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APPENDIX 8-1

FLOOD RISK ASSESSMENT

TOBIN

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Kingston Stables Ltd.

Residential Development at Kingston, Knocknacarra, Co. Galway

Flood Risk Assessment

BUILT ON KNOWLEDGE

Document Control Sheet	
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1. INTRODUCTION

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1.1 PROJECT BACKGROUND

TOBIN were appointed by Kingston Stables Ltd. to undertake a Flood Risk Assessment (FRA) for a proposed residential development at Kingston, Knocknacarra, Co. Galway.

The Planning System and Flood Risk Management (PSFRM) Guidelines categorise types of development into three vulnerability classes based on their sensitivity to flooding. As per Table 2.1 for the classification of vulnerability of different types of development in the PSFRM Guidelines, "residential properties and ESB substations" are categorized as "highly vulnerable" development and as such are considered appropriate in Flood Zone C (Less frequently than the 0.1% AEP event), 'local centres' . are considered appropriate in Flood Zone B (Between the 0.1% and 1% AEP event)

The subject site is bounded to the south of the site by residential properties followed by Kingston Road. Residential properties bound the site to the southwest and north, greenfield to the east and west. The western distributor road is just north of the subject site.

There is one hydraulic feature of particular interest to the subject site. The Knocknacarra culvert flows just north of the subject site. The culvert was installed to redirect a river which historically to flow through the subject site from north to south.

The purpose of this Stage 2 FRA report is to identify, quantify, and communicate the risks of flooding, if any, to the proposed development.

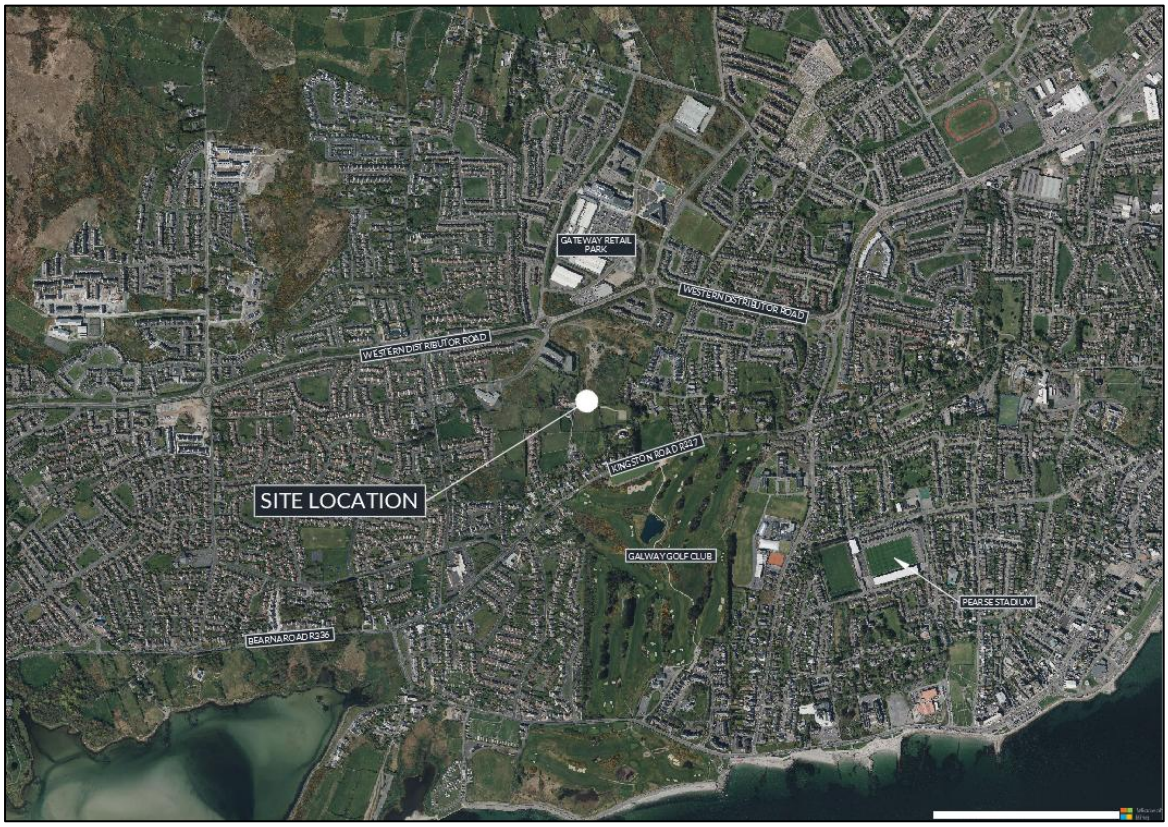


Figure 1-1: Site Location

1.2 Development Description

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TOBIN were appointed by Kingston Stables Ltd. to provide engineering consultancy services for a proposed Large Residential Development (LRD) at Kingston, Knocknacarra, Galway, off the Western Distributor Road in Knocknacarra. The site development description is as follows:

Planning permission is sought by Kingston Stables Limited for development of a Large-Scale Residential Development (LRD) for a 10-year planning permission, on a site which extends to 2.9 ha on lands located at Rahoon, Knocknacarra, Galway.

