

Part 8 Proposed Redevelopment of The Wonderful Barn P82024.10

Stage 2b Infrastructure Report

Kildare County Council
Part 8

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1. Introduction

AECOM has been appointed on behalf of the Kildare County Council (KCC) to prepare a Stage 2b Infrastructure Report for the proposed redevelopment of the The Wonderful Barn. The report outlines the civil engineering infrastructure design for the proposed development which details the existing and proposed surface water, foul water and watermain infrastructure. An assessment of the proposed development options with their opportunities and constraints relating to civil engineering infrastructure is also outlined in this report.

The assessment is supported by a review of key documents, including but not limited to:

- Action Area Plan for Lands at the Wonderful Barn and Barnhall House;
- Kildare County Development Plan 2023 – 2029;
- Building Regulations Technical Guidance Document H: 2010 – Drainage and Water;
- CIRIA Document C753: 2015 – The SuDS Manual.

Section 2 of the report provides an overview of the strategic context of the proposed development. Details pertaining to the site's background include location, boundary conditions, and topographic features. A summary of the proposed development, which encompasses both the proposed levels and ground investigations are included.

Section 3 of the report outlines the preliminary discussions and/or consultations related to the pre-planning stages of the proposed development. This includes details of pre-connection enquiries and applications.

Section 4 to Section 7 of the report outlines the civil infrastructure requirements for the proposed development. As part of the assessment, a review of the existing surface water drainage, foul water drainage and watermain records has been carried out in order to inform the drainage, SuDS and watermain strategies.

2. Site Background

The Wonderful Barn, located in Leixlip, County Kildare, stands as a significant historical building within Irish history. Erected in 1743 under the supervision of Katherine Conolly, the structure served a dual purpose as a granary and famine relief initiative as part of the expansive Castletown Estate. Its distinctive design, drafted by architect Richard Castle, features a tapering conical silhouette encircled with a spiralling staircase, and stands at 22m tall. Regarded as an emblem of wealth and influence, the Wonderful Barn remains a cherished and important heritage site for Ireland's rich architectural legacy. As such, the Wonderful Barn is seen as a protected national structure by KCC. The Wonderful Barn forms part of Castletown House Estate which is currently under supervision of the Office of Public Works (OPW) (formerly under supervision of the Castletown Foundation) which seek to continue the ongoing restoration of the lands.

2.1 Site Location

The subject site is predominantly comprised of soft landscaping, with some hardstanding areas present, which consists of the Wonderful Barn, outhouses, and several allotments. The site is located at The Wonderful Barn, Celbridge Rd, Barnhall, Leixlip, Co. Kildare, adjacent the Kildare-Dublin County border. The subject site spans an approximate area of 218,000 m² (21.8 ha), defined by the red line boundary and is strategically located approximately 1.1 km southwest of Leixlip town centre. The subject site is bounded to the north by Barnhall Meadows road and an existing residential development, to the south by the M4 motorway, to the east by Celbridge Road (R404), and to the west by some residential dwellings and greenfields. Refer to Figure 2.1 for the site location map. The approximate subject site centre can be located at Irish Grid Reference location [E: 299153, N: 235360].



Figure 2.1: Site Location Map

2.2 Topographic information and Utility Survey

AECOM have been provided with a topographical survey carried out by Murphy Geospatial dated the 22nd of April, 2024. Based on the topographic survey, levels range from approximately 50.5 mOD in the south to 58.2 mOD in the north, with an average gradient of 1:100. The existing levels within the site show a falling trend towards a low point along the southern side of the subject site. It should also be noted in the southwest corner of the site, there is an earth mound with a high point of 56.56 mOD and an infiltration basin that provides drainage for the Barnhill residential development. An additional 2 no. infiltration basins are noted at the northwest of the site and a separate

infiltration basin is located at the entrance to the Wonderful Barn. Refer to Figure 2.2 for the site topographical map. Refer to Appendix A for the full topographical survey carried out by Murphy Geospatial.



Figure 2.2: Site Topographical Map (Source: Murphy Geospatial)

As part of this assessment, AECOM have been provided with a ground penetration radar (GPR) and utility survey to detect, locate, and record all existing utilities within the subject site which was carried out by Murphy Geospatial on the 9th of August 2022, with delivery of drawings received by AECOM on the 12th of October 2022. While stormwater systems, ditches, and electrical cables/ducts were identified, no evidence of foul water drainage pipes, water mains, public lighting, gas pipes, or cables from service providers was found on-site. However, unidentified services near buildings necessitate further investigation as recommended by Murphy Geospatial, possibly through slit trenching, to determine precise location and depth of existing services both identified and unidentified. This includes manholes which could not be accessed/ opened. An updated utility survey has been requested by AECOM, which is yet to be received.

Existing services within the site are summarised based on the Murphy Geospatial report as follows:

- Stormwater sewers were identified running through offsite manholes, but no evidence of drainage pipes found on-site.
- Cables/ducts detected within the survey area connecting to buildings and electrical boxes. No evidence of public lighting or traffic cables found on-site.
- No evidence of water main pipes found on-site. Service records drawings indicate a 250 mm CI pipe crossing the area on the east side, but no clear signal was detected in this area.
- No evidence of cables from Eir, Enet, Virgin Media, or BT found within the survey area.
- No evidence of gas pipes found on-site. GNI records drawings don't show any connections on-site.
- Unidentified services found nearby buildings, with trace lost due to weak signal. Further investigation recommended to verify nature and location through slit trenching.
- Each manhole and inspection cover opened and documented within the survey area. Some manholes couldn't be inspected due to access restrictions/ unable to open, requiring further investigation.

2.3 Proposed Development

The proposed redevelopment of The Wonderful Barn itself comprises an area of c.19.8sqm and incorporates the renowned protected structure of the Wonderful Barn and its ancillary buildings, all protected structures, including Barnhall House, two dovecotes, a walled garden and two ranges of adjacent courtyards containing former farm buildings and the public parklands enclosed by the M4 motorway to the South, Celbridge Road R404 to the East and suburban residential developments to the North and West.

For illustrations of the proposed development, please refer to Figure 2.3 and Figure 2.4, which show the proposed site layout plan, and the proposed landscape conceptual plan for the development, respectively.

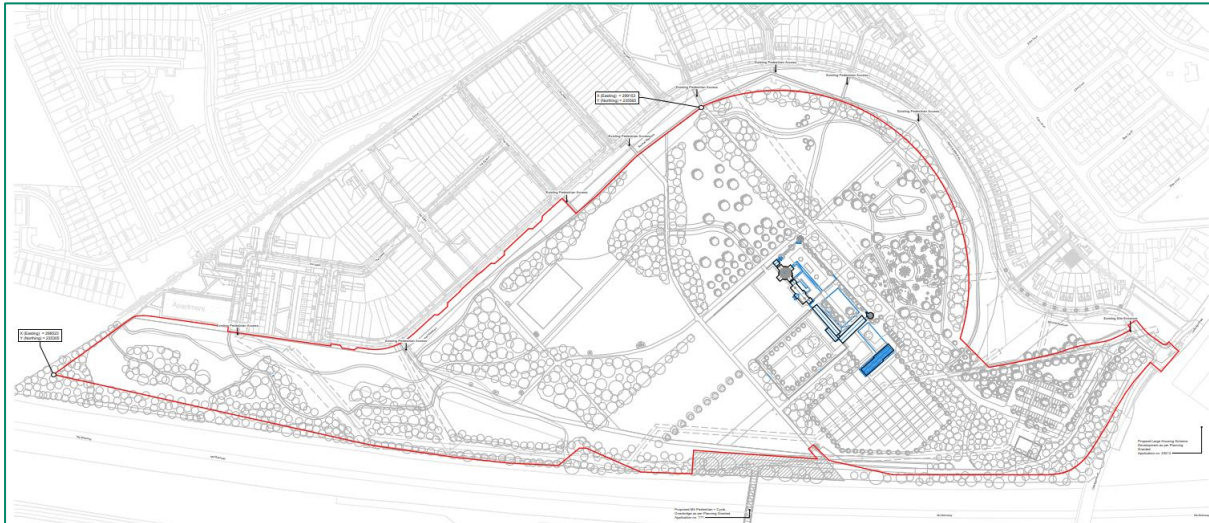


Figure 2.3: Proposed Site Layout Plan (Source: Networks Drawing No. 081002)



**Figure 2.4: Landscape Conceptual Plan
(Source: AECOM Drawing No. 60689541-AEC-XX-00-00-DR-L-1000)**

The proposed works will protect and enhance the rich architectural heritage and amenity of the Wonderful Barn and adjacent buildings and provide an integrated public amenity park and tourism destination at The Wonderful Barn and associated lands, informed by a detailed conservation and management plan.

The proposed works will comprise of the following:

- Repair, restoration and minor interventions within and to the Wonderful Barn, Barnhall House, two dovecotes, a walled garden and two ranges of adjacent courtyards and former farm buildings to improve and accommodate existing tourist and community amenities and facilities.

- Provision of a 115m² extension to former farm buildings to provide a commercial kitchen and café with southern outlook into the historic walled working vegetable garden amenity.
- Redevelopment of the current 55 no. allotments to realign the plots within the restored historical landscape axes and provide new and improved facilities for the local allotment users.
- Provision of a new 174m² building to the East of the existing building complex which will provide a storage facility to replace an existing container on site, new toilets, kitchenette and workshop facilities for the local allotment user group as well as short term workplace facilities for the KCC Parks Department.
- Provision of water and power outlet market facilities adjacent to the new building to accommodate weekly / monthly local markets.
- Improvements and upgrading of existing pedestrian footways and provision of new pedestrian footways and cycle pathways throughout the site.
- Development of a new pedestrian and cycle link through the Wonderful Barn; a continuation of the pedestrian and cycle link (outside of the project boundary) from Celbridge/Backweston to Leixlip, via Castletown House, through Kildare Innovation Campus (former Hewlett Packard site), across the proposed M4 overpass to the Wonderful Barn and onto Leixlip Town Centre and Leixlip Louisa Bridge Station, in accordance with the requirements of TII publications.
- Protection and reinstatement the axial views between Castletown House and the Wonderful Barn and undergrounding of overhead cables as required to maintain uninterrupted views.
- Protection and reinstatement of the integrity of the historic landscape including the Southern and South-Western formal tree lined avenues and forecourt to Barnhall House, formal planting of the walled garden, formal planting of the historic orchard to the Northwest of the building complex and an historic treeline and hedgerow to the Northern boundary of the courtyards.
- Realignment and improvements to pedestrian, cycle and vehicular access to site.
- Provision of new street furniture, seating and public lighting throughout the parkland.
- Provision of new wayfinding and signage throughout the parkland.
- Provision of all utilities, necessary services, drainage works and associated site works.

Please refer to the statutory Part 8 notices which provide a full description of the proposed development including the breakdown of applicable floor areas.

2.4 Ground Investigations

A site investigation was carried out by IGSL Ltd, with reporting issued to AECOM on the 27th of February 2024. As part of the assessment, the following site investigation methods were undertaken during October and November of 2023 to assess the existing ground conditions and groundwater:

- 11 No. Foundation Inspection Pits
- 2 No. Cable Percussion Boreholes
- 1 No. Terrier Percussive Borehole
- 5 No. Soakaway Tests
- 5 No. Slit Trenches
- 5 No. Plate Load Testing

It was noted that an additional cable percussion borehole was constructed at location BH01A after encountering a shallow obstruction in BH01. Also, terrier percussive borehole BH01B was constructed to allow for the installation of a 50 mm diameter standpipe, which was constructed on the 20th of February 2024.

Moreover, it was noted that only 2 of the 5 soakaway tests (soakaway test 2 and 4) were found to be successful, with these tests producing infiltration rates of 5.27704×10^{-6} m/sec and 1.98091×10^{-6} m/sec, respectively. As a

result of these findings, SuDS features within the proposed surface water drainage network will only be designed to allow for infiltration in locations where infiltration rates were found to be good.

