CELBRIDGE HAZELHATCH MOBILITY CORRIDOR

Flood Risk Assessment Report

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1 INTRODUCTION

1.1 Background

Celbridge, located on the River Liffey in northern Kildare, is a key regional and commuter town for Dublin. Since the mid-20th century, its population has more than doubled, with over 70% living north of the river. The town is connected by a narrow, historic bridge, which creates traffic congestion, especially during peak hours.

To support ongoing development, particularly housing, a second crossing of the River Liffey and a link road to Hazelhatch Train Station are needed. The existing road infrastructure is inadequate, leading to severe congestion and potential air pollution. Hazelhatch Station is set to expand its capacity significantly under the DART+ Expansion Programme.

This scheme entails the construction of a new roadway, inclusive of cycling and pedestrian facilities, designed to connect Celbridge town with Hazelhatch Train Station, including the new bridge over the River Liffey as shown in **Figure 1-1**. The proposed roadway will facilitate access to Key Development Areas and educational lands situated south of the river, incorporating suitable junctions to interface with existing regional and local road networks.

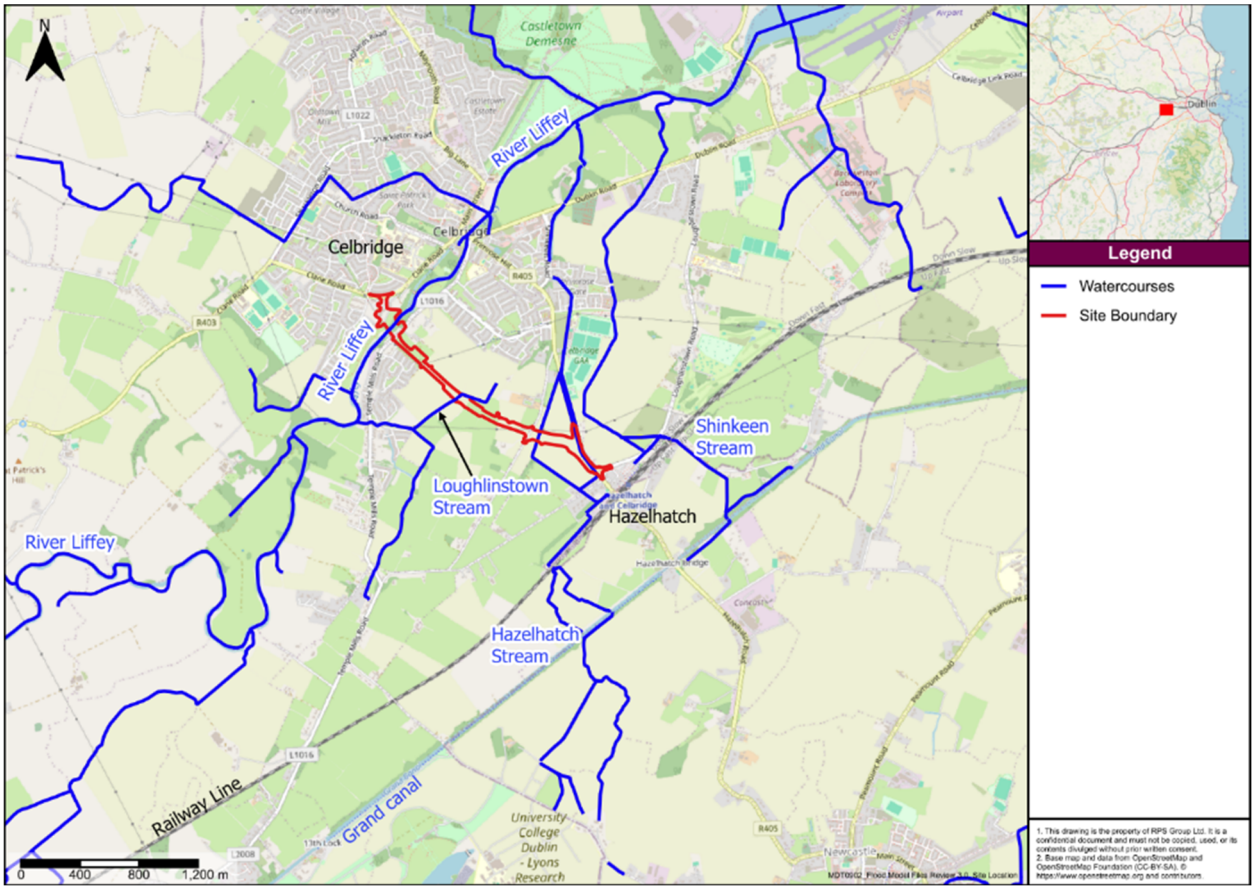

Figure 1-1 Site Location

1.2 Terms of Reference and Scope

Kildare County Council (KCC) has commissioned RPS to provide engineering and consultancy services for the Celbridge Hazelhatch Mobility Corridor (CHMC) Scheme which includes the requirement for a Site-Specific Flood Risk Assessment (FRA).

1.3 Flood Risk Assessment: Aims and Objectives

The proposed CHMC is required to undergo a Flood Risk Assessment under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009) (hereinafter referred to as “the Guidelines”).

This assessment aims to identify, quantify, and communicate to applicant, Planning Authority officers and other stakeholders the risk of flooding to land, property and people and the measures that would be recommended to manage the risk. This report will help guide and inform the design and planning of the potential development, with a view to obtaining a successful application.

The objectives of this report are to:

- Identify potential sources of flood risk,
- Confirm the level of flood risk and identify key hydraulic features,
- Develop appropriate flood risk mitigation and management measures which will allow for the long-term development of the infrastructure,
- Assess the impact of the proposed development on flood risk in elsewhere.

1.4 Proposed Development

The Proposed CHMC scheme commences at R403 Clane Road between the service station and the garden centre adjacent to Celbridge Abbey. It crosses the River Liffey and Newtown Road then heads in a south-easterly direction. It crosses Simmonstown Manor / The Drive between Simmonstown Lodge and Simmonstown Stud before connecting to R405 Hazelhatch Road. Then it continues along the R405 Hazelhatch Road to the roundabout at Hazelhatch Train Station. The scheme consists of mainline carriageway with cycle and pedestrian facilities connecting Celbridge town with Hazelhatch Train Station.

The proposed CHMC has 4no. waterway crossings, the River Liffey, 2 no. branches of the Hazelhatch River, and Loughlinstown Stream. The proposed CHMC incorporates an open span bridge at the River Liffey crossing, and culverts for the Hazelhatch River and Loughlinstown Stream. Each structural watercourse crossing has been sized in accordance with Section 50 of the 1945 Arterial Drainage Act and will be subject to OPW consent.

The objective for the proposed CHMC is to improve journey times, provide better and safer access for all road user types between Celbridge town centre and the Train Station, and facilitate future measures to reduce traffic congestion in the town centre.

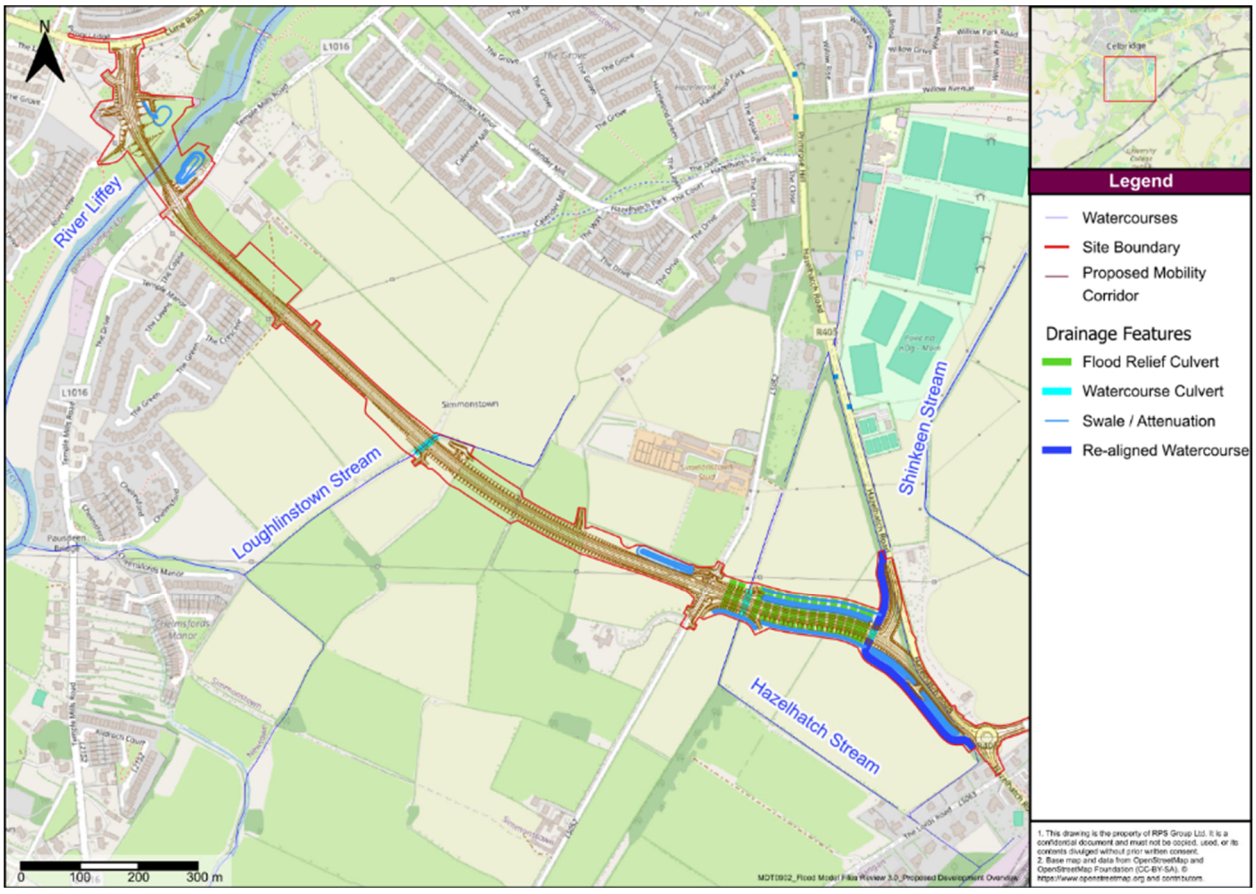

Figure 1-2 Proposed Development

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2 THE PLANNING SYSTEM AND FLOOD RISK MANAGEMENT

In September 2008 “The Planning System and Flood Risk Management Guidelines” (The Guidelines) were published by the Department of the Environment, Heritage and Local Government in Draft format. In November 2009 the adopted version of the document was published.

The guidelines give guidance on flood risk and development. The guidelines recommend a precautionary approach when considering flood risk management in the planning system.

Foremost, flood risk is a combination of the likelihood/probability of flooding and the potential consequences arising.

Flood Risk = Likelihood of Flooding x Consequences of Flooding

The assessment of flood risk requires the understanding of where the water comes from (i.e. the source), how and where it flows (i.e. the pathways) and the people and assets affected by it (i.e. the receptors). This is highlighted in **Figure 2-1** below which is extracted from the guidelines.

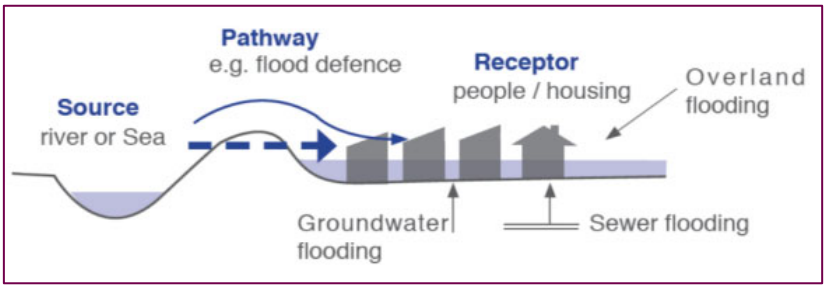


Figure 2-1 Sources, Pathways and Receptors of Flooding (Extract from PSFRM)

The core principle of the guidelines is to adopt a risk based sequential approach to managing flood risk and to avoid development in areas that are at risk (refer to **Figure 2-2**). The sequential approach is based on the identification of flood zones for river and coastal flooding.

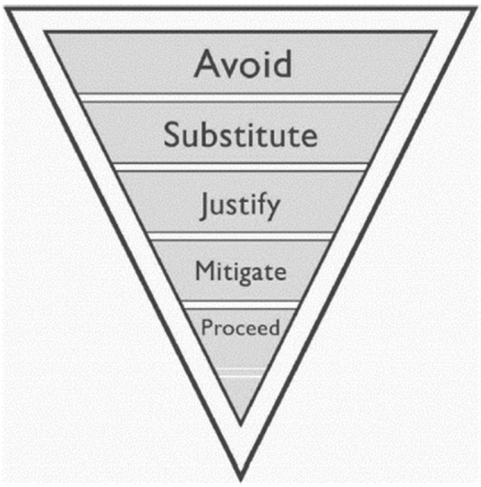


Figure 2-2 Sequential approach principles in flood risk management

The guidelines include definitions of Flood Zones A, B and C as noted below. It should be noted that these do not take into account the presence of flood defences, as risks remain of overtopping and breach of the defences.

Zone A (high probability of flooding) is for lands where the probability of flooding is greatest (greater than 1% or the 1 in 100 for river flooding and 0.5% or 1 in 200 for coastal flooding).

Zone B (moderate probability of flooding) refers to lands where the probability of flooding is moderate (between 0.1% or 1 in 1,000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1,000 and 0.5% or 1 in 200 for coastal flooding).

Zone C (low probability of flooding) refers to lands where the probability of flooding is low (less than 0.1% or 1 in 1,000 for both river and coastal flooding).

Once a flood zone has been identified, the guidelines set out the different types of development appropriate to each zone. Exceptions to the restriction of development due to potential flood risks are provided for through the use of the **Justification Test**, where the planning need and the sustainable management of flood risk to an acceptable level must be demonstrated as shown in **Table 2-1**. This recognises that there will be a need for future development in existing towns and urban centres that lie within flood risk zones, and that the avoidance of all future development in these areas would be unsustainable.

Table 2-1: Matrix of Development Vulnerability vs Flood Zone (Extract from The Guidelines)

	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

A three-staged approach to undertaking an FRA is recommended:

Flood Risk Identification (Stage 1) - Identification of any issues relating to the site that will require further investigation through a Flood Risk Assessment.

Initial Flood Risk Assessment (Stage 2) - Involves establishment of the sources of flooding, the extent of the flood risk, potential impacts of the development and possible mitigation measures.

Detailed Flood Risk Assessment (Stage 3) - Assess flood risk issues in sufficient detail to provide quantitative appraisal of potential flood risk of the development, impacts of the flooding elsewhere and the effectiveness of any proposed mitigation measures.

This report addresses the requirements for Stages 1 to 3.

2.1 Potential Sources of Flooding

When carrying out a flood risk assessment one should consider all the potential flood risks and sources of flood water at the site. Generally, the relevant flood sources are:

2.1.1 Coastal Flood Risk

Coastal flooding results from sea levels which are higher than normal and result in sea water overflowing onto the land. Coastal flooding is influenced by the following three factors which often work in combination: tides, storm surges, and wave action.

2.1.2 Fluvial Flood Risk

Fluvial flooding refers to flooding from rivers and streams. Fluvial flooding is the result of a river/stream exceeding its channel capacity and excess water spilling out onto the adjacent floodplain. The process of flooding on watercourses depends on a number of characteristics associated within the catchment including geographical location, and variation in rainfall, steepness of the channel and surrounding floodplain and infiltration rate of runoff associated with urban and rural catchments.

2.1.3 Pluvial Flood Risk

Pluvial flooding relates to flooding as a direct result of extreme rainfall. Pluvial flooding can occur during a rainfall event of extreme intensity. If the rate at which water falls on the ground is faster than the rate at which the water can make its way to the drainage network, then flooding will occur. This type of flood is also referred to as ‘ponding’ and typically occurs during summer months.

2.1.4 Groundwater Flooding

Groundwater flooding can occur during lengthy periods of heavy rainfall, typically during later winter/early spring when the groundwater table is already high. If the groundwater level rises above surface level, it can pond at local points and cause periods of flooding.

3 EXISTING SITE CHARACTERISTICS

3.1 Hydrology & Drainage

There are four watercourses of influence to the Site Area: The River Liffey, Hazelhatch River, Shinkeen River and Loughlinstown Stream

3.1.1 River Liffey

The River Liffey is one of the most prominent rivers in the east midlands of Ireland. The river originates in the Wickow Mountains, heading inland initially before sweeping its way north through County Kildare, then east towards Dublin, before discharging into the Irish Sea from the centre of Dublin City. The river flows through Celbridge at an elevation of about 40m above sea level, approximately 24km upstream of its outfall into the sea. Therefore, the hydrology at the site location is not subject to tidal influence. The catchment area of the River Liffey and its associated tributaries to Celbridge is approximately 837km^2. The extent of the River Liffey Catchment upstream of the site area is illustrated in **Figure 3-1**.

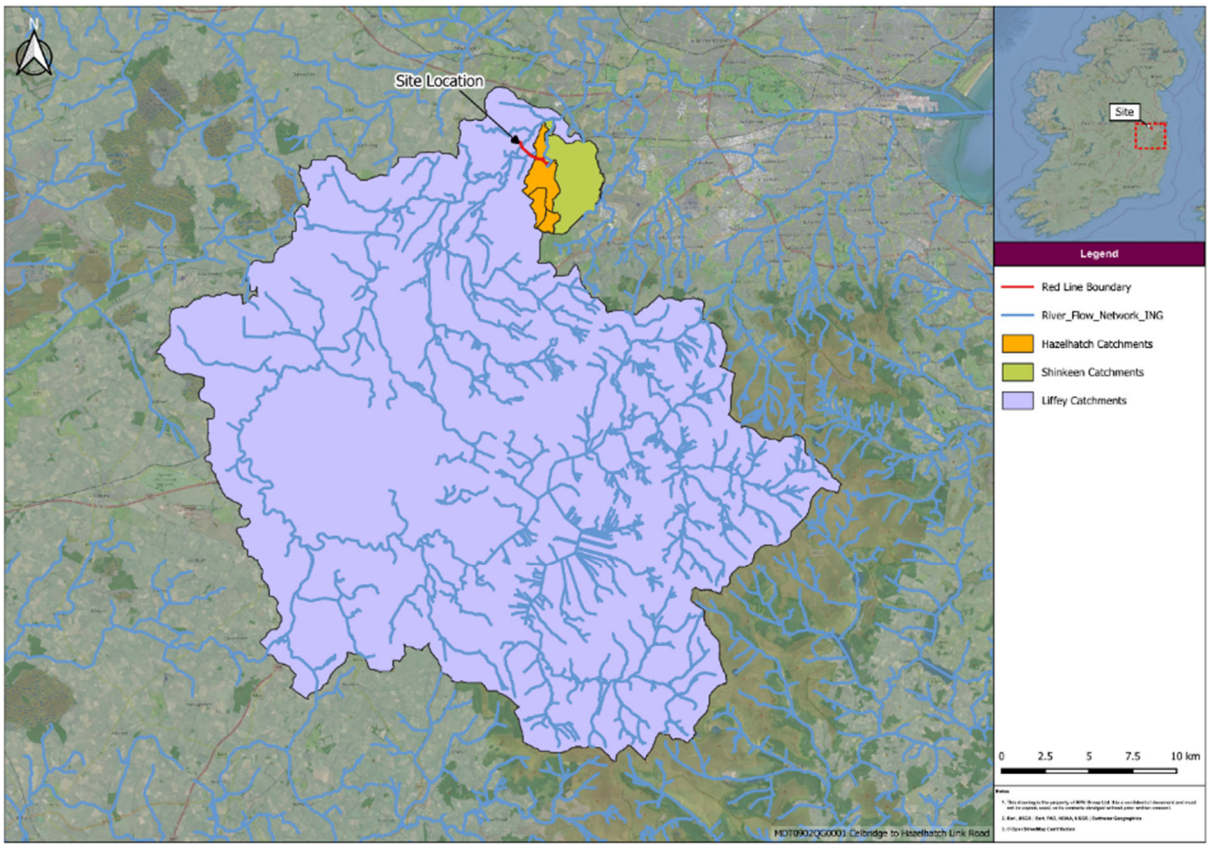


Figure 3-1 River Liffey Catchment Upstream of Study Area (https://opw.hydronet.com)

3.1.2 Hazelhatch River

The Hazelhatch River drains a catchment area of approximately 5.77km^2 and flows north-westwards from Lyons Road to the confluence with the River Liffey downstream of Celbridge. The Hazelhatch River catchment encompasses part of the Hazelhatch Railway Station as well as the urbanised area of Hazelhatch. It is noted that quite a significant impact to hydrology in the area is the presence of the Cork-Dublin railway line, which cuts across the catchment area just 100m upstream of the proposed Celbridge Hazelhatch Mobility Corridor. The catchment land use is mostly agricultural with non-irrigated arable land and pastures making up most of the catchment. The lower catchment, downstream of the proposed CHMC is the only area with an urban landscape. The extent of the Hazelhatch River catchment is shown in **Figure 3-2**.

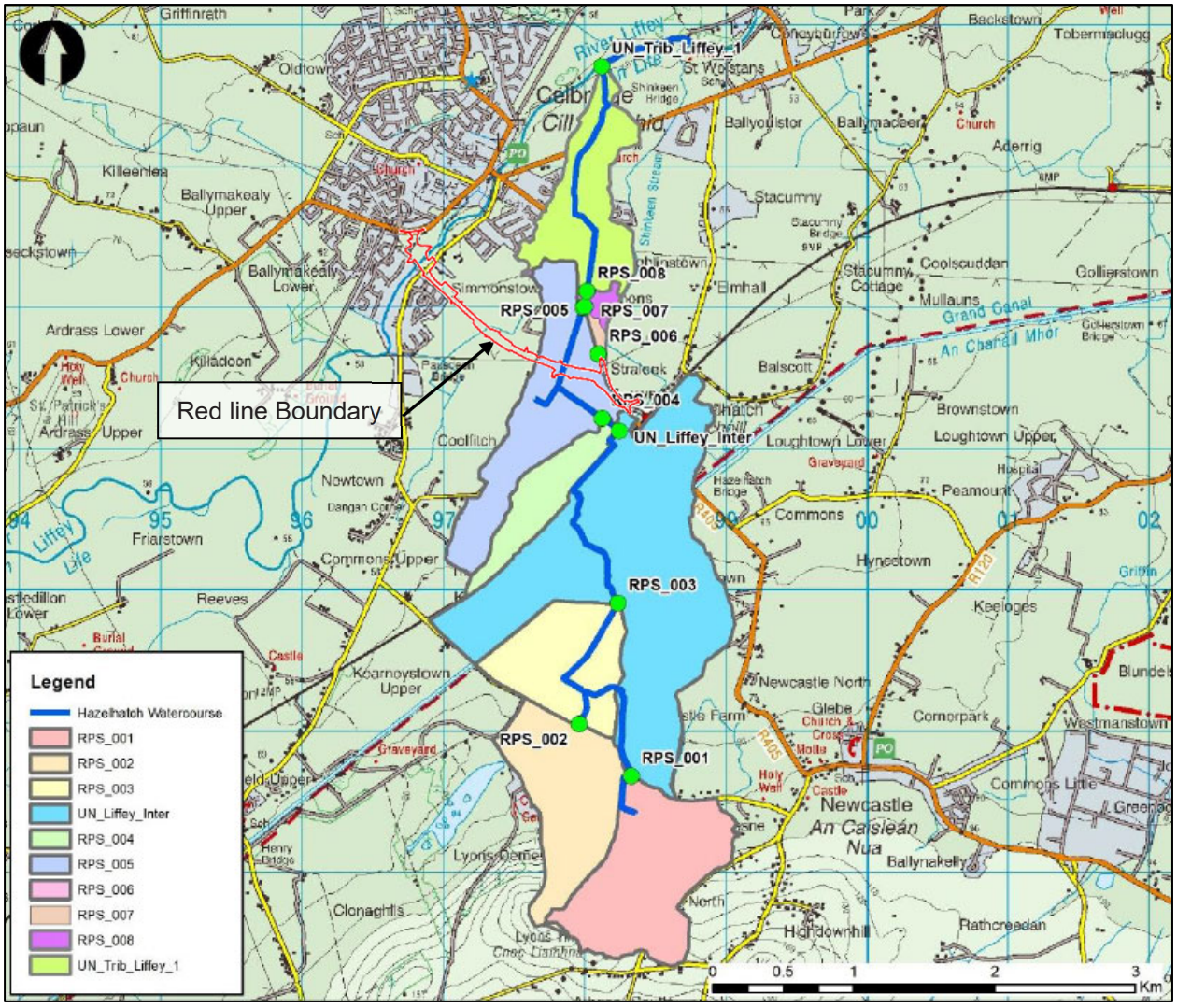


Figure 3-2 Hazelhatch River Sub-Catchments (Obtained from Hazelhatch Flood Study)

3.1.3 Shinkeen River

The Shinkeen River drains a catchment area of approximately 12.66km^2 and is adjacent to the Hazelhatch River catchment. This watercourse flows north-westwards from the urbanised area of Newcastle to the confluence with the River Liffey downstream of Celbridge. The Shinkeen River catchment includes part of the Dublin – Cork Railway and the Grand Canal. The catchment land use is mostly agricultural with non-irrigated arable land, pastures and complex cultivation patterns. The main urban landscape is the village of Newcastle which is found in the upper catchment. The extent of the Shinkeen River catchment is shown in **Figure 3-3**.

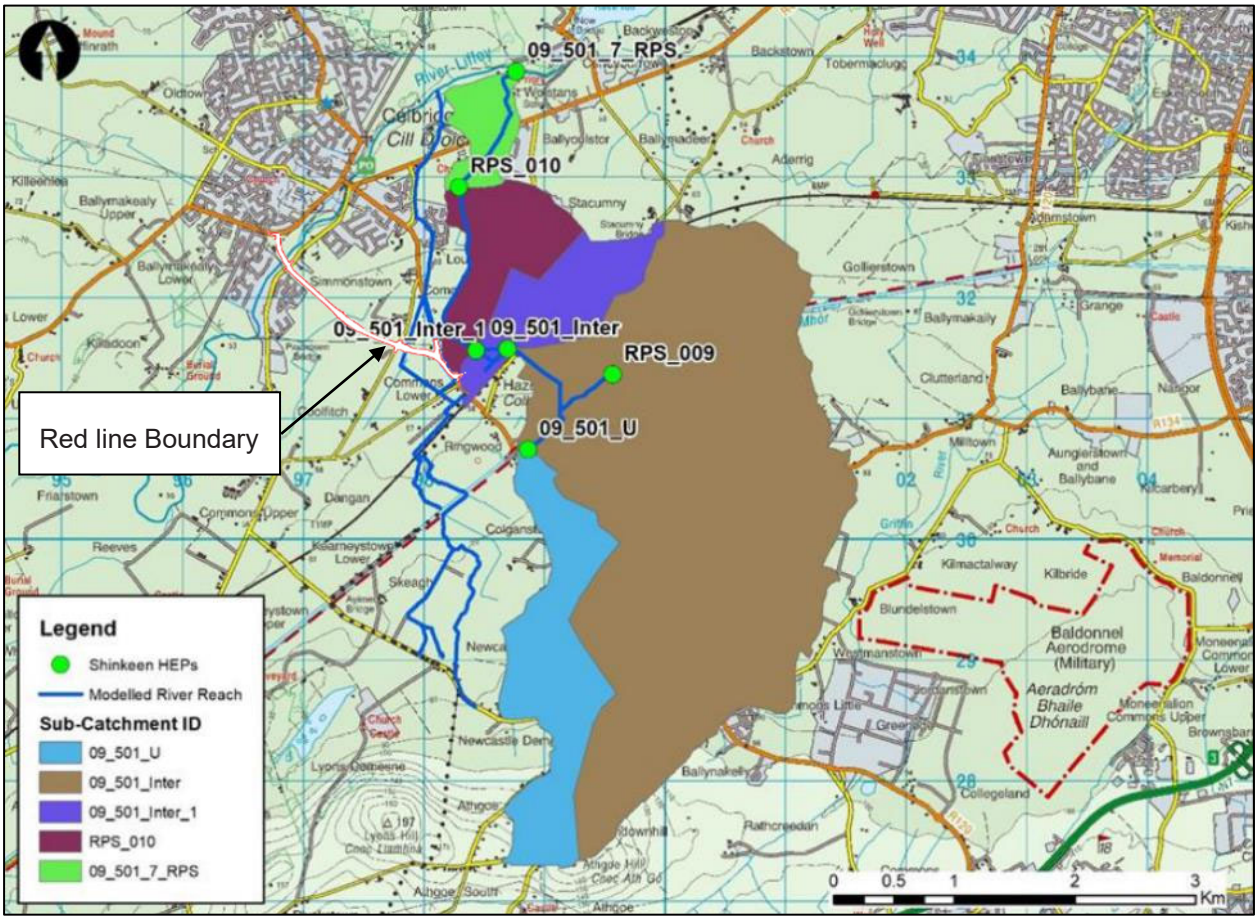


Figure 3-3 Shinkeen River Sub-Catchments (Obtained from Hazelhatch Flood Study)

3.1.4 Loughlinstown Stream

A local watercourse, referred to as Loughlinstown Stream also crosses the alignment of proposed CHMC. As shown in **Figure 3-4**, the watercourse originates in the townland of Simmonstown, 350m to the northeast of the proposed CHMC intersection and runs through a rural area from north to south before discharging to the River Liffey 700m to the southwest. The stream consists primarily of open channel but is culverted downstream under existing local roads and field accesses. The estimated size of the channel is 1.0m to 2.0m wide at its base and 1.0m to 1.8m deep. The catchment size for this stream, upstream of the proposed CHMC, is 0.36km^2 derived using the 1:50,000 Discovery series contour maps and planned drainage scheme.

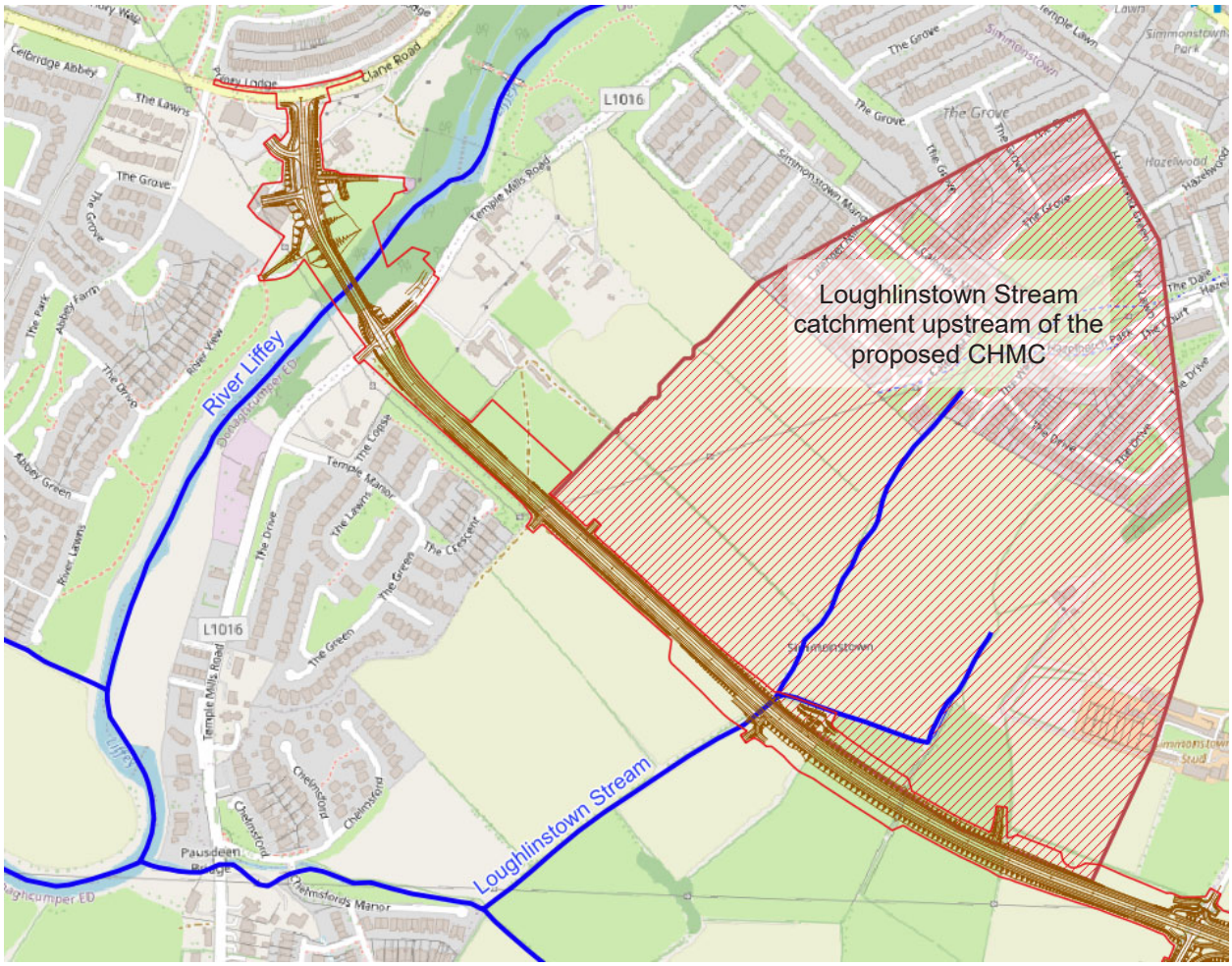


Figure 3-4 Loughlinstown Stream Catchment

3.2 Topography

The topography in the vicinity of the subject site is flat to undulating with slight rises between each watercourse. Across the entire site there is only a level difference of 10m, ranging from approximately 50mAOD to 60mAOD as shown in **Figure 3-5**. The Hazelhatch Stream is particularly flat upstream of Celbridge with a wide open floodplain in the vicinity of the proposed Mobility Corridor alignment.

