Project

Residential Development, Cornelscourt, Dublin 18

Report Title

Infrastructure Design Report

Client

Cornel Living Ltd.

INFRASTRUCTURE

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APPENDICES

1. INTRODUCTION

1.1. Background

DBFL have been instructed to prepare an Infrastructure Design Report to accompany a planning application for a proposed residential development located at Cornelscourt Village, Old Bray Road, Cornelscourt, Dublin 18.

The proposed development ("the site") comprises of 412 apartments, 7 houses, residential amenities (a gym; a variety of tenant amenity lounges including a concierge; a single storey multipurpose pavilion building within the communal courtyard), a childcare facility and café / retail unit on a 2.15 Ha site (approx.).

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 site which is currently greenfield (with the exception of a temporary carpark in its north-west corner) is located adjacent to Cornelscourt Village (refer to Figure 1.1).

The N11 road is located to the north-east of the site, existing residential development (Willow Grove) is located to the south-east of the site and the AIB (and associated carparking) is located to the north-west of the site. Old Bray Road is located to the south-west of the site.

1.4. Topography

The site generally falls from its western corner towards its eastern corner at a gradient of approximately 1/24.

Existing topographic survey information is shown in the background of the Proposed Roads Layout Plan (refer to DBFL Drawing Nos. 180208-XX-XX-DR-C-2001).

1.5. Ground Conditions

Ground Investigations Ireland carried out site investigations in January 2019 (trial pit logs are included in Appendix B).

The site is overlaid by a topsoil layer of up to 300mm deep with the exception of the temporary carpark area where made ground comprising of clayey gravels were observed at surface level.

Observed subsoil material comprises of sandy / gravelly clays.

Soakaway testing was carried out at three locations (in the vicinity of the proposed attenuation facility). Infiltration was not observed at any of the test locations. Infiltration test results are included in Appendix B.

1.6. Proposed Development

The proposed development ("the site") comprises of 412 apartments, 7 houses, residential amenities (a gym; a variety of tenant amenity lounges including a concierge; a single storey multipurpose pavilion building within the communal courtyard), a childcare facility and café / retail unit and associated engineering infrastructure including access for vehicles and pedestrians from the Old Bray Road, surface water drainage, foul drainage and water supply infrastructure. Proposed foul drainage infrastructure includes provision of a 2,150 m^3 balancing storage tank which will facilitate a potential future upgrade of the Foxrock Catchment by Irish Water. Foul drainage flows from the development will be routed via a pump station which is to be incorporated within the balancing storage tank.

Figure 1.1 Extract from myplan.ie viewer (Site Boundary Indicative Only).

2. SITE ACCESS

2.1. Site Access Layout

Vehicle Access – Old Bray Road

The primary access point for motorised vehicles is from Old Bray Road. This access route also serves the AIB carpark (north-west of the site). Refer to DBFL Drawings 180208-XX-XX-DR-C-2001 & 180208-XX-XX-DR-C-2002 for the proposed site access layout.

The access arrangement described above serves as the vehicular access route to the basement carpark and to the podium area (set down only) and provides a more formalised access when compared to the existing access arrangements for the AIB carpark. A layby is also provided adjacent to Block E use by delivery vehicles.

No direct vehicle access for residents is provided to the seven houses located along the eastern boundary (this is intended as a pedestrian zone), however, fire tender access to this area and access to the ESB sub-station and foul drainage pumping station in the eastern corner of the site is facilitated via the podium (removable bollards are located on the southern side of the podium).

The Old Bray Road has a posted speed limit of 50 km/hour. The site entrance complies with minimum visibility splays as required by DMURS (Y Distance = 45m, X Distance = 2.4m).

Line marking is provided in accordance with the Department of Transport's Traffic Signs Manual.

Pedestrian and Cycle Access

The site layout also facilitates high levels of cycle and pedestrian connectivity as noted below. Also refer to DBFL Drawing 180208-DBFL-XX-XX-DR-C-2010 (Pedestrian and Cycle Linkage Plan).

- Provides pedestrian access to the podium area of the development from two locations along Old Bray Road (i.e. direct, dedicated, attractive and safe linkage to a range of local amenities and local service destinations in Cornelscourt Village).
- A pedestrian crossing is provided at the key pedestrian desire line on approach to the podium area (at the point where vehicles approach the podium area) allowing pedestrian to informally assert a degree of priority.

- At the northern corner of the site, provision is made for cycle access from the adjacent bicycle parking area at basement level to the existing cycle track located along the N11.Pedestrian access is also facilitated at this location from the development to the proposed footpath along the N11 (this proposed footpath aligns with objectives in the Bus Connects Emerging Preferred Route for Bray to the City Centre).
- Dedicated cycle access to bicycle parking areas at basement level is also provided at two locations along the eastern side of the basement (accessed from Old Bray Road via the shared surface which runs from the podium area, along the southern site boundary before turning north towards the cycle access points at the eastern side of the basement).
- As a secondary means of accessing bicycle parking at basement level, wheeled channels adjacent to stairs from podium level are also provided.
- The cycle access points noted above are completely separate from the vehicle access ramp to the basement.
- Provision is also made for a potential future cycle / pedestrian link at the eastern corner of the site (linking the proposed development to the existing park at the northern end of Willow Grove).

2.2. Vehicle Tracking

The proposed site layout has been tracked (using AutoTrack software) to demonstrate that large vehicles such as a high-reach fire tender can access the site, travel onto the podium slab and access the houses along the eastern boundary (refer to DBFL Drawings 180208-XX-XX-DR-C-2003, 180208-XX-XX-DR-C-2004 and 180208-XX-XX-DR-C-2005).

2.3. Pavement Design Standards

The primary site access off Old Bray Road is designed in accordance with the Design Manual for Urban Roads and Streets (DMURS) and Local Authority requirements.

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

2.4. Traffic and Transportation

A separate Traffic and Transportation Assessment has been prepared as part of this planning application (refer to DBFL Report No. 180208-DBFL-RP-D-0001).

3. SURFACE WATER DRAINAGE

3.1. Existing Surface Water Drainage

The site falls from its western corner towards its eastern corner forming a single surface water catchment. An existing 225mm diameter surface water drain is located adjacent to the site's eastern corner (at the northern end of Willow Grove, refer to Figure 3.1). This pipeline outfalls to the east via a crossing under the N11, South Park and Clonkeen College. DLRCC have confirmed that this infrastructure has been "taken in charge".

An existing 600mm concrete surface water line is located adjacent to the site's north-eastern boundary. It is understood that this drain serves the N11 carriageway.

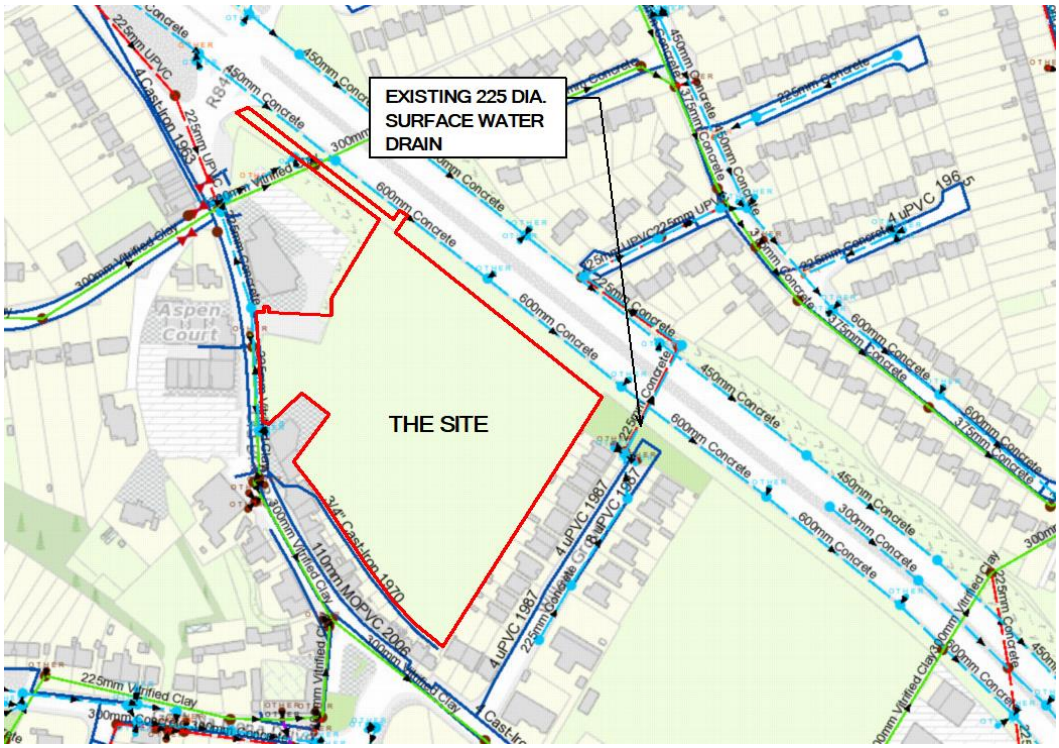


Figure 3.1 Extract from Irish Water Network Plan (Site Boundary Indicative Only)

3.2. Basis of Design

3.2.1. General Description of Surface Water Design

As noted previously, an existing 225mm diameter surface water drain is located adjacent to the site's eastern corner (at the northern end of Willow Grove). This pipe is expected to provide a suitable surface water outfall for the proposed development.

Refer to DBFL Drawing No. 180208-XX-XX-DR-C-3001 for proposed surface water outfall location as noted above.

Surface water discharge rates from the proposed surface water drainage network will be controlled by vortex flow control devices (Hydrobrake or equivalent) and associated underground attenuation tanks (Stormtech Chambers or equivalent). Surface water discharge will also pass via a full retention fuel / oil separator (sized in accordance with permitted discharge from the site).

The proposed surface water drainage network will collect surface water runoff from the site via a piped network prior to discharging off site via the attenuation tanks, flow control device and separator arrangement as noted above.

Surface water runoff from **apartment roofs will be captured by green roofs** (sedum blanket) prior to being routed to the piped surface water drainage network.

Surface water runoff from the **roofs of houses along the south-eastern boundary will be routed to the proposed surface water pipe network via filter drains** located in their rear gardens (providing an additional element of attenuation and treatment).

A **drainage reservoir (drainage board) is to be provided on the podium slab over basement** (for green areas and paved areas).

Surface water runoff from the **site's internal street network (adjacent to the south-western and south-eastern boundaries) will be directed to the proposed pipe network via tree pits** with overflow to conventional road gullies.

Surface water runoff from **paved areas adjacent to the site access from Old Bray Road will be directed to the proposed pipe network via conventional road gullies.**

Any incidental surface water runoff generated from the basement carpark would drain through a separate system beneath the basement slab (out falling to the proposed foul drainage network via a petrol interceptor).

3.2.2. Compliance with Surface Water Drainage Policy

The site's surface water management infrastructure has been designed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS).

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 SUDS features such as permeable paving of driveways, underground attenuation tanks 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 DBFL Report No. 180208-rep-002 (Site Specific 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. Proposed Runoff Coefficients and Factored Impermeable Areas

Proposed Runoff Coefficients

Noted below are the proposed reduction factors for the proposed development.

- Green Roof – 5% Reduction Factor

  The proposed build-up will be an extensive type with 100mm minimum construction depth and sedum planting. The soil build-up will partially absorb some of the initial run-off and once saturated will reduce flow rates through the green roof medium to the outlets and final attenuation storage location.

- Green Areas Over Podium – 15% Reduction Factor

  Soft landscaped podium areas will have typical soil depths of up to 300mm to facilitate grassed areas, plants, shrubs and trees i.e. similar to a deep intensive green roof build up.

- Permeable Paving Over Podium – 10% Reduction Factor

  On the podium will have a free draining material within the build-up and will reduce the flow rate from these areas. A reduction in velocity will also occur as the aggregate used will slow the run-off at source.

- Roof Areas Draining Via SuDS – 15% Reduction Factor

  The houses located along the site's south-eastern boundary (adjacent to Willow Grove) drain via filter drains. There will be a reduction of velocity as the aggregate/filter material used in SuDS features slow the run-off at source ultimately reduce the peak inflow for attenuation calculations.

- Permeable Paved Areas Draining via SUDS – 30% Reduction Factor

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

- Soft Landscaped / Grassed Areas – 47% Reduction Factor

  Grassed / Landscaped areas slows the run-off at source ultimately reduce the peak inflow for attenuation calculations.

- Impermeable Roads (Site Access from Old Bray Road) – 5% Reduction Factor

  A 5% reduction of the surface area is applied to take account of run-off not collected and stored within the micro and macro texture of the surfacing.

Factored Impermeable Areas

Proposed Runoff Coefficients and Factored Impermeable Areas are noted below in Table 3.1.

		Catchment A		Catchment B		Catchment C		Catchment D		Total (m2)	
	Runoff Coefficients	Gross Areas (m2)	Factored Areas (m2)	Gross Areas (m2)	Factored Areas (m2)	Gross Areas (m2)	Factored Areas (m2)	Gross Areas (m2)	Factored Areas (m2)	Gross Area (m2)	Factored Areas (m2)
Roofs (Houses) Draining Via SUDs	0.85	-	-	94	79	251	213	407	346	751	639
Green Roofs (Apartment Buildings) - Sedum Blanket	0.95	1,505	1,430	1,125	1,069	1,847	1,755	956	908	5,433	5,161
Green Areas on Podium (Over Drainage Board)	0.85	-	-	503	427	852	724	688	585	2,043	1,736
Permeable Paved Areas on Podium (Over Drainage Board)	0.9	-	-	1,903	1,712	991	892	459	413	3,352	3,017
Paved Areas Draining to Gullys (adjacent to Old Bray Road)	0.95	477	453	-	-	-	-	-	-	477	453
Permeable Paved Areas – Draining via Tree Pits with Overflow to Gullies	0.7	-	-	-	-	585	409	321	225	906	634
Soft Landscaping	0.53	1,251	663	597	316	4,347	2,304	1,960	1,039	8,154	4,322
		3233.400	2546.184	4220.400	3603.952	8872.600	6297.395	4789.700	3514.553	21116.100	15962.084

Table 3.1 Proposed Runoff Coefficients and Factored Impermeable Areas

3.2.4. Allowable Greenfield Runoff Rate

Ground Conditions

Observed subsoil material comprises of sandy / gravelly clays (refer trial pit logs included in Appendix B of this report). Three number infiltration tests were also carried out. Infiltration was not observed at any of the test locations.

Assessment of Soil Type

Drainage Group 1

Depth to Impermeable Layer 2 (40cm – 80cm)

Permeability Group 3 (Slow)

Slope Class >8°

Therefore, Soil Type 4

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

Drainage 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			1	2	3
	40 - 80					2		3		4
	<40	—	—	—	—	—	—	—	—	—
2	>80	2		3			4	—		
	40 - 80									
	<40	3								
3	>80							—		
	40 - 80					5		—		
	<40									

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.

Figure 3.2, Assessment of Soil Type

Allowable Greenfield Runoff Rate

Qbar has been assessed based on GDSDS requirements

i.e. Qbar(m3/s) = 0.00108x(Area)0.89(SAAR)1.17(SOIL)2.17

Area – Approx.2.11 Ha (for purposes of total surface water catchment area)

SAAR – 945mm (based on local information from Met Eireann)

SOIL – Soil Type 4

Qbar = 13.16 l/sec (equivalent to 6.24 l/sec/Ha)

3.2.5. 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 Waste Water 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
- Soil Type 4
- Allowable Outflow 6.24 l/sec/ha
- Time of entry 4 minutes
- M5 - 60 16.4 mm
- M5 – 2 Day 60.1 mm
- Ratio "r" 0.273
- Pipe Friction (Ks) 0.6 mm
- Minimum Velocity (based on pipe flowing full) 1.0 m/s
- Rainfall Depth Factored for Climate Change (as per GDSDS) 10%

  (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

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

3.2.6. SuDS

The following methodologies are being implemented as part of a SuDS treatment train approach:

- Green Roof – The proposed build-up will be an extensive type with 100mm minimum construction depth and sedum planting.
- Green Areas Over Podium –Soft landscaped podium areas will have typical soil depths of up to 450mm to facilitate grassed areas, plants, shrubs and trees i.e. similar to a deep intensive green roof build up.
- Permeable Paving Over Podium – Free draining material within the build-up and will reduce the flow rate from these areas.
- Roof Areas Draining Via SuDS – Houses located along the site's south-eastern boundary (adjacent to Willow Grove) drain via filter drains and a bioretention area respectively.
- Permeable Paved Areas Draining via SUDS – Aggregate / filter material used in the permeable paving and tree pits slow run-off at source.
- Soft Landscaped / Grassed Areas – Slows run-off at source.
- Attenuation of the 30 and 100 year return period storms within Stormtech Attenuation Chambers.
- Installation of a vortex flow control devices (Hydrobrake or equivalent), limiting surface water discharge from the site to 13.0 l/sec
- Surface water discharge will also pass via a Class 1 full retention fuel / oil separator (sized in accordance with permitted discharge from the site)

3.2.7. Attenuation Calculation

Attenuation volumes have been calculated based on an allowable outflow / greenfield runoff rate of 6.24 l/sec/ha (refer to Section 3.4.2 above). Run-off from the proposed development will be controlled / attenuated using vortex type flow control devices (Hydrobrake or equivalent). The resultant storage system types, discharge limits and storage volumes for each catchment are detailed in Table 3.1.

The location of proposed attenuation systems is shown on DBFL Drawing 180208-XX-XX-DR-C-3001. Refer to Appendix C for Attenuation Design Calculations (attenuation volumes have been calculated using Microdrainage WinDes analysis software). In total 779m^3 of stormwater storage is provided.

Catchment / Attenuation Area	**Storage System Type**	**Catchment Area (Total)**	**Impermeable Catchment Area (Total)**	**Allowable Outflow (Max.)**	**Storage Volume Required (100 Yr.)**	**Storage Volume Provided (100 Yr.)**
A (cascades into Catchment B)	Aquacell Underground Chamber	0.323 Ha	0.255 Ha	2 l/s	107.4m^3	129.2m^3
B	Aquacell Underground Chamber	0.422Ha	0.360 Ha	5.7 l/s	133.8m^3	144m^3
C (cascades into Catchment D)	Stormtech Underground Chamber	0.887 Ha	0.630 Ha	5.0 l/s	260.3m^3	342.3m^3
D	Stormtech Underground Chamber	0.478 Ha	0.351 Ha	7.3 l/s	146m^3	154m^3
Total		2.11 Ha	1.596 Ha	-	647.5m^3	769.5m^3

Note, Catchment B (5.7 l/s) & Catchment D (7.3 l/s) share a single discharge point. i.e. Qbar 13 l/s (i.e. in accordance with allowable Greenfield Runoff Rate Calculated in Section 3.2.4).

Table 3.1 – Surface Water Attenuation Storage and Discharge Limits

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.

This 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 within the Stormtech Attenuation Chambers).

3.2.9. Stormwater Audit (Stage 1)

JBA Consulting have carried out a Stage 1 Stormwater Audit of the proposed surface water drainage design (refer to Appendix H). JBA conclude that "the surface water drainage design for the proposed development is acceptable and meets the requirement of the Stage 1 Stormwater Audit". The Stormwater Audit should be read in conjunction with Section 3.0 of this Infrastructure Design Report.

3.3. Flood Risk

A separate Site Specific Flood Risk Assessment has been prepared as part of this planning application (refer to DBFL Report No. 180208-rep-002).

This flood risk assessment has been undertaken by reviewing information from the Office of Public Works (OPW) National Flood Hazard Mapping (www.floods.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;

- Surface water network designed in accordance with GDSDS requirements
- Incorporates SUDS features e.g. green roofs, drainage reservoir (drainage board) on the podium slab over basement, bio-swale filter drains, bioretention areas and tree pits with overflow to conventional road gullies
- Surface water attenuation (i.e. treatment / filtration provided within the granular surround of the Stormtech Chambers) in conjunction with a final Class 1 fuel / oil separator prior to discharge to the downstream surface water network.

4. FOUL DRAINAGE

4.1. Existing Foul Drainage

An existing foul drain (225 diameter) is located adjacent to the site's eastern corner, at the northern end of Willow Grove. An existing combined sewer (300 diameter) is located approx. 240m from the eastern corner of the site (in the verge adjacent to the N11). Refer to Figure 4.1 and the Irish Water Network Plan included in Appendix A.

Both the foul sewer and combined sewer noted above ultimately outfall to Shanganagh WWTP.

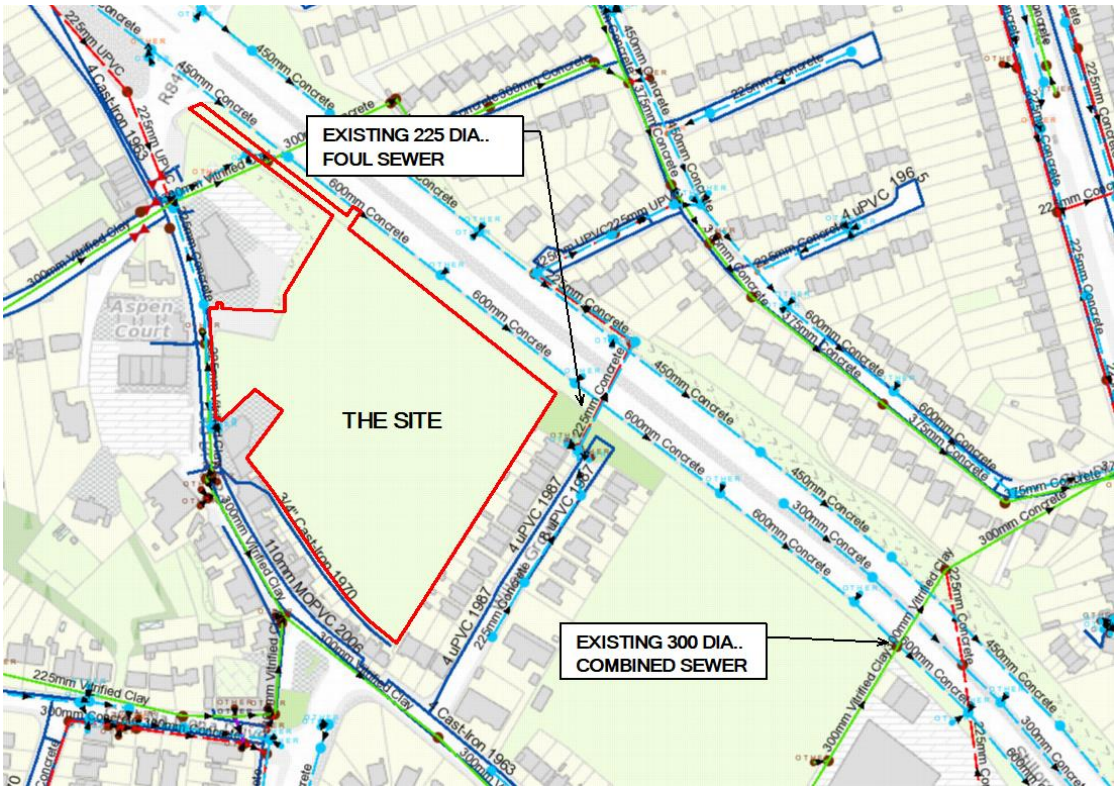


Figure 4.1 Extract from Irish Water Network Plan (Site Boundary Indicative Only)

4.2. Design Strategy

As per earlier comments regarding surface water drainage, the site falls from its south-west corner towards its north-east corner forming a single foul drainage catchment.

