Kildare County Library

Part 8 Infrastructure Report

Project number: 60669624
60669624-ACM-XX-00-RP-CE-10-0001

March 2023

Delivering a better world

Quality information

Prepared by	Checked by	Verified by	Approved by
			
Jamie Cullen Consultant Engineer	Marc O'Dowd Principal Civil Engineer	Laura Shaughnessy Associate Director	Marc O'Dowd Principal Civil Engineer

Revision History

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Prepared for:

Kildare County Council

Prepared by:

Jamie Cullen
Consultant Engineer
E: jamie.cullen@aecom.com

AECOM Ireland Limited
4th Floor
Adelphi Plaza
Georges Street Upper
Dun Laoghaire
Co. Dublin A96 T927
Ireland

T: +353 1 696 6220
aecom.com

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1. Introduction

This report has been produced to outline the civil engineering infrastructure design as part of a Part 8 application to Kildare County Council (KCC) for the redevelopment of Kildare County Library Archives and Cultural Centre at Main Street, Newbridge, Co. Kildare.

This report will detail the existing and proposed foul, surface water and watermain infrastructure for the site and proposed public realm works.

The existing site is located at Main Street, Newbridge, Co. Kildare and is bounded to the east by Athgarvan Road (R416), to the north by Main Street (R445), to the west by the Riverbank Arts Centre and to the south by existing residential developments. Refer to Figure 1 for the site location and proposed works boundary for the development.

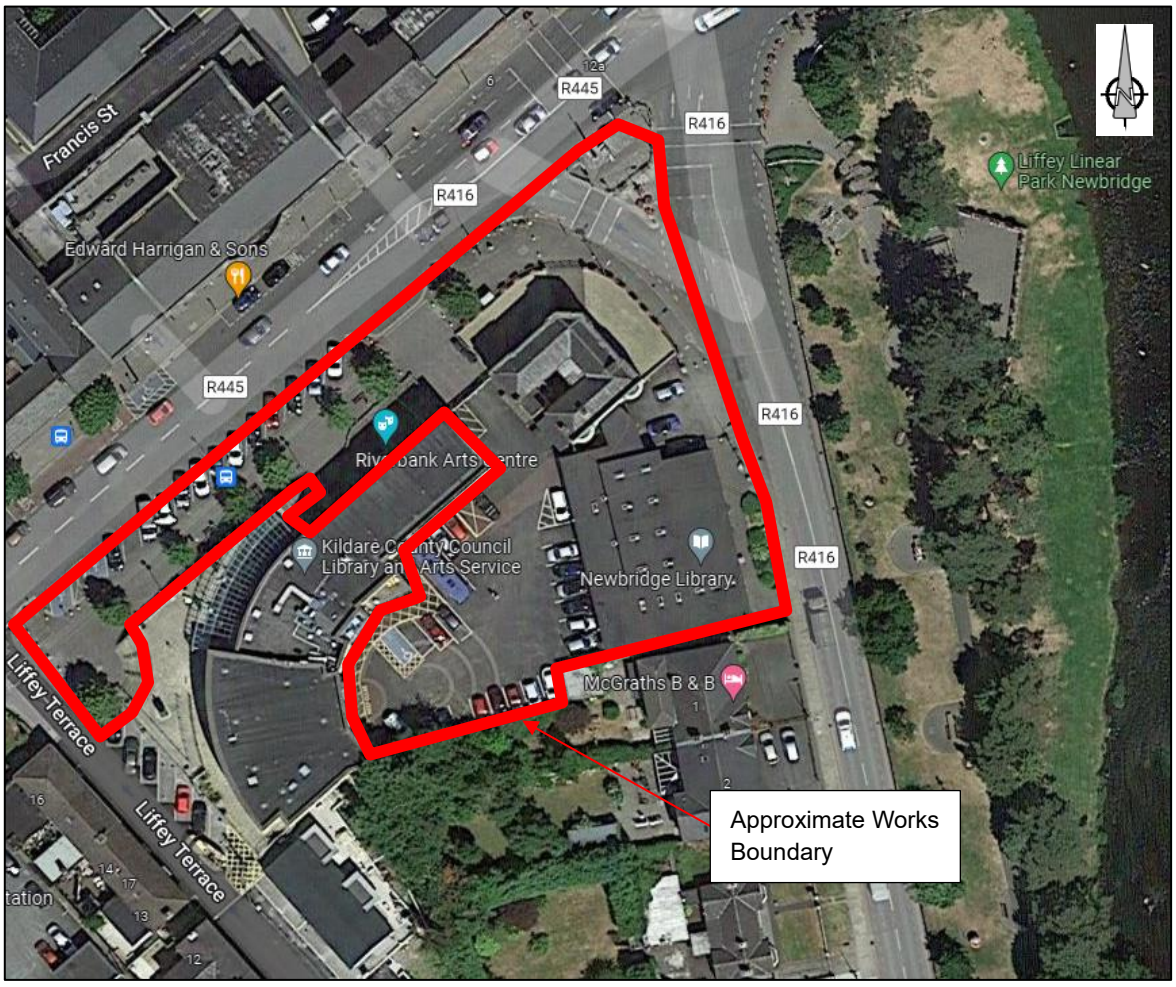


Figure 1: Existing Site Location & Works Boundary (Source: Google Maps)

The existing site consists of the Newbridge Library and is predominately made up of a hardstanding area with some vegetation present around the site. The existing library site, including the rear car park amounts to 0.20ha.

1.1 Proposed Development

The proposed works will consist of the demolition of the existing library extension and the construction of a new three-storey library, archives and cultural centre which will include works to a new interior courtyard and surrounding public realm areas. The historic protected library building will be retained and refurbished as part of the works.

The extent of the proposed works is illustrated in Figure 2, which includes a new entrance will be provided to the rear car park at the south-east corner of the site and the existing disabled car parking bay will be moved to a suitable alternative location.

Figure 2: Proposed General Arrangement (Source: AECOM Drawing 606669624-ACM-XX-00-DR-CE-10-0001)

1.2 Site Investigation

As part of the SI, it has been requested that groundwater monitoring be carried out for a minimum of 6 months and include 1 winter period. These results are not available as of the date of this report therefore, the Flood Risk Assessment has considered the groundwater flood risk through the results of the GSI and OPW floodinfo.ie groundwater flood mapping.

There were 3no. boreholes carried out as part of the SI works and while there was no evidence of groundwater in one of the boreholes, moderate inflows of water were observed in the other two boreholes at depths of 3.2m and 3.3m. During the 20-minute observation periods the water levels rose to depths of 2.9m and 2.8m.

Infiltration testing was also requested to be carried out as part of the works, this test was performed in accordance with BRE Digest 365 ‘Soakaway Design’ and following the initial saturation stage and infiltration rate of 0.00016 m/min was recorded for the second, and slowest, stage.

1.3 Ground Penetrating Radar (GPR) Survey

Murphy Geospatial have undertaken a Ground Penetrating Radar (GPR) Survey within the site and the adjacent public roads. This GPR survey has scanned and mapped the existing sub-surface utilities and services which has been used in the preparation of the proposals within this report.

The GPR survey drawing can be found in Appendix A of this report.

1.4 National Transport Authority (NTA) Newbridge Transport Plan

In January 2019 the NTA published the Draft Newbridge Transport Plan for public consultation. This plan included a number of proposed amendments and upgrades to the transport infrastructure within Newbridge Town. This includes amendments to the existing Main Street/Athgarvan Road junction, as illustrated below in Figure 3. These proposals also include the removal of an existing left turn slip land adjacent to the existing Newbridge Library, an upgraded public realm in front of the library, improvements in cycle provisions and upgraded signalised pedestrian crossings.

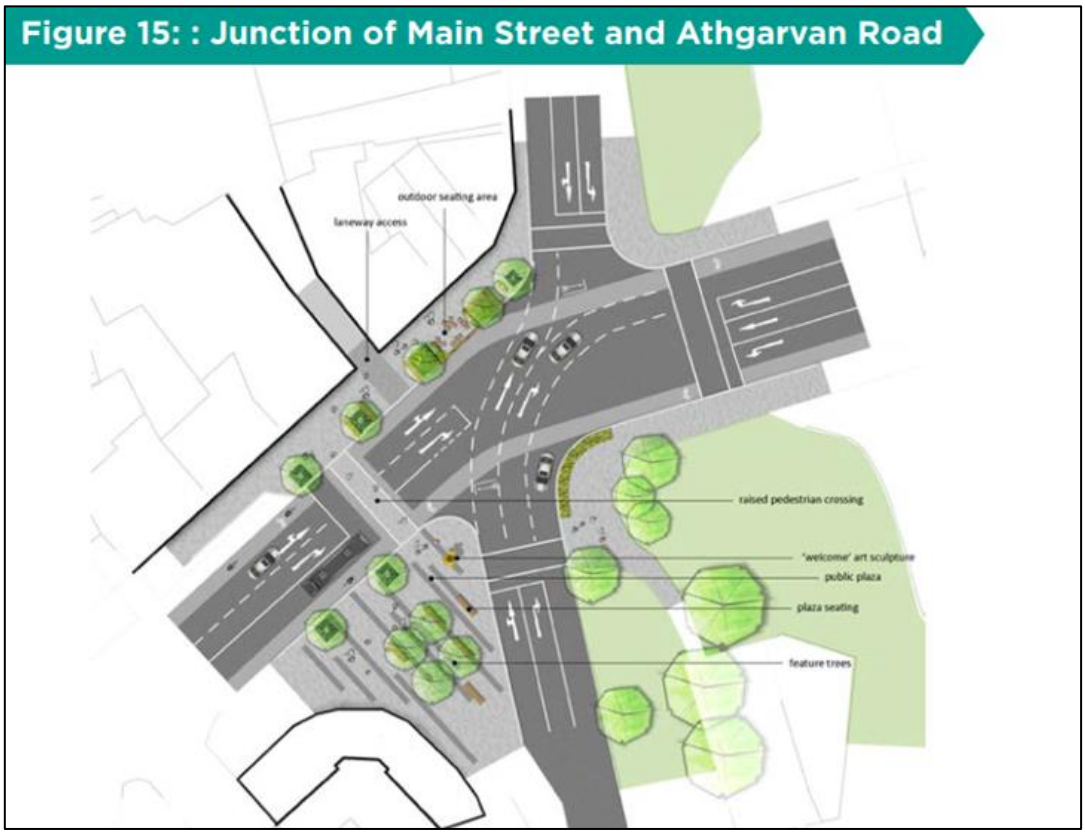


Figure 3: NTA Proposals for Athgarvan junction (Source: NTA Draft Newbridge Transport Plan)

The current proposal for this scheme will include the implementation of the nearside plaza as outlined in the NTA proposals which includes the removal of the existing left turn lane. Refer to AECOM Traffic and Transport Assessment 60669624-ACM-S2-XX-RP-TR-0001 for more information.

2. Surface Water

2.1 Surface Water Criteria

This chapter contains an outline of the conceptual philosophy and design criteria for surface water in the Kildare County Library scheme. The proposed surface water drainage systems have been designed in accordance with the following documents:

- Greater Dublin Strategic Drainage Study (GDSDS)
- Kildare County Development Plan 2017-2023 Chapter 7 Infrastructure
- Kildare County Development Plan 2023-2029 Chapter 6 Infrastructure
- Newbridge Local Area Plan 2013-2019 (Including Amendments)
- Department of Housing, Local Government and Heritage (DoHLGH) Water Sensitive Urban Design Best Practice Interim Guidance Document
- Building Regulations Technical Guidance Document H: 2010 – Drainage and Water
- Department of the Environment, Heritage and Local Government 'Recommendations for Site Development Works'
- BS EN 752: Part 4: Drain and Sewer systems outside buildings: hydraulic design and environmental considerations
- CIRIA Document C753: 2015 – The SuDS Manual
- CIRIA C768: 2017 – Guidance on the Construction of SuDS

2.2 Existing Surface Water

Existing drainage records have been received from KCC which indicate that there is an existing 150mm Dia. uPVC surface water sewer within the site that appears to service both the Riverbanks Arts Centre and the existing library.

These records also indicate that there are two parallel pipes at the existing library, one is a 330mm reinforced plastic matrix while the pipe shown to pass under the existing building does not have any annotations. The existing sewer under the building appears to be a historic brick sewer, refer to Figure 4 below which shows the brick build up within the manhole at the head of this pipe run.

Figure 4: Manhole Opening at Historic Brick Sewer

A utility survey (GPR) was undertaken for the site and confirmed the presence of this 150mm Dia. uPVC pipe. In addition to this pipe another 150mm Dia. uPVC pipe was picked up within the existing central courtyard that appears to be providing drainage for this area.

Additional surface water drainage pipes were picked up in front of the Riverbank Arts Centre that appear to be providing drainage for this building and also the existing public realm. These pipes connect with a manhole located at the existing courtyard entrance before ultimately discharging into the River Liffey.

There was no connection found for the manhole which runs under the existing library building with a CCTV survey undertaken to investigate the route and structural stability of this sewer. The two existing manholes located outside the existing library before discharging towards the River Liffey could not be found on site during the GPR survey but will also be investigated as part of the CCTV survey.

On receipt of the CCTV survey, it was not possible to survey this pipe run as there was too much build-up of silt within the pipe. It was also not possible to carry out the CCTV on the existing outfall from the site as there was no access through the buried manhole and there is an existing petrol interceptor located on the outfall line.

The CCTV survey did indicate that the existing pipe networks that are to be kept as part of the works are in good condition and will be diverted into the proposed drainage network for the site. These pipe runs generally provide drainage for the existing Art's centre and can be seen on AECOM drawing 60669624-ACM-XX-00-DR-CE-10-0502.

As part of the SI works it was requested that the buried manhole SN80156224, refer to Figure 5 below for the existing KCC surface water records, this manhole was found to be in good condition with photos provided outside the manhole from ground level, refer to Figure 6 below for an image of this manhole from the SI report.

Please refer to Appendix B for the existing drainage record drawings and Appendix A for the GPR survey drawing carried out by Murphy's Geospatial.

Figure 5: Existing Kildare County Council Surface Water Records (Source: KCC)

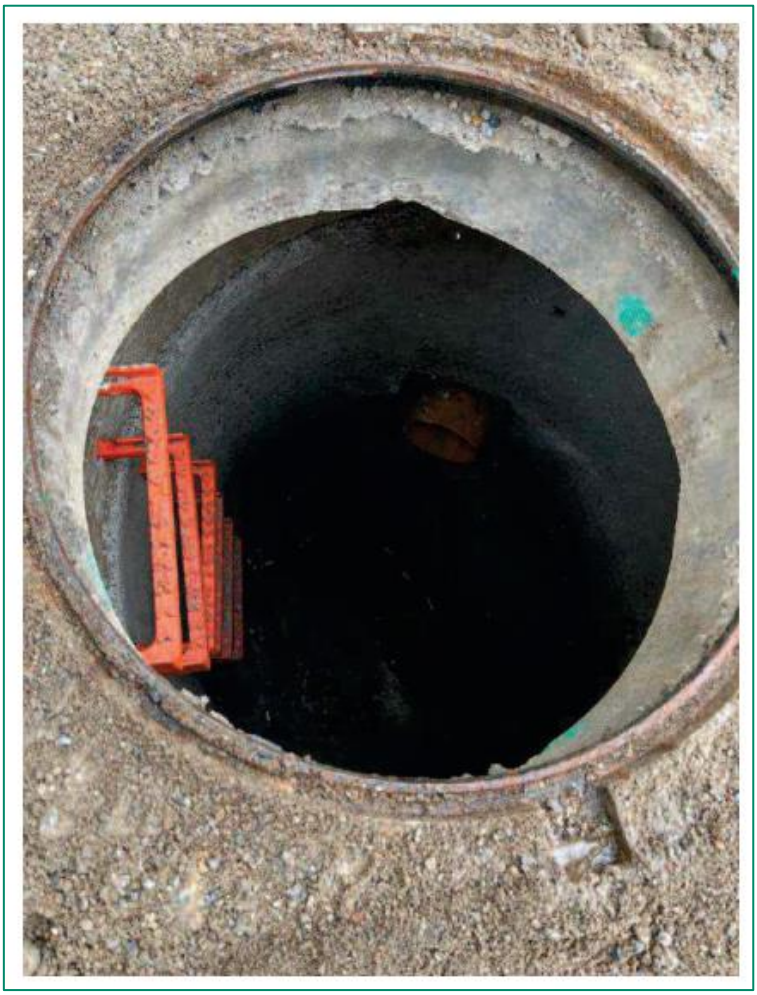


Figure 6: Buried Manhole SN80156224 (Source: IGSL GI Report)

2.3 Proposed Surface Water Drainage Strategy

It is currently proposed to provide 1No. new connection to the existing manhole (ref. SN80156224) located outside the existing library that ultimately discharges through a 225mm Dia. Concrete pipe into the River Liffey. This connection will take the discharge from the proposed courtyard and site while the surface water runoff within the public realm area will not discharge to a combined or foul sewer.

