	0.120	163.1	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	19.160	0.081	236.5	0.052	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.003	8.191	0.043	190.5	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.004	6.611	0.032	206.6	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	9.014	0.045	200.3	0.099	4.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	9.910	0.068	145.7	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	4.39	64.214	0.072	0.0	0.0	2.6	1.13	45.0	15.5
1.001	50.00	4.95	63.938	0.200	0.0	0.0	7.2	0.95	67.3	43.3
2.000	50.00	4.32	64.015	0.000	0.0	0.0	0.0	1.02	40.6	0.0
1.002	50.00	5.27	63.820	0.252	0.0	0.0	9.1	1.02	72.0	54.6
1.003	50.00	5.39	63.739	0.252	0.0	0.0	9.1	1.14	80.3	54.6
1.004	50.00	5.49	63.696	0.252	0.0	0.0	9.1	1.09	77.1	54.6
3.000	50.00	4.16	63.852	0.099	0.0	0.0	3.6	0.92	36.6	21.4
3.001	50.00	4.32	63.807	0.099	0.0	0.0	3.6	1.08	43.0	21.4

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Network 2020.1

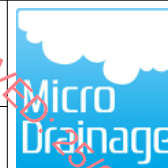
Type	Auto Design
nduit	
nduit	
nduit	
nduit	
nduit	
nduit	
nduit	
nduit	
nduit	
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nduit	
nduit	
nduit	

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.005	20.235	0.139	145.6	0.062	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	11.190	0.080	139.9	0.000	4.00	0.0	0.600	o	225	Pipe/Conduit	
4.001	18.771	0.102	184.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.002	6.379	0.040	159.5	0.048	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.003	25.293	0.141	179.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.004	23.585	0.147	160.4	0.042	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.005	23.677	0.158	150.0	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.006	3.026	0.018	170.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.007	14.595	0.060	243.3	0.026	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.006	1.980	0.006	330.0	0.033	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	11.157	0.074	150.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	7.894	0.032	246.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	4.204	0.083	50.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.010	22.207	0.159	139.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.000	31.665	0.186	170.2	0.110	4.00	0.0	0.600	o	225	Pipe/Conduit	
5.001	16.834	0.077	218.6	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.002	17.737	0.117	151.6	0.039	0.00	0.0	0.600	o	225	Pipe/Conduit	

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.005	50.00	5.75	63.664	0.413	0.0	0.0	14.9	1.30	92.0	89.5
4.000	50.00	4.17	64.380	0.000	0.0	0.0	0.0	1.10	43.9	0.0
4.001	50.00	4.49	64.300	0.000	0.0	0.0	0.0	0.96	38.2	0.0
4.002	50.00	4.60	64.198	0.048	0.0	0.0	1.7	1.03	41.1	10.3
4.003	50.00	5.03	64.158	0.048	0.0	0.0	1.7	0.97	38.7	10.3
4.004	50.00	5.41	64.017	0.090	0.0	0.0	3.2	1.03	40.9	19.4
4.005	50.00	5.78	63.870	0.110	0.0	0.0	4.0	1.07	42.4	23.9
4.006	50.00	5.83	63.637	0.110	0.0	0.0	4.0	1.20	85.0	23.9
4.007	50.00	6.07	63.619	0.137	0.0	0.0	4.9	1.00	70.9	29.6
1.006	50.00	6.10	63.525	0.583	0.0	0.0	21.1	0.99	109.5	126.4
1.007	50.00	6.23	63.519	0.583	0.0	0.0	21.1	1.47	162.7	126.4
1.008	50.00	6.34	63.445	0.583	0.0	0.0	21.1	1.15	126.9	126.4
1.009	50.00	6.37	63.413	0.583	0.0	0.0	21.1	2.55	281.8	126.4
1.010	50.00	6.61	63.330	0.583	0.0	0.0	21.1	1.53	169.1	126.4
5.000	50.00	4.53	64.440	0.110	0.0	0.0	4.0	1.00	39.7	23.9
5.001	50.00	4.85	64.254	0.138	0.0	0.0	5.0	0.88	35.0	29.9
5.002	50.00	5.13	64.177	0.177	0.0	0.0	6.4	1.06	42.1	38.3

Date 03/05/2024 10:02
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Type	Auto Design
Unit	
Unit	
Unit	
Unit	
Unit	

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
6.000	17.089	0.191	89.5	0.014	4.00	0.0	0.600	o	225	Pipe/Conduit	🟢
5.003	15.357	0.161	95.5	0.042	0.00	0.0	0.600	o	300	Pipe/Conduit	🔴
5.004	34.349	0.228	150.5	0.044	0.00	0.0	0.600	o	300	Pipe/Conduit	🟢
5.005	28.170	0.164	171.6	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	🟢
7.000	10.379	0.061	170.0	0.032	4.00	0.0	0.600	o	225	Pipe/Conduit	🟢
7.001	15.230	0.092	166.0	0.041	0.00	0.0	0.600	o	225	Pipe/Conduit	🟢
7.002	41.155	0.249	165.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🟢
7.003	21.435	0.160	134.0	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	🟢
7.004	8.705	0.058	150.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	🟢
5.006	3.515	0.028	125.0	0.015	0.00	0.0	0.600	o	300	Pipe/Conduit	🟢
5.007	35.569	0.087	410.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	🔴
5.008	39.978	0.151	264.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	🟢
5.009	9.331	0.031	301.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	🟢

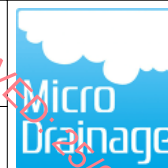
Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
6.000	50.00	4.21	64.650	0.014	0.0	0.0	0.5	1.38	55.0	3.0
5.003	50.00	5.28	63.985	0.233	0.0	0.0	8.4	1.61	113.7	50.4
5.004	50.00	5.73	63.824	0.276	0.0	0.0	10.0	1.28	90.4	59.9
5.005	50.00	6.12	63.596	0.292	0.0	0.0	10.6	1.20	84.6	63.4
7.000	50.00	4.17	64.127	0.032	0.0	0.0	1.2	1.00	39.8	7.0
7.001	50.00	4.42	64.066	0.073	0.0	0.0	2.6	1.01	40.2	15.9
7.002	50.00	5.10	63.974	0.073	0.0	0.0	2.6	1.02	40.4	15.9
7.003	50.00	5.42	63.725	0.104	0.0	0.0	3.8	1.13	44.8	22.5
7.004	50.00	5.55	63.565	0.104	0.0	0.0	3.8	1.07	42.4	22.5
5.006	50.00	6.17	63.432	0.412	0.0	0.0	14.9	1.40	99.3	89.2
5.007	50.00	6.83	63.329	0.412	0.0	0.0	14.9	0.89	98.1	89.2
5.008	50.00	7.43	63.242	0.412	0.0	0.0	14.9	1.11	122.5	89.2
5.009	50.00	7.58	63.091	0.412	0.0	0.0	14.9	1.04	114.8	89.2

DBFL Consulting Engineers										Page 4	
Ormond House Upper Ormond Quay Dublin 7											
Date 03/05/2024 10:02 File 230143-Network Model Fo...					Designed by rajavadiveluip Checked by						
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Manhole Schedules for SW_1											
MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	
S8	65.388	1.174	Open Manhole	1200	1.000	64.214	225				
S7	65.348	1.410	Open Manhole	1200	1.001	63.938	300	1.000	64.013	225	
S6-1	65.369	1.354	Open Manhole	1200	2.000	64.015	225				
S6	65.275	1.455	Open Manhole	1200	1.002	63.820	300	1.001	63.820	300	
								2.000	63.895	225	
S5	65.272	1.533	Open Manhole	1200	1.003	63.739	300	1.002	63.739	300	
S4	65.210	1.514	Open Manhole	1200	1.004	63.696	300	1.003	63.696	300	
S3-2	65.000	1.148	Open Manhole	1200	3.000	63.852	225				
S3-1	65.153	1.346	Open Manhole	1200	3.001	63.807	225	3.000	63.807	225	
S3	65.144	1.480	Open Manhole	1200	1.005	63.664	300	1.004	63.664	300	
								3.001	63.739	225	
S2-8	65.428	1.048	Open Manhole	1200	4.000	64.380	225				
S2-7	65.523	1.223	Open Manhole	1200	4.001	64.300	225	4.000	64.300	225	
S2-6	65.628	1.430	Open Manhole	1200	4.002	64.198	225	4.001	64.198	225	
S2-5	65.661	1.503	Open Manhole	1200	4.003	64.158	225	4.002	64.158	225	
S2-4	65.541	1.524	Open Manhole	1200	4.004	64.017	225	4.003	64.017	225	
S2-3	65.265	1.395	Open Manhole	1200	4.005	63.870	225	4.004	63.870	225	
S2-2	65.203	1.566	Open Manhole	1200	4.006	63.637	300	4.005	63.712	225	
S2-1	65.098	1.479	Open Manhole	1200	4.007	63.619	300	4.006	63.619	300	
S2	65.174	1.649	Open Manhole	1350	1.006	63.525	375	1.005	63.525	375	
								4.007	63.559	300	
19	64.890	1.371	Open Manhole	1350	1.007	63.519	375	1.006	63.519	375	
19	64.890	1.445	Open Manhole	1350	1.008	63.445	375	1.007	63.445	375	
20	64.890	1.477	Open Manhole	1350	1.009	63.413	375	1.008	63.413	375	
S1	64.890	1.560	Open Manhole	1350	1.010	63.330	375	1.009	63.330	375	
	64.900	1.729	Open Manhole	0		OUTFALL		1.010	63.171	375	
S28	65.720	1.280	Open Manhole	1200	5.000	64.440	225				
S27	65.617	1.363	Open Manhole	1200	5.001	64.254	225	5.000	64.254	225	
S26	65.687	1.510	Open Manhole	1200	5.002	64.177	225	5.001	64.177	225	
27	65.747	1.097	Open Manhole	1200	6.000	64.650	225				
S25	65.608	1.623	Open Manhole	1200	5.003	63.985	300	5.002	64.060	225	
								6.000	64.459	225	
S24	65.547	1.723	Open Manhole	1200	5.004	63.824	300	5.003	63.824	300	
S23	65.243	1.647	Open Manhole	1200	5.005	63.596	300	5.004	63.596	300	
S21-3	65.550	1.423	Open Manhole	1200	7.000	64.127	225				
S21-2	65.480	1.414	Open Manhole	1200	7.001	64.066	225	7.000	64.066	225	
32	65.301	1.327	Open Manhole	1200	7.002	63.974	225	7.001	63.974	225	
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Date 03/05/2024 10:02
File 230143-Network Model Fo...

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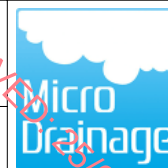


Network 2020.1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S2-7	702507.300	741723.529	702507.300	741723.529	Required	
S2-6	702525.820	741720.471	702525.820	741720.471	Required	
S2-5	702529.993	741715.646	702529.993	741715.646	Required	
S2-4	702529.535	741690.357	702529.535	741690.357	Required	
S2-3	702527.823	741666.834	702527.823	741666.834	Required	
S2-2	702528.285	741643.162	702528.285	741643.162	Required	
S2-1	702525.261	741643.051	702525.261	741643.051	Required	
S2	702510.674	741643.546	702510.674	741643.546	Required	
19	702510.902	741641.579	702510.902	741641.579	Required	
19	702511.965	741630.473	702511.965	741630.473	Required	
20	702519.859	741630.486	702519.859	741630.486	Required	
S1	702519.992	741626.283	702519.992	741626.283	Required	
	702518.666	741604.116			No Entry	
S28	702297.941	741658.183	702297.941	741658.183	Required	
S27	702298.828	741626.530	702298.828	741626.530	Required	

Date 03/05/2024 10:02
File 230143-Network Model Fo...

