DEVELOPMENT OF LAND AT MONKSTOWN ROAD, DUBLIN, DALGUISE HOUSE

Drainage Impact Assessment Report

GEDV Monkstown Owner Limited

Report No. W3683-BLP-XX-XX-RP-Z-04

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Disclaimer: Please note that this report is based on specific information, instructions and information from our Client and should not be relied upon by third parties.					

Contents

1 Introduction

1.1 General

Byrne Looby Partners have been commissioned by GEDV Monkstown Owner Limited to prepare a Drainage Impact Assessment Report (DIA) for the proposed development of land at Dalguise House, Monkstown, Co. Dublin as part of the pre-planning application to Dun Laoghaire Rathdown County Council.

The report details the existing site condition, existing drainage infrastructure within the site and surrounding area and provides an overview of the proposed foul and storm drainage infrastructure for the development.

1.2 Objectives and Scope

The objectives of this DIA are to:

- Outline the strategy for the discharge of foul water from the development
- Outline the surface water drainage strategy for the development
- Identify any drainage issues which may arise from the development

In order to achieve these objectives this DIA provides the following information:

- The existing drainage infrastructure on the site
- Outline the relevant policy, standards and guidance for the design of the site drainage
- The proposed strategy for surface and foul water drainage

2 Site Location

2.1 Site Location

The site is located some 11km Southeast of Dublin City Centre and approx. 2 km from Dun Laoghaire. The Dalguise House proposed residential development consists of an overall site area of c.3.58 hectares within a mature landscape setting adjoining, with Monkstown Valley to the West, Richmond Park to the East, Brock Court to the South with Monkstown Road to the Northern boundary of the site.

The site comprises of Dalguise House, 2 gate lodges and a dwelling house, walled garden and associated buildings and garden lands. There is significant tree coverage and vegetative screening from the surrounding area, which is predominantly residential.

Pedestrian & vehicle access is proposed through the existing Dalguise access and Purbeck Road off Monkstown Road. Current access to the site is provided via the current existing entrance opposite Albany Avenue, off the Monkstown Road. The access via a bridge from Purbeck Road is to be developed as part of the site development. See Figure 1 below.

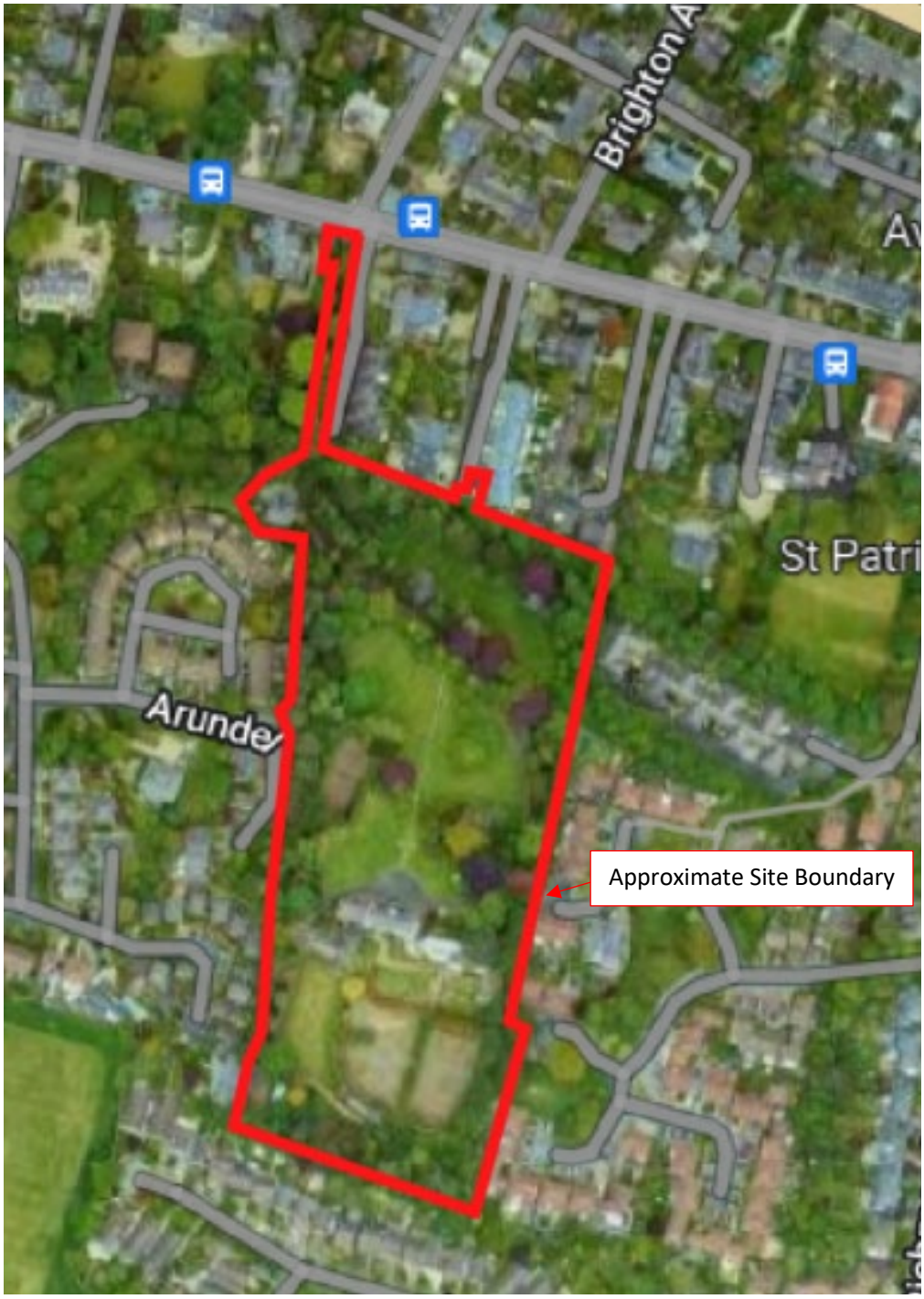

Figure 1 Site Location (Extracted from Google Maps)

