St Teresa's Land's, Temple Hill, Monkstown, Blackrock, Co Dublin

Flood Risk Assessment

September 2021

www.jbaconsulting.ie

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Revision History

Revision Ref/Date	Amendments	Issued to
13/02/2018 / v1.0	Draft Report	Oval Target Ltd
01/08/2018 / v2.0	Revised Site Layout	Oval Target Ltd
28/08/2018 / v3.0	Update Drainage Calculations	Oval Target Ltd
15/02/2019 / v4.0	Response to RFI	Oval Target Ltd
15/12/2021 / v5.0	Updated Site Layout	Oval Target Ltd

Contract

This report describes work commissioned by Lisa Rocca, on behalf of Oval Target Ltd, by a letter dated 17/01/2018. Oval Target's representative for the contract was Marcus Wallace of JJ Campbell. David Casey of JBA Consulting carried out this work.

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Purpose

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Contents

List of Figures

1 Overview

Under The Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHIG & OPW, 2009) proposed development must undergo a Flood Risk Assessment to ensure sustainability and effective management of flood risk. This requires a review of all available flood information and assessment of Flood Zones for the development site.

1.1 Terms of Reference

JBA Consulting was appointed to prepare a Flood Risk Assessment (FRA) for a proposed residential development located at Temple Hill, Blackrock, Co Dublin.

1.2 Aims & Objectives

This study is being completed to inform the planning application for the proposed site. It aims to identify, quantify and communicate to applicant, Planning Authority officials and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk.

The objectives are to:

- Identify potential sources of flood risk,
- Confirm the level of flood risk and identify key hydraulic features,
- Assess the impact the proposed development has on flood risk in respect to the issue of attenuation and displacement of flooding,
- Develop appropriate flood risk mitigation and management measures which will allow for the long-term development of the site.

Recommendations for development have been provided in the context of the OPW / DoEHLG planning guidance, "The Planning System and Flood Risk Management ". A review of the likely effects of climate change, and the long-term impacts this may have on any development has also been undertaken.

1.3 Development Proposal

Oval Target Limited intend to apply to An Bord Pleanála for planning permission for a Strategic Housing Development on a site of c. 3.9 ha at 'St. Teresa's House' (A Protected Structure) and 'St. Teresa's Lodge' (A Protected Structure) Temple Hill, Monkstown, Blackrock, Co. Dublin.

The development will consist of a new residential and mixed use scheme of 493 residential units and associated residential amenities, a childcare facility and café in the form of (a) a combination of new apartment buildings (A1-C2 and D1 – E2); (b) the subdivision, conversion and re-use of 'St. Teresa's House' (Block H); and (c) the dismantling, relocation and change of use from residential to café of 'St. Teresa's Lodge' (Block G) within the site development area. A detailed development description is now set out as follows:

The proposal provides for the demolition (total c. 207 sq m GFA) of (a) a single storey return (approx. 20 sq m) along the boundary with The Alzheimer's Society of Ireland; (b) the ground floor switch room (approx. 24.9sq.m.), (c) ground floor structures northwest of St. Teresa's House (26.8sq.m), (d) basement boiler room northwest of St. Teresa's House (17.0 sq.m), (e) ground floor structures northeast of St. Teresa's house (22.0sq.m.) (f) basement stores northeast of St. Teresa's house (67.8 sq.m.) and (g) a non - original ground floor rear extension (approx. 28.5 sq m) associated with the Gate Lodge.

The new development will provide for the construction of a new mixed use scheme of 487 no. apartment units in the form of 11 no. new residential development blocks (Blocks A1-C2 and D1 – E2) as follows:

- Block A1 (5 storeys) comprising 37 no. apartments (33 no. 1 bed units and 4 no. 2 bed units)
- Block B1 (10 storeys) comprising 55 no. apartments (37 no. 1 bed units, 10 no. 2 bed units, 8 no. 3 bed units)
- Block B2 (8 storeys) comprising 42 no. apartments (28 no. 1 bed units, 9 no. 2 bed units and 5 no. 3 bed units)
- Block B3 (8 storeys) comprising 42 no. apartments (28 no. 1 bed units, 9 no. 2 bed units and 5 no. 3 bed units)
- Block B4 (5 storeys) comprising 41 no. apartments (4 no. studio units, 4 no. 1 bed units, 27 no. 2 bed units and 6 no. 3 bed units)
- Block C1 (3 storeys) comprising 10 no. apartments (1 no. studio units, 3 no. 1 bed units and 6 no. 2 beds)
- Block C2 (3 storeys) comprising 6 no. apartments (2 no. 1 bed units and 4 no. 2 bed units) together with a creche facility of 392 sq m at ground floor level and outdoor play area space of 302 sq m.
- Block C3 (1 storey over basement level) comprising residential amenity space of 451 sq m.
- Block D1 (6 storeys) comprising 134 no. apartments (12 no. studio units, 22 no. 1 bed units, 90 no. 2 bed units and 10 no. 3 bed units).
- Block E1 (6 storeys) comprising 70 no. apartment units (34 no. 1 bed units, 26 no. 2 bed units and 10 no. 3 bed units).
- Block E2 (6 storeys) comprising 50 units (1 no. studio units, 29 no. 1 bed units, 18 no. 2 bed units and 2 no. 3 bed units).

Each new residential unit has associated private open space in the form of a terrace / balcony.

The development also provides for Block H, which relates to the subdivision and conversion of 'St. Teresa's House' (3 storeys) into 6 no. apartments (5 no. 2 bed units and 1 no. 3 bed unit) including the demolition of non-original additions and partitions, removal and relocation of existing doors, re-instatement of blocked up windows, replacement of windows, repair and refurbishment of joinery throughout and the upgrade of roof finishes and rainwater goods where appropriate.

It is also proposed to dismantle and relocate 'St. Teresa's Lodge' (1 storey) from its current location to a new location, 180 m south west within the development adjacent to Rockfield Park. St. Teresa's Lodge (Block G) will be deconstructed in its original location and reconstructed in a new location using original roof timbers, decorative elements and rubble stonework, with original brickwork cleaned and re-used where appropriate.

It is also proposed to dismantle and relocate 'St. Teresa's Lodge' (1 storey - gross floor area 69.63sq m) from its current location to a new location, 180 m south west within the development adjacent to Rockfield Park. St. Teresa's Lodge (Block G) will be deconstructed in its original location and reconstructed in a new location using original roof timbers, decorative elements and rubble stonework, with original brickwork cleaned and re-used where appropriate. A non - original extension (approx. 28.5 sq m) is proposed for demolition. The current proposal seeks a new

extension of this building (approx. 26.8 sq m) and a change of use from residential to café use to deliver a Part M compliant single storey building of approx. 67.4 sq m

Total Open space (approx. 15,099.7 sq m) is proposed as follows: (a) public open space (approx. 11,572.3 sq m) in the form of a central parkland, garden link, woodland parkland (incorporating an existing folly), a tree belt; and (b) residential communal open space (approx. 3,527.4 sq m) in the form of entrance gardens, plazas, terraces, gardens and roof terraces for Blocks B2 and B3. Provision is also made for new pedestrian connections to Rockfield Park on the southern site boundary and Temple Hill along the northern site boundary.

Basement areas are proposed below Blocks A1, B1 to B4 and D1 (c. 7,295 sq. m GFA). A total of 252 residential car parking spaces (161 at basement level and 91 at surface level); 1056 bicycle spaces (656 at basement level and 400 at surface level); and 20 motorcycle spaces at basement level are proposed. 8 no. car spaces for creche use are proposed at surface level.

The proposal also provides for further Bin Storage areas, Bike Storage areas, ESB substations and switch rooms with a combined floor area of 356.2 sq m at surface level.

The development also comprises works to the existing entrance to St. Teresa's; the adjoining property at 'Carmond'; and residential development at St. Vincent's Park from Temple Hill (N31/R113). Works include the realignment and upgrade of the existing signalised junction and associated footpaths to provide for improved and safer vehicular access/egress to the site and improved and safer access/egress for vehicular traffic to/from the property at 'Carmond' and the adjoining residential development at St Vincent's Park.