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Network 2020.1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S26	702299.302	741609.703	702299.302	741609.703	Required	
27	702316.544	741627.209	702316.544	741627.209	Required	
S25	702317.034	741610.127	702317.034	741610.127	Required	
S24	702332.383	741610.619	702332.383	741610.619	Required	
S23	702337.259	741576.618	702337.259	741576.618	Required	
S21-3	702431.015	741614.704	702431.015	741614.704	Required	
S21-2	702434.286	741604.854	702434.286	741604.854	Required	
32	702420.103	741599.306	702420.103	741599.306	Required	
S21-1	702381.713	741584.475	702381.713	741584.475	Required	
34	702361.596	741577.075	702361.596	741577.075	Required	
S22	702364.324	741568.808	702364.324	741568.808	Required	
36	702367.587	741570.115	702367.587	741570.115	Required	
S21	702400.981	741582.362	702400.981	741582.362	Required	
S20	702438.989	741594.757	702438.989	741594.757	Required	
	702445.266	741587.852			No Entry	

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Network 2020.1

Upstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
1.000	26.742	133.0	S7	65.348	64.013	1.110	Open Manhole		1200
1.001	31.857	270.0	S6	65.275	63.820	1.155	Open Manhole		1200
2.000	19.570	163.1	S6	65.275	63.895	1.155	Open Manhole		1200
2.002	19.160	236.5	S5	65.272	63.739	1.233	Open Manhole		1200
2.003	8.191	190.5	S4	65.210	63.696	1.214	Open Manhole		1200
2.004	6.611	206.6	S3	65.144	63.664	1.180	Open Manhole		1200
3.000	9.014	200.3	S3-1	65.153	63.807	1.121	Open Manhole		1200
3.001	9.910	145.7	S3	65.144	63.739	1.180	Open Manhole		1200
3.005	20.235	145.6	S2	65.174	63.525	1.349	Open Manhole		1350
4.000	11.190	139.9	S2-7	65.523	64.300	0.998	Open Manhole		1200
4.001	18.771	184.0	S2-6	65.628	64.198	1.205	Open Manhole		1200
4.002	6.379	159.5	S2-5	65.661	64.158	1.278	Open Manhole		1200
4.003	25.293	179.4	S2-4	65.541	64.017	1.299	Open Manhole		1200
4.004	23.585	160.4	S2-3	65.265	63.870	1.170	Open Manhole		1200
4.005	23.677	150.0	S2-2	65.203	63.712	1.266	Open Manhole		1200
4.006	3.026	170.0	S2-1	65.098	63.619	1.179	Open Manhole		1200

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Network 2020.1

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
4.007	o	300	S2-1	65.098	63.619	1.179	Open Manhole		1200
1.006	o	375	S2	65.174	63.525	1.274	Open Manhole		1350
1.007	o	375	19	64.890	63.519	0.996	Open Manhole		1350
1.008	o	375	19	64.890	63.445	1.070	Open Manhole		1350
1.009	o	375	20	64.890	63.413	1.102	Open Manhole		1350
1.010	o	375	S1	64.890	63.330	1.185	Open Manhole		1350
5.000	o	225	S28	65.720	64.440	1.055	Open Manhole		1200
5.001	o	225	S27	65.617	64.254	1.138	Open Manhole		1200
5.002	o	225	S26	65.687	64.177	1.285	Open Manhole		1200
6.000	o	225	27	65.747	64.650	0.872	Open Manhole		1200
5.003	o	300	S25	65.608	63.985	1.323	Open Manhole		1200
5.004	o	300	S24	65.547	63.824	1.423	Open Manhole		1200
5.005	o	300	S23	65.243	63.596	1.347	Open Manhole		1200
7.000	o	225	S21-3	65.550	64.127	1.198	Open Manhole		1200
7.001	o	225	S21-2	65.480	64.066	1.189	Open Manhole		1200
7.002	o	225	32	65.301	63.974	1.102	Open Manhole		1200

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection		MH DIAM., (mm)	L*W
4.007	14.595	243.3	S2	65.174	63.559	1.315	Open	Manhole		1350
1.006	1.980	330.0	19	64.890	63.519	0.996	Open	Manhole		1350
1.007	11.157	150.8	19	64.890	63.445	1.070	Open	Manhole		1350
1.008	7.894	246.7	20	64.890	63.413	1.102	Open	Manhole		1350
1.009	4.204	50.7	S1	64.890	63.330	1.185	Open	Manhole		1350
1.010	22.207	139.7		64.900	63.171	1.354	Open	Manhole		0
5.000	31.665	170.2	S27	65.617	64.254	1.138	Open	Manhole		1200
5.001	16.834	218.6	S26	65.687	64.177	1.285	Open	Manhole		1200
5.002	17.737	151.6	S25	65.608	64.060	1.323	Open	Manhole		1200
6.000	17.089	89.5	S25	65.608	64.459	0.924	Open	Manhole		1200
5.003	15.357	95.5	S24	65.547	63.824	1.423	Open	Manhole		1200
5.004	34.349	150.5	S23	65.243	63.596	1.347	Open	Manhole		1200
5.005	28.170	171.6	S22	65.222	63.432	1.490	Open	Manhole		1200
7.000	10.379	170.0	S21-2	65.480	64.066	1.189	Open	Manhole		1200
7.001	15.230	166.0	32	65.301	63.974	1.102	Open	Manhole		1200
7.002	41.155	165.0	S21-1	65.121	63.725	1.171	Open	Manhole		1200

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Volumetric Runoff Coeff	1.000	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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	1.000
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.300	Storm Duration (mins)	30
Ratio R	0.271		

DBFL Consulting Engineers		Page 12
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 10:02 File 230143-Network Model Fo...	Designed by rajavadiveluip Checked by	
Innovyze	Network 2020.1	

Online Controls for SW_1

Hydro-Brake® Optimum Manhole: S1, DS/PN: 1.010, Volume (m³): 2.5

Unit Reference	MD-SHE-0098-4800-1360-4800
Design Head (m)	1.360
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	63.330
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.360	4.8
Flush-Flo™	0.406	4.8
Kick-Flo®	0.834	3.8
Mean Flow over Head Range	-	4.2

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)
0.100	3.2	1.200	4.5	3.000	6.9	7.000	10.4
0.200	4.4	1.400	4.9	3.500	7.5	7.500	10.7
0.300	4.7	1.600	5.2	4.000	8.0	8.000	11.1
0.400	4.8	1.800	5.5	4.500	8.4	8.500	11.4
0.500	4.8	2.000	5.7	5.000	8.8	9.000	11.7
0.600	4.6	2.200	6.0	5.500	9.3	9.500	12.0
0.800	4.0	2.400	6.3	6.000	9.6		
1.000	4.2	2.600	6.5	6.500	10.0		

Hydro-Brake® Optimum Manhole: S21, DS/PN: 5.008, Volume (m³): 5.9

Unit Reference	MD-SHE-0089-3600-1060-3600
Design Head (m)	1.060
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	89
Invert Level (m)	63.242
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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DBFL Consulting Engineers		Page 13																																																																								
Ormond House Upper Ormond Quay Dublin 7																																																																										
Date 03/05/2024 10:02 File 230143-Network Model Fo...	Designed by rajavadiveluip Checked by																																																																									
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Hydro-Brake® Optimum Manhole: S21, DS/PN: 5.008, Volume (m³): 5.9																																																																										
<table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>1.060</td><td>3.6</td></tr><tr><td>Flush-Flo™</td><td>0.316</td><td>3.6</td></tr><tr><td>Kick-Flo®</td><td>0.663</td><td>2.9</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>3.1</td></tr></table>			Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.060	3.6	Flush-Flo™	0.316	3.6	Kick-Flo®	0.663	2.9	Mean Flow over Head Range	-	3.1																																																									
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Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																			
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0.500	3.5	2.000	4.8	5.000	7.4	9.000	9.8																																																																			
0.600	3.2	2.200	5.0	5.500	7.8	9.500	10.1																																																																			
0.800	3.2	2.400	5.3	6.000	8.1																																																																					
1.000	3.5	2.600	5.5	6.500	8.4																																																																					
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DBFL Consulting Engineers		Page 14
Ormond House Upper Ormond Quay Dublin 7		
Date 03/05/2024 10:02 File 230143-Network Model Fo...	Designed by rajavadiveluip Checked by	
Innovyze	Network 2020.1	

Storage Structures for SW_1

Complex Manhole: S1, DS/PN: 1.010

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	204.5	204.5	1.061	204.5	204.5
0.300	204.5	204.5	1.360	204.5	204.5
0.301	0.0	204.5	1.361	0.0	204.5
1.060	0.0	204.5			

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	0.0	204.5	1.060	204.5	204.5
0.300	0.0	204.5	1.061	0.0	204.5
0.301	204.5	204.5	1.360	0.0	204.5

Pipe

Diameter (m) 0.600 Length (m) 6.084
Slope (1:X) 600.000 Invert Level (m) 63.330

Cellular Storage

Invert Level (m) 63.330 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	129.5	129.5	1.061	129.5	129.5
0.300	129.5	129.5	1.360	129.5	129.5
0.301	0.0	129.5	1.361	0.0	129.5
1.060	0.0	129.5			

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DBFL Consulting Engineers		Page 15																																																																																				
Ormond House Upper Ormond Quay Dublin 7																																																																																						
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<u>Cellular Storage</u> Invert Level (m) 63.330 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>0.0</td><td>129.5</td><td>1.061</td><td>0.0</td><td>129.5</td></tr><tr><td>0.300</td><td>0.0</td><td>129.5</td><td>1.360</td><td>0.0</td><td>129.5</td></tr><tr><td>0.301</td><td>129.5</td><td>129.5</td><td>1.361</td><td>0.0</td><td>129.5</td></tr><tr><td>1.060</td><td>129.5</td><td>129.5</td><td></td><td></td><td></td></tr></table> <u>Complex Manhole: S21, DS/PN: 5.008</u> <u>Cellular Storage</u> Invert Level (m) 63.242 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.40 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>310.0</td><td>310.0</td><td>0.911</td><td>310.0</td><td>310.0</td></tr><tr><td>0.150</td><td>310.0</td><td>310.0</td><td>1.060</td><td>310.0</td><td>310.0</td></tr><tr><td>0.151</td><td>0.0</td><td>310.0</td><td>1.061</td><td>0.0</td><td>310.0</td></tr><tr><td>0.910</td><td>0.0</td><td>310.0</td><td></td><td></td><td></td></tr></table> <u>Cellular Storage</u> Invert Level (m) 63.242 Safety Factor 2.0 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95 Infiltration Coefficient Side (m/hr) 0.00000 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th><th>Inf. Area (m²)</th></tr><tr><td>0.000</td><td>0.0</td><td>310.0</td><td>0.910</td><td>310.0</td><td>310.0</td></tr><tr><td>0.150</td><td>0.0</td><td>310.0</td><td>0.911</td><td>0.0</td><td>310.0</td></tr><tr><td>0.151</td><td>310.0</td><td>310.0</td><td></td><td></td><td></td></tr></table>			Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	0.0	129.5	1.061	0.0	129.5	0.300	0.0	129.5	1.360	0.0	129.5	0.301	129.5	129.5	1.361	0.0	129.5	1.060	129.5	129.5				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	310.0	310.0	0.911	310.0	310.0	0.150	310.0	310.0	1.060	310.0	310.0	0.151	0.0	310.0	1.061	0.0	310.0	0.910	0.0	310.0				Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	0.000	0.0	310.0	0.910	310.0	310.0	0.150	0.0	310.0	0.911	0.0	310.0	0.151	310.0	310.0			
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)																																																																																	
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DBFL Consulting Engineers				Page 16					
Ormond House Upper Ormond Quay Dublin 7									
Date 03/05/2024 10:02		Designed by rajavadiveluip							
File 230143-Network Model Fo...		Checked by							
Innovyze		Network 2020.1							
Summary of Critical Results by Flow Capacity Ratio (Rank 1) for SW_1									
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 Coefficient 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 Storage Structures 2					
Number of Online Controls		2		Number of Time/Area Diagrams 0					
Number of Offline Controls		0		Number of Real Time Controls 0					
Synthetic Rainfall Details									
Rainfall Model		FSR		Ratio R 0.271					
Region Scotland and Ireland		Cv (Summer) 1.000							
M5-60 (mm)		15.300		Cv (Winter) 1.000					
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)		1, 30, 100							
Climate Change (%)		20, 20, 20							
Viewing Purpose									
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	S8 15	Summer	100	+20%	30/15	Summer			65.198
1.001	S7 15	Summer	100	+20%	30/15	Summer			65.142
2.000	S6-1 15	Summer	100	+20%	30/15	Summer			64.996
1.002	S6 15	Summer	100	+20%	30/15	Summer			65.008
1.003	S5 30	Summer	100	+20%	30/15	Summer			64.913
1.004	S4 15	Summer	100	+20%	30/15	Summer			64.793
3.000	S3-2 15	Summer	100	+20%	30/15	Summer			64.820
3.001	S3-1 30	Summer	100	+20%	30/15	Summer			64.786
1.005	S3 30	Summer	100	+20%	30/15	Summer			64.737
4.000	S2-8 15	Summer	100	+20%					64.570
4.001	S2-7 15	Summer	100	+20%	100/15	Summer			64.570
4.002	S2-6 15	Summer	100	+20%	100/15	Summer			64.592
4.003	S2-5 15	Summer	100	+20%	100/15	Summer			64.584
4.004	S2-4 15	Summer	100	+20%	30/15	Summer			64.572
4.005	S2-3 15	Summer	100	+20%	30/15	Summer			64.521
4.006	S2-2 15	Summer	100	+20%	30/15	Summer			64.432
4.007	S2-1 15	Summer	100	+20%	30/15	Summer			64.424
1.006	S2 30	Summer	100	+20%	30/15	Summer			64.410
1.007	19 30	Summer	100	+20%	30/15	Summer			64.233
1.008	19 30	Summer	100	+20%	30/15	Summer			64.056
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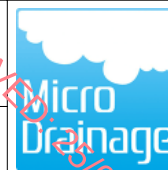


