Residential Development, Fortfield Road, Terenure

Engineering Planning Report
222102-PUNCH-XX-XX-RP-C-0002

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1 Introduction

PUNCH Consulting Engineers have been appointed by 1 Celbridge West Land Limited to provide Civil & Structural Consulting Engineering services for a site located at Fortfield Road, Terenure, Dublin 6W.

The site can be viewed in Figure 1-1 below where the red line site boundaries are identified. The overall site is 4.77 ha, which includes 4.64 ha of land that relates to the present application to Dublin City Council (DCC) (the development site). There is also 0.13 ha of land that is within the South Dublin County Council administrative area and this is subject to a separate application to South Dublin County Council.

The development site is accessed from Fortfield Road, off Templeogue Road (R137). Figure 1-1 indicates the location of the subject lands.

Figure 1-1: Site Location (© Google Maps).

1.1 Proposed Development

The development will comprise a Large-Scale Residential Development (LRD) on a site at Fortfield Road, Terenure of 284 no. units delivering 19 no. houses and 265 no. apartments made up of studios; 1 beds; 2 beds; 3 beds; and 4 beds. The development will also provide community, cultural and arts space and a creche. Communal internal space for residents will also be delivered. Provision of car, cycle and motorbike parking will be provided in the development, including at basement and surface level. Vehicular/pedestrian/cyclist access from Fortfield Road. Proposed upgrade works to the surrounding road network is also included. All associated site development works, open space, services provision, ESB substations, plant areas, waste management areas, landscaping (both public and communal) and boundary treatments.

The proposed works are outlined in a series of architectural drawings prepared by Urban Agency Architects and engineering drawings prepared by PUNCH and supplied as part of the planning documentation.

2 Surface Water Management Plan

In compliance with Dublin City Development Plan 2022-2028 Policy SI25, a Surface Water Management Plan (SWMP) is contained within this section which sets out the proposed strategy for managing surface water.

2.1 Existing Conditions at the Development Site

The development site location is shown in Figure 2-1 below.

The development site currently consists of playing fields and an open artificial drainage pond. The development site is bounded to the west by Fortfield Road and to the east by Lakelands Park. The development site also adjoins Terenure College to the south, Terenure College Rugby Football Club to the northeast and the rear of residential dwellings on Greenlea Road to the north.

A topographical survey of the development site and its environs was completed by Murphy Geospatial in February 2022. The survey indicates that the ground level within the development site varies from approximately 48.5m AOD at the south-western corner, to 47.0m AOD at the north-eastern corner of the development site. Please refer to Appendix H for a copy of Murphy Geospatial's topographic survey. In general, the development site slopes gently in a north westerly direction.

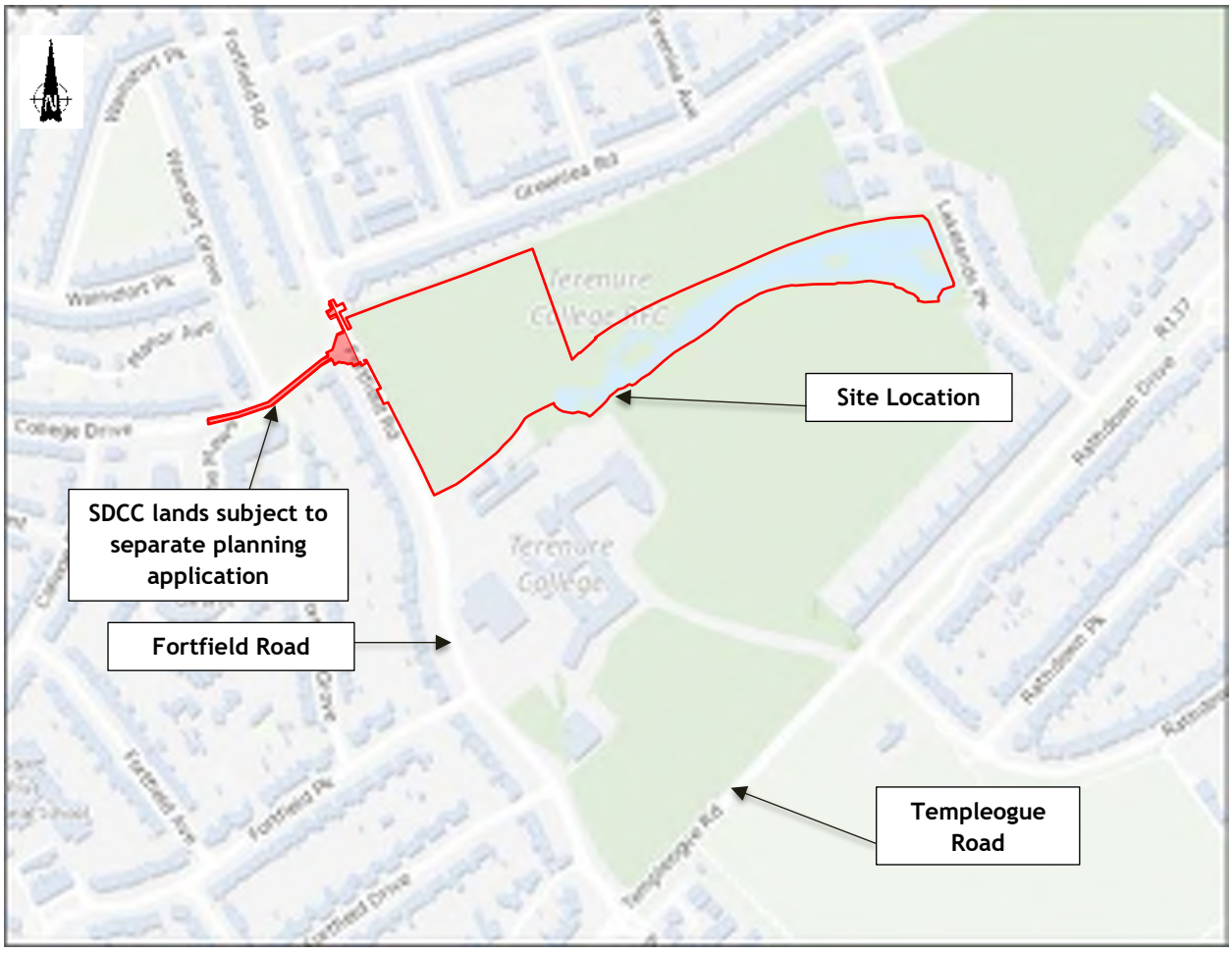


Figure 2-1: Location of the Proposed development (© Geohive)

2.2 Existing Ground Conditions

A ground investigation was conducted by IGSL Limited in April 2022, and final report issued by IGSL Limited in May 2022 (Report No. 24013). The investigation determined that there are layers of sandy

gravelly clay, with the appearance of glacial till at the development site. There was stiff to very stiff deposits of Black Boulder Clay identified by the boreholes. Rotary drilling and coring techniques identified limestone bedrock at depths of 7.5m to 11.0m below ground level. Ground monitoring identified ground water to rise to 1.2m below ground level. Infiltration testing at the development site indicated little to no potential for infiltration at the development site. IGSL Limited's Geotechnical Report (Report No. 24013) has been included in Appendix E. There has been no changes to the lands or associated ground conditions since the completion of the site investigations and therefore no material changes to the site investigations and associated results are applicable.

2.3 Existing Stormwater Drainage

Based on available records obtained from Dublin City Council, the following stormwater drainage exists adjacent to the development site:

1. 300mm concrete stormwater sewer flowing south to north along Fortfield Road. This increases to 450mm on approach to the Greenlea Road junction.
2. There is an existing lake located at the development site's south-eastern boundary adjacent to Terenure College Rugby Club. According to the drainage records the pond is fed from an existing off-take on the River Poddle, known as Lakelands Overflow, which is located at Wainsfort Manor to the west of the subject site. The overflow is piped underground via a 1230mm x 1230mm concrete box culvert for a distance of 1.4km before discharging into the pond. The pond discharges to the River Dodder located to the southeast of the subject site via a 1450mm x 1480mm concrete box culvert. Refer to the Site-Specific Flood Risk Assessment for further information on this arrangement.

Please refer to Appendix A for Record Drawings illustrating the existing stormwater drainage arrangement. An extract is shown in Figure 2-2 below.