Based on the ground assessments discussed in the site investigations report, the following recommendations were made by IGSL Ltd:

- Ground investigation revealed topsoil to be of a firm brown clay, which transitioned to a firmer over-consolidated glacial till at depth. Historic strip footings were found at depths between 600mm and 900mm below ground level (BGL), situated on firm clay capable of supporting an allowable bearing capacity of 100kPa. Visual observations during trial pitting suggested a safe or allowable bearing capacity of 150 to 175kPa for natural soils at depths of approximately 1.20 to 1.70m. Further investigation, possibly through rotary boreholes, is recommended to obtain the depth to rockhead for future development.
- Shallow groundwater strikes were generally absent from excavations on-site. Groundwater ingress was noted in the base of some pits and boreholes. Rapid groundwater rise was observed in boreholes, necessitating potential de-watering measures such as sump pumping, and/or perimeter drains. Seasonal variations in groundwater levels should be monitored, with further assessment recommended, particularly during higher groundwater periods.
- Recommended maximum slope angles for temporary and long-term batters in upper medium strength fine-grained soils at angles of 33 degrees and 26 degrees respectively. Trench box support is advised for deep excavation works. Geogrid recommended for slopes at risk of spalling.
- Plate load tests conducted on shallow subsoils indicated California Bearing Ratio (CBR) design values of 0.3 to 8.2%, with recommendations for pavement construction based on test results. Suggestions for capping thickness, sub-base materials, and compaction methods provided in the site investigations report concluded a CBR design value of <2%, with a minimum 6F capping thickness of 500 to 600mm and a sub-base thickness (UGM) of 150mm is recommended to support the road pavements. The above recommendation should be reassessed, particularly for very low strength subgrade soils.
- Chemical analysis of natural soil samples indicated suitability for buried concrete, with recommended Table C1 Area of Critical Environmental Concern (ACEC) for greenfield sites in BRE SD 1 2005 suitable for use.
- Soil samples were analysed for compliance with landfill directive and Environmental Protection Agency (EPA) guidance. One sample exceeded metal concentration limits for Geochemical Domain 2. Asbestos was not detected in soil samples.

3. Pre-Planning Consultation

3.1 Pre-Connection Enquiry Application

AECOM submitted a pre-connection enquiry (PCE) application on the 14th of May 2024 to Uisce Éireann for the subject site to estimate the impacts that the proposed development would have on the existing water and wastewater network. AECOM have reviewed the existing watermain and wastewater infrastructure in the surrounding area and have propose a new proposed 100 mm watermain connection into the existing 250 mm cast iron watermain located in the north of the site, adjacent the existing Wonderful Barn building. AECOM also propose a new proposed 150 mm foul water sewer connection outfall location into the existing 300 mm foul water sewer which runs south of the site boundary along Barnhall Meadows Boulevard. Refer to Figure 3.1 for the proposed connection locations.

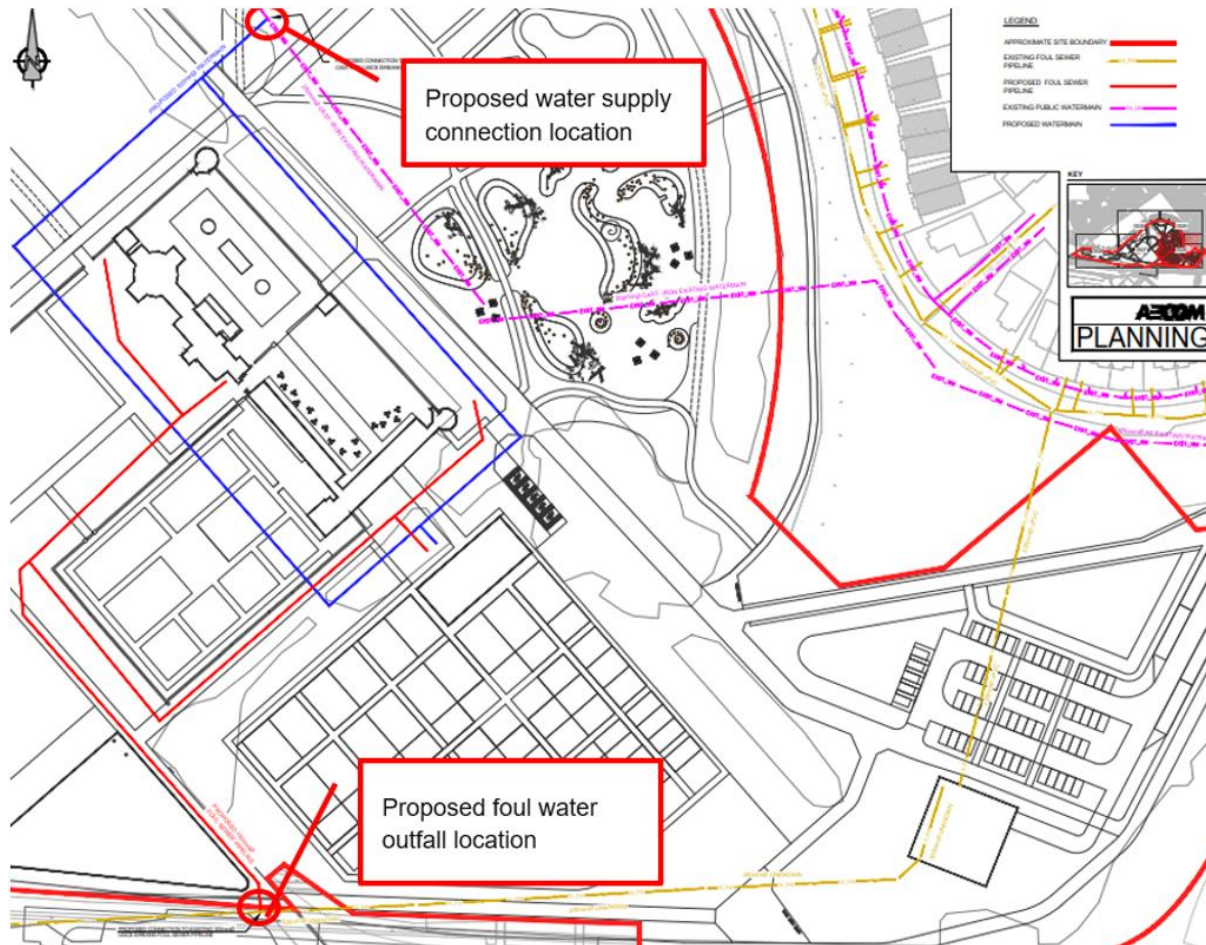


Figure 3.1: Proposed Watermain and Foul Water Connection Locations (Source: AECOM Drawing No. 60689541-ACM-XX-00-DR-CE-10-0528)

At the time of writing this report, AECOM have not yet received a Confirmation of Feasibility (CoF) for the proposed water and wastewater connection locations, although an application reference number of CDS24004213 has been provided.

4. Surface Water Drainage

4.1 Surface Water Criteria

This chapter contains an outline of the conceptual philosophy and design criteria for surface water for the Wonderful Barn project. It is AECOM's intention that the proposed surface water drainage system will be designed in accordance with the following:

- Greater Dublin Strategic Drainage Study (GSDSDS)
- Kildare County Development Plan 2017-2023 Chapter 7 Infrastructure
- Kildare County Development Plan 2023-2029 Chapter 6 Infrastructure
- Leixlip Local Area Plan 2020-2023
- 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 'Recommendation 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

4.2 Existing Surface Water Drainage

Existing drainage records from KCC indicates that there are no existing surface water pipes contained within the subject site. To the south of the subject site, three existing surface water networks are located along the M4, which run in a west to east direction which vary in sizes from 375 mm to 750 mm in diameter. DCC records also indicate the presence of an existing 225 mm surface water pipe which runs north to south along Celbridge Road (R404), to the east of the subject site. Refer to Figure 4.1 for details.

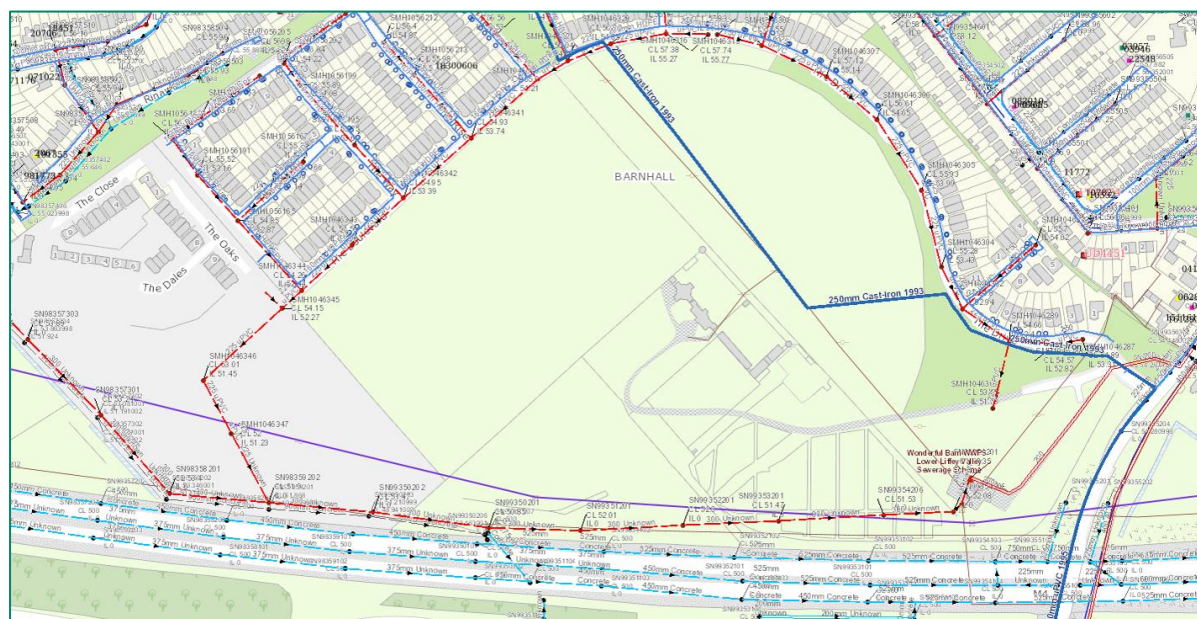


Figure 4.1: Existing Drainage and Watermain Records (Source: KCC)

As discussed under Section 2.2 of this report, a GPR survey was undertaken by Murphy Geospatial on the 9th of August 2022 in order to locate and identify existing services within and around the vicinity of the subject site. Based on the received GPR survey, an existing 225 mm concrete surface water sewer was located to the east and south of the subject site, within the red line boundary. The existing network runs along the recently constructed access

road to the east of the subject site before diverging southwest at the allotments and running parallel to Barnhall Meadows Avenue before it outfalls towards the south of the subject site. Due to the existing construction site located by the outfall, the exact alignment of the existing pipe could not be confirmed due to site access restrictions.

Drawings issued as part of the adjacent planning application (application number 18300606) by DBFL confirm that the existing 225 mm concrete surface water pipe discussed above outfalls to an existing 900 mm surface water pipe which drains west along the southern boundary of the site before it outfalls at Barnhall Meadows, located to the northwest of the subject site. The existing surface water drainage is further facilitated by two existing infiltration basins located to the south and east, along the existing surface water network discussed. The existing infiltration basin to the south is fed by an existing 600 mm diameter surface water pipe which diverges from the existing 450 mm surface water network along Barnhall Meadows which travels east to west along the northern boundary of the subject site. Further illustrations of the existing surface water network are presented in Figure 4.2.

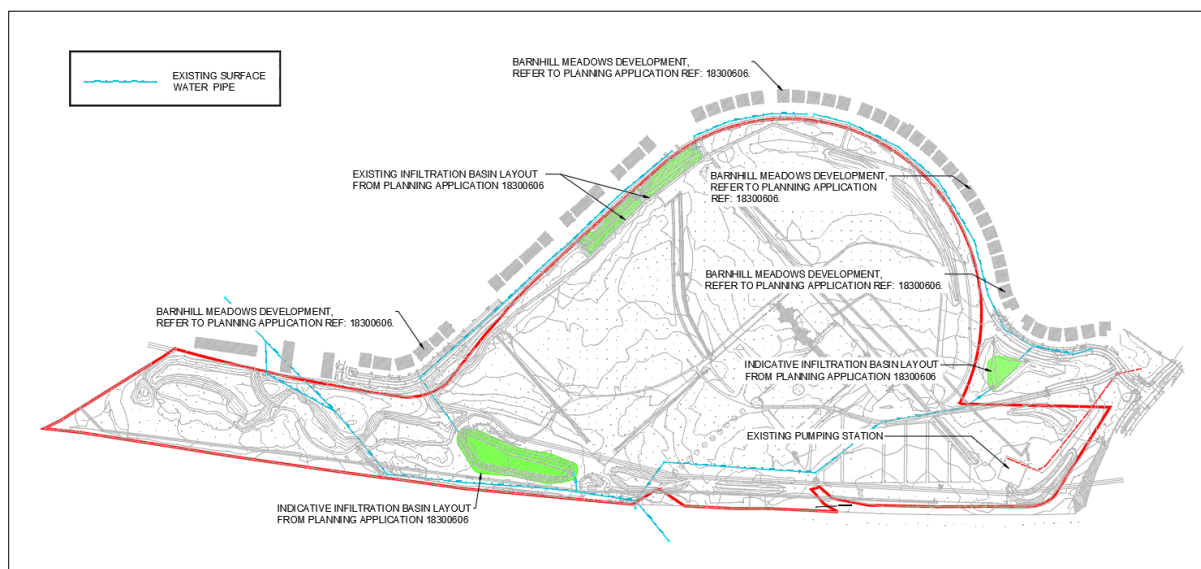


Figure 4.2: Existing Surface Water Drainage Network

4.3 Proposed Surface Water Drainage

Surface water from the proposed development shall discharge in accordance with the sustainable drainage policies set out in the GSDSDS. In accordance with such policies, surface water from the site will be managed through the use of sustainable surface water measures, which will improve water quality, reduce surface water discharge volume, and provide bio-diversity and amenity value.