Network 2020.1

Summary of Critical Results by Flow Capacity Ratio (Rank 1) for SW_1

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)		
1.000	S8	0.759	0.000	0.62			25.9	FLOOD RISK	
1.001	S7	0.904	0.000	1.07			65.6	FLOOD RISK	
2.000	S6-1	0.756	0.000	0.09			3.5	SURCHARGED	
1.002	S6	0.888	0.000	1.21			75.4	FLOOD RISK	
1.003	S5	0.874	0.000	1.25			75.5	SURCHARGED	
1.004	S4	0.797	0.000	1.39			76.4	SURCHARGED	
3.000	S3-2	0.743	0.000	1.20			35.9	FLOOD RISK	
3.001	S3-1	0.754	0.000	0.88			31.3	SURCHARGED	
1.005	S3	0.773	0.000	1.52			122.1	SURCHARGED	
4.000	S2-8	-0.035	0.000	0.03			1.2	OK	
4.001	S2-7	0.045	0.000	0.14			4.7	SURCHARGED	
4.002	S2-6	0.169	0.000	0.72			21.6	SURCHARGED	
4.003	S2-5	0.201	0.000	0.52			18.6	SURCHARGED	
4.004	S2-4	0.330	0.000	0.80			30.2	SURCHARGED	
4.005	S2-3	0.426	0.000	0.78			30.4	SURCHARGED	
4.006	S2-2	0.495	0.000	0.63			32.1	SURCHARGED	
4.007	S2-1	0.505	0.000	0.61			36.0	SURCHARGED	
1.006	S2	0.510	0.000	1.90			166.1	SURCHARGED	
1.007	19	0.339	0.000	1.55			166.0	SURCHARGED	
1.008	19	0.236	0.000	1.88			165.6	SURCHARGED	

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Network 2020.1

Table 1: Summary of Flood Risk Assessment Data									Water Level (m)
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) SurchARGE	First (Y) Flood	First (Z) Overflow	Overflow Act.	
1.009	20	30 Summer	100	+20%	30/15 Summer				63.937
1.010	S1	10080 Summer	100	+20%	1/120 Summer				63.713
5.000	S28	15 Summer	100	+20%	30/15 Summer				65.370
5.001	S27	15 Summer	100	+20%	30/15 Summer				65.161
5.002	S26	15 Summer	100	+20%	30/15 Summer				64.977
6.000	27	15 Summer	100	+20%					64.706
5.003	S25	15 Summer	100	+20%	30/15 Summer				64.668
5.004	S24	15 Summer	100	+20%	30/15 Summer				64.566
5.005	S23	30 Summer	100	+20%	30/15 Summer				64.310
7.000	S21-3	15 Summer	100	+20%	100/15 Summer				64.368
7.001	S21-2	15 Summer	100	+20%	100/15 Summer				64.353
7.002	32	15 Summer	100	+20%	100/15 Summer				64.309
7.003	S21-1	15 Summer	100	+20%	30/15 Summer				64.221
7.004	34	15 Summer	100	+20%	30/15 Summer				64.110
5.006	S22	30 Summer	100	+20%	30/15 Summer				64.062
5.007	36	30 Summer	100	+20%	30/15 Summer				63.787
5.008	S21	5760 Summer	30	+20%	30/60 Summer				63.529
5.009	S20	5760 Summer	30	+20%					63.141

PN	US/MH Name	Surcharged	Flooded	Flow / Cap.	Overflow (l/s)	Half Drain	Pipe	Status	Level Exceeded
		Depth (m)	Volume (m³)			Time (mins)	Flow (l/s)		
1.009	20	0.149	0.000	1.46			164.8	SURCHARGED	
1.010	S1	0.008	0.000	0.03		600	4.8	SURCHARGED	
5.000	S28	0.705	0.000	1.12			41.8	SURCHARGED	
5.001	S27	0.682	0.000	1.56			48.6	SURCHARGED	
5.002	S26	0.575	0.000	1.60			60.3	SURCHARGED	
6.000	27	-0.169	0.000	0.14			6.9	OK	
5.003	S25	0.383	0.000	0.80			76.5	SURCHARGED	
5.004	S24	0.442	0.000	1.07			89.1	SURCHARGED	
5.005	S23	0.414	0.000	1.22			93.4	SURCHARGED	
7.000	S21-3	0.016	0.000	0.47			15.7	SURCHARGED	
7.001	S21-2	0.062	0.000	0.99			35.1	SURCHARGED	
7.002	32	0.110	0.000	0.79			30.5	SURCHARGED	
7.003	S21-1	0.271	0.000	0.82			33.6	SURCHARGED	
7.004	34	0.320	0.000	0.98			33.4	SURCHARGED	
5.006	S22	0.330	0.000	2.21			130.5	SURCHARGED	
5.007	36	0.083	0.000	1.46			128.9	SURCHARGED	
5.008	S21	-0.088	0.000	0.03		528	3.6	OK	
5.009	S20	-0.325	0.000	0.04			3.6	OK	



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Appendix E : Foul Drainage Calculations

DBFL Consulting Engineers		Page 1
Ormond House Upper Ormond Quay Dublin 7		
Date 08/03/2024 15:08 File 230143-Network Model Fo...	Designed by rajavadiveluip Checked by	
Innovyze Network 2020.1		

FOUL SEWERAGE DESIGN

Design Criteria for Foul

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00
Industrial Peak Flow Factor	0.00
Calculation Method	BS 8301
Frequency Factor	0.50
Domestic (l/s/ha)	0.00
Domestic Peak Flow Factor	6.00
Add Flow / Climate Change (%)	20
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul

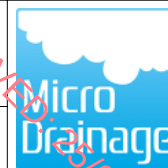
PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	28.704	0.478	60.1	0.000	42.0	0.0	1.500	o	150	Pipe/Conduit	
F1.001	7.459	0.124	60.2	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	
F2.000	15.120	0.252	60.0	0.000	42.0	0.0	1.500	o	150	Pipe/Conduit	
F1.002	16.424	0.274	59.9	0.000	56.0	0.0	1.500	o	150	Pipe/Conduit	
F1.003	35.308	0.235	150.2	0.000	154.0	0.0	1.500	o	225	Pipe/Conduit	
F1.004	13.324	0.067	198.9	0.000	56.0	0.0	1.500	o	225	Pipe/Conduit	
F1.005	5.816	0.029	200.6	0.000	28.0	0.0	1.500	o	225	Pipe/Conduit	
F1.006	8.211	0.041	200.3	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	64.614	0.000	0.0	42.0	0.7	45	0.87	1.13	20.0	3.9
F1.001	64.136	0.000	0.0	42.0	0.7	45	0.87	1.13	20.0	3.9
F2.000	64.264	0.000	0.0	42.0	0.7	45	0.88	1.13	20.0	3.9
F1.002	64.012	0.000	0.0	140.0	0.9	52	0.95	1.13	20.0	5.1
F1.003	63.663	0.000	0.0	294.0	1.0	62	0.69	0.94	37.2	6.2
F1.004	63.428	0.000	0.0	350.0	1.1	69	0.64	0.81	32.3	6.6
F1.005	63.361	0.000	0.0	378.0	1.1	70	0.64	0.81	32.2	6.7
F1.006	63.332	0.000	0.0	378.0	1.1	70	0.64	0.81	32.2	6.7

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PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Units	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F3.000	24.886	0.415	60.0	0.000	28.0	0.0	1.500	o	150	Pipe/Conduit	🔒
F3.001	21.553	0.359	60.0	0.000	28.0	0.0	1.500	o	150	Pipe/Conduit	🔒
F3.002	5.781	0.096	60.2	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	🔒
F3.003	5.111	0.085	60.1	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	🔒
F3.004	9.759	0.163	59.9	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	🔒
F3.005	17.671	0.296	59.7	0.000	0.0	0.0	1.500	o	150	Pipe/Conduit	🔒
F1.007	12.143	0.061	199.1	0.000	28.0	0.0	1.500	o	225	Pipe/Conduit	🔒
F1.008	21.548	0.108	199.5	0.000	42.0	0.0	1.500	o	225	Pipe/Conduit	🔒
F1.009	62.307	0.312	200.0	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	🔒
F4.000	28.483	0.475	60.0	0.000	70.0	0.0	1.500	o	150	Pipe/Conduit	🔒
F1.010	36.464	0.183	199.3	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	🔒
F5.000	19.934	0.332	60.0	0.000	126.0	0.0	1.500	o	150	Pipe/Conduit	🔒
F5.001	23.639	0.158	149.6	0.000	154.0	0.0	1.500	o	225	Pipe/Conduit	🔒
F5.002	5.454	0.027	202.0	0.000	80.0	0.0	1.500	o	225	Pipe/Conduit	🔒
F5.003	24.288	0.121	200.7	0.000	126.0	0.0	1.500	o	225	Pipe/Conduit	🔒

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F3.000	64.780	0.000	0.0	28.0	0.6	43	0.85	1.13	20.0	3.6
F3.001	64.365	0.000	0.0	56.0	0.7	47	0.89	1.13	20.0	4.2
F3.002	64.006	0.000	0.0	56.0	0.7	47	0.89	1.13	20.0	4.2
F3.003	63.910	0.000	0.0	56.0	0.7	47	0.89	1.13	20.0	4.2
F3.004	63.825	0.000	0.0	56.0	0.7	47	0.89	1.13	20.0	4.2
F3.005	63.662	0.000	0.0	56.0	0.7	46	0.89	1.14	20.1	4.2
F1.007	63.291	0.000	0.0	462.0	1.2	72	0.65	0.81	32.3	7.2
F1.008	63.230	0.000	0.0	504.0	1.2	73	0.66	0.81	32.3	7.4
F1.009	63.122	0.000	0.0	504.0	1.2	73	0.66	0.81	32.2	7.4
F4.000	63.360	0.000	0.0	70.0	0.7	48	0.90	1.13	20.0	4.4
F1.010	62.810	0.000	0.0	574.0	1.3	75	0.67	0.81	32.3	7.8
F5.000	64.735	0.000	0.0	126.0	0.8	51	0.94	1.13	20.0	5.0
F5.001	64.328	0.000	0.0	280.0	1.0	62	0.69	0.94	37.3	6.1
F5.002	64.170	0.000	0.0	360.0	1.1	69	0.63	0.81	32.1	6.6
F5.003	64.143	0.000	0.0	486.0	1.2	73	0.65	0.81	32.2	7.3

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Units	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F3.000	64.780	0.000	0.0	28.0	0.6	43	0.85	1.13	20.0	3.6
F3.001	64.365	0.000	0.0	56.0	0.7	47	0.89	1.13	20.0	4.2
F3.002	64.006	0.000	0.0	56.0	0.7	47	0.89	1.13	20.0	4.2
F3.003	63.910	0.000	0.0	56.0	0.7	47	0.89	1.13	20.0	4.2
F3.004	63.825	0.000	0.0	56.0	0.7	47	0.89	1.13	20.0	4.2
F3.005	63.662	0.000	0.0	56.0	0.7	46	0.89	1.14	20.1	4.2
F1.007	63.291	0.000	0.0	462.0	1.2	72	0.65	0.81	32.3	7.2
F1.008	63.230	0.000	0.0	504.0	1.2	73	0.66	0.81	32.3	7.4
F1.009	63.122	0.000	0.0	504.0	1.2	73	0.66	0.81	32.2	7.4
F4.000	63.360	0.000	0.0	70.0	0.7	48	0.90	1.13	20.0	4.4
F1.010	62.810	0.000	0.0	574.0	1.3	75	0.67	0.81	32.3	7.8
F5.000	64.735	0.000	0.0	126.0	0.8	51	0.94	1.13	20.0	5.0
F5.001	64.328	0.000	0.0	280.0	1.0	62	0.69	0.94	37.3	6.1
F5.002	64.170	0.000	0.0	360.0	1.1	69	0.63	0.81	32.1	6.6
F5.003	64.143	0.000	0.0	486.0	1.2	73	0.65	0.81	32.2	7.3