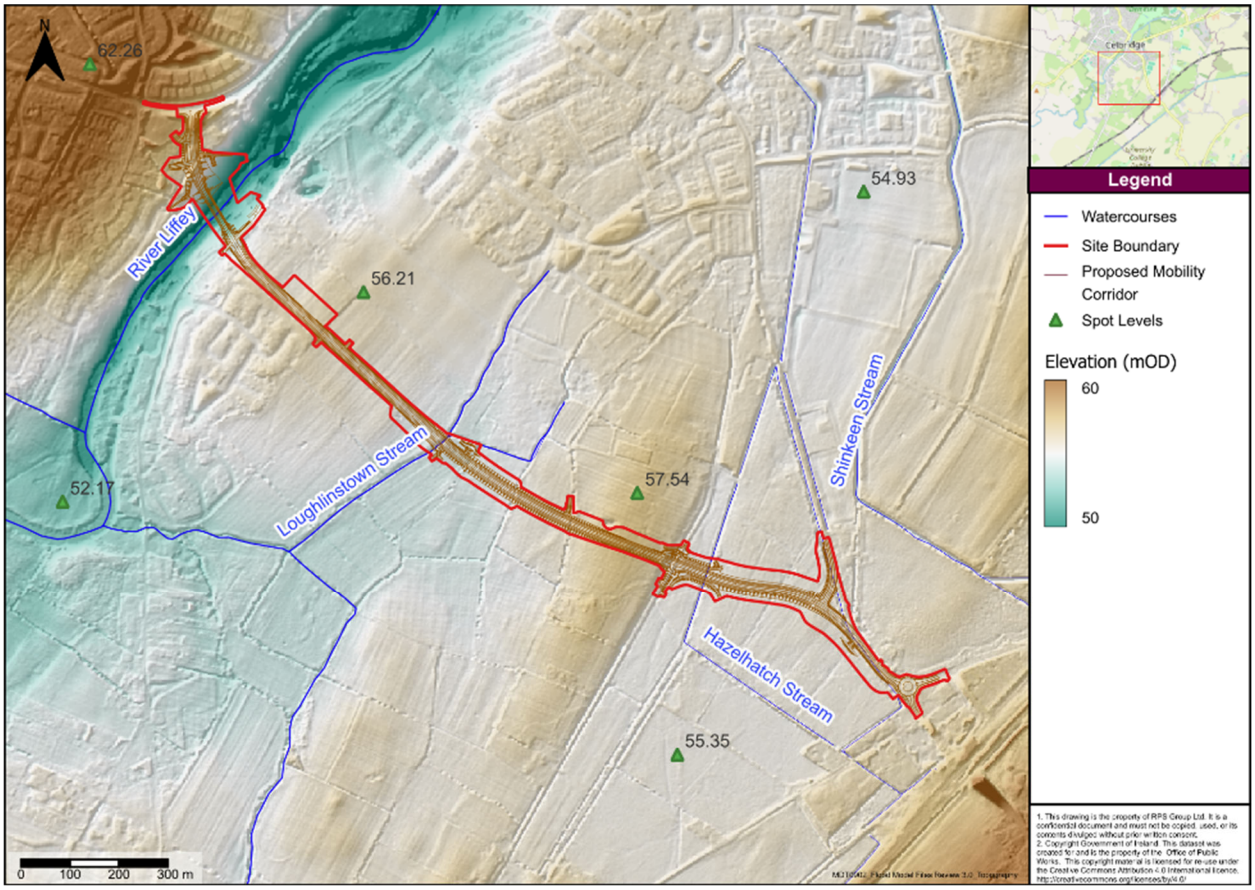


Figure 3-5 Site Topography

3.3 Geology

According to the GSI database, the bedrock at the site is described as *dark- fine-grained, occasionally cherty, micritic limestones*, with subsoils of *shale derived from metamorphic rock*. Groundwater vulnerability is noted as being moderate to high as seen in **Figure 3-6**, with rock close to the surface, indicating a shallow water table.

The site is underlain by the Lucan Formation and there are no karst features present at the site. The soils present at the proposed site are predominately Straffan soils as seen in **Figure 3-7** which are a combination of deep well drained, mainly basic mineral soils (BminDW) from the grey brown podzolics and brown earths soil group and poorly drained, mainly basic mineral soils (BminPD) from the surface water gleys and groundwater gleys soil group.

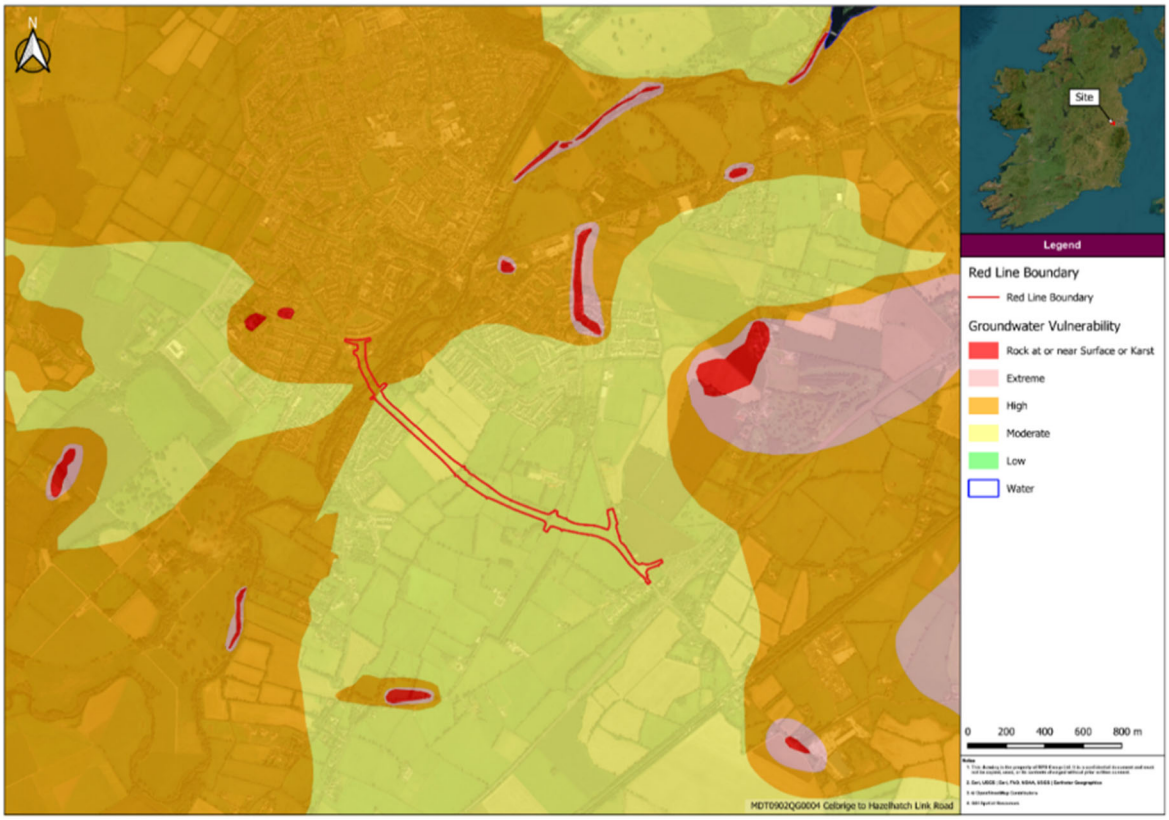


Figure 3-6 GSI Groundwater Vulnerability

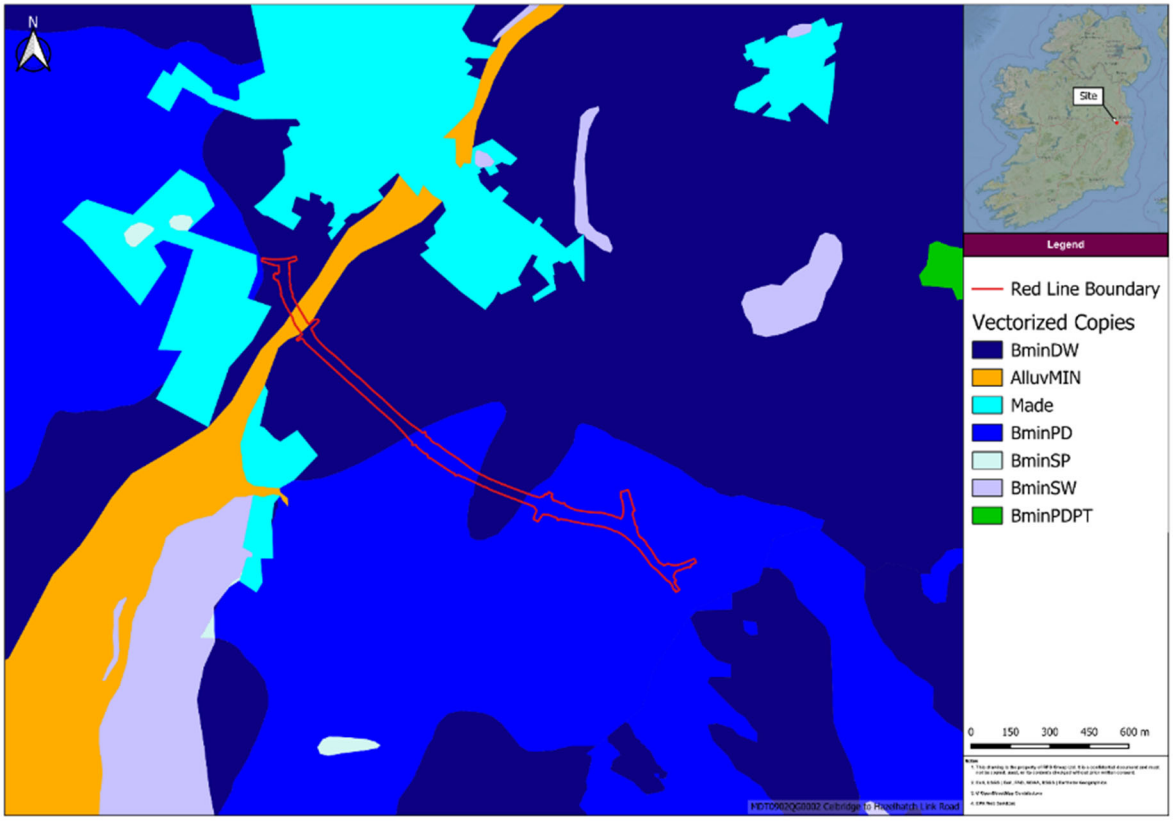


Figure 3-7 GSI Soil Geology

3.4 Land Use Zones – Celbridge Local Area Plan 2017-2023

The Celbridge Local Area Plan 2017-2023 (LAP) was adopted on the 17th of August 2017. The Kildare County Council website notes that "Kildare County Council will have regard to the following adopted Local Area Plans until such time as they are reviewed, or another plan made."[1] The Celbridge LAP therefore remains the relevant policy document that sets out the overall strategy for the proper planning and sustainable development of Celbridge in the context of the Kildare County Development Plan and Regional Planning Guidelines.

Within the Celbridge LAP. The proposed CHMC alignment is primarily zoned as land use classification, "New Residential", as shown in **Figure 3-8**. A small area zoned as "Existing residential" is present on either side of the proposed Mobility Corridor near the proposed new bridge across the River Liffey. To note also, the eastern half of the CHMC alignment is outside of the LAP area and therefore is not currently zoned for a particular land use within the LAP.

The land use objectives for the subject lands at Celbridge are listed below:

New Residential: *To provide for new residential development.*

Existing residential: *To protect and enhance the amenity of established residential communities and promote sustainable intensification.*

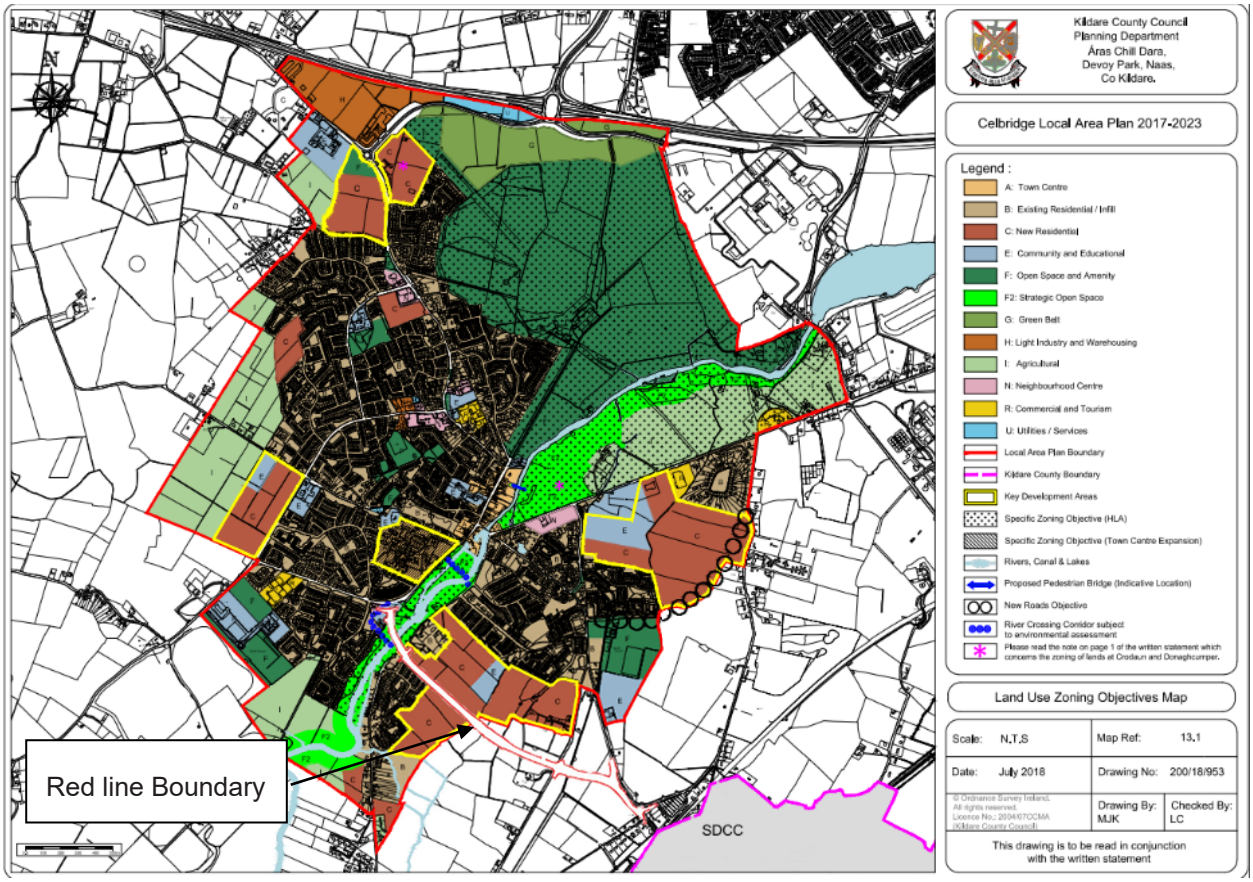


Figure 3-8 Land Use Zoning Objectives (Celbridge Local Area Plan 2017-2023)

[1] https://kildarecoco.ie/AllServices/Planning/LocalAreaPlans/CurrentLocalAreaPlans/

Objectives outlined in the Celbridge Local Area Plan 2017-2023 regarding flooding include:

INFO3.1: To manage flood risk in Celbridge in accordance with the requirements of the Planning System and Flood Risk Management Guidelines for Planning Authorities, DECLG and OPW (2009) and Circular PL02/2014 (August 2014).

INFO3.2: To ensure development proposals within the areas outlined on the Flood Risk Map are the subject of Site-Specific Flood Risk Assessment, appropriate to the nature and scale of the development being proposed.

INFO3.3: To support and co-operate with the OPW in delivering flood alleviation work under the Eastern CFRAM Programme Flood Risk Identification – Stage 1.

This section identifies existing information pertinent to flood risk at the site. The information used to inform this assessment includes historical mapping and indicative sources relating to previous predictive flood studies and risk assessments.

A key objective outlined in the Kildare Sustainability Mobility & Transport development plan is **TMO 66**, which states,

“Secure the implementation of the Priority Road and Bridge Projects and the Regional Roads Identified for Improvement (Table 5.4 and 5.5, refer) and maintain corridors free from development to facilitate future roads, cycle facilities and other transport infrastructure improvement identified within this Plan and Local Area Plans.”

Item “G” of the referenced Table 5.4 (Priority Road and Bridge Projects) is relevant to the proposed Mobility Corridor, being listed as a second river crossing in Celbridge from R403 Clane Road to Hazelhatch train station.

4 FLOOD RISK IDENTIFICATION – STAGE 1

4.1 Flooding History

4.1.1 OPW Past Flood Events

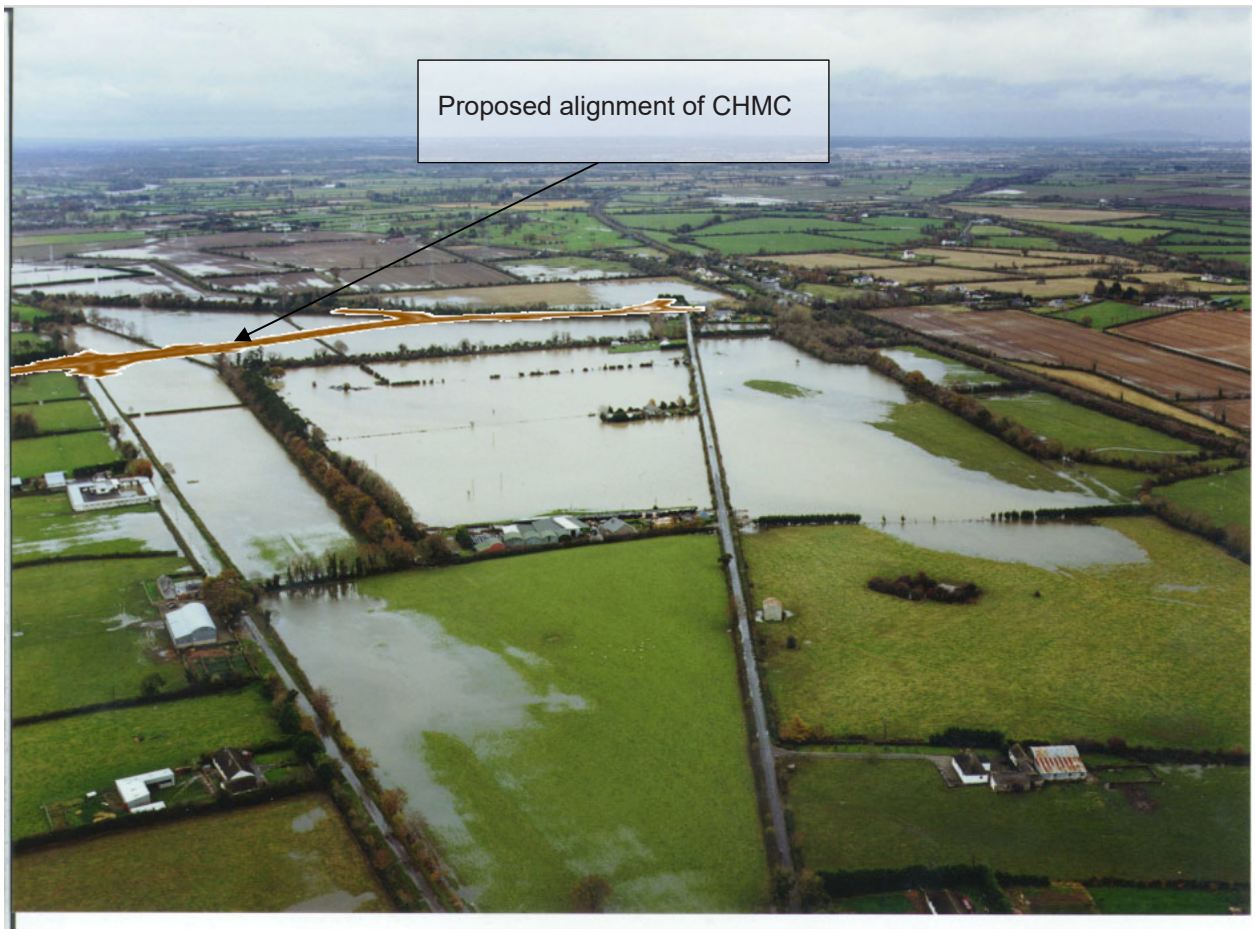
The OPW website Flood Maps - Floodinfo.ie[2] contains historic flood information which has been reviewed, verified, assessed and catalogued to create a National Flood Data Archive based on information collected from over 50 organisations. A past flood event is defined by the OPW website as, "*the occurrence of recorded flooding at a given location on a given date, or on a recurring basis. The event is derived from available flood information documentation including Flood Event Reports, news articles, archive information and photos*". The National Flood Data Archive is not a comprehensive catalogue of all past flood events in Ireland. However, the National Flood Data Archive is still the most comprehensive and complete collection of data on past flood events available in Ireland. The National Flood Data Archive was access via Flood Maps - Floodinfo.ie to identify past flood events along the proposed alignment of the Mobility Corridor. The locations identified are highlighted in **Figure 4-1**. Significant repeated flooding is noted in the Hazelhatch area with repeated refence to flooding of Hazelhatch Road, Celbridge GAA Club, Primary School and Tennis Club. The details of the previous flood events are listed in **Table 4-1** and a photograph provided in **Figure 4-2** of flooding during the November 2000 flood event of the Hazelhatch River floodplain with the alignment of the CHMC overlaid.

Figure 4-1 Previous Flooding Reported Locations (www.floodinfo.ie)

[2] https://www.floodinfo.ie/map/floodmaps/

Table 4-1: Details of Previous Flood Events

Document Type, Title, Date	Notes
OPW Flood Hazard Mapping – Phase 1 Meeting with Area Engineer Minutes dated April 2005.	Newtown Road/Ardclough Road, Clane Road and Oldtown Road Junction noted to be located on low lying land and roads subjected to flooding.
Floodinfo.ie report Flood event – 10th June 1993	(Out of Bank) Flooding affected Celbridge Town Centre, Hazelhatch Road and the railway line. Flooding considered to be an extreme event with rainfall estimated in the magnitude of a 200 year return period.
Floodinfo.ie report August 1996	Flooding to Hazelhatch Road.
Floodinfo.ie report 9th April 1998	Flooding to homes on the Hazelhatch Road, Celbridge, tennis courts and Celbridge GAA club.
Floodinfo.ie report September 1999	Parts of Hazelhatch and Hazelhatch Road flooded to depths varying from 100mm to over 500mm. This caused traffic disruption and parts of Hazelhatch were impassable for some time. It was recorded that five or six houses on the Hazelhatch Road were surrounded with water. No internal damage was recorded. Celbridge tennis courts and Celbridge GAA clubhouse carpark and football pitch was inundated. Some flooding of the clubhouse basement was experienced.
Floodinfo.ie report 5th November 2000	Flooding from Shinkeen River to Hazelhatch railway lines contributing to closure of southern train services. The Celbridge GAA club also affected.
Floodinfo.ie report Flood Event - 4th/15th November 2002	Newtown Road/Ardclough Road, Clane Road and Tea Lane/Main Street Junction affected by flooding during this event. One house on Newtown Road/Ardclough Road was flooded. Two premises at the mill adjacent to the junction between Tea Lane and Main Street was also flooded.
Floodinfo.ie report 14th November 2014	Celbridge GAA club pitches, the primary school and tennis club courts were flooded.
Floodinfo.ie report 22nd/23rd November 2017	Celbridge GAA club pitches, the primary school and tennis club courts were flooded. Anecdotal evidence from residents indicated the culverts on the Hazelhatch River appear to have exacerbate the flooding during this event. The culverts on the stream have been subjected to maintenance to remove debris using trash screen at culvert inlets.
Floodinfo.ie report 8th November 2019	Celbridge GAA club pitches and tennis club were flooded.



Source: floodinfo.ie

Figure 4-2 Hazelhatch Area Flooding Nov 2000 (with proposed CHMC overlaid)

4.1.2 Groundwater Flood Maps

Groundwater Flood maps were prepared by Geological Survey Ireland (GSI), Department of Environment Climate and Communications[3]. The maps were initially developed in collaboration with Trinity College Dublin and the Institute of Technology Carlow as part of the 2016-2019 GWFlood Project and have since continued to be developed through the 2020-2022 GWClimate Project[4]. The historic groundwater flood map shows maximum observed flood extents for locations of recurrent groundwater flooding in limestone regions. The map is primarily based on the winter 2015/2016 flood event, which in most areas represented the largest groundwater flood event on record. In addition to the historic groundwater flood map, the flood mapping methodology was also adapted to produce a surface water flood map of the 2015/2016 flood event. This flood map encompasses fluvial and pluvial flooding in non-urban areas.

There is no historical groundwater flooding identified within proximity of the proposed Celbridge Hazelhatch Mobility Corridor as shown in **Figure 4-3**. Winter 2015/2016 Surface Water Flooding was noted in the fields upstream of the proprosed Mobility Corridor alignment, however no flooding is noted within the site boundary.

[3] https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

[4] https://www.gsi.ie/en-ie/programmes-and-projects/groundwater/projects/gwclimate/Pages/default.aspx

Figure 4-3 GSI Historical Groundwater Flooding

4.1.3 Surface Water Flooding

GSI Synthetic Aperture Radar (SAR) seasonal flood maps as shown in **Figure 4-4** present the peak observed flood extents of groundwater and surface water over each winter season since 2015. The maps do not distinguish between surface water and groundwater floods. The maps include a confidence index which indicates the likelihood of possible misclassifications. This parameter is mostly related to confidence on the shape of the mapped flood, but when the whole flood is classified as low confidence it can also indicate that the flood may not have occurred.

The GSI Synthetic Aperture Radar (SAR) seasonal flood map shows a low confidence of historic pluvial flooding intersecting the proposed alignment of the CHMC. This most likely attributed to low lying, flat and poorly drained greenfields in the vicinity of the proposed CHMC.

Figure 4-4 GSI Surface Water Seasonal Flood Maps

4.2 Predictive Flood Risk Mapping

4.2.1 OPW CFRAM Mapping - Fluvial

The Office of Public Works (OPW) Catchment Flood Risk Assessment Management (CFRAM) Flood Maps are 'predictive' flood maps showing areas predicted to be inundated during a theoretical or 'design' flood event with an estimated probability of occurrence, rather than information for actual floods that have occurred in the past, which is presented, where available, on the 'past' flood maps.

The maps refer to flood event probabilities in terms of a percentage Annual Exceedance Probability, or 'AEP'. This represents the probability of an event of this, or greater, severity occurring in any given year. These probabilities may also be expressed as odds (e.g. 100 to 1) of the event occurring in any given year. They are also commonly referred to in terms of a return period (e.g. the 100-year flood).

The OPW CFRAM predicted fluvial flood extents for 'present-day' conditions are presented in **Figure 4-5**. The proposed CHMC intersects the predicted 1% and 0.1% Annual Exceedance Probability (AEP) fluvial flooding extents from the River Liffey and Hazelhatch River.

However, the more recent Hazelhatch Further Study has superseded the CFRAM mapping of the Hazelhatch River and Shinkeen River floodplain.

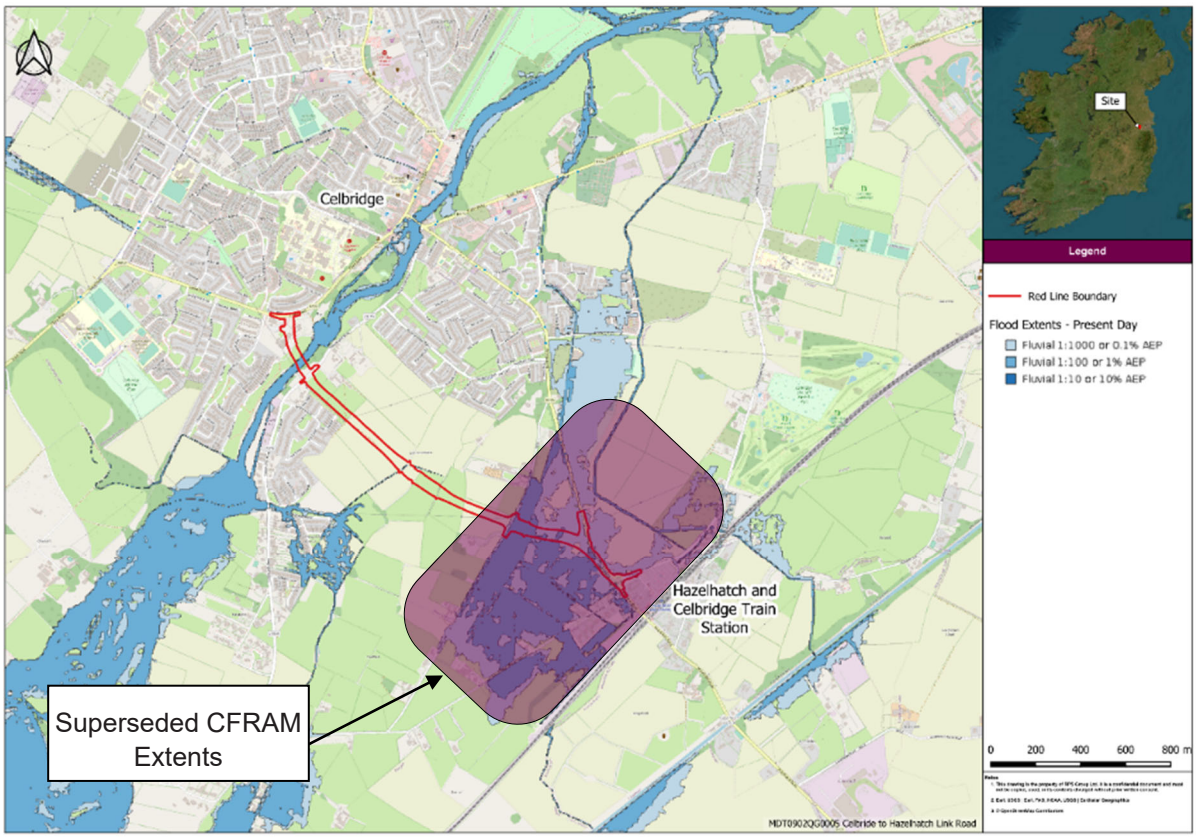


Figure 4-5 CFRAM Fluvial Predictive Flooding - Present Day

4.2.2 Hazelhatch Further Study

The Hazelhatch Further Study was commissioned following recommendation made in the CFRAM study for further analysis to establish more certainty in the hydraulic model flood predictions for the Hazelhatch River and Shinkeen River catchments. Permission was provided to RPS from Kildare County Council to

use the Hazelhatch Further Study model as it provides a more complete and up to date flood model. **Figure 4-6** shows the flood extents from this study.

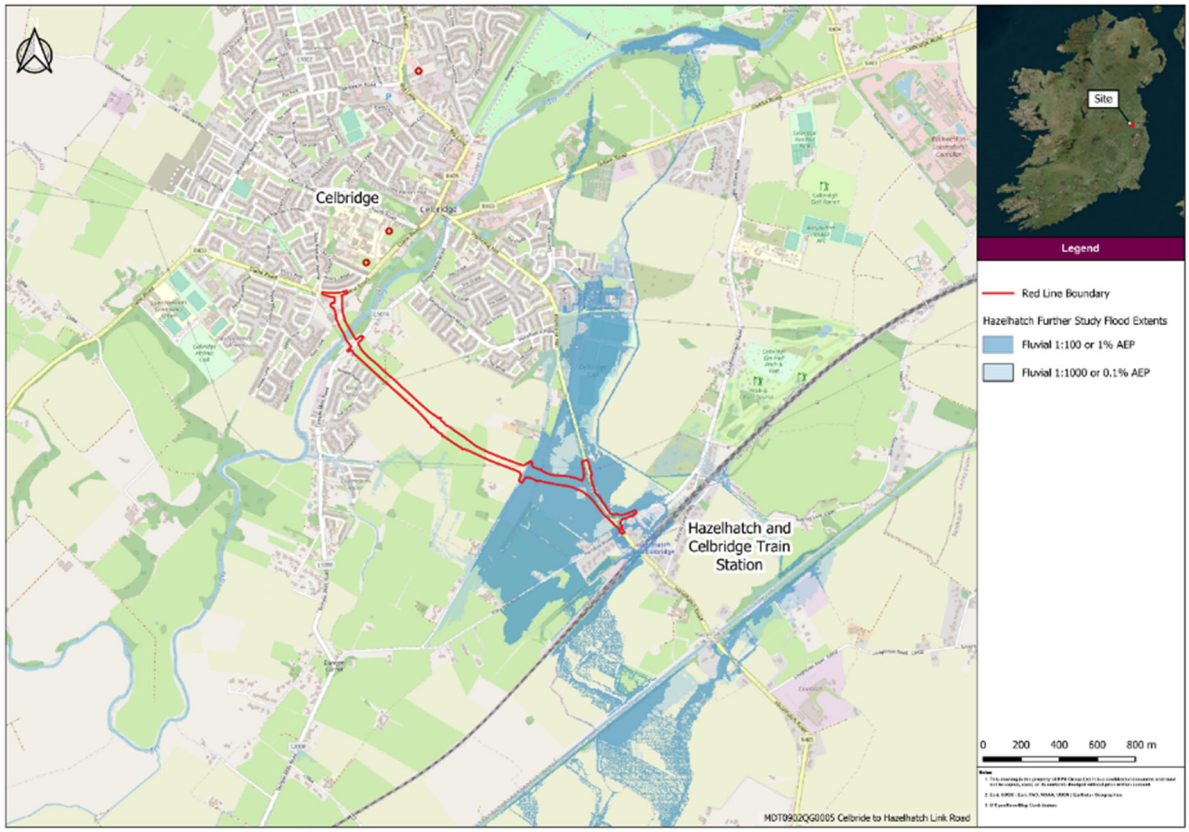


Figure 4-6 Hazelhatch Further Study Fluvial Predictive Flooding - Present Day

4.2.3 GSI GW Flood Predictive Groundwater Flooding

The Geological Survey Ireland predictive mapping provided at Geological Survey Ireland Spatial Resources does not indicate any groundwater flooding in the vicinity of the proposed development boundary.[5]

4.2.4 Strategic Flood Risk Assessment (SFRA) of the Draft Kildare County Development Plan 2023-2029

The Kildare SFRA County Development Plan 2023-2029 was completed by RPS in March 2022 and reviewed, however this document does not assess Celbridge town, as it was deemed more appropriate to assess the town in a separate local area plan given the size and population of the town.

4.2.5 Strategic Flood Risk Assessment (SFRA) of the Celbridge Local Area Plan 2017-2023

A Strategic Flood Risk Assessment was completed by RPS in September 2017 as part of the Celbridge Local Area Plan 2017-2023. The SFRA maps indicate the site to be partially contained within Flood Zone A & B as shown in **Figure 4-7**.

[5] https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

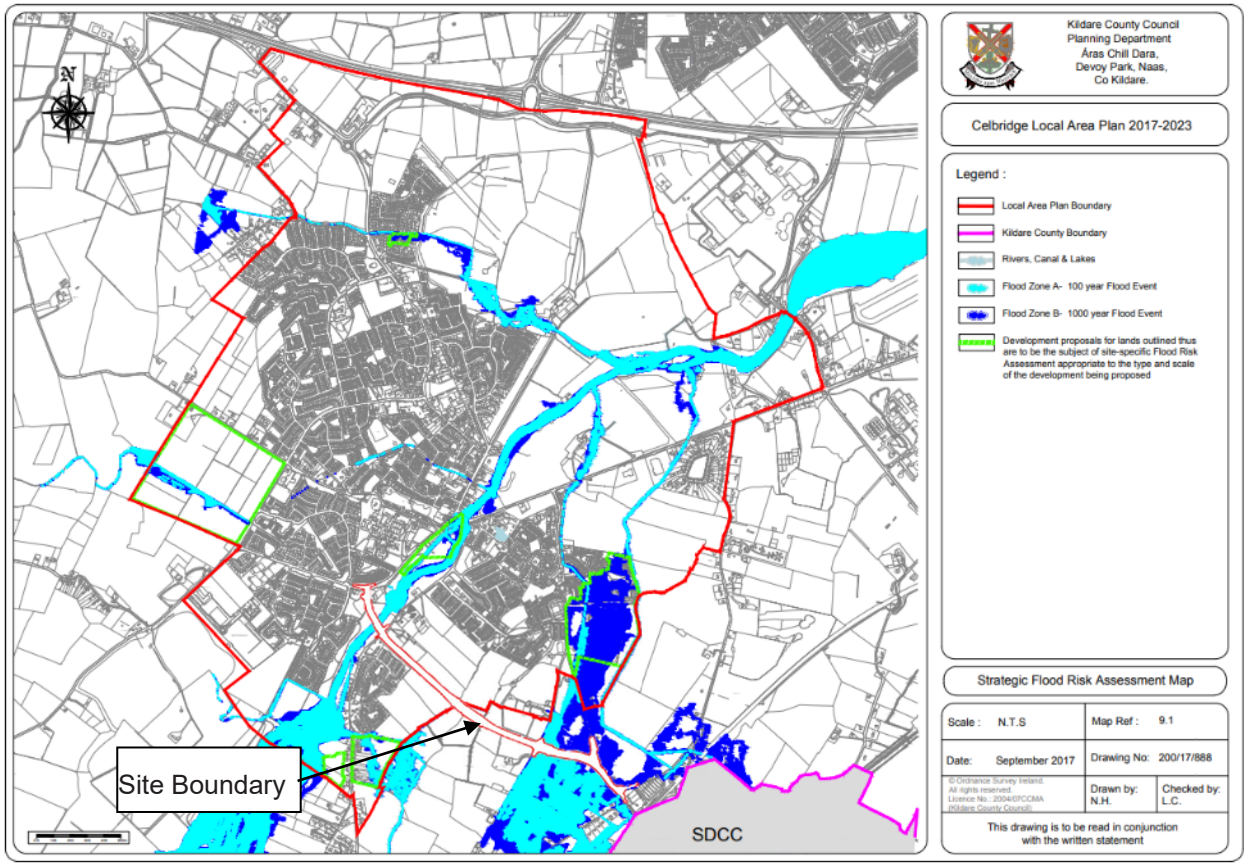


Figure 4-7 Celbridge Local Area Plan SFRA 2017-2023

4.3 Stage 1 Conclusion

The existing information reviewed, particularly the predictive flood mapping, indicates the subject site is at risk of fluvial and pluvial flooding, hence this Flood Risk Assessment is required to progress to Stage 2. **Table 4-2** presents a summary of the initial flood risk assessment. The site is identified to be required to undertake a detailed assessment of flood risks.