It is also proposed to divert some of the existing drainage pipes within the courtyard into a new 225mm Dia. drainage pipe which will be laid through the new proposed entrance, located off Athgarvan Road, before discharging northwards to the existing manhole (ref. SN80156224). This is to ensure there is no clashes between the new proposed structure and existing stormwater network.

The existing drainage pipes located at the front of the Riverbank Arts Centre will be diverted into a new 225mm Dia. concrete sewer, this is to ensure that the proposed sewer will be located a minimum of 1m away from any of the new proposed columns and their concrete pad foundations. Refer to Figure 7 below for the approximate route for the proposed diversions.

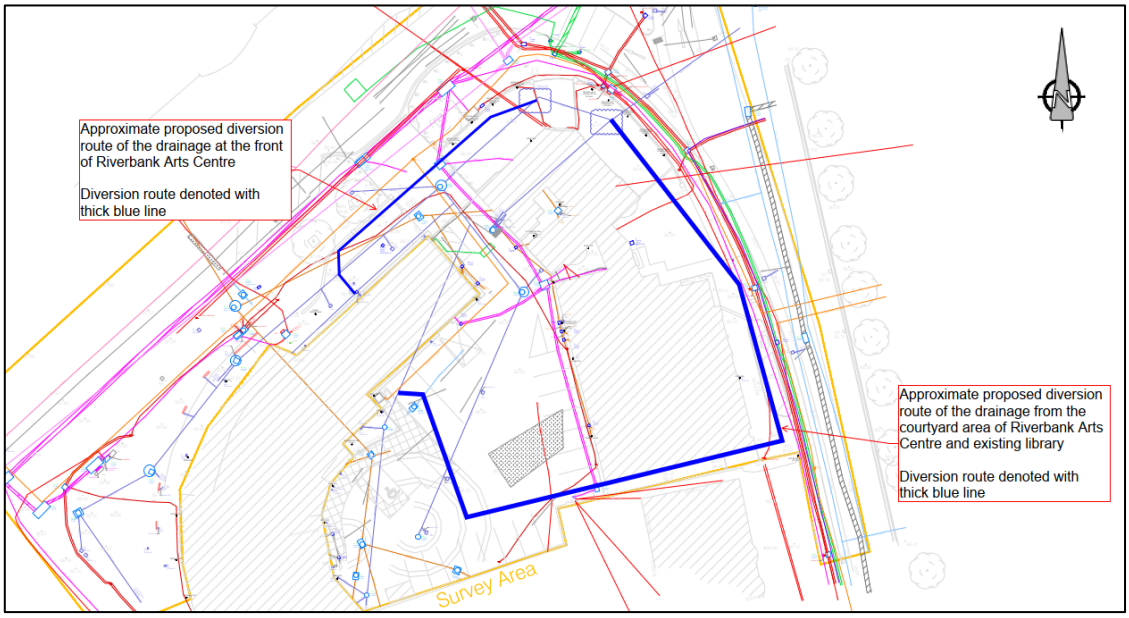


Figure 7: Approximate Diversion Routes

The location of the proposed connections and the proposed drainage layout including any diversions is illustrated in AECOM Drawing no. 60669624-ACM-XX-00-DR-CE-10-0501.

The proposed drainage design will include a number of Sustainable urban Drainage Systems (SuDS) measures which will intercept and treat runoff prior to entering the positive drainage network. The current proposals include the use of green roof, permeable paving and bio-retention to effectively intercept and reduce the quantity of runoff leaving the site. An oil separator will be provided upstream of the proposed outfall to the existing positive drainage network.

The proposed SuDS design has been prepared in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) Volume 2 New Development and relevant best practice guidance in order to ensure that the measures proposed are sufficient to reduce the quantity and improve the quality of runoff entering receiving watercourses from the proposed site.

2.4 Network Design

The proposed surface water drainage network for the library site has been designed using Innovyze MicroDraiange software in accordance with the GDSDS design guide. A model was developed for the proposed development using a M5-60 value of 15.400 and a Ratio R of 0.285 which is based on the Met Eireann rainfall data for the site location, refer to Appendix C for this data. A return period of 5 years was used throughout the initial sizing of the pipe networks.

For the model base flows of 5 L/s were estimated where the existing pipe connects to the new proposed network to ensure flows are accounted for from these areas within the network. It is not expected that attenuation storage will be feasible due to the limited space available within the car park and the extent of existing underground services therefore, the inclusion of suitable at source SuDS measures will reduce the quantity of runoff from the site and represent an improvement on the existing situation.

It should be noted within the model different runoff coefficients (impermeable factors) were applied to the different areas containing SuDS features. A breakdown of the different areas are their corresponding coefficients is provided below:

- Road Areas – 90% impermeable
- Impermeable Roof Areas – 100% impermeable
- Green Roof Areas – 70% impermeable
- Bio-retention Areas – 50% impermeable

The above factors were taken as a conservative estimate to ensure the model is simulated to what be expected on site as best as possible. An urban creep factor was not applied to the simulation as given the small site area and how unlikely it is for the areas surrounding the library site will increase the discharges from our site.

The surface network was simulated with the runoff factors applied as set out above. No flooding is occurring on site for the 1 in 100-year event plus 30% climate change allowance and is therefore in accordance with GDSDS Criterion 3. Refer to Appendix D for the surface water network calculations and AECOM drawing 60669624-ACM-XX-00-DR-CE-10-0501 for the proposed drainage layout.

The 150mm pipe that is referenced in the surface water calculations was included as this is an existing pipe denoted by ‘E2’ manhole label. This pipe was included within the model to ensure there is no clashing between any of the existing pipes that will be staying as part of the proposal and the new proposed pipe network.

2.5 SuDS Strategy

The proposed development has been assessed in relation to SuDS in accordance with the guidelines of the GDSDS and the SuDS Manual CIRIA C753. The aim of the proposed drainage system is to replicate the natural characteristics of rainfall runoff, minimising the environmental impact from rainfall events by reducing the runoff leaving the site for small rainfall events.

As per Table 6.3 of the GDSDS Sub-Criterion 1.2, River Water Quality Protection, there is a requirement to provide a minimum volume of treatment storage equalling 15mm of runoff over 80% of all impermeable surfaces. The provision of interception storage as per GDSDS Table 6.3 Sub-Criterion 1.1 has been dismissed as the site investigation has not been received to date and it is unlikely to be possible to provide sufficient infiltration within the proposed site due to the proximity to adjacent structures, boundary walls and other utility services.

Soft SuDS have been prioritised over hard SuDS features where possible with the features that are considered suitable based on the current site layout as follows:

- Extensive Green Roof (Library Site)
- Porous Surfacing (Library Site)
- Bio-Retention / Rain Gardens (Library Site & Public Realm)
- Oil Separator (Library Site)
- Tree Pits (Public Realm)
- Soft Landscape Areas (Public Realm)

The proposed SuDS features will be designed in accordance with the CIRIA C753 SuDS Manual, providing treatment volume on site. Please refer to AECOM drawing 60669624-ACM-XX-00-DR-CE-10-0520 for the proposed SuDS measures which are detailed in the following sections.

2.5.1 Green Roof

Green roofs comprise a multi-layered system that covers the roof of a building or podium structure with vegetation cover/landscaping. It is proposed that extensive green roof will be provided to the flat roof areas of the library

extension that do not require plant equipment and to the bin store and bike sheltered area within the courtyard. The roof is likely to consist of an impermeable layer, a substrate or growing medium and a drainage layer (although not all green roofs require a drainage layer), refer to Figure 8 below for a section through a typical extensive green roof.

Green roofs are designed to intercept and retain precipitation, reducing the volume of runoff and attenuating peak flows.

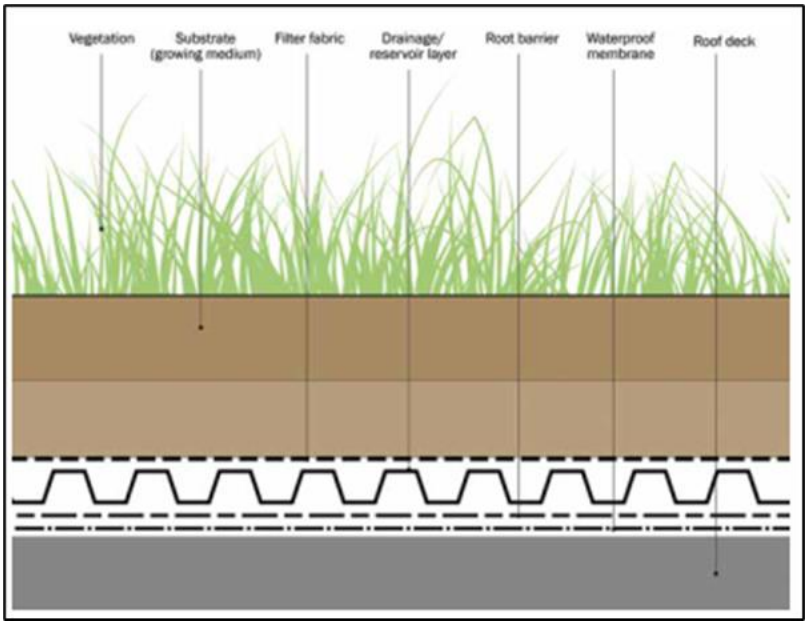


Figure 8: Typical Section through Extensive Green Roof (Source: CIRIA C753 SuDS Manual)

2.5.2 Porous Surfacing

Porous surfacing is proposed within the sensory garden area and the bike area outside the existing protected structure. Porous surfacing (paving block or open graded material) which can treat rainwater, at source, and allow infiltration through to an underlying porous subbase where water can be stored within the voids of the subbase before being slowly released to the drainage collection system through natural flow via the porous medium.

These systems will allow some form of storage for small rainfall events and can result in water evaporation and adsorption in small quantities, therefore there will be less run-off from these areas in small rainfall events thus mimicking the natural response for this catchment. As well as reducing the amount of run-off from the surface, permeable paving will slow down the rate of runoff from the pavement in extreme rainfall events contributing to attenuation of flows.

In addition, permeable paving will increase the quality of water which is intercepted by the system through filtration, biodegradation, pollutant adsorption and settlement and retention of solids, also the reduction in peak flows to the outfall will enhance settlement and biodegradation of pollutants.

Refer to Figure 9 for an illustration of a typical permeable paving detail. Given that the proposed site is not considered suitable for infiltration with no SI results, no infiltration has been assumed for the porous surfacing systems proposed throughout the site.

Permeable paving was proposed within the courtyard area to carparking bays and pedestrian areas however, it has since been noted of the requirements for an 18T truck to enter the site a few times over the year. Given it is not safe to reverse into the site with the truck, the car parking will require to be emptied to allow the truck to drive in and turn to allow for a safe exit from the site. Based on this and the vehicle turning movements required it is not deemed suitable to provide permeable paving anywhere within the courtyard, this is to ensure there is no rutting of the surface occurs with rigid paving to be provided throughout.

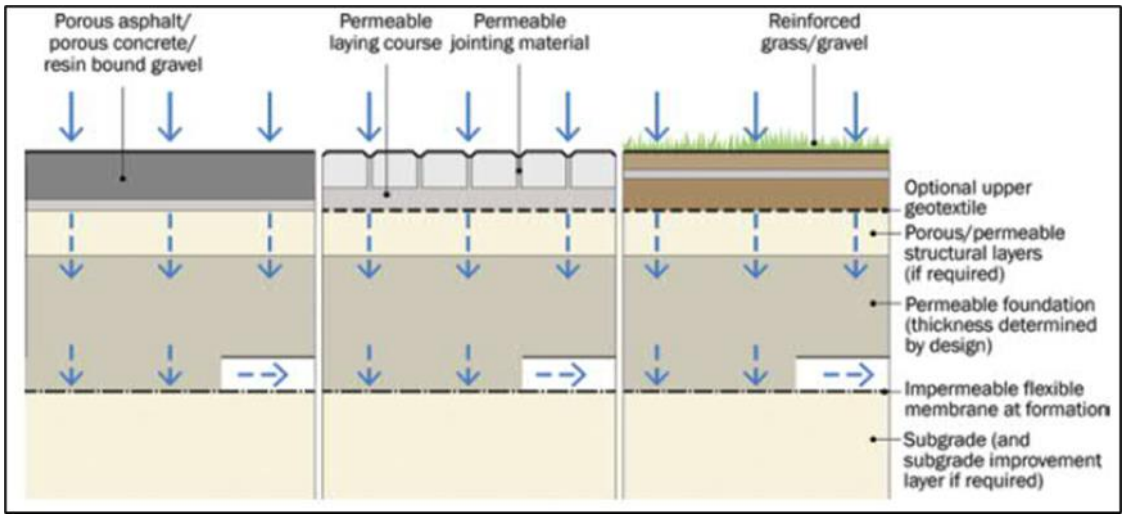


Figure 9: Porous Surfacing System - No Infiltration (Source: CIRIA C753 SuDS Manual)

2.5.3 Bio-Retention / Raingardens

The Bio-Retention proposals will provide suitable at-source interception and treatment to roof runoff from the existing protected structure and impermeable roof areas within the library site. Bio-Retention / Raingardens are currently proposed wherever possible within the public realm area with runoff directed to these areas via slot drains. Bio-Retention features are seen to provide two stages of treatment alone where it can be shown that the runoff is conveyed via the surface of the bio-retention Area.

Figure 10 illustrates a typical bio-retention section for use adjacent to building structures. Given that the proposed site is not suitable for infiltration with no SI results available, no infiltration has been assumed for the bio-retention systems proposed throughout the site.

Soft landscaping areas are proposed within the public realm where runoff cannot be directed towards. These areas will provide some form of treatment to surface water which falls directly on their surface. It should also be noted with the inclusion of these soft landscaped areas they provide a betterment on the current scenario by reducing the amount of impermeable area.

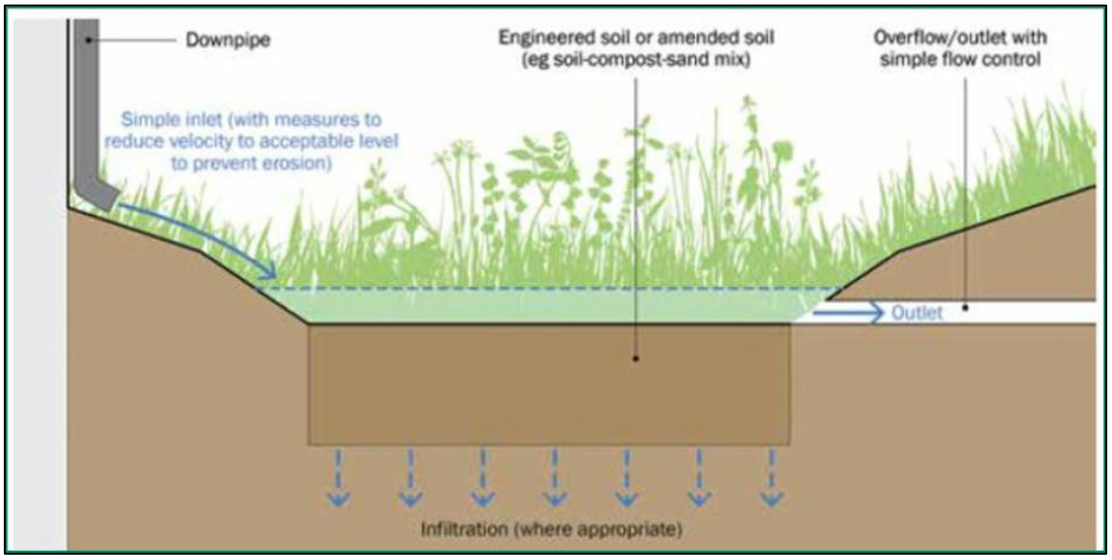


Figure 10: Typical Bio-Retention Section (Source: CIRIA C753 SuDS Manual)

2.5.4 Tree Pits

Trees can be planted within a wide range of infiltration SuDS components raging from bio-retention systems, detention basins, to swales, to help improve their performance, or they can be used as standalone features within

soil-filled tree pits, tree planters or structural soils, refer to Figure 11 for an example of the collection of surface water runoff for trees.

