Carrigtwohill URDF Initiative - Urban Expansion Area Infrastructure

Flood Risk Assessment

Technical Report

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Cork County Council

JBA Project Manager

David Casey
Unit 8,
Greenogue Business Plaza
Greenogue Business Park
Rathcoole
Dublin
D24 CY64
Ireland

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Contract

This report describes work commissioned by Atkins, on behalf of Cork County Council, by a letter correspondence dated 14 December 2020. Cork County Council's representative for the contract was John O'Callaghan of Atkins. David Casey and Daniel Iordache of JBA Consulting carried out this work.

Prepared by ..... Daniel Iordache BEng, MEng
Engineer

Reviewed by ..... David Casey BSc MSc PGCert MCIWEM
Senior Engineer

Purpose

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Abbreviations

1D	One Dimensional (modelling)
2D	Two Dimensional (modelling)
AEP	Annual Exceedance Probability
CFRAM	Catchment Flood Risk Assessment and Management
FB	Freeboard
FFL	Finish Floor Levels
FRA	Flood Risk Assessment
FSR	Flood Studies Report
FSU	Flood Studies Update
GSI	Geological Survey of Ireland
OPW	Office of Public Works
PFRA	Preliminary Flood Risk Assessment
RR	Rainfall-Runoff
SAAR	Standard Average Annual Rainfall (mm)
SFRA	Strategic Flood Risk Assessment
WL	Water Level

1 Introduction

Under the "Planning System and Flood Risk Management Guidelines" for Planning Authorities (DoEHLG & OPW, 2009), the proposed development must undergo a Flood Risk Assessment prior to planning to ensure sustainability and effective management of flood risk.

1.1 Terms of Reference and Scope

JBA Consulting was appointed by Atkins on behalf of Cork County Council to prepare a Flood Risk Assessment (FRA) for the Carrigtwohill URDF Initiative - Urban Expansion Area (UEA) Infrastructure in Carrigtwohill, Co. Cork.

1.2 Flood Risk Assessment; Aims and Objectives

This study is being completed to inform the proposed development as it relates to flood risk. It aims to identify, quantify and communicate to relevant 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 at and adjacent to the proposed development and identify key hydraulic features,
- Assess the impact the proposed development has on flood risk,
- Develop appropriate flood risk mitigation and management measures which will reduce flood risk and allow for safe and sustainable development of the proposed infrastructure.

In 2013, JBA completed a study to investigate flood risk for the wider Carrigtwohill area; the reports and associated flood mapping published under this study are available publicly for download on the Cork County Council website. This has been used as the base data for this assessment, supported and updated where necessary by updated survey and site specific data.

Recommendations for development have been provided in the context of the OPW / DoEHLG planning guidance, "The Planning System and Flood Risk Management[1]".

1.3 Development Proposal

With reference to Figure 1-1 the infrastructure which makes up the Carrigtwohill URDF Initiative UEA Infrastructure is described as follows:

a. Western (A1) and Eastern (A2) Services Corridor Link Roads connecting Wise's Road (L3616-0) on the western side of the UEA with Carrigane Road (L3617-25) on the eastern side of the UEA. The roads will also provide connectivity to Station Road (L3603-0), Leamlara Road (L3607-37) and the Ballyadam Road (L7640-0) and includes the realignment of the Carrigane Road near Ballyadam Bridge;
b. Northern Services Corridor Link Road connecting the Western Services Corridor Link Road with the new Northern Schools Link Road via an existing vehicular underpass below the Cork to Midleton railway line;
c. Upgrade/ re-alignment of Wises Road (C1) from north of its crossing of the Cork to Midleton Railway Line to the L3615-0 to the north of the UEA. The upgrade will also include a pedestrian/ cycle bridge (C2) across the railway line providing connectivity to Wises Road south of the railway;
d. Upgrade/ re-alignment of Station Road (D1) from south of its crossing of the Cork to Midleton Railway Line to the L3615-0 to the north of the UEA. The upgrade will also include a pedestrian/ cycle bridge (D2) across the railway line providing connectivity to Station Road south of the railway line;

1 The Planning System and Flood Risk Management: Guidelines for Planning Authorities, (2009) OPW/DoEHLG

e. Upgrade/ re-alignment of Leamlara Road from its junction with Station Road to its new western junction with the Eastern Services Corridor Link Road and from north of the UEA to its new eastern junction with the Eastern Services Corridor Link Road;

f. Upgrade/ re-alignment of Ballyadam Road from its new junction with the Eastern Services Corridor Link Road to the L7639-0 north of the UEA including the permanent closure of the existing Ballyadam Road between the Eastern Services Corridor Link Road and Carrigane Road to vehicular traffic including the junction of the existing Ballyadam Road and Carrigane Road;

The infrastructure will also include shared cycling/pedestrian paths connecting the new road network with the planned Carrigtwohill to Midleton Inter-urban Cycle Route, areas of green open space, underground services including surface water drainage networks including detention ponds and attenuation, foul water networks, electrical and fibre optic/ telecoms ducting and water and gas supply. Services will be connected to existing services/ infrastructure in Carrigtwohill as required.

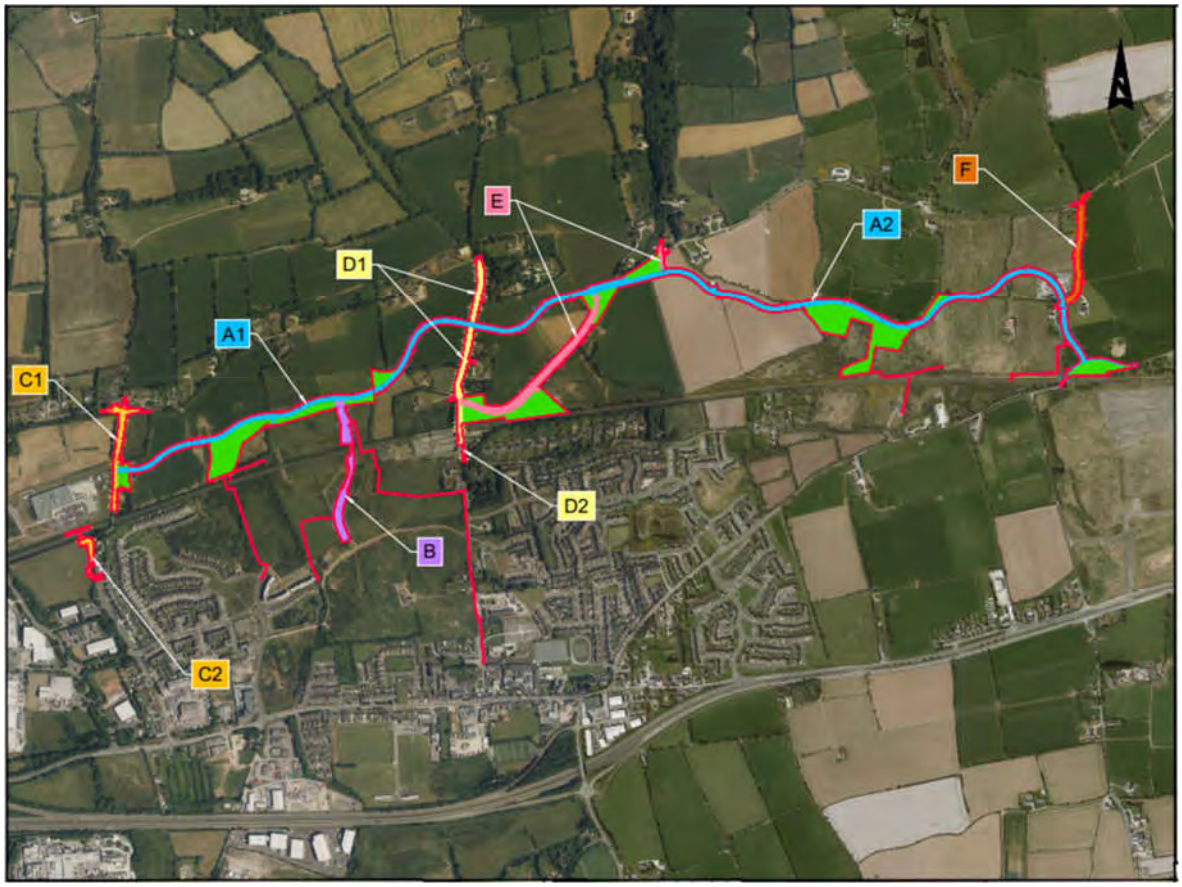


Figure 1-1: Carrigtwohill URDF Initiative - UEA Infrastructure

1.4 Report Structure

Section 2 of this report gives an overview of the study location and associated watercourses. Section 3 contains background information and initial assessment of flood risk. The hydraulic model is covered in Section 4. Site-specific mitigation measures are outlined in Section 5, while conclusions are provided in Section 6.

2 Site Background

This section of the report describes the site, including the relevant water courses and key hydraulic features.

2.1 Location

Carrigtwohill is a commuter town located 11km east of Cork City on the main Cork to Rosslare Europort N25 national route. The town has experienced extensive development in recent years, in part supported by the re-opening of the rail line with a new station in Carrigtwohill.

The proposed Carrigtwohill URDF Initiative - UEA Infrastructure site context map is shown in Figure 2-1 below.

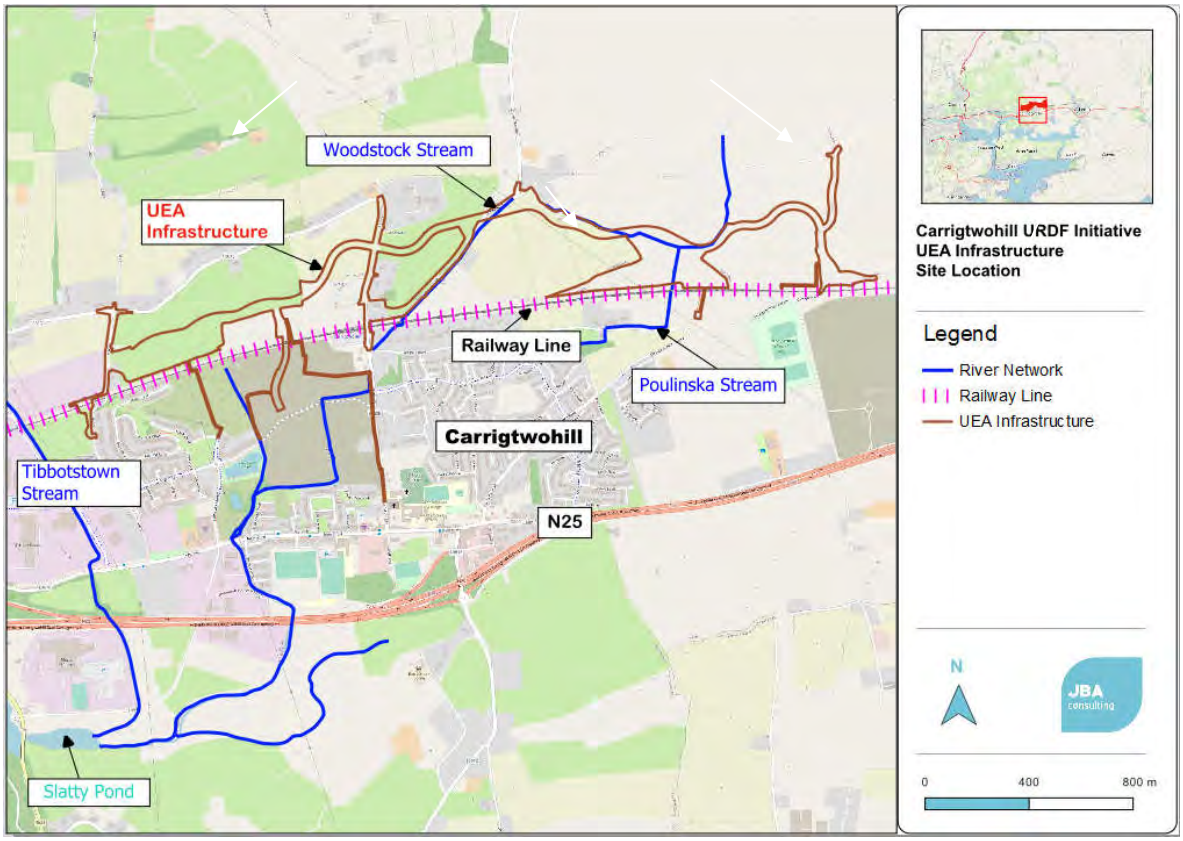


Figure 2-1: Site Context (UEA Infrastructure shown indicatively)

