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TRIM MILLENNIUM PEDESTRIAN BRIDGE SCHEME

Site Specific Flood Risk Assessment

Prepared for:

Meath County Council

comhairle chontae na mí
meath county council

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SITE SPECIFIC FLOOD RISK ASSESSMENT FOR TRIM MILLENNIUM BRIDGE SCHEME

REVISION CONTROL TABLE, CLIENT, KEYWORDS AND ABSTRACT

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Abstract: Fehily Timoney and Company (FT) was commissioned by Meath County Council to prepare a Site-Specific Flood Risk Assessment (SSFRA) for the replacement of the Trim Millennium Pedestrian Footbridge.

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1. INTRODUCTION

Meath County Council (MCC) have commissioned Fehily Timoney and Company (FT) to provide Multi Discipline Engineering Consultancy Services through Phases 1 to 7 as per TII's "Project Management Guidelines" for the replacement of the Trim Millennium Pedestrian Footbridge.

The proposed scheme is located in a sensitive environmental area and the proposed footbridge will span the River Boyne. The proposed bridge will connect Trim Castle with the medieval Porchfield located north-east of the bridge and is a replacement for the Millennium Pedestrian Footbridge which was demolished in August 2022. The superstructure of the demolished bridge was constructed from Ekki timber in 2001 but was observed as having undergone significant failure during a structural inspection undertaken in July 2022. The abutments and foundation of the bridge are still in place, and it is proposed to reuse the existing foundations for the new bridge structure. The existing abutment will be removed and replaced with a newly constructed abutment to accommodate the new bridge structure. The new bridge will therefore be at the same location and have the same span as that of the original Millennium Pedestrian Bridge.

This report includes a hydraulic analysis and technical details for the proposed replacement of the Millennium Pedestrian footbridge over the River Boyne. The surface water elevation was determined at the proposed Millennium Pedestrian footbridge over the River Boyne for the existing scenario and proposed scenario with a design flood event of 1 in 100 years and 1 in 1000 years incorporating a climate change factor (20%).

For this analysis, various empirical hydrological equations were utilized, as discussed in Section 6.2 of this report.

HEC-RAS modelling software was used to determine surface water elevation for both the existing scenario, as outlined in Section 6.3, and the proposed structure. The results are summarized in Section 6.3 and Appendix 5.

Figure 1-1: Site Location

2. FLOOD RISK ASSESSMENT METHODOLOGY

2.1 General

The Guidelines for Planning Authorities and its Technical Appendices outline the requirements for a SSFRA. The Guidelines for Planning Authorities requires that works:

- Avoid development in areas at risk of flooding.
- Substitute less vulnerable uses where avoidance is not possible.
- Mitigate and manage the risk where avoidance and substitution are not possible.

The key principles of the Guidelines for Planning Authorities apply the Sequential Approach to the planning process. Figure 2-1 of this report describes the mechanism of the sequential approach for use in the planning process.

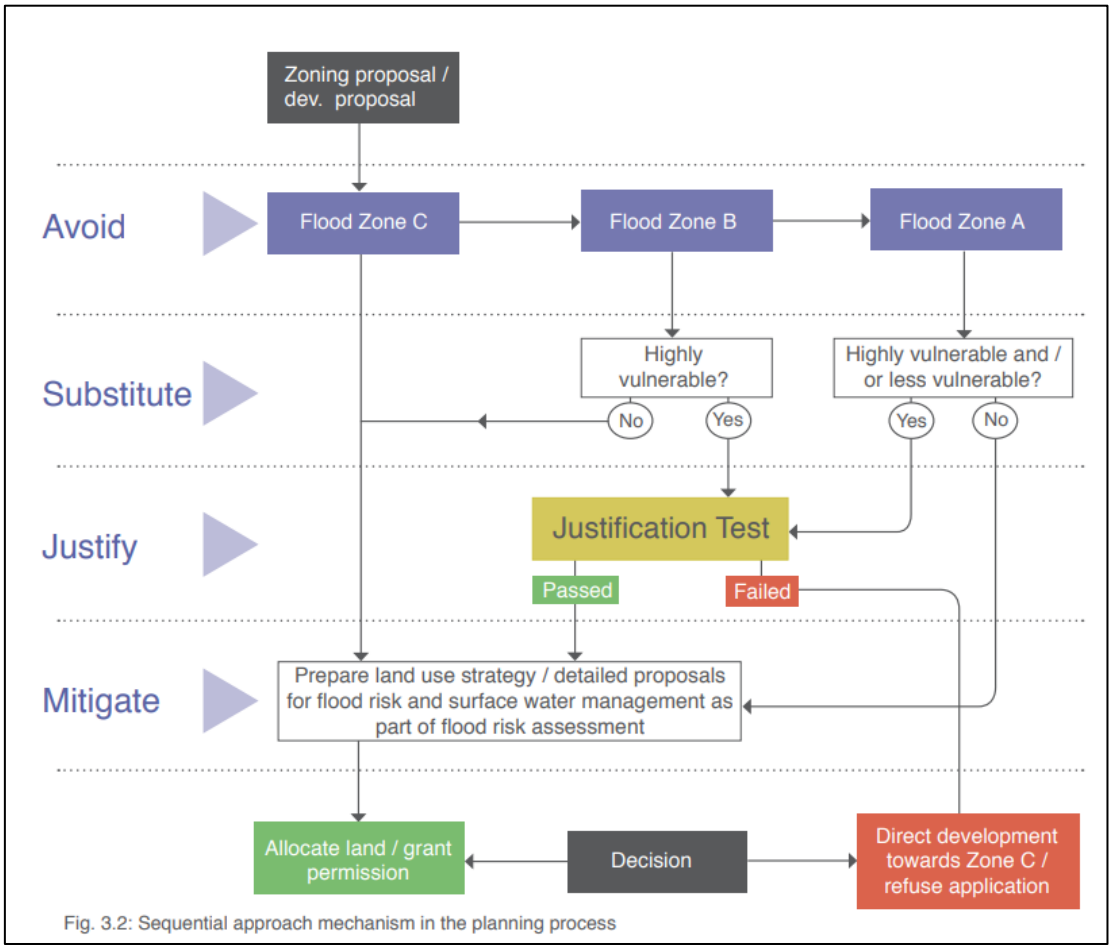

Figure 2-1: Sequential Approach Mechanism[1]

[1] Figure 3.2 of the *Guidelines for Planning Authorities*.

2.2 Source-Pathway-Receptor Model

The assessment of flood risk requires a thorough understanding of the following:

- The sources of flood water (e.g., high sea levels, intense or prolonged rainfall leading to runoff and increased flow in rivers and sewers)
- The pathways by which the flood water reaches those receptors (e.g., river channels, river and coastal floodplains, drains, sewers and overland flow).
- The people and assets affected by flooding (known as the receptors).

The Source-Pathway-Receptor (S-P-R) Model illustrated in Figure 2-2 has become widely used to assess and inform the management of environmental risks.

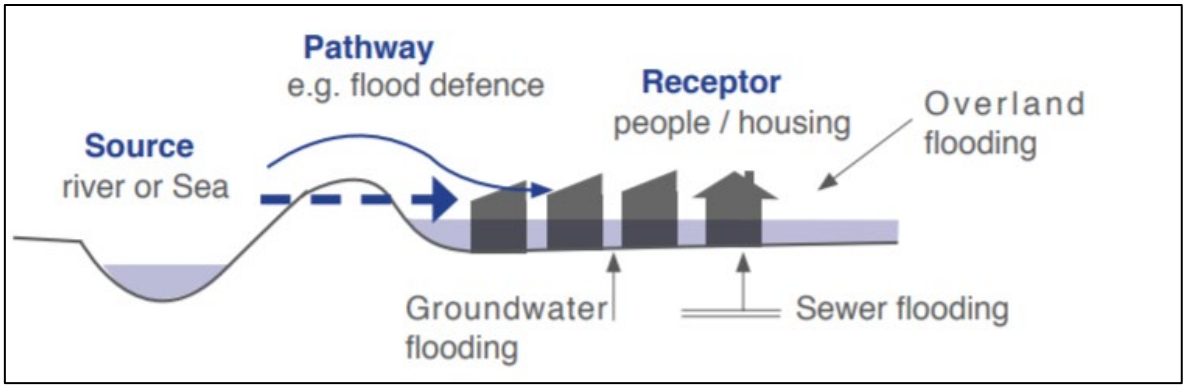

Figure 2-2: Source-Pathway- Receptor Model[2]

2.3 Likelihood of Flooding and Definition of Flood Zones

The Guidelines for Planning Authorities define the likelihood of flooding as the percentage probability of a flood of a given magnitude occurring or being exceeded in any given year. The likelihood of flooding is expressed as a return period or annual exceedance probability (AEP).

Flood Zones are graphical areas within which the likelihood of flooding is in a particular range. They are a key tool in flood risk management within the planning process as well as in flood warning and emergency planning. The Guidelines for Planning Authorities split these flood zones into three categories:

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

[2] Source: Fig 2.2 of the *Guidelines for Planning Authorities*.

2.4 Classification of the Proposed Development and Justification Test

The Guidelines for Planning Authorities categorises all types of development as either:

- Highly Vulnerable (garda, ambulances, schools, hospitals, dwelling houses, student halls…).
- Less Vulnerable (buildings used for: retail leisure, warehousing, commercial, industrial, and non-residential institutions,).
- Water Compatible (flood control infrastructure, docks, marinas, amenity open spaces...).

The Guidelines classify potential development in terms of its vulnerability to flooding. The types of development falling within each vulnerability class are described in Table 2.1 of the Guidelines, which is reproduced in Table 2-2.

Table 2-1: Vulnerability Class[3]

Highly vulnerable development (Including essential infrastructure)	• Garda, ambulance and fire stations and command centres required to be operational during flooding; • Hospitals; • Emergency access and egress points; • Schools; • Dwelling houses, student halls of residence and hostels; • Residential institutions such as residential care homes, children's homes and social services homes; • Caravans and mobile home parks; • Dwelling houses designed, constructed or adapted for the elderly or, other people with impaired mobility; • Essential infrastructure, such as primary transport and utilities distribution, including electricity generating power stations and sub-stations, water and • Sewage treatment, and potential significant sources of pollution (SEVESO sites, IPPC sites, etc.) in the event of flooding.
Less vulnerable development	• Buildings used for: retail, leisure, warehousing, commercial, industrial and non-residential institutions; • Land and buildings used for holiday or short-let caravans and camping, subject to specific warning and evacuation plans; • Land and buildings used for agriculture and forestry; • Waste treatment (except landfill and hazardous waste); • Mineral working and processing; • Local transport infrastructure.

[3] Source: Table 3.2 of the *Guidelines for Planning Authorities*.

Water-compatible development	• Flood control infrastructure; • Docks, marinas and wharves; • Navigation facilities; • Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location; • Water-based recreation and tourism (excluding sleeping accommodation); • Lifeguard and coastguard stations; • Amenity open space, outdoor sports and recreation and essential facilities such as changing rooms; • Essential ancillary sleeping or residential accommodation for staff required by uses in this category (subject to a specific warning and evacuation plan).

Uses which are not listed in the table should be considered on their own merits.

The Sequential Approach restricts development types to occur within the flood zone appropriate to their respective vulnerability classes. Table 2-2 identifies the types of development appropriate for each flood zone and those that will require a Justification Test.

Table 2-2: Matrix of Vulnerability Versus Flood Zone[4]

	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

The Justification Test has been designed to rigorously assess the appropriateness of developments that are being considered in areas of moderate or high flood risk. There are two types of the Justification Test:

- The first is the Plan-making Justification Test which is used at the plan preparation and adoption stage where it is intended to zone or otherwise designate land which is at moderate or high risk of flooding.
- The second is the Development Management Justification Test which is used at the planning application stage where it is intended to develop land at moderate or high risk of flooding for uses or development vulnerable to flooding that would generally be inappropriate for that land.

[4] Source: Table 3.2 of the *Guidelines for Planning Authorities*.

2.5 Flood Risk Assessment Stages

The Guidelines for Planning Authorities outline that a staged approach should be adopted when carrying out a SSFRA. These stages, see also Figure 2-3 below are:

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

Shapes FRA

Influences FRA

	Flood risk identification	Initial flood risk assessment	Detailed flood risk assessment
Regional Flood Risk Appraisal	✓	U	U
Strategic Flood Risk assessment – County-wide	✓	P	U
Strategic Flood Risk Assessment – City or town within a county plan	✓	✓	P
Site-specific flood risk assessment	✓	✓	✓

P = Probably needed to meet the requirements of the Justification Test

U = Unlikely to be needed

✓ = Required to be undertaken

Figure 2-3: Flood risk assessment stages required per scale of study undertaken[5]

Stage 1: Flood risk identification – to identify whether there may be any flooding or surface water management issues relating to the Proposed Development site that may warrant further investigations. The flood risk identification stage uses existing information to identify whether there may be any flooding or surface water management issues related to the site. Flood risks identified in this stage are then addressed in Stage 2.

Stage 2: Initial flood risk assessment – to confirm sources of flooding that may affect the development site, to appraise the adequacy of existing information and to determine what surveys and modelling approach is appropriate to match the spatial resolution required and complexity of the flood risk issues. This stage involves the review of data addressed in Stage 1. Data where the flood risk at the site is recognised as being low is screened out and it is not further addressed in the report, data which recognised the flood risk on the site to be medium or high is further analysed in the report.

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

[5] Source: Appendix A of *Guidelines for Planning Authorities*, Table A3.

3. EXISTING SITE

3.1 Site Description

The proposed bridge is surrounded by Trim Castle to the south, Trim town centre to the west and the porch fields to the north. Small approach embankments are required on both sides of the proposed bridge to ensure it is constructed above the design flood levels. At the south abutment, three paths lead towards the bridge. Two of these feed from the adjacent car park, situated at a higher level, and descend towards the bridge location. Extending east from the south abutment, a path runs along the banks of the River Boyne, between the river and Trim Castle.