3 Proposed Development Site

3.1 Development Description

GEDV Monkstown Owner Limited intends to apply for a seven year permission for development on a site of c. 3.58 hectares at Dalguise House (Protected Structure RPS No. 870), Monkstown Road, Monkstown, County Dublin, A94 D7D1 (the lands include the following structures identified as Garage (A94 N3A1); Gate Lodge (aka Brick Lodge) (A94 R9T1); Dalguise Lodge (aka Entrance Lodge) (No. 71 Monkstown Rd, A94 TP46); White Lodge (A94 V6V9)); and on-street car parking in front of Nos. 6 and 7 Purbeck (A94 C586 and A94 HT99, respectively), with the provision of vehicular and pedestrian access and egress at two points on Monkstown Road: the existing entrance to Dalguise; and at Purbeck.

Alterations will be made at Purbeck including the relocation of 4 No. existing car parking spaces to facilitate the construction of a new vehicular and pedestrian bridge over the Stradbrook Stream.

The development, with a total gross floor area of approximately 47,382 sq m (including a basement of 5,396 sq m and undercroft parking of 1,403 sq m) (of which some 46,154 sq m is new build, and 1,228 sq m retained existing buildings), will consist of the construction of 493 No. residential units, consisting of 486 No. new build and 7 No. residential units (the latter within existing structures (repurposed from Dalguise House, Gate Lodge (Brick Lodge) and Coach House)).

The residential provision will comprise: 3 No. three storey 3-bed terraced houses (GFA 569 sq m), and 490 No. Build-to-Rent units (consisting of 2 No. studio units; 289 No. 1-beds; 20 No. 2-beds/3 persons; 166 No. 2-beds/4-persons; and 13 No. 3-beds) (with an option for the use of 4 No. of the BTR Units to cater for short-term stays of up to 14 days at any one time to cater inter alia for visitors and short-term visits to residents of the overall scheme) residential amenities and residential support facilities; a childcare facility; and restaurant/café.

The development will consist of: the demolition and partial demolition of existing structures (total demolition area 967 sq m, comprising: two residential properties (White Lodge (A94 V6V9), a 2 storey house (192 sq m); and a residential garage (A94 N3A1) and shed to the southwest of Dalguise House (285 sq m)); swimming pool extension to the southeast of Dalguise House (250 sq m); lean-to structures to the south of the walled garden (142 sq m); part-demolition of Lower Ground Floor at Dalguise House (9 sq m); single storey extension to the south of the Coach House (29 sq m) and three ancillary single-storey structures (8 sq m, 8 sq m, and 31 sq m) within the yard; potting shed (13 sq m); removal of 2 No. glasshouses; and alterations to, including the creation of 3 No. opes and the removal of a 12.4 m section of the walled garden wall to the east); the construction of: 11 No. residential blocks (identified as: Block A (total GFA 2,015 sq m) 7 storey, comprising 19 No. apartment units (15 No. 1-beds, 4 No. 2-beds/4-persons) and a childcare facility (540 sq m over Ground and First Floor Levels); Block B (total GFA 3,695 sq m) 7 storey over undercroft car parking, comprising 48 No. apartment units (33 No. 1-beds, 1 No. 2-beds/3 persons, 14 No. 2-beds/4-persons); Block C (total GFA 3,695 sq m) 7 storey over undercroft car parking, comprising 48 No. apartment units (33 No. 1-beds, 1 No. 2-beds/3 persons, 14 No. 2-beds/4-persons); Block D (total GFA 4,325 sq m) 7 storey over basement level car park, comprising 52 No. apartment units (25 No. 1-beds, 26 No. 2-beds/4-persons, 1 No. 3-bed); Block E (total GFA 5,946 sq m) 9 storey over basement level car park, comprising 66 No. apartment units (40 No. 1-beds, 26 No. 2-beds/4-persons), with residents' support facilities (75 sq m) and residents' amenities (gym, yoga studio, residents' lounge/co-working space; lobby 485 sq m) at Ground Floor Level, residents' amenities (bookable rooms 42 sq m) at First Floor, and