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Network 2020.1

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F6	702477.117	741730.898	702477.117	741730.898	Required	
F6	702477.672	741715.788	702477.672	741715.788	Required	
F7	702478.315	741699.376	702478.315	741699.376	Required	
F8	702478.710	741664.070	702478.710	741664.070	Required	
F7	702479.215	741650.756	702479.215	741650.756	Required	
F9	702483.599	741646.934	702483.599	741646.934	Required	
F11	702528.284	741698.144	702528.284	741698.144	Required	
F12	702526.292	741673.338	702526.292	741673.338	Required	
F13	702526.162	741651.786	702526.162	741651.786	Required	
F14	702523.831	741646.496	702523.831	741646.496	Required	
F15	702519.079	741644.613	702519.079	741644.613	Required	
F16	702509.329	741644.189	702509.329	741644.189	Required	
F10	702491.733	741645.807	702491.733	741645.807	Required	
F11	702491.258	741633.673	702491.258	741633.673	Required	
F12	702498.450	741613.361	702498.450	741613.361	Required	

DBFL Consulting Engineers						Page 5
Ormond House Upper Ormond Quay Dublin 7						
Date 08/03/2024 15:08 File 230143-Network Model Fo...			Designed by rajavadiveluip Checked by			
Innovyze			Network 2020.1			
Manhole Schedules for Foul						
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F18	702430.071	741621.101	702430.071	741621.101	Required	
F13	702439.189	741594.118	702439.189	741594.118	Required	
F14	702404.582	741582.627			No Entry	
F17	702300.471	741657.883	702300.471	741657.883	Required	
F21	702300.888	741637.953	702300.888	741637.953	Required	
F18	702301.612	741614.325	702301.612	741614.325	Required	
F19	702305.742	741610.762	702305.742	741610.762	Required	
F	702330.012	741611.697			No Entry	
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Upstream Manhole

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., (mm)	L*W
F1.000	28.704	60.1	F5	65.520	64.136	1.234	Open	Manhole	1200
F1.001	7.459	60.2	F6	65.450	64.012	1.288	Open	Manhole	1200
F2.000	15.120	60.0	F6	65.450	64.012	1.288	Open	Manhole	1200
F1.002	16.424	59.9	F7	65.298	63.738	1.410	Open	Manhole	1200
F1.003	35.308	150.2	F8	65.248	63.428	1.595	Open	Manhole	1200
F1.004	13.324	198.9	F7	65.248	63.361	1.662	Open	Manhole	1200
F1.005	5.816	200.6	F9	65.298	63.332	1.741	Open	Manhole	1200
F1.006	8.211	200.3	F10	65.178	63.291	1.662	Open	Manhole	1200
F3.000	24.886	60.0	F12	65.370	64.365	0.855	Open	Manhole	1200
F3.001	21.553	60.0	F13	65.100	64.006	0.944	Open	Manhole	1200
F3.002	5.781	60.2	F14	65.048	63.910	0.988	Open	Manhole	1200
F3.003	5.111	60.1	F15	65.098	63.825	1.123	Open	Manhole	1200
F3.004	9.759	59.9	F16	65.198	63.662	1.386	Open	Manhole	1200
F3.005	17.671	59.7	F10	65.178	63.366	1.662	Open	Manhole	1200
F1.007	12.143	199.1	F11	65.064	63.230	1.609	Open	Manhole	1200
F1.008	21.548	199.5	F12	64.548	63.122	1.201	Open	Manhole	1200
F1.009	62.307	200.0	F13	64.680	62.810	1.645	Open	Manhole	1200



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Appendix F : Site Investigation Report



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Station Road, Dunboyne – Ground Investigation

Client: Merville Homes

Client's Representative: DBFL

Report No.: 18-1272

Date: October 2018

Status: Final for Issue

CONTENTS

Document Control Sheet

Note on: Methods of describing soils and rocks & abbreviations used on exploratory hole logs

1	AUTHORITY	4
2	SCOPE.....	4
3	DESCRIPTION OF SITE	4
4	SITE OPERATIONS.....	5
4.1	Summary of site works.....	5
4.2	Trial Pits.....	5
4.3	Infiltration tests.....	5
5	GROUND CONDITIONS.....	5
5.1	General geology of the area.....	5
5.2	Ground types encountered during investigation of the site	6
5.3	Groundwater.....	6
6	REFERENCES	6

APPENDICES

Appendix A	Site and exploratory hole location plans
Appendix B	Trial pit logs
Appendix C	Trial pit photographs
Appendix D	Infiltration test results

Document Control Sheet

Report No.:		18-1272			
Project Title:		Station Road, Dunboyne			
Client:		Merville Homes			
Client's Representative:		DBFL			
Revision:	A00	Status:	Final for Issue	Issue Date:	31 October 2018
Prepared by:		Reviewed by:		Approved by:	
 Sean Ross BSc MSc		 Colm Hurley BSc FGS		 Darren O'Mahony BSc MSc MIEI	

The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015, Code of practice for site investigations.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015, The Code of Practice for Site Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler)
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler)
P	Nominal 100mm diameter undisturbed piston sample
B	Bulk disturbed sample
LB	Large bulk disturbed sample
D	Small disturbed sample
C	Core sub-sample (displayed in the Field Records column on the logs)
L	Liner sample from dynamic sampled borehole
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained)
SPT (c)	Standard penetration test using 60 degree solid cone
x,x/x,x,x,x	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. The length achieved is stated (mm) for any test increment less than 75mm
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm)
N=X/Z	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm)
V VR	Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa V: undisturbed vane shear strength VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
▽	Water strike: initial depth of strike
▼	Water strike: depth water rose to
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum).

Station Road, Dunboyne

1 AUTHORITY

On the instructions of DBFL Consulting Engineers, ("the Client's Representative"), acting on the behalf of Merville Homes ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed residential development.

This report details the work carried out both on site; it contains a description of the site and the works undertaken and the exploratory hole logs

All information given in this report is based upon the ground conditions encountered during the site investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client's Representative in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included, trial pits, in-situ testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted on a site east of Dunboyne Herbal Clinic, south of the L2228. The site is currently used for agricultural purposes.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted on 30th October 2018, comprised:

- six machine dug trial pits; and
- an infiltration test performed in three trial pits.

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

4.2 Trial Pits

Six trial pits (TP01-TP06) were excavated using a 3T tracked excavator fitted with a 600mm wide bucket, to depths of 1.5 – 2.2m. Three trial pits were excavated to allow completion of infiltration test.

Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. The stability of the trial pit walls was noted on completion.

Appendix B presents the trial pit logs with photographs of the pits and arising provided in Appendix C.

4.3 Infiltration tests

An infiltration/soakaway test was carried out at three locations (SA01- SA03) in accordance with BRE Digest 365 - Soakaways (BRE, 2016).

Appendix D presents the results and analysis of the infiltration test. SA01 and SA02 recorded a test infiltration rate of 1.490 and 0.407m/h respectively, the absence of the outflow from the SA03 precluded calculation of infiltration coefficients.

5 GROUND CONDITIONS

5.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise alluvium and glacial till. These deposits are underlain by limestone and shale of the Lucan Formation.

5.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Topsoil/Made ground:** encountered in every trial pit with a thickness of 100mm. consisted of reworked topsoil with bits of plastic and fragments of red brick.
- **Fluvioglacial deposits:** typically, water bearing gravelly sand/sandy gravel lenses encountered in all trial pits to a maximum depth of 2.2m in TP04.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically soft or firm in upper horizons, becoming stiff with increasing depth. Encountered overlying fluvioglacial deposits in all trial pits.

5.3 Groundwater

Groundwater was encountered during trial pit excavation as water strikes as shown in Table 1 below:

Table 1 Groundwater strikes encountered during the ground investigation

GI Ref.	Water Level (mbgl)	Comments
TP01	1.8	Trial Pit unstable
TP02	1.5	Trial Pit unstable
TP03	1.9	Trial Pit unstable
TP04	1.85	Trial Pit unstable
TP05	2.0	Trial Pit unstable
TP06	1.6	Trial Pit unstable

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Seasonal variation in groundwater levels should be factored into design considerations.

6 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

BS 5930: 2015: Code of practice for ground investigations. British Standards Institution.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description.

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

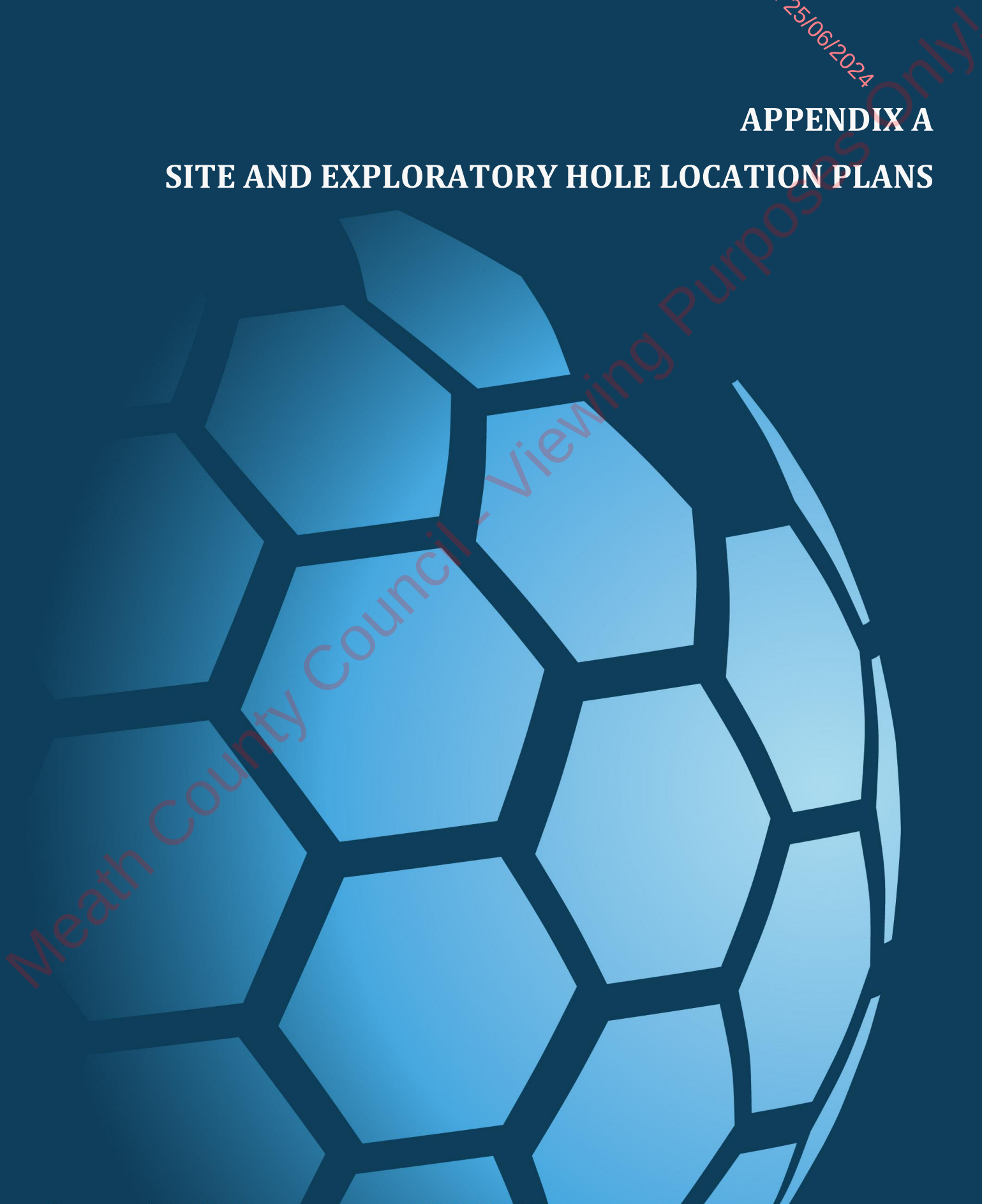
Building Research Establishment (2007), BRE Digest 365: Soakaways.



