Project

Proposed Residential Development,
Parkside 4, Parkside, Dublin 13

Report Title

Infrastructure Design Report

Client

Cairn Homes Properties Ltd.

INFRASTRUCTURE

DBFL CONSULTING ENGINEERS

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APPENDICES

1.0 INTRODUCTION

1.1 Background

DBFL have been instructed to prepare an Infrastructure Design Report to accompany a planning application for the proposed residential development at Parkside, Dublin 13. The proposed development site is located within the Clongriffin – Belmayne Local Area Plan and is approximately 8km north-east of the City Centre

1.2 Location & Topography

The proposed development site is located to the north of Parkside Boulevard and is bounded to the north by the Mayne River. The Balgriffin Park road is located to the east and an existing park is located to the west of the site. The site is approximately 3.17Ha and is a former temporary school site.

As per Dublin City Council's development plan, the site has been zoned Z14, *to seek the social, economic and physical development and/or rejuvenation of an area with mixed use, of which residential and "Z6" would be the predominant uses.*

Generally, the site falls from west to east. The existing topography levels range from 13.5m AOD in the western area of the site to circa 10.5m AOD in the eastern area of the site.

The topographical survey has been included in as a background to the roads and site services drawings.

Figure 1.1 *Site Location (Site Boundary Indicative Only)*

1.3 Existing Ground Conditions

A Ground Investigation contract for the proposed development, was carried out by Ground Investigations Ireland Limited between May and June 2019 and included the following scope of work within the subject site:

- 8 No. Trial Pits.
- 2 No. Infiltration Tests.
- 9 No. Window Sample Boreholes.
- 1 No. Slit Trenches.
- 7 No. Cable Percussion Boreholes.
- 4 No. Rotary Core Follow-on Boreholes.
- 4 No. Groundwater Monitoring Wells.

A copy of the ground investigation report is provided with the planning application. The ground conditions of the site were summarized by Ground Investigations Ireland as follows:

- Maximum of 0.4m thick topsoil overlaying;
- Made ground layer encountered beneath topsoil or from the surface and present to depths of between 0.6m and 2.6m BGL overlying;
- Cohesive Deposits, generally described as clay, were encountered beneath Made Ground or Topsoil. Granular Deposits, generally described as gravel, were encountered within the cohesive deposits.
- Rotary core boreholes recovered Medium strong or strong grey fine grained Limestone bedrock with calcite veins. The depth to rock varies from 3.8m BGL in BH05 to a maximum of 9.2m BGL in BH01 and BH02.

Both infiltration tests carried out failed as the water level dropped too slowly to allow the required calculations. Consequently, no benefit has been assumed from infiltration of surface water in the design calculations to ensure a robust, conservative design. Notwithstanding this some infiltration will naturally occur. Groundwater was only encountered in Trial Pit TP03, which is located in the floodplain area to the north of the subject site, at 1.2m BGL.

1.4 Proposed Development

The proposed development will comprise a residential scheme of 282 residential units in 4 apartment blocks ranging in height from 3 to 7 storeys in height. Apartments will have north/south/ east/ west facing balconies/ terraces. The proposed development also includes residential amenity facilities (concierge, media centre, and gymnasium), 286 no. car parking, and 423 no. cycle parking throughout the development (in the basement and

at surface level). The proposed development provides for the continuation and completion of the Mayne River Linear Park as well as public open space and communal open spaces between the buildings. The proposed development and all other development and associated works are as set out in full in the statutory planning notices.

2.0 Flood Risk

A separate Site Specific Flood Risk Assessment has been prepared as part of this planning application (refer to DBFL Report No. 190011-rep-002).

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

3.0 SITE ACCESS AND ROAD LAYOUT

3.1 Existing Access

The existing site which previously accommodated two temporary schools had one priority access from Parkside Boulevard. This access will be relocated and upgraded as part of the proposed development.

3.2 Proposed Access

Vehicular access to the basement car park will be provided from Parkside Boulevard. A raised entry treatment table will be provided across the entrance to highlight the presence of the existing cycle track and footpath along Parkside Boulevard. Bicycle access to the basement is proposed adjacent to the vehicular ramp and is delineated by bollards.

Pedestrian access to each block will be from the footpath on Parkside Boulevard through the proposed courtyards.

Fire tender access will be provided via dropped kerbs to the podiums between blocks A & B and C & D. The podiums have been tracked to demonstrate sufficient area has been provided for the turning of the fire tender (refer to DBFL Drawings 190011-2000).

3.3 Parking and Servicing on Parkside Boulevard

It is proposed to provide 9 no. on-street visitor parking spaces including 4 no. disabled spaces on Parkside Boulevard adjacent to the existing carriageway. It is proposed to realign the existing footpath and cycle track to accommodate the parking bays. A 750mm buffer in accordance with the National Cycle Manual has been provided between the proposed parking bays and realigned cycle track. The realigned cycle track has been provided with curvature in accordance with the National Cycle Manual to reduce sharp directional changes in the alignment of the cycle track.

A loading bay is proposed on Parkside Boulevard to accommodate service vehicles for the proposed development. A waste marshalling area is also proposed adjacent to the loading bay to accommodate refuse bins at collection times.

3.4 Cyclist and Pedestrian Connectivity

It is proposed to upgrade the existing uncontrolled crossing point on Parkside Boulevard to a Toucan Crossing to provide quality connections between the proposed development and the recently constructed Parkside Development, Parkside Green-Link and future Belmayne Main Street Core Bus Corridor to the south.

It is proposed to provide an uncontrolled pedestrian crossing point adjacent to the existing mini-roundabout at Balgriffin Park to provide connectivity to the south and east towards Clongriffin.

A pedestrian crossing facility can be provided across Balgriffin Park road in conjunction with the local authority when developments are progressed on each side of Balgriffin Park road. This will provide connectivity to the development currently under construction on the east side of Balgrffin Park road and along the Mayne River.

3.5 Vehicle Tracking

The podiums have been tracked for a fire tender vehicle to ensure they can access the dry risers for firefighting requirements (refer to DBFL Drawings 190011-2000).

3.6 Traffic & Transportation

A separate Traffic and Transportation Assessment has been prepared as part of this planning application (refer to DBFL Report No. 190011-RP-D-0003).

4.0 EXISTING SERVICES AND UTILITIES

4.1 General

A comprehensive topographical survey was carried out for the subject site and existing drainage and utility records in the vicinity of the site obtained and surveyed in detail. A summary of the existing main services is provided below, and the Irish Water records can be found in Appendix B.

4.2 Surface Water Drainage

There is an existing surface water sewer within the subject site running parallel to Parkside Boulevard. This sewer connects to the existing 900mm diameter surface water sewer from the recently constructed Parkside Development which outfalls to the existing attenuation system to the west of the development. The outfall from the above attenuation system traverses the subject site to the north of the proposed buildings. These sewers are not shown on the DCC record maps as they are not taken in charge at present.

4.3 Foul Sewer

The North Fringe Sewer was constructed under the alignment of Parkside Boulevard in 2002, the sewer and its corresponding wayleave is shown on drawing number 190011-3000. No buildings, basements or structures are proposed within the wayleave of the existing North Fringe Sewer.

A 300mm diameter foul outfall from the Castlemoyne development crosses the subject site before discharging to the North Fringe Sewer. Currently this foul sewer is not an asset of Irish Water.

4.4 Water Supply

Similar to the North Fringe Sewer, a 450mm diameter watermain was constructed under Parkside Boulevard as part of the North Fringe enabling works. No buildings, basements or structures are proposed within the wayleave of the existing North Fringe Watermain.

A series of existing watermains have been laid as part of the recently constructed Parkside Development to the south of Parkside Boulevard. These watermains are shown on drawing 190011-3007 and include a 250mm diameter main running parallel to Parkside Boulevard and a series of 100mm and 150mm diameter distribution mains.