The proposed development will consist of the following:

1. Provision of 133 no. residential units in 2 no. development areas with a mix of duplex and house types on a site area of 2.9 ha. The buildings range between 2 no. and 3 no. storeys in height. The development will comprise the following:
    - 51 no. 3-bed townhouses;
    - 6 no. 4-bed townhouses;
    - 1 no. 1-bed duplex apartments;
    - 1 no. 2-bed duplex houses;
    - 37 no. 2-bed ground floor duplex apartments;
    - 37 no. 3-bed duplex houses.
2. Demolition of existing structures (409sqm);
3. Vehicular access to the proposed development from a permitted road (Planning Reference 24/60370 refers);
4. Upgrades to the permitted road (Planning Reference 24/60370 refers);
5. Conversion and upgrade of an existing structure to a local centre (65.8 sqm);
6. The provision of public open space;
7. The provision of 192 no. bicycle parking spaces;
8. The provision of 142 no. car parking spaces;
9. Public lighting, bin stores, signage, services, ESB substation, site landscaping and all ancillary site development and enabling works.

An Environmental Impact Assessment (EIAR) and Natura Impact Statement (NIS) will be prepared in respect of the proposed development.

Refer to the drawings that accompany this document for the site layout details.

2. FLOOD RISK MANAGEMENT GUIDANCE

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This Stage 2 Flood Risk Assessment was carried out in accordance with the following flood risk management guidance documents:

- The Planning System and Flood Risk Management Guidelines for Planning Authorities
- Flood Risk Management Climate Change Sectoral Adaptation Plan
- Galway City Development Plan (2023 – 2029)
- Galway City SFRA (2023 - 2029)

2.1 THE PLANNING SYSTEM AND FLOOD RISK MANAGEMENT GUIDELINES

The Planning System and Flood Risk Management Guidelines for Planning Authorities (PSFRM Guidelines) were published in 2009 by the Office of Public Works (OPW) and Department of the Environment, Heritage, and Local Government (DoEHLG). Their aim is to ensure that flood risk is considered in development proposals and the assessment of planning applications.

2.1.1 Flood Zones and Vulnerability Classes

The PSFRM Guidelines discuss flood risk in terms of three flood zones (A, B, and C), which correspond to areas of high, medium, or low probability of flooding, respectively. The extents of each flood zone are based on the Annual Exceedance Probability (AEP) of various flood events.

The PSFRM Guidelines also categorise different types of development into three vulnerability classes based on their sensitivity to flooding. The guidelines classify residential properties and substations as "highly vulnerable" and are therefore considered appropriate in Flood Zone C (less than 0.1% AEP), whereas local centres are classified as "less vulnerable" and are therefore appropriate in Flood Zone B (between 0.1 and 1% AEP).

Table 2.1 shows a decision matrix that indicates which types of development are appropriate in each flood zone and when the Justification Test (see Section 2.1.2) must be satisfied. The annual exceedance probabilities used to define each flood zone are also provided.

Table 2.1: Decision Matrix for Determining the Appropriateness of a Development

Flood Zone: (Probability)	Annual Exceedance Probability (AEP)	Highly Vulnerable	Less Vulnerable	Water Compatible
A (High)	Coastal Flooding: More frequent than 0.5% AEP Fluvial & Pluvial Flooding: More frequent than 1% AEP	Justification Test Required	Justification Test Required	Appropriate
B (Medium)	Coastal Flooding: 0.1% to 0.5% AEP Fluvial & Pluvial Flooding: 0.1% to 1% AEP	Justification Test Required	Appropriate	Appropriate
C (Low)	Fluvial, Pluvial & Coastal Flooding: Less frequent than 0.1% AEP	Appropriate	Appropriate	Appropriate

2.1.2 Justification Test

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Any proposed development being considered in an inappropriate flood zone (as determined by Table 2.1) must satisfy the criteria of the Justification Test outlined in Figure 2-1(taken from the PSFRM Guidelines).

Box 5.1 Justification Test for development management (to be submitted by the applicant)

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

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

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Figure 2-1: Criteria of the Justification Test

2.2 THE FLOOD RISK MANAGEMENT CLIMATE ADAPTION PLAN

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The Flood Risk Management Climate Change Sectoral Adaptation Plan was published in 2019 under the National Adaptation Framework and Climate Action Plan. This plan outlines the OPW's approach to climate change adaptation in terms of flood risk management.

This approach is based on a current understanding of the potential impacts of climate change on flooding and flood risk. Research has shown that climate change is likely to worsen flooding through more extreme rainfall patterns, more severe river flows, and rising mean sea levels.

To account for these changes, the Adaptation Plan presents two future flood risk scenarios to consider when assessing flood risk:

- Mid-Range Future Scenario (MRFS)
- High-End Future Scenario (HEFS)

Table 2.2 indicates the allowances that should be added to estimates of extreme rainfall depths, peak flood flows, and mean sea levels for the future scenarios.

Table 2.2: Climate Change Adaptation Allowances for Future Flood Risk Scenarios

Parameter	Mid-Range Future Scenario (MRFS)	High-End Future Scenario (HEFS)
Extreme Rainfall Depths	+ 20%	+ 30%
Peak River Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 0.5 m	+ 1 m

For the purpose of this flood risk assessment, the proposed development has been assessed against the Mid-Range Future Scenario as it represents a likely future scenario.

2.3 GALWAY CITY DEVELOPMENT PLAN (2023 – 2029)

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The Current Galway City Development Plan[1] provides a strategic framework for planning and sustainable development in Co. Galway for 2023-2029. The Galway City Development Plan (GCDP) for 2023-2029 was adopted by the Elected Members of Galway City Council at the conclusion of the Special Meeting on 24th November 2022 and it came into effect on the 4th January 2023.

