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Druids Glen Road Phase 3 – Cherrywood SDZ

Flood Risk Assessment – Stage 1

02 July 2025

Formerly JB Barry Partners who became part of Egis in 2023

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CR	As Constructed Record file	Cnn (C=Contractual/Complete) starting at C01

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1 INTRODUCTION

1.1 General

Egis (formerly Barry Transportation who became part of Egis in 2023) have been commissioned by the Client, Dún Laoghaire-Rathdown County Council (DLRCC) to undertake a site-specific Flood Risk Assessment (FRA) for the Druids Glen Road Phase 3 – Cherrywood SDZ (referred to as the "proposed development") in Co. DLRCC. The aim of the FRA is to identify, quantify and communicate to decision makers and other stakeholders the risk of flooding associated with the preferred option.

The FRA has been carried out in accordance with" The Planning System and Flood Risk Management Guidelines for Planning Authorities" (hereafter referred to as the FRM Guidelines) published in November 2009 jointly by the Department of Environment, Heritage and Local Government, DEHLG, and the Office of Public Works (OPW).

1.2 Site Location

The proposed development road is situated west of the N11 Bray Road and accessed via Beech Park or via Barrington Road in Cherrywood Strategic Development Zone (SDZ) as shown on Figure 1-1 below. The proposed road alignment transverses over Carrickmines River along the existing footprint of Lehaunstown L20323 bridge.

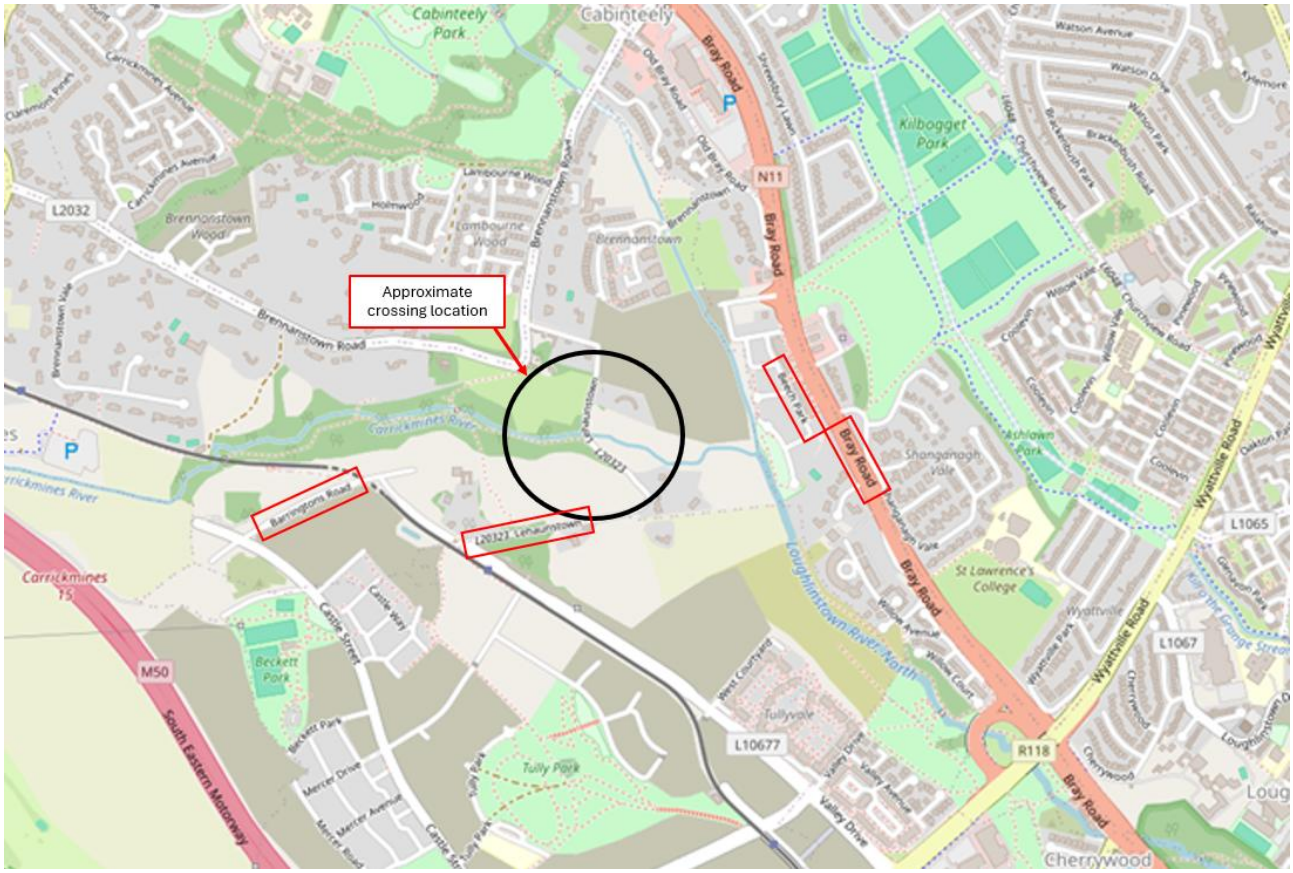


FIGURE 1-1: LOCATION OF PROPOSED DEVELOPMENT AT DRUID'S GLEN ROAD PHASE 3 (SOURCE: WWW.EPA.IE, ANNOTATIONS BY EGIS)

1.3 Proposed Development Options

Egis have identified a preferred alignment and an Emerging Preferred Bridge Design for that alignment. The flood risk posed by the Emerging Preferred Bridge Design (Option 3) along with other elements of the project, including (inter alia) approx. 67 metres of south road and 44m of north road including tie in with Druids Glen

Road Phase 2, a new junction at Point P, and tie in with a temporary pond, is assessed in this FRA. To inform the assessment of bridge design options and public consultation, this FRA has also been extended to include Alternative Bridge Design options that were considered as part of the accompanying Final Options Assessment Report.

Option 3, the Emerging Preferred Option, is a three span extradosed bridge comprising of concrete girders and a cable stayed design with low pylons. The overall length of the bridge is 147m with a 65m central span traversing the Carrickmines Stream.

Option 1, an Alternative Bridge Design Option, is a three span, low rise bow string arch with bridge deck positioned at mid arch height level and inclined struts supporting deck end spans. The overall length of the bridge is 125m with a central span of 72.5m above the Carrickmines Stream and existing bridge structure.

Option 2, an Alternative Bridge Design Option, is a four span girder bridge featuring a composite deck of steel girder and concrete slab. The overall length of the bridge is 121m with a span of 29m traversing the Carrickmines Stream and existing bridge structure.

2 ASSESSMENT CRITERIA

2.1 Methodology

The methodology used for flood risk assessment for the proposed development is based on the 2009 publication "The Planning System and Flood Risk Management, Guidelines for Planning Authorities" (FRM Guidelines). The FRM Guidelines require the planning system at national, regional and national levels:

- Avoid development in areas at risk of flooding, particularly flood plains, unless there are proven wider sustainability grounds that justify appropriate development;
- Adopt a sequential approach to flood risk management when assessing the location for new development based on avoidance, reduction and then mitigation of flood risk; and
- Incorporate flood risk assessment into the process of making decisions on planning applications, land use and planning appeals.

The sequential approach (see Figure 3.1 of the FRM Guidelines below) in flood risk management requires the following three steps to identify the necessity for the justification test for a development.:

- Step 1: Identification of the Flood Zone at the proposed development site (Section 2.23 of the FRM Guidelines);
- Step 2: Identification of the vulnerability of the type of the proposed development (Table 3.1 of the FRM Guidelines); and
- Step 3: Using the matric of vulnerability versus Flood Zone (Table 3.2 of the FRM Guidelines), identify the necessity for the justification test for the proposed development.

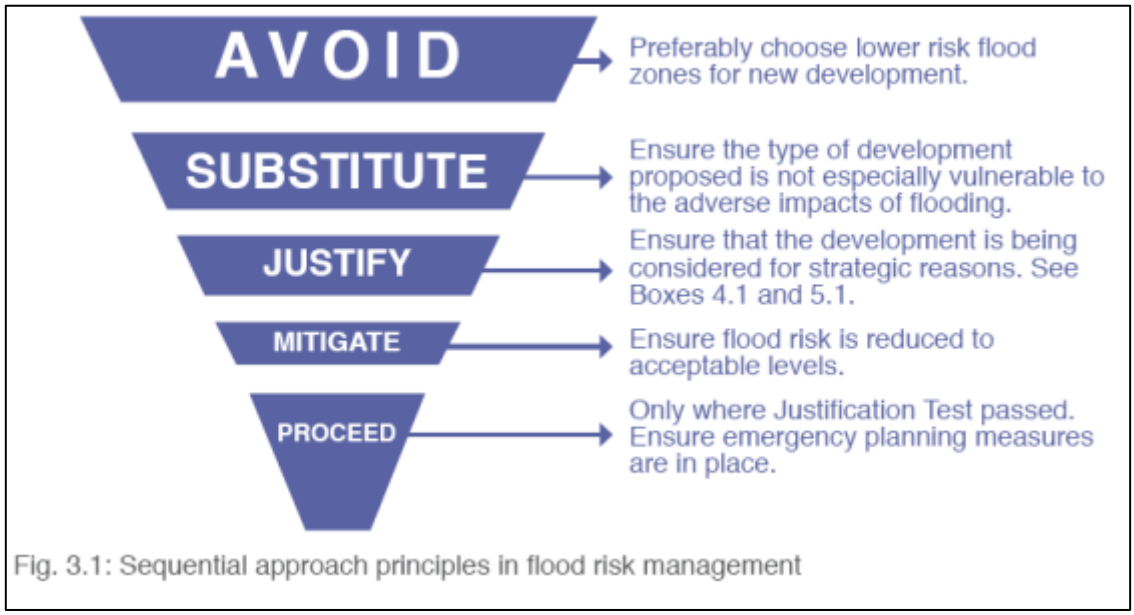


Fig. 3.1: Sequential approach principles in flood risk management

While Figure 3.1 of the FRM Guidelines sets out the broad philosophy underpinning the sequential approach in the flood risk management, Figure 3.2 of the Guidelines (shown below) describes the mechanism of the sequential approach for use in the planning process.

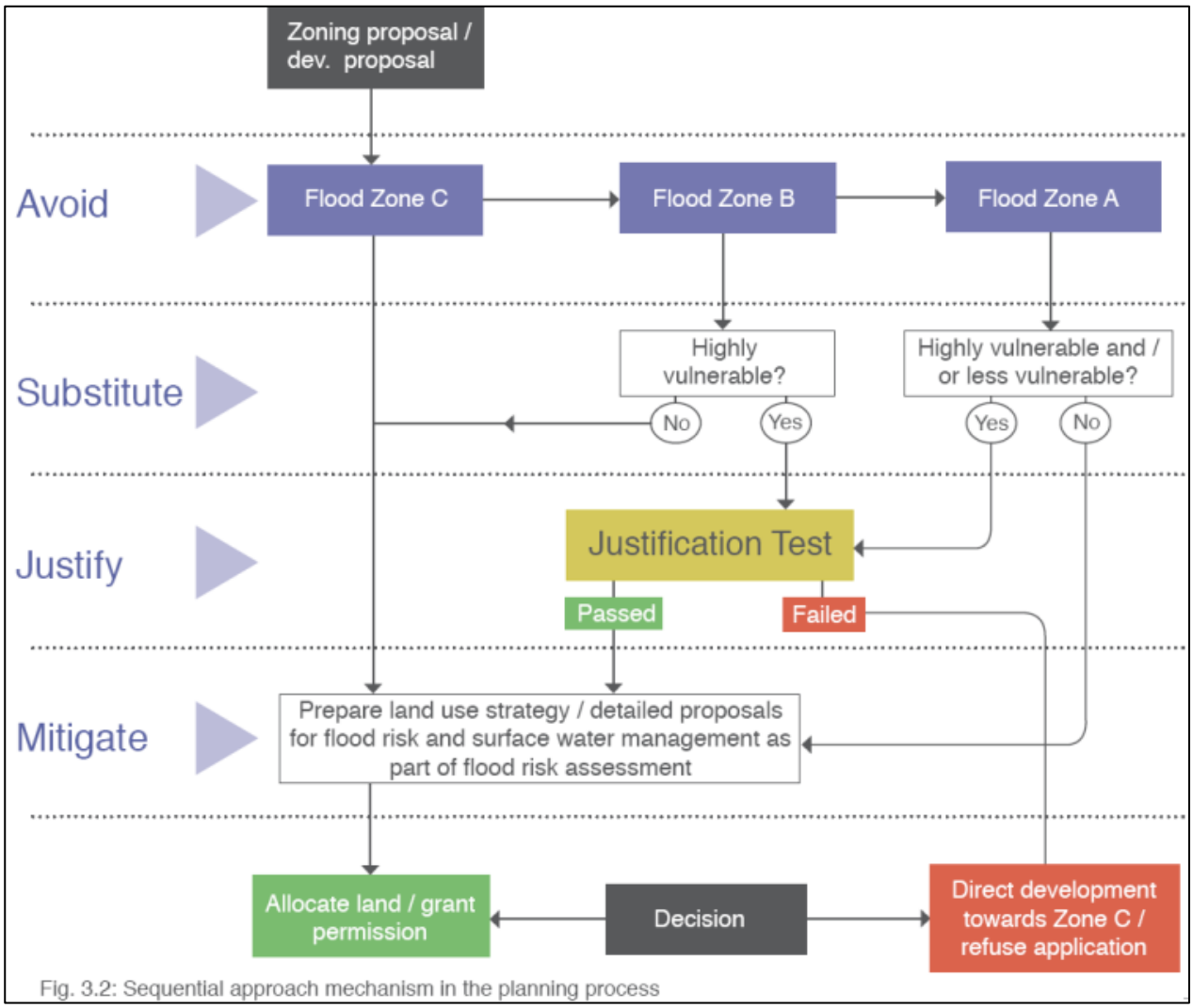


Fig. 3.2: Sequential approach mechanism in the planning process

According to FRM Guidelines, Flood Zones are graphical areas with which the likelihood offlooding is in a particular range. They are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. There are three Flood Zones, namely,

- **Flood Zone A** – where the **Flood Zone A** – where the probability of flooding from rivers and the sea is highest (greater than 1% AEP or 1 in 100-year for river flooding or 0.5% or 1 in 200-year for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% AEP or 1 in 1000 year and 1% AEP or 1 in 100-year for river flooding and between 0.1% AEP or 1 in 1000 year and 0.5% AEP or 1 in 200-year for coastal flooding);
- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% AEP or 1 in 1000 year for both river and coastal flooding).