5.0 PROPOSED SURFACE WATER DRAINAGE

5.1 Surface Water Policy

The management of surface water for the proposed development has been designed to comply with the policies and guidelines outlined in the Greater Dublin Strategic Drainage Study (GDSDS) and with the requirements of Dublin City Council. The guidelines require the following 4 main criteria to be provided by the design;

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage and treatment within the green roof, attenuation systems and green podiums and garden.
- Criterion 2: River Regime Protection – satisfied by attenuating to greenfield run-off rates.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the development's surface water drainage design, planned flood routing, run-off contained within site, flood storage and building set greater than 0.5m above the 100-year flood level.
- Criterion 4: River flood protection – attenuation volume and discharge limit designed to greenfield run-off rates (long term storage not provided).

5.2 Surface Water Strategy

To meet the requirements of the surface water policy above, the surface water strategy has been described in this section to give a clearer indication of how the design development has progressed to the submitted design. To give a clearer understanding of each SuDS element, and the different stages of the treatment train, the strategy has been broken down to different levels, which include roof, podium and ground level. An overview of the different SuDS features incorporated within the development proposals can be seen on DBFL Drawing 190011-3005.

Poor permeability within the existing ground was discovered in the site investigation contract therefore no benefit has been assumed from infiltration of surface water in the design calculations to ensure a robust, conservative design. Notwithstanding this some infiltration will naturally occur.

DBFL met with Dublin City Council's Drainage Department as part of the pre-planning process where the drainage strategy was discussed and agreed.

Roof Level and Terraces:

As the first part of the treatment train, the SuDS features have been designed to prioritise interception and reduction of flow rates. The features that will be incorporated into the design are:

- Green roof - this will be an extensive type green roof with 80mm minimum construction depth. All necessary safety requirements will be designed and constructed to ensure safe maintenance can occur. The green roof will provide interception and reduction of flow rates at the beginning of the treatment train, providing source control for a large area of the development. Drawing 190011-3005 shows the extents of the greenroof. A minimum of 70% of the roof area is proposed to be green roof as requested by Dublin City Council through the pre-planning process. After surface water has passed through the Green Roof, this will pass through to the surface water drainage network to the attenuation system.
- Planters will also be installed on the roof terraces locally acting to reduce run off and allowing an element of interception to occur.
- The hardstanding of roof terraces will drain to the underlying free draining aggregate and drainage board allowing the surface water to slowly percolate through the build-up before being discharged to the open-bottomed attenuation system.
- Impermeable roof areas will be sloped towards the green roof where possible to infiltrate water runoff through the green roof build up before draining to the attenuation system.
- Remaining roof areas such as plant areas will drain via a positive drainage system to the below surface water network and open-bottomed attenuation facility.

Podium Level (Ground Floor):

- The proposed podiums of the development will predominantly be green landscaping which will act as a SuDs feature. Paved areas are provided for pedestrian and fire tender access. Generally these paved areas will drain to the green landscaping and where not possible will drain to slot drains which outfall to the free draining aggregate and drainage board below. Refer to DBFL drawing 190011-3005 for extents.

  The green landscaped areas will constitute what is similar to an intensive green roof build-up, allowing surface water run-off to slowly percolate through the vegetation, planters and build-up medium reducing the flows through the drainage network and also allowing vegetation to intercept run-off creating a reduction in run-off volumes before discharging to the drainage board below.

- Paved areas will generally drain to the green areas or to slot drains which outfall to the free draining aggregate and drainage board below allowing a reduction in flows within the drainage network.
- Once the rainwater has filtered through the various build-up mediums and drainage broard, run-off will drain to gullies located at the structural slab level and then conveyed to the below ground system via slung drainage.
- A typical drainage board and green podium is shown below.

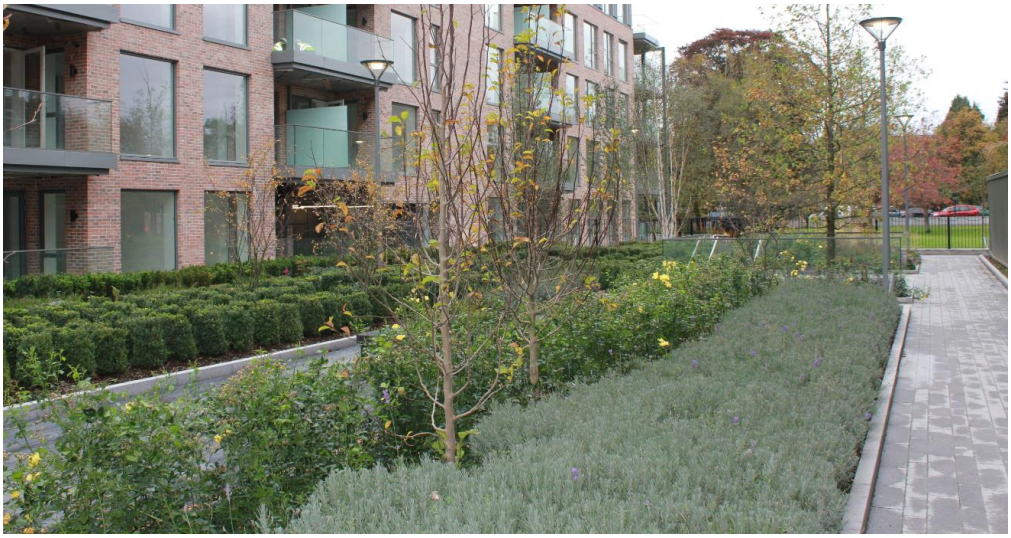

Figure 5.1 *Example of Green Podium*

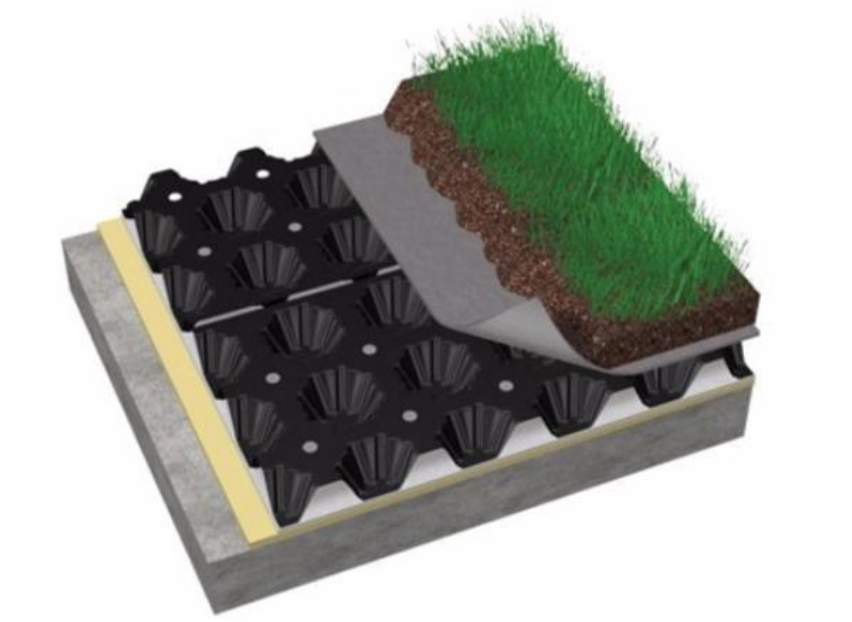

Figure 5.2 *Example of Drainage Board on Green Podium*

Ground Floor:

- The remaining areas surrounding the 4 blocks and podiums will be green landscaped areas with no positive drainage to the surface water network. The verge between the realigned footpath and cycletrack on Parkside Boulevard will be retained and realigned to reduce the impact on the existing surface water network.

The above source control SuDS measures being included within the design have been co-ordinated into the landscape design to ensure the surface water strategy is integral to the Landscape design. This has reduced the sites reliance on attenuation tanks to reduce peak run-off flow rates. Although due to the design storm event, and the need to incorporate climate change within the design a certain volume is still required within an attenuation tank to satisfied design requirements.

One attenuation tank is required to the east of Block D within the open space. The tank is sized for the 1 in 100 year storm event plus climate change (20%). SuDS elements as described previously have decreased the reliance on attenuation systems and using a co-ordinated multi element SuDS network to service the site.

The incorporation of the above SUDS elements will provide a sustainable manner in which to disperse surface water from the site and provide treatment of run-off and subsequent improvement of discharge quality.