Table 4-2: Summary of Flood Risk Identification

Sources of Flooding	Comments	Risk
Fluvial	Recurring historical flooding is noted on the Hazelhatch River floodplain where the CHMC alignment is proposed. The Hazelhatch further study indicates predicted fluvial flooding from the Hazelhatch River within the eastern section of the proposed mobility corridor which will need to be examined in further detail. The proposed CHMC includes for 4 no. waterway crossings which has the potential to increase fluvial flood risk	High
Pluvial	The soils present at the site are noted to be a combination of poor and well-draining soils. GSI historic mapping indicates surface water flooding in fields in and adjacent to the proposed CHMC alignment. The proposed Celbridge Hazelhatch Mobility Corridor consists of hardstanding areas which has the potential to increase pluvial flood risk due to increased run-off if not managed accordingly.	High
Coastal	The inland site location is not influenced by coastal water levels.	Low
Groundwater	Groundwater flooding is not identified as a significant risk. There is no reported history of groundwater flooding, no predicted groundwater flooding, and no identified karst features.	Low

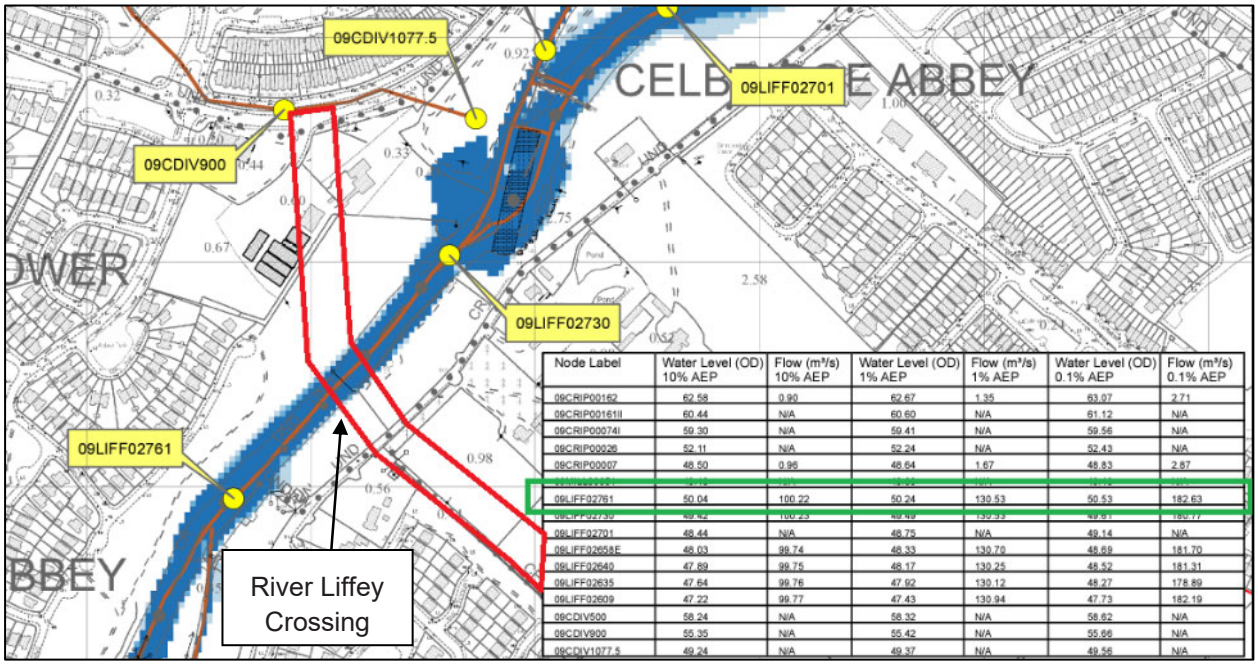
5 INITIAL FLOOD RISK ASSESSMENT – STAGE 2

The Flood Risk Identification found that the proposed CHMC is at risk from fluvial and pluvial flooding. Further information was gathered to appraise the adequacy of available information and propose a course of action.

5.1 Fluvial Flood Risk

5.1.1 River Liffey Bridge Crossing

Figure 5-1 shows that the CFRAM predicted 10% AEP, 1% AEP and 0.1% AEP flood extents are contained within steep bank slopes in the vicinity of the proposed CMHC River Liffey Bridge Crossing.



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09CRIP00152	62.58	0.90	62.67	1.35	63.07	2.71
09CRIP00161II	60.44	N/A	60.60	N/A	61.12	N/A
09CRIP00074I	59.30	N/A	59.41	N/A	59.56	N/A
09CRIP00026	52.11	N/A	52.24	N/A	52.43	N/A
09CRIP00007	48.50	0.96	48.64	1.67	48.83	2.87
09LIFF02761	50.04	100.22	50.24	130.53	50.53	182.63
09LIFF02701	48.44	N/A	48.75	N/A	49.14	N/A
09LIFF02658E	48.03	99.74	48.33	130.70	48.69	181.70
09LIFF02640	47.89	99.75	48.17	130.25	48.52	181.31
09LIFF02635	47.64	99.76	47.92	130.12	48.27	178.89
09LIFF02609	47.22	99.77	47.43	130.94	47.73	182.19
09CDIV500	58.24	N/A	58.32	N/A	58.62	N/A
09CDIV900	55.35	N/A	55.42	N/A	55.66	N/A
09CDIV1077.5	49.24	N/A	49.37	N/A	49.56	N/A

Figure 5-1 CFRAM Study Predicted Flooding Extent – River Liffey Bridge Crossing

The proposed River Liffey Bridge Crossing will consist of a single span of 65.50 metres completely across the CFRAM 0.1% AEP flood extent as showing in **Figure 5-2.** The proposed bridge will provide a clearance height of at least 1m above the predicted 0.1% AEP CFRAM peak flood level (50.53m.AOD) as shown in **Figure 5-3**. As such, there will be no interaction between the proposed CHMC and predicted flooding from the River Liffey for flood events up to and including the 0.1% AEP event.

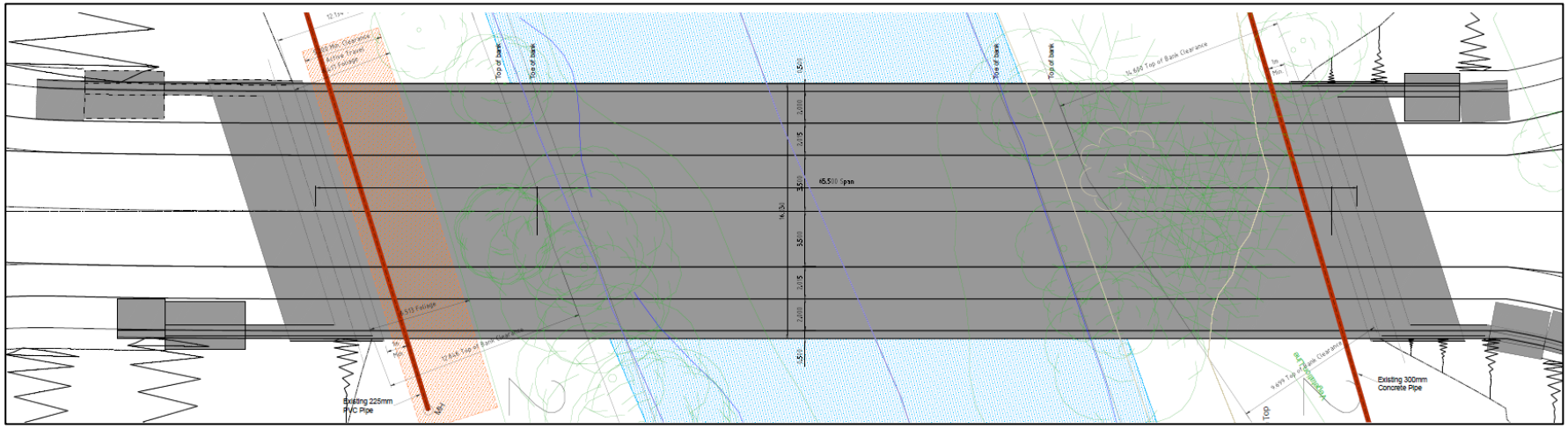


Figure 5-2 River Liffey Proposed Bridge Crossing - Plan Layout

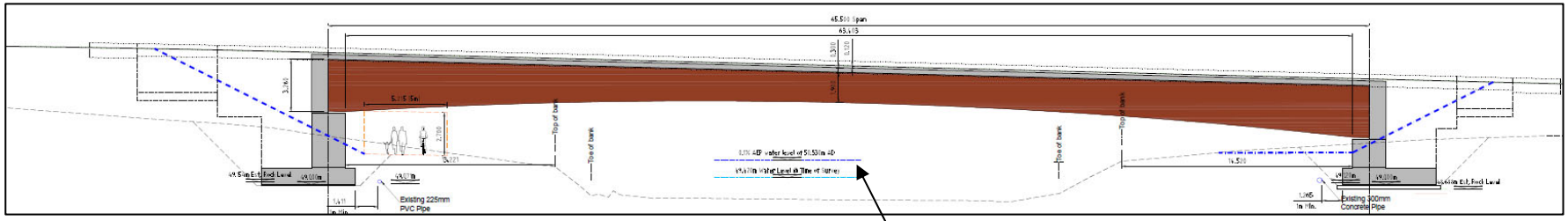


Figure 5-3 River Liffey Proposed Bridge Crossing - Section View

5.1.2 Hazelhatch River Crossings

Figure 5-4 gives an overview of the Hazelhatch further study predicted fluvial flood extents from the Hazelhatch and Shinkeen Rivers in the vicinity of the proposed CHMC and the Hazelhatch River Crossings. There is no predicted flooding from the Shinkeen River in the vicinity of the proposed CHMC, but the proposed CHMC intersects the predicted 1% and 0.1% AEP flood extents from the Hazelhatch River. Further analysis is required to assess the potential flood risk impact on the proposed CHMC and elsewhere from the Hazelhatch River predicted flooding.

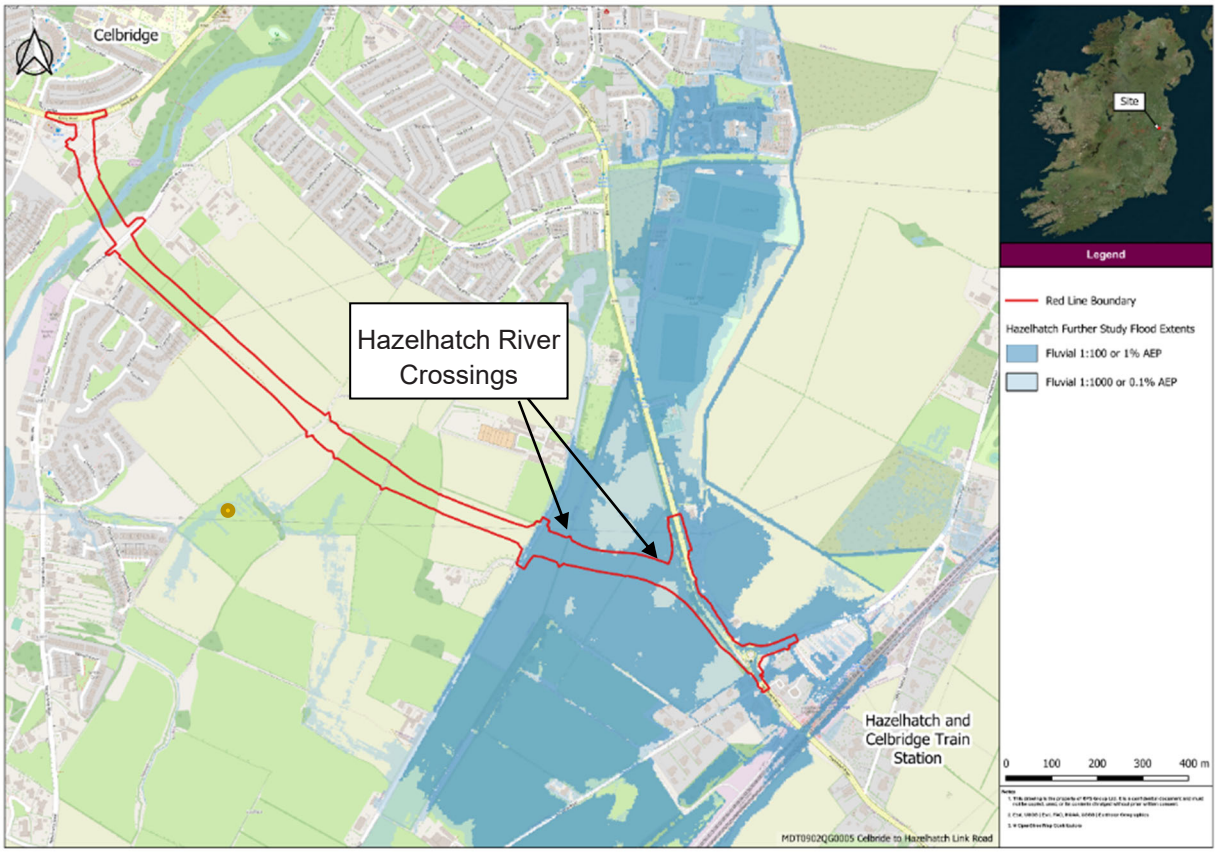


Figure 5-4 Hazelhatch Further Study Predicted Flooding Overview

5.1.3 Loughlinstown River Crossing

The Loughlinstown River Crossing consists of a culvert crossing the open channel to facilitate the proposed CHMC (Cul-01) as shown in **Figure 5-5**.

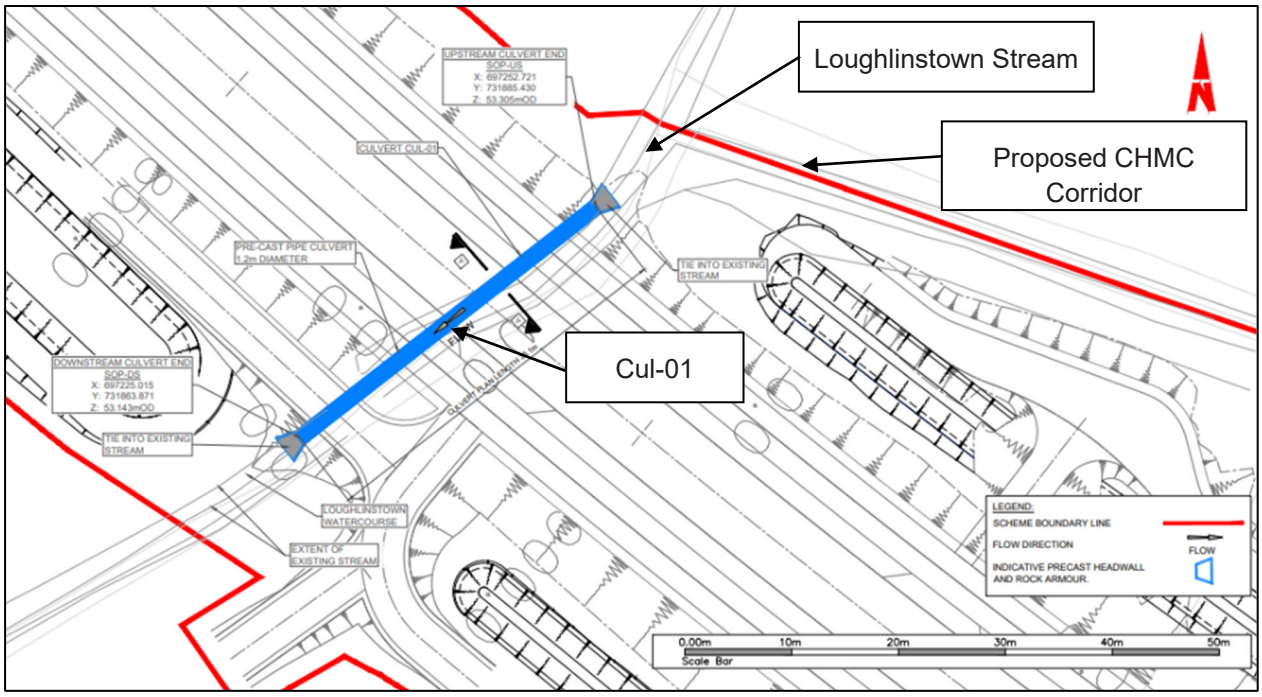


Figure 5-5 Loughlinstown River Crossing Culvert (Cul-01)

The culvert is sized to accommodate the 1% AEP flow including 20% uplift for climate change as per the requirements of Section 50 of the 1945 Arterial Drainage Act. The following flow estimation methods were used to determine the appropriate median flow for the Cul-01 catchment:

- Institute of Hydrology Report No.124 (IH 124) Method
- Flood Studies Update 3-variable (FSU 3-var) Method
- Flood Studies Update 3-variable (FSU 5-var) Method
- Flood Studies Supplementary Report 6-variable (FSSR 6-var) Method

The FSU 3-Var method provided the highest design flow of 0.596 m3/s and is applied to the culvert sizing calculations. Further details on the flow calculations are included in the Section 50 report included in **Appendix A** of this report. The Section 50 Letter of Approval from the OPW is provided in **Appendix B** of this report.

Culvert Cul-01 was sized based on the calculations set out in the updated CIRIA document 'Culvert, Screen and Outfall Manual (2019)', CIRIA Report No. C786. A summary of the proposed culvert sizes and resulting calculation outputs are given in **Table 5-1** and **Table 5-2** respectively.

Table 5-1: Proposed Culvert (Cul-01) Size

Structure Ref.	Chainage	Location	Type	Span/ Length (m)	Size (m)	Embedment (m)
Cul-01	0+880	Mainline Corridor	Pipe	35.11	1.2mØ	0.300

Table 5-2: Cul-01 Calculation Results Summary

Structure Ref.	Culvert US Soffit Level (m.AOD)	Culvert DS Soffit Level (m.AOD)	Design Flood Level (m.AOD)	Culvert Gradient (1 / x)	Freeboard (m)
Cul-01	54.505	54.343	54.155	127.0	0.350

The proposed culvert (Cul-01) provides a minimum freeboard of 0.3m for the design flow as per the requirements of Section 50 of the 1945 Arterial Drainage Act. Hence the proposed CHMC with the Cul-01 culvert in place do not pose a fluvial flood risk.

5.2 Pluvial Flooding

The GSI Synthetic Aperture Radar (SAR) seasonal flood map shows a low confidence of historic pluvial flooding intersecting the proposed alignment of the CHMC as shown in **Figure 4-4**. This possible pluvial flood extent is confined to low lying poorly drained greenfield in the vicinity of the proposed CHMC.

The proposed CHMC drainage design includes for filter drains along the southern perimeter which will intercept rainfall and allow discharge to the Hazelhatch River and River Liffey. The proposed CHMC will improve the field drainage at the possible flooding location thereby reducing the pluvial flood risk.

The proposed CHMC drainage design includes for bioretention features (Basins and Swales) designed to provide storage for up to the 1-in-100-year rainfall event including uplift for climate change whilst limiting discharge to receiving watercourses to the greenfield discharge rate (i.e. Q_{BAR}).

The surface water drainage design has been developed with careful consideration of the potential impacts of climate change. The proposed drainage system is resilient and capable of managing future storm events effectively, thereby reducing the risk of flooding. Furthermore, full compliance with the Kildare County Council (KCC) Sustainable Drainage Systems Guidance Document (KCC, 2024) will be demonstrated during the detailed design stage. This will include adherence to all relevant standards, best practices, and specific requirements outlined by KCC to promote sustainable water management, enhance biodiversity, and protect local water quality.

5.3 Stage 2 Conclusion

The Stage 2 assessment concludes that the proposed CHMC does not have a negative impact on the pluvial flood risk to the proposed CHMC and elsewhere, and also it does not interact with the CFRAM predicted 0.1% AEP flooding from the River Liffey and Shinkeen River Catchments. The proposed Loughlinstown Stream crossing also does not pose a fluvial flood risk. Hence no further assessment is required for these areas.

The Stage 2 assessment concludes that it is not possible to fully assess the likely implications of the proposed CHMC on the Hazelhatch River predicted flooding at this stage, therefore a Stage 3 assessment will be required for this source of flood risk.

6 STAGE 3 DETAILED FLOOD RISK ASSESSMENT

6.1 Hazelhatch Further Flood Study

The Hazelhatch Further Study (HFS) provides the most complete and up to date information available on the predicted flood risk to the proposed CHMC from the Hazelhatch River. Permission was granted by Kildare County Council to utilise the hydraulic model developed from this study for the purpose of this FRA.

6.1.1 Hydrology Review

The FSU methodologies were applied in the Hazelhatch Further Study (HFS) to compute the design flows for the Hazelhatch River catchment Hydrological Estimation Points (HEPs). The FSU 7-variable catchment descriptor equation shown below was applied to calculate the median flow (Q_{MED}) for all HEPs with catchments greater than 1km^2.

$$Q_{med} = 1.237 \times 10^{-5} AREA^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} DRAIND^{0.341} S1085^{0.185} (1+ARTDRAIN2)^{0.408}$$

The FSU 5-variable catchment descriptor equation shown below was applied to calculate Q_{MED} for all HEPs with catchments smaller than 1km^2.

$$Q_{med} = 1.237 \times 10^{-5} AREA^{0.937} BFIsoils^{-0.922} SAAR^{1.306} FARL^{2.217} S1085^{0.185}$$

A review of the gauged sites was carried out to identify the ones most hydrologically similar to the Hazelhatch River catchment. The gauged sites are referred to as pivotal sites in the Flood Studies Update Methodology and are used to compute an adjustment factor to account for differences in gauged and ungauged flows to establish confidence in the calculated Q_{MED} flow. Two pivotal sites were chosen for the following reasons:

- they were the two most geographically close sites.
- the catchment parameters for these sites were also most similar to the Hazelhatch Catchment in comparison to the other pivotal sites.

Further details on the chosen pivotal sites are listed in **Table 6-1**.

Table 6-1: Pivotal Sites Catchment Values

Gauging Station Number	Catchment / Location	Catchment Area (km2)	BFI	SAAR (mm)	FARL	Adjustment Factor
09002	Griffen at Lucan	34.95	0.67	755	1	1.70
09035	Camac	37.14	0.67	794	0.993	1.35
Average Adjustment Factor						**1.53**

An average adjustment factor of 1.53 was determined from the chosen pivotal sites and was applied to the HEPs Q_{MED} values for the Hazelhatch Catchment.

The Eastern Catchment Flood Risk Assessment Management Study (ECFRAMS) growth factors was applied to Q_{MED} values compute the design flows. The design flow for the Hazelhatch River immediately upstream (RPS_004) and downstream (RPS_008) of the proposed CMHC are listed in **Table 6-3** and the locations are shown in **Figure 6-1**.

Table 6-2: HEP Catchment Descriptors

HEP ID	AREA (km^2)	SAAR (mm)	BFI_{SOILS}	FARL	DRAIND (km/km^2)	S1085 (m/km)	ARTDRAIN2	URBEXT
RPS_004	5.146	731.16	0.588	1	0.997	8.144	0.089	0
RPS_008	6.101	731.17	0.586	1	1.267	5.419	0.546	0

Table 6-3: HEP Design Flows

HEP ID	QMED (m^3/s)	10% AEP Flow (m^3/s)	2% AEP Flow (m^3/s)	1% AEP Flow (m^3/s)	0.1% AEP Flow (m^3/s)
RPS_004	1.163	2.091	3.234	3.864	6.890
RPS_008	1.331	2.393	3.702	4.423	7.887

Figure 6-1 HEP Locations

6.1.2 Hydraulics Review

A hydraulic model was built using InfoWorks ICM version 10.5 software to represent the Hazelhatch River and Shinkeen River as part of the HFS. The extent of the watercourses modelled is shown in **Figure 6-2**.

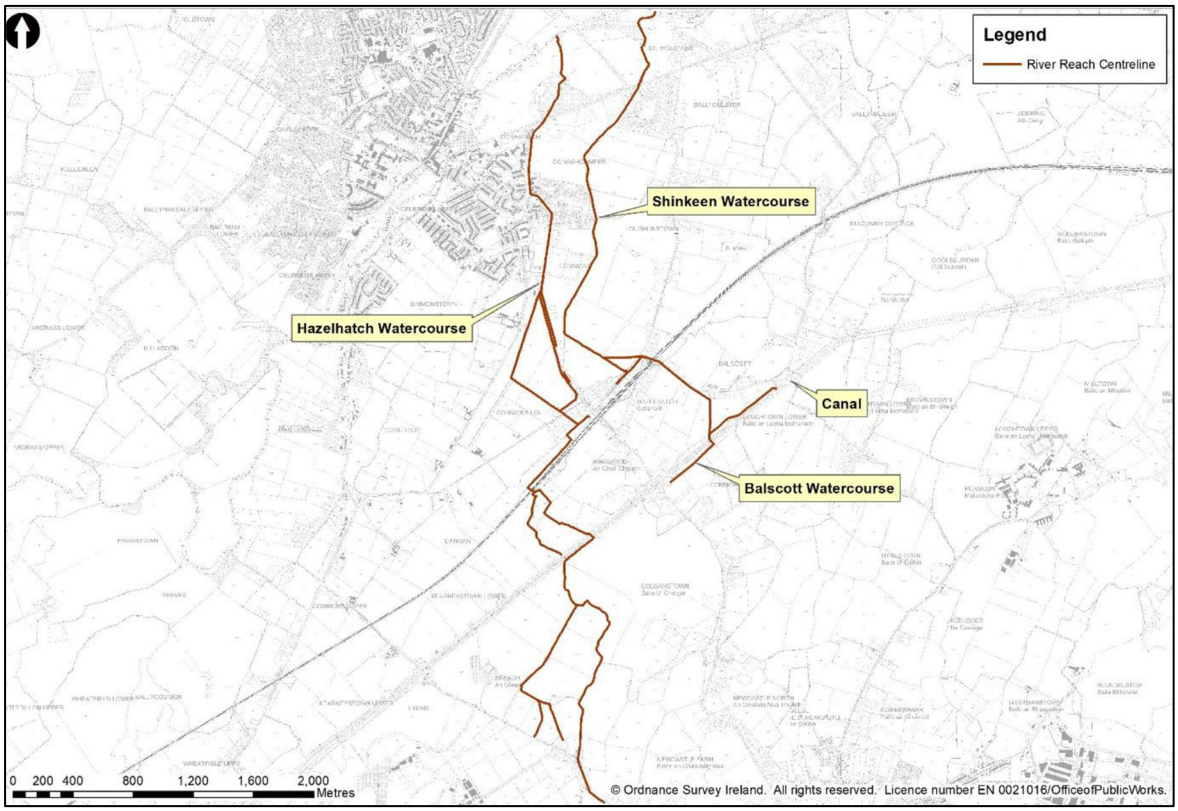


Figure 6-2 Modelled Watercourses

The watercourses are modelled as 1-dimensional (1-D) and its floodplains are represented as 2-dimensional (2-D). The bank lines for the modelled watercourses provide connection between the 1-D channel model and the 2-D floodplain.

6.1.2.1 1-D Model

The 1-D channel model was created using cross sections from topographical surveys completed in February 2020 for the HFS, particularly for the areas impacted by flooding. The ECFRAMS cross section survey completed in 2012 was also used to supplement the model. The 1-D model includes in-channel structures such as bridges and culverts and are defined by the surveyed geometry. A total of 48 bridges and culverts and 3 weirs were included in the 1-D model.

6.1.2.2 2-D Model

The 2-D floodplain model consist of a computational mesh which provides representation of out-of-bank-flooding flow paths in 2-D. The LiDAR data obtained by the OPW in 2009 for the purpose of the ECFRAMS is the most up to date available information on the ground terrain for the Celbridge and Hazelhatch area. Hence it was used to inform the 2-D floodplain model. The 2-D model mesh was augmented to include buildings which will affect out-of-bank-flooding flow paths.

6.1.2.3 Boundary Conditions

The upstream boundary conditions for the 1D-2D model consist of flow hydrographs from the hydrological assessments inputted as point and lateral inflows to the 1-D model. The point inflows were applied to upstream end of modelled watercourses to represent the flows for the upstream catchment. The lateral inflows between HEP locations were disaggregated for the appropriate river reaches based on length.

The downstream boundaries of the 1-D model are located at the confluence of the Hazelhatch and Shinkeen Rivers with the River Liffey. The downstream boundary conditions consist of level hydrographs obtained from the ECFRAMS hydraulic model for the River Liffey for all flow event modelled including 1% AEP and 0.1% AEP events. The level hydrographs were extracted from the River Liffey Cross Section Locations closest to the individual confluences in the ECFRAMS hydraulic model.

A review of the hydraulic model 0.1% AEP simulation confirmed that the downstream boundary conditions applied does not impact the predicted flooding area in the vicinity of the proposed CHMC. The proposed CHMC location is outside the hydraulic influence of the 0.1% AEP downstream boundary peak water level. This is due to the decrease in topography and also river bed levels from the proposed CHMC location to the Hazelhatch River confluence with the River Liffey.

6.1.2.4 Model Roughness

The manning's (N) roughness values applied to the 1-D and 2-D models are listed in **Table 6-4**.

Table 6-4: Model Roughness N Values

Area Type	Manning's N Value
River Bed Areas	0.040
River Bank Areas	0.060
Road & Rail Infrastructure	0.013
Non-irrigated arable land/ Pastures/ Natural grassland	0.035
Moors and Heathlands	0.045
Vegetated Areas/ Mixed Forests	0.060

6.1.3 Hydraulic Model Verification & Limitations

The HFS hydraulic model verification was based on the hydraulic model calibration against key flood events which were the 14th November 2014 and 22nd/23rd November 2017 events. These two significant flood events were the only two events where detailed information is available to which a definitive judgement can be made to establish confidence in the hydraulic model predictions.

The HFS hydraulic model calibration included for a sensitivity analysis for a range of model parameters including river and floodplain roughness coefficients, structure roughness and head loss coefficients. But the analysis did not fully capture the previous key flood events entirely.

The anecdotal information provided from residents and the OPW included observations of culvert/bridge blockages during the previous two key flood events. Hence a blockage analysis was carried out on the culverts and bridges which included Willow Avenue Culvert downstream of the proposed CHMC.

The results of the blockage analysis showed good correlation with the observed flood extents from the key flood events. Hence the HFS concluded that that the hydraulic model is well calibrated, and the modelled outputs were accurate.

6.1.4 Model Update

OPW provided observations from their HFS hydraulic model review particularly for the Shinkeen River upstream and downstream of Loughlinstown Road Crossing shown in **Figure 6-3.**

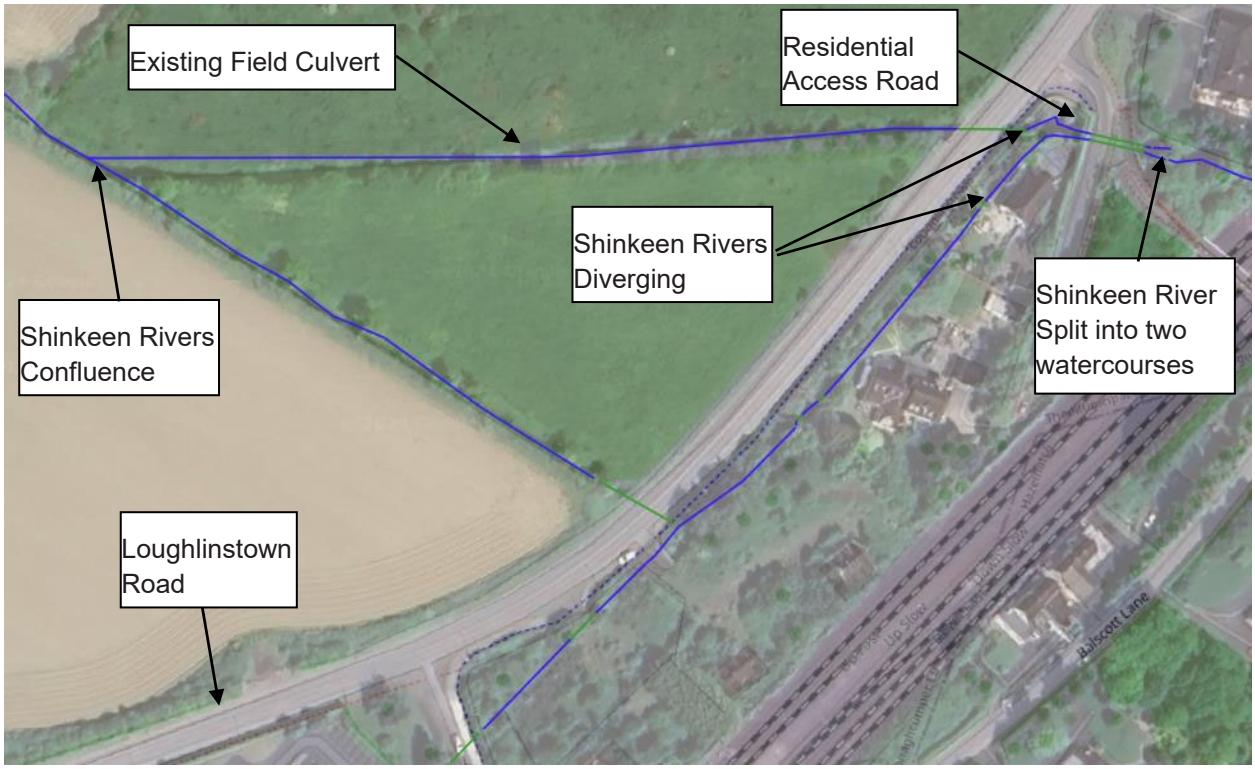


Figure 6-3 Shinkeen River Schematisation

The Shinkeen River splits into two separate watercourses immediately upstream of a residential access road and diverges in separate directions before the Loughlinstown Road Crossing. Both watercourses confluence into a single watercourse approximately 250m downstream of Loughlinstown Road Crossing.

The OPW noted the following observations:

- Existing Field Culvert on the Shinkeen River downstream of Loughlinstown Road Crossing was removed on site and no longer exists.
- Limited connectivity between the two Shinkeen watercourses running side by side during the 0.1% AEP event in the model contributing to a glass-walling effect.

