

TABLE OF CONTENTS

5	DESCRIPTION OF THE PROPOSED SCHEME	5-1
5.1	Introduction	5-1
5.2	Scheme Development Process	5-1
5.3	Location of the Proposed Scheme	5-2
5.4	Flood Risk Background.....	5-3
5.4.1	CFRAM Assessment	5-3
5.4.2	Catchment Description	5-4
5.4.3	Existing Flood Risk Environment.....	5-5
5.4.4	Baseline Damages Assessment.....	5-8
5.5	The Proposed Scheme	5-9
5.5.1	Flood Embankments	5-12
5.5.2	New Channel.....	5-13
5.5.3	Flood Walls.....	5-13
5.5.4	Obstruction Removal.....	5-15
5.5.5	In-Channel Works.....	5-16
5.5.6	Overflow Pipeline.....	5-18
5.5.7	Public Realm	5-18
5.5.8	Land Requirements	5-19
5.5.9	Design Considerations	5-19
5.6	Construction.....	5-21
5.6.1	Duration of the Works.....	5-21
5.6.2	Construction & Environmental Management Plan	5-22
5.6.3	Construction Compound.....	5-23
5.7	Proposed Construction Methodology	5-24
5.8	Embankment Works (E-001, E-002, E-004, E-005)	5-26
5.9	Pedestrian Access and New Channel (E-003, D-001)	5-26
5.10	Flood Walls Adjacent to Properties (L-001, L-002)	5-30
5.11	In-Channel Works (LW-002, G-001, D-002, G-002)	5-30
5.12	Piped Route (P-001).....	5-31
5.13	Obstruction Removal (X-001, X-002)	5-32
5.14	Weir Removal and Bridge Removal / Replacement (X-003)	5-32
5.15	Flood Wall adjacent to Hazelbrook (L-003)	5-33
5.16	Fish Passage Works (G-003, G-004)	5-33
5.17	Main St Bridge Works (P-002).....	5-34
5.18	Operation and Maintenance of the Project.....	5-34
5.18.1	Maintenance and Monitoring	5-34
5.19	Decommissioning	5-35
5.20	References	5-36

APPENDICES

Appendix 5-1	Scheme Drawings
Appendix 5-2	Construction & Environmental Management Plan

5 Description of the Proposed Scheme

5.1 Introduction

As outlined in Chapter 1 - Kilkenny County Council (KCC), in collaboration with the Office of Public Works (the funding authority for the scheme), intends to undertake engineering works along the Ballyhale River and its tributaries with the objective of providing protection from the 1% AEP Flood Event in the village of Ballyhale.

This chapter provides a detailed description of the proposed Flood Relief Scheme at Ballyhale, Co. Kilkenny. The overall scheme objectives are set out in Chapter 2 of this EIAR.

5.2 Scheme Development Process

The development of the proposed scheme has been a multi staged process in order to arrive at the final scheme design. The general Scheme Development process is outlined in Figure 5-1 below.

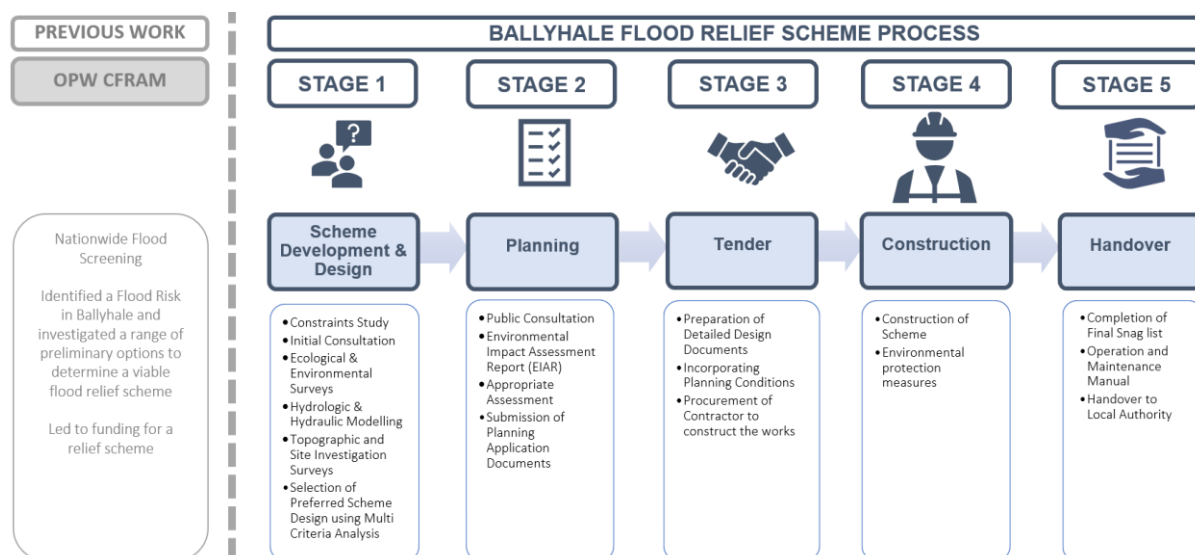


Figure 5-1: Scheme Development Process

The development process required a wide range of complementary studies to ensure a robust Environmental and Technical basis for the proposed scheme. These include:

- Environmental Constraints Report [200055-DBFL-XXXX-XX-RP-C-0002]
- Flood Risk Management Option Report [200055-DBFL-XXXX-XX-RP-C-0004]
- Cost Benefit Analysis Report [200055-DBFL-XXXX-XX-RP-C-0005]
- Hydrology Report [M02151-01_DG01]
- Hydraulics Report [M02151-01_DG02]

This Chapter provides a background to the Schemes as well as a description of the proposed scheme and construction methodology. More detailed information is also provided within the individual project documents. These supporting project documents are available on the project website at <https://www.kilkennycoco.ie/eng/services/roads/flood-relief/ballyhale-flood-relief-scheme/>.

5.3 Location of the Proposed Scheme

Ballyhale is a town located in the south east of Ireland and located in the South of County Kilkenny. It is located approximately 116km south west of Dublin, 21km south of Kilkenny and 25km north of Waterford. The parish of Ballyhale encompasses the areas of Knockmoylan, Ballyhale and Knocktopher.

Ballyhale and its surrounding hinterland has a very accessible road network though the regional road R448. Ballyhale is predominantly orientated through a North-South axis as a result of its development along the R448.

Ballyhale is within the catchment of the Little Arrigle River which is a tributary of the River Nore. The catchment is located wholly within the jurisdiction of Kilkenny County Council.

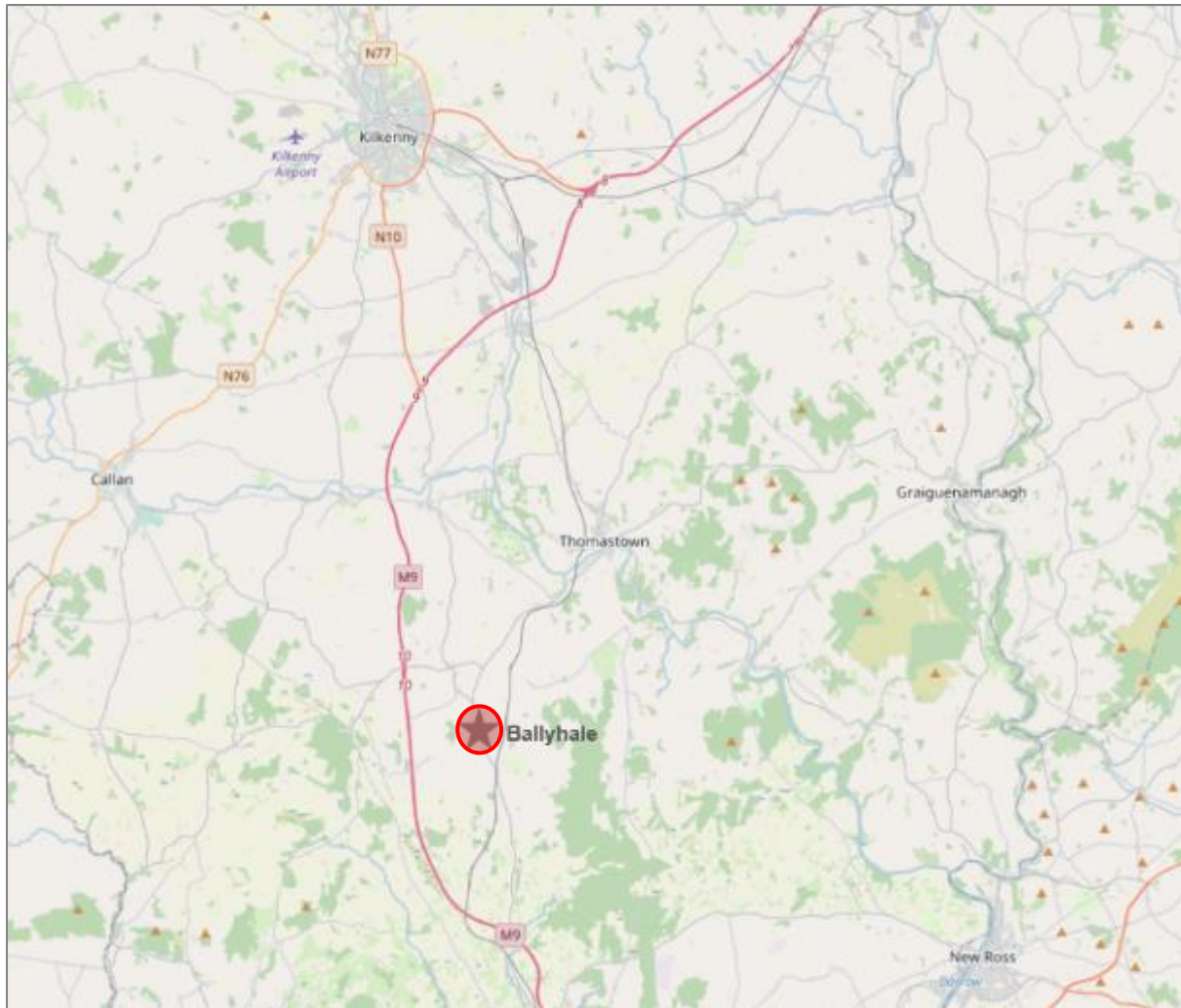


Figure 5-2 - Site Location

5.4 Flood Risk Background

In order to understand the existing flood risk environment which, the scheme seeks to address, this section provides a background to the scheme and high-level summary of complementary assessments which include the CFRAM (precursor to current scheme), Hydrology Report & Hydraulics Report.