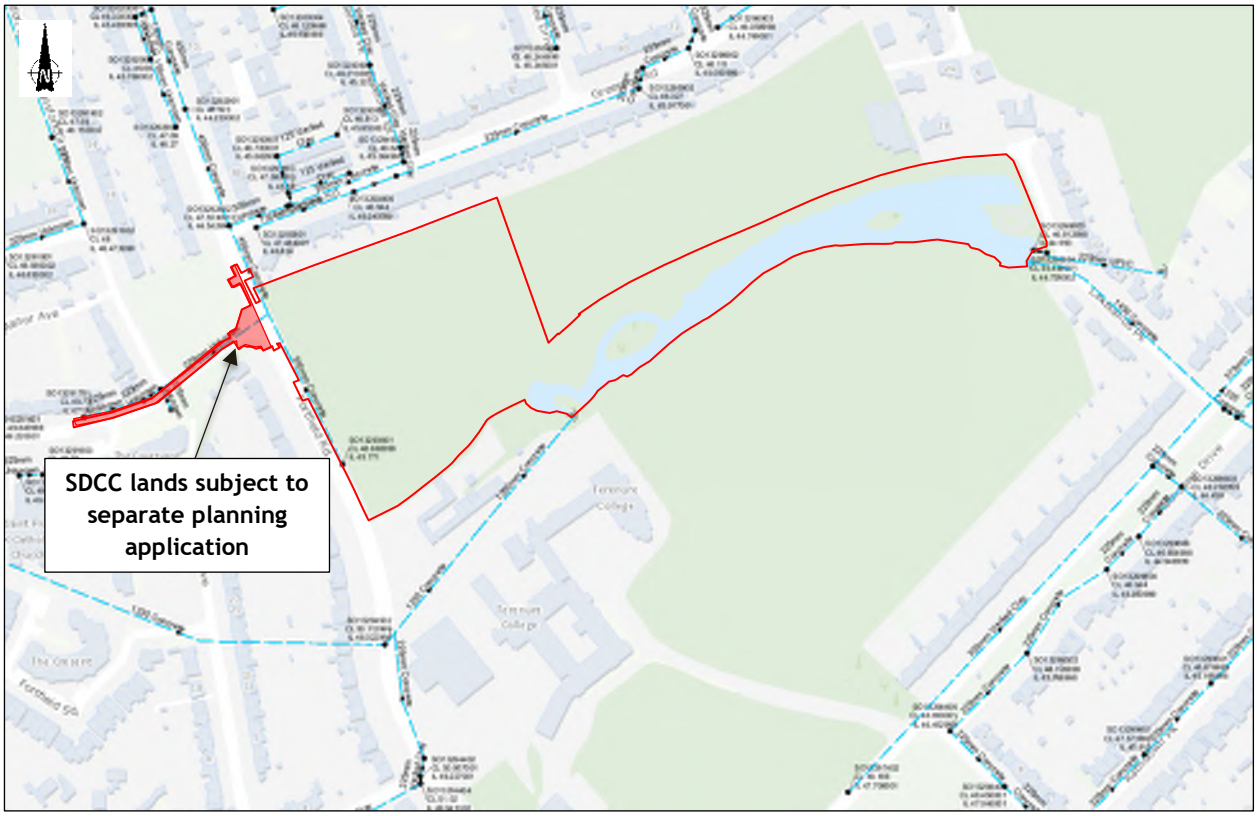


Figure 2-2: Existing stormwater drainage surrounding the development site shown in light blue (Extract from Dublin City Council records)

The existing lake located at the development site's southeastern boundary, adjacent to Terenure College Rugby Club, will remain entirely unaffected by the proposed development. To guarantee the lake's continued use and ecological integrity, a maintenance regime will be implemented by suitably qualified operatives. This regime will include regular inspections, and clearance of any blockages to ensure the uninterrupted flow of water both to and from the lake, preserving its role within the local drainage network. Table 2-1 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.

For further information on the existing Hydrological environment, refer to the Site Specific Flood Risk Assessment (report reference 222102-PUNCH-XX-XX-RP-0003) prepared by PUNCH Consulting Engineers and submitted with this application.

Table 2-1: Operation and Maintenance Actions for the Pond

Maintenance schedule	Required Action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect material and bankside vegetation and remove nuisance plants	As required
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Monthly or as required
	Inspect water body for signs of poor water quality	Monthly (May - October)
	Inspect silt accumulation rates and establish appropriate removal frequencies; undertake contamination testing once some build-up has occurred, to inform management and disposal options	Half yearly
	Tidy all dead growth (scrub clearance) before start of growing season	Annually
Occasional maintenance	Remove sediment from the main body of big ponds when pool volume is reduced by 20%.	As required
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required

	Aerate pond where signs of eutrophication are detected	As required
	Repair/ rehabilitate inlets, outlets, and overflows	As required

2.4 Proposed Surface Water Management Strategy

A new surface water sewer network shall be provided for the proposed development which will be entirely separated from the foul water sewer network. The proposed surface water drainage system is being designed using Causeway Flow software with reference to the following documents:

a) Dublin City Development Plan 2022-2028
b) Dublin City Council Green & Blue Roof Guide 2021
c) Dublin City Council Sustainable Drainage Design & Evaluation Guide 2021
d) CIRIA SuDS Manual 2015 C753 – The SuDS Manual
e) CIRIA Publications C644 – Building Greener
f) Greater Dublin Strategic Drainage Study (GDSDS)
g) Greater Dublin Regional Code of Practice for Drainage Works
h) Recommendations for Site Development Works for Housing Areas - Department of the Environment and Local Government

The proposed surface water drainage network will serve the developed section of the development site. Due to the topography across the development site, it is not possible to discharge the surface water from the development site to the existing lake on the development site. Therefore, it is proposed to discharge to the 300mm stormwater sewer on Fortfield Road. Please refer to drawing 222102-PUNCH-XX-XX-DR-C-0100 for a plan of the proposed drainage network and discharge point from the development site.

Surface water drainage for the proposed development is to be restricted to QBar as per the requirements of the Greater Dublin Strategic Drainage Strategy. In order to restrict surface water drainage to QBar sustainable drainage systems (SuDS) will be implemented by the developer. QBar for the development site can be seen below in Table 2-2, and a calculation for QBar is included in Appendix B.

The ground conditions have been reviewed through site investigations carried out by IGSL Limited (Geotechnical Report No. 24013 dated May 2022) and the design parameters outlined in Table 2-2 have been identified. IGSL Limited's Geotechnical Report is included in Appendix E of this report.

Interception, treatment, and attenuation measures will be provided to reduce, treat and restrict outflow from the development site. The SuDS measures provided will ensure that all surface water from the proposed development will pass through at least one SuDS element, which includes intensive and extensive green roofs, blue roofs, paving, raingardens, swales and attenuation tanks. This will ensure the surface water discharge from the development is restricted to Qbar for the 1 in 100-year storm with 20% climate change allowance. Please refer to Section 2.5 of this report for discussion on the proposed SuDS elements for this development.

PUNCH Site Specific Flood Risk Assessment Report (222102-PUNCH-XX-XX-RP-C-0003) accompanying this Application has identified that there is pluvial flooding on development site. A proposal to alleviate the pluvial flooding on Fortfield Road has been developed. Please refer to Section 3 of this report for a discussion on the drainage design being proposed to address the pluvial flood risk.

Table 2-2: Stormwater Drainage Design Parameters

Description	Value
Total red line boundary area	4.77 ha
Total proposed drained area within the development site (area drained to piped network as shown on PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0100)	2.468 Ha – Area used in Qbar Calculation
Factored total drained area from the development site due to runoff coefficients (Refer to Section 2.4.3)	1.856 Ha – Area used in the drainage analysis (Refer to Section 2.4.3)
Climate Change (CC) (refer to Section 2.4.5)	20%
Return period target	Pipe Design 1 in 5 year Network Design 1 in 30 year + CC Check 1 in 100 year + CC for flooding
M5-60	18.50
Ratio R	0.277
SOIL type	4 (clayey) *(As confirmed through ground investigation carried out by IGSL Limited)*
Soil value	0.45 *(Due to SOIL Type)*
SPR value	0.47 *(Due to SOIL Type)*
Standard Average Annual Rainfall (SAAR)	773mm
Flow reduction parameter	Qbar or 2l/s/Ha, whichever is greater
Controlled Outflow	Qbar = 12.2 l/s
Flow restriction method	Hydrobrake
Attenuation Tanks Storage Volume (1% AEP)	832.6 m^3
Blue Roofs Storage Volume	189.2 m^3
Infiltration Rate	N/A *(As confirmed through ground investigation carried out by IGSL Limited)*

2.4.1 Mean Annual Peak Greenfield Flow (Qbar) Calculation

As there is no drainage network within the existing development site, all surface water runoff on the existing development site, currently infiltrates to the natural ground or runs overland.

Ground investigations carried out by IGSL Limited found the following:

1. SOIL Type: a mixture of generally impermeable soils at the development site were identified, including soft/firm brown sandy gravelly clay and stiff dark brown sandy gravelly clay. This soil type conforms with Soil Type 4 as per the GDSDS.
2. Infiltration rate: Four soakaway infiltration tests were also carried out by IGSL in four separate locations on the development site. The tests showed poor infiltration to negligible infiltration in places.

IGSL Limited's Site Investigation report can be seen in Appendix E, including infiltration test results and excavation logs.

Based on the above, a soil type of 4 was used for the purposes of calculation of Qbar which characteristics the soil as 'Clayey, poorly drained'. This SOIL type of 4 equates to a SOIL ratio of 0.45.

The Standard Average Annual Rainfall (SAAR) for the development site has been sourced from the Met Éireann 1981-2010 Annual Average Rainfall Grid. This was identified to be 729mm.