2.2 Site Topography

The terrain typically descends toward the railway from the north. To the south of the railway line, the landscape gently slopes in the direction of Slatty Pond. The area of the development has an elevation ranging between 5mOD-32mOD.

The Woodstock stream flows along the lowest topographical area north of the N25 (natural flow path).

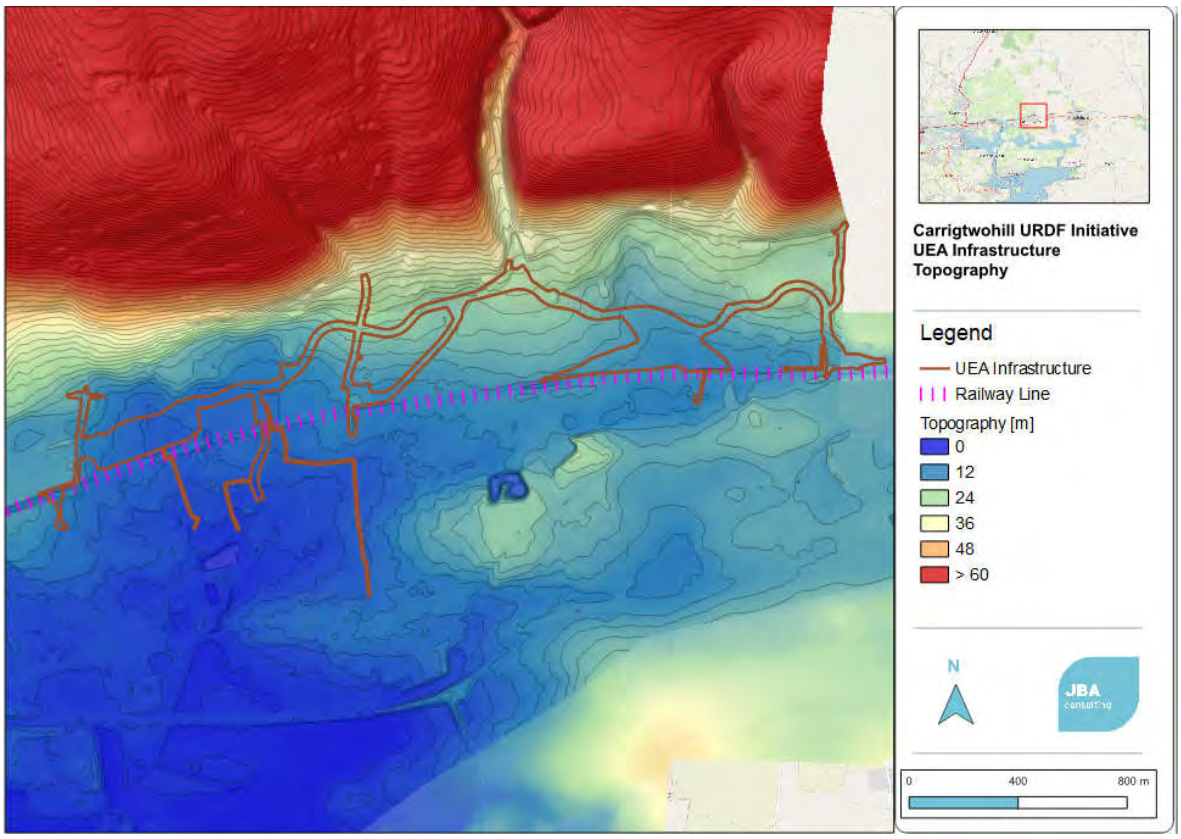


Figure 2-2: Carrigtwohill Topography (UEA Infrastructure shown indicatively)

2.3 Local Watercourses

2.3.1 Woodstock Stream

The course of the Woodstock Stream is shown in Figure 2-1. The stream meanders in a southwesterly direction, passing through the planned development area before flowing beneath the railway line. It continues its course across private residential properties, entering an extended culvert near the intersection of the railway station and Bog Road. The stream then traverses additional private land, flowing under Carrigtwohill Bridge and further downstream beneath the N25 road embankment, ultimately flowing into Slatty Pond.

The following photos give an indication of the general size and nature of the Woodstock Stream through Carrigtwohill.

Figure 2-3: Woodstock Stream - Upper Reach (left) & Middle Reach (right)

2.3.2 Poulinska Stream

The Poulinska Stream flows southward, approaching the proposed development area prior to passing beneath the railway line. It then discharges into a network of underground caves at Cúl Ard housing estate. It then flows in a westerly direction along the Bog Road, before turning southward and discharging into a network of underground caves.

Based on the hydrogeological surveys/studies undertaken to inform this project, it is understood the flow re-emerges further downstream, near Slatty Pond.

The following photos give an indication of the general size and nature of the Poulaniska Stream.

Figure 2-4: Poulaniska Stream - Upper Reach (left) & Lower Reach (right)

2.3.3 Tibbotstown

The Tibbotstown Stream flows through IDA lands to the west of Carrigtwohill UEA and Carrigtwohill Town Centre. It is located beyond the extent of the proposed development, to the west. To facilitate on-going development in the area this stream has been subject to modifications, i.e. inclusion of weirs, realignment.

The stream flows from North to South crossing under a local third-class road upstream of Gilead. From here the stream flows over 2 stone weirs, under an IDA culvert into a localised deep pond section before discharge into a 3 way flow split structure at the rail line. The flow is directed to a siphon under the rail line to continue downstream in an open channel, to a cascade leading into the

rail diversion channel and the remainder enters the IDA surface water drainage network and then re-emerges in the open channel further downstream.

Additional works undertaken in 2019 as part of the IDA Land Minor Works Scheme, involved the construction of new embankments, enlarged attenuation pond and associated control structures. This includes a 1.5m dia. overflow pipe from the Tibbotstown Stream to an attenuation pond constructed as part of the flood alleviation works, a storm water manhole, pipework and outfall to intercept the previous network downstream of the railway line, and replacement of the trash screen on the Tibbotstown Stream.

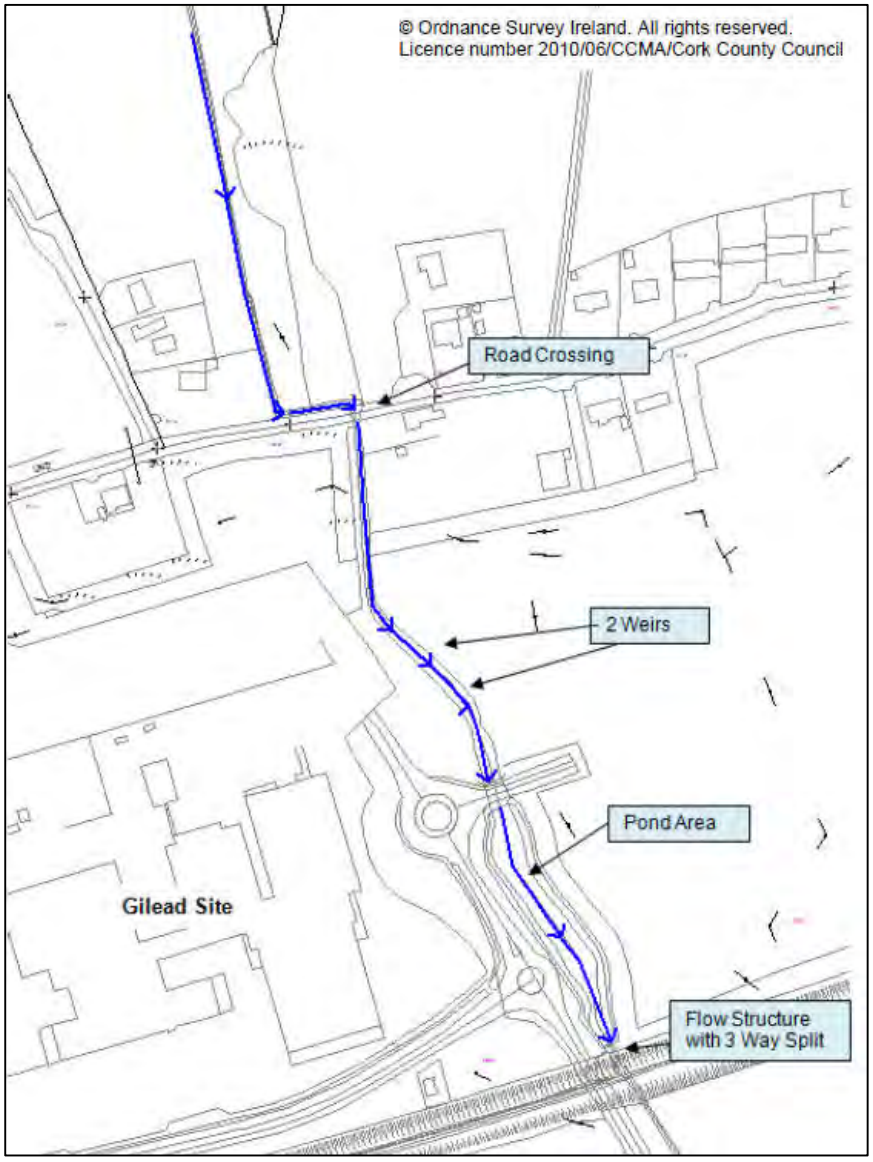


Figure 2-5: Tibbotstown Upper Reach[2]

2.3.4 Slatty Pond

Slatty Pond is located at the southern end of the catchment, as shown in Figure 2-6, being supplied by the Woodstock Stream and other watercourses before draining into Slatty Water. This pond was once part of the larger estuary but since the construction of Slatty Bridge, a large portion of land in the vicinity has been reclaimed for agricultural purposes.