5.4.1 CFRAM Assessment

The CFRAM was a regional scale study of Flood Risk which predates the current assessment. The South Eastern CFRAM Study Flood Risk Review report (IBE0601Rp0001) identified Ballyhale as an Area for Further Assessment (AFA). The CFRAM study carried out initial hydraulic modelling of the watercourse and determined a flood risk in the Village. The CFRAM Preliminary Option Report (IBE0601Rp0025) identified a range of Preliminary Options to resolve flooding and determined that an Option involving a flow diversion and hard defences may be appropriate to resolve flood risk. The modelling and outline designs in the CFRAM

Reports has been reviewed as part of the current project level assessment however these are superseded by the more detailed project level assessment carried out and detailed within this EIAR and supporting project documents.

5.4.2 Catchment Description

Ballyhale is within the catchment of the Little Arrigle River which is a tributary of the River Nore. The main channel of the Little Arrigle runs to the west of the village and a tributary of the Little Arrigle runs though the village. This tributary is also known locally as the Little Arrigle however will be termed the Ballyhale River for the purposes of this assessment (this is also referred to in EPA mapping as Knockwilliam Stream). The Ballyhale River rises approximately 2.9km south of the town of Ballyhale. It begins in a forested region and flows north through largely agricultural land. The Ballyhale River enters the village near the church and splits into two channels either side of the church. The western branch flows in a generally open channel though agricultural land. The eastern channel flows through the rear of a number of domestic properties though a heavily modified channel with frequent structures of varying construction type. The branches merge upstream of Arrigle Business Park and flow through a long (circa 50m) culvert under buildings in the business park. Several additional culverts/bridges are present on the watercourse along its remaining route through the village. A number of weirs are also present on the channel within the village. The Ballyhale River leaves Ballyhale and merges with the Little Arrigle approximately 850 m north of Ballyhale.

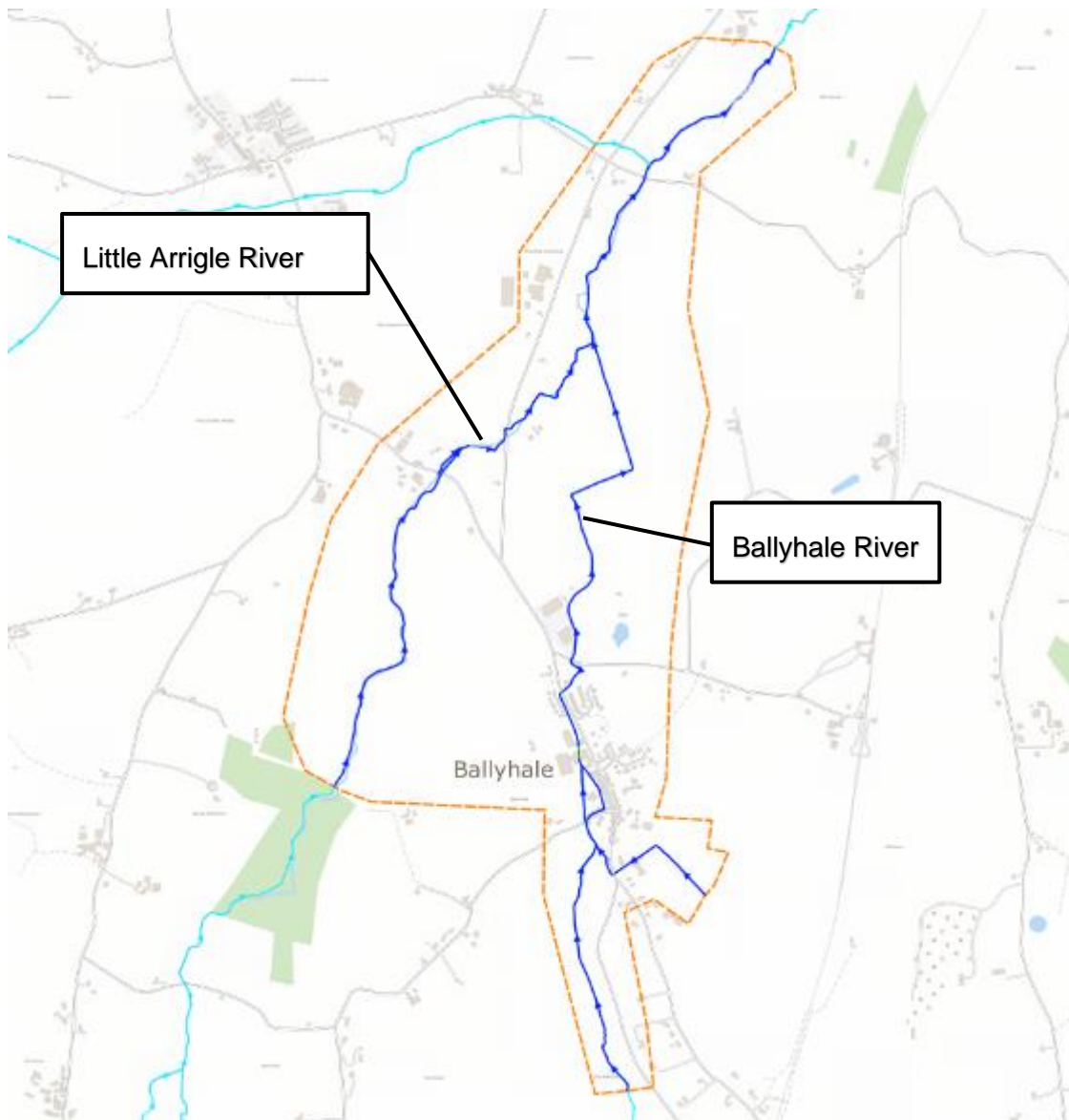


Figure 5-3 – Local Watercourses

5.4.3 Existing Flood Risk Environment

A detailed hydrological study and hydraulic modelling of the existing flood risk environment has been carried out as part of this project. The existing flood risk and flood mechanisms are described in the Hydrology Report and Hydraulics Report. The predicted Q100 flood events are shown in Figure 5-4.



*Figure 5-4 Fluvial Flood Extents 1% AEP
(Source – McCloy Consulting – Hydraulics Report Ballyhale, Co. Kilkenny)*

The primary flood mechanism for the flooding within the village is caused by structure incapacity with resulting backwater effect causing out of bank flooding along the Ballyhale River resulting in flooding at the rear of the Main Street properties, coupled with two significant overland flow routes from the south of the village.

Channel incapacity upstream of the village from the Ballyhale River creates an overland flow path that flows northerly towards Chapel Lane, re-entering the western church reach of the Ballyhale River at the church access bridge.

A second overland flow route is evident from an unmapped tributary of the Ballyhale River that flows adjacent to the school boundary. A low point in the bank where the channel turns at an approximately 90-degree bend coupled with unmaintained vegetation restricting flows within the channel downstream causes flooding from the right-hand bank flowing down 'Sheff's Lane' that emerges onto the Main Street. The flow route diverges at the Chapel Lane junction, flows that tend down Chapel Lane enters the western church reach at the church access bridge. Flows that tend down Main Street enters the main Ballyhale River at the former Garda Station.

In higher flow events, the flow path on the Main Street continues and re-joins the Ballyhale River at either the downstream section of the 'Main Street Bridge' at the Hazelbrook development or downstream of the Station Road bridge.