residents' amenities (residents' lounge; games room; screen room; private lounge; kitchen 350 sq m) with roof terrace (106 sq m) at Eighth Floor Level; Block F (total GFA 5,469 sq m) 7 storey over basement level car park, comprising 76 No. apartment units (46 No. 1-beds, 5 No. 2-beds/3-persons, 23 No. 2-beds/4-persons, 2 No. 3-beds); Block G (total GFA 5,469 sq m) 7 storey over basement level car park, comprising 76 No. apartment units (46 No. 1-beds, 5 No. 2-beds/3-persons, 23 No. 2-beds/4-persons, 2 No. 3-beds); Block H (total GFA 4,252 sq m) 5 storey over Lower Ground Floor, comprising 54 No. apartment units (30 No. 1-beds, 1 No. 2-beds/3-persons, 21 No. 2-beds/4-persons, 2 No. 3-beds); Block I1 (total GFA 1,038 sq m) 3 storey, comprising 12 No. apartment units (3 No. 1-beds, 3 No. 2-beds/3-persons, 6 No. 2-beds/4-persons); Block I2 (total GFA 1,038 sq m) 3 storey, comprising 12 No. apartment units (3 No. 1-beds, 3 No. 2-beds/3-persons, 6 No. 2-beds/4-persons); and Block J (total GFA 1,844 sq m) 4 storey, comprising 20 No. apartment units (13 No. 1-beds; 1 No. 2-bed/4-persons, 6 No. 3-beds));the refurbishment, adaptation and reuse of: two storey Dalguise Lodge (Entrance Lodge) (GFA 55 sq m) comprising residential support facilities; a single storey Gate Lodge (GFA 55 sq m) comprising 1 No. 1-bed unit; and two storey Coach House and single storey Stableman's House (GFA 319 sq m) to provide 3 No. apartment units (1 No. 1-bed, 2 No. 2-bed/4 persons); the refurbishment, adaptation and change of use of Dalguise House (GFA 799 sq m) from a single residential dwelling to provide: 3 No. apartment units (2 No. studios and 1 No. 2-bed/3 person) at First Floor Level; a restaurant/cafe at Lower Ground Floor Level (GFA 273 sq m); and residents' amenities at Ground Floor Level (library, residents' lounge, events space, bar/bookable room, 157 sq m); works to the existing structures include: removal of existing internal partitions and doors, alterations to internal layout including provision of new partitions and doors to Dalguise Lodge (Entrance Lodge); removal of existing internal partitions and doors, and alterations to internal layout including provision of new partitions and doors to Gate Lodge (Brick Lodge); replacement of existing roof, windows and doors, non-original mezzanine floor and stairs of Coach House, creation of new internal and external opes, reconstruction of chimney, construction of new stairs, provision of new internal partitions and doors, replacement of the demolished single storey structure to south of Coach House with a 42 sq m single storey extension, including construction of a link between Coach House and Stableman's House; replacement of existing roofs, windows, doors, creation of new external opes and provision of new internal partitions and doors to Stableman's House; restoration of Coach House yard walls; removal of security bars from windows, internal partitions, doors, two secondary staircases, non-original fireplaces; and the reconfiguration of internal layout including introduction of new partitions, doors and fireplaces, in-fill of former secondary staircases; removal of an existing window at rear facade of Lower Ground Level, alterations to ope and replacement with a new external door; reinstatement of external wall fabric in place of demolished lean-to at the rear facade; and removal of external door to swimming pool on eastern facade and closure of ope; and creation of new external ope at Lower Ground Floor rear façade, provision of external plant (connected to the new ope by ducting), waste storage area, water tank at surface level adjoining the western façade, enclosed within a screen at Dalguise House).

The development will also consist of: the construction of a garden pavilion; the provision of balconies and terraces, communal open space including roof gardens, public open spaces, hard and soft landscaping, landscaping works including the removal of trees, alterations to boundaries; the provision of: 228 No. car parking spaces (148 No. at basement level; 19 No. at undercroft; and 61 No. at surface level); motorbike spaces; level changes; ESB Substations (at Block D and Block H); plant areas; waste storage areas; provision of cycle parking (including cargo bike spaces) at basement and surface level; signage/wayfinding; and all ancillary site development works above and below ground.

Provision is made in the landscaping proposals for potential future pedestrian and cycle connections that would facilitate permeability through the site boundaries with the residential estates of Arundel and Richmond Park, respectively, and the former Cheshire Home site, subject to agreement with those parties and/or Dún Laoghaire-Rathdown County Council, as appropriate.