Chapter 9 of the Galway City Development Plan 2023-2029 outlines the City plan for Environment and Infrastructure. Section 9.2 of the Galway City Development Plan discusses Flood Risk Management for the City.

Flood Risk Policies for Galway City are as follows:

1. Support, in co-operation with the OPW, the implementation of EU Flood Risk Directive (2007/60/EC), the Flood Risk Regulations (SI No, 122 of 2010) and the DECLG and OPW Guidelines for Planning Authorities, the Planning System and Flood Risk Assessment Management (2009), updated/superseding legislation or departmental guidelines and have regard to the findings and relevant identified actions of the Corrib Catchment Flood Risk Management (CFRAM) Study.
2. Support and facilitate the implementation of the Coirib go Cósta Galway City Flood Relief Scheme in conjunction with the OPW to support a climate resilient city, protect against flooding and minimise the impact of future climate events. Support in general the associated mitigation and adaptation measures in order to prevent flooding and coastal erosion, subject to appropriate environmental, visual, built heritage and other relevant considerations.
3. Ensure the recommendations of the Strategic Flood Risk Assessment (SFRA) for the Galway City Development Plan 2023-2029 are taken into consideration in the assessment of developments in identified areas of flood risk and require site specific Flood Risk Assessment (FRA) and associated design and construction measures appropriate to the scale and nature of the development and the risks arising, in all areas of identified flood risk including on sites where only small proportion of the site is at risk of flooding and adopt a sequential approach in accordance with the Planning System and Flood Risk Management Guidelines for Planning Authorities (2009).
4. Protect and promote sustainable management and uses of water bodies and watercourses from inappropriate development, including rivers, streams, associated undeveloped riparian strips, wetlands and natural floodplains.
5. Ensure flood risk is incorporated into the preparation of any future local area plans, framework plans and masterplans in the city.
6. Ensure any proposed measure designed to alleviate flooding/coastal erosion is subject to Appropriate Assessment in accordance with Article 6 of the EU Habitats Directive, where appropriate.
7. Continue to protect the coastal area and the foreshore and avoid inappropriate development in areas at risk of coastal erosion and/or would cause and escalate coastal erosion in adjoining areas.

[1] https://www.galwaycity.ie/development-plan-2023-2029

8. Protect and maintain, where feasible, undeveloped riparian zones and natural floodplains along the River Corrib and its tributaries.

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The Galway City Development Plan zones the subject site as "residential" and "Enterprise, Light Industry and Commercial" as seen in Figure 2-2. The development is appropriate with this zoning.

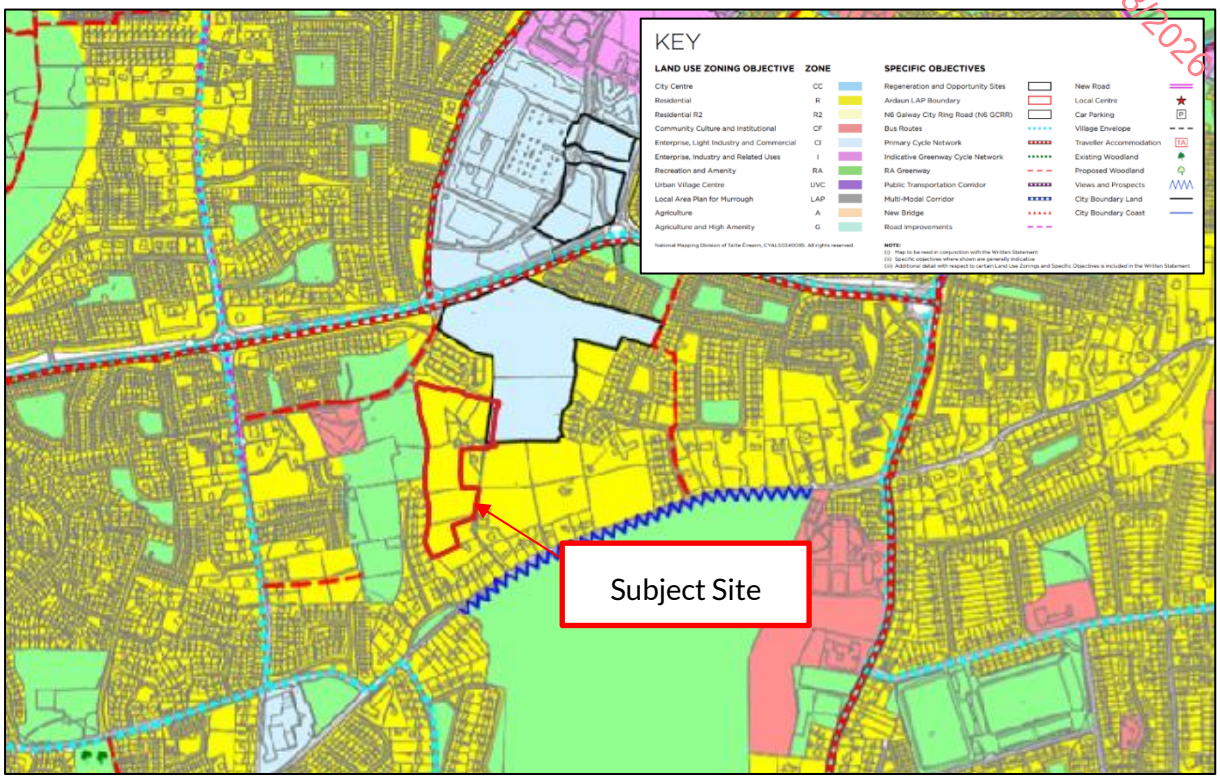


Figure 2-2: Galway City Development Plan Map A - Land Use Zoning

2.4 GALWAY CITY SFRA (2023 – 2029)

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The subject site is within the study area of the Galway City Strategic Flood Risk Assessment (2023 – 2029). As seen in Figure 2-3, the subject site is not seen to be in Flood Zone A or B and is therefore located in Flood Zone C.