Flood Zones A, B and C are based on the current assessment of the 1% AEP and the 0.1% AEP fluvial events and the 0.5% AEP and 0.1% AEP tidal events, without the inclusion of climate change factors. Table 3.1 of the FRM Guidelines (See extract of Table 3.1 overleaf) shows the classification of the vulnerability to flooding of different types of development.

Vulnerability class	Land uses and types of development which include*:
Highly vulnerable development (including essential infrastructure)	Garda, ambulance and fire stations and command centres required to be operational during flooding; Hospitals; Emergency access and egress points; Schools; Dwelling houses, student halls of residence and hostels; Residential institutions such as residential care homes, children's homes and social services homes; Caravans and mobile home parks; Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; and Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; Land and buildings used for agriculture and forestry; Waste treatment (except landfill and hazardous waste); Mineral working and processing; and Local transport infrastructure.
Water-compatible development	Flood control infrastructure; Docks, marinas and wharves; Navigation facilities; Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; Water-based recreation and tourism (excluding sleeping accommodation); Lifeguard and coastguard stations; Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; and Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).
*Uses not listed here should be considered on their own merits	

Table 3.1 Classification of vulnerability of different types of development

Table 3.2 of the FRM Guidelines (shown below) identifies the type of development that would be appropriate for each Flood Zone and those that would be required to meet the Justification test. Since, essential infrastructure such as primary transportation are classified as '*Highly vulnerable development*' the section highlighted in Table 3.2 presents the required actions for each flood zone for this assessment.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

The FRM Guidelines (Chapter 2) outlines the following three stages of flood risk assessment:

Stage 1: Flood Risk Identification – to identify whether there may be any flooding or surface water management issues relating to the proposed development site that may warrant further investigations.

Stage 2: Initial Flood Risk Assessment - to confirm the sources of flooding that may affect the proposed development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. This stage involves the review of existing studies and hydraulic modelling to assess flood risk and to assist with the development of FRM measures.

Stage 3: Detailed Flood Risk Assessment – to assess flood risk issues in sufficient detail and to provide a quantitative appraisal of potential flood risk to a proposed or existing development, of its potential impacts on flood risk elsewhere and of the effectiveness of any proposed mitigation measures. This will typically involve use of an existing or construction of a hydraulic model across a wide enough area to appreciate the catchment wide impact and hydrological process involved.

2.2 Data Collection

Data required for the flood risk assessment was obtained from various sources, as described below.

- Historic mapping of the proposed development and surrounding watercourses was obtained from *www.geohive.ie*.
- The historic flood data and flood extent mapping was obtained from the National Flood Hazard Mapping website *www.floodinfo.ie*
- The Subsoil and Aquifer vulnerability data was obtained from the Geological Survey of Ireland website *www.gsi.ie*
- Shanaganagh-Carrickmines River Flood Extent Maps were obtained from Eastern CFRAM Study 2017 undertaken by the OPW and obtained from *www.floodinfo.ie*
- Flood extent maps were acquired from the DLRCC County Development Plan 2022 – 2028, prepared by JBA for DLRCC in 2022.
- Salient hydrological features and site location imagery were obtained from *https://gis.epa.ie/EPAMaps/*
- Topographical data was obtained from surveys carried out by Murphy Surveys on behalf of CS Consulting for DLRCC, supplied to Egis by DLRCC. An additional topographical survey has been referenced, which was carried out by iO Geomatics for AECOM as part of the Cherrywood Strategic Development Zone (SDZ) Green Routes Network Development.

3 EXISTING HYDROLOGICAL REGIME

3.1 Historic Mapping

Desktop investigation of historic mapping of the proposed development and surrounding watercourses was carried out through www.geohive.ie web portal. Table 3-1 below presents the findings of the proposed development and surrounding watercourses.

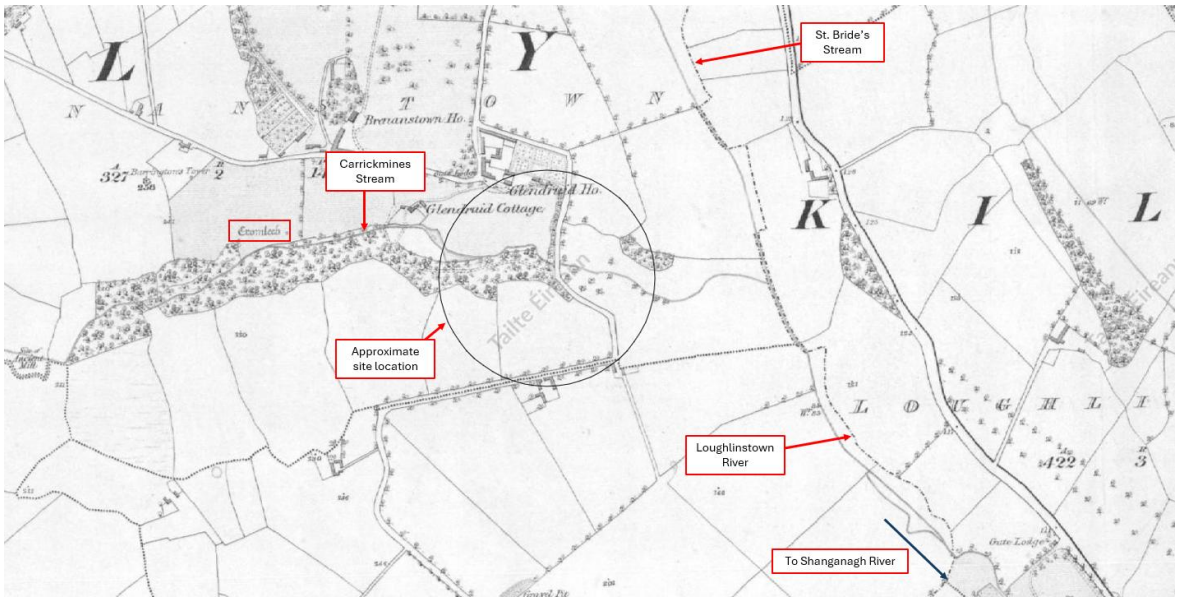
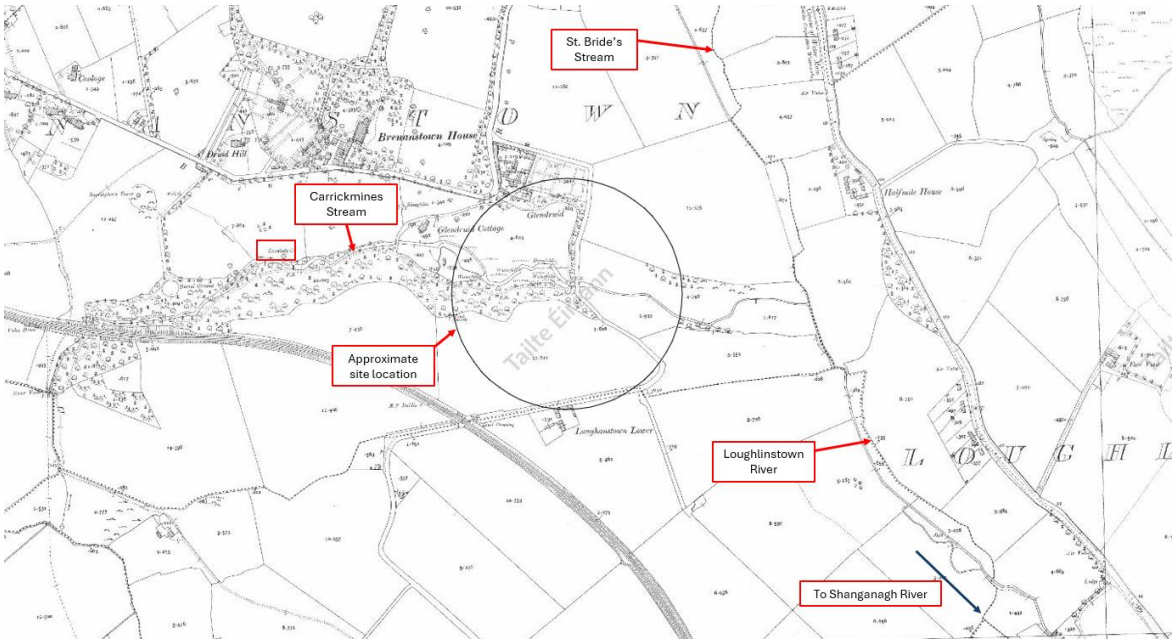
Mapping	Findings
6 Inch	 The proposed bridge and section of road including tie in with Phase 2 is situated on the eastern edge of a low-lying wooded area surrounding the Carrickmines Stream. A dolmen is highlighted to the west of the site. St. Bride's Stream (Bride's Glen Stream), the Loughlinstown River and the path towards the Shanganagh river are also marked. There are many present day features absent from the map, such as the various river crossings of the west of the site, the railway line and the M50 motorway.
25 Inch	 St. Bride's Stream (Bride's Glen Stream), Carrickmines Stream, Loughlinstown River and the path towards the Shanganagh River are highlighted above. The 25 inch map included the railway line and some further residential developments to the surrounding areas. Also marked to the west of the development is a waterfall & a burial ground.

TABLE 3-1: HISTORIC 6 INCH AND 25 INCH MAPPING OF THE PROPOSED DEVELOPMENT AND NEARBY WATERCOURSES (SOURCE: WWW.GEOHIVE.IE, ANNOTATIONS BY EGIS)

3.2 Salient Hydrological Features

The primary hydrological feature within the vicinity of the proposed development is the Carrickmines Stream, which is indicated in Figure 3-1. It runs beneath the proposed bridge element of the development in an easterly direction, before becoming the Loughlinstown River at the confluence location of St. Bride's Stream (Bride's Glen Stream) and Carrickmines Stream. The Loughlinstown river then flows into the Shanganagh River in a southeasterly direction. The distance of flow from the site location to Killiney Bay is c.3.3 km.

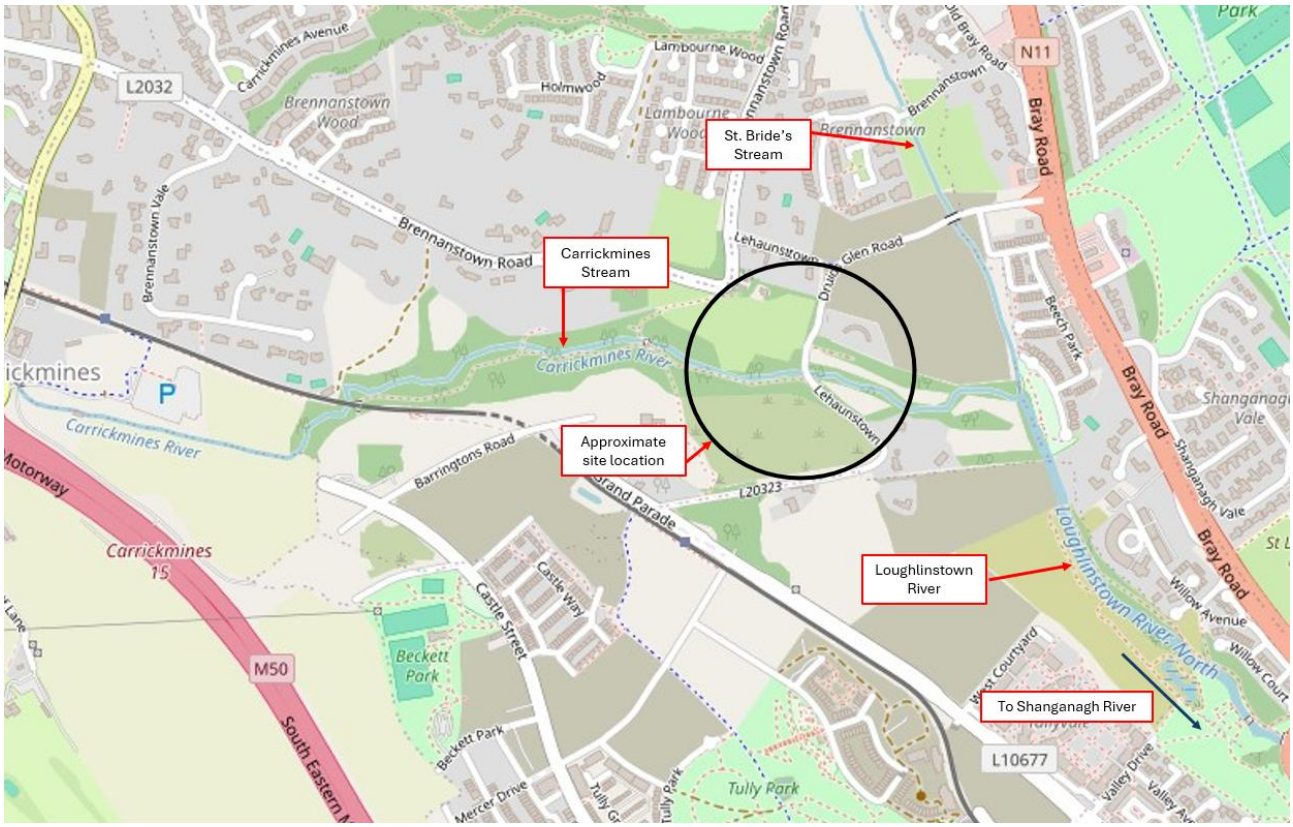


FIGURE 3-1: HYDROLOGICAL FEATURES OF THE STUDY AREA (SOURCE: WWW.EPA.IE, ANNOTATIONS BY EGIS)

3.3 Topographical Survey

A topographical survey of the area directly to the west of the proposed crossing was carried out on the 21st of October 2020 by Murphy Surveys on behalf of CS Consulting and supplied to Egis by a private landowner via DLRCC. The survey scope includes the levels of the upstream reach of the existing bridge. An additional topographical survey was supplied to Egis, which was carried out on the 9th of April 2020 by iO Geomatics for the client AECOM and is illustrated in Figure 3-4 and Figure 3-5. This survey is not as detailed to the study area and relevant bed and channel level information as that carried out by Murphy Surveys.