Using the parameters listed in Table 2-2 above, the Qbar discharge rate has been calculated in accordance with IH124 (GDSDS drainage design criterion 2). A copy of the calculation report for this assessment can be found in Appendix B. Based on a Soil Type 4, a drained area of 2.468 Ha and the rainfall parameters noted above, Qbar has been calculated for the development site as 11.37 l/s.

2.4.2 Causeway Flow Modelling – General

The proposed surface water drainage system has been designed using Causeway Flow software in accordance with the Department of Environment and Local Government's guidance document "Recommendations for Site Development Works for Housing Areas", with guidance taken from the "Greater Dublin Strategic Drainage Study" (GDSDS) and the Dublin City Development Plan.

The model analyses a range of storms at the 1% AEP (1 in 100-year return period storm), with a 20% additional rainfall to allow for climate change.

The network is modelled with the proposed attenuation tank volumes and associated hydrobrake flow control outlets included.

Depths of water in the network model (including pipework, manholes, the attenuation tanks and hydrobrakes) have been assessed for surcharging and flood risk. The model is established such that a flood risk is identified in the simulation results if the water rises to within 300mm of the cover level. If the water level rises to a level below this, it is identified as a surcharge within the model results. It is important to note that this warning is given related to proposed ground level at the node and not related to Finished Floor level. All proposed drainage is within roadways, and the adjacent Floor levels will be higher than the road level at that location. The maximum water level in the attenuation tanks is more than 500mm below the Finished Floor level of the adjacent property. This aligns with Criterion 3 of the GDSDS, which requires Finished Floor levels at least 500mm above maximum adjacent on-site surface water storage retention.

Causeway includes a design setting called "additional storage". This is included in the software to account for storage volume in the network provided by secondary drainage including access junctions, inspection chambers, service connections etc. This provides additional storage in the network above the storage provided within the attenuation tank and primary drainage network. $20m^3/ha$ is the standard allowance provided for in Causeway Flow and was utilised for this design.

Please refer to detailed surface water Causeway calculations (inputs and outputs) enclosed in Appendix F for details.

2.4.3 Causeway Flow - Area Contribution

The Dublin City Council Sustainable Drainage Design & Evaluation Guide 2021 provides "coefficient of volumetric runoff" (CV) values that would be acceptable to DCC for various surfaces as presented in Table 2-3. These values represent the percentage of rainfall that will run off a particular type of surface.

Table 2-3: CV values for alternative surfaces. (Ref: Section 9.4.3.1 of the Dublin City Council Sustainable Drainage Design & Evaluation Guide 2021.)

Surface	Coefficient of Volumetric Runoff (CV)
Roofs	0.95
Paved areas	0.90
Soft Landscaping (free draining – clay soils)	0.15

For the drainage storms modelled, 1% AEP (plus 20% climate change), the design assumes that the percentage rainfall that occurs as runoff from roofs is 95%, and the percentage from all paved areas is 90%.

Landscape areas positioned above the basement extents were conservatively modelled as being 100% impervious as surface water will not have the opportunity to infiltrate to the ground below, and all other landscape areas positioned south of the 4 no. apartment blocks were taken as being pervious and that 15% of rainfall that occurred on these areas was runoff. Applying the coefficients shown in Table 2-3 resulted in a reduced total drainage area for the proposed development site; 1.837 Ha as shown in Table 2-2. The value of 1.837 Ha of drained development site area was used in the Causeway Flow drainage analysis.

2.4.4 Causeway Flow – Rainfall Data Inputs

Rainfall data for inclusion in the drainage model has been obtained from Met Éireann. The M5-60mins value (storm with a 5-year return period and duration of 60 minutes) is 18.50. The M5-2 day value (storm with a 5-year return period and duration of two days) is 66.8. The dimensionless ratio "R" is the M5-60 value divided by the M5-2 days value. For this development site, the ratio "R" value has been calculated to be 0.277. Please refer to the Return Period Rainfall Depths for sliding durations obtained from Met Éireann included in Appendix C.

A value for the SAAR for the development site has been obtained from the Met Éireann Website. This value is 773mm.

2.4.5 Climate Change

An allowance of 20% was allowed for climate change in the drainage design as per the Dublin City Development Plan 2022-2028.

2.4.6 Proposed Surface Water Pipe Runs

Please refer to the following drawings for information on the proposed surface water pipe runs indicating route, levels, pipe size, gradient etc.:

1. 222102-PUNCH-XX-XX-DR-C-0100 PROPOSED GROUND FLOOR DRAINAGE LAYOUT
2. 222102-PUNCH-XX-XX-DR-C-0200 SURFACE WATER LONG SECTIONS - SHEET 1
3. 222102-PUNCH-XX-XX-DR-C-0201 SURFACE WATER LONG SECTIONS - SHEET 2
4. 222102-PUNCH-XX-XX-DR-C-0202 SURFACE WATER LONG SECTIONS - SHEET 3
5. 222102-PUNCH-XX-XX-DR-C-0203 SURFACE WATER LONG SECTIONS - SHEET 4

2.5 Sustainable Urban Drainage Systems (SuDS) Proposals

The proposed development has been assessed in relation to Sustainable Urban Drainage Systems (SuDS). A variety of SuDS measures have been proposed to comply with Council recommendations. All SuDS measures are to be implemented with reference to the CIRIA UK SuDS Manual and Dublin City Council drainage requirements as outlined in the Dublin City Development Plan 2022-2028.

Relatively small volumes of rainwater collected on the respective SuDS systems will enter the public sewer network during typical low intensity storms. This is because the proposed SuDS measures will retain rainwater until it is either used via evapotranspiration in the green areas or infiltrated to the ground.

The SuDS processes decrease the impact of the development on the receiving environment by providing amenity and biodiversity in many cases. The SuDS proposals will be regularly maintained by a suitably qualified operative to ensure they are operating to their optimal level throughout their design life.

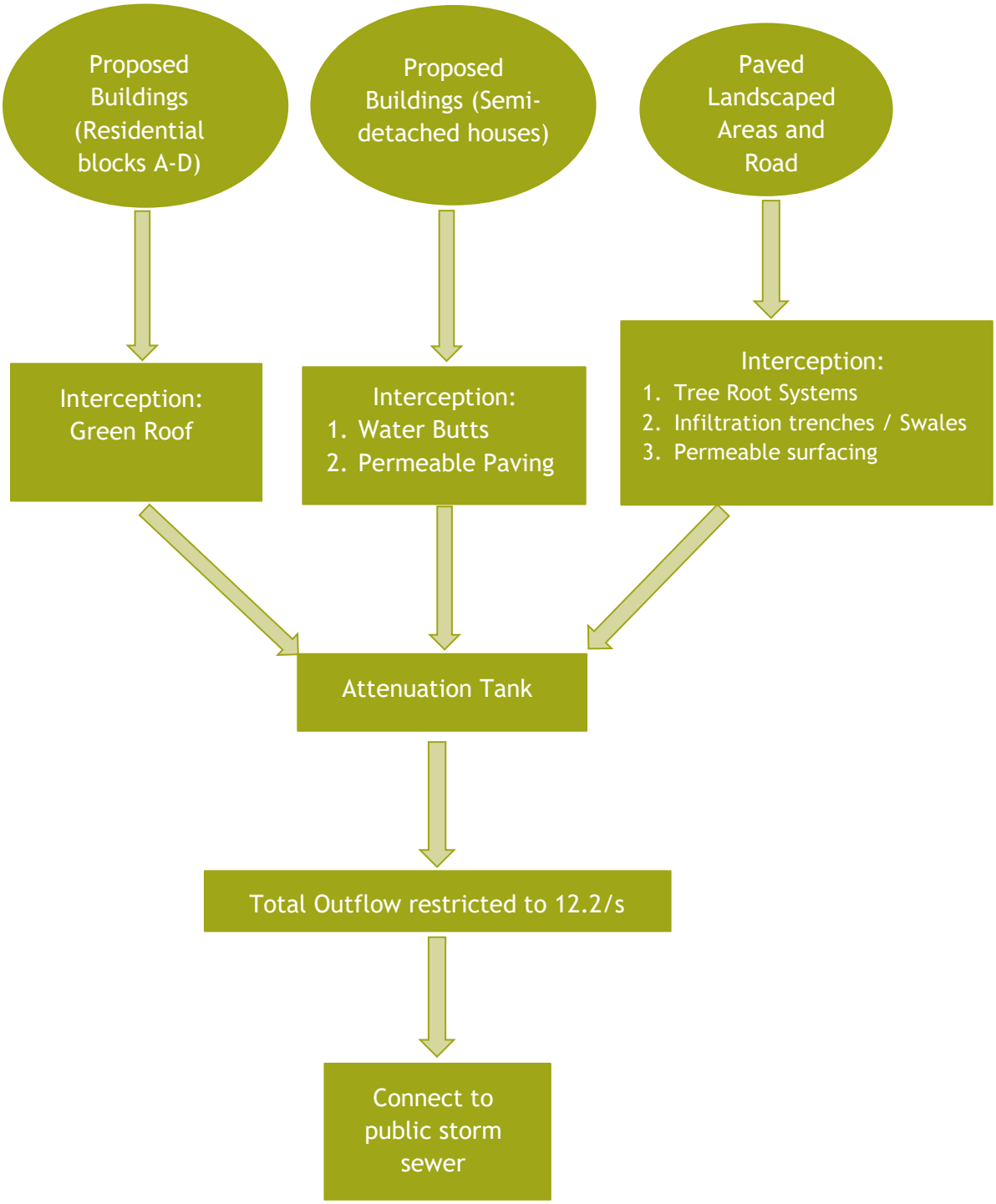
2.5.1 Compliance with the Greater Dublin Strategic Drainage Study (GDSDS)

There are 4 criteria as set out in the GDSDS-RDP Volume 2 Section 6.3.4 (table 6.3).