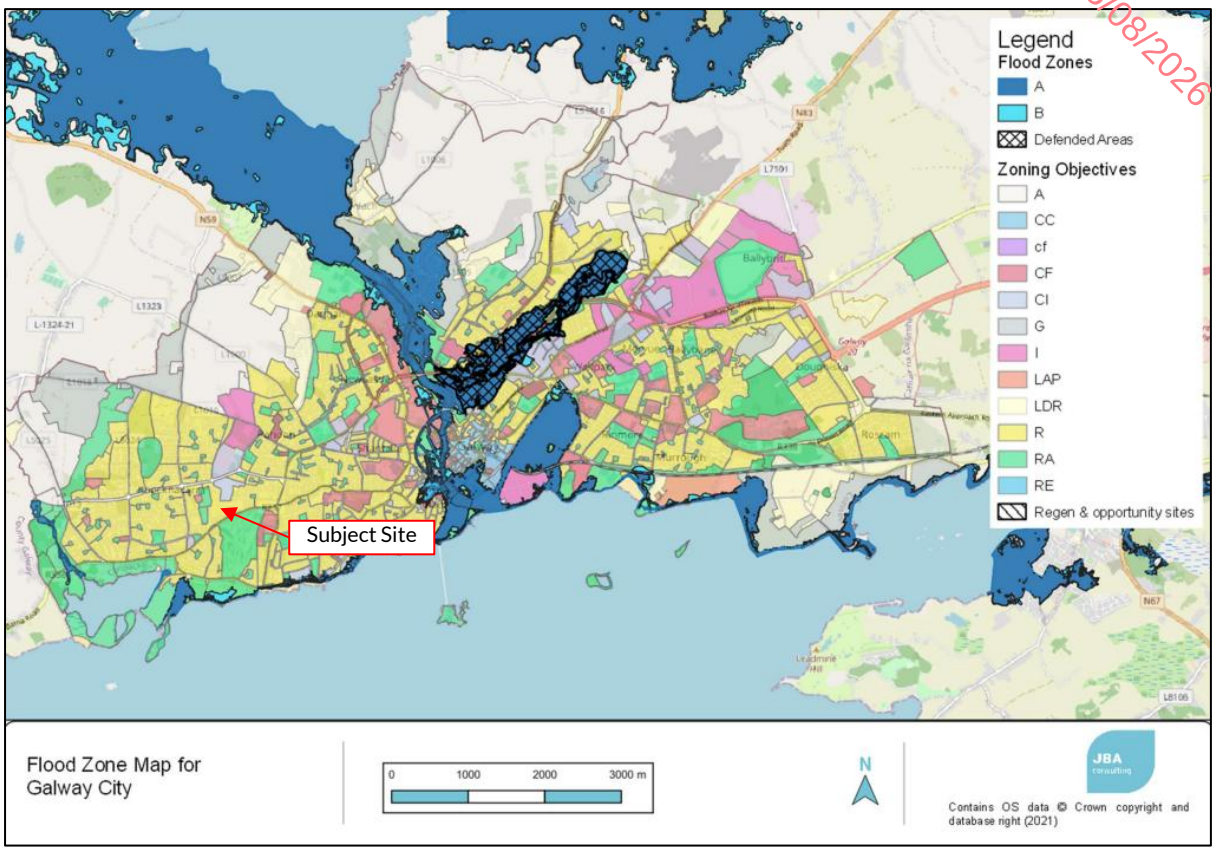


Figure 2-3: Galway City SFRA Flood Zone Mapping

3. INITIAL FLOOD RISK ASSESSMENT

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3.1 PAST FLOOD EVENTS

The OPW's National Flood Information Portal[2] provides past flood event mapping with records of flooding reports, meeting minutes, photos, and/or hydrometric data. Based on the flood map shown in Figure 3-1, there are no historical flood events recorded in the vicinity of the subject site. The closest past flood events to the subject site are located approximately 1.95km southeast of the subject site and the flood labelled (ID: 13235) occurred in December 2015. This event is located on the coast and is as a result of coastal flooding. There are multiple other flood events in the vicinity of the above-mentioned flood event, all as a result of coastal flooding. There is no hydraulic link between the subject site and the past flood event