This will be achieved by the use of infiltration basins, swales, and other SuDS measures across the development. Any excess surface water remaining, following infiltration and subsequent attenuation, will be piped to the existing surface water network towards the southern end of the development site.

The surface water discharge rate from the proposed development will be restricted in line with GSDSDS requirements. For this proposal, the discharge rate will be restricted to 2 litres per second, which lies within the required discharge rate limit of 2 litres/second/hectare. Flows in excess of the allowable discharge rate will be infiltrated and attenuated on site for storms up to and including a 1 in 100-year rainfall event, with an additional 30% allowance for climate change.

The proposed surface water strategy has been designed and modelled using InnoVizy MicroDrainage. The following standards have been followed in the design of the proposed surface water drainage network for the site:

- BS EN 752 – Drains and sewer system outside buildings.
- Greater Dublin Strategic Drainage Study (GSDSDS) Volume 2 – New Developments.
- No pipe flooding during a 1 in 100-year return period rainfall event.
- Surface water storage sized based on a 1 in 100-year return period rainfall event.
- An additional 30% has been allowed for climate change in relation to rainfall intensities.

The following design criteria have been used in the design of the proposed surface water drainage network:

- Colebrook White roughness value of 0.6mm for all pipework.
- Time of entry: 1 minutes.
- Return Period: 5 years.
- M5/60 = 16.1mm (Met Éireann rainfall data for site).
- Ratio $r = 0.277$ (Met Éireann rainfall data for site).

Additional information regarding the surface water attenuation storage parameters for the site is presented in Table 4.1.

Table 4.1: Attenuation Storage Volume Parameters

Site Area (ha)	Qbar (L/sec)	Impermeable Area (ha)	Attenuation Storage (m ³)
21.18	2.0	1.270	2,036

When considering the information presented in Table 4.1, the calculated impermeable area considers all impervious surfaces associated within the development. Appendix B presents the rainfall data collected from Met Éireann, while Appendix C presents the summarised MicroDrainage network model simulation results.

In total, the SuDS features proposed for this development will provide a surface water attenuation volume of approximately 2,036 m³. After being restricted to a discharge rate of 2 L/sec, the proposed surface water system will discharge into an existing 225mm diameter surface water pipe towards the southern end of the site, as illustrated on AECOM's drainage drawing 60689541-ACM-XX-00-DR-CE-10-0501-0505 and SuDS drawing 60689541-ACM-XX-00-DR-CE-10-0520-0525.

5. Sustainable Urban Drainage Systems (SuDS)

The proposed development has been assessed in relation to Sustainable Urban Drainage Systems (SuDS) in accordance with the guidelines of the GSDS and the SuDS CIRIA Manual C753. The aim of the proposed drainage system is to replicate the natural characteristics of rainfall run-off, minimising the environmental impact from rainfall events by reducing the run-off leaving the site for small rainfall events.

SuDS are designed to manage water quantity reducing/preventing the likelihood of flooding from the proposed development and to maximise the opportunities and benefits from surface water management.

Based on the existing site topography and the proposed site layout, the following SuDS measures have been provided to treat the surface water runoff, to replicate the natural characteristics of the greenfield runoff, and minimise the environmental impact.

- Infiltration basins;
- Infiltration trenches / filter drains;
- Permeable paving / porous asphalt;
- Swales;
- Flow control device.

Refer to AECOM drawings 60689541-ACM-XX-00-DR-CE-10-0520-0525 for the proposed SuDS layout.

The proposed SuDS features will be designed in accordance with the CIRIA C753 SuDS Manual, providing treatment volume on site. It is currently proposed to treat runoff from the different sources of runoff as per Table 5.1.

Table 5.1: SuDS Measures Proposed by Surface Type

Surface Type	Proposed SuDS Measures
Roofs	Swales, Infiltration Basins
Roads/Car Parking	Permeable Paving, Swales, Filter Drains
Hardstanding Paths	Filter Drains, Infiltration Basins, Swales

5.1.1 Permeable Paving

Permeable paving is proposed for all proposed parking spaces. Porous surfacing (paving block or open graded material) which can treat rainwater at source, allows 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 5.1 for an illustration of a typical permeable paving detail. No infiltration has been assumed for the permeable paving systems proposed throughout the site with an 800mm sub-base depth at 30% porosity.

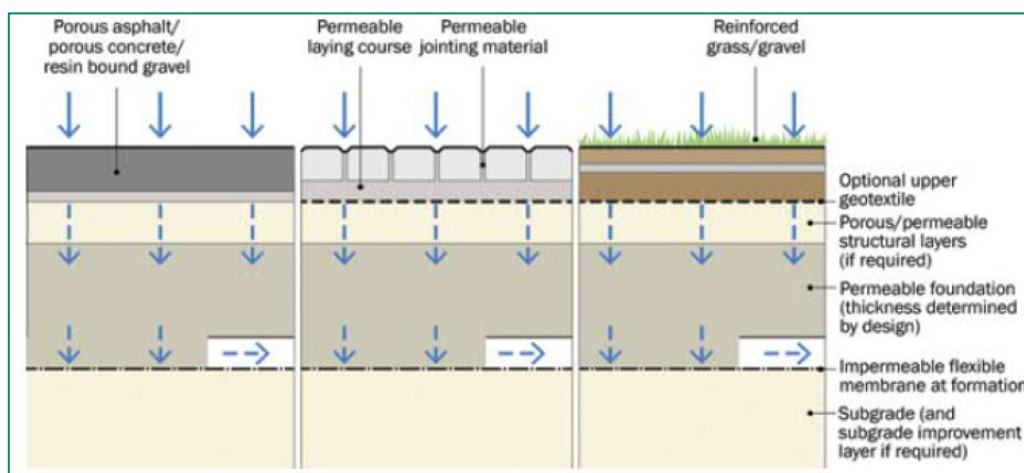


Figure 5.1: Permeable Pavement Detail - No Infiltration (Source: CIRIA SuDS Manual C753)

5.1.2 Filter Drains

Filter drains, as shown in Figure 5.2, are shallow trenches filled with stone/gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. The stone may be contained in a simple trench lined with a geotextile membrane or other impermeable liner, or within a more structural facility such as a concrete trough. Filter drains can help to reduce pollutant levels in runoff by filtering out fine sediments, metals, hydrocarbons and other pollutants.

Filter drains are generally 1-2m deep, with a minimum depth of filter beneath any inflow distribution pipework and outfall collection systems of 0.5m to ensure reasonable levels of pollutant removal. A porosity of 45% was assumed.

It is proposed to provide filter drains, at a depth of 1m, adjacent to the impermeable footpaths wherever possible. No infiltration has been assumed for the filter drains proposed throughout the site.

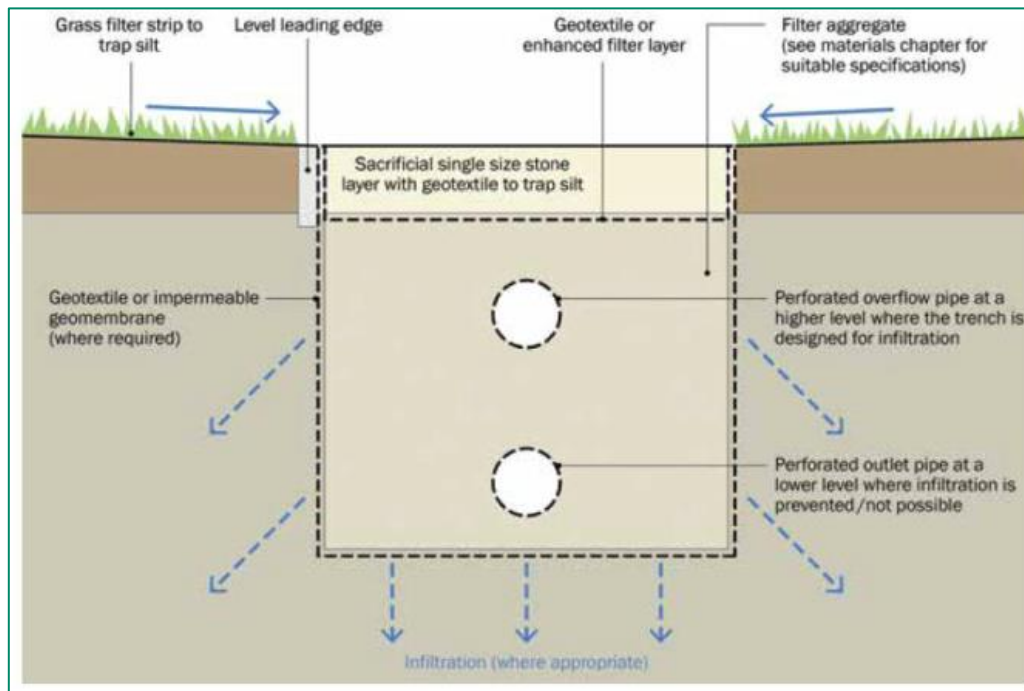


Figure 5.2: Typical Filter Drain Detail (Source: CIRIA SuDS Manual C753)

5.1.3 Infiltration Basins

Infiltration basins are commonly used to infiltrate and attenuate surface water runoff, which ultimately assists in the prevention of flooding and the treatment of surface water at source. For this development, nine separate infiltration basins have been proposed. Each basin has also been designed to incorporate an 800 mm depth of clean stone sub-base with a porosity of 30%, with this sub-base being located beneath the base of the infiltration basin surface. For illustrations of these infiltration basins, along with all other included SuDS features, please refer to AECOM drawings 60689541-ACM-XX-00-DR-CE-10-0520-0525 and 60689541-ACM-XX-00-DR-CE-10-0560.

5.1.4 Swales

Swales are shallow, vegetated channels designed to manage surface water runoff, assisting in the treatment of surface water at source, and promoting biodiversity on site. Three separate swales have been proposed for this development, with each swale incorporating a clean stone sub-base with 30% porosity. Please see AECOM drawings 60689541-ACM-XX-00-DR-CE-10-0520-0525 for further details regarding the swales proposed as part of this development.

5.1.5 Existing Drainage Ditches

There are numerous existing drainage ditches on site that are to be retained to assist in the attenuation and treatment of surface water on site. While assisting in treating surface water at source, these existing drainage ditches allow for the promotion of further biodiversity across the development.

5.1.6 Flow Control Device

A hydro-brake outflow control device is proposed within this development to manage the surface water flows from the on-site network, and the subsequent discharge flow into the existing surface water network. This outflow control is to be located upstream of the proposed surface water outfall, and, as outlined in Section 4.3, will restrict the outflow to a rate of 2.0 litres/second.

6. Foul Water Drainage

6.1 Existing Foul Water Drainage

Existing drainage records from KCC indicates the presence of existing foul water sewers contained within the subject site. To the south of the subject site, an existing 300 mm foul water sewer runs west to east along the southern boundary which converges at the Wonderful Barn Wastewater Pumping Station (WWPS) as part of the Lower Liffey Valley Sewerage Scheme. Foul water is pumped via a twin rising main off-site at the southeastern corner. There is an additional 225 mm uPVC foul water pipe which diverges from the existing network along Barnhall Meadows Boulevard which enters the subject site and travels south, where it converges with the existing 300 mm foul water sewer to the south Refer to Figure 6.1 for details.