1) River water quality protection: the initial 5-10mm of rainfall is to be intercepted or treated (<1 year return period)
2) River regime protection: the discharge rate from the development site will be restricted to Qbar and will cater for the 1 in 100-year event. This is as per the DCC Development Plan and the GDSDS.
3) Level of service (flooding) for the development site:
    a. No flooding on development site, except where planned (30 year high estimated rainfall).
    b. No internal property flooding (100-year high intensity rainfall event).
    c. No internal flooding (100-year river event and critical duration for development site).
    d. No flooding off site except where specifically planned (100-year high intensity rainfall event).
4) River flood protection: Attenuation storage is provided with a discharge rate of Qbar.

The mitigation measures proposed as part of the SuDS management train will allow the development to comply with the items 1-4 noted above.

The SuDS Management Train



2.5.2 Green and Blue Roofs

It is proposed to provide a large extent of green and blue roof systems within the proposed development. Green/ blue roofs have been designed taking guidance from CIRIA Publications C644 – "Building Greener", C697 – "The SUDS Manual", and the Green & Blue Roof Guide 2021 produced by Dublin City Council.

Green roofs are widely recognised as an effective SuDS solution and an important tool in mitigating the adverse effects of development on rainfall run-off and for managing urban flood risk. Research in the UK by Kellagher and Lauchlan (2005)[1] and CIRIA C753 (The SuDS Manual) indicates that green roofs are effective in providing both attenuation and volume reduction in runoff for minor rainfall events.

Extensive Green Roofs areas typically contain vegetation such as sedums and small grasses, which require less maintenance than other green roof types, and no permanent irrigation system. The topsoil substrate depth is approximately 100mm.

Intensive green roofs include significant landscaping, and commonly referred as a 'roof garden'. Planting typically includes shrubs, grasses, perennials, and small species of trees. These roofs have a greater depth of build up to support the plant life, of approximately 300-500mm.

The green and blue roofs will improve water quality, reduce water quantity being discharged from the development site, offers an amenity to residents and offers a biodiversity element to the development site also (addressing the four pillars of SuDS design for the development site).

The green/ blue roof areas proposed have been maximised, considering requirements for M&E plant at roof level. At upper roof level where there are areas that have not been covered with an extensive green roof system, the surface water from these areas will be conveyed as far as possible to discharge to the extensive green roof.

The overall development site coverage for green/ blue roofs and soft landscaped areas (at podium level and upper roof level) will be greater than the minimum requirement as per the Green & Blue Roof Guide 2021 produced by Dublin City Council. Assuming 5% of the substrate depth is available for water storage, the green roofs shall provide interception storage for the first 10mm of rainfall, as required by the GDSDS criteria for River Water Quality Protection.

Please refer to Figure 2-3 for a typical green roof detail.

[1] Kellagher and Lauchlan (2005), *Use of SuDS in high density developments*

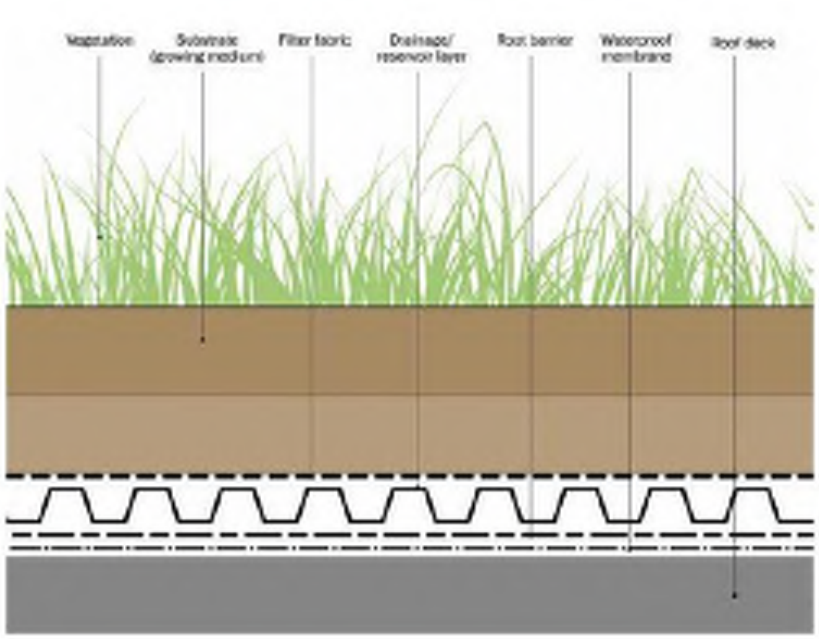


Figure 2-3: Typical Green Roof Detail (Source: SuDS manual - Figure 12.1)

The extent of green roof must meet the coverage requirements presented in Table 2-4 as a percentage of total roof area as required in the Green & Blue Roof Guide 2021 produced by Dublin City Council.

Table 2-4: Green/ blue Roof Minimum Coverage (DCC Green & Blue Roof Guide 2021).

Type of green roof	Minimum coverage (% of total roof area being developed)
Extensive	70%
Intensive	50%

A breakdown of the green/ blue roof areas can be seen below in Table 2-5. The green roof area is a mixture of extensive and intensive areas. The proposed blue roof areas will comprise of a blue roof attenuation cell with associated extensive buildup being placed on top of it. The roof over Blocks B & C is proposed with a large portion of communal terrace areas.

The total percentage of green/blue roof provided can be seen in Table 2-5 and considering the mixture of intensive and extensive roof build-up this more that satisfies the DCC requirements.

The total roof coverage is equal to 75.3% and therefore, in accordance with the Green & Blue Roof Guide 2021 produced by Dublin City Council the proposed development has achieved the required 70% extensive green roof for the total roof area.

Please refer to PUNCH drawing *222102-PUNCH-XX-XX-DR-C-015 – 0152* for extent of green roof and roof areas breakdown for individual blocks.

Table 2-5: Green Roof Area Breakdown

Area	Total Roof Area (m^2) [1]	Intensive Green Roof Area (m^2)	Extensive Green Roof Area (m^2)	Blue Roof Area with Extensive Green Roof (m^2)	Intensive + Extensive + Blue/Green Area (m^2)	Percentage Calculation
Block A	1624.5	-	787.1	592	1379.1	84.9%
Block B	1348	308.6	-	570.4	879	65.2%
Block C	1347.7	299.9	570.5	-	870.4	64.6%
Block D	982.7	-	480.7	332.9	813.6	82.8%
Single Level Roof Between Blocks A & B	332.5	-	284	-	284	85.4%
2 No. Bike Shelters	66	-	66	-	66	100.0%
Total	**5701.4**	**608.5**	**2188.3**	**1495.3**	**4292.1**	75.3%

[1] The total roof area refers to the roof area being available for green roof proposals, i.e. areas associated with parapets have been excluded from this total.

2.5.3 Permeable Surfacing

The treatment processes that occurs within permeable pavements include:

I. Filtration of silt and the attached pollutants – the majority of silt is trapped within the top 30mm of the jointing material between the blocks
II. Biodegradation of organic pollutants, such as petrol and diesel within the pavement construction
III. Adsorption of pollutants (pollutants attach or bind to surfaces within the construction) which depends on factors such as texture, aggregate structure and moisture content
IV. Settlement and retention of solids.

The use of permeable pavers for this purpose is supported by the treatment processes outlined above. CIRIA C753 (The SuDS Manual) notes that regarding interception design of pervious pavements, studies have shown that runoff typically does not occur from pervious pavements for rainfall events up to 5 mm.

It is proposed to provide 691.89^2 of permeable paving across the development site. Permeable paving will be provided in parking bays and driveways throughout the development site. It is proposed to incorporate a geocellular diffuser in the permeable paving for each of the semi-detached units. This system will allow the runoff from the units to discharge to the permeable paving system allowing for additional storage and controlled discharge to the network. Permeable paving will be located as shown on PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0150 with details shown on drawing 222102-PUNCH-XX-XX-DR-C-0550.