The HFS hydraulic model was updated to remove the existing field culvert, and also the connectivity improved between the two Shinkeen watercourses running side by side. The model connectivity between the two Shinkeen watercourses running side by side were verified during a site walkover on 28/09/23. The model was re-run for the 0.1% AEP event and the results showed no glass-walling effect between the two Shinkeen watercourses running side by side.

The updated 0.1% AEP predicted flood extents and the HFS 0.1% AEP predicted flood extents is shown in **Figure 6-4**. The comparison shows reduced flooding downstream of Loughlinstown Road and limited or no change in predicted flood extents elsewhere.

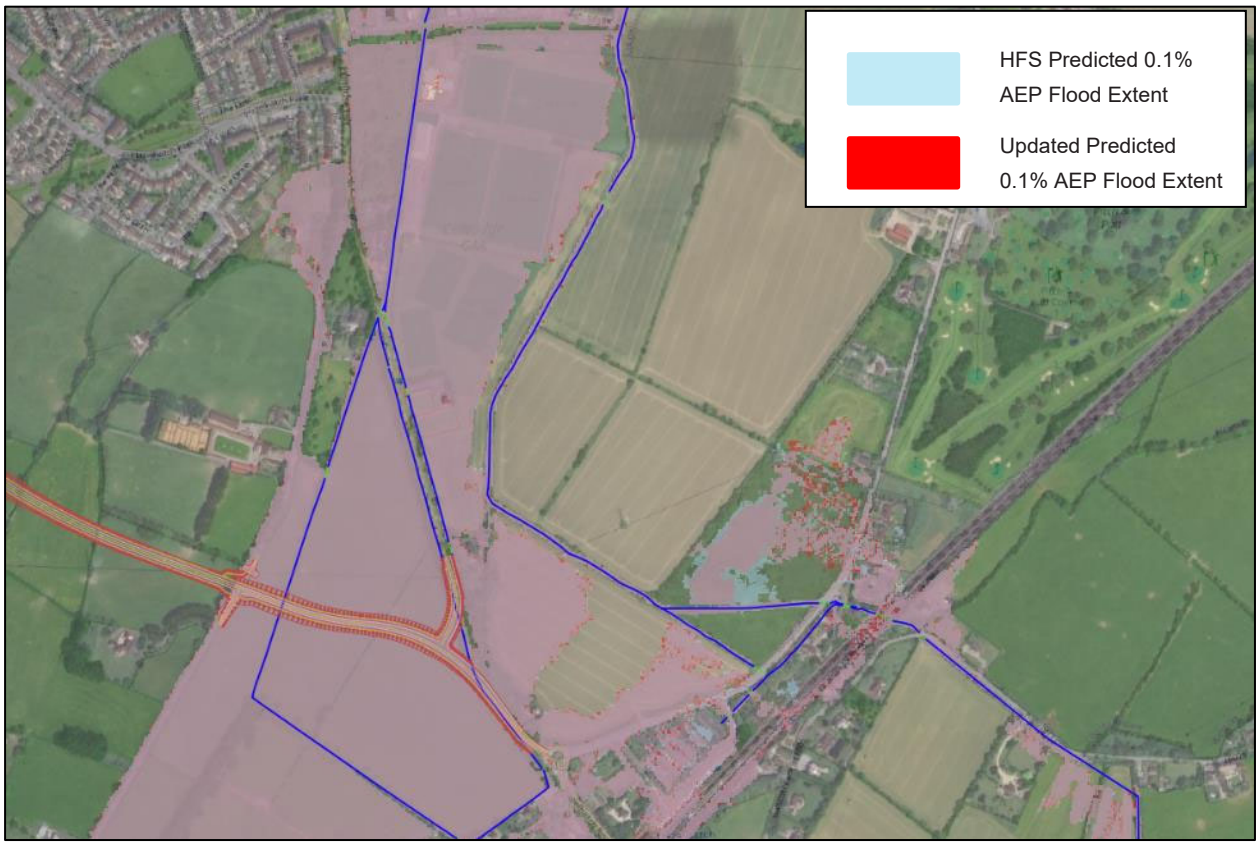


Figure 6-4 Updated 0.1% AEP Predicted Flood Extents

6.2 Existing Flooding Scenario

The hydraulic model was run for the 1% AEP and 0.1% AEP flow events to establish the existing flooding conditions for the proposed CHMC from the Hazelhatch and Shinkeen Rivers. The existing 1% AEP and 0.1% AEP predicted flood extents are shown in **Figure 6-5.**

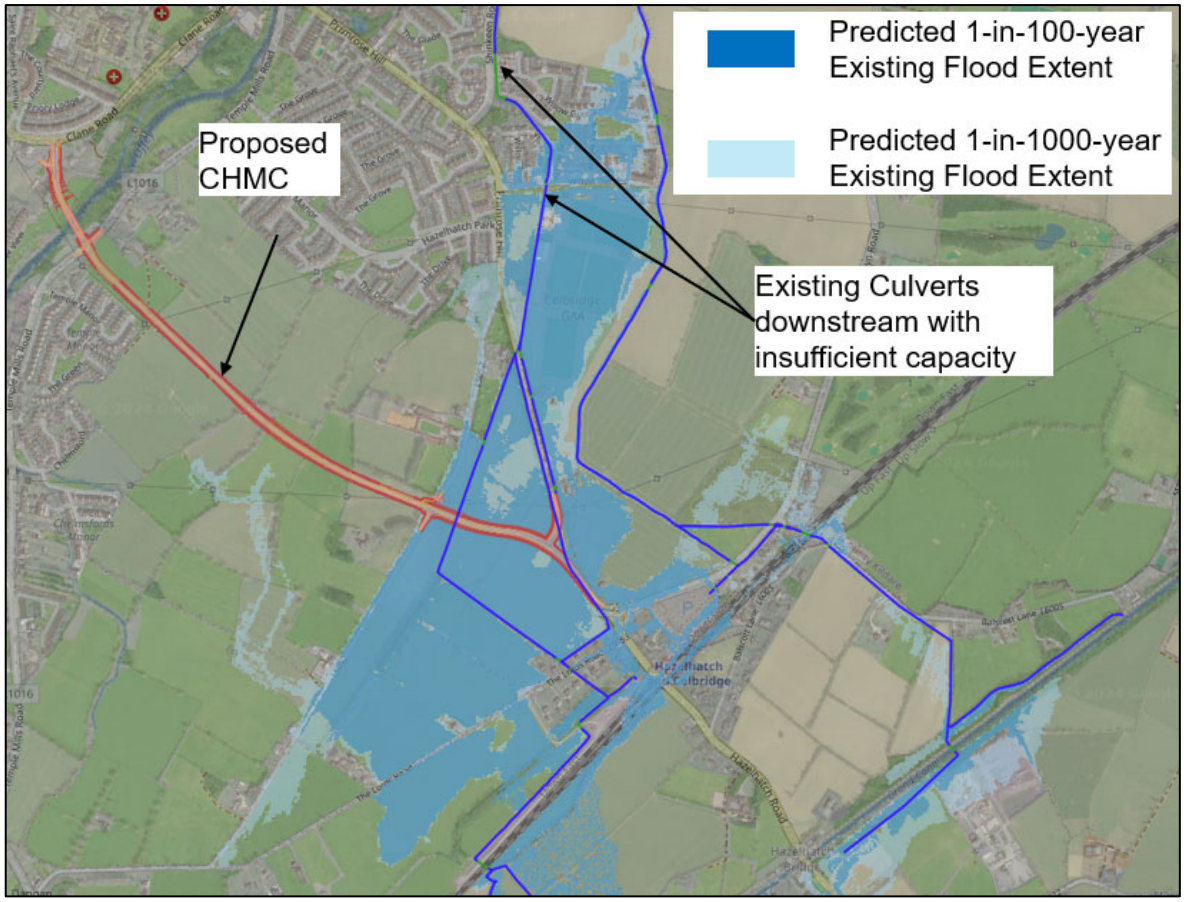


Figure 6-5 Existing 1% AEP & 0.1% AEP Predicting Flooding Extents

The proposed CHMC traverses the 1% AEP and 0.1% AEP predicted flood extents from the Hazelhatch River. This flooding is largely a consequence of the surcharging of existing culverts downstream as shown in **Figure 6-6**. The existing ground terrain immediately upstream and downstream of the proposed CHMC is relatively flat and low-lying, hence the predicted floodplain essentially acts as flood storage during extreme flow events and has little or no conveyance.

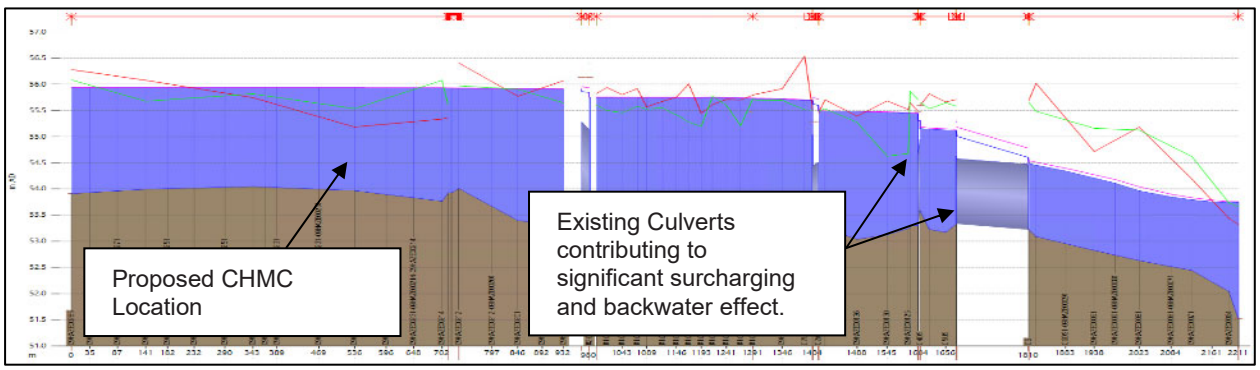


Figure 6-6 Existing Culverts Surcharging during 0.1% AEP Event - Long Section

6.3 Proposed Flooding Scenario

6.3.1 No Mitigation Measures Scenario

The proposed CHMC was incorporated into the hydraulic model with road level set above the existing 0.1% AEP flood level of 55.95m.AOD. The Hazelhatch River section along the western boundary of the Hazelhatch Road was re-aligned to accommodate the proposed CHMC as shown in **Figure 6-7**.

The following measures were included in the model to accommodate proposed CHMC on the Hazelhatch Rivers:

- 2 River Culverts:
    - Culvert 02 (4.0m wide x 2.7m height x 37.4m length)
    - Culvert 03 (3.5m wide x 2.6m height x 31.2m length)
- River Realignment (410m length)
- Abandonment of Existing River Section (353m length)

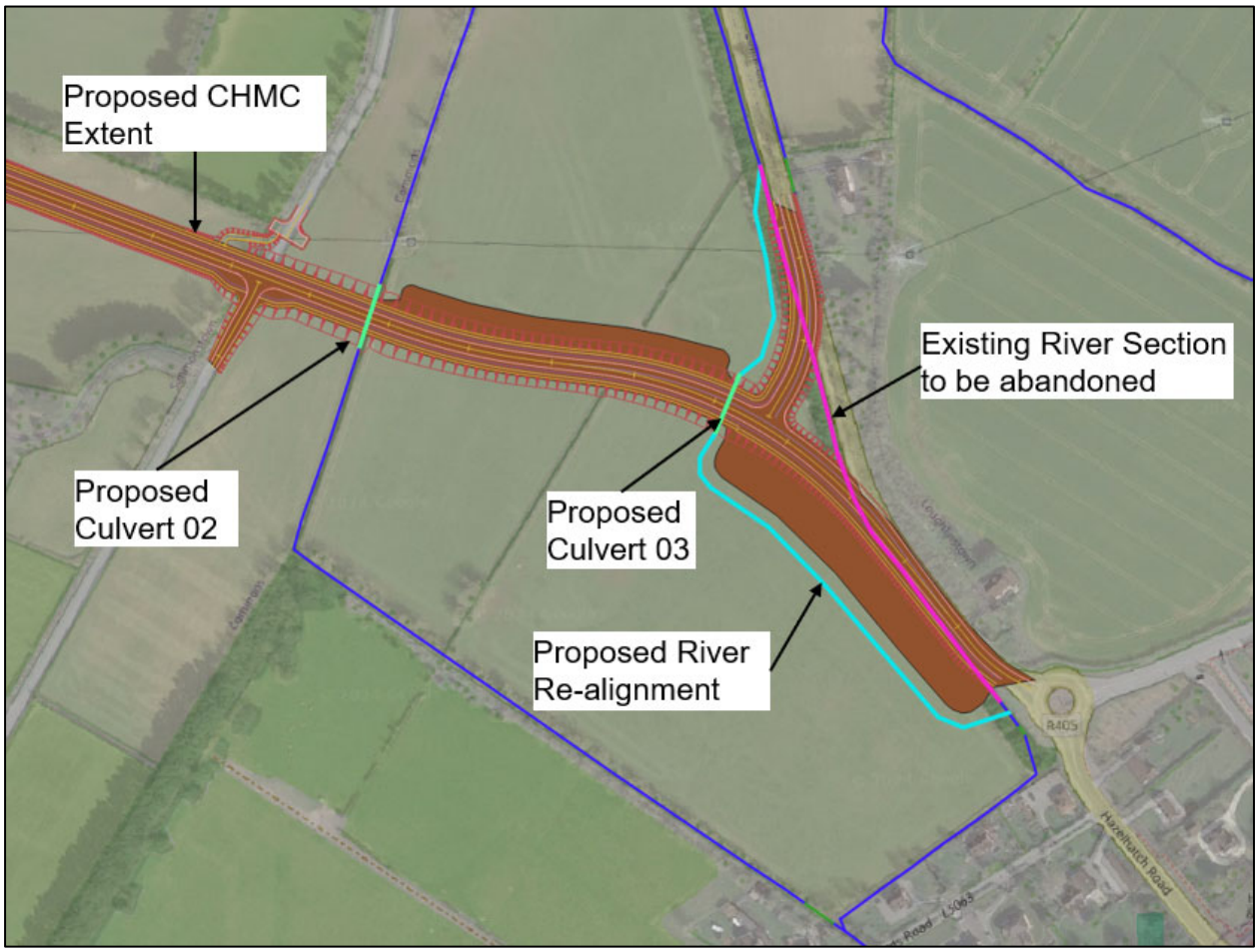


Figure 6-7 Proposed River Culverts & River Re-alignment

The results for the 0.1% AEP simulation showed that the proposed CHMC contributes to an increase in predicted flood depths upstream and a decrease downstream as shown in **Figure 6-8**. The maximum increase in predicted 0.1% AEP flood depth upstream is 45mm and the maximum decrease downstream is 19mm. The results for the 0.1% AEP simulation also show the proposed 2no. River Culverts achieve a minimum freeboard of 0.3m during peak flows. Hence the proposed 2no. River Culverts have sufficient capacity to convey the 0.1% AEP flows.

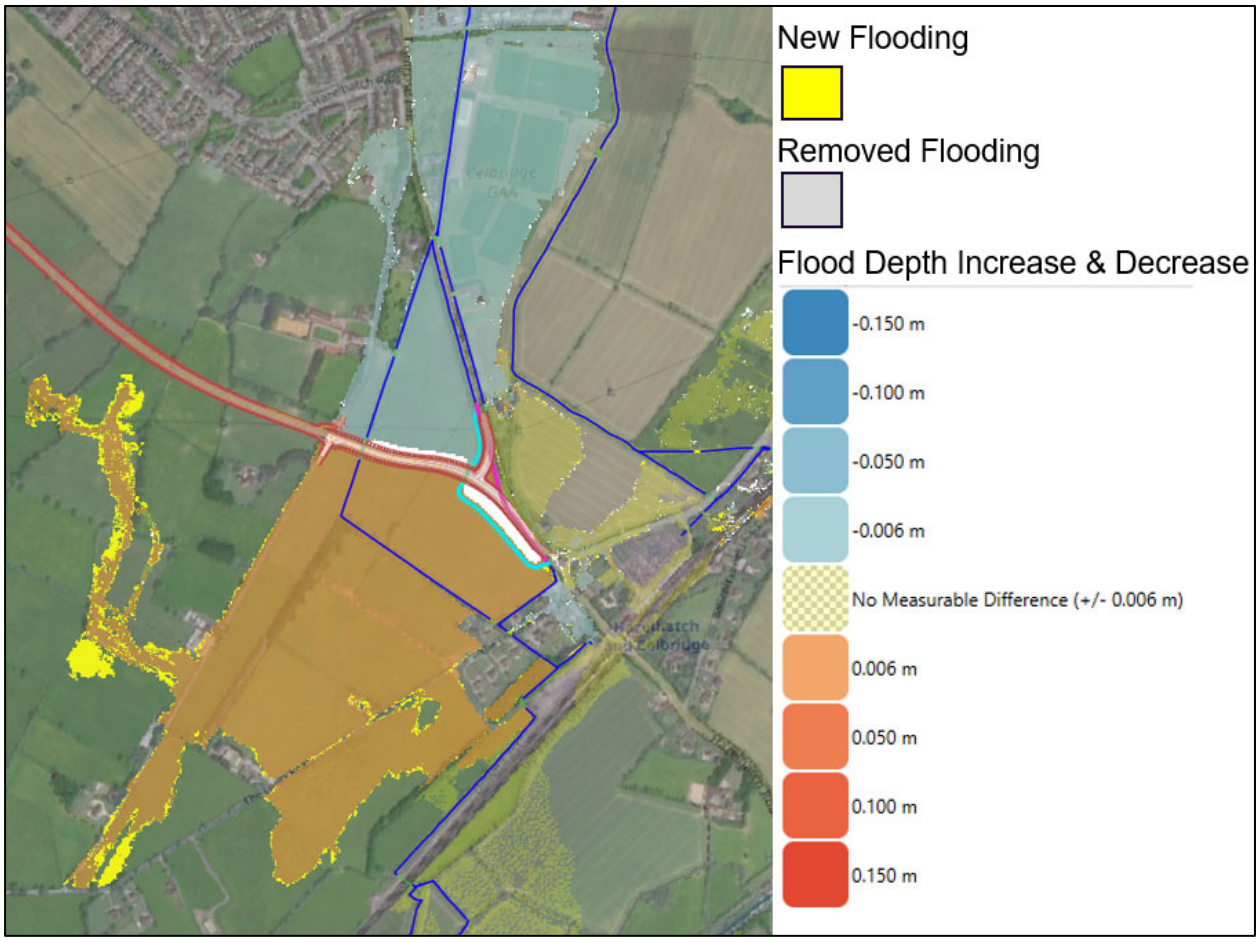


Figure 6-8 Proposed CHMC No Mitigation Scenario - Predicted 0.1% AEP Flood Depth Impact

6.3.2 Mitigation Measures Scenario

The following mitigation measures shown in **Figure 6-9** were applied to the model to reduce the predicted flood depths increase upstream of the proposed CHMC:

- Proposed 15no. 0.9m Diameter Floodplain Culverts (60m length each)
- Proposed 4no. 1m deep ditches (500m total length)
- Proposed Ditch on downstream side of the proposed CHMC includes for outfalls to the Hazelhatch Rivers and accommodates drainage outfalls from swales

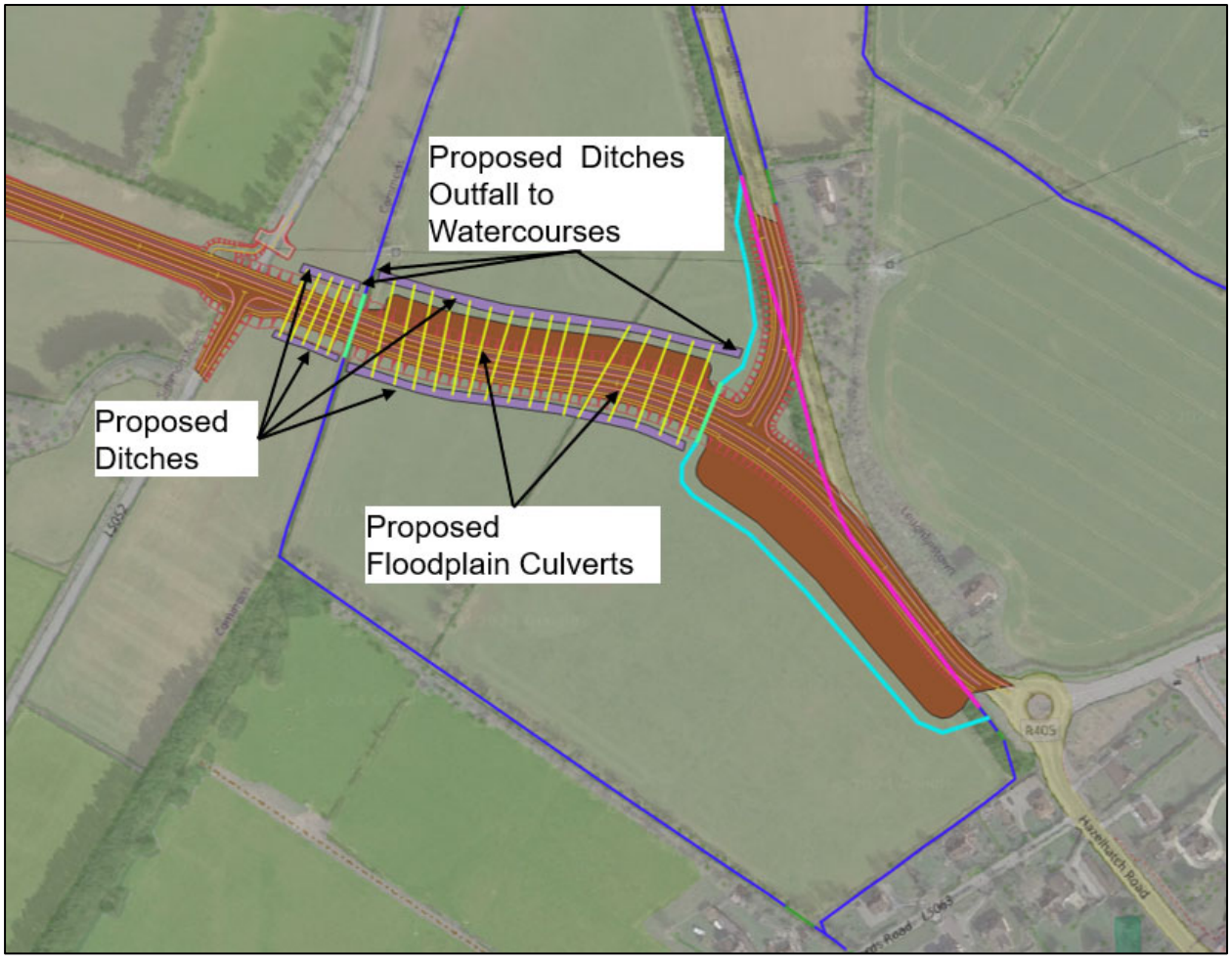


Figure 6-9 Proposed Mitigation Measures

The results of the 0.1% AEP simulation for the proposed CHMC with the additional measures (**Figure 6-10**) showed the following:

- Maximum Increase in 0.1% AEP predicted Flood Depth is 13mm (32mm reduction on 'No Mitigation Measures' Scenario)
- Maximum Decrease in 0.1% AEP predicted Flood Depth is 3mm (16mm reduction on 'No Mitigation Measures' Scenario)

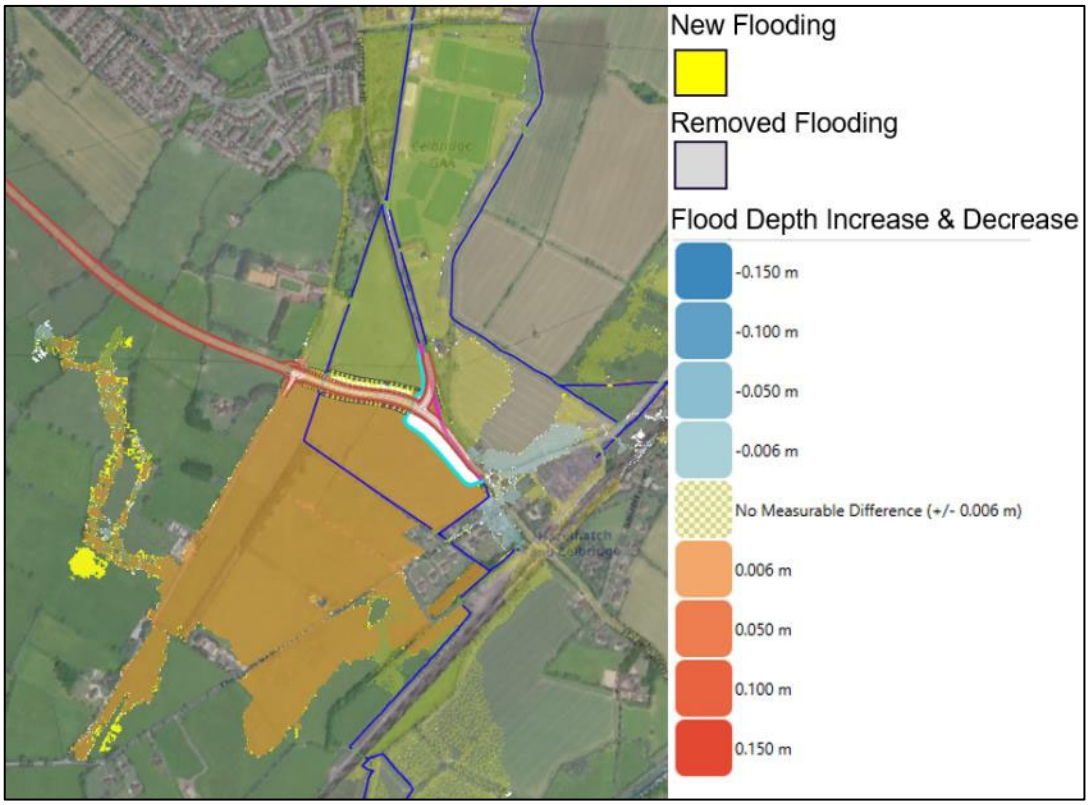


Figure 6-10 Proposed CHMC Mitigation Scenario - Predicted 0.1% AEP Flood Depth Impact

The number of proposed floodplain culverts were reviewed to determine the optimal number to mitigate increase in predicted 0.1% AEP flood depths. The results of the analysis showed 15No. culverts to be the optimal number as shown in **Figure 6-11**.

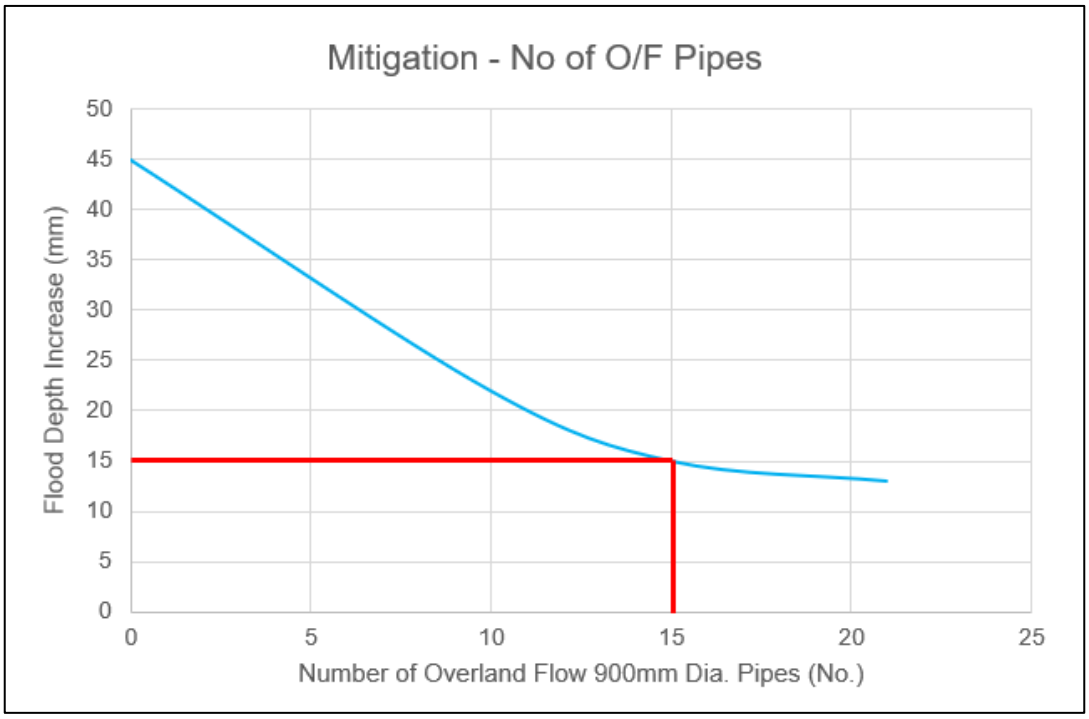


Figure 6-11 Predicted 0.1% Flood Depth Increases vs No. of Floodplain Culverts

6.3.3 Potential Flood Risk Impact on Properties Elsewhere

6.3.3.1 Existing Conditions

The existing residential dwellings in the vicinity of the Hazelhatch and Shinkeen Rivers were assessed to establish the potential flood risk impact from the proposed CMHC. The existing residential dwellings identified in the vicinity of the 10% AEP, 2% AEP, 1% AEP and 0.1% AEP predicted flood extents are shown in **Figure 6-12.**

A threshold survey was carried out by Murphy Surveys to obtain the Finished Floor Levels (FFL) for the residential dwellings to assess the freeboard for these properties for each respective flood event. The threshold survey covered 34 of the 38 properties scoped. The remaining 4No. properties were not surveyed due to no property access. Engineering judgement was applied using drone survey elevation data which covered the remaining 4 properties and site visit observations to estimate the finished floor level.

The finished floor levels for the residential dwellings were compared with the predicted flood levels based on existing conditions to determine the available freeboard (height of FFL above flood level) for each property prior to construction of the proposed CHMC. This was carried out for the 10% AEP, 2% AEP, 1% AEP and 0.1% AEP flood events to determine whether the residential dwellings are liable to flood for each flood event or not. The results are listed in **Table 6-5** and summarised below:

- No residential dwelling at risk of flooding for the 10% AEP predicted flood event.
- 3 residential dwellings at risk of flooding for the 2% AEP predicted flood event.
- 4 residential dwellings at risk of flooding for the 1% AEP predicted flood event.
- 6 residential dwellings at risk of flooding for the 0.1% AEP predicted flood event.

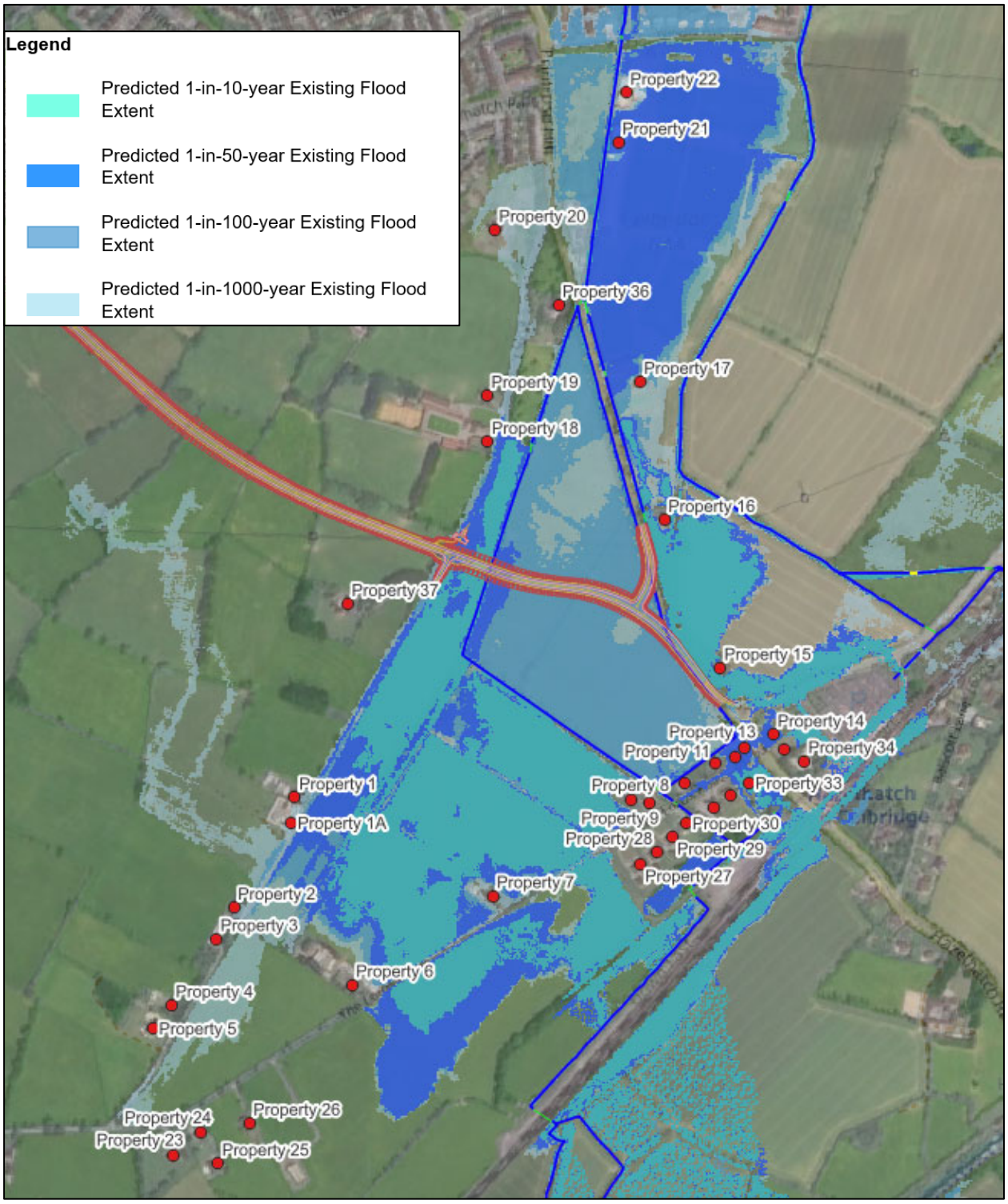


Figure 6-12 Existing Predicted Flood Extents

Table 6-5: Existing Properties Predicted Flood Risk for Existing Scenario

Property ID	1-in-10-year Return Period (Y/N)	1-in-50-year Return Period (Y/N)	1-in-100-year Return Period (Y/N)	1-in-1000-year Return Period (Y/N)
Property 1	N	N	N	N
Property 1A	N*	N*	N*	N*
Property 2	N	N	N	N
Property 3	N	N	N	N
Property 4	N	N	N	N
Property 5	N	N	N	N
Property 6	N	N	N	N
Property 7	N	N	N	N
Property 8	N	N	N	N
Property 9	N	N	N	N
Property 10	N	N	N	N
Property 11	N	N	N	N
Property 12	N*	Y*	Y*	Y*
Property 13	N	Y	Y	Y
Property 14	N	N	N	N
Property 15	N	N	N	N
Property 16	N	N	N	N
Property 17	N	N	N	N
Property 18	N	N	N	N
Property 19	N	N	N	N
Property 20	N	N	N	N
Property 21	N*	N*	Y*	Y*
Property 22	N	N	N	N
Property 23	N	N	N	N
Property 24	N	N	N	N
Property 25	N	N	N	N
Property 26	N	N	N	N
Property 27	N	N	N	N
Property 28	N	N	N	N
Property 29	N	N	N	N
Property 30	N	N	N	N
Property 31	N	N	N	N
Property 32	N	N	N	N
Property 33	N*	Y*	Y*	Y*
Property 34	N	N	N	N
Property 35	N	N	N	N
Property 36	N	N	N	N
Property 37	N	N	N	N
Properties at risk of flooding	**0**	3	**4**	**6**

** Estimated Finished Floor Survey based on engineering judgement due to no property access for threshold survey*

6.3.3.2 Proposed Conditions

As per the existing conditions, an assessment was carried out to establish the potential risk of flooding to existing properties at risk for the 2% AEP, 1% AEP and 0.1% AEP events after construction of the proposed CHMC.