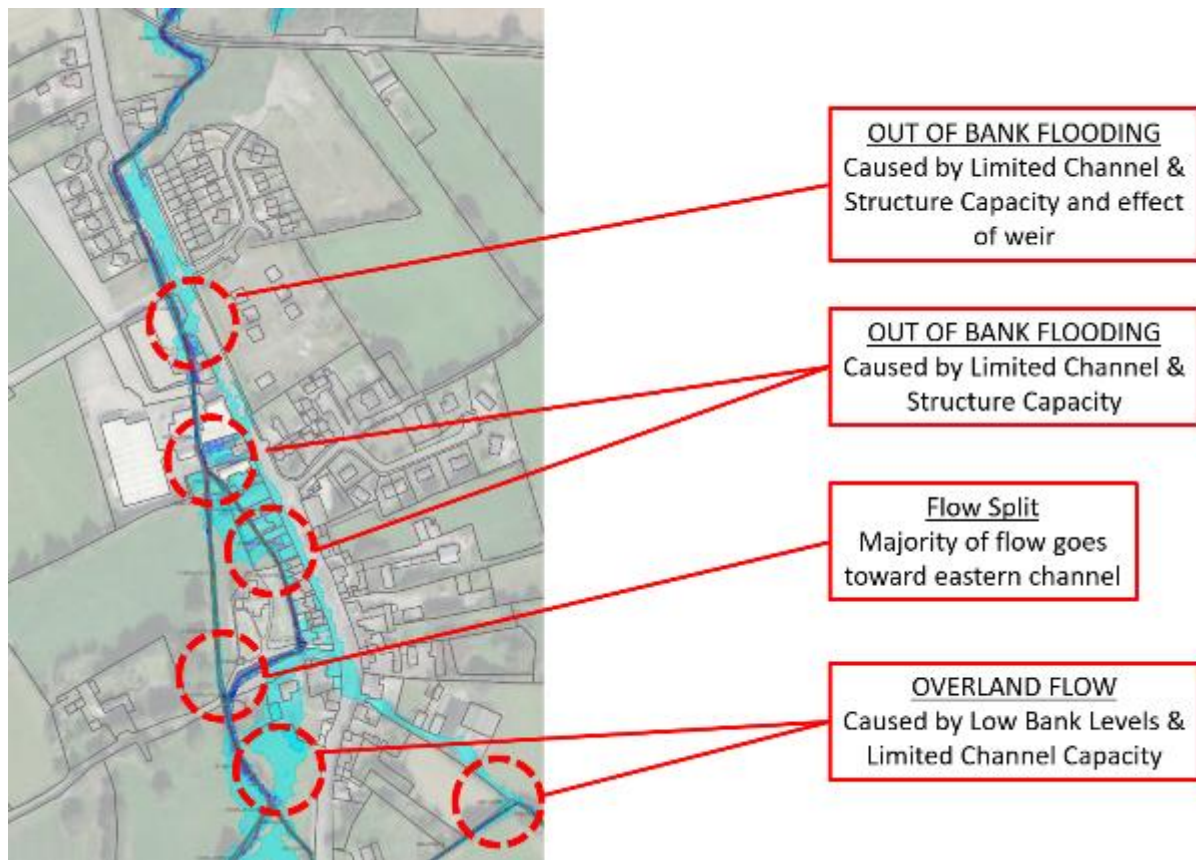


Figure 5-5 Flood Mechanisms – Overview

5.4.4 Baseline Damages Assessment

The calculation of flood damages was undertaken using standardised guidelines and figures set out in the 'Multi-Coloured Manual' of 2020 (FHRC, 2020) as referred to in FHRC 2020, subject to caveats, amendments and clarifications set out herein as per OPW guidance document - NATIONAL 'CFRAM' PROGRAMME Technical Methodology Note - Cost-Benefit Analysis (CBA).

The assessment of economic damages associated with flooding is comprised of the following elements;

- Principal Direct Damages
- Intangible and Indirect Damages
- Infrastructure Utility Damages
- Emergency Services

Refer to the Project Cost Benefit Analysis Report for detailed information on calculation of baseline damages. A summary of flood event damages is presented in Table 5-1.

Table 5-1 Baseline Flood Damages

Type of Risk	Flood Risk for Design AEP (%) Event		
	10% AEP	1% AEP	0.1% AEP
Current Scenario (Present Day)			
Event Damage	€ 112,350.03	€ 4,666,904.85	€ 8,660,426.26
No. Residential Properties at Risk	1	20	33
No. business Properties at risk	0	7	9
Mid-Range Future Scenario			
Event Damage	€ 822,049.10	€ 6,644,463.72	€ 9,699,276.73
No. Residential Properties at Risk	17	24	36
No. business Properties at risk	2	9	11
High-End Future Scenario			
Event Damage	€ 1,329,183.63	€ 6,796,622.33	€ 11,259,417.54
No. Residential Properties at Risk	19	24	37
No. business Properties at risk	4	10	12

5.5 The Proposed Scheme

The overview schematic layout drawing of the proposed Ballyhale Flood Relief Scheme is shown in Figure 5-6: Overview Layout.

Detailed drawings of the works are provided in Appendix 5-1 and are listed in Table 5-2 below.

Table 5-2: Scheme Drawings

Description	Drawing Reference
Site Location – Context Plan	200055-DBFL-ZO-SP-DR-C-001
Site Location Plan	200055-DBFL-ZO-SP-DR-C-002
Site Layout Plan - Overview	200055-DBFL-ZO-SP-DR-C-003
Site Layout Plan – Sheet 1	200055-DBFL-ZO-SP-DR-C-004
Site Layout Plan – Sheet 2	200055-DBFL-ZO-SP-DR-C-005
Embankment E-001 General Arrangement	200055-DBFL-RD-SP-DR-C-1001
Embankment E-002 General Arrangement	200055-DBFL-RD-SP-DR-C-1002
Flood Wall L-001 General Arrangement	200055-DBFL-RD-SP-DR-C-1003
Walkway D-001, E-003, G-001 General Arrangement	200055-DBFL-RD-SP-DR-C-1004
Embankment E-004 General Arrangement	200055-DBFL-RD-SP-DR-C-1005
Flood Wall L-002 General Arrangement	200055-DBFL-RD-SP-DR-C-1006
Embankment E-005 General Arrangement	200055-DBFL-RD-SP-DR-C-1007
Bridge D-002, X-003 General Arrangement	200055-DBFL-RD-SP-DR-C-1008
Flood Wall L-003, G-003 General Arrangement	200055-DBFL-RD-SP-DR-C-1009
Channel Realignment G-002 General Arrangement	200055-DBFL-RD-SP-DR-C-1010
Bridge P-002, G-004 General Arrangement	200055-DBFL-RD-SP-DR-C-1011
Surface Water P-001 General Arrangement	200055-DBFL-RD-SP-DR-C-1012
Portal Frame Culvert Construction Details	200055-DBFL-RD-SP-DR-C-1013
Proposed New Entrances – Sightlines	200055-DBFL-RD-SP-DR-C-1014
Proposed New Entrances – Sightlines	200055-DBFL-RD-SP-DR-C-1015
Typical Construction Details - Sheet 1	200055-DBFL-CS-SP-DR-C-5001

Description	Drawing Reference
Landscape Proposals Key Plan	20393-1-100
Landscape Proposals 1 of 3	20393-1-101
Landscape Proposals 2 of 3	20393-1-102
Landscape Proposals 3 of 3	20393-1-103
Landscape Sections	20393-1-201

The Flood Relief Scheme consists of a range of interventions along the watercourse reach. The general intent of the Flood Relief Scheme is to enhance the flow capacity and level of defence through the town so that the design flows can be conveyed through the town without causing property flooding.

It seeks to remove the existing flow split at the church and direct all flow to the open channel western branch. This removes flow from the heavily modified and under capacity eastern channel which is adjacent to a number of at-risk properties. It allows a continuous flood defence to be provided between all river flows and the at-risk properties.

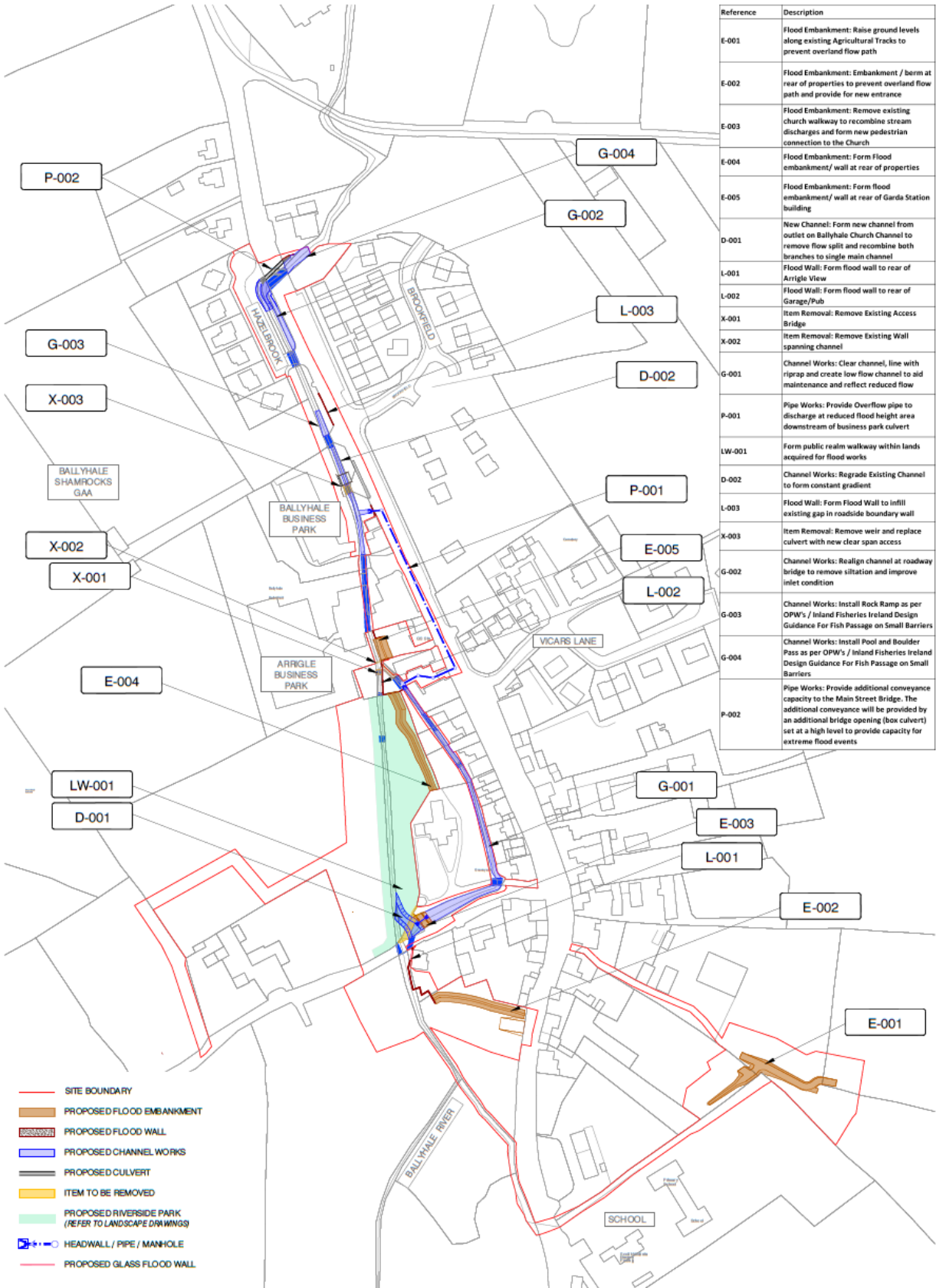


Figure 5-6: Overview Layout

A text summary of the primary measures in the Flood Relief Scheme is presented below;

5.5.1 Flood Embankments

A series of flood embankments are proposed to resolve elements of the flooding within Ballyhale. Upstream embankments of the townland of Ballyhale (E-001 & E-002) are provided to resolve existing overland flood routing issues. The Embankments (E-001 & E-002) are located wholly within agricultural land and work to prevent an overland flood path that flows towards Ballyhale and along the main street. These embankments range from 0.22m to 0.81m (E-001) and 0.83m to 1.14m (E-002).