Emergency vehicular access and pedestrian/cyclist access is also proposed via a secondary long established existing access point along Temple Hill. There are no works proposed to the existing gates (Protected Structure) at this location.

The associated site and infrastructural works include provision for water services; foul and surface water drainage and connections; attenuation proposals; permeable paving; all landscaping works including tree protection; green roofs; boundary treatment; internal roads and footpaths; and electrical services including solar panels at roof level above Blocks A1, B1 - B4, C1-C3, D1, E1, E2, as depicted in Figure 1-2 over page.

Figure 1-1 Site Layout

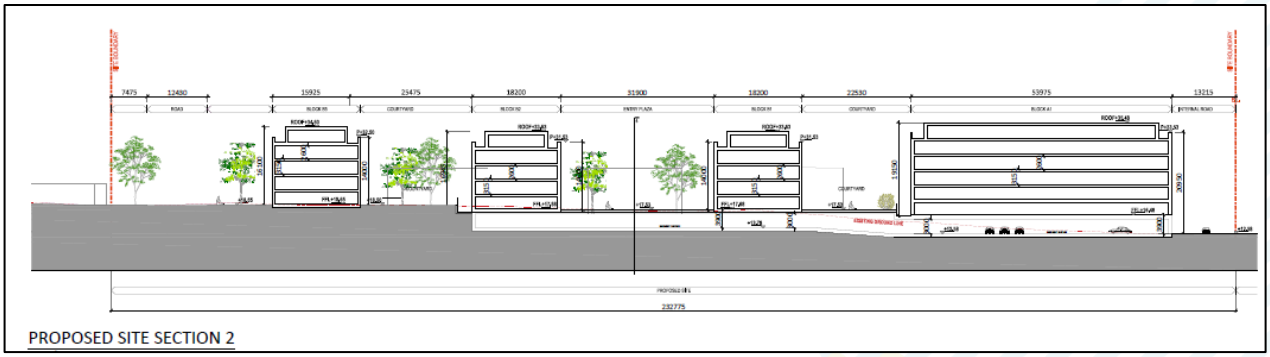

Figure 1-2 Site Cross Section

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2 Site Background

2.1 Location

The proposed development is located in St Teresa's lands in Temple Hill, Blackrock, Dublin. The site is located in an urban environment. The N31 runs along the sites northern boundary, while existing residential developments border the site to west and south-east. The Rockfield Park playing pitches are located to the south of the development.

The site is zoned for residential use under the Dun Laoghaire Rathdown Development Plan 2016-2022. Figure 2-1 outlines the site location and local mapping.

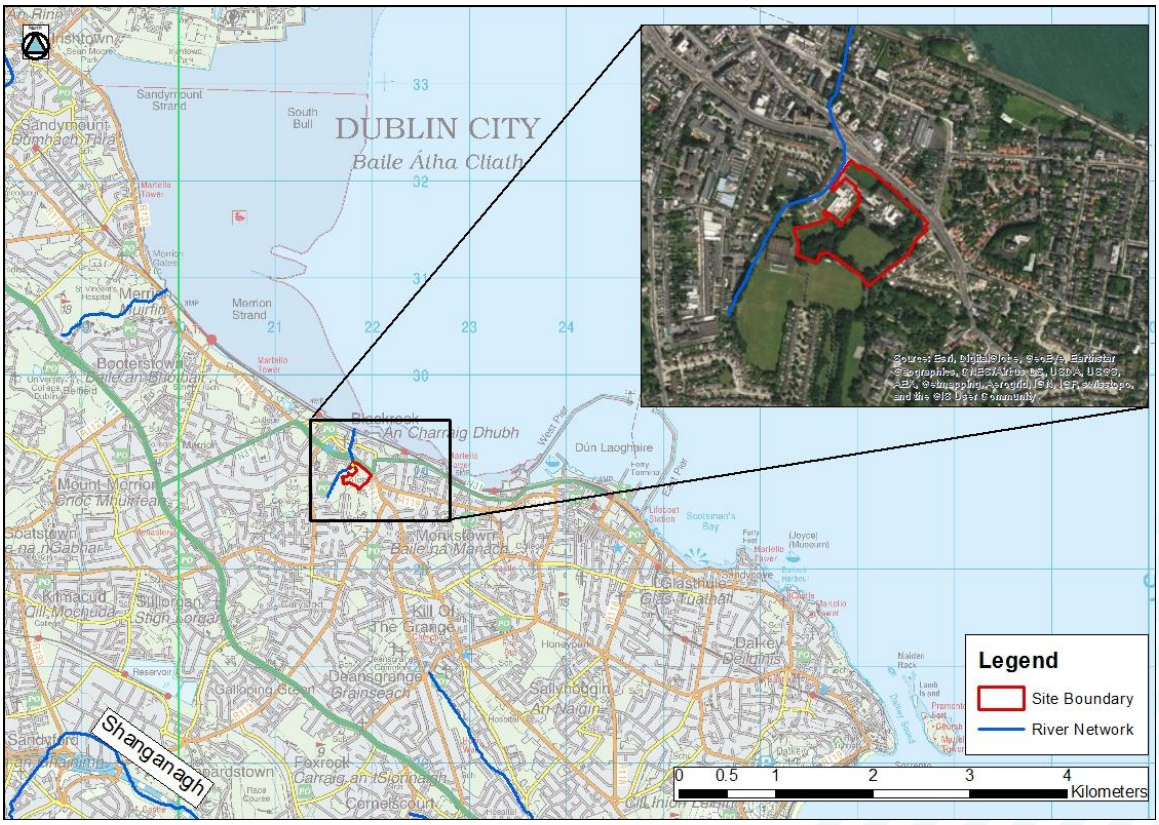

Figure 2-1 Site Location & Hydrological Environment

2.2 Watercourses

The site is located in close proximity to the coastline, with Dublin Bay located c. 350m northeast of the site boundary. The main watercourse is identified as the Carysfort-Maretimo Stream which is located c. 20m from the site's western boundary. The Carysfort-Maretimo Stream runs predominantly in a north-easterly direction in the area and discharges to Dublin Bay c. 400m north of the site.

Flood defences are in place along the Carysfort-Maretimo in the vicinity of the development. The stream is culverted under the Temple Road at the sites north-western boundary.

Other watercourses in the area have been identified as the Priory Stream which is located c. 650m northwest and the Sradbrook Stream which is located c. 850m to the southeast.

2.3 Local and site topography

The site covers an area of approximately 4 ha. There is a fall noted across the site that runs in an SW-NE direction towards the coastline. The topography varies from a high of c. 21mOD along the sites southern boundary to a low of c. 12.5mOD with the boundary with the Temple Road.

3 Flood Risk Identification

An assessment of the potential and scale of flood risk at the site is conducted using historical and predictive information. This identifies any sources of potential flood risk to the site and reviews historic flood information. The findings from the flood risk identification stage of the assessment are provided in the following sections. Further detail on the Planning Guidelines and technical concepts are provided in Appendix A.

3.1 Flood History

A number of sources of flood information were reviewed to establish any recorded flood history at, or near the site. This includes the OPW's website, www.floodmaps.ie and general internet searches.

The OPW host a National Flood hazard mapping website, www.floodmaps.ie, which highlights areas at risk of flooding through the collection of recorded data and observed flood events. See Figure 3-1 for historic flood events in the area.

- Flooding at Barclay Road and Temple Road, Blackrock, Co. Dublin, on the 24th Oct 2011- Overtopping of the Carysfort-Maretimo Stream following heavy rainfall. Located at the sites northern boundary.
- Flooding at Carysfort Avenue, Blackrock, Co. Dublin, on the 24th Oct 2011- Overtopping of the Carysfort-Maretimo Stream following heavy rainfall. Located c. 450m to the south of the site.
- Flooding at Newtownpark Avenue, Blackrock, Co. Dublin, on the 24th Oct 2011. Pluvial/Surface water flooding following heavy rainfall. Located c. 1km south-east of the site.