Photographs of the proposed bridge and the surrounding areas are provided in Appendix 7.

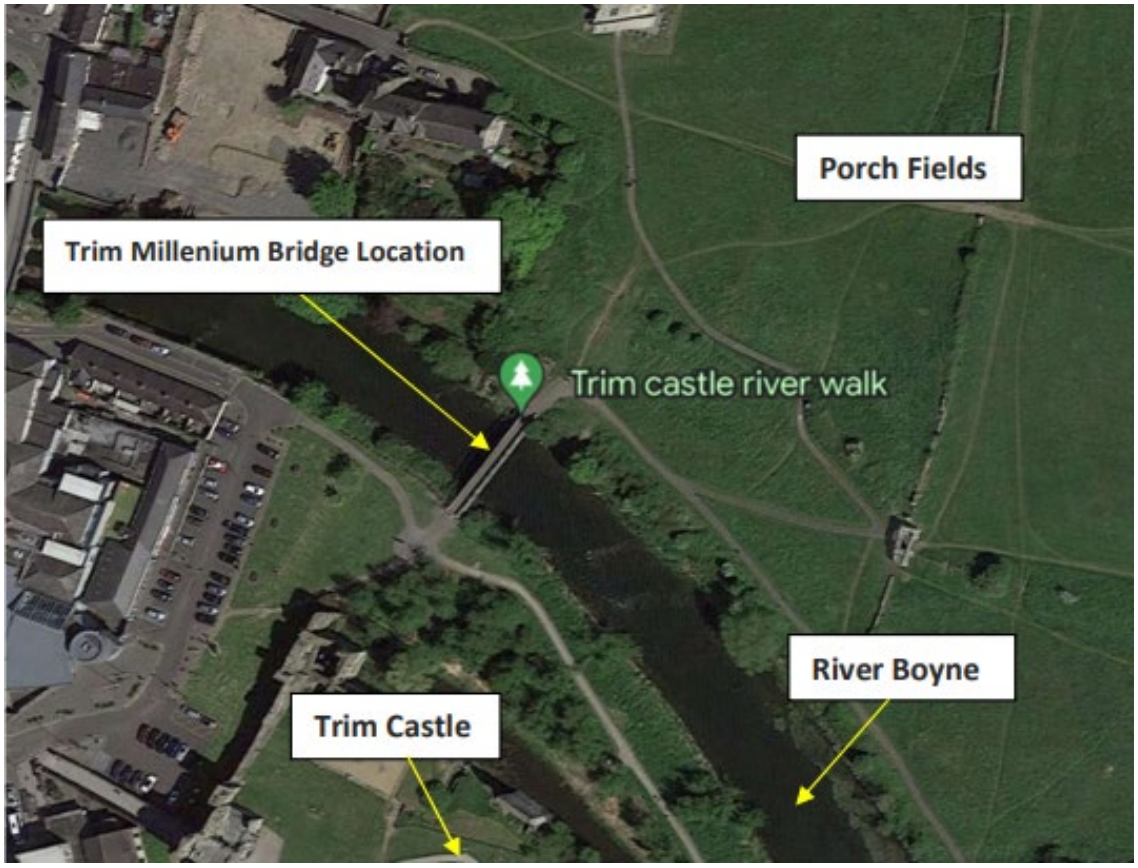

Figure 3-1: Plan Location of Trim Millennium Pedestrian Bridge

The ITM coordinates for the Bridge are provided in Table 1-1.

Table 3-1: Location of Existing Bridge

Bridge Reference	Easting Coordinates	Northing Coordinates
	X (ITM)	Y (ITM)
Millennium Pedestrian footbridge	680217	756860

3.1.1 Topography

The site is situated within small hills with elevations approximately 60m above sea level and gentle slopes. The river at the site location has a small section of floodplains, varying in extent from 20m to 50m. Approximately 300m downstream of the proposed site, the flood extents become more expansive, reaching approximately 100m.

3.2 Existing Bridge

The superstructure of the demolished bridge, constructed from Ekki timber in 2001, was observed as having experienced a significant failure during a structural inspection undertaken in July 2022. For the existing scenario considered in this report, we will assume the presence of the demolished bridge and compare it with the proposed one.

Table 3-2: Existing Bridge Information

Bridge Name	Span (m)	Deck Width (m)	Inlet Coordinates		Outlet Coordinates	
			Easting (ITM)	Northing (ITM)	Easting (ITM)	Northing (ITM)
Millennium Pedestrian Bridge	12	2.5	680214	756861	680219	756857

3.3 Description of Catchments

This section discusses the catchment characteristics of the site for the proposed Trim Millennium Pedestrian Bridge installation.

The Bridge crosses the River Boyne, originating within the Boyne Water Framework (WFD) Catchment 7. Approximately 300m upstream of the bridge location, there is the confluence of Boyne_SC_60, Boyne_SC_70 and Boyne_SC_80 sub-catchments. The catchment size for the river is approximately 1362.18Km², this measurement was obtained using the FSU Web Portal Map from OPW, as shown in Figure3-2 below.

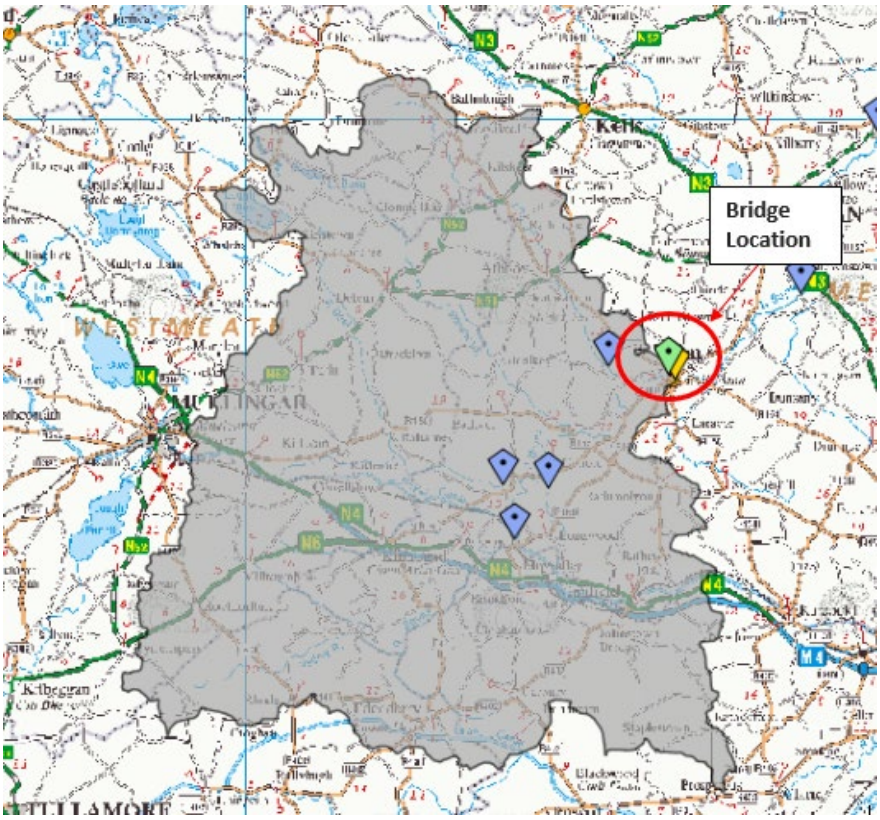

Figure 3-2: Catchment Area of River Boyne at the Bridge location - Source: FSU Web Portal

The elevation range of the site varies between approximately 60 m OD and 50 m OD, and it generally has a flat topography. The proposed bridge will be installed in the banks and flood plains of the River Boyne with a range between approximately 52 m OD and 53 m OD.

The Standard Average Annual Rainfall (SAAR) of the site from the FSU Portal is approximately 878.64 mm.

3.4 Subsoil and Hydrogeology

According to the Geological Survey of Ireland (GSI), local deposits are comprised of made ground on the Southern Abutment and gravels derived from limestones on the Northern Abutment, with a strip of river deposits described as alluvium between those two materials. Bedrock is shallow, with outcrop and subcrop around the proposed bridge as it appears in Figure 3-3 below. This has been confirmed through Ground Investigation, with top of bedrock encountered at 4.3mBGL on the Southern Abutment and at 2.4mBGL on the Northern Abutment.

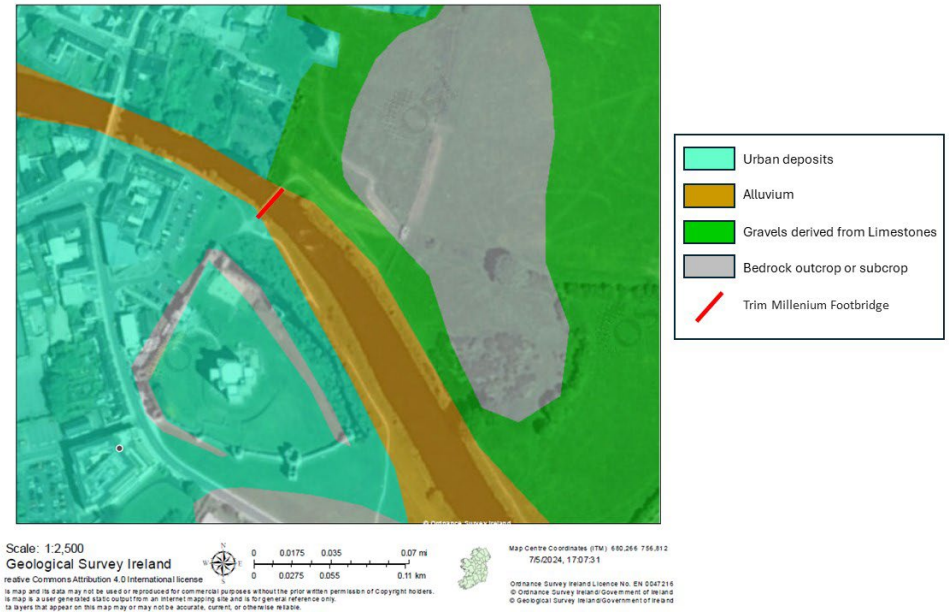

Figure 3-3: Soil Characteristic

According to GSI, the proposed bridge is located on Namurian formation, aged as carboniferous and described as Pale sandstone and dark shale. The project area is located near the contact with Lucan Formation.

In Ground Investigation logs, rock is described as strong to locally very weak, medium bedded to thinly laminated, pale to dark grey/black, fine-grained, LIMESTONE (interbedded and interlaminated sandy limestone with subordinate muddy limestone and occasional shale layers at 3.02-3.04m, 3.08-3.11m and 4.06-4.09m), fresh to locally slightly weathered. Discontinuities are medium to closely spaced, smooth to rough, fractures are planar. Apertures are tight to locally moderately open, locally clay-smeared. Dips are subhorizontal, 10-20° & locally 50-70°.

The logs description suits better with the adjacent rock formation (Lucan Formation), which is described by GSI as dark-grey to black, fine-grained, occasionally cherty, micritic limestones and shale.

The figure below shows the bedrock formation distribution according to GSI.

Figure 3-4: Bedrock Formation

The figure below shows the bedrock context of Namurian formation and its proximity to Lucan Formation.

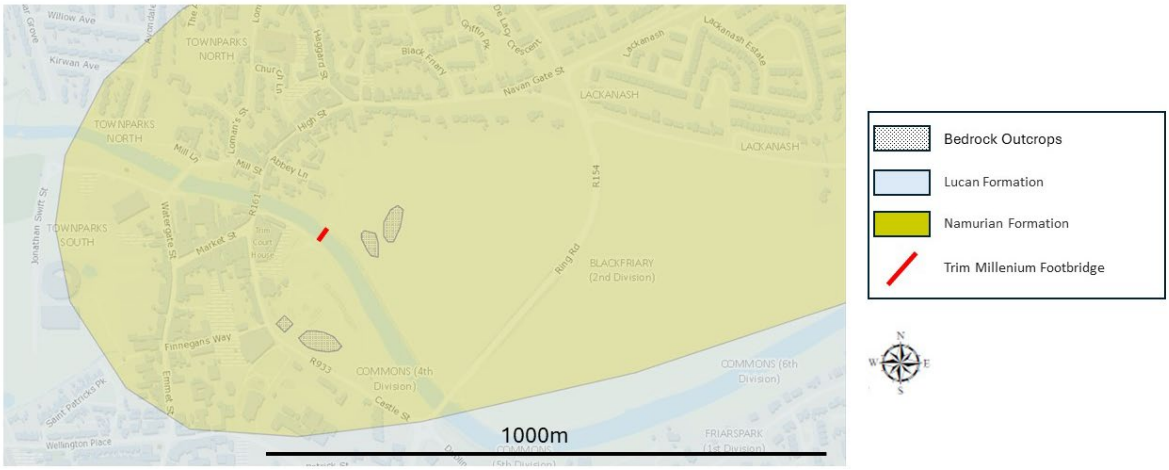

Figure 3-5: Bedrock Regional Context

No local permeability has been mapped in the project area, but according to the ground context, high permeability is expected on the Northern Abutment and moderate permeability is expected on the Southern Abutment. The overburden soil has been logged as CLAY with variable fraction of coarser particles. Variable deposits distribution and shallow top of bedrock are expected. Therefore, it is recommended to assume conservative permeability values as recommended by GSI. The groundwater vulnerability has been classified as Extreme.

There are no identified karst features located within the site. The nearest karst formation is located approximately 5.3 km northwest of the subject site, which is a spring associated with the Lucan formation. No karst signs were identified in the Ground Investigation.

3.5 Hydrological Features

The site has a generally flat slope on the south bank and generally hilly on the north bank, with a flood plain that starts widening on both sides of the proposed bridge crossing, following the downstream direction of the River Boyne.

3.5.1 Proposed Infrastructure - Water Crossing

As part of this SSFRA, a detailed review of the proposed structure was carried out to ensure the designs would be acceptable for Section 50 consent in accordance with OPW requirements.