Tree pits and planters can be designed to collect and attenuate runoff by providing additional storage within the underlying structure while the soils around the trees can also be used to filter out pollutants from runoff directly. Tree pits can also provide further amenity and biodiversity benefits to a development. It is proposed to provide tree pits wherever possible within the Public Realm area with slot drains used to convey stormwater flows within the public realm to these areas.

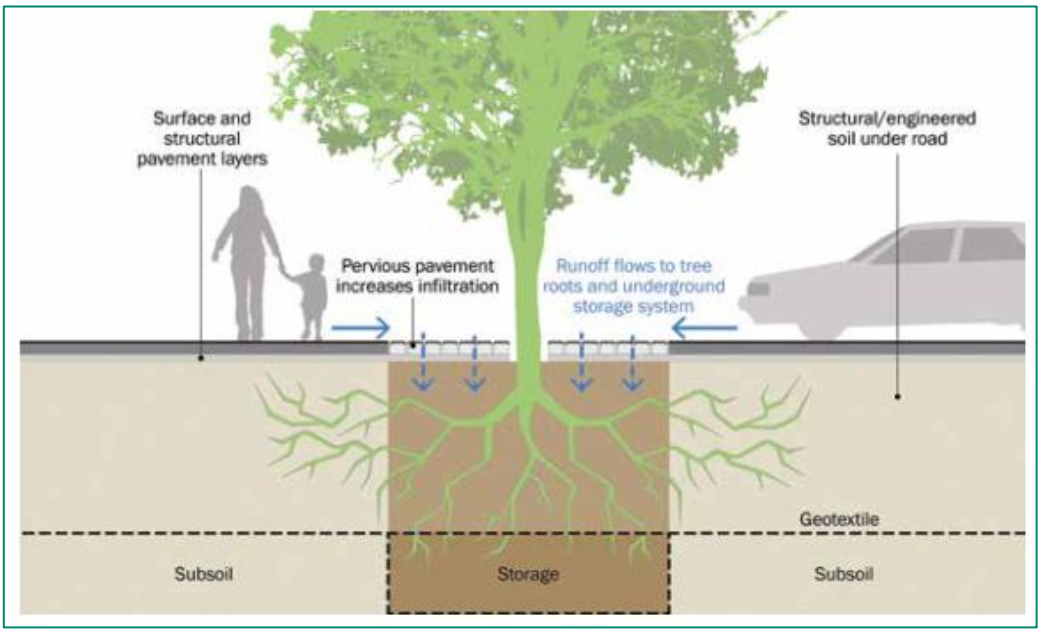


Figure 11: Collection of Surface Water Runoff for Trees (Source: CIRIA C753 SuDS Manual)

2.5.5 Oil Separator

A Class 1 NSBE 050 bypass interceptor is proposed downstream of each of the hydrobrake systems. Petrol interceptors are widely used to avoid and prevent hazardous chemical and petroleum by-products from entering watercourses and public sewers. They should be installed close to the potential pollution source to minimise emulsification of oils and their coating of sediments.

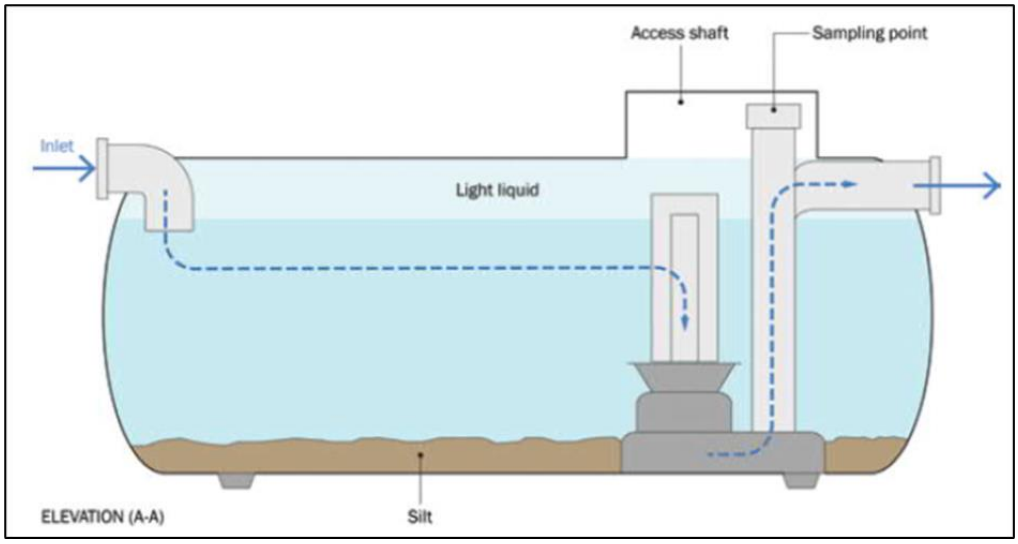


Figure 12: Typical Petrol Interceptor Detail (Source: CIRIA C753 SuDS Manual)

2.5.6

2.5.6 Water Quality Protection – Treatment Volume

An assessment has been undertaken to quantify the volume of treatment storage that is currently being proposed and that which is required to provide a minimum of 15mm as per Sub-Criterion 1.2. The proposed treatment volumes are outlined in Table 1 below.

Table 1. Library Site Proposed Treatment Volume

Feature	Area (m^2)	Treatment Storage Required (m^3) *	Treatment Storage Provided (m^3)
Total Impermeable Area	2000	24.0	-
Green Roof **	265	3.2	2.0
Bio-retention / Raingardens ***	186	-	33.5
Porous Surfacing ****	43	0.5	3.9
Treatment Provision		**27.7**	**39.4**

* Based on 15mm of rainfall over 80% of the total impermeable area as per GDSDS Appendix E E1.1.5

** Assuming a 25mm substrate depth of Extensive Green Roof with 30% porosity

*** Assuming a typical 0.6m deep pit with a planting soil void ratio of 0.3 (30%)

**** Assuming a 0.3m deep stone media with a void ratio of 0.3 (30%)

As illustrated above, the proposed layout provides an excess of treatment storage, and for the purposes of this exercise, the volume of tree pits, bio-retention and landscape areas in the public realm and oil separators have not been included. It is envisioned that the provision of slot drains within the public realm area will direct flows to the tree pit areas and provide a betterment on the current scenario.

Rainwater harvesting has been considered however, it is not envisioned that the predicted greywater demand will merit the provision of rainwater harvesting and the storage requirements associated with it. Green living façade walls have also been considered but these are not recommended on the basis of ongoing maintenance requirements and the risk that they will not grow as a result of their sensitivity to solar orientation. It has also been noted that the inclusion of a living wall would not be in keeping with the protected structure.

2.5.7 SuDS Maintenance Checklist

Please refer to Appendix E for a typical SuDS Maintenance Inspection checklist which includes the typical operation and maintenance requirements for the proposed SuDS measures discussed above, this is sourced from the CIRIA C753 SuDS Manual.

3. Foul Water Drainage

3.1 Existing Foul Water Drainage

Based on KCC wastewater drainage records, refer to Figure 14, there is an existing 150mm and 225mm uPVC sewer located within the existing courtyard area which runs in a north-west direction, collecting the wastewater discharge from the existing library and Riverbank Arts Centre, which then connects to an existing 450mm concrete foul sewer located in the Main Street adjacent to the site.

The GPR survey carried out indicates the wastewater drainage within the courtyard is consistent with what is displayed on the drainage records drawing. Some foul water inspection manholes were picked up within the courtyard which is draining the existing library and Riverbank Arts Centre. These inspection chambers collect the foul water before ultimately discharging to the Irish Water foul manhole located at the existing entrance to the courtyard.

Based on the CCTV survey carried out on site the existing network appears to be in generally good condition. The foul network within the courtyard that serves the existing developments was found to have a water level of 50% of the vertical dimension of the pipe at the foul manhole located at the southern boundary (circled red in Figure 13 below where this water level was recorded). This reduces to 5% of the vertical dimension approx. 8m into the pipe run with no deviations noted on this run. As part of the works, it is proposed to relay this pipe at 1:150 gradient to provide sufficient self-cleansing velocity within the pipe run.

The pipe in the green outline circle was noted to have a joint displacement which we are proposing to amend this and the above as part of the proposed works which will be subject to agreement with Irish Water at the connection application stage.

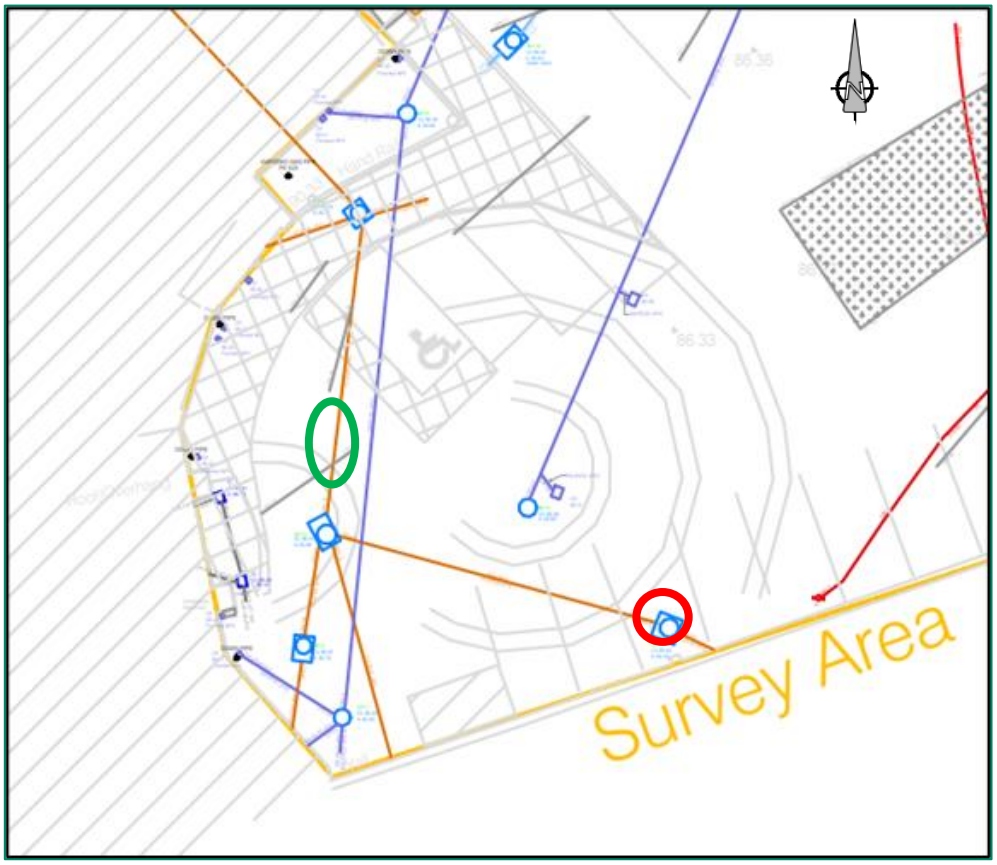


Figure 13: Existing Foul Pipes to be Amended as part of the Works

The existing KCC drainage records are provided in Appendix B and the GPR survey is included in Appendix A.

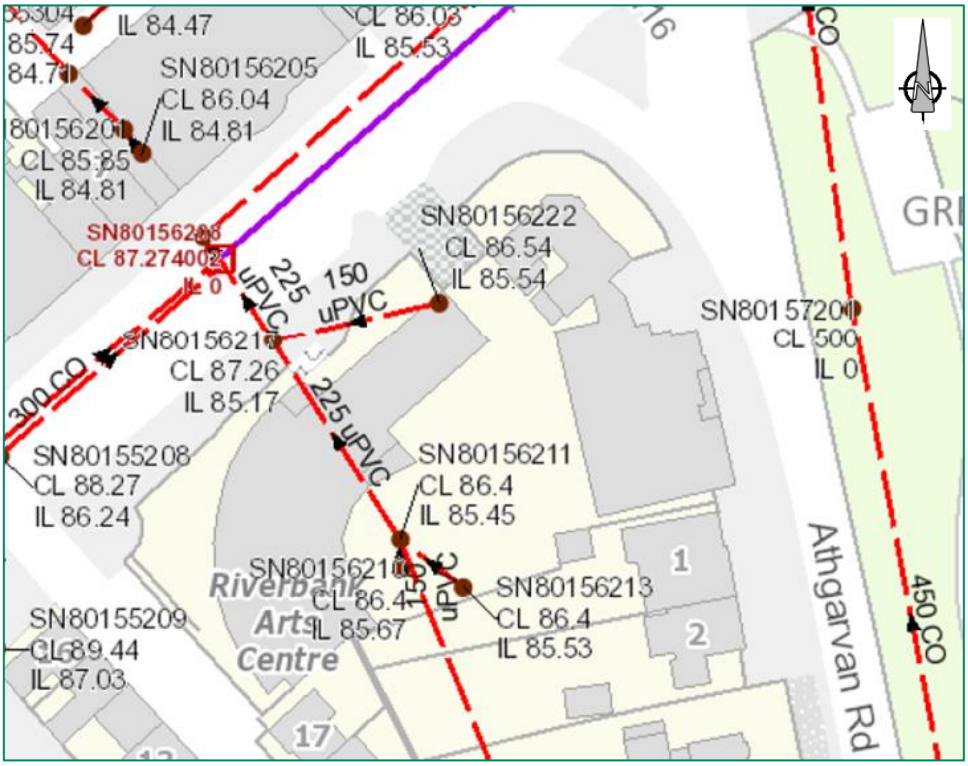


Figure 14: Existing Kildare County Council Foul Water Records (Source: KCC)

3.2 Proposed Foul Water Drainage

It is currently proposed to make new 150mm Dia. connections to the existing Irish water sewers, as illustrated in AECOM drawing no. 60669624-ACM-XX-00-DR-CE-10-0501. This will include diverting the existing drainage from the Riverbank Arts Centre, located within the existing entrance to the courtyard, and discharging this through a new foul sewer that will also drain the existing library though a new 150mm Dia. concrete pipe. This pipe will connect to the existing foul sewer manhole located in the public realm outside the Riverbank Arts Centre.

The wastewater generated from the proposed library will discharge through a 150mm Dia. concrete pipe located in the courtyard. This will connect to the existing manhole located outside the Riverbank Arts Centre that ultimately flows under the building and out to the existing 450mm sewer in Main Street.

The proposed foul water drainage network was modelled in Innovyze Microdrainage software to ensure that there would be no clashes between the proposed foul sewer and the existing/proposed surface water network. The output from the model is provided in Appendix F.

The estimated wastewater discharge associated with the proposed development has been based on Irish Water's Code of Practice for Wastewater Infrastructure. The design foul loading is outlined in Table 2 below.

Table 2. Estimate Foul Loading Associated with the Proposed Development

Use	Total Area (m^2)	Area per Employee (m^2) *	Associated Population (rounded up)	Peaking Factor	Foul Discharge (l/d) **	Average Foul Discharge (l/s)	Peak Flow (l/s) ***
Library	2340	17	138	4.5	7,590	0.088	0.395

* Based on 'Employment Densities Guide' published by Drivers Jonas Deloitte

** Based on foul loading of 50 l/p/d, plus 10%-unit consumption allowance for infiltration, as per Irish Water Requirements

*** Based on commercial peaking factor of 4.5, as per Irish Water Requirements

Please refer to Appendix G for the confirmation of feasibility (CDS21009023) received from Irish Water on the 12th of January 2022 for the proposed redevelopment works.

4. Watermain Infrastructure

4.1 Existing Watermain Infrastructure

Records provided by KCC (Figure 15) indicate the presence of an existing 6” (150mm dia.) Cast Iron and 12” (300mm dia.) Ductile Iron watermain located along Athgarvan Road. This was picked up on the GPR survey and it was also noted on this survey that there are additional water meters identified within the existing courtyard which appears to indicate that the current supply feeds the Riverbank Arts Centre which in turn supplies the other buildings within the site.

Refer to Appendix B for the existing watermain record provided by KCC and Appendix A for the GPR survey that was carried out.