The proposed foul drainage network will comprise of a series of 225mm diameter pipes. Each residential unit located along the site's south-eastern boundary is to be serviced by individual 100mm diameter connections.

Refer to DBFL Drawings 180208-XX-XX-DR-C-3001 and 180208-XX-XX-DR-C-3002 for the proposed foul drainage infrastructure described above.

4.3. Pre-Connection Feedback from Irish Water

The applicants and DBFL have engaged in significant consultation on foul drainage provisions for the subject site with Irish Water. Following these detailed discussions and submission of design proposals an updated Confirmation of Feasibility has been received from Irish Water(included in Appendix D).

- A key design requirement during these discussions was the provision of a 2,150 m3 balancing storage tank within the subject site to accommodate for additional storm storage within the wider catchment (this is also referenced in the updated confirmation of feasibility letter). The proposed development makes provision for the on-site 2,150 m3 balancing storage tank (located in the eastern corner of the site) which will facilitate a potential future upgrade of the Foxrock catchment by Irish Water. The applicant will continue to engage with Irish Water with regard to the scope of works and delivery strategy for the balancing storage tank. The proposed arrangement of the balancing storage tank is shown on the drawings 180208-DBFL-XX-XX-DR-C-3001 (Site Services Layout - Sheet 1), 180208-DBFL-XX-XX-DR-C-3004 (Site Services Layout - Sheet 2) and 180208-DBFL-XX-XX-DR-C-3051 (Foul Pump Station & Additional Balancing Storage).
- In addition to the new catchment storm storage tank a new 825mm diameter combined sewer will be constructed, traversing the site from the entrance at Old Bray Road to the 2,150 m3 balancing storage tank (located in the eastern corner of the site). This pipeline will also facilitate a potential future upgrade of the Foxrock catchment by Irish Water. Refer to drawings 180208-DBFL-XX-XX-DR-C-3001 (Site Services Layout - Sheet 1) and 180208-DBFL-XX-XX-DR-C-3040 (IW Interceptor Sewer Long Sections)
- Provision of the balancing storage tank and 825mm diameter combined sewer as noted above is not required to facilitate the proposed development itself but will

form part of future upgrades within the wider Foxrock catchment by Irish Water. The site is therefore delivering a positive element of future foul infrastructure for the local area and general drainage catchment.

- As part of the proposal referred to in the Confirmation of Feasibility and to service the development in the short term the storm storage facility includes an on-site pumping station / storage in order to store foul drainage flows from the development during heavy rainfall conditions should the existing combined sewer network downstream come under pressure. The on-site pump station is to be integrated within the 2,150 m3 balancing storage tank. As noted in the confirmation of feasibility letter from Irish Water dated 4th October 2021 “Design of the pump station and related equipment has to be agreed with IW at connection application stage. Some enhanced features in terms of telemetry, pump resilience will be required at this foul pump station”. Emergency storage is facilitated at this pump station for both 24-hour and 48-hour foul drainage flows from the development. As noted previously, design of the pump station will be agreed with Irish Water at connection application stage (this will include integration of the pump station with the 2,150 m3 balancing storage which the development is providing to facilitate potential future upgrades of the wider Foxrock catchment by Irish Water). Refer to drawing 180208-DBFL-XX-XX-DR-C-3050 (Foul Pump Station Layout & Section).
- Post catchment storm events stored foul flows from the development are then returned to proposed 300 diameter pipeline which outfalls from the site’s eastern corner, towards northern end of Willow Grove and onwards along the verge adjacent to the N11 prior to discharge to manhole SO22257704 on the existing combined sewer network (approx. 240m from the eastern corner of the site). The proposed 300 diameter pipeline will also facilitate potential future upgrades of the wider Foxrock catchment by Irish Water. Refer to drawing 180208-DBFL-XX-XX-DR-C-3004 (Site Services Layout - Sheet 2). The 300mm outfall also receives flows from the site foul pump station during its standard operation, (ie outside storm events). The telemetry provisions referred to above will be used to control the operation of and discharge from the site pump station.
- Vehicle access for servicing / maintenance of the proposed foul pump station / storage tank is facilitated via the site access from Old Bray Road and the podium area (removable bollards are located on the southern side of the podium allowing access via the shared surface which runs from the podium area, along the southern site boundary before turning north towards the pump station / balancing storage).

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
- Department of the Environment's Building Regulations "Technical Guidance Document Part H Drainage and Waste Water Disposal"
- BS EN 752: 2008 Drain and Sewer Systems Outside Buildings
- IS EN 12056: Part 2 (2000) Gravity Drainage Systems Inside Buildings

Design of the foul drainage network has been carried out using Microdrainage WinDes analysis software (refer to Appendix G for the foul drainage model).

Design Criteria:

Demand	446 l/dwelling/day
Discharge units	14 units per house (as 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	< 4.0m

4.5. Foul Drainage – Environmental Impacts

Residential

Waste Water Discharge Calculation

(as outlined in Irish Water's Code of Practice for Wastewater Infrastructure)

No. of Dwellings	419
Post Development Average Discharge (DWF)	2.16 l/sec
Post Development Peak Discharge (DWF)	12.96 l/sec
Daily Foul Discharge Volume (446l per dwelling)	186,874 l/Day

Café / Retail Unit / Concierge / Residential Amenity / Childcare Facility

Waste Water Discharge Calculation

(as outlined in Irish Water's Code of Practice for Wastewater Infrastructure)

Assumed occupancy (persons)	75
Flow Rate / Person / Day (litres) (Based on IW Flow Rate for Design non-residential school with canteen)	50
Post Development Average Discharge (based on 8 hour occupancy)	0.13 l/sec
Post Development Peak Discharge (6 X DWF)	0.78 l/sec
Daily Foul Discharge Volume (50l per person)	3,750 l/Day

5. Water Supply

5.1. Existing Public Watermains

Existing public water supply infrastructure is located along Old Bray Road (24" Cast Iron Watermain, 9" Cast Iron Watermain and 4" uPVC Watermain).

Refer to Figure 5.1 and the Irish Water Network Plan included in Appendix A which shows the location of these watermains.

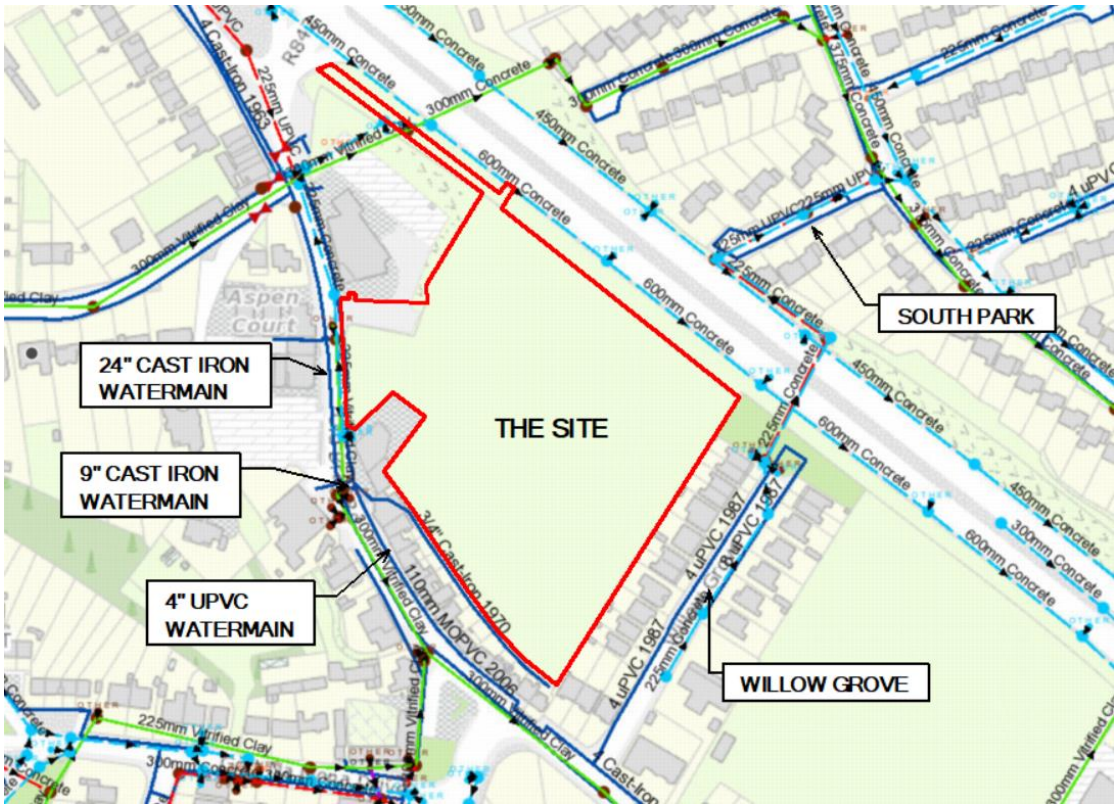


Figure 5.1 Extract from Irish Water Network Plan

5.2. Pre-Connection Feedback from Irish Water

Pre-connection enquiry feedback has been received from Irish Water (included in Appendix D). Irish Water have advised as follows:

- Provision of a water connection is feasible subject to construction of a 40m long watermain between the site and an existing 9' watermain on Old Bray Road.

5.3. Proposed Watermain Layout

As noted previously, existing 24" Cast Iron, 9" Cast Iron and 4" uPVC watermains are located along Old Bray Road. This infrastructure is expected to provide a suitable connection for the proposed development.

The site's proposed water main layout is shown on DBFL Drawing 180208-XX-XX-DR-C-3002.

In line with the pre-connection feedback received from Irish Water, it is proposed to take a 200mm diameter connection off the existing 9" Cast Iron public water supply line (located along the Old Bray Road).

The proposed water main layout and connections to existing public water mains have been designed in accordance with Irish Water Standard Detail STD-W-02.

Individual houses located along the site's eastern boundary will have their own connections (25mm O.D. PE pipe) to distribution water mains via service connections and meter / boundary boxes. Individual connections are to be installed in accordance with Irish Water Standard Detail STD-W-03.

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 are to be HDPE 100 SDR17.

Service connections (to individual houses) are to be MDPE 80 SDR11.

5.6. Water Demand

Residential

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

- No. of Dwellings 419
- Average Occupancy Ration (Persons Per Dwelling) 2.7
- Per-Capita Consumption (l/person/day) 150
- Average Domestic Daily Demand (l/sec) 2.0
- Post Development Average Hour Water Demand (l/sec) 2.5
  (1.25 x Average Domestic Daily Demand)
- Post Development Peak Hour Water Demand (l/sec) 12.5
  (5.0 x Post Development Average Hour Water Demand)

Café / Retail Unit / Concierge / Residential Amenity / Creche

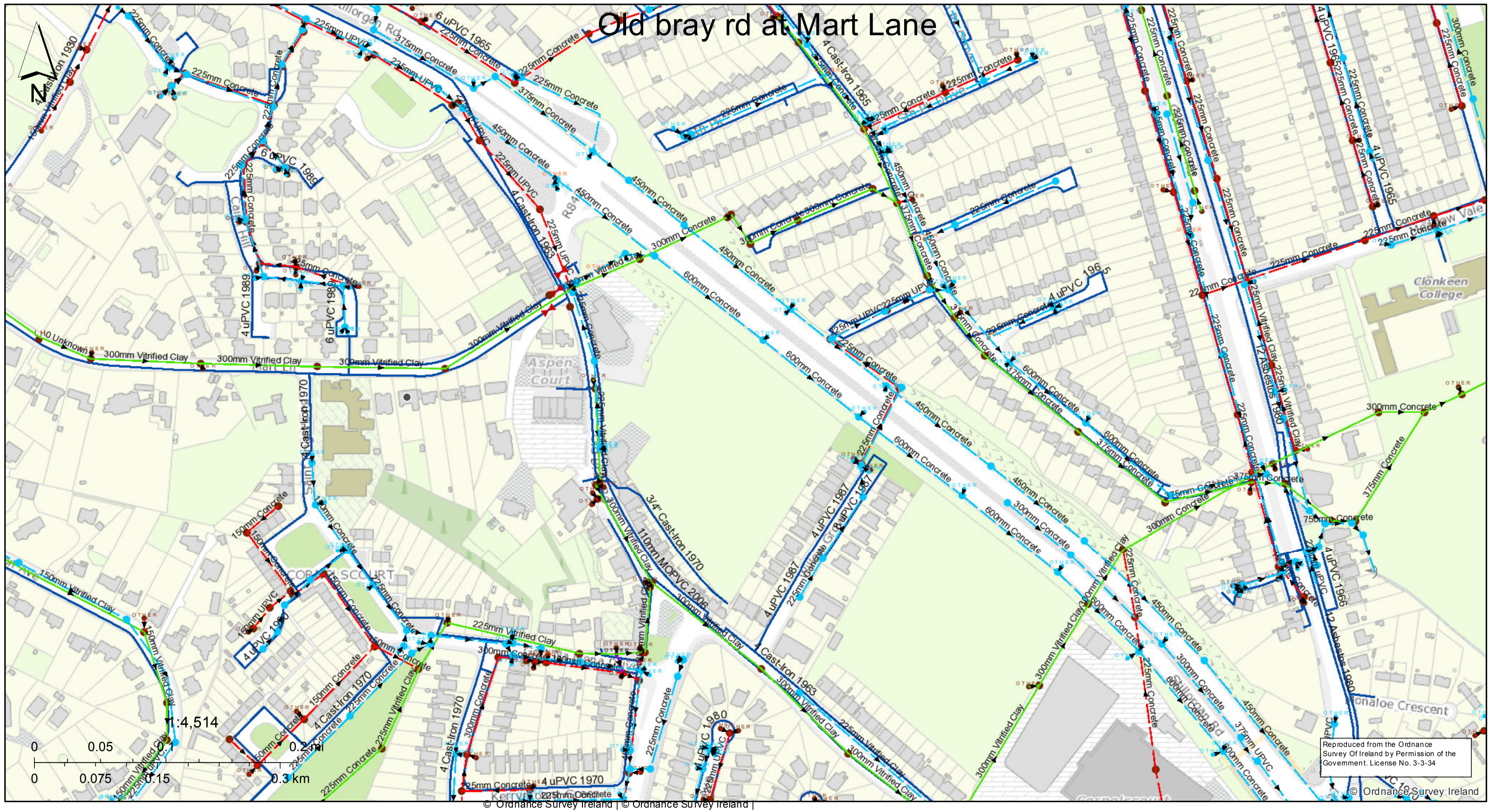
Water Demand has been calculated in accordance with the guidelines outlined in Irish Water's Code of Practice for Water Infrastructure:

- Assumed occupancy (persons) 75
- Per-Capita Consumption (l/person/day) 50
  (Based on IW Flow Rate for Design
  non-residential school with canteen)
- Average Domestic Daily Demand (l/sec) 0.13
  (based on 8 hour occupancy)
- Post Development Average Hour Water Demand (l/sec) 0.16
  (1.25 x Average Domestic Daily Demand)
- Post Development Peak Hour Water Demand (l/sec) 0.8
  (5.0 x Post Development Average Hour Water Demand)

APPENDIX A

IRISH WATER NETWORK PLANS

Old bray rd at Mart Lane



10/10/2018 12:18:24 PM

Legend

Stormwater Gravity Mains (Irish Water Owned)

- Surface

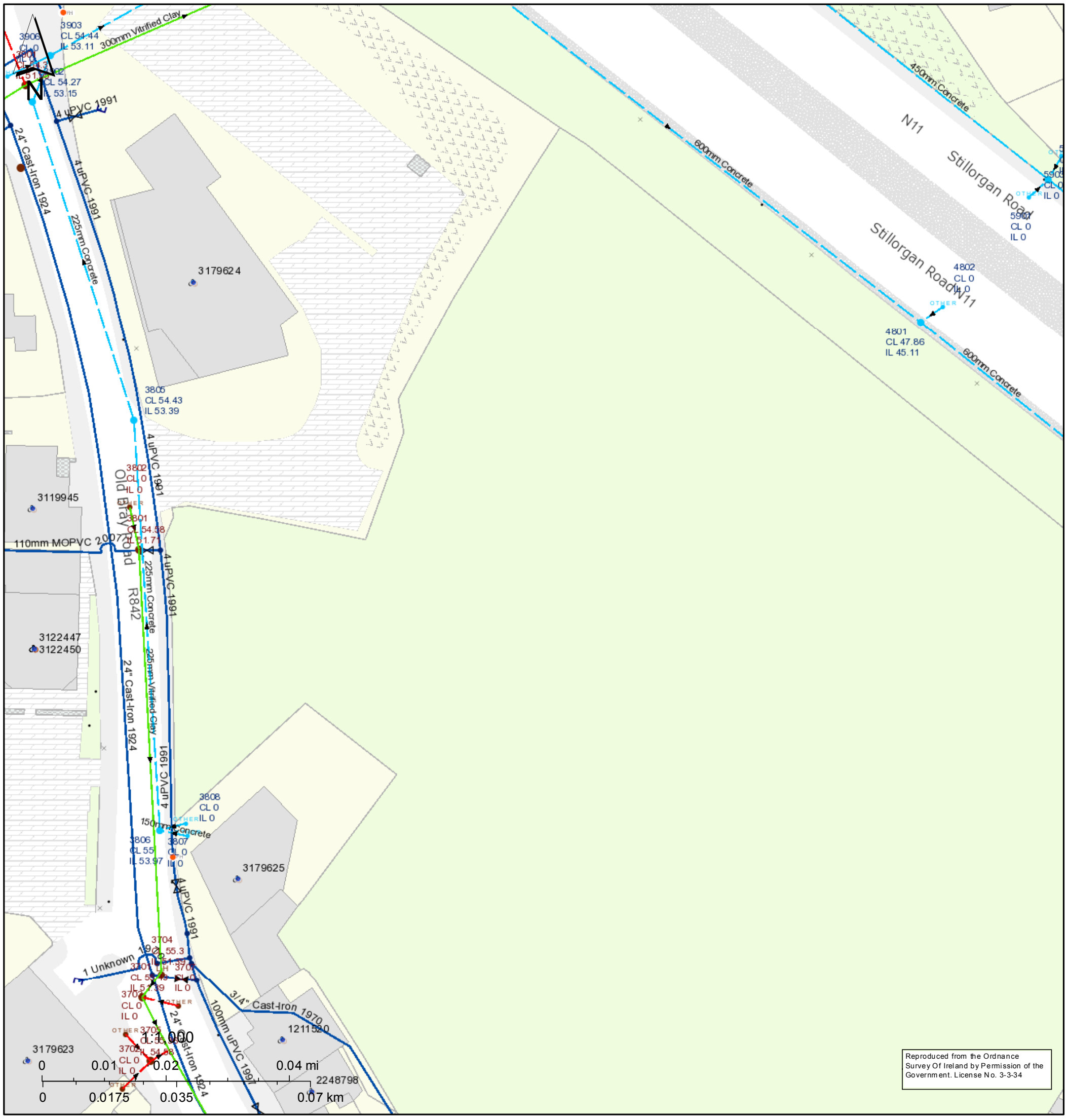
Stormwater Gravity Mains (Non-Irish Water Owned)

- Surface

Storm Manholes

- Cascade
- Catchpit
- Hatchbox

Site at Cornelscourt



7/31/2018 8:35:19 AM

Legend

Stormwater Gravity Mains (Irish Water Owned)
- Surface

Stormwater Gravity Mains (Non-Irish Water Owned)
- Surface

Storm Manholes
- Cascade
- Catchpit
- Hatchbox
- Lamphole
- Standard
- Other; Unknown

Storm Inlets
- Gully
- Standard
- Other; Unknown

Storm Fittings
- Vent/Col
- Other; Unknown

Storm Discharge Points
- Outfall
- Overflow
- Soakaway
- Other; Unknown
- Storm Culverts
- Storm Clean Outs

Sewer Gravity Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Gravity Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Sewer Pressurized Mains (Non-Irish Water owned)
- Combined
- Foul
- Overflow
- Unknown

Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland. It should not be relied upon in the event of excavations or other works being carried out in the vicinity of the network. The onus is on the parties carrying out the works to ensure the exact location of the network is identified prior to mechanical works being carried out. Service pipes are not generally shown but their presence should be anticipated.

"Gas Networks Ireland (GNI), their affiliates and assigns, accept no responsibility for any information contained in this document concerning location and technical designation of the gas distribution and transmission network ("the Information"). Any representations and warranties express or implied, are excluded to the fullest extent permitted by law. No liability shall be accepted for any loss or damage including, without limitation, direct, indirect, special, incidental, punitive or consequential loss including loss of profits, arising out of or in connection with the use of the Information (including maps or mapping data). NOTE: DIAL BEFORE YOU DIG Phone 1850 427 747 or e-mail dig@gasnetworks.ie – The actual position of the gas/electricity distribution and transmission network must be verified on site before any mechanical excavating takes place. If any mechanical excavation is proposed, hard copy maps must be requested from GNI re gas. All work in the vicinity of the gas distribution and transmission network must be completed in accordance with the current edition of the Health & Safety Authority publication, 'Code of Practice For Avoiding Danger From Underground Services' which is available from the Health and Safety Authority (1890 28 93 89) or can be downloaded free of charge at www.hsa.ie."