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APPENDIX A
SITE AND EXPLORATORY HOLE LOCATION PLANS

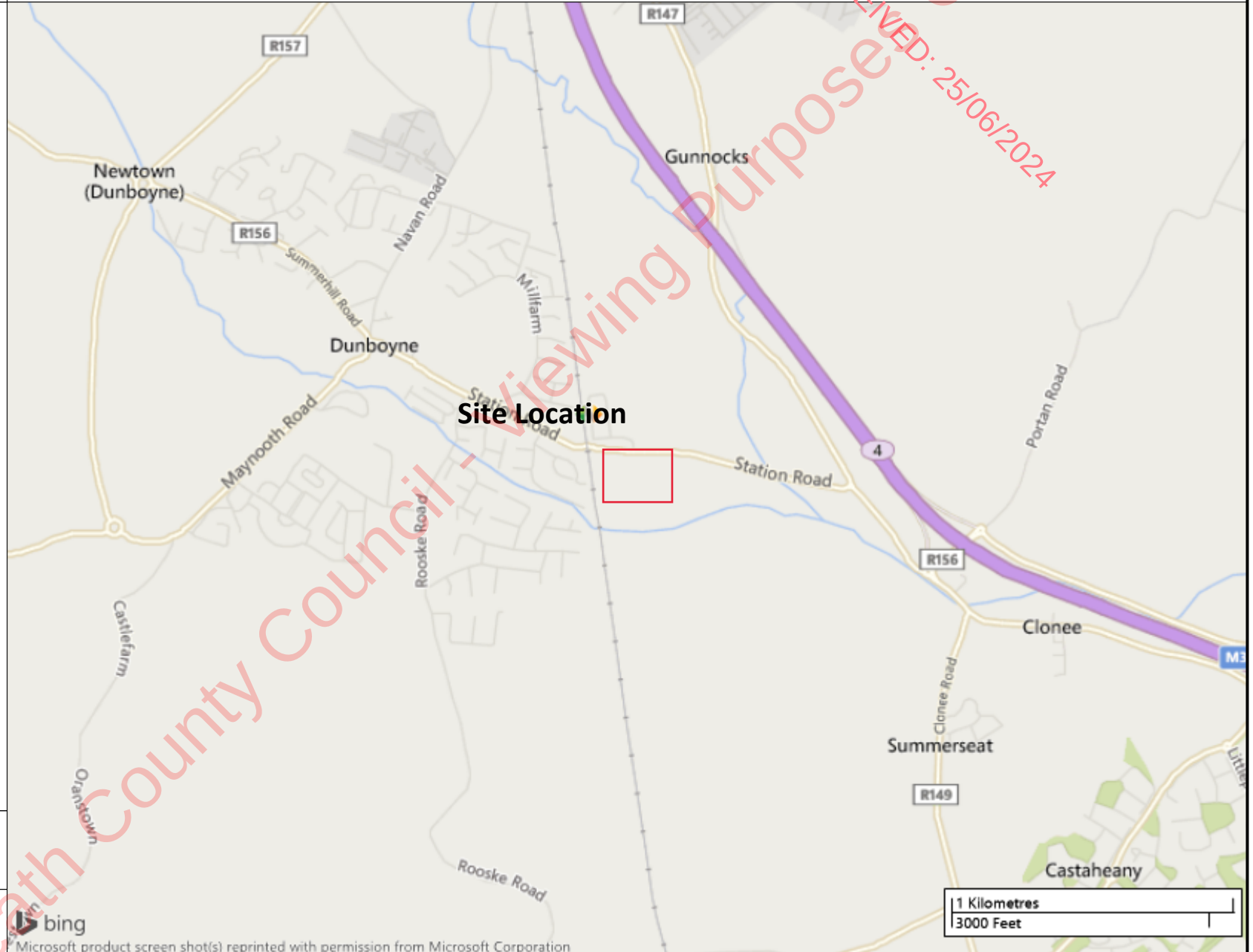




Project No.: 18-1272
Project Name: Dunboyne, Co. Meath

Client: Dunboyne, Co. Meath
Client's Representative: DBFL

Legend Key



Title:
Site Location Plan

Last Revised:
31/10/2018

Scale:
1:20000



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Project No.: 18-1272
Project Name: Dunboyne, Co. Meath

Client: Dunboyne, Co. Meath
Client's Representative: DBFL

Legend Key

▣ Locations By Type - TP



Title:
Exploratory Hole Location Plan

Last Revised:
31/10/2018

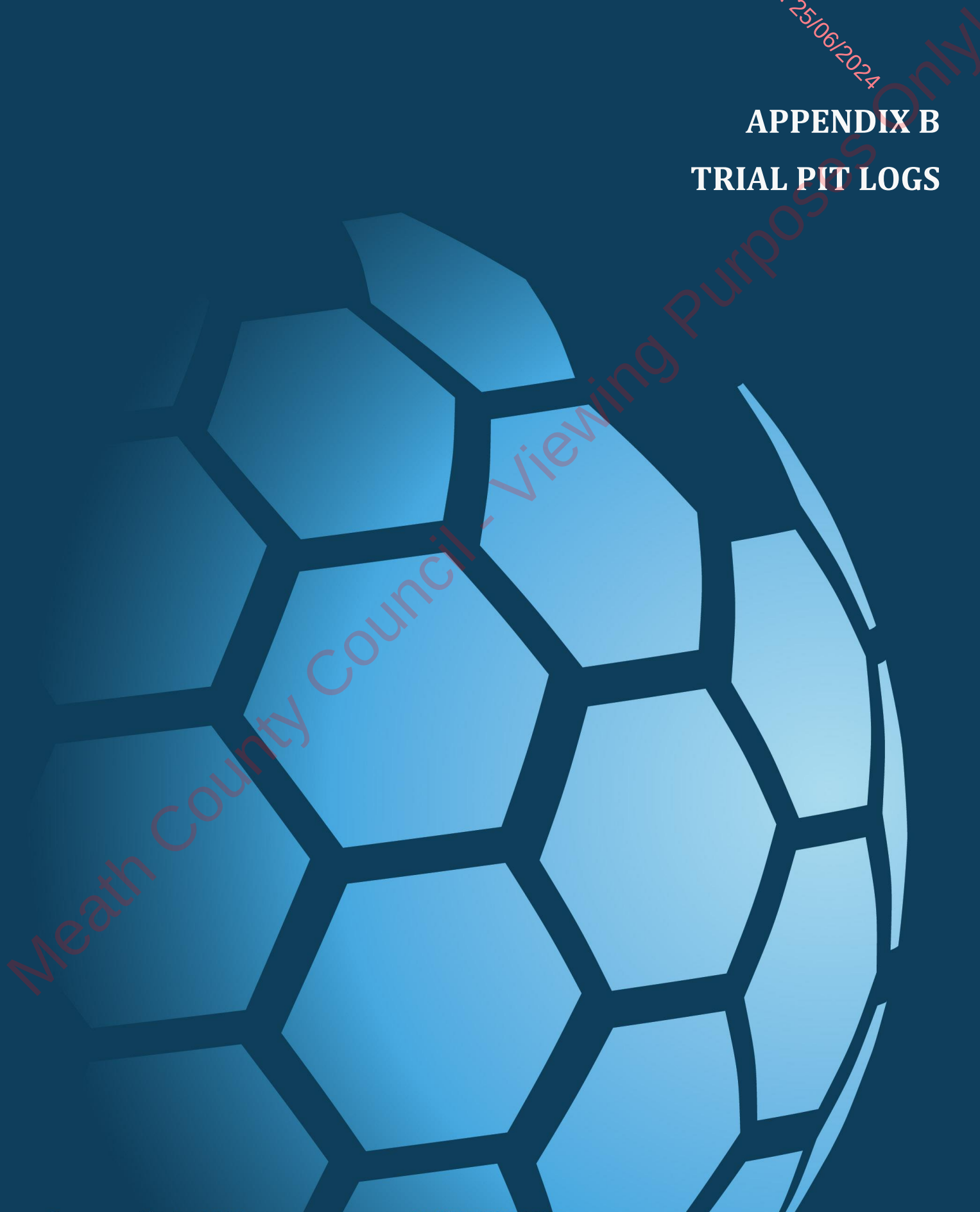
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APPENDIX B
TRIAL PIT LOGS



Meath County Council - Viewing Purposes Only!



Length: 1.80

 CAUSEWAY GEOTECH			Project No.: 18-1272		Project Name: Dunboyne, Co. Meath		Trial Pit No.: TP02	
Method: Trial Pitting			Co-ordinates: 302334.10 E		Client: Dunboyne, Co. Meath		Sheet 1 of 1	
			241651.32 N		Client's Representative: DBFL		Scale: 1:25	
Plant: 3T Tracked Excavator			Ground Level: 65.22 mOD		Date: 30/10/2018		Logger: SG	
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	
			65.12	(0.10) 0.10		MADE GROUND: Soft brown slightly sandy slightly gravelly CLAY with grass and roots. (Reworked topsoil)		
				(0.40)		Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
			64.72	0.50		Firm greyish brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded.		0.5
				(0.60)				
			64.12	1.10		Grey sandy subrounded fine to coarse GRAVEL. Sand is fine to coarse.		1.0
				(0.40)				
		Groundwater encountered at 1.50m	63.72	1.50		End of trial pit at 1.50m	▼	1.5
								2.0
								2.5
								3.0
								3.5
								4.0
								4.5
Remarks Terminated due to pit walls collapsing						Water Strikes:		Stability: Unstable
						Struck at (m):	Remarks:	Width: 0.50 Length: 2.10
						1.50	Groundwater encountered at 1.50m	

 CAUSEWAY GEOTECH			Project No.: 18-1272		Project Name: Dunboyne, Co. Meath		Trial Pit No.: TP03		
Method: Trial Pitting			Co-ordinates: 302379.95 E		Client: Dunboyne, Co. Meath		Sheet 1 of 1		
			241616.31 N		Client's Representative: DBFL		Scale: 1:25		
Plant: 3T Tracked Excavator			Ground Level: 65.62 mOD		Date: 30/10/2018		Logger: SG		
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water		
			65.52	(0.10) 0.10		MADE GROUND: Soft brown slightly sandy slightly gravelly CLAY with grass and roots. (Reworked topsoil)			
				(0.50)		Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.		0.5	
			65.02	0.60		Firm greyish brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse predominately of limestone. Cobbles are subrounded.		1.0	
				(0.85)				1.5	
			64.17	1.45		Brownish grey very sandy slightly silty subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded.		2.0	
				(0.45)				2.5	
		Groundwater encountered at 1.80m	63.72	1.90		End of trial pit at 1.90m		3.0	
								3.5	
								4.0	
								4.5	
Remarks Terminated due to pit walls collapsing						Water Strikes:		Stability: Unstable	
						Struck at (m):		Remarks:	Width: 0.50 Length: 2.30
						1.80		Groundwater encountered at 1.80m	

 CAUSEWAY GEOTECH		Project No.: 18-1272		Project Name: Dunboyne, Co. Meath		Trial Pit No.: TP04	
		Co-ordinates: 302454.30 E		Client: Dunboyne, Co. Meath		Sheet 1 of 1	
Method: Trial Pitting		241622.00 N		Client's Representative: DBFL		Scale: 1:25	
Plant: 3T Tracked Excavator		Ground Level: 65.61 mOD		Date: 30/10/2018		Logger: SG	

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water
			65.51	(0.10)		MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with grass roots and fragments of brick and plastic. Sand is fine to coarse. Gravel is subrounded fine to coarse. (Reworked topsoil)	
				(0.35)		Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.	
			65.16	0.45		Firm greyish brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse predominately of limestone. Cobbles are subrounded.	0.5
				(1.40)			1.0
							1.5
							2.0
		Water strike at 1.85m	63.76	1.85		Brownish grey very sandy subrounded fine to coarse GRAVEL. Sand is fine to coarse.	2.0
				(0.35)			2.5
			63.41	2.20		End of trial pit at 2.20m	2.5
							3.0
							3.5
							4.0
							4.5

Remarks SA02 carried out. Terminated due to pit walls collapsing	Water Strikes:		Stability: Unstable
	Struck at (m):	Remarks:	
	1.85	Water strike at 1.85m	Width: 0.50 Length: 1.80

 CAUSEWAY GEOTECH			Project No.: 18-1272		Project Name: Dunboyne, Co. Meath		Trial Pit No.: TP05		
Method: Trial Pitting			Co-ordinates: 302482.86 E		Client: Dunboyne, Co. Meath		Sheet 1 of 1		
			241588.59 N		Client's Representative: DBFL		Scale: 1:25		
Plant: 3T Tracked Excavator			Ground Level: 65.26 mOD		Date: 30/10/2018		Logger: SG		
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description		Water	
			65.16	(0.10) 0.10		MADE GROUND: Soft brown slightly sandy slightly gravelly CLAY with roots and plastic. Sand is fine to coarse. Gravel is subrounded fine to medium. (Reworked topsoil)			
				(0.40)		Soft to firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.			
			64.76	0.50		Firm greyish brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		0.5	
				(1.00)				1.0	
			63.76	1.50		Grey very sandy subrounded fine to coarse GRAVEL. Sand is fine to coarse.		1.5	
		Groundwater encountered at 1.80		(0.50)					
			63.26	2.00		End of trial pit at 2.00m		2.0	
								2.5	
								3.0	
								3.5	
								4.0	
								4.5	
Remarks SA03 carried out. Terminated due to pit walls collapsing						Water Strikes:		Stability: Unstable	
						Struck at (m):		Remarks:	Width: 0.50 Length: 1.70
						1.80		Groundwater encountered at 1.80	