Slatty Pump Station was constructed in recent years to address local concerns about rising water levels in the pond. This pump station pumps water from Slatty Pond to Slatty Water, the tidal estuary downstream of Slatty Bridge. Water also drains by gravity through 5 non-return valves at Slatty Bridge.

2 Source: Carrigtwohill Flood Risk Assessment, 2013

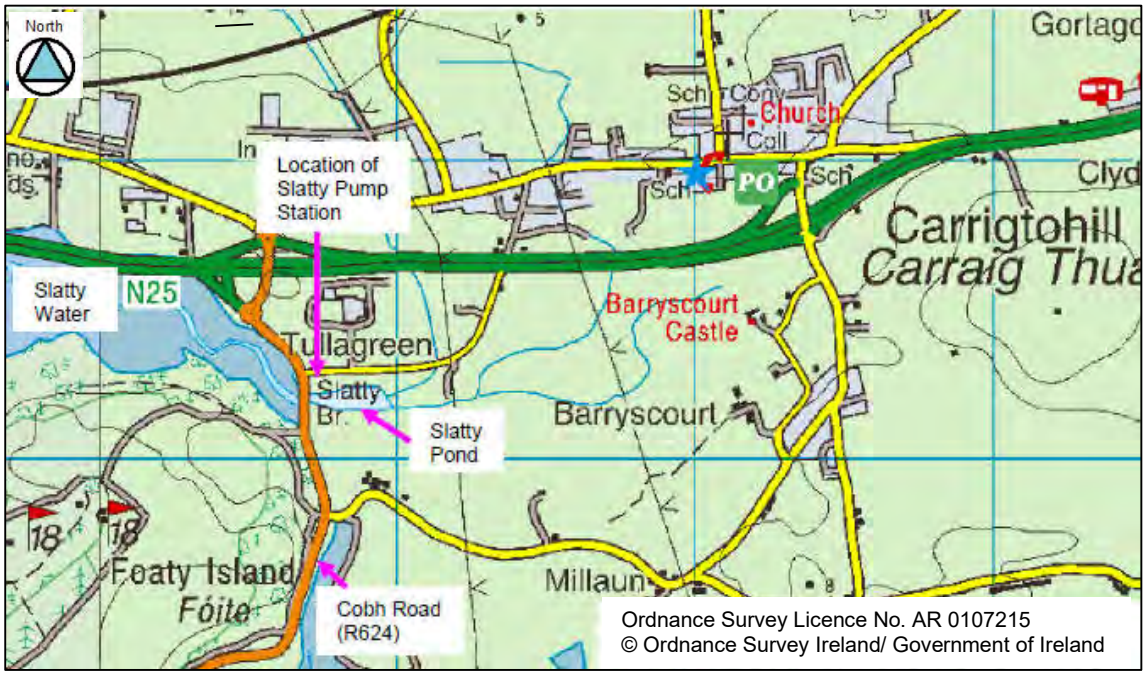


Figure 2-6: Slatty Pond[3]

3 Source: Carrigtwohill Flood Risk Assessment, 2013

2.4 Site Geology

To evaluate the site and surrounding area, the Geological Survey of Ireland (GSI) groundwater and geological data viewer was consulted. The analysis revealed that the primary bedrocks in the proposed development area, in a north-to-south direction, are the Cuskinny Member, Ballysteen Formation, and Waulsortian Limestone.

Regarding Quaternary sediments in the proposed development area, it can be observed in Figure 2.7 that Tills derived from Devonian sandstones are the predominant sediment type. The Gravels derived from Devonian sandstones occupy the western corner, while the northern boundary is bordered by Bedrock outcrops. To the south of the proposed development, Alluvium sediments are located, which may indicate past flooding events in the absence of any other records.

The groundwater vulnerability across the proposed development ranges from ‘Medium' to 'Moderate’, with a very small area classified as 'Extreme'. This classification is due to the proximity of the bedrock to the surface. At the site location itself the bedrock is not exposed; it is covered by predominantly hardstanding area which has a low permeability.

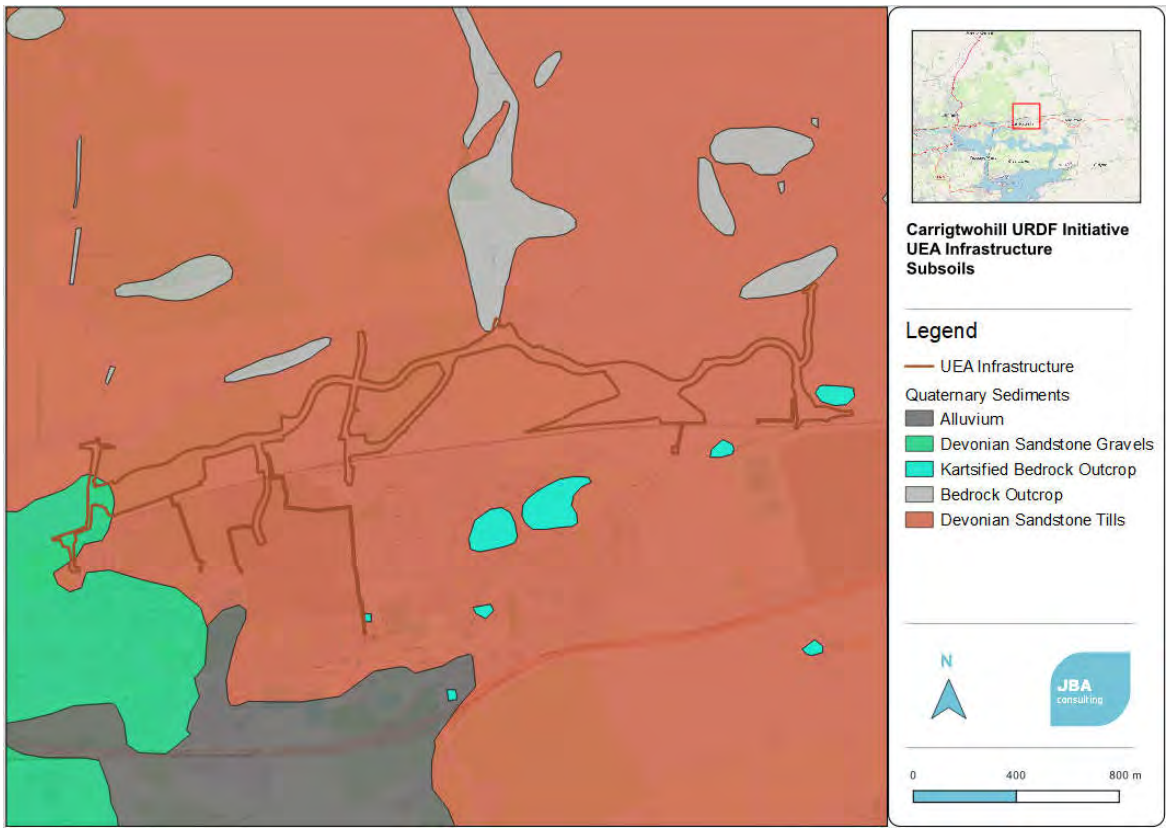


Figure 2-7: Quaternary Sediments (UEA Infrastructure shown indicatively)

3 Flood Risk Identification

To begin the process, an assessment of the potential and scale of flood risk at the site is conducted using existing and historical information. This identifies 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 is 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.floodinfo.ie, information from local residents and anecdotal evidence collated during a previous FRA study in Carrigtwohill in 2013.

3.1.1 Floodinfo.ie

The OPW host a national flood hazard mapping database that is now incorporated into www.floodinfo.ie, which highlights areas at risk of flooding through the collection of recorded data and observed flood events. There are two recurring flood events identified in the vicinity of Carrigtwohill. Both of these relate to the Turlough located in Ballyadam, 2.4km east of the proposed development area. This is related to groundwater flooding and links in with the findings of the hydrogeological assessment undertaken as part of the Carrigtohill FRA 2013. It is important to note however that other instances of flooding may have occurred in the past in the locality as the website depends on information being supplied to the OPW for inclusion.

3.1.2 Anecdotal Evidence

3.1.2.1-Carrigtwohill FRA, 2013

As part of an FRA carried out in Carrigtwohill in 2013, anecdotal evidence was collated from a number of local stakeholders including the community council, local landowners, IDA, Irish Rail and local authority personnel. A public consultation day was also held, to allow the general public highlight particular areas of concern in relation to flooding. Information collated from this process that is relevant to the proposed site is summarised in Figure 3-1. This indicates that there is a history of flooding in Carrigtwohill. Flooding has been reported to occur in the past as a result of blockage at culverts i.e. on the Bog Road and N25.

The Community Council highlighted concerns regarding flooding at Castlelake. Castlelake is situated approximately 400m south of the proposed development and it experienced severe flooding in 2009. The flooding was believed to have been aggravated by the installation of a temporary small culvert during the construction period.

The anecdotal evidence was found to correlate well with the predictive flood mapping produced as part of the Carrigtwohill FRA 2013.

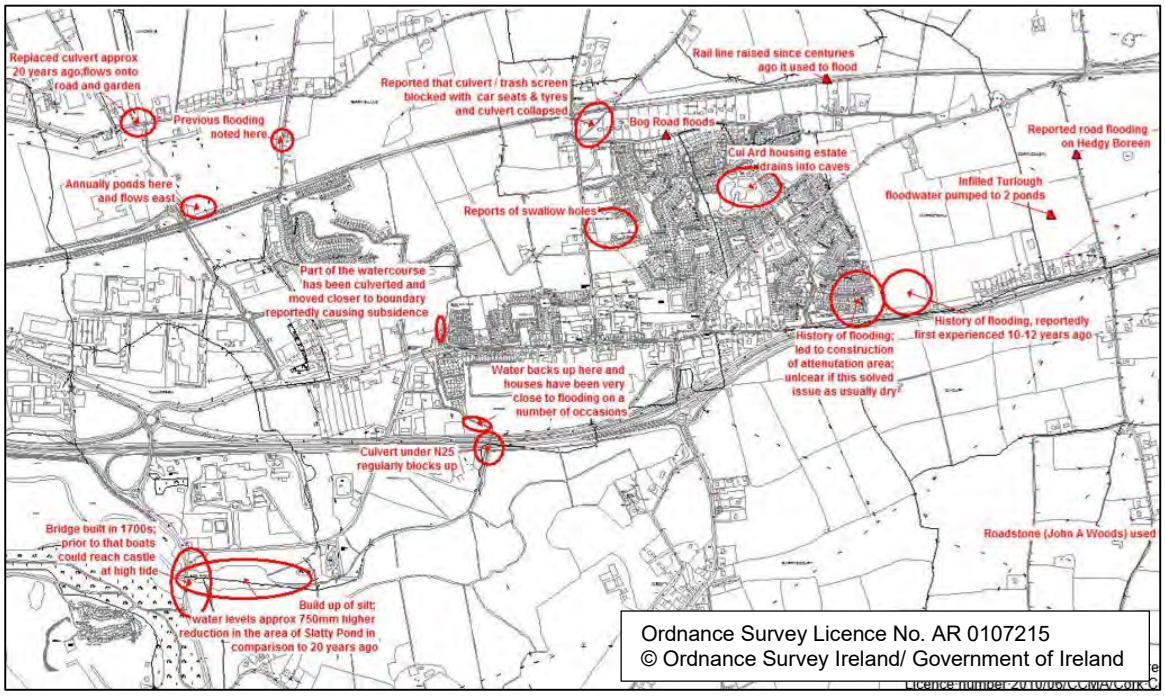


Figure 3-1: Summary of Anecdotal Evidence (Source: Cork County Council)

3.1.2.2-Local Residents

A video was provided by local residents, whose property is traversed by the Woodstock Stream, north of the railway line. The video shows flood waters flowing along the Leamlara road after the Woodstock burst its banks. The video was taken in October 2019 and they indicated that this was not the first time this has occurred. Figure 3-2 below shows the location of where the video was taken and also a screenshot of the flooding shown in the video.