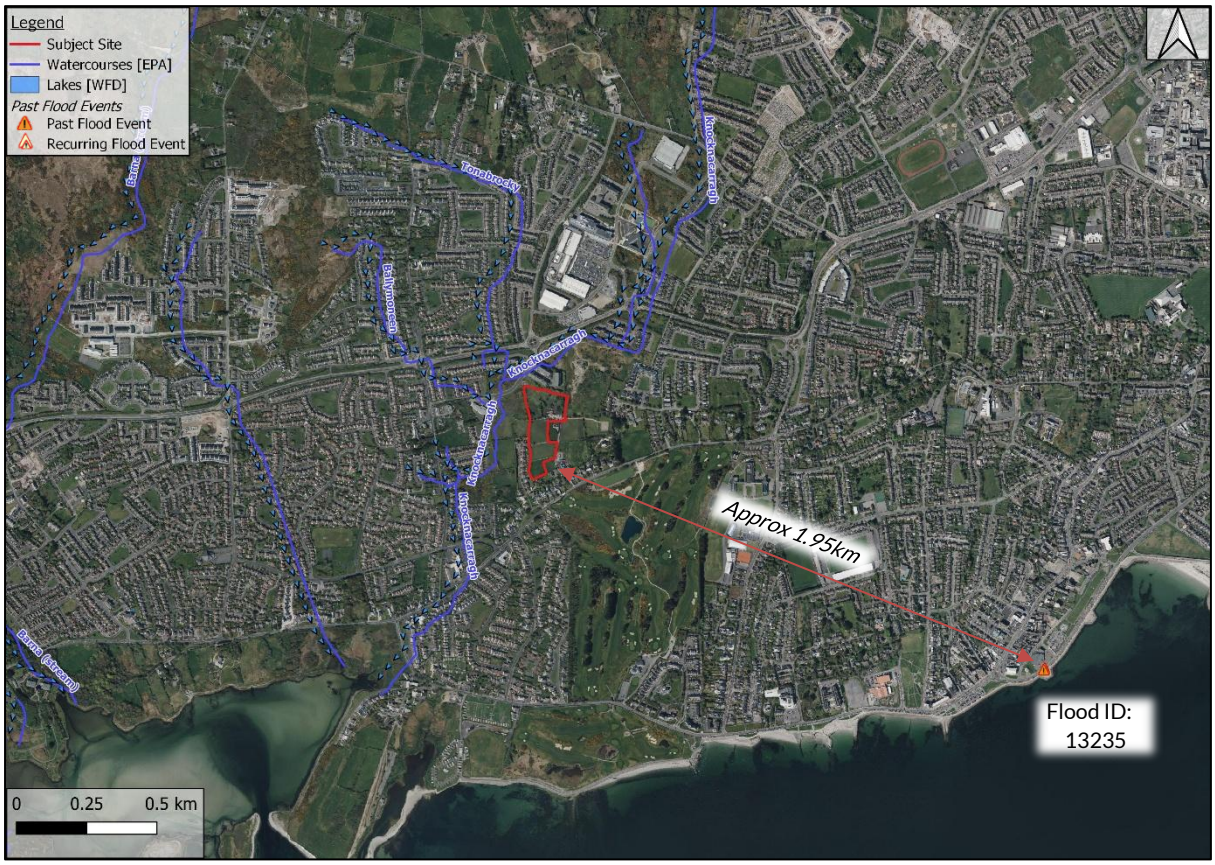


Figure 3-1: Past Flood Events

[2] floodinfo.ie

3.2 OPW Preliminary Flood Risk Assessment (PFRA) Study

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In 2009, the OPW produced a series of maps to assist in the development of a broad-scale FRA throughout Ireland. These maps were produced from several sources.

The OPW's National Preliminary Flood Risk Assessment (PFRA) Overview Report from March 2012 noted that *"the flood extents shown on these maps are based on broad-scale simple analysis and may not be accurate for a specific location".*

Figure 3-2 provides an overview of the fluvial, coastal, pluvial, and groundwater indicative flood extents in the vicinity of the subject site.

As per Figure 3-2, the subject site is not predicted to be liable to coastal, fluvial, groundwater, or pluvial flooding during extreme events. The PFRA mapping indicates one area of pluvial flooding located just north of the subject site.