APPENDIX B

GII TRIAL PIT LOGS

Site Boundary
Trial Pit
CBR
Infiltration Test

Client:

Project Code:
8354-01-19

Project Title:
Cornelscourt

Drawing Title:
Figure 14 Trial Pit, CRB and Infiltration Test Locations

GROUND INVESTIGATIONS IRELAND
Ground Investigations Ireland Ltd.
Catherinstown House,
Hazelhatch Road,
Newcastle, Co. Dublin
www.gii.ie 01-6015175/5176

0 10 20 30 40 50 60 m

Drawn By:	Date:
BS	14/02/2019

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** IT01
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL	**Job Number** 8354-01-19
	Location	**Dates** 21/01/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL.		
					(0.30) 0.50	MADE GROUND: Brown slightly sandy slightly gravelly CLAY.		
					(1.40) 1.90	Firm brown slightly sandy slightly gravelly CLAY.		
						Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT01

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	IT02

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly sandy slightly gravelly TOPSOIL.		
					0.30	Firm to stiff light brown slightly sandy slightly gravelly CLAY.		
					(1.10)			
					1.40	Stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(0.50)			
					1.90	Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT02

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	IT03

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25) 0.25	Brown slightly sandy slightly gravelly TOPSOIL.		
					(0.25) 0.50	Firm to stiff light brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles.		
					(0.80) 1.30	Firm to stiff brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(0.60) 1.90	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
						Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT03

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP-01
Machine : JCB 3CX **Method :** Trial Pit	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL	**Job Number** 8354-01-19
	Location (Handheld GPS)	**Dates** 21/01/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with fragments of conrete and plastic.		
					(0.15) 0.35	MADE GROUND: Blueish grey slightly sandy CLAY with angular to subangular, fine to coarse gravel.		
					(1.35)	Firm, brown, slightly sandy slightly gravelly CLAY with rare subangular to subrounded cobbles of granite.		
					1.70			
					(1.10)	Firm, brown, slightly sandy, slightly gravelly CLAY with occasional subangular to subrounded weathered cobbles of granite and limestone. Rare boulders of granite.		
					2.80			
					(0.20) 3.00	Firm, brown, very sandy, angular to subangular, fine to coarse gravel with rare cobbles of granite and possible weathered rock. Trial pit terminated due to sidewall collapse.		
						Complete at 3.00m		

Plan

Remarks

Groundwater encountered at 1.40m (Slight seepage), 2.10m (medium seepage) and 2.80m (medium seepage).
Trial pit sidewall collapsed between 0.70m and 2.80m BGL.
Trial pit terminated at 3.0m BGL due to sidewall collapse.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP01

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP02

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	Brown slightly sandy slightly gravelly TOPSOIL.		
					0.25			
					(0.25)	Firm to stiff light brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles.		
					0.50			
					(0.80)	Firm to stiff brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.30			
					(0.60)	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.90	Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

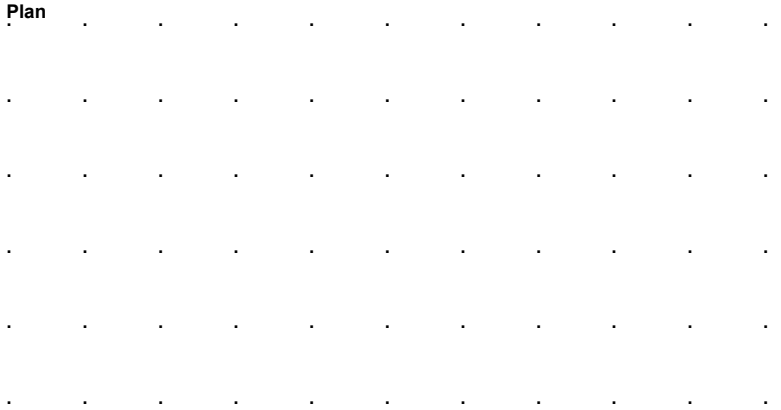
Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT03

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP03
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL	**Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly sandy slightly gravelly TOPSOIL with fragments of plastic and grass rootetls.		
					0.30	Firm light brown slightly sandy slightly gravelly CLAY.		
					(0.60)			
					0.90	Firm to stiff greyish brown slightly sandy gravelly CLAY with occaisonal sub-angular cobbles.		
					(2.10)			
					3.00	Terminated due to sidewalls collapsing.		
						Complete at 3.00m		

Plan



Remarks

Groundwater encountered at 2.80m BGL (Medium Seepage).
Trial pit sidewall collapsed between 0.90m and 2.30m.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP03

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Site Cornelscourt			**Trial Pit Number** TP04
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL	**Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer**	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly sandy slightly gravelly TOPSOIL with grass rootetls.		
					0.30			
					(0.30)	Firm light brown slightly sandy slightly gravelly CLAY.		
					0.60			
					(1.50)	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles and rare boulders.		
					2.10			
					(1.40)	Stiff light orange/brown slightly sandy gravelly CLAY with rare sub-rounded cobbles.		
					3.50	Obstruction: Presumed Rock.		
						Complete at 3.50m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP04

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Site Cornelscourt			**Trial Pit Number** TP-06
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location (Handheld GPS)	**Dates** 21/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Topsoil		
					(0.10) 0.30	MADE GROUND: Blueish grey slightly sandy CLAY with angular to subangular fine to coarse gravel.		
					(0.80) 1.10	Firm brown slightly sandy slightly gravelly CLAY with a piece of concrete slab.		
					(1.40) 2.50	Soft brown slightly sandy slightly gravelly CLAY with rare subangular cobbles of limestone and granite.		
					(0.40) 2.90	Stiff dark brown/grey slightly sandy gravelly CLAY with rare subangular cobbles.		
						Trial pit terminated.		
						Complete at 2.90m		

Plan

Remarks

Groundwater encountered at 0.70m (Slight seepage).
Trial pit collapsed from 1.20m to 2.40m BGL.
Trial pit terminated due to sidewall collapse.

Scale (approx)	Logged By	Figure No.
1:25	TMcI	8354-01-19.TP-06

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Site Cornelscourt			**Trial Pit Number** TP07A
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 21/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.60)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with rare fragments of plastic and metal.		
					0.60			
					(0.65)	Firm light brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles.		
					1.25			
					(0.25)	Soft to firm greyish brown slightly sandy slightly gravelly CLAY with rare sub-angular to sub-rounded cobbles.		
					1.50			
					(0.70)	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-rounded cobbles.		
					2.20			
					(0.60)	Stiff grey mottled brown slightly sandy gravelly CLAY with occasional boulders.		
					2.80	Obstruction: Boulder or rock.		
						Complete at 3.30m		

Plan

Remarks

Trial pit stable.
No Groundwater encountered.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP-14

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Site Cornelscourt			**Trial Pit Number** TP08
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					0.40			
					(0.40)	Firm light brown slightly sandy slightly gravelly CLAY.		
					0.80			
					(2.10)	Firm to stiff greyish brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and sandy gravel lenses.		
					2.90	Trial pit terminated due to sidewall collapse.		
						Complete at 2.90m		

Plan

Remarks

Groundwater encountered at 2.00m (slight seepage) and 2.30m BGL(fast seepage).
Trial pit sidewalls collapsed.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP08

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP09

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 22/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	MADE GROUND: Brown slightly sandy slightly gravelly CLAY with occasional fragments of concrete and plastic.		
					0.40			
					(0.40)	Soft to firm light brown slightly sandy slightly gravelly CLAY.		
					0.80			
					(0.70)	Firm greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.50			
					(0.50)	Firm to stiff greyish brown slightly sandy gravelly CLAY with rare sub-rounded boulders of limestone.		
					2.00			
					(1.50)	Stiff greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					3.50	Obstruction: Presumed Rock.		
						Complete at 3.50m		

Plan

Remarks

Groundwater encountered at 2.60m BGL.
Trial pit sidewalls collapsed between 1.0m and 1.80m BGL.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP09

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP11

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.80)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with frequent fragments of concrete, glass, red brick, cloth and plastic.		
					0.80 (0.20)	Soft light brown slightly sandy slightly gravelly CLAY with rare sub-angular to sub-rounded cobbles.		
					1.00 (1.00)	Firm grey slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and a strong hydrocarbon odour.		
					2.00 (1.00)	Firm to stiff grey slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and a hydrocarbon odour.		
					3.00	Obstruction: Boulders or rock. Complete at 3.00m		

Plan

Remarks

Trial pit stable.
No Groundwater encountered.
Trial pit sidewall collapsed between 0.80m and 2.25m BGL.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP11

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP12

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 22/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20) 0.20	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					(0.30) 0.50	Firm light brown slightly sandy slightly gravelly CLAY.		
					(0.20) 0.70	Firm greu mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(2.20)	Firm to stiff gey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					2.90	Obstruction: Granite Boulder.		
						Complete at 2.90m		

Plan

Remarks

Groundwater encountered at 2.50m (Medium seepage).
Trial pit sidewalls collapsed from 0.90m to 2.60m
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP12

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP13

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 22/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	MADE GROUND: Brown slightly sandy slightly gravelly CLAY with rare fragments of metal, plastic, concrete and grass rootlets.		
					0.40			
					(0.50)	Firm to stiff light brown slightly sandy slightly gravelly CLAY.		
					0.90			
					(1.10)	Firm to stiff greyish brown slightly sandy gravelly CLAY with rare sub-angular to sub-rounded cobbles.		
					2.00			
					(1.20)	Stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					3.20			
						Complete at 3.20m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP13

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP-14
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 21/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.80)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with frequent fragments of concrete, glass, red brick, cloth and plastic.		
					0.80 (0.20)	Soft light brown slightly sandy slightly gravelly CLAY with rare sub-angular to sub-rounded cobbles.		
					1.00 (1.00)	Firm grey slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and a strong hydrocarbon odour.		
					2.00 (1.30)	Firm to stiff grey slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and a hydrocarbon odour.		
					3.30	Obstruction: Boulders or rock. Complete at 3.30m		

Plan

Remarks

Trial pit stable.
No Groundwater encountered.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP-14

Ground Investigations Ireland Ltd
www.gii.ie

Site Cornelscourt			**Trial Pit Number** TP16
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					0.25	Soft to firm light brown slightly sandy slightly gravelly CLAY.		
					(0.55)			
					0.80	Firm greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(0.50)			
					1.30	Firm to stiff greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles and sandy gravel lenses.		
					(1.40)			
					2.70	Obstruction: Presumed Rock(granite).		
						Complete at 2.70m		

Plan

Remarks

Groundwater encountered at 2.60m BGL (Medium seepage).
Trial pit stable.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP16

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	TP17

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 22/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25) 0.25	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					(0.65)	Firm light brown slightly sandy slightly gravelly CLAY.		
					0.90	Firm to stiff greyish brown slightly sandy gravelly CLAY with rare sub-rounded cobbles limestone.		
					(1.90)			
					2.80	Light yellowish grey very sandy slightly clayey sub-angular to sub-rounded fine to coarse GRAVEL of granite(Weathered Rock).		
					(0.40)			
					3.20	Obstruction: Rock (Granite).		
						Complete at 3.20m		

Plan

Remarks

Groundwater encountered at 3.10m BGL (Medium seepage).
Trial pit sidewalls spalling.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP16

Ground Investigations Ireland Ltd
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Site	Trial Pit Number
Cornelscourt	TP20

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client DBFL	Job Number 8354-01-19
	Location	Dates 21/01/2019	Engineer	Sheet 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.50)	MADE GROUND: Brown slightly sandy slightly gravelly Clay with rare fragments of plastic, wire, cloth and glass.		
					0.50			
					(0.20)	Firm light brown slightly sandy slightly gravelly CLAY.		
					0.70			
					(0.80)	Stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.50			
					(1.00)	Firm greyish brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					2.50			
					(0.50)	Stiff to very stiff black slightly sandy gravelly CLAY with rare cobbles and boulders.		
					3.00	Obstruction: Boulder or rock.		
						Complete at 3.00m		

Plan

Remarks

Groundwater encountered at 2.0m BGL(Medium seepage).
Trial pit sidewalls spalling.
Trial pit backfilled on completion.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP20

Ground Investigations Ireland Ltd
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Site Cornelscourt			**Trial Pit Number** TP21
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)**	**Client** DBFL **Job Number** 8354-01-19
	Location	**Dates** 22/01/2019	**Engineer** **Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25) 0.25	Brown slightly sandy slightly gravelly TOPSOIL with grass rootlets.		
					(0.35) 0.60	Firm light brown slightly sandy slightly gravelly CLAY.		
					(0.35) 0.95	Firm greyish brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles and lenses of granite.		
					(0.25) 1.20	Grey very sand slightly clayey subrounded to rounded fine to coarse GRAVEL with rare sub-rounded cobbles.		
					(1.80) 3.00	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
						Obstruction: Rock (Granite).		
						Complete at 3.00m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Trial pit backfilled on completion.
Strong hydrocarbon odour upon reaching rock.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.TP21

Ground Investigations Ireland Ltd
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Site Cornelscourt			**Trial Pit Number** IT01
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)** 53.25	**Client**	**Job Number** 8354-01-19
	Location 722326.2 E 725877.3 N	**Dates** 21/01/2019	**Engineer** DBFL	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	Brown slightly sandy slightly gravelly TOPSOIL.		
				53.05	0.20	MADE GROUND: Brown slightly sandy slightly gravelly CLAY.		
					(0.30)			
				52.75	0.50	Firm brown slightly sandy slightly gravelly CLAY.		
					(1.40)			
				51.35	1.90	Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT01

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Site Cornelscourt			**Trial Pit Number** IT02
Machine : JCB **Method :**	**Dimensions**	**Ground Level (mOD)** 48.87	**Client**	**Job Number** 8354-01-19
	Location 722441.6 E 725841.6 N	**Dates** 21/01/2019	**Engineer** DBFL	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Brown slightly sandy slightly gravelly TOPSOIL.		
				48.57	0.30	Firm to stiff light brown slightly sandy slightly gravelly CLAY.		
					(1.10)			
				47.47	1.40	Stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					(0.50)			
				46.97	1.90	Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT02

Ground Investigations Ireland Ltd
www.gii.ie

Site	Trial Pit Number
Cornelscourt	IT03

Machine : JCB Method :	Dimensions	Ground Level (mOD)	Client	Job Number
				8354-01-19
	Location	Dates 21/01/2019	Engineer: DBFL	Sheet: 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.25)	Brown slightly sandy slightly gravelly TOPSOIL.		
					0.25			
					(0.25)	Firm to stiff light brown slightly sandy slightly gravelly CLAY with rare sub-angular cobbles.		
					0.50			
					(0.80)	Firm to stiff brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.30			
					(0.60)	Firm to stiff grey mottled brown slightly sandy gravelly CLAY with rare sub-angular cobbles.		
					1.90			
						Complete at 1.90m		

Plan

Remarks

No Groundwater encountered.
Trial pit stable.
Infiltration test completed in trial pit.
Trial pit backfilled on completion of infiltration test.

Scale (approx)	Logged By	Figure No.
1:25	Tmcl	8354-01-19.IT03

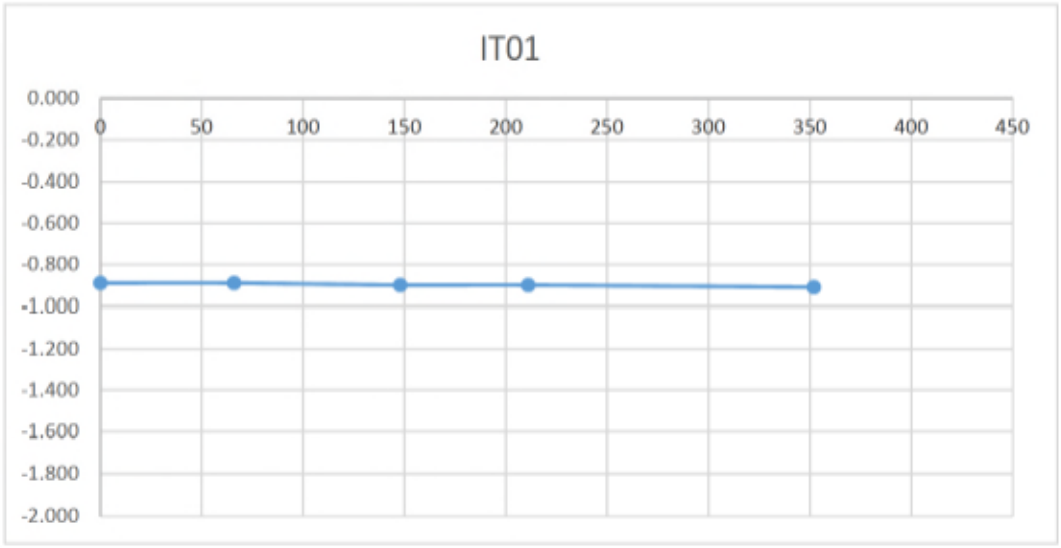
IT01

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.50m x 0.40m 1.90m (L x W x D)

Date	Time	Water level (m bgl)
22/01/2019	0	-0.890
22/01/2019	66	-0.890
22/01/2019	148	-0.900
22/01/2019	211	-0.900
22/01/2019	352	-0.910

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.89	1.900	1.010	1.1425	1.6475



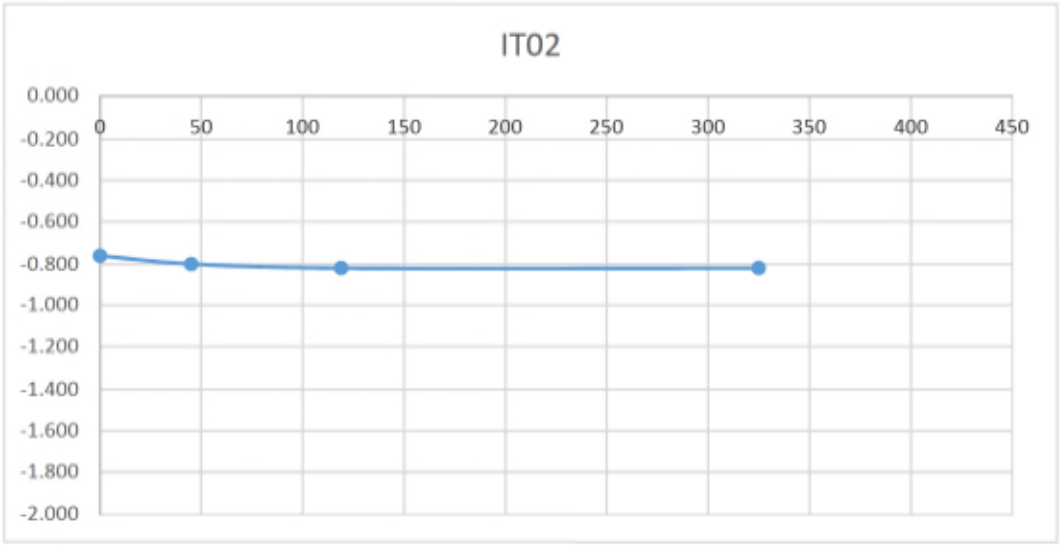
IT02

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.90m x 0.40m 1.90m (L x W x D)

Date	Time	Water level (m bgl)
22/01/2019	0	-0.760
22/01/2019	45	-0.800
22/01/2019	119	-0.820
22/01/2019	325	-0.820

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.76	1.900	1.140	1.045	1.615



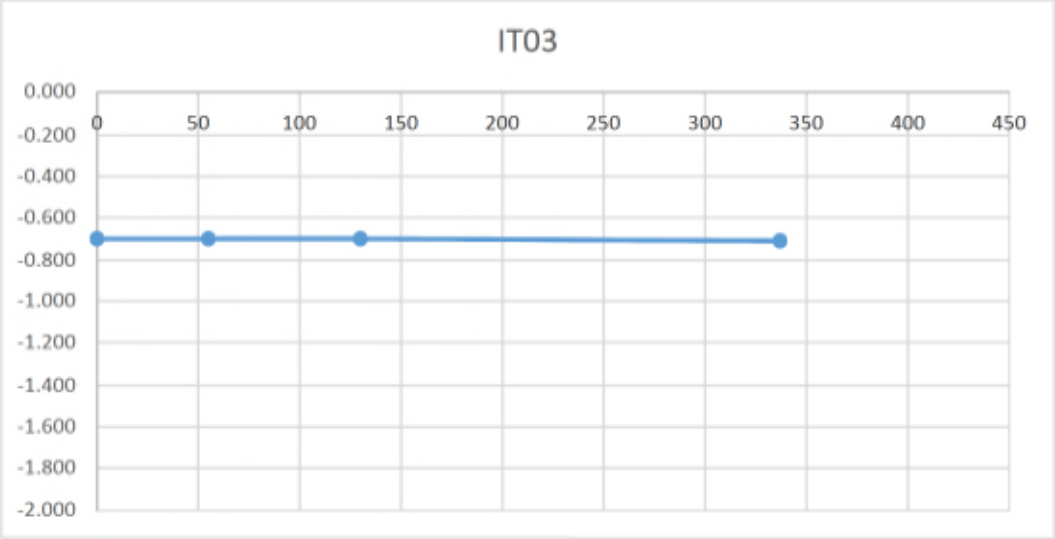
IT03

Soakaway Test to BRE Digest 365
Trial Pit Dimensions: 1.5m x 0.50m 2.0m (L x W x D)

Date	Time	Water level (m bgl)
14/09/2016	0	-0.700
14/09/2016	55	-0.700
14/09/2016	130	-0.700
14/09/2016	337	-0.710

***Soakaway failed - Pit backfilled**

Start depth	Depth of Pit	Diff	75% full	25%full
0.70	1.900	1.200	1	1.6



APPENDIX C

ATTENUATION CALCULATION

Cascade Summary of Results for A.srcx

Upstream Structures	Outflow To	Overflow To
(None)	B.srcx	(None)

Half Drain Time : 533 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	48.051	0.646	0.0	1.3	1.3	36.5	O K
30 min Summer	48.289	0.884	0.0	1.4	1.4	50.0	O K
60 min Summer	48.525	1.120	0.0	1.5	1.5	63.3	O K
120 min Summer	48.757	1.352	0.0	1.7	1.7	76.4	O K
180 min Summer	48.876	1.471	0.0	1.7	1.7	83.1	O K
240 min Summer	48.946	1.541	0.0	1.8	1.8	87.1	O K
360 min Summer	49.011	1.606	0.0	1.8	1.8	90.8	O K
480 min Summer	49.034	1.629	0.0	1.8	1.8	92.1	O K
600 min Summer	49.044	1.639	0.0	1.8	1.8	92.6	O K
720 min Summer	49.046	1.641	0.0	1.8	1.8	92.7	O K
960 min Summer	49.035	1.630	0.0	1.8	1.8	92.1	O K
1440 min Summer	48.991	1.586	0.0	1.8	1.8	89.7	O K
2160 min Summer	48.907	1.502	0.0	1.8	1.8	84.9	O K
2880 min Summer	48.814	1.409	0.0	1.7	1.7	79.6	O K
4320 min Summer	48.630	1.225	0.0	1.6	1.6	69.2	O K
5760 min Summer	48.462	1.057	0.0	1.5	1.5	59.7	O K
7200 min Summer	48.313	0.908	0.0	1.4	1.4	51.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.546	0.0	37.4	23
30 min Summer	54.456	0.0	51.9	37
60 min Summer	35.457	0.0	67.8	68
120 min Summer	22.431	0.0	85.7	126
180 min Summer	17.011	0.0	97.5	186
240 min Summer	13.956	0.0	106.7	246
360 min Summer	10.526	0.0	120.7	364
480 min Summer	8.606	0.0	131.6	418
600 min Summer	7.356	0.0	140.6	480
720 min Summer	6.469	0.0	148.4	546
960 min Summer	5.281	0.0	161.5	680
1440 min Summer	3.965	0.0	181.8	958
2160 min Summer	2.976	0.0	204.9	1372
2880 min Summer	2.425	0.0	222.6	1792
4320 min Summer	1.815	0.0	249.8	2596
5760 min Summer	1.476	0.0	271.0	3352
7200 min Summer	1.257	0.0	288.5	4112