Figure 5-7 Embankment E-002 – Existing



Figure 5-8 Embankment E-002 - Proposed

An embankment (E-003) will be formed as part of the new channel designed to reconnect the flows into the western river branch after the bridge southwest of the Ballyhale Church. The works will require the excavation and removal of the existing church pedestrian access bridge to the southwest of the church. The embankment (E-003) will have a height of 1.1m and will replace the existing walkway with a new paved path and stonework walls to match the existing road boundary walls. As part of public consultation, it was noted that the residents of Ballyhale wanted to see a nominal flow retained in the eastern channel. To accommodate this a 225mm diameter culvert will be installed through the embankment to provide the nominal baseflow into the eastern channel. The 225mm diameter culvert will be fitted with a 12mm mesh screen to prevent fish entry into the low flow channel. Stop logs or penstock will also be incorporated to allow isolation of the channel for maintenance.

Within the public realm lands an embankment (E-004) is proposed with heights ranging from 0.3m to 1.2m. The embankment (E-004) is proposed to prevent an overland flood path from the western channel that contains the recombined flows to the rear of the properties along Ballyhale's Main Street. The proposed embankment will be landscaped and incorporated into a public riverside walkway.



Figure 5-9 Embankment E-004 - Existing



Figure 5-10 Embankment E-004 - Proposed

Works are proposed to the rear of the Garda station in the form of an embankment (E-005) and where space is constricted a flood wall. The heights of these defences range from 1.66m to 1.6m. These defences work to retain flood waters in-channel at the inlet of an existing under capacity culvert which traverse under Kilkenny Living. The defences also work to protect two utility cabinets to the rear of the Garda Station.

5.5.2 New Channel

A new Channel will be created (D-001) re-connecting all outlet barrels from the bridge into the western river branch and removing the flow split. The re-combining of flows into the western channel is required due to the limited capacity of the existing eastern channel which currently takes the majority of the flow. This will require excavation of the existing church pedestrian access and replacement via a new pedestrian connection (E-003) which also serves to form a new bank to the redirected river. The bank will be lined with riprap and planted to add amenity value to the proposed public realm area.

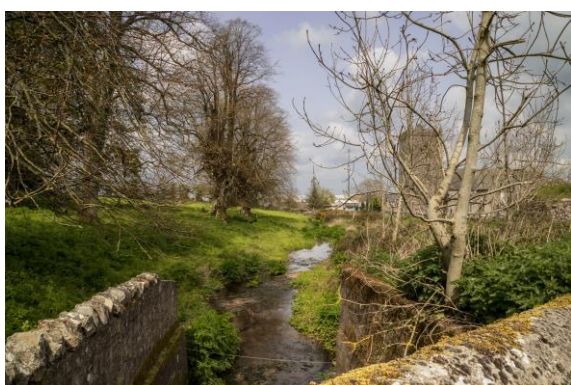


Figure 5-11 New Channel D-001 – Existing

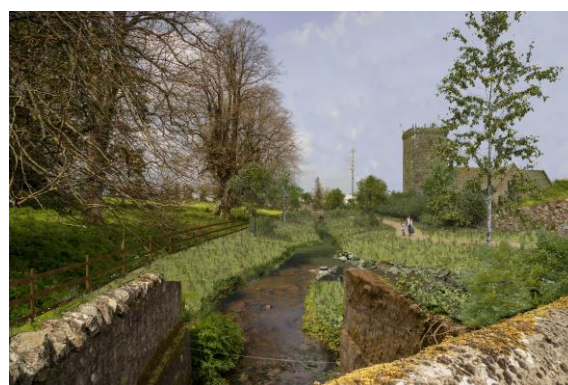


Figure 5-12 New Channel D-001 - Proposed

5.5.3 Flood Walls

A flood wall (L-001) is proposed alongside the “Arrigle View” property at a height of 0.95m to 1.95m. The provision of this flood wall is required for a blockage event of the adjacent bridge

(refer to section 5.5.9). The blockage event at this bridge causes flood waters to follow an overland flood path route along the roadway bypassing the flood defences into the existing eastern channel and flood the at-risk properties along the Main Street as well as Arrigle View. It is proposed that a section of the flood wall will be glass in front of the properties windows to reduce impact on views and sunlight to the landowner. The floodwall will also be stone clad to reduce visual impact.



Figure 5-13 Flood Wall L-001 – Existing



Figure 5-14 Flood Wall L-001 - Proposed

A Flood defence wall (L-002) will be installed between the western channel and the properties at risk on Main St. The flood wall will be at a height ranging from 0.9m to 2.1m from the existing surface levels. The flood wall will provide a continuous defence from an existing pedestrian bridge to the embankment (E-006), this will require the removal of one of two existing minor private bridges providing access across the river to a small private land parcel (X-001) and infilling of a section of redundant channel.



Figure 5-15 Flood Wall L-002 – Existing



Figure 5-16 Flood Wall L-002 – Proposed

A low wall (L-003) is proposed alongside the road to prevent out of bank flows emerging onto the road surface. The required height of the flood wall is 0.6m but the total height of the wall will be 1.2 to match the existing walls. This flood wall will combine to existing sections of roadside boundary wall and will be stone clad to match the existing boundary walls.



Figure 5-17 Flood Wall L-003 – Existing



Figure 5-18 Flood Wall L-003 – Proposed

5.5.4 Obstruction Removal

X-001 is one of two existing minor private bridges providing access across the river to a small private land parcel. Providing the continuous defence L-002 will partially block off one side of this bridge affecting its use. Leaving a gap in the defence at the bridge will provide a potential flood route from the opposite side, over the bridge deck and through the flood defences. Therefore, it is proposed to remove this bridge. Removal of the structure also increases channel capacity and removes a potential blockage risk. The deck level of the second bridge is above the required flood defence level so can be retained in place.



Figure 5-19 Obstruction Removal X-001 – Existing



Figure 5-20 Obstruction Removal X-001 – Proposed

The existing weir at the Ballyhale Business Park will be removed (X-003) allowing the channel gradient to be increased along this section which increases capacity (D-002). In addition to providing extra capacity in-channel, this will remove a barrier to fish passage upstream. The existing bridge will be removed and replaced with a 6m wide bottomless portal culvert.

X-002 is a wall spanning the watercourse which serves no function other than boundary demarcation. It will be removed to facilitate the installation of the new flood defences. Removal of the structure also increases channel capacity and removes a potential blockage risk.



Figure 5-21 Obstruction Removal X-002 - Existing

5.5.5 In-Channel Works

In-Channel works (G-001) will be required once the majority of the flow has been removed from the existing eastern channel. This channel is currently heavily prone to siltation and overgrowth along the channel extents. Following reconnection of the flow split, the channel of the eastern branch will have a significantly reduced inflow and will serve a local drainage function only. The channel has a very wide cross section in front of the church (circa 8m width) which is prone to overgrowth and siltation even in the existing flow situation. This area will be landscaped create a low flow channel (G-001). A series of shallow pools with extensive native wetland planting along this section of channel will be installed to improve the amenity and biodiversity of this area.



Figure 5-22 In-Channel Works G-001 – Existing



Figure 5-23 In-Channel Works G-001 - Proposed

The remainder of the channel runs alongside and through a number of properties. In light of the reduced inflow, it is proposed to modify the remainder of the eastern channel into a low flow channel to aid maintenance (G-001). These in-channel works are required to allow the channel to operate as a low flow channel as it will serve to take any surface water run-off from the properties along the Main Street as well as the nominal flow that passes through E-003. These works will ensure the eastern channel is easier to maintain as it is located to the rear of domestic properties and is hard to access. The channel will be lined with clean stone with a series of gentle bends.

The in-channel works G-002 will realign the channel at Main Street bridge to improve inlet conditions and prevent siltation of the existing bridge arches. The banks of the river will have riprap installed to prevent erosion. The in-channel works are required due to the heavy siltation of the existing Main Street bridge due to the sharp angle the river turns at the main street bridge.



Figure 5-24 In Channel Works G-002 – Existing



Figure 5-25 In Channel Works G-002 – Proposed

It is proposed to remove the existing weir at the entrance to Ballyhale Shamrocks GAA Grounds and install a 16m long Rock Ramp (G-003) to reduce a 0.36m deep drop to a slope of 1:40. The Rock Ramp has been designed as per the OPW's 'Design Guidance for Fish Passage on Small Barriers'. This will remove a barrier to fish passage within the Ballyhale River.

At the downstream face of the Main Street Bridge, it is proposed to remove an existing drop of 0.66m at the outlet with a Pool and Boulder Pass (G-004). The Pool and Boulder Pass will reduce the drop of 0.66m with a series of 4 pools proposed at 2.5m long with a 0.16m drop across each pool. The Pool and Barrier pass has been designed as per the OPW's 'Design Guidance for Fish Passage on Small Barriers'. This will remove a barrier to fish passage within the Ballyhale River.

5.5.6 Overflow Pipeline

Hydraulic modelling has indicated that even with reduced incoming flows and a flap valved outlet, the eastern channel would be prone to flooding due to the elevated flood levels caused by the Ballyhale Business Park culvert. Therefore, an Overflow pipe (P-001) will be provided at the northern end of the eastern channel which will discharge at a reduced flood height area further downstream of the business part culvert. The overflow pipe will be sized as a 600mm diameter pipe to take the surface runoff of the properties that discharge into the eastern channel and also to take the nominal flow from the 225mm diameter culvert upstream. The Overflow pipe will be constructed through the outdoor area of 'Andy's Pub', this area will be reinstated as per agreements with the landowner.