Figure 3-2: Video showing Woodstock Flooding

3.1.3 Internet Searches

An internet search was conducted to gather information about whether the area had been flooded previously. There were no explicit mentions of properties within Carrigtwohill being flooded however there were records of road closures around the Carrigtwohill area found for various events.

3.1.4 Cork County Development Plan (2022-2028)

The Carrigtwohill area is encompassed by the Cork County Development Plan (CCDP) that was adopted in April 2022 and came into effect in June 2022. The aim of the CCDP is to inform development within the municipal district. The Carrigtwohill Plan map is shown in Figure 3-3 below. The proposed development transverses a number of zones - Residential, Open Space, Town Centre and Community.

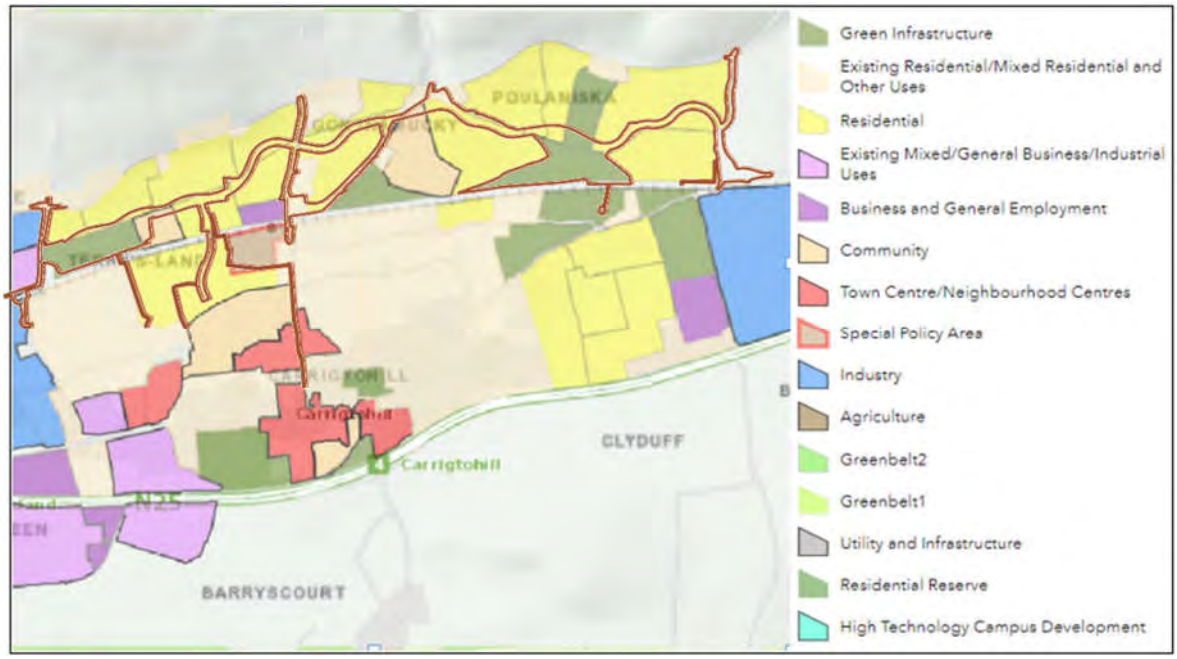


Figure 3-3: Cork County Development Plan - Land Zoning (UEA Infrastructure shown indicatively)

3.2 Predictive Flooding

The area has been subject to one predictive flood mapping/modelling study.

3.2.1 Cobh Municipal District Local Area Plan (2017)

Cork County Council appointed JBA Consulting to undertake a flood risk assessment study at Carrigtwohill, Co. Cork, in January 2012. The results of that study were used in the Cobh Municipal District LAP (2017). The JBA study follows on from the recommendations in the Lee Catchment Flood Risk Assessment and Management Study (CFRAMS) that a more detailed assessment of flood risk in Carrigtwohill is warranted "due to the nature of the watercourses, on-going development and work recently undertaken by Cork County Council.'' The following watercourses were modelled as part of the 2012 study;

- Killacloyne Stream
- Tibbotstown Stream
- Woodstock Stream
- Poulaniska Stream

Figure 3-4 identifies the areas at risk of flooding. The proposed development area is shown to be located mainly in Flood Zone C, with a small part in Flood Zone A on the western and southern corners.

The Cobh Municipal District Local Area Plan mapping was superseded by Cork County Development Plan (2022-2028).

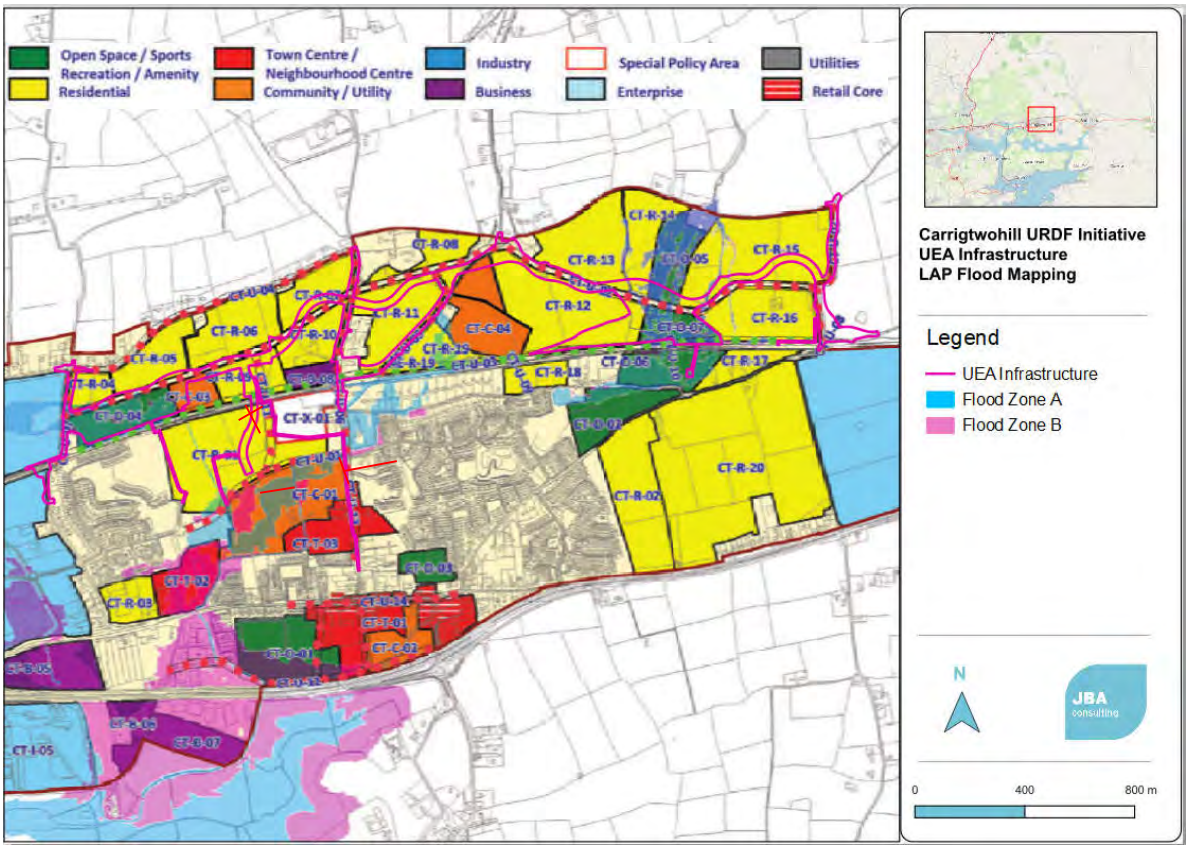


Figure 3-4: LAP Flood Zones (UEA Infrastructure shown indicatively)

3.2.2 Carrigtwohill Flood Relief Scheme

The preparatory work was originally commissioned in 2010 and the Carrigtwohill Flood Mitigation Scheme was completed in Autumn 2019. The works were undertaken at the IDA business park lands in Carrigtwohill.

The scheme involved the construction of new embankments on the Tibbotstown Stream north of the railway line, an enlarged attenuation pond and associated control structures, a 1.5m diameter overflow pipe from the Tibbotstown Stream to new attenuation pond, a storm water manhole,

pipework and outfall to intercept the previous network downstream of railway line, and replacement of the trash screen on the Tibbotstown Stream.

JBA Consulting was appointed to undertaken hydraulic modelling of the scheme. The resulting flood map is presented in Figure 3-5.