The topography to the north of the site is gradually sloping from the Brennanstown Road to the left bank of the Carrickmines Stream. Land surveyed to the south of the stream comprises of a steep slope from the right bank until **46.15 mOD**, where the slope gradually reduces towards the Lehaunstown Road. The full survey scope is included in Figure 3-2 below (See Appendix 1 also).

FIGURE 3-2: FULL SCOPE OF TOPOGRAPHICAL SURVEY (SOURCE: MURPHY SURVEYS, 2020)

A detailed view of the existing crossing is included in Figure 3-3 below. The bed level (BL) at the upstream face of the bridge is noted as **26.90 mOD.** Left and right bank levels are approximately **27.31 mOD** and **27.03 mOD** respectively. The crown level is specified as **28.89 mOD** and invert level as **27.18 mOD**.

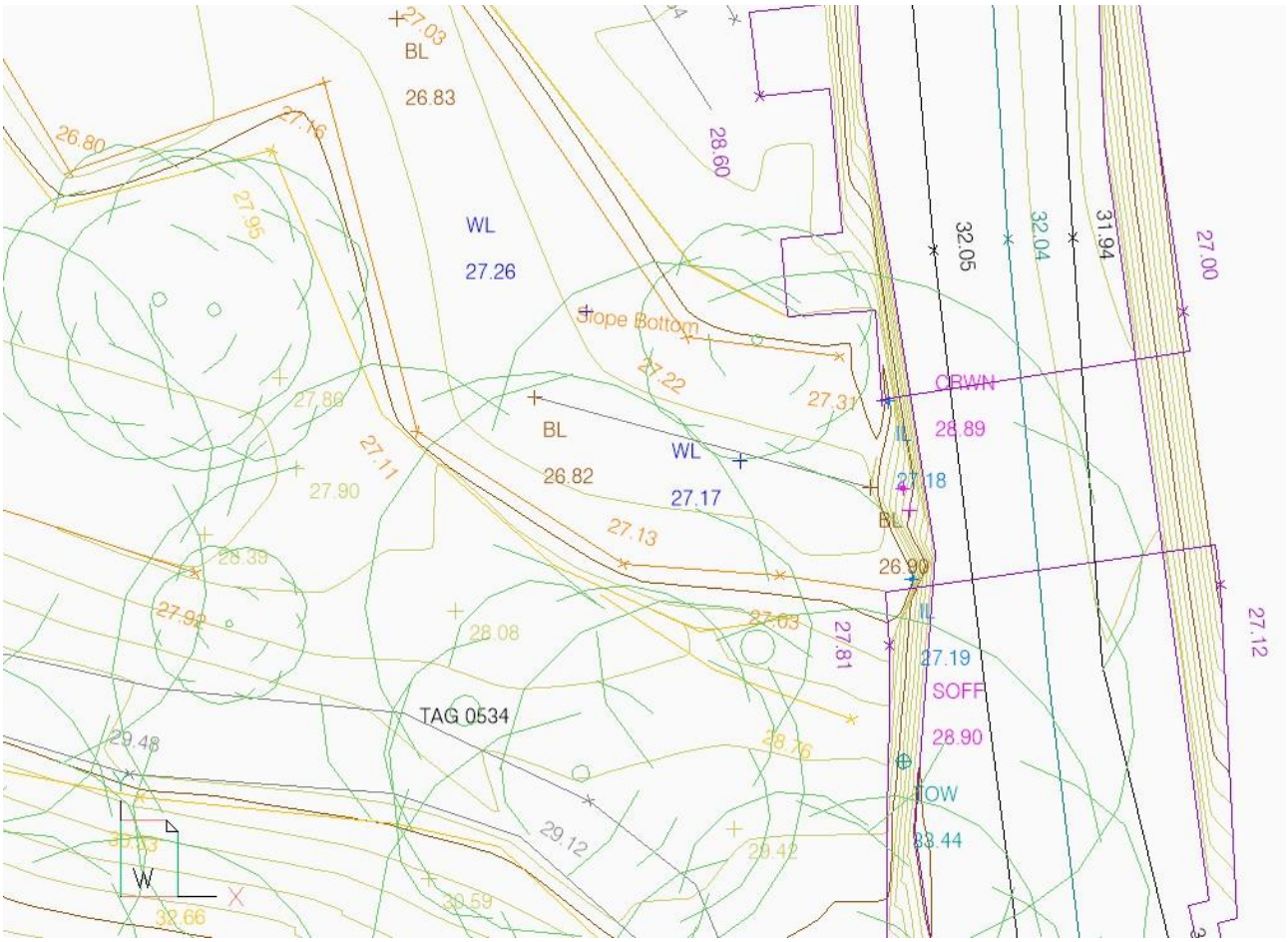


FIGURE 3-3: TOPOGRAPHICAL SURVEY OF PROPOSED CROSSING LOCATION (SOURCE: MURPHY SURVEYS, 2020)

Downstream topography of the proposed bridge element of the development is supplied in the iO Geomatic survey. The Loughlinstown River & Bride's Glen stream are located circa 1.5 kilometres downstream of the proposed development location. The topography observed is similar to that of the upstream face, consisting of gradual slopes extending from the left and right banks of the Carrickmines stream. Approximately 160m downstream of the existing crossing the slope steepens briefly before meeting the Carrickmines Stream joins with the Bride's Glen Stream, from which point they are known as the Loughlinstown River.

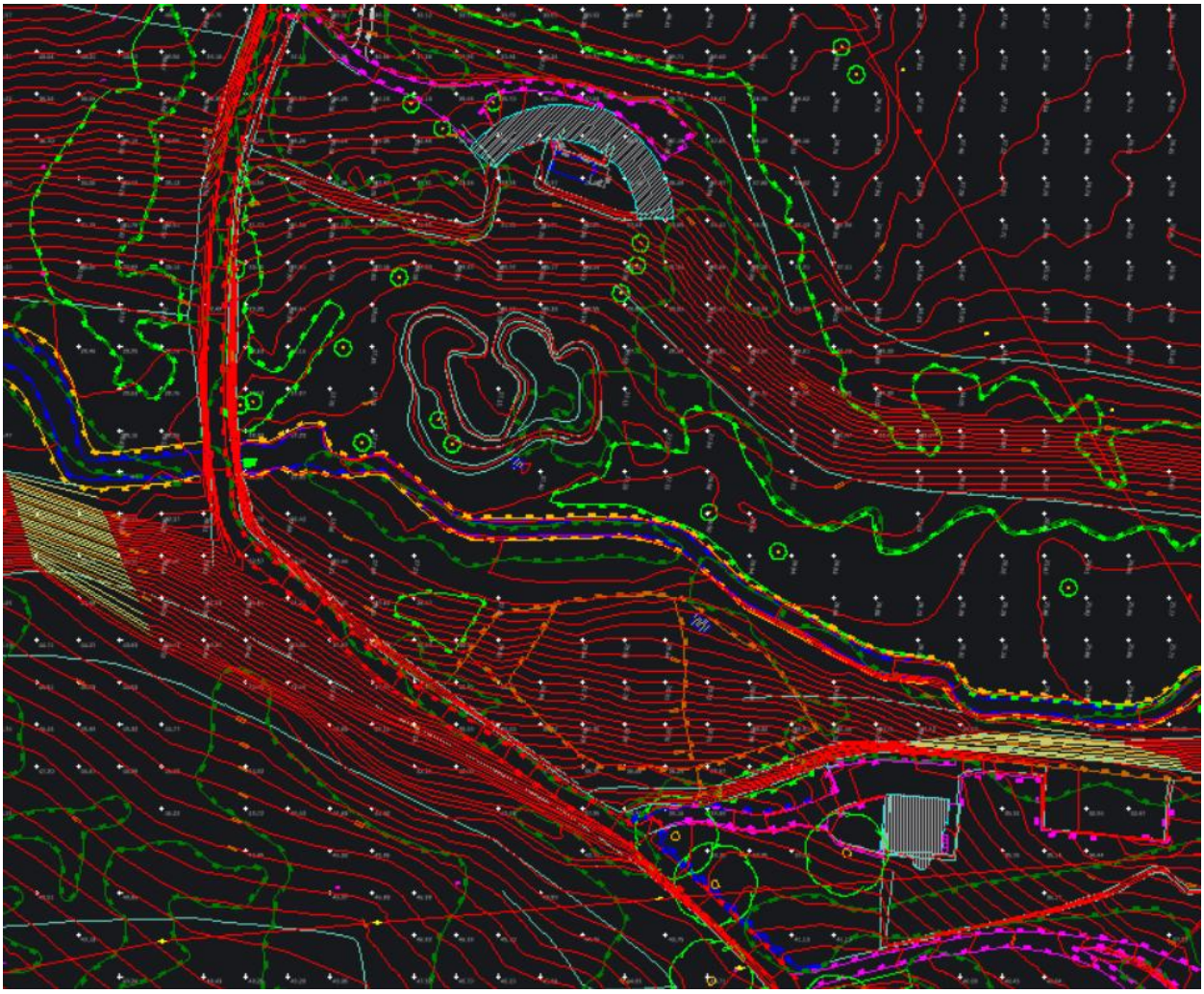


FIGURE 3-4: FULL SCOPE OF ADDITIONAL TOPOGRAPHICAL SURVEY OF THE PROPOSED CROSSING LOCATION (SOURCE: IO GEOMATICS, 2020.)

This survey does not include the bed level (BL) at either face of the existing bridge. Left and right bank levels upstream are approximately **27.68 mOD** and **27.66 mOD** respectively. The crown level is specified as **31.95mOD** and invert level is not specified. The downstream left and right banks are listed at **27.11mOD** and **27.27mOD**.

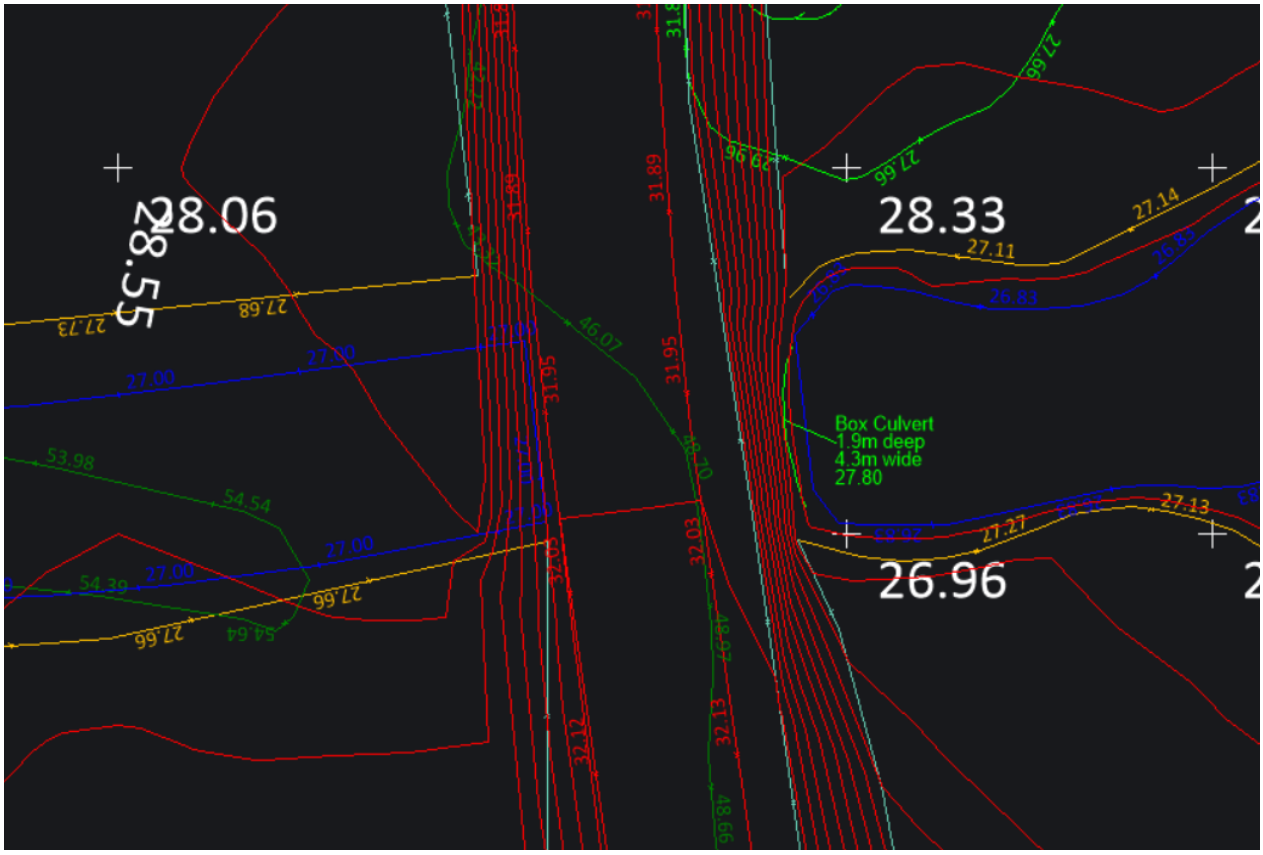


FIGURE 3-5: ADDITIONAL TOPOGRAPHICAL SURVEY OF THE PROPOSED CROSSING AREA. (SOURCE: IO GEOMATICS, 2020)

3.4 Existing Geology and Hydrogeology

The Geological Survey of Ireland (GSI) website provides information on their public online mapping services at *www.gsi.ie* on subsoil type and aquifer vulnerability. The maps presented in Figure 3-7 and Figure 3-6 below depict the aquifer vulnerability and subsoil type for the proposed development. The site is comprised of multiple soil categories. The most plentiful being "Till derived from limestones", indicated in blue. The second most common soil category is "Bedrock outcrop or subcrop", marked in grey. Additional subsoil types include "Alluvium" (orange) present along the channel line of the Carrickmines Stream and "Gravels derived from granite" (green) at the northern edge of the site. This is illustrated in Figure 3-6.