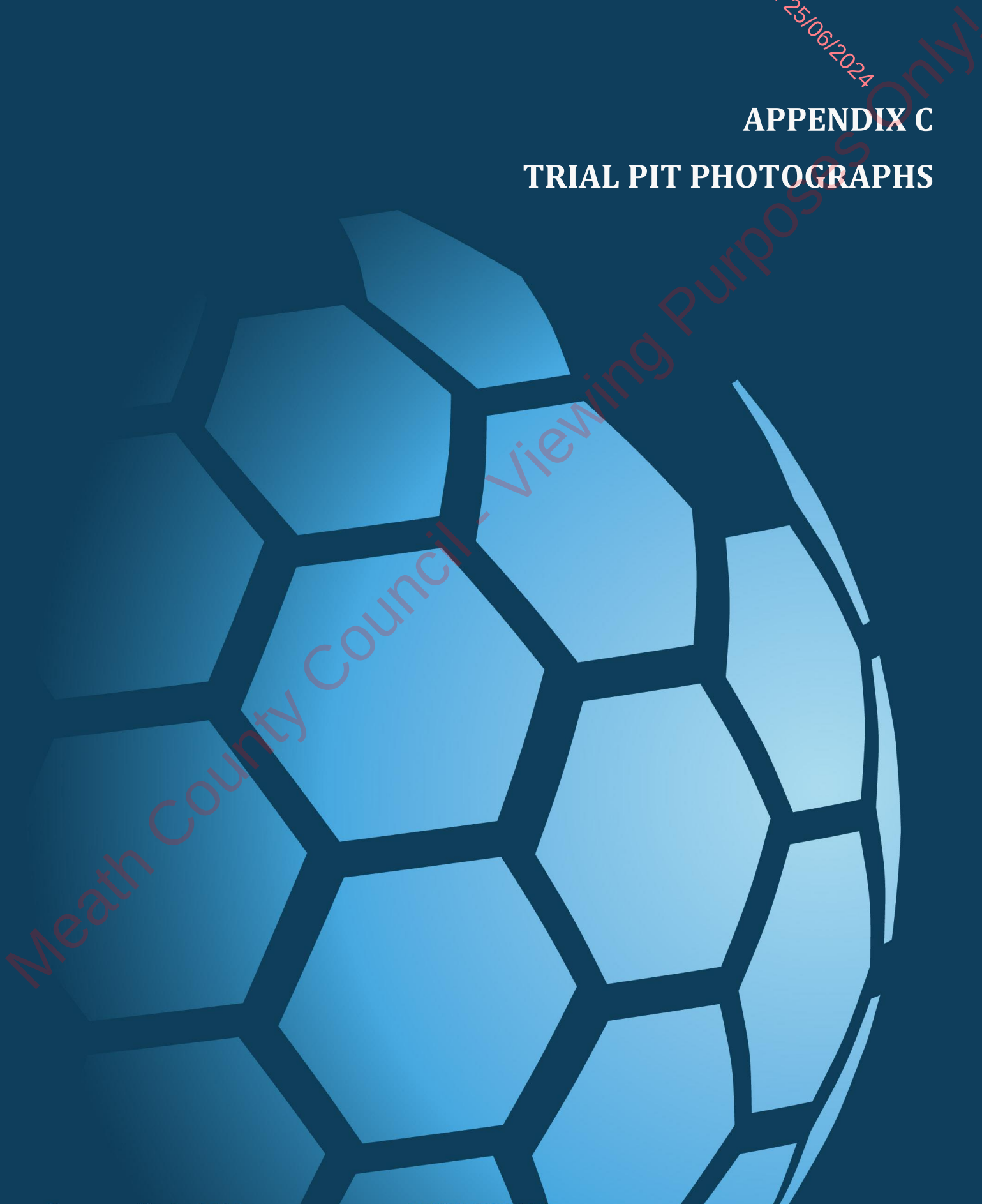
 CAUSEWAY GEOTECH		Project No.: 18-1272		Project Name: Dunboyne, Co. Meath		Trial Pit No.: TP06		
Method: Trial Pitting		Co-ordinates: 302480.40 E 241688.82 N		Client: Dunboyne, Co. Meath Client's Representative: DBFL		Sheet 1 of 1		
Plant: 3T Tracked Excavator		Ground Level: 65.37 mOD		Date: 30/10/2018		Scale: 1:25 Logger: SG		
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	
			65.27	(0.10) 0.10		MADE GROUND: Brown slightly sandy slightly gravelly CLAY with roots, grass and fragments of plastic. Sand is fine to coarse. Gravel is subrounded fine to medium. (Reworked topsoil) Firm locally stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.		
				(0.70)			0.5	
			64.57	0.80		Firm locally stiff dark greyish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.	1.0	
				(0.55)				
			64.02	1.35		Black very gravelly fine to coarse SAND. Gravel is subrounded fine to coarse.	1.5	
		Groundwater encountered at 1.60m		(0.35)				
			63.67	1.70		End of trial pit at 1.70m		
Remarks						Water Strikes:		Stability: Unstable
Terminated due to pit walls collapsing						Struck at (m):		Width: 0.50 Length: 2.30
						1.60		
						Remarks:		



CAUSEWAY
— GEOTECH

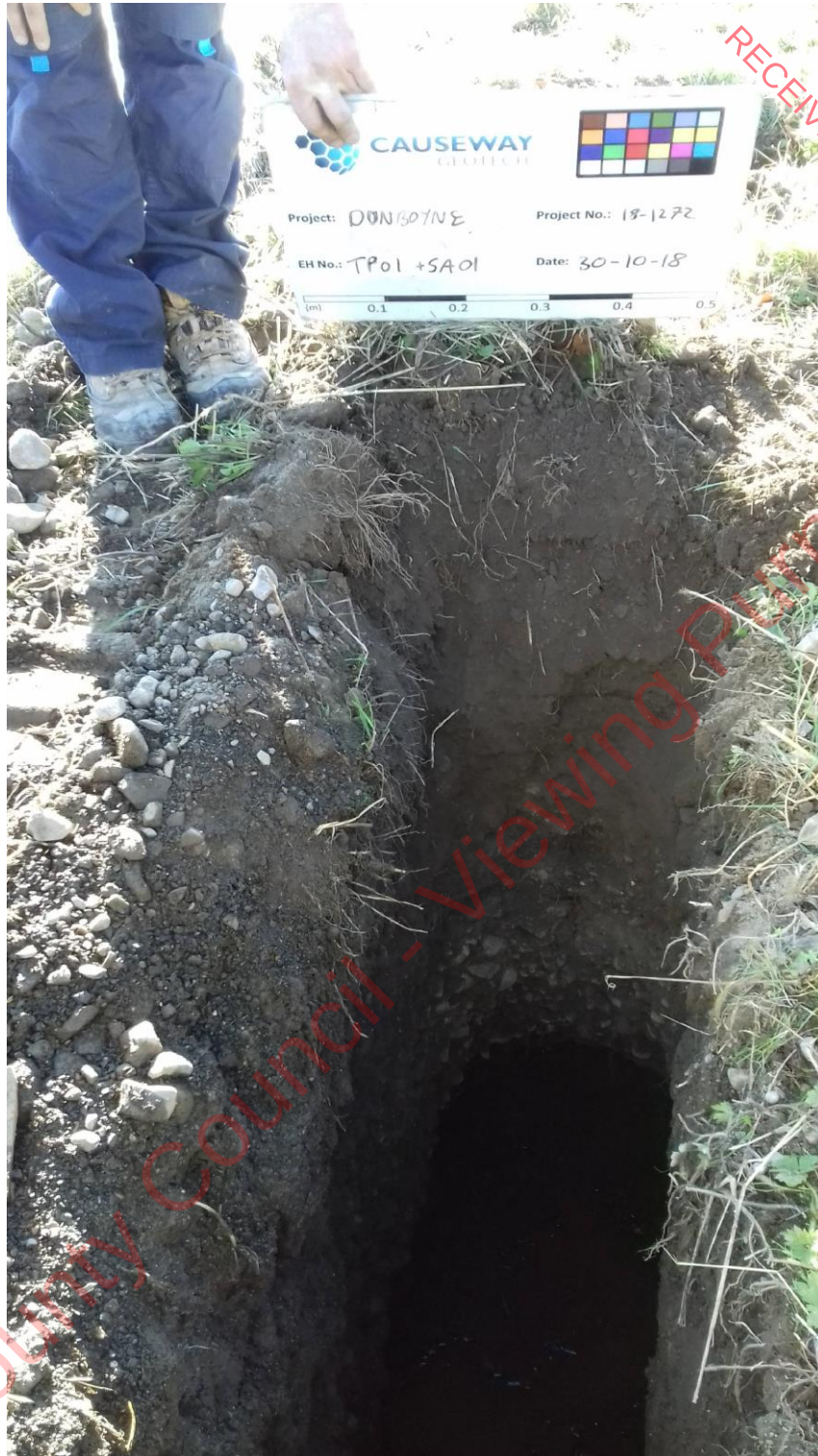
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APPENDIX C
TRIAL PIT PHOTOGRAPHS