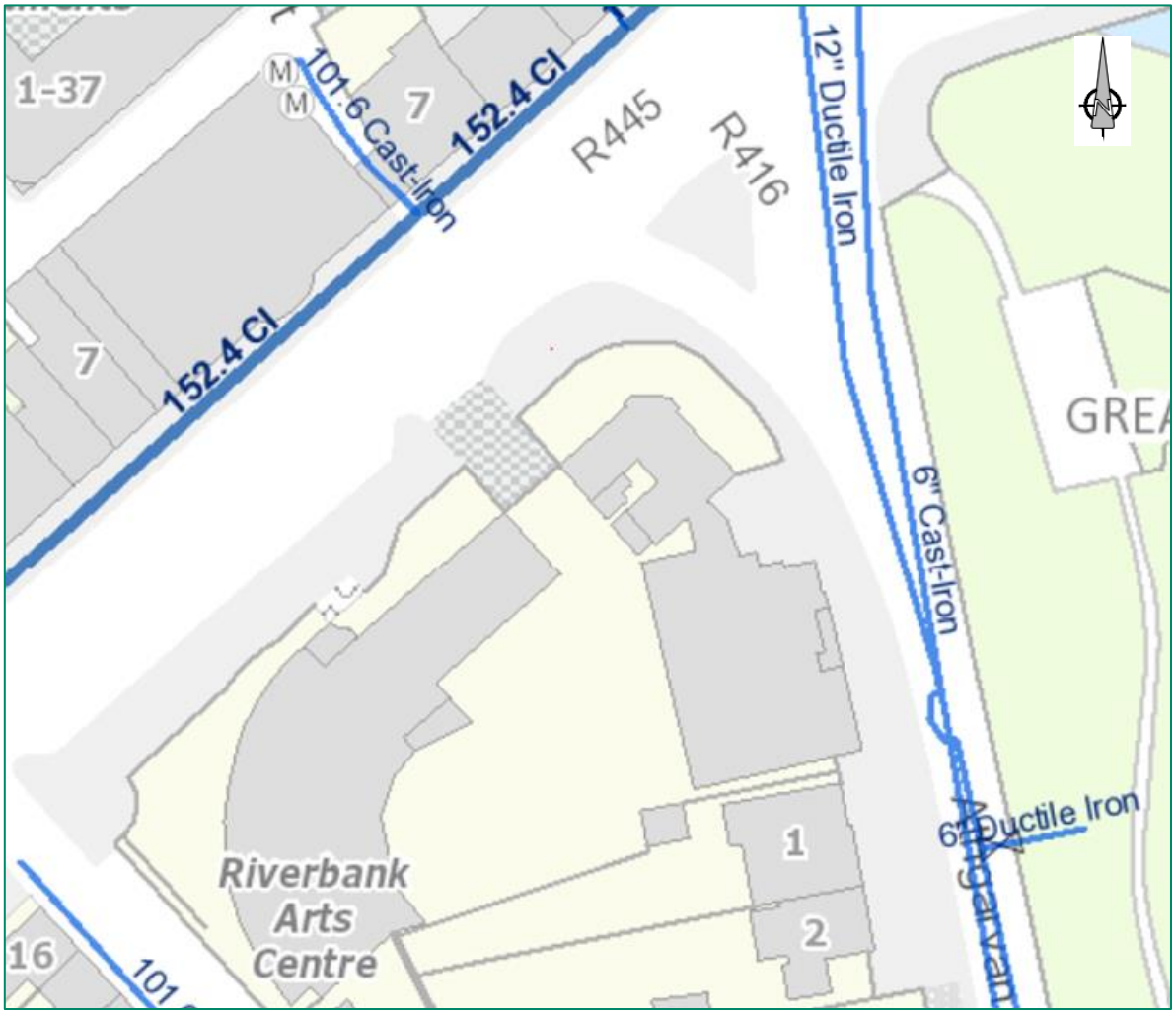


Figure 15: Existing Kildare County Council Watermain Records (Source: KCC)

4.2 Proposed Watermain Infrastructure

It is currently proposed to make 1 No. new 150mm Dia. connection to the existing Irish Water watermains, as illustrated in AECOM drawing no. 60669624-ACM-XX-00-DR-CE-10-2701. This proposed connection to supply the development will be via a new 150mm Dia. internal watermain from the existing 150mm Dia. watermain within Athgarvan Road.

The proposed watermain has been designed in accordance with Irish Water Code of Practice for Water Infrastructure including the necessary fire hydrant and sluice valve provisions.

The estimated water demand associated with the proposed development was based on Irish Water’s Code of Practice for Water Infrastructure. The design demand is outlined in Table 3 below.

Table 3. Water Demand Associated with the Proposed Development

Use	Total Area (m^2)	Area per Employee (m^2) *	Associated Population (rounded up)	Average Water Demand (l/d) **	Average Day/Peak Week Demand (l/s) ***	Peak Demand (l/s) ****
Library	2340	17	138	6,900	0.100	0.499

* Based on 'Employment Densities Guide' published by Driver Jonas Deloitte

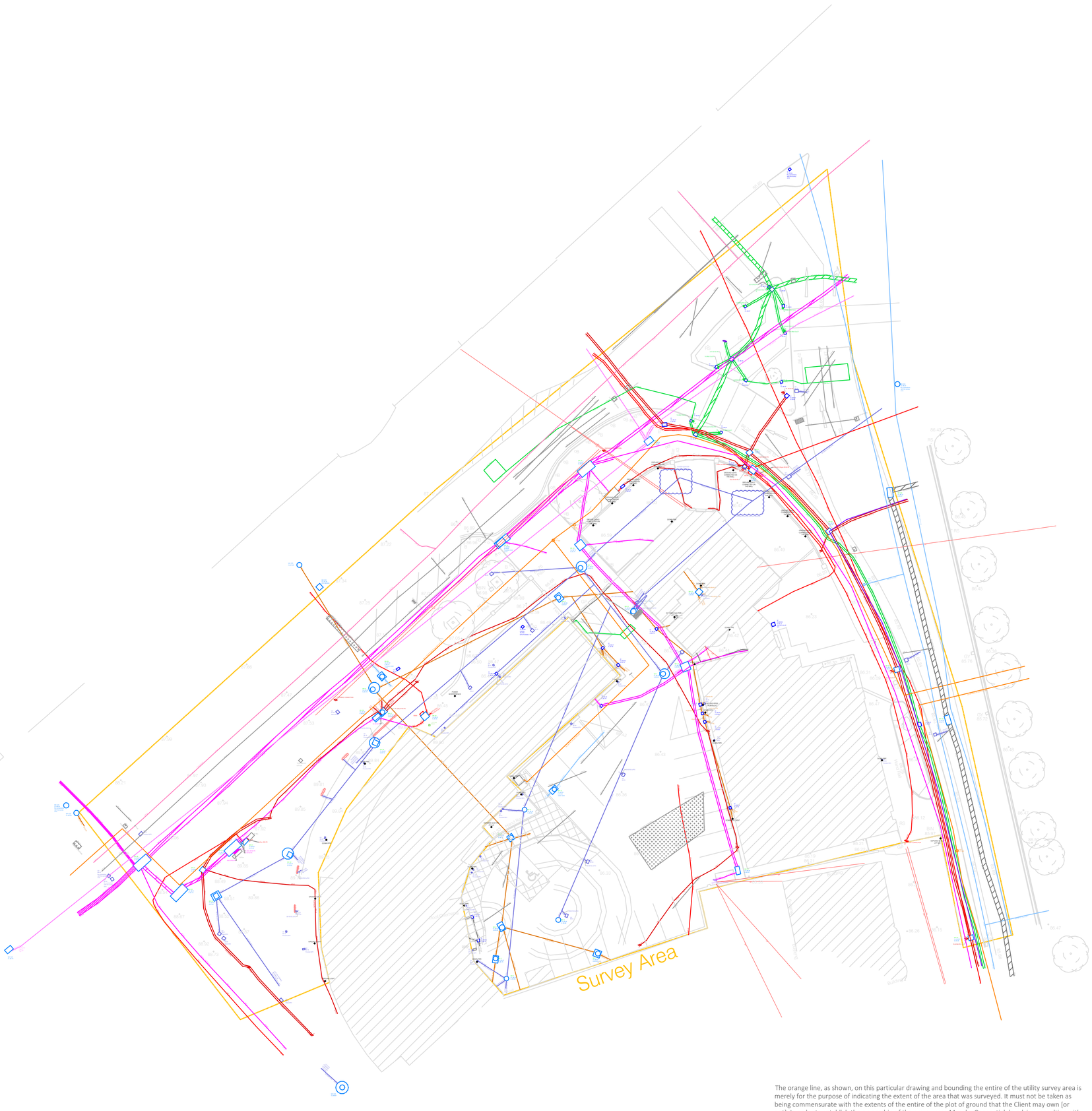
** Based on per-capita consumption of 50 l/p/d as per Irish Water Requirements

*** 1.25 times the average daily domestic demand, as per Irish Water Requirements

**** 5 times the average day/peak week demand, for sizing of the pipe network, as per Irish Water Requirements

Please refer to Appendix G for the confirmation of feasibility (CDS21009023) received from Irish Water on the 12th of January 2022 for the proposed redevelopment works.

Appendix A – GPR Survey



LEGEND
Underground Utilities

- WM Water Main
- FW Fire Water
- PW Process Water
- SW Storm Water Drainage
- FS Foul Sewer
- CO Combined Sewer
- Manhole Chamber
- Eircom
- NTL/Virgin
- ENET/OCEAN
- BT BT/ESAT
- Colt Colt
- Aurora Aurora
- Bend / Weld
- Oxy Oxygen Pipe
- WELD Weld Point
- Gas
- Hydrogen Pipe
- Oil Pipe
- Magnet
- Adshel
- Traffic
- Heating Pipe
- Electrical
- Public Lighting
- GPR Anomaly
- Unknown Cable Duct
- Unknown Empty Duct
- Nitrogen Pipe
- Unidentified Service
- Unidentified Radio Signal
- Unidentified Power Signal
- Photo point
- Reinforced Concrete (GPR)
- Possible Slab (GPR)
- Other observations - see description (GPR)
- (DP0.50) Depth from ground level to Top of Pipe/GPR Target (m)
- (D150) PE Pipe/Duct diameter (mm) and material
- S/L Signal Lost
- T/L Trace Lost
- N/S No Signal
- Exp Exposed
- Off Off-site
- UTT Unable to trace
- UTS Unable to sonde
- Blkd Blocked
- CD Closed Duct
- UTO Unable to Open
- NPV No pipes visible
- WL Water Level
- FO Fibre Optic
- Unk Unknown
- Ab Abandoned
- (Ass) Assumed
- (Records) Utility taken from records
- CC Concrete
- VC Vitrified Clay
- BR Brick
- CI Cast Iron
- DI Ductile Iron
- ST Steel
- Poss./Prob. Possible/Probable
- AC Asbestos Concrete
- PE Polyethylene
- S1 Survey Station

The orange line, as shown, on this particular drawing and bounding the entire of the utility survey area is merely for the purpose of indicating the extent of the area that was surveyed. It must not be taken as being commensurate with the extents of the entire of the plot of ground that the Client may own [or not]. In order to establish the ownership of the survey area Murphy Geospatial do advise consulting with your Client and their legal team.

Murphy Geospatial Ltd. Disclaimer

The survey aims to map all existing utilities and sub surface structures and provide information with respect to pipe size, material type and drainage connectivity. However GPR surveying is limited by the following guidelines and it may not be possible to accurately survey, define and locate all services and sub surface features.

- Locational accuracy is determined by referring to the manufacturers guidelines for the detectors used.
- Existing record information showing underground services is often incomplete and unknown accuracy; therefore it should be regarded only as an indication.
- In ideal conditions these spatial accuracies for the underground utilities are +/- 5% for the RD4000 and +/- 10% of depth for the GPR to 2.5m deep. However, variations within the subsurface may alter this estimated accuracy.
- Although all reasonable steps have been taken to locate all features, there is no guarantee that all will be shown on the drawing as some above ground features may have obstructed the survey.
- GPR surveying operates best within high resistivity material. Clay overburden can impair GPR surveying.
- Due to the attenuation of the radar signal with depth, resolution is restricted, hence making identification of anomalies difficult with increasing depth.
- The depth penetration and quality of the data depends on the ground conditions on the site. Poor data may be a result of areas with high conductivity. Also, high reflective materials close to the surface i.e. rebar may hide deeper anomalies.
- It is not always possible to trace the entire length of each underground service.
- It is always our intention to use the Utility providers' details, if supplied prior to survey commencement as a guide for location purposes. However, should we not be able to locate those guided services we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider and therefore shown "Taken from Records" on the drawing and we are not liable for any loss that may arise due to the lack of accuracy in the guided information.
- Unless otherwise stated, all services and sub surface structures shown on Murphy Geospatial Limited plan drawings have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to run straight.
- Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run on close proximity, separation may be impossible. Successful tracing of non metallic pipes may be limited.
- Please note that not all buried pipes, cables and ducts can be detected and mapped in consideration of their depth, location, material type, geology and proximity to other utilities. Even an appropriate and professionally executed survey may not be able to achieve a 100% detection rate.
- Services which have been untraceable are shown from Records where possible.
- DP represents distance from the surface level to the top of the service/ radar.

No allowance has been made within our quotation, unless otherwise stated, for the location and mapping of undeclared services. Failure to detect or fully map any declared service will be recorded within the notes accompanying our final drawings.

Where technically possible, depth indications will be given. These should be used for guidance only and wherever critical accuracy is required these should be confirmed by the Client by undertaking trial excavations or similar. Bends, lateral service connections, or the close proximity of other services and local magnetic, atmospheric or ground conditions, could in certain situations influence the accuracy of the plan and depth indication facility. Depths will not be provided unless we are reasonably confident of their validity.

Where Murphy Geospatial Limited issues a CAD drawn utility service plan, this should be read in conjunction with all available public utility records etc. As part of our exhaustive Quality Control procedures, Murphy Geospatial Limited Endeavour to add relevant Public Utility record information onto the final issue drawing. An allowance should be made for the width of services, particularly where these are laid in bands or are of significant size etc. For clarification or appropriate easement bands, we would recommend that direct contact is made with the Asset Owner or Statutory Undertaker.

We exclude the following, except where otherwise specified and possible to do so;

- All private service connections, (including water or gas fittings where no through flow of applied signal is possible.
- Pot ended or disconnected cables or terminated short lengths of pipe.
- Internal building services
- Fibre optic cables (except where laid with a standard communications cable or built in tracer wire or similar conductor system) or can be clearly located using ground penetrating radar.
- Small diameter cables less than 17mm diameter, or pipes less than 38mm diameter.
- Above ground services unless specifically requested.
- Lifting manhole covers which require longer than 10 minute effort using standard heavy duty lifting apparatus.
- Services positioned directly below other pipes or cables etc (i.e. masking signal) - intrusive verification options available on request.
- Deep non metallic pipes, ducts or culverts (unless probing or Pipe Track 3d is specified as part of the fully invasive survey option).
- Passing through defective pipework (displaced joints etc) or acute bends between access points.

Please note that our Quotation does not allow for location of individual service feeds to properties unless reasonable to do so, as access would be required into each property to apply direct connections to inlet points and this would significantly increase the scope of work, survey cost and also cause possible disruption to occupants.

All work carried out by Murphy Geospatial Limited (MGS) conforms to the guidelines set out by The Survey Association (TSA).