The freeboard (height of FFL above predicted water level) for each dwelling was assessed for two potential scenarios:

- Proposed CHMC without mitigation measures Scenario
- Proposed CHMC with mitigation measures Scenario

Figure 6-13, **Figure 6-14** and **Figure 6-15** illustrate the predicted change in flood depths between the proposed CHMC with mitigation measures scenario and the existing flood conditions for the 2% AEP, 1% AEP and 0.1% AEP events.

The residential dwellings freeboard was computed for all 3 scenarios, and the results are listed in **Table 6-6** to **Table 6-8** for the 2% AEP, 1% AEP and 0.1% AEP events.

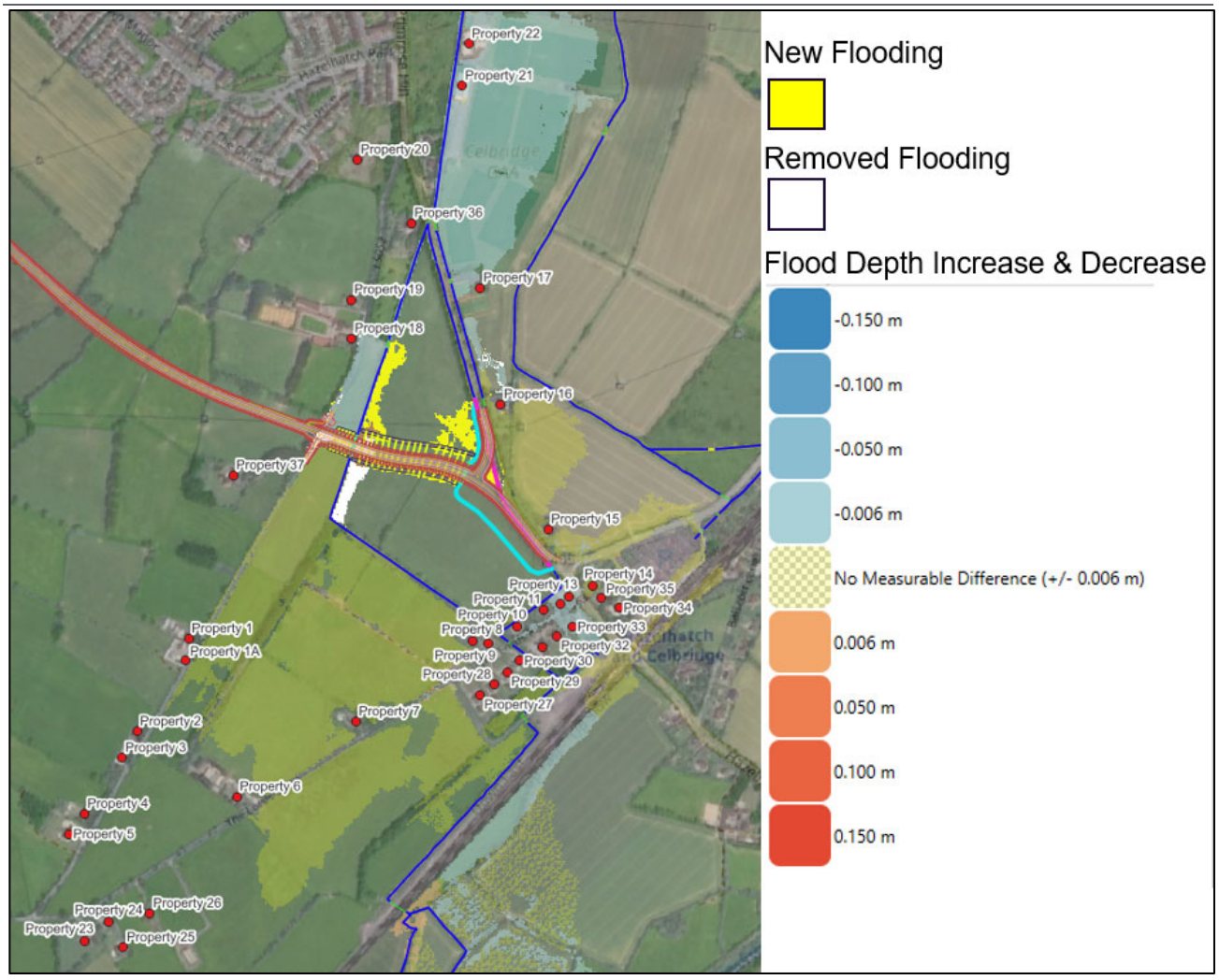


Figure 6-13 Proposed CHMC (with mitigation) Flood Risk Impact Review on Existing Properties – 2% AEP Event

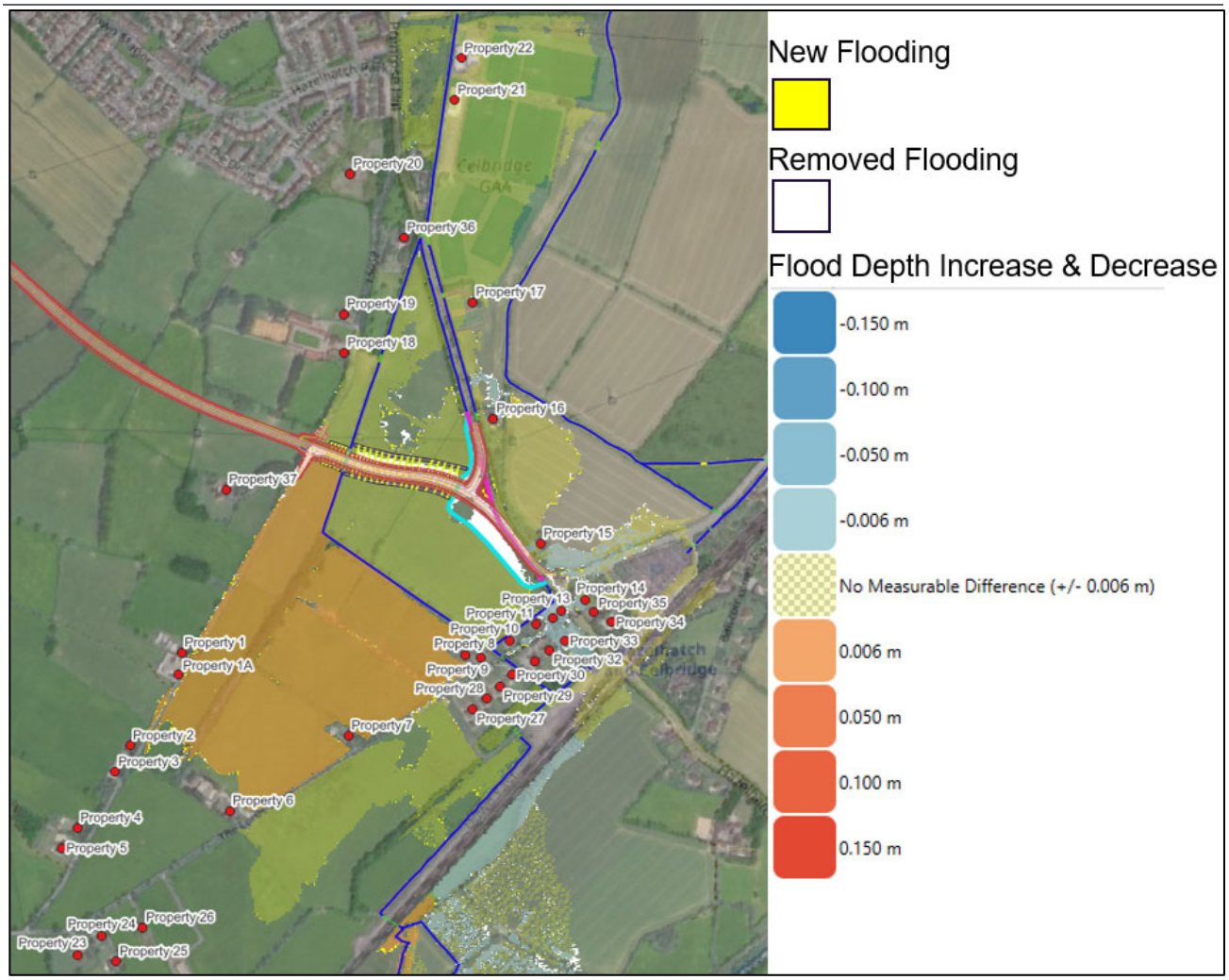


Figure 6-14 Proposed CHMC (with mitigation) Flood Risk Impact Review on Existing Properties – 1% AEP Event

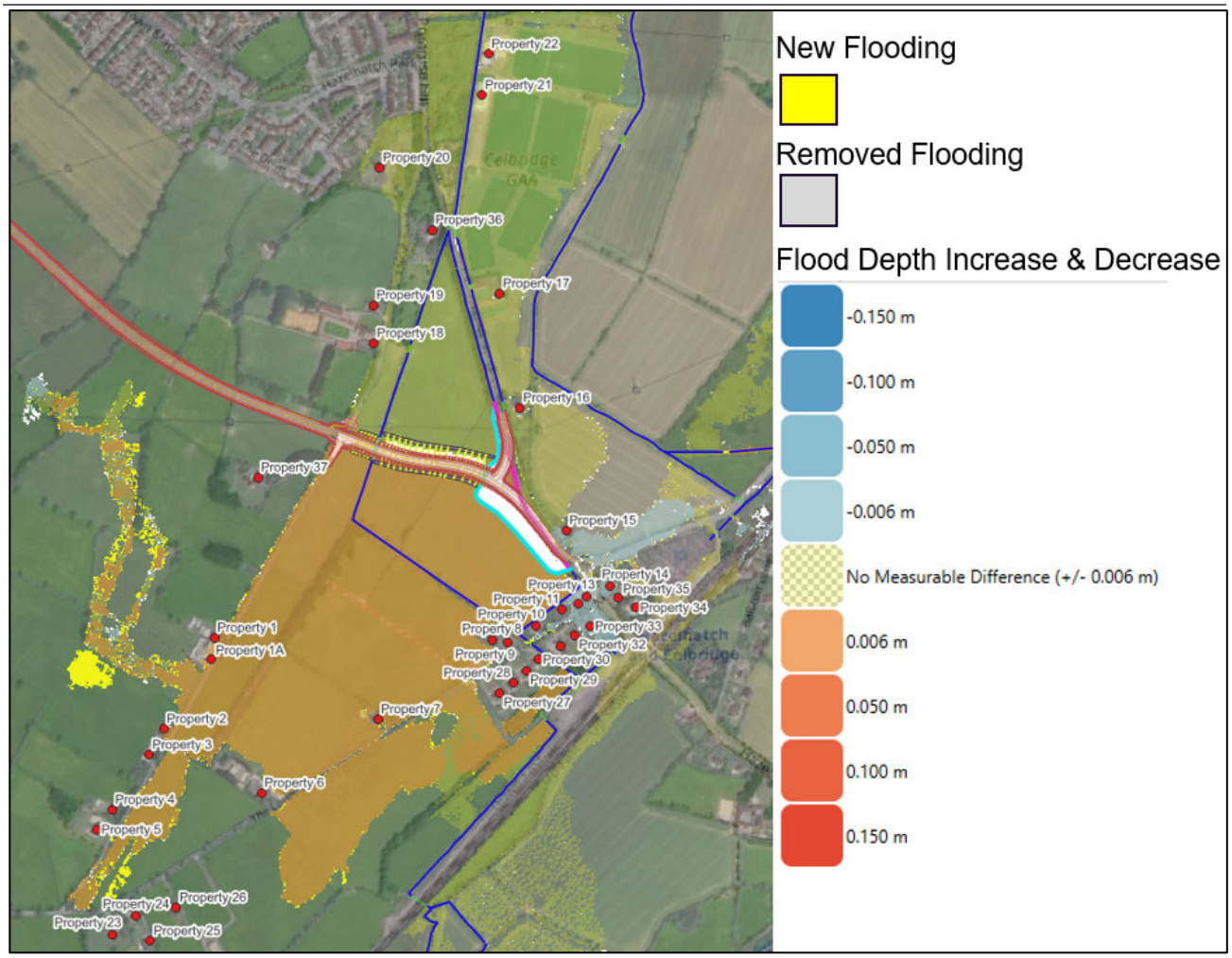


Figure 6-15 Proposed CHMC (with mitigation) Flood Risk Impact Review on Existing Properties – 0.1% AEP Event

Table 6-6: Proposed CHMC Flood Risk Impact Review on Existing Properties – 2% AEP Event

Property ID	Existing 1-in-50-year Freeboard (mm)	Proposed (no mitigation) 1-in-50-year Freeboard (mm)	Proposed (with mitigation) 1-in-50-year Freeboard (mm)
Properties with Decreased Freeboard			
Property 23	950	949	944
Property 24	1390	1389	1384
Property 25	2320	2319	2314
Property 26	3060	3059	3054
Property 27	1044	1043	1038
Property 28	1083	1082	1078
Property 29	1073	1072	1069
Property 30	923	922	919
Properties with Increased Freeboard			
Property 1	532	538	535
Property 1A	397*	403*	400*
Property 2	402	407	405
Property 3	1122	1127	1124
Property 4	1261	1267	1264
Property 5	1171	1177	1174
Property 6	1931	1937	1934
Property 7	671	677	674
Property 8	1041	1046	1044
Property 9	771	776	774
Property 10	455	464	468
Property 11	335	344	348
Property 12	**-264***	**-255***	**-251***
Property 13	**-124**	**-116**	**-112**
Property 14	152	158	154
Property 15	554	556	559
Property 16	261*	286*	294*
Property 17	668	695	678
Property 18	836	866	851
Property 19	1036	1066	1051
Property 20	651	680	660
Property 21	86*	117*	97*
Property 22	461*	493*	472*
Property 31	345	354	358
Property 32	315	324	328
Property 33	**-76**	**-67**	**-63**
Property 34	384	384	385
Property 35	305	309	308
Property 36	713	746	724
Property 37	2209*	2215*	2211*
Properties at risk of flooding	**3**	**3**	**3**

**Based on Estimated Finished Floor Survey from Drone Topographical Survey – no threshold survey undertaken due to no access to property*

Table 6-7: Proposed CHMC Flood Risk Impact Review on Existing Properties – 1% AEP Event

Property ID	Existing 1-in-100-year Freeboard (mm)	Proposed (no mitigation) 1-in-100-year Freeboard (mm)	Proposed (with mitigation) 1-in-100-year Freeboard (mm)
Properties with Decreased Freeboard			
Property 1	433	418	424
Property 1A	298*	283*	289*
Property 2	303	288	294
Property 3	1023	1008	1014
Property 4	1163	1148	1153
Property 5	1073	1058	1064
Property 6	1833	1818	1823
Property 7	573	558	563
Property 8	943	928	933
Property 9	673	658	663
Property 23	936	935	936
Property 24	1376	1375	1376
Property 25	2306	2305	2306
Property 26	3046	3045	3046
Property 27	1293	1278	1283
Property 28	1333	1318	1323
Property 29	1323	1308	1313
Property 30	1173	1158	1163
Properties with Increased Freeboard			
Property 10	441	456	460
Property 11	321	336	340
Property 12	**-277***	**-263***	**-259***
Property 13	**-138**	**-124**	**-120**
Property 14	141	150	148
Property 15	544	549	550
Property 16	253*	278*	282*
Property 17	548	549	549
Property 18	728	732	729
Property 19	928	932	929
Property 20	532	533	533
Property 21	**-37***	**-36***	**-36***
Property 22	337*	339*	338*
Property 31	331	346	350
Property 32	301	316	320
Property 33	**-91**	**-75**	**-71**
Property 34	381	381	382
Property 35	300	303	302
Property 36	493	493	493
Property 37	2104*	2089*	2095*
Properties at risk of flooding	**4**	**4**	**4**

**Based on Estimated Finished Floor Survey from Drone Topographical Survey – no threshold survey undertaken due to no access to property*

Table 6-8: Proposed CHMC Flood Risk Impact Review on Existing Properties – 0.1% AEP Event

Property ID	Existing 1-in-1000-year Freeboard (mm)	Proposed (no mitigation) 1-in-1000-year Freeboard (mm)	Proposed (with mitigation) 1-in-1000-year Freeboard (mm)
Properties with Decreased Freeboard			
Property 1	165	125	152
Property 1A	30*	-10	17*
Property 2	35	-5	22
Property 3	755	715	742
Property 4	895	855	882
Property 5	805	765	792
Property 6	1564	1525	1552
Property 7	304	265	292
Property 8	674	635	662
Property 9	404	365	392
Property 10	796	755	784
Property 11	676	635	664
Property 24	1339	1307	1330
Property 25	2269	2237	2260
Property 26	3009	2977	3000
Property 27	996	970	986
Property 28	1035	1009	1026
Property 29	1025	999	1017
Property 30	876	850	867
Property 37	1839*	1795*	1826*
Properties with Increased Freeboard			
Property 12	**-302***	**-298***	**-289***
Property 13	**-164**	**-159**	**-150**
Property 14	116	125	127
Property 15	522	520	524
Property 16	150*	153*	152*
Property 17	350	359	352
Property 18	456	478	458
Property 19	661	682	663
Property 20	213	220	213
Property 21	**-372***	**-364***	**-370***
Property 22	140*	150*	143*
Property 23	1111	1120	1114
Property 31	300	315	323
Property 32	270	283	291
Property 33	**-123**	**-114**	**-103**
Property 34	373	373	373
Property 35	287	290	289
Property 36	210	229	213
Properties at risk of flooding	**4**	**6**	**4**

**Based on Estimated Finished Floor Survey from Drone Topographical Survey – no threshold survey undertaken due to no access to property*

6.3.3.3 Impact Assessment

The freeboard assessment concludes the following outcomes:

- 3 no. residential dwellings are identified within the existing 2% AEP flood extent, prior to any proposed development.
- 4 no. residential dwellings are identified within the existing 1% AEP flood extent, prior to any proposed development.
- 4 no. residential dwellings are identified within the existing 0.1% AEP flood extent, prior to any proposed development.
- 2 no. residential dwellings would be introduced into the flood extent during the 0.1% AEP event if the CHMC is constructed without the proposed mitigation.
- No additional residential dwellings are introduced into the flood extent during the 0.1% AEP event if the CHMC is constructed with the proposed mitigation.
- Construction of the CHMC (both without and with mitigation) would improve freeboard for 18 no. properties including all 4 no. properties currently located within the predicted flood extent for the 0.1% AEP event.
- Freeboard is reduced for 20 no. properties for the proposed CHMC scenarios (both without and with mitigation) for the 0.1% AEP event. However, only 3 no. of these properties have a freeboard less than 300mm.
- Freeboard is predicted to be reduced for 18 no. properties following construction of the proposed CHMC scenarios (both without and with mitigation) for the 1% AEP event. Of these 18 no. properties, only 2 no. have freeboard less 300mm, though both have a freeboard greater than 285mm.
- Construction of the CHMC (both without and with mitigation) would improve freeboard for 20 no. properties including all 4 no. properties currently located within the predicted flood extent for the 1% AEP event.
- 8 no. residential dwellings are noted to have a minor reduction of freeboard in the 2% AEP event because of the CHMC, however all eight of these properties retain a freeboard in excess of 900m above water level after construction of the CHMC.
- The 3 no. properties located within the predicted flood extent for the 2% AEP event all benefit from a reduced depth of flooding from construction of the proposed CHMC (both with and without proposed mitigation).

6.4 Stage 3 Conclusion

The Stage 3 assessment concludes that the proposed CHMC without any additional flood mitigation measures may result in some minor increase in water level within the Hazelhatch River floodplain, particularly for the 0.1% AEP event. Therefore, flood mitigation measures are proposed within the design of the CHMC to offset this potential increase in risk.

Mitigation proposed in the design of the CHMC include:

- 15no. 0.9m Diameter Floodplain Culverts (60m length each)
- 4no. 1m deep ditches (500m total length)
- Swale on downstream side of the proposed CHMC includes for outfalls to the Hazelhatch Rivers and accommodates drainage outfalls from swales.

The results of the hydraulic modelling and impact analysis shows that the proposed CHMC provides an improved freeboard for all properties currently identified within the flood extent prior to any proposed development.

Furthermore, the impact assessment of the proposed CHMC with the additional flood mitigation measures demonstrates that no additional residential dwellings are introduced into the predicted flood extents for fluvial flood events up to and including the 0.1% AEP event.

Whilst there is a slight reduction of freeboard for some properties. However, all but three properties retain a freeboard greater than 300mm in the 0.1% AEP event. The results of the analysis showed the proposed CHMC provides an improved freeboard and benefits the most vulnerable residential dwellings located within proximity of the proposed CHMC.

It can be concluded that the proposed CHMC does not contribute to an increase in flood risk for existing properties predicted to experience flooding under existing conditions, and, that based on the hydraulic modelling undertaken for this Flood Risk Assessment, the proposed CHMC with the proposed mitigation, does not introduce any additional residential dwellings into the predicted flood extent for fluvial flood events up to and including the 0.1% AEP event.

7 JUSTIFICATION TEST

7.1.1 Justification Test Requirement

The proposed CHMC is strategic infrastructure, and a section of the proposed infrastructure lies within the Hazelhatch River Fluvial Flood Zone A. Therefore, a Justification Test is required.

7.1.2 Justification Test

The criteria of the Justification Test are listed and addressed in **Table 7-1**.

Table 7-1: Justification for Development Management

Criteria		Response
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	The *Kildare County Development Plan 2023 - 2029* objective TMO 66 is, *"Secure the implementation of the Priority Road and Bridge Projects and the Regional Roads Identified for Improvement (Table 5.4 and 5.5, refer) and maintain corridors free from development to facilitate future roads, cycle facilities and other transport infrastructure improvement identified within this Plan and Local Area Plans."* In Table 5.4 Number G is Second River Crossing- Celbridge from R403 Clane Road to Hazelhatch Train Station.
2.	**The proposal has been subject to an appropriate flood risk assessment that demonstrates:**	
2(i)	The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk:	The proposed CHMC is within the Hazelhatch River predicted floodplain. The FRA Stage 3 assessment has detailed that the proposed CHMC with mitigation does not increase fluvial flood risk elsewhere from the Hazelhatch River. The results of the analysis showed the proposed CHMC provide an improved freeboard for several residential dwellings located downstream.
2(ii)	The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible:	The minimum road level for the section of the proposed CHMC located in Flood Zone A and B is set above the existing 0.1% AEP peak water level plus freeboard. Hence the proposed CHMC will be removed from the flooding and remain accessible during flood event. The proposed CHMC includes mitigation measures which will reduce any risk of flooding brought about by the proposed infrastructure.
2(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 proposed CHMC, located in Flood Zone A, will be removed from the flooding and remain accessible. The out-of-bank flooding upstream and downstream of the proposed CHMC will be intercepted and pass through the 15no. floodplain culverts underneath the proposed infrastructure to mitigate obstruction of floodplain flow.
2(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 proposed CHMC fulfils objective TMO 66 of the *Kildare County Development Plan 2023 – 2029* in providing a new mobility corridor between Celbridge and Hazelhatch Train Station and also to provide connectivity for future development.

8 CONCLUSION

Based on the review of existing information referenced throughout this report and the information which has been established as a result of undertaking the flood risk assessment described in this report, the conclusions can be summarised as follows:

- The proposed development must undergo a Flood Risk Assessment under the Planning System and Flood Risk Management Guidelines for Planning Authorities (DoEHLG & OPW, 2009) (hereinafter referred to as “the Guidelines”).
- The proposed CHMC fulfils a key objective of the Kildare Sustainability Mobility & Transport development plan to fulfil requirement for a new mobility corridor between Celbridge and Hazelhatch Train Station and also to provide connectivity for future development.
- Alternative alignments have been considered, with the proposed alignment being the only feasible location.
- The desktop study undertaken identified fluvial flooding from the Hazelhatch Rivers as the primary source of flood risk to the proposed CHMC site. Potential fluvial flood risk was also identified for the River Liffey and Loughlinstown River Crossing. Fluvial Flooding caused by insufficient channel and/or hydraulic structures capacity contributing to out-of-bank flooding. Pluvial flooding was identified as a possible risk to the site due to the extent of the hardstanding area proposed for the development, and also due to GSI Synthetic Aperture Radar (SAR) seasonal flood map showing a low probability of localised pluvial flooding intersecting the proposed CHMC.
- The Stage 2 Initial Flood Risk Assessment completed in Section 5 concludes the design for the River Liffey and Loughlinstown River Crossings are adequate and does not pose a fluvial flood risk. The proposed CHMC drainage design improves the existing pluvial flood risk, and it also caters for the run-off from hardstanding areas and the discharge to receiving watercourses are limited to greenfield runoff rates. The fluvial flood risk from the Hazelhatch Rivers required further assessment and was progressed to Stage 3 Detailed Flood Risk Assessment.
- The Stage 3 Detailed Flood Risk Assessment completed in Section 6 concludes that the proposed CHMC with mitigation does not increase flood risk elsewhere. The results of the analysis showed the proposed CHMC provide an improved freeboard benefitting the most vulnerable residential dwellings located within proximity of the proposed CHMC.
- The proposed CHMC is considered an appropriate development of the site in accordance with the requirements of the Justification Test and the Planning Guidelines for Flood Risk Management (DoEHLG 2009).

Appendix A: Section 50 Application Report

CELBRIDGE HAZELHATCH MOBILITY CORRIDOR

Technical Report For OPW Section 50 Application

MDT0902-RPS-00-XX-RP-Z-0045
Celbridge Hazelhatch Mobility Corridor
A1 C01
29th April 2025

Document status

Status	Revision	Purpose	Authored by	Reviewed by	Approved by	Review date
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1 INTRODUCTION

1.1 Celbridge Hazelhatch Mobility Corridor Proposed Development

A 2020 report by Kildare County Council (A High-level Analysis of Bridge Infrastructure in Large Towns Located on Major Rivers in Ireland) found that Celbridge was one of only two Irish towns situated on a major waterway with a population range between 17,100 and 30,200 that was connected by a single bridge crossing of the major river.

In March 2020, RPS were commissioned by Kildare County Council (KCC) to provide the engineering and consultancy services required to deliver the Celbridge Hazelhatch Mobility Corridor scheme through Phases 1 to 4 of the TII Project Management Guidelines (PE-PMG-02041), including Concept and Feasibility, Options Selection, Design and Environmental Evaluation and the Statutory Processes.

The project is currently at Phase 3 Design and Environmental Evaluation.

The scheme consists of a second river crossing of the River Liffey and c. 2.1km mainline carriageway linking Celbridge to Hazelhatch train station. The project includes appropriate road junctions where the new route interfaces with existing regional and local roads.

The proposed scheme will improve journey times, provide better and safer access for all road user types between Celbridge town centre and Hazelhatch train station, and facilitate future measures to reduce traffic congestion in the town centre.

Figure 1-1: Site Location

1.2 Existing Watercourses

In addition to the primary watercourse crossing at the River Liffey, the route crosses a number of other minor watercourses including field drains and small streams. Where these streams will be crossed by the proposed road and require the consent of the Office of Public Works (OPW) in accordance with Section 50 of the Arterial Drainage Act, 1945, a Section 50 application will be submitted to the OPW for approval.

This report is prepared in support of a preliminary application for 1 No. such river crossing and 3 No. such culvert crossings under Section 50 of the Arterial Drainage Act, 1945, and forms the basis for preliminary Section 50 approval of these culverts.

The Section 50 application forms for all crossings included in this application are enclosed in Appendix A. The following information is presented in the drawings provided in Appendix B:

- Locations of the bridge, culverts, and necessary stream diversions
- Culvert and stream diversion longitudinal sections
- Typical construction details

1.2.1 River Liffey Crossing Catchment

The river Liffey and its associated tributaries upstream of the River Liffey Crossing drain a catchment area of approximately 837km^2, flowing north-eastwards from the Wicklow Mountains, discharging to the Irish Sea at Dublin City Centre. The River Liffey at Celbridge is approximately 24km away from the estuary with the Irish Sea and is approximately 40 meters above ground level at the estuary. Hence the River Liffey at the proposed location is not subject to tidal influence. The extent of the River Liffey Catchment upstream of the site area is indicated in Figure 1-2.

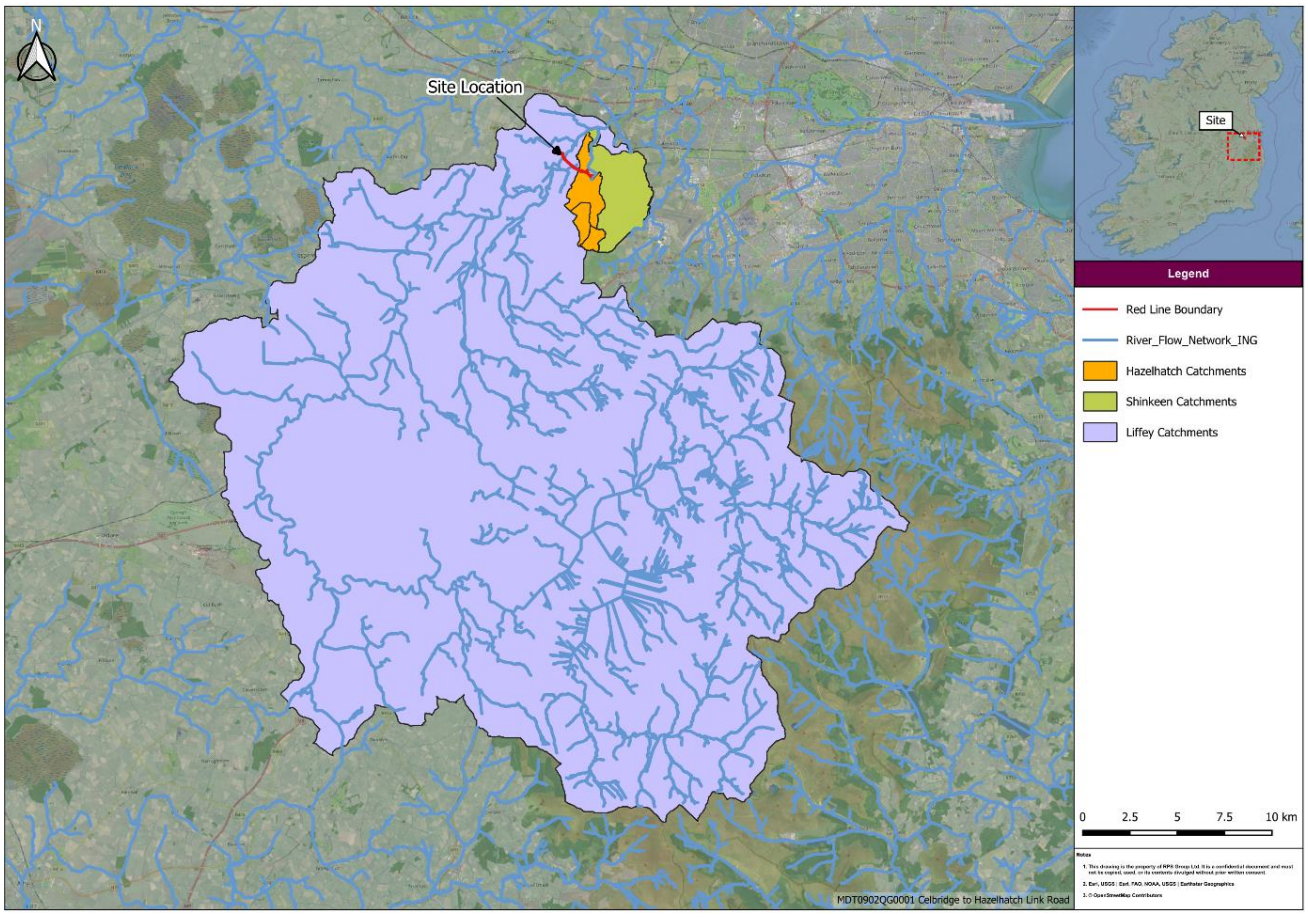


Figure 1-2: River catchment upstream of the proposed River Liffey Bridge

1.2.2 Culvert Catchment Cul-01

Proposed culvert Cul-01 facilitates the crossing of an open channel under the proposed mainline alignment at approximate chainage 0+880. The watercourse, called Loughlinstown Stream on Environmental Protection Agency (EPA) maps originates in the townland of Simmonstown, 350m to the northeast of the culvert and runs through a rural area from north to south and then terminates in the River Liffey 700m to the southwest of the culvert. The stream consists primarily of open channel but is culverted downstream under existing local roads and field accesses. The estimated size of the channel is 1.0m to 2.0m wide at its base and 1.0m to 1.8m deep. The catchment size for this stream upstream of culvert Cul-01 is 0.36km^2 derived using the 1:50,000 Discovery series contour maps and planned drainage scheme.

1.2.3 Culvert Catchment Cul-02

Proposed culvert Cul-02 facilitates the crossing of the Hazelhatch River under the proposed mainline alignment at approximate chainage 1+490. The watercourse originates in the townland of Dangan, 1,350m to the southeast of the culvert and runs through a mix of urban and rural area from south to north and then terminates in the River Liffey 2,160m to the north of the culvert. The stream consists primarily of open channel but is culverted downstream under existing local roads and field accesses. The estimated size of the river is 2.0m to 3.0m wide at its base and 0.8m to 1.0m deep. The catchment size for this river, upstream of culvert Cul-02, is 3.36km^2 derived using the 1:50,000 Discovery series contour maps and planned drainage scheme.

1.2.4 Culvert Catchment Cul-03

Proposed culvert Cul-03 facilitates the crossing of an open channel under the proposed mainline alignment at approximate chainage 1+710. The watercourse originates in the townland of Commons Lower, 300m to the southeast of the culvert and runs through a rural area from south to north and then terminates in the Hazelhatch River 470m to the north of the culvert. The stream consists primarily of open channel but is culverted upstream under field accesses. The estimated size of the channel is 1.0m to 1.2m wide at its base and 1.0m to 1.2m deep. The catchment size for this stream, upstream of culvert Cul-03, is 0.06km^2 derived using the 1:50,000 Discovery series contour maps and planned drainage scheme.