In Figure 3-7 the aquifer vulnerability is mapped as "Extreme" (pink) and "Rock at or near surface or Karst" (red). It can be determined that the groundwater in the area will be highly vulnerable to infiltration and contamination. GSI states that "Vulnerability is a term used to represent the intrinsic geological and hydrogeological characteristics that determines the ease with which groundwater may be contaminated by human activities". GSI further describes that the vulnerability of groundwater depends on:

- The time of travel of infiltrating water (and contaminants);
- The relative quantity of contaminants that can reach the groundwater; and
- The contaminant attenuation capacity of the geological materials through which the water and contaminants infiltrate.

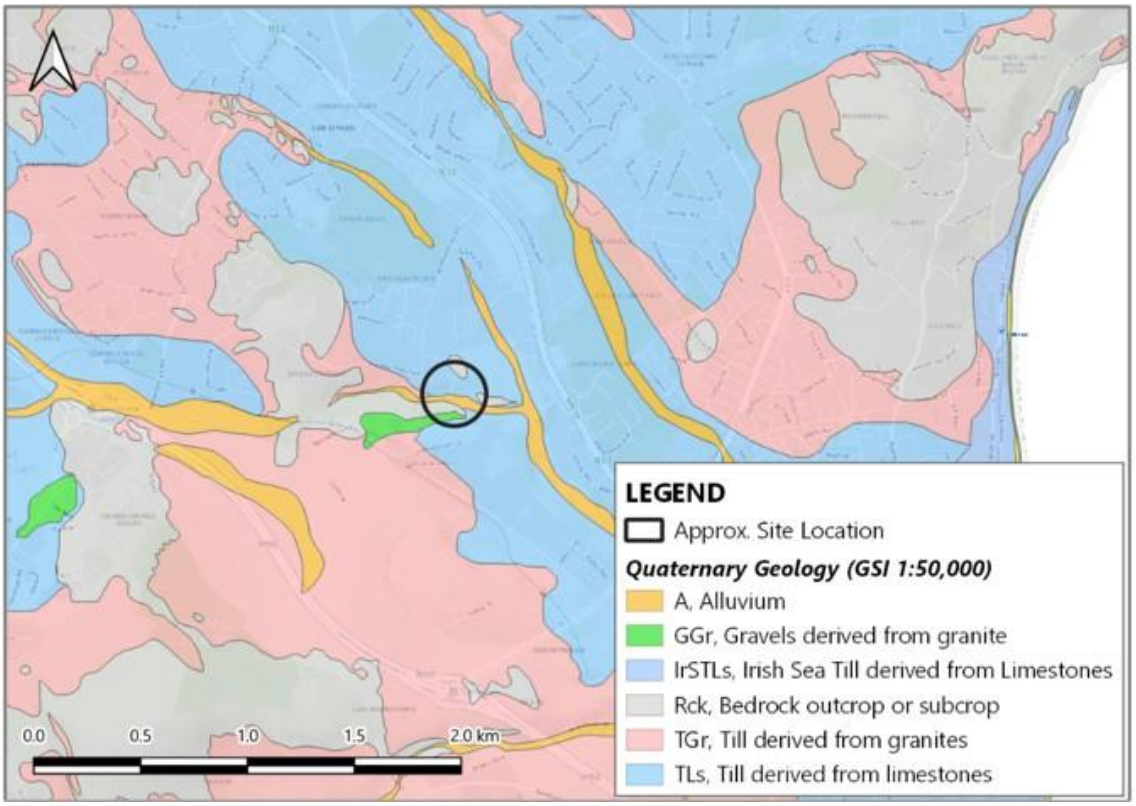


FIGURE 3-6: GSI SUBSOIL MAPPING (SOURCE: WWW.GSI.IE, ANNOTATIONS BY EGIS)

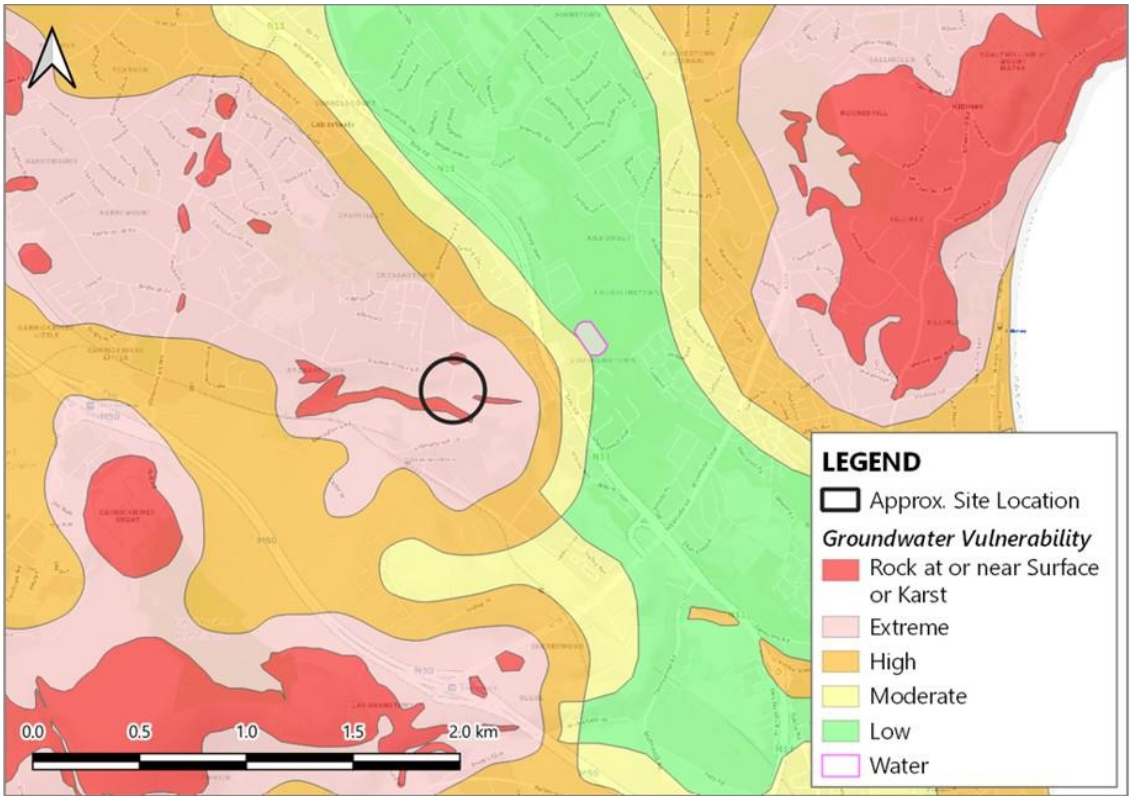


FIGURE 3-7: GSI AQUIFER VULNERABILITY MAPPING (SOURCE: WWW.GSI.IE, ANNOTATIONS BY EGIS)

Geological Survey Ireland mapping indicates the presence of a borehole well directly south of the proposed crossing site, as illustrated in Figure 3-8 below. Information provided includes the drill date as September 1st 1994, drill depth at 61.3m and depth to rock confidence as 39.5. The well use is unknown. Yield class is classified as good and yield volume is listed as 220m^3/d.

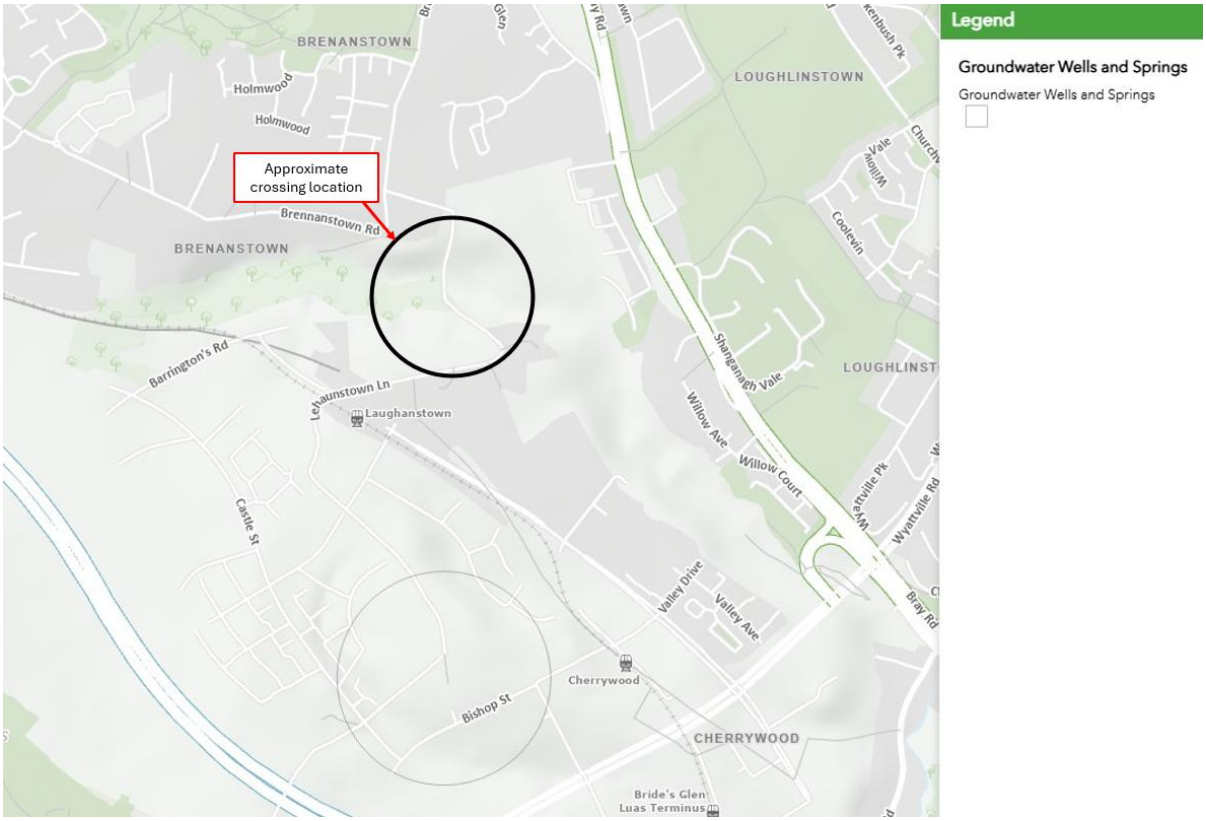


FIGURE 3-8: GSI GROUNDWATER WELLS AND SPRINGS (SOURCE: WWW.GSI.IE, ANNOTATIONS BY EGIS)

3.5 Historic Flood Events

Flooding events in the vicinity of the proposed development site have been limited. There are no reported historic floods in close proximity to the site, as illustrated in Figure 3-9 below (See Appendix 2 : OPW Past Flood Event Summary). The closest event occurred in Coolevin Ballybrack, to the east of the site, in February 1980. This was a pluvial flood event resulting from road gully misconnections to the foul system. There have been historic fluvial events to the west of the site in Shanganagh Carrickmines. The Dún Laoghaire-Rathdown County Council South Eastern Motorway River Catchment Study, Volume 1: Carrickmines & Shanganagh Catchment (February 2001) states that flooding has occurred from on the Shanganagh River and the Carrickmines Stream. Both affecting houses and roadways.

FIGURE 3-9: LOCATION OF HISTORIC FLOODING EVENTS IN THE VICINITY OF THE PROPOSED DEVELOPMENT (SOURCE: WWW.FLOODINFO.IE, ANNOTATIONS BY EGIS)

3.6 Flood Studies

There have been and are ongoing, several flood studies which include the proposed site as part of the Cherrywood SDZ. The most relevant results from studies reviewed have been compiled below.