5.3 Attenuation

Attenuation volumes have been calculated based on an allowable outflow runoff rate of 2l/s/ha as required by Dublin City Council which equates to 2.1l/s for the site based on a catchment area of 1.05ha. A summary of the gross and net impermeable areas used for the calculation of the allowable outflow runoff is summarized in Table 5.1 below:

Table 5.3 *Impermeable Areas Calculations*

Surface Type	Gross Area (m^2)	Runoff Coefficient	Net Area (m^2)
Roofs Draining to Gullies	1929	0.95	1833
Green Roofs	3528	0.7	2470
Access Ramp and Ventilation Areas	410	0.95	390

Paved Areas Over Podium	1819	0.9	1637
Green Areas Over Podium	2880	0.5	1440
Total	**10566**	**N/A**	**7770**

Underground attenuation is considered the most suitable option for the development due to space restrictions caused by the Mayne River floodplain and the development's footprint. An over ground attenuation facility with sufficient capacity to attenuate the proposed development would result in a significantly deep open water system which may be a health and safety risk to children and residents.

No groundwater was encountered in two trail pits undertaken at the proposed attenuation location therefore an opened bottomed attenuation facility is provided to promote infiltration of surface water and ground water recharge.

Run-off from the new development will be restricted to green field run-off rates and has been calculated using a maximum of 2l/s/ha in accordance with the requirements of Dublin City Council. Outflow will be controlled using a 'hydrobrake optimum' or similar approved as a flow control device. The hydrobrake orifice size will be 64mm based on the calculated allowable outflow rate. The proposed hydrobrake and underground attenuation tank will be maintained by a management company.

The impermeable areas contributing to the attenuation volume have the following reduction factors applied:

Roof Level:

- Green roofs, the proposed build-up will be a mix of intensive and extensive type with 80mm minimum construction depth. The soil build-up will primarily absorb some of the initial run-off and once saturated will reduce the flow of run-off through the green roof medium. Therefore, a reduction of volume and flow rate will occur due to the presence of the green roof. Also, the green roof plant life will absorb a percentage of the run-off, further reducing volume that will drain to the surface water network. Therefore a 30% reduction factor has been applied.
- Flat impermeable roof and roads, a 5% reduction of the surface area is applied to take account of run-off not collected and stored within the micro and macro texture of the surfacing (various sources recommend different reduction

coefficients e.g. IS EN752 recommends Runoff Coefficient (C for the Rational Method) of 0.9 to 1.0 for impermeable areas and steeply sloping roofs. For flat roofs it recommends 0.5 to 1.0 depending on area).

Podium Level & Ground Floor:

- Green areas over podium, a reduction factor of 50% has been applied. The deep soil build-up, vegetation and planting will primarily absorb a substantial amount of the initial run-off and once saturated will reduce the flow of run-off through the green roof medium.
- Paved Areas on podium and terraces will generally drain to the green areas or to slot drains which outfall to the free draining aggregate and drainage board below allowing a reduction in flows within the drainage network. Rainfall will 'wet' the initial surface of the paving allowing water to be stored in the micro and macrotexture of the surfacing and will be lost to evapotranspiration, as the run-off drains through the drainage board it will also 'wet' giving another volume reduction due to evapotranspiration and natural storage within the SuDS feature. A reduction in velocity will also occur as the aggregate used will slow the run-off at source, changing the input hydrograph which will ultimately reduce the peak inflow for attenuation calculations. A reduction factor of 10% has been applied for these reasons.

A geocellular storage system has been selected and designed to provide the required volume for the 100-year storm event (+20% climate change) using Micro Drainage source control software, refer to Appendix A for summary of results for the required storm-water durations. Calculations show that 536m^3 of storage volume for the 100-year event (+20% climate change) is required.

Surface water attenuation calculations can be found in Appendix A. The storage structure required at the selected design and the hydrobrake used are shown in the calculations.

5.4 Surface Water Outfall

The outfall for the surface water drainage is to the Mayne River at the same location as the outfall from the existing Parkside attenuation system located in the open space to the west of the proposed development. The 100 year FEMFRAMS flood level of the Mayne River at the outfall point is 11.0m AOD which is 0.8m higher than the base of the attenuation system and below the flood level at the outfall. To mitigate the risk of flood waters entering the attenuation system a "smart manhole" is proposed with a weir wall level of 11.00m AOD at the inlet to the tank to ensure that flood waters cannot enter the attenuation system and a positive head is maintained upstream of the hydrobrake. This arrangement is illustrated on drawing number 190011-3006.

Hydrobrake flow controllers are compatible for both free discharge and submerged outlet scenarios. Where the risk of a submerged outlet occurs hydrobrakes are fitted with a vent pipe which ensures that air is continuously available in the core of the vortex controller. Maintaining available air at this point ensures that the vortex motion within the hydrobrake is not inhibited by a submerged outlet condition. Therefore, it is proposed to install a vortex vent pipe as shown in Figure 5.4 below.

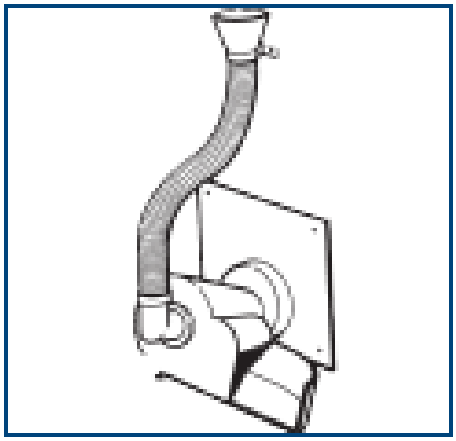

Figure 5.4 *Typical Vortex Vent Pipe*

The finished ground level surrounding the attenuation system is set at 12.5 which is 1.3m higher than the corresponding FEMFRAMS 1000 year flood level at Section 1MA2101 in the floodplain of the Mayne River adjacent to the attenuation system. This ensures floodwater will not enter the drainage system through manhole covers.

5.5 Surface Water Drainage Diversions

It is required to divert the following surface water sewers to facilitate the proposed development. The existing surface water sewers are associated with the Parkside Development and are in the control of the applicant as they are not taken in charge at present.

450mm diameter outfall

It is proposed to divert the 450mm diameter outfall from the Parkside attenuation facility to the west of the subject site. The outfall pipe is being diverted to the north of the proposed apartment blocks. The outfall pipe is not affected by the floodplain as it is downstream of the existing hydrobrake and smart manhole arrangement for the Parkside attenuation facility.

900mm diameter surface water sewer

The 900mm diameter surface water sewer conveying surface water from the Parkside Development to the Parkside attenuation facility to the west of the subject site requires

a diversion to provide a minimum clear distance of 3m between the proposed building and the sewer. An easement can be provided over the sewer when it is taken in charge by Dublin City Council.

225mm diameter surface water sewer

There is an existing 225mm surface water sewer serving Parkside Boulevard road drainage traversing the southern area of the subject site. It is required to divert the existing sewer to provide a minimum clear distance of 3m between the proposed building and the sewer. An easement can be provided over the sewer when it is taken in charge by Dublin City Council. It is not possible to relocate the sewer into the carriageway of Parkside Boulevard due to the location of the North Fringe Sewer and watermain and their associated wayleaves.

5.6 Design Standards

Storm-water drainage has been designed in accordance with the Greater Dublin Code of Practice for Drainage Works. The following design parameters are applicable to the design:

- Time of entry: 4 minutes
- Pipe Friction (Ks): 0.6 mm
- Minimum Velocity: 1.0 m/s
- Standard Average Annual Rainfall: 745mm
- M5-60: 15.5mm
- Ratio r (M5-60/M5-2D): 0.27
- Attenuation Tank Storm Return Event — GDSDS Volume 2, p61, Criterion 3

  30 year no flooding on site.

  100 year check no internal property flooding. Flood routing plan. FFL freeboard above 100-year flood level. No flooding to adjacent areas.
- Climate Change

  20% as required by DCC. (GDSDS requires 10%) 20% has been used in design.

Surface water sewers have been designed in accordance with IS EN 752 and the recommendations of the ‘Greater Dublin Strategic Drainage Study’, (GDSDS).

The minimum pipe diameter for public surface water sewers is 225mm. Private drains comprise of diameters from 100mm.