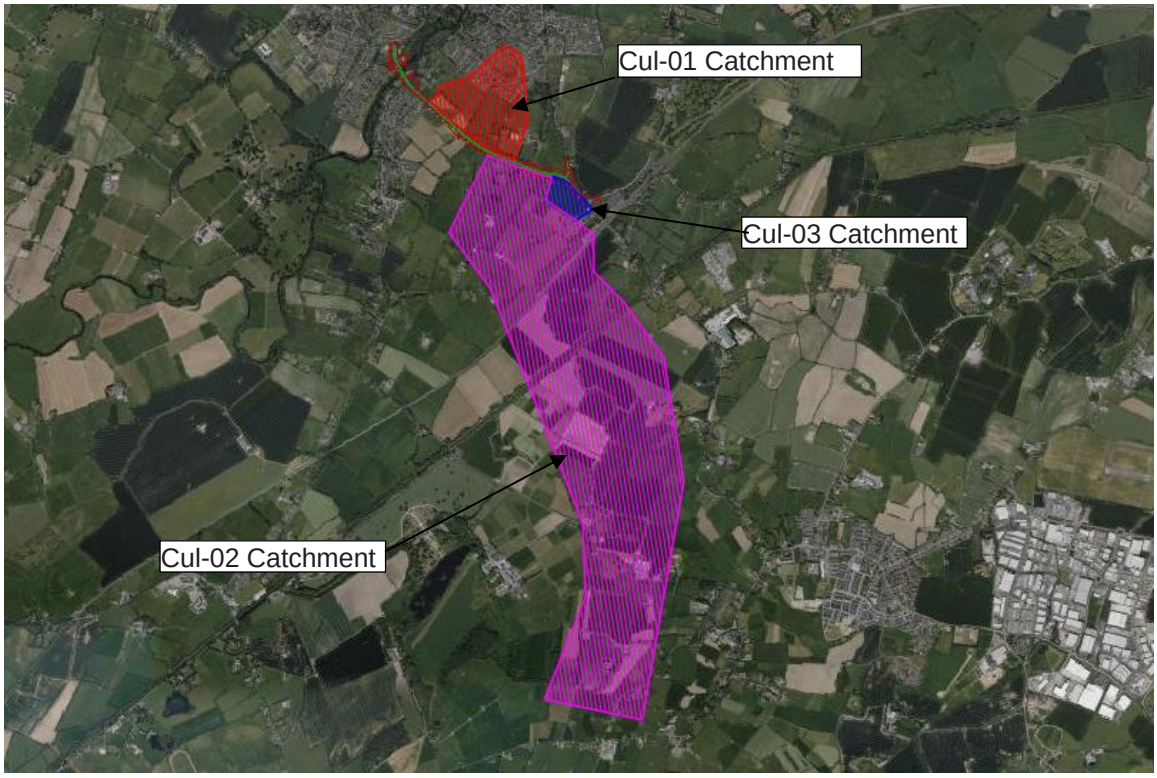


Figure 1-3: Culvert Catchments (www.bing.com/maps)

1.3 Proposed Watercourse Crossing Structures

The details of the proposed watercourse crossing structures are outlined in Table 1-1. The proposed River Liffey Bridge structure is shown on drawings MDT0902-RPS-01-XX-DR-Z-BR1010-BR1012 included in Appendix B and the proposed culverts layouts are shown on drawings MDT0902-RPS-01-XX-DR-C-DR1001-DR1004 included in Appendix B.

The proposed River Liffey Bridge will be an integral Single Span Varying Depth Steel Composite Plate Girder Bridge. Being an integral structure, the superstructure is connected monolithically to the substructure. This design enhances durability and reduces maintenance by eliminating expansion joints and bearings. The substructure will be reinforced concrete abutments on shallow footing foundations based on the geotechnical conditions.

Table 1-1: Proposed Crossing Information

Structure Ref.	Chainage	Location	Type	Span/ Length (m)	Size (m)	Embedment (m)	Inlet Co-ords (ITM)	Outlet Co-ords (ITM)
River Liffey Crossing	0+230	Mainline Corridor	Single Span Bridge	65.50	-	-	696774.830E 732339.077N	696785.138E 732353.128N
Cul-01	0+880	Mainline Corridor	Pipe	35.11	1.2mØ	0.300	697252.721E 731885.430N	697225.015E 731863.871N
Cul-02	1+490	Mainline Corridor	Box	37.40	4.0m (W) x 2.7m (H)	0.500	697776.993E 731586.745N	697788.980E 731622.206N
Cul-03	1+710	Mainline Corridor	Box	31.20	3.5m (W) x 2.6m (H)	0.500	697991.497E 731536.948N	698004.951E 731565.055N

1.4 Flood Risk Identification

1.4.1 Flood History

The OPW maintained database (www.floodinfo.ie) was consulted to identify areas prone to flooding. A flood hazard report was generated for all recorded flood events within 2.5km of the site and is shown in Figure 1-4. The report shows that there are 22 flood occurrences within 2.5km of the site. The details of the previous flood events are listed in Table 1-2.

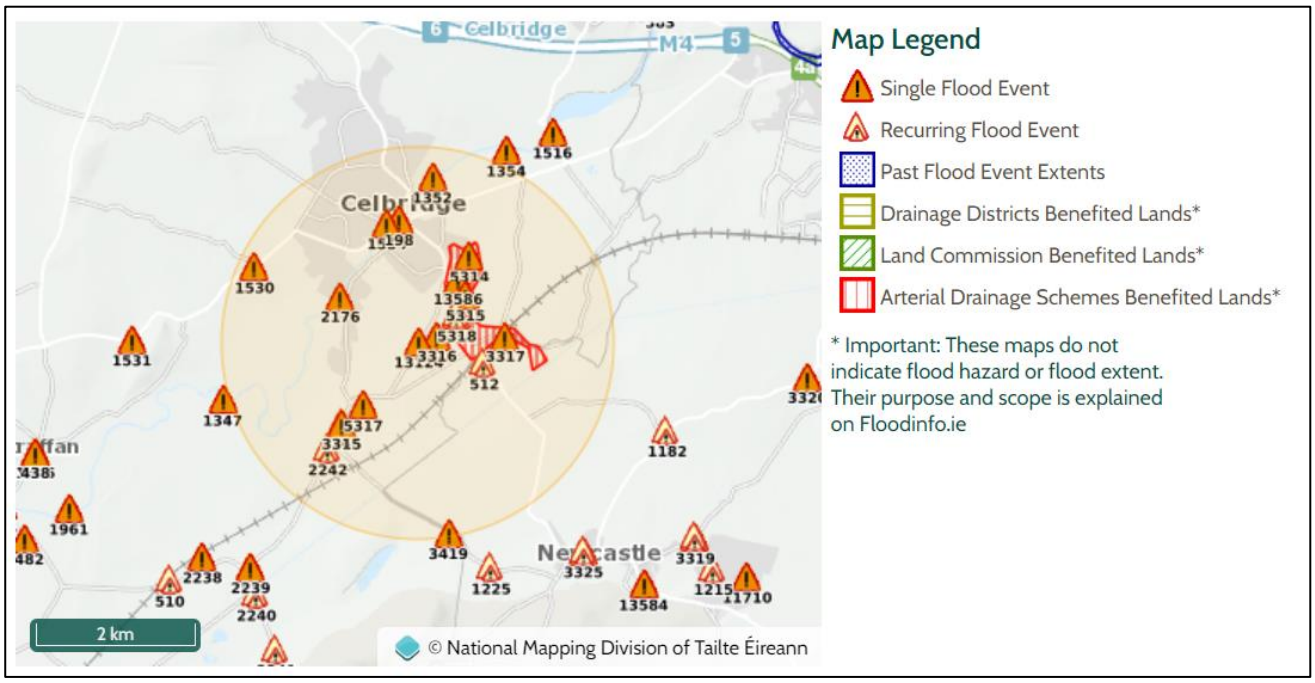


Figure 1-4: Past Flood Events (www.Floodinfo.ie)

Table 1-2: Details of Previous Flood Events

Document Type, Title, Date	Notes
OPW Flood Hazard Mapping – Phase 1 Meeting with Area Engineer Minutes dated April 2005.	Newtown Road/Ardclough Road, Clane Road and Oldtown Road Junction noted to be located on low lying land and roads subjected to flooding.
Floodinfo.ie report Flood event – 10th June 1993	(Out of Bank) Flooding affected Celbridge Town Centre, Hazelhatch Road and the railway line. Flooding considered to be an extreme event with rainfall estimated in the magnitude of a 200 year return period.
Floodinfo.ie report August 1996	Flooding to Hazelhatch Road.
Floodinfo.ie report 9th April 1998	Flooding to homes on the Hazelhatch Road, Celbridge, tennis courts and Celbridge GAA club.
Floodinfo.ie report September 1999	Parts of Hazelhatch and Hazelhatch Road flooded to depths varying from 100mm to over 500mm. This caused traffic disruption and parts of Hazelhatch were impassable for some time. It was recorded that five or six houses on the Hazelhatch Road were surrounded with water. No internal damage was recorded. Celbridge tennis courts and Celbridge GAA clubhouse carpark and football pitch was inundated. Some flooding of the clubhouse basement was experienced.
Floodinfo.ie report 5th November 2000	Flooding from Shinkeen River to Hazelhatch railway lines contributing to closure of southern train services. The Celbridge GAA club also affected.

Document Type, Title, Date	Notes
Floodinfo.ie report Flood Event 4th/15th November 2002	Newtown Road/Ardclough Road, Clane Road and Tea Lane/Main Street Junction affected by flooding during this event. One house on Newtown Road/Ardclough Road was flooded. Two premises at the mill adjacent to the junction between Tea Lane and Main Street was also flooded.
Floodinfo.ie report 14th November 2014	Celbridge GAA club pitches, the primary school and tennis club courts were flooded.
Floodinfo.ie report 22nd/23rd November 2017	Celbridge GAA club pitches, the primary school and tennis club courts were flooded. Anecdotal evidence from residents indicated the culverts on the Hazelhatch River appear to have exacerbate the flooding during this event. The culverts on the stream have been subjected to maintenance to remove debris using trash screen at culvert inlets.
Floodinfo.ie report 8th November 2019	Celbridge GAA club pitches and tennis club were flooded.

1.4.2 Indicative Flood Risk Mapping

The Preliminary Flood Risk Assessment (PFRA) fluvial mapping was produced to identify areas of potentially significant risk to be further assessed under the Catchment Flood Risk Assessment Management (CFRAM) studies. The Eastern CFRAM HA 09 study included the entirety of the mainline corridor in its study extents. The proposed development intersects the 1% Annual Exceedance Probability (AEP) and 0.1% AEP floodplains, with flooding indicated at culvert crossings Cul-02 and Cul-03. The floodplains are considered Very High importance in the vicinity of Chelmsfords Manor and High importance in the vicinity of the Hazelhatch roundabout at Commons Lower. The CFRAM study predicted 10% AEP, 1% AEP and 0.1% AEP flood extents to be contained within steep bank slopes in the vicinity of the proposed River Liffey Bridge Crossing.

The Hazelhatch Further Study was commissioned following a recommendation made in the Eastern CFRAM study for further analysis to establish more certainty in the hydraulic model flood predictions for the Hazelhatch and Shinkeen River Catchments. Permission was provided to RPS from Kildare County Council to use the Hazelhatch further study model as it provides a more complete and up to date flood model. Figure 1-5 shows the flood extents from this study.

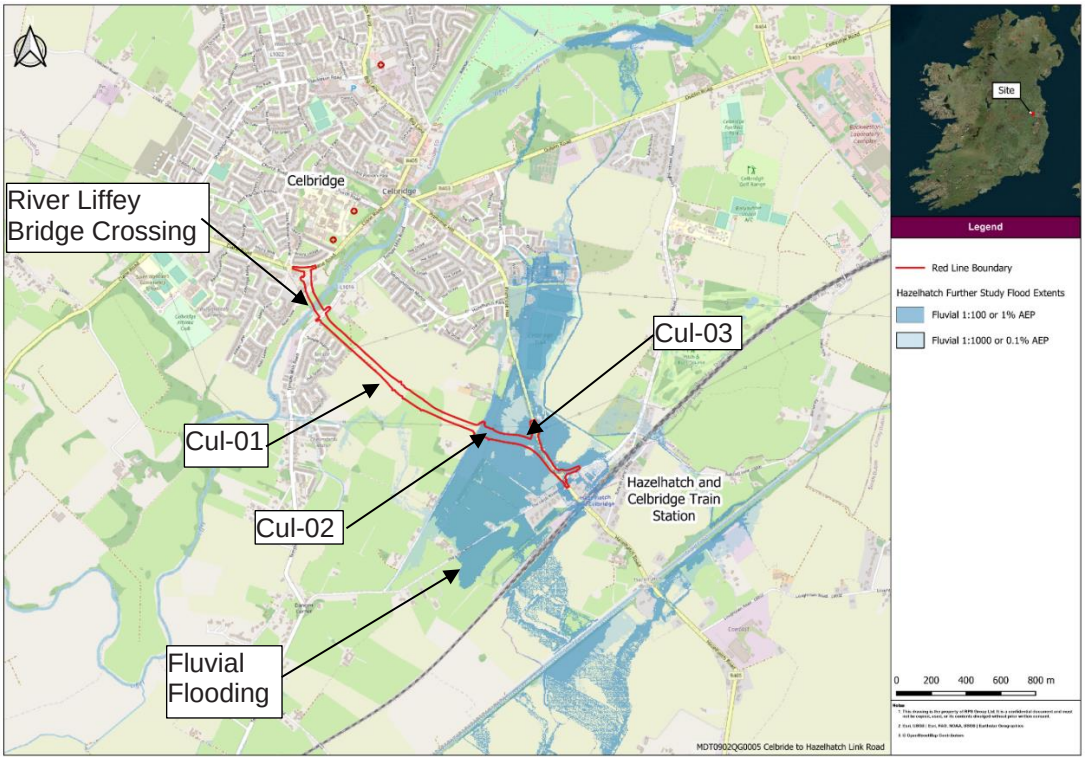


Figure 1-5: Hazelhatch Further Study Fluvial Predictive Flooding – Present Day

2 CROSSING CATCHMENTS AND DESIGN FLOWS

As discussed in section 1.4.2, detailed flood studies have been completed recently for the watercourses associated with the proposed River Liffey bridge crossing and culvert crossings Cul-02 and Cul-03. It has been agreed with OPW and KCC that the 'Eastern CFRAM study HA09' and the 'Hazelhatch Further Study' reports can be used in the hydrological estimation of flow for these watercourse crossings.

Notwithstanding this, flood estimation flow calculations have been carried out for all watercourses using the methods outlined in section 2.1 below to ensure the most conservative flows (i.e. the largest flows) are adopted.

2.1 Flood Estimation Calculation Methods

Most streams are ungauged and so the design flows have been estimated using methods dictated by the catchment size.

The catchment size for the watercourses upstream of the proposed crossings were derived using OPW Hydronet web portal or the EPA contours available on the Geological Survey Ireland (GSI) GIS Data Viewer maps (https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=bc0dba38f3f5477c8fd400f66b5eedcd).

The UK Institute of Hydrology Methodology (IH 124), the 3-variable revision of the original Flood Studies Supplementary Report No. six variable equation (FSSR 6, 3-Variable), the Agricultural Development and Advisory Service (ADAS) method, OPW Flood Studies Update (FSU) 3-Variable, OPW FSU 5-Variable or flood frequencies module of the FSU 7-Variable online portal were used to estimate flow depending on the catchment size. **Table 2-1** below outlines the applicable calculation method based on the catchment size.

Table 2-1: Design Flow Calculation Methods

Catchment Size (km^2)	Calculation Method	Method Reference
< 0.4	ADAS	DN-DNG-03064 (TII)
< 25.0	IH 124	DN-DNG-03064 (TII)
< 25.0	FSSR 6, 3-Variable	FSR
0.4 to 25.0	FSU 3 Variable	opw.hydronet.com
0.4 to 25.0	FSU 5 Variable	opw.hydronet.com
> 25.0	FSU Web Portal (FSU 7 Variable)	opw.hydronet.com

As indicated by the table, the flows from catchments less than $25km^2$ were calculated by the IH 124, FSSR 6, 3-Variable and the ADAS method. Additionally, for catchments between $0.4km^2$ and $25km^2$, the OPW FSU 3-Variable method and the OPW FSU 5-Variable method were also calculated. Once all methods were estimated, the most conservative flow (i.e. the largest flow) adopted as the design flow.

2.2 Design Flows

2.2.1 Design Flows Using Flood Estimation Methods

If the watercourse forms part of an OPW arterial drainage scheme, a drainage district factor of 1.6 was applied to all methods (except the FSU 7 Variable as an arterial drainage factor is in-built in the calculations) as required by the OPW. A factorial standard error (FSE) of 1.651 was applied to the IH 124 method and a factor of 1.58 was applied to the FSSR 3-variable method. FSEs of 2.059 and 1.686 were applied to the FSU 3-Variable method and FSU 5-variable methods respectively.

A growth factor of 1.96 was applied to IH124 and FSSR 3 variable methods to account for the 100-year flood flows while a growth factor of 2.60 was applied to the FSU 3-variable and 5-variable methods. After reviewing the results from each method with relevant factors applied, the most conservative (i.e. the highest) estimated flow was considered as design flow for the culvert sizing calculations. As the ADAS method

calculates the 75-year flood flow, a growth factor of 1.05 was applied to account for the 100-year flood flow in accordance with Flood Studies Report (FSR) growth curves. All design flows are subject to a 20% climate change allowance.

The Standard Average Annual Rainfall (SAAR) was obtained from the FSU website and the SOIL index value was calculated from the winter rain acceptance potential (WRAP) map and associated formulae. For the ADAS calculation, the largest site-wide SAAR value was applied to all catchments as a conservative measure.

A summary of flow calculations is given in Table 2-2 with catchment descriptors in Table 2-3.

Table 2-2: Catchment Design Flows

Bridge/ Crossing	Catchment (km^2)	Q_{75}*	Q_{bar}/Q_{med}* (m^3/s)					Flow Q100 + SFE + 20% (CC) (m^3/s)
		ADAS Method	IH 124 Method	FSU 3-Var Method	FSU 5-Var Method	FSU 7-Var Method	FSSR 6, 3-Var Method	
River Liffey	837	-	-	**-**	-	**63.406**	-	129.396
Cul-01	0.36	-	0.071	**0.093**	0.029		0.071	0.596
Cul-02	3.36	-	0.520	0.595	**0.621**		0.562	3.270
Cul-03	0.06	**0.093**	0.056	-	-		-	0.120

*Values in bold indicate the adopted method

Table 2-3: Catchment Descriptors

Bridge / Culvert	All methods								IH124, FSSR and FSU methods				FSU	ADAS Method	
	Catch't Area	Soil Factor Calculation						SAAR	BFISOIL	FARL	DRAIND	S1085	GF	Max Catch't Width	Avg. Height of Catch't Divide
		WRAP1	WRAP2	WRAP3	WRAP4	WRAP5	Soil Factor								
	km^2	*%*	*%*	*%*	*%*	*%*	*-*	*mm*	*-*	*-*	*km/ km^2*	*m/ km^2*	*-*	*(W)m*	*(Z)m*
River Liffey	837	-	-	-	-	-	-	1037.7	0.65	0.9	1.02	1.98	1.7	-	-
Cul-01	0.36	0	1	0	0	0	0.3	727.6	0.65	1	0.24	0.10	2.6	-	-
Cul-02	1.18	0	1	0	0	0	0.3	727.6	0.65	1	0.24	5.35	2.6	-	-
Cul-03	0.06	0	1	0	0	0	0.3	727.6	0.65	1	0.24	0.10	2.6	180	10

2.2.2 Design Flows from OPW Reports

Table 2-4 presents design flows for the proposed river Liffey bridge crossing and culvert crossings Cul-02 and Cul-03 taken from flood modelling reports previously commissioned by the OPW. As the design flows for these crossings exceed those calculated in section 2.2.1, these flows are adopted as the design flows for the crossings listed below.

Table 2-4: Design Flows from OPW Reports

Bridge / Crossing	OPW Report	Q_{med} (m^3/s)	Flow Q100 + SFE + 20% (CC) (m^3/s)
River Liffey	**Eastern CFRAM Study HA09**	56.5	130.53
Cul-02	**Hazelhatch Further Study – Hydrological and Hydraulic Analysis Report**	1.163	3.864
Cul-03	**Hazelhatch Further Study – Hydrological and Hydraulic Analysis Report**	1.163	3.864

Table 2-5 below lists the design flows adopted for the design of the watercourse crossings.

Table 2-5: Adopted design flows for watercourse crossings.

Bridge / Crossing	Flow Calculation Method	Q_{bar}/Q_{med}* (m^3/s)	Design Flow Q100 (m^3/s)
River Liffey	**Eastern CFRAM Study**	56.50	130.53
Cul-01	**FSU 3-Variable**	0.241	0.596
Cul-02	**Hazelhatch Further Study**	1.163	3.864
Cul-03	**Hazelhatch Further Study**	1.163	3.864

3 PROPOSED CROSSING DETAILS

3.1 Environmental Requirements

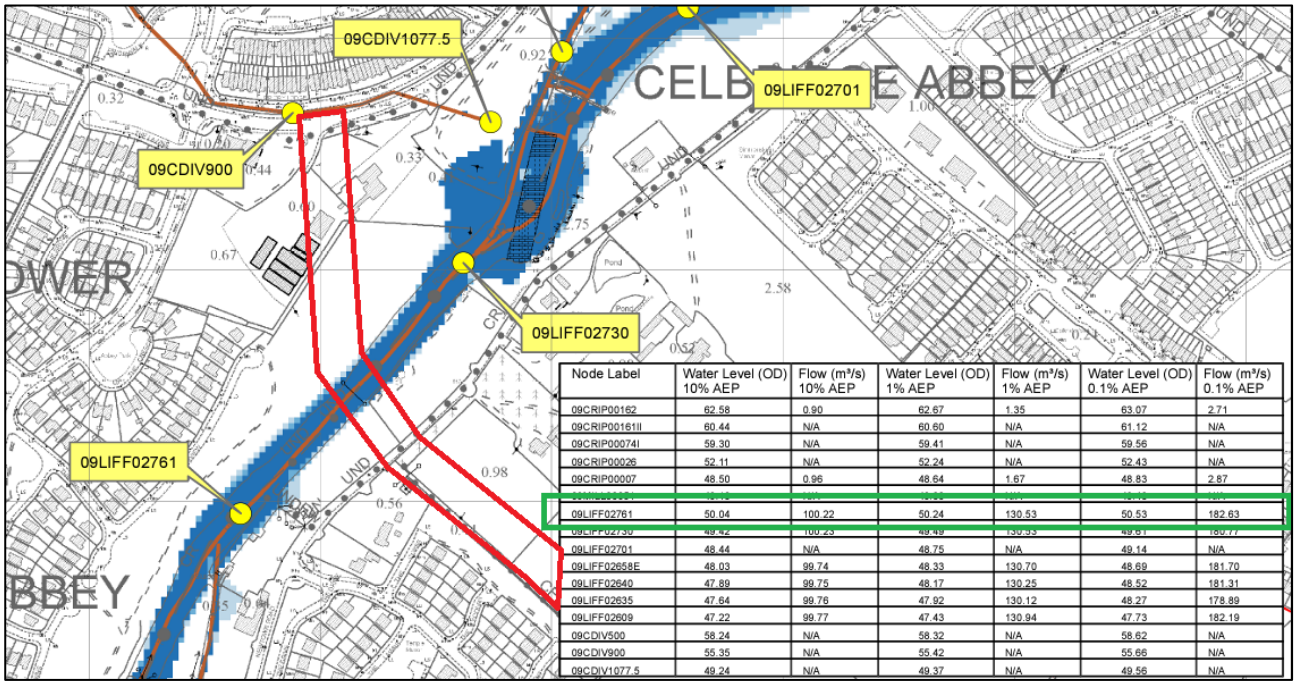
The proposed river bridge will span the River Liffey in the townland of Celbridge Abbey approximately 850m upstream of the existing R405 crossing (Celbridge Bridge), currently the sole river crossing in the town.

To mitigate the potential ecological impacts of the bridge construction a minimum of 1.2m clearance between the bottom of the structure and the stream banks will be maintained and a minimum of 5m riparian buffer zone will be provided offset from both stream banks.

3.2 Hydraulic Design

3.2.1 River Liffey Bridge

The proposed River Liffey Bridge crossing will span across the CFRAM 0.1% AEP predicted peak flood level (50.53mOD) as shown in Figure 3-1. The 0.1% AEP flood extents are contained within the river's steep bank slopes in the vicinity of the proposed crossing, and the proposed bridge is designed to span above the top of the riverbanks. Hence the proposed structure will not have any impact on the predicted flooding from the River Liffey and no hydraulic modelling was deemed necessary. A summary of the resulting proposed bridge details is given in Table 3-1 below.



Node Label	Water Level (OD) 10% AEP	Flow (m³/s) 10% AEP	Water Level (OD) 1% AEP	Flow (m³/s) 1% AEP	Water Level (OD) 0.1% AEP	Flow (m³/s) 0.1% AEP
09CRIP00162	62.58	0.90	62.67	1.35	63.07	2.71
09CRIP00161II	60.44	N/A	60.60	N/A	61.12	N/A
09CRIP00074I	59.30	N/A	59.41	N/A	59.56	N/A
09CRIP00026	52.11	N/A	52.24	N/A	52.43	N/A
09CRIP00007	48.50	0.96	48.64	1.67	48.83	2.87
09LIFF02761	50.04	100.22	50.24	130.53	50.53	182.63
09LIFF02701	48.44	N/A	48.75	N/A	49.14	N/A
09LIFF02658E	48.03	99.74	48.33	130.70	48.69	181.70
09LIFF02640	47.89	99.75	48.17	130.25	48.52	181.31
09LIFF02635	47.64	99.76	47.92	130.12	48.27	178.89
09LIFF02609	47.22	99.77	47.43	130.94	47.73	182.19
09CDIV500	58.24	N/A	58.32	N/A	58.62	N/A
09CDIV900	55.35	N/A	55.42	N/A	55.66	N/A
09CDIV1077.5	49.24	N/A	49.37	N/A	49.56	N/A

Figure 3-1: CFRAM Study Predicted Flooding Extent – River Liffey Bridge Crossing (www.floodinfo.ie)

3.2.2 Culvert Cul-01

Culvert Cul-01 was sized based on the calculations set out in the updated Construction Industry Research and Information Association (CIRIA) document 'Culvert, Screen and Outfall Manual (2019)', CIRIA Report No. C786. A summary of the resulting calculation outputs and proposed culvert details are given in Table 3-2 below.

3.2.3 Culverts Cul-02 & 03

Culverts Cul-02 and 03 are heavily influenced by the 1% AEP event of the Hazelhatch River as outlined in the OPW report 'Hazelhatch Further Study'. To accurately determine sizes for Culverts Cul-02 and Cul-03, both culverts were included in a 1D-2D Infoworks Integrated Catchment Modelling (ICM) model developed

as part of the Flood Risk Assessment produced to examine the flooding response due to the proposed development. The Infoworks model also included 15 no. 0.9m diameter floodplain culverts located immediately west of culvert Cul-03, between chainage 1+450 to 1+700, to mitigate an increase in the predicted flood depths upstream of the proposed scheme. Design flood levels for crossings Cul-02 and 03 in the Flood Risk Assessment model greatly exceeded the levels calculated for the crossings using the calculation methods as set out in CIRIA document 'Culvert, Screen and Outfall Manual (2019)', CIRIA Report No. C786. Therefore, the peak design flood levels computed in the Infoworks ICM model are adopted as design flood level for these culverts.

The design flood level plus freeboard determines the minimum height required for the culverts. Culvert widths were chosen to ensure culverts are not prone to blockage, that flow velocities are adequate to prevent excessive sedimentation and to closely match flow velocities in the existing watercourse. A summary of the resulting proposed culverts details are given in Table 3-2 below.

Table 3-1: River Bridge Crossing Details

Culvert/ Crossing	Townland	Structure Type	Approximate Structure Width	Approximate Structure Span	Structure Soffit Level	Stream Bed Level	Stream Bank Level	Design Flood Level
		-	*(m)*	*(m)*	*(mOD)*	*(mOD)*	*(mOD)*	*(mOD)*
River Liffey Crossing	Celbridge Abbey	Single Span Varying Depth Steel Composite Plate Girder Bridge, Integral Structure	16.03	65.50	51.964 to 54.241	48.000	50.118 to 50.464	50.530

Table 3-2: Proposed Culvert Sizes & Hydrological Calculation Output

Culvert Name	Type	Length	Size			Depth of Embedment	USIL (Top of Embedment)	DSIL (Top of Embedment)	Design Flood Level	Culvert Gradient	Freeboard (Min. 0.3m)	Net Head Loss (Max. 0.3m)
			Diameter	Width	Height (incl. embedment)							
		(m)	*(m)*	*(m)*	*(m)*	*(m)*	*(mOD)*	*(mOD)*	*(mOD)*	*(1:x)*	*(m)*	*(m)*
Cul-01	Pipe	35.106	1.2		-	0.30	53.605	53.443	54.155	127.0	0.350	0.219
Cul-02	Box	37.400	-	4.0	2.7	0.50	53.989	53.971	55.797	2077.8	0.384	0.005
Cul-03	Box	31.200		3.5	2.6	0.50	54.005	53.990	55.794	2080.0	0.300	0.003

4 CONCLUSIONS

The main findings of the Section 50 are as follows:

- The proposed Celbridge Hazelhatch Mobility Corridor scheme intersects a number of water courses along its route.
- New culverts/bridges will be installed as required at these locations in order to maintain the flow within the watercourses, while facilitating the proposed works.
- Installation of these crossings requires the consent of the OPW in accordance with Section 50 of the Arterial Drainage Act, 1945.
- A new crossing of the Liffey River is proposed.
- The hydrologic and hydraulic modelling for the River Liffey and proposed bridge structure has been adopted from the modelling undertaken in the 'Eastern CFRAM Study Unit of Management 09 hydraulic modelling report' published in August 2017. As the proposed bridge abutments are located beyond the extent of the river cross-section for the design flood level, the hydraulic conditions modelled in the CFRAM study will be maintained.
- The new bridge is designed to span over the existing river and maintain the existing bed levels within the river.
- Crossing of other watercourses intersected by the scheme will require the provision of 3 no. culverts.
- In order to facilitate the works, it is proposed to construct 1 No. 1.2mØ pipe culvert, 1 No. 4.0m wide x 2.7m high box culvert and 1 No. 3.5m wide x 2.6m high box culvert at the proposed locations.
- Floodinfo.ie indicates significant historical flooding within the subject site at Culverts Cul-02 and Cul-03. Design of these culverts have been undertaken in Infoworks ICM model utilising the design flow estimates produced in the OPW report 'Hazelhatch Further Study'.
- The new culverts were designed to mimic as far as is reasonably possible the existing bed levels within the stream.
- All crossings satisfy the minimum requirements of the Section 50 process.

Appendix A

Section 50 Application Forms

Construction, Replacement or Alteration of Bridges and Culverts
Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010

Project Name	**Celbridge To Hazelhatch Link Road**	Structure Ref No.	**Cul-01**

Applicant (Correspondence will issue to agent)		
Company or Organisation Name: Kildare County Council		
Postal Address:	Áras Chill Dara, Devoy Park, Nass, Co. Kildare, W91 X77F	
Contact Person:	Kevin Kane	
Phone:	+353 087 360 7606	Fax:
E-mail:	kkane@kildarecoco.ie	

Agent (Correspondence will issue to agent)		
Company or Organisation Name: RPS Consulting Engineers		
Postal Address:	Lyrr Building, IDA Business and Technology Park, Mervue, Galway	
Contact Person:	Brendan Lyons	
Phone:	+353 91 400 200	Fax:
E-mail:	brendan.lyons@rpsgroup.com	

Location and Parameters of crossing				
Watercourse:	Loughlinstown Stream		Catchment:	Liffey River
Address (Townland – County):	Simonstown, Celbridge, Co. Kildare			
Grid Reference	X:	697252.721	Y:	731885.430
Hydrometric Station(s) utilized (including reference number):	N/A			
Area of Contributing Catchment:	0.36 Km^2		Road Reference:	N/A
Design Flood Flow:	0.6m^3/s	Annual Exceedance Probability (AEP):		1.0 %

Statement of Authenticity	
I hereby certify that the information contained in this application form, along with all appended supporting information, has been checked by me and that all statements are true and accurate.	
Name:	Brendan Lyons
Company/Organisation:	RPS
Signature:	Brendan Lyons
Date:	**29th April 2025**

Application Check List	
COMPLETED APPLICATION FORM	☒
SUPPORTING HYDROLOGICAL AND HYDRAULIC INFORMATION	☒
PHOTOGRAPHS COVERING SITE OF ALL PROPOSED WORKS	☒
SCALED PLAN OF BRIDGE/CULVERT/APPROACH EARTHWORKS	☐
SCALED CROSS SECTION OF BRIDGE/CULVERT/APPROACH EARTHWORKS	☐
SCALED LONG SECTION OF CHANNEL THROUGH BRIDGE/CULVERT	☐
DETAILS OF RELEVANT EXISTING STRUCTURES	☐
COMPLETED STATEMENT OF AUTHENTICITY	☐
PLAN OF CATCHMENT AREA	☐
COPY OF NOTICE OF GRANT OF PLANNING PERMISSION WITH CONDITIONS *1	☐

For OPW use only	*Date of Receipt*							
OPW Drainage Maintenance Region	*East*	☐	*South East*	☐	*South West*	☐	*West*	☐

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

Correspondence Number	*OPW Register No:*	
	Consent Issued	☐

ADDITIONAL INFORMATION

Hydrological Analysis

Methodology Applied		
Method Used	Tick box if used or state other	Flow *2 (m^3/sec)
6 – Variable Catchment characteristics	☐	
3 – Variable Catchment Characteristics	☒	**0.071**
IH 124	☒	**0.071**
Gauged Flow	☐	
Unit Hydrograph	☐	
ADAS	☐	
Other	☐	

FSR ☐ FSU ☒ Other ☐

Comments SAAR 727.6mm/yr; Soil Factor=0.3;
FSU (3-var) = 0.093(m^3/sec)

Factors Applied	
Type of Factor	Value Used
Climate Change	
Irish Growth Curve (IH 124 & 3 - Variable Catchment Characteristics)	1.96
Irish Growth Curve (FSU)	2.60
Factor for Standard Error (FSU 3-var)	2.059
Factor for Standard Error (FSU 5-var)	1.686
Factor for Standard Error (IH 124)	1.65
Factor for Standard Error (3 - Variable Catchment Characteristics)	1.58
Tidal ☐	
Comments:	

Hydraulic/Structure Details

Description of Structure*3: Construction of a new 1.2mØ culvert with headwalls. The culvert will have 300mm embedment.	
Effective Conveyance Area *4	**0.85m²**
Upstream Invert Level: **53.305**mOD	Downstream Invert Level: **53.143**mOD
Upstream Soffit Level: **54.505**mOD	Downstream Soffit Level: **54.343**mOD
Upstream Design Flood Level: **54.155**mOD	Downstream Design Flood Level: **53.773**mOD

NOTES :

1. In line with OPW policy, section 50 approvals should be sought for bridges and culverts that are necessary for access or deemed acceptable by the planning authority. A copy of the notice of grant of planning permission with all conditions should be enclosed with all applications, that are not exempt development under the Planning and Development Act, 2000, as evidence that these factors have been considered.
2. Flow is the estimated flow from the catchment, without any factors applied.
3. The following details are to be included: the channel bed level, invert and soffit levels of the structure along with the width, length and total conveyance area. Any environmental considerations such as bed depression, baffles, mammal walkways etc. should be described.

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

4. Effective conveyance area is from channel bed level to design flood level.
5. All levels must be given to Ordnance Datum, Malin Head.

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

Construction, Replacement or Alteration of Bridges and Culverts
Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010

Project Name	**Celbridge To Hazelhatch Link Road**	Structure Ref No.	**Cul-02**

Applicant (Correspondence will issue to agent)			
Company or Organisation Name: Kildare County Council			
Postal Address:	Áras Chill Dara, Devoy Park, Nass, Co. Kildare, W91 X77F		
Contact Person:	Kevin Kane		
Phone:	+353 087 360 7606	Fax:	
E-mail:	kkane@kildarecoco.ie		

Agent (Correspondence will issue to agent)			
Company or Organisation Name: RPS Consulting Engineers			
Postal Address:	Lyrr Building, IDA Business and Technology Park, Mervue, Galway		
Contact Person:	Brendan Lyons		
Phone:	+353 91 400 200	Fax:	
E-mail:	brendan.lyons@rpsgroup.com		

Location and Parameters of crossing					
Watercourse:	Hazelhatch River			Catchment:	Liffey River
Address (Townland – County):		Commons, Celbridge, Co. Kildare			
Grid Reference	X:	697776.993	Y:	731586.745	
Hydrometric Station(s) utilized (including reference number):		N/A			
Area of Contributing Catchment:		3.36 Km^2		Road Reference:	N/A
Design Flood Flow:	3.864 m^3/s		Annual Exceedance Probability (AEP):		1.0 %

Statement of Authenticity

I hereby certify that the information contained in this application form, along with all appended supporting information, has been checked by me and that all statements are true and accurate.