North

Site Location

Map Sheet Layout:

Surveyed by : MGS	Date: Jan 2022	Datum:	Malin Head
Drawn by : CM	Date: 31.01.22	Grid System:	
Checked by : DS	Date: 31.01.22	Irish National Grid ☐ ITM ☒	

Revisions

No.	Date	Description
1	31.01.22	First Drawing

Murphy GEOSPATIAL

Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography

Kildare Cork Dublin Belfast Glasgow Manchester London

Head Office

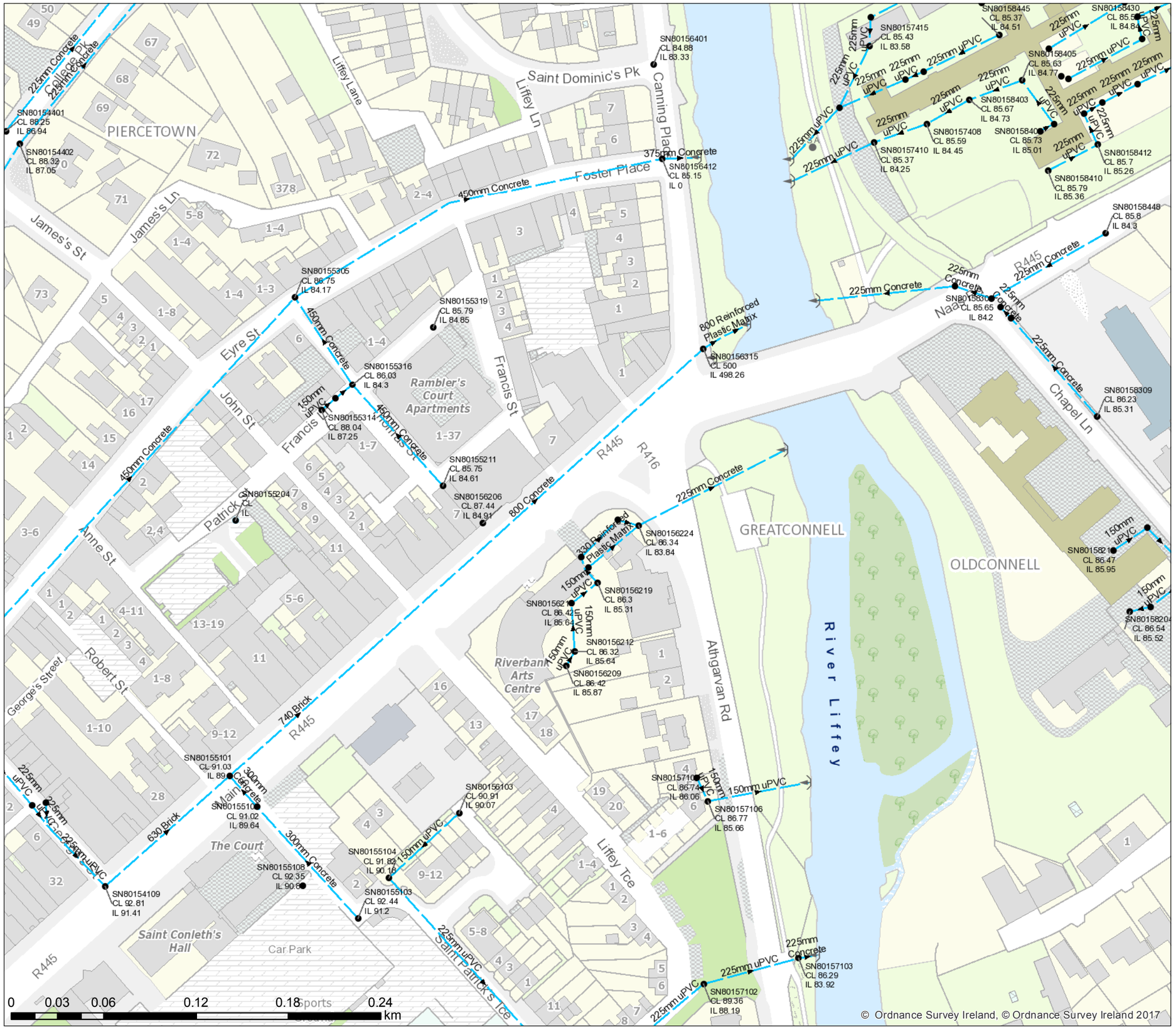
Global House
Kilcullen Business Campus
Kilcullen Co. Kildare, Ireland

Phone: (+353) 045 484040
Fax: (+353) 045 484004
Email: info@murphygs.ie

Client :	Metropolitan Workshop
Project :	County Library Kildare
Date : 31.01.2022	**Scale :** NTS@A1
Description :	Utility Survey
Drawing Number :	**MGS42041_44975_U**

Appendix B – Existing Irish Water Records

Irish Water Web Map



Print Date: 23/11/2021

Printed by:Irish Water

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
- Storage Cell/Tower
- Dosing Point
- Meter Station
- Abstraction Point
- Telemetry Kiosk

Reservoir
- Potable
- Raw Water

Water Distribution Mains
- Irish Water
- Private

Trunk Water Mains
- Irish Water
- Private

Water Lateral Lines
- Irish Water
- Non IW
- Water Casings
- Water Abandoned Lines
- Boundary Meter
- Bulk/Check Meter
- Group Scheme
- Source Meter
- Waste Meter
- Unknown Meter ; Other Meter
- Non-Return
- PRV
- PSV
- Sluice Line Valve Open/Closed
- Butterfly Line Valve Open/Closed
- Sluice Boundary Valve Open/Closed
- Butterfly Boundary Valve Open/Closed
- Scour Valves
- Single Air Control Valve
- Double Air Control Valve
- Water Stop Valves
- Water Service Connections
- Water Distribution Chambers
- Water Network Junctions
- Pressure Monitoring Point
- Fire Hydrant
- Fire Hydrant/Washout

Water Fittings
- Cap
- Reducer
- Tap
- Other Fittings

Sewer Foul Combined Network
- Waste Water Treatment Plant
- Waste Water Pump station

Sewer Mains Irish Water
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown
- Storm Culverts
- Storm Clean Outs
- Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
- Other; Unknown

Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

ESB Networks

ESB HV Lines
- HV Underground
- HV Overhead
- HV Abandoned

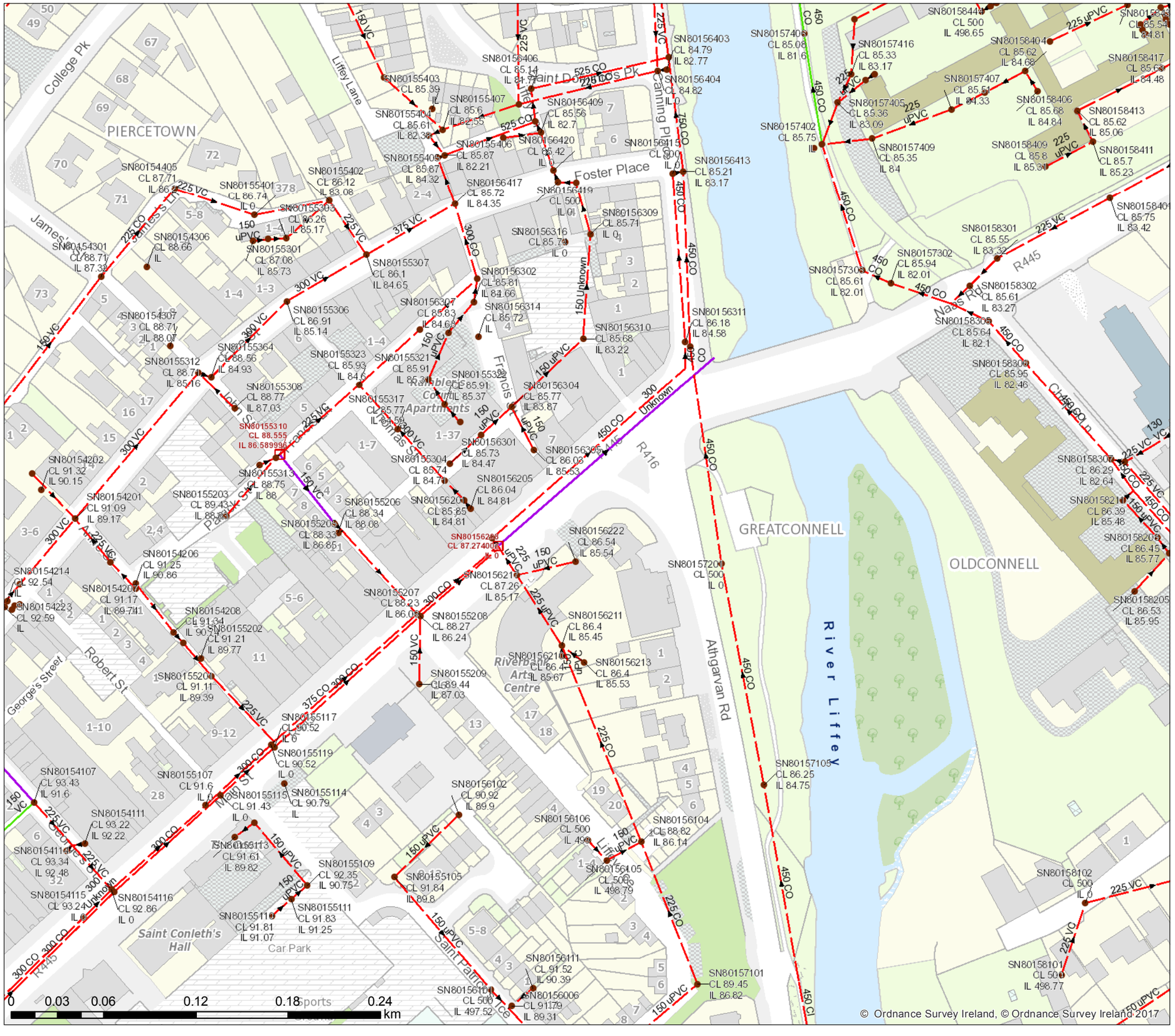
ESB MVLV Lines
- MV Overhead Three Phase
- MV Overhead Single Phase
- LV Overhead Three Phase
- LV Overhead Single Phase
- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Irish Water Web Map



UISCE ÉIREANN : IRISH WATER

Print Date: 23/11/2021

Printed by:Irish Water

Water Distribution Network
- Water Treatment Plant
- Water Pump Station
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- Dosing Point
- Meter Station
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- Telemetry Kiosk

Reservoir
- Potable
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- Gravity - Unknown
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- Pumping - Foul
- Pumping - Unknown
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- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Storm Culverts

Storm Clean Outs

Stormwater Chambers

Discharge Type
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- Overflow
- Soakaway
- Other; Unknown

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- Distribution Medium Pressure Gasline
- Distribution Low Pressure Gasline

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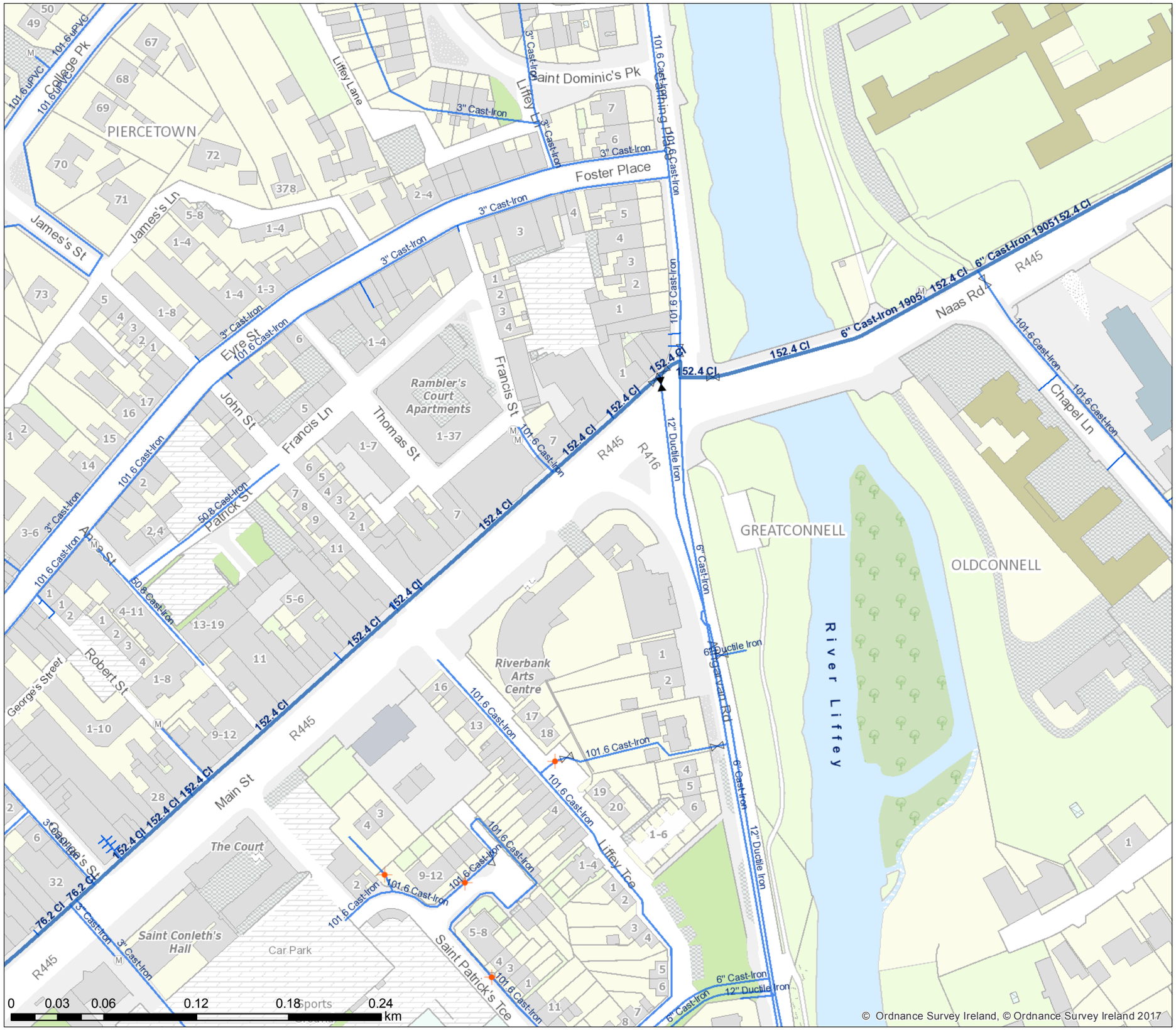

UISCE ÉIREANN : IRISH WATER

Print Date: 23/11/2021

Printed by:Irish Water

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- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow

Sewer Mains Private
- Gravity - Combined
- Gravity - Foul
- Gravity - Unknown
- Pumping - Combined
- Pumping - Foul
- Pumping - Unknown
- Syphon - Combined
- Syphon - Foul
- Overflow
- Sewer Lateral Lines
- Sewer Casings

Sewer Manholes
- Standard
- Backdrop
- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Discharge Type
- Outfall
- Overflow
- Soakaway
- Standard Outlet
- Other; Unknown

Cleanout Type
- Rodding Eye
- Flushing Structure
- Other; Unknown

Sewer Inlets
- Catchpit
- Gully
- Standard
- Other; Unknown

Sewer Fittings
- Vent/Col
- Other; Unknown

Storm Water Network

Surface Water Mains
- Surface Gravity Mains
- Surface Gravity Mains Private
- Surface Water Pressurised Mains
- Surface Water Pressurised Mains Private

Inlet Type
- Gully
- Standard
- Other; Unknown

Storm Manholes
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- Cascade
- Catchpit
- Bifurcation
- Hatchbox
- Lamphole
- Hydrobrake
- Other; Unknown

Storm Culverts

Storm Clean Outs

Stormwater Chambers

Discharge Type
- Outfall
- Overflow
- Soakaway
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Gas Networks Ireland
- Transmission High Pressure Gasline
- Distribution Medium Pressure Gasline
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ESB Networks

ESB HV Lines
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- MV Overhead Three Phase
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- LV Overhead Three Phase
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- MVLV Underground
- Abandoned

Non Service Categories
- Proposed
- Under Construction
- Out of Service
- Decommissioned

Water Non Service Assets
- Water Point Feature
- Water Pipe
- Water Structure

Waste Non Service Assets
- Waste Point Feature
- Sewer
- Waste Structure

Appendix C – Met Eireann Rainfall Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 280655, Northing: 215263,