2.5.4 Infiltration Trenches (Filter Drains)

Proposed surface water along the development's landscaped paved areas where possible will discharge to a SuDS element for interception and treatment prior to entering the drainage network. The infiltration trenches will provide a level of attenuation storage within the voids in the stone within the trench.

The base and sides of the infiltration trench will be lined and a high-level overflow to the drainage network within the build-up will accommodate removal of water.

CIRIA C753 (The SuDS Manual) Table 24.6 notes that regarding interception design of infiltration trenches, pavements drained by infiltration trenches can be considered to provide Interception, i.e. it can be assumed that there will be zero runoff from the first 5 mm rainfall for 80% of events during the summer and 50% in winter. Infiltration trenches (filter drains) will be located as shown on PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0150 with details shown on drawing 222102-PUNCH-XX-XX-DR-C-0500.

2.5.5 Tree Root Systems

Proposed surface water along the development's landscaped paved areas where possible will discharge to a SuDS element for interception and treatment prior to entering the drainage network.

The tree root systems will incorporate drainage stone/subsoil and will provide a level of attenuation within the tree root system.

The base and sides of the tree root system will be lined and a high-level overflow to the drainage network within the build-up will accommodate removal of water.

CIRIA C753 (The SuDS Manual) Table 24.6 notes that regarding interception design of tree root system (bio retention areas), pavements drained by tree root systems can be considered to provide Interception, i.e. it can be assumed that there will be zero runoff from the first 5 mm rainfall for 80% of events during the summer and 50% in winter.

2.5.6 Attenuation Tank

The proposed attenuation tanks are sized to reduce the runoff from the development site to 11.37l/s to mimic the Mean Annual Peak Greenfield Flow (Qbar) (as detailed in Section 2.4.1 of this report) for the 1:100 year storm return period storm, with 20% additional rainfall to allow for climate change. Geo-cellular attenuation tanks are proposed, such as the Wavin AquaCell Core-R or similar. The attenuation

tanks proposed are within the manufacturers required maximum installation depths and minimum cover depths. Attenuation tanks will be located below ground as shown on PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0100.

2.5.7 Rainwater Harvesting

Rainwater harvesting (RWH) is the collection of rainwater runoff for use. Runoff can be collected from roofs and other impermeable areas, stored, treated (where required) and then used as a supply of water for various uses. RWH systems have a number of key benefits:

1. They can meet some of the building's water demand, delivering sustainability and climate resilience benefits.
2. They can help reduce the volume of runoff from a development site.
3. They can help reduce the volume of attenuation storage required on the development site.

The proposed development will incorporate rainwater harvesting in the form of water butts to the rear of the semi-detached housing units. Locations of proposed rainwater harvesting units are shown on drawing 222102-PUNCH-XX-XX-DR-C-0150.

2.5.8 Rain Gardens

A large proportion of pedestrian/fire tender pavement surfaces are to run overland to rain gardens.

The proposed rain gardens will serve to provide treatment to pavement runoff for low intensity storms. Rainwater will be treated through evapotranspiration within the filter media of the rain garden structure.

These rain gardens are to comprise a landscape area with high permeability soil in the top 900mm depth. A perforated surface water drain is to be provided at a low level to drain any excess surface water.

The extent and detail of rain gardens is to be as per the landscape architects' drawings.

Any water that drains through the above-mentioned perforated drainage pipe will subsequently discharge to the main stormwater drainage system. For the proposed development site, the rain gardens will be alongside the proposed pedestrian paved areas, taking overland flow from the surfaces.

Refer to PUNCH drawing *222102-PUNCH-XX-XX-DR-C-0150* for locations of proposed rain gardens. Please note that the rain gardens will be further detailed in the landscape drawings for the development.

2.5.9 Petrol Interceptor

It is proposed that all water run-off from the basement car park areas will outfall via a Class 1 Bypass Separator located upstream of the proposed basement pump chamber. This device will remove hydrocarbons and fine sediment particles from the development site runoff and lower the risk of downstream contamination following an oil spillage on development site.

Bypass separators fully treat all flows generated by rainfall rates of up to 6.5mm/hr. This covers over 99% of all rainfall events. Flows above this rate are allowed to bypass the separator. These separators are used when it is considered an acceptable risk not to provide full treatment for high flows, for example where the risk of a large spillage and heavy rainfall occurring at the same time is small.

Class 1 devices are designed to achieve a concentration of less than 5mg/l of oil under standard test conditions.

2.5.10 Interception and Treatment Storage Calculation

The interception storage volume will be calculated based on:

1. Entirety of the paved / roof area & basement slab area at ground level
2. 5mm rainfall depth
3. 80% runoff factor

The treatment storage volume will be calculated based on:

1. Entirety of the paved / roof area & basement slab area at ground level
2. 15mm rainfall depth
3. 80% runoff factor

Interception storage is to be provided within the green roof and landscape zones at ground level. The volumes to be provided for each zone are subject to further design development but will be ultimately outlined in Table 2-7 below, and the required volume for each area to be provided in Table 2-6.

Table 2-6: Interception and Treatment Storage Area Requirement Breakdown

Area	Impervious Area (m^2)	Interception Volume Calculation	Interception Volume Required (m^3)	Treatment Volume Calculation	Treatment Volume Required (m^3)
Residential Units Roof	1,628.50	Area x 0.005 x 0.8	6.514	Area x 0.015 x 0.8	19.542
Block A Roof	1624.50	Area x 0.005 x 0.8	6.498	Area x 0.015 x 0.8	19.494
Block B Roof	1,348.00	Area x 0.005 x 0.8	5.392	Area x 0.015 x 0.8	16.176
Block C Roof	1,347.70	Area x 0.005 x 0.8	5.3908	Area x 0.015 x 0.8	16.1724
Block D Roof	982.70	Area x 0.005 x 0.8	3.9308	Area x 0.015 x 0.8	11.7924
Single Level Roof Between Blocks A & B	332.50	Area x 0.005 x 0.8	1.33	Area x 0.015 x 0.8	3.99
Bike Shelters Roof	66	Area x 0.005 x 0.8	0.264	Area x 0.015 x 0.8	0.792
Basement Slab at Ground Level	2,399.62	Area x 0.005 x 0.8	9.59848	Area x 0.015 x 0.8	28.79544
Road/ Parking Areas	2,552.51	Area x 0.005 x 0.8	10.21004	Area x 0.015 x 0.8	30.63012
Paved areas at rear of residential units	137.15	Area x 0.005 x 0.8	0.5486	Area x 0.015 x 0.8	1.6458
Footpaths	1,657.95	Area x 0.005 x 0.8	6.6318	Area x 0.015 x 0.8	19.8954
Total	14,077.13		56.31		168.93

Table 2-7: Interception and Treatment Storage Provision Calculation

Type	Plan Area of Suds Feature (m^2)	Rate Calculation	Interception Rate	**Interception Volume Calculation**	Interception Volume Provided (m^3)	Treatment Rate	**Treatment Volume Calculation**	Treatment Volume Provided (m^3)
Intensive Green Roof	608.45	Based on a minimum 500mm deep engineered soil depth	5l/sq.m	Area x Interception Rate	3.04	30% storage available	Area x system depth x storage available	91.28
Blue Roof with Extensive Green Roof	1495.35	Based on a minimum 100mm deep water storage and 100mm deep sedum moss substrate	5l/sq.m	Area x Interception Rate	7.48	30% storage available	Area x system depth x storage available	44.86
Extensive Green Roof	2188.31	Based on a minimum 100mm deep sedum moss substrate	5l/sq.m	Area x Interception Rate	10.94	30% storage available	Area x system depth x storage available	65.65
Permeable Pavement	691.89	Deemed to provide treatment for area draining to SuDS measure up to 5 times permeable pavement area (as per Table 24.6 of the UK SuDS Manual 2015). 450mm deep drainage layer with 30% voids	Area draining to SuDS measure. x 0.005m rainfall depth	Area draining to SuDS measure. x 0.005m rainfall depth	9.56	30% storage available	Area x system depth x storage available	93.41
Infiltration Trenches	58.63	Roads drained by infiltration trenches can be considered to provide Interception (as per Table 24.6 of the UK SuDS Manual 2015).	Road area draining to SuDS measure. x 0.005m rainfall depth	Road area draining to SuDS measure. x 0.005m rainfall depth	10.29	30% storage available	Area x system depth x storage available	7.92

Type	Plan Area of Suds Feature (m^2)	Rate Calculation	Interception Rate	**Interception Volume Calculation**	Interception Volume Provided (m^3)	Treatment Rate	**Treatment Volume Calculation**	Treatment Volume Provided (m^3)
Tree Pits	135no. tree pits = 194.42m2	Deemed to provide treatment for up to 5 times area draining to SuDS measure (as per Table 24.6 of the UK SuDS Manual 2015).	Area draining to SuDS measure. x 0.005m rainfall depth	Area draining to SuDS measure. x 0.005m rainfall depth	4.86	30% storage available	Area x system depth x storage available	52.49
Rain Gardens	274.33	Impervious basement slab at ground level. 600mm deep drainage layer with 30% voids	Area draining to SuDS measure. x 0.005m rainfall depth	Area draining to SuDS measure. x 0.005m rainfall depth	13.37	30% storage available	Area x system depth x storage available	49.38
Total	**5,511.38**	**-**	**-**		**59.54**	**-**		**404.98**

Please note that the proposed total interception storage is 59.54m^3 and treatment storage is 404.98m^3. This is more than the required total interception volume of 56.31m^3 and total treatment volume of 168.93m^3.