TP01



TP01



TP01



TP01



TP02



TP02



TP02



TP02



TP03



TP03



TP03



TP03



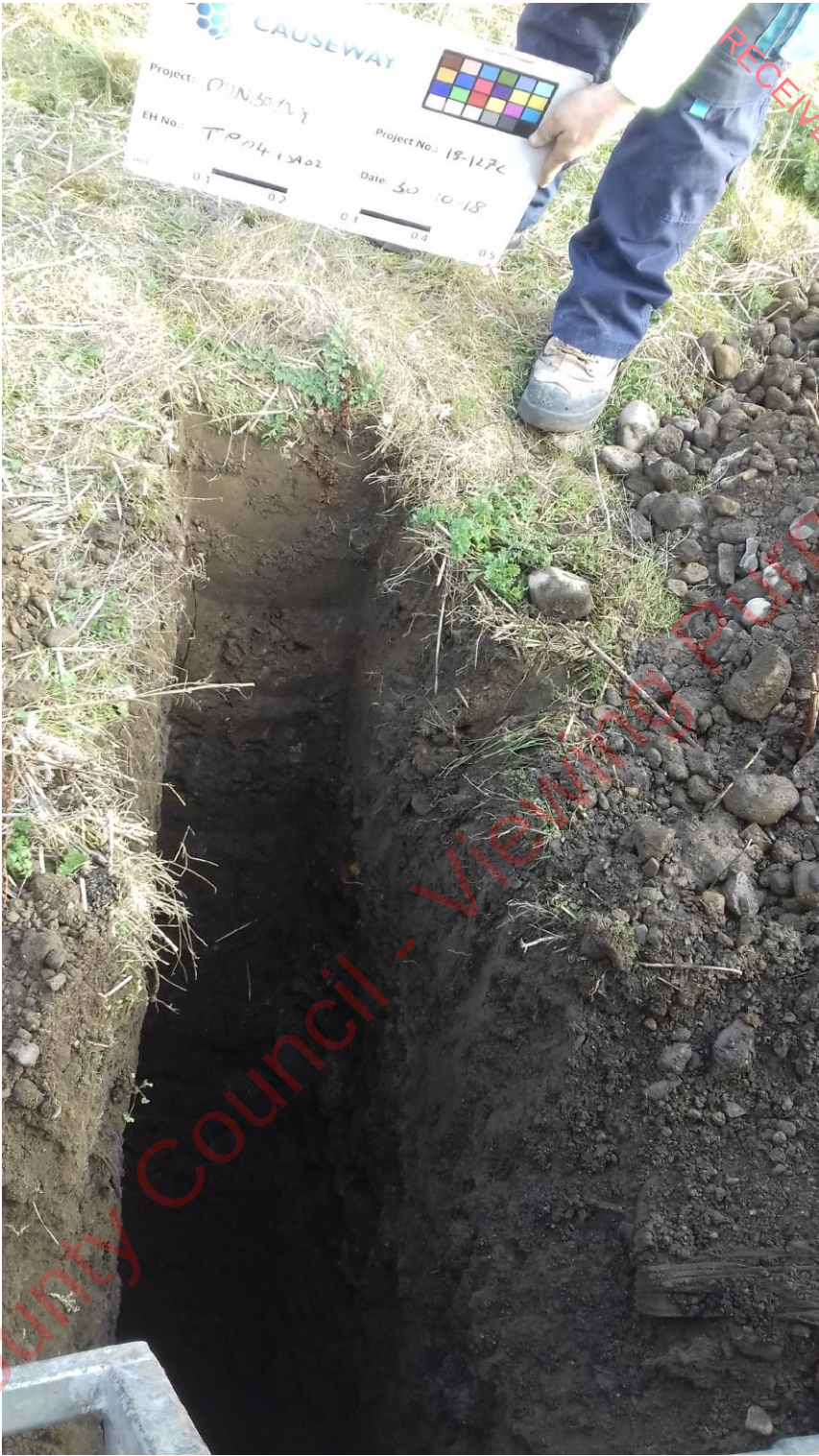
TP03



TP03



TP04



TP04



TP04



TP04



TP04



TP05



TP05



TP05



TP05



TP05



TP06



TP06



TP06



TP06



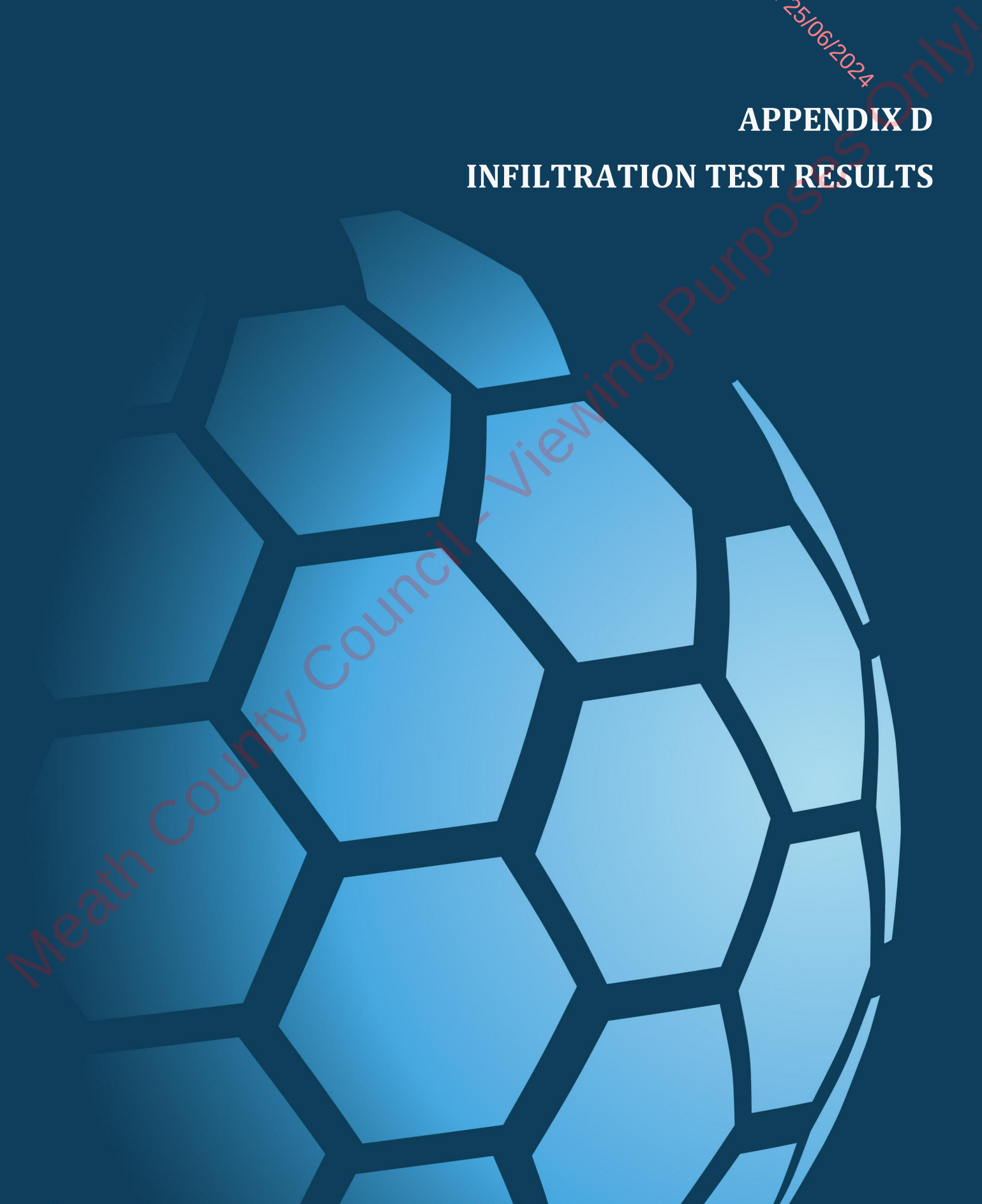
TP06



CAUSEWAY
— GEOTECH

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APPENDIX D
INFILTRATION TEST RESULTS



Soakaway Infiltration Test

Project No.: 18-1272

Site: Station Road, Dunboyne

Test Location: SA01

Test Date: 30 October 2018



*Analysis using method as described in BRE Digest 365
and CIRIA Report C697-The SUDS Manual*

	width (m)	length (m)
test pit top dimensions	0.50	1.80
test pit base dimensions	0.60	2.20
test pit depth (m)	1.80	

depth to groundwater before adding water (m) = 1.70

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	1.47	0.33
1	1.56	0.24
2	1.62	0.18
4	1.70	0.10
6	1.74	0.06
8	1.80	0.00
10		
15		
20		
25		
30		
45		
60		
75		

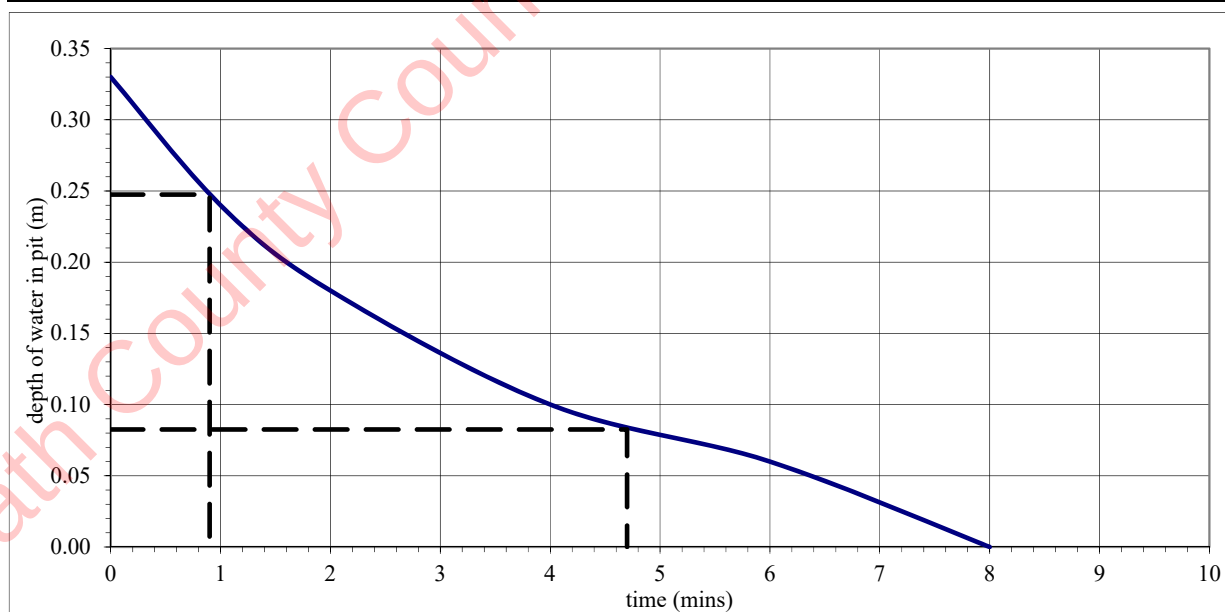
From graph below:

test start - 75% depth at
0.2475 m water depth
time is 0.9 minutes

test end - 25% depth at
0.0825 m water depth
time is 4.7 minutes

test infiltration rate (q) = 1.490 m/h

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m ³)	Area of walls and base at 50% drop (m ²)	q (m/min)	q (m/h)
0.9	1.55	0.2475	3.8	0.21	2.23	2.5E-02	1.490
4.7	1.72	0.0825					



Soakaway Infiltration Test

Project No.: 18-1272
Site: Station Road, Dunboyne
Test Location: SA02
Test Date: 30 October 2018



*Analysis using method as described in BRE Digest 365
and CIRIA Report C697-The SUDS Manual*

	width (m)	length (m)
test pit top dimensions	0.50	1.80
test pit base dimensions	0.50	1.80
test pit depth (m)	2.20	

depth to groundwater before adding water (m) = 2.10

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	1.74	0.46
1	1.81	0.39
2	1.83	0.37
4	1.88	0.32
6	1.92	0.28
8	1.96	0.24
10	1.99	0.21
15	2.05	0.15
20	2.10	0.10
25		
30		
45		
60		
75		

From graph below:

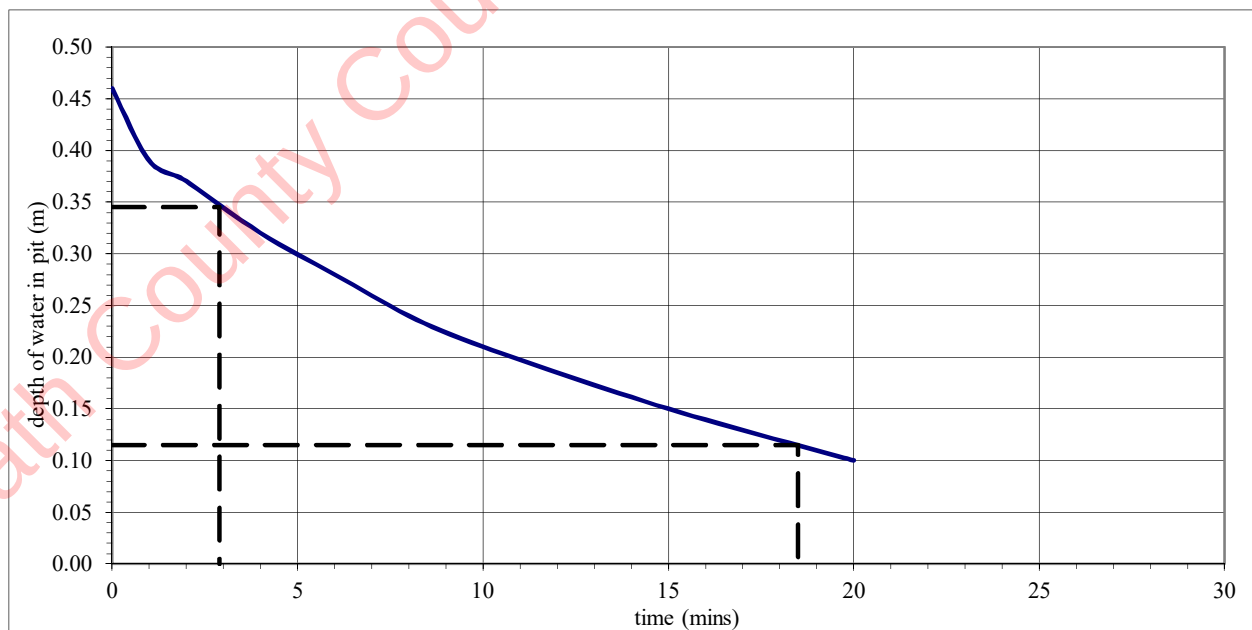
test start - 75% depth at
0.345 m water depth
time is 2.9 minutes

test end - 25% depth at
0.115 m water depth
time is 18.5 minutes

test infiltration rate (q) = 0.407 m/h

***Note:** Trial pit sides collapsed at 1.96mbgl. Readings at 10, 15 and 20 mins are extrapolated.

time (mins)	water surface (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m ³)	Area of walls and base at 50% drop (m ²)	q (m/min)	q (m/h)
2.9	1.86	0.345	15.6	0.21	1.96	6.8E-03	0.407
18.5	2.09	0.115					



Soakaway Infiltration Test

Project No.: 18-1272
Site: Station Road, Dunboyne
Test Location: SA03
Test Date: 30 October 2018



*Analysis using method as described in BRE Digest 365
and CIRIA Report C697-The SUDS Manual*

	width (m)	length (m)
test pit top dimensions	0.50	1.70
test pit base dimensions	0.50	1.70
test pit depth (m)	1.95	

depth to groundwater before adding water (m) = 1.75

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	1.59	0.36
1	1.65	0.30
2	1.68	0.27
4	1.70	0.25
6	1.71	0.24
8	1.72	0.23
10	1.73	0.22
15	1.75	0.20
20	1.75	0.20
25	1.75	0.20
30	1.75	0.20
45		
60		
75		