5.7 Climate Change

Surface water calculations for the development made use of rainfall values for the Parkside Area as provided by Met Eireann. Rainfall intensities were increased by a factor of 20% to take account of climate change, as required by Dublin City Council.

5.8 Flooding Provision

The lowest finished floor level (Block C & D) is set at 13.3m AOD which is 1.6m higher than the corresponding FEMFRAMS 1000 year flood level at Section 1MA2115ln in the floodplain of the Mayne River. The access ramp to the basement, located between Block A and Block B (13.44m AOD), and basement vents (13.3m AOD) are also set above the corresponding FEMFRAMS 1000 year flood levels.

In the case that an exceedance storm event occurs, in excess of the 1% AEP, the development's layout is designed to ensure over-land flows are directed away from the buildings. In larger than the 100-year storm events, there will be additional volume within the surface water network which will be able to surcharge before flooding. When this tolerance has been exceeded the attenuation storage features will flood and overtop, with overland flows expected to pass from the attenuation system and flow in a north east direction to the Mayne Road Floodplain.

The Mayne River has a catchment area of approximately 104 Km^2 (10400 ha) while the proposed development catchment area is 1.05 ha therefore a 100 year flood event in the Mayne River and the development's drainage system will not occur simultaneously. The time of concentration for the Mayne River adjacent to the site will be significantly longer than the development site's drainage network therefore the attenuation volume will have discharged to the Mayne River before the river is in flood adjacent to the site.

Flooding provision is discussed further in the Site Specific Flood Risk Assessment (refer to DBFL Report No. 190011-rep-002).

5.9 Floodplain Modification

DBFL have mapped the flood extents of the Mayne River on the detailed topographical survey for the subject site. The flood water level was provided by the FEMFRAMS project team. See attached DBFL drawing 190011-3002 for existing flood zone extents.

The extent of the predicted 0.1% AEP Flood Event is shown marginally encroaching on the proposed residential development. In order to allow a regularised development to proceed within this minor encroachment, it is proposed to modify the floodplain and provide floodplain compensation on a "level for level" basis as shown on DBFL Drawing

No. 190011-3002. Flooding is discussed further in the Site Specific Flood Risk Assessment (refer to DBFL Report No. 190011-rep-002).

DBFL have calculated the floodplain volume before and after the proposed floodplain modification using Civil 3D software and an excess floodplain volume has been provided. Refer to DBFL Drawing No. 190011-3002. The proposed development is outside the extents of the modified floodplain. Detailed cross sections of the floodplain modification at 10m chainages are provided on drawings 190011-3003 and 3004.

All earthworks and embankments constructed as part of the floodplain compensation works detailed on DBFL drawings 190011-3002, 3003 & 3004 will be constructed in accordance with TII Specification Series 600 to ensure stability of embankments.

A minimum riparian strip of approximately 12m will be achieved between the residential blocks and the Mayne River on completion of the proposed flood compensation works. The riparian strip will form part of the public park along the Mayne River.

5.10 Surface Water Quality Impact

The type of development is low risk i.e. it does not present a high risk of run-off contamination. The development's design and layout further reduce the risk of contaminants entering the surface water network as the majority of the site coverage will either be roof area or green / pedestrianised podium areas with the majority of vehicle parking provided within the basement. Run-off from roofs will have a first stage of treatment by draining through green-roof medium which in turn drain to the open bottom attenuation storage systems. Soft and hard landscaped podiums will drain via their build-ups to a slung system which in turn also drain via the geo-cellular open bottom attenuation storage systems which provide further secondary removal of pollutants due to the geotextiles and filter stone before final discharge to the Mayne River via a Class 1 Bypass Separator.

In this way it is considered that the development provides treatment of collected run-off, provides a SUDS treatment train approach and is low risk of pollutants. The proposed surface water system has therefore been designed to incorporate SuDS techniques which naturally reduce pollutants and improve water quality.

All incidental drainage from the basement car park is discharged separately via a Class 2 oil separator and pumped to the foul sewer network. The pumping station will be alarmed and connected to the building management system to alert management personnel if the pumps are running excessively or not working.

Regular maintenance of the attenuation, smart manhole, hydrobrake and interceptor is required in accordance with the manufacturer's recommendations. A yearly inspection

report will be forwarded to Dublin City Council Maintenance Department including maintenance details of the hydrobrake, smart manhole, interceptor and attenuation system.

5.11 Interception

The GDSDS recommends that no run-off should pass directly to a river for rainfall depths of 5mm and up to 10mm if possible, i.e. interception. The development's drainage design allows for collection of a majority of the site's run-off via SuDS features e.g. green roofs and landscaped podiums, providing interception at source. In turn resulting runoff is conveyed to an open bottomed attenuation storage system which remove pollutants and provide a level of further interception.

5.12 Surface Water Audit

As part of this application, the applicant has commissioned JBA Consulting to undertake a third-party surface water audit on the proposed surface water drainage and attenuation strategy for the development. JBA Consulting specialise in hydraulics and hydrology and have undertaken a number of the regional flood risk management studies for the OPW.

The final audit report concludes that the surface water drainage design for the proposed development is acceptable and meets the requirements of the GDSDS, a copy of the report is included in Appendix E.

6.0 PROPOSED FOUL DRAINAGE

6.1 Proposed Foul Layout

The proposed foul drainage layout for the development will be constructed as slung drainage within the basement and connected to an external drainage manhole to the east of Block D. It is proposed to construct a manhole on the existing 300mm foul outfall from the Castlemoyne development to the north. Foul flows from the development will connect to this manhole before discharging to the North Fringe Sewer via the existing 300mm connection. No drainage works are required to the existing North Fringe Sewer or within the wayleave for the sewer

Basement incidental car park drainage will be collected in the basement before passing through a Class 2 Light Liquid Separator and pumped to the foul network as required by GDSDS. The pumping station will be alarmed and connected to the building management system to alert management personnel if the pumps are running excessively or not working.

It is also proposed to divert the existing 300mm diameter foul outfall from the Castlemoyne Development outside the line of the proposed development. All manhole cover levels will be set above the 100 year flood level of the Mayne River.

The proposed foul drainage network can be found on DBFL drawing 190011-3000.

6.2 Design Calculations

Minimum gradients and pipe diameters for gravity collector and main sewers are designed in accordance with the Building Regulations and Irish Water's Code of Practice for wastewater infrastructure and Standard Details for wastewater infrastructure.

The sewer network is designed in accordance with the principles and methods set out in Irish Water's Code of Practice for Wastewater Infrastructure Connections and Developer Services Design & Construction Requirements for Self-Lay Developments December 2017, IS EN 752 (2008), IS EN12056: Part2 and Building Regulations Part H.

Foul sewer design criteria are as follows:

Pipe Roughness Coefficient	1.5 mm
Minimum Velocity	0.75 m/s (self-cleansing)
Maximum Velocity	3.0 m/s

Estimated peak foul loading generated by the proposed development is provided in Table 6.1 below:

RESIDENTIAL - PREDICTED DEVELOPMENT FOUL FLOWS						
Use Type	**No. of Units**	**Occupancy Rate**	**Population (P)**	**Loading (G) (l/day/person)***	**Daily Loading (PG) (l/day)**	**Daily Loading (l/s)**
Residential	282	2.7 people/dwelling	762	150	114,300	1.32
					Daily Loading	**1.32**
					Growth factor	1.00
					Infiltration @ 10% (as CoP Appendix C - 1.2.4)	0.132
					Dry Weather Flow (l/s)	**1.452**
					Residential Peaking Factor (as CoP Appendix C - 1.2.5)	6.00
					Design Foul Flow (l/s)	**8.71**
Flow rates extracted from IW CoP for Wastewater Infrastructure - Appendix D						

Table 6.1: Estimated Foul Loading for residential development

The capacity of the existing 300mm diameter foul outfall from the Castlemoyne Development has been assessed taking account of all upstream development connecting to the outfall. The 300mm pipe has capacity of 115.5 l/s. There are 950 proposed and existing residential units connected to the outfall pipe upstream of the proposed development and the proposed development has 282 residential units. See table 6.2 below which shows the pipe has capacity for the proposed development meaning the existing connection to the north Fringe Sewer is sufficient.