A detailed flood modelling and hydrological analysis was carried out and shown in Section 6.3. As a result of this assessment, a single span bridge is proposed with a span of 30 m.

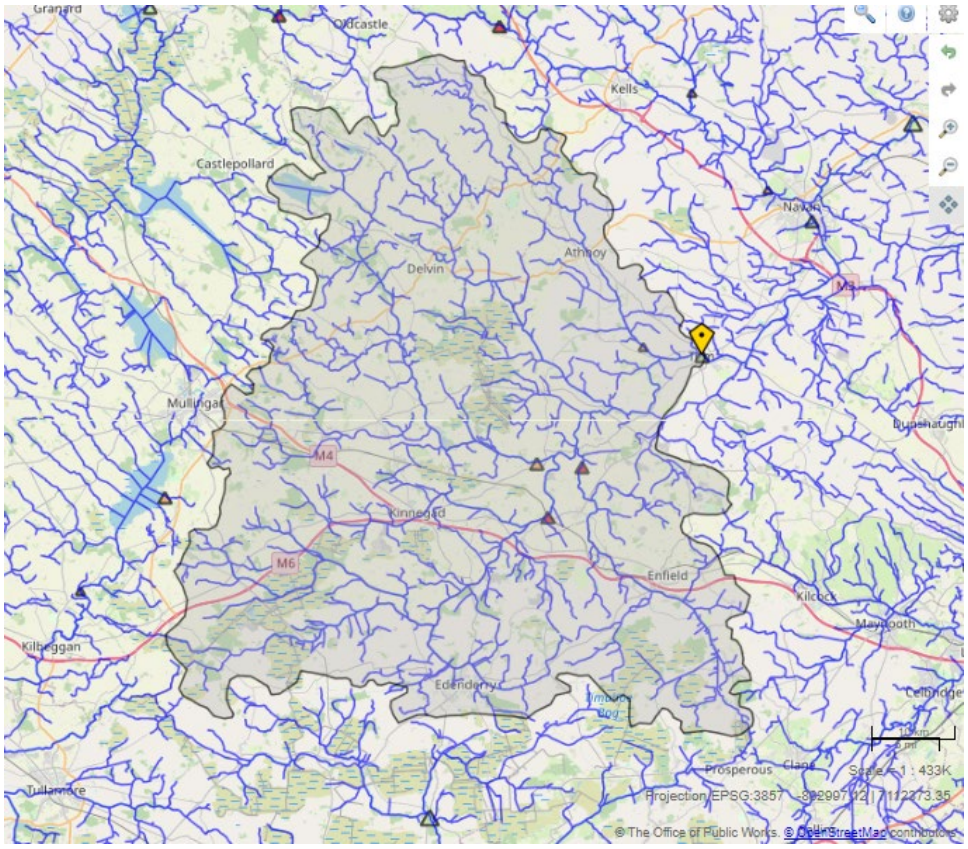

Figure 3-6:Hydrological Features and Proposed Structure Location (Map from https://opw.hydronet.com)

4. STAGE 1 - FLOOD RISK IDENTIFICATION

4.1 Flood History

To identify any recorded flood history at or near the site, multiple sources of flood information were examined. These sources included the website of the Office of Public Works (OPW) at www.floodmaps.ie, as well as general internet searches.

The Office of Public Works (OPW) maintains a National Flood Hazard mapping website at http://www.floodmaps.ie/. This online resource gathers recorded data and observed flood events to identify areas at risk of flooding.

To gather further flood information about the subject area, an internet search was conducted. However, no relevant records were found.

4.2 Flood Sources

The first step in conducting a flood risk assessment is to identify and examine the potential sources of flooding. Once this initial phase is complete, it becomes possible to assess the level of risk associated with each source of flooding. The flood sources in question are outlined below.

4.2.1 Fluvial Flooding

Fluvial flooding occurs when river levels rise and overflow onto land that is typically dry. Based on Floodmaps.ie mapping, the proposed bridge is inside of the flood zones A, B and C. Based on the Table 2-1, the proposed bridge is a less vulnerable development due to it is a transport infrastructure.

- 10% Fluvial AEP (Annual Exceedance Probabilities) or 1 in 10-year return period.
- 1% Fluvial AEP or 1 in 100-year return period.
- 0.1% Fluvial AEP or 1 in 1000-year return period.

Figure 4-1: Fluvial Flood Zones (Map from www.floodinfo.ie)

4.2.2 Coastal Flooding

Coastal flooding occurs when tide levels rise and overflow onto normally dry land. As shown in Figure 4-2 below, the mapping provided by Floodmaps.ie indicates no coastal flood vulnerability for the site during or exceeding the following flood event probabilities:

- 10% Tidal AEP (Annual Exceedance Probabilities) or 1 in 10-year return period.
- 0.5% Tidal AEP or 1 in 200-year return period.
- 0.1% Tidal AEP or 1 in 1000-year return period.

The subject site is within the Boyne Water Framework (WFD) Catchment 7, part of the confluence of Boyne_SC_60, Boyne_SC_70 and Boyne_SC_80 sub-catchments, Meath (Leinster). The Proposed Development is within CFRAM Study Area for River Flood Extents. The site is located approximately 40 km from sea. Therefore, the site is not at risk of coastal flooding.

Figure 4-2: Coastal Flood Extents (Map from www.floodinfo.ie)

4.2.3 Pluvial Flooding

The occurrence of pluvial or surface water flooding is typically caused by high-intensity rainfall, generating flows before runoff enters a watercourse or sewer. As illustrated in Figure 4-3 below, the mapping provided by Floodmaps.ie indicates no pluvial flood vulnerability for the site during or exceeding the following flood event probabilities.

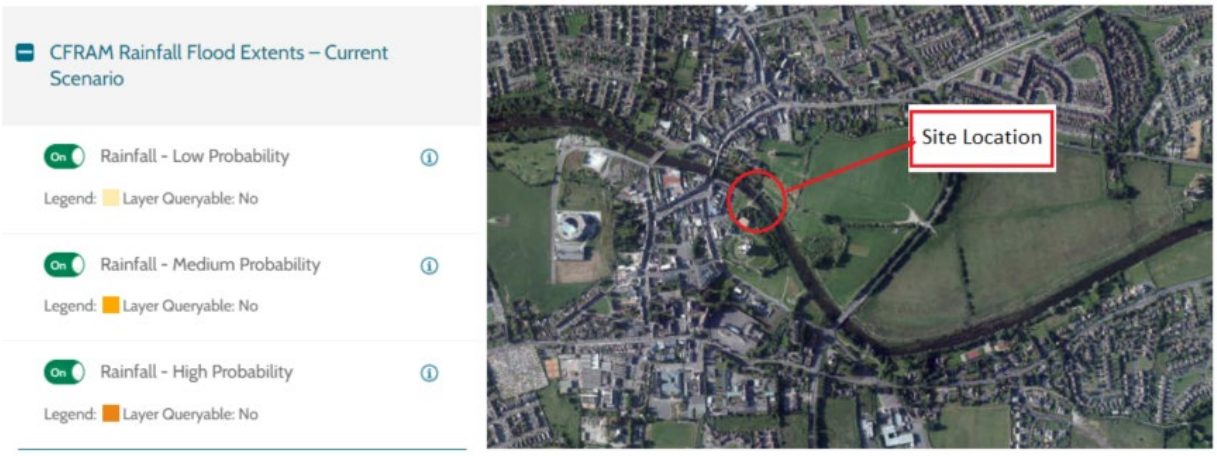

Figure 4-3: Rainfall Flood Extents (Source: Floodmaps.ie)

4.2.4 Groundwater Flooding

Groundwater flooding occurs when sub-surface water levels are elevated, resulting in the saturation of upper layers of soil and previously dry areas. As illustrated in Figure 4-4 below, the mapping provided by Floodmaps.ie indicates no groundwater flood vulnerability for the site during or exceeding the following flood event probabilities.

- 10% Groundwater AEP (Annual Exceedance Probabilities) or 1 in 10-year return period.
- 0.5% Groundwater AEP or 1 in 200-year return period.
- 0.1% Groundwater AEP or 1 in 1000-year return period.

Figure 4-4: Hydrological Features and Proposed Structure Location (Map from www.floodinfo.ie)

4.2.5 Climate Change

Every new development project must consider climate change in their flood risk evaluations for a given site. Designs for extreme rainfall scenarios should incorporate an additional 20% flow to account for these potential changes. The proposed bridge engineered to withstand storms and flood events up to the intensity of a 1-in-100-year event, including an extra 20% capacity for climate change effects. Therefore, the development can be deemed resilient to climate change.

4.2.5.1 Historical Flooding

The National Flood Hazard Mapping, available at www.floodmaps.ie, depicts historical flood events in Trim Town, which have affected surrounding lands as well as town streets and properties.

The first significant flood event occurred on November 17, 1965. Several photographs and newspaper articles document flooding in various streets of Trim. This event also impacted the existing Watergate Street Bridge.

The second notable flood event took place on February 1, 1995. Again, photographs and multiple newspaper articles record flooding in several Trim streets. This event also affected floodplains and surrounding lands.

Figure 4-5: Historical Flooding (Map from www.floodinfo.ie)

5. STAGE 2 - INITIAL FLOOD RISK ASSESSMENT

The primary objective of conducting an initial flood risk assessment is to investigate flood-related concerns identified during Stage 1 Flood Risk Identification. Based on the information recorded in Stage 1, it has been determined that the Site is within the flood zone.

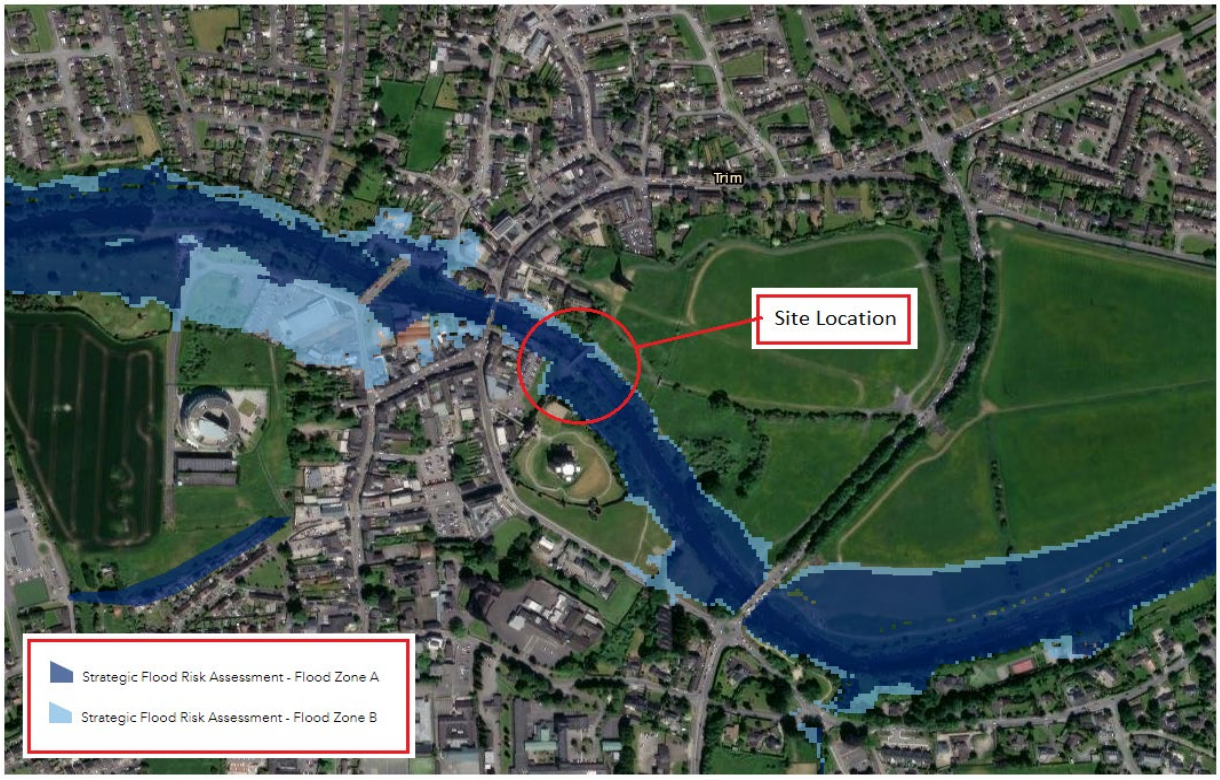

Figure 5-1: Meath County Development Plan 2021-2027

According to the Meath County Development Plan 2021-2027 (MCDP), the site is within Flood Zone A and B. Given that this structure is considered as "Less Vulnerable Development" as defined under "Local Transport Infrastructure", the Proposed Development is deemed 'Appropriate' in accordance with the guidelines of the Planning Authorities, as shown in Table 5-1. Therefore Stage 3 Detailed Flood Risk is not needed. To ensure the most accurate assessment, considering the flood history of the area, a Justification Test has been developed in Section 6 below.

Table 5-1: Matrix of Vulnerability Versus Flood Zone - Case of Study

	Flood Zone A	Flood Zone B	Flood Zone C
Highly Vulnerable Development	Justification Test	Justification Test	Appropriate
Less Vulnerable Development	Justification Test	Appropriate	Appropriate
Water-Compatible Development	Appropriate	Appropriate	Appropriate

6. STAGE 3 - DETAILED FLOOD RISK ASSESSMENT

As part of the Site-Specific Flood Risk Assessment, hydrological and hydraulic analysis and modelling was undertaken along the specific reach of the Hydrological Features. This enabled the delineation of appropriate flood zones and to provide information on flood depths for various flood events.

Hydraulic modelling conducted for the site provided estimates of peak flood flows across the River Boyne catchment; the specific location can be viewed in Figure 6-1. Using these estimated peak flows and a digital terrain model (DTM), maps have been generated showing the flood extent and depth for both 1% AEP and 0.1% AEP scenarios.