Please refer to PUNCH Drawing No. *222102-PUNCH-XX-XX-DR-C-0150* for the proposed sustainable urban drainage layout and PUNCH drawing *222102-PUNCH-XX-XX-DR-C-015 - 0152* for extent of green roof and roof areas breakdown for individual blocks.

2.5.11 Surface Water Quality Management

Typical key SuDS components permanence in reducing urban runoff contamination have been outlined in Table 2-8 and follow Chapter 26 of the CIRIA C753 (The SuDS Manual).

Table 2-8: Performance of SuDS components in reducing urban runoff contamination

	Concentration ranges: 25%ile - 75%ile				
	TSS	Total cadmium	Total copper	Total zinc	Total nickel
	(mg/l)	(µg/l)	(µg/l)	(µg/l)	(µg/l)
Inflow from urban surface (average values)	20-114	0.2-0.6	6-22	29-112	3-8
Selected environmental standards (Tables 26.1 to 26.5):					
Surface water	25	0.66	66	506	206
Groundwater		0.1	1.5	5	15
Outflows from SuDS components:					
Bioretention/tree pit systems	5-20	0.04-0.1	4-10	5-29	3-8
Permeable pavements	14-44	0.3-0.5	4-11	2-29	1-3
Infiltration systems	7-26		3-10	19-59	
Oil separators	16-87		6-18	60-121	

2.5.12 Amenity & Biodiversity

Many of the proposed SuDS will provide potential for amenity and biodiversity. The sedum in the extensive roofs provide opportunity for biodiversity. The intensive green roofs and Tree Root Structural Cell Systems provide potential for biodiversity. The provision of soft landscaping associated with the infiltration trenches and tree pit systems provides amenity for the residents also. Please refer to the Landscape Design Statement and associated drawings prepared by NMP Landscape Architecture for further details in relation to amenity and biodiversity provision through proposed landscaping throughout the development.

2.5.13 Operation & Maintenance

Typical key SuDS components outlined in section 2.5 will be operated and maintained in accordance with Chapter 32 of the CIRIA C753 (The SuDS Manual). A detailed operation and maintenance plan will be prepared for the Client at detailed design stage.

Regular maintenance is to be carried out typically every 1 to 3 months. Occasional maintenance is to be carried out every 6months to 1 year. Remedial maintenance is to be carried out as required.

Please refer to Table 2-9 for typical key SuDS components operation and maintenance activities.

Table 2-9: Typical key SuDS components operation and maintenance activities

Operation and maintenance activity	SuDS component					
	Green roofs, Blue Roofs	Permeable Paving	Infiltration trenches	Trees root systems	Attenuation Tanks	Bypass Separator
Regular maintenance						
Inspection	✓	✓	✓	✓	✓	✓
Litter and debris removal		✓	✓	✓	✓	✓
Grass cutting			✓	✓		
Weed and invasive plant control	✓	✓	✓	✓		
Shrub management (including pruning)				✓		
Occasional maintenance						
Sediment management		✓	✓	✓	✓	✓
Vegetation replacement	✓			✓		
Vacuum sweeping and brushing		✓				
Remedial maintenance						
Structure rehabilitation /repair	✓	✓	✓	✓	✓	

2.6 Surface Water Management Plan Conclusion

In accordance with the Dublin City Development Plan 2022-2028 Appendix 13, a Surface Water Management Plan (SWMP) has been prepared for the proposed development. The table below outlines how the requirements of the SWMP have been met.

	Dublin City Development Plan 2022-2028 Appendix 13 (SWMP) Requirement	Response
1.	Site location map with proposed planning boundary indicated in red	Please refer to Site Location Map prepared by Urban Agency (Drawing No. PP-001).
2.	Overall surface water drainage layout indicating: • Existing public surface water infrastructure • Proposed connection points to existing public sewers • Spine sewers (if any) • Detail of any surface water sewer extension, diversions, surface water sewer upgrades etc. to be clearly indicated	Please refer to PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0100 Proposed Ground Floor Drainage Layout.
3.	Report detailing existing site conditions including: • Topography • Ground conditions • Land drain features • Overland flow paths • Floodplains • Utilities	Please refer to Sections 2.1, 2.2 and 2.3 of this report. Additionally, please refer to the Site Specific Flood Risk Assessment prepared by PUNCH accompanying this application.
4.	Detail of proposed surface water management strategy shall include:	
a.	Longitudinal section details of proposed surface water pipe runs if required indicating route, levels, pipe size, gradient etc. A well-designed SuDS scheme will reduce or even eliminate the need for significant piped drainage.	Please refer to the following PUNCH drawings for longitudinal sections of the proposed surface water pipe runs: 222102-PUNCH-XX-XX-DR-C-0200 222102-PUNCH-XX-XX-DR-C-0201 222102-PUNCH-XX-XX-DR-C-0202 222102-PUNCH-XX-XX-DR-C-0203 222102-PUNCH-XX-XX-DR-C-0204 As per Section 2.5 of this report, a significant emphasis has been placed on SuDS within the development site, which results in much of the low levels storms being intercepted before water can enter the piped drainage network.

	Dublin City Development Plan 2022-2028 Appendix 13 (SWMP) Requirement	Response
b.	Identify proposed location to discharge to stream or public drainage system.	Please refer to PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0100 Proposed Ground Floor Drainage Layout for proposed location to discharge to the public drainage system.
c.	Identification of appropriate SuDS features to meet the key criteria of the GDSDS and reference in Section 16.3 of the Greater Dublin Regional Code of Practice for Drainage Works - source control and interception storage provided and volumes defined – no run-off from site for events up to 5mm. See also the Council's Sustainable Drainage Design & Evaluation Guide (2021) and Appendix 12.	Please refer to Section 2.5 of this report for details of the proposed SuDS measures at the development site. Please also refer to PUNCH SuDS layout drawings 222102-PUNCH-XX-XX-DR-C-0150, 222102-PUNCH-XX-XX-DR-C-0151 and 222102-PUNCH-XX-XX-DR-C-0152. For confirmation that interception storage provided exceed the minimum required, please refer to Section 2.5.10.
d.	Provide a clear explanation of the SuDS proposals proposed for each hardstanding area including defined control structures and sizes of same.	Please refer to Section 2.5 of this report for details of the proposed SuDS measures at the development site.
e.	Discharge rate applied.	Please refer to Section 2.4 of this report for details of the proposed discharge rate applied to the development site.
f.	Attenuation storage provided and volumes defined – storage for 1% and 3.3% annual probability with factor in accordance with the SFRA for climate change shall be applied. A figure of 20% will be applicable in most cases.	Please refer to Section 2.4 of this report for details of the proposed attenuation storage volumes proposed which caters for the 1% and 3.3% annual probability. Climate change allowance of 20% has been applied within the proposed design.
g.	Exceedance and overland flow routes.	Please refer to the Site Specific Flood Risk Assessment. Finished Floor levels within the site have been raised to ensure the proposed buildings are protected from any identified pluvial and fluvial flood risk at the proposed development site. Please refer also to Section 3 of this report that details how the existing pluvial flood risk on Fortfield Road is being addressed.
h.	Phased development – where development under a planning application/permission is phased, coordination of the overall surface water management strategy shall be implemented at the first phase in order to ensure the overall integrated design is implemented. This would allow different	The proposed development is not proposed to be phased. Therefore, the full surface water management strategy will be implemented with the proposed development in a single phase.

	Dublin City Development Plan 2022-2028 Appendix 13 (SWMP) Requirement	Response
	parts of a site to be developed at different times, while ensuring that the final developed site shall meet the overall design criteria as set out in this Appendix.	
i.	Identify green space and public space locations including any that are designed to be multifunctional – integrating SuDS (see also Section 15.6 – Green Infrastructure and Landscaping).	Please refer to Niall Montgomery + Partners (NMP) Landscape Architecture Total Open Space layout (NMP drawing L1-101).
j.	Details of any proposed wayleaves or land transfers in relation to surface water drainage.	The only proposed surface water drainage element that is proposed to be taken in charge by DCC is the proposed detention basin to address the existing pluvial flood risk on Fortfield Road. Please refer to PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0470 for details of the proposed detention basin, and Section 3 of this report.
k.	An undertaking that SuDS will be completed to taking in charge standards (in accordance with Policy SI26).	All proposed SuDS will be completed to DCC's taking in charge standards.

3 Fortfield Road Pluvial Flood Management

As outlined in PUNCH Consulting Engineers' Site Specific Flood Risk Assessment (SSFRA), a pluvial flood risk associated with the 1% AEP (Annual Exceedance Probability) has been identified along Fortfield Road. For details on the estimated flood volume, predicted at 70m³ for the 1% AEP, please refer to the Site Specific Flood Risk Assessment submitted under separate cover.