3.6.1 Previous CFRAM - Eastern CFRAM Study

The Eastern Catchment Flood Risk Assessment and Management study commenced in 2011 and was completed in 2017. The study area covered 6,300 km^2 including the proposed site location. The aims of the study were to identify flood hazard areas and the impact of flooding, identify mitigation measures, prepare a Flood Risk Management Plan and Strategic Environmental Assessment and to ensure that public and stakeholder consultation and engagement was achieved throughout.

The Study produced flood risk mapping for the region for pluvial, fluvial and coastal events. The CFRAM mapping produced for the proposed bridge crossing site includes both fluvial and coastal flooding risks, despite the Carrickmines Stream not being considered an estuarial waterbody. Coastal extents for this stream are not mapped in detail, but are available in a illustrative manner without levels provided, online (*www.floodinfo.ie/map/floodmaps*) as seen in Figure 3-10. The coastal risk illustrated in the figure effects the area in which the proposed bridge development is located. The Eastern CFRAM mapping indicates the same extents for low, medium and high probability in the area of the proposed bridge development. This indicates that the proposed bridge site is at a high risk of coastal flooding. No flood maps (*www.floodinfo.ie/map/floodmaps*) of this location available for assessment.

The fluvial extent mapping is of higher confidence, as it includes levels and each probability level is mapped differently. It can therefore be determined that they are far greater than the coastal extents and therefore will be the levels referenced for the purpose of this assessment.

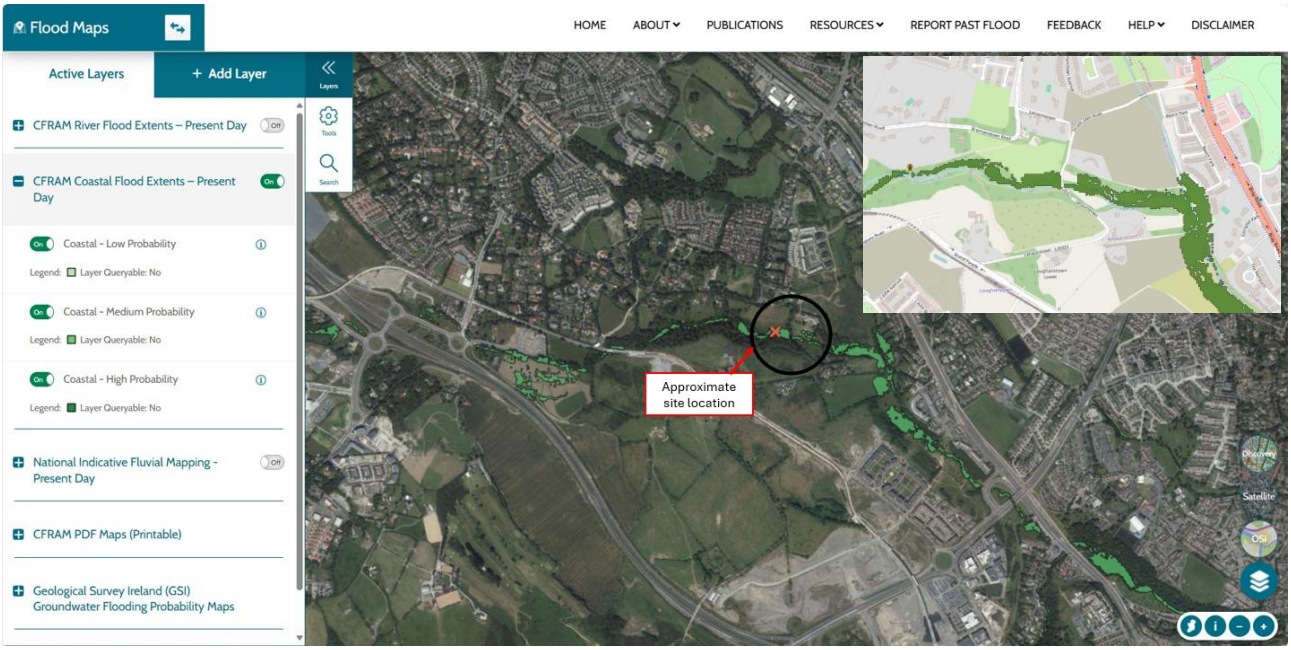


FIGURE 3-10: INDICATIVE COASTAL FLOODING MAP (SOURCE: WWW.FLOODINFO.IE)

The CFRAM fluvial model included 4no. nodes in close proximity to the site, each modelled for 10%, 1% and 0.1% AEP water levels and flows. The results are illustrated in Figure 3-11 and Table 3-2 below. The conclusion of this study is that the proposed development lies in Flood Zones A and B of the Carrickmines Stream.

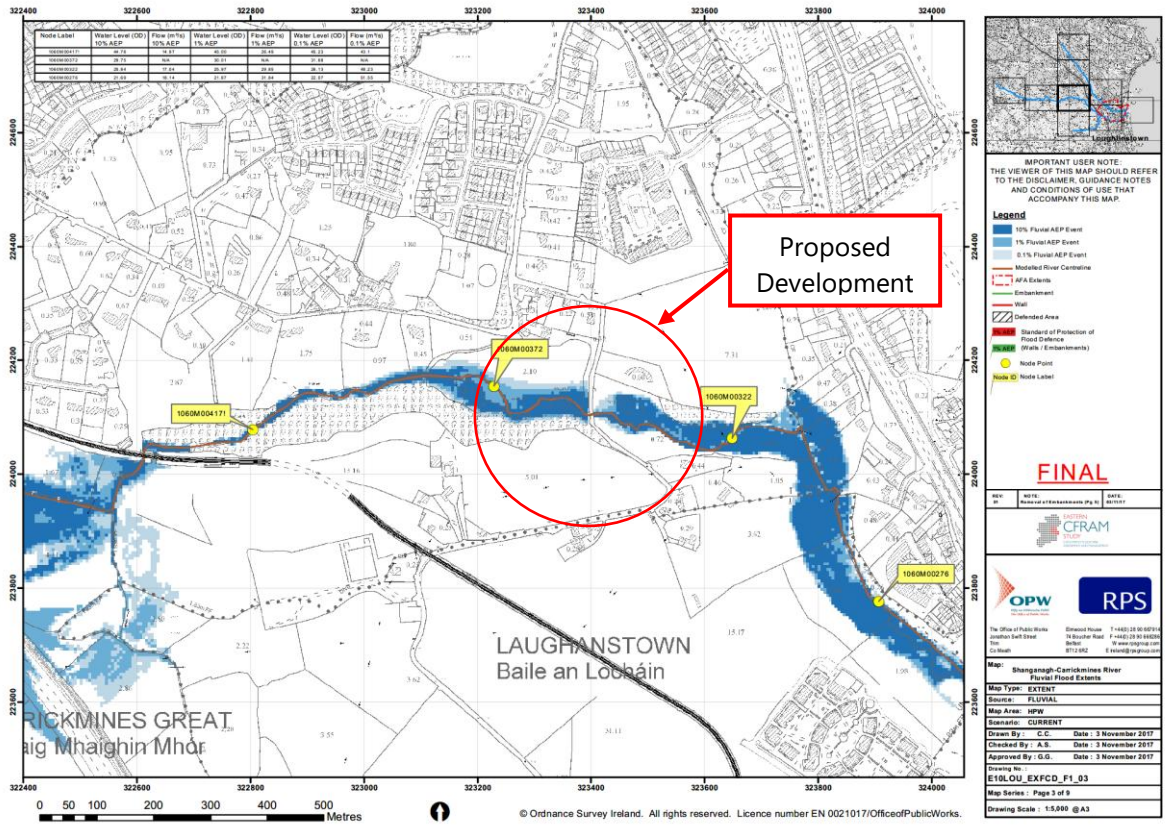


FIGURE 3-11: FLUVIAL FLOOD EXTENTS OF THE CARRICKMINES STREAM (SOURCE: EASTERN CFRAM, WWW.FLOODINFO.IE)

Node Label	Water Level (OD) 10% AEP	Flow (m/s^3) 10% AEP	Water Level (OD) 1% AEP	Flow (m/s^3) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m/s^3) 0.1% AEP
1060M00417	44.78	14.97	45.00	26.49	45.23	43.1
1060M00372	29.75	N/A	30.01	N/A	31.68	N/A
1060M00322	25.84	17.04	25.97	29.85	26.13	48.23
1060M00276	21.69	18.14	21.87	31.84	22.07	51.55

TABLE 3-2: FLUVIAL FLOOD LEVELS OF NEARBY NODES (SOURCE: EASTERN CFRAM, WWW.FLOODINFO.IE)

3.6.2 Cherrywood Green Routes Network – Flood Risk Assessment

A previous FRA of the Cherrywood Strategic Development Zone was prepared out for Dún Laoghaire-Rathdown County Council (DLRCC) by AECOM in February 2022. The study encompassed the Cherrywood Strategic Development Zone (SDZ) as a part of the planning process for its Green Routes Network (GRN). This comprehensive Stage 1 desktop study of the area concluded that the GRN was susceptible to fluvial flooding and therefore proceeded to a Stage 2 and 3 assessments.

The Stage 2 assessment identified that the flood risk from the Carrickmines and Loughlinstown watercourse is high risk (Flood Zone A). A 1D-2D model was created to model the greenroute crossing proposed further downstream towards the Loughlinstown river as part of the Cherrywood GRN FRA, but which is in a different location to the proposed bridge crossing for Druids Glen Road Phase 3. The existing masonry arch bridge located along Lehaunstown Lane however, also was included in the model.

Modelling was carried out for Mid-Range Future Scenario (MRFS) and High-End Future Scenario (HEFS) using ESTRY/TUFLOW. The baseline model results are presented in Figure 3-12 below.

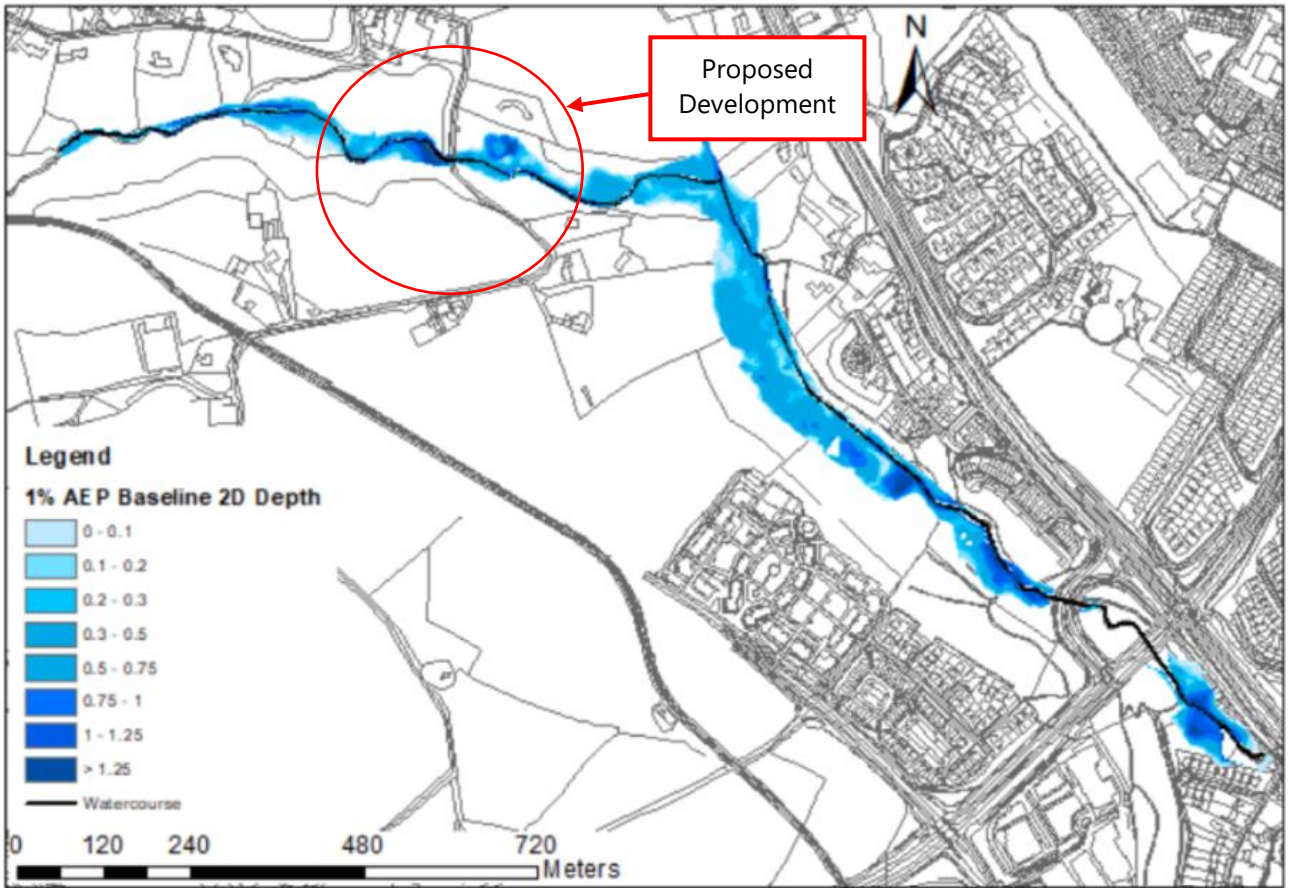


FIGURE 3-12: FLUVIAL FLOODING BASELINE MODEL RESULTS (SOURCE: AECOM, 2022)

The flood mechanisms affecting the area were determined to be a lack of existing channel capacity and the gradient surrounding said channel. Sensitivity testing was carried out at the location of the existing bridge

which will remain unchanged under the Preferred Option assessed in this report. The impact of the blockage was reported as negligible with no differences in water levels found.