Residents voiced concerns through the consultations about the capacity of the Main Street Bridge. Hydraulic modelling found that the existing structure had adequate capacity to convey the Q100 flood levels; however, it caused flooding in higher return period events or blockage events. Therefore, it is proposed to provide additional conveyance to the Main Street Bridge (P-002). The additional conveyance will be provided by a 15m long box culvert with an internal opening of 0.6m high by 1.6m wide. An overflow structure will be provided which keeps normal flows within the existing channel and twin arches but provide additional capacity during extreme flood events. The external faces of the Overflow Culvert and diversion structure will be stone clad to match the existing Main Street Bridge.



Figure 5-26 Overflow Pipeline P-002 – Existing



Figure 5-27 Overflow Pipeline P-002 - Proposed

5.5.7 Public Realm

The provision of a new public realm Riverside Walkway is proposed within a section of the lands which are to be acquired as part of the scheme. These lands constitute an area containing the western channel (containing the recombined flows) and an Embankment (E-003) which are lands indicated as flood plains in the post scheme flood maps. The new public realm will include footpaths, landscaping, viewing area and planting of Native wildflower

meadows. The public realm area supports objective 8F of the Kilkenny County Council Development plan to “To continue the development of new trails and walkways such as the Castlecomer, Knockdrinna Wood and Ballyhale Looped Walks and the upgrade of others such as the Freshford, Gathabawn and Kilmacoliver Looped Walks and the Nore Valley Walk.”

The public realm space also offers significant amenity value within the village centre.



Figure 5-28 Public Realm LW-001 – Existing



Figure 5-29 Public Realm LW-001 – Proposed

5.5.8 Land Requirements

The lands required to construct and maintain the proposed development are in the ownership of KCC and other Landowners. The lands not in the ownership of KCC will be acquired via a separate CPO process which has been lodged concurrently with the scheme.

The Compulsory purchase order (CPO) includes, under the CPO Schedule the following:

- Lands to be Permanently acquired.
- Wayleaves to be Permanently acquired.
- Rights of Way to be Permanently acquired.
- Temporary Wayleaves for working areas.

The lands identified in the CPO are necessary to construct, operate and maintain the proposed development. See Chapter 14 Material Assets for Land Impact Assessments.

5.5.9 Design Considerations

Design Standard

The design standard for this study is the 1% AEP event for fluvial flood risk.

Freeboard

Freeboard is a safety margin to account for uncertainties in water-level prediction and/or structural performance. It is the difference between the height of the flood defence or floor level and the design flood level. Freeboard should account for uncertainty in hydrological

predictions, wave action, modelling accuracy, topographical accuracy and the quality of digital elevation models.

The OPW standard freeboard allowance is 0.3m for hard defences and 0.5m for soft defences. This allowance shall be applied to new defences at a minimum and is appropriate for most situations.

The design has made increased freeboard allowance in the locations below:

- A low wall (L-001) is proposed alongside the “Arrigle View” property on Church Lane. Although this property is not anticipated to flood in the baseline scenario, hydraulic modelling indicates that a flow route through and around this property would be anticipated in the event of a blockage of the adjacent bridge. Therefore, providing a defence at this location reduces residual risk to this property and to downstream properties which may be affected by the overland flow bypassing flood defences. The height of this wall shall be set to retain the flood level associated with a 50% blockage event of the adjacent bridge. Since this bridge is the first structure downstream of a significantly vegetated catchment it is considered at a higher risk of blockage.
- It is proposed to increase the freeboard for defences E-005, L-002 & E-006 such that they would retain the flood level associated with a 50% blockage of the long culvert under Arrigle Business Park. This culvert is considered to have a higher risk of blockage to the length of the culvert, the change in cross section through the barrel and the level of visibility.
- Additional conveyance capacity (P-002) is proposed to the Main Street Bridge. Although this structure is not predicted to flood in the baseline scenario, hydraulic modelling indicates that in a blockage event this bridge causes out of bank which puts properties at risk. Therefore, additional conveyance at this location will reduce the risk to properties which may be affected by the overland flow path. The additional conveyance will be provided at a high level to only provide capacity for extreme flood events.

Climate Change Adaptability

In the development of options, it is required that the proposals represent solutions which are flexible and can be adapted to the changes in the climate and its potential impact on flood risk over the course of its lifetime.

The scheme has been developed taking consideration the following allowances for future scenarios, namely the Mid-Range Future Scenario (MRFS) and the High-End Future Scenario (HEFS).

Table 5-3: Allowances for Future Scenarios

	MRFS	HEFS
Extreme Rainfall Events	+ 20%	+ 30%
Flood Flows	+ 20%	+ 30%
Mean Sea Level Rise	+ 500 mm	+ 1000 mm

The maps included as part of the Hydraulics Report demonstrate the Climate Change Scenarios impact both with and without the scheme.

New hard defences shall ensure that the defence height is sufficient to retain the climate change events within the freeboard allowances.

Climate Change Adaptability has been considered during option selection within the Multi Criteria Analysis under the Technical category.

The scheme has been designed to be adaptable to climate change with the simulations conducted for the design scenario 1% AEP present day flood event and checked against the mid-range (+20%) and the high end (+30%) climate change scenarios. All receptors are shown to be protected for the standard of protection (SoP) 1% AEP present day event with freeboard provided to the scheme over the 1% present day being sufficient to provide a level of protection up to the 1% AEP + HEFS CC event.

To allow for future climate change adaptability, the hard defences have been designed to facilitate increases in height.

5.6 Construction

This section outlines the proposed construction phase of the Ballyhale Flood Relief Scheme. Construction of the scheme is dependent on planning approval.

5.6.1 Duration of the Works

It is estimated that the works will be tendered in 2024 with commencement in 2025 and an estimated site programme of approximately 20 months depending on construction phasing.

The primary works elements are anticipated to include:

- Site Setup
- Advance Archaeology Surveys
- Site Clearance and Demolition
- Earthworks
- Installation of Drainage
- New Structures
- Landscaping & Demobilisation

5.6.2 Construction & Environmental Management Plan

A Construction and Environmental Management Plan (CEMP) has been produced as part of this Planning Application. Prior to any demolition, excavation or construction, the Contractor will take ownership of the CEMP. The Contractor will comply with the conditions of the EIAR and will produce the Construction Stage Construction & Environmental Management Plan to detail how the project is to be executed in accordance with all project, statutory and environmental requirements.

The Construction & Environmental Management Plan is included as Appendix 5-2. The plan seeks to demonstrate how works can be delivered in a logical sensible and safe sequence with the incorporation of specific measures to mitigate the potential impact on people and the surrounding environment, particularly the residential areas adjacent the site. Upon appointment of a contractor this document will be issued to them to be further developed into their final construction management plan for the project. The final construction management plan will include relevant mitigation measures identified in the EIAR and any further measures agreed and included into the updated Schedule of Mitigation during the planning process. The CEMP will include any conditions imposed by the Competent Authority in making a Determination before being submitted by the contractor to be agreed with the local authority prior to commencement of development.

The Construction Stage CEMP will detail at a minimum:

- Working hours and days and construction schedule;
- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages);
- Details of construction plant storage, chemical and fuel storage, temporary toilet
- Traffic management plan (Chapter 15) (to be developed in conjunction with the Local Authority Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic;

programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;

- Site Compound locations & layouts.
- Erosion and Sediment Control Plan for surface water runoff and in stream works
- Truck wheel wash details (including measures to reduce and treat runoff);
- Dust management to prevent nuisance (demolition & construction);
- Noise and vibration management to prevent nuisance (demolition & construction);
- Landscape management;
- Stockpile locations;
- Temporary hoarding & lighting plans;

The Construction Stage CEMP will also detail areas of concern with regard to Health and Safety and any will incorporate all mitigation measures outlined within the EIAR and any additional measures imposed as part of a grant of planning.

5.6.3 Construction Compound

Temporary Construction Compound space will be required to provide store, office, material storage, parking and welfare facilities for the contractor and employers representatives. The exact location of the construction compound will be detailed in the Contractors Construction Management Plan which will be submitted to the local authority for approval will be within an area proximate to the works from which safe access to the surrounding road network can be provided and will be located outside environmental restriction zones set out in the EIAR/CEMP. The proposed location of the site compound has been provided in Figure 5-30: Compound Location and temporary land acquisition for a compound at this location has been included in the scheme CPO.

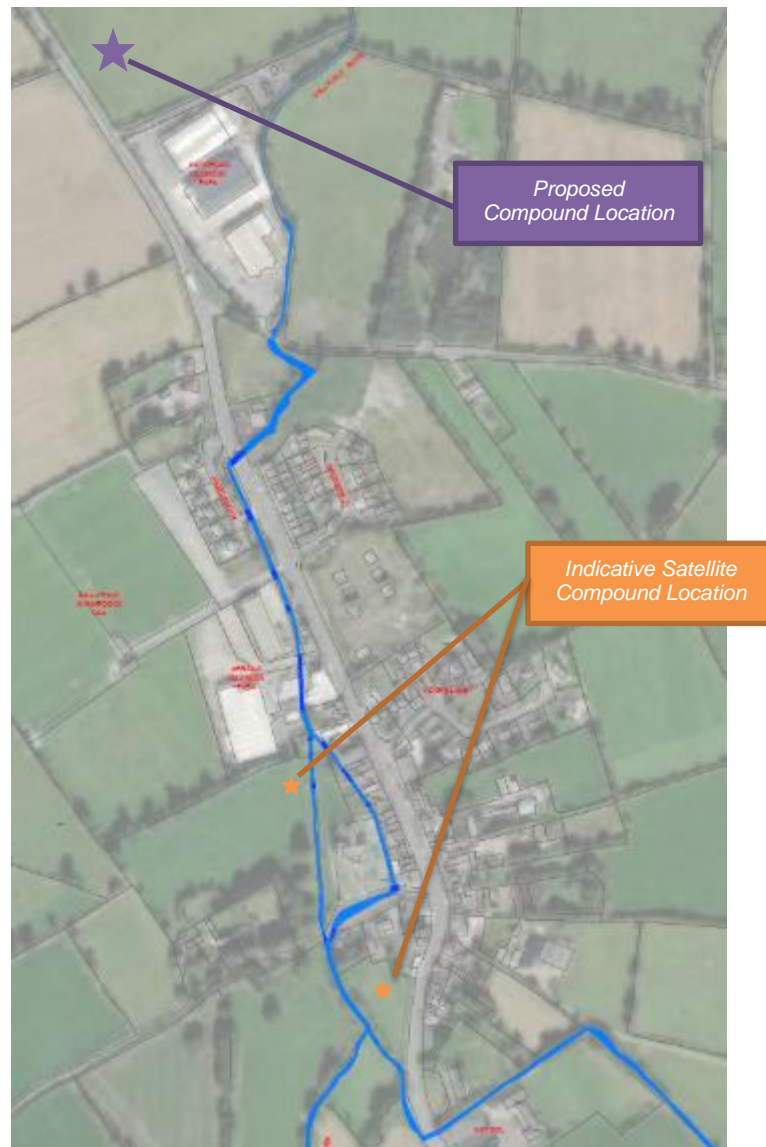


Figure 5-30: Compound Location

The compound location is located greater than 50m away from any surrounding water course and is located with access to the R448.