The October 24th flood event occurred along Temple Rd at the site's north-eastern boundary. Based on the proximity of the site to this flood point, inundation of a section of the site was likely but restricted to the most northern boundary. Based on the site topography it is unlikely that any areas containing the proposed residential uses were affected.

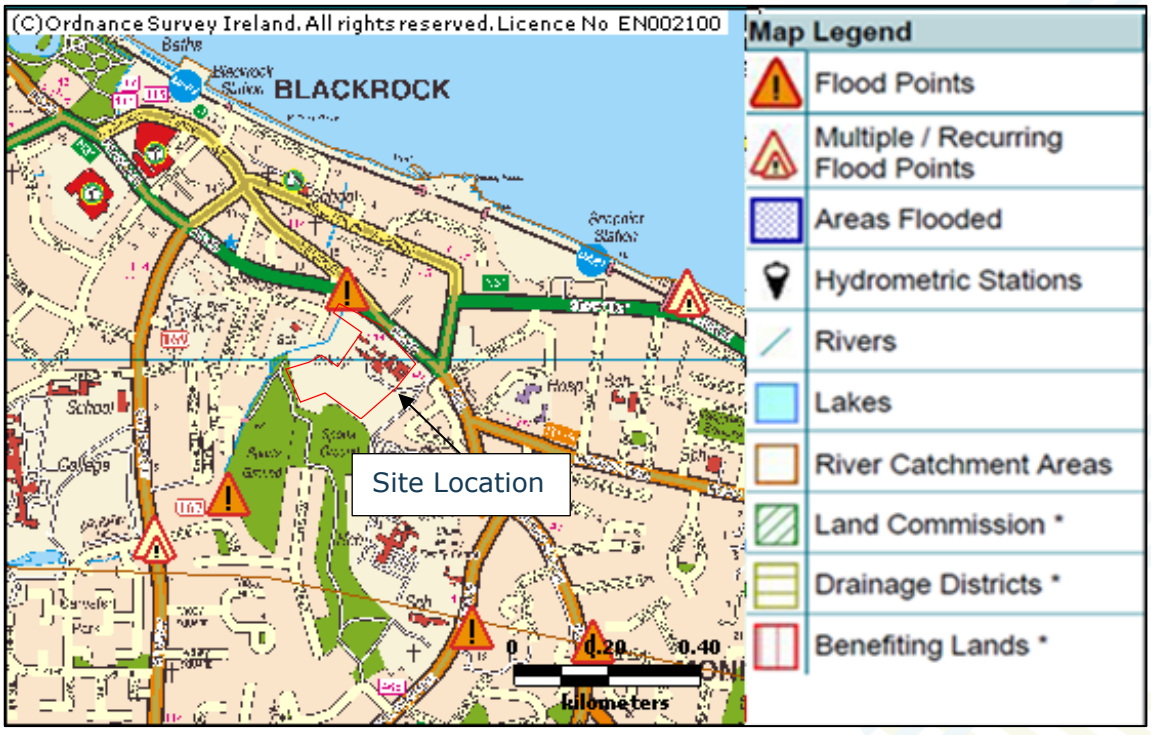

Figure 3-1 Floodmaps.ie

3.1.1 Internet Search

An internet search was conducted to gather information about whether or not the site was affected by flooding previously. While there were no results for flooding affecting the site itself, there were reports confirming the flooding in the areas as highlighted on Floodmaps.ie (Section 3.1).

3.2 Predictive Flooding

The area has been a subject to two predicative flood mapping or modelling studies and another related study:

- Eastern Catchment Flood Risk Assessment and Management Study (2016);
- OPW Preliminary Flood Risk Assessment (2011);
- Dun Laoghaire-Rathdown Development Plan 2016-2022 (2016).

The level of detail presented by each method varies according to the quality of the information used and the approaches involved. The Eastern CFRAM is the most detailed assessment of flood extent and supersedes the fluvial flood outlines presented by the OPW PRFA study.

3.2.1 Catchment Flood Risk Assessment and Management Study (Eastern CFRAM)

The Eastern CFRAM Study is the most detailed mapping undertaken in the Dublin region. It commenced in June 2011 with final flood maps issued during 2016. The Eastern CFRAM Study involves detailed hydraulic modelling of rivers and their tributaries, including the Carysfort-Maretimo, which is the nearest watercourse to the site. Following the detailed hydraulic modelling, flood maps were produced for the 10%, 1% and 0.1% AEP flood events.

The available flood maps have been reviewed and confirm that the most northern extent of the site, and directly adjacent to the Carysfort-Maretimo is located within Flood Zone A (defended) & B. The flood defences along the Carysfort-Maretimo provides flood protection up to the 1% AEP flood event. See Figure 3-2 for the flood maps

Flooding appears to originate from Carysfort-Maretimo system following surcharging of the culvert system underneath the Temple Rd, directly downstream of the site. The stream overtops its right bank which results in inundation of c. 40m into the site.

Review of the available data confirms that the 0.1% AEP flood level flood depth within the site is ranges from 0-250mm in the affected area, refer to Figure 3-3.

Coastal flooding does not impact on or in the vicinity of the proposed development. Review of the Eastern CFRAM data indicates a 0.5% AEP and 0.1% AEP flood level of 3.04mOD and 3.25mOD respectively. Refer to Figure 3-4 for the tidal flood extents in the area.