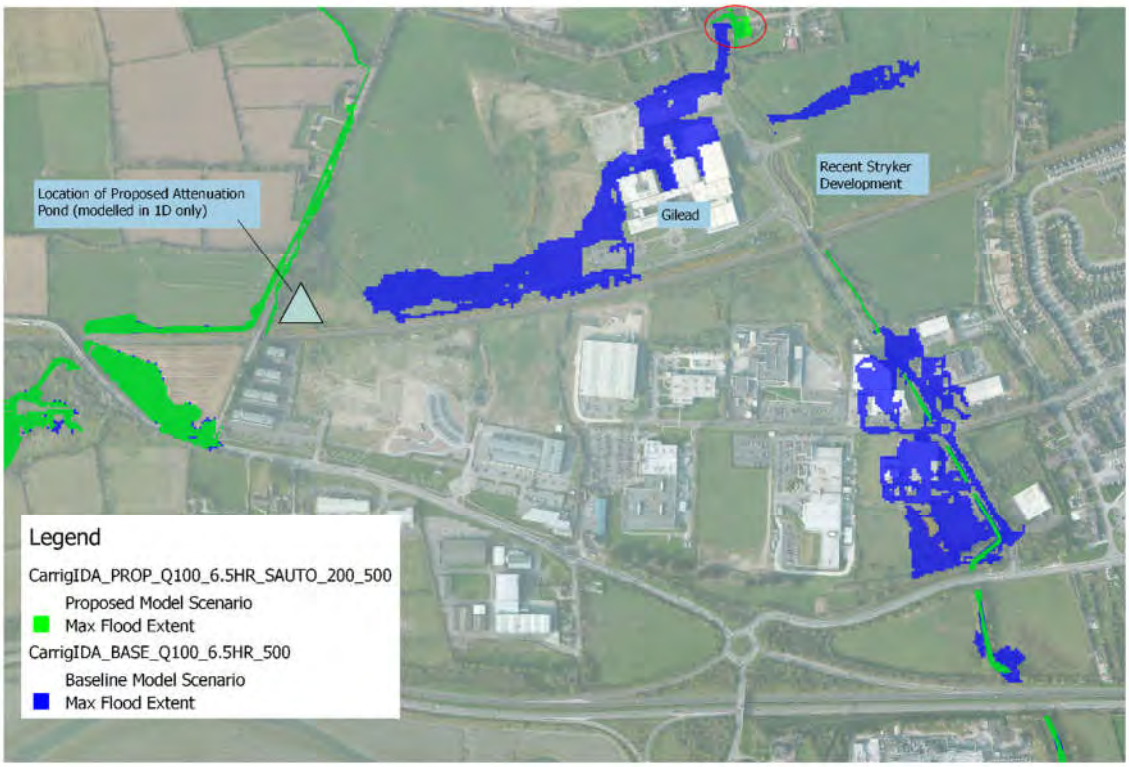


Figure 3-5: Pre & Post Scheme Flood Maps

3.2.3 Carrigtwohill Local Area Plan FRA 2012

JBA undertook a Flood Risk Assessment for the Carrigtwohill area in 2012. The aim of the study was to confirm the flood risk from the main watercourses in Carrigtwohill. Extensive hydraulic modelling was undertaken as part of the study and the resulting flood maps have been utilised in the Cobh Municipal District Local Area Plan (2017).

3.2.4 Cork County Development Plan (2022-2028)

The Cork County Development Plan Flood Map, illustrated in Figure 3-6, reveals that the western portion of the proposed development site lies within Flood Zone A. Additionally, the Woodstock Stream's overland flow during both the 1% and 0.1% AEP events (Flood Zone A/B) traverses the UEA property. These overland flows primarily follow the existing Leamlara Road and the adjacent lands to its north and south.

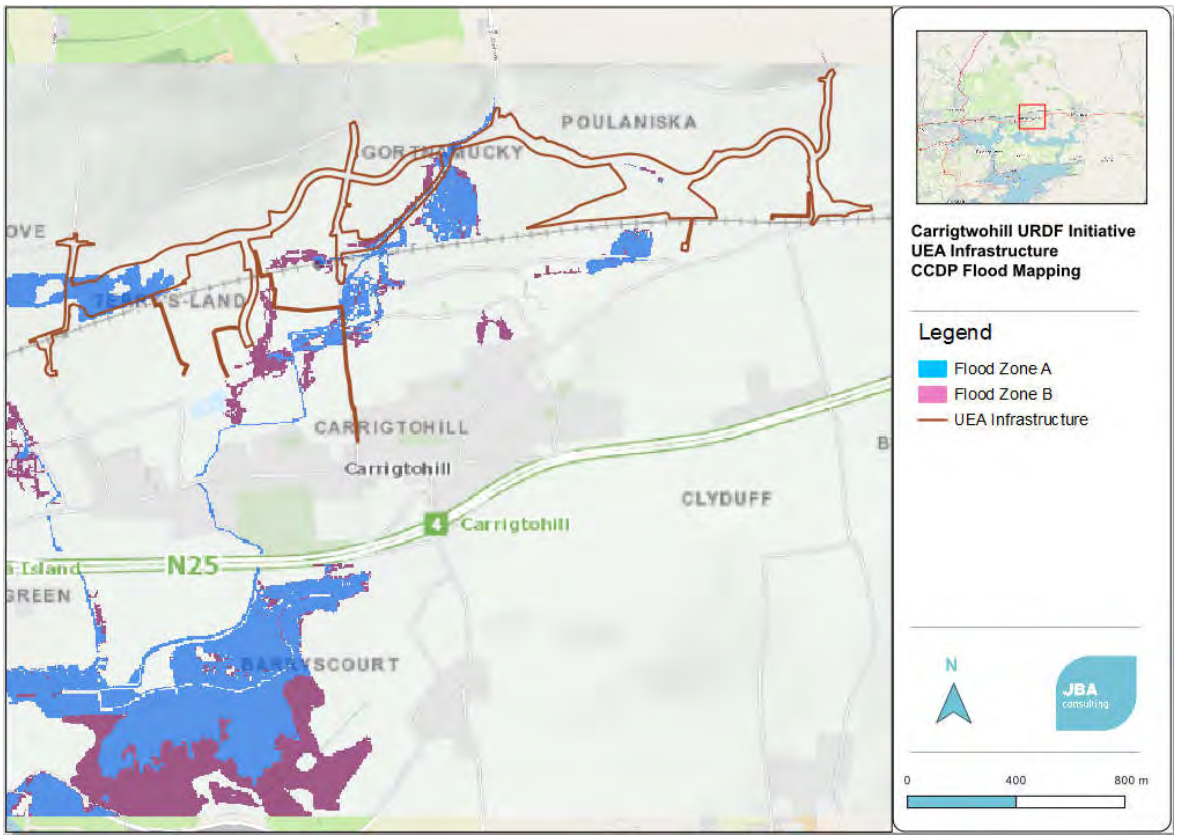


Figure 3-6: CCDP Flood Map (UEA Infrastructure shown indicatively)

3.3 Flood Sources

The potential flood sources in the wider Carrigtwohill area include fluvial, tidal, pluvial (surface water), and groundwater flooding.

3.3.1 Fluvial

Various sources were examined to determine past flooding in the area. A video provided by nearby residents whose property is located along the Woodstock Stream north of the railway line displays flood waters along the Leamlara road, highlighting potential flood risk within the site boundary.

The main sources of flood risk is provided from the Carrigtwohill Flood Risk Assessment completed by JBA in 2013 as part of the Carrigtwohill LAP and from the Cork County Development Plan (2022-2028). The Carrigtwohill FRA involved a detailed assessment of the watercourses that flow through Carrigtwohill, including Slatty Pond and its pump station at the downstream extent.

Review of the flood maps produced as part of the Carrigtwohill FRA confirms that a small area at the western corner of the proposed development is located in Flood Zone A, while the CCDP mapping shows the western corner and areas at the existing Leamlara Road to be located within Flood Zone A

To fully assess the fluvial risk in the region of the upgrades work, a hydraulic model was developed. This is discussed in detail in Section 4.

3.3.2 Tidal

The area of interest is a sufficient distance from the tidal downstream boundary. Therefore, tidal flooding has been screened out at this stage.

3.3.3 Pluvial/ Surface Water

Pluvial, or surface water, flooding is the result of rainfall-generated flows that arise before run-off can enter a watercourse or sewer. It is usually associated with high intensity rainfall. Flood risk from pluvial sources exists in all areas.

To fully assess the pluvial risk in the region of the proposed development, a rain on grid model was developed. This model was developed to provide indicative flow paths in the area but can also be used to highlight areas of potential pluvial flooding and also provide indicative flood depths. This is discussed in detail in Section 4.

3.3.4 Groundwater

Groundwater flooding results from high sub-surface water levels that impact upper levels of the soil strata and overland areas that are usually dry. The groundwater vulnerability across the proposed development ranges from ‘Medium' to 'Moderate’, with a very small area classified as 'Extreme'. Mitigation measures to reduce the groundwater risk are discussed in Section 5.2 below.

4 Flood Model Assessment

4.1 Hydrology

To assist in the estimation of potential flood risk to the proposed development area, this section provides flow estimates for the 1% and 0.1% AEP flood event flows expected along the watercourses that flow through the area of interest.

The flows for the model were calculated for a number of hydrological estimation points (HEPs), refer to Figure 4-1. HEPs were calculated along the Tibbotstown, Woodstock and Poulinska Streams. Flows were calculated using a range of flow estimation methods, but the FSU method was used for the design flows.

The flows were applied to the model by summing each of the lateral sub-catchments together for each watercourse and applying this to the point inflow flows at the upstream extent of each watercourse. Table 4-1 shows the 1% AEP flows to be applied to each watercourse based on this approach. This method ensures the lateral catchment areas are accounted for in the flows without the complication of deriving the lateral flows applying them along the watercourse.

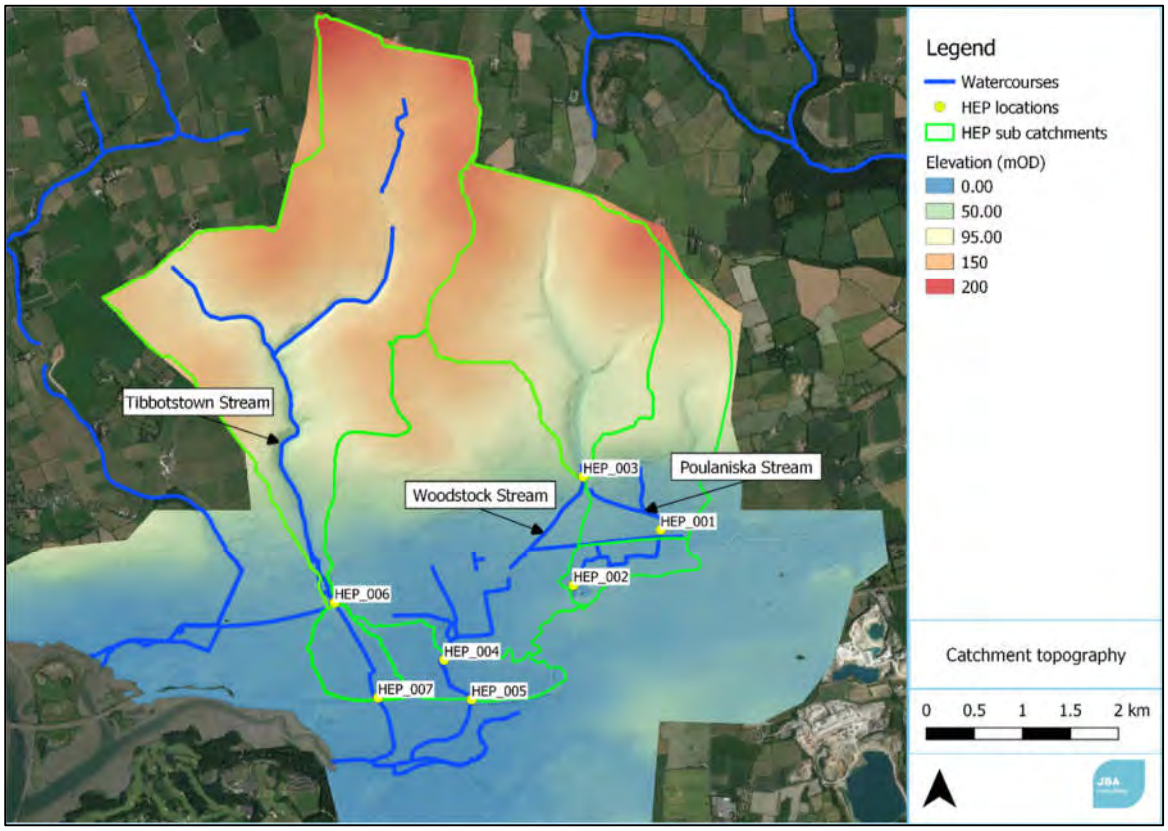


Figure 4-1: Catchments and HEPs

Table 4-1: Peak 1%AEP inflows for the three watercourse

Method	1%AEP flow (m^3/s)
Tibbotstown (HEP_006+HEP_007)	2.56
Woodstock (HEP_003+HEP_004+HEP_005)	5.07
Poulinska (HEP_001+HEP_002)	1.21

4.2 Hydraulic Model Set-Up

Due to the identified flood risk within the area, it was necessary to develop a hydraulic model to further define the fluvial flood risk to the proposed development. The model used to appraise the flood risk has been developed from the Carrigtwohill Flood Risk Assessment completed by JBA in 2013 on behalf of Cork County Council and OPW.