Cascade Summary of Results for A.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	48.182	0.777	0.0	1.3	43.9	O K
10080 min Summer	48.061	0.656	0.0	1.3	37.1	O K
15 min Winter	48.130	0.725	0.0	1.3	41.0	O K
30 min Winter	48.399	0.994	0.0	1.5	56.2	O K
60 min Winter	48.669	1.264	0.0	1.6	71.4	O K
120 min Winter	48.937	1.532	0.0	1.8	86.6	O K
180 min Winter	49.080	1.675	0.0	1.8	94.7	O K
240 min Winter	49.169	1.764	0.0	1.9	99.7	O K
360 min Winter	49.263	1.858	0.0	1.9	105.0	O K
480 min Winter	49.297	1.892	0.0	1.9	107.0	O K
600 min Winter	49.302	1.897	0.0	1.9	107.2	O K
720 min Winter	49.305	1.900	0.0	1.9	107.4	O K
960 min Winter	49.289	1.884	0.0	1.9	106.5	O K
1440 min Winter	49.209	1.804	0.0	1.9	102.0	O K
2160 min Winter	49.063	1.658	0.0	1.8	93.7	O K
2880 min Winter	48.911	1.506	0.0	1.8	85.1	O K
4320 min Winter	48.629	1.224	0.0	1.6	69.2	O K
5760 min Winter	48.389	0.984	0.0	1.4	55.6	O K
7200 min Winter	48.179	0.774	0.0	1.3	43.7	O K
8640 min Winter	47.946	0.541	0.0	1.3	30.6	O K
10080 min Winter	47.667	0.262	0.0	1.3	14.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.103	0.0	303.6	4928
10080 min Summer	0.987	0.0	317.0	5656
15 min Winter	78.546	0.0	41.9	23
30 min Winter	54.456	0.0	58.2	37
60 min Winter	35.457	0.0	75.9	66
120 min Winter	22.431	0.0	96.0	124
180 min Winter	17.011	0.0	109.2	182
240 min Winter	13.956	0.0	119.5	240
360 min Winter	10.526	0.0	135.2	350
480 min Winter	8.606	0.0	147.4	456
600 min Winter	7.356	0.0	157.5	540
720 min Winter	6.469	0.0	166.2	572
960 min Winter	5.281	0.0	180.8	726
1440 min Winter	3.965	0.0	203.6	1040
2160 min Winter	2.976	0.0	229.4	1480
2880 min Winter	2.425	0.0	249.3	1908
4320 min Winter	1.815	0.0	279.8	2768
5760 min Winter	1.476	0.0	303.5	3576
7200 min Winter	1.257	0.0	323.2	4392
8640 min Winter	1.103	0.0	340.1	5280
10080 min Winter	0.987	0.0	355.1	5552

Cascade Rainfall Details for A.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.400	Shortest Storm (mins)	15
Ratio R	0.273	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.255

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	0.255

Cascade Model Details for A.srcx

Storage is Online Cover Level (m) 49.805

Cellular Storage Structure

Invert Level (m) 47.405 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	59.5	0.0	2.001	0.0	0.0
2.000	59.5	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	47.405
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

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	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

Cascade Summary of Results for B.srcx

Upstream Structures	Outflow To	Overflow To
A.srcx	(None)	(None)

Half Drain Time : 241 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	46.220	0.620	0.0	4.8	4.8	50.4	O K
30 min Summer	46.449	0.849	0.0	4.8	4.8	68.9	O K
60 min Summer	46.671	1.071	0.0	4.8	4.8	87.0	O K
120 min Summer	46.869	1.269	0.0	4.8	4.8	103.1	O K
180 min Summer	46.956	1.356	0.0	4.8	4.8	110.1	O K
240 min Summer	46.997	1.397	0.0	4.8	4.8	113.5	O K
360 min Summer	47.019	1.419	0.0	4.8	4.8	115.3	O K
480 min Summer	47.020	1.420	0.0	4.9	4.9	115.3	O K
600 min Summer	47.010	1.410	0.0	4.8	4.8	114.5	O K
720 min Summer	46.996	1.396	0.0	4.8	4.8	113.4	O K
960 min Summer	46.961	1.361	0.0	4.8	4.8	110.5	O K
1440 min Summer	46.873	1.273	0.0	4.8	4.8	103.4	O K
2160 min Summer	46.726	1.126	0.0	4.8	4.8	91.5	O K
2880 min Summer	46.556	0.956	0.0	4.8	4.8	77.7	O K
4320 min Summer	46.129	0.529	0.0	4.8	4.8	43.0	O K
5760 min Summer	45.929	0.329	0.0	4.8	4.8	26.7	O K
7200 min Summer	45.828	0.228	0.0	4.5	4.5	18.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.546	0.0	90.2	22
30 min Summer	54.456	0.0	125.1	37
60 min Summer	35.457	0.0	163.4	66
120 min Summer	22.431	0.0	206.7	126
180 min Summer	17.011	0.0	235.2	186
240 min Summer	13.956	0.0	257.3	244
360 min Summer	10.526	0.0	291.1	318
480 min Summer	8.606	0.0	317.3	386
600 min Summer	7.356	0.0	339.0	450
720 min Summer	6.469	0.0	357.7	518
960 min Summer	5.281	0.0	389.3	660
1440 min Summer	3.965	0.0	438.3	942
2160 min Summer	2.976	0.0	494.0	1368
2880 min Summer	2.425	0.0	536.7	1792
4320 min Summer	1.815	0.0	602.4	2424
5760 min Summer	1.476	0.0	653.6	3064
7200 min Summer	1.257	0.0	695.8	3744

Cascade Summary of Results for B.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	45.779	0.179	0.0	4.3	14.6	O K
10080 min Summer	45.752	0.152	0.0	4.1	12.4	O K
15 min Winter	46.299	0.699	0.0	4.8	56.7	O K
30 min Winter	46.559	0.959	0.0	4.8	77.9	O K
60 min Winter	46.809	1.209	0.0	4.8	98.2	O K
120 min Winter	47.041	1.441	0.0	4.9	117.1	O K
180 min Winter	47.150	1.550	0.0	5.1	125.9	O K
240 min Winter	47.209	1.609	0.0	5.1	130.7	O K
360 min Winter	47.248	1.648	0.0	5.2	133.8	O K
480 min Winter	47.240	1.640	0.0	5.2	133.2	O K
600 min Winter	47.228	1.628	0.0	5.2	132.2	O K
720 min Winter	47.206	1.606	0.0	5.1	130.5	O K
960 min Winter	47.147	1.547	0.0	5.0	125.7	O K
1440 min Winter	47.002	1.402	0.0	4.8	113.9	O K
2160 min Winter	46.761	1.161	0.0	4.8	94.3	O K
2880 min Winter	46.400	0.800	0.0	4.8	65.0	O K
4320 min Winter	45.920	0.320	0.0	4.8	26.0	O K
5760 min Winter	45.775	0.175	0.0	4.3	14.3	O K
7200 min Winter	45.731	0.131	0.0	3.9	10.6	O K
8640 min Winter	45.716	0.116	0.0	3.7	9.4	O K
10080 min Winter	45.707	0.107	0.0	3.4	8.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.103	0.0	732.3	4408
10080 min Summer	0.987	0.0	764.5	5136
15 min Winter	78.546	0.0	101.0	22
30 min Winter	54.456	0.0	140.1	37
60 min Winter	35.457	0.0	183.0	66
120 min Winter	22.431	0.0	231.5	124
180 min Winter	17.011	0.0	263.4	180
240 min Winter	13.956	0.0	288.1	238
360 min Winter	10.526	0.0	326.0	346
480 min Winter	8.606	0.0	355.3	404
600 min Winter	7.356	0.0	379.7	474
720 min Winter	6.469	0.0	400.7	554
960 min Winter	5.281	0.0	436.0	710
1440 min Winter	3.965	0.0	490.8	1026
2160 min Winter	2.976	0.0	553.3	1480
2880 min Winter	2.425	0.0	601.1	1908
4320 min Winter	1.815	0.0	674.7	2468
5760 min Winter	1.476	0.0	732.0	3112
7200 min Winter	1.257	0.0	779.4	3624
8640 min Winter	1.103	0.0	820.2	4352
10080 min Winter	0.987	0.0	856.2	5128

Cascade Rainfall Details for B.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.400	Shortest Storm (mins)	15
Ratio R	0.273	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.360

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	0.360

Cascade Model Details for B.srcx

Storage is Online Cover Level (m) 48.000

Cellular Storage Structure

Invert Level (m) 45.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	85.5	0.0	2.001	0.0	0.0
2.000	85.5	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0098-5700-2000-5700
Design Head (m)	2.000
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	45.600
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.7
Flush-Flo™	0.430	4.8
Kick-Flo®	0.874	3.9
Mean Flow over Head Range	-	4.6

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	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.6
0.300	4.7	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.8	1.800	5.4	4.500	8.3	8.500	11.3
0.500	4.8	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.7	2.200	5.9	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.4	6.500	9.9		

Cascade Summary of Results for C.srcx

Upstream Structures	Outflow To	Overflow To
(None)	D.srcx	(None)

Half Drain Time : 443 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	47.376	0.378	0.0	5.0	5.0	89.3	O K
30 min Summer	47.514	0.516	0.0	5.0	5.0	122.0	O K
60 min Summer	47.651	0.653	0.0	5.0	5.0	154.3	O K
120 min Summer	47.784	0.786	0.0	5.0	5.0	185.8	O K
180 min Summer	47.854	0.856	0.0	5.0	5.0	202.5	O K
240 min Summer	47.899	0.901	0.0	5.0	5.0	213.0	O K
360 min Summer	47.939	0.941	0.0	5.0	5.0	222.5	O K
480 min Summer	47.948	0.950	0.0	5.0	5.0	224.6	O K
600 min Summer	47.949	0.951	0.0	5.0	5.0	224.9	O K
720 min Summer	47.945	0.947	0.0	5.0	5.0	224.0	O K
960 min Summer	47.930	0.932	0.0	5.0	5.0	220.3	O K
1440 min Summer	47.880	0.882	0.0	5.0	5.0	208.5	O K
2160 min Summer	47.781	0.783	0.0	5.0	5.0	185.0	O K
2880 min Summer	47.683	0.685	0.0	5.0	5.0	161.8	O K
4320 min Summer	47.511	0.513	0.0	5.0	5.0	121.2	O K
5760 min Summer	47.382	0.384	0.0	5.0	5.0	90.7	O K
7200 min Summer	47.291	0.293	0.0	4.8	4.8	69.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.546	0.0	91.4	22
30 min Summer	54.456	0.0	127.1	37
60 min Summer	35.457	0.0	166.9	66
120 min Summer	22.431	0.0	211.2	126
180 min Summer	17.011	0.0	240.3	186
240 min Summer	13.956	0.0	263.0	246
360 min Summer	10.526	0.0	297.5	364
480 min Summer	8.606	0.0	324.3	444
600 min Summer	7.356	0.0	346.6	504
720 min Summer	6.469	0.0	365.7	568
960 min Summer	5.281	0.0	398.0	698
1440 min Summer	3.965	0.0	448.0	984
2160 min Summer	2.976	0.0	505.7	1368
2880 min Summer	2.425	0.0	549.4	1760
4320 min Summer	1.815	0.0	616.3	2472
5760 min Summer	1.476	0.0	669.3	3176
7200 min Summer	1.257	0.0	712.5	3888

Cascade Summary of Results for C.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	47.228	0.230	0.0	4.7	54.3	O K
10080 min Summer	47.184	0.186	0.0	4.4	44.1	O K
15 min Winter	47.423	0.425	0.0	5.0	100.4	O K
30 min Winter	47.579	0.581	0.0	5.0	137.3	O K
60 min Winter	47.736	0.738	0.0	5.0	174.3	O K
120 min Winter	47.894	0.896	0.0	5.0	211.8	O K
180 min Winter	47.978	0.980	0.0	5.0	231.8	O K
240 min Winter	48.030	1.032	0.0	5.0	243.9	O K
360 min Winter	48.082	1.084	0.0	5.0	256.3	O K
480 min Winter	48.099	1.101	0.0	5.0	260.3	O K
600 min Winter	48.098	1.100	0.0	5.0	260.0	O K
720 min Winter	48.089	1.091	0.0	5.0	257.8	O K
960 min Winter	48.067	1.069	0.0	5.0	252.7	O K
1440 min Winter	47.994	0.996	0.0	5.0	235.6	O K
2160 min Winter	47.835	0.837	0.0	5.0	197.9	O K
2880 min Winter	47.665	0.667	0.0	5.0	157.7	O K
4320 min Winter	47.410	0.412	0.0	5.0	97.4	O K
5760 min Winter	47.257	0.259	0.0	4.8	61.3	O K
7200 min Winter	47.174	0.176	0.0	4.4	41.6	O K
8640 min Winter	47.128	0.130	0.0	4.0	30.8	O K
10080 min Winter	47.111	0.113	0.0	3.6	26.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.103	0.0	749.7	4576
10080 min Summer	0.987	0.0	782.4	5248
15 min Winter	78.546	0.0	102.5	22
30 min Winter	54.456	0.0	142.5	37
60 min Winter	35.457	0.0	186.9	66
120 min Winter	22.431	0.0	236.6	124
180 min Winter	17.011	0.0	269.2	182
240 min Winter	13.956	0.0	294.5	240
360 min Winter	10.526	0.0	333.3	352
480 min Winter	8.606	0.0	363.3	462
600 min Winter	7.356	0.0	388.2	564
720 min Winter	6.469	0.0	409.6	592
960 min Winter	5.281	0.0	445.7	744
1440 min Winter	3.965	0.0	501.6	1058
2160 min Winter	2.976	0.0	566.4	1500
2880 min Winter	2.425	0.0	615.4	1876
4320 min Winter	1.815	0.0	690.4	2596
5760 min Winter	1.476	0.0	749.7	3232
7200 min Winter	1.257	0.0	798.1	3888
8640 min Winter	1.103	0.0	839.8	4496
10080 min Winter	0.987	0.0	876.5	5144

Cascade Rainfall Details for C.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.400	Shortest Storm (mins)	15
Ratio R	0.273	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.630

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.000	4	8	0.630

Cascade Model Details for C.srcx

Storage is Online Cover Level (m) 49.690

Cellular Storage Structure

Invert Level (m) 46.998 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.80
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	295.5	0.0	1.445	0.0	0.0
1.440	295.5	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0099-5000-1445-5000
Design Head (m)	1.445
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	99
Invert Level (m)	46.998
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.445	5.0
Flush-Flo™	0.434	5.0
Kick-Flo®	0.883	4.0
Mean Flow over Head Range	-	4.4

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	3.3	1.200	4.6	3.000	7.0	7.000	10.5
0.200	4.5	1.400	4.9	3.500	7.6	7.500	10.9
0.300	4.9	1.600	5.2	4.000	8.1	8.000	11.2
0.400	5.0	1.800	5.5	4.500	8.5	8.500	11.5
0.500	5.0	2.000	5.8	5.000	9.0	9.000	11.8
0.600	4.9	2.200	6.1	5.500	9.4	9.500	12.2
0.800	4.4	2.400	6.3	6.000	9.8		
1.000	4.2	2.600	6.6	6.500	10.1		

Cascade Summary of Results for D.srcx

Upstream Structures	Outflow To	Overflow To
C.srcx	(None)	(None)

Half Drain Time : 174 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	46.024	0.474	0.0	7.3	7.3	49.9	O K
30 min Summer	46.200	0.650	0.0	7.3	7.3	68.5	O K
60 min Summer	46.381	0.831	0.0	7.3	7.3	87.5	O K
120 min Summer	46.568	1.018	0.0	7.3	7.3	107.1	O K
180 min Summer	46.653	1.103	0.0	7.3	7.3	116.1	O K
240 min Summer	46.696	1.146	0.0	7.3	7.3	120.6	O K
360 min Summer	46.735	1.185	0.0	7.3	7.3	124.7	O K
480 min Summer	46.750	1.200	0.0	7.3	7.3	126.3	O K
600 min Summer	46.757	1.207	0.0	7.3	7.3	127.0	O K
720 min Summer	46.758	1.208	0.0	7.3	7.3	127.2	O K
960 min Summer	46.752	1.202	0.0	7.3	7.3	126.5	O K
1440 min Summer	46.729	1.179	0.0	7.3	7.3	124.1	O K
2160 min Summer	46.699	1.149	0.0	7.3	7.3	121.0	O K
2880 min Summer	46.658	1.108	0.0	7.3	7.3	116.7	O K
4320 min Summer	46.510	0.960	0.0	7.3	7.3	101.1	O K
5760 min Summer	46.133	0.583	0.0	7.3	7.3	61.4	O K
7200 min Summer	45.958	0.408	0.0	7.3	7.3	42.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	78.546	0.0	142.4	23
30 min Summer	54.456	0.0	198.0	37
60 min Summer	35.457	0.0	259.8	68
120 min Summer	22.431	0.0	329.0	126
180 min Summer	17.011	0.0	374.3	186
240 min Summer	13.956	0.0	409.5	244
360 min Summer	10.526	0.0	463.3	356
480 min Summer	8.606	0.0	505.1	412
600 min Summer	7.356	0.0	539.7	476
720 min Summer	6.469	0.0	569.5	538
960 min Summer	5.281	0.0	619.7	676
1440 min Summer	3.965	0.0	697.7	954
2160 min Summer	2.976	0.0	787.5	1412
2880 min Summer	2.425	0.0	855.5	1880
4320 min Summer	1.815	0.0	959.7	2892
5760 min Summer	1.476	0.0	1042.2	3344
7200 min Summer	1.257	0.0	1109.5	3960

Cascade Summary of Results for D.srcx

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ Outflow (l/s)	Max Volume (m³)	Status
8640 min Summer	45.850	0.300	0.0	7.1	31.5	O K
10080 min Summer	45.783	0.233	0.0	6.9	24.5	O K
15 min Winter	46.083	0.533	0.0	7.3	56.1	O K
30 min Winter	46.282	0.732	0.0	7.3	77.1	O K
60 min Winter	46.491	0.941	0.0	7.3	99.1	O K
120 min Winter	46.687	1.137	0.0	7.3	119.7	O K
180 min Winter	46.786	1.236	0.0	7.3	130.2	O K
240 min Winter	46.849	1.299	0.0	7.3	136.8	O K
360 min Winter	46.913	1.363	0.0	7.3	143.5	O K
480 min Winter	46.934	1.384	0.0	7.3	145.7	O K
600 min Winter	46.936	1.386	0.0	7.3	145.9	O K
720 min Winter	46.937	1.387	0.0	7.3	146.0	O K
960 min Winter	46.922	1.372	0.0	7.3	144.5	O K
1440 min Winter	46.862	1.312	0.0	7.3	138.1	O K
2160 min Winter	46.788	1.238	0.0	7.3	130.3	O K
2880 min Winter	46.730	1.180	0.0	7.3	124.2	O K
4320 min Winter	46.270	0.720	0.0	7.3	75.8	O K
5760 min Winter	45.910	0.360	0.0	7.3	37.9	O K
7200 min Winter	45.770	0.220	0.0	6.8	23.1	O K
8640 min Winter	45.705	0.155	0.0	6.2	16.3	O K
10080 min Winter	45.682	0.132	0.0	5.7	13.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.103	0.0	1167.5	4584
10080 min Summer	0.987	0.0	1218.3	5248
15 min Winter	78.546	0.0	159.7	22
30 min Winter	54.456	0.0	221.9	37
60 min Winter	35.457	0.0	291.1	66
120 min Winter	22.431	0.0	368.5	124
180 min Winter	17.011	0.0	419.3	182
240 min Winter	13.956	0.0	458.7	238
360 min Winter	10.526	0.0	519.0	350
480 min Winter	8.606	0.0	565.7	456
600 min Winter	7.356	0.0	604.5	496
720 min Winter	6.469	0.0	637.9	568
960 min Winter	5.281	0.0	694.1	724
1440 min Winter	3.965	0.0	781.2	1028
2160 min Winter	2.976	0.0	882.0	1476
2880 min Winter	2.425	0.0	958.3	2024
4320 min Winter	1.815	0.0	1075.1	2856
5760 min Winter	1.476	0.0	1167.3	3320
7200 min Winter	1.257	0.0	1242.7	3896
8640 min Winter	1.103	0.0	1307.7	4504
10080 min Winter	0.987	0.0	1364.8	5144

Cascade Rainfall Details for D.srcx

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	16.400	Shortest Storm (mins)	15
Ratio R	0.273	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+10

Time Area Diagram

Total Area (ha) 0.351

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.000	4	8	0.351

Cascade Model Details for D.srcx

Storage is Online Cover Level (m) 48.190

Cellular Storage Structure

Invert Level (m) 45.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.82
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	128.4	0.0	1.445	0.0	0.0
1.440	128.4	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0119-7300-1445-7300
Design Head (m)	1.445
Design Flow (l/s)	7.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	45.550
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.445	7.3
Flush-Flo™	0.422	7.3
Kick-Flo®	0.886	5.8
Mean Flow over Head Range	-	6.4

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	4.2	1.200	6.7	3.000	10.3	7.000	15.4
0.200	6.6	1.400	7.2	3.500	11.1	7.500	15.9
0.300	7.1	1.600	7.7	4.000	11.8	8.000	16.4
0.400	7.3	1.800	8.1	4.500	12.5	8.500	16.9
0.500	7.2	2.000	8.5	5.000	13.1	9.000	17.4
0.600	7.1	2.200	8.9	5.500	13.7	9.500	17.8
0.800	6.5	2.400	9.3	6.000	14.3		
1.000	6.1	2.600	9.6	6.500	14.9		