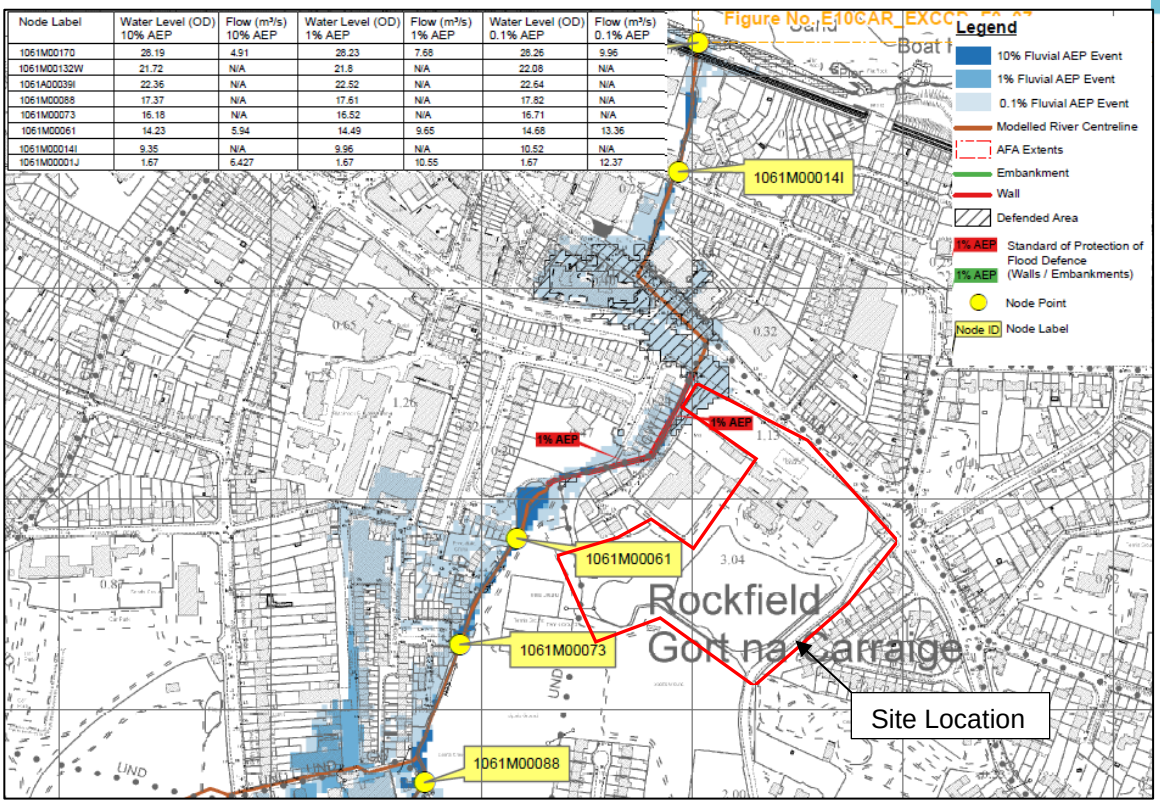

Figure 3-2 Eastern CFRAM Flood Extent Map

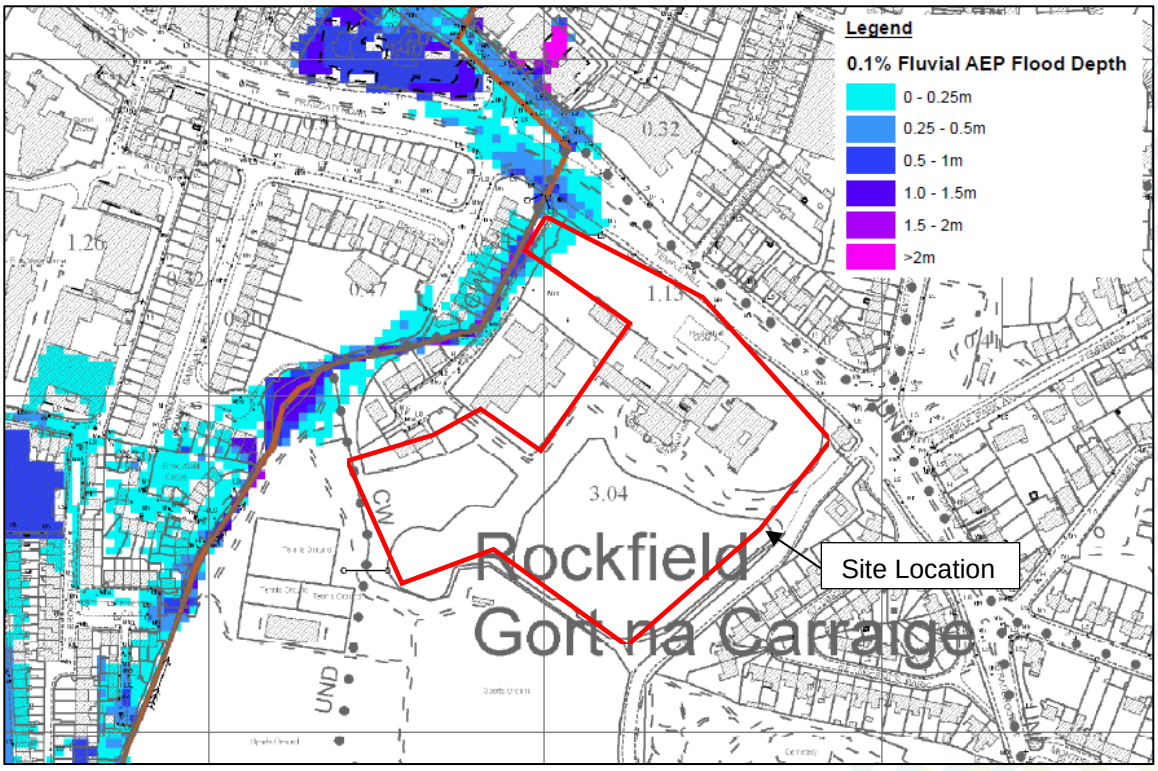

Figure 3-3 Eastern CFRAM Flood Depth Map

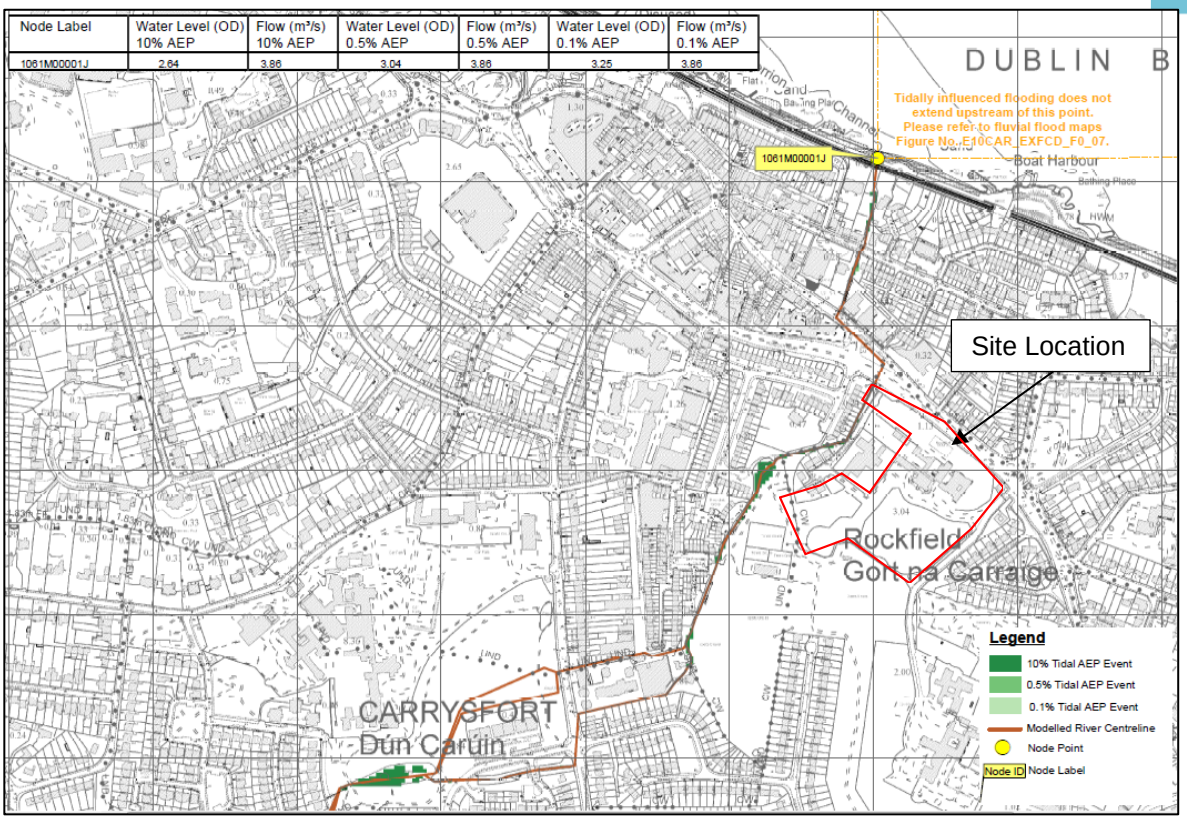

Figure 3-4 Eastern CFRAM Tidal Flood Risk Map

3.2.1 Dun Laoghaire-Rathdown County Council Strategic Flood Risk Assessment

The Strategic Flood Risk Assessment (SFRA) has been prepared as part of the Dun Laoghaire-Rathdown Development Plan (DLR) 2016-2022. The SFRA informs the strategic land use planning decisions by providing an assessment of flood risk within the region and enables the application of the sequential approach, including Justification Test. A range of flood map sources (OPW PFRA, Eastern CFRAM etc.) were reviewed as part of the SFRA to inform the use of the Justification Test for developments at risk of flooding. In addition to the Justification Test, various flood management policies and objectives are outlined for inclusion within the Dun Laoghaire-Rathdown Development Plan. See Appendix B for the stated policies.

An extract of the flood map produced as part of the SFRA is presented in Figure 3-5. It should be noted that the SFRA flood maps are based on the Eastern CFRAM flood outlines, which places the western boundary of the site within Flood Zone B and therefore, at a moderate risk of flooding.