The hydraulic model was developed in Tuflow-Estry and used topographic river survey data acquired as part of the study. A rain-on-grid model was used to provide indicative flow routes in the area. The results of this model are also used to highlight low-lying areas along the UEA Infrastructure site area which would be prone to pluvial flooding and also provide indicative pluvial flood depths in these areas.

4.3 Model Results

4.3.1 Fluvial Results

4.3.1.1 Pre-Development

Figure 4-2 displays the results of the fluvial scenario for the pre-development condition, depicting the flood extents from both the 1% and 0.1% AEP events. Figure 4-2 illustrates overland flows during the 1% and 0.1% AEP events along the Woodstock Stream as it passes through the UEA lands. Overland flows are concentrated along the existing Leamlara Road and in the lands located to the north and south of it.

It's important to note that the flood extents presented in the figure reflect the 'existing' scenario in Carrigtwohill and are not a result of the proposed UEA infrastructure. The infrastructure layers have been overlaid onto the existing flood extents.

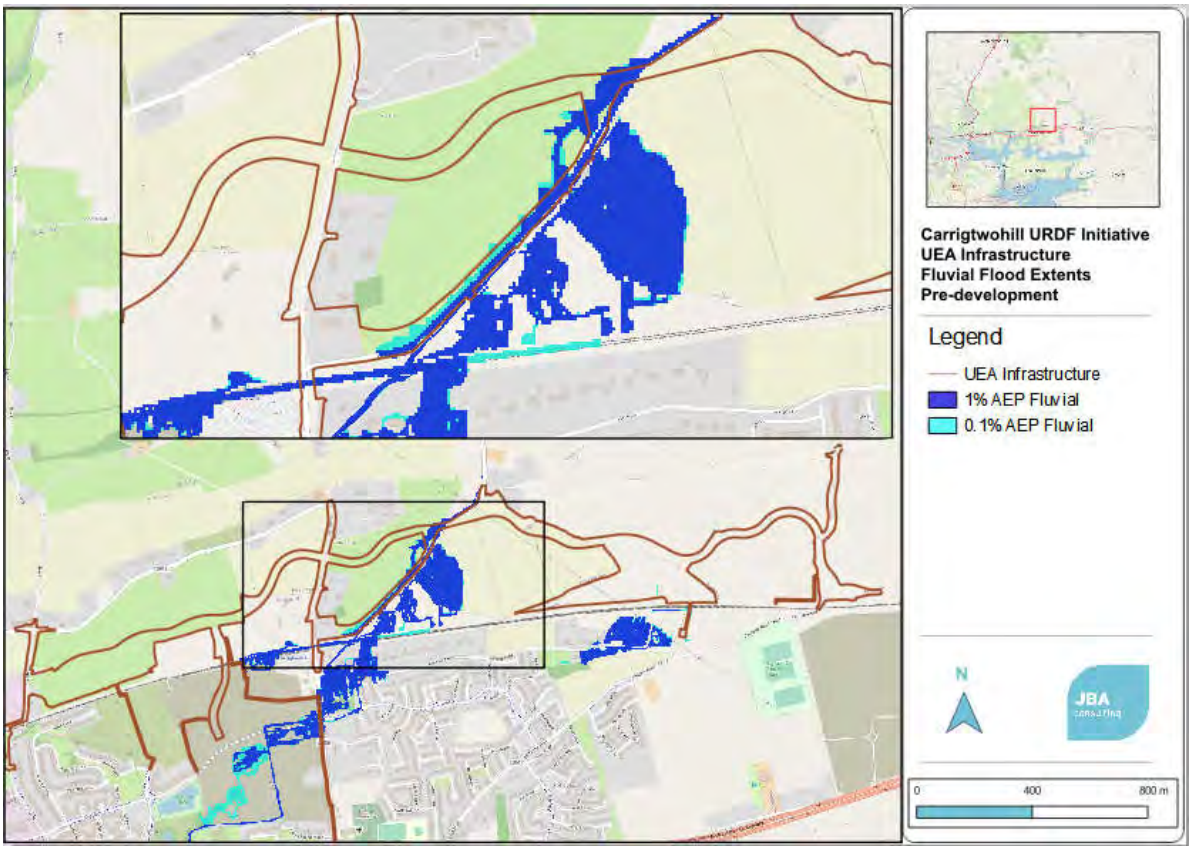


Figure 4-2: Fluvial Flood Extents - Pre-Development

4.3.1.2 Post-Development

The Post-development flood extents are displayed in Figure 4-3, with mitigation measures incorporated into the model. The mitigation measures include a proposed open channel which collects the overland flows and runs along the Corridor Link Road, culverts and a flow storage. The mitigation measures are discussed further in Section 5.

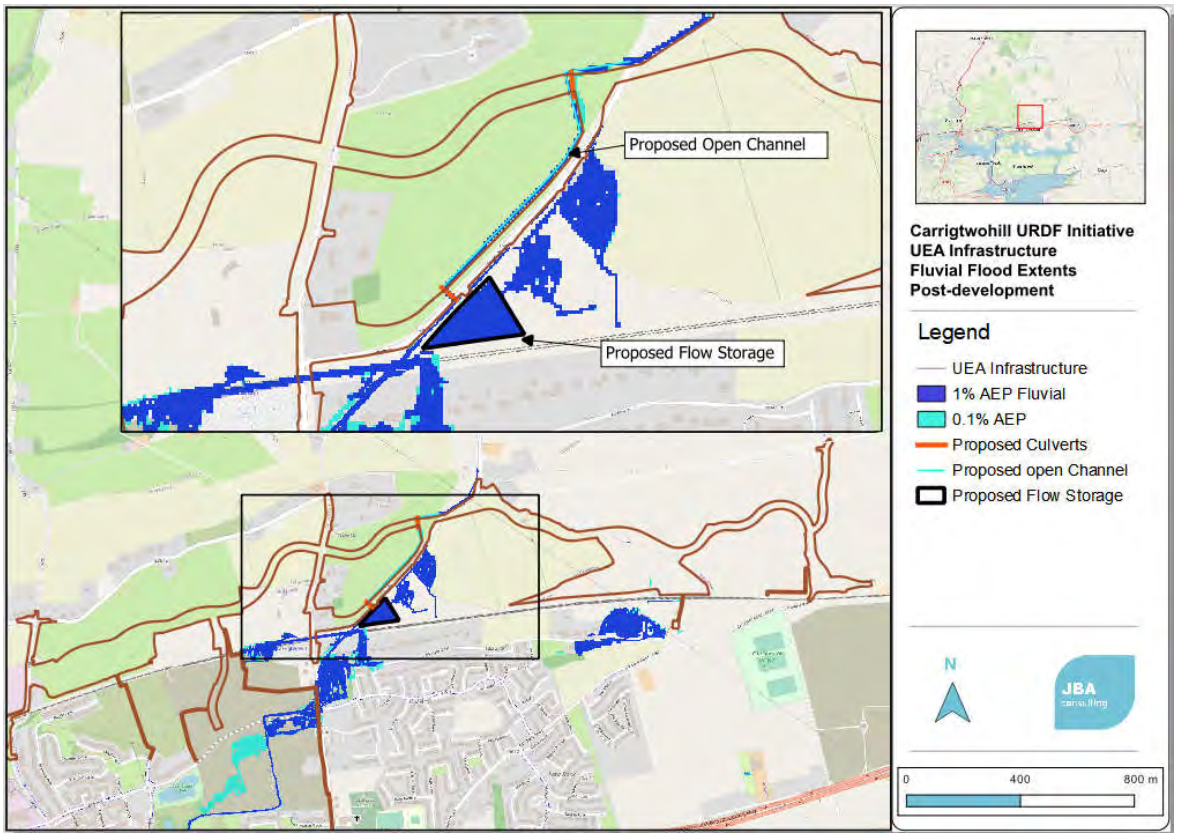


Figure 4-3: Fluvial Flood Extents - Post-Development

4.3.2 Pluvial Flood Extents - Post Development

Figure 4-4 presents the results of the pluvial scenario for the post-development condition, indicating the flood extents and depths resulting from the 1% AEP event. The figure also highlights the inclusion of 10 proposed culverts.

Furthermore, the proposed road is subjected to 200mm flood depths at four specific locations denoted by red polygons within Figure 4-4. The road has been raised by 300mm at these locations and a filter drain will be provided on the north side of this road to channel these flows across the road, to ground or to existing watercourses.