	Interval		Years											
DURATION	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.6,	3.6,	4.1,	4.9,	5.4,	5.8,	7.0,	8.5,	9.4,	10.7,	11.8,	12.7,	14.0,	15.1,	15.9,	N/A ,
10 mins	3.6,	5.0,	5.7,	6.8,	7.5,	8.0,	9.8,	11.8,	13.1,	14.9,	16.5,	17.7,	19.6,	21.0,	22.2,	N/A ,
15 mins	4.3,	5.9,	6.7,	8.0,	8.8,	9.5,	11.5,	13.9,	15.4,	17.5,	19.4,	20.8,	23.0,	24.7,	26.1,	N/A ,
30 mins	5.7,	7.7,	8.7,	10.3,	11.3,	12.1,	14.6,	17.4,	19.3,	21.8,	24.0,	25.7,	28.3,	30.3,	32.0,	N/A ,
1 hours	7.5,	10.0,	11.3,	13.2,	14.5,	15.4,	18.5,	21.9,	24.1,	27.2,	29.8,	31.8,	34.9,	37.2,	39.2,	N/A ,
2 hours	9.9,	13.0,	14.7,	17.0,	18.6,	19.7,	23.5,	27.6,	30.2,	33.8,	36.9,	39.3,	42.9,	45.7,	47.9,	N/A ,
3 hours	11.6,	15.2,	17.1,	19.7,	21.5,	22.8,	27.0,	31.6,	34.5,	38.4,	41.9,	44.5,	48.5,	51.5,	54.0,	N/A ,
4 hours	13.1,	17.0,	19.0,	21.9,	23.8,	25.2,	29.8,	34.7,	37.8,	42.1,	45.8,	48.6,	52.9,	56.1,	58.7,	N/A ,
6 hours	15.4,	19.9,	22.1,	25.4,	27.5,	29.1,	34.2,	39.7,	43.2,	47.9,	52.0,	55.1,	59.7,	63.2,	66.1,	N/A ,
9 hours	18.1,	23.2,	25.8,	29.4,	31.8,	33.6,	39.3,	45.4,	49.2,	54.4,	58.9,	62.3,	67.4,	71.3,	74.4,	N/A ,
12 hours	20.3,	25.9,	28.7,	32.7,	35.3,	37.2,	43.4,	49.9,	54.0,	59.6,	64.4,	68.1,	73.5,	77.6,	80.9,	N/A ,
18 hours	23.9,	30.3,	33.4,	37.9,	40.8,	43.0,	49.8,	57.1,	61.6,	67.8,	73.1,	77.1,	83.0,	87.5,	91.1,	N/A ,
24 hours	26.9,	33.8,	37.2,	42.1,	45.2,	47.6,	55.0,	62.8,	67.7,	74.3,	79.9,	84.1,	90.5,	95.3,	99.1,	112.1,
2 days	31.8,	39.4,	43.0,	48.2,	51.6,	54.1,	61.8,	69.8,	74.9,	81.6,	87.3,	91.6,	98.0,	102.7,	106.6,	119.5,
3 days	36.2,	44.3,	48.3,	53.8,	57.3,	60.0,	68.1,	76.5,	81.8,	88.8,	94.7,	99.1,	105.7,	110.6,	114.5,	127.7,
4 days	40.2,	48.9,	53.0,	58.9,	62.6,	65.4,	73.9,	82.8,	88.3,	95.5,	101.7,	106.3,	113.0,	118.1,	122.2,	135.7,
6 days	47.5,	57.1,	61.7,	68.2,	72.3,	75.3,	84.6,	94.2,	100.1,	107.9,	114.5,	119.4,	126.6,	131.9,	136.3,	150.5,
8 days	54.1,	64.6,	69.7,	76.7,	81.1,	84.4,	94.4,	104.6,	110.9,	119.2,	126.2,	131.4,	139.0,	144.7,	149.2,	164.2,
10 days	60.3,	71.7,	77.1,	84.6,	89.3,	92.8,	103.4,	114.3,	121.0,	129.8,	137.1,	142.6,	150.6,	156.5,	161.3,	177.0,
12 days	66.3,	78.4,	84.2,	92.1,	97.1,	100.8,	112.1,	123.5,	130.5,	139.8,	147.5,	153.2,	161.6,	167.8,	172.7,	189.1,
16 days	77.6,	91.1,	97.5,	106.3,	111.9,	115.9,	128.3,	140.8,	148.5,	158.5,	166.9,	173.1,	182.1,	188.8,	194.2,	211.8,
20 days	88.3,	103.1,	110.2,	119.8,	125.8,	130.2,	143.6,	157.1,	165.3,	176.1,	185.1,	191.7,	201.4,	208.6,	214.3,	233.0,
25 days	101.2,	117.6,	125.2,	135.8,	142.3,	147.2,	161.7,	176.4,	185.3,	197.0,	206.7,	213.8,	224.2,	231.9,	238.0,	258.1,

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

M5-60 = 15.4
Ratio R = 0.285

SAAR = 898mm

Appendix D – Surface Water Network Calculations

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)	15.400	Add Flow / Climate Change (%)	10
Ratio R	0.285	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	75	Maximum Backdrop Height (m)	2.500
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)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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
S1.000	3.195	0.033	96.8	0.008	4.00	5.0	0.600	o	225	Pipe/Conduit	
S2.000	17.160	0.322	53.3	0.027	4.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	2.134	0.013	164.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	14.401	0.085	169.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	14.570	0.086	169.4	0.022	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.004	7.910	0.079	100.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.000	4.589	0.048	95.6	0.087	4.00	5.0	0.600	o	225	Pipe/Conduit	
S3.001	12.067	0.082	147.3	0.035	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.002	13.294	0.076	174.9	0.021	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.003	26.223	0.150	174.8	0.037	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)
S1.000	63.37	4.04	86.020	0.008	5.0	0.0	0.6	1.33	52.8	7.0
S2.000	62.50	4.21	85.730	0.027	0.0	0.0	0.5	1.38	24.4	5.1
S1.001	62.32	4.24	85.333	0.035	5.0	0.0	1.1	1.02	40.5	12.1
S1.002	61.14	4.48	85.320	0.035	5.0	0.0	1.1	1.00	39.8	12.1
S1.003	60.00	4.72	85.235	0.057	5.0	0.0	1.4	1.00	39.8	15.7
S1.004	59.54	4.82	85.149	0.057	5.0	0.0	1.4	1.31	52.0	15.7
S3.000	63.28	4.06	85.600	0.087	5.0	0.0	2.0	1.34	53.2	21.9
S3.001	62.31	4.24	85.300	0.122	5.0	0.0	2.6	1.08	42.7	28.2
S3.002	61.20	4.47	85.218	0.143	5.0	0.0	2.9	0.99	39.2	31.6
S3.003	59.15	4.91	85.142	0.180	5.0	0.0	3.4	0.99	39.2	37.3

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
S3.004	20.043	0.115	175.0	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S3.005	27.254	0.182	150.0	0.031	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	33.121	0.414	80.0	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)
S3.004	57.69	5.25	84.992	0.184	5.0	0.0	3.4	0.99	39.2	37.3
S3.005	55.98	5.68	84.878	0.215	5.0	0.0	3.8	1.07	42.4	41.3
S1.005	54.57	6.06	84.696	0.272	10.0	0.0	5.0	1.46	58.2	55.2

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)
S1	86.450	0.430	Open Manhole	1200	S1.000	86.020	225				
SE2	89.820	4.090	Open Manhole	1200	S2.000	85.730	150				
S3	86.500	1.167	Open Manhole	1200	S1.001	85.333	225	S1.000	85.987	225	654
								S2.000	85.408	150	
S4	86.500	1.180	Open Manhole	1200	S1.002	85.320	225	S1.001	85.320	225	
S5	86.700	1.465	Open Manhole	1200	S1.003	85.235	225	S1.002	85.235	225	
S6	86.500	1.351	Open Manhole	1200	S1.004	85.149	225	S1.003	85.149	225	
S7	86.460	0.860	Open Manhole	1200	S3.000	85.600	225				
S8	86.450	1.150	Open Manhole	1200	S3.001	85.300	225	S3.000	85.552	225	252
S9	86.450	1.232	Open Manhole	1200	S3.002	85.218	225	S3.001	85.218	225	
S10	86.550	1.408	Open Manhole	1200	S3.003	85.142	225	S3.002	85.142	225	
S11	86.120	1.128	Open Manhole	1200	S3.004	84.992	225	S3.003	84.992	225	
S12	86.100	1.222	Open Manhole	1200	S3.005	84.878	225	S3.004	84.878	225	
S13	86.500	1.804	Open Manhole	1200	S1.005	84.696	225	S1.004	85.070	225	374
								S3.005	84.696	225	
SRiver	85.500	1.218	Open Manhole	0		OUTFALL		S1.005	84.282	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1	680576.339	715295.201	680576.339	715295.201	Required	
SE2	680561.224	715286.483	680561.224	715286.483	Required	
S3	680574.268	715297.634	680574.268	715297.634	Required	
S4	680575.199	715299.553	680575.199	715299.553	Required	
S5	680585.576	715309.539	680585.576	715309.539	Required	
S6	680597.440	715317.998	680597.440	715317.998	Required	
S7	680579.813	715278.408	680579.813	715278.408	Required	

Manhole Schedules for Storm

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S8	680584.337	715279.179	680584.337	715279.179	Required	
S9	680588.273	715267.772	680588.273	715267.772	Required	
S10	680601.182	715270.946	680601.182	715270.946	Required	
S11	680626.780	715276.640	680626.780	715276.640	Required	
S12	680623.137	715296.349	680623.137	715296.349	Required	
S13	680605.278	715316.936	680605.278	715316.936	Required	
SRiver	680633.267	715334.646			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	S1	86.450	86.020	0.205	Open Manhole	1200
S2.000	o	150	SE2	89.820	85.730	3.940	Open Manhole	1200
S1.001	o	225	S3	86.500	85.333	0.942	Open Manhole	1200
S1.002	o	225	S4	86.500	85.320	0.955	Open Manhole	1200
S1.003	o	225	S5	86.700	85.235	1.240	Open Manhole	1200
S1.004	o	225	S6	86.500	85.149	1.126	Open Manhole	1200
S3.000	o	225	S7	86.460	85.600	0.635	Open Manhole	1200
S3.001	o	225	S8	86.450	85.300	0.925	Open Manhole	1200
S3.002	o	225	S9	86.450	85.218	1.007	Open Manhole	1200
S3.003	o	225	S10	86.550	85.142	1.183	Open Manhole	1200
S3.004	o	225	S11	86.120	84.992	0.903	Open Manhole	1200
S3.005	o	225	S12	86.100	84.878	0.997	Open Manhole	1200
S1.005	o	225	S13	86.500	84.696	1.579	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	3.195	96.8	S3	86.500	85.987	0.288	Open Manhole	1200
S2.000	17.160	53.3	S3	86.500	85.408	0.942	Open Manhole	1200
S1.001	2.134	164.2	S4	86.500	85.320	0.955	Open Manhole	1200
S1.002	14.401	169.4	S5	86.700	85.235	1.240	Open Manhole	1200
S1.003	14.570	169.4	S6	86.500	85.149	1.126	Open Manhole	1200
S1.004	7.910	100.0	S13	86.500	85.070	1.205	Open Manhole	1200
S3.000	4.589	95.6	S8	86.450	85.552	0.673	Open Manhole	1200
S3.001	12.067	147.3	S9	86.450	85.218	1.007	Open Manhole	1200
S3.002	13.294	174.9	S10	86.550	85.142	1.183	Open Manhole	1200
S3.003	26.223	174.8	S11	86.120	84.992	0.903	Open Manhole	1200
S3.004	20.043	175.0	S12	86.100	84.878	0.997	Open Manhole	1200
S3.005	27.254	150.0	S13	86.500	84.696	1.579	Open Manhole	1200
S1.005	33.121	80.0	SRiver	85.500	84.282	0.993	Open Manhole	0

Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.008	0.008	0.008
2.000	User	-	90	0.030	0.027	0.027
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
1.003	User	-	70	0.015	0.011	0.011
	User	-	100	0.011	0.011	0.022
1.004	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.087	0.087	0.087
3.001	User	-	90	0.037	0.033	0.033
	User	-	100	0.003	0.003	0.035
3.002	User	-	90	0.023	0.021	0.021
3.003	User	-	90	0.015	0.013	0.013
	User	-	70	0.002	0.002	0.015
	User	-	100	0.009	0.009	0.024
	User	-	80	0.017	0.014	0.037
3.004	User	-	50	0.008	0.004	0.004
3.005	User	-	100	0.010	0.010	0.010
	User	-	70	0.020	0.014	0.024
	User	-	50	0.008	0.004	0.028
	User	-	100	0.003	0.003	0.031
1.005	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.305	0.272	0.272

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)
S1.005	SRiver	85.500	84.282	84.070	0	0

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

Simulation Criteria

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

Number of Input Hydrographs	0	Number of Storage Structures	0
Number of Online Controls	0	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 0.285
Region	Scotland and Ireland	Cv (Summer)	0.750
M5-60 (mm)	15.400	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	100.0	DVD Status	ON
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 30

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	S1	15 Summer	100	+30%					86.101
S2.000	SE2	15 Winter	100	+30%					85.806
S1.001	S3	15 Summer	100	+30%					85.473
S1.002	S4	15 Summer	100	+30%					85.443
S1.003	S5	15 Winter	100	+30%					85.401
S1.004	S6	15 Winter	100	+30%					85.364
S3.000	S7	15 Winter	100	+30%	100/15 Summer				86.420
S3.001	S8	15 Winter	100	+30%	30/15 Summer				86.350
S3.002	S9	15 Winter	100	+30%	30/15 Summer				86.261
S3.003	S10	15 Winter	100	+30%	30/15 Summer				86.161
S3.004	S11	15 Winter	100	+30%	30/15 Summer				85.901
S3.005	S12	15 Winter	100	+30%	30/15 Summer				85.685
S1.005	S13	15 Winter	100	+30%	30/15 Summer				85.313

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	S1	-0.144	0.000	0.28			8.4	OK	

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
S2.000	SE2	-0.074	0.000	0.51			11.6	OK	
S1.001	S3	-0.085	0.000	0.70			20.0	OK	
S1.002	S4	-0.102	0.000	0.57			20.0	OK	
S1.003	S5	-0.059	0.000	0.82			28.5	OK	
S1.004	S6	-0.010	0.000	0.70			27.6	OK	
S3.000	S7	0.595	0.000	1.08			33.4	FLOOD RISK	
S3.001	S8	0.825	0.000	1.09			40.0	SURCHARGED	
S3.002	S9	0.818	0.000	1.24			42.1	SURCHARGED	
S3.003	S10	0.794	0.000	1.37			49.8	SURCHARGED	
S3.004	S11	0.684	0.000	1.38			48.8	SURCHARGED	
S3.005	S12	0.583	0.000	1.41			55.5	SURCHARGED	
S1.005	S13	0.392	0.000	1.40			76.7	SURCHARGED	

Appendix E – SuDS Maintenance Checklist

- a plan clearly showing the extent of the adopted area along with easements and rights of way for access to carry out maintenance. If other parties are responsible for different parts of a scheme, this should be clearly shown on the plan.
- the access that is required to each surface water management component for maintenance purposes and a plan for the safe and sustainable removal and disposal of waste periodically arising from the drainage system
- a review of the work to be undertaken, based on regular day-to-day maintenance, occasional tasks and remedial work. Details of the likely maintenance requirements for each SuDS element are provided in this Manual. Maintenance requirements for proprietary systems should be provided by the manufacturer or supplier.
- the maintenance specification – detailing the materials to be used and the standard of work required. A specification should describe how the work should be carried out and should contain clauses giving general instructions to the maintenance contractor.
- the maintenance schedule of work – itemising the tasks to be undertaken and the frequency at which they should be performed so that an acceptable long-term performance standard is secured. This schedule can then be priced and checked on site, and it can form the basis of an inspection log where appropriate. The schedule should be a living document because it may change, where inspections advise changes to the scheme maintenance requirements.
- contact sheet and any extra guidance notes – eg action plan for dealing with accidental spillages
- photographic records of the inspections. This can pick up long-term changes that might not be apparent on a single visit, especially where inspections are carried out by different members of staff.

Note: An example of a Maintenance Plan is available in Box B.2.

B.8.3 Maintenance inspection checklist

This checklist is a generic list that can be added to, or have items removed from it, to suit a particular site. The exact content of the checklist will depend on the combination of different SuDS components used in a scheme. Checklists should be selected based on the combination of elements in the drainage system to provide a bespoke inspection report.

The objective of this checklist is to:

- confirm that appropriate routine maintenance of the system is being undertaken
- confirm that the system is continuing to operate effectively
- identify any remedial works required
- provide a consistent record of the condition and performance of the system.

It is not a checklist of maintenance items, which is covered in Chapters 11 to 23 of this manual (Table B.24). It is a checklist to facilitate consistent inspection of the condition of the system. It can be used by any organisation responsible for the long-term maintenance of the SuDS system as a recording process, or by a subcontracted organisation as part of their client reporting procedures.

Inspections should comply with all relevant health and safety legislation (The Management of Health and Safety at Work Regulations 1999) including the development of risk assessments for working close to or in water.

Inspections should ideally be carried out monthly (and no less than three-monthly), at the same time as other routine maintenance activities.