The flood defences along the Carysfort-Maretimo is referred to within the SFRA, as site 16, as follows *"These defences are of robust construction, although consideration of the impacts of overtopping, either through higher return period events or with the impact of climate change on river flows, should be taken into account in any site specific flood risk assessment. Breach assessment is unlikely to be required"*

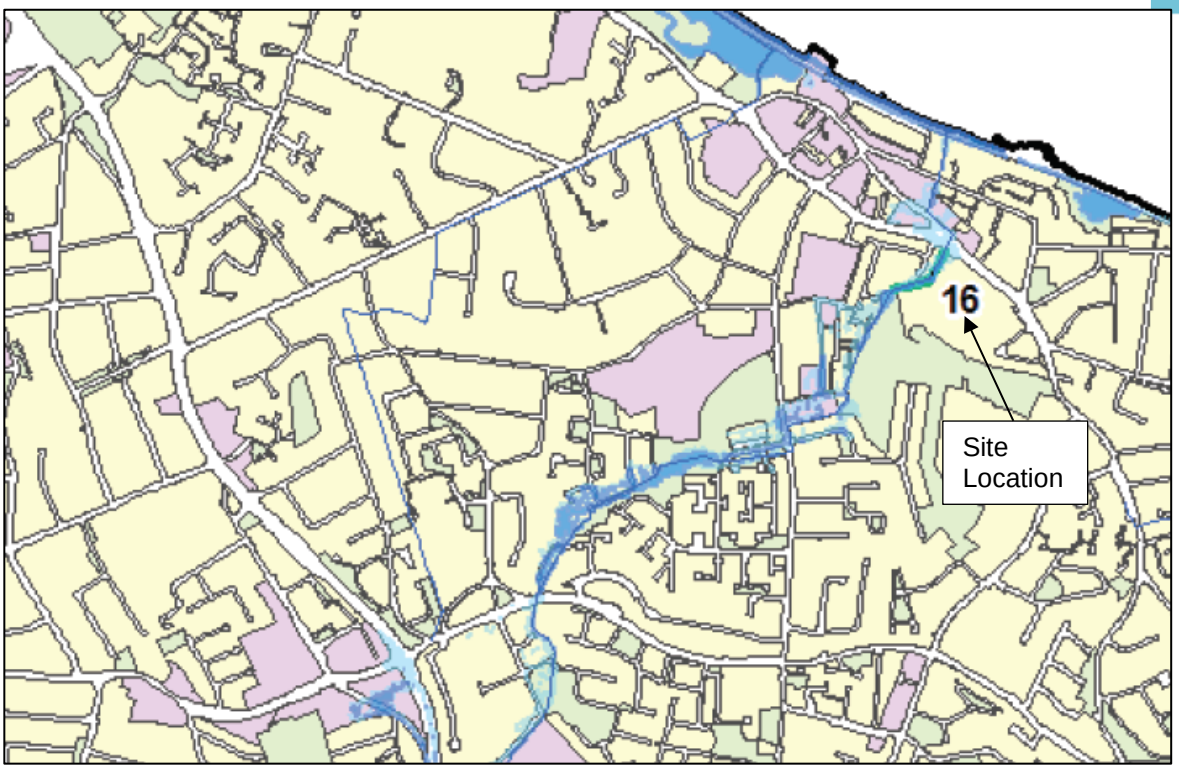

Figure 3-5 DLR SFRA Flood Map

3.3 Sources of Flooding

The initial stage of a Flood Risk Assessment requires the identification and consideration of probable sources of flooding. These sources are described below:

3.3.1 Fluvial

Sources of historic flood information have been researched as part of the FRA. The main watercourse in the area is the Carysfort-Maretimo which runs adjacent to the site's northern boundary (<20m). The Carysfort-Maretimo provides the main source of flood risk to the development.

Review of floodmaps.ie indicates the occurrence of historic flooding along Temple Road in the vicinity of the site's northern boundary. The source of flooding originated from overtopping of the Carysfort-Maretimo following heavy rainfall. It is unclear if the site itself was inundated, but based on the site topography, any inundation onsite would have been restricted to the north-western corner.

Review of the Eastern CFRAM and SFRA flood maps places the eastern boundary of the site within Flood Zone A, albeit defended, and Flood Zone B. The site is protected by a flood wall located along the Carysfort-Maretimo that provides protection up to the 1% AEP standard. Although the site is protected from the 1% AEP flood event, as per the guidelines the flood zone extents should not be inclusive of any flood defences. It is considered therefore that the eastern boundary of site is within Flood Zone A/B.

Specific mitigation measures will be outlined in Section 4 to manage the identified fluvial flood risks to the site.

3.3.2 Coastal

The site is located within 300m of the coastline, therefore the risk of tidal flooding has been assessed. There has been no recorded instance of coastal flooding in the study area. Review of the Eastern CFRAM flood map for the area indicates a 0.5% AEP and

0.1% AEP flood level of 3.04mOD and 3.25mOD respectively, while the lowest site level onsite is c. 12.5mOD.

Considering the above, coastal flooding is not considered to present a flood risk to the site.

3.3.3 Pluvial

Pluvial or surface water flooding is the result of rainfall-generated flows that arise before run-off can enter a watercourse or sewer. A number of sources have been researched such as the OPW PFRA flood mapping and review of floodmaps.ie. Based on review of the available information there is no recorded or predicted pluvial flooding at the site or immediate surrounding area.

Specific measures in relation to the proposed stormwater system to manage onsite surface water flows is referred to Section 4.

3.3.4 Groundwater

The OPW PFRA was reviewed and did not indicate groundwater flooding at the site or surrounding area. The GSI groundwater vulnerability for the site is classified as 'moderate' and 'high' which indicates a groundwater depth of ranging from 3-10+m.

Furthermore, there are no karst features in the area which would indicate areas at risk of groundwater flooding.

In summary, there is no known risk of groundwater flooding in this area and has been screened out at this stage.

4 Flood Risk Assessment

4.1 Flood Risk

Review of the available sources of flooding outlined in Section 3 confirms that there has likely been some inundation at the site along its most northern boundary. The is based on recoded flooding that has occurred along Temple Road in October 2011. Furthermore, both the Eastern CFRAM and Dublin City SFRA flood maps identifies that the eastern boundary of the site lies within Flood Zone A (defended) and B.

The main flood risk is identified as overtopping of the Carysfort-Maretimo Steam adjacent to the site's boundary. Flood defences have been constructed along the Carysfort-Maretimo that provide protection to the 1% AEP standard. Therefore, flood risk is only considered at the site from overtopping of the Carysfort-Maretimo flood defences or exceedance events. The only possible receptor at risk of inundation is identified as the ground floor carpark at Block A1.

With reference to Figure 4-1, it is shown that the proposed ground/basement car park entrance is located in Flood Zone A/B. The apartments contained in Block A1 are situated on the first floor at a level of 16.48mOD and therefore, are not at risk of flooding. The associated ground floor FFL for Block A1 is 13.15mOD.