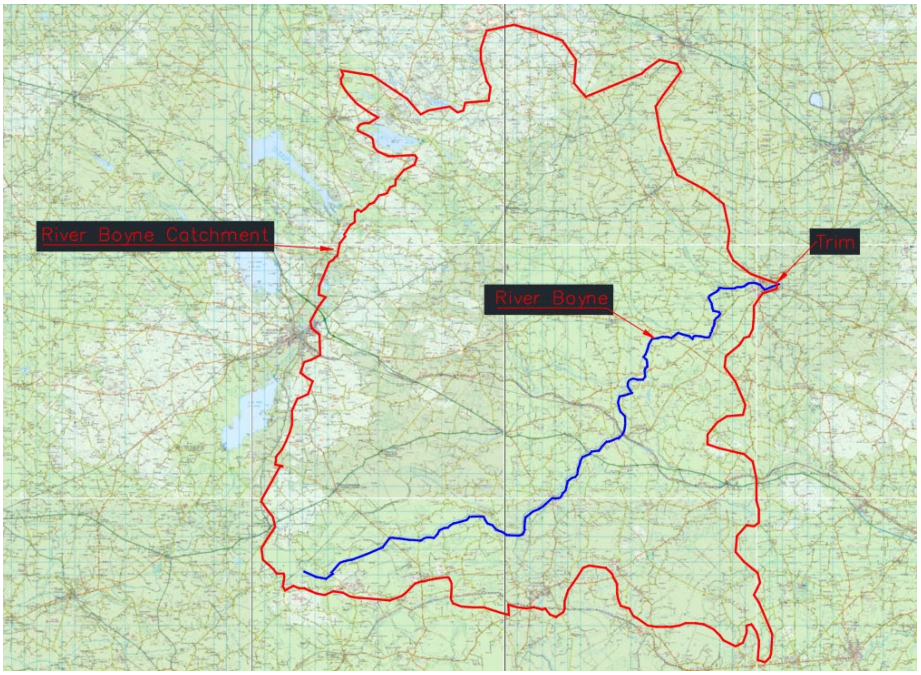

Figure 6-1: Site Location and Catchment

6.1 Contributing Catchment

The hydrology of a catchment is significantly influenced by its physical characteristics, including its size, length of the stream, steepness of the terrain and average annual rainfall. The following table lists the parameters used in the hydrology calculations:

Table 6-1: Catchment Characteristics

Variable	Value	Description
Area (km²)	1362.18	Area of the catchment
SAAR (mm)	878.64	Standard Average Annual Rainfall
FARL	0.984	Flood Attenuation by River and Lakes
MSL (Km)	56.72	Main river Length
S1085 (m/km)	0.425	Slope based on the stream elevation at 10% and 85% along MSL

Variable	Value	Description
BFIsoil	0.717	Base flow index for soil
URBEXT	0.0071	Index of urban extent
SOIL	0.1	Soil index, which is a composite index determined from soil survey maps that accompany the Flood Studies Report
DRAIND (km/km²)	0.8	Drainage density
ARTDRAIN 2	0.00	Percentage of catchment river network that is included in the drainage scheme

6.2 Hydrology Analysis

The Site is an ungauged catchment, therefore the flow estimation techniques adopted rely on ungauged methods. The flood estimation, in accordance with the OPW guidelines on Hydrology, three methods were considered for estimating the peak flow of the streams.

The methods used to estimate the peak flow of the streams included:

- Institute of Hydrology Report 124 Method (IH124).
- FSU 7 Variables Method.
- FSU 6 Variables Method.

The Hydrology Analysis was conducted to ascertain the flow values corresponding to the Annual Exceedance Probabilities (AEP) of 1% and 0.1%, plus 20% of Climate Change and 68% Confidence. To address potential errors in the flows estimates, different factors have been applied to each method.

For the IH124 method, a factorial standard error (FSE) of 1.65 has been applied. For the FSU 7 Variable method, a factor of 1.37 has been applied. For The FSR - 6 Variable Equations, a factor of 1.47 has been applied.

The IoH 124 and the FSR 6 Variable methods gained non conservative values.

After reviewing the results from each method with relevant factors applied, the flows obtained using the FSU 7-Variable Method have been chosen as a conservative flow for the bridge sizing analysis, as it is the preferred method for all catchments with an area greater than 25 km².

Table 6-2 and Table 6-3 below display a comparison of the various methods. The methods selected for each catchment are highlighted in green.

Table 6-2: Comparison of Index Flood for Three Applied Methods - 1% AEP + 20%CC and 68% C.I.

	Catchment Area	IoH 124	FSU 6-Variable	FSU - 7 Variable
	Km²	(m3/s)	(m3/s)	(m3/s)
River Boyne Catchment	1362.18	80.09	156.78	296.70

Table 6-3: Comparison of Index Flood for Three Applied Methods - 0.1% AEP + 20%CC and 68% C.I.

	Catchment Area	IoH 124	FSU 3-Variable	FSU - 7 Variable
	Km²	(m3/s)	(m3/s)	(m3/s)
River Boyne Catchment	1362.18	106.11	207.73	381.47

6.3 Hydraulic Analysis

6.3.1 Model Details

The hydraulic design of the proposed bridge was carried out by developing a Hec-Ras hydraulic model of the associated river channel in accordance with the guidelines set out in the UK CIRIA Report No. 6892 Bridge Design and Operation Guide" (2010). The proposed bridge has been designed to provide upstream and downstream freeboard equal or greater than 300mm, a maximum afflux no more than 200mm, a maximum hydraulic loss no more than 300mm for a design peak flow associated with a 100-year return period, 20% of climate change and 68% of confidence.

The contraction and expansion coefficient used were also recommended by the Hec-Ras reference manual. The site survey was undertaken in May 2012 by Murphy Survey Ltd. Terrain upstream and downstream of the crossing structure was surveyed, along with the crossing structure.

The following details were provided from survey information:

- Profile of the stream channel.
- Bed levels along the reach and the cross section.

The hydraulic modelling was conducted in software HEC-RAS in a 1D steady flow model. The hydraulic model comprises 31 cross sections, with 17 located upstream and 14 located downstream of the Millennium Pedestrian Bridge.

The design parameters, such as Manning's values for the river channel, flood plain and existing structure were estimated based on the site visit photos and the proposed manning's values in the Hec-Ras reference manual. The contraction and expansion coefficient used were also recommended by the Hec-Ras reference manual.

The coefficients chosen are summarized below in Table 6-4:

Table 6-4: Design Parameter used in the Hydraulic Design

Hydraulic Features	Manning Value Upstream Sections	Manning Value Middle Sections	Manning Value Downstream Sections	Reference
River Channel	0.0288	0.0288	0.051	Hec-Ras Reference Manual
Flood Plain	0.035	0.027	0.42	Hec-Ras Reference Manual

After selecting an appropriate design flow, a hydraulic analysis was conducted using Hec-Ras 6 software. To compare pre-construction and post-construction flow regime, separate hydraulic models were created for each scenario. The hydraulic behaviour was simulated using the developed models, which provided values for water velocity and elevation at various locations, including the river and flood plains both upstream and downstream of the existing and proposed bridges.

6.3.2 Flood Zone A

6.3.2.1 Comparison Between Existing and Proposed Scenarios - 1% EAP Fluvial

Upon completion of the hydraulic modelling, a comparison has been undertaken between the water levels obtained from the existing and proposed scenarios. This comparison allowed for conclusions to be drawn regarding the potential impact of the proposed bridge. The table below compares the result of the existing and proposed scenarios at each cross-section.

Table 6-5: Water Level Comparison – Existing VS Proposed Scenarios - 1% AEP + 20% CC and 68% C.I.

Cross Section	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Observation
880	Upstream	54.99	54.96	-0.03	Slight decrease of water level
840	Upstream	54.95	54.92	-0.03	Slight decrease of water level
817.5	Upstream	54.8	54.77	-0.03	Slight decrease of water level
814.075	**Trim Footbridge**	**Trim Footbridge**	**Trim Footbridge**	**Trim Footbridge**	-
810.65	Upstream	54.79	54.76	-0.03	Slight decrease of water level
800	Upstream	54.85	54.82	-0.03	Slight decrease of water level
760	Upstream	54.85	54.82	-0.03	Slight decrease of water level
742.53	Upstream	54.77	54.74	-0.03	Slight decrease of water level
732.43	**Watergate Street Bridge**	**Watergate Street Bridge**	**Watergate Street Bridge**	**Watergate Street Bridge**	-
722.33	Upstream	54.73	54.7	-0.03	Slight decrease of water level
700	Upstream	54.71	54.68	-0.03	Slight decrease of water level

Cross Section	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Observation
660	Upstream	54.68	54.65	-0.03	Slight decrease of water level
620	Upstream	54.67	54.64	-0.03	Slight decrease of water level
594.65	Upstream	53.92	53.86	-0.06	Slight decrease of water level
589.565	**Ireland's Oldest Bridge**	**Ireland's Oldest Bridge**	**Ireland's Oldest Bridge**	**Ireland's Oldest Bridge**	-
584.48	Upstream	53.74	53.68	-0.06	Slight decrease of water level
560	Upstream	53.91	53.85	-0.06	Slight decrease of water level
519.99	Upstream	53.86	53.8	-0.06	Slight decrease of water level
480	Upstream	53.85	53.77	-0.08	Slight decrease of water level
460.57	Upstream	53.62	53.56	-0.06	Slight decrease of water level
457.275	**Trim Millennium Pedestrian Bridge**	**Trim Millennium Pedestrian Bridge**	**Trim Millennium Pedestrian Bridge**	**Trim Millennium Pedestrian Bridge**	-
453.98	Dowmstream	53.6	53.59	-0.01	Slight decrease of water level
440	Downstream	53.75	53.75	0	No Variations
400	Downstream	53.78	53.78	0	No Variations
360	Downstream	53.76	53.76	0	No Variations
320	Downstream	53.75	53.75	0	No Variations
280	Downstream	53.71	53.71	0	No Variations
240	Downstream	53.64	53.64	0	No Variations
200	Downstream	53.6	53.6	0	No Variations
160	Downstream	53.55	53.55	0	No Variations
120	Downstream	53.44	53.44	0	No Variations
89.17	Downstream	53.22	53.22	0	No Variations

Cross Section	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Observation
79.22	**R154 Bridge**	**R154 Bridge**	**R154 Bridge**	**R154 Bridge**	-
71.28	Downstream	53.13	53.13	0	No Variations
40	Downstream	53.16	53.16	0	No Variations
0	Downstream	53.11	53.11	0	No Variations

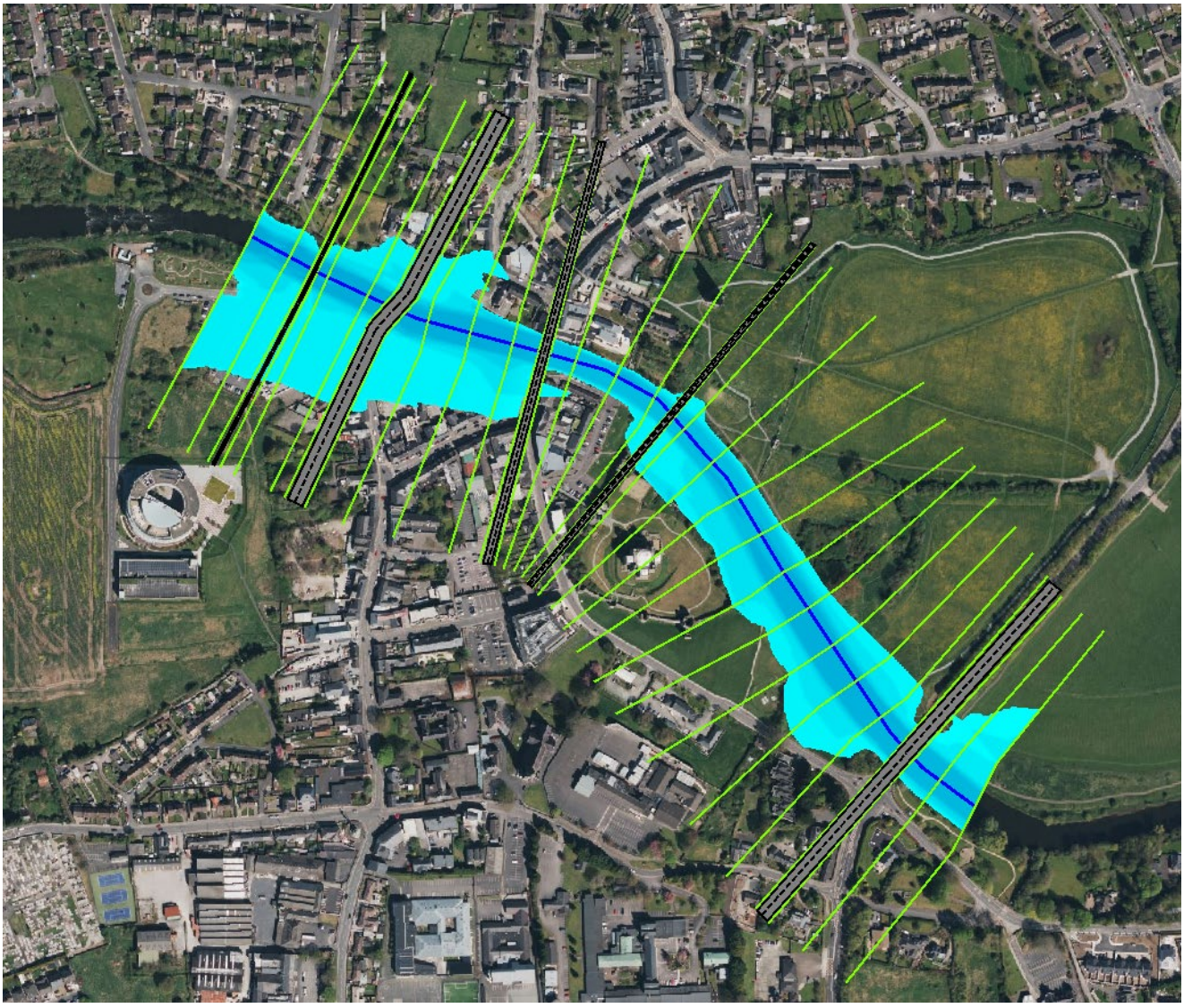

Figure 6-2: Flood Extents Existing Scenario - 1% AEP + 20% CC and 68% C.I.