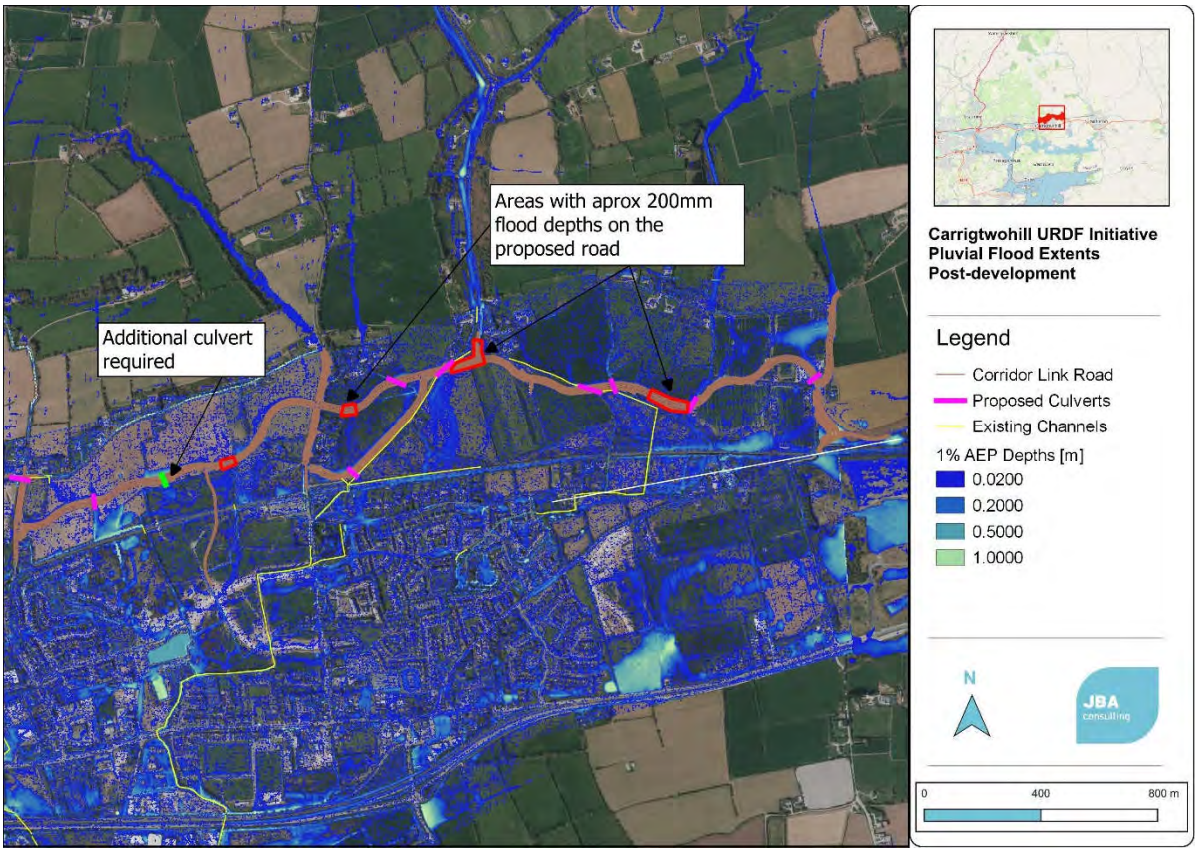


Figure 4-4: 1% AEP Pluvial Flood Extents

5 Flood Risk Assessment

5.1 Flood Risk

As discussed in Section 4-3.1, overland flows occur during the 1% and 0.1% AEP events within the middle section of the Corridor Link Road location. Specific mitigation measures are discussed in Section 5.2

5.2 Mitigation

The mitigation measures consist of the following:

- A proposed channel which collects the overland flows and conveys them downstream, along the Corridor Link Road. The channel is 1m in depth, 4m wide and collects 1.75m^3/s during the 1% AEP event;
- 2 culverts along the proposed channel under the Corridor Link Road, The proposed culverts will need to be designed to convey flows up to 1.75m^3/s without surcharging. Initial modelling suggest that a culvert size of 2.1m*0.8m will suffice;
- A flow storage that collects the overland flows, with an area of 6000m^2 and a minimum volume required of 3200m^3 for the 1% AEP event and 4000 m^3 for the 0.1% AEP event.

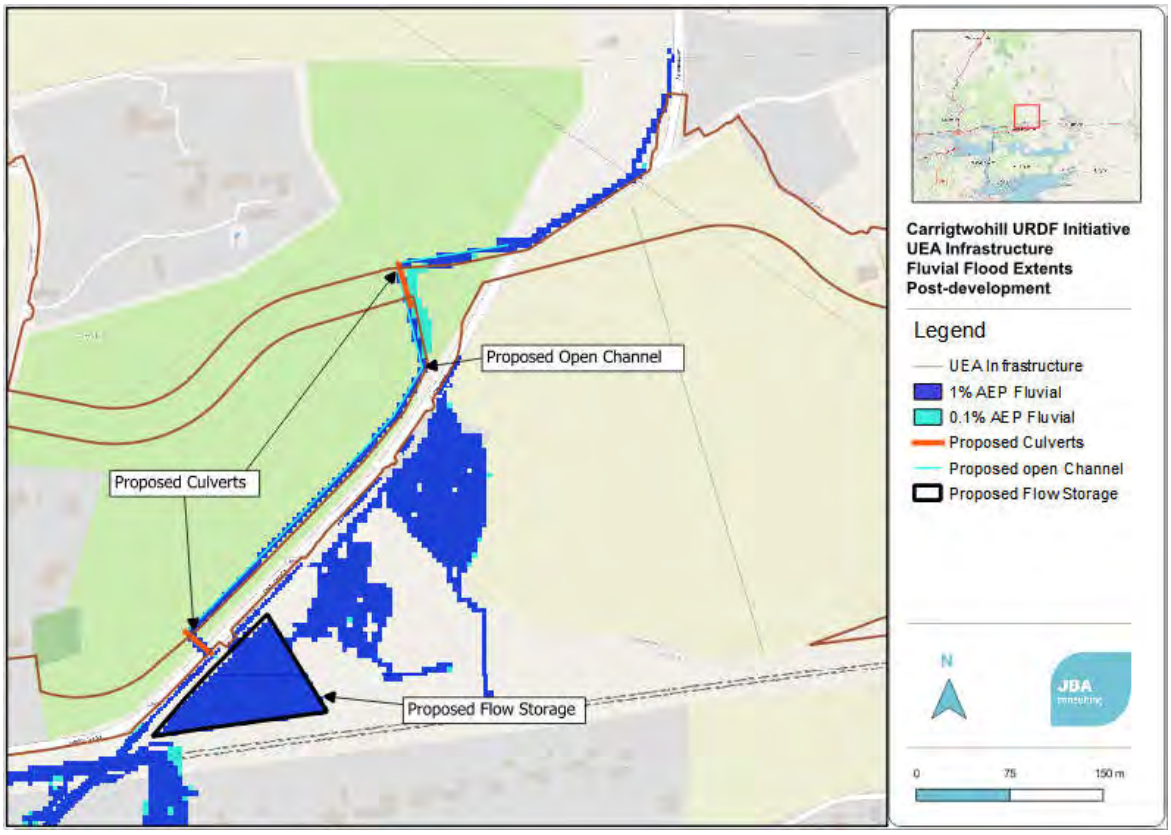


Figure 5-1: Mitigation Measures

5.3 Impacts

Figure 5-3 depicts the impacts of the proposed development, demonstrating that there is no increase in flood risk as a result of the proposed development. As expected, water level increases within the storage area, compared to the pre-development condition.

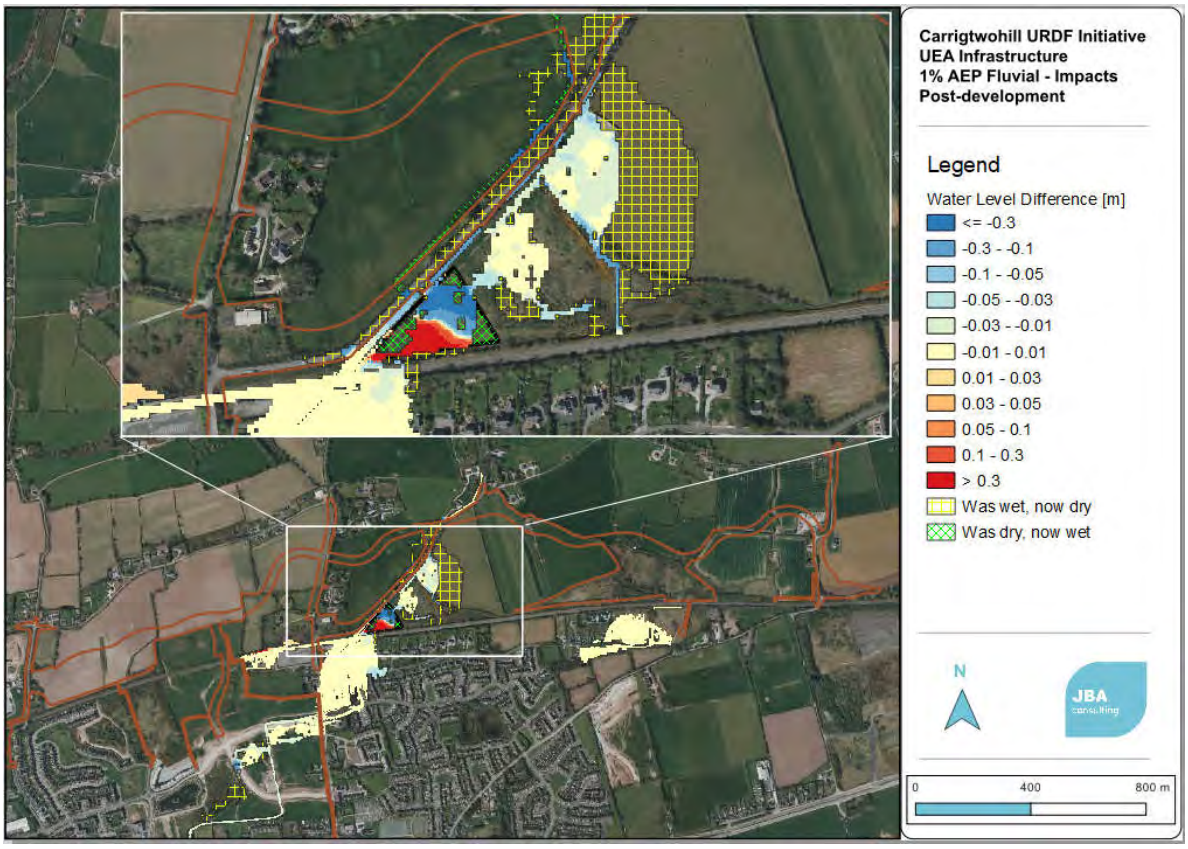


Figure 5-2: 1% AEP Fluvial - Impacts

5.4 Stormwater Design

A stormwater system will be provided for the Urban Expansion Area Infrastructure to manage the surface water flows. A pollution control is proposed, which incorporates various strategies to enhance water quality, including tree pits in road verges for initial rainfall interception and sediment filtering, filter drains in one network for debris removal before discharging into the Poulinska Stream, ponds with permanent treatment volumes in four networks to improve water quality before discharging into Woodstock and Poulinska Streams, an isolator row in Network 6's StormTech structure for easy debris removal, and bypass interceptors in all networks to ensure cleaner discharge into the streams.

The overall flow attenuation design approach is based on limiting surface water discharge to greenfield run-off rates, based on QBAR (or mean annual peak flow) from existing permeable areas where this does not require significant diversion of watercourses/ removal of hedgerows. The current run-off rates from existing impermeable road areas will also be reduced post-construction. This will result in a reduction in the total discharge rates, and associated impacts, following the construction of the proposed infrastructure to the Woodstock and Poulinska Streams respectively. Attenuation and flow restriction will be provided to ensure no increase in flood levels downstream. Surface water run-off from future development in the UEA will be required to be attenuated within development sites with discharge to downstream surface water drainage limited to QBAR.