Following completion of construction this area will be cleared and reinstated and all construction materials will be removed. Mobile welfare units may be placed at works locations as necessary.

5.7 Proposed Construction Methodology

The general construction process for key elements of the project is set out below. Refer also to the CEMP included in Appendix 5.2

All elements of work will need to monitor weather conditions to ensure suitable conditions and carry out any in-stream works during the summer months when there is low flow to ensure no adverse environmental effects to the downstream SAC.

The contractor shall prepare a detailed method statements for all elements of instream works and all in-stream works will comply with current best practice, notably the Inland Fisheries Ireland Guidelines on protection of fisheries during construction works in and adjacent to waters (IFI, 2016) and Transport Infrastructure Ireland's Guidelines for the crossing of watercourses during the construction of national road schemes (TII 2008).

For any construction work within or directly adjacent to the water the following will apply:

- Works to be carried out in the dry (offline or outside the water flow) in all cases.
- "Dry" works areas will be achieved either via full isolation of the channel section via Gravity Pipe/Flume or via partial isolation using cofferdams. See schematic diagrams below.

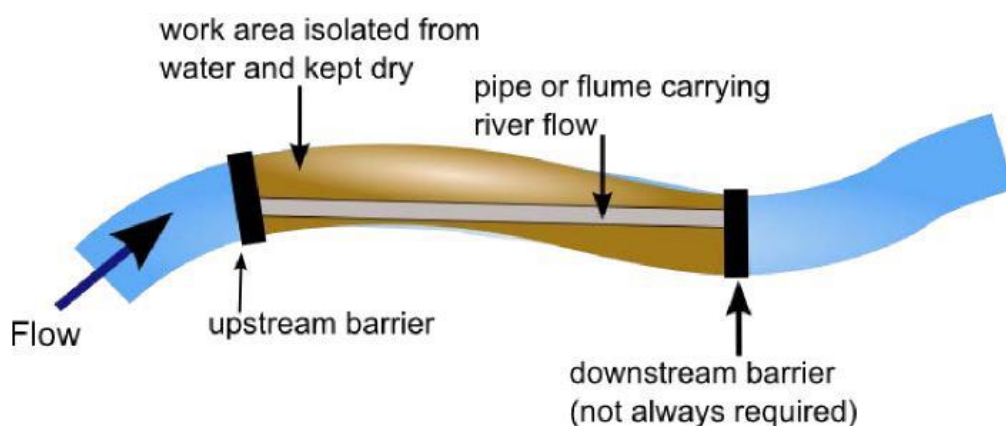


Figure 5-31: Full Isolation Gravity/Flume pipe
[Source SEPA Engineering in the Water Environment Good Practice Guide Temporary Construction Methods]

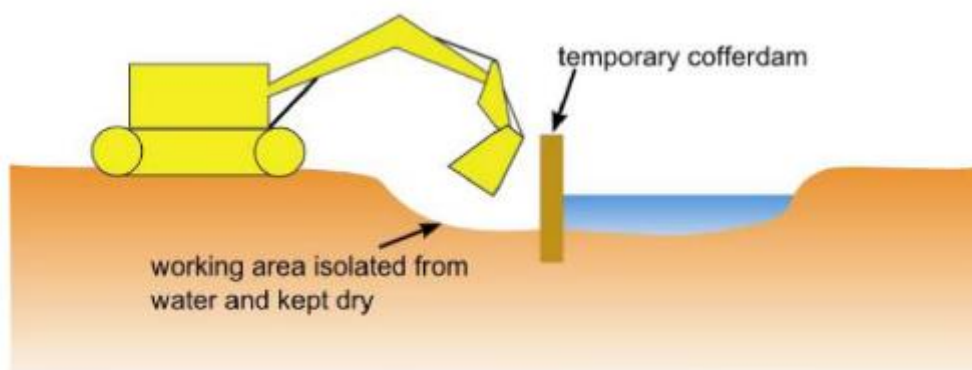


Figure 5-32: Partial Isolation Cofferdam
[Source SEPA Engineering in the Water Environment Good Practice Guide Temporary Construction Methods]

- Relevant fisheries authorities shall be informed of all in-stream construction work scheduled to take place. Any in-stream or culverting works shall be undertaken in

consultation and with the agreement of the relevant statutory body and during the permitted times of the year.

5.8 Embankment Works (E-001, E-002, E-004, E-005)

- Vegetation within the embankment footprint will be cleared and removed from site and disposed of in accordance with the relevant waste management legislation and outside of the bird nesting season.
- The topsoil will be stripped and stored for reuse or the excess material will be disposed of offsite. Unsuitable material occurring in embankment footprint shall be removed. All material removed from site will be disposed of in accordance with relevant waste management legislation.
- The embankment material shall then be spread in layers not exceeding 250 mm compacted thicknesses suitably compacted to the required degree of compaction. The embankment will be constructed to the desired height as per the longitudinal and cross sections of the embankment as per the contact drawings. Soil for embankment to be approved by Employers Representative/Designer. Soil to be either suitable material excavated as part of works or imported low permeability material.
- Topsoil will be spread on the embankment core from the stockpiled material to a layer of 150mm. The topsoil will be gently firmed before adding additional layers. The finished depth of topsoil should be 150mm for the grass areas.
- Embankments shall be seeded or protected via geotextiles as soon as possible. The optimum grass seeding periods are between 1st March – 31st May or 1st September and 31st October. Meadow grass seeding optimum seeding periods are April and September.

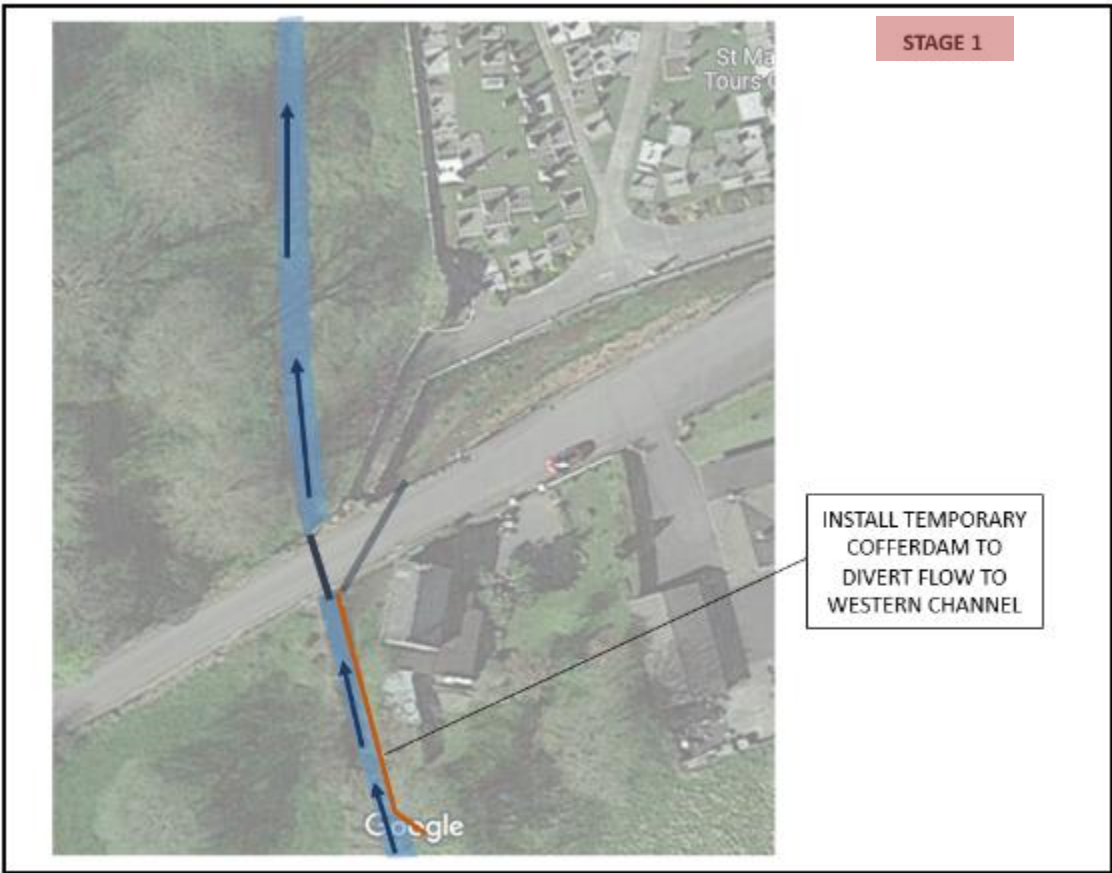
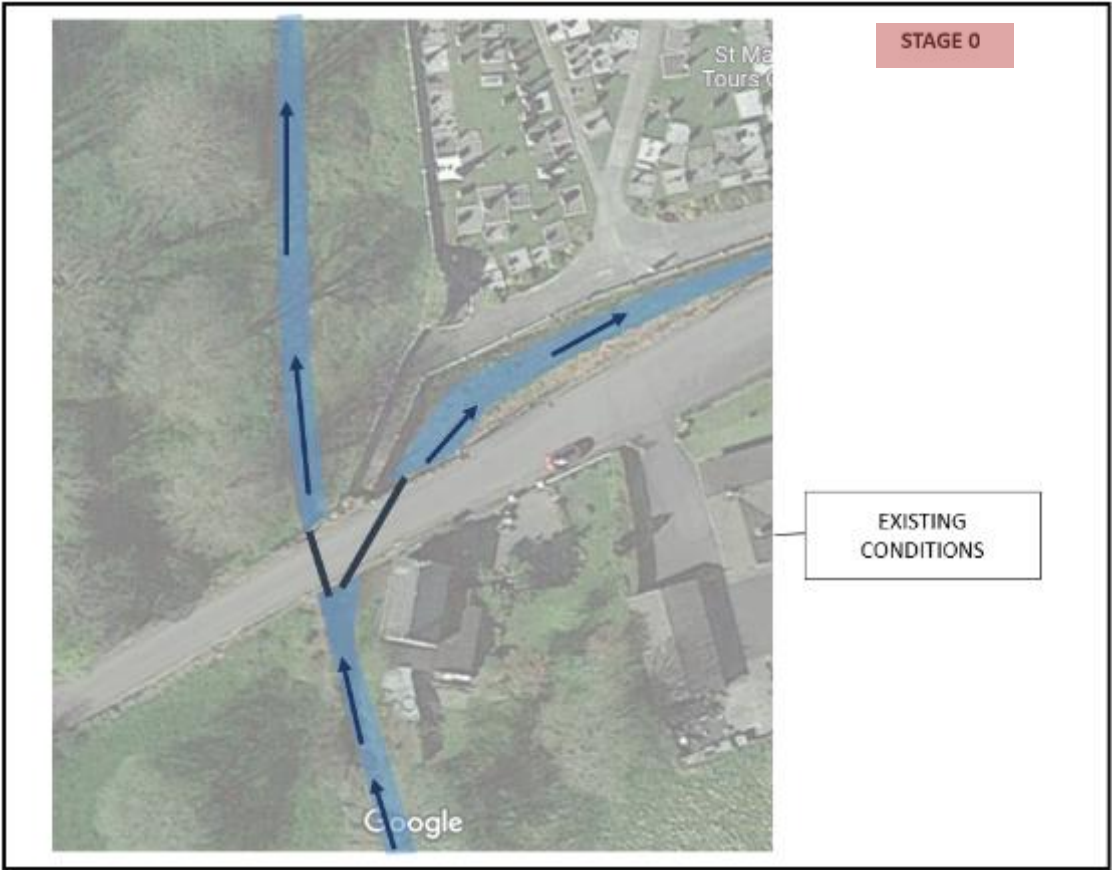
5.9 Pedestrian Access and New Channel (E-003, D-001)