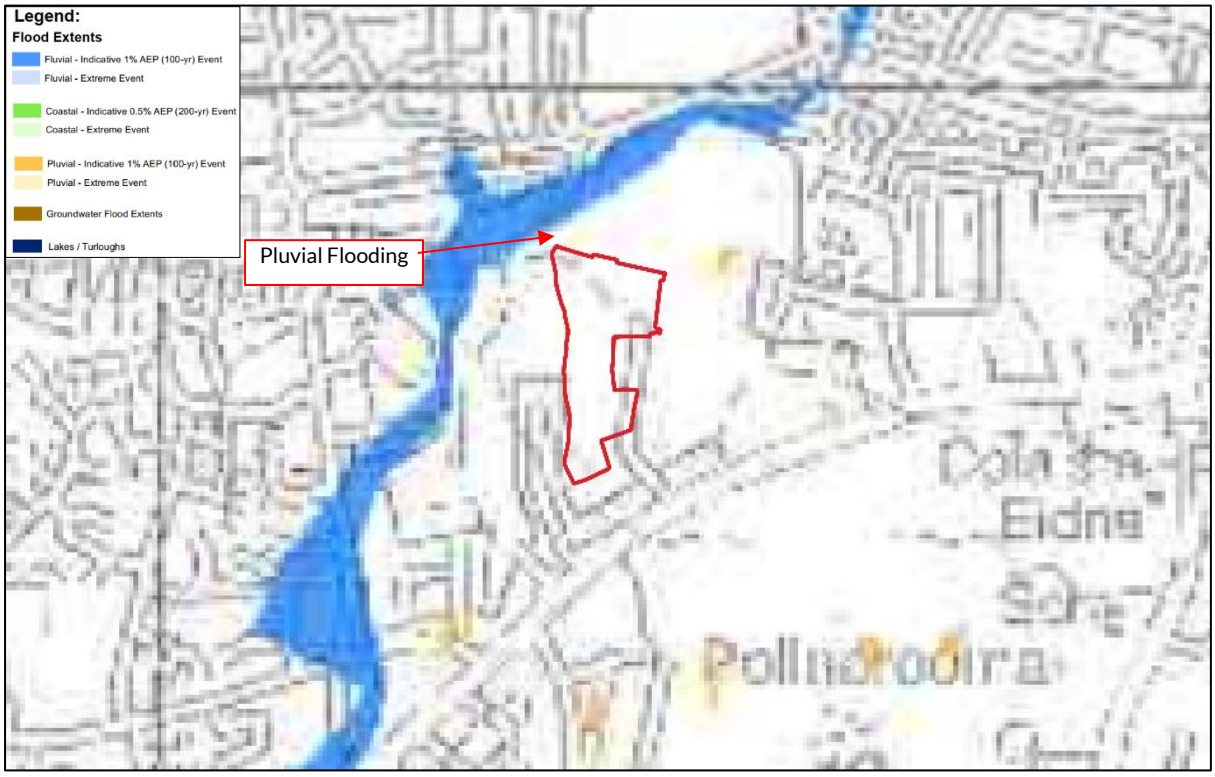


Figure 3-2: Indicative Flood Mapping [extract from PFRA Map 209 & 226]



Figure 3-3: PFRA Fluvial Flood Extents

Figure 3-3 shows that there is a small area of fluvial flooding at the northwestern corner of the subject site.

There are no coastal or groundwater flood extents within the subject site.

Limitations on potential sources of error associated with the PFRA maps include:

- Assumed channel capacity (due to absence of channel survey information)
- Absence of flood defences and other drainage improvements and channel structures (bridges, weirs, culverts)
- Local errors in the national Digital Terrain Model (DTM)

Improved hydraulic modelling was carried out through the Catchment Flood Risk Assessment and Management Study (CFRAM) in 2015 (discussed in Section 3.4) and is considered more accurate than the PFRA study as it utilised surveyed river geometry and was subject to greater model calibration.

3.3 National Coastal Flood Hazard Mapping (NCFHM)

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The National Coastal Flood Hazard Mapping (NCFHM) was completed in 2021. The aim of the project is to produce updated national scale coastal flood extent and depth maps for the 50%, 20%, 10%, 5%, 2%, 1%, 0.5% and 0.1% Annual Exceedance Probabilities (AEPs) for the present day scenario and for the Mid-Range Future Scenario (MRFS), High End Future Scenario (HEFS), High+ End Future Scenario (H+EFS) and High++ End Future Scenario (H++EFS) which represent a 0.5m, 1.0m, 1.5m and 2.0m increase in sea level respectively. The mapping is based on the extreme levels calculated in the Irish Coastal Wave and Water Level Modelling Study (ICWWS).

The Irish Coastal Wave and Water Level Modelling Study (ICWWS) was undertaken in 2018[3]. The study provides an update to the Extreme Coastal Water Levels for the coastal of Ireland. The study provides an update to the water levels presented in the ICPSS undertaken between 2004 and 2013. The Irish Coastal Protection Strategy Study (ICPSS was a national study that was commissioned in 2003 with the objective of providing information to support decision making about how best to manage risks associated with coastal flooding and coastal erosion. [4]

Figure 3-4 and Table 3-1 below outlines the location of and extreme water levels at node W7 which is the closest ICWWS node to the subject site.



Figure 3-4: National Coastal Extreme Water Level Estimation Point W7 Location

[3]Irish Coastal Wave and Water Level Modelling Study(ICWWS)
Microsoft Word - IBE1505_ICWWS_Ph1_Rp01_F02.docx

[4]https://www.gov.ie/ga/foilsiuchan/eed0fb-irish-coastal-protection-strategy-study-icpss/

Table 3-1: ICWWS Modelled Extreme Water Levels

Return Period	Existing Scenario Water Level (mOD)	Mid-Range Future Scenario (MRFS) Water Level (mOD)
1 in 100-Year (1% AEP) Event	3.84	4.34
1 in 200-Year (0.5% AEP) Event	3.94	4.44
1 in 1,000-Year (0.1% AEP) Event	4.18	4.68

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A topographical survey of the north section of the subject site shows minimum ground levels of 25mOD, which provides a freeboard of over 20m between coastal 0.1% AEP Event water level and the proposed development.

3.4 Catchment Flood Risk Assessment and Management Study

In 2015, the OPW produced flood maps as part of the Catchment Flood Risk Assessment and Management (CFRAM) Study. The flood extents in these maps are based on detailed modelling of Areas for Further Assessment identified by the National Preliminary Flood Risk Assessment.[5]. The watercourses in the vicinity of the subject site were not modelled as part of the CFRAM Study.

[5] https://www.floodinfo.ie/about_frm/

3.5 OPW Drainage Districts and Arterial Drainage Schemes

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The OPW Drainage Districts were carried out by the commissioners of Public Works under a number of drainage and navigation acts from 1842 to the 1930s to improve land for agriculture and to mitigate flooding.[6] The local authorities are charged with the responsibility to maintain Drainage Districts.