Name:	Brendan Lyons
Company/Organisation:	RPS
Signature:	Brendan Lyons
Date:	**29th April 2025**

Application Check List	
COMPLETED APPLICATION FORM	☒
SUPPORTING HYDROLOGICAL AND HYDRAULIC INFORMATION	☒
PHOTOGRAPHS COVERING SITE OF ALL PROPOSED WORKS	☒
SCALED PLAN OF BRIDGE/CULVERT/APPROACH EARTHWORKS	☐
SCALED CROSS SECTION OF BRIDGE/CULVERT/APPROACH EARTHWORKS	☐
SCALED LONG SECTION OF CHANNEL THROUGH BRIDGE/CULVERT	☐
DETAILS OF RELEVANT EXISTING STRUCTURES	☐
COMPLETED STATEMENT OF AUTHENTICITY	☐
PLAN OF CATCHMENT AREA	☐
COPY OF NOTICE OF GRANT OF PLANNING PERMISSION WITH CONDITIONS *1	☐

For OPW use only	*Date of Receipt*							
OPW Drainage Maintenance Region	*East*	☐	*South East*	☐	*South West*	☐	*West*	☐

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

Correspondence Number	*OPW Register No:*	
	Consent Issued	☐

ADDITIONAL INFORMATION

Hydrological Analysis

Methodology Applied		
Method Used	Tick box if used or state other	Flow [*2] (m^3/sec)
6 – Variable Catchment characteristics	☐	
3 – Variable Catchment Characteristics	☒	0.562
IH 124	☒	0.520
Gauged Flow	☐	
Unit Hydrograph	☐	
ADAS	☐	
Other	☐	

FSR ☐ FSU ☒ Other ☐

Comments SAAR 727.6mm/yr; Soil Factor=0.3;
FSU (3-var) = 0.595 (m^3/sec) FSU (5-var) = 0.621 (m^3/sec)
OPW Hazelhatch Further Study, Q100 Flow = 3.864 (m^3/sec)

Factors Applied	
Type of Factor	Value Used
Climate Change	
Irish Growth Curve (IH 124 & 3 - Variable Catchment Characteristics)	1.96
Irish Growth Curve (FSU)	2.60
Factor for Standard Error (FSU 3-var)	2.059
Factor for Standard Error (FSU 5-var)	1.686
Factor for Standard Error (IH 124)	1.65
Factor for Standard Error (3 - Variable Catchment Characteristics)	1.58
Tidal ☐	
Comments:	

Hydraulic/Structure Details

Description of Structure[*3]: Construction of a new 4.0m (W) x 2.7m (H) box culvert with headwalls. The culvert will have 500mm embedment.	
Effective Conveyance Area [*4]	**7.232m²**
Upstream Invert Level: **53.489**mOD	Downstream Invert Level: **53.471**mOD
Upstream Soffit Level: **56.189**mOD	Downstream Soffit Level: **56.171**mOD
Upstream Design Flood Level: **55.797**mOD	Downstream Design Flood Level: **55.787**mOD

NOTES :

1. In line with OPW policy, section 50 approvals should be sought for bridges and culverts that are necessary for access or deemed acceptable by the planning authority. A copy of the notice of grant of planning permission with all conditions should be enclosed with all applications, that are not exempt development under the Planning and Development Act, 2000, as evidence that these factors have been considered.
2. Flow is the estimated flow from the catchment, without any factors applied.

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

3. The following details are to be included: the channel bed level, invert and soffit levels of the structure along with the width, length and total conveyance area. Any environmental considerations such as bed depression, baffles, mammal walkways etc. should be described.
4. Effective conveyance area is from channel bed level to design flood level.
5. All levels must be given to Ordnance Datum, Malin Head.

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

Construction, Replacement or Alteration of Bridges and Culverts
Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010

Project Name	**Celbridge To Hazelhatch Link Road**	Structure Ref No.	**Cul-03**

Applicant (Correspondence will issue to agent)			
Company or Organisation Name: Kildare County Council			
Postal Address:	Áras Chill Dara, Devoy Park, Nass, Co. Kildare, W91 X77F		
Contact Person:	Kevin Kane		
Phone:	+353 087 360 7606	Fax:	
E-mail:	kkane@kildarecoco.ie		

Agent (Correspondence will issue to agent)			
Company or Organisation Name: RPS Consulting Engineers			
Postal Address:	Lyrr Building, IDA Business and Technology Park, Mervue, Galway		
Contact Person:	Brendan Lyons		
Phone:	+353 91 400 200	Fax:	
E-mail:	brendan.lyons@rpsgroup.com		

Location and Parameters of crossing					
Watercourse:	Commons Lower Stream			Catchment:	Liffey River
Address (Townland – County):		Commons Lower, Celbridge, Co. Kildare			
Grid Reference	X:	697991.497	Y:	731536.948	
Hydrometric Station(s) utilized (including reference number):		N/A			
Area of Contributing Catchment:		0.06	Km^2	Road Reference:	N/A
Design Flood Flow:	3.864 m^3/s		Annual Exceedance Probability (AEP):		1.0 %

Statement of Authenticity	
I hereby certify that the information contained in this application form, along with all appended supporting information, has been checked by me and that all statements are true and accurate.	
Name:	Brendan Lyons
Company/Organisation:	RPS
Signature:	Brendan Lyons
Date:	**29th April 2025**

Application Check List	
COMPLETED APPLICATION FORM	☒
SUPPORTING HYDROLOGICAL AND HYDRAULIC INFORMATION	☒
PHOTOGRAPHS COVERING SITE OF ALL PROPOSED WORKS	☒
SCALED PLAN OF BRIDGE/CULVERT/APPROACH EARTHWORKS	☐
SCALED CROSS SECTION OF BRIDGE/CULVERT/APPROACH EARTHWORKS	☐
SCALED LONG SECTION OF CHANNEL THROUGH BRIDGE/CULVERT	☐
DETAILS OF RELEVANT EXISTING STRUCTURES	☐
COMPLETED STATEMENT OF AUTHENTICITY	☐
PLAN OF CATCHMENT AREA	☐
COPY OF NOTICE OF GRANT OF PLANNING PERMISSION WITH CONDITIONS *1	☐

For OPW use only	*Date of Receipt*							
OPW Drainage Maintenance Region	*East*	☐	*South East*	☐	*South West*	☐	*West*	☐

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

Correspondence Number	*OPW Register No:*	
	Consent Issued	☐

ADDITIONAL INFORMATION

Hydrological Analysis

Methodology Applied

Method Used	Tick box if used or state other	Flow *2 (m^3/sec)
6 – Variable Catchment characteristics	☐	
3 – Variable Catchment Characteristics	☒	**0.014**
IH 124	☒	**0.014**
Gauged Flow	☐	
Unit Hydrograph	☐	
ADAS	☐	
Other	☐	

FSR ☐ FSU ☒ Other ☐

Comments SAAR 727.6mm/yr; Soil Factor=0.3;
FSU (3-var) = 0.021(m^3/sec)
OPW Hazelhatch Further Study, Q100Flow = 3.864(m^3/sec)

Factors Applied

Type of Factor	Value Used
Climate Change	
Irish Growth Curve (IH 124 & 3 - Variable Catchment Characteristics)	1.96
Irish Growth Curve (FSU)	2.60
Factor for Standard Error (FSU 3-var)	2.059
Factor for Standard Error (FSU 5-var)	1.686
Factor for Standard Error (IH 124)	1.65
Factor for Standard Error (3 - Variable Catchment Characteristics)	1.58

Tidal ☐

Comments:

Hydraulic/Structure Details

Description of Structure*3: Construction of a new 3.5m (W) x 2.6m (H) box culvert with headwalls. The culvert will have 500mm embedment.	
Effective Conveyance Area *4	**6.262m²**
Upstream Invert Level: **53.505**mOD	Downstream Invert Level: **53.490**mOD
Upstream Soffit Level: **56.105**mOD	Downstream Soffit Level: **56.090**mOD
Upstream Design Flood Level: **55.794**mOD	Downstream Design Flood Level: **55.790**mOD

NOTES :

1. In line with OPW policy, section 50 approvals should be sought for bridges and culverts that are necessary for access or deemed acceptable by the planning authority. A copy of the notice of grant of planning permission with all conditions should be enclosed with all applications, that are not exempt development under the Planning and Development Act, 2000, as evidence that these factors have been considered.
2. Flow is the estimated flow from the catchment, without any factors applied.

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3. The following details are to be included: the channel bed level, invert and soffit levels of the structure along with the width, length and total conveyance area. Any environmental considerations such as bed depression, baffles, mammal walkways etc. should be described.
4. Effective conveyance area is from channel bed level to design flood level.
5. All levels must be given to Ordnance Datum, Malin Head.

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

Construction, Replacement or Alteration of Bridges and Culverts
Application for Consent under Section 50 of the Arterial Drainage Act, 1945 & EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010

Project Name	**Celbridge To Hazelhatch Link Road**	Structure Ref No.	**R. Liffey Bridge**

Applicant (Correspondence will issue to agent)			
Company or Organisation Name: Kildare County Council			
Postal Address:	Áras Chill Dara, Devoy Park, Nass, Co. Kildare, W91 X77F		
Contact Person:	Kevin Kane		
Phone:	+353 087 360 7606	Fax:	
E-mail:	kkane@kildarecoco.ie		

Agent (Correspondence will issue to agent)			
Company or Organisation Name: RPS Consulting Engineers			
Postal Address:	Lyrr Building, IDA Business and Technology Park, Mervue, Galway		
Contact Person:	Brendan Lyons		
Phone:	+353 91 400 200	Fax:	
E-mail:	brendan.lyons@rpsgroup.com		

Location and Parameters of crossing					
Watercourse:	River Liffey			Catchment:	Liffey River
Address (Townland – County):		Celbridge Abbey, Celbridge, Co. Kildare			
Grid Reference	X:	696774.830	Y:	732339.077	
Hydrometric Station(s) utilized (including reference number):		N/A			
Area of Contributing Catchment:		837 Km^2		Road Reference: N/A	
Design Flood Flow:	130.53 m^3/s		Annual Exceedance Probability (AEP):		1.0 %

Statement of Authenticity	
I hereby certify that the information contained in this application form, along with all appended supporting information, has been checked by me and that all statements are true and accurate.	
Name:	Brendan Lyons
Company/Organisation:	RPS
Signature:	Brendan Lyons
Date:	**29th April 2025**

Application Check List	☐
COMPLETED APPLICATION FORM	☒
SUPPORTING HYDROLOGICAL AND HYDRAULIC INFORMATION	☒
PHOTOGRAPHS COVERING SITE OF ALL PROPOSED WORKS	☒
SCALED PLAN OF BRIDGE/CULVERT/APPROACH EARTHWORKS	☐
SCALED CROSS SECTION OF BRIDGE/CULVERT/APPROACH EARTHWORKS	☐
SCALED LONG SECTION OF CHANNEL THROUGH BRIDGE/CULVERT	☐
DETAILS OF RELEVANT EXISTING STRUCTURES	☐
COMPLETED STATEMENT OF AUTHENTICITY	☐
PLAN OF CATCHMENT AREA	☐
COPY OF NOTICE OF GRANT OF PLANNING PERMISSION WITH CONDITIONS *1	☐

For OPW use only	*Date of Receipt*							
OPW Drainage Maintenance Region	*East*	☐	*South East*	☐	*South West*	☐	*West*	☐

If the application form is not completed correctly, and in its entirety, the application may be deemed invalid and returned for correction.

Correspondence Number	*OPW Register No:*	
	Consent Issued	☐

ADDITIONAL INFORMATION

Hydrological Analysis

Methodology Applied		
Method Used	Tick box if used or state other	Flow *2 (m^3/sec)
6 – Variable Catchment characteristics	☐	
3 – Variable Catchment Characteristics	☐	
IH 124	☐	
Gauged Flow	☐	
Unit Hydrograph	☐	
ADAS	☐	
Other	☐	

FSR ☐ FSU ☒ Other ☐

Comments; Eastern CFRAM study flow rate = 130.53 m^3/sec

Factors Applied	
Type of Factor	Value Used
Climate Change	
Irish Growth Curve (IH 124 & 3 - Variable Catchment Characteristics)	
Irish Growth Curve (FSU)	
Factor for Standard Error (FSU 3-var)	
Factor for Standard Error (FSU 5-var)	
Factor for Standard Error (IH 124)	
Factor for Standard Error (3 - Variable Catchment Characteristics)	
Tidal ☐	
Comments:	

Hydraulic/Structure Details

Description of Structure*3: Integral Single Span Varying Depth Steel Composite Plate Girder Bridge 16.030m wide x 65.50m long.	
Effective Conveyance Area *4	**135m²**
Upstream Invert Level: **47.910**mOD	Downstream Invert Level: **47.910**mOD
Upstream Soffit Level: **51.964**mOD	Downstream Soffit Level: **51.964**mOD
Upstream Design Flood Level: **50.530**mOD	Downstream Design Flood Level: **50.530**mOD

NOTES :

1. In line with OPW policy, section 50 approvals should be sought for bridges and culverts that are necessary for access or deemed acceptable by the planning authority. A copy of the notice of grant of planning permission with all conditions should be enclosed with all applications, that are not exempt development under the Planning and Development Act, 2000, as evidence that these factors have been considered.
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4. Effective conveyance area is from channel bed level to design flood level.
5. All levels must be given to Ordnance Datum, Malin Head.

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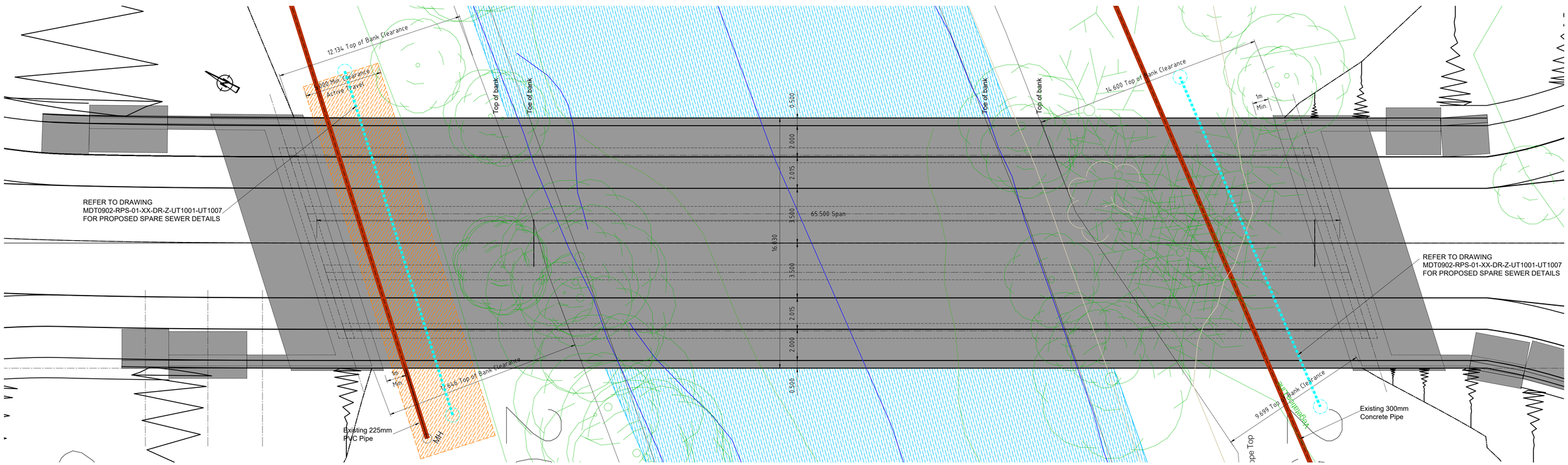
Appendix B
Drawings



PLAN LAYOUT
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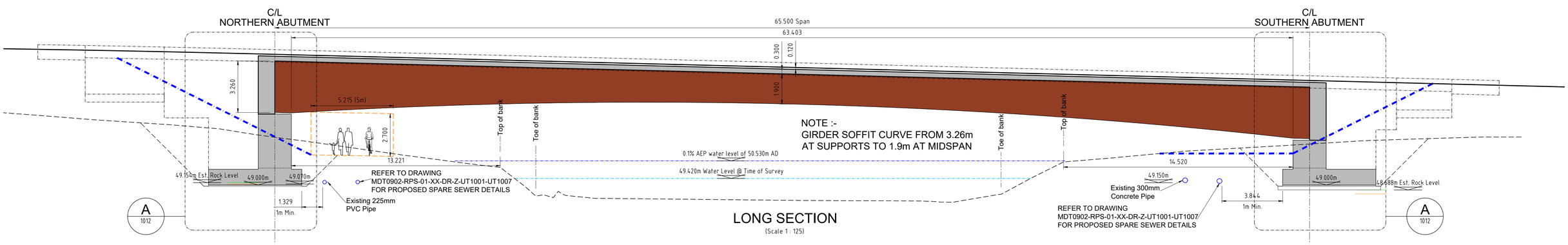
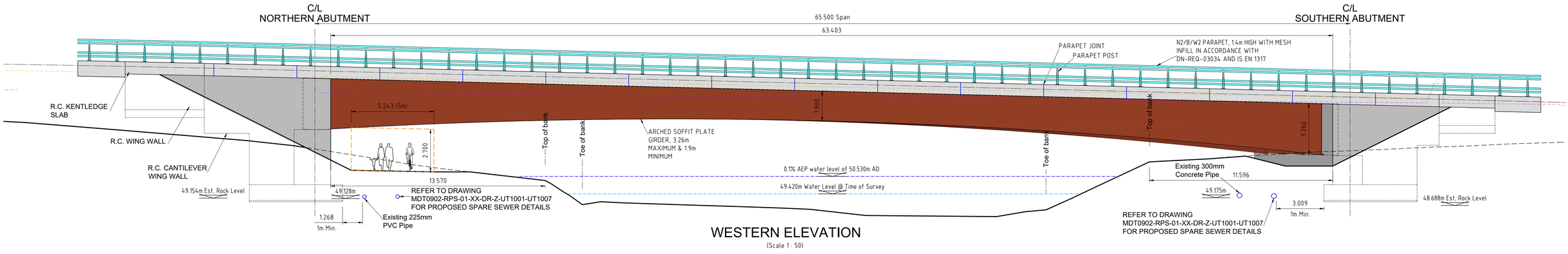


LONG SECTION
(Scale 1 : 125)



WESTERN ELEVATION
(Scale 1 : 50)

\\dubl-wp-f01\Work_Transport\MDT0902 - Celbridge to Hazelhatch Link Road\8.0 Drawings\Br\MDT0902-RPS-01-XX-DR-Z-BR1010-BR1012.dwg

Client

Key Plan

General Notes

(i) Hard copies, dwf and pdf will form a controlled issue of the drawing. All other formats (dwg etc.) are deemed to be an uncontrolled issue and any work carried out based on these files is at the recipients own risk. RPS will not accept any responsibility for any errors from the use of these files, either by human error by the recipient, listing of the un-dimensioned measurements, compatibility with the recipients software, and any errors arising when these files are used to aid the recipients drawing production, or setting out on site.

(ii) DO NOT SCALE, use figured dimensions only.

(iii) This drawing is the property of RPS, it is a project confidential classified document. It must not be copied used or its contents divulged without prior written consent. The needs and expectations of client and RPS must be considered when working with this drawing.

(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.

(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
S4 P01	15/11/24	DC	JM	FOR APPROVAL	MM

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F +353 1 2835676
W www.rpsgroup.com/ireland
E ireland@rpsgroup.com

File Identifier

Scale: As Shown @ A1, Half @ A3

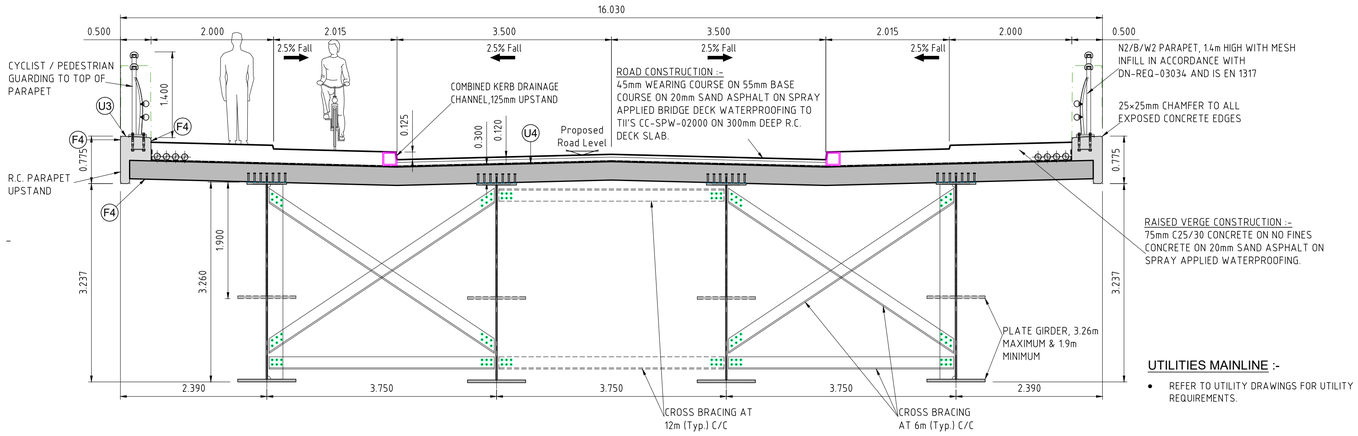
Created on: 15/11/2024

Sheets: 1 of 3

Project: CELBRIDGE HAZELHATCH MOBILITY CORRIDOR

Title: RIVER LIFFEY CROSSING
General Arrangement
(Sheet 1 of 3)

Drawing Number	Status	Rev
MDT0902-RPS-01-XX-DR-Z-BR1010	S4	P01

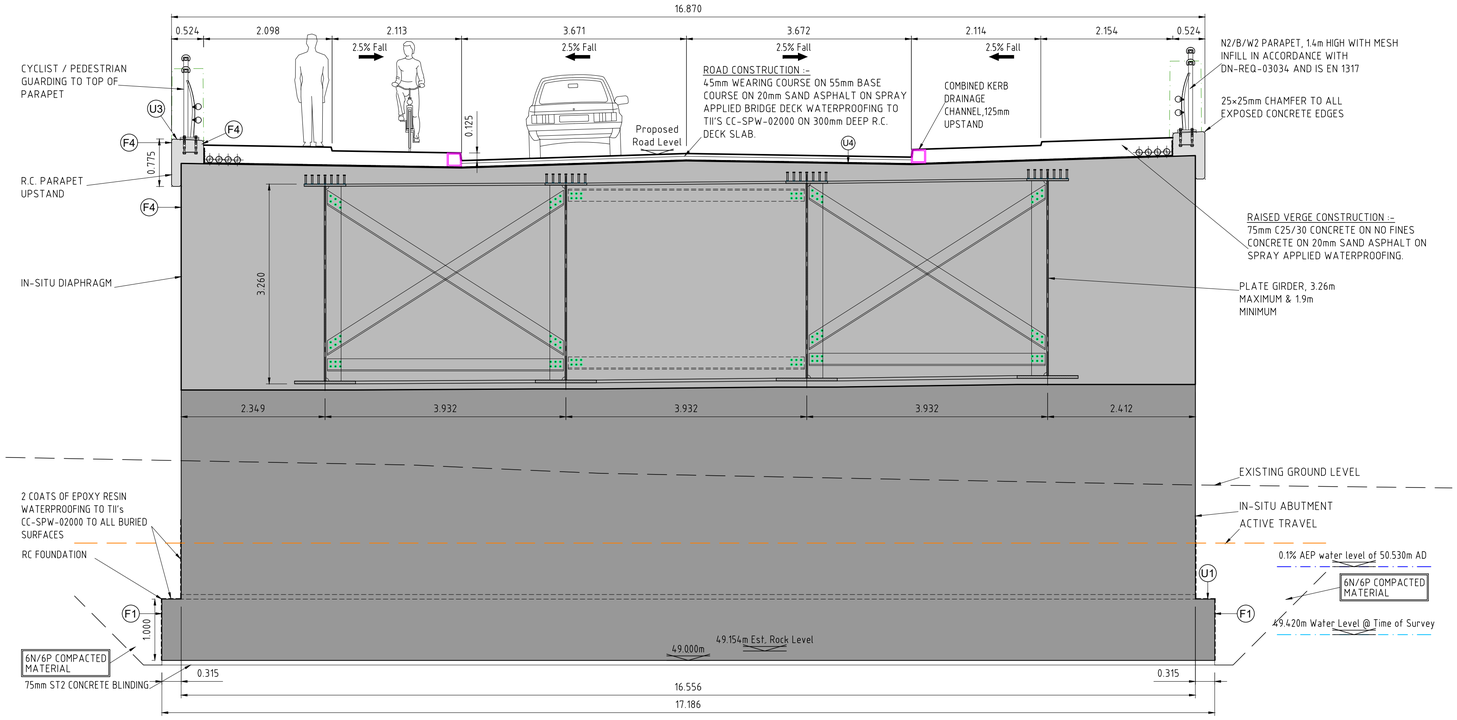


TYPICAL DECK CROSS SECTION

(Scale 1 : 50)

UTILITIES MAINLINE :-

- REFER TO UTILITY DRAWINGS FOR UTILITY REQUIREMENTS.



TYPICAL ABUTMENT SECTION

(Scale 1 : 50)

DETAIL A

(Scale 1 : 50)

1010

Client

Key Plan

General Notes

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Rev	Date	Drn	Chk	Amendment / Issue	App
S4 P01	15/11/24	DC	JM	FOR APPROVAL	MM

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E ireland@rpsgroup.com

File Identifier

Scale: As Shown @ A1, Half @ A3

Created on: 15/11/2024

Sheets: 2 of 3

Project: CELBRIDGE HAZELHATCH MOBILITY CORRIDOR

Title: RIVER LIFFEY CROSSING General Arrangement (Sheet 2 of 3)

Drawing Number	Status	Rev
MDT0902-RPS-01-XX-DR-Z-BR1011	S4	P01

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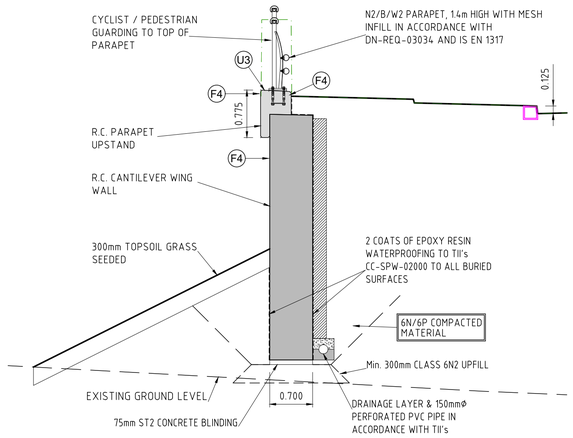

TYPICAL CANTILEVER WING WALL

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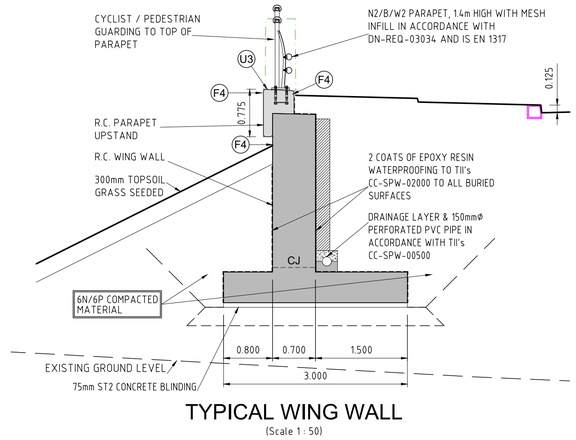

TYPICAL WING WALL

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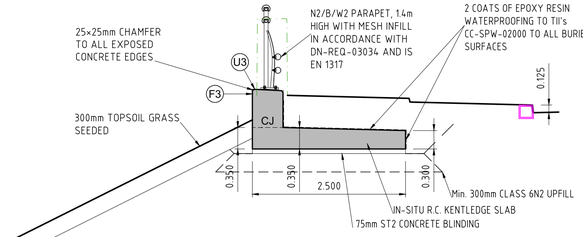
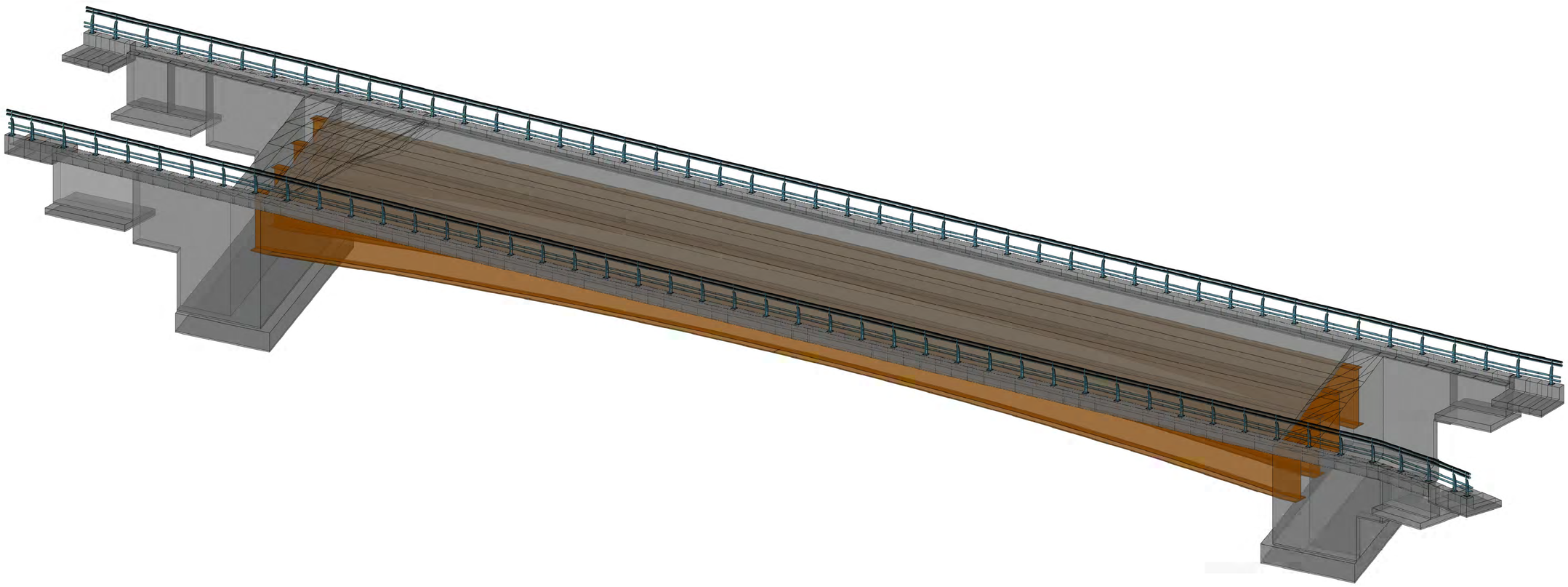


TYPICAL KENTLEDGE SLAB

(Scale 1 : 50)



3D VIEW

(N.T.S.)