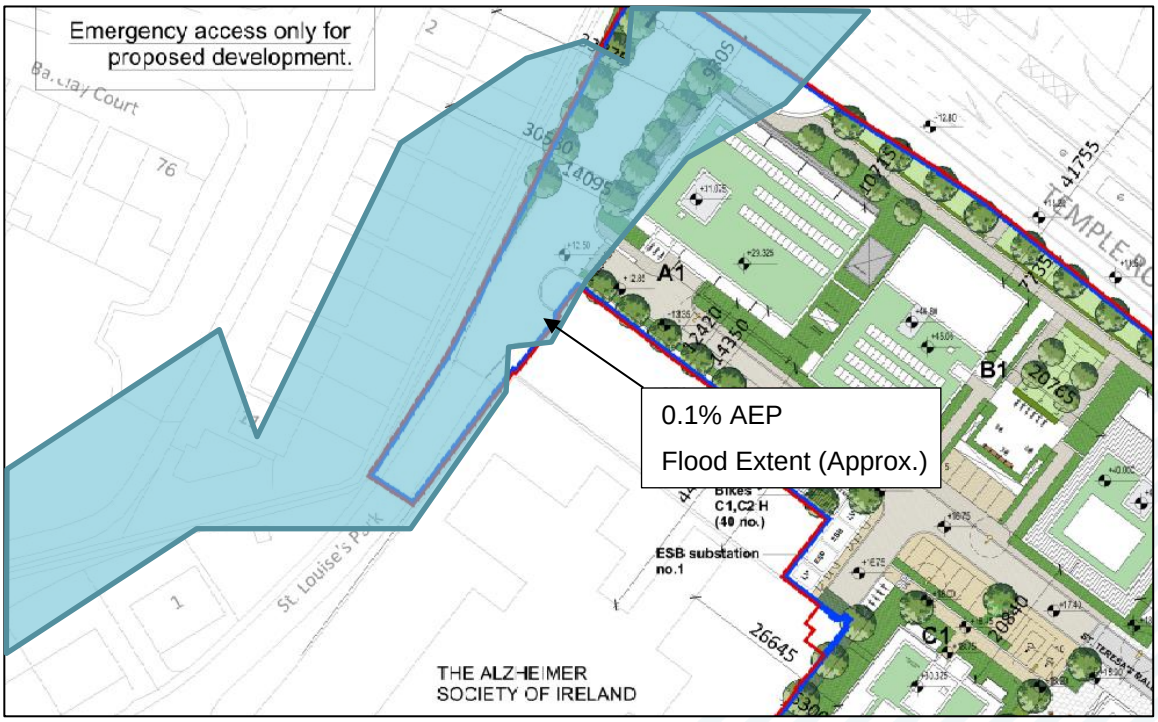

Figure 4-1 Overlay of 0.1% AEP Flood Extent onto Site Layout

Following the site visit it was noted that a stone-faced block boundary wall currently runs along the site's boundary with the access roadway along the site north-western boundary, see Figure 4-2. The existing wall, gateway and access road will be retained for access to the proposed development. It is reasonable to assume that the boundary wall was not incorporated into the CFRAM model, as it is an informal, ineffective structure as per standard CFRAM modelling practices. Therefore, its potential impact on the flood extents has not been accounted for.

Figure 4-2 Access Road Photograph

Given the construction type and height, the wall is reasoned to be of sufficient stature/size to impede overland flow at least up to 300mm. It will therefore have an impact upon the flood extents depicted in the CFRAM flood map presented in Figure 3-2 and Figure 4-1. It is noted that there is a gateway, and the impact of this is discussed in the following paragraphs.

Although the extents will be changed by the wall, the overland flow rates overtopping the Carysfort-Maretimo Steam will remain the same so the overall impact will be an increase in flood depths along the road, when compared to the CFRAM outputs.

Further analysis has been carried out to appraise the potential impact of the boundary wall on the CFRAM flood extents. The methodology employed was to use the Manning's equation to calculate the flow rate along the access road based on the maximum flood depth (250mm) and CFRAM flow path width (17.5m). Refer to Table 4-1 for a summary of the parameters used in the Manning's calculation.

Table 4-1 Manning's Calc Parameters

Parameter	CFRAM extents	Existing condition
Width	17.5	8.3
Slope	0.004	0.004
Manning's	0.035	0.35
Qm^3/s	1.44	1.44
Depth (m)	0.25	0.27

Based on a lowest road level of 12.47mOD (from topographic survey) and maximum flood depth of 250mm (from CFRAM 0.1% AEP depth map), this equates to a flood level of 12.72mOD. Applying the Manning's equation gives a flow of 1.44m^3/s.

As noted, the boundary wall will constrict water into a narrower flow path than that presented in the CFRAM flood maps. This has been estimated as a reduction in width from c. 17.5m to c.8.3m. The Manning's equation was then recalculated with the same parameters as provided in Table 4-1, but reducing the pathway width to 8.3m whilst maintaining a flow of 1.44m^3/s. This process gave a revised flood depth of 270mm, or a 20mm increase in flood levels when compared with the CFRAM indicated levels. This indicates a possible flood level of 12.74mOD on Temple Road in the 0.1% AEP event.

The resulting 0.1% AEP flood extents are presented in Figure 4-3, including the levels used in the calculation process.

Although the gateway is being retained through the wall, ground levels on the inside (development side) of the gate are c. 12.85mOD, which is above the calculated flood level and mean that, although there may be a small area of inundation in the gate opening, water depths will not be sufficient to enter the site and form the flood extent indicated by the CFRAM mapping.

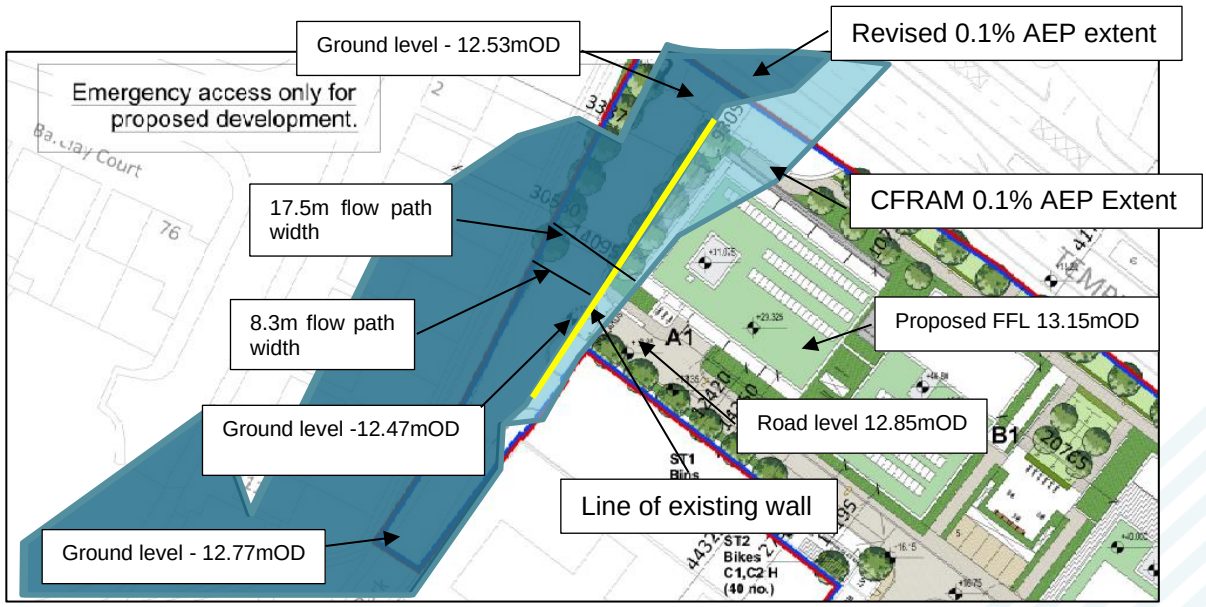

Figure 4-3 Boundary Wall

Following the above calculations, a freeboard of 410mm is available above the calculated 0.1% AEP flood level to the ground floor (non-residential) development in Block A1 (13.15m OD). Furthermore, the presence of a boundary wall, which will be retained post-development will prevent the ingress of flood waters onto the site.

Any potential floodwaters that enter the site upstream of the boundary wall will be redirected onto the access road due to the proposed ramping of the basement car park access. This is discussed further in Section 4.2.1

4.2 Flood Mitigation Measures

4.2.1 Ramping of Carpark Entrance

The Eastern CFRAM Study flood depth map indicates a maximum flood depth of 250mm, during the 0.1% AEP flood event. Following the calculations undertaken in Section 4.1, the depth has been increased to 270mm which equates to an estimated flood level of 12.74mOD. Although this depth of flooding will be retained on the road, it is prudent to ensure access to the buildings, and in particular the basement, are above this level. To achieve this, the car park entrance is ramped up from 12.5mOD

to 13.35mOD, which places the car park entrance some 500mm above the 0.1% AEP flood level. Refer to Figure 4-2 for the proposed mitigation measure for the car park entrance in proximity to the Carysfort-Maretimo.

The ramping of the car park to protect the basement level from inundation will have the secondary effect of redirecting any overland flow back into the access road, as depicted in Figure 4-2. To ensure that flood waters are prevented from entering the site, the proposed kerb adjacent to the apartment block should be set at a minimum level of 12.95mOD.

As discussed above, any flood waters which enter the site from the upstream end of the boundary wall will be below the level of the ramped entrance and will be re-routed through the gateway and back onto the road.