- The river instream works will only take place during the instream open season (1st July – 30th September). The weather will be monitored during this period to determine a period of low flow within the channel.
- Appropriate preconstruction surveys should be carried out before the works. The contractor shall put in place temporary works measures as necessary to ensure no undermining of existing structures.
- A temporary flow bypass system will be put in place following one of the measures listed in Paragraph 5.8.
- Vegetation within the footprint of the proposed works will be removed from site and disposed of in accordance with the relevant waste management legislation. The riverbed material will be stripped and stored for reuse within the site. Unsuitable

material occurring in the works footprint shall be removed. All material removed from site will be disposed of in accordance with relevant waste management legislation.

- The contractor will undertake a pre-construction Property Condition Survey of the adjacent church shrine and protect it in place throughout the works.
- The existing pedestrian walkway will be demolished, and the stonework material stored for reuse within the proposed pedestrian walkway. The excess material will be removed from site and disposed of in accordance with the relevant waste management legislation.
- The contractor will excavate down to the required formation levels of the pedestrian walkway, new channel and the low flow route.
- The low flow pipeline will be installed at the base of the pedestrian access along the line of the existing channel and the pedestrian bridge will be built up as per the drawings to the required levels.
- The walls of the pedestrian bridge will be constructed as per the relevant drawings and the new walls will tie into the existing roadway and church ground boundary walls with recovered material or material as per direction and approval of the Engineer.
- When the permanent works are complete the bed and banks will be reinstated.
- When the works are complete temporary dams will be removed from the river to restore the river to free flow conditions.

A schematic staging for these works is outlined below:



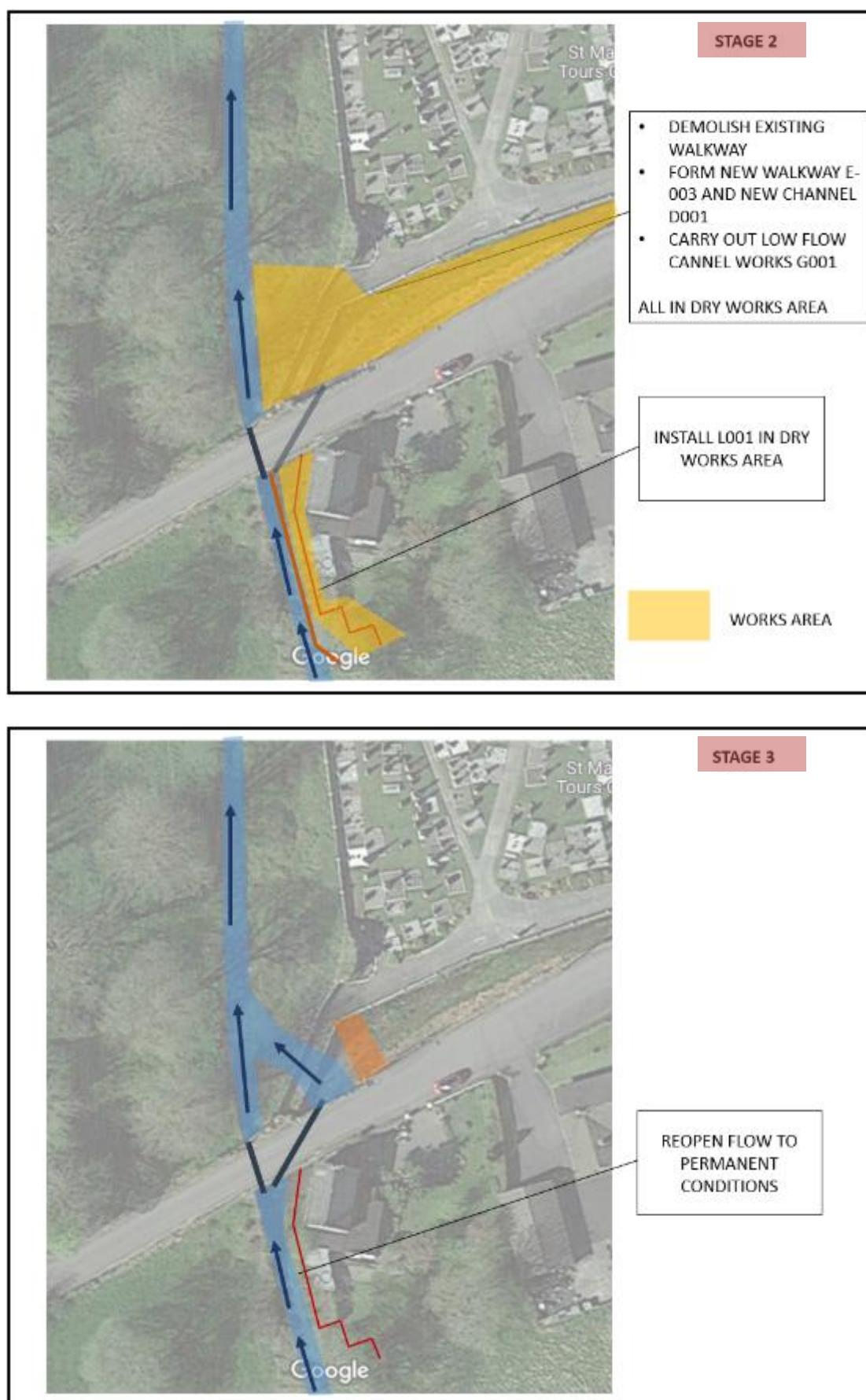


Figure 5-33 Schematic E-003, D-001 construction staging

5.10 Flood Walls Adjacent to Properties (L-001, L-002)

- The river instream works elements will only take place during the instream open season (1st July – 30th September). The weather will be monitored during this period to determine a period of low flow within the channel.
- Appropriate preconstruction surveys shall be carried out before the works. The contractor shall put in place temporary works measures as necessary to ensure no undermining of existing structures.
- A temporary flow bypass system will be put in place following one of the measures listed in paragraph 5.8.
- Vegetation within the footprint of the proposed flood wall will be removed from site and disposed of in accordance with the relevant waste management legislation. The riverbed material will be stripped and stored for reuse within the site. Unsuitable material occurring in the works footprint shall be removed. All material removed from site will be disposed of in accordance with relevant waste management legislation.
- The sections of the existing boundary/bank will be removed and disposed of in accordance with relevant waste management legislation.
- An in-situ reinforced concrete foundation will be cast along the length of the proposed flood wall.
- The proposed wall will be constructed to the desired height as per the contract drawings.
- The flood wall will tie into the existing boundaries as noted on the corresponding drawings.
- When the permanent works are complete the bed and banks will be reinstated.
- When the works are complete temporary dams will be removed from the river to restore the river to free flow conditions.