Figure 6-3: Flood Extents Proposed Scenario - 1% AEP + 20% CC and 68% C.I.

6.3.3 Flood Zone B

6.3.3.1 Comparison Between Existing and Proposed Scenarios - 0.1% EAP Fluvial

Upon completion of the hydraulic modelling, a comparison has been undertaken between the water levels obtained from the existing and proposed scenarios. This comparison allowed for conclusions to be drawn regarding the potential impact of the proposed bridge. The table below compares the result of the existing and proposed scenarios at each cross-section.

Table 6-6: Water Level Comparison – Existing VS Proposed Scenarios - 0.1% AEP + 20% CC and 68% C.I.

Cross Section	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Observation
880	Upstream	56.16	56.16	0	No Variations
840	Upstream	56.14	56.14	0	No Variations
817.5	Upstream	56.12	56.12	0	No Variations
814.075	**Trim Footbridge**	**Trim Footbridge**	**Trim Footbridge**	**Trim Footbridge**	-
810.65	Upstream	56.1	56.1	0	No Variations
800	Upstream	56.1	56.1	0	No Variations
760	Upstream	56.11	56.11	0	No Variations
742.53	Upstream	56.09	56.09	0	No Variations
732.43	**Watergate Street Bridge**	**Watergate Street Bridge**	**Watergate Street Bridge**	**Watergate Street Bridge**	-
722.33	Upstream	56.07	56.07	0	No Variations
700	Upstream	56.06	56.06	0	No Variations
660	Upstream	56.05	56.05	0	No Variations
620	Upstream	56	56	0	No Variations
594.65	Upstream	55.99	55.99	0	No Variations
589.565	**Ireland's Oldest Bridge**	**Ireland's Oldest Bridge**	**Ireland's Oldest Bridge**	**Ireland's Oldest Bridge**	-
584.48	Upstream	54.55	54.44	-0.11	Moderate decrease of water level
560	Upstream	54.94	54.83	-0.11	Moderate decrease of water level

Cross Section	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Observation
519.99	Upstream	54.9	54.79	-0.11	Moderate decrease of water level
480	Upstream	54.97	54.87	-0.11	Moderate decrease of water level
460.57	Upstream	54.98	54.87	-0.11	Moderate decrease of water level
457.275	**Trim Millennium Pedestrian Bridge**	**Trim Millennium Pedestrian Bridge**	**Trim Millennium Pedestrian Bridge**	**Trim Millennium Pedestrian Bridge**	-
453.98	Downstream	54.5	54.5	0	No Variations
440	Downstream	54.55	54.55	0	No Variations
400	Downstream	54.56	54.56	0	No Variations
360	Downstream	54.54	54.54	0	No Variations
320	Downstream	54.55	54.55	0	No Variations
280	Downstream	54.53	54.53	0	No Variations
240	Downstream	54.48	54.48	0	No Variations
200	Downstream	54.45	54.45	0	No Variations
160	Downstream	54.43	54.43	0	No Variations
120	Downstream	54.36	54.36	0	No Variations
89.17	Downstream	54.09	54.09	0	No Variations
79.22	**R154 Bridge**	**R154 Bridge**	**R154 Bridge**	**R154 Bridge**	-
71.28	Downstream	53.45	53.45	0	No Variations

Cross Section	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Observation
40	Downstream	53.54	53.54	0	No Variations
0	Downstream	53.5	53.5	0	No Variations

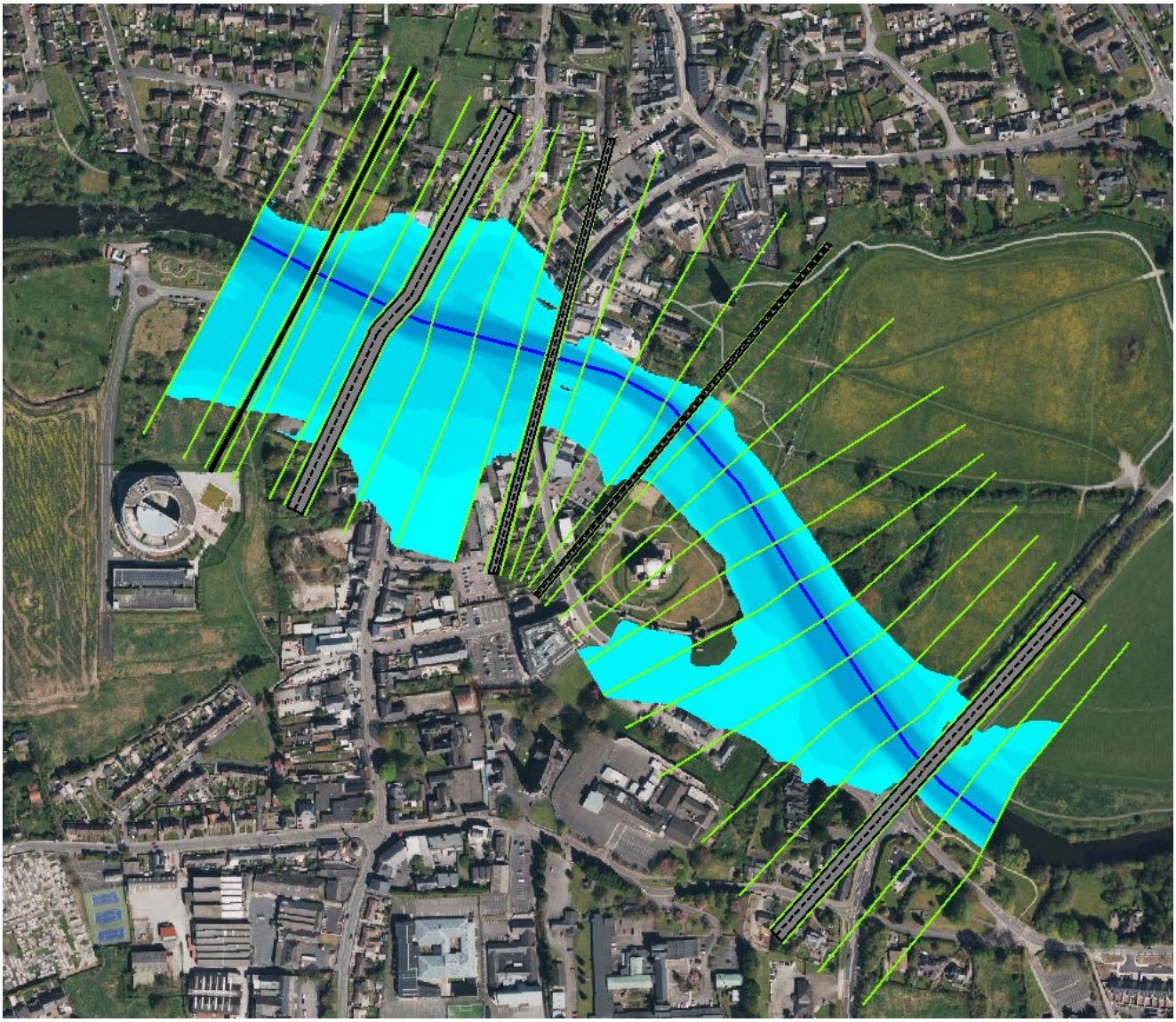

Figure 6-4: Flood Extents Existing Scenario - 1% AEP + 20% CC and 68% C.I.

Figure 6-5: Flood Extents Proposed Scenario - 1% AEP + 20% CC and 68% C.I.

7. MITIGATION MEASURES

Given that the proposed structure is situated within the river channels and banks, it was necessary to incorporate mitigation measures into their design. Sufficient span and height have been provided to the structure, and the embankment has been optimized to minimize the footprint and height. These measures are intended to reduce flow restrictions that could potentially cause an increase in flood extents. It is important to note that ongoing monitoring and maintenance of the bridge will be essential to ensure it continues not to inhibit flow over time.

Construction stage methodologies and mitigation measures to be adopted for the construction of proposed clear span bridge is set out in the Construction and Environmental Management Plan submitted as part of the planning application.

8. CONCLUSION

The Site-Specific Flood Risk Assessment (SSFRA) conducted a thorough investigation into the local hydrological conditions related to the proposed Trim Millennium Pedestrian Bridge. The study indicates susceptibility to flooding for 1 in 100 years and 1 in 1000 years fluvial events, particularly upstream and downstream of the proposed structure.

Based on the SSFRA findings, it's been established that flood risk to the site can be effectively managed by implementing a design featuring a single span bridge. The assessment also addresses embankment design concerning the banks of the River Boyne.

Considering the SSFRA outcomes, it's evident that adopting a single span bridge over the River Boyne adequately addresses flood risk concerns. Additionally, with the mitigation measures discussed, the proposed structure is not expected to negatively impact anticipated flood extent and levels in the site vicinity. Therefore, the proposed development aligns with the core principles of the Planning System and Flood Risk Management Guidelines.

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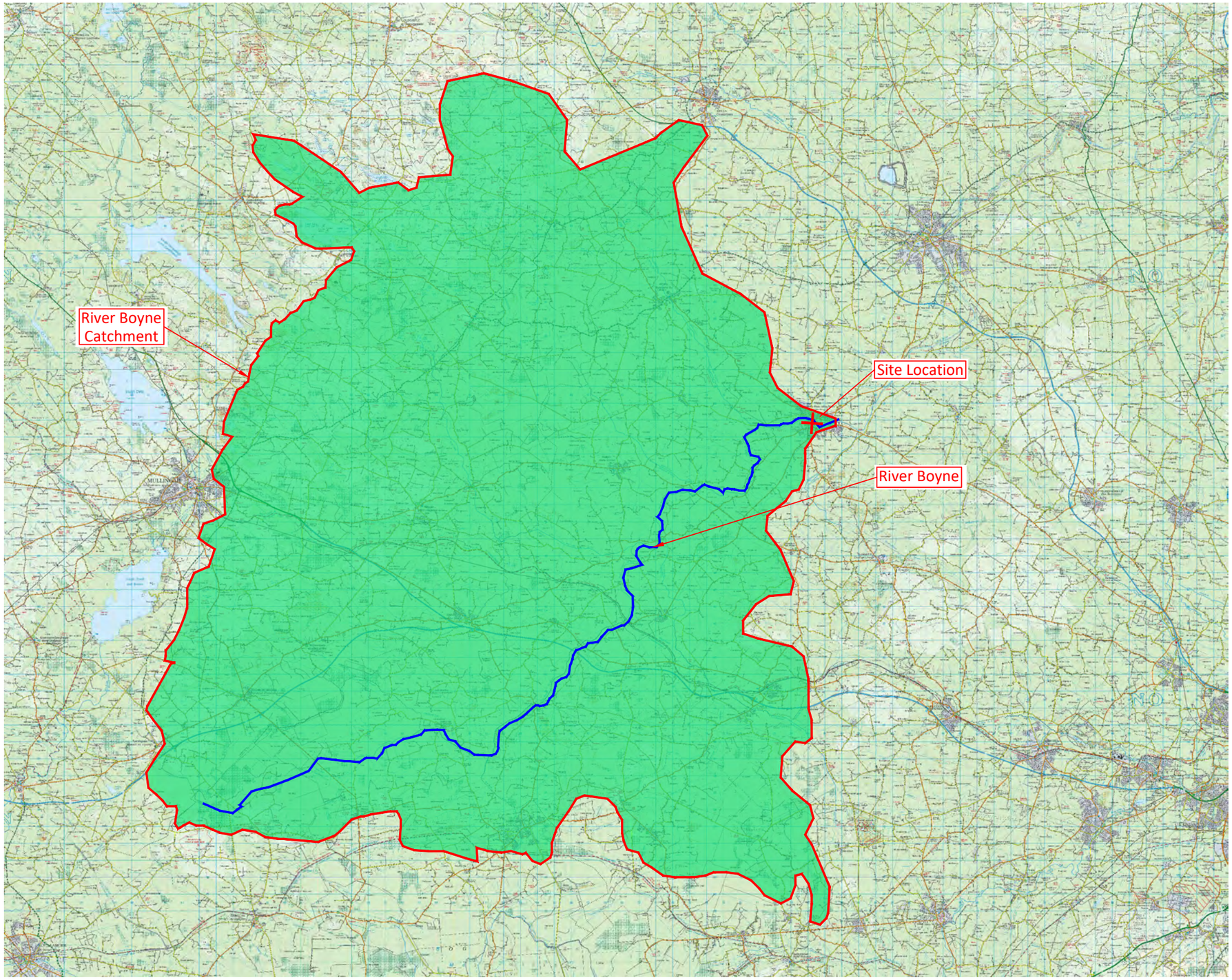
APPENDIX 1

Catchment and Location PLan



LEGEND:

Catchment Area

Site Location

0m 1250m 2500m 3750m 5000m 6250m 7500m 8750m 10000m 11250m 12500m

Scale 1:250000

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Rev.	Description	App By	Date
P01	ISSUE FOR IMFORMATION	BB	30.04.24

PROJECT

TRIM MILLENNIUM PEDESTRIAN BRIDGE

CLIENT

comhairle chontae na mí
meath county council

SHEET

SITE LOCATION AND CATCHMENT PLAN

Date 30.04.24	Project number P22-256	Scale (@ A3) 1:250000	
Drawn by SK	Drawing Number P22256-FT-XX-ZZ-DR-D-0001		Rev P01
Checked by PD			

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1 May 2024

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APPENDIX 2

Proposed Structure

LEGEND:

- SITE BOUNDARY
- RIVER BOYNE
- NEW 1:2 EMBANKMENT 53.50
- EXISTING VEGETATION
- BRIDGE DECK
- PROPOSED FOOTPATH
- EXISTING FOOTPATH
- EXISTING PAVED AREA (To Be Removed)