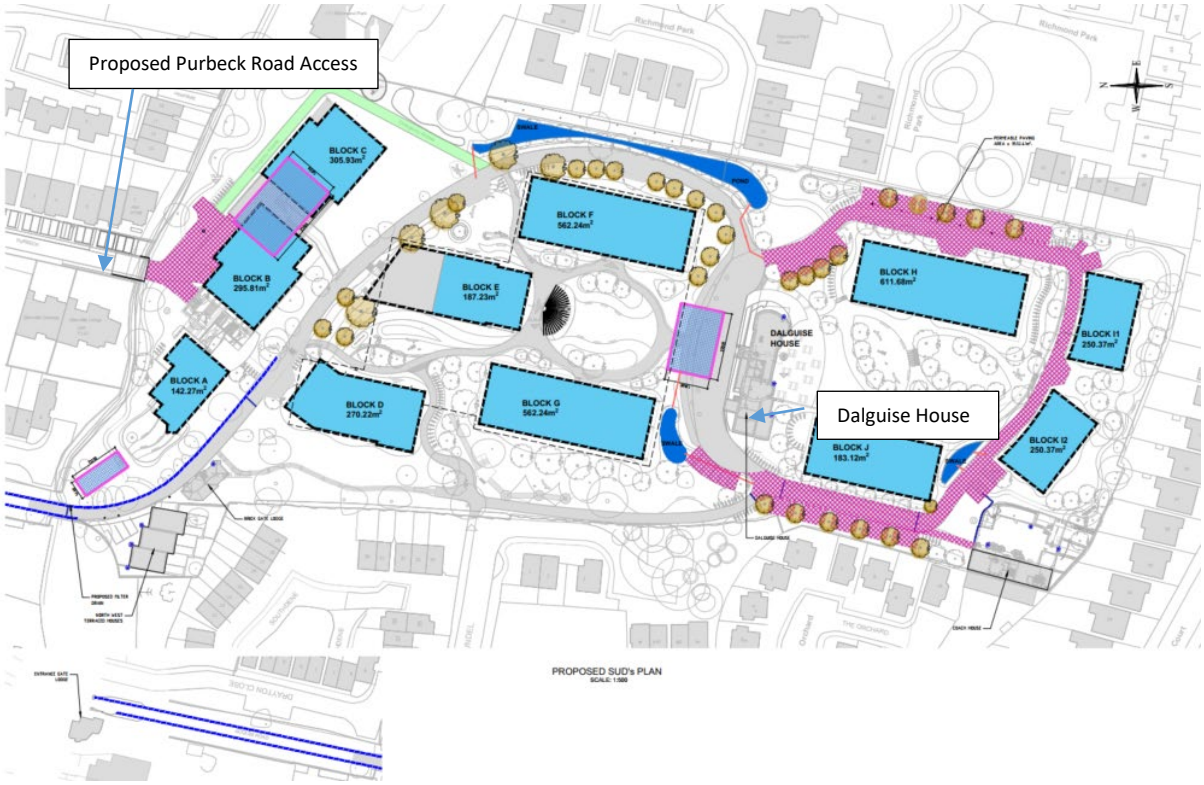

Figure 2 – Proposed development site

3.2 Site Topography

The general topography of the site falls from south to north towards the Stradbrook stream. Levels vary in the region of 29.15m – 15.0m. The highest area in the site is the area surrounding Dalguise House and the lowest point on site is at the northern boundary adjacent to Stradbrook stream.

A small area of land north of the Stradbroke Stream at Purbeck is included in the Planning Application boundary (with the consent of a third party) to allow for the relocation of 4 no. existing car parking spaces and in order to facilitate the construction of the new bridge. The levels and surface water system on the north side of the new bridge at Purbeck will tie into the existing network and therefore no stormwater runoff to surrounding lands.

3.3 Flood Risk

A site specific Flood Risk Assessment was prepared by McCloy Consulting for the development (Report No. M02136-04_DG02 July 2023). The report identifies the Stradbrook stream as the potential main source of fluvial flooding within the site. It has been demonstrated through site-specific hydraulic modelling that proposed development will be resilient to flooding; lying outside the present day and climate change 1%

AEP and 0.1% AEP fluvial floodplain of the Stradbrook Stream. Furthermore, hydraulic modelling has shown that the proposals will not increase flood risk elsewhere.

Location / Description	1% AEP Flood Level (m OD)		0.1% AEP Flood Level (m OD)	
	Pre-Development	Post-Development	Pre-Development	Post-Development
Upstream extent of Site (location point 1)	15.84	15.84 *(0)*	15.85	15.86 *(+0.01)*
Middle of Site (location point 3)	15.57	15.71 *(+0.14)*	15.61	15.76 *(+0.15)*
Downstream extent of Site (location point 8)	15.38	15.38 *(0)*	15.46	15.46 *(0)*
Downstream of Site (location point 12)	14.95	14.95 *(0)*	15.14	15.14 *(0)*

Table 1 Effect of the Development summary – 1% AEP and 0.1% AEP Present Day

The main findings of the report relating to site drainage infrastructure are as follows:

- The report recommends a minimum Finished Floor Level/Finished Ground Level of 16.15m.
- The outfall for the surface water drainage system shall be above the 1% AEP + Climate Change (CC) level. The relevant 1% AEP + CC level at the downstream end of the site is 15.40m

4 Foul Infrastructure

4.1 Existing Foul Sewer Infrastructure

The background information identifies that a main combined sewer exists running under/on the line of the Stradbrook/Monkstown Stream. The sewer is a 450mm dia. vitrified clay (VC) line flowing towards Carrickbrennan Road.

A further 450mm dia. Irish Water/ DLRCC Vitrified Clay (VC) combined line, exists, which runs from the Monkstown Valley development onto the application site, current entrance/exit roadway, and onto Monkstown Road, down Albany Avenue before connecting onto a main combined line on Seapoint Avenue was noted.

4.2 Existing Site-Specific Foul Sewer Infrastructure

Dalguise House is served by a separate septic tank and percolation area located in the lands outside to the Walled Garden on the western boundary. (See figure 3 below).

A detailed Remediation Plan will be developed to cater for the de-commissioning of the septic tank and removal of contaminated soils. This proposal is to be utilised and forms part of the current LRD application.

The White Lodge, (3 No existing residential units) along with Gate Lodge 1 & 2, drain into the existing 450mm dia. V.C sewer draining thru the existing estate entrance roadway, onto Albany Avenue and to the sewer running along Seapoint Avenue (information from GDSDS F011- West Pier West Report April 2006).