TABLE B.24 Where to find information on maintenance activities and frequencies

Component	Ref (within this manual)
Green roofs	Section 12.12
Infiltration systems	Section 13.12
Proprietary systems	Section 14.12
Filter strips	Section 15.12
Filter drains	Section 16.12
Swales	Section 17.12
Bioretention systems	Section 18.12
Trees	Section 19.12
Pervious pavements	Section 20.14
Attenuation storage tanks	Section 21.13
Detention basins	Section 22.12
Ponds and wetlands	Section 23.12

TABLE B.25 SuDS maintenance inspection checklist

General information			
Site ID			
Site location and co-ordinates (GIS if appropriate)			
Elements forming the SuDS scheme		Approved drawing reference(s)	
Inspection frequency		Approved specification reference	
Type of development		Specific purpose of any parts of the scheme (eg biodiversity, wildlife and visual aspects)	

Inspection date								
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date Completed
General inspection items								
Is there any evidence of erosion, channelling, ponding (where not desirable) or other poor hydraulic performance?								
Is there any evidence of accidental spillages, oils, poor water quality, odours or nuisance insects?								
Have any health and safety risks been identified to either the public or maintenance operatives?								
Is there any deterioration in the surface of permeable or porous surfaces (eg rutting, spreading of blocks or signs of ponding water)?								
Silt/sediment accumulation								
Is there any sediment accumulation at inlets (or other defined accumulation zones such as the surface of filter drains or infiltration basins and within proprietary devices)? If yes, state depth (mm) and extent. Is removal required? If yes, state waste disposal requirements and confirm that all waste management requirements have been complied with (consult environmental regulator)								

continued...

continued from...

TABLE B.25 SuDS maintenance inspection checklist

Inspection date								
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date Completed
Is surface clogging visible (potentially problematic where water has to soak into the underlying construction or ground (eg underdrained swale or infiltration basin)?								
Does permeable or porous surfacing require sweeping to remove silt?								
System blockages and litter build-up								
Is there evidence of litter accumulation in the system? If yes, is this a blockage risk?								
Is there any evidence of any other clogging or blockage of outlets or drainage paths?								
Vegetation								
Is the vegetation condition satisfactory (density, weed growth, coverage etc)? (Check against approved planting regime.)								
Does any part of the system require weeding, pruning or mowing? (Check against maintenance frequency stated in approved design.)								
Is there any evidence of invasive species becoming established? If yes, state action required								
Infrastructure								
Are any check dams or weirs in good condition?								
Is there evidence of any accidental damage to the system (eg wheel ruts?)								
Is there any evidence of cross connections or other unauthorised inflows?								
Is there any evidence of tampering with the flow controls?								

continued...

continued from...

TABLE B.25 SuDS maintenance inspection checklist

Inspection date								
	Details	Y/N	Action required	Date completed	Details	Y/N	Action required	Date Completed
Are there any other matters that could affect the performance of the system in relation to the design objectives for hydraulic, water quality, biodiversity and visual aspects? (Specify.)								
Other observations								
Information appended (eg photos)								
Suitability of current maintenance regime								
Continue as current Increase maintenance Decrease maintenance								
Next inspection								
Proposed date for next inspection								

Correct application of the waterproof membrane is essential to the viability of the green roof. Quality control must be assured through the use of certified roofing procedures and an electronic water leakage test immediately following membrane application to ensure that the surface is impermeable.

Temporary ballasting of individual components may be required during construction to prevent uplift due to wind. The growing medium should be protected from over-compaction during construction, and mulch, mat or other measures to control erosion of the growing medium should be maintained until 90% vegetation coverage is achieved. The growing medium and separation fabric should be isolated from sedimentation during construction.

Safe access is required for construction of the green roof, and also for all activities in areas beneath the roof. Ideally, the roof should be installed when no follow-on trades need access to the roof after installation, in order to reduce the risk of damage.

- Further detail on construction activities and the programming of construction activities is provided in Chapter 31.
- Generic health and safety guidance is presented in Chapter 36.

A construction phase health and safety plan is required under the Construction (Design and Management) Regulations (CDM) 2015. This should ensure that all construction risks have been identified and eliminated/reduced and/or controlled where appropriate.

12.12 OPERATION AND MAINTENANCE REQUIREMENTS

Intensive green roofs are likely to require regular inspection and maintenance. Grassed areas may require mowing weekly or fortnightly, plant beds may require weeding on a weekly or fortnightly basis during the growing season, and wildflower meadows may require annual mowing with the cuttings removed. Extensive green roofs should normally only require biannual or annual visits to remove litter, check fire breaks and drains and, in some cases, remove unwanted invasive plants. The most maintenance is generally required during the establishment stage (12 to 15 months), and this should usually be made the responsibility of the green roof provider. Maintenance contractors with specialist training in green roof care should be used, where possible.

Table 12.5 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required. Actual requirements will depend on the planting, the desired aesthetic and visual effect and the biodiversity objectives for the system. Maintenance specifications and schedules should therefore be specified for any individual green roof.

If mechanical systems are located on the roof, then spill prevention measures should be exercised to ensure that roof runoff is not contaminated. The mechanical system area should be bunded and provided with separate drainage.

All maintenance actions carried out at roof level must be in full compliance with the appropriate health and safety regulations, and particularly those specifically dealing with working at height. Training and guidance information on operating and maintaining the roof should be provided to all property owners and tenants. Safety fastenings will be required for personnel working on the roof.

Access routes to the roof should be designed and maintained to be safe and efficient, and walkways should always be kept clear of obstructions. Secure points for harness attachments should be provided when access near to the roof edges is required.

Specific maintenance needs of the green roof should be monitored and maintenance schedules adjusted to suit requirements.

TABLE 12.5 Operation and maintenance requirements for green roofs

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect all components including soil substrate, vegetation, drains, irrigation systems (if applicable), membranes and roof structure for proper operation, integrity of waterproofing and structural stability	Annually and after severe storms
	Inspect soil substrate for evidence of erosion channels and identify any sediment sources	Annually and after severe storms
	Inspect drain inlets to ensure unrestricted runoff from the drainage layer to the conveyance or roof drain system	Annually and after severe storms
	Inspect underside of roof for evidence of leakage	Annually and after severe storms
Regular maintenance	Remove debris and litter to prevent clogging of inlet drains and interference with plant growth	Six monthly and annually or as required
	During establishment (ie year one), replace dead plants as required	Monthly (but usually responsibility of manufacturer)
	Post establishment, replace dead plants as required (where > 5% of coverage)	Annually (in autumn)
	Remove fallen leaves and debris from deciduous plant foliage	Six monthly or as required
	Remove nuisance and invasive vegetation, including weeds	Six monthly or as required
	Mow grasses, prune shrubs and manage other planting (if appropriate) as required – clippings should be removed and not allowed to accumulate	Six monthly or as required
Remedial actions	If erosion channels are evident, these should be stabilised with extra soil substrate similar to the original material, and sources of erosion damage should be identified and controlled	As required
	If drain inlet has settled, cracked or moved, investigate and repair as appropriate	As required

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 32.

CDM 2015 requires designers to ensure that all maintenance risks have been identified and eliminated, reduced or controlled where appropriate. This information will be required as part of the health and safety file.

▶ Generic health and safety guidance is presented in Chapter 36.

A construction phase health and safety plan is required under the Construction (Design and Management) Regulations (CDM) 2015. This should ensure that all construction risks have been identified, eliminated, reduced and/or controlled where appropriate.

Manufacturers should provide advice on whether the treatment systems need to be protected from construction phase runoff, and how this can best be achieved.

14.12 OPERATION AND MAINTENANCE REQUIREMENTS

14.12.1 General guidance

Proprietary treatment systems will require routine maintenance to ensure continuing operation to design performance standards. Because of the wide range of different designs and performance, all manufacturers should provide detailed specifications and frequencies for the required maintenance activities along with likely machinery requirements and typical annual costs for any given site. The treatment performance of proprietary systems is strongly dependent on maintenance, and robust management plans will be required to ensure that maintenance is carried out in the long term. There are examples where not undertaking maintenance has led to pollution, and the companies involved have been fined. The cost of maintenance would have been much less than the subsequent fine and clean-up costs. Different proprietary treatment devices will have different operation and maintenance requirements, but this section gives some generic guidance. Ease of access for maintenance and inspection is essential. In particular, access lids and covers should be kept as lightweight as practicable.

Many proprietary systems are beneath the ground, and malfunctioning is not easy to detect, and it is therefore often ignored unless alarms are provided or the system is designed to cause localised surface ponding if full. If systems lead to other surface features, early warning of maintenance being required may be easily observed at the inlet to the feature (which should be designed to prevent it entering the main part of the component). Preference should be given to systems or designs that give some easily observable indication that maintenance is required.

Lack of routine maintenance is more likely to cause poor outflow water quality than with other SuDS due to resuspension of solids and anaerobic conditions developing within the device. For example, anaerobic conditions can develop in deep sumps and catchpits that result in nutrients and metals being released from captured sediments. During the first few months after installation, subsurface treatment units should be visually inspected after rainfall events, and the amount of deposition measured to give the operator an idea of the expected rate of sediment and oil deposition. After this initial period, systems should be inspected every six months to verify the appropriate level of maintenance. During these inspections, the floating debris and any floating oils should normally be removed. This may be done using a van-mounted system, without the need for a large tanker. Silt should be removed when it reaches 75% of the capacity of the sump. In most situations, the units should be fully cleaned out at least annually. If there is a significant spill of oil (or other pollutant) the system should be cleaned immediately.

Hilliges *et al* (2013) recommends cleaning treatment channels out every six months, in spring and after the summer. This was based on observed silt build up for a busy road (AADT 57 000 vehicles per day) and this frequency could possibly be reduced in less trafficked areas. Experience with other channels in less trafficked areas shows silt removal may only be required every 10 years.

Proper disposal of oil, solids and floating debris removed from components must be ensured, and the environmental regulator should be approached for advice where there are any doubts concerning disposal options. A small portion of water will be removed along with the pollutants during the clean-out process, which should be considered when costing sediment disposal processes.

▶ Further guidance on waste management is given in **Chapter 33**.

Harmful vapours may develop in subsurface filtration or hydrodynamic separation units, as hydrocarbons may remain there for extended periods of time. Appropriate testing for harmful vapours and venting

TABLE 14.2 An example of operation and maintenance requirements for a proprietary treatment system

Maintenance schedule	Required action	Typical frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and establish appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

should be undertaken whenever access for maintenance is required. Removal of oil, silt and other pollutants must be in accordance with the appropriate waste management legislation.

Maintenance responsibility for all systems should be placed with an appropriate organisation, and Maintenance Plans and schedules should be developed during the design phase.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 32.

Table 14.2 provides guidance on the type of operation and maintenance schedule that may be appropriate for a proprietary treatment system. The list of actions is not exhaustive and some actions may not always be required.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

▶ Generic health and safety guidance is presented in Chapter 36.

14.12.2 Oil water separators

Specific requirements for oil/water separators are provided in PPG3 (EA/SEPA/EHSNI, 2006). The following items should be undertaken every six months as a minimum:

- check volume of sludge
- check thickness of light liquid
- check function of automatic closure device
- empty the separator, if required
- check the coalescing material and clean or change if necessary (class 1 only)
- check the function of the warning device (if fitted)

General inspection of the integrity of oil/water separators should occur at a maximum frequency of five years, and should cover the following:

- watertightness of system

- structural condition
- internal coatings
- in-built parts
- electrical devices and installations
- adjustment of automatic closure devices

It is usually a requirement that separators are filled with clean water before being put into operation and each time after emptying for maintenance. Failure to do so will cause the separator to malfunction until surface water builds up the required permanent water level in the facility. It is possible to fit an alarm to separators that will indicate when the collected oil volume is at a maximum, and this may be a regulatory requirement. The alarms should be placed in a location that is clearly visible to those responsible for maintenance of the system.

14.13 REFERENCES

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bioretention areas should be protected from runoff by using silt fences or straw bales as recommended in Woods Ballard *et al* (2007).

In Australia there has been a significant issue with bioretention blinding, compaction and failure during the site construction phase. One approach to address this is to place the filter medium in the system and cover it with a temporary impermeable cover to collect all the silt and sediment that is washed into the depression during construction (ie the system is acting as a silt basin during construction). This impermeable layer and accumulated silt is removed once construction is completed and the system is planted. Relying on sediment fences and straw bales has not been found to be as effective as protecting the systems with a temporary cover.

To minimise the risk of premature system failure, the following points should be closely monitored during the construction of bioretention areas:

- Care should be taken not to over-compact the soils below the bioretention area, and particularly the filter and soil planting bed, as this will reduce infiltration capacities.
- To excavate a bioretention area, a backhoe excavator should be used, and construction plant should avoid running over the bioretention area. For smaller systems and rain gardens, hand excavation may be more suitable if access is limited.
- If mulch is required, it should be applied before planting. It should not be piled up around plants, as this will cause disease and encourage pests. It should be 50–75 mm thick and should be kept clear of plant stems by 50 mm to prevent excessive moisture around the stems.
- Care should be taken to ensure that geotextiles are not clogged or torn during construction.
- The filter medium should not be placed if it is saturated or if the ground below the system is saturated.

The filter medium should be tested to ensure that it meets the required criteria before placing (**Box 18.1**). It is important to establish the planting in the systems as quickly as possible. Watering, weeding and replanting will be required during the establishment period to ensure that greater than 90% of plants survive and give good cover.

The surface of the filter medium should be free of localised depressions so that water is distributed evenly across the surface and prevents localised ponding and clogging. The surface levels should be within a tolerance of ± 25 mm for smaller systems and ± 40 mm for systems with an area greater than 300 m^2. The thicknesses for the various layers should be constructed with a tolerance of + 25 mm (ie they should not be less than the design thickness). Levels around the edge of the system should be within ± 25 mm of design levels.

▶ Further detail on construction activities and the programming of construction activities is provided in **Chapter 31**.

A construction phase health and safety plan is required under the Construction (Design and Management) Regulations (CDM) 2015. This should ensure that all construction risks have been identified, eliminated, reduced and/or controlled where appropriate.

▶ Generic health and safety guidance is presented in **Chapter 36**.

18.12 OPERATION AND MAINTENANCE REQUIREMENTS

Dalrymple (2013) concluded that bioretention systems will typically require approximately 2.5 times more maintenance than typical landscape designs. Bioretention systems will require regular maintenance to ensure continuing operation to design performance standards, and all designers should provide detailed specifications and frequencies for the required maintenance activities along with likely machinery requirements and typical annual costs – within the Maintenance Plan. The treatment performance of bioretention systems is dependent on maintenance, and robust management plans will be required to

ensure that maintenance is carried out in the long term. Different designs will have different operation and maintenance requirements, but this section gives some generic guidance. Ease of access for maintenance and inspection is essential.

The main cause of failure of bioretention systems is clogging of the surface, which is easily visible. Underdrains and drainage layers are beneath the ground, and malfunctioning is not so easy to detect and therefore could potentially be ignored. However, the results of any malfunction are likely to cause surface ponding. The clogging of the surface or drainage layers can cause poor outflow water quality due to water bypassing the filter medium to the overflow more frequently than allowed for. During the first few months after installation, the system should be visually inspected after rainfall events, and the amount of deposition measured, to give the operator an idea of the expected rate of sediment deposition. After this initial period, systems should be inspected each quarter, to verify the appropriate level of maintenance.

▶ Further detail on waste management is provided in **Chapter 33**.

Adequate access should be provided for all bioretention areas for inspection and maintenance, including for the appropriate equipment and vehicles.

Litter picking should be frequent, as rubbish is detrimental to the visual appearance of bioretention systems. Frequent street sweeping in the catchment area will increase the time interval between cleaning out forebays or the filter surface and will reduce the loading of fine suspended solids that can potentially clog the filter medium.

All vegetation management activities should take account of the need to maximise biosecurity and prevent the spread of invasive species.

Maintenance responsibility for all systems should be placed with an appropriate organisation, and Maintenance Plans and schedules should be developed during the design phase. **Table 18.3** provides guidance on the type of operation and maintenance schedule that may be appropriate. The list of actions is not exhaustive and some actions may not always be required. The most intensive maintenance is required during the establishment period. Herbicides and pesticides (such as Roundup) and fertilizers should not be used on bioretention systems. This is because these pollutants will wash through the system quite easily.

Sediments excavated from pre-treatment devices that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation, to determine its classification and appropriate disposal methods. For industrial site runoff, sediment testing will be essential. In the majority of cases, it will be acceptable to distribute the sediment on site, if there is an appropriate safe and acceptable location to do so. Proper disposal of sediment and debris removed must be ensured, and the environmental regulator should be approached for advice where there are any doubts concerning disposal options.

▶ Further detail on waste management is given in **Chapter 33**.

Specific maintenance needs of the bioretention area should be monitored, and maintenance schedules adjusted to suit requirements.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in **Chapter 32**.