Benefited lands are areas that were previously subject to poor drainage and/or flooding but that have benefited from the implementation of Arterial Drainage Schemes carried out under the Arterial Drainage Act 1945.

The subject site has not benefited from any arterial drainage scheme and is not located in a Drainage District. The Knocknacarra River is a Land Commission Watercourse as seen in Figure 3-5.



Figure 3-5 Arterial Drainage

[6] www.floodinfo.ie

3.6 GEOLOGICAL SURVEY IRELAND MAPPING

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Based on a review of the OPW's Preliminary Flood Risk Assessment (PFRA) mapping (see Figure 3-2) there is no noted risk of groundwater flooding to the subject site.

GSI Groundwater Flooding Probability Maps[7] for the subject site were reviewed. The closest recorded groundwater flood extent is approximately 5.9km northeast of the subject site. There is no hydraulic link between this event and the subject site.



Figure 3-6: GSI Mapping of Groundwater Flooding

The closest surface water flooding is approximately 3.8km Northeast of the site, assumed to be as a result of flooding from the River Corrib and is not expected to have any effect on the sites hydrology.

Geological Survey Ireland (GSI) subsurface mapping of karst features[8] in the area show that there are no karst features located in the vicinity of the subject site (see Figure 3-7). The closest karst feature to the subject site is a swallow located 5.6km Northeast of the subject site.

[7]FloodInfo.ie | National Flood Information Portal, Available at: https://www.floodinfo.ie/map/floodmaps/

[8]GSI Groundwater Data Viewer, Available at: https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=7e8a202301594687ab14629a10b748ef

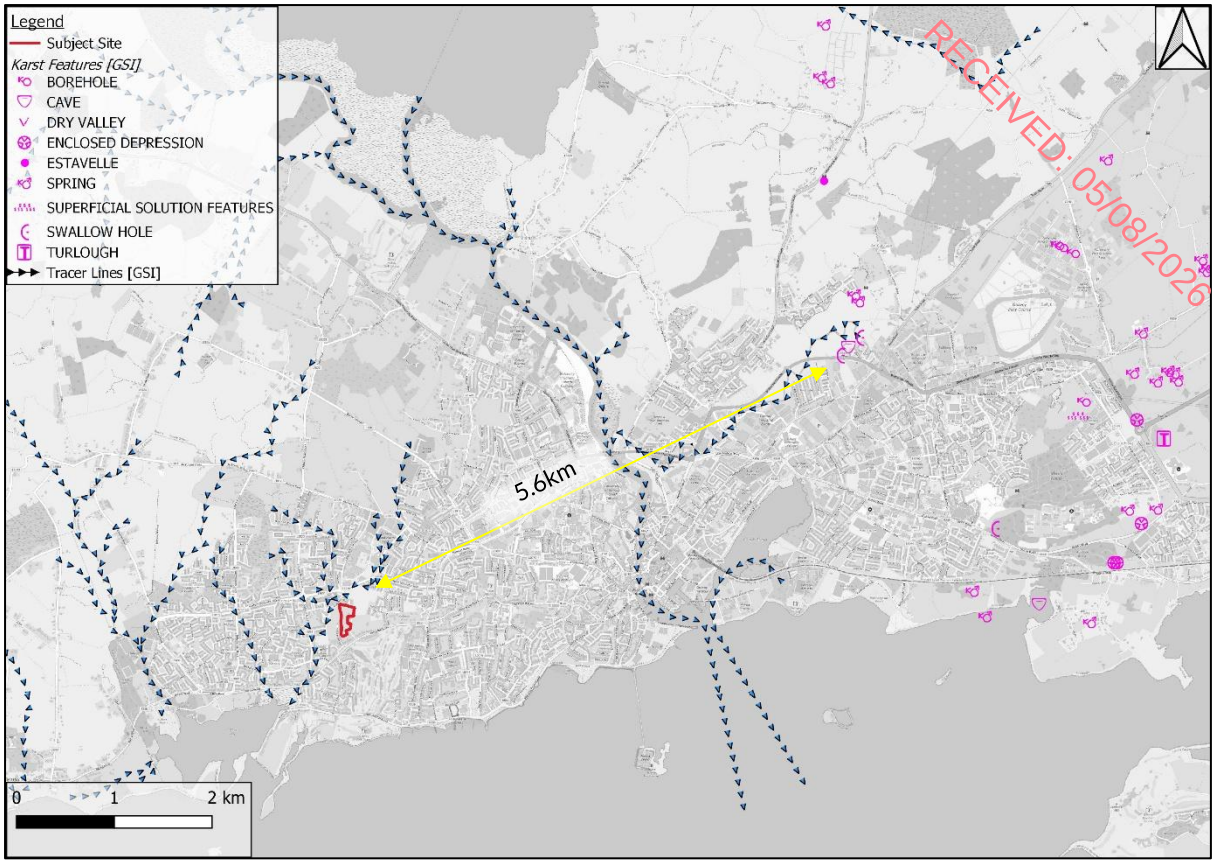


Figure 3-7: GSI Mapping of Karst Features

4. SITE VISIT FINDINGS

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TOBIN conducted a site visit on 11th March 2024 to review site conditions and potential flood risk at the subject site. The area of particular interest for the site visit was the area where, on the mapping, a watercourse is located. Mapping shows the Knocknacarra watercourse flowing north of the subject site before flowing in a southerly direction to the west of the site.