Figure 3 Existing Foul Infrastructure

4.3 Proposed Foul Infrastructure

4.3.1 Overview

The Foul Drainage System for the site will be separated from the surface water network through-out the development. The proposed foul system consists of two networks.

The first network begins adjacent to the Block I and follows the proposed access road before collecting flows from the second Block I, Block J, Block G, Dalguise House, Block H, Block F, and down along the emergency road. This line also collects fouls from Block A, Block B, Block C and Block E.

The second network collects flow from Block D, the existing brick lodge house and the north west houses and connects to the existing 450mm sewer adjacent to Purbeck Access Road.

All basement drainage shall be collected in a separate collection chamber. This collection chamber will pump to the foul sewer system via duty and standby pumps passing through a suitable petrol interceptor.

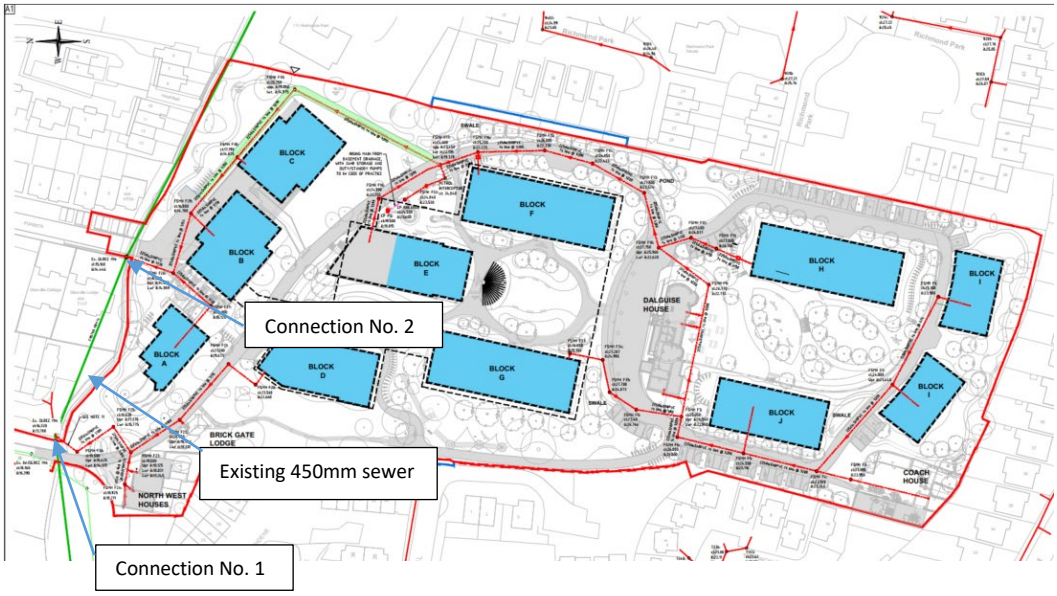

Figure 3 Foul Network Overview

The connection points to the existing sewer are indicated in Figure 3 above and have been approved by Irish Water on 8th March 2022 following a pre-connection enquiry application submitted on 15 December 2021 (see Appendix A of ESR Report for response letter). Irish water has requested that proposed structures and works will not inhibit access for maintenance or endanger structural or functional integrity of the assets during and after the works. Recent amendments to drawings in 2023 have not changed the principles to the drainage design agreed with Irish Water.

Specific details on the above are contained within Appendix B of the ESR report and on ByrneLooby Partners Ltd Drg. No. W3683-DR-1007, included with this submission.

4.3.2 Proposed Discharge

The proposed development is to consist of 493 units total, inclusive of childcare facility and cafe/restaurant. Based on Irish Water guidelines, the foul effluent generated will be based on Irish Water guidelines and is described in detail below.

The following criteria has been adopted for calculation of foul demands:

- 150 litres/head/day domestic loading
- 2.7 head/apartment
- 60 litres/head/day non-domestic loading
- Domestic Peaking Factor = 3
- Non-domestic Peaking Factor = 4.5

A detailed breakdown of the foul drainage demand calculations is provided in Appendix B of the ESR report.

5 Storm Water Infrastructure

5.1 Existing Storm Drainage Infrastructure

Examination of the drainage infrastructure maps supplied by Irish Water/ Dun Laoghaire Rathdown County Council Drainage Division for the surrounding areas of Dalguise House site, indicate that there is no specific separate surface water main in proximity to the development.

In general, existing developed sites adjacent to the subject site have discharged surface water to the Stradbrook Stream located on the Northern boundary, using agreed controlled flows, set by the Local Authority, equivalent to, our less then undeveloped greenfield discharge Qbar as defined in the section 6.3.1.2.2 "River Regime Protection" of the Greater Dublin Strategic Drainage Study Volume 2 – New development and within Report 124 " Flood estimation for small catchments",1994 produced by the Institute of Hydrology.

The existing development site is generally greenfield but there are some small areas of brownfield located within the overall site area of 3.58-hectare section of site (excluding roadway section in Purbeck lodge, 77 Monkstown Road of Area = 0.156 ha), at Dalguise House, the White Lodge (3 No existing houses subject to demolition and re-development), Gate Lodges (2 No) and the Coach House located on the South-West boundary.

The current site surface water from the above existing areas is combined with foul discharges and connected to an existing site septic tank or onto the existing 450 dia. vitrified clay Irish Water combined main from Monkstown Valley flowing down the existing site entrance roadway onto Albany Avenue -see Irish Water Web map.