EXISTING CONNECTION TO NORTH FRINGE SEWER CAPACITY			
Conditions	**No. of Units**	**Flow from development (l/s)**	**Sewer Capacity (l/s)**
Existing	950	41.7	115.5
Proposed	282	7.7	115.5
Total	1228	49.4	115.5

Table 6.2: Existing Connection Pipe to North Fringe Sewer Capacity.

6.3 Compliance with Irish Water Standards

The proposed foul sewer design and layout is in accordance with the Irish Water Code of Practice for Wastewater Infrastructure and The Irish Water Wastewater Infrastructure

Standard Details. DBFL have received a Statement of Design Acceptance from Irish Water which is included in Appendix D.

An Irish Water Feedback form has been received outlining that a Wastewater connection can be facilitated for the proposed development. Refer to Appendix C for a copy of the feedback form.

7.0 WATER SUPPLY AND DISTRIBUTION

7.1 Proposed Water main and Supply

As part of the development proposals, it is proposed to provide a watermain connection for the proposed development from the existing 250mm diameter watermain constructed as part of the Parkside Development. This existing watermain runs parallel to Parkside Boulevard and connects to the 450mm diameter North Fringe Watermain at a PRV approximately 450m to the west of the proposed development.

Refer to DBFL Drawing 190011-3007 for watermain connection details. The proposed watermain will connect to the domestic water plant room in the basement where it will be pumped to feed the 4 residential blocks.

7.2 Hydrants

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

7.3 Design Calculations

The water demand is designed in accordance with the principles and methods set out in Irish Water's Code of Practice for Water Infrastructure Connections and Developer Services Design & Construction Requirements for Self-Lay Developments December 2017:

Overall water demand is calculated using IW CoP for Water Infrastructure section 3.7.2, as outlined below:

Per-capita consumption	150l/person/day
Average day/week demand factor	1.25
Peak demand factor	5.0

Average daily domestic demand = Total occupancy * Per-capita consumption

Average day/peak week demand = Average daily domestic demand * Average day/week demand factor

Peak hour water demand = Average day/peak week demand * Peak demand factor

Estimated water demand for the proposed development is provided in Table 7.1:

RESIDENTIAL WATER DEMAND							
Use Type	**No. of Units**	**Occupancy Rate**	**Population (P)**	**Average daily domestic demand (l/day)**	**Average daily domestic demand (l/s)**	**Average day/peak week demand (l/s)**	**Peak hour water demand (l/s)**
Residential	282	2.7 persons/dwelling	762	114,300	1.32	1.65	8.25
						Peak hour water demand (l/s)	**8.25**

Table 7.1 Estimated Water Demand for Residential Development

7.4 Compliance with Irish Water Standards

The proposed watermain design and layout is in accordance with the Irish Water Code of Practice for Water Infrastructure and The Irish Water Infrastructure Standard Details. DBFL have received a Statement of Design Acceptance from Irish Water which is included in Appendix D.

An Irish Water Feedback form has been received outlining that a water connection can be facilitated for the proposed development. Refer to Appendix C for a copy of the feedback form.

Appendix A

ATTENUATION CALCULATIONS

Summary of Results for 100 year Return Period (+20%)

Half Drain Time : 2447 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	10.592	0.392	0.0	1.4	1.4	117.2	O K
30 min Summer	10.744	0.544	0.0	1.4	1.4	162.7	O K
60 min Summer	10.908	0.708	0.0	1.4	1.4	211.9	O K
120 min Summer	11.086	0.886	0.0	1.6	1.6	265.2	O K
180 min Summer	11.197	0.997	0.0	1.6	1.6	298.4	O K
240 min Summer	11.278	1.078	0.0	1.7	1.7	322.7	O K
360 min Summer	11.393	1.193	0.0	1.8	1.8	357.1	O K
480 min Summer	11.474	1.274	0.0	1.8	1.8	381.1	O K
600 min Summer	11.533	1.333	0.0	1.8	1.8	399.0	O K
720 min Summer	11.579	1.379	0.0	1.9	1.9	412.7	O K
960 min Summer	11.643	1.443	0.0	1.9	1.9	431.8	O K
1440 min Summer	11.707	1.507	0.0	1.9	1.9	451.0	O K
2160 min Summer	11.729	1.529	0.0	2.0	2.0	457.4	O K
2880 min Summer	11.727	1.527	0.0	2.0	2.0	457.0	O K
4320 min Summer	11.701	1.501	0.0	1.9	1.9	449.3	O K
5760 min Summer	11.672	1.472	0.0	1.9	1.9	440.5	O K
7200 min Summer	11.638	1.438	0.0	1.9	1.9	430.3	O K
8640 min Summer	11.602	1.402	0.0	1.9	1.9	419.5	O K
10080 min Summer	11.564	1.364	0.0	1.9	1.9	408.1	O K
15 min Winter	10.639	0.439	0.0	1.4	1.4	131.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	80.311	0.0	118.8	23
30 min Summer	55.926	0.0	113.6	38
60 min Summer	36.693	0.0	217.2	68
120 min Summer	23.292	0.0	236.8	126
180 min Summer	17.704	0.0	240.6	186
240 min Summer	14.537	0.0	245.1	246
360 min Summer	10.981	0.0	256.6	366
480 min Summer	8.986	0.0	266.7	484
600 min Summer	7.687	0.0	274.0	604
720 min Summer	6.764	0.0	279.6	724
960 min Summer	5.526	0.0	287.1	962
1440 min Summer	4.153	0.0	293.6	1440
2160 min Summer	3.121	0.0	546.6	1888
2880 min Summer	2.546	0.0	558.7	2280
4320 min Summer	1.908	0.0	554.8	3072
5760 min Summer	1.553	0.0	883.6	3920
7200 min Summer	1.324	0.0	941.4	4760
8640 min Summer	1.162	0.0	959.3	5616
10080 min Summer	1.040	0.0	923.1	6448
15 min Winter	80.311	0.0	118.3	23

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	10.810	0.610	0.0	1.4	1.4	182.6	O K
60 min Winter	10.995	0.795	0.0	1.5	1.5	237.9	O K
120 min Winter	11.197	0.997	0.0	1.6	1.6	298.3	O K
180 min Winter	11.323	1.123	0.0	1.7	1.7	336.2	O K
240 min Winter	11.417	1.217	0.0	1.8	1.8	364.0	O K
360 min Winter	11.550	1.350	0.0	1.9	1.9	404.0	O K
480 min Winter	11.644	1.444	0.0	1.9	1.9	432.2	O K
600 min Winter	11.715	1.515	0.0	1.9	1.9	453.5	O K
720 min Winter	11.771	1.571	0.0	2.0	2.0	470.2	O K
960 min Winter	11.852	1.652	0.0	2.0	2.0	494.4	O K
1440 min Winter	11.943	1.743	0.0	2.1	2.1	521.7	O K
2160 min Winter	11.991	1.791	0.0	2.1	2.1	536.0	O K
2880 min Winter	11.987	1.787	0.0	2.1	2.1	534.8	O K
4320 min Winter	11.959	1.759	0.0	2.1	2.1	526.3	O K
5760 min Winter	11.901	1.701	0.0	2.0	2.0	509.0	O K
7200 min Winter	11.843	1.643	0.0	2.0	2.0	491.6	O K
8640 min Winter	11.781	1.581	0.0	2.0	2.0	473.2	O K
10080 min Winter	11.717	1.517	0.0	1.9	1.9	454.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	55.926	0.0	111.9	37
60 min Winter	36.693	0.0	234.4	66
120 min Winter	23.292	0.0	240.3	126
180 min Winter	17.704	0.0	247.3	184
240 min Winter	14.537	0.0	256.2	242
360 min Winter	10.981	0.0	271.5	360
480 min Winter	8.986	0.0	281.8	478
600 min Winter	7.687	0.0	289.2	594
720 min Winter	6.764	0.0	294.7	710
960 min Winter	5.526	0.0	301.9	942
1440 min Winter	4.153	0.0	307.2	1396
2160 min Winter	3.121	0.0	581.0	2040
2880 min Winter	2.546	0.0	591.6	2424
4320 min Winter	1.908	0.0	585.0	3288
5760 min Winter	1.553	0.0	989.8	4216
7200 min Winter	1.324	0.0	1045.8	5120
8640 min Winter	1.162	0.0	1019.6	6048
10080 min Winter	1.040	0.0	996.9	6952