In general, the maintenance for bioretention areas can often be undertaken as part of routine landscape maintenance.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

TABLE 18.3 Operation and maintenance requirements for bioretention systems

Maintenance schedule	Required action	Typical frequency
Regular inspections	Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary	Quarterly
	Check operation of underdrains by inspection of flows after rain	Annually
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
	Inspect inlets and outlets for blockage	Quarterly
Regular maintenance	Remove litter and surface debris and weeds	Quarterly (or more frequently for tidiness or aesthetic reasons)
	Replace any plants, to maintain planting density	As required
	Remove sediment, litter and debris build-up from around inlets or from forebays	Quarterly to biannually
Occasional maintenance	Infill any holes or scour in the filter medium, improve erosion protection if required	As required
	Repair minor accumulations of silt by raking away surface mulch, scarifying surface of medium and replacing mulch	As required
Remedial actions	Remove and replace filter medium and vegetation above	As required but likely to be > 20 years

▶ Generic health and safety guidance is presented in **Chapter 36**.

▶ Further detail on construction activities and the programming of construction activities is provided in Chapter 31.

A construction phase health and safety plan is required under the Construction (Design and Management) Regulations 2015. This should ensure that all construction risks have been identified, eliminated, reduced and/or controlled where appropriate.

▶ Generic health and safety guidance is provided in Chapter 36.

19.12 OPERATION AND MAINTENANCE REQUIREMENTS

Maintenance requirements of trees will be greatest during the first few years, when the tree is becoming established. Early maintenance should involve regular inspection, removal of invasive vegetation and possibly irrigation during long dry periods, particularly in soils with high void ratios. Tree roots need to establish good root–soil contact before they can efficiently extract water from the soil. The expertise of a arboriculturist/landscape architect with local knowledge should be sought regarding appropriate irrigation schedules. Maintenance responsibility for a tree pit or planter should always be placed with an appropriate organisation.

Table 19.3 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

TABLE 19.3 Operation and maintenance requirements for trees (after CRWA, 2009)

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets and outlets	Inspect monthly
Occasional maintenance	Check tree health and manage tree appropriately	Annually
	Remove silt build-up from inlets and surface and replace mulch as necessary	Annually, or as required
	Water	As required (in periods of drought)
Monitoring	Inspect silt accumulation rates and establish appropriate removal frequencies	Half yearly

Sediments excavated from a tree pit or planter that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or landfilling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. For runoff, from busy streets with high vehicle traffic sediment testing will be essential.

▶ Further detail on waste management is provided in Chapter 33.

Maintenance Plans and schedules should be developed during the design phase. Specific maintenance needs of the tree pits/planters should be monitored and maintenance schedules adjusted to suit requirements.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in Chapter 31.

Many of the specific maintenance activities for trees can be undertaken as part of a general landscaping or specific tree maintenance contracts.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

▶ Generic health and safety guidance is provided in Chapter 36.

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20.14 OPERATION AND MAINTENANCE REQUIREMENTS

Regular inspection and maintenance is important for the effective operation of pervious pavements. Maintenance responsibility for a pervious pavement and its surrounding area should be placed with an appropriate responsible organisation. Before handing over the pavement to the client, it should be inspected for clogging, litter, weeds and water ponding, and all failures should be rectified. After handover, the pavement should be inspected regularly, preferably during and after heavy rainfall to check effective operation and to identify any areas of ponding.

Pervious pavements need to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Extensive experience suggests that sweeping once per year should be sufficient to maintain an acceptable infiltration rate on most sites. However, in some instances, more or less sweeping may be required and the frequency should be adjusted to suit site-specific circumstances and should be informed by inspection reports.

A brush and suction cleaner (which can be a lorry-mounted device or a smaller precinct sweeper) should be used for regular sweeping. Care should be taken in adjusting vacuuming equipment to avoid removal of jointing material. Any lost material should be replaced. It is also possible to clean the surface using lightweight rotating brush cleaners combined with power spraying using hot water, as shown in **Figure 20.30**. This is done every two years at the site shown.

If the surface has clogged then a more specialist sweeper with water jetting and oscillating and rotating brushes may be required, especially for porous asphalt surfaces, to restore the surface infiltration rate to an acceptable level. The specialist equipment should be adjusted so that it does not strip binder from the aggregate in the asphalt.

Figure 20.30 Deep cleaning a supermarket car park, Dundee (courtesy Abertay University)

The likely design life of grass reinforcement will be dictated by trafficking and is likely to be about 20 years if designed correctly. For concrete block permeable paving the design life should be no different from standard paving, assuming that an effective maintenance regime is in place to minimise risks of infiltration clogging. Porous asphalt will lose strength and begin to fatigue due to oxidation of the binder. This is likely to occur slightly faster in porous asphalt than normal asphalt, so the design life will be reduced slightly. Porous concrete should have a similar design life to a normal concrete slab.

The reconstruction of failed areas of concrete block pavement should be less costly and disruptive than the rehabilitation of continuous concrete or asphalt porous surfaces due to the reduced area that is likely to be affected. Materials removed from the voids or the layers below the surface may contain heavy metals and hydrocarbons and may need to be disposed of as controlled waste. Sediment testing should be carried out before disposal to confirm its classification and appropriate disposal methods.

▶ Guidance on waste management is provided in **Chapter 33**.

Table 20.15 provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive and some actions may not always be required.

Maintenance Plans and schedules should be prepared during the design phase. Specific maintenance needs of the pervious pavement should be monitored, and maintenance schedules adjusted to suit requirements.

▶ Further detail on the preparation of maintenance specifications and schedules of work is given in **Chapter 32**.

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Many of the specific maintenance activities for pervious pavements can be undertaken as part of a general site cleaning contract (many car parks or roads are swept to remove litter and for visual reasons to keep them tidy) and therefore, if litter management is already required at site, this should have marginal cost implications.

Generally, pervious pavements require less frequent gritting in winter to prevent ice formation. There is also less risk of ice formation after snow melt, as the melt water drains directly into the underlying sub-base and does not have chance to refreeze. A slight frost may occur more frequently on the surface of pervious pavements compared to adjacent impermeable surfaces, but this is only likely to last for a few hours. It does not happen in all installations and, if necessary, this can be dealt with by application of salt. It is not likely to pose a hazard to vehicle movements.

- Generic health and safety guidance is presented in **Chapter 36**.

CDM 2015 requires designers to ensure that all maintenance risks have been identified, eliminated, reduced and/or controlled where appropriate. This information will be required as part of the health and safety file.

Appendix F – Foul Water Network Calculations

FOUL SEWERAGE DESIGN

Design Criteria for Foul - Main

Pipe Sizes STANDARD Manhole Sizes STANDARD

Industrial Flow (l/s/ha)	0.00	Add Flow / Climate Change (%)	0
Industrial Peak Flow Factor	0.00	Minimum Backdrop Height (m)	0.200
Flow Per Person (l/per/day)	165.00	Maximum Backdrop Height (m)	2.500
Persons per House	2.70	Min Design Depth for Optimisation (m)	1.200
Domestic (l/s/ha)	6.00	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 - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
F1.000	13.233	0.158	84.0	0.000	0	0.1	1.500	o	150	Pipe/Conduit	
F1.001	17.478	0.129	135.5	0.000	0	0.2	1.500	o	150	Pipe/Conduit	
F1.002	5.712	0.092	62.1	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F1.003	7.897	0.058	136.2	0.000	0	0.0	1.500	o	150	Pipe/Conduit	
F2.000	6.477	0.048	134.9	0.000	0	0.1	1.500	o	150	Pipe/Conduit	
F2.001	8.977	0.066	136.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit	

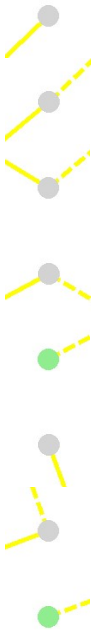
Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	85.600	0.000	0.1	0	0.0	9	0.25	0.96	16.9	0.1
F1.001	85.442	0.000	0.3	0	0.0	16	0.30	0.75	13.3	0.3
F1.002	85.313	0.000	0.3	0	0.0	13	0.39	1.11	19.7	0.3
F1.003	85.221	0.000	0.3	0	0.0	16	0.30	0.75	13.3	0.3
F2.000	85.600	0.000	0.1	0	0.0	10	0.21	0.75	13.3	0.1
F2.001	85.552	0.000	0.1	0	0.0	10	0.21	0.75	13.3	0.1

Manhole Schedules for Foul - Main

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)
F1	86.630	1.030	Open Manhole	1200	F1.000	85.600	150				
F2	86.800	1.358	Open Manhole	1200	F1.001	85.442	150	F1.000	85.442	150	
F3	86.500	1.187	Open Manhole	1200	F1.002	85.313	150	F1.001	85.313	150	
F4	87.100	1.879	Open Manhole	1200	F1.003	85.221	150	F1.002	85.221	150	
FOut_PR	87.260	2.097	Open Manhole	0		OUTFALL		F1.003	85.163	150	
F5	86.460	0.860	Open Manhole	1200	F2.000	85.600	150				
F6	86.450	0.898	Open Manhole	1200	F2.001	85.552	150	F2.000	85.552	150	
FOut_CY	86.500	1.014	Open Manhole	0		OUTFALL		F2.001	85.486	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
F1	680596.116	715314.685	680596.116	715314.685	Required	
F2	680586.528	715305.565	680586.528	715305.565	Required	
F3	680573.104	715294.373	680573.104	715294.373	Required	
F4	680568.206	715297.313	680568.206	715297.313	Required	
FOut_PR	680561.256	715293.563			No Entry	
F5	680584.348	715284.197	680584.348	715284.197	Required	
F6	680586.589	715278.120	680586.589	715278.120	Required	
FOut_CY	680578.170	715275.003			No Entry	



PIPELINE SCHEDULES for Foul - Main

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	150	F1	86.630	85.600	0.880	Open Manhole	1200
F1.001	o	150	F2	86.800	85.442	1.208	Open Manhole	1200
F1.002	o	150	F3	86.500	85.313	1.037	Open Manhole	1200
F1.003	o	150	F4	87.100	85.221	1.729	Open Manhole	1200
F2.000	o	150	F5	86.460	85.600	0.710	Open Manhole	1200
F2.001	o	150	F6	86.450	85.552	0.748	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	13.233	84.0	F2	86.800	85.442	1.208	Open Manhole	1200
F1.001	17.478	135.5	F3	86.500	85.313	1.037	Open Manhole	1200
F1.002	5.712	62.1	F4	87.100	85.221	1.729	Open Manhole	1200
F1.003	7.897	136.2	FOut_PR	87.260	85.163	1.947	Open Manhole	0
F2.000	6.477	134.9	F6	86.450	85.552	0.748	Open Manhole	1200
F2.001	8.977	136.0	FOut_CY	86.500	85.486	0.864	Open Manhole	0

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.003	FOut_PR	87.260	85.163	85.160	0	0

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F2.001	FOut_CY	86.500	85.486	85.470	0	0

Appendix G – Irish Water Confirmation of Feasibility

Nicholas Orr

4th Floor
Adelphi Plaza George's Street Upper
Dun Laoghaire
Co. Dublin
A96T927

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

12 January 2022

Re: CDS21009023 pre-connection enquiry - Subject to contract | Contract denied

Connection for a Business Connection at Riverbank Arts Centre, Main Street, Co. Kildare

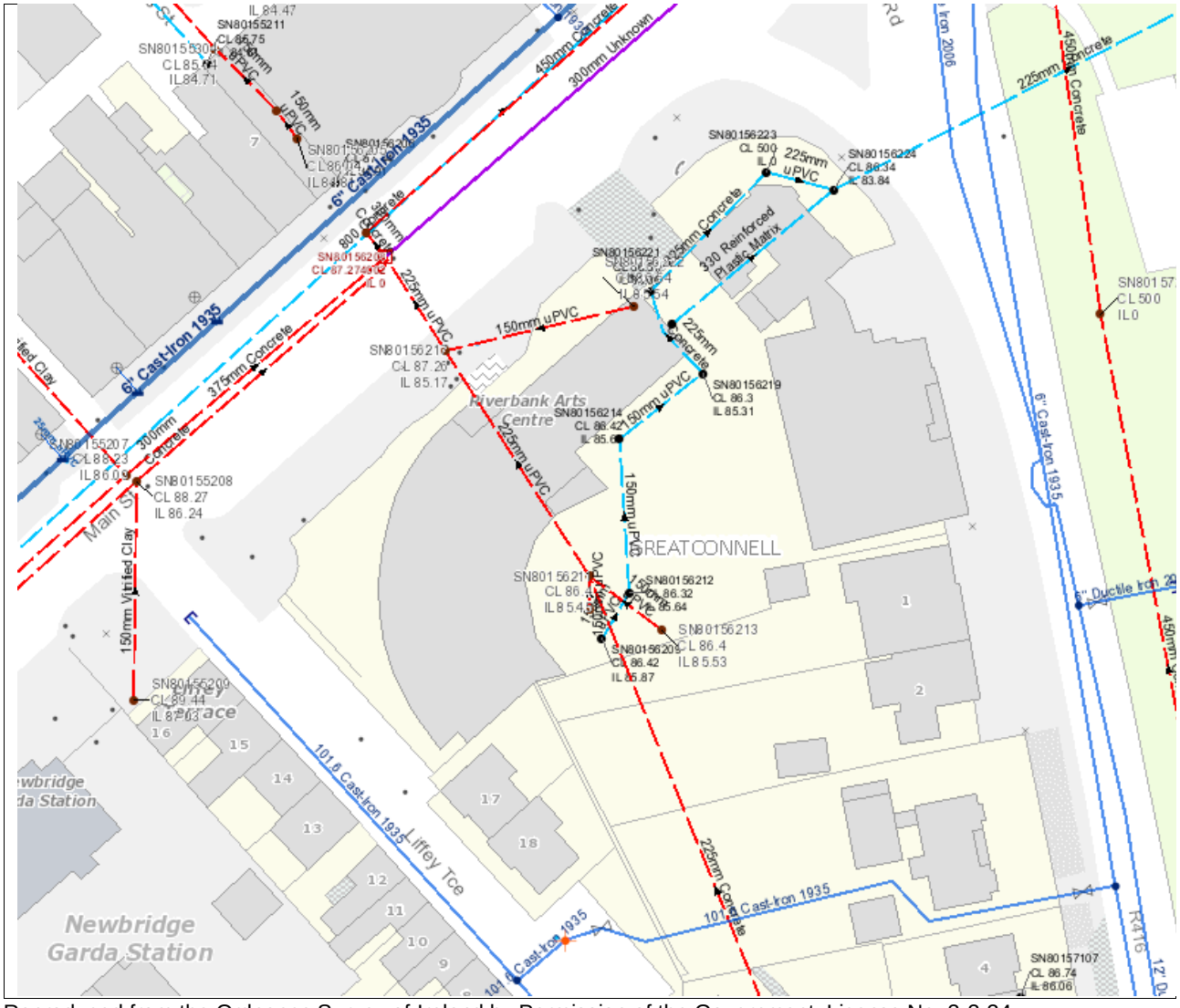
Dear Sir/Madam,

Irish Water has reviewed your pre-connection enquiry in relation to a Water & Wastewater connection at Riverbank Arts Centre, Main Street, Co. Kildare (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 networks as assessed by Irish Water, we wish to advise you that your proposed connection to the Irish Water networks 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 without infrastructure upgrade by Irish Water
Wastewater Connection	Feasible without infrastructure upgrade by Irish Water
SITE SPECIFIC COMMENTS	
Wastewater Connection	The proposed Development indicates that Irish Water assets are present on the site. The Developer has to demonstrate that proposed structures and works will not inhibit access for maintenance or endanger structural or functional integrity of the assets during and after the works. Drawings (showing clearance distances, changing to ground levels) and Method Statements should be included in the Detailed Design of the Development. A wayleave in favour of Irish Water will be required over the assets that are not located within the Public Space. For design submissions and queries related to diversion/build near or over, please contact IW Diversion Team via email address diversions@water.ie

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:



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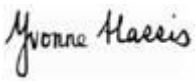
Whilst every care has been taken in its compilation Irish Water gives this information as to the position of its underground network as a general guide only on the strict understanding that it is based on the best available information provided by each Local Authority in Ireland to Irish Water. Irish 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 Tinus van der Walt from the design team at twalt@water.ie For further information, visit **www.water.ie/connections.**

Yours sincerely,



Yvonne Harris

Head of Customer Operations

aecom.com