As referred to in Section 4.2 of this report, a site-specific Remediation Plan will be prepared for the removal of the septic tank and associated percolation area pipework and contaminated soils.

Any retained structures as part the new site development will be provided with new separate foul, surface water and mains water connections.

5.2 Proposed Infrastructure

In accordance with Dun Laoghaire Rathdown County Council requirements, storm water shall be managed in two phases. The first is to restrict storm water run-off from the proposed development to greenfield run-off rates. The second aspect to be included in new applications is to incorporate sustainable urban drainage systems ('SuDs') proposals into the scheme. The 'SuDs' concept requires that storm water quality is improved before disposal and, where applicable, storm water is discharged into the ground on site. The proposed surface water system within the site will be separated from the foul system as required.

The development will be served by a simple gravity drainage system (as far as reasonably possible) including Suds features (swales, permeable paving, tree pits etc) and will follow the natural topography of the site, falling towards the Stradbrook Stream on the Northern end of the site.

The proposed basement car park, located under Blocks D, E, F, G and the Central Plaza, will have a series of gullies and drainage channels cast into the floor slab which will cater for limited amounts of run-off that enters the proposed car park through ramps, service ventilation opes etc. and vehicles entry point.

The proposed channels and gullies will be connected to a buried gravity pipe network that will fall to the pumping station located in the car park that will forward the flow through a petrol interceptor before connecting into the sites foul network as shown in Drg. No. W3683-DR-1007 and 1038. The outflow from the carpark, will flow to the outfall points via a gravity system and through oil interceptors again prior to connecting into the existing network outside of the site.

The site has been split into two catchment areas, the upper catchment area (south of the site) and the lower catchment area (north of the site). The upper catchment includes runoff from Block I (No. 1 & 2), Block H, Block J, Block E, Block F, Block C, Block B, and existing buildings to the north and south of Block J and associated hardstanding areas/roads. The lower catchment includes runoff from Block D, Block A and from associated road and hardstanding areas. Refer to Drawing W3683-DR-C-1032 for Storm Catchment Map.

5.2.1 SuDs Methodology

The development will be designed in accordance with the principles of Sustainable Urban Drainage Systems (SuDs) as embodied in the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS) and Chapter 10 to the DLR CoCo Development plan 2022-2028.

- Criterion 1: River Water Quality Protection – satisfied by providing interception storage and treatment of run-off within 'SUDS' features e.g., landscaping and green roof areas.
- Criterion 2: River Regime Protection - satisfied by attenuating run-off from the site in accordance with greenfield runoff rates.
- Criterion 3: Level of Service (flooding) for the site – satisfied by the site being outside the 1000 year coastal and fluvial flood levels. Pluvial flood risk addressed by development designed to accommodate a 100-year extreme storm as noted in 'GDSDS'. Planned flood routing for storms greater that 100-year level considered in design and development run-off contained on site.
- Criterion 4: River Flood Protection – attenuation and/or long-term storage provided within the 'SuDs' features. In accordance with the requirements of DCC all new developments are to incorporate the principles of 'SuDs'. The 'SuDs' principles require a two-fold approach to address storm water management on new developments.

5.2.2 Description of SUDS Measures

As per Criterion 4, in accordance with the recommendations of CIRIA 753 (SUDs Manual) and requirements of DCC all new developments are to incorporate the principles of 'SuDs'. The aim of 'SuDs', inclusion across the development is to provide an effective system separate from the foul network to mitigate the adverse effects of storm water run-off on the environment, through enhanced quality systems and on local infrastructure to aid in preventing downstream flooding. The features proposed shall reduce runoff volumes, pollution concentrations and enhance groundwater recharge and biodiversity.

The proposed development 'SuDs' features shall consist of:

a) Blue Green Roof – The proposed system is a ACO Roofbloxx Blue roof system, this allows the roof areas of the proposed apartments to use a filter layer to direct rainfall events into a storage layer below. An 85mm space will be provided for rainfall to be retained in the storage layer. As more intense rain falls on the blue roof can overflow from the roof through down pipes and into the schemes main drainage runs. The storage area will be covered with a sedum topsoil to increase the water retention on each roof. This technology also controls the amount of water that will be released into the storm network.

b) Permeable Paving – this system allows rainwater to be directed into carparking bays whereby the rainwater can filter through gaps in the paving blocks and percolate into the subsoil or to swales. The area which can be drained is subject to the infiltration characteristics of the subsoil, (Ref IGSL Report) which is established following ground investigation testing on site.

c) Tree Pits – Tree pits will be located along the existing avenue to capture runoff for the existing hard standing area. It is proposed that the tree pits will be connected and act like an attenuation basin where the water can then be released slowly into the storm network.

d) Swales and pond – it's proposed to allow storm water to be directed locally into swales when the permeable paving is overflowing to delay storm water from entering the main drainage network. As the swales overall can only accommodate relatively small surface areas across this site, the proposal cannot be used to drain the site as a whole, but will be installed to contribute to the overall 'SuDs' strategy.

e) Filter Strip – An area of the existing road will have a filter strip located to the North to capture rod run-off for small rain fall events. This allows run-off from localised hardstanding areas to be filtered and trap silt prior to entering the storm network.

f) Attenuation Tanks – As noted above, for extreme storm events, a dedicated system to contain the storm water flows generated during a 1-in-100-year storm, increased by 20% for climate change are required by DLR. It is proposed to use underground storage tanks in three locations for this purpose see Drg. No. W3683-DR-1018. Two of these tanks are proposed to be constructed of a stormcell block system where no buildings are proposed above.

g) Low Water Usage Appliances – It is also worth highlighting that low water usage appliances should also be utilised to aid in the reduction of water usage on the development.