APPENDIX D

CORRESPONDANCE WITH IRISH WATER

Brendan Keogh - DBFL Consulting Engineers

Ormond House
Upper Ormond Quay
Dublin 7
Dublin
D07W704

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

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

www.water.ie

4 October 2021

Re: CDS20003703 pre-connection enquiry - Subject to contract | Contract denied

Connection for Multi/Mixed Use Development of 475 units at Old Bray Road, Cornelscourt, Dublin 18, Co. Dublin

Dear Sir/Madam,

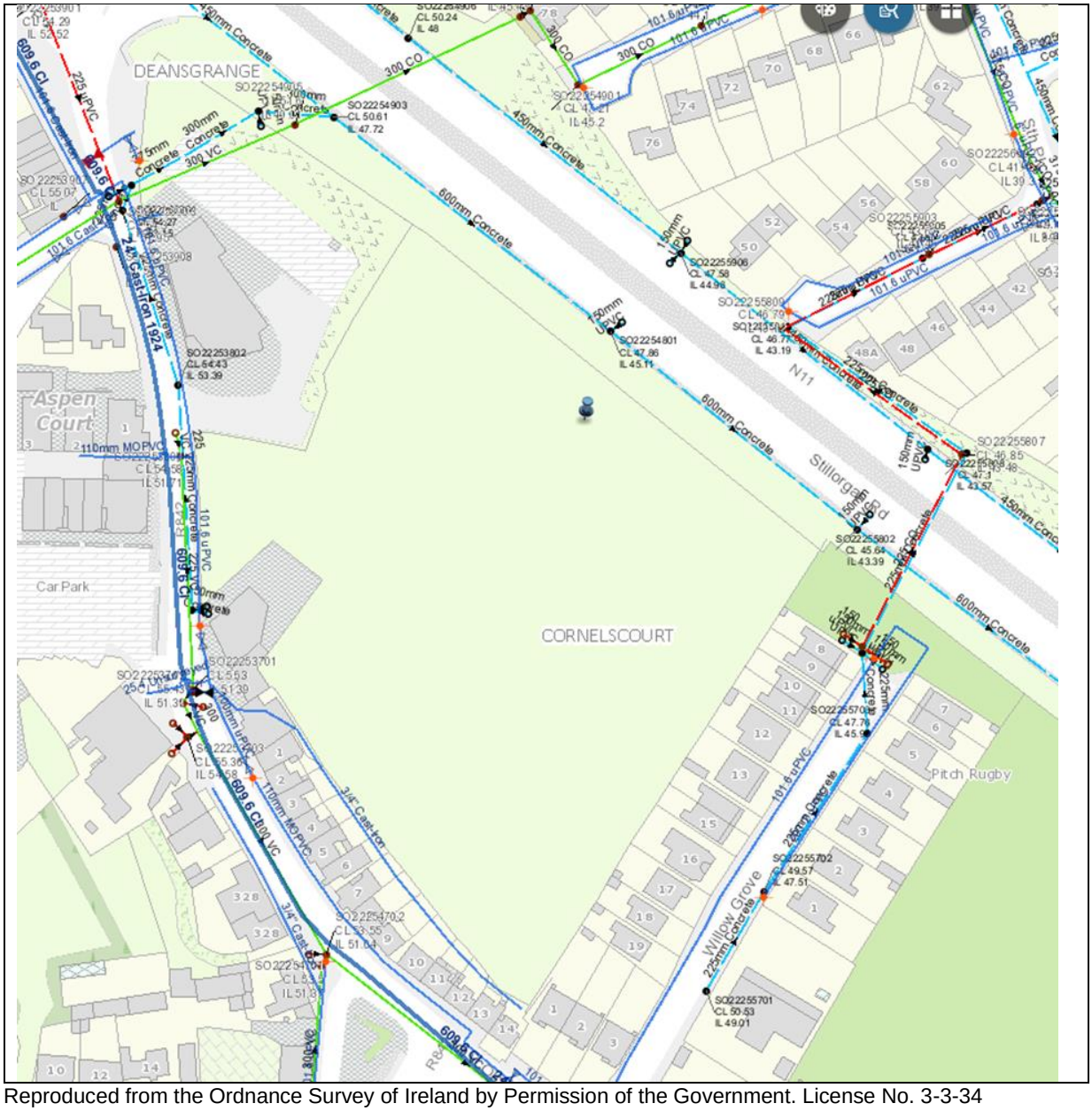
Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Old Bray Road, Cornelscourt, Dublin 18, Co. Dublin (the **Premises**). Based upon the details you have provided with your pre-connection enquiry and on our desk top analysis of the capacity currently available in the Irish Water network(s) as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water network(s) can be facilitated at this moment in time.

SERVICE	**OUTCOME OF PRE-CONNECTION ENQUIRY** **THIS IS NOT A CONNECTION OFFER. YOU MUST APPLY FOR A CONNECTION(S) TO THE IRISH WATER NETWORK(S) IF YOU WISH TO PROCEED.**
Water Connection	Feasible Subject to upgrades
Wastewater Connection	Feasible Subject to upgrades
SITE SPECIFIC COMMENTS	
Water Connection	Feasible subject to approximately 40m of new 150mm ID pipe to be laid to connect the development to the existing 9” Cast Iron water main, which in turn is connected to the existing strategic 24” Cast Iron trunk main. A boundary valve on the 9” pipe will need to be opened. A bulk meter is to be installed along this connection main.
Wastewater Connection	Construction of an on-site pumping station and storage tank is required to pump only foul water into the proposed combined sewer. In heavy rainfall conditions and if the combined sewer is under pressure the developers flow will cease, and the flow will be stored in the proposed tank. It will then be returned to the system when the system returns to capacity. Design of the pump station and related equipment has to be agreed with IW at connection application stage. Some enhanced features in terms of telemetry, pump resilience will be required at this foul pump station. The 2150m3 tank should

	be compartmentalised to enable sequential filling to reduce cleaning maintenance after use. Dosing facilities may also be required at the site. Storm water from the Site has to be discharged separately.

The design and construction of the Water & Wastewater pipes and related infrastructure to be installed in this development shall comply with the Irish Water Connections and Developer Services Standard Details and Codes of Practice that are available on the Irish Water website. Irish Water reserves the right to supplement these requirements with Codes of Practice and these will be issued with the connection agreement.

The map included below outlines the current Irish Water infrastructure adjacent to your site:



Reproduced from the Ordnance Survey of Ireland by Permission of the Government. License No. 3-3-34

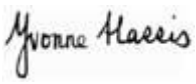
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish Water can assume no responsibility for and give no guarantees, undertakings or warranties concerning the accuracy, completeness or up to date nature of the information provided and does not accept any liability whatsoever arising from any errors or omissions. This information should not be relied upon in the event of excavations or any other works being carried out in the vicinity of the Irish Water underground network. The onus is on the parties carrying out excavations or any other works to ensure the exact location of the Irish Water underground network is identified prior to excavations or any other works being carried out. Service connection pipes are not generally shown but their presence should be anticipated.

General Notes:

1) The initial assessment referred to above is carried out taking into account water demand and wastewater discharge volumes and infrastructure details on the date of the assessment. **The availability of capacity may change at any date after this assessment.**
2) This feedback does not constitute a contract in whole or in part to provide a connection to any Irish Water infrastructure. All feasibility assessments are subject to the constraints of the Irish Water Capital Investment Plan.
3) The feedback provided is subject to a Connection Agreement/contract being signed at a later date.
4) A Connection Agreement will be required to commencing the connection works associated with the enquiry this can be applied for at https://www.water.ie/connections/get-connected/
5) A Connection Agreement cannot be issued until all statutory approvals are successfully in place.
6) Irish Water Connection Policy/ Charges can be found at https://www.water.ie/connections/information/connection-charges/
7) Please note the Confirmation of Feasibility does not extend to your fire flow requirements.
8) Irish Water is not responsible for the management or disposal of storm water or ground waters. You are advised to contact the relevant Local Authority to discuss the management or disposal of proposed storm water or ground water discharges
9) To access Irish Water Maps email datarequests@water.ie
10) All works to the Irish Water infrastructure, including works in the Public Space, shall have to be carried out by Irish Water.

If you have any further questions, please contact Marina Byrne from the design team via email mzbyrne@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



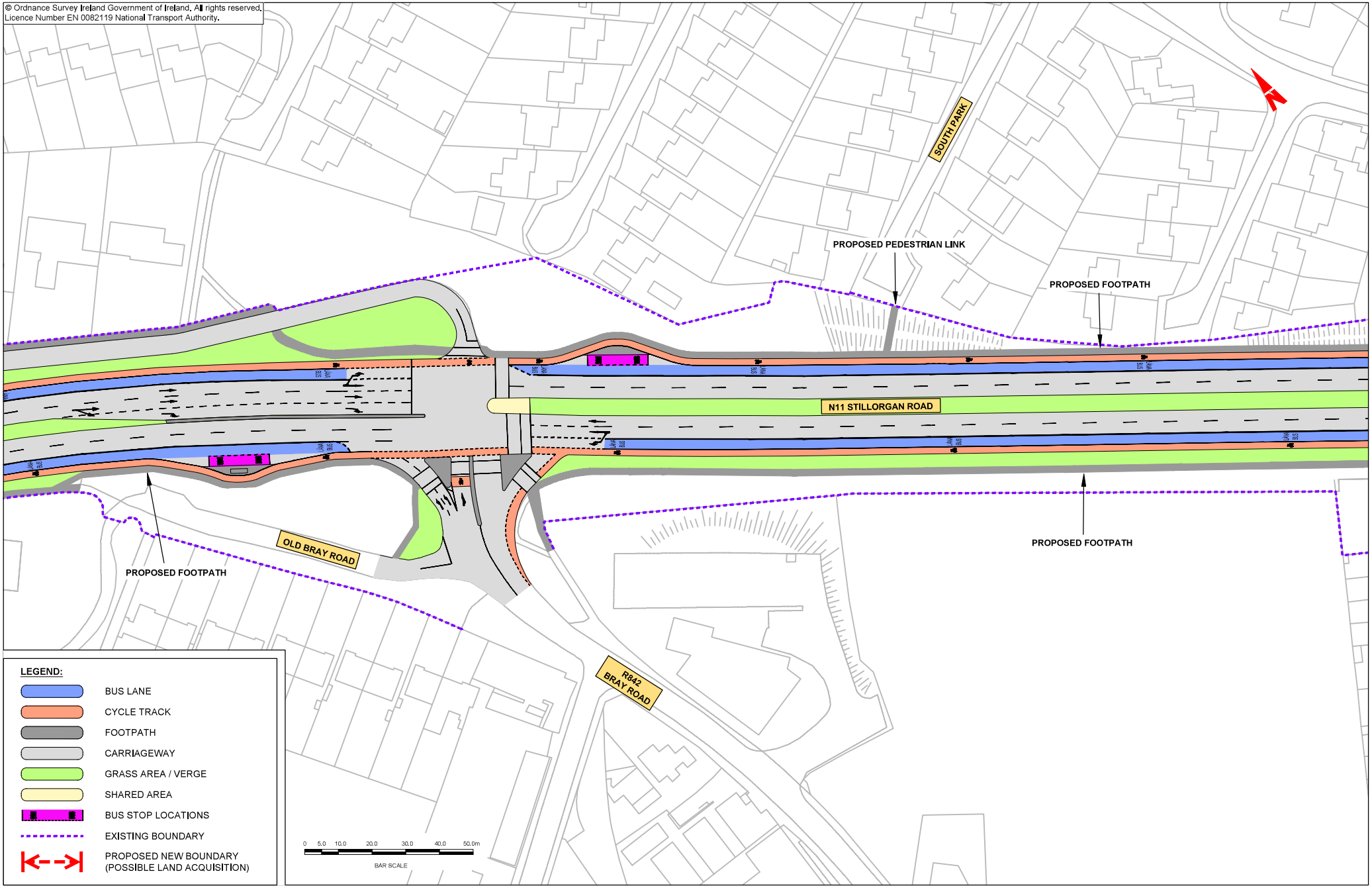
Yvonne Harris

Head of Customer Operations

APPENDIX E

BUS CONNECTS CBC BRAY TO CITY CENTRE

MAP 31: Emerging Preferred Route



APPENDIX F

SURFACE WATER DRAINAGE NETWORK DESIGN

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.400	Add Flow / Climate Change (%)	10
Ratio R	0.273	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.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - 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
S1.000	28.120	1.406	20.0	0.087	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	13.000	0.650	20.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	40.694	2.035	20.0	0.112	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	13.811	0.068	203.1	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.315	0.298	34.6	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	9.547	0.274	34.8	0.005	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.006	38.736	1.171	33.1	0.334	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	24.814	0.062	400.2	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	29.044	0.290	100.2	0.007	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	41.175	0.789	52.2	0.135	4.00	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)
S1.000	50.00	4.16	52.275	0.087	0.0	0.0	1.2	2.94	116.9	13.0
S1.001	50.00	4.23	50.869	0.103	0.0	0.0	1.4	2.94	116.9	15.3
S1.002	50.00	4.46	49.508	0.215	0.0	0.0	2.9	2.94	116.9	32.0
S1.003	50.00	4.72	47.473	0.236	0.0	0.0	3.2	0.91	36.3	35.2
S1.004	50.00	4.79	47.405	0.255	0.0	0.0	3.5	2.23	88.7	38.0
S1.005	50.00	4.86	47.107	0.260	0.0	0.0	3.5	2.22	88.4	38.7
S1.006	50.00	5.10	46.833	0.594	0.0	0.0	8.0	2.74	193.9	88.5
S1.007	50.00	5.63	45.662	0.608	0.0	0.0	8.2	0.78	55.1«	90.6
S1.008	50.00	6.00	45.600	0.615	0.0	0.0	8.3	1.31	51.9«	91.6
S2.000	50.00	4.38	51.375	0.135	0.0	0.0	1.8	1.81	72.2	20.1

Network Design Table for Storm

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
S2.001	19.469	0.483	40.3	0.018	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.002	13.566	0.136	99.8	0.041	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.003	22.024	0.220	100.1	0.157	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.004	45.394	0.117	388.0	0.269	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.005	11.827	0.118	100.2	0.053	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	22.271	0.223	99.9	0.201	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.007	22.611	0.040	565.3	0.096	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.008	7.089	0.169	41.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.009	17.306	0.109	158.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.010	28.213	0.188	150.1	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)
S2.001	50.00	4.51	50.551	0.153	0.0	0.0	2.1	2.48	175.6	22.8
S2.002	50.00	4.62	48.856	0.194	0.0	0.0	2.6	2.04	323.8	28.9
S2.003	50.00	4.80	48.720	0.351	0.0	0.0	4.8	2.03	323.2	52.3
S2.004	50.00	5.54	47.115	0.620	0.0	0.0	8.4	1.03	163.2	92.4
S2.005	50.00	5.66	46.998	0.673	0.0	0.0	9.1	1.57	111.0	100.2
S2.006	50.00	5.87	46.813	0.874	0.0	0.0	11.8	1.81	200.3	130.2
S2.007	50.00	6.37	46.590	0.970	0.0	0.0	13.1	0.75	83.4«	144.5
S2.008	50.00	6.43	46.550	0.970	0.0	0.0	13.1	2.03	80.5«	144.5
S1.009	50.00	6.70	44.700	1.585	0.0	0.0	21.5	1.04	41.2«	236.1
S1.010	50.00	7.15	44.591	1.585	0.0	0.0	21.5	1.06	42.3«	236.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S12	54.150	1.875	Open Manhole	1200	S1.000	52.275	225				
S11	53.000	2.131	Open Manhole	1200	S1.001	50.869	225	S1.000	50.869	225	
S10	52.455	2.947	Open Manhole	1200	S1.002	49.508	225	S1.001	50.219	225	711
S9	50.365	2.892	Open Manhole	1200	S1.003	47.473	225	S1.002	47.473	225	
S8	49.758	2.353	Open Manhole	1200	S1.004	47.405	225	S1.003	47.405	225	
S7	49.250	2.143	Open Manhole	1200	S1.005	47.107	225	S1.004	47.107	225	
S6	49.110	2.277	Open Manhole	1200	S1.006	46.833	300	S1.005	46.833	225	
S5	48.450	2.788	Open Manhole	1200	S1.007	45.662	300	S1.006	45.662	300	
S4	48.750	3.150	Open Manhole	1200	S1.008	45.600	225	S1.007	45.600	300	
S3-9	52.800	1.425	Open Manhole	1200	S2.000	51.375	225				
S3-8	52.560	2.009	Open Manhole	1200	S2.001	50.551	300	S2.000	50.586	225	
S3-7	51.650	2.794	Open Manhole	1350	S2.002	48.856	450	S2.001	50.068	300	1062
S3-6	51.250	2.530	Open Manhole	1350	S2.003	48.720	450	S2.002	48.720	450	
S3-5	51.530	4.415	Open Manhole	1350	S2.004	47.115	450	S2.003	48.500	450	1385
S3-4	49.690	2.692	Open Manhole	1350	S2.005	46.998	300	S2.004	46.998	450	
S3-3	49.790	2.977	Open Manhole	1350	S2.006	46.813	375	S2.005	46.880	300	
S3-2	48.810	2.220	Open Manhole	1350	S2.007	46.590	375	S2.006	46.590	375	
S3-1	48.190	1.640	Open Manhole	1350	S2.008	46.550	225	S2.007	46.550	375	
S3	47.990	3.290	Open Manhole	1200	S1.009	44.700	225	S1.008	45.310	225	610
								S2.008	46.381	225	1681
S2	47.650	3.059	Open Manhole	1200	S1.010	44.591	225	S1.009	44.591	225	
S	45.950	1.547	Open Manhole	0		OUTFALL		S1.010	44.403	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S12	722307.088	725897.535	722307.088	725897.535	Required	
S11	722335.025	725894.337	722335.025	725894.337	Required	
S10	722337.699	725907.059	722337.699	725907.059	Required	
S9	722358.078	725942.283	722358.078	725942.283	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S8	722371.889	725942.211	722371.889	725942.211	Required	
S7	722382.180	725941.500	722382.180	725941.500	Required	
S6	722389.828	725935.786	722389.828	725935.786	Required	
S5	722420.338	725911.918	722420.338	725911.918	Required	
S4	722440.020	725896.807	722440.020	725896.807	Required	
S3-9	722336.143	725812.287	722336.143	725812.287	Required	
S3-8	722361.102	725779.539	722361.102	725779.539	Required	
S3-7	722375.134	725766.043	722375.134	725766.043	Required	
S3-6	722387.996	725770.355	722387.996	725770.355	Required	
S3-5	722402.179	725787.205	722402.179	725787.205	Required	
S3-4	722427.388	725824.956	722427.388	725824.956	Required	
S3-3	722432.100	725835.803	722432.100	725835.803	Required	
S3-2	722445.326	725853.722	722445.326	725853.722	Required	
S3-1	722458.315	725872.230	722458.315	725872.230	Required	
S3	722462.255	725878.123	722462.255	725878.123	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S2	722475.901	725867.479	722475.901	725867.479	Required	
S	722500.163	725853.081			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	S12	54.150	52.275	1.650	Open Manhole	1200
S1.001	o	225	S11	53.000	50.869	1.906	Open Manhole	1200
S1.002	o	225	S10	52.455	49.508	2.722	Open Manhole	1200
S1.003	o	225	S9	50.365	47.473	2.667	Open Manhole	1200
S1.004	o	225	S8	49.758	47.405	2.128	Open Manhole	1200
S1.005	o	225	S7	49.250	47.107	1.918	Open Manhole	1200
S1.006	o	300	S6	49.110	46.833	1.977	Open Manhole	1200
S1.007	o	300	S5	48.450	45.662	2.488	Open Manhole	1200
S1.008	o	225	S4	48.750	45.600	2.925	Open Manhole	1200
S2.000	o	225	S3-9	52.800	51.375	1.200	Open Manhole	1200
S2.001	o	300	S3-8	52.560	50.551	1.709	Open Manhole	1200
S2.002	o	450	S3-7	51.650	48.856	2.344	Open Manhole	1350
S2.003	o	450	S3-6	51.250	48.720	2.080	Open Manhole	1350
S2.004	o	450	S3-5	51.530	47.115	3.965	Open Manhole	1350
S2.005	o	300	S3-4	49.690	46.998	2.392	Open Manhole	1350
S2.006	o	375	S3-3	49.790	46.813	2.602	Open Manhole	1350
S2.007	o	375	S3-2	48.810	46.590	1.845	Open Manhole	1350
S2.008	o	225	S3-1	48.190	46.550	1.415	Open Manhole	1350
S1.009	o	225	S3	47.990	44.700	3.065	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	28.120	20.0	S11	53.000	50.869	1.906	Open Manhole	1200
S1.001	13.000	20.0	S10	52.455	50.219	2.011	Open Manhole	1200
S1.002	40.694	20.0	S9	50.365	47.473	2.667	Open Manhole	1200
S1.003	13.811	203.1	S8	49.758	47.405	2.128	Open Manhole	1200
S1.004	10.315	34.6	S7	49.250	47.107	1.918	Open Manhole	1200
S1.005	9.547	34.8	S6	49.110	46.833	2.052	Open Manhole	1200
S1.006	38.736	33.1	S5	48.450	45.662	2.488	Open Manhole	1200
S1.007	24.814	400.2	S4	48.750	45.600	2.850	Open Manhole	1200
S1.008	29.044	100.2	S3	47.990	45.310	2.455	Open Manhole	1200
S2.000	41.175	52.2	S3-8	52.560	50.586	1.749	Open Manhole	1200
S2.001	19.469	40.3	S3-7	51.650	50.068	1.282	Open Manhole	1350
S2.002	13.566	99.8	S3-6	51.250	48.720	2.080	Open Manhole	1350
S2.003	22.024	100.1	S3-5	51.530	48.500	2.580	Open Manhole	1350
S2.004	45.394	388.0	S3-4	49.690	46.998	2.242	Open Manhole	1350
S2.005	11.827	100.2	S3-3	49.790	46.880	2.610	Open Manhole	1350
S2.006	22.271	99.9	S3-2	48.810	46.590	1.845	Open Manhole	1350
S2.007	22.611	565.3	S3-1	48.190	46.550	1.265	Open Manhole	1350
S2.008	7.089	41.9	S3	47.990	46.381	1.384	Open Manhole	1200
S1.009	17.306	158.8	S2	47.650	44.591	2.834	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.010	o	225	S2	47.650	44.591	2.834	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.010	28.213	150.1	S	45.950	44.403	1.322	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	S	45.950	44.403	44.500	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	10.000
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	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	5	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	16.400	Storm Duration (mins)	30
Ratio R	0.273		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S8, DS/PN: S1.004, Volume (m³): 3.2

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	47.405
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