5.5 Climate Change

The 1% AEP Climate Change (MRFS) event was tested to assess the long-term sustainability of the proposed development. The flood extents for the 1% AEP MRFS event are displayed in Figure

5-3, showing the proposed development is not at risk and the mitigation measure are effective including during the 1% AEP MRFS event.

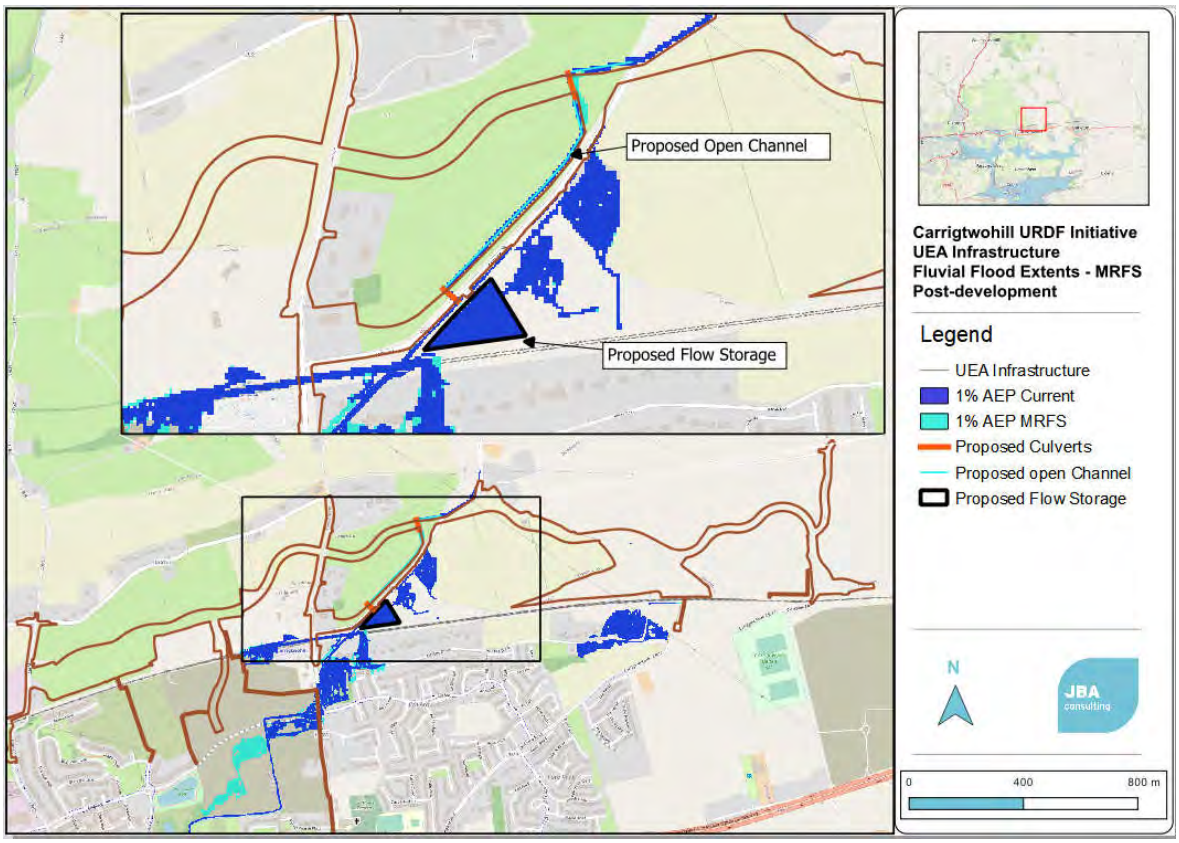


Figure 5-3: 1% AEP MRFS - Flood Extents

6 The Justification Test for Development Management

6.1 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.

The Justification Test for the development has been undertaken to demonstrate the development satisfies the planning Guidelines. The lands within Flood Zone A/B are classified as local transport infrastructure and are considered less vulnerable as indicated in Table 3.1 of "The Planning System and Flood Risk Management".

Under the Local Area Plan, the site traverses a number of lands zoned, such as Residential, Community and Green Infrastructure.

The specific aim of the development design is to place less vulnerable development outside of Flood Zone A. A Justification Test (JT) will be applied and passed in order to satisfy the Guidelines.

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

6.2 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.

Under the Cork County Development Plan 2022-2028, the UEA Infrastructure traverses lands zoned as residential, community and green infrastructure. As stated above it is considered that the proposed development complies with the land use zoning.

Conclusion: It has been outlined that the proposed development complies with the existing land use zoning.

6.3 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;

A detailed hydraulic model has been undertaken as part of the assessment of flood risk. Both the pre-development and post-development conditions at site were tested within the model and the results show there is no increase of flood risk elsewhere as a result of the proposed development. Additionally, a stormwater system will be included to manage surface water flows.

In summary, the works for the UEA Infrastructure does not increase flood risk elsewhere.

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

The aim of the works is to remain neutral regarding flood risk using appropriate mitigation measures to minimise flood risk to people, property, economy and environment.

(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.

The FRA has been undertaken to appraise the impacts on flooding resulting from the proposed development. The results confirm that the proposed infrastructure and associated mitigation measures will not result in an increased risk of inundation. The proposed development is not impacted during the 1% AEP and 0.1% AEP events, as such the emergency service access is retained.

(**iv) The development proposed will address 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.**

Refer to the supporting planning application documents for the wider planning objectives.

7 Conclusion

JBA Consulting has undertaken a detailed Flood Risk Assessment for the Carrigtwohill URDF Initiative - UEA Infrastructure at Carrigtwohill, Co. Cork.

The Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management' guidelines and confirms that the development is in agreement with the core principles contained within.

The town of Carrigtwohill has a history of flooding due to blockages at culverts and groundwater flooding in the nearby Turlough. The flood risk has been assessed using historical data, anecdotal evidence, and predictive flood mapping.

A hydraulic model was developed to assess the fluvial flood risk to the proposed development, The model results showed overland flows during the 1% and 0.1% AEP events along the Woodstock Stream, which pass through the UEA lands. Mitigation measures, including a proposed open channel, culverts, and flow storage have been incorporated into the model to address these risks.

The flood risk assessment shows that the proposed development, along with the mitigation measures, will not result in increased flood extents or flood levels.

The Flood Risk Assessment was undertaken in accordance with 'The Planning System and Flood Risk Management' guidelines and confirms that the development is in agreement with the core principles contained within.

Appendices

A Appendix - 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 years, a 1% AEP flood 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 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

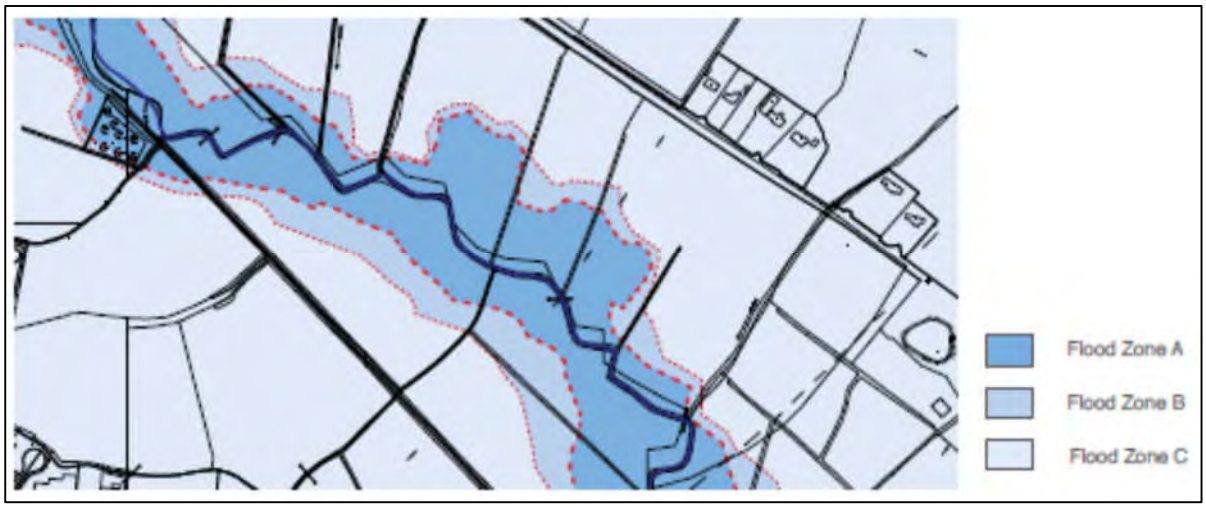
Return period (years)	Annual exceedance probability (%)
2	50
10	10
50	2
100	1
200	0.5
1000	0.1

A.2 Flood Zones

Flood Zones are geographical areas illustrating the probability of flooding. For the purpose of the Planning Guidelines, there are 3 types of 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 will be maintained in perpetuity.



A.3 Consequences of Flooding

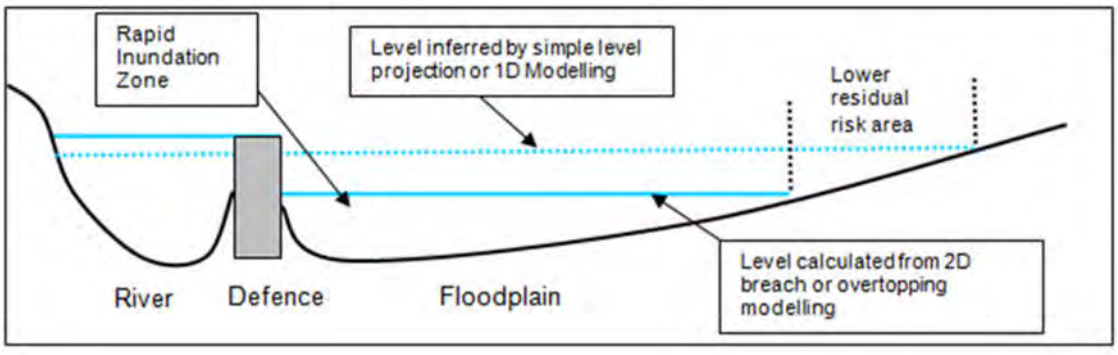
Consequences of flooding depend on the Hazards caused by flooding (depth of water, speed of flow. Rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure of the population, presence and reliability of mitigation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

The 'Planning System and Flood Risk Management' provides three vulnerability categories, based on type of development, nature, which are detailed in 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, such as changing rooms.
- **Water compatible**, including open space, outdoor recreation and associated essential infrastructure, such as changing rooms.

A.4 Residual Risk

The presence of flood defences, by their very nature, hinder the movement of flood water across the floodplain and prevent flooding unless river levels rise above the defence crest level or a breach occurs. This known as residual risk:



Offices at
Dublin
Limerick

Registered Office
24 Grove Island
Corbally
Limerick
Ireland

t: +353 (0) 61 345463
e:info@jbaconsulting.ie

JBA Consulting Engineers and Scientists Limited
Registration number 444752

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ISO 9001:2015
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Visit our website
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