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	Scotland and Ireland	Cv (Winter)	0.840
M5-60 (mm)	15.500	Shortest Storm (mins)	15
Ratio R	0.270	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.790

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.395	4	8	0.395

Model Details

Storage is Online Cover Level (m) 12.800

Cellular Storage Structure

Invert Level (m) 10.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	315.0	0.0	1.300	315.0	0.0
0.100	315.0	0.0	1.400	315.0	0.0
0.200	315.0	0.0	1.500	315.0	0.0
0.300	315.0	0.0	1.600	315.0	0.0
0.400	315.0	0.0	1.700	315.0	0.0
0.500	315.0	0.0	1.800	315.0	0.0
0.600	315.0	0.0	1.900	0.0	0.0
0.700	315.0	0.0	2.000	0.0	0.0
0.800	315.0	0.0	2.100	0.0	0.0
0.900	315.0	0.0	2.200	0.0	0.0
1.000	315.0	0.0	2.300	0.0	0.0
1.100	315.0	0.0	2.400	0.0	0.0
1.200	315.0	0.0	2.500	0.0	0.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0059-2100-1900-2100
Design Head (m)	1.900
Design Flow (l/s)	2.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	59
Invert Level (m)	10.100
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.900	2.1
Flush-Flo™	0.261	1.4
Kick-Flo®	0.527	1.2
Mean Flow over Head Range	-	1.6

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

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	1.200	1.7	3.000	2.6	7.000	3.8
0.200	1.4	1.400	1.8	3.500	2.8	7.500	4.0
0.300	1.4	1.600	1.9	4.000	3.0	8.000	4.1
0.400	1.4	1.800	2.0	4.500	3.1	8.500	4.2
0.500	1.2	2.000	2.1	5.000	3.3	9.000	4.3
0.600	1.2	2.200	2.2	5.500	3.4	9.500	4.4
0.800	1.4	2.400	2.3	6.000	3.6		
1.000	1.6	2.600	2.4	6.500	3.7		

Appendix B

IRISH WATER RECORDS

UISCE ÉIREANN : IRISH WATER

Legend

- Bulk Meter
- Unknown Meter ; Other Meter
- PRV
- Sluice Valve Open
- Sluice Valve Closed
- Butterfly Valve Open
- Sluice Valve Closed
- Double Air Control Valve

Water Hydrants

Hydrant Function

- Fire Hydrant
- Telemetry Kiosk
- Cap
- Other Fittings

Water Distribution Mains

Owned By

- Irish Water
- Irish Water

Sewer Manholes

Manhole Type

- Standard
- Other; Unknown
- Gravity - Foul
- Gravity - Overflow

Storm Manholes

Manhole Type

- Standard

Storm Discharge Points

Discharge Type

- Outfall
- Surface Gravity Mains
- Surface Gravity Mains Private

Storm Inlets

Inlet Type

- Gully
- Storm Detention Areas

1:1,000 at A0

Last edited: 30/01/2018

Metres

0 25 50 100

Appendix C

IRISH WATER FEEDBACK FORM

Fernando Szeliga
Ormond House
Ormond Quay Upper
Dublin 7, Dublin

15 August 2019

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

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

www.water.ie

Dear Fernando Szeliga,

Re: Connection Reference No CDS19006004 pre-connection enquiry -
Subject to contract | Contract denied

Connection for Housing Development of 300 units at Belmayne North, Dublin 13.

Irish Water has reviewed your pre-connection enquiry in relation to water and wastewater connections at Belmayne North, Dublin 13, Dublin.

Based upon the details that you have provided with your pre-connection enquiry and on the capacity currently available in the networks, as assessed by Irish Water, we wish to advise you that, subject to a valid connection agreement being put in place, your proposed connection to the Irish Water networks can be facilitated.

Water:
The proposed water connection for this development connects to the Irish Water network via infrastructure that has not been taken in charge by Irish Water (Third Party Infrastructure). Please be advised that at connection application stage and prior to the commencement of any Self-Lay Works, you have to:

- identify and procure transfer to Irish Water of the arterial water Infrastructure within the Third Party Infrastructure
- demonstrate that the arterial infrastructure are in compliance with requirements of Irish Water Code of Practice and Standard Details and in adequate condition and capacity to cater for the additional water demand

New connection to the existing network is feasible without Irish Water network upgrade with above conditions related to the Third Party Infrastructure.

Wastewater:

New connection to the existing network is feasible without upgrade.

Strategic Housing Development

Irish Water notes that the scale of this development dictates that it is subject to the Strategic Housing Development planning process. Therefore:

A. In advance of submitting your full application to An Bord Pleanala for assessment, you must have reviewed this development with Irish Water and received a Statement of Design Acceptance in relation to the layout of water and wastewater services. All infrastructure should be designed and installed in accordance with the Irish Water Codes of Practice and Standard Details.

B. You are advised that this correspondence does not constitute an offer in whole or in part to provide a connection to any Irish Water infrastructure and is provided subject to a connection agreement being signed and appropriate connection fee paid at a later date.

A connection agreement can be applied for by completing the connection application form available at **www.water.ie/connections**. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities.

If you have any further questions, please contact Marina Zivanovic Byrne from the design team on 01 89 25991 or email mzbyrne@water.ie. For further information, visit **www.water.ie/connections.**

Yours sincerely,

Maria O'Dwyer

Connections and Developer Services

Appendix D

IRISH WATER STATEMNENT OF DESIGN ACCEPTANCE

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

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

www.water.ie

Cairn Homes Construction Ltd.,
c/o Fernando Szeliga,
7 Grand Canal,
Grand canal Street Lower,
Dublin
D02 KW81

20 September 2019

Re: Design Submission for Belmayne North, Dublin 13 (the "Development") (the "Design Submission") / Connection Reference No: 9157570868

Dear Fernando Szeliga,

Many thanks for your recent Design Submission.

We have reviewed your proposal for the connection(s) at the Development. Based on the information provided, which included the documents outlined in Appendix A to this letter, Irish Water has no objection to your proposals.

This letter does not constitute an offer, in whole or in part, to provide a connection to any Irish Water infrastructure. Before you can connect to our network you must sign a connection agreement with Irish Water. This can be applied for by completing the connection application form at www.water.ie/connections. Irish Water's current charges for water and wastewater connections are set out in the Water Charges Plan as approved by the Commission for Regulation of Utilities (CRU)(https://www.cru.ie/document_group/irish-waters-water-charges-plan-2018/).

You the Customer (including any designers/contractors or other related parties appointed by you) is entirely responsible for the design and construction of all water and/or wastewater infrastructure within the Development which is necessary to facilitate connection(s) from the boundary of the Development to Irish Water's network(s) (the "**Self-Lay Works**"), as reflected in your Design Submission. Acceptance of the Design Submission by Irish Water does not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

If you have any further questions, please contact your Irish Water representative:

Name: Donal O'Dwyer
Phone: (022) 54606
Email: dodwyer@water.ie

Yours sincerely,

Maria O'Dwyer
Connections and Developer Services

Appendix A

Document Title & Revision

- [190011-3000 Rev. A Site Services Layout]
- [190011 – Drainage.mdx Foul Water Longitudinal Sections]

Standard Details/Code of Practice Exemption:
<N/A>

For further information, visit ***www.water.ie/connections***

Notwithstanding any matters listed above, the Customer (including any appointed designers/contractors, etc.) is entirely responsible for the design and construction of the Self-Lay Works. Acceptance of the Design Submission by Irish Water will not, in any way, render Irish Water liable for any elements of the design and/or construction of the Self-Lay Works.

Appendix E

JBA STORMWATER DRAINAGE AUDIT REPORT

STORMWATER AUDIT (STAGE 1)

JBA Project Code	2019s1153
Contract	Residential Development at Parkside 4, Parkside, Dublin 13
Client	Cairn Homes
Date	10th October 2019
Author	Leanne Leonard
Subject	**Stormwater Audit - Stage 1 Report**

1 Residential Development at Parkside 4, Parkside, Dublin 13.

1.1 Introduction

JBA Consulting have been contracted by Cairn Homes to undertake a Stage 1 audit of the surface water drainage design by DBFL for the proposed residential development at Parkside 4, Parkside, Dublin 13.