3.6.3 Dún Laoghaire-Rathdown County Council Development Plan 2022-2028

The Dún Laoghaire-Rathdown County Council Development Plan 2022-2028 was prepared to set out the policy objectives and the strategy for planning and sustainable development within the county. Appendix 16 of the report is a Strategic Flood Risk Assessment, carried out by JBA consulting engineers.

Analysis of the Loughlinsown River and Shanganagh River were carried out as part of the SFRA. The Carrickmines Stream was not assessed as a stage 3 assessment was previously caried out for the Cherrywood SDZ (see Section 2.9.3). Flood extent mapping of the surrounding areas was included as part of the study which places the proposed site in Flood Zone A, as illustrated in Figure 3-13.

FIGURE 3-13: FLOOD EXTENTS OF THE CARRICKMINES STREAM (SOURCE: DLRCC COUNTY DEVELOPMENT PLAN 2022 - 2028, ANNOTATIONS BY EGIS)

The SFRA also presents the planning requirements for climate change for proposed developments. It is noted that specific advice on expected impacts of climate change and the allowances to provide for future flood risk management in Ireland are provided by OPW Scheme Climate Change Adaptation Plans Technical Methodology Note for new Flood Relief Schemes. The guidance recommends assessment of adaptation measures and dealing with uncertainty. The SFRA recommends two climate change scenarios presented in Table 4-2 of DLRCC SFRA. See extract overleaf in Figure 3-14.

Development vulnerability	Fluvial climate change allowance (increase in flows)	Tidal climate change allowance (increase in sea level)	Storm water / surface water
Less vulnerable	20%	0.5m (MRFS)	Refer to the Stormwater Management Policy in Appendix 7.1 for details of climate change allowances
Highly vulnerable	20%	1.0m (HEFS)	
Critical or extremely vulnerable (e.g. hospitals, major sub-stations, blue light services)	30%	1.2m (and test up to 2m)[9]	
Note: there will be no discounting of climate change allowances for shorter lifespan developments.			

FIGURE 3-14: EXTRACT OF DLRCC SFRA TABLE 4-2 CLIMATE CHANGE ALLOWANCES BY VULNERABILITY AND FLOOD SOURCE

3.6.4 Carrickmines-Shanganagh Flood Relief Scheme

Carrickmines-Shanaganagh River Flood Relief Scheme was commissioned in 2021 and is currently in Stage 1: Identification and development of a preferred scheme. A public consultation event of the preferred option was held in December 2023 and it is anticipated for Stage 1 to be completed in 2024. Dún Laoghaire-Rathdown County Council also submitted a planning application, accompanied by an EIAR, to An Bord Pleanála under Section 175 of the Planning and Development Act 2000 (As Amended) in April 2025 which is currently awaiting decision. The application includes proposed flood defences upstream of the Cherrywood SDZ at Glenamuck Rd North Roundabout and downstream of the SDZ at Cherrywood Road, upstream of the Cherrywood Viaduct. Observations of the preferred options presented indicate that the subject Project Area and Cherrywood SDZ was excluded as part of the scheme.

3.6.5 Summary of Flood Studies

In conclusion, flood levels produced by the Cherrywood GRN FRA was considered the most appropriate study to be considered for Stage 2 & 3 assessment for the proposed development. Topographical surveys (Murphy Survey & iO Geomatics) will also be referenced. Rationale for consideration:

- Most recent flood study – carried out in February 2022.
- Hydraulic model depicted similar results to Previous CFRAM and DLRCC SFRA flood extents. Sensitivity testing of flooding was carried out including downstream flood impacts.
- Model nodes most accurately represent the location of the proposed development.
- Topographical surveys supply ground elevation data for the flood plain which is not supplied by the Cherrywood GRN FRA.

Node ID	Flood Level 1% AEP Baseline (mAOD)	Flood Level 1%+CC AEP (mAOD)
1060M00372 (CFRAM Node)	*30.052*	*unknown*
1060M00352 (upstream of existing bridge*)	29.160	29.687
1060M00351I (upstream face of existing bridge*)	29.086	29.645
1060M00350J (downstream face of existing bridge*)	27.750	27.844
1060M00347 (downstream of existing bridge*)	27.520	27.605

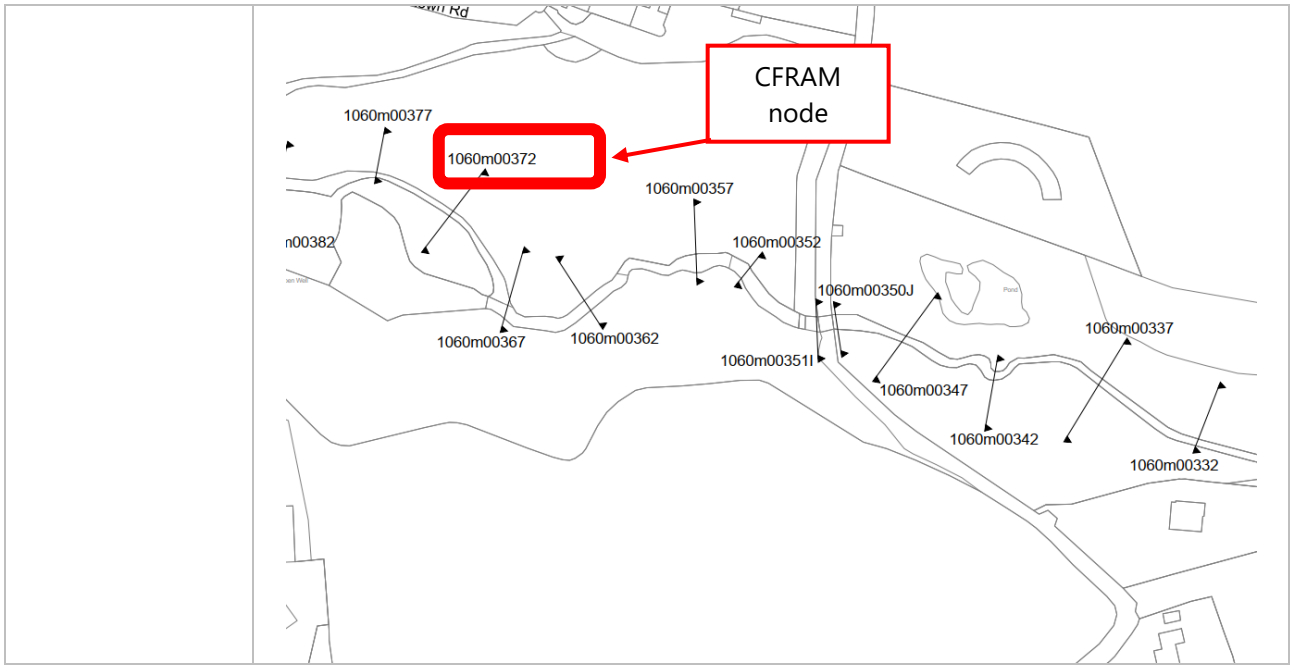


TABLE 3-3: MODEL OUTPUT AND CROSS SECTION DATA (SOURCE: AECOM, ANNOTATIONS BY EGIS)

*Note that the location of the existing bridge is the same as that of the proposed development

4 FLOOD RISK ASSESSMENT

4.1 Introduction

As outlined in Section 2 of this report, the FRM Guidelines identifies three stages of Flood Risk Assessment namely;

- Stage 1: Flood Risk Identification
- Stage 2: Initial Flood Risk Assessment
- Stage 3: Detailed Flood Risk Assessment

4.2 Stage 1 – Flood Risk Identification

According to the FRM Guidelines, flood risk identification is the process for deciding whether a plan or project requires further investigation. This is a desk-based exercise based on existing information. All the existing information is described in Section 3 of this report and the identification of flood risk from each of the five sources of flooding (coastal, fluvial (river), groundwater, pluvial (rainfall) and from artificial drainage systems) is considered.

4.2.1 Coastal Flood Risk

The proposed development lies west of the N11 Bray Road, crossing the Carrickmines Stream via the path of the Lehaunstown Road. The Carrickmines Stream is not classed as estuarial by the EPA, however within Eastern CFRAM the coastal extent modelled identified the proposed development to be at coastal flood risk (see Section 3.6.1).

The coastal flood extents modelled cannot be examined in detail as water levels for the standard AEP flood events were not published. It is however apparent that there is a predicted flood risk for low, medium and high probability flood events, as seen in Figure 3-10. The proposed site therefore lies in **Flood Zone A and B.**

4.2.2 Fluvial Flood Risk

The proposed development site is indicated at flood risk under the Eastern CFRAM fluvial flood extent maps. The proposed development site therefore lies in Flood **Zones A and B** for fluvial flood risk.

4.2.3 Groundwater Flood Risk

The aquifer vulnerability map (refer to Section 2.7 above) classifies the site as having 'high and extreme vulnerability'. There is no historical evidence of groundwater flooding of the site. Review of Geological Survey Ireland mapping indicates a nearby borehole well to the south of the site (see Section 2.7). It is recommended that groundwater level at the site is monitored to allow better assessment of groundwater flood risk including during the Detailed Design Phase.

4.2.4 Pluvial Flood Risk

Pluvial flood risk has been identified historically at Commons Road, which is located to the east of the N11. The latest report of pluvial flooding was however in the 1980's. The site of the event is approximately 2km southeast of the proposed development and thus is not considered an accurate representation of the risk to the proposed site. It can be deduced that the proposed site is not at risk of pluvial flooding.

4.2.5 Artificial Drainage Systems Flood Risk

No artificial drainage system has been identified at the proposed development site, and consequently artificial drainage systems flood risk is not relevant to this assessment.

4.3 Stage 2 – Initial Flood Risk Assessment

The Flood Risk Assessment has identified that there is a flood risk at the proposed crossing location. The FRM Guidelines define a three-step approach is required to confirm the appropriateness of the development in terms of flood risk.

Step 1: Identification of the Flood Zone at the proposed development site

Using the Flood Zone criteria from the FRM Guidelines and as defined in Section 2 previously, the flood zones for each of the sites were determined.

- **Flood Zone A** – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 year for river flooding or 0.5% or 1 in 200 for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 year and 1% or 1 in 100 year for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 year for coastal flooding); and
- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).

As discussed in Section 3.2 above, the proposed crossing site lies primarily within **Flood Zone A** for coastal and fluvial flooding. Desktop review of previous FRA's, the Eastern CFRAM and DLRCC County Development Plan 2022-2028 suggest that fluvial flood risk is far greater than coastal flood risk to the proposed development site at Druid's Glen. As coastal flood levels are unavailable for the site the ***fluvial flood levels will be regarded going forward.***

Step 2: Identification of the vulnerability of the type of the proposed development (Table 3.1 of the FRM Guidelines)

The different types of proposed infrastructure are then assigned a vulnerability classification according to the definitions in 'Table 3.1 – Classification of vulnerability of different types of development' of the FRM Guidelines.

As described in Section 1 above, the project consists of a green travel corridor, including a proposed bridge to traverse an existing bridge over the Carrickmines Stream. This is classified as '**highly vulnerable development'**.

Step 3: Using the matrix of vulnerability versus Flood Zone (Table 3.2 of the FRM Guidelines), identify the necessity for the justification test for the proposed development

The proposed river crossing is situated above the existing Lehaunstown Road river crossing, which is located in Flood Zones A and B and is categorised as a Highly Vulnerable Development. Table 3.2 of the FRM guidelines and Figure 3.2 – Sequential approach mechanism in the planning process (FRM guidelines) stipulate that a justification test will be required such before it is deemed appropriate development for the flood zone categories. Figure 4-1 below highlights the matrix of vulnerability versus flood zone.

	Flood Zone A	Flood Zone B	Flood Zone C
Highly vulnerable development (including essential infrastructure)	Justification Test	Justification Test	Appropriate
Less vulnerable development	Justification Test	Appropriate	Appropriate
Water-compatible development	Appropriate	Appropriate	Appropriate

Table 3.2: Matrix of vulnerability versus flood zone to illustrate appropriate development and that required to meet the Justification Test.

FIGURE 4-1: MATRIX OF VULNERABILITY VERSUS FLOOD ZONE TO ILLUSTRATE APPROPRIATE DEVELOPMENT.

4.4 Stage 3 – Detailed Flood Risk Assessment

4.4.1 Justification Test

According to the FRM Guidelines, the Justification Test has been designed to rigorously assess the appropriateness, or otherwise, of particular developments that are being considered in areas of moderate or high flood risk (Flood Zones A and B; respectively).

The FRM Guidelines outlines in Box 5.1 (shown in the five criteria, namely Criterion 1, 2(i), 2(ii), 2(iii), and 2(iv), all of which must be satisfied under the Justification Test as it applies to development management. These justification criteria have been addressed in the following paragraphs.

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.

4.4.1.1 Criterion 1: The subject land has been designated for this particular use

The development is located within the Cherrywood Strategic Development Zone (SDZ), part of the SDZ Planning Scheme. The Cherrywood SDZ provides c. 16 hectares of land zoned for employment and c. 7.7 hectares of lands designated for non-retail commercial uses. The land use is zoned for "Physical Infrastructure" and "Green Infrastructure" in the –Cherrywood Planning Scheme 2014 (Updated July 2023), as illustrated in Figure 4-2.

The Lehaunstown area south of the proposed bridge is zoned for residential development and at present is only accessible from the north via Grand Parade. Construction of an access route from the north is a vital component in accessibility of the area to southbound traffic on the M50 and N11 roadways. Section 3.5 of the Planning System and Flood Risk Management Guidelines states that development in Flood Zone A should only be considered in exceptional circumstances or in the case of essential infrastructure that cannot be located elsewhere, and where the Justification Test has been applied. Similar requirements are noted in the guidelines for development in Flood Zone B.