With the above SUDs provisions it meant that oil separators are not required prior to final disposal of storm water from the development drainage network into the Stradbrook Stream (at two locations).

The combination of the above noted elements will allow the proposed development to adhere to the principles of sustainable drainage practices while enhancing overall storm water quality.

5.2.3 QBAR and Impervious area calculations

To ensure an accurate calculation of the required attenuation for the site Met Eireann was contacted to provide:

a) The SAAR (Standard Annual Average Rainfall) for the area: 900mm/year.

b) The sliding duration table for the site indicating the 1:100-year rainwater intensities to be used.

c) Soil type value obtained from the Flood Studies Report, has been established as soil type 4.

These parameters allow the Q-Bar, greenfield run-off rate, to be calculated. The Q-Bar value for the site is 22.14 l/sec. The calculations for the attenuation on site takes account of the positively drained areas only which is identified below.

Area	**Upper Catchment (m2)**	**Lower Catchment (m2)**
Roofs and Green/Blue Roofs	6084.12	991.91
Road/Permeable Paving	4882.05	1104.20

Existing Properties	970.00	170.00
Total	13,824.74 (1.384 ha)	1,850.31 (0.185 ha)

The allowable discharge rate off site is as follows:

Upper Catchment (downstream outfall) – 8.9 l/s (flow rate of 6.48l/s/ha)

From Tank 1 – 5.2l/s

From Tank 2 – 8.9l/s

Lower Catchment (upstream outfall) – 1.2l/s (flow rate of 10.81 l/s/ha)

In accordance with the requirement of the SuDs Manual C752 Section 4.3 "Water Quality Design Standards" and Section 24.8 "Designing for interception", interception needs to be provided for any contributing impermeable area so a check is required to confirm that adequate provision is made for all such areas throughout the site.

There is an amount of storage provided for interception across the site in accordance with Ciria 753. This is to capture and retain the first 5mm of the rainfall to result in no runoff to the stream. Interception and evaporation can account for 15-50% of yearly precipitation. Several approaches below have been taken to include interception storage across the site.

- Permeable paving

- Green/blue roofs

- Swales and pond

- Tree pits and bio – retention areas

- Filter strip

Additional approaches were looked at but were not found to be effective for this development. For example, soakaways, the existing ground conditions to do not support this system.

Interception Storage Requirement = 15675 x 0.005 = 78.38m^3 which is the total volume of the first 5mm to be intercepted across the positively drained area site.

SUDs Element	**Volume of Interception (m^3)**
Permeable Paving	23.06
Green/Blue Roof Area	324.72
Swale/Pond	10.50
Tree Pits and Bio-retention Areas	639
Filter Strip	0.35
Total Volume of Interception (m^3)	997.63

The Calculations below show that the total interception storage equates to 998.56m^3 for the site providing adequate interception is provided to meet the requirements within the SuDs Manual and GDSDS.

5.2.4 Permeable Paving

In areas across the site where the development will require new hard standing for road access and car parking, permeable paving will be installed to a total area of c.2429.10m^2 . This is proposed to prevent surface ponding without the need for an additional channel drainage system. The overflow connection from the permeable paving is connected to swales located close by where possible. Otherwise the flow will connect directly into the storm network.

Total hard standing area = 5986.25m^2

Permeable Paving = 2429.102 m^2 x 0.005 x 2 =24.29m^3

The emergancy access road is made off a grasscrete structure which will allow it to drain 90% like a grassed area and therefore has not been considered for the permeable paving or hardstanding areas across the site.

5.2.5 Green/Blue Roofs

All of the proposed buildings on site are to have a blue roof system to comply with the requirements of Appendix 7 of DLRCC Development Plan 2022-2028 70% of a new roof areas to be constructed as Green/Blue Roofs, this is summarised in Appendix F. The blue roof has is to be installed as a first stage storage system and its volume is separate from the overall site attenuation requirement to aid storage during and exceedance event. The proposed Green/ Blue Roof will be an Extensive type, build up comprising of durable, slow growing, low maintenance planting generally sedum type, with a substrate depth of typically 100mm of free-draining growing medium. The substrate will be agreed between the blue/green roof supplier and the landscape architect. The provision of PV panels on the roofs has meant that some of the roof area is unable to be utilised for the blue/green roof storage, however the PV area used is minimal overall.

Access will be provided to the blue/green roof spaces via stairs and/or openable hatches, AOVs. Alternative means of access will also be considered such as external mobile access. This will be developed further at detailed design stage in conjunction with the Development Facilities Company and Project Supervisor Design Stage.

The retention from the roofs alone has been set to an 125mm depth which gives an overall maximum retention of 324.72m^3 for all the blue roofs across the development and a maximum outflow of 0.37l/s. As the design develops across the site the depth can be increased to higher levels to give more capacity. We have engaged with a specialist Green/Blue roof supplier for identify the available capacities of the system for the site.