Furthermore, all service/ ventilation openings in this area should be positioned a minimum of 400mm above the existing ground level to ensure no secondary flow pathway is provided. This will give a freeboard of approximately 150mm over the estimated flood depths of 250mm.

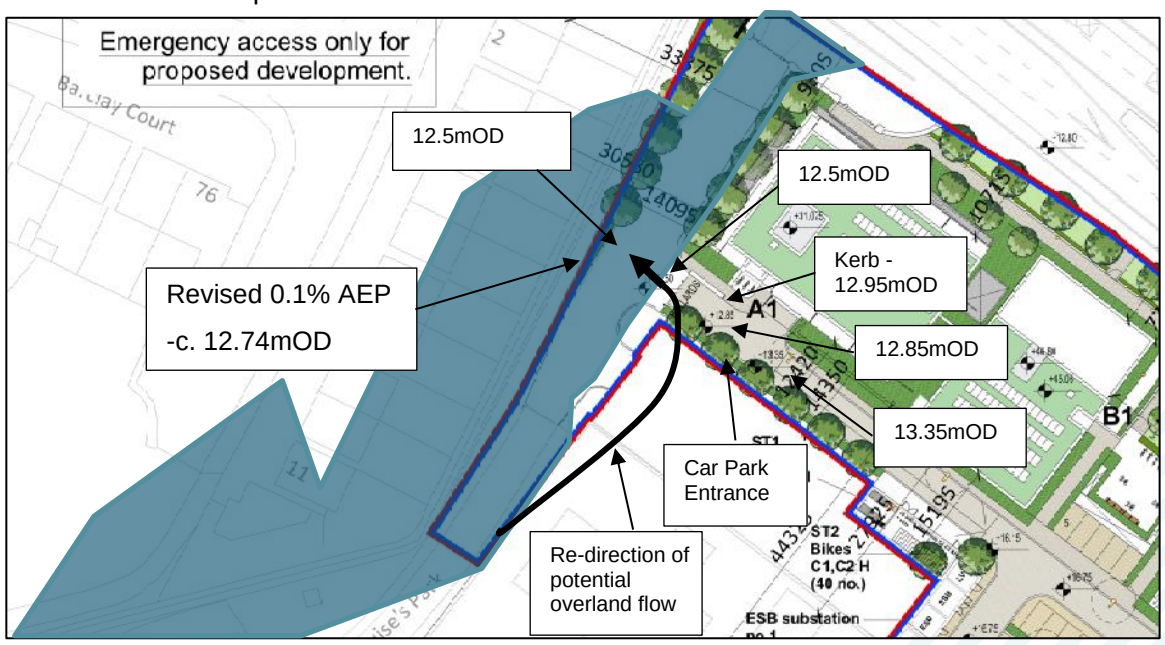

Figure 4-4 Mitigation Measures

4.3 Access

The main site entrance to the development is provided within Flood Zone C, refer to Figure 1-1. However, the emergency entrance is situated within Flood Zone A (defended). Given the estimated maximum flood depth of 250mm, access to the carpark can be maintained during a flood event, if required.

If pedestrian access to Block A1 is provided from lands within Flood Zone A/B, the access threshold should be set to 400mm above the external hardstanding area, again providing a freeboard of approximately 150mm.

In summary, as the main site entrance is located within Flood Zone C, access is not considered to be an issue during a potential flood event at the site.

4.4 Drainage Design/ Pluvial Flood Risk

A stormwater system will be incorporated within the development design to manage surface water run-off from the site. Stormwater attenuation tanks are included as part of the design to ensure that stormwater discharge is limited to its greenfield equivalent. The attenuation tank is designed to retain a 100 year rainfall event including an allowance for climate change (20%). The design discharge is 8.17 l/s while the total required attenuation volume is 1600m^3. Attenuation is provided over two attenuation structures each providing 50% of the storage volume. JBA Consulting have not review the calculations as part of this FRA and are assumed to be calculated to the best practice guidelines.

Further to the attenuation storage, additional SuDs measures have incorporated into the design. This includes the implementation of green roofs to the apartment blocks covering a minimum of 60% of the roof area. Permeable paving has also been provided which has been designed to intercept the first 5mm of runoff.

To minimise the risk to the development, all finish floor levels, thresholds or basement entrances should be raised by 100mm from the surrounding hardstanding areas to risk of inundation.

4.5 Residual Risk

Residual risks are defined as risks that remain after all risk avoidance, substitution and mitigation measures have been taken. The flood risk assessment identifies the following as the main sources of residual risk to the proposed development:

4.5.1 Climate Change

The impacts of climate change can result in more frequent flood event with a higher volumes of river flow. The potential residual risk to the development will need to be considered in this context.

The Carysfort-Maretimo Steam flood defences includes an allowance for climate change and freeboard. This will ensure that site will remain protected from the potential increase in the occurrence and magnitude of flood events due to climate change.

The 0.1% AEP flood event will result in inundation of up to 250mm in some areas of the site. For the purpose of the FRA, the 0.1% AEP is taken to represent the 1% AEP plus climate change scenario. The proposed mitigation measures have been designed to protection against these flood events.

4.5.2 Failure of the Carysfort-Maretimo Flood Alleviation Scheme

The Carysfort-Maretimo flood defences provide protection up to the 1% AEP flood event including an allowance for climate change. During a possible failure of the flood defence scheme, the resulting flood outlines would be expected to be similar to the current modelled CFRAM results for the 0.1% AEP flood event.

The proposed flood defence measures (refer to Section 4.2.1) have been designed to provide protection above the 0.1% AEP flood level. Therefore, if the flood defences were to fail, the basement car park will remain protected.

4.5.3 Failure of the Boundary Wall

Following review of Figure 4-1, failure of the boundary wall is not considered likely. However, in the event of a failure the flood extents would be expected to be similar to the CFRAM flood map outlines presented in Figure 3-3 and Figure 4-1. The access road to basement level has been raised by 400mm to provide a freeboard of 500mm over the 0.1% AEP flood levels if failure of the boundary wall was to occur.

5 The Justification Test for Development Management

5.1 Strategy

The planning guidance appropriate to this development is, "The Planning System and Flood Risk Management" and sets out a framework within which the planning authority should consider proposals for new development in areas of flood risk. This framework is called the Justification Test for Development Management.

Although the revised calculations confirm that the site is located in Flood Zone C, since the proposed development is classified as a highly vulnerable development and is located adjacent to Flood Zone A/B, a Justification Test (JT) is provided.

In the following text, each of the criteria within the JT is responded to as they relate to the proposed residential development. For ease of reading, where the responses are supported by technical detail which is contained in later parts of the report, an appropriate chapter has been referenced.

5.2 Justification Test: Part 1

The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of the Planning Guidelines.

The DLR Development Plan 2016-2022 outlines the development strategy for the area. Zonal development maps have been produced including the development site. These are based on predictive flood mapping, historical flood event data and other indicative data sets such as benefiting land maps. The Development Plan shows the site to be zoned for residential. Objective A- To protect and-or improve residential amenity. There are a number of specific policies in relation to managing flood risks, which have been incorporated into the design recommendations.

Conclusion: The development Passes Part 1 of the Justification Test. The site is zoned as residential Objective A which aims to protect and/or improve residential amenity.

5.3 Justification Test: Part 2

The proposal has been subject to an appropriate flood risk assessment that demonstrates:

(i) the development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;

As part of the FRA, calculation have been undertaken to confirm that the development is not located in a flood zone or will interact with a conveyance route. The site is defended from the 1% AEP flood event, and is located outside of Flood Zone C, therefore it will have no impact on these events.

Conclusion: The site is shown to be located in Flood Zone C, and is not at risk from the 1% and 0.1% AEP flood events. The site will not impact upon the Flood Zone A (1% AEP) event as it protected by the Carysfort-Maretimo flood defences.

(ii) the development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;

The proposed FFL level for the residential apartments within Block A is 16.48mOD which provides a freeboard of 3.58m over the expected Flood Zone A/B flood levels. The basement carpark entrance will be protected from inundation by raising the entrance above the expected flood depths.