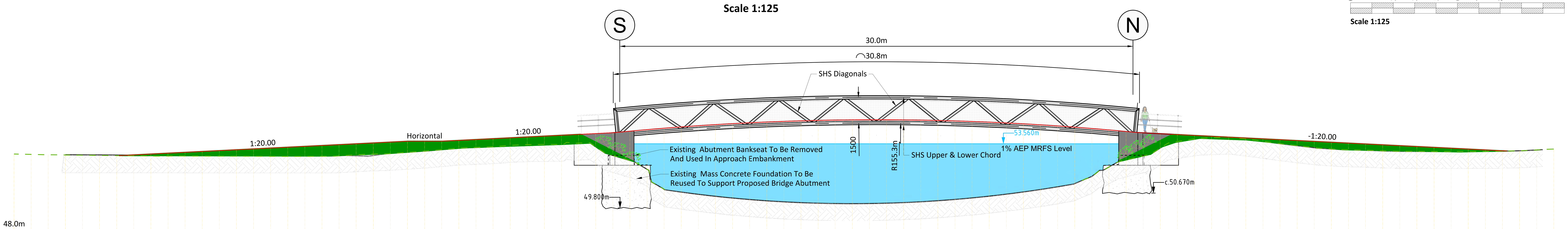
Note:
Levels given are with reference to Malin Head Benchmark

BRIDGE PLAN

Scale 1:125

0m 1.25m 2.50m 3.75m 5.00m 6.25m 7.50m 8.75m 10.00m 11.25m 12.50m

Scale 1:125



Chainage	0.000	01.000	02.000	03.000	04.000	5.000	06.000	07.000	08.000	09.000	10.000	11.000	12.000	13.000	14.000	15.000	16.000	17.000	18.000	19.000	20.000	21.000	22.000
Ramp/Deck								52.895	52.945	52.995	53.045	53.095	53.145	53.195	53.245	53.295	53.345	53.395	53.445	53.495	53.545	53.595	53.645
Existing Ground Level	52.946	52.923	52.903	52.891	52.878	52.866	52.854	52.841	52.829	52.827	52.828	52.825	52.821	52.818	52.814	52.811	52.807	52.809	52.813	52.838	52.897	52.948	52.973

Chainage	23.000	24.000	25.000	26.000	27.000	28.000	29.000	30.000	31.000	32.000	33.000	34.000	35.000	36.000	37.000	38.000	39.000	40.000	41.000	42.000	43.000	44.000	45.000
Ramp/Deck	53.695	53.695	53.695	53.745	53.795	53.845	53.895	53.945	53.995	54.045	54.095	54.145	54.195	54.283	54.373	54.456	54.533	54.603	54.667	54.724	54.775	54.820	54.858
Existing Ground Level	53.045	53.118	53.203	53.292	53.331	53.379	53.450	53.494	53.504	53.510	53.582	53.369	52.865	52.572	52.053	50.884							

Chainage	46.000	47.000	48.000	49.000	50.000	51.000	52.000	53.000	54.000	55.000	56.000	57.000	58.000	59.000	60.000	61.000	62.000	63.000	64.000	65.000	66.000	67.000	68.000
Ramp/Deck	54.889	54.914	54.933	54.945	54.951	54.950	54.943	54.930	54.910	54.883	54.851	54.811	54.766	54.714	54.655	54.590	54.518	54.440	54.356	54.265	54.185	54.135	54.085
Existing Ground Level																		51.636	52.188	52.604	52.837	53.294	53.672

Chainage	69.000	70.000	71.000	72.000	73.000	74.000	75.000	76.000	77.000	78.000	79.000	80.000	81.000	82.000	83.000	84.000	85.000	86.000	87.000	88.000	89.000	90.000
Ramp/Deck	54.035	53.985	53.935	53.885	53.835	53.785	53.735	53.685	53.635	53.585	53.535	53.485	53.435	53.385	53.335	53.285	53.235	53.185	53.135			
Existing Ground Level	53.833	53.895	53.940	53.824	53.694	53.555	53.434	53.315	53.245	53.195	53.169	53.131	53.107	53.103	53.093	53.094	53.097	53.103	53.116	53.138	53.186	53.236

BRIDGE ELEVATION (Viewed From South East)

Scale 1:125

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Rev.	Description	App By	Date
P01	ISSUE FOR IMFORMATION	BB	01.05.24

PROJECT
TRIM MILLENNIUM PEDESTRIAN BRIDGE

SHEET
PLAN & ELEVATION

CLIENT
comhairle chontae na mí
meath county council

Date	Project number	Scale (@ A1-)
01.05.24	P22-256	1:125

Drawn by	SK
Checked by	AB

Drawing Number: P22256-FT-XX-ZZ-DR-D-0004
Rev: P01

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1 May 2024

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APPENDIX 3

Hydrology Analysis

Project	P22-256 Trim Pedestrian Scheme		
Subject	Calculation of Flow Estimation		
Prepared by:	RM	Job No	P20-132
Checked by:	PD	Date	15/05/2024
Approved by:	PD	Revision	P01

1.0 PHYSICAL CATCHMENT DESCRIPTORS (PCD'S):

1.1 Hydrological PCD's

S1085 - Mainstream Slope	0.425	m/km

1.2 Spatial PCD's

AREA - Catchment Area	1362.183	km^2
SAAR - Standard Annual Average Rainfall	878.64	mm
FARL - Flood Attenuation by Rivers and Lakes	0.984	-

1.3 Spatial PCD's Representing Soil, Subsoil & Aquifer Types

BFI_{SOIL}	0.717	-
URBEXT	0.0071	-
SOIL	0.1	-
DRAIND	0.800	km/km^2
ARTDRAIN2	0	-
LAKE	0.00363387	-
STMFRQ	0.26868637	$1/km^2$
RSMD	33.5118185	mm

1.4 Catchment characteristics

Width	56471.99	m
Height	18	m
Time of Concentration	276.3	min

3.0 INSTITUTE OF HYDROLOGY REPORT 124 (IoH 124)

$QBAR_{RURAL}$	**12.507**	**m^3/s**

7.0 FSU - 7 VARIABLE EQUATION

$QMED_{RURAL}$	*77.562*	*m^3/s*
QMED	*78.380*	*m^3/s*
QBAR	**81.646**	**m^3/s**

8.0 A FSR - 6 Variable Equation (Cunnane and Lynn 1976)

Q BAR	*30.847*	*m^3/s*

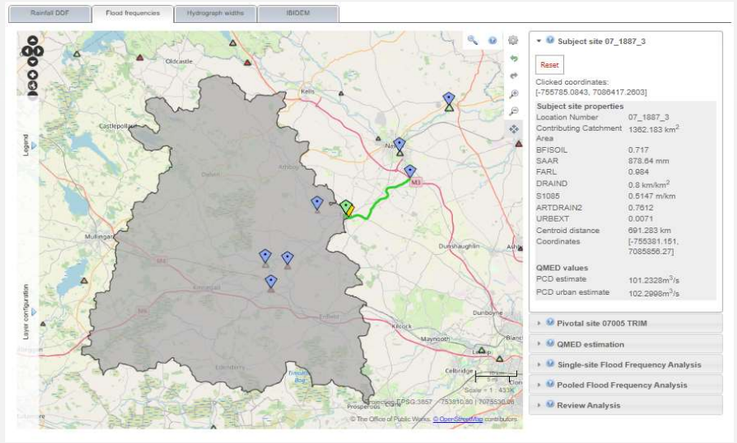
Stream Length (km)	10%	85%	DS Level (m) (10%)	US Level (m) (85%)	Slope (m/km)
56.5	5.647199	48.0011915	61	79	0.425

Calculation of Flow Estimation

Method	QBAR/QMED	FSE	$QBAR_{FSE}$ (68% C.I.)	Growth Factor Q100	100 Year Flow(68% C.I)	OPW maintenance factor (No maintained = 1, Maintained =1.6) does not apply for FSU Methods.	100 Year Flow(68% C.I) + Maintenance factor	FSU Adjustment Factor (only applicable to 7 Variables Equation) - Source: FSW web portal	100 Year Flow(68% C.I) + Maintenance factor +Adjusted factor	Climate Change	Design Flow (68% C.I.) (m3/s)
IoH 124	12.507 m3/s	1.65	34.050 m3/s	1.96	66.738	1.0	66.738	N/A	66.738	1.2	**80.09 m3/s**
FSU - 7 Variable Equation	81.646 m3/s	1.37	111.855 m3/s	2.1	234.894	1.0	234.894	1.053	247.250	1.2	**296.70 m3/s**
FSR - 6 Variable Equation (Cunnane and Lynn 1976)	30.847 m3/s	1.47	66.658 m3/s	1.96	130.650	1.0	130.650	N/A	130.650	1.2	**156.78 m3/s**

QMED = 0.96QBAR as per "Flood Estimation in Small and Urbanised Catchments in Ireland" by the OPW
This catchment is ungauged and there was no subject site created on the watercourse, hence the following values were utilised:
Flood Estimation in Small and Urbanised Catchments in Ireland
* Value taken from adjacent FSU catchment location 19_916_3

Catchement



Project	P22-256 Trim Pedestrian Scheme		
Subject	Calculation of Flow Estimation		
Prepared by:	RM	Job No	P20-132
Checked by:	PD	Date	15/05/2024
Approved by:	PD	Revision	P01

1.0 PHYSICAL CATCHMENT DESCRIPTORS (PCD'S):

1.1 Hydrological PCD's

S1085 - Mainstream Slope	0.425	m/km

1.2 Spatial PCD's

AREA - Catchment Area	1362.183	km^2
SAAR - Standard Annual Average Rainfall	878.64	mm
FARL - Flood Attenuation by Rivers and Lakes	0.984	-

1.3 Spatial PCD's Representing Soil, Subsoil & Aquifer Types

BFI_{SOIL}	0.717	-
URBEXT	0.0071	-
SOIL	0.1	-
DRAIND	0.800	km/km^2
ARTDRAIN2	0	-
LAKE	0.00363387	-
STMFRQ	0.26868637	$1/km^2$
RSMD	33.5118185	mm

1.4 Catchment characteristics

Width	56471.99	m
Height	18	m
Time of Concentration	276.3	min

3.0 INSTITUTE OF HYDROLOGY REPORT 124 (IoH 124)

$QBAR_{RURAL}$	**12.507**	**m^3/s**

7.0 FSU - 7 VARIABLE EQUATION

$QMED_{RURAL}$	*77.562*	*m^3/s*
QMED	*78.380*	*m^3/s*
QBAR	**81.646**	**m^3/s**

8.0 A FSR - 6 Variable Equation (Cunnane and Lynn 1976)

Q BAR	*30.847*	*m^3/s*

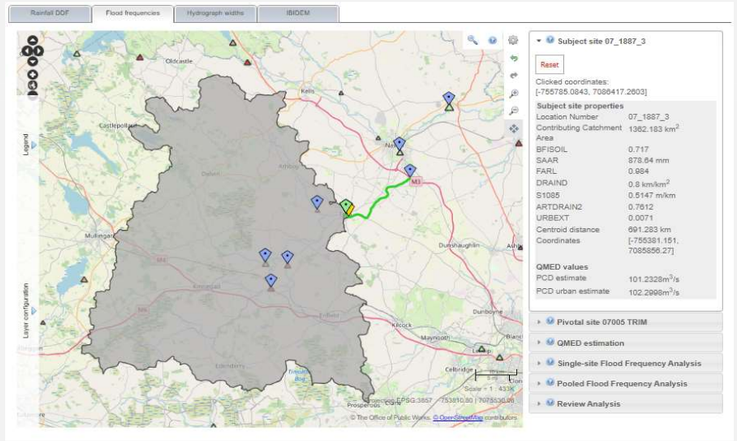
Stream Length (km)	10%	85%	DS Level (m) (10%)	US Level (m) (85%)	Slope (m/km)
56.5	5.647199	48.0011915	61	79	0.425

Calculation of Flow Estimation

Method	QBAR/QMED	FSE	$QBAR_{FSE}$ (68% C.I.)	Growth Factor Q1000	100 Year Flow(68% C.I)	OPW maintenance factor (No maintained = 1, Maintained =1.6) does not apply for FSU Methods.	100 Year Flow(68% C.I) + Maintenance factor	FSU Adjustment Factor (only applicable to 7 Variables Equation) - Source: FSW web portal	100 Year Flow(68% C.I) + Maintenance factor +Adjusted factor	Climate Change	Design Flow (68% C.I.) (m3/s)
IoH 124	12.507 m3/s	1.65	34.050 m3/s	2.597	88.428	1.0	88.428	N/A	88.428	1.2	**106.11 m3/s**
FSU - 7 Variable Equation	81.646 m3/s	1.37	111.855 m3/s	2.7	302.007	1.0	302.007	1.053	317.893	1.2	**381.47 m3/s**
FSR - 6 Variable Equation (Cunnane and Lynn 1976)	30.847 m3/s	1.47	66.658 m3/s	2.597	173.111	1.0	173.111	N/A	173.111	1.2	**207.73 m3/s**

QMED = 0.96QBAR as per "Flood Estimation in Small and Urbanised Catchments in Ireland" by the OPW
This catchment is ungauged and there was no subject site created on the watercourse, hence the following values were utilised:
Flood Estimation in Small and Urbanised Catchments in Ireland
* Value taken from adjacent FSU catchment location 19_916_3

Catchement



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APPENDIX 4

Hydraulic Analysis

Water Level Comparison - Existing Vs. Proposed Scenarios - 1% AEP + 20% CC and 68% C.I.