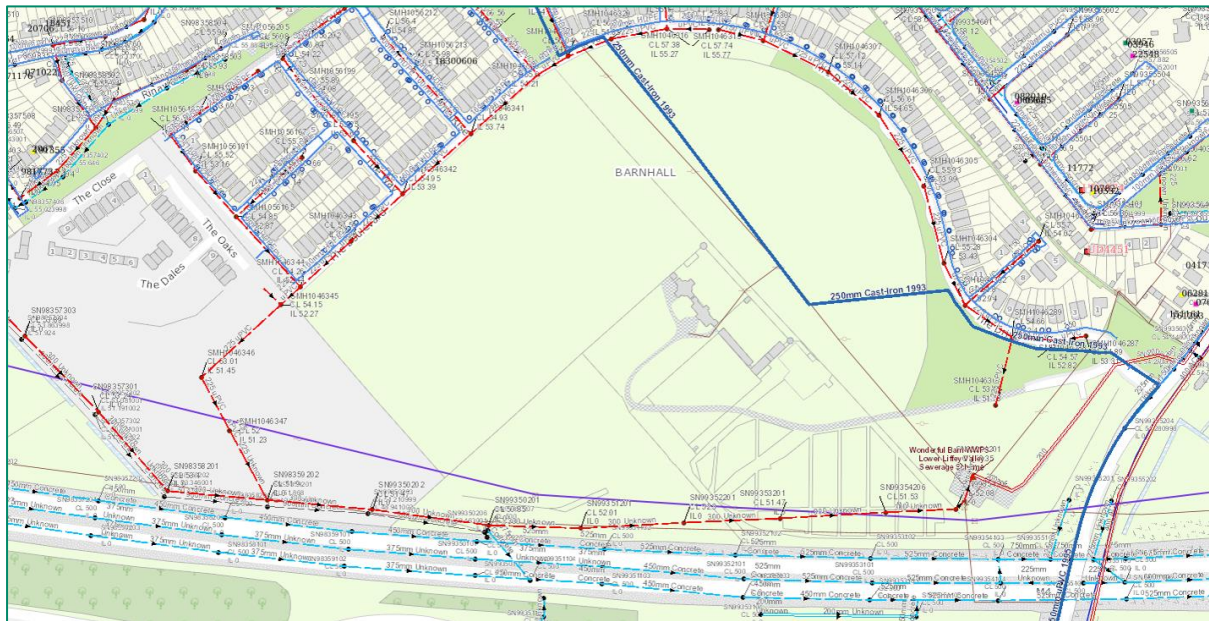


Figure 6.1: Existing Drainage Records (Source: KCC)

As discussed under Section 2.2 of this report, a GPR survey was undertaken by Murphy Geospatial on the 9th of August 2022 in order to locate and identify existing services within and around the vicinity of the subject site. As this survey did not capture all the information required, AECOM are awaiting an updated GPR survey, which is yet to be received.

6.2 Proposed Foul Water Drainage

The proposed foul water network has been designed in accordance with Uisce Éireann's code of practice.

A pre-connection enquiry (PCE) was submitted to Uisce Éireann for this development in May 2024, with estimations of 150 and 30 persons being taken for visitors and staff, respectively. The associated wastewater generated from the proposed development is tabulated in Table 6.1.

Table 6.1: Proposed Wastewater Discharge Parameters

Use	Associated Population	Peaking Factor	Foul Discharge (L/day)	Foul Discharge (L/sec)	Peak Flow (L/sec)
Visitors	150	6.0	9,000	0.10	0.63
Staff	30	6.0	1,800	0.02	0.13

* Based on known daily visitor capacity of approximately 150 persons. Assumption made of 30 on-site staff per day.

** Based on per-capita consumption of 60L/person/day for hotels/pubs/clubs, as per Uisce Éireann Code of Practice.

*** Based on peak factor of 6 as per Uisce Éireann requirements (population of 0-750 persons).

From Table 6.1, it is shown that a total peak flow of 0.76 L/sec has been projected to be generated on site as part of this development. These calculations have been based on the foul loading rates and commercial peaking factor as per Uisce Éireann requirements as set out in the Uisce Éireann code of practice. Upon submission of the PCE, Uisce Éireann provided an application reference number of CDS24004213.

Due to the topography of the site, along with the location of the existing foul network to the south of the site, it is proposed to discharge foul water effluent generated on site to the existing foul sewer network, running from west to east, towards the southern end of the site. For further illustrations regarding the proposed foul water network for this development, please refer to AECOM drawings 60689541-ACM-XX-00-DR-CE-10-0501-0505. It must also be noted that the access road to the WWPS is to be altered as part of this proposed development. For an overview of the proposed WWPS access, please refer to AECOM drawing 60689541-AEC-XX-00-00-DR-L-1000.

7. Water Supply

7.1 Existing Watermain Infrastructure

A number of Uisce Éireann watermains are situated within the vicinity of this development, namely a 250 mm cast iron main running through the north-eastern portion of the development, spanning from Barnhall Madows to Celbridge Road. Further illustrations of the existing watermains within the site vicinity are presented in Figure 7.1.

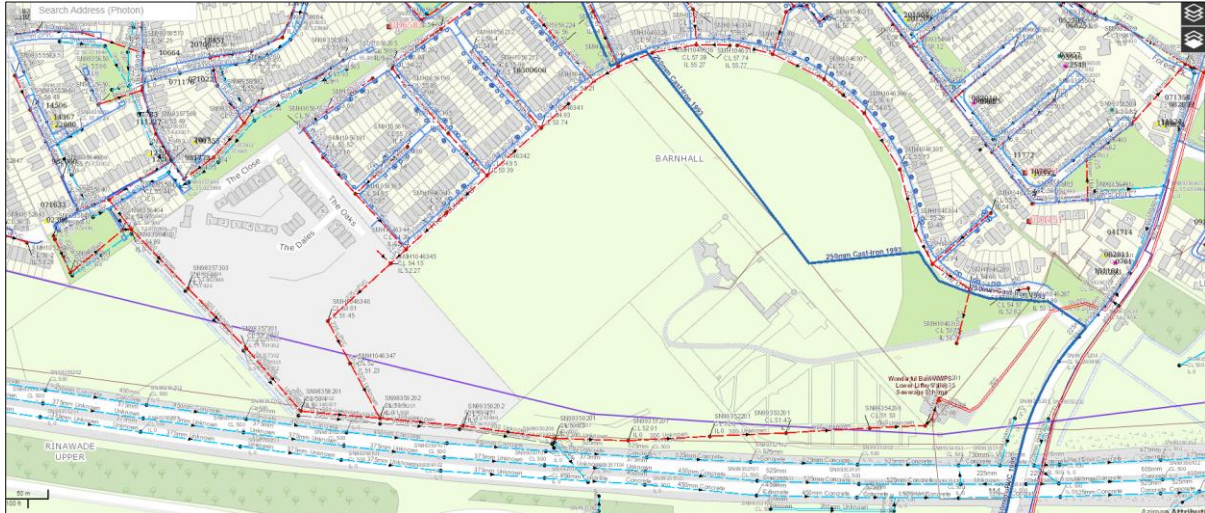


Figure 7.1: Existing Watermain Records (Source: KCC)

7.2 Proposed Watermain Infrastructure

The proposed watermain network has been designed in accordance with Uisce Éireann’s code of practice.

As outlined in Section 6.2, pre-connection enquiry was submitted to Uisce Éireann for this development in May 2024, with estimations of 150 and 30 persons being taken for visitors and staff, respectively. The associated water demand generated from the proposed development is tabulated in Table 7.1.

Table 7.1: Proposed Watermain Discharge Parameters

Use	Associated Population	Peaking Factor	Average Water Demand (L/day)	Average Day / Peak Week Demand (L/sec)	Peak Demand (L/sec)
Visitors	150	6.0	9,000	0.13	0.65
Staff	30	6.0	1,800	0.03	0.13

* Based on known daily visitor capacity of approximately 150 persons. Assumption made of 30 on-site staff per day.

** Based on per-capita consumption of 60L/person/day for hotels/pubs/clubs, as per Uisce Éireann Code of Practice.

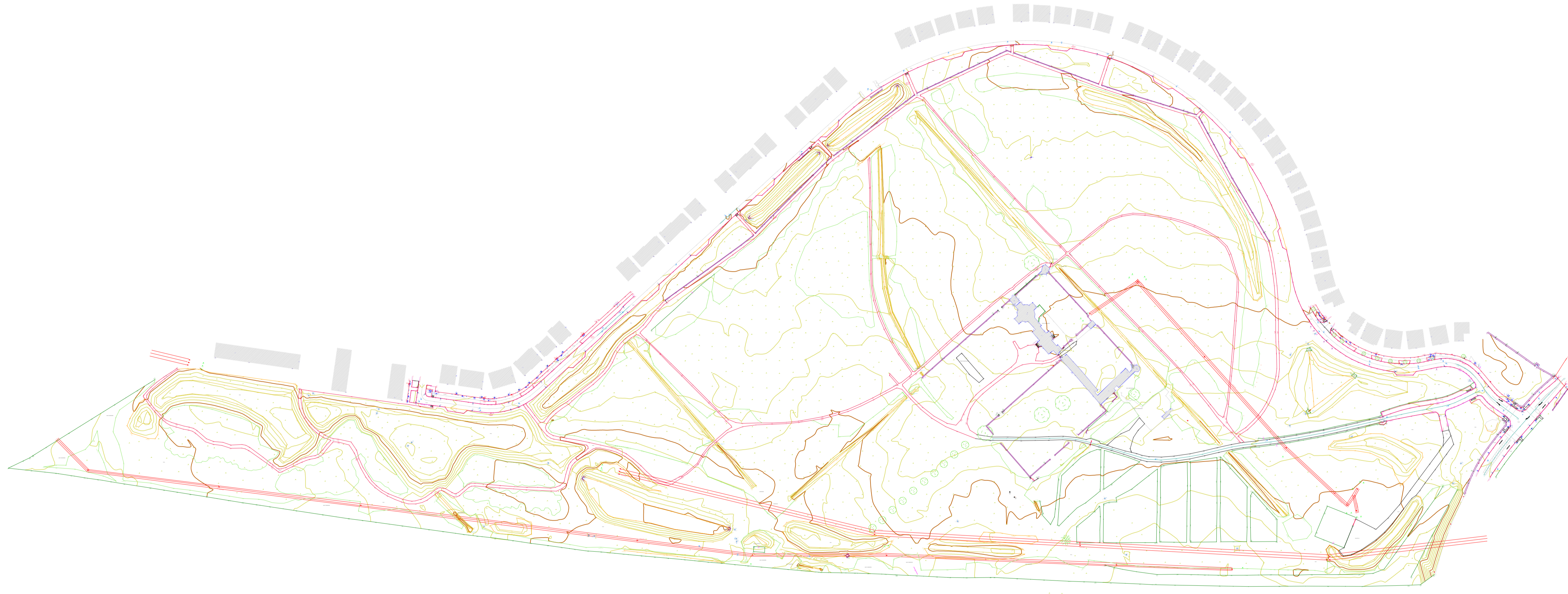
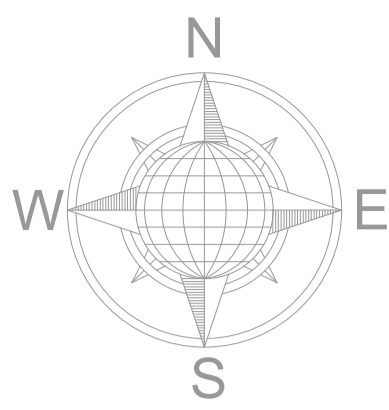
*** Average Day / Peak Week Demand is 1.25 times the average daily domestic demand, as per Uisce Éireann requirements.

**** Peak Demand is 5 times the Average Day / Peak Week Demand, for network sizing, as per Uisce Éireann requirements.

From Table 7.1, it is shown that a total peak demand of 0.78 L/sec has been projected to be generated on site as part of this development. These calculations have been based on the foul loading rates and commercial peaking factor as per Uisce Éireann requirements as set out in the Uisce Éireann code of practice.

Due the location of the existing watermain network, it is proposed to connect a new 100 mm watermain to the existing 250 mm cast iron main towards the eastern end of the site, subject to agreement with Uisce Éireann. This proposed watermain network will be inclusive of scour and air valves at low and high points of the site, respectively, along with associated sluice valves, fire hydrants, and a new bulk water meter for the development, in line with Uisce Éireann requirements. For further details regarding the proposed watermain network for this development, please refer to AECOM drawings 60689541-ACM-XX-00-DR-CE-10-2701-2705.