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

1.2 Stage 1 Audit

Design Parameter	Audit Result
Proposed Development	The subject site is located to the north of Parkside Boulevard and is bounded along the northern boundary by the Mayne River. The proposed development will comprise 282nr apartments in 4nr separate blocks. The total site area is stated to be 3.17 hectares (ha), however, only 1.05ha of the site will comprise impermeable surfaces drained to the proposed storm water system. The subject of this Stage 1 stormwater audit is to review the proposed surface water drainage design and sustainable urban drainage system proposals for the proposed development.
Relevant Studies/Documents	The following documents were considered as part of this surface water audit: • The SuDS Manual (CIRIA C753); • Recommendations for Site Development Works for Housing Areas (DoEHLG); • Greater Dublin Strategic Drainage Strategy (GDSDS);
Key Considerations & Benefits of SUDs	The key benefits and objectives of SuDS considered as part of this audit and listed below include: • Reduction of run-off rates; • Provision of volume storage; • Volume treatment provided; • Reduction in volume run-off; • Water quality improvement; • Biodiversity.
Site Characteristics	**Soil:** A site investigation was undertaken by Ground Investigations Ireland in May - June 2019, typically 0.4m topsoil overlying made ground overlying cohesive deposits. Infiltration testing was carried out as part of the SI, the results of which indicated very little by any of infiltration. The proposed discharge rate as required by Dublin City Council is 2l/sec/ha which is lower than the QBAR value, hence, a more conservative design. **Rainfall (basis for surface water pipeline network design):** Rainfall parameters can be estimated using Met Éireann data, using the Flood Studies Report (FSR) values or the values in the GDSDS. The Met Éireann method can be more representative of a site if selected correctly. A comparison of values estimated by DBFL and JBA is shown below: **DBFL value** / **JBA Value** Rainfall model: Met Éireann / Met Éireann M5-60 (mm): 15.50mm / 15.5mm Ratio R: 0.270 / 0.275

	The above variances are within acceptable limits with no impact on the design. DBFL propose to discharge to the Mayne River via the existing surface water pipe from Parkside. **Windes Calculations** Attenuation provision is made for the 1 in 100-year event plus 20% Climate Change.
SuDS Measures Considered	DBFL have included the following SUDs measures within the proposed development. No reference has been made to any other measures considered.

SUDS Technology	Comments
Blue/Green Roofs	Green roofs are proposed to all apartment blocks
Swale/ Filter Drain / Infiltration trench	Planters will be provided on roof terraces
Permeable Paving	Hardstanding roof terraces will drain to underlying free draining aggregate and drainage board.
Petrol Interceptor	It is proposed to include a hydrocarbon interceptor prior to discharge from site.
Surface Water Attenuation	Attenuation will be provided by way of: A. 1 nr primary attenuation system to the east of block D. B. planters. C. drainage boards D. local SuDS / landscaped features E. Green roofs to apartment blocks.
Site Run-off Rates	DBFL propose to limit discharge to the equivalent of 2l/sec/ha for all storm events as per the requirements of Dublin City Council.
Detention Basins, Retention Ponds, Stormwater Wetlands	N/A
Tree Root Structural Cell Systems, Bio-retention, rain garden	1st floor podium will be drained to green landscaped areas.

Surface Water Drainage Design	All surface water flows generated by the development will be attenuated and discharged to the Mayne River at a rate 2.1l/sec (2l/sec/ha).
SuDS Management Train	**Source Control** and **Site Control** are addressed by the use of SuDS devices (interception storage) and attenuation with outflow controlled by a Hydrobrake. A petrol interceptor has been proposed prior to discharge from site. As recommended with the SUDs Manual (Table 3.3) assuming effective pre-treatment is in place the following number of treatment train components are recommended:

	<table><tr><th></th><th>No. of treatment train components recommended</th><th>Comment/Proposals</th></tr><tr><td>Roof areas</td><td>1</td><td>Green roof, planters, aggregate build up under roof terraces, drainage boards, green landscaping will address all impermeable areas.</td></tr><tr><td>Residential roads, parking areas, commercial zones</td><td>2</td><td>Not applicable</td></tr><tr><td>Refuse collection, industrial areas, loading bays, lorry parks and highways.</td><td>3</td><td>Not applicable.</td></tr></table> A hydrobrake designed for a linear discharge profile will be provided at the outfalls of the attenuation structures to limit flows to a maximum of 2l/sec/ha to the Mayne River.
Climate Change	An allowance of 20% increase in flows has been included for climate change for the rainfall intensities for the purposes of sizing the attenuation storage. This is over and above the requirements of the GDSDS.
Volume Storage	DBFL have run a Windes model to assess the attenuation volumes provided. The proposed attenuation structure is sized such that surcharging to a level greater than 300mm below manhole cover level will not occur. Volumes account for the 100-year return storm event + climate change.
Volume Run-off	No comparison of pre and post development storm volumes have been provided, however, as it is proposed to limit discharge to 2l/sec/ha for all storm events, such a calculation is not deemed necessary.
Treatment Volume / Water Quality Improvement	Interception storage is now proposed by way green roof, planters and drainage boards and open bottomed attenuation.
Return Period	A 100-year return period plus 20% for climate change has been used in the design for the attenuation systems.
Exceedance flows	DBFL have considered exceedance flows. In the unlikely event of blockage of roof terrace gullies / slot drains, flow will be conveyed to local and adjacent SuDS / landscape features. DBFL have also introduced additional gullies / slot drains to minimise risk associated with blocked gullies.
Health & Safety and Maintenance Issues	The proposed drainage system comprises SuDS devices, traditional gullies / slot drains, attenuation systems and underground pipes. These elements are considered acceptable from a Health & Safety perspective once supplier/manufacturers guides are followed and complied with during the detailed design, construction and operation. Optimum performance of the SuDS treatment train is subject to the frequency of maintenance provided. At detailed design stage, it is recommended that a maintenance regime be adopted.

	Particular consideration is required at detailed design stage to the design, maintenance requirements and whole life plan (and replacement) of the SuDS system as a whole. Regular maintenance of the flow control device will be required to remove any blockages, particularly in the wake of heavy rainfall events or local floods. It is recommended that the petrol interceptor be fitted with an audible high-level silt and oil alarm for maintenance and safety purposes. Regular inspection and maintenance are recommended for the petrol interceptor. Please note that silt and debris removed from the petrol interceptor during maintenance will be classified as contaminated material and should only be handled and transported by a suitably licensed contractor and haulier and disposed of at a suitably licensed landfill only.
Design Review Process	Upon review of the initial drainage design, there was no meaningful change to the drainage design. A summary of comments and record of the audit trail are appended to this report. Based on this being at preliminary design stage and a Stage 1 Surface Water Audit, JBA Consulting's comments have all been satisfactorily addressed or sufficient commitment provided that details will be confirmed at detailed design stage.
Summary of items to be considered at Detailed Design Stage	There are a number of items that can be addressed at detailed design stage. A summary of same are as follows: • Full details of the green roof details to be developed and agreed. • Landscaping proposals should accommodate local profiling roof terraces to intercept exceedance flows and convey same back into the drainage / attenuation system. • Proper detail design and construction of SuDS devices is paramount to ensure long term optimum hydraulic performance as well as maximisation of biodiversity opportunity. It is recommended that a collaborated approach to detail design is adopted between engineers, architects, ecologies and landscape architects. • Maintenance regime for each of the components on site to be prepared and submitted to Dublin City Council; • Hydrobrake selection to be give due consideration to hydraulic performance, actual head behind the unit, maximum potential clear passage size and maintenance requirements.
Audit Result	JBA Consulting considers that the surface water drainage design for the proposed development is acceptable and meets the requirements of the GDSDS and Stage 1 Stormwater Audit.