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	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.008, Volume (m³): 5.2

Unit Reference	MD-SHE-0098-5700-2000-5700
Design Head (m)	2.000
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	45.600
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.008, Volume (m³): 5.2

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.7
Flush-Flo™	0.430	4.8
Kick-Flo®	0.874	3.9
Mean Flow over Head Range	-	4.6

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	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.6
0.300	4.7	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.8	1.800	5.4	4.500	8.3	8.500	11.3
0.500	4.8	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.7	2.200	5.9	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.4	6.500	9.9		

Hydro-Brake® Optimum Manhole: S3-4, DS/PN: S2.005, Volume (m³): 10.9

Unit Reference	MD-SHE-0099-5000-1450-5000
Design Head (m)	1.450
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	99
Invert Level (m)	46.998
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	5.0
Flush-Flo™	0.432	5.0
Kick-Flo®	0.882	4.0
Mean Flow over Head Range	-	4.4

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	0.300	4.9	0.500	5.0	0.800	4.4
0.200	4.5	0.400	5.0	0.600	4.9	1.000	4.2

Hydro-Brake® Optimum Manhole: S3-4, DS/PN: S2.005, Volume (m³): 10.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	4.6	2.400	6.3	5.000	8.9	8.000	11.2
1.400	4.9	2.600	6.6	5.500	9.3	8.500	11.5
1.600	5.2	3.000	7.0	6.000	9.7	9.000	11.8
1.800	5.5	3.500	7.5	6.500	10.1	9.500	12.1
2.000	5.8	4.000	8.0	7.000	10.5		
2.200	6.1	4.500	8.5	7.500	10.8		

Hydro-Brake® Optimum Manhole: S3-1, DS/PN: S2.008, Volume (m³): 4.7

Unit Reference	MD-SHE-0119-7300-1450-7300
Design Head (m)	1.450
Design Flow (l/s)	7.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	46.550
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	7.3
Flush-Flo™	0.433	7.3
Kick-Flo®	0.900	5.8
Mean Flow over Head Range	-	6.4

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	4.2	1.200	6.7	3.000	10.3	7.000	15.4
0.200	6.6	1.400	7.2	3.500	11.1	7.500	15.9
0.300	7.1	1.600	7.6	4.000	11.8	8.000	16.4
0.400	7.3	1.800	8.1	4.500	12.5	8.500	16.9
0.500	7.3	2.000	8.5	5.000	13.1	9.000	17.3
0.600	7.2	2.200	8.9	5.500	13.7	9.500	17.8
0.800	6.6	2.400	9.2	6.000	14.3		
1.000	6.1	2.600	9.6	6.500	14.8		

Storage Structures for Storm

Cellular Storage Manhole: S8, DS/PN: S1.004

Invert Level (m) 47.405 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	68.0	0.0	2.001	0.0	0.0
2.000	68.0	0.0			

Cellular Storage Manhole: S4, DS/PN: S1.008

Invert Level (m) 45.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	76.0	0.0	2.001	0.0	0.0
2.000	76.0	0.0			

Cellular Storage Manhole: S3-4, DS/PN: S2.005

Invert Level (m) 46.998 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.80
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	295.5	0.0	1.451	0.0	0.0
1.450	295.5	0.0			

Cellular Storage Manhole: S3-1, DS/PN: S2.008

Invert Level (m) 46.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.82
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	128.2	0.0	1.451	0.0	0.0
1.450	128.2	0.0			

Summary of Results for 30 minute 5 year Winter (Storm)

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

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S12	52.332	-0.168	0.000	0.15			16.0	OK
S1.001	S11	50.934	-0.160	0.000	0.18			18.5	OK
S1.002	S10	49.597	-0.136	0.000	0.34			37.2	OK
S1.003	S9	47.903	0.205	0.000	1.25			39.7	SURCHARGED
S1.004	S8	47.899	0.269	0.000	0.02			1.3	SURCHARGED
S1.005	S7	47.132	-0.200	0.000	0.03			2.0	OK
S1.006	S6	46.949	-0.184	0.000	0.32			57.4	OK
S1.007	S5	46.184	0.222	0.000	1.20			59.1	SURCHARGED
S1.008	S4	46.179	0.354	0.000	0.10			4.8	SURCHARGED
S2.000	S3-9	51.469	-0.131	0.000	0.36			24.6	OK
S2.001	S3-8	50.637	-0.214	0.000	0.18			27.7	OK
S2.002	S3-7	48.978	-0.328	0.000	0.17			34.6	OK
S2.003	S3-6	48.865	-0.305	0.000	0.23			60.5	OK
S2.004	S3-5	47.399	-0.166	0.000	0.71			104.0	OK
S2.005	S3-4	47.345	0.047	0.000	0.06			4.9	SURCHARGED
S2.006	S3-3	46.932	-0.256	0.000	0.22			37.4	OK
S2.007	S3-2	46.882	-0.083	0.000	0.83			52.8	OK
S2.008	S3-1	46.877	0.102	0.000	0.12			7.2	SURCHARGED
S1.009	S3	44.787	-0.138	0.000	0.32			11.6	OK
S1.010	S2	44.674	-0.142	0.000	0.30			11.6	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.400	Add Flow / Climate Change (%)	10
Ratio R	0.273	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.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - 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
S1.000	28.120	1.406	20.0	0.087	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	13.000	0.650	20.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	40.694	2.035	20.0	0.112	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	13.811	0.068	203.1	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.315	0.298	34.6	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	9.547	0.274	34.8	0.005	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.006	38.736	1.171	33.1	0.334	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	24.814	0.062	400.2	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	29.044	0.290	100.2	0.007	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	41.175	0.789	52.2	0.135	4.00	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)
S1.000	50.00	4.16	52.275	0.087	0.0	0.0	1.2	2.94	116.9	13.0
S1.001	50.00	4.23	50.869	0.103	0.0	0.0	1.4	2.94	116.9	15.3
S1.002	50.00	4.46	49.508	0.215	0.0	0.0	2.9	2.94	116.9	32.0
S1.003	50.00	4.72	47.473	0.236	0.0	0.0	3.2	0.91	36.3	35.2
S1.004	50.00	4.79	47.405	0.255	0.0	0.0	3.5	2.23	88.7	38.0
S1.005	50.00	4.86	47.107	0.260	0.0	0.0	3.5	2.22	88.4	38.7
S1.006	50.00	5.10	46.833	0.594	0.0	0.0	8.0	2.74	193.9	88.5
S1.007	50.00	5.63	45.662	0.608	0.0	0.0	8.2	0.78	55.1«	90.6
S1.008	50.00	6.00	45.600	0.615	0.0	0.0	8.3	1.31	51.9«	91.6
S2.000	50.00	4.38	51.375	0.135	0.0	0.0	1.8	1.81	72.2	20.1

Network Design Table for Storm

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
S2.001	19.469	0.483	40.3	0.018	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.002	13.566	0.136	99.8	0.041	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.003	22.024	0.220	100.1	0.157	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.004	45.394	0.117	388.0	0.269	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.005	11.827	0.118	100.2	0.053	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	22.271	0.223	99.9	0.201	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.007	22.611	0.040	565.3	0.096	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.008	7.089	0.169	41.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.009	17.306	0.109	158.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.010	28.213	0.188	150.1	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)
S2.001	50.00	4.51	50.551	0.153	0.0	0.0	2.1	2.48	175.6	22.8
S2.002	50.00	4.62	48.856	0.194	0.0	0.0	2.6	2.04	323.8	28.9
S2.003	50.00	4.80	48.720	0.351	0.0	0.0	4.8	2.03	323.2	52.3
S2.004	50.00	5.54	47.115	0.620	0.0	0.0	8.4	1.03	163.2	92.4
S2.005	50.00	5.66	46.998	0.673	0.0	0.0	9.1	1.57	111.0	100.2
S2.006	50.00	5.87	46.813	0.874	0.0	0.0	11.8	1.81	200.3	130.2
S2.007	50.00	6.37	46.590	0.970	0.0	0.0	13.1	0.75	83.4«	144.5
S2.008	50.00	6.43	46.550	0.970	0.0	0.0	13.1	2.03	80.5«	144.5
S1.009	50.00	6.70	44.700	1.585	0.0	0.0	21.5	1.04	41.2«	236.1
S1.010	50.00	7.15	44.591	1.585	0.0	0.0	21.5	1.06	42.3«	236.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S12	54.150	1.875	Open Manhole	1200	S1.000	52.275	225				
S11	53.000	2.131	Open Manhole	1200	S1.001	50.869	225	S1.000	50.869	225	
S10	52.455	2.947	Open Manhole	1200	S1.002	49.508	225	S1.001	50.219	225	711
S9	50.365	2.892	Open Manhole	1200	S1.003	47.473	225	S1.002	47.473	225	
S8	49.758	2.353	Open Manhole	1200	S1.004	47.405	225	S1.003	47.405	225	
S7	49.250	2.143	Open Manhole	1200	S1.005	47.107	225	S1.004	47.107	225	
S6	49.110	2.277	Open Manhole	1200	S1.006	46.833	300	S1.005	46.833	225	
S5	48.450	2.788	Open Manhole	1200	S1.007	45.662	300	S1.006	45.662	300	
S4	48.750	3.150	Open Manhole	1200	S1.008	45.600	225	S1.007	45.600	300	
S3-9	52.800	1.425	Open Manhole	1200	S2.000	51.375	225				
S3-8	52.560	2.009	Open Manhole	1200	S2.001	50.551	300	S2.000	50.586	225	
S3-7	51.650	2.794	Open Manhole	1350	S2.002	48.856	450	S2.001	50.068	300	1062
S3-6	51.250	2.530	Open Manhole	1350	S2.003	48.720	450	S2.002	48.720	450	
S3-5	51.530	4.415	Open Manhole	1350	S2.004	47.115	450	S2.003	48.500	450	1385
S3-4	49.690	2.692	Open Manhole	1350	S2.005	46.998	300	S2.004	46.998	450	
S3-3	49.790	2.977	Open Manhole	1350	S2.006	46.813	375	S2.005	46.880	300	
S3-2	48.810	2.220	Open Manhole	1350	S2.007	46.590	375	S2.006	46.590	375	
S3-1	48.190	1.640	Open Manhole	1350	S2.008	46.550	225	S2.007	46.550	375	
S3	47.990	3.290	Open Manhole	1200	S1.009	44.700	225	S1.008	45.310	225	610
								S2.008	46.381	225	1681
S2	47.650	3.059	Open Manhole	1200	S1.010	44.591	225	S1.009	44.591	225	
S	45.950	1.547	Open Manhole	0		OUTFALL		S1.010	44.403	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S12	722307.088	725897.535	722307.088	725897.535	Required	
S11	722335.025	725894.337	722335.025	725894.337	Required	
S10	722337.699	725907.059	722337.699	725907.059	Required	
S9	722358.078	725942.283	722358.078	725942.283	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S8	722371.889	725942.211	722371.889	725942.211	Required	
S7	722382.180	725941.500	722382.180	725941.500	Required	
S6	722389.828	725935.786	722389.828	725935.786	Required	
S5	722420.338	725911.918	722420.338	725911.918	Required	
S4	722440.020	725896.807	722440.020	725896.807	Required	
S3-9	722336.143	725812.287	722336.143	725812.287	Required	
S3-8	722361.102	725779.539	722361.102	725779.539	Required	
S3-7	722375.134	725766.043	722375.134	725766.043	Required	
S3-6	722387.996	725770.355	722387.996	725770.355	Required	
S3-5	722402.179	725787.205	722402.179	725787.205	Required	
S3-4	722427.388	725824.956	722427.388	725824.956	Required	
S3-3	722432.100	725835.803	722432.100	725835.803	Required	
S3-2	722445.326	725853.722	722445.326	725853.722	Required	
S3-1	722458.315	725872.230	722458.315	725872.230	Required	
S3	722462.255	725878.123	722462.255	725878.123	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S2	722475.901	725867.479	722475.901	725867.479	Required	
S	722500.163	725853.081			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	S12	54.150	52.275	1.650	Open Manhole	1200
S1.001	o	225	S11	53.000	50.869	1.906	Open Manhole	1200
S1.002	o	225	S10	52.455	49.508	2.722	Open Manhole	1200
S1.003	o	225	S9	50.365	47.473	2.667	Open Manhole	1200
S1.004	o	225	S8	49.758	47.405	2.128	Open Manhole	1200
S1.005	o	225	S7	49.250	47.107	1.918	Open Manhole	1200
S1.006	o	300	S6	49.110	46.833	1.977	Open Manhole	1200
S1.007	o	300	S5	48.450	45.662	2.488	Open Manhole	1200
S1.008	o	225	S4	48.750	45.600	2.925	Open Manhole	1200
S2.000	o	225	S3-9	52.800	51.375	1.200	Open Manhole	1200
S2.001	o	300	S3-8	52.560	50.551	1.709	Open Manhole	1200
S2.002	o	450	S3-7	51.650	48.856	2.344	Open Manhole	1350
S2.003	o	450	S3-6	51.250	48.720	2.080	Open Manhole	1350
S2.004	o	450	S3-5	51.530	47.115	3.965	Open Manhole	1350
S2.005	o	300	S3-4	49.690	46.998	2.392	Open Manhole	1350
S2.006	o	375	S3-3	49.790	46.813	2.602	Open Manhole	1350
S2.007	o	375	S3-2	48.810	46.590	1.845	Open Manhole	1350
S2.008	o	225	S3-1	48.190	46.550	1.415	Open Manhole	1350
S1.009	o	225	S3	47.990	44.700	3.065	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	28.120	20.0	S11	53.000	50.869	1.906	Open Manhole	1200
S1.001	13.000	20.0	S10	52.455	50.219	2.011	Open Manhole	1200
S1.002	40.694	20.0	S9	50.365	47.473	2.667	Open Manhole	1200
S1.003	13.811	203.1	S8	49.758	47.405	2.128	Open Manhole	1200
S1.004	10.315	34.6	S7	49.250	47.107	1.918	Open Manhole	1200
S1.005	9.547	34.8	S6	49.110	46.833	2.052	Open Manhole	1200
S1.006	38.736	33.1	S5	48.450	45.662	2.488	Open Manhole	1200
S1.007	24.814	400.2	S4	48.750	45.600	2.850	Open Manhole	1200
S1.008	29.044	100.2	S3	47.990	45.310	2.455	Open Manhole	1200
S2.000	41.175	52.2	S3-8	52.560	50.586	1.749	Open Manhole	1200
S2.001	19.469	40.3	S3-7	51.650	50.068	1.282	Open Manhole	1350
S2.002	13.566	99.8	S3-6	51.250	48.720	2.080	Open Manhole	1350
S2.003	22.024	100.1	S3-5	51.530	48.500	2.580	Open Manhole	1350
S2.004	45.394	388.0	S3-4	49.690	46.998	2.242	Open Manhole	1350
S2.005	11.827	100.2	S3-3	49.790	46.880	2.610	Open Manhole	1350
S2.006	22.271	99.9	S3-2	48.810	46.590	1.845	Open Manhole	1350
S2.007	22.611	565.3	S3-1	48.190	46.550	1.265	Open Manhole	1350
S2.008	7.089	41.9	S3	47.990	46.381	1.384	Open Manhole	1200
S1.009	17.306	158.8	S2	47.650	44.591	2.834	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.010	o	225	S2	47.650	44.591	2.834	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.010	28.213	150.1	S	45.950	44.403	1.322	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	S	45.950	44.403	44.500	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	10.000
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)	1200
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	10

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	30	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	16.400	Storm Duration (mins)	600
Ratio R	0.273		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S8, DS/PN: S1.004, Volume (m³): 3.2

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	47.405
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

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	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.008, Volume (m³): 5.2

Unit Reference	MD-SHE-0098-5700-2000-5700
Design Head (m)	2.000
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	45.600
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.008, Volume (m³): 5.2

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.7
Flush-Flo™	0.430	4.8
Kick-Flo®	0.874	3.9
Mean Flow over Head Range	-	4.6

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	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.6
0.300	4.7	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.8	1.800	5.4	4.500	8.3	8.500	11.3
0.500	4.8	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.7	2.200	5.9	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.4	6.500	9.9		

Hydro-Brake® Optimum Manhole: S3-4, DS/PN: S2.005, Volume (m³): 10.9

Unit Reference	MD-SHE-0099-5000-1450-5000
Design Head (m)	1.450
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	99
Invert Level (m)	46.998
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	5.0
Flush-Flo™	0.432	5.0
Kick-Flo®	0.882	4.0
Mean Flow over Head Range	-	4.4

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	0.300	4.9	0.500	5.0	0.800	4.4
0.200	4.5	0.400	5.0	0.600	4.9	1.000	4.2

Hydro-Brake® Optimum Manhole: S3-4, DS/PN: S2.005, Volume (m³): 10.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	4.6	2.400	6.3	5.000	8.9	8.000	11.2
1.400	4.9	2.600	6.6	5.500	9.3	8.500	11.5
1.600	5.2	3.000	7.0	6.000	9.7	9.000	11.8
1.800	5.5	3.500	7.5	6.500	10.1	9.500	12.1
2.000	5.8	4.000	8.0	7.000	10.5		
2.200	6.1	4.500	8.5	7.500	10.8		

Hydro-Brake® Optimum Manhole: S3-1, DS/PN: S2.008, Volume (m³): 4.7

Unit Reference	MD-SHE-0119-7300-1450-7300
Design Head (m)	1.450
Design Flow (l/s)	7.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	46.550
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	7.3
Flush-Flo™	0.433	7.3
Kick-Flo®	0.900	5.8
Mean Flow over Head Range	-	6.4

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	4.2	1.200	6.7	3.000	10.3	7.000	15.4
0.200	6.6	1.400	7.2	3.500	11.1	7.500	15.9
0.300	7.1	1.600	7.6	4.000	11.8	8.000	16.4
0.400	7.3	1.800	8.1	4.500	12.5	8.500	16.9
0.500	7.3	2.000	8.5	5.000	13.1	9.000	17.3
0.600	7.2	2.200	8.9	5.500	13.7	9.500	17.8
0.800	6.6	2.400	9.2	6.000	14.3		
1.000	6.1	2.600	9.6	6.500	14.8		

Storage Structures for Storm

Cellular Storage Manhole: S8, DS/PN: S1.004

Invert Level (m) 47.405 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	68.0	0.0	2.001	0.0	0.0
2.000	68.0	0.0			

Cellular Storage Manhole: S4, DS/PN: S1.008

Invert Level (m) 45.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	76.0	0.0	2.001	0.0	0.0
2.000	76.0	0.0			

Cellular Storage Manhole: S3-4, DS/PN: S2.005

Invert Level (m) 46.998 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.80
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	295.5	0.0	1.451	0.0	0.0
1.450	295.5	0.0			

Cellular Storage Manhole: S3-1, DS/PN: S2.008

Invert Level (m) 46.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.82
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	128.2	0.0	1.451	0.0	0.0
1.450	128.2	0.0			

Summary of Results for 600 minute 30 year Winter (Storm)

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

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S12	52.301	-0.199	0.000	0.03			3.6	OK
S1.001	S11	50.898	-0.196	0.000	0.04			4.2	OK
S1.002	S10	49.550	-0.183	0.000	0.08			8.8	OK
S1.003	S9	48.924	1.226	0.000	0.30			9.4	SURCHARGED
S1.004	S8	48.921	1.291	0.000	0.02		620	1.8	SURCHARGED
S1.005	S7	47.163	-0.169	0.000	0.02			1.8	OK
S1.006	S6	47.161	0.028	0.000	0.08			15.2	SURCHARGED
S1.007	S5	47.154	1.192	0.000	0.31			15.3	SURCHARGED
S1.008	S4	47.148	1.323	0.000	0.10		480	5.0	SURCHARGED
S2.000	S3-9	51.417	-0.183	0.000	0.08			5.5	OK
S2.001	S3-8	50.590	-0.261	0.000	0.04			6.3	OK
S2.002	S3-7	48.912	-0.394	0.000	0.04			7.9	OK
S2.003	S3-6	48.787	-0.383	0.000	0.05			14.4	OK
S2.004	S3-5	48.037	0.472	0.000	0.17			25.1	SURCHARGED
S2.005	S3-4	48.035	0.737	0.000	0.06		550	5.0	SURCHARGED
S2.006	S3-3	47.650	0.462	0.000	0.07			12.7	SURCHARGED
S2.007	S3-2	47.646	0.681	0.000	0.26			16.3	SURCHARGED
S2.008	S3-1	47.642	0.867	0.000	0.13			7.3	SURCHARGED
S1.009	S3	44.788	-0.137	0.000	0.32			11.9	OK
S1.010	S2	44.675	-0.141	0.000	0.30			11.9	OK

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - Scotland and Ireland

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	16.400	Add Flow / Climate Change (%)	10
Ratio R	0.273	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.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - 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
S1.000	28.120	1.406	20.0	0.087	4.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	13.000	0.650	20.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	40.694	2.035	20.0	0.112	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	13.811	0.068	203.1	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	10.315	0.298	34.6	0.019	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	9.547	0.274	34.8	0.005	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.006	38.736	1.171	33.1	0.334	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.007	24.814	0.062	400.2	0.014	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.008	29.044	0.290	100.2	0.007	0.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	41.175	0.789	52.2	0.135	4.00	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)
S1.000	50.00	4.16	52.275	0.087	0.0	0.0	1.2	2.94	116.9	13.0
S1.001	50.00	4.23	50.869	0.103	0.0	0.0	1.4	2.94	116.9	15.3
S1.002	50.00	4.46	49.508	0.215	0.0	0.0	2.9	2.94	116.9	32.0
S1.003	50.00	4.72	47.473	0.236	0.0	0.0	3.2	0.91	36.3	35.2
S1.004	50.00	4.79	47.405	0.255	0.0	0.0	3.5	2.23	88.7	38.0
S1.005	50.00	4.86	47.107	0.260	0.0	0.0	3.5	2.22	88.4	38.7
S1.006	50.00	5.10	46.833	0.594	0.0	0.0	8.0	2.74	193.9	88.5
S1.007	50.00	5.63	45.662	0.608	0.0	0.0	8.2	0.78	55.1«	90.6
S1.008	50.00	6.00	45.600	0.615	0.0	0.0	8.3	1.31	51.9«	91.6
S2.000	50.00	4.38	51.375	0.135	0.0	0.0	1.8	1.81	72.2	20.1