Cross Section / Chainages	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Observation
880	Upstream	54.99	54.96	-0.03	Slight decrease of water level
840	Upstream	54.95	54.92	-0.03	Slight decrease of water level
817.5	Upstream	54.8	54.77	-0.03	Slight decrease of water level
Trim footbridge	Trim footbridge	Trim footbridge	Trim footbridge	Trim footbridge	Trim footbridge
810.65	Upstream	54.79	54.76	-0.03	Slight decrease of water level
800	Upstream	54.85	54.82	-0.03	Slight decrease of water level
760	Upstream	54.85	54.82	-0.03	Slight decrease of water level
742.53	Upstream	54.77	54.74	-0.03	Slight decrease of water level
Watergate Street Bridge	Watergate Street Bridge	Watergate Street Bridge	Watergate Street Bridge	Watergate Street Bridge	Watergate Street Bridge
722.33	Upstream	54.73	54.7	-0.03	Slight decrease of water level
700	Upstream	54.71	54.68	-0.03	Slight decrease of water level
660	Upstream	54.68	54.65	-0.03	Slight decrease of water level
620	Upstream	54.67	54.63	-0.04	Slight decrease of water level
594.65	Upstream	53.92	53.86	-0.06	Slight decrease of water level
Ireland's Oldest Bridge	Ireland's Oldest Bridge	Ireland's Oldest Bridge	Ireland's Oldest Bridge	Ireland's Oldest Bridge	Ireland's Oldest Bridge
584.48	Upstream	53.74	53.68	-0.06	Slight decrease of water level
560	Upstream	53.91	53.85	-0.06	Slight decrease of water level
519.99	Upstream	53.86	53.8	-0.06	Slight decrease of water level
480	Upstream	53.85	53.77	-0.08	Slight decrease of water level
460.57	Upstream	53.62	53.56	-0.06	Slight decrease of water level
Millennium Footbridge	Millennium Footbridge	Millennium Footbridge	Millennium Footbridge	Millennium Footbridge	Millennium Footbridge
453.98	Downstream	53.6	53.59	-0.01	Slight decrease of water level
440	Downstream	53.75	53.75	0	No Variations
400	Downstream	53.78	53.78	0	No Variations
360	Downstream	53.76	53.76	0	No Variations
320	Downstream	53.75	53.75	0	No Variations
280	Downstream	53.71	53.71	0	No Variations
240	Downstream	53.64	53.64	0	No Variations
200	Downstream	53.6	53.6	0	No Variations
160	Downstream	53.55	53.55	0	No Variations
120	Downstream	53.44	53.44	0	No Variations
89.17	Downstream	53.22	53.22	0	No Variations
R154 Bridge	R154 Bridge	R154 Bridge	R154 Bridge	R154 Bridge	R154 Bridge
71.28	Downstream	53.13	53.13	0	No Variations
40	Downstream	53.16	53.16	0	No Variations
0	Downstream	53.11	53.11	0	No Variations

Water Level Comparison - Existing Vs. Proposed Sscenario - 0.1% EAP + 20% CC and 68% C.I.

Cross Section / Chainages	Location	Water Surface Elevation (Existing) (m)	Water Surface Elevation (Proposed) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)	Difference of Water Surface Elevation (Proposed - Existing) (m)
880	Upstream	56.16	56.16	0	No Variations
840	Upstream	56.14	56.14	0	No Variations
817.5	Upstream	56.12	56.12	0	No Variations
814.075	Trim Footbridge	Trim Footbridge	Trim Footbridge	Trim Footbridge	-
810.65	Upstream	56.1	56.1	0	No Variations
800	Upstream	56.1	56.1	0	No Variations
760	Upstream	56.11	56.11	0	No Variations
742.53	Upstream	56.09	56.09	0	No Variations
732.43	Watergate Street Bridge	Watergate Street Bridge	Watergate Street Bridge	Watergate Street Bridge	-
722.33	Upstream	56.07	56.07	0	No Variations
700	Upstream	56.06	56.06	0	No Variations
660	Upstream	56.05	56.05	0	No Variations
620	Upstream	56	56	0	No Variations
594.65	Upstream	55.99	55.99	0	No Variations
589.565	Ireland's Oldest Bridge	Ireland's Oldest Bridge	Ireland's Oldest Bridge	Ireland's Oldest Bridge	-
584.48	Upstream	54.55	54.44	-0.11	Moderate decrease of water level
560	Upstream	54.94	54.83	-0.11	Moderate decrease of water level
519.99	Upstream	54.9	54.79	-0.11	Moderate decrease of water level
480	Upstream	54.97	54.87	-0.1	Moderate decrease of water level
460.57	Upstream	54.98	54.87	-0.11	Moderate decrease of water level
457.275	Millennium Pedestrian Br	Trim Millennium Pedestrian Bridg	m Millennium Pedestrian Bri	Trim Millennium Pedestrian Bridge	-
453.98	Downstream	54.5	54.5	0	No Variations
440	Downstream	54.55	54.55	0	No Variations
400	Downstream	54.56	54.56	0	No Variations
360	Downstream	54.54	54.54	0	No Variations
320	Downstream	54.55	54.55	0	No Variations
280	Downstream	54.53	54.53	0	No Variations
240	Downstream	54.48	54.48	0	No Variations
200	Downstream	54.45	54.45	0	No Variations
160	Downstream	54.43	54.43	0	No Variations
120	Downstream	54.36	54.36	0	No Variations
89.17	Downstream	54.09	54.09	0	No Variations
79.22	R154 Bridge	R154 Bridge	R154 Bridge	R154 Bridge	-
71.28	Downstream	53.45	53.45	0	No Variations
40	Downstream	53.54	53.54	0	No Variations
0	Downstream	53.5	53.5	0	No Variations

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APPENDIX 5

OPW and MCDP Flood Maps

0m 125m 250m 375m 500m 625m 750m 875m 1000m 1125m 1250m

Scale 1:25000

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Rev.	Description	App By	Date
P01	ISSUE FOR PLANNING APPLICATION	BB	15.05.24

PROJECT

TRIM MILLENNIUM PEDESTRIAN BRIDGE

CLIENT

comhairle chontae na mí
meath county council

SHEET

OPW FLOOD EXTENTS 1% EAP & 0.1% EAP-P01

Date 15.05.24	Project number P22-256	Scale (@ A3-) 1:25000	
Drawn by CS	Drawing Number P22256-FT-XX-ZZ-DR-D-0007		Rev P01
Checked by PD			

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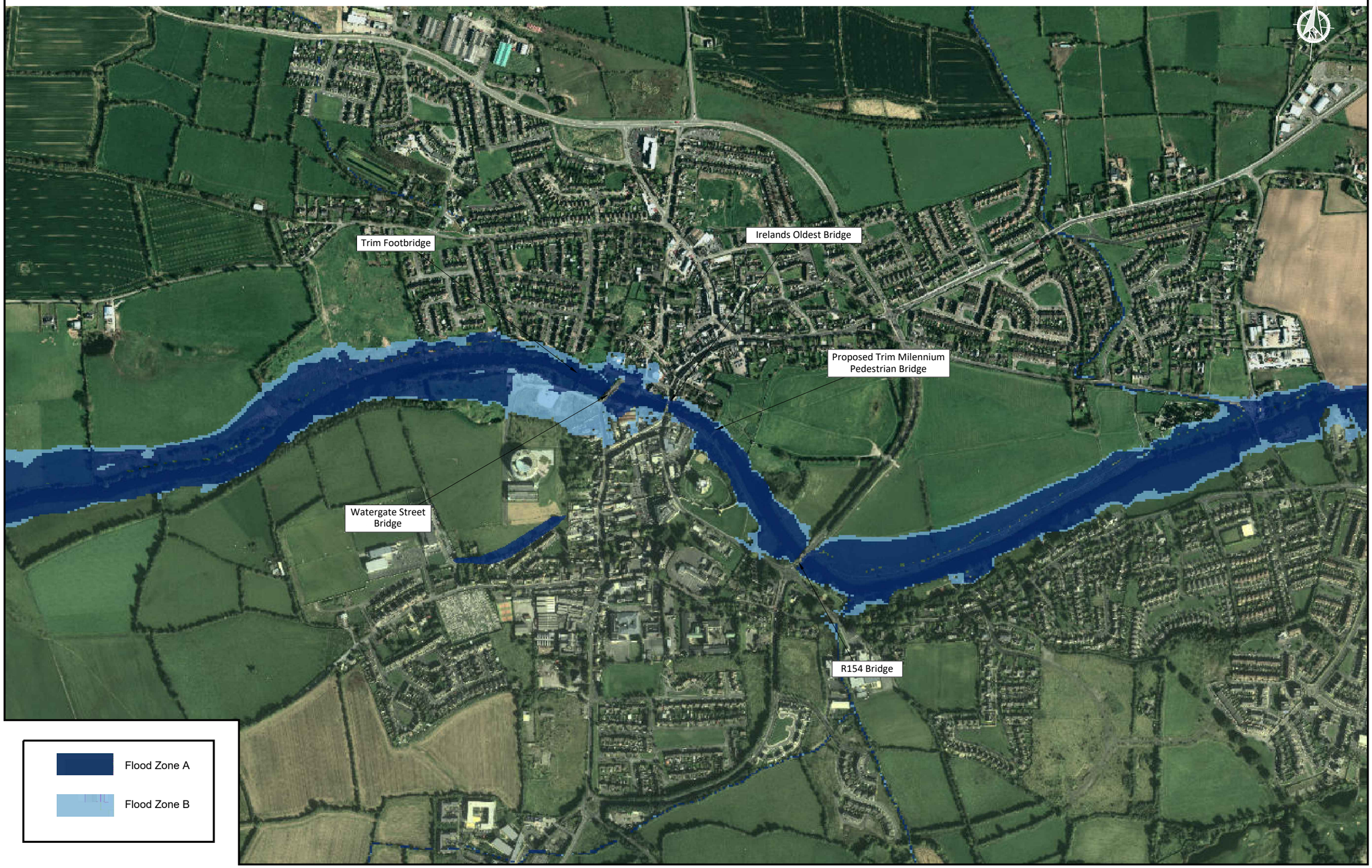
15 May 2024



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Scale 1:25000

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P01	ISSUE FOR PLANNING APPLICATION	BB	15.05.24

PROJECT

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meath county council

SHEET

MCDP FLOOD EXTENTS 1% EAP & 0.1% EAP-P01

Date 15.05.24	Project number P22-256	Scale (@ A3-) 1:25000	
Drawn by CS	Drawing Number P22256-FT-XX-ZZ-DR-D-0008		Rev P01
Checked by PD			

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15 May 2024

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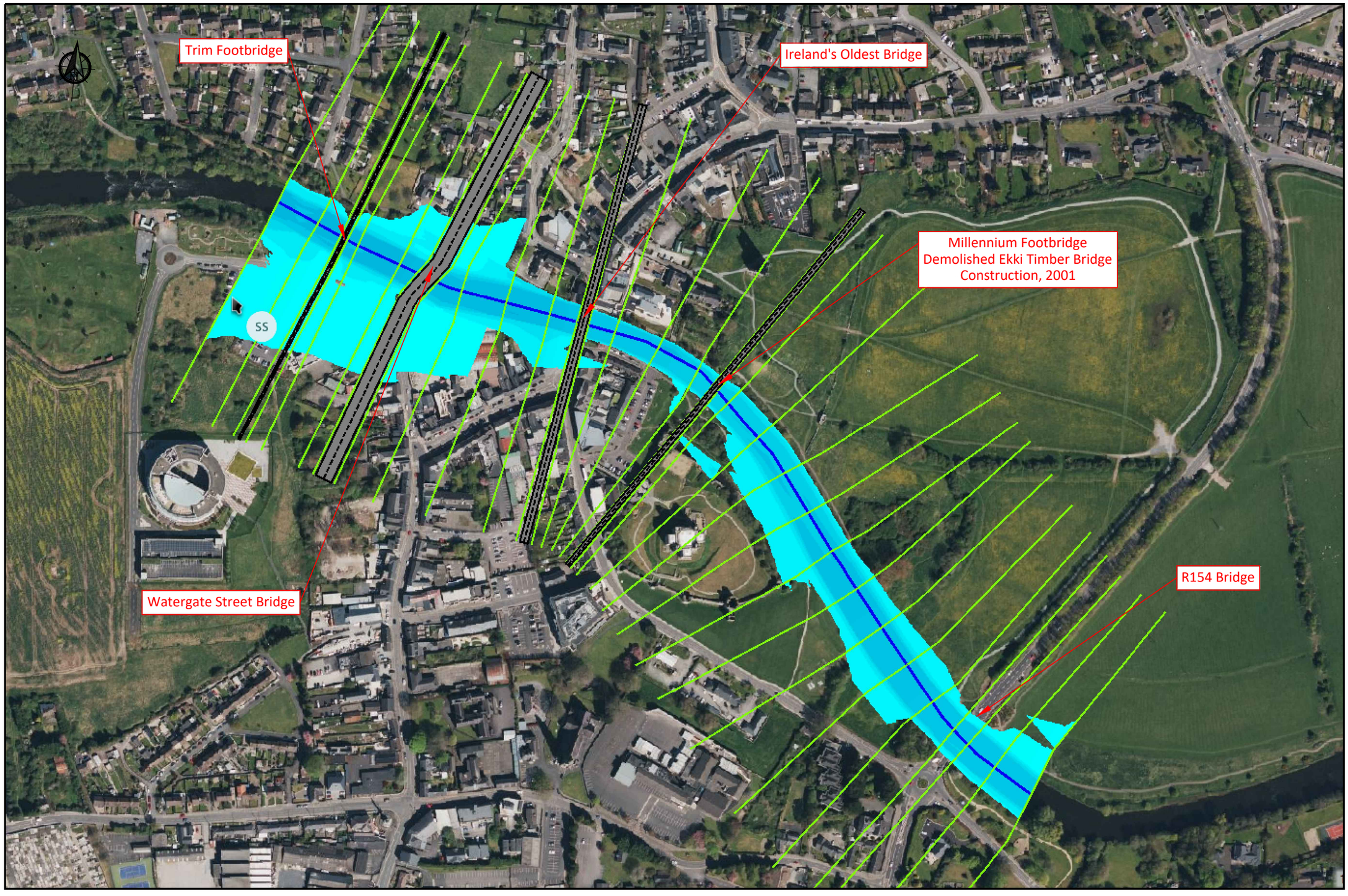
APPENDIX 6