From graph below:

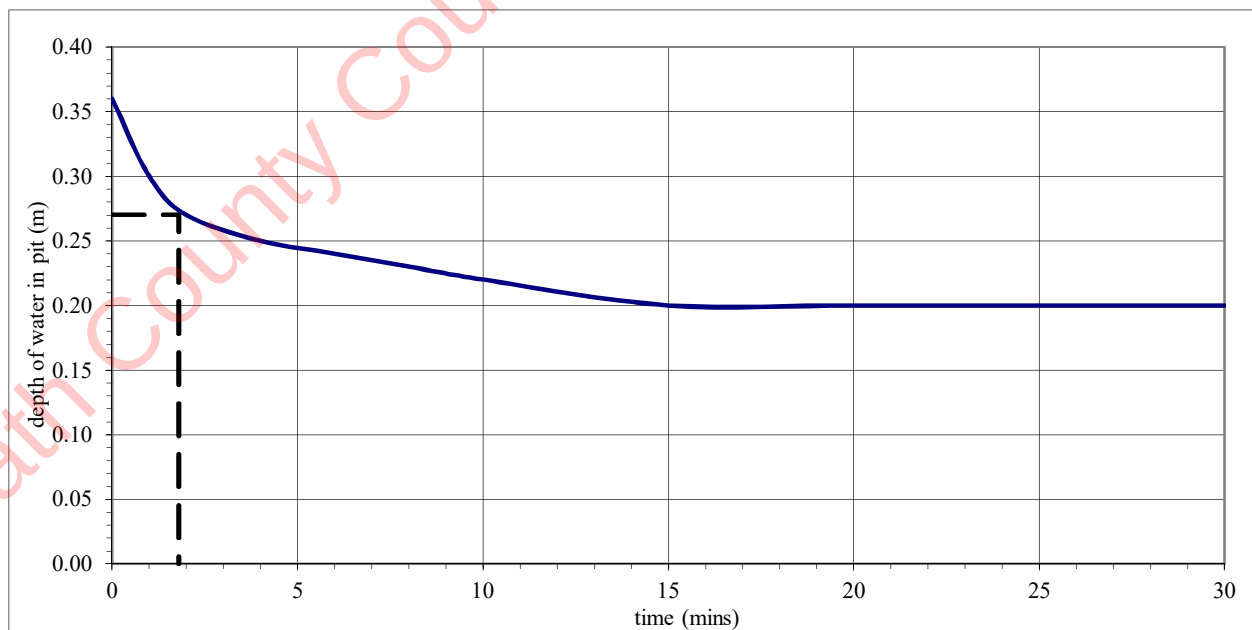
test start - 75% depth at
0.27 m water depth
time is 1.8 minutes

test end - 25% depth at
0.09 m water depth
time is not determined

infiltration rate (q) is very low

***Note:** Trial pit sides collapsed at 1.96mbgl. Readings at 10, 15 and 20 mins are extrapolated.

time (mins)	water surface (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m ³)	Area of walls and base at 50% drop (m ²)	q (m/min)	q (m/h)
1.8	1.68	0.27					





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Appendix G : Irish Water Correspondence

CONFIRMATION OF FEASIBILITY

Indhu Priya Rajavadivelu

DBFL Consulting

Ormond House Upper ,
Ormond Quay
Dublin
Dublin
D07W704

17 April 2024

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

Uisce Éireann
PO Box 448
South City
Delivery Office
Cork City

www.water.ie

Our Ref: CDS24001654 Pre-Connection Enquiry
Townland Of Castlefarm, South Of Station Road, Dunboyne, Meath

Dear Applicant/Agent,

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

Uisce Éireann has reviewed the pre-connection enquiry in relation to a Water & Wastewater connection for a Multi/Mixed Use Development of 76 unit(s) at Townland Of Castlefarm, South Of Station Road, Dunboyne, Meath, (the **Development**).

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

- **Water Connection** - Feasible Subject to upgrades
- In order to accommodate the proposed connection at the Premises, upgrade works are required to increase the capacity of the Uisce Éireann watermain network. Approximately 155m of existing 200mm ID watermain is required to be upsized to 400mm ID watermain (Red line in Fig 1 mapping below). These upgrade works are not currently on the Uisce Éireann investment plan therefore, the applicant will be required to fund these local network upgrades. The fee will be calculated at connection application stage.

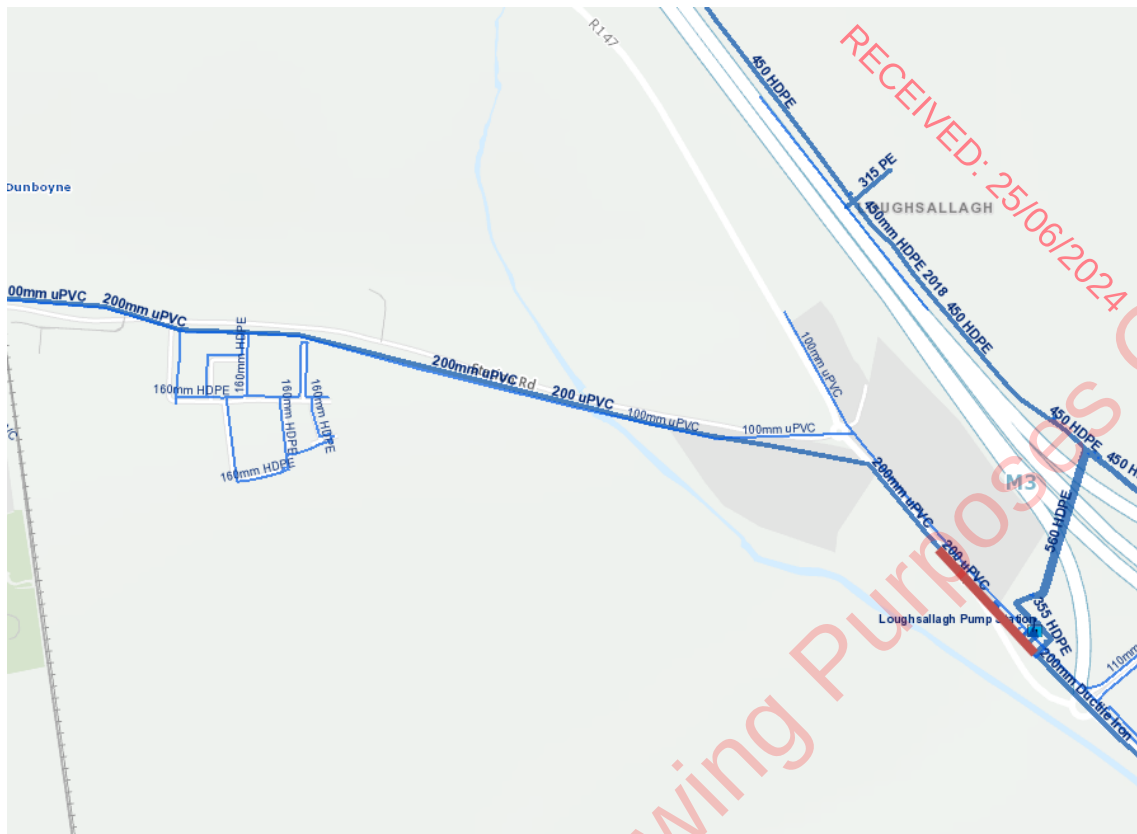


Figure 1 Watermain upgrades required

- **Wastewater Connection**
 - Feasible without infrastructure upgrade by Irish Water
 - The proposed Development indicates that Uisce Éireann assets are present on the site. The Developer has to demonstrate that proposed structures and works will not inhibit access for maintenance or endanger structural or functional integrity of the assets during and after the works. Drawings (showing clearance distances, changing to ground levels) and Method Statements should be included in the Detailed Design of the Development. A wayleave in favour of Uisce Éireann will be required over the assets that are not located within the Public Space. For design submissions and queries related to diversion/build near or over, please contact IW Diversion Team via email address diversions@water.ie

This letter does not constitute an offer, in whole or in part, to provide a connection to any Uisce Éireann 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 Uisce Éireann.

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/

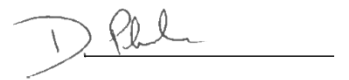
Where can you find more information?

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

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

For any further information, visit www.water.ie/connections, email newconnections@water.ie or contact 1800 278 278.

Yours sincerely,



Dermot Phelan
Connections Delivery Manager

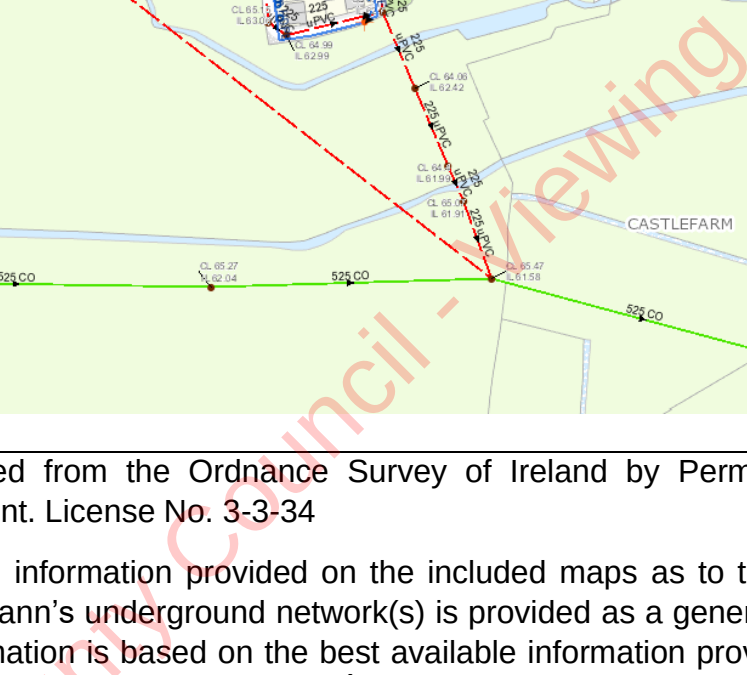
Section A - What is important to know?

What is important to know?	Why is this important?
Do you need a contract to connect?	- 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 Uisce Éireann's network(s). - Before the Development can connect to Uisce Éireann's network(s), you must submit a connection application <u>and be granted and sign</u> a connection agreement with Uisce Éireann.
When should I submit a Connection Application?	A connection application should only be submitted after planning permission has been granted.
Where can I find information on connection charges?	Uisce Éireann connection charges can be found at: https://www.water.ie/connections/information/charges/
Who will carry out the connection work?	All works to Uisce Éireann's network(s), including works in the public space, must be carried out by Uisce Éireann*. *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
Fire flow Requirements	- 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. What to do? - Contact the relevant Local Fire Authority
Plan for disposal of storm water	- The Confirmation of Feasibility does not extend to the management or disposal of storm water or ground waters. What to do? - Contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges.
Where do I find details of Uisce Éireann's network(s)?	Requests for maps showing Uisce Éireann's network(s) can be submitted to: datarequests@water.ie

What are the design requirements for the connection(s)?	The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this Development shall comply with <i>the Uisce Éireann Connections and Developer Services Standard Details and Codes of Practice</i>, available at www.water.ie/connections
Trade Effluent Licensing	- 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). - More information and an application form for a Trade Effluent License can be found at the following link: https://www.water.ie/business/trade-effluent/about/ **trade effluent is defined in the Local Government (Water Pollution) Act, 1977 (as amended)

infrastructure
rail

Only!



No. 3-3-34

on provided on the included maps as to the
ground network(s) is provided as a general
based on the best available information provided

and to Uisce Éireann.

been taken in respect of the information contained in the map. Uisce Éireann assumes no responsibility for claims or warranties concerning the accuracy or completeness of the information provided, nor does it accept any liability in or out of any errors or omissions. This information should not be relied upon in the event of excavations or any other works in the vicinity of Uisce Éireann's underground network. When carrying out excavations or any other works, the location of the Uisce Éireann's underground network(s) is identified and marked. Whether works being carried out. Service connections to the network should be anticipated.



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DBFL CONSULTING ENGINEERS

Registered Office

Ormond House
Upper Ormond Quay
Dublin 7 Ireland D07 W704

+ 353 1 400 4000
info@dbfl.ie
www.dbfl.ie

Cork Office

14 South Mall
Cork T12 CT91

+ 353 21 202 4538
info@dbfl.ie
www.dbfl.ie

Waterford Office

Suite 8b The Atrium
Maritona Gate, Canada St
Waterford X91 W028

+ 353 51 309 500
info@dbfl.ie
www.dbfl.ie