Appendix A – Topographical Survey



LEGEND
Street furniture & Services

Over Head Wires (LUAS) - Pylon ESB	Bus Stop	Road Sign	Phone Box
Flowbed	Bus Stop	Bench Seat	Duct
Pipe	Beacon	Kiosk	Gas Cover
Lift	Beacon	Guilty	CP Box
Barrier	Counter Cover	Waste Bin	Waste Bin
Pump	Box Hole	Hydrant	Hydrant
Trail Pit	Electricity Pole	Fire Hydrant	Fire Hydrant
Bus/Tram Shelter	Telegraph pole	ESB Box	ESB Box
Postbox	OCS Pole	ESB Inspection Cover	ESB Inspection Cover
Valve - General	OCTV Camera Pole	Traffic Control Box	Traffic Control Box
Water Valve	Lamp Post	LUAS Technical Cubicle	LUAS Technical Cubicle
Gas Valve	Food Manhole	Ticket Vending Machine	Ticket Vending Machine
Blow Valve	Surface Water MH	Water Meter Cover	Water Meter Cover
Air Valve	Manholes	Telecom Inspection Cover	Telecom Inspection Cover
Street Cook	Air Conditioning Vents	Monument / Toilets	Monument / Toilets
C P Post	Services Inspection Cover	Tank Storage	Tank Storage
Marker Post	Traffic Inspection Cover	Basement - IM1 Cover & Pip	Basement - IM1 Cover & Pip
Traffic light	Cable TV Inspection Cover	Dished Aerial Mark	Dished Aerial Mark
Parking Meter	ESAT Inspection Cover	Stay for pole	Stay for pole
Plane Aerial Mark	NTL Inspection Cover	Pipe Protection	Pipe Protection
Smart Card Validator	Encom Inspection Cover	Washout	Washout
Unknown Valve	Roading Eye		

Natural Features

Surface Change	Water Level	Golf
Land Drain	Crown Level	Fair Way
Bottom of Slope	Invert level	Green
Top of Slope	Bed Level	Tree Box
Ditch	Spotlight	Other
Water Edge / Lake / Pond		Survey Station
Hedge / Trees Dip Line / Vegetation		Photo point
Tree Deciduous		Top of Tree

Built Features

Roads & Road Markings

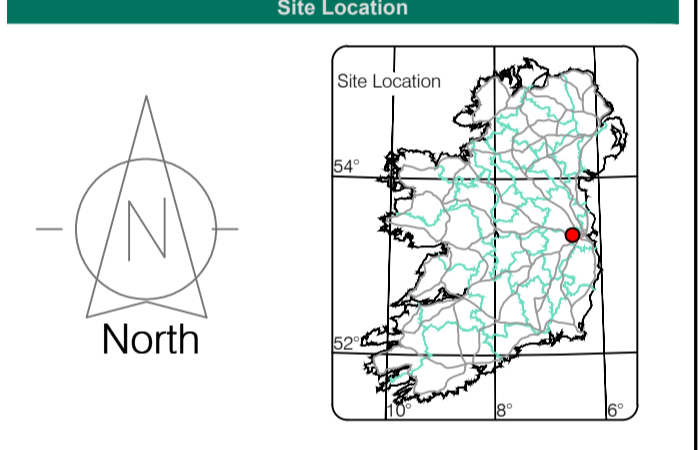
Building	Fence	Floor Level
Edge of Road	Gate	Apex Height
Kerb Bottom	Road Centreline	Eaves Height
Kerb Top	Top of Wall	Parapet Height
Bridge Abutment	Hoarding	Soffit Elevation
Bridge Deck	Property Line	Shop Level
Bridge Parapet	Road Scar	Concrete Pad
Building Flagpole	Top of Fence	Track
Footpath / Platform Train & Tram	Wall / Raising Wall	
Damp Proof Course / Verge	Railway / Tram Rail / Grating / Ramp	
Bridge Pier / Wall & Gate Pillar / LUAS Trackbed	Building Canopy / Roof / Overhang	
Cycleway / Private Landing Area		

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Revisions

Rev	Description	Surveyed by	Drawn by	Checked by
0	First Issue	MC - 09/04/2024	MC - 18/04/2024	PK, SD - 22/04/2024



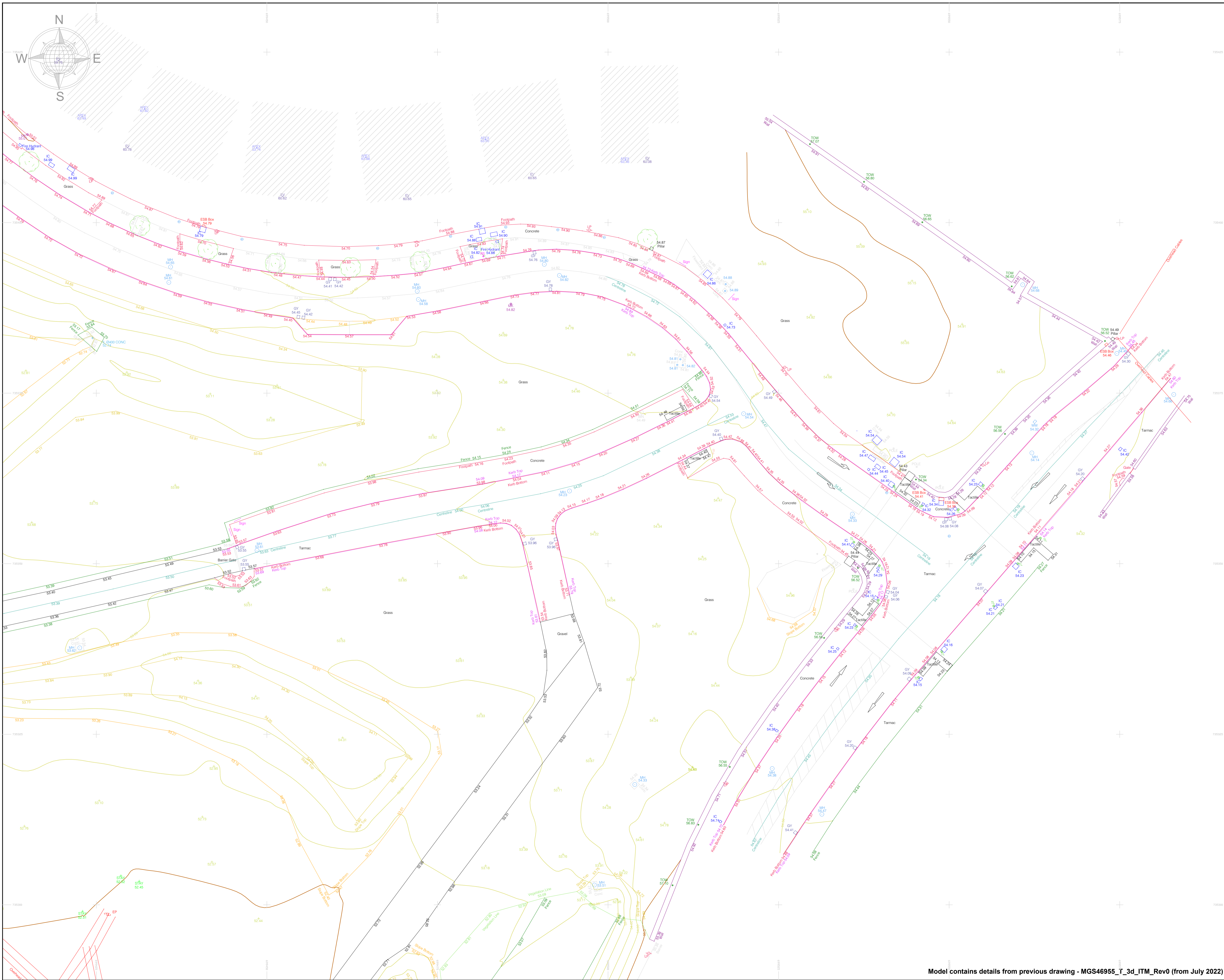
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THE SURVEY ASSOCIATION
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Client	Metropolitan Workshop
Project	Wonderful Barn Additional Survey
Description	Topographical Survey
Survey Grid	ITM15
Survey Datum	Malin Head
RICS Band	Band E
Presentation Scale	NTS@A1
MGS Project ID	57199
Drawing Number	MGS57199_T_ITM_Rev0-00



LEGEND
Street furniture & Services

Over Head Wires (LUAS) - Pylon ESB	Bus Stop	Road Sign	Phone Box
Flowbed	Bus Stop	Street Light	Duct
Pipe	Bollard	Street Light	Gas Cover
Lift	Beacon	Street Light	Gas Cover
Barrier	Beacon	Street Light	Gas Cover
Pump	Beacon	Street Light	Gas Cover
Trail Pit	Beacon	Street Light	Gas Cover
Bus/Tram Shelter	Beacon	Street Light	Gas Cover
Postbox	Beacon	Street Light	Gas Cover
Valve - General	Beacon	Street Light	Gas Cover
Water Valve	Beacon	Street Light	Gas Cover
Gas Valve	Beacon	Street Light	Gas Cover
Blow Valve	Beacon	Street Light	Gas Cover
Air Valve	Beacon	Street Light	Gas Cover
Shut Cock	Beacon	Street Light	Gas Cover
C/P Post	Beacon	Street Light	Gas Cover
Marker Post	Beacon	Street Light	Gas Cover
Traffic Light	Beacon	Street Light	Gas Cover
Parking Meter	Beacon	Street Light	Gas Cover
Plane Aerial Mark	Beacon	Street Light	Gas Cover
Smart Card Validator	Beacon	Street Light	Gas Cover
Unknown Valve	Beacon	Street Light	Gas Cover

Natural Features

Surface Change	Water Level	Golf
Land Drain	Crown Level	Fair Way
Bottom of Slope	Invert Level	Green
Top of Slope	Bed Level	Tree Box
Ditch	Spotlight	Other
Water Edge / Lake / Pond	Spotlight	Survey Station
Hedge / Trees Dip Line / Vegetation	Spotlight	Photo point
Tree Coniferous	Spotlight	Top of Tree
Tree Deciduous	Spotlight	Top of Tree

Built Features

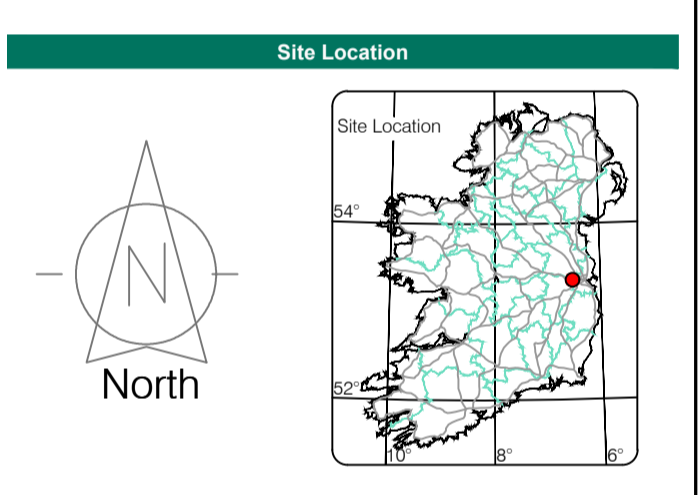
Building	Fence	Floor Level
Edge of Road	Gate	Apex Height
Kerb Bottom	Road Centreline	Eaves Height
Kerb Top	Top of Wall	Parapet Height
Bridge Abutment	Hoarding	Soffit Elevation
Bridge Deck	Property Line	Stop Level
Building Flagpole	Road Scar	Concrete Pad
Footpath / Platform Train & Tram	Top of Fence	Track
Damp Proof Course / Verge	Wall / Retaining Wall	
Bridge Pier / Wall & Gate Pillar / LUAS Trackbed	Railway / Tram Rail / Grating / Ramp	
Cycleway / Private Landing Area	Building Canopy / Roof / Overhang	

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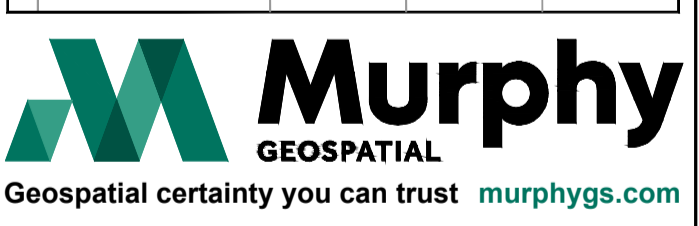
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The Client must promptly notify the Company of any errors in mapping of which it becomes aware. If misleading, inaccurate or otherwise inappropriate information is brought to the Company's attention to the Company's best knowledge and belief, it shall use all reasonable endeavours to fix or remove it and if necessary in certain instances, the Company being on notice of any such misleading, inaccurate or otherwise inappropriate information, it will re-survey the area and reproduce the data to within the specified scale or accuracy.