SSFRA Flood Maps



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Scale 1:25000

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Rev.	Description	App By	Date
P01	ISSUE FOR IMFORMATION	BB	30.04.24

PROJECT

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SHEET

FLOOD MAP
EXISTING SCENARIO 1% AEP MRFS 68% CI

Date 30.04.24	Project number P22-256	Scale (@ A3) 1:25000	
Drawn by SK	Drawing Number P22256-FT-XX-ZZ-DR-D-0002		Rev P01
Checked by PD			

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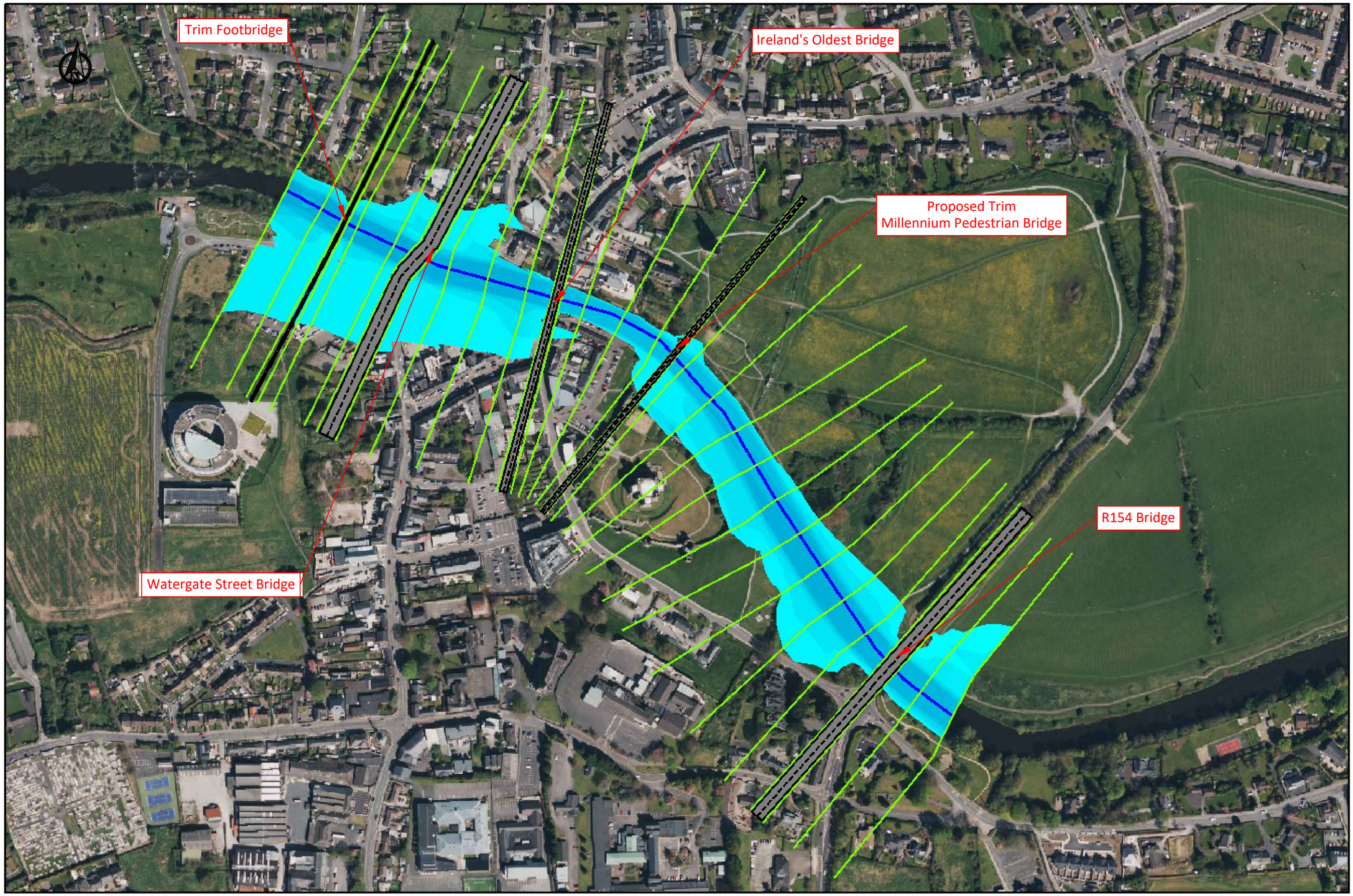
2 May 2024



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Scale 1:25000

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Rev.	Description	App By	Date
P01	ISSUE FOR IMFORMATION	BB	30.04.24

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SHEET

FLOOD MAP
PROPOSED SCENARIO 1% AEP MRFS 68% CI

Date 30.04.24	Project number P22-256	Scale (@ A3) 1:25000	
Drawn by SK	Drawing Number P22256-FT-XX-ZZ-DR-D-0003		Rev P01
Checked by PD			

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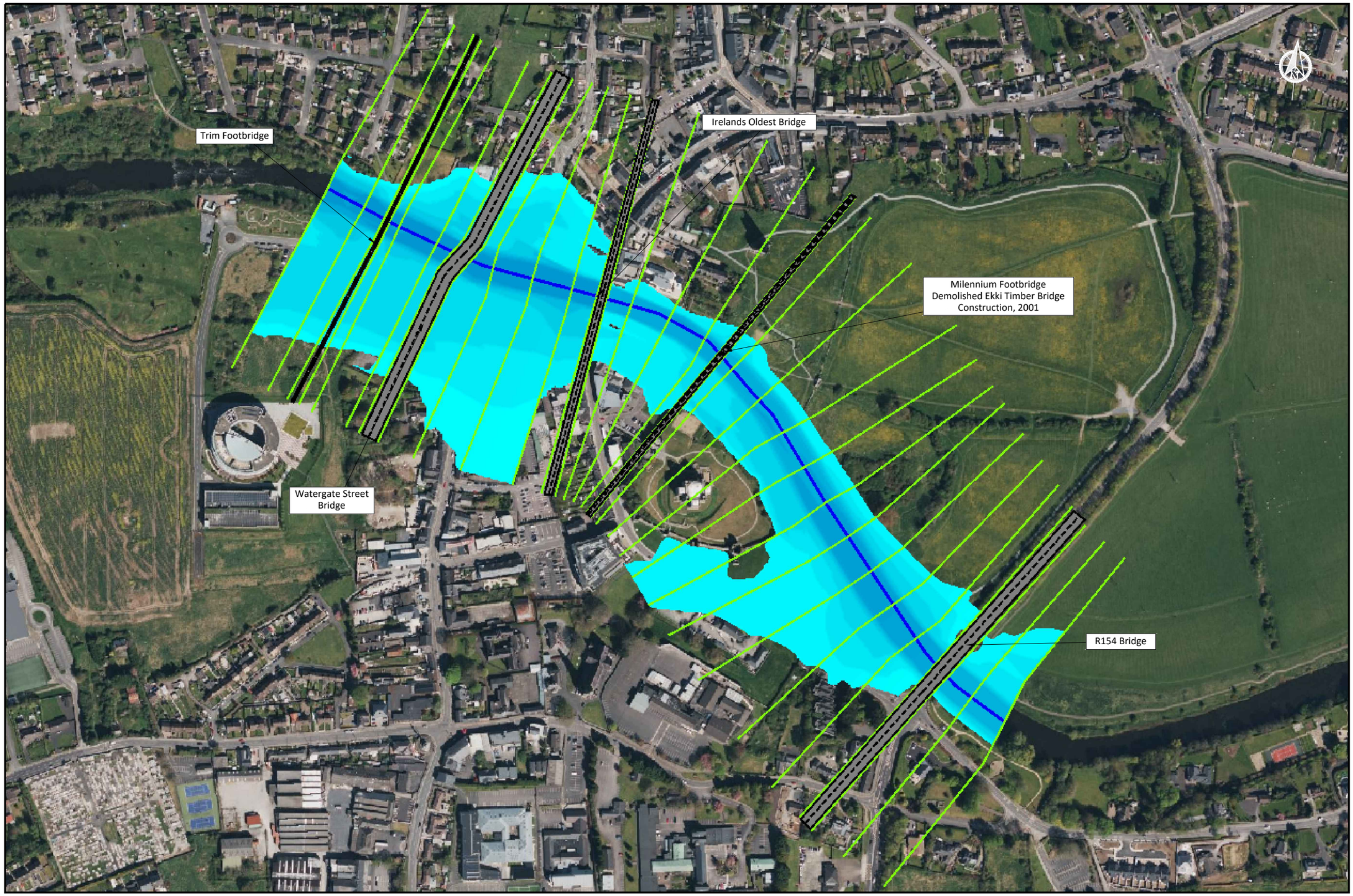
1 May 2024



0m 125m 250m 375m 500m 625m 750m 875m 1000m 1125m 1250m

Scale 1:25000

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EXISTING SCENARIO 0.1% AEP + 20% CC & 68% CI-P01

Date 15.05.24	Project number P22-256	Scale (@ A3-) 1:25000
Drawn by CS	Drawing Number P22256-FT-XX-ZZ-DR-D-0005	Rev P01
Checked by PD		

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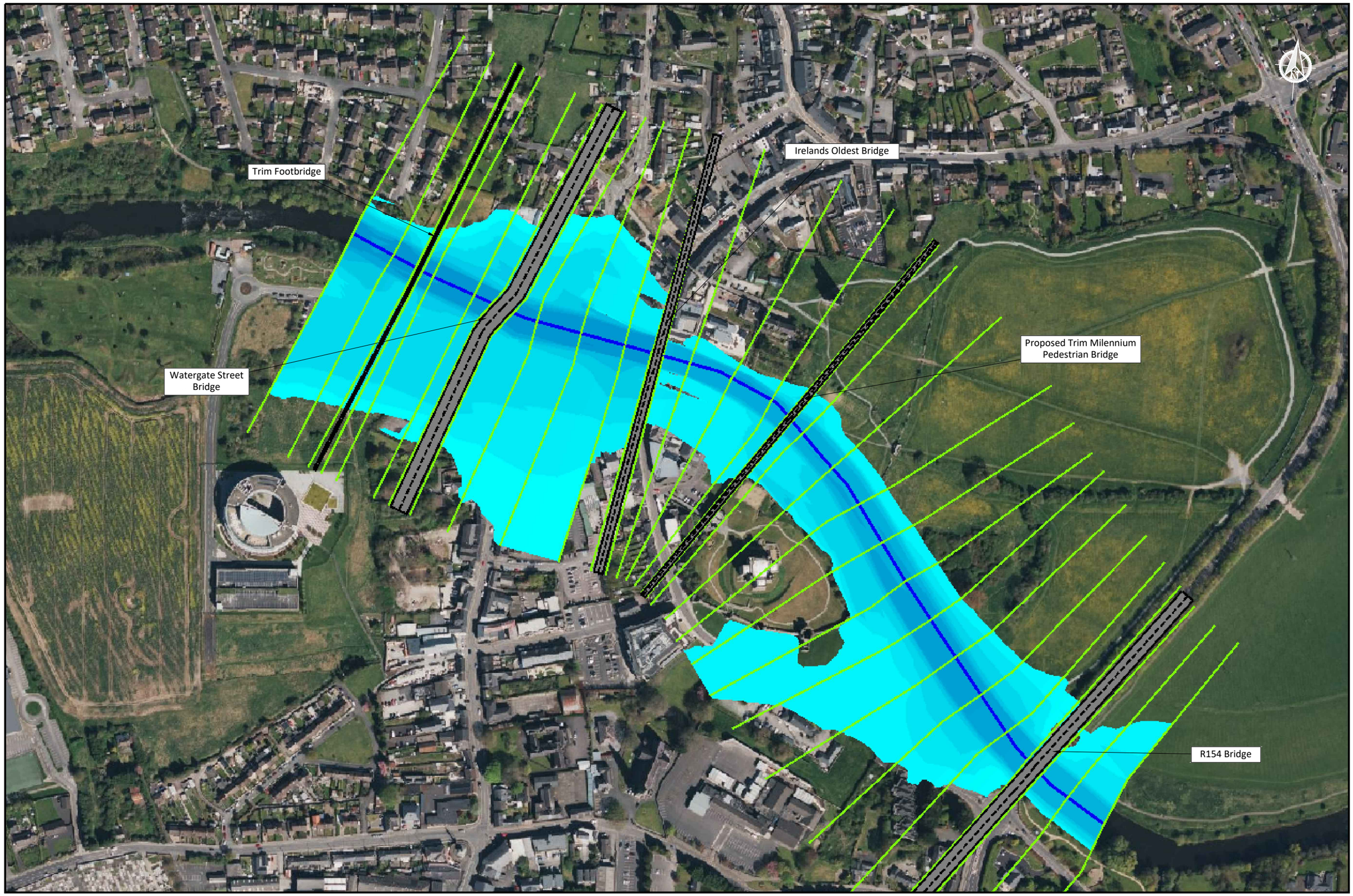
15 May 2024



0m 125m 250m 375m 500m 625m 750m 875m 1000m 1125m 1250m

Scale 1:25000

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SHEET

PROPOSED SCENARIO 0.1% AEP + 20% CC & 68% CI-P01

Date 15.05.24	Project number P22-256	Scale (@ A3-) 1:25000	
Drawn by CS	Drawing Number P22256-FT-XX-ZZ-DR-D-0006		Rev P01
Checked by PD			

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15 May 2024

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APPENDIX 7

Site Photos

Photo 1: Demolished Ekki Timber Bridge Construction, 2001 - View from the Righ Bank

Photo 2: Demolished Ekki Timber Bridge Construction, 2001 - View from the Left Bank

Photo 3: **Demolished Ekki Timber Bridge Construction, 2001 - Upstream Perspective**

Photo 4: **Demolished Ekki Timber Bridge Construction, 2001 - Downstream Perspective**

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