A proposal has been developed to address the pluvial flooding on Fortfield Road, which includes the provision of a detention basin within the proposed development site. This detention basin has a storage capacity of 91.80m³, representing a 31% overprovision for the 1% AEP flood event. This volume is designed to fully accommodate the predicted pluvial flood volumes in accordance with the design requirements for the 1% AEP flood extents.

The pluvial flood alleviation strategy during a flood event will operate as follows:

1. There is an existing low point on Fortfield Road, directly adjacent to the proposed development site boundary, where the road level is approximately 47.58mOD. During an intense rainfall event, water will begin to accumulate at this location. Existing gullies on Fortfield Road capture rainfall from low-intensity storms by draining surface water into the public surface water sewers. However, pluvial flooding will occur when rainfall intensity exceeds the capacity of the existing drainage infrastructure, overwhelming the network.
2. Once pluvial flooding starts to accumulate on Fortfield Road and reaches a level of approximately 47.70mOD, the proposed detention basin system will come into effect. It is proposed to take up and relay the footpath lining the east side of Fortfield Road between the roadway and the proposed detention basin. A new footpath will be laid, with a standard 125mm high kerb on the roadside, but with a 1:40 fall towards the detention basin. Therefore, when flood water reaches a level of approximately 47.70mOD, it will overtop the kerb and footpath and flow down towards the detention basin.
3. To ensure surface water does not pool at the back of the footpath for low level storms, a filter drain will be installed directly adjacent to the footpath. This will remove water from the footpath to prevent pooling or standing water during low level storms.
4. For safety reasons, a fence will be installed around the perimeter of the detention basin. There will be 300mm clearance between the ground and the bottom of the fence so that vegetation or debris will not block the flow of water during a flood event by getting blocked in a grid type fence. This 300mm clearance is also low enough to prevent access by small children into the detention basin area. A gate for maintenance access will also be provided. The location of this gate and the final fence type will be agreed with DCC prior to construction of the detention basin.
5. At the base of the detention basin, a 500mm deep filtration blanket is proposed. Once the flood risk subsides and capacity becomes available in the public surface water sewer, the water in the detention basin will filter down through the blanket, into a 225mm diameter filter pipe, and then be discharged into the public surface water sewer via a catchpit manhole, which will capture any remaining silt. A non-return valve will be installed in the discharge manhole to prevent backflows from the public surface water sewer into the detention basin during rainfall events.

For a plan of the proposed drainage network, detention basin extents, and discharge point from the development site, please refer to PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0100. Additionally, refer to PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0470 for a detailed view of the detention basin and associated section views.

At the request of DCC, a further exercise was carried out to confirm that the 0.1%AEP pluvial flood event will not result in property flooding. This was done by calculating the available overground pluvial storage

volume within the development site including the detention basin, roads and verges and comparing it against the estimated 0.1% pluvial flood volume of 120m^3. The road levels and camber of the roadways have been designed to prevent flood water overtopping the kerbs within the development site, protecting the residential buildings. This exercise confirmed that there is sufficient storage available within the development site to ensure that the development will not flood even in the extreme 0.1%AEP pluvial event.

As this system will be entirely separate from the proposed drainage network serving the proposed development, there is a clear delineation between the networks. It is proposed that the detention basin will be takin in charge by DCC.

3.1.1 Detention Basin Design

The detention basin design aligns with the principles set out in the CIRIA SuDS Manual (2015). The basin features side slopes with a gradient of 1:3, which is standard practice as outlined in the CIRIA UK SuDS Manual 2015 to ensure stability and safety while allowing for effective water storage and drainage. This gentle slope facilitates maintenance, providing easy access for vegetation cutback and general upkeep, while enhancing the basin's overall aesthetic and ecological value. The basin is designed to remain dry for the majority of the time, only filling with pluvial flood water during high-intensity rainfall events.

Due to unsuitable ground conditions for infiltration, an impermeable liner is proposed to line the detention basin. An infiltration test conducted undertaken by IGSL (as outlined in their Geotechnical Report (Ref No. 24013) dated May 2022) at the location of the proposed basin revealed no measurable fall in water level over a 60-minute period. Based on the ground investigation results, it is reasonably concluded that the area is not suitable for infiltration, and the installation of an impermeable liner is recommended to ensure the basin functions effectively.

Fencing is proposed around the perimeter of the basin for safety reasons. Refer to PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0470 for location of proposed fence. Gate locations will be agreed with DCC prior to construction to ensure straightforward access for routine maintenance tasks, including sediment removal. Edge planting will be used as a natural deterrent to discourage unauthorised access while also contributing to biodiversity by providing habitats and helping the basin blend into the surrounding landscape.

Overall, the detention basin complies with the requirements for sustainable and effective flood management as recommended by the CIRIA SuDS Manual, while also prioritising safety, ease of maintenance, and environmental benefits.

3.1.2 Maintenance of the Detention Basin

The detention basin will require regular maintenance when taken in charge by DCC to ensure continuing operation to design performance standards. Site vegetation should be trimmed as necessary and the detention basin should be kept free of leaf build-up. Slope areas that have become bare should be re-vegetated and any eroded areas should be regraded before replanting.

Table 3-1 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.

Table 3-1: Operation and Maintenance Requirements of Detention Basin.

Maintenance schedule	Required Action	Typical frequency
Regular maintenance	Remove litter and debris	Monthly (or as required)
	Cut the grass – public areas	Monthly (during growing season)
	Cut the meadow grass	Half yearly (spring, before nesting season, and autumn)
	Inspect material and bankside vegetation and remove nuisance plants (for first 3 years)	Monthly (at start, then as required)
	Inspect inlets, outlets, banksides, structures, pipework etc for evidence of blockage and/or physical damage	Quarterly
	Hand cut submerged and emergent aquatic plants (at minimum of 0.1 m above basin base; include max 25% of basin surface)	Annually
	Tidy all dead growth (scrub clearance) before start of growing season	Annually
Occasional maintenance	Remove sediment from the basin when volume is reduced by 10%.	As required
Remedial actions	Repair erosion or other damage	As required
	Replant, where necessary	As required
	Repair/ rehabilitate inlets, outlets, and overflows	As required

4 Foul Water Drainage Design

4.1 Existing Foul Water Drainage

Available records obtained from Uisce Éireann show the following foul water drainage infrastructure exists within lands in close proximity to the development site:

1. 225mm vitrified clay foul sewer flowing south to north along Fortfield Road. This sewer increases in size to a 300mm foul sewer and splits into two lines at the junction of Fortfield Road and Greenlea Road.
2. 375mm concrete combined sewer flows west-east along Greenlea Road.

Please refer to Appendix A for Record Drawings illustrating the existing stormwater drainage arrangement. An extract is shown in Figure 4-1 below.

Figure 4-1: Existing foul drainage surrounding the development site (Extract from Uisce Éireann records).

4.2 Proposed Foul Water Drainage

The proposed foul water sewers have been designed using Causeway Flow software in accordance with Uisce Éireann's *Code of Practice for Wastewater Infrastructure* and the DOE's *Recommendations for Site Development Works for Housing Areas*. The foul loading has been calculated in accordance with the *Code of Practice for Wastewater Infrastructure* (particularly Section 3.6, Appendix C and Appendix D) published by Uisce Éireann.

It is proposed that the foul sewer will discharge by gravity to the sewer on Fortfield Road. All foul water drainage shall be designed in accordance with Uisce Éireann's Wastewater Code of Practice and Standard Details.

To ensure the proposed foul drainage can connect to the existing foul sewer on Fortfield Road, and to ensure pipe gradients are provided in accordance with Uisce Éireann's Wastewater Code of Practice, the proposed development site levels have been raised to achieve adequate cover, with a concrete surround proposed to pipes where adequate cover as per Uisce Éireann's Wastewater Code of Practice cannot be achieved. The concrete surround to pipes will be installed in line with Uisce Éireann's Standard Details for Wastewater Infrastructure.

The construction phase of the proposed development is estimated to have a duration of 36 months. Therefore, the timeline for connection to the public foul drainage system will be approx. 34-36 months after commencement of construction on development site.

Table 4-1 describes the foul water drainage design parameters used.