Audit Report Prepared by:	Leanne Leonard BEng Engineer
Approved by:	Declan White BE CEng MIEI IMaPS Principal Engineer

Note:

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

Appendix A – Audit Trail Record

JBA Consulting Stormwater Audit

Project:	Residential Development at Parkside Phase 4, Belmayne, Co Dublin
Date:	26/09/2019
JBA Reviewers	Leanne Leonard - Engineer

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
	26/09/2019		04/10/2019	
	Documents Reviewed - DBFL Infrastructure Design Report dated September 2019 - Site Specific Flood Risk Assessment - SI Report by IGSL Limited - Drg No 190011-3000 Rev. A - Drg No 190011-3001 - Drg No 190011-3002 - Drg No 190011-3005 - Drg No 190011-3006 - Drg No 190011-3013			
1	Existing Surface Water Drainage Section 4.2 of the infrastructure report indicates existing attenuation to west of the development but it is not shown on drainage drawing nr 190011-3000 Rev. A. It is not clear if this is attenuation is for the existing site, other 3rd party lands and if same is to be retained, replaced or decommissioned.	DBFL to advise.	The existing attenuation system to the west of the subject site only attenuates existing and future residential developments located to the south of the subject site. This existing attenuation system will not provide attenuation for the proposed development Parkside Phase 4. A section of the existing drainage which drains water from the existing attenuation to the outfall in the Mayne River will be diverted (Manhole S4 to Manhole S1) for the construction of the proposed blocks under this development, Parkside Phase 4. Please see attached construction drawings for this attenuation facility which was constructed in 2015.	Acceptable
2	Existing Surface Water Drainage The existing 225mm diameter storm sewer from Parkside Boulevard and proposed diversion is noted on drawing nr 190022-3000 Rev. A. It is assumed that manhole S8 as proposed will intercept the existing storm line as opposed to a new line being required between manhole S8 and the existing storm manhole on Parkside Boulevard	DBFL to advise.	Manhole S8 will be the start of the proposed diversion of the existing 225mm diameter sewer coming off Parkside Boulevard as showing on drawing 190011-3000. No new line will be required between proposed manhole S8 and the existing 225mm diameter pipe from Parkside Boulevard. Drawing will be amended accordingly to avoid confusions on this matter.	Acceptable
3	Existing Surface Water Drainage It is not clear if any storm drainage from the proposed development is to connect to the existing stormwater drainage and attenuation system or if all storm water from the proposed development will connect via slung drainage pipes to the proposed attenuation system to the east of the development.	DBFL to advise.	All surface water from the proposed development will drain through the proposed slung drainage at basement level (refer to drawing number 190011-3001) to discharge into the proposed attenuation tank to the east of the subject site.	Acceptable
4	Impact of flood conditions on attenuation storage The bottom of the attenuation facility is c.10.2m based on Section B-B on drawing nr 190011-3006. Given it is an 'opened bottomed attenuation facility' as noted in Section 5.3 of the infrastructure report, there is potential for a high water table and/or flood conditions in the River Mayne with associated seepage thru the subsoil which should be considered as regards risk of inundation inundation.	DBFL to review.	The Site Investigation Report of the subject site carried out by Ground Investigations Ireland includes trial pit record TP06 and boreholes records BH5, BH6 and BH7. These are located approximately in the same area where the proposed attenuation system will be constructed. In TP06 (Ground Level 12.51m and 3.1m Depth) no groundwater was encountered. Ground water strikes were encountered in BH5, BH6 and BH7 at 8.59mOD, 9.28mOD and 7.61mOD respectively. Records indicate that the water level only increase by 0.1m in 20min after the strike was detected. The invert level of the proposed attenuation tank is above the levels at which groundwater strikes were found by at least approximately 1m. Two standpipes were installed in BH5 and BH7. Appendix 7 of the Ground Investigation Report indicates that the groundwater levels in BH5 (Ground Level: 12.29m) and BH7 (Ground Level: 12.51m) were 2.6m (9.69 mOD) and 2.72m (9.79 mOD) below ground level respectively. These ground water levels are below the invert level of the proposed attenuation tank. Trial pit record TP06 and Borehole Records BH06 and BH7 confirm the presence of firm and stiff clay and made ground at the same depths where the proposed attenuation tank will be constructed. In addition, both soakaway tests carried out on the site failed. This confirms the existing ground has low permeability which will protect the attenuation system from inundation from the Mayne River floodplain. It should be noted that the proposed ground level surrounding the attenuation system is set above the 100 year flood level of the Mayne River which will protect the attenuation system from flood waters entering the system through manhole covers	Acceptable

Item No.	JBA Review Comment	Comment/Clarification Request/Suggested Mitigation	Response from Client/Client Representative	Acceptable / Not Acceptable
5	Allowable Discharge Rate Section 5.3 of the infrastructure report indicates that the discharge rate will be controlled to 2l/sec/ha which equates to 2.1l/sec based on a site area of 1.05ha. Appendix A attenuation calcs appear to be based on a total area of 0.79ha. The difference may be down to actual site area v that is positively drained by the proposed stormwater network and attenuation facility, therefore, runoff co-efficient as applied to be provided.	DBFL to advise.	The site area, as indicated in our reports, is 3.17 Ha. The gross area of the catchment draining through the proposed surface water drainage is 1.05 Ha. The net impermeable area of the catchments equates to 0.79 Ha (75% of the catchment area). The net impermeable area is calculated by factoring the gross impermeable areas with appropriate run off coefficients. Also note that the green areas part of the modified floodplain will drain directly to the Mayne River as per the existing greenfield scenario and were not included in our calculations allowable discharge rate calculation.	Acceptable
6	Runoff Co-Efficient Further to 5 above, a table showing gross site areas of various surfaces with associated runoff coefficients would be beneficial in the planning report	DBFL to advise.	Tabled added in section 5.3 of Infrastructure Design Report, please see attached.	Acceptable
7	Surcharged Outfall Level of flooding noted from SFRA. Given potential for surcharging of the outfall, joint probability of River flooding (surcharged outfall conditions) coinciding with exceedance rainfall to be considered as regards impact on attenuation volume as proposed.	DBFL to advise.	The Mayne River has a catchment area of approximately 104 Km2 (10400 ha) while the proposed development catchment area is 1.05 ha therefore a 100 year flood event in the Mayne River and the development's drainage system will not occur simultaneously. The time of concentration for the Mayne River adjacent to the site will be significantly longer than the development site's drainage network therefore the attenuation volume will have discharged to the Mayne River before the river is in flood adjacent to the site.	Acceptable
8	Reduction Factors Given the extent of basement underneath external paved and grassed surfaces, infiltration is very much dependent on the depth of subsoil above basement cover slab. In view of same, the reduction factor is also dependent on the available depth of subsoil and such a detail is not available to assess the proposed 50% reduction for green areas over podium.	DBFL to provide detail and review reduction factors for all surfaces.	The green areas over podium will consist of a intensive greening (similar to intensive greenroof) where a wide range of plants and landscaping options will be utilised. Figure 5.1 of the Infrastructure Design Report is a graphical example of the proposed green podium in the development. According to the SUDs Manual, intensive greening typically have a growing medium thickness >150mm. This typical thickness will be exceeded in the proposed development. The proposed green podiums will reduce the amount of water which runs off into the drainage system by retention and infiltration. According to the German FLL Guidelines for the Planning, Execution and Upkeep of Green-Roof Sites, intensive greening have an annual coefficient of discharge between 0.1 and 0.4. DBFL applied a more conservative coefficient of 0.5. Explanation and reasoning behind each of the other coefficients applied to other types of surface is detailed in Section 5 of the Infrastructure Design Report.	Acceptable
9	Drawing No. 190011-3013 It is not clear on the plan layouts where the SuDS measures as shown on drawing no. 190011-3013 (Typical Drainage Details Sheet 3) are proposed.	DBFL to advise.	Items included in draft drawing number 190011-3013 will not be part of the proposed surface water drainage strategy. Hence this drawing will be removed from the final planning pack.	Acceptable
10	SuDS Details For the roof and pavement surfaces as shown on drawing nr 190011-3005, no cross-sectional details are available	DBFL to advise.	The proposed green roof will be an extensive greenroof with a minimum growing medium depth of 80mm. Refer to attached cross section for more details on the build up in paved areas over podium.	Acceptable