Conclusion: The residential dwellings within the site are all located with Flood Zone C. Flood risks to the basement carpark have been identified and mitigation measures proposed. The car park entrance will be raised by to provide a 400mm freeboard over the expected maximum flood depth.

(iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access.

Residual risk have been assessed for the site and have been considered regards the proposed mitigation measures. Access to the development is provided within Flood Zone C via Temple Road.

Conclusion: The proposed mitigation measures have been designed to provide flood protection from the identified residual risks. Site access to the development is provided for in Flood Zone C.

(iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

See supporting planning application documents for details of the urban design.

6 Conclusion

JBA Consulting were commissioned by Oval Target Ltd to undertaken a Flood Risk Assessment (FRA) for a proposed residential development located along Temple Rd, Blackrock, Dublin.

Historical flood information was reviewed and confirmed that flooding occurred along Temple Road during October 2011. If inundation occurred at the site during this flood event, it would have likely been limited to the area alongside the site's northern boundary.

Review of the Eastern CFRAM and DLR SFRA flood maps indicates that the northern boundary of the site is within Flood Zone A (defended)/B. However, based on the site visit and provided calculations, it is confirmed that the development is not at risk from the 0.1% AEP flood event. Flood defences are located along the Carysfort-Maretimo and provides protection from a 1% AEP standard. The 0.1% AEP event will result in inundation of the access road, but floodwaters will be prevented from entering the site.

A single apartment block intersects the Flood Zone A/B outline. Residential apartments are restricted to the 1st floor level at 16.48mOD. The proposed basement / ground floor car park entrance is located in Flood Zone C, with a freeboard of 600mm above the estimated 1% AEP flood level. All residential properties onsite are located in Flood Zone C.

To mitigate against the identified flood risks, it is necessary to provide a barrier to the ingress of floodwater to the basement car park. This can be achieved by raising the proposed carpark entrance to provide a 400mm freeboard of over the expected 0.1% AEP flood level. The kerbs along the car park entrance should be set to a level of 12.95mOD. All openings to the basement in this area should be raised to a minimum of 400mm over the existing ground level.

A stormwater system has been designed to manage surface water runoff from the site. An attenuation tank is included as part of the design and has a storage capacity of 1,545m^3/s to retain a 100 year rainfall event, including a 20% allowance for climate change. Stormwater discharge will be limited to the site's greenfield equivalent of 8.17l/s. In addition, green roofs have been provided in the apartment blocks cover a minimum of 60% of the roof area, which will not be connected to the stormwater system. Permeable paving has also been provided.

Residual risks have been identified as potential increase in stream flow & frequency of flooding resulting from climate change and failure of the Carysfort-Maretimo flood defences. The proposed mitigation measures above are sufficient to protect the site from the identified residual risks.

As a result of the analysis, design and mitigation measures the proposed development is considered to be in line with the core principles of the Planning Guidelines and objectives outlined in the DLR Development Plan 2016-2022.

Appendices

A Understanding Flood Risk

Flood risk is generally accepted to be a combination of the likelihood (or probability) of flooding and the potential consequences arising. Flood risk can be expressed in terms of the following relationship:

Flood Risk = Probability of Flooding x Consequences of Flooding

A.1 Probability of Flooding

The likelihood or probability of a flood event (whether tidal or fluvial) is classified by its Annual Exceedance Probability (AEP) or return period (in years). A 1% AEP flood has a 1 in 100 chance of occurring in any given year.

In this report, flood frequency will primarily be expressed in terms of AEP, which is the inverse of the return period, as shown in the table below and explained above. This can be helpful when presenting results to members of the public who may associate the concept of return period with a regular occurrence rather than an average recurrence interval, and is the terminology which will be used throughout this report.

Table: Conversion between return periods and annual exceedance probabilities

Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purposes of the Planning Guidelines, there are 3 types or levels of flood zones, A, B and C.

Zone	Description
Flood Zone A	Where the probability of flooding is highest; greater than 1% (1 in 100) from river flooding or 0.5% (1 in 200) for coastal/tidal flooding.
Flood Zone B	Moderate probability of flooding; between 1% and 0.1% from rivers and between 0.5% and 0.1% from coastal/tidal.
Flood Zone C	Lowest probability of flooding; less than 0.1% from both rivers and coastal/tidal.

It is important to note that the definition of the flood zones is based on an undefended scenario and does not take into account the presence of flood protection structures such as flood walls or embankments. This is to allow for the fact that there is a residual risk of flooding behind the defences due to overtopping or breach

and that there may be no guarantee that the defences will be maintained in perpetuity.

Indicative Flood Zones (OPW & DoEHLG 2009)

A.3 Consequence of Flooding

Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc.).

The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on the type of development, which are detailed in Table 3.1 of the Guidelines, and are summarised as:

- Highly vulnerable, including residential properties, essential infrastructure and emergency service facilities;
- Less vulnerable, such as retail and commercial and local transport infrastructure;
- Water compatible, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

B Dun Laoghaire-Rathdown Development Plan 2016-2022

B.1.1 Flood Management Policies

Policy EI3: Surface Water Drainage and Appropriate Assessment It is Council policy to require that a Sustainable Drainage System (SuDS) is applied to any development and that site specific solutions to surface water drainage systems are developed, which meet the requirements of the Water Framework Directive and the associated River Basin Management Plans and 'Water Quality in Ireland 2007-2009' (EPA 2011) or any updated version of the document.

5.2.5.2 Policy CC15: Flood Risk Management. It is Council policy to support, in cooperation with the OPW, the implementation of the EU Flood Risk Directive (2007/60/EC) on the assessment and management of flood risks, the Flood Risk Regulations (SI No 122 of 2010) and the Department of the Environment, Heritage and Local Government and the Office of Public Works Guidelines on 'The Planning System and Flood Risk Management, (2009)' and relevant outputs of the Eastern District Catchment and Flood Risk Assessment and Management Study (ECFRAMS Study).

The Council will ensure the implementation of the DoEHLG/OPW Guidelines 'The Planning System and Flood Risk Management', (2009) and DoECLG Circular Pl2/2014 (or any updated/superseded document) in relation to flood risk management within the County. A Strategic Flood Risk Assessment of the County has been carried out as part of this County Development Plan process (Refer to Appendix 13). Implementation of the Guidelines will include the following:

- Avoid, reduce and/or mitigate, as appropriate, in accordance with the Flood Risk Management Guidelines, the risk of flooding within the flood risk areas indicated in the ECFRAM study and the Strategic Flood Risk Assessment of the County and any other flood risk areas that may be identified during the period of the Plan or in relation to a planning application (Refer to Section 6 of Appendix 13).
- Development proposals in areas where there is an identified or potential risk of flooding or that could give rise to a risk of flooding elsewhere must be accompanied by a Site-specific Flood Risk Assessment, and Justification Test where appropriate, (Refer to Development Management section 8.2.10.4 and Appendix 13 SFRA for further detail).
- Development that would be subject to an inappropriate risk of flooding or that would cause or exacerbate such a risk at other locations shall not normally be permitted.
- Where certain measures proposed to mitigate or manage the risk of flooding associated with new developments are likely to result in significant effects to the environment or European sites downstream, such measures will undergo environmental assessment and Habitats Directive Assessment, as appropriate.
- Flood Risk Management and Strategic Flood Risk Assessment (SFRA) shall be incorporated into the preparation of all Local Area Plans and any other lower tier plans.
- Regard shall be had to any future flood hazard maps, flood risk maps and flood risk management plans prepared as part of the Eastern District Catchment Flood Risk Assessment and Management Study and future iterations of other similar studies of impacts of climate change.
- Where flood protection or alleviation works take place the Council will ensure that the natural and cultural heritage and rivers, streams and watercourses are protected and enhanced.

- Existing wetland Habitats within the County which serve as flood protection/management measures shall be managed and enhanced.
- The Council will also require that all proposed flood protection or alleviation works will be subject to Appropriate Assessment (AA) to ensure there are no likely significant effects on the integrity, defined by the structure and function, of any Natura 2000 sites and that the requirements of Article 6 of the EU Habitats Directive are met.

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