Revisions

Rev	Description	Drawn by	Checked by
0	First Issue	MC - 09/04/2024	MC - 18/04/2024



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

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Partners: THE SURVEY ASSOCIATION, SCS1, GPR, RICS

Offices in London, Birmingham, Manchester, Glasgow, Dublin, Cork, Kildare, Cologne, Barcelona, Geneva.

Client	Metropolitan Workshop
Project	Wonderful Barn Additional Survey
Description	Topographical Survey
Survey Grid	ITM15
Survey Datum	Malin Head
RICS Band	Band E
Presentation Scale	1:250 @A1
MGS Project ID	57199
Drawing Number	MGS57199_T_ITM_Rev0-01

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Model contains details from previous drawing - MGS46955_T_3d_ITM_Rev0 (from July 2022)

Appendix B – Met Éireann Rainfall Return Period Data

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 299239, Northing: 235419,

DURATION	Interval		Years													
	6months,	1year,	2,	3,	4,	5,	10,	20,	30,	50,	75,	100,	150,	200,	250,	500,
5 mins	2.3,	3.4,	4.0,	4.9,	5.5,	6.0,	7.7,	9.6,	10.9,	12.8,	14.5,	15.8,	17.9,	19.5,	20.9,	N/A ,
10 mins	3.2,	4.7,	5.5,	6.8,	7.7,	8.4,	10.7,	13.4,	15.2,	17.8,	20.2,	22.0,	24.9,	27.2,	29.1,	N/A ,
15 mins	3.7,	5.5,	6.5,	8.0,	9.0,	9.8,	12.6,	15.7,	17.9,	21.0,	23.7,	25.9,	29.3,	32.0,	34.2,	N/A ,
30 mins	4.9,	7.2,	8.4,	10.3,	11.6,	12.6,	15.9,	19.8,	22.4,	26.1,	29.4,	32.0,	36.1,	39.2,	41.9,	N/A ,
1 hours	6.5,	9.4,	10.9,	13.2,	14.8,	16.1,	20.2,	24.9,	28.1,	32.5,	36.5,	39.6,	44.4,	48.2,	51.3,	N/A ,
2 hours	8.6,	12.2,	14.1,	17.1,	19.0,	20.6,	25.6,	31.3,	35.1,	40.5,	45.3,	49.0,	54.7,	59.1,	62.8,	N/A ,
3 hours	10.1,	14.3,	16.5,	19.8,	22.0,	23.7,	29.4,	35.8,	40.1,	46.0,	51.3,	55.4,	61.7,	66.7,	70.7,	N/A ,
4 hours	11.4,	15.9,	18.3,	22.0,	24.4,	26.3,	32.5,	39.4,	44.0,	50.4,	56.1,	60.5,	67.3,	72.6,	76.9,	N/A ,
6 hours	13.4,	18.6,	21.3,	25.5,	28.2,	30.3,	37.3,	45.1,	50.2,	57.3,	63.6,	68.5,	76.0,	81.8,	86.6,	N/A ,
9 hours	15.8,	21.7,	24.9,	29.5,	32.6,	35.0,	42.8,	51.5,	57.2,	65.2,	72.2,	77.6,	85.8,	92.2,	97.5,	N/A ,
12 hours	17.7,	24.2,	27.7,	32.8,	36.2,	38.8,	47.3,	56.7,	62.8,	71.4,	78.9,	84.7,	93.6,	100.4,	106.0,	N/A ,
18 hours	20.9,	28.3,	32.2,	38.0,	41.8,	44.8,	54.3,	64.8,	71.7,	81.2,	89.5,	95.9,	105.7,	113.2,	119.4,	N/A ,
24 hours	23.4,	31.6,	35.9,	42.2,	46.4,	49.6,	59.9,	71.3,	78.7,	88.9,	97.9,	104.7,	115.2,	123.2,	129.9,	152.7,
2 days	29.4,	38.6,	43.4,	50.2,	54.7,	58.2,	69.1,	80.9,	88.5,	98.9,	107.9,	114.8,	125.1,	133.0,	139.5,	161.6,
3 days	34.3,	44.3,	49.4,	56.8,	61.5,	65.2,	76.6,	88.9,	96.7,	107.4,	116.6,	123.6,	134.0,	142.0,	148.5,	170.6,
4 days	38.6,	49.3,	54.7,	62.5,	67.5,	71.3,	83.2,	95.9,	104.0,	114.9,	124.3,	131.4,	142.0,	150.1,	156.6,	178.8,
6 days	46.2,	58.1,	64.0,	72.4,	77.9,	81.9,	94.7,	108.2,	116.6,	128.0,	137.8,	145.1,	156.1,	164.3,	171.0,	193.6,
8 days	52.9,	65.8,	72.2,	81.2,	87.0,	91.3,	104.7,	118.9,	127.7,	139.5,	149.6,	157.2,	168.4,	176.9,	183.7,	206.7,
10 days	59.2,	72.9,	79.7,	89.2,	95.2,	99.8,	113.8,	128.5,	137.7,	149.9,	160.3,	168.1,	179.6,	188.3,	195.2,	218.6,
12 days	65.0,	79.5,	86.6,	96.6,	102.9,	107.7,	122.3,	137.5,	146.9,	159.5,	170.2,	178.1,	189.9,	198.8,	205.9,	229.6,
16 days	75.9,	91.8,	99.5,	110.3,	117.1,	122.2,	137.8,	153.9,	163.8,	177.0,	188.2,	196.5,	208.7,	217.9,	225.2,	249.6,
20 days	86.0,	103.1,	111.4,	122.8,	130.1,	135.4,	151.9,	168.8,	179.2,	192.9,	204.5,	213.1,	225.8,	235.2,	242.7,	267.8,
25 days	97.9,	116.4,	125.2,	137.4,	145.1,	150.8,	168.2,	186.0,	196.9,	211.2,	223.3,	232.2,	245.3,	255.0,	262.8,	288.5,

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

Appendix C – MicroDrainage Results

AECOM		Page 1
Midpoint Alencon Link Basingstoke, RG21 7PP	The Wonderful Barn	
Date 05/06/2024 File Network Model (Draft) - ...	Designed by SG Checked by MO'D	
Innovyze	Network 2020.1	

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)	100	PIMP (%)	100
M5-60 (mm)	16.100	Add Flow / Climate Change (%)	0
Ratio R	0.277	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits


Network Design Table for Storm

« - Indicates pipe capacity < flow















PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	51.056	1.021	50.0	0.047	1.00	0.0	0.600	o	225	Pipe/Conduit	
S2.000	35.813	0.179	200.1	0.096	1.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	43.085	0.215	200.4	0.219	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.002	29.170	0.151	193.6	0.055	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.003	3.646	0.014	260.4	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.004	27.342	0.137	199.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	1.46	53.975	0.047	0.0	0.0	0.0	1.85	73.7	6.4
S2.000	50.00	1.65	52.600	0.096	0.0	0.0	0.0	0.92	36.6	13.0
S1.001	50.00	2.21	52.271	0.363	0.0	0.0	0.0	1.28	141.0	49.1
S1.002	50.00	2.59	52.056	0.418	0.0	0.0	0.0	1.30	143.4	56.6
S1.003	50.00	2.64	51.905	0.418	0.0	0.0	0.0	1.12	123.5	56.6
S1.004	50.00	3.00	51.891	0.418	0.0	0.0	0.0	1.28	141.3	56.6


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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
S3.000	41.775	0.209	199.9	0.112	1.00	0.0	0.600	o	225	Pipe/Conduit	
S1.005	59.377	0.218	272.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.006	23.799	0.119	200.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S4.000	10.359	0.052	199.2	0.120	1.00	0.0	0.600	o	225	Pipe/Conduit	
S4.001	62.562	0.782	80.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.002	21.383	0.381	56.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.003	62.370	0.474	131.7	0.009	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.004	89.781	2.064	43.5	0.162	0.00	0.0	0.600	o	300	Pipe/Conduit	
S5.000	65.292	0.597	109.4	0.053	1.00	0.0	0.600	o	225	Pipe/Conduit	
S5.001	32.782	0.179	183.1	0.024	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.002	10.397	0.061	170.4	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.000	16.568	0.080	207.1	0.033	1.00	0.0	0.600	o	225	Pipe/Conduit	
S6.001	31.362	0.713	44.0	0.013	0.00	0.0	0.600	o	225	Pipe/Conduit	
S7.000	4.862	0.162	30.0	0.010	1.00	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)
S3.000	50.00	1.76	51.900	0.112	0.0	0.0	0.0	0.92	36.6	15.2
S1.005	50.00	3.90	51.541	0.530	0.0	0.0	0.0	1.09	120.6	71.8
S1.006	50.00	4.21	51.323	0.530	0.0	0.0	0.0	1.28	141.1	71.8
S4.000	50.00	1.19	53.500	0.120	0.0	0.0	0.0	0.92	36.7	16.2
S4.001	50.00	1.90	53.448	0.120	0.0	0.0	0.0	1.46	58.2	16.2
S4.002	50.00	2.10	52.666	0.120	0.0	0.0	0.0	1.75	69.6	16.2
S4.003	50.00	3.02	52.285	0.129	0.0	0.0	0.0	1.14	45.2	17.4
S4.004	50.00	3.64	51.736	0.291	0.0	0.0	0.0	2.39	169.0	39.4
S5.000	50.00	1.87	50.955	0.053	0.0	0.0	0.0	1.25	49.7	7.2
S5.001	50.00	2.44	50.358	0.077	0.0	0.0	0.0	0.96	38.3	10.5
S5.002	50.00	2.61	50.179	0.077	0.0	0.0	0.0	1.00	39.7	10.5
S6.000	50.00	1.31	52.200	0.033	0.0	0.0	0.0	0.90	36.0	4.5
S6.001	50.00	1.57	52.120	0.046	0.0	0.0	0.0	1.98	78.6	6.3
S7.000	50.00	1.03	51.575	0.010	0.0	0.0	0.0	2.40	95.3	1.3


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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
S6.002	9.866	0.329	30.0	0.011	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.003	10.933	0.050	216.5	0.008	0.00	0.0	0.600	o	225	Pipe/Conduit	
S8.000	8.476	0.045	188.4	0.010	1.00	0.0	0.600	o	225	Pipe/Conduit	
S6.004	9.668	0.082	118.5	0.032	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.005	11.188	0.067	168.0	0.005	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.006	3.855	0.019	200.0	0.025	0.00	0.0	0.600	o	225	Pipe/Conduit	
S6.007	22.076	0.171	129.1	0.004	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.000	11.040	0.291	38.0	0.038	1.00	0.0	0.600	o	225	Pipe/Conduit	
S9.001	10.996	0.312	35.2	0.028	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.002	8.970	0.112	80.0	0.018	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.003	10.890	0.255	42.7	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
S9.004	7.664	0.045	170.0	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
S10.000	2.504	0.013	192.6	0.015	1.00	0.0	0.600	o	100	Pipe/Conduit	
S6.008	43.738	0.182	240.3	0.009	0.00	0.0	0.600	o	300	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)
S6.002	50.00	1.64	51.403	0.067	0.0	0.0	0.0	2.40	95.3	9.1
S6.003	50.00	1.84	51.074	0.075	0.0	0.0	0.0	0.88	35.2	10.1
S8.000	50.00	1.15	51.075	0.010	0.0	0.0	0.0	0.95	37.7	1.3
S6.004	50.00	1.98	51.024	0.117	0.0	0.0	0.0	1.20	47.7	15.8
S6.005	50.00	2.16	50.942	0.122	0.0	0.0	0.0	1.01	40.0	16.5
S6.006	50.00	2.23	50.875	0.147	0.0	0.0	0.0	0.92	36.6	19.9
S6.007	50.00	2.55	50.856	0.151	0.0	0.0	0.0	1.15	45.7	20.4
S9.000	50.00	1.09	51.700	0.038	0.0	0.0	0.0	2.13	84.6	5.2
S9.001	50.00	1.17	51.409	0.067	0.0	0.0	0.0	2.21	87.9	9.0
S9.002	50.00	1.27	51.097	0.085	0.0	0.0	0.0	1.46	58.2	11.5
S9.003	50.00	1.36	50.985	0.105	0.0	0.0	0.0	2.01	79.8	14.2
S9.004	50.00	1.49	50.730	0.125	0.0	0.0	0.0	1.00	39.8	16.9
S10.000	50.00	1.08	50.698	0.015	0.0	0.0	0.0	0.55	4.3	2.1
S6.008	50.00	3.28	50.685	0.300	0.0	0.0	0.0	1.01	71.4	40.6