Construction of a bridge at Druid's Glen is an integral part of the development of Cherrywood. It is therefore determined to have passed the Justification Test Criterion 1.

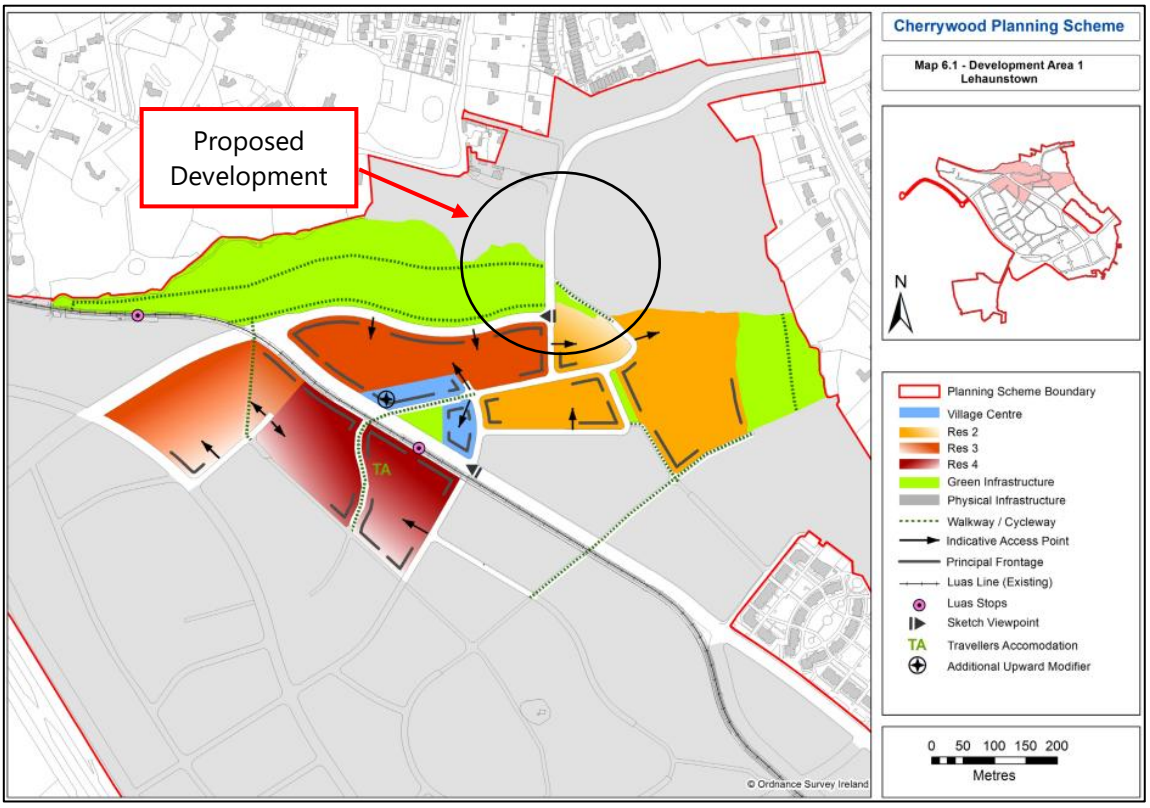


FIGURE 4-2: CHERRYWOOD PLANNING SCHEME LAND USE (SOURCE: ORDANANCE SURVEY IRELAND)

4.4.1.2 Criterion 2: The proposal has been subject to an appropriate flood risk assessment

In accordance with the FRM Guidelines, a detailed flood risk assessment should be undertaken to satisfy the four sub-criteria included under criterion 2 in Box 5.1. The four sub-criteria are as follows:

- Sub-criterion 2 (i) – Detailed flood risk assessment
- Sub-criterion 2 (ii) – Flood risk mitigation measures
- Sub-criterion 2 (iii) – Residual risks
- Sub-criterion 2 (iv) – Wider planning objectives

4.4.1.3 Sub-criterion 2 (i) – Detailed Flood Risk Assessment

To determine if a detailed flood risk assessment is required for this proposed development, which lies within Flood Zones A and B, the risks associated with the development must be examined and effectively managed and mitigated in the Detailed Design stages.

Development on a floodplain has the potential to increase flood risk elsewhere by:

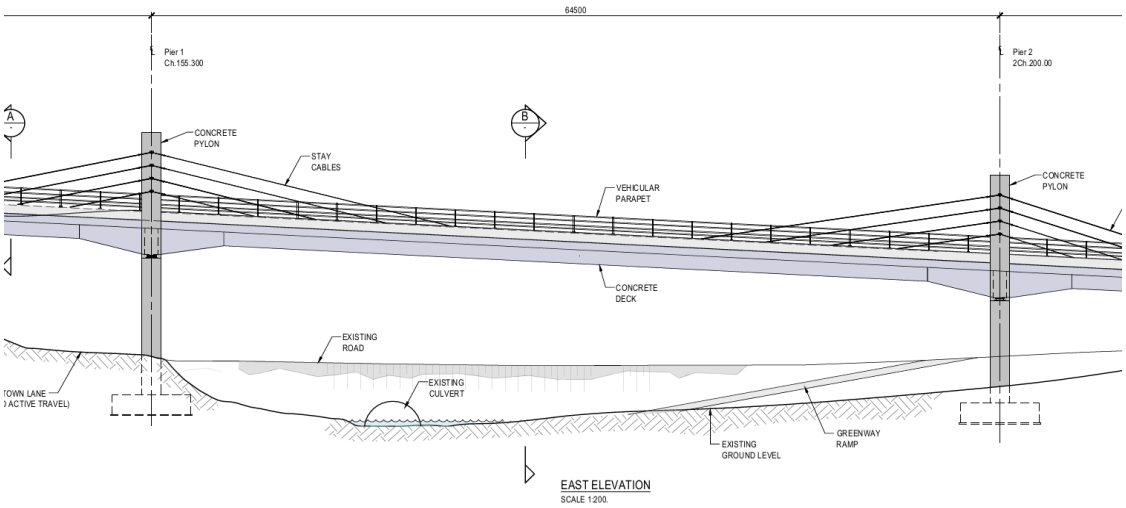
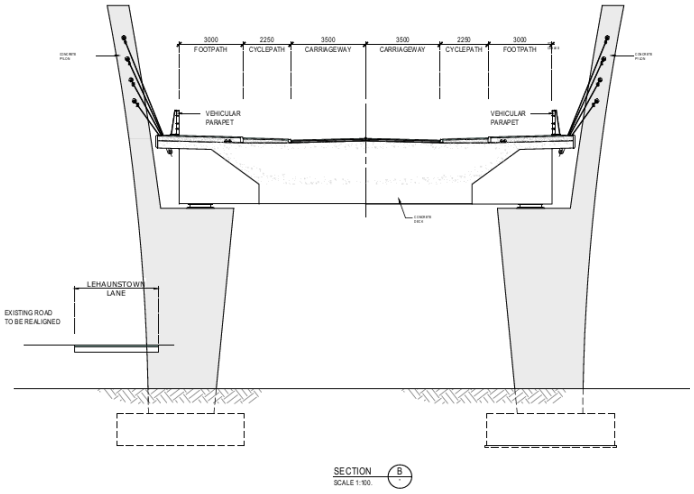
- Increasing the rate and volume of runoff from reduced permeable areas, and
- A decrease in the volume of available flood storage.

In the case of the proposed crossing development at Druid's Glen, the likely interactions between the proposed bridge and the Carrickmines Stream must be assessed against the above criteria. Neither the existing bridge nor Lehaunstown Lane will be altered under either option being considered at this stage. The assessment must therefore focus on determining if the proposed pier locations under options 2 and 3 would potentially affect flood risk in the area. If the piers are concluded to obstruct upon the existing hydraulics of the stream, increasing flood risk elsewhere, a Detailed Flood Risk Assessment including a hydraulic model will be required to determine the likely impact of the development.

The bed level and channel width of the Carrickmines Stream can be determined from the Murphy Surveys (2020) topographical survey. This data, along with fluvial flood levels modelled as part of the Cherrywood GRN FRA, will be compared against the option layouts to determine if the pier will encroach upon the stream, and thus if this encroachment would cause increased flooding elsewhere.

4.4.1.4 Option 3 (Emerging Preferred Option) – 3 Span Extradosed Bridge

Under Option 3 (Emerging Preferred Option), construction of a 3-span extradosed bridge is proposed (see Table 4-1). The Carrickmines Stream, existing bridge and existing road pass under the central span, which has a length of 64.5mOD. Embankments with a 1:1.5 slope are included at both north and south abutments. As mentioned above, bed level at the illustrated downstream face of the bridge is 25.862mOD, but the upstream value of 26.90mOD is considered for floodplain estimation.

View	Drawing
Elevation	
Section	

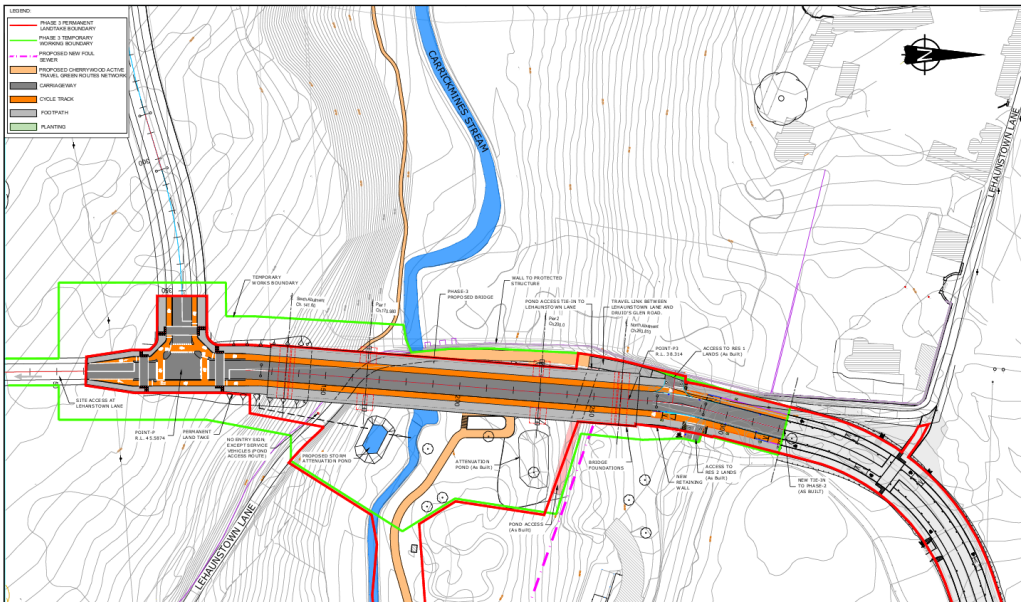
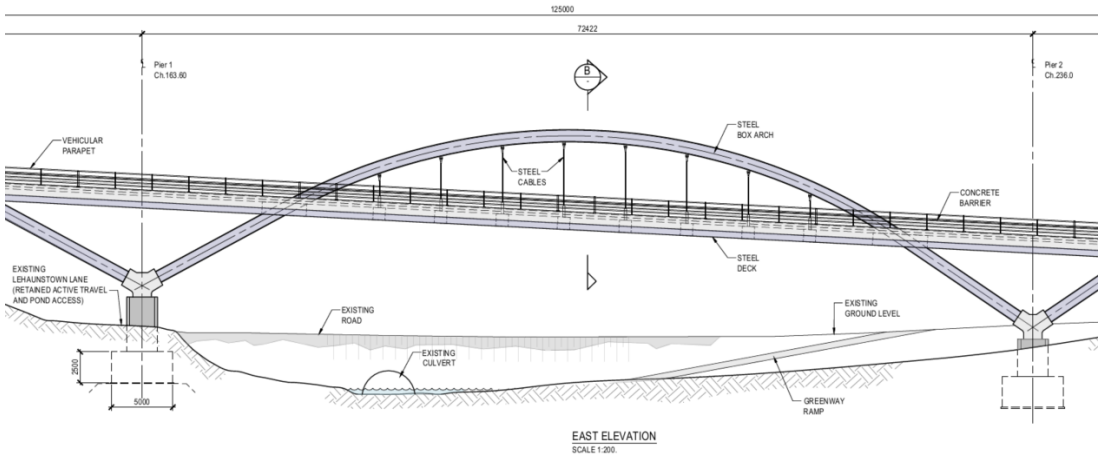
Plan	

TABLE 4-1: OPTION 3 ELEVATION, SECTION AND PLAN

4.4.1.5 Option 1 (Alternative Bridge Design Option) – 3 Span Bow String Arch Bridge

Table 4-2 below illustrates the elevation and section views of Option 1 (Alternative Bridge Design Option), a 3-span low rise bow string arch bridge. The central 72.5m span shown traverses the Carrickmines Stream, existing bridge and culvert and Lehaunstown Lane. Bed level at the illustrated downstream face of the bridge is 25.862mOD. The upstream value of 26.90mOD is considered for assessment. Embankments with a 1:1.5 slope are included at both north and south abutments.