\\dubl-wp-f01\Work_Transport\MDT0902 - Celbridge to Hazelhatch Link Road\8.0 Drawings\Br\MDT0902-RPS-01-XX-DR-Z-BR1010-BR1012.dwg

Client

Key Plan

General Notes

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Rev	Date	Dm Chk	Amendment / Issue	App
S4 P01	15/11/24	DC JM	FOR APPROVAL	MM

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File Identifier

Scale: As Shown @ A1, Half @ A3

Created on: 15/11/2024

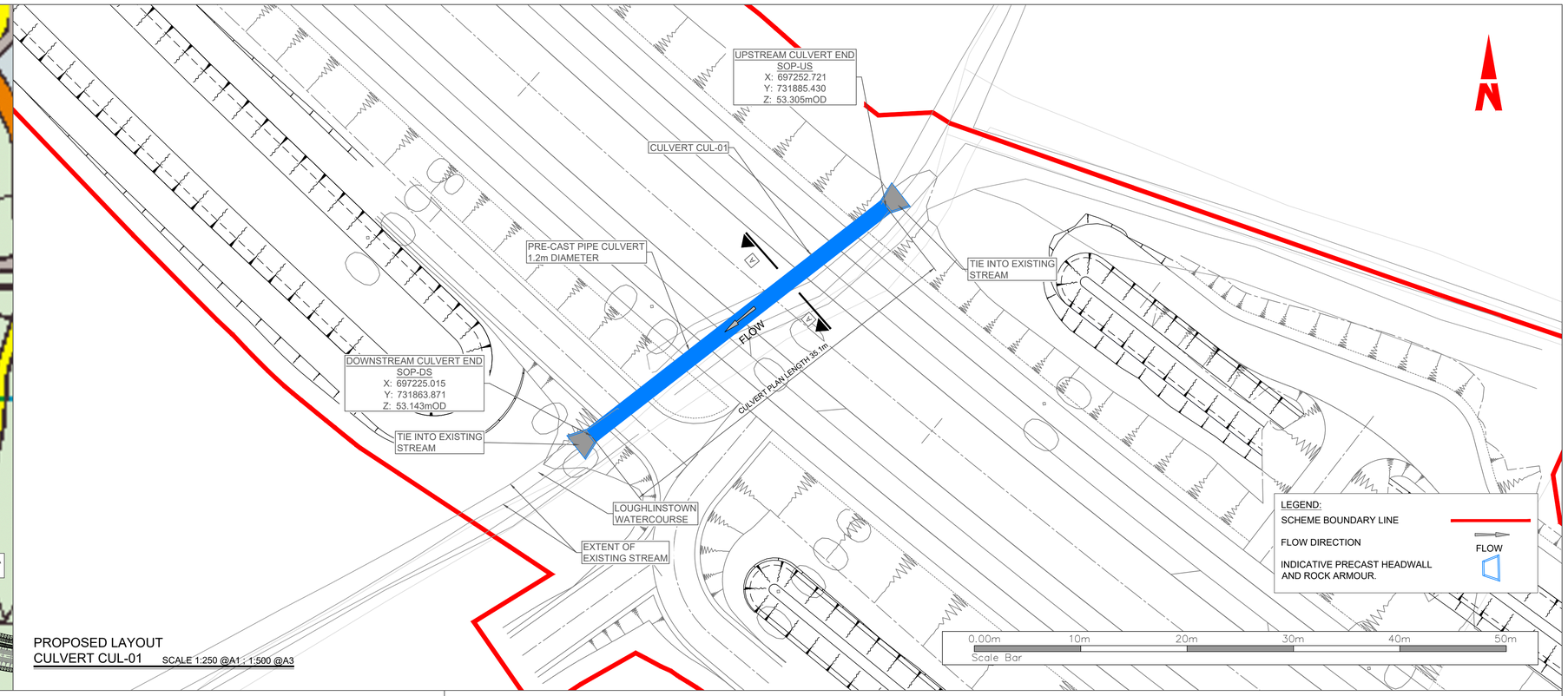
Sheets: 3 of 3

Project: CELBRIDGE HAZELHATCH MOBILITY CORRIDOR

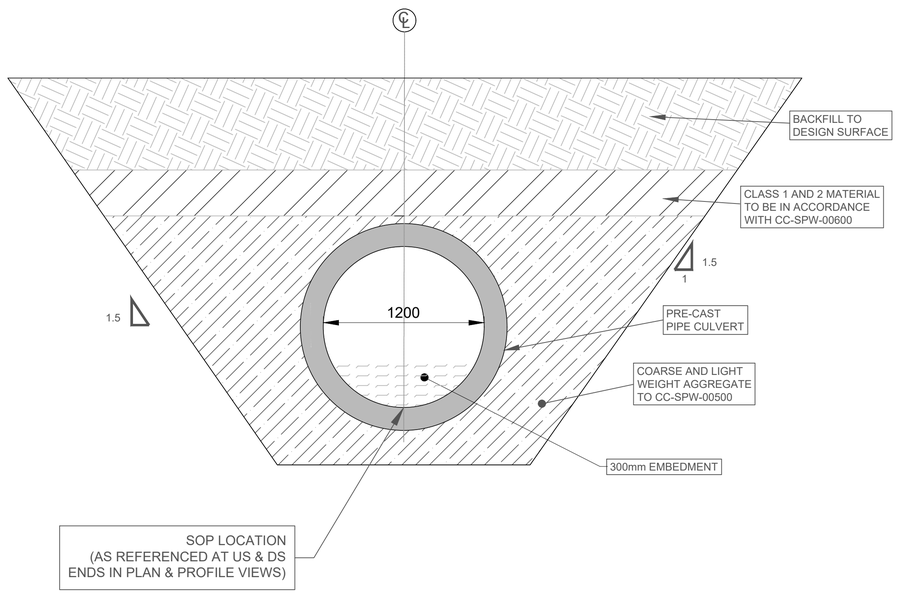
Title: RIVER LIFFEY CROSSING
General Arrangement
(Sheet 3 of 3)

Drawing Number	Status	Rev
MDT0902-RPS-01-XX-DR-Z-BR1012	S4	P01

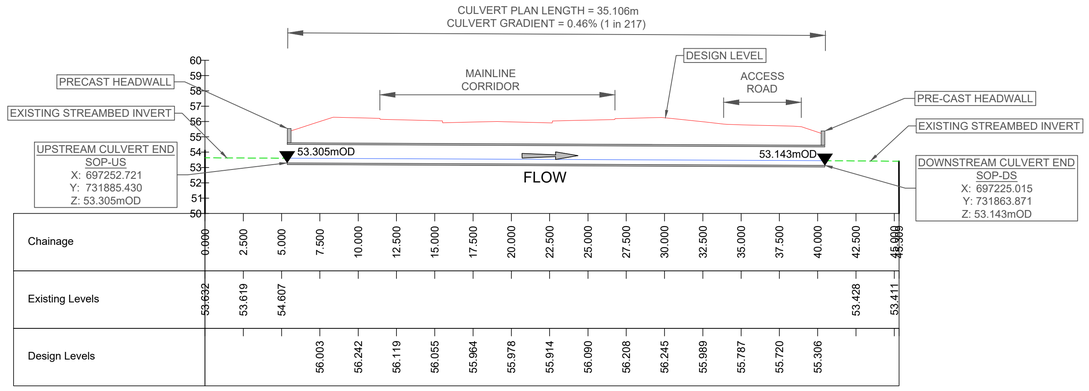
CATCHMENT AREA
CULVERT CUL-01 NOT TO SCALE



PROPOSED LAYOUT
CULVERT CUL-01 SCALE 1:250 @A1 ; 1:500 @A3



CROSS SECTION A - A
CULVERT CUL-01 SCALE 1:20 @A1 ; 1:40 @A3



LONGITUDINAL SECTION
CULVERT CUL-01 SCALE 1:200 @A1 ;1:400 @A3

Client

General Notes

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(iv) Information including topographical survey, geotechnical investigation and utility detail used in the design have been provided by others.

(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Dsn / Chk	Amendment / Issue	App
P01	15/11/24	RM / EMcK	ISSUE FOR APPROVAL	BL

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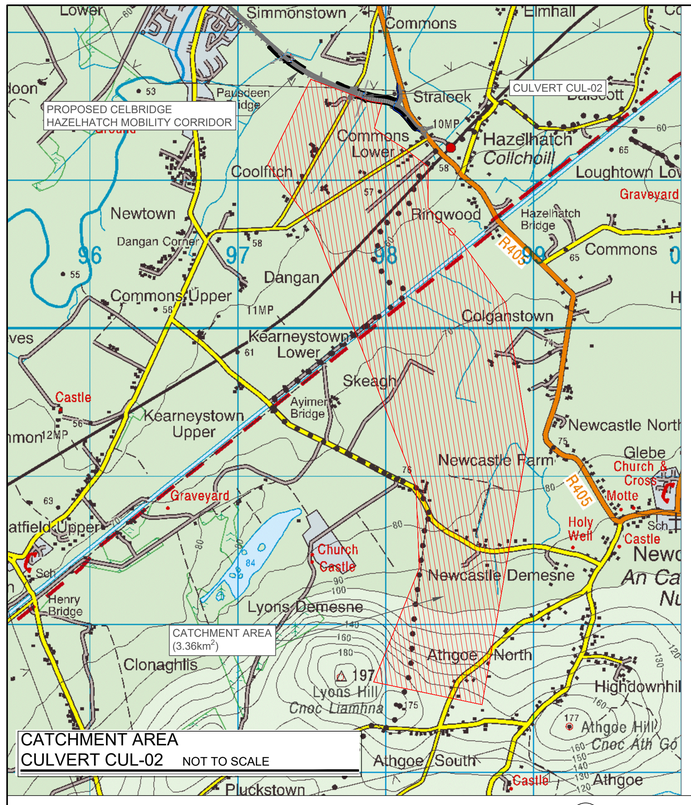
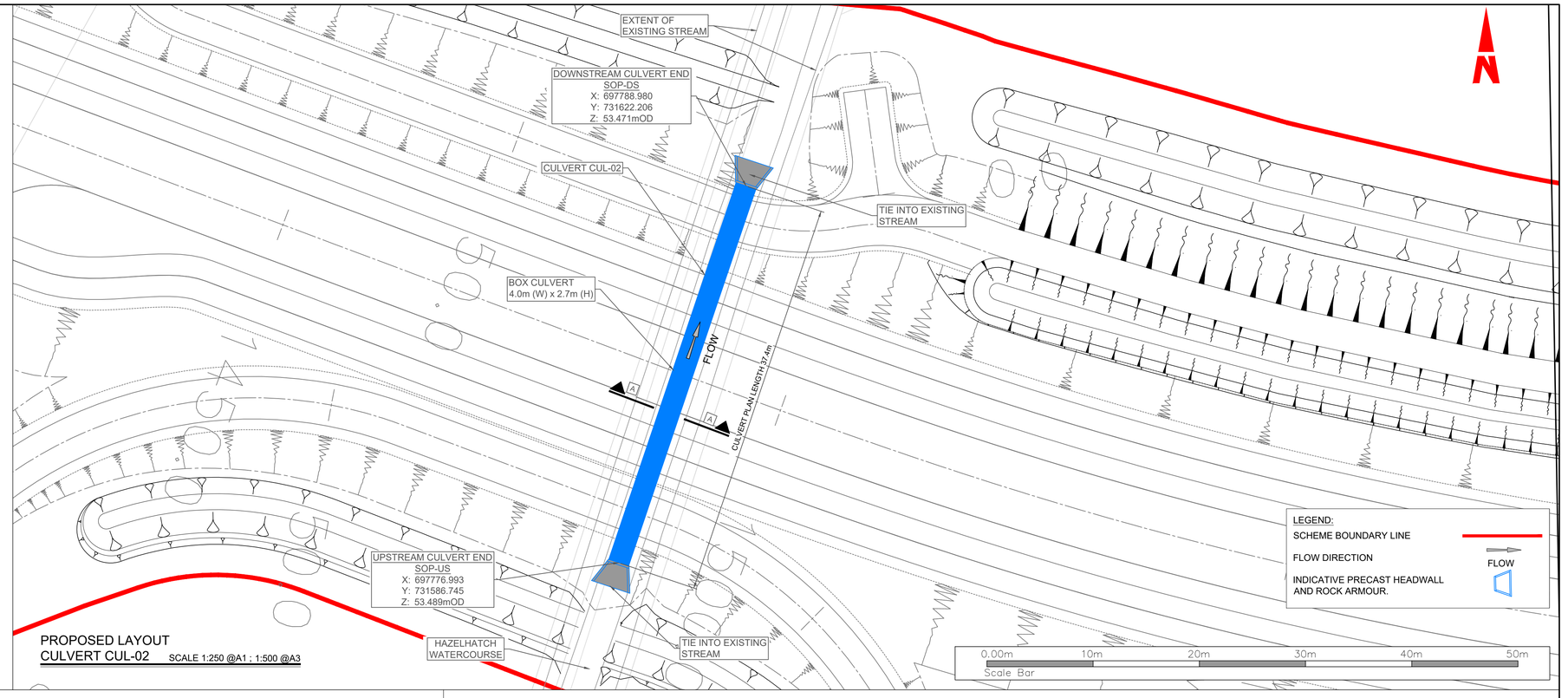
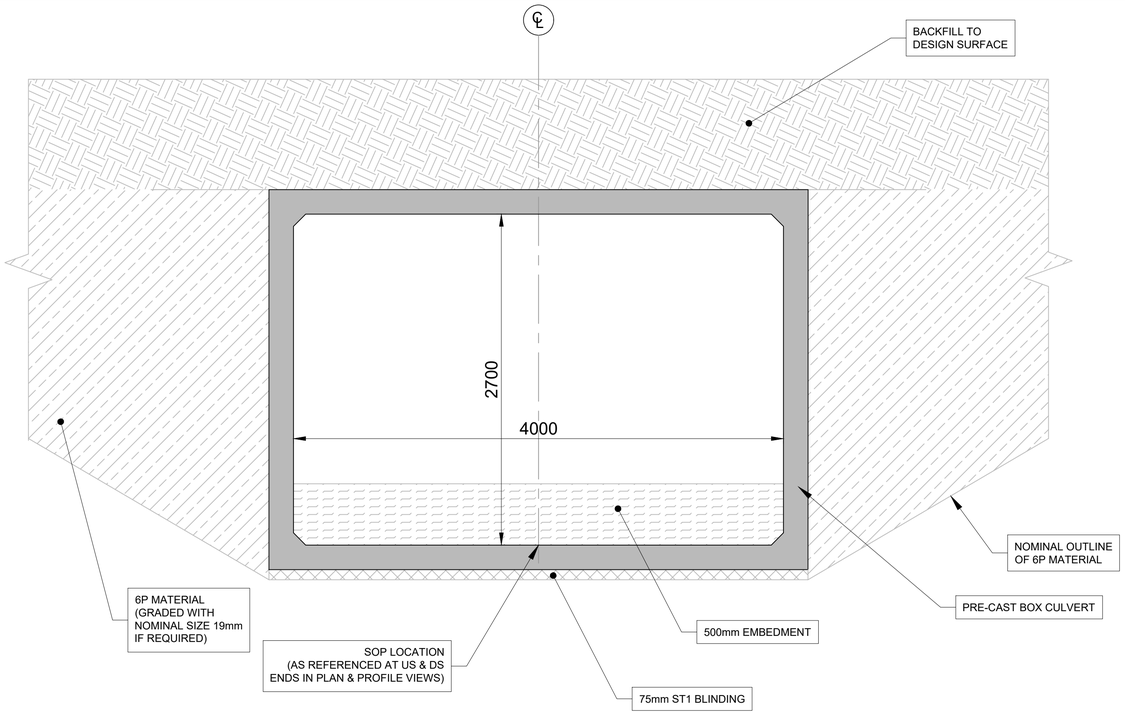
Scale	AS SHOWN @ A1 AS SHOWN @ A3
Created on	15/11/24
Sheets	01 of 04
File Identifier	MDT0902-RPS-01-XX-DR-C-DR1001-1004
Project	CELBRIDGE HAZELHATCH MOBILITY CORRIDOR
Title	DRAINAGE CULVERT CUL-01 PLAN, PROFILE & CROSS-SECTION
Drawing Number	MDT0902-RPS-01-XX-DR-C-DR1001
Status	S4
Rev	P01

R:\MDT0902 - Celbridge to Hazelhatch Link Road\8.0 Drawings\DR\MDT0902-RPS-01-XX-DR-C-DR1001-1004 - S50 Culvert GA.dwg

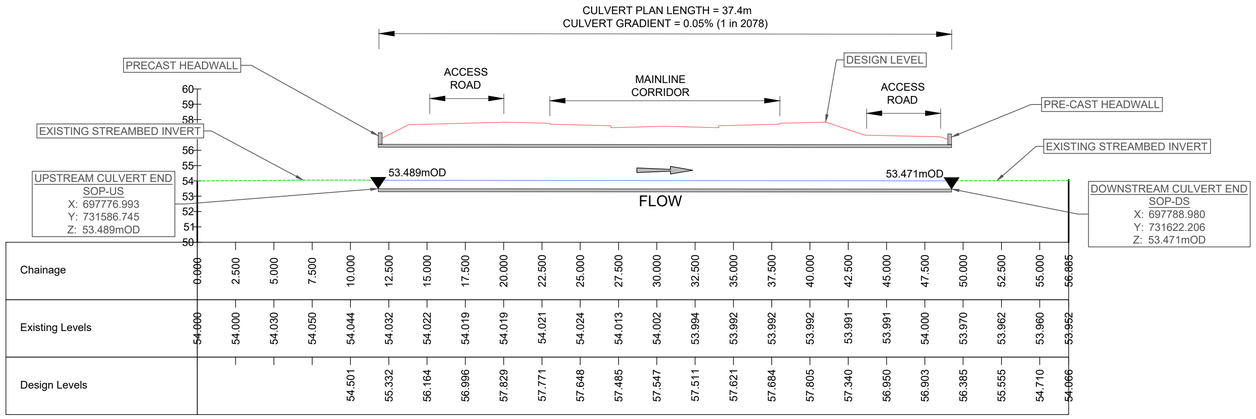




PROPOSED LAYOUT
CULVERT CUL-02 SCALE 1:250 @A1 ; 1:500 @A3



CROSS SECTION A - A
CULVERT CUL-02 SCALE 1:25 @A1 ; 1:50 @A3



LONGITUDINAL SECTION
CULVERT CUL-02 SCALE 1:200 @A1 ;1:400 @A3

Client

General Notes

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(v) All Levels refer to Ordnance Survey Datum, Malin Head.

Rev	Date	Drn	Chk	Amendment / Issue	App
P01	15/11/24	PM	Check	ISSUE FOR APPROVAL	BL

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Scale: AS SHOWN @ A1, AS SHOWN @ A3
Created on: 15/11/24
Sheets: 02 of 04

Project: CELBRIDGE HAZELHATCH MOBILITY CORRIDOR
Title: DRAINAGE CULVERT CUL-02 PLAN, PROFILE & CROSS-SECTION

File Identifier: MDT0902-RPS-01-XX-DR-C-DR1001-1004
Drawing Number: MDT0902-RPS-01-XX-DR-C-DR1002
Status: S4
Rev: P01

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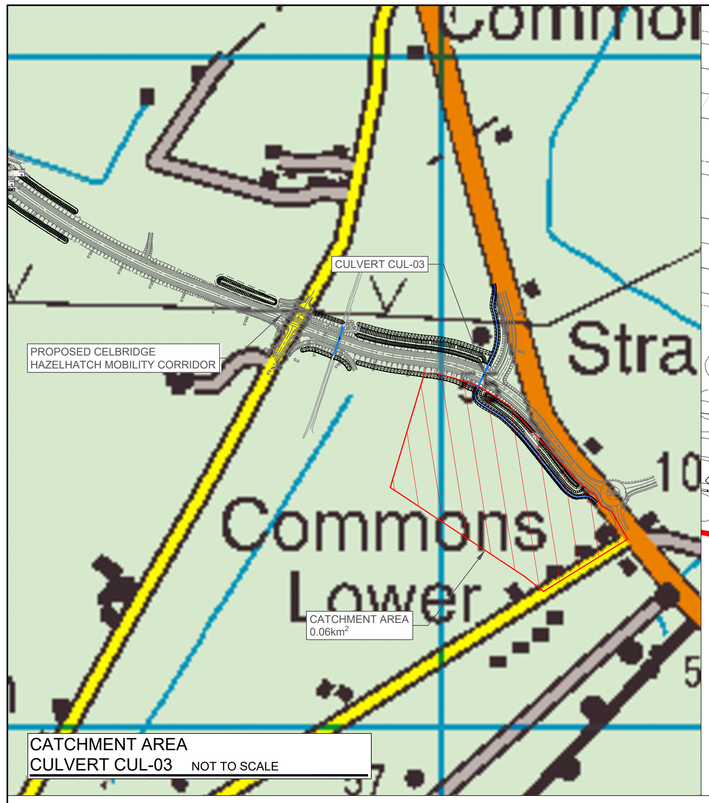
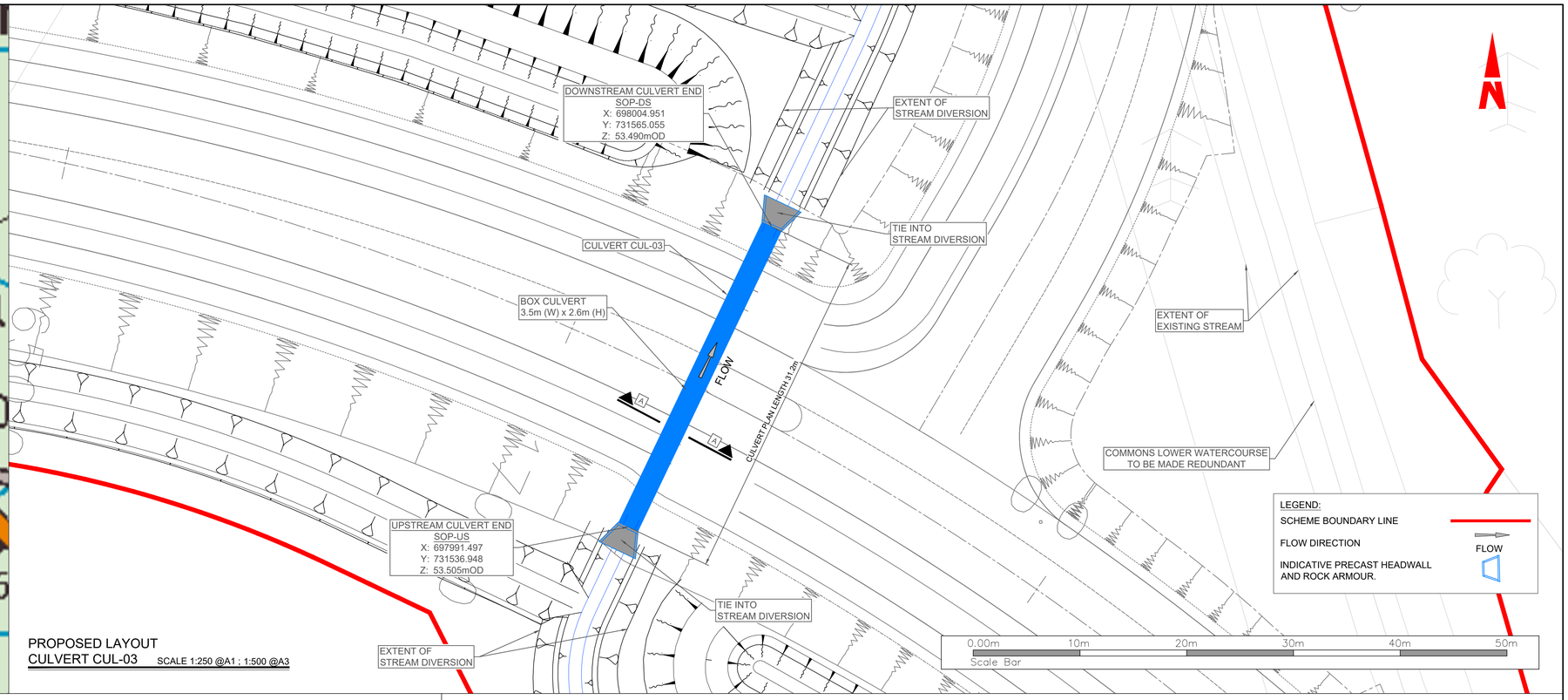
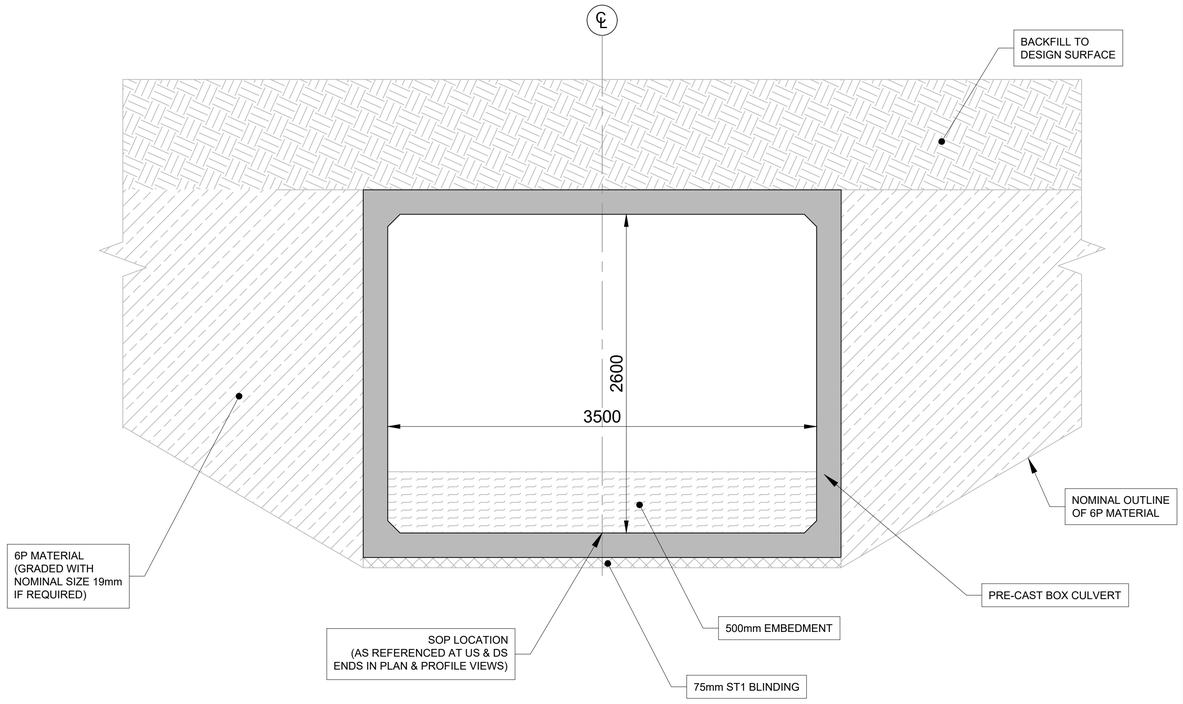


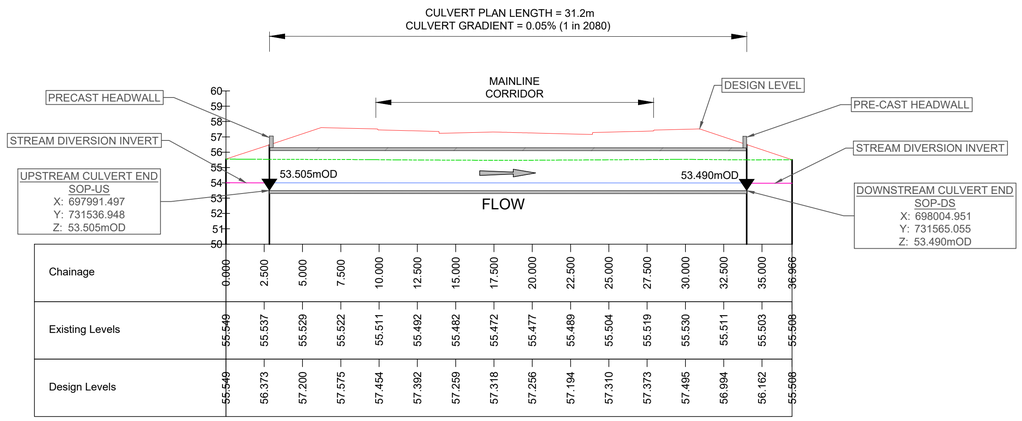
CATCHMENT AREA
CULVERT CUL-03 NOT TO SCALE



PROPOSED LAYOUT
CULVERT CUL-03 SCALE 1:250 @A1 ; 1:500 @A3



CROSS SECTION A - A
CULVERT CUL-03 SCALE 1:25 @A1 ; 1:50 @A3



LONGITUDINAL SECTION
CULVERT CUL-03 SCALE 1:200 @A1 ;1:400 @A3

Client

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Scale
AS SHOWN @ A1
AS SHOWN @ A3

Created on
15/11/24

Sheets
03 of 04

Project
CELBRIDGE HAZELHATCH MOBILITY CORRIDOR

Title
DRAINAGE
CULVERT CUL-03
PLAN, PROFILE & CROSS-SECTION

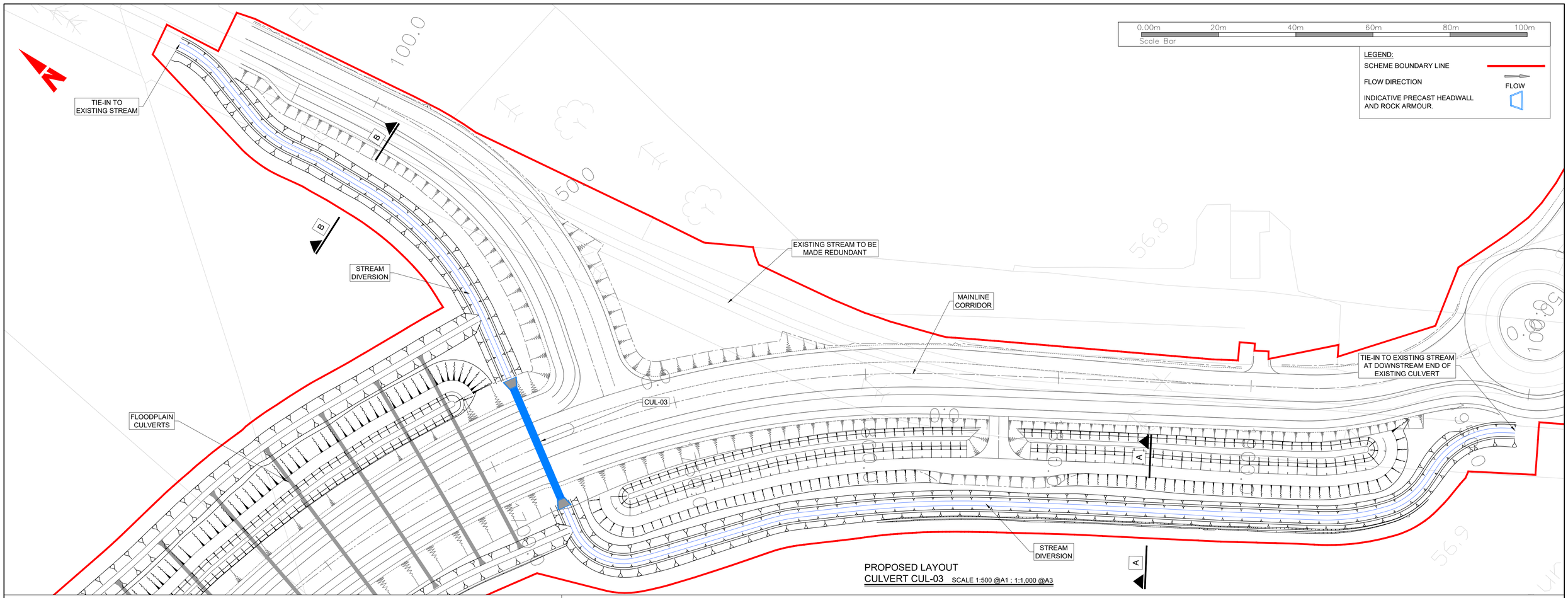
File Identifier
MDT0902-RPS-01-XX-DR-C-DR1001-1004

Drawing Number
MDT0902-RPS-01-XX-DR-C-DR1003

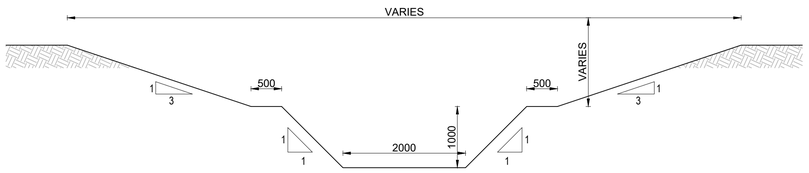
Status
S4

Rev
P01

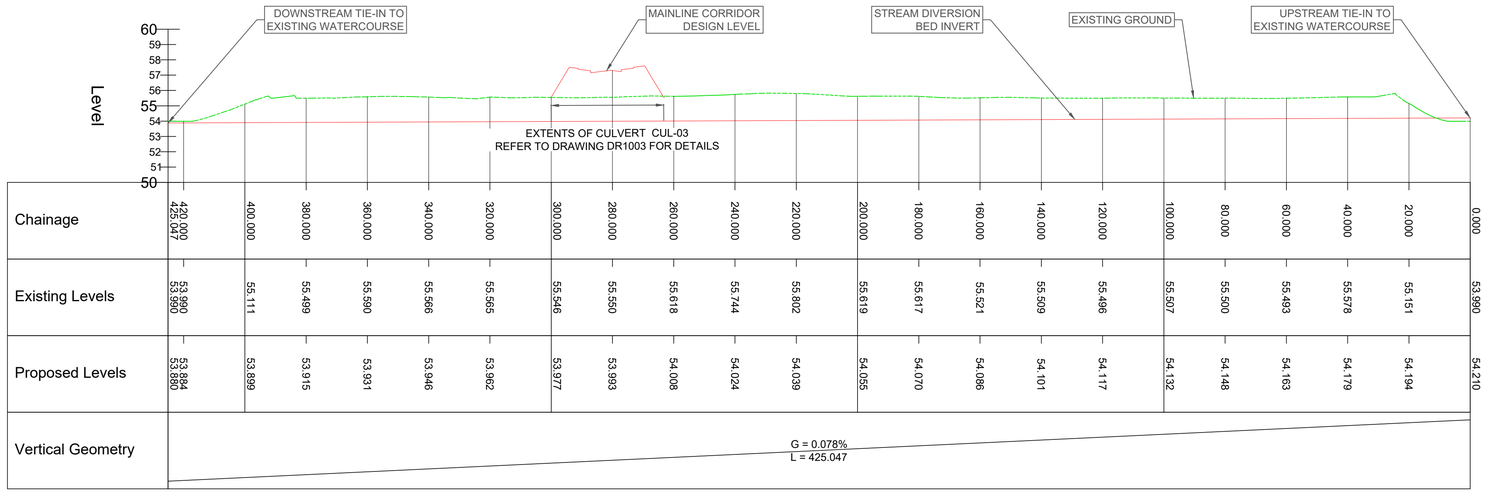
R:\MDT0902 - Celbridge to Hazelhatch Link Road\8.0 Drawings\DR\MDT0902-RPS-01-XX-DR-C-DR1001-1004 - S50 Culvert GA.dwg



PROPOSED LAYOUT
CULVERT CUL-03 SCALE 1:500 @A1 ; 1:1,000 @A3



STREAM DIVERSION
CROSS SECTION A-A AND B-B SCALE 1:50 @A1 ;1:100 @A3



CUL-03 - STREAM DIVERSION - LONGSECTION
SCALE: H 1:1000,V 1:200. DATUM: 50.000

LONGITUDINAL SECTION
STREAM DIVERSION SCALE 1:1,000 @A1 ; 1:2,000 @A3

Client

General Notes

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File Identifier: MDT0902-RPS-01-XX-DR-C-DR1001-1004

Scale: AS SHOWN @ A1 / AS SHOWN @ A3
Created on: 15/11/24
Sheets: 04 of 04

Project: CELBRIDGE HAZELHATCH MOBILITY CORRIDOR
Title: DRAINAGE
CUL-03 STREAM DIVERSION
PLAN, PROFILE & CROSS-SECTION

Drawing Number: MDT0902-RPS-01-XX-DR-C-DR1004
Status: S4
Rev: P01

R:\MDT0902 - Celbridge to Hazelhatch Link Road\8.0 Drawings\DR\MDT0902-RPS-01-XX-DR-C-DR1001-1004 - S50 Culvert GA.dwg

Appendix B: Section 50 Approval

OPW Oifig na nOibreacha Poiblí Office of Public Works

Ionad Cothabhála Siltin Regiún an Oirthir
An Baile Nua
Baile Átha Troim
Co. na Mí
C15 K8V0
Telephone: (046) 9431484
(046) 9431352
Fax: (046) 9431451
East Region Drainage Maintenance
Newtown
Trim
Co. Meath
C15 K8V0
Telephone: (046) 9431484
(046) 9431352
Fax: (046) 9431451

Ref 217 -2025

Mr. Brendan Lyons,
RPS Consulting Engineers,
Lynn Building,
Mervue,
Co. Galway.

Re: Section 50 applications for 3no. Proposed culverts and 1 new bridge for the Celbridge to Hazelhatch Mobility Corridor Scheme

Brendan.Lyons@rps.tetratech.com

Dear Mr. Lyons,

I refer to the above Section 50 application received by this office.
The documentation submitted has been examined and based on the Engineers assessment on behalf of the Commissioners of Public Works in Ireland; I confirm the consent of the Commissioners of Public Works under Section 50 of the Arterial Drainage Act, 1945, is granted for Section 50 applications for 3no. Proposed culverts and 1 new bridge for the Celbridge to Hazelhatch Mobility Corridor Scheme for proposed new pedestrian Bridge, Maynooth, Co. Kildare as follows:

These Section 50 applications for the above project were submitted by RPS Consulting Engineers on 23rd June 2025 on behalf of Kildare Co. Council. This office recommends Section 50 Consent for the four structures as detailed in the Section 50 application and drawings submitted by email on June 23rd 2025.

The structures include Cul-01 A 1200mm diameter pipe with 300mm embedment.
Cul-02 A 4m wide by 2.7m high box culvert with 500mm embedment
Cul -03 A 3.5m wide by 2.6m high box culvert with 500mm embedment.
A single span bridge over the river Liffey 16m wide by 65.5m long.

OPW Oifig na nOibreacha Poiblí Office of Public Works

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Co. na Mí
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Fax: (046) 9431451
East Region Drainage Maintenance
Newtown
Trim
Co. Meath
C15 K8V0
Telephone: (046) 9431484
(046) 9431352
Fax: (046) 9431451

It should be noted that consent is granted only for the purpose of Section 50 and does not absolve the recipient of responsibility for any adverse effects caused by this installation to any third party.

The Commissioners of Public Works are not responsible and accept no liability for any loss or damage whatsoever caused as a result of this development. The Commissioners of Public Works must be informed of any amendments/alterations to the approved application before the works are undertaken.

Signed on behalf of the Commissioners of Public Works in Ireland.

Yours sincerely

Leah Ainsworth P.P Nora Carey
Nora Carey

July 14th 2025

Flood Project Management