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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
S11.000	3.707	0.020	188.2	0.009	1.00	0.0	0.600	o	225	Pipe/Conduit		
S11.001	6.890	0.033	208.8	0.029	0.00	0.0	0.600	o	225	Pipe/Conduit		
S6.009	21.993	0.092	239.1	0.018	0.00	0.0	0.600	o	300	Pipe/Conduit		
S12.000	2.489	0.015	170.0	0.000	1.00	0.0	0.600	o	225	Pipe/Conduit		
S6.010	19.836	0.083	239.0	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit		
S6.011	50.438	0.210	240.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit		
S5.003	57.235	0.140	408.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit		
S5.004	51.201	0.140	365.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit		
S5.005	15.128	0.043	351.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit		
S5.006	41.040	0.123	333.7	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit		
S4.005	66.625	0.214	311.3	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit		
S4.006	28.997	0.091	318.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit		
S1.007	13.030	0.038	342.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit		
S1.008	13.272	0.039	340.3	0.000	0.00	0.0	0.600	o	450	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)
S11.000	50.00	1.07	51.305	0.009	0.0	0.0	0.0	0.95	37.8	1.2
S11.001	50.00	1.19	50.536	0.038	0.0	0.0	0.0	0.90	35.8	5.1
S6.009	50.00	3.64	50.503	0.356	0.0	0.0	0.0	1.01	71.6	48.1
S12.000	50.00	1.04	50.935	0.000	0.0	0.0	0.0	1.00	39.8	0.0
S6.010	50.00	3.96	50.411	0.372	0.0	0.0	0.0	1.01	71.6	50.3
S6.011	50.00	4.80	50.328	0.372	0.0	0.0	0.0	1.01	71.4	50.3
S5.003	50.00	5.87	50.118	0.449	0.0	0.0	0.0	0.89	98.3	60.8
S5.004	50.00	6.77	49.978	0.449	0.0	0.0	0.0	0.94	104.0	60.8
S5.005	50.00	7.04	49.838	0.449	0.0	0.0	0.0	0.96	106.1	60.8
S5.006	50.00	7.73	49.795	0.449	0.0	0.0	0.0	0.99	108.9	60.8
S4.005	50.00	8.82	49.672	0.740	0.0	0.0	0.0	1.02	112.8	100.2
S4.006	50.00	9.30	49.458	0.740	0.0	0.0	0.0	1.01	111.5	100.2
S1.007	50.00	9.52	49.367	1.270	0.0	0.0	0.0	0.97	107.4	172.0
S1.008	50.00	9.72	49.329	1.270	0.0	0.0	0.0	1.10	174.4	172.0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.047	0.047	0.047
2.000	User	-	100	0.096	0.096	0.096
1.001	User	-	100	0.185	0.185	0.185
	User	-	100	0.035	0.035	0.219
1.002	User	-	100	0.055	0.055	0.055
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.112	0.112	0.112
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.039	0.039	0.039
	User	-	100	0.081	0.081	0.120
4.001	-	-	100	0.000	0.000	0.000
4.002	-	-	100	0.000	0.000	0.000
4.003	User	-	80	0.011	0.009	0.009
4.004	User	-	100	0.162	0.162	0.162
5.000	User	-	100	0.053	0.053	0.053
5.001	User	-	80	0.030	0.024	0.024
5.002	-	-	100	0.000	0.000	0.000
6.000	User	-	100	0.033	0.033	0.033
6.001	User	-	100	0.012	0.012	0.012
	User	-	100	0.001	0.001	0.013
7.000	User	-	80	0.012	0.010	0.010
6.002	User	-	100	0.011	0.011	0.011
6.003	User	-	80	0.005	0.004	0.004
	User	-	100	0.004	0.004	0.008
8.000	User	-	80	0.012	0.010	0.010
6.004	User	-	100	0.020	0.020	0.020
	User	-	80	0.006	0.005	0.025
	User	-	100	0.007	0.007	0.032
6.005	User	-	80	0.006	0.005	0.005
6.006	User	-	100	0.013	0.013	0.013
	User	-	80	0.006	0.005	0.018
	User	-	100	0.007	0.007	0.025
6.007	User	-	100	0.004	0.004	0.004
9.000	User	-	100	0.037	0.037	0.037
	User	-	100	0.001	0.001	0.038
9.001	User	-	80	0.006	0.005	0.005
	User	-	80	0.006	0.005	0.010
	User	-	100	0.006	0.006	0.016
	User	-	100	0.010	0.010	0.026
	User	-	100	0.001	0.001	0.027
	User	-	100	0.001	0.001	0.028
9.002	User	-	80	0.006	0.005	0.005
	User	-	80	0.005	0.004	0.009
	User	-	100	0.008	0.008	0.017


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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
	User	-	100	0.001	0.001	0.017
	User	-	100	0.001	0.001	0.018
9.003	User	-	80	0.006	0.005	0.005
	User	-	80	0.005	0.004	0.009
	User	-	100	0.001	0.001	0.010
	User	-	100	0.001	0.001	0.011
	User	-	100	0.010	0.010	0.020
9.004	User	-	80	0.006	0.005	0.005
	User	-	80	0.005	0.004	0.009
	User	-	100	0.009	0.009	0.018
	User	-	100	0.001	0.001	0.019
	User	-	100	0.001	0.001	0.020
10.000	User	-	100	0.015	0.015	0.015
6.008	User	-	100	0.009	0.009	0.009
11.000	User	-	80	0.011	0.009	0.009
11.001	User	-	100	0.029	0.029	0.029
6.009	User	-	100	0.018	0.018	0.018
12.000	-	-	100	0.000	0.000	0.000
6.010	User	-	100	0.016	0.016	0.016
6.011	-	-	100	0.000	0.000	0.000
5.003	-	-	100	0.000	0.000	0.000
5.004	-	-	100	0.000	0.000	0.000
5.005	-	-	100	0.000	0.000	0.000
5.006	-	-	100	0.000	0.000	0.000
4.005	-	-	100	0.000	0.000	0.000
4.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.299	1.270	1.270

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)
S1.008	SMH	51.500	49.290	0.000	0	0

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Online Controls for Storm

Orifice Manhole: SMH5, DS/PN: S1.003, Volume (m³): 6.1

Diameter (m) 0.261 Discharge Coefficient 0.600 Invert Level (m) 51.905

Orifice Manhole: SMH8, DS/PN: S1.005, Volume (m³): 7.6

Diameter (m) 0.025 Discharge Coefficient 0.600 Invert Level (m) 51.541

Orifice Manhole: SMH9, DS/PN: S1.006, Volume (m³): 9.3

Diameter (m) 0.017 Discharge Coefficient 0.600 Invert Level (m) 51.323

Orifice Manhole: SMH11, DS/PN: S4.001, Volume (m³): 2.0

Diameter (m) 0.031 Discharge Coefficient 0.600 Invert Level (m) 53.448

Orifice Manhole: SMH13, DS/PN: S4.003, Volume (m³): 2.4

Diameter (m) 0.044 Discharge Coefficient 0.600 Invert Level (m) 52.285

Orifice Manhole: SMH16, DS/PN: S5.001, Volume (m³): 3.8

Diameter (m) 0.030 Discharge Coefficient 0.600 Invert Level (m) 50.358

Orifice Manhole: SMH19, DS/PN: S6.001, Volume (m³): 2.2

Diameter (m) 0.034 Discharge Coefficient 0.600 Invert Level (m) 52.120

Orifice Manhole: SMH21, DS/PN: S6.002, Volume (m³): 3.0


Diameter (m) 0.089 Discharge Coefficient 0.600 Invert Level (m) 51.403

Orifice Manhole: SMH22, DS/PN: S6.003, Volume (m³): 2.0

Diameter (m) 0.090 Discharge Coefficient 0.600 Invert Level (m) 51.074

Orifice Manhole: SMH24, DS/PN: S6.004, Volume (m³): 2.3

Diameter (m) 0.044 Discharge Coefficient 0.600 Invert Level (m) 51.024

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Orifice Manhole: SMH25, DS/PN: S6.005, Volume (m³): 2.0

Diameter (m) 0.044 Discharge Coefficient 0.600 Invert Level (m) 50.942

Orifice Manhole: SMH26, DS/PN: S6.006, Volume (m³): 2.0

Diameter (m) 0.028 Discharge Coefficient 0.600 Invert Level (m) 50.875

Orifice Manhole: SMH29, DS/PN: S9.001, Volume (m³): 2.0

Diameter (m) 0.028 Discharge Coefficient 0.600 Invert Level (m) 51.409

Orifice Manhole: SMH30, DS/PN: S9.002, Volume (m³): 2.0

Diameter (m) 0.028 Discharge Coefficient 0.600 Invert Level (m) 51.097

Orifice Manhole: SMH31, DS/PN: S9.003, Volume (m³): 1.9

Diameter (m) 0.044 Discharge Coefficient 0.600 Invert Level (m) 50.985

Orifice Manhole: SMH32, DS/PN: S9.004, Volume (m³): 2.1

Diameter (m) 0.044 Discharge Coefficient 0.600 Invert Level (m) 50.730

Orifice Manhole: SMH39, DS/PN: S6.010, Volume (m³): 3.7


Diameter (m) 0.018 Discharge Coefficient 0.600 Invert Level (m) 50.411

Orifice Manhole: SMH41, DS/PN: S5.003, Volume (m³): 5.8

Diameter (m) 0.079 Discharge Coefficient 0.600 Invert Level (m) 50.118

Hydro-Brake® Optimum Manhole: SMH48, DS/PN: S1.008, Volume (m³): 5.0

Unit Reference	MD-SHE-0054-2000-2571-2000
Design Head (m)	2.571
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	54
Invert Level (m)	49.329
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: SMH48, DS/PN: S1.008, Volume (m³): 5.0

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.571	2.0	Kick-Flo®	0.481	0.9
Flush-Flo™	0.238	1.1	Mean Flow over Head Range	-	1.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0	1.200	1.4	3.000	2.1	7.000	3.2
0.200	1.1	1.400	1.5	3.500	2.3	7.500	3.3
0.300	1.1	1.600	1.6	4.000	2.4	8.000	3.4
0.400	1.1	1.800	1.7	4.500	2.6	8.500	3.5
0.500	1.0	2.000	1.8	5.000	2.7	9.000	3.6
0.600	1.0	2.200	1.9	5.500	2.8	9.500	3.7
0.800	1.2	2.400	1.9	6.000	3.0		
1.000	1.3	2.600	2.0	6.500	3.1		

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Storage Structures for Storm

Complex Manhole: SMH5, DS/PN: S1.003

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	7.6
Infiltration Coefficient Side (m/hr)	0.01900	Trench Length (m)	19.4
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	0.30	Cap Volume Depth (m)	0.800
Invert Level (m)	51.905	Cap Infiltration Depth (m)	0.000

Infiltration Basin

Invert Level (m)	53.485	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01900	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.01900		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	123.0	0.500	353.0	0.501	0.0

Complex Manhole: SMH7, DS/PN: S3.000


Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	8.0
Infiltration Coefficient Side (m/hr)	0.01900	Trench Length (m)	48.0
Safety Factor	2.0	Slope (1:X)	80.0
Porosity	0.30	Cap Volume Depth (m)	0.800
Invert Level (m)	51.900	Cap Infiltration Depth (m)	0.000

Infiltration Basin

Invert Level (m)	52.840	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01900	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.01900		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	697.0	0.500	1070.0	0.501	0.0

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Complex Manhole: SMH8, DS/PN: S1.005

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	7.8
Infiltration Coefficient Side (m/hr)	0.01900	Trench Length (m)	15.6
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	0.30	Cap Volume Depth (m)	0.800
Invert Level (m)	51.541	Cap Infiltration Depth (m)	0.000

Infiltration Basin

Invert Level (m)	53.241	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01900	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.01900		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	100.0	0.500	250.0	0.501	0.0

Complex Manhole: SMH9, DS/PN: S1.006

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	8.0
Infiltration Coefficient Side (m/hr)	0.01900	Trench Length (m)	28.0
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	0.30	Cap Volume Depth (m)	0.800
Invert Level (m)	51.323	Cap Infiltration Depth (m)	0.000

Infiltration Basin

Invert Level (m)	52.843	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.01900	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.01900		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	319.0	0.500	576.0	0.501	0.0

Complex Manhole: SMH10, DS/PN: S4.000

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Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	10.0
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	22.0
Safety Factor	2.0	Slope (1:X)	80.0
Porosity	0.30	Cap Volume Depth (m)	0.800
Invert Level (m)	53.500	Cap Infiltration Depth (m)	0.000