5.11 In-Channel Works (LW-002, G-001, D-002, G-002)

- The river instream works will only take place during the instream open season (1st July – 30th September). The weather will be monitored during this period to determine a period of low flow within the channel.
- A temporary flow bypass system will be put in place following one of the measures listed in paragraph 5.8.
- Vegetation within the footprint of the proposed works will be removed from site and disposed of in accordance with the relevant waste management legislation. The riverbed and bank material will be stripped and stored for reuse within the site. Unsuitable material occurring in the works foundation shall be removed. All material

removed from site will be disposed of in accordance with relevant waste management legislation.

- Channels will be excavated and shaped to the required alignment. Approved bed material will be re-laid along the line of the channel and riprap placed along the banks.
- When the works are complete temporary dams will be removed from the river to restore the river to free flow conditions.

5.12 Piped Route (P-001)

- The works will be carried out after the installation of D001/E003 which will allow isolation of the church channel flows which will reduce incoming flows to those generated from its small natural catchment only. Suitable temporary diversion of the minor flows will be put in place to allow works to be completed in the dry.
- The upstream and downstream portion of works which are located in the river channel will only take place during the instream open season (1st July – 30th September). The weather will be monitored during this period to determine a period of low flow within the channel.
- Works within existing private commercial lands to be carried out in accordance with landowner requirements and are to be scheduled to minimise disturbance. Suitable safety and security fencing to be in place at all times. Area to be reinstated to allow for use by landowner as soon as practicable.
- Temporary traffic and pedestrian diversions shall be put in place ahead of works on public carriageway. The temporary traffic management measures for this work shall be included within the contractors Traffic Management Plan /Construction & Environmental Management Plan and the contractor shall apply for a road opening license from KCC for the works. It is anticipated that the works would involve temporary closure of one side of the carriageway and an alternating one-way traffic management system on the other lane.
- The pipeline will be installed by excavating along the roadway in stages and installing pipeline at the desired falls. The completed sections are to be reinstated to match existing road.
- The outfall will be constructed in the dry and the existing boundary wall will be reinstated.
- The pipeline will be CCTV'd prior to removal of the flow bypasses to ensure the pipeline has been constructed as per the scheme drawings. The flow bypass system will be removed from the upstream headwall of the pipeline to allow flow through the pipeline.

5.13 Obstruction Removal (X-001, X-002)

- The river instream works will only take place during the instream open season (1st July – 30th September). The weather will be monitored during this period to determine a period of low flow within the channel.
- A temporary flow bypass system will be put in place following one of the measures listed in paragraph 5.8.
- Remove the obstructions along channel length and dispose of material to an appropriately licensed facility.
- When the works are complete temporary dams will be removed from the river to restore the river to free flow conditions.

5.14 Weir Removal and Bridge Removal / Replacement (X-003)

- The river instream works will only take place during the instream open season (1st July – 30th September). The weather will be monitored during this period to determine a period of low flow within the channel.
- A temporary flow bypass system will be put in place following one of the measures listed in paragraph 5.8.
- Vegetation within the footprint of the proposed works will be removed from site and disposed of in accordance with the relevant waste management legislation. The riverbed and bank material will be stripped and stored for reuse within the site. Unsuitable material occurring in the works foundation shall be removed. All material removed from site will be disposed of in accordance with relevant waste management legislation.
- A Stop-Go System will be put in place across the existing entrance to allow for safe access to the Ballyhale Business Park and a safe working environment.
- Area to be excavated for foundations of the new portal frame culvert and culvert to be installed in sections. Reinstall the bed and banks of channel at new elevation using approved riverbed material.
- Road surface and entrance walls to be installed across the channel on the portal frame culvert.
- Existing entrance to be decommissioned and traffic will be directed over the newly installed culvert.
- The methodology for the removal of existing bridge and weir will be subject to a detailed structural demolition plan. Existing entrance bridge and weir to be demolished within a dry working area. The material generated during the demolition works will be disposed of at an appropriately licensed facility.

- Channels will be excavated and shaped to the required alignment. Approved bed material will be re-laid along the line of the channel and riprap placed along the banks.
- When the works are complete temporary dams will be removed from the river to restore the river to free flow conditions.

5.15 Flood Wall adjacent to Hazelbrook (L-003)

- Vegetation within the footprint of the proposed works will be removed from site and disposed of in accordance with the relevant waste management legislation. Unsuitable material occurring in the works foundation shall be removed as per direction and approval of the Engineer and replaced by approved materials laid in layers and suitably compacted to the required and specified degree of compaction. All material removed from site will be disposed of in accordance with relevant waste management legislation.
- An in-situ reinforced concrete foundation will be cast along the length of the proposed flood wall.
- The proposed wall will be constructed to the desired height as per the longitudinal and cross sections as per the contact drawings.
- The flood wall will tie into the existing boundaries as noted on the drawings.

5.16 Fish Passage Works (G-003, G-004)

- The river instream works will only take place during the instream open season (1st July – 30th September). The weather will be monitored during this period to determine a period of low flow within the channel.
- A temporary flow bypass system will be put in place following one of the measures listed in paragraph 5.8.
- Vegetation within the footprint of the proposed works will be removed from site and disposed of in accordance with the relevant waste management legislation. The riverbed and bank material will be stripped and stored for reuse within the site. Unsuitable material occurring in the works foundation shall be removed. All material removed from site will be disposed of in accordance with relevant waste management legislation.
- Suitable boulders gravels and geotextiles (where necessary) will be imported and placed to form the rock ramps/pools.
- Works shall be completed with supervision by Project Ecologist and in accordance with OPW's Design Guidance For Fish Passage On Small Barriers
- When the works are complete temporary dams will be removed from the river to restore the river to free flow conditions.

5.17 Main St Bridge Works (P-002)

- The in channel works upstream and downstream will be carried out as described in paragraph 5.12 and 5.17. These may be carried out before or after the new culvert installation.
- A temporary stream diversion to isolate the works area will be put in place following one of the measures listed in paragraph 5.8.
- The existing bridge is on the National Inventory of Architectural Heritage. Therefore, all works shall ensure the integrity of the existing twin arches. Preconstruction surveys shall be carried out to comprehensively record existing conditions.
- Demolition/excavation works to form the new opening will be subject to a specific contractor method statement incorporating the mitigation measures included in the EIAR and PCEMP. All stonework will be removed and retained for reinstatement works.
- Since the works require a new culvert crossing of the existing R448. Traffic Management Measures will be required to facilitate installation and reinstatement. The works will generally be carried out by closing and excavating one side of the road and implementing a one-way alternating lane arrangement on the other and access will be maintained for vulnerable uses at all times.
- The culvert will be delivered to site in precast sections which can be laid in place by crane/excavator and backfilled with suitable road construction materials. When one side is complete the alternating lane will move to the completed side and the remainder of the work would be completed. There may be a requirement for short term (<1 day) full closures to facilitate tie ins or resurfacing works. All works would be subject to the Road Opening License restrictions set by KCC.
- On completion of the culvert installation tie in works, stone cladding and fencing etc will be completed and river can be restored to free flow conditions.

5.18 Operation and Maintenance of the Project

5.18.1 Maintenance and Monitoring

As time progresses the natural processes of the environment will change some aspects of the proposed development. Operational measures will be required and will include regular maintenance of the proposed scheme. The natural process which would alter the scheme are as follows:

- Vegetation will continue to grow along the river banks.

- Materials will be carried downstream during flood events and impact the scheme.
- Sediment from surface water runoff will be transported down river.

There may also be the non-natural process which would require inspection and maintenance. These would be as follows:

- Illegal Dumping of materials which would cause a blockage event at one of the various structures within the scheme.
- Illegal alterations of the scheme elements which may reduce the heights of the proposed scheme elements or damage individual elements.

Therefore, maintenance activities will be required as follows:

- Removal of Silt-Build-up, Vegetation and branches impacting on the hydraulic capacity of the river channels will be carried out ensure conveyance capacity is retained within the river channel. This will be carried out in Autumn prior to the winter flood season and it will cover the channel from the Bridge Structure Upstream of D-001 to downstream of G-004.
- Structure faces will be regularly inspected and any debris causing a blockage will be removed. The reinforced concrete and cladding of the proposed structures will be inspected and any required maintenance undertaken.
- The Overflow Pipe will be inspected and cleaned as required.

A regular inspection regime will be carried out on all elements of the scheme to ensure the various elements have not been damaged or altered.

5.19 Decommissioning

Kilkenny County Council considers the Ballyhale Flood Relief Scheme a strategic asset for the protection of Ballyhale town from flooding. The scheme will have a 50-year design life as a minimum and as such it is anticipated that the proposed development will be maintained by Kilkenny County Council in the long term. The elements of the Flood Relief Scheme will not be decommissioned in the foreseeable future as they are required for the long-term protection of the town.

5.20 References

- EPA (2022) Guidelines on preparation of Environmental Impact Assessment Reports;
- Department of the Environment, Community and Local Government (DoECLG), (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment;
- National Roads Authority (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide (Transport Infrastructure Ireland (TII), (formerly);
- TII (2004) Environmental Assessment and Construction Guidelines;
- EPA (2002) Guidelines on the Information to be contained in Environmental Impact Statements;
- EPA (2003) Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- EPA (2015) Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements;
- EPA (2015) Draft Revised Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- EPA (2015) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- EPA (2017) Draft Guidelines on preparation of Environmental Impact Assessment Reports;
- Department of the Environment, Community and Local Government (DoECLG), (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment;
- National Roads Authority (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide (Transport Infrastructure Ireland (TII), (formerly);
- TII (2004) Environmental Assessment and Construction Guidelines;
- EPA (2002) Guidelines on the Information to be contained in Environmental Impact Statements;
- EPA (2003) Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- EPA (2015) Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements;

- EPA (2015) Draft Revised Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- EPA (2015) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- SEPA Engineering in the Water Environment Good Practice Guide: Temporary Construction Methods First edition, March 2009

APPENDIX 5-1

Scheme Drawings

APPENDIX 5-2

Construction & Environmental Management Plan