Network Design Table for Storm

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
S2.001	19.469	0.483	40.3	0.018	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.002	13.566	0.136	99.8	0.041	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.003	22.024	0.220	100.1	0.157	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.004	45.394	0.117	388.0	0.269	0.00	0.0	0.600	o	450	Pipe/Conduit	
S2.005	11.827	0.118	100.2	0.053	0.00	0.0	0.600	o	300	Pipe/Conduit	
S2.006	22.271	0.223	99.9	0.201	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.007	22.611	0.040	565.3	0.096	0.00	0.0	0.600	o	375	Pipe/Conduit	
S2.008	7.089	0.169	41.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.009	17.306	0.109	158.8	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.010	28.213	0.188	150.1	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)
S2.001	50.00	4.51	50.551	0.153	0.0	0.0	2.1	2.48	175.6	22.8
S2.002	50.00	4.62	48.856	0.194	0.0	0.0	2.6	2.04	323.8	28.9
S2.003	50.00	4.80	48.720	0.351	0.0	0.0	4.8	2.03	323.2	52.3
S2.004	50.00	5.54	47.115	0.620	0.0	0.0	8.4	1.03	163.2	92.4
S2.005	50.00	5.66	46.998	0.673	0.0	0.0	9.1	1.57	111.0	100.2
S2.006	50.00	5.87	46.813	0.874	0.0	0.0	11.8	1.81	200.3	130.2
S2.007	50.00	6.37	46.590	0.970	0.0	0.0	13.1	0.75	83.4«	144.5
S2.008	50.00	6.43	46.550	0.970	0.0	0.0	13.1	2.03	80.5«	144.5
S1.009	50.00	6.70	44.700	1.585	0.0	0.0	21.5	1.04	41.2«	236.1
S1.010	50.00	7.15	44.591	1.585	0.0	0.0	21.5	1.06	42.3«	236.1

Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S12	54.150	1.875	Open Manhole	1200	S1.000	52.275	225				
S11	53.000	2.131	Open Manhole	1200	S1.001	50.869	225	S1.000	50.869	225	
S10	52.455	2.947	Open Manhole	1200	S1.002	49.508	225	S1.001	50.219	225	711
S9	50.365	2.892	Open Manhole	1200	S1.003	47.473	225	S1.002	47.473	225	
S8	49.758	2.353	Open Manhole	1200	S1.004	47.405	225	S1.003	47.405	225	
S7	49.250	2.143	Open Manhole	1200	S1.005	47.107	225	S1.004	47.107	225	
S6	49.110	2.277	Open Manhole	1200	S1.006	46.833	300	S1.005	46.833	225	
S5	48.450	2.788	Open Manhole	1200	S1.007	45.662	300	S1.006	45.662	300	
S4	48.750	3.150	Open Manhole	1200	S1.008	45.600	225	S1.007	45.600	300	
S3-9	52.800	1.425	Open Manhole	1200	S2.000	51.375	225				
S3-8	52.560	2.009	Open Manhole	1200	S2.001	50.551	300	S2.000	50.586	225	
S3-7	51.650	2.794	Open Manhole	1350	S2.002	48.856	450	S2.001	50.068	300	1062
S3-6	51.250	2.530	Open Manhole	1350	S2.003	48.720	450	S2.002	48.720	450	
S3-5	51.530	4.415	Open Manhole	1350	S2.004	47.115	450	S2.003	48.500	450	1385
S3-4	49.690	2.692	Open Manhole	1350	S2.005	46.998	300	S2.004	46.998	450	
S3-3	49.790	2.977	Open Manhole	1350	S2.006	46.813	375	S2.005	46.880	300	
S3-2	48.810	2.220	Open Manhole	1350	S2.007	46.590	375	S2.006	46.590	375	
S3-1	48.190	1.640	Open Manhole	1350	S2.008	46.550	225	S2.007	46.550	375	
S3	47.990	3.290	Open Manhole	1200	S1.009	44.700	225	S1.008	45.310	225	610
								S2.008	46.381	225	1681
S2	47.650	3.059	Open Manhole	1200	S1.010	44.591	225	S1.009	44.591	225	
S	45.950	1.547	Open Manhole	0		OUTFALL		S1.010	44.403	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S12	722307.088	725897.535	722307.088	725897.535	Required	
S11	722335.025	725894.337	722335.025	725894.337	Required	
S10	722337.699	725907.059	722337.699	725907.059	Required	
S9	722358.078	725942.283	722358.078	725942.283	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S8	722371.889	725942.211	722371.889	725942.211	Required	
S7	722382.180	725941.500	722382.180	725941.500	Required	
S6	722389.828	725935.786	722389.828	725935.786	Required	
S5	722420.338	725911.918	722420.338	725911.918	Required	
S4	722440.020	725896.807	722440.020	725896.807	Required	
S3-9	722336.143	725812.287	722336.143	725812.287	Required	
S3-8	722361.102	725779.539	722361.102	725779.539	Required	
S3-7	722375.134	725766.043	722375.134	725766.043	Required	
S3-6	722387.996	725770.355	722387.996	725770.355	Required	
S3-5	722402.179	725787.205	722402.179	725787.205	Required	
S3-4	722427.388	725824.956	722427.388	725824.956	Required	
S3-3	722432.100	725835.803	722432.100	725835.803	Required	
S3-2	722445.326	725853.722	722445.326	725853.722	Required	
S3-1	722458.315	725872.230	722458.315	725872.230	Required	
S3	722462.255	725878.123	722462.255	725878.123	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S2	722475.901	725867.479	722475.901	725867.479	Required	
S	722500.163	725853.081			No Entry	

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	225	S12	54.150	52.275	1.650	Open Manhole	1200
S1.001	o	225	S11	53.000	50.869	1.906	Open Manhole	1200
S1.002	o	225	S10	52.455	49.508	2.722	Open Manhole	1200
S1.003	o	225	S9	50.365	47.473	2.667	Open Manhole	1200
S1.004	o	225	S8	49.758	47.405	2.128	Open Manhole	1200
S1.005	o	225	S7	49.250	47.107	1.918	Open Manhole	1200
S1.006	o	300	S6	49.110	46.833	1.977	Open Manhole	1200
S1.007	o	300	S5	48.450	45.662	2.488	Open Manhole	1200
S1.008	o	225	S4	48.750	45.600	2.925	Open Manhole	1200
S2.000	o	225	S3-9	52.800	51.375	1.200	Open Manhole	1200
S2.001	o	300	S3-8	52.560	50.551	1.709	Open Manhole	1200
S2.002	o	450	S3-7	51.650	48.856	2.344	Open Manhole	1350
S2.003	o	450	S3-6	51.250	48.720	2.080	Open Manhole	1350
S2.004	o	450	S3-5	51.530	47.115	3.965	Open Manhole	1350
S2.005	o	300	S3-4	49.690	46.998	2.392	Open Manhole	1350
S2.006	o	375	S3-3	49.790	46.813	2.602	Open Manhole	1350
S2.007	o	375	S3-2	48.810	46.590	1.845	Open Manhole	1350
S2.008	o	225	S3-1	48.190	46.550	1.415	Open Manhole	1350
S1.009	o	225	S3	47.990	44.700	3.065	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	28.120	20.0	S11	53.000	50.869	1.906	Open Manhole	1200
S1.001	13.000	20.0	S10	52.455	50.219	2.011	Open Manhole	1200
S1.002	40.694	20.0	S9	50.365	47.473	2.667	Open Manhole	1200
S1.003	13.811	203.1	S8	49.758	47.405	2.128	Open Manhole	1200
S1.004	10.315	34.6	S7	49.250	47.107	1.918	Open Manhole	1200
S1.005	9.547	34.8	S6	49.110	46.833	2.052	Open Manhole	1200
S1.006	38.736	33.1	S5	48.450	45.662	2.488	Open Manhole	1200
S1.007	24.814	400.2	S4	48.750	45.600	2.850	Open Manhole	1200
S1.008	29.044	100.2	S3	47.990	45.310	2.455	Open Manhole	1200
S2.000	41.175	52.2	S3-8	52.560	50.586	1.749	Open Manhole	1200
S2.001	19.469	40.3	S3-7	51.650	50.068	1.282	Open Manhole	1350
S2.002	13.566	99.8	S3-6	51.250	48.720	2.080	Open Manhole	1350
S2.003	22.024	100.1	S3-5	51.530	48.500	2.580	Open Manhole	1350
S2.004	45.394	388.0	S3-4	49.690	46.998	2.242	Open Manhole	1350
S2.005	11.827	100.2	S3-3	49.790	46.880	2.610	Open Manhole	1350
S2.006	22.271	99.9	S3-2	48.810	46.590	1.845	Open Manhole	1350
S2.007	22.611	565.3	S3-1	48.190	46.550	1.265	Open Manhole	1350
S2.008	7.089	41.9	S3	47.990	46.381	1.384	Open Manhole	1200
S1.009	17.306	158.8	S2	47.650	44.591	2.834	Open Manhole	1200

PIPELINE SCHEDULES for Storm

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.010	o	225	S2	47.650	44.591	2.834	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.010	28.213	150.1	S	45.950	44.403	1.322	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.010	S	45.950	44.403	44.500	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	1.000	Additional Flow - % of Total Flow	10.000
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)	1200
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	10

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	1.000
M5-60 (mm)	16.400	Storm Duration (mins)	600
Ratio R	0.273		

Online Controls for Storm

Hydro-Brake® Optimum Manhole: S8, DS/PN: S1.004, Volume (m³): 3.2

Unit Reference	MD-SHE-0057-2000-2000-2000
Design Head (m)	2.000
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	57
Invert Level (m)	47.405
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	2.0
Flush-Flo™	0.247	1.3
Kick-Flo®	0.506	1.1
Mean Flow over Head Range	-	1.5

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	1.2	1.200	1.6	3.000	2.4	7.000	3.6
0.200	1.3	1.400	1.7	3.500	2.6	7.500	3.7
0.300	1.3	1.600	1.8	4.000	2.7	8.000	3.8
0.400	1.3	1.800	1.9	4.500	2.9	8.500	3.9
0.500	1.1	2.000	2.0	5.000	3.0	9.000	4.0
0.600	1.2	2.200	2.1	5.500	3.2	9.500	4.1
0.800	1.3	2.400	2.2	6.000	3.3		
1.000	1.5	2.600	2.3	6.500	3.4		

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.008, Volume (m³): 5.2

Unit Reference	MD-SHE-0098-5700-2000-5700
Design Head (m)	2.000
Design Flow (l/s)	5.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	45.600
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.008, Volume (m³): 5.2

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.7
Flush-Flo™	0.430	4.8
Kick-Flo®	0.874	3.9
Mean Flow over Head Range	-	4.6

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	10.3
0.200	4.4	1.400	4.8	3.500	7.4	7.500	10.6
0.300	4.7	1.600	5.1	4.000	7.9	8.000	11.0
0.400	4.8	1.800	5.4	4.500	8.3	8.500	11.3
0.500	4.8	2.000	5.7	5.000	8.8	9.000	11.6
0.600	4.7	2.200	5.9	5.500	9.2	9.500	11.9
0.800	4.3	2.400	6.2	6.000	9.6		
1.000	4.1	2.600	6.4	6.500	9.9		

Hydro-Brake® Optimum Manhole: S3-4, DS/PN: S2.005, Volume (m³): 10.9

Unit Reference	MD-SHE-0099-5000-1450-5000
Design Head (m)	1.450
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	99
Invert Level (m)	46.998
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	5.0
Flush-Flo™	0.432	5.0
Kick-Flo®	0.882	4.0
Mean Flow over Head Range	-	4.4

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	0.300	4.9	0.500	5.0	0.800	4.4
0.200	4.5	0.400	5.0	0.600	4.9	1.000	4.2

Hydro-Brake® Optimum Manhole: S3-4, DS/PN: S2.005, Volume (m³): 10.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	4.6	2.400	6.3	5.000	8.9	8.000	11.2
1.400	4.9	2.600	6.6	5.500	9.3	8.500	11.5
1.600	5.2	3.000	7.0	6.000	9.7	9.000	11.8
1.800	5.5	3.500	7.5	6.500	10.1	9.500	12.1
2.000	5.8	4.000	8.0	7.000	10.5		
2.200	6.1	4.500	8.5	7.500	10.8		

Hydro-Brake® Optimum Manhole: S3-1, DS/PN: S2.008, Volume (m³): 4.7

Unit Reference	MD-SHE-0119-7300-1450-7300
Design Head (m)	1.450
Design Flow (l/s)	7.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	46.550
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.450	7.3
Flush-Flo™	0.433	7.3
Kick-Flo®	0.900	5.8
Mean Flow over Head Range	-	6.4

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	4.2	1.200	6.7	3.000	10.3	7.000	15.4
0.200	6.6	1.400	7.2	3.500	11.1	7.500	15.9
0.300	7.1	1.600	7.6	4.000	11.8	8.000	16.4
0.400	7.3	1.800	8.1	4.500	12.5	8.500	16.9
0.500	7.3	2.000	8.5	5.000	13.1	9.000	17.3
0.600	7.2	2.200	8.9	5.500	13.7	9.500	17.8
0.800	6.6	2.400	9.2	6.000	14.3		
1.000	6.1	2.600	9.6	6.500	14.8		

Storage Structures for Storm

Cellular Storage Manhole: S8, DS/PN: S1.004

Invert Level (m) 47.405 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	68.0	0.0	2.001	0.0	0.0
2.000	68.0	0.0			

Cellular Storage Manhole: S4, DS/PN: S1.008

Invert Level (m) 45.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	76.0	0.0	2.001	0.0	0.0
2.000	76.0	0.0			

Cellular Storage Manhole: S3-4, DS/PN: S2.005

Invert Level (m) 46.998 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.80
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	295.5	0.0	1.451	0.0	0.0
1.450	295.5	0.0			

Cellular Storage Manhole: S3-1, DS/PN: S2.008

Invert Level (m) 46.550 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.82
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	128.2	0.0	1.451	0.0	0.0
1.450	128.2	0.0			

Summary of Results for 600 minute 100 year Winter (Storm)

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

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S12	52.304	-0.196	0.000	0.04			4.5	OK
S1.001	S11	50.902	-0.192	0.000	0.05			5.3	OK
S1.002	S10	49.726	-0.007	0.000	0.10			11.1	OK
S1.003	S9	49.721	2.023	0.000	0.37			11.8	SURCHARGED
S1.004	S8	49.718	2.088	0.000	0.03			2.0	FLOOD RISK
S1.005	S7	48.178	0.846	0.000	0.03			2.3	SURCHARGED
S1.006	S6	48.162	1.029	0.000	0.11			18.9	SURCHARGED
S1.007	S5	48.321	2.359	0.000	0.38			18.9	FLOOD RISK
S1.008	S4	48.466	2.641	0.000	0.13		570	6.2	FLOOD RISK
S2.000	S3-9	51.423	-0.177	0.000	0.10			6.9	OK
S2.001	S3-8	50.595	-0.256	0.000	0.05			7.9	OK
S2.002	S3-7	48.919	-0.387	0.000	0.05			10.0	OK
S2.003	S3-6	48.796	-0.374	0.000	0.07			18.0	OK
S2.004	S3-5	48.423	0.858	0.000	0.21			31.5	SURCHARGED
S2.005	S3-4	48.420	1.122	0.000	0.06		630	5.0	SURCHARGED
S2.006	S3-3	47.952	0.764	0.000	0.09			14.9	SURCHARGED
S2.007	S3-2	47.948	0.983	0.000	0.31			19.5	SURCHARGED
S2.008	S3-1	47.943	1.168	0.000	0.13			7.3	FLOOD RISK
S1.009	S3	44.795	-0.130	0.000	0.36			13.2	OK
S1.010	S2	44.682	-0.134	0.000	0.34			13.2	OK

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	10.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	4
Number of Online Controls	4	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 0.273
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)		16.400	Cv (Winter) 0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	5, 30, 100
Climate Change (%)	10, 10, 10

WARNING: Half Drain Time has not been calculated as the structure is too full.

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S12	15 Winter	100	+10%					52.364
S1.001	S11	15 Winter	100	+10%					50.971
S1.002	S10	15 Winter	100	+10%					49.666
S1.003	S9	600 Winter	100	+10%	5/15 Summer				49.230
S1.004	S8	600 Winter	100	+10%	5/15 Summer				49.227
S1.005	S7	360 Winter	100	+10%	100/180 Winter				47.490
S1.006	S6	360 Winter	100	+10%	100/120 Winter				47.488
S1.007	S5	360 Winter	100	+10%	5/15 Summer				47.480
S1.008	S4	360 Winter	100	+10%	5/15 Summer				47.474
S2.000	S3-9	15 Winter	100	+10%					51.530
S2.001	S3-8	15 Winter	100	+10%					50.686
S2.002	S3-7	15 Winter	100	+10%					49.050
S2.003	S3-6	15 Winter	100	+10%					48.959
S2.004	S3-5	600 Winter	100	+10%	5/360 Winter				48.276
S2.005	S3-4	600 Winter	100	+10%	5/30 Winter				48.274
S2.006	S3-3	720 Winter	100	+10%	30/120 Winter				47.842
S2.007	S3-2	720 Winter	100	+10%	5/120 Winter				47.838

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S12	-0.136	0.000	0.33			36.2	OK	
S1.001	S11	-0.123	0.000	0.42			42.8	OK	
S1.002	S10	-0.067	0.000	0.81			89.4	OK	
S1.003	S9	1.532	0.000	0.34			10.9	SURCHARGED	
S1.004	S8	1.597	0.000	0.03			1.9	SURCHARGED	
S1.005	S7	0.158	0.000	0.03			2.0	SURCHARGED	
S1.006	S6	0.355	0.000	0.14			24.5	SURCHARGED	
S1.007	S5	1.518	0.000	0.50			24.4	SURCHARGED	
S1.008	S4	1.649	0.000	0.11			5.5	SURCHARGED	
S2.000	S3-9	-0.070	0.000	0.81			55.8	OK	
S2.001	S3-8	-0.165	0.000	0.41			63.1	OK	
S2.002	S3-7	-0.256	0.000	0.38			79.8	OK	
S2.003	S3-6	-0.211	0.000	0.54			144.0	OK	
S2.004	S3-5	0.711	0.000	0.20			29.1	SURCHARGED	
S2.005	S3-4	0.976	0.000	0.06		580	5.0	SURCHARGED	
S2.006	S3-3	0.654	0.000	0.08			13.0	SURCHARGED	
S2.007	S3-2	0.873	0.000	0.26			16.7	SURCHARGED	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S2.008	S3-1	720 Winter	100	+10%	5/15 Winter				47.833
S1.009	S3	480 Winter	100	+10%					44.790
S1.010	S2	480 Winter	100	+10%					44.677

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S2.008	S3-1	1.058	0.000	0.13			7.3	SURCHARGED	
S1.009	S3	-0.135	0.000	0.34			12.4	OK	
S1.010	S2	-0.139	0.000	0.31			12.4	OK	

APPENDIX G

FOUL DRAINAGE NETWORK DESIGN

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Unit

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	10
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Calculation Method	EN 752	Maximum Backdrop Height (m)	1.500
Frequency Factor	0.50	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	0.00	Min Vel for Auto Design only (m/s)	0.75
Domestic Peak Flow Factor	6.00	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Foul - Unit

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	27.044	0.276	98.0	0.000	1890.0	0.0	1.500	o	225	Pipe/Conduit	
F1.001	10.160	0.104	97.7	0.000	840.0	0.0	1.500	o	225	Pipe/Conduit	
F1.002	21.172	0.216	98.0	0.000	840.0	0.0	1.500	o	225	Pipe/Conduit	
F1.003	7.384	0.075	98.5	0.000	490.0	0.0	1.500	o	225	Pipe/Conduit	
F1.004	29.574	0.299	98.9	0.000	210.0	0.0	1.500	o	225	Pipe/Conduit	
F1.005	10.907	0.110	99.2	0.000	0.0	0.0	1.500	o	225	Pipe/Conduit	
F2.000	47.984	0.480	100.0	0.000	30.0	0.0	1.500	o	225	Pipe/Conduit	
F2.001	34.125	1.465	23.3	0.000	10.0	0.0	1.500	o	225	Pipe/Conduit	
F2.002	27.227	0.182	149.6	0.000	13.0	0.0	1.500	o	225	Pipe/Conduit	
F2.003	51.926	2.478	21.0	0.000	34.0	0.0	1.500	o	225	Pipe/Conduit	
F2.004	43.756	0.730	59.9	0.000	20.0	0.0	1.500	o	225	Pipe/Conduit	
F1.006	11.093	0.118	94.0	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	47.020	0.000	0.0	1890.0	2.2	115	1.17	1.16	46.1	23.9
F1.001	46.744	0.000	0.0	2730.0	2.6	129	1.22	1.16	46.2	28.7
F1.002	46.640	0.000	0.0	3570.0	3.0	141	1.26	1.16	46.1	32.9
F1.003	46.424	0.000	0.0	4060.0	3.2	147	1.27	1.16	46.0	35.0
F1.004	46.349	0.000	0.0	4270.0	3.3	150	1.28	1.15	45.9	35.9
F1.005	46.050	0.000	0.0	4270.0	3.3	150	1.27	1.15	45.8	35.9
F2.000	51.275	0.000	0.0	30.0	0.3	39	0.65	1.15	45.6	3.0
F2.001	50.795	0.000	0.0	40.0	0.3	30	1.12	2.38	94.8	3.5
F2.002	49.330	0.000	0.0	53.0	0.4	50	0.61	0.94	37.3	4.0
F2.003	49.148	0.000	0.0	87.0	0.5	35	1.31	2.51	100.0	5.1
F2.004	46.670	0.000	0.0	107.0	0.5	47	0.94	1.48	59.0	5.7
F1.006	45.940	0.000	0.0	4377.0	3.3	149	1.31	1.18	47.1	36.4

Network Design Table for Foul - Unit

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
F1.007	2.753	0.028	98.3	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)
F1.007	45.822	0.000	0.0	4377.0	3.3	151	1.28	1.16	46.0	36.4