Infiltration Basin

Invert Level (m)	54.745	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	1.00
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	270.0	0.250	324.0	0.251	0.0

Porous Car Park Manhole: SMH13, DS/PN: S4.003

Infiltration Coefficient Base (m/hr)	0.01900	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	19.2
Max Percolation (l/s)	32.0	Slope (1:X)	250.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	52.285	Cap Volume Depth (m)	0.800

Complex Manhole: SMH15, DS/PN: S5.000

Infiltration Trench

Infiltration Coefficient Base (m/hr)	0.00000	Trench Width (m)	0.8
Infiltration Coefficient Side (m/hr)	0.00000	Trench Length (m)	136.0
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	0.30	Cap Volume Depth (m)	0.800
Invert Level (m)	50.955	Cap Infiltration Depth (m)	0.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

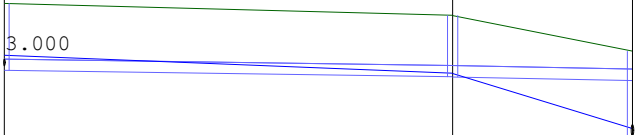
Infiltration Coefficient Base (m/hr)	0.00000	Base Width (m)	1.0
Infiltration Coefficient Side (m/hr)	0.00000	Length (m)	136.0
Safety Factor	2.0	Side Slope (1:X)	4.0
Porosity	1.00	Slope (1:X)	100.0
Invert Level (m)	51.755	Cap Volume Depth (m)	0.250

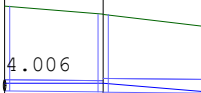
Appendix D – Proposed Surface Water Long Sections



MH Name	SMH1	SMH3	SMH4
Hor Scale 1000			
Ver Scale 250			
Datum (m) 49.000			
PN	S1.000	S1.001	
Dia (mm)	225	375	
Slope (1:X)	50.0	200.4	
Cover Level (m)	55.400	54.380	54.100
Invert Level (m)	53.975	52.954 52.271	52.056
Length (m)	51.056	43.085	

MH Name	SMH4	SMH6	SMH8
Hor Scale 1000			
Ver Scale 250			
Datum (m) 48.000			
PN	S1.002	S1.004	
Dia (mm)	375	375	
Slope (1:X)	193.6	199.6	
Cover Level (m)	54.100	54.000 54.000	53.750
Invert Level (m)	52.056	51.905 51.905 51.891	51.754
Length (m)	29.170	27.342	

MH Name	SMH8	SMH9	SMH47
Hor Scale 1000			
Ver Scale 250			
Datum (m) 47.000			
PN	S1.005	S1.006	
Dia (mm)	375	375	
Slope (1:X)	272.9	200.0	
Cover Level (m)	53.750	53.350	52.170
Invert Level (m)	51.541	51.323 51.323	51.204
Length (m)	59.377	23.799	

MH Name	SMH47	SMH48	SMH
Hor Scale 1000			
Ver Scale 250			
Datum (m) 46.000			
PN	S1.007	S1.008	
Dia (mm)	375	450	
Slope (1:X)	342.9	340.3	
Cover Level (m)	52.170	51.900	51.500
Invert Level (m)	49.367	49.329 49.329	49.290
Length (m)	13.030	13.272	



MH Name	SMH2	SMH3
Hor Scale 1000		
Ver Scale 250		
Datum (m) 49.000		
PN	S2.000	
Dia (mm)	225	
Slope (1:X)	200.1	
Cover Level (m)	54.100	54.380
Invert Level (m)	52.600	52.421
Length (m)	35.813	

MH Name	SMH7	SMH8
Hor Scale 1000		
Ver Scale 250		
Datum (m) 48.000		
PN	S3.000	
Dia (mm)	225	
Slope (1:X)	199.9	
Cover Level (m)	53.350	53.750
Invert Level (m)	51.900	51.691
Length (m)	41.775	

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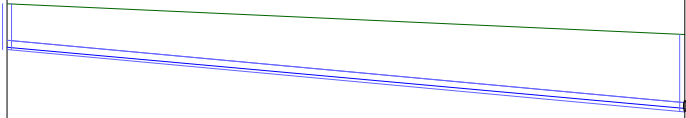
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MH Name			SMH11	SMH12	SMH13
Hor Scale 1000					
Ver Scale 250					
Datum (m) 49.000					
PN			S4.001	S4.002	
Dia (mm)			225	225	
Slope (1:X)			80.0	56.1	
Cover Level (m)		55.000	54.910	54.100	53.720
Invert Level (m)	53.500	53.448	53.448	52.666	52.285
Length (m)			62.562	21.383	

MH Name			SMH13	SMH14
Hor Scale 1000				
Ver Scale 250				
Datum (m) 48.000				
PN			S4.003	
Dia (mm)			225	
Slope (1:X)			131.7	
Cover Level (m)			53.720	53.250
Invert Level (m)			52.285	51.811
Length (m)			62.370	

MH Name	SMH14	SMH45
Hor Scale 1000		
Ver Scale 250		
Datum (m) 47.000		
PN	S4.004	
Dia (mm)	300	
Slope (1:X)	43.5	
Cover Level (m)	53.250	52.230
Invert Level (m)	51.736	49.672
Length (m)	89.781	

MH Name	SMH45	SMH46	SMH47
Hor Scale 1000			
Ver Scale 250			
Datum (m) 46.000			
PN	S4.005	S4.006	
Dia (mm)	375	375	
Slope (1:X)	311.3	318.6	
Cover Level (m)	52.230	52.730	52.170
Invert Level (m)	49.672	49.458 49.458	49.367
Length (m)	66.625	28.997	

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MH Name		SMH15	SMH16
Hor Scale 1000			
Ver Scale 250			
Datum (m) 47.000			
PN		S5.000	
Dia (mm)		225	
Slope (1:X)		109.4	
Cover Level (m)		52.380	51.500
Invert Level (m)		50.955	50.358
Length (m)		65.292	

MH Name		SMH16	SMH41
Hor Scale 1000			
Ver Scale 250			
Datum (m) 46.000			
PN		S5.001	
Dia (mm)		225	
Slope (1:X)		183.1	
Cover Level (m)		51.500	51.480
Invert Level (m)		50.358	50.179
Length (m)		32.782	



MH Name		SMH41	SMH42
Hor Scale 1000			
Ver Scale 250			
Datum (m) 46.000			
PN		S5.003	
Dia (mm)		375	
Slope (1:X)		408.8	
Cover Level (m)		51.480	51.420
Invert Level (m)		50.118	49.978
Length (m)		57.235	

MH Name		SMH42	SMH43	SMH44
Hor Scale 1000				
Ver Scale 250				
Datum (m) 46.000				
PN		S5.004	S5.005	
Dia (mm)		375	375	
Slope (1:X)		365.7	351.8	
Cover Level (m)		51.420	52.100	52.200
Invert Level (m)		49.978	49.838 49.838	49.795
Length (m)		51.201	15.128	




MH Name	SMH44	SMH45
Hor Scale 1000		
Ver Scale 250		
Datum (m) 46.000		
PN	S5.006	
Dia (mm)	375	
Slope (1:X)	333.7	
Cover Level (m)	52.200	52.230
Invert Level (m)	49.795	49.672
Length (m)	41.040	


MH Name	SMH18	SMH19						SMH27					
Hor Scale 1000													
Ver Scale 250													
Datum (m) 48.000													
PN	S6.000	S6.001											
Dia (mm)	225	225											
Slope (1:X)	207.1	44.0											
Cover Level (m)	53.650	53.550	52.850	52.500	52.500	52.400	52.320	52.300					
Invert Level (m)	52.200	52.120	52.120	51.407	51.403	51.074	51.074	51.024	51.024	50.942	50.942	50.875	50.875
Length (m)	16.568	31.362											



MH Name	SMH27	SMH34	SMH37	SMH39
Hor Scale 1000				
Ver Scale 250				
Datum (m) 47.000				
PN	S6.007	S6.008	S6.009	
Dia (mm)	225	300	300	
Slope (1:X)	129.1	240.3	239.1	
Cover Level (m)	52.300	52.100	52.700	52.350
Invert Level (m)	50.856	50.685	50.503	50.411
Length (m)	22.076	43.738	21.993	

MH Name	SMH39	SMH40	SMH41
Hor Scale 1000			
Ver Scale 250			
Datum (m) 47.000			
PN	S6.010	S6.011	
Dia (mm)	300	300	
Slope (1:X)	239.0	240.2	
Cover Level (m)	52.350	52.120	51.480
Invert Level (m)	50.411	50.328	50.118
Length (m)	19.836	50.438	

MH Name			SMH21
Hor Scale 1000			
Ver Scale 250			6.001
Datum (m) 48.000			
PN			
Dia (mm)			
Slope (1:X)			
Cover Level (m)		53.000 52.850	
Invert Level (m)		51.575	
Length (m)			

MH Name			SMH24
Hor Scale 1000			
Ver Scale 250			6.003
Datum (m) 47.000			
PN			
Dia (mm)			
Slope (1:X)			
Cover Level (m)		52.500 52.500	
Invert Level (m)		51.075 51.030	
Length (m)			



MH Name							SMH34					
Hor Scale 1000							0.0070					
Ver Scale 250												
Datum (m) 47.000												
PN												
Dia (mm)												
Slope (1:X)												
Cover Level (m)		53.170	52.840	52.550	52.410	52.240	52.100					
Invert Level (m)		51.700	51.409	51.409	51.097	51.097	50.985	50.985	50.730	50.730	50.685	50.685
Length (m)												

MH Name							SMH34					
Hor Scale 1000							0.004					
Ver Scale 250												
Datum (m) 47.000												
PN												
Dia (mm)												
Slope (1:X)												
Cover Level (m)							52.100					
Invert Level (m)												
Length (m)												

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MH Name			SMH37
Hor Scale 1000			
Ver Scale 250			6.008
Datum (m) 47.000			
PN			
Dia (mm)			
Slope (1:X)			
Cover Level (m)		52.730 52.710	52.700
Invert Level (m)		51.305 50.536	
Length (m)			

MH Name			SMH39
Hor Scale 1000			
Ver Scale 250			6.009
Datum (m) 47.000			
PN			
Dia (mm)			
Slope (1:X)			
Cover Level (m)		52.350	
Invert Level (m)			
Length (m)			

Appendix E – Proposed Foul Water Long Sections

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MH Name		FMH1	FMH2		FMH5
Hor Scale 1000					
Ver Scale 250					
Datum (m) 49.000					
PN		F1.000	F1.001		
Dia (mm)		150	150		
Slope (1:X)		70.0	98.0		
Cover Level (m)		55.300	54.900	54.700	54.450
Invert Level (m)		53.950	53.538 53.538	53.350 53.350	53.280
Length (m)		28.808	18.480		

MH Name		FMH5		FMH6
Hor Scale 1000				
Ver Scale 250				
Datum (m) 49.000				
PN		F1.003		
Dia (mm)		150		
Slope (1:X)		136.0		
Cover Level (m)		54.450		53.800
Invert Level (m)		52.507		51.986
Length (m)			70.890	



MH Name	FMH6	FMH12	
Hor Scale 1000			
Ver Scale 250			
Datum (m) 48.000			
PN	F1.004		
Dia (mm)	150		
Slope (1:X)	136.0		
Cover Level (m)	53.800	53.090	52.960
Invert Level (m)	51.986	51.598 50.912	
Length (m)	52.747		

MH Name	FMH12	FMH	
Hor Scale 1000			
Ver Scale 250			
Datum (m) 47.000			
PN	F1.006		
Dia (mm)	150		
Slope (1:X)	137.0		
Cover Level (m)	52.960	52.000	51.850
Invert Level (m)	50.866	50.484 50.484 50.426	
Length (m)	52.449		



MH Name	FMH4	FMH5
Hor Scale 1000		
Ver Scale 250		
Datum (m) 49.000		
PN	F2.000	
Dia (mm)	100	
Slope (1:X)	79.0	
Cover Level (m)	54.070	54.450
Invert Level (m)	52.770	52.557
Length (m)	16.815	

MH Name	FMH10
Hor Scale 1000	
Ver Scale 250	
Datum (m) 48.000	
PN	
Dia (mm)	
Slope (1:X)	
Cover Level (m)	53.690
Invert Level (m)	52.390
Length (m)	

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MH Name	FMH10	FMH11
Hor Scale 1000		
Ver Scale 250		
Datum (m) 48.000		
PN	F3.003	
Dia (mm)	100	
Slope (1:X)	78.0	
Cover Level (m)	53.640	53.090
Invert Level (m)	52.097	50.962
Length (m)	88.571	