Figure 4-1: View of subject site watercourse location facing northeast

During the site visit, no standing water was observed. No external water sources appeared to enter the site. The area designated as the Knocknacarra watercourse on EPA maps is dry, lacking any visible watercourse. This suggests that the Knocknacarra watercourse has been culverted, rendering the flood extents depicted in the OPW PFRA mapping inaccurate.

To the north of the site, a minor depression exists in the general vicinity of the mapped watercourse. However, this depression is insignificant in the context of the site's overall flat topography. No visible banks or inverts were observed.

A review of Uisce Éireann Stormwater mapping reveals a 1500mm diameter concrete culvert running parallel to the Western Distributor Road to the north and northwest of the site. This culvert likely receives surface water drainage from what was historically the Knocknacarrra watercourse. Consequently, the PFRA mapping's indication of fluvial flooding at the site is inaccurate due to the absence of an open channel at the delineated location. Furthermore, the

culvert lies outside the site boundaries, and the proposed buildings will not impede surface water flow.

Surface water arising within the subject site will be managed by a dedicated stormwater drainage system. The landscaping and topography within the subject site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

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Figure 4-2: View of subject site watercourse location facing south east

5. DETALED FLOOD RISK ASSESMENT

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With reference to the PSFRM guidelines, the proposed development is comprised of 'highly vulnerable' (residential properties and substation), and 'less vulnerable' (local centres) elements.

Therefore, residential properties and the ESB substation are considered appropriate in Flood Zone C (less frequently than the 0.1% AEP event), while the local centre is considered appropriate in Flood Zone B (between the 0.1% and 1% AEP event)

5.1 FLUVIAL FLOODING

There is one hydraulic feature seen on the mapping which is of particular interest to the subject site. The Knocknacarra watercourse flows just north of the subject site. From Available PFRA mapping the flood extents noted around the watercourse inundate a small area of the northwest of the site. The Site Visit confirmed that this watercourse has been culverted and therefore, the PFRA mapping is unrealistic.

5.2 COASTAL FLOODING

The subject site is located approximately 1km inland from the sea and therefore it is estimated that the risk of coastal flooding associated with the development is minimal. The Topo survey of the subject site shows minimum ground levels of 19.5mOD, which provides a freeboard of over 15m between coastal 0.1% AEP Event extents and the proposed development.

5.3 PLUVIAL FLOODING

The PFRA indicative mapping indicates that there are no areas of pluvial flooding within the subject site.

Surface water arising on the proposed mixed-use development will be managed by a dedicated stormwater drainage system in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates.

The landscaping and topography of the developed site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

Therefore, it is estimated that risk of pluvial flooding associated with the proposed development is minimal.

5.4 GROUNDWATER FLOODING

Based on a review of Geological Survey Ireland (GSI) subsurface mapping of karst features (Figure 3-7), predicted groundwater flooding in the area (Figure 3-6), and the PFRA study (Figure 3-2), there is no evidence to suggest liability to groundwater flooding at the proposed development site.

5.5 THE JUSTIFICATION TEST

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The proposed development is appropriately located in Flood Zone C with appropriate drainage measures; therefore, the Justification Test is not required.

6. CONCLUSIONS

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TOBIN were appointed by Kingston Stables Ltd. to undertake a Flood Risk Assessment (FRA) for a proposed residential development at Kingston, Knocknaccara, Co. Galway.

With reference to the PSFRM guidelines, the proposed development is comprised of 'highly vulnerable' (residential properties and ESB substation) and 'less vulnerable' (local centre) elements.

Fluvial Flooding

Based on a review of the available information, it was estimated that the subject site is not liable to fluvial flooding during any scenario. The Knocknacarra watercourse is the only watercourse in the vicinity of the site and although extents show flooding at the northwestern corner of the subject site, a site visit confirmed that the watercourse is culverted and therefore the PFRA extents are unrealistic

Therefore, the risk of fluvial flooding to the subject site is minimal.

Coastal Flooding

The subject site is not at risk of coastal flooding due to its distance inland from coastal waters.

Pluvial Flooding

The PFRA indicative mapping indicates that there are no pluvial flood extents noted within the subject site.

Surface water arising on the proposed mixed-use development will be managed by a dedicated stormwater drainage system in accordance with Sustainable Drainage Systems (SuDS) principles, limiting discharge from the site to greenfield runoff rates.

The landscaping and topography of the developed site will provide safe exceedance flow paths and prevent surface water ponding to minimise residual risks associated with an extreme flood event or a scenario where the stormwater drainage system becomes blocked.

Therefore, the risk of pluvial flooding to the subject site is minimal.

Groundwater Flooding

There is no evidence to suggest groundwater as a potential source of flood risk to the proposed subject site.

Justification Test

The proposed development is appropriately located in Flood Zone C; therefore, the Justification Test is not required.

Based on the results of this flood risk assessment, it is estimated that the risk of flooding to the proposed residential development will be minimal, and that the development will not increase the risk of flooding elsewhere. "Highly Vulnerable" residential properties and the ESB substation area appropriately located in Flood Zone C and with appropriate drainage design, the risk to the site from pluvial flooding will be minimal.

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Appendix A TOPOGRAPHIC SURVEY

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Altan Apartments

Key

Grove of Mature Trees.

Grove of Mature Trees.

Grove of Mature Trees top canopy=46.1

Monument Cross

Chapelton Road