Table 4-1: Foul Water Drainage Design Parameters from Uisce Éireann Code of Practice for Wastewater Infrastructure

Description	Value
Residential Flow Rate	150 l/person/day
Communal Amenities & Culture/ Art Space Flow Rate (flow rate obtained from Wastewater Engineering: Treatment and Resource Recovery by Metcalf & Eddy)	400 l/day/100m^2
Creche Flow Rate	90 l/person/day
Persons per Dwelling	2.7
Infiltration	10%
Peaking Factor	6 x dry weather flow (DWF) (Residential)
Minimum Self Cleansing Velocity	0.75m/s
Minimum Pipe Diameter	150mm

Table 4-2: Foul Sewerage Dry Weather Flow

Source	Quantity	Unit	Flow	Flow unit	Daily	DWF	DWF	6 DWF	6 DWF + 10% infiltration
					(litres/ day)	m^3/day	litres/ sec	litres/ sec	litres/ sec
Domestic	284	Dwelling	405	l/unit/ day	115,020	115.02	1.33	7.99	8.79
Communal Amenities & Culture/ Art Space	1701.4	m^2	400	l/day/ 100m^2	6,806	6.81	0.08	0.47	0.52
Creche	30	Children & Staff	90	l/unit/ day	2700	2.70	0.03	0.19	0.21
				Total	124,526	124.53	1.44	8.65	9.51

4.3 Correspondence with Uisce Éireann

A Pre-Connection Enquiry Form has been issued to Uisce Éireann in relation to the proposed development and Uisce Éireann has issued a Confirmation of Feasibility for the proposals. This Confirmation of Feasibility can be seen in Appendix D.

Uisce Éireann has confirmed that the wastewater connection is feasible subject to upgrades. In order to accommodate the proposed connection, upgrade of the existing 225mm VC sewer on Fortfield Road to a 300mm ID sewer for approximately 60m, will be required. This has been included in the development proposals, as shown on PUNCH drawing 222102-PUNCH-XX-XX-DR-C-0100.

5 Watermain Design

5.1 Existing Watermain

Available records obtained from Uisce Éireann show, the following existing public watermain infrastructure exists adjacent to the development site:

1. 101.6mm uPVC watermain running through Fortfield Road.
2. 6-inch cast-iron watermain running through Greenlea Road.
3. 150mm MOPVC watermain running through Greenlea Road.

Please refer to Appendix A for Record Drawings illustrating the existing stormwater drainage arrangement. An extract is shown in Figure 5-1 below.

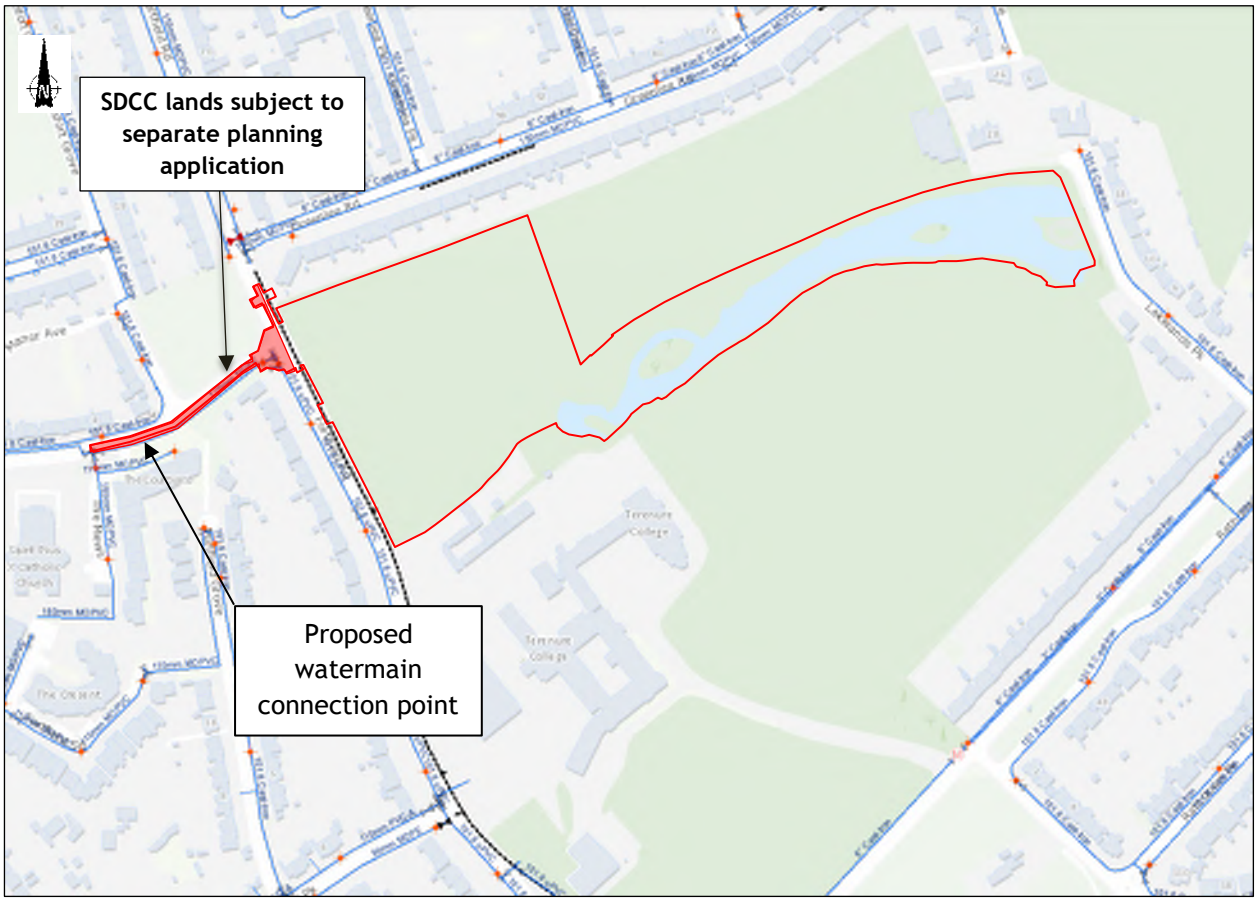


Figure 5-1: Existing watermains surrounding the development site (Extract from Uisce Éireann records)

5.2 Proposed Watermain

All watermain proposals have been designed in accordance with Uisce Éireann's Waste Code of Practice and Standard Details.

The construction phase of the proposed development is estimated to have a duration of 36 months. Therefore, the timeline for connection to the public watermain system will be approx. 34-36 months after commencement of construction on site.

Uisce Éireann have confirmed via the Pre-Connection Enquiry process that the development can be supported by the public watermain network.

Two watermain networks have been provided for the development site:

1) The watermain being fed directly from the public watermain on College Drive that will provide potable water to each residential block and house on the development site.
2) The fire main. There is a fire storage tank provided within the centre of the development site. This water within this fire storage tank will be pumped around a proposed fire main, which will be separate to the potable watermain. Pump sets from the tank are to operate to ensure 35l/s flow for 60 minutes. The tank has been sized to cater for this flow rate, with a volume of 126m^3.

Refer to Drawing 222102-PUNCH-XX-XX-DR-C-0300 for the proposed watermain layout for the proposed development.

Table 5-1 describes the watermain design parameters used.

Table 5-1: Watermain Design Parameters from Uisce Éireann Code of Practice for Water Infrastructure with flow rates taken from Uisce Éireann Code of Practice for Wastewater Infrastructure

Description	Value
Residential Flow Rate	150 l/person/day
Communal Amenities & Culture/ Art Space Flow Rate (flow rate obtained from Wastewater Engineering: Treatment and Resource Recovery by Metcalf & Eddy)	400 l/day/100m^2
Creche Flow Rate	90 l/person/day
Persons per Dwelling	2.7
Average Demand	1.25 DWF
Peak Demand	5 x Average Demand

Table 5-2: Watermain Design Calculation

Category	Quantity	Unit	Flow	Flow unit	Daily Flow (l/day)	DWF (l/s)	Average Demand (1.25DWF) (l/s)	Peak Demand (5xAvg.) (l/s)
Domestic	284	Dwelling	405	l/unit/ day	115,020	1.33	1.66	8.32
Communal Amenities & Culture/ Art Space	1701.4	m^2	400	l/day/ $100m^2$	6,806	0.08	0.10	0.49
Creche	30	Children & Staff	90	l/unit/ day	2,700	0.03	0.04	0.20
				Total	**124,526**	**1.44**	**1.80**	**9.01**

To reduce the water demand on Local Authority water supplies and to reduce the foul discharge from the development, water conservation measures will be incorporated in the sanitary facilities throughout the development, e.g. dual flush toilets, monobloc low volume push taps and waterless urinals.

The watermain layout has been designed in accordance with "Uisce Éireann Code of Practice for Water Infrastructure". All watermains are to be constructed in accordance with Uisce Éireann Code of Practice.

Important Note: Please note that the proposed watermain extension and connection to the public network extends through South Dublin County Council (SDCC) lands as illustrated in Figure 4-1 and Drawing 222102-PUNCH-XX-XX-DR-C-0300. A separate planning submission relating to proposed Works on SDCC lands (including the watermain extension and connection to the public network) is being progressed with SDCC in parallel with this LRD planning submission.

5.3 Correspondence with Uisce Éireann

A Pre-Connection Enquiry Form has been issued to Uisce Éireann in relation to the proposed development and Uisce Éireann has issued a Confirmation of Feasibility for the proposals. This Confirmation of Feasibility can be seen in Appendix D.

Uisce Éireann has confirmed that the watermain connection is feasible without infrastructure upgrades.