View	Drawing
Elevation	

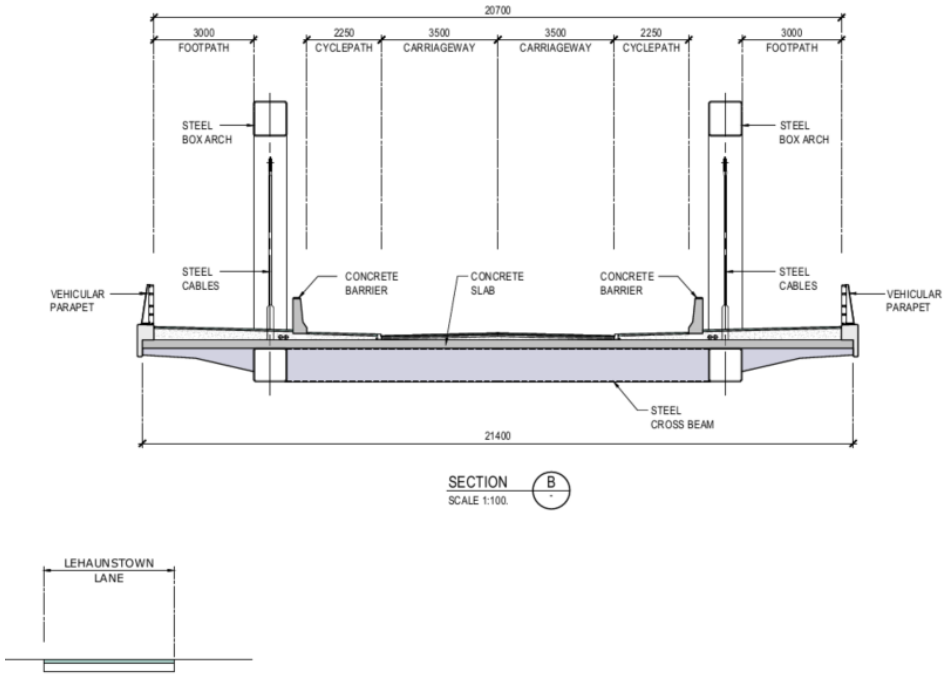
Section	

TABLE 4-2: OPTION 1 ELEVATION AND SECTION

4.4.1.6 Option 2 (Alternative Bridge Design Option) – 4 Span Girder Bridge

The elevation and section of the 4-span girder bridge proposed under Option 2 (Alternative Bridge Design Option) is illustrated in Table 4-3 below. The Carrickmines Stream, existing road and existing bridge pass underneath the bridge. The existing culvert is located beneath a 29m span, approximately equidistant from the piers located at chainages 170.98 and 200. Bed level at the illustrated downstream face of the bridge is 25.862mOD. The upstream value of 26.90mOD is considered for assessment. Embankments with a 1:1.5 slope are included at both north and south abutments. A similar profile design, Option 4, has been assessed as an alternative option in the accompanying FOAR.

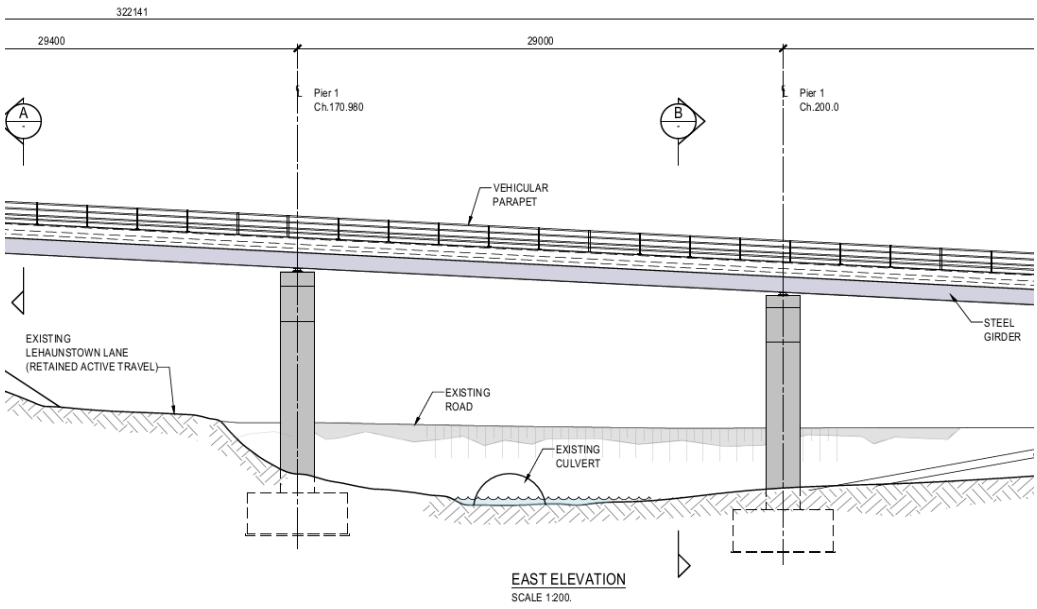
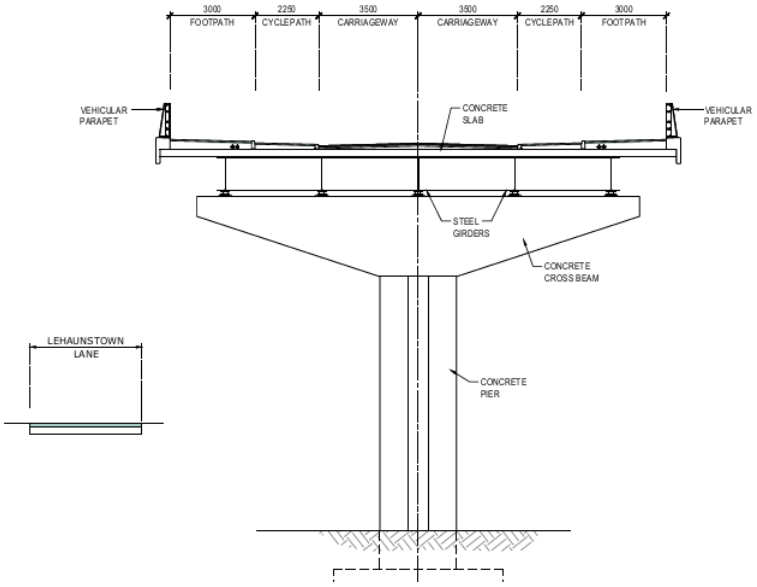
View	Drawing
Elevation	
Section	

TABLE 4-3: OPTION 2 ELEVATON AND SECTION

4.4.1.7 Water Level Assessment

An analysis of the flood water levels was be carried out using model results from the AECOM Cherrywood Green Routes Network FRA as presented in Table 4-4, namely node 1060M00352I, the upstream face of the existing bridge structure on the Carrickmines Stream. This cross section represents the upstream face of the proposed bridge also. Table 4-4 below describes the indicative flood plain widths as measured from topographical data for 1%+CC AEP Baseline fluvial flood events at 1060M00352I.

The channel width between left bank and right bank of the stream was measured as **5.75m**. At this width there is ***no encroachment by bridge piers under any option***.

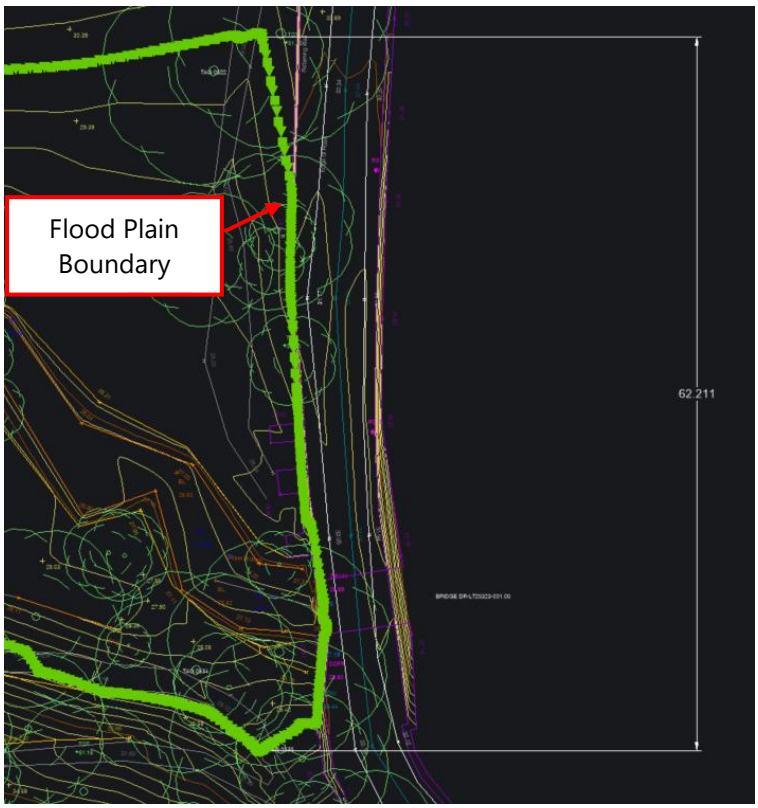
Flood Zone	Flood Level (m)	Flood Plain Width (m)	Topographical Survey Imagery
1%+CC AEP	29.645	56.12	

TABLE 4-4: FLOOD PLAIN WIDTH

The data gathered in Table 4-4 indicates that the proposed bridge piers will be within the flood plain in some instances. Approximation from this assessment during a 1%+CC AEP event, it is unlikely that any piers will lay within the flood plain under **Option 3** (Emerging Preferred Option). It also concludes that neither piers proposed under **Option 1** (Alternative Bridge Design Option) are likely to be in the flood plain during a 1%+CC AEP event. **Option 2** (Alternative Bridge Design Option) is likely to have 2no. piers within the flood plain during a 1%+CC AEP flood event.

Although there may be encroachment upon the flood plain in the events listed above, the disturbances caused by the piers will be minimal and ***are highly unlikely to increase flooding at the site or at any other location.*** The abutments, vehicular parapet and connecting roads are unlikely to be affected according to this analysis of flood levels. The existing bridge and culvert at the site are to be retained and unaltered, as such the requirement for further investigation regarding the impact of the proposed development is eliminated.

No element of the proposed development, other than the proposed bridge is within flood zones identified in previous studies. Of the proposed bridge development, the only element which lies within the flood zone is the bridge pier under Option 2 (Alternative) for a 1%+CC AEP event. There is no encroachment under Option

3 (Preferred) and Option 1 (Alternative). The proposed bridge development therefore can be deemed not at risk of fluvial or coastal flooding.

4.4.1.8 Sub-criterion 2 (ii) – Flood Risk Mitigation Measures

It has been identified that the site is at risk of fluvial flooding from the Carrickmines Stream at 10%, 1% and 0.1% AEP. In accordance with the FRM Guidelines the minimum floor level of a new development should be set above the 1% AEP fluvial flood level and should include 0.5m freeboard plus an allowance for climate change.

All proposed bridge developments assessed at Druid's Glen meet and surpass these allowances. It is recommended that scour protection be included at the bridge piers under all Options, as they may be impacted by flood events.

4.4.1.9 Sub-criterion 2 (iii) – Residual Risks

Flood damage risks to all proposed bridge design options will be minimised by the implementation of scour protection at the piers.

4.4.1.10 Sub-criterion 2 (iv) – Wider Planning Objectives

All options assessed for the proposed development are compatible with the wider planning objectives for the Cherrywood SDZ as outlined by the DLRCC County Development Plan 2022 – 2028 and Cherrywood Planning Scheme.

5 SUMMARY OF ASSESSMENT

5.1 Summary

A flood risk assessment for the proposed development including the Emerging Preferred Bridge Design Option and Alternative Bridge Design options as part of a wider development that would include (inter alia) approximately 67 metres of south road and 44m of north road including tie in with Druids Glen Road Phase 2, a new junction at Point P, and tie in with a temporary pond at Point P3 has been undertaken in accordance with the methodology recommended in the FRM Guidelines. The following is a summary of the flood risk assessment:

- The proposed development is a bridge crossing of the Carrickmines Stream in the Druid's Glen area intending to include carriageways, footpaths and cycleways.
- Eastern CFRAM flood extent maps and DLRCC County Development Plan place the site in fluvial Flood Zone A and B.
- This type of development is defined as a "highly vulnerable development". Using the sequential approach mechanism, it is assessed that a Justification Test is required for the development.
- It was identified that the effects of the proposed development, including the Emerging Preferred Bridge Design (Option 3) and Alternative Bridge Design options, are negligible as the existing crossing is to be retained and there is no encroachment upon the river channel.
- The appropriate freeboard and climate change allowances are adhered to under all options including the Emerging Preferred Bridge Design (Option 3).
- Scour protection is recommended at the bridge piers under all options including the Emerging Preferred Bridge Design (Option 3).

5.2 Impact of the Emerging Preferred Options on the existing flood regime of the area

It has been assessed that the proposed development, including the Emerging Preferred Bridge Design (Option 3) and Alternative Bridge Design options, is unlikely to have an impact on the existing flood regime of Druid's Glen and the greater Cherrywood area.

To prevent an increase in flooding at the proposed site or at any location upstream or downstream as a consequence of this development the components which lay within the 0.1% and 1% AEP fluvial flood extents consist only of bridge piers. The vehicular parapet, abutments and connecting road levels are outside the aforementioned flood extents.

APPENDIX 1: TOPOGRAPHICAL SURVEY

APPENDIX 2: OPW PAST FLOOD EVENT SUMMARY

APPENDIX 3: EASTERN CFRAM FLOOD EXTENT MAP

APPENDIX 4: EMERGING PREFERRED BRIDGE OPTION LAYOUT

APPENDIX 5: OPTIONS 1 AND 2 - ALTERNATIVE BRIDGE OPTION LAYOUTS

APPENDIX 6: DLRCC COUNTY DEVELOPMENT PLAN FLOOD ZONE MAP

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