See Appendix F for the proposed blue roof arrangement and calculations summarised below.

Lower catchment green/blue roof 350.62m^2 contribution = 39.44m^3

Upper catchment green/blue roof 2755.10m^2 contribution = 285.28 m^3

Interception volume over the green/blue roofs = 324.72m^3

Total Roof Area (proposed) = 3105.72m^2

5.2.6 Tree Pits and Bio-retention Areas

To allow for the capture of surface run-off along the existing road, tree pits and bio-retention basin will be located intermittently to intercept run-off along this route. The aim is to use medium in the bio-retention and tree-pit system that meets the criteria of the Facility for Advanced Water Biofiltration (FAWB) or similar for interception of run-off and to allow evaporation of leaves and provide biodiversity benefits. Guidance on the construction and maintenance of the tree pit should align with BS 8545.

Following the SDCC SUDs Explanatory, Design and Evaluation Guide by McCloys Consulting notes that on average the available storge in a bio-retention basin:

Total retention basin area of c.1065m^2

Total basin volume = c.1065m^2 x 0.6 = 639m^3

5.2.7 Pond and Swales

It is proposed that the swales will be lined as per Table 24.6 of the CIRIA 753 Suds Manual. Based on the recent SI carried out in 2022 confirming no appropriate soil infiltration capability and therefore the swales can only provide interception of up to 5 times the swale area. The swale is utilized as a connection from the permeable paving for overflow scenarios. The swales are proposed to be terraced and or flat with a raised outlet to create a temporary storage zone. This is proposed to be developed further at detailed design stage with the landscape architect.

There is a total swale/pond area of c.419.82m^2.

Swale/Pond Volume = c. 419.82m^2 x 0.005m x 5= 10.50m^3

5.2.8 Filter Strips

Filter strips are an open stone trench of 0.4-1m wide proposed to be located at the side of the existing site entrance to the entrance of Block D, for capturing run off and removing silt before entering the storm network. The filter strip is utilised areas where utilisation of tree pits is not possible, where existing trees prevent the installation of either tree pit or filter drain, and ACO drain or gully is installed. The road length the filter strip is draining is 86m long, with 1m sections of filter strip every 6m along this section of road, connecting into the stormwater network at the end of the strip. Based on Table 24.6 of the CIRIA 753 Suds Manual the filter strip provides the following interception volume.

Total length of filter strip = 14m Proposed width of 500mm

Filter strip = 14m^2 x 0.005m x 5= 0.35m^3

5.3 Long-term Attenuation Storage and Volume

Using the microdrainage software, the volumes of the required attenuation for the site as shown in Appendix D result in the following tank volumes:

Upper Catchment stormcell tank 1 is 640m^3. Modelled with a 5.2 l/s discharge @ 1.98m head.

Upper Catchment tank 2 is 360m^3 modelled with 8.9 l/s discharge @ 1.45m head.

Lower catchment stormcell tank is 85.12m^3 modelled with 1.2 l/s discharge @ 1.5m head.

These tanks have been designed for a 1:100 year storm event accommodating a 20% climate change and runoff rates for summer and winter (Cv) at a value of 1.0 to ensure accurate simulation results as per Appendix 7 the DLRCC Development Plan 2022-2028 requirements for sizing the attenuation tanks.

The filtration test results across the site indicates that infiltration of water through the soil is not possible, however at the request of DLR, stormcell tanks have been provided in areas free of buildings to allow some nature recharge, if ever possible. The above volume of water is critical, the change from concrete material to stormcell tanks where suitable is possible ensuring the above volumes are accommodated.

As part of the storm network review, the effect of blockages occurring at critical points in the system were examined in order to ensure that any flood flows will be away from buildings. The locations chosen and consequential flows are listed below. The effect of blockages occurring at critical points in the system were examined in order to ensure that any flood flows will be away from buildings. The locations chosen and consequential flows are listed below.

The effect of blockages occurring at critical points in the system were examined in order to ensure that any flood flows will be away from buildings or captured by suds measures. The scenarios modelled and the consequential flows are listed below. Refer to drawing W3683-DR-C-1041 for the flood location during scenarios 1 and 2.

Scenario 1 - 30 year storm + 50% blockage on upper catchment stormcell tank no. 1 inlet: flooding at SWMH S7 opposite block J and the coach house will flow away from the buildings and be captured by tree pits and permeable paving.

Scenario 2 - 30 year storm + 99% blockage on upper catchment stormcell tank no. 1 outlet flooding at SWMH S7 opposite block J and the coach house will flow away from the buildings and be captured by tree pits and permeable paving.

Scenario 3 - 30 year storm + 50% blockage on upper catchment tank no. 2 inlet: no flooding

Scenario 4 - 30 year storm + 99% blockage on upper catchment tank no. 2 outlet: no flooding

Scenario 5 - 30 year storm + 50% blockage on lower catchment stormcell tank inlet: no flooding

Scenario 6 - 30 year storm + 99% blockage on lower catchment tank outlet: no flooding

Note that SWMH S7 is located at the lowest point of the site, any flooding that occurs due to blockages will be captured by the surrounding SUDs systems.

5.4 Summary

The below table summarises the total volume of interception and attenuation storage provided across the site.

	Volume Required (m^3)	**Volume Provided (m^3)**
Attenuation	796.80	1092
Interception	78.38	997.63