Manhole Schedules for Foul - Unit

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
F7	49.200	2.180	Open Manhole	1200	F1.000	47.020	225				
F6	48.600	1.856	Open Manhole	1200	F1.001	46.744	225	F1.000	46.744	225	
F5	50.030	3.390	Open Manhole	1200	F1.002	46.640	225	F1.001	46.640	225	
F4	49.610	3.186	Open Manhole	1200	F1.003	46.424	225	F1.002	46.424	225	
F3	48.750	2.401	Open Manhole	1200	F1.004	46.349	225	F1.003	46.349	225	
F2	47.990	1.940	Open Manhole	1200	F1.005	46.050	225	F1.004	46.050	225	
F1-5	53.300	2.025	Open Manhole	1200	F2.000	51.275	225				
F1-4	52.686	1.891	Open Manhole	1200	F2.001	50.795	225	F2.000	50.795	225	
F1-3	51.408	2.078	Open Manhole	1200	F2.002	49.330	225	F2.001	49.330	225	
F1-2	51.119	1.971	Open Manhole	1200	F2.003	49.148	225	F2.002	49.148	225	
F1-1	49.700	3.030	Open Manhole	1200	F2.004	46.670	225	F2.003	46.670	225	
F1	48.190	2.250	Open Manhole	1200	F1.006	45.940	225	F1.005	45.940	225	
								F2.004	45.940	225	
F0	47.710	1.888	Open Manhole	1200	F1.007	45.822	225	F1.006	45.822	225	
F	48.200	2.406	Open Manhole	0		OUTFALL		F1.007	45.794	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F7	722389.787	725933.572	722389.787	725933.572	Required	
F6	722411.029	725916.836	722411.029	725916.836	Required	
F5	722416.405	725908.214	722416.405	725908.214	Required	
F4	722433.231	725895.362	722433.231	725895.362	Required	
F3	722440.477	725893.944	722440.477	725893.944	Required	
F2	722463.290	725875.124	722463.290	725875.124	Required	
F1-5	722331.608	725825.249	722331.608	725825.249	Required	

Manhole Schedules for Foul - Unit

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F1-4	722359.865	725786.467	722359.865	725786.467	Required	
F1-3	722386.890	725765.631	722386.890	725765.631	Required	
F1-2	722405.292	725785.698	722405.292	725785.698	Required	
F1-1	722433.679	725829.177	722433.679	725829.177	Required	
F1	722457.284	725866.020	722457.284	725866.020	Required	
F0	722466.692	725860.142	722466.692	725860.142	Required	
F	722465.255	725857.794			No Entry	

PIPELINE SCHEDULES for Foul - Unit

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	o	225	F7	49.200	47.020	1.955	Open Manhole	1200
F1.001	o	225	F6	48.600	46.744	1.631	Open Manhole	1200
F1.002	o	225	F5	50.030	46.640	3.165	Open Manhole	1200
F1.003	o	225	F4	49.610	46.424	2.961	Open Manhole	1200
F1.004	o	225	F3	48.750	46.349	2.176	Open Manhole	1200
F1.005	o	225	F2	47.990	46.050	1.715	Open Manhole	1200
F2.000	o	225	F1-5	53.300	51.275	1.800	Open Manhole	1200
F2.001	o	225	F1-4	52.686	50.795	1.666	Open Manhole	1200
F2.002	o	225	F1-3	51.408	49.330	1.853	Open Manhole	1200
F2.003	o	225	F1-2	51.119	49.148	1.746	Open Manhole	1200
F2.004	o	225	F1-1	49.700	46.670	2.805	Open Manhole	1200
F1.006	o	225	F1	48.190	45.940	2.025	Open Manhole	1200
F1.007	o	225	F0	47.710	45.822	1.663	Open Manhole	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
F1.000	27.044	98.0	F6	48.600	46.744	1.631	Open Manhole	1200
F1.001	10.160	97.7	F5	50.030	46.640	3.165	Open Manhole	1200
F1.002	21.172	98.0	F4	49.610	46.424	2.961	Open Manhole	1200
F1.003	7.384	98.5	F3	48.750	46.349	2.176	Open Manhole	1200
F1.004	29.574	98.9	F2	47.990	46.050	1.715	Open Manhole	1200
F1.005	10.907	99.2	F1	48.190	45.940	2.025	Open Manhole	1200
F2.000	47.984	100.0	F1-4	52.686	50.795	1.666	Open Manhole	1200
F2.001	34.125	23.3	F1-3	51.408	49.330	1.853	Open Manhole	1200
F2.002	27.227	149.6	F1-2	51.119	49.148	1.746	Open Manhole	1200
F2.003	51.926	21.0	F1-1	49.700	46.670	2.805	Open Manhole	1200
F2.004	43.756	59.9	F1	48.190	45.940	2.025	Open Manhole	1200
F1.006	11.093	94.0	F0	47.710	45.822	1.663	Open Manhole	1200
F1.007	2.753	98.3	F	48.200	45.794	2.181	Open Manhole	0

Free Flowing Outfall Details for Foul - Unit

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.007	F	48.200	45.794	46.408	0	0

APPENDIX H

STAGE 1 STORMWATER AUDIT

JBA Consulting Stormwater Audit - Stage 1 Feedback Form

Project:	Development at Cornelscourt - Stage 1 SWA
Date:	08/11/2021
JBA Reviewers	Michael O'Donoghue
Project Number:	2021s1438

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
	10/11/2021	**10/11/2021**		
	Reference Documents 2021-05-20n11 (4)pb 180208-5 year 30 minute event 180208-100 year 600 event 180208-DBFL-XX-XX-DR-C-3001 Site Services Layout - Sheet 1 180208-DBFL-XX-XX-DR-C-3003-Surface Water Catchment Areas 180208-DBFL-XX-XX-DR-C-3004 Site Services Layout - Sheet 2 180208-rep-001 IDR (Draft) Catchment A Source Control Catchment B Source Control Catchment C Source Control Catchment D Source Control Met_Eireann_Rain_Data			
1	Calculations/180208-rep-001 IDR 1. The network and attenuation have been assessed separately, which doesn't fully imitate how the network reacts to various rainfall events and doesn't indicate the impact of backwater effects. 2. The time of concentration for the network and the attenuation structures don't correlate across the separate sets of calculations. 3. Time of entry is set to zero for all entry points bar the head of the system, despite further nodes having contributing areas. 4. The contributing areas in the network calculations don't correlate with the areas used in the attenuation. For example, the sum of the impermeable area up to PN 1.004 is .186, though the contributing area for Catchment A is 0.238 Ha. 5. A 50% runoff factor for permeable paving seems excessively low, given that no infiltration allowance exists across the site. 6. A network design for a 1 in 100 year event has been provided, however a 1 in 5 year network is what is indicated in the IDR. The intensities are capped at 50mm/hr for this 1 in 100 network. In addition, it is unclear as to how the storage structures are catered for in the network calculations, as only hydrobrakes are shown to be included. Normal procedures would be to ensure the network has capacity for a 1 in 5 year event, and then that same network is assessed against a 1 in 30 and 1 in 100 year event, ensuring that the parameters set out in Criterion 3 of GDSDS (16.3) are met. 7. An SOIL classification of 3 has been used, yet the infiltration tests in all cases failed. This suggests a SOIL type 4 may be more appropriate.	1. It is recommended that the attenuation and network are assessed as a complete system to imitate the impact the storage systems have on the incoming network. 1. Provide network results from a 1 in 30 year event. 2. Review ToC values to ensure correlation between attenuation and network calculations. 3. Provide reasoning for not providing ToE values for individual nodes downstream from the head of the line. 4. Ensure contributing areas used within the network calculation correspond to the attenuation calculations. 5. A higher run-off factor should be considered for the permeable paving, given the lack of infiltration. 80-85% run-off would be more appropriate. 6. Provide clarity on network assessment for 1 in 100 year event, and provide results for 1 in 30 year event. Review intensities used for 1 in 100 assessement. 7. Provide rationale for chosen SOIL type, taking infiltration tests into account.	1.Attenuation was built in to the network model , see updated reports shows attenuation structures. 2.ToC demonstrated with attenuation structures in calculations 3.The time of entry set applies the rainfall instantaneously to the network 4.contributing areas have been updated to be consistent across the appropriate Pipes/areas. 5.Reduction Factor for permeable paving has been increased to 70% and filter drain has also been added. 6.Updated network calculations provided show the attenuation structures, the network is designed for 5 years and the 5year-30 minute, 30year-600minute, and 100year-600minute events are provided. 7.Soil type has been changed to soil type 4, and runoff factor for green areas has been changed to 0.47 as discussed.	See Note 5
2	180208-DBFL-XX-XX-DR-C-3001 Site Services Layout - Sheet 1 180208-DBFL-XX-XX-DR-C-3003-Surface Water Catchment Areas 180208-DBFL-XX-XX-DR-C-3004 Site Services Layout - Sheet 2 1. Gullies are shown on the permeable paving, which are noted as acting as overflow outlets for the proposed tree pits. It is unclear how this would work as a tree pit overflow is located normally at the bottom of the growing medium. A high level overflow from a tree pit will create anerobic conditions around the root structure. 2. There does not appear to be any proposed method of interception or treatment of the entrance roadway. 3. The paved footway within Catchment A does not have any proposed method of interception or treatment. 4. Infiltration trenches are proposed to the rear of the properties to the south east of the site. C753 notes that any infiltration proposal should have a 5m clearance from any structure. The outlet for the infiltration trenches are running between the properties and thus breaching this 5m requirement. 5. It is difficult to correlate the calculations with the drawings due to the inconsistent labelling.	1. Provide a prelim detail on the tree pit/gully connection. 2, 3. Ensure interception or treatment for all contributing areas are considered. 4. Rexonsider installing infiltration trenches in close proximity to structures. Consider revising the outlet carrier drain to solid pipework 5. Re-label drawing to correspond with nodes and links on calculations	1.See tree pit detail attached to email. 2.The entrance roadway is drained by traditional gullies and Aco channels, which worked up in grated detail during construction stage. 3.footpath on the western side of the development is drained by a filter drain. 4.The infiltration trench to the rear of the house are connected back to the network by a solid pipe which runs between the buildings. No infiltration is intended next to the buildings. 5.Labeling in calculations and drawing are now consistent	Acceptable
3	Site Investigation The borehole logs indicate a high water table (approx. 1m BGL). This will require the permeable paving and the attenuation structures are lined to prevent cross-contamination from groundwater.	1. Ensure that attenuation and permeable paving systems are lined to prevent cross-contamination from groundwater.	Attenuation system are to be wrapped in an impermeable membrane	Acceptable
4	Exceedence Flows Exceedence Flows should be considered as part of the scheme	1. Provide comment on surface flow paths in the case of exceedance flows. This may be covered within the Flood Risk Assessment.	see attached draft Flood risk assessment section 5.3	Acceptable
	17/11/2021	**17/11/2021**		
5	1. There are a number of inconsistencies with the existing drawings and the revised calculations. The attenuation provided at S3-4 is 404.6m3 in the calculations but 342.3 m3 has been identified on the drawing. S3-1 has 176.2m3 in the calculations but 154m3 shown on the drawings. S3-1 has a flow rate of 7.3l/s in the calculations, but 4.2l/s on the drawing. S3-4 has 2l/s on the drawing, but 3l/s in the calculations. S4 has a flow rate of 5.7l/s in the calculations but 4.2l/s in the drawing. 2. The revised engineering report contains references to the older flow rates relating to the SOIL Type 3. 3. The Critical results sheet states that climate change allowance is 0%. 4. MH 3-6 has a water level of 51.234m in the 1 in 100 event. The arrangement of the network at this location will mean that the filter drain will back up to this level and flood the gardens. The flood level is higher than the floor levels of the adjacent properties. A 500mm clearance between flood levels and floor levels is required to comply with GDSDS.	1. Crosscheck/update drawing with required values in calculations to ensure consistency. 2. Update the engineering report to reference updated Qbar value throughout. 3. Clarify why 0% cc is allowed for in the Critical Results sheet. 4. Review flood risk at M3-6, upstream of Attenuation Storage 3.	1.All Attenuation volumes & flow rates allowed for in the calculations are represented on the drawings. 2.All references to soil type 3 have been removed (see updated report). 3.The Critical results sheet has been updated to include a climate change allowance of 10%. 4.The max water level In manhole 3-6 is now 48.959, the adjacent FFL is 51.2. The Filter drain to the rear of these houses connects to the main line between MH S3-5 & S3-4 which has an invert of 46.998 therefore this should not cause flooding in the garden.	Acceptable

STORMWATER AUDIT (STAGE 1)

JBA Project Code	2021s1438
Contract	Development at Cornelscourt, Dublin 18
Client	Cornel Living Ltd
Date	12th November 2021
Author	Michael O'Donoghue
Subject	**Stormwater Audit - Stage 1 Report**

1 Residential Development at Cornel Living, Dublin 18

1.1 Introduction

JBA Consulting have been contracted by Cornel Living Ltd. to undertake a Stage 1 audit of the surface water drainage design by Waterman-Moylan Engineering Consultants for the proposed development at Cornelscourt Village, Bray, Cornelscourt, Dublin 18.

The results of the audit are set out in the table below.

1.2 Stage 1 Audit

Design Parameter	Audit Result
Proposed Development	The subject site is located at Cornelscourt, Dublin 18. The proposed development comprises of 412 apartments, 7 houses, residential amenities (a gym, tenant amenity lounges, multi-purpose pavilion building) a childcare facility and a café. The site location is shown in Figure 1 below.  *Figure 1-1 Site Location* The existing site is predominantly greenfield, with an existing temporary car park located in the north-west corner. The site generally falls from its western corner eastwards at a gradient of approximately 1/24. The total site area is 2.14 Ha. A SOIL type 3 was initially chosen for the site. All areas of the site are deemed to be positively drained by the system. This resulted in a Qbar of 8.36 l/s or 4l/s/ha. An existing 225mm diameter surface water drain is located ain the eastern corner of the site. This is the head of this line and is proposed to be used as the intended discharge point. The stormwater network will consist of a series of underground attenuation tanks with downstream flow control devices. It is noted that any storm run-off that enters the basement will be catered for within the foul drainage network via a petrol interceptor. The subject of this Stage 1 stormwater audit is to review the proposed surface water drainage design and sustainable urban drainage system proposals for the proposed development with any proposed amendments to the design to be incorporated into the construction stage drawings.

Relevant Studies/Documents	The following documents were considered as part of this surface water audit: • The SuDS Manual (CIRIA C753); • Recommendations for Site Development Works for Housing Areas (DoEHLG); • Greater Dublin Strategic Drainage Strategy (GDSDS); • Greater Dublin Regional Code of Practice for Drainage Works; • DLRCC Green Roof Guidance Document (Appendix 16 of the County Development Plan 2016-2022); • BRE Digest 365
Key Considerations & Benefits of SUDs	The key benefits and objectives of SuDS considered as part of this audit and listed below include: • Reduction of run-off rates; • Provision of volume storage; • Volume treatment provided; • Reduction in volume run-off; • Water quality improvement; • Biodiversity.
Site Characteristics	**Soil:** The soil at the site has been indicated as being Soil Type 3 (SPR 0.37) in accordance with HR Wallingford procedures. A site investigation was carried out by GII Ltd. in February/March 2019, consisting of mechanically excavated trial pits and dynamic probes. In-situ infiltration tests were undertaken in three of the trial pits to investigate subsoil soakage characteristics. The following exploratory works were carried out: • 16 no. mechanically excavated trial pits to a depth of 3.3m; • 26 no. dynamic probes; • 3 no. in-situ infiltration tests in trial pits; • 13 No. window sample boreholes • 12 No. Dynamic Probes • 9 No. Cable Percussion boreholes • 10 No. Rotary Core Boreholes • 4 No. Groundwater monitoring wells All trial pits encountered a stratum of grey sandy gravelly clay beneath a stratum of made ground. Occasional gravel deposits were encountered immediately above the bedrock. This sandy gravelly clay gives reason for the failure of all three of the in-situ infiltration tests. The ground encountered is more consistent with Soil Type 4. Groundwater monitoring wells were installed at BH-03, 07, 08 & 11. Groundwater levels ranged from 0.96m to 2.27m BGL. Any proposed underground attenuation units should be lined in instances where the groundwater levels are within 1m of the invert levels of the proposed systems. **Rainfall (basis for surface water pipeline network design):** Rainfall parameters can be estimated using Met Éireann data, using the Flood Studies Report (FSR) values or the values in the GDSDS. The Met Éireann method can be more representative of a site if selected correctly. A comparison of values estimated by DBFL and JBA is shown below: **DBFL value** / **JBA Value** Rainfall model: Met Éireann / Met Éireann M5-60 (mm): 16.4 mm / 16.4 mm

	Ratio R: 0.273 0.273 SAAR: 945 862 The SAAR value contained within JBAs records differs from that of DBFLs, which results in a variance of approx. 1.5l/s. Using DBFL's value the QBar is thus the conservative value The development will discharge into an existing storm network to the north-east of the site, into an existing 225mm dia. storm sewer. An initial assessment of the site designated the underlying strata as reflecting a SOIL type 3 classification. However, following review of site investigation results, it was proposed to use an SPR. of 0.47. This more accurately reflected the poor ground conditions on the site. This resulted in a revised Qbar being devised for the site.
SuDS Measures Considered	DBFL have included the following SUDs measures within the proposed development. No reference has been made to any other measures considered.

SUDS Technology	Comments
Green Roofs	5,433m2 of green roof has been provided for within the development. The green roof is currently shown as covering the entirety of each of the development blocks. If the detailed design reverts to smaller green roof areas, then the calculations will require amendment.
Swale/ Filter Drain / Infiltration trench	Filter drains are proposed within the rear gardens of the units to the south-east of the site. Filter drains will also be located adjacent to the footpaths that run adjacent to the green spaces on the perimeter of the site.
Permeable Paving	Permeable paving has been proposed within the pedestrian zone over the basement podium as well as on the footways within the perimeter of the site. The permeable paving is not intended to provide iinfiltration, due to the poor ground conditions present on the site. An impermeable membrane is proposed beneath the paving to prevent cross-contamination from groundwater. 4736m2 of permeable paving is proposed within the site.
Petrol Interceptor	A petrol interceptor is proposed upstream of the site outlet point.
Surface Water Attenuation	4 no. sub-surface cellular storage systems are proposed within the system. This proprietary cellular storage system will provide 725m3 of storage.
Site Run-off Rates	DBFL propose to limit discharge to a rate of 6.24 l/s/ha (Qbar of 13.16 l/s), which is the calculated greenfield run-off rate for the site.
Detention Basins, Retention Ponds, Stormwater Wetlands	N/A

	Tree Root Structural Cell Systems, Bio-retention, rain garden — Bio-retention tree pits are proposed throughout the development. Roadside gullies discharge into the tree pits, which then overflow into the main sub-surface network.
Surface Water Drainage Design	Surface water flows generated by the development will be attenuated within sub-surface attenuation before being discharged into the existing storm network at 13.16 l/s, based on the greenfield run-off rate of 6.24 l/s/ha. The surface water design has been presented using MicroDrainage software.
SuDS Management Train	**Source Control** and **Site Control** are addressed by the use of SuDS devices (interception storage) and attenuation with outflow controlled by Hydro-Brakes. Petrol interceptors have been proposed prior to discharge from site. As recommended within the SUDs Manual (Table 26.7) assuming effective pre-treatment is in place the following number of treatment train components are recommended:

	No. of treatment train components recommended	Comment/Proposals
Roof areas	1	In excess of 60% of the roof space on the development has been designed as green roof.
Residential roads, parking areas, commercial zones	2	Pervious paving has been proposed to all pedestrian walkways around the site as well as within the pedestrian hardscape on the basement podium. Where road gullies are proposed, these all discharge into bio-retention tree pits prior to entering the sub-surface network.
Refuse collection, industrial areas, loading bays, lorry parks and highways.	3	N/A

The above table summarises the SuDS Management Train for the site.

Hydro-Brakes designed for a linear discharge profile will be provided at the outfalls of each attenuation structure to limit the ultimate flow to a maximum of 13.16 l/s.

Climate Change	An allowance of 10% increase in flows has been included for climate change for the rainfall intensities for the purposes of sizing the attenuation storage. This is in compliance with the requirements of the GDSDS.
Volume Storage	DBFL have provided attenuation calculations using MicroDrainage for the attenuation volumes provided. MH S3-6 is deemed to be at FLOOD RISK. The critical storm events for these flood risk events is the 15-minute 100-year Winter event + 10% for climate change. The storage is designed as per River Protection Criteria 4.3 of the GDSDS,

	namely discharge rates are to mimic QBAR or 2l/s/ha whichever is the greater. Volumes account for the 100-year return storm event + 10% climate change.
Volume Run-off	A comparison between pre and post construction run-off was not provided.
Treatment Volume / Water Quality Improvement	Interception storage is proposed by way of pervious paving, silt traps, filter drains, bio-retention tree pits and green roofs.
Return Period	A 100-year return period plus 10% for climate change has been used in the design for the attenuation systems. This is in line with GDSDS. It is stated that the network has been designed for the 5-year return period, however, the rainfall intensities have been capped at 50mm/hr. A 50mm/hr intensity is not entirely reflective of a 5-year return period, but it's capping will not be a determining factor on the overall design.
Exceedance flows	DBFL have considered exceedance flows and included for the same within the Flood Risk Assessment.
Health & Safety and Maintenance Issues	The proposed drainage system comprises SuDS devices, traditional road gullies, attenuation systems and underground pipes. These elements are considered acceptable from a Health & Safety perspective once supplier/manufacturers guides are followed and complied with during the detailed design, construction and operation. A number of manholes are in excess of 3m deep, and will require specific maintenance procedures allocated to them. Optimum performance of the SuDS treatment train is subject to the frequency of maintenance provided. Regular maintenance of the flow control devices will be required to remove any blockages, particularly in the wake of heavy rainfall events or local floods. It is recommended that the petrol interceptor be fitted with an audible high-level silt and oil alarm for maintenance and safety purposes. Regular inspection and maintenance are recommended for the petrol interceptor. Please note that silt and debris removed from the petrol interceptor during maintenance will be classified as contaminated material and should only be handled and transported by a suitably licensed contractor and haulier and disposed of at a suitably licensed landfill only.
Design Review Process	Upon review of the detailed drainage design, JBA Consulting provided feedback to DBFL, namely: • A 50% run-off factor was used for permeable paving, which seems disproportionately low. A 70% minimum is recommended. • Volumetric run-offs should be set to 1 in the modelling, as reduced run-off factors are being considered. • A SOIL Classification type 3 was considered, but given the impermeability of the soil observed in the trial holes, a SOIL type 4 was recommended. • 10% increase in rainfall volumes was included. • A number of green areas were deemed to be contributing to the network, but no positive inlet was included. All green areas are to have filter drains to allow them to be included in the stormwater catchment. A summary of comments and record of the audit trail are appended to this report.

Audit Result	JBA Consulting considers that the surface water drainage design for the proposed development is acceptable and meets the requirements of the Stage 1 Stormwater Audit.

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Principal Engineer

Note:

JBA Consulting Engineers & Scientists Ltd. role on this project is as an independent reviewer/auditor. JBA Consulting Engineers & Scientists hold no design responsibility on this project. All issues raised and comments made by JBA are for the consideration of the Design Engineer. Final design, construction supervision, with sign-off and/or commissioning of the surface water system so that the final product is fit for purpose with a suitable design, capacity and life-span, remains the responsibility of the Design Engineers.

Appendix A – Feedback Form Record