



South Western CFRAM Study

Preliminary Options Report UoM 19

July 2016

The Office of Public Works



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The Office of Public Works

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Executive Summary

The Office of Public Works (OPW) is undertaking six catchment-based flood risk assessment and management (CFRAM) studies to identify and map areas across Ireland which are at existing and potential future risk of flooding. Mott MacDonald Ireland Ltd. has been appointed by the OPW to assess flood risk and develop flood risk management options in the South Western River Basin District. This Preliminary Options Report is one of a series of reports being produced as part of the South Western Catchment Flood Risk Assessment and Management Study (SW CFRAM Study). This report details the analysis undertaken to identify the preferred measures and options to manage flood risk in Unit of Management 19 (The Lee / Cork Harbour Catchment) which will form the basis for the Flood Risk Management Plan for this Unit of Management.

The preferred Flood Risk Management Options selected for inclusion in the Flood Risk Management Plan for UoM 19 are set out below:

- Planning Control
- Building Regulations
- SUDS
- Flood Forecasting and Warning Systems
 - Build on Lower Lee Flood Warning System
- Public Awareness
- Individual Property Flood Resilience
- Land Use Management

In addition to the options selected for the UoM, the preferred options selected for inclusion in the Flood Risk Management Plan for the Ballingeary / Inchigeelagh Sub-Catchment are set out below:

- Flood Forecasting and Warning Systems
 - River Level Gauges along with forecast rainfall to predict flooding from Lough Allua
 - Build on the Lower Lee Flood Warning System

The benefit of a flood forecasting and warning system may be reduced through the implementation of a measure / option at another SSA (i.e. AFA flood relief scheme). Therefore, the timing of other measures / options must be considered when implementing a flood forecasting and warning system.

The preferred Flood Risk Management Options selected for inclusion in the Flood Risk Management Plan for each of the AFAs in UoM 19 are set out below:

The preferred option for Ballingeary as identified in the MCA is Flood Defences.

The preferred option for Inchigeelagh as identified in the MCA is Flood Defences.

The preferred option for Castlemartyr as identified in the MCA is Flow Diversion and Flood Defences.

1 Introduction

1.1 Background

Flooding is a natural process that occurs throughout Ireland as a result of extreme rainfall, river flows, storm surges, waves, and high groundwater. Flooding can become an issue where the flood waters interact with people, property, farmland and protected habitats.

Flood risk in Ireland has historically been addressed through the use of structural or engineered solutions (arterial drainage schemes and / or flood relief schemes). In line with internationally changing perspectives, the Government adopted a new policy in 2004 that shifted the emphasis in addressing flood risk towards:

- A catchment-based context for managing risk;
- More pro-active flood hazard and risk assessment and management, with a view to avoiding or minimising future increases in risk, such as that which might arise from development in floodplains;
- Increased use of non-structural and flood impact mitigation measures.

A further influence on the management of flood risk in Ireland is the 'Floods' Directive [2007/60/EC]. The aim of this Directive is to reduce the adverse consequences of flooding on human health, the environment, cultural heritage and economic activity.

The Office of Public Works (OPW) is the lead agency in implementing flood management policy in Ireland. The OPW have commissioned a number of Catchment Flood Risk Assessment and Management Studies in order to assess and develop Flood Risk Management Plans (FRMPs) to manage the existing flood risk and also the potential for significant increases in this risk due to climate change, ongoing development and other pressures that may arise in the future.

Mott MacDonald Ireland Ltd. has been appointed by the OPW to undertake the Catchment-Based Flood Risk Assessment and Management Study (CFRAM Study) for the South Western River Basin District, henceforth referred to as the SW CFRAM Study. Under the project, Mott MacDonald Ireland Ltd. will produce FRMPs which will set out recommendations for the management of existing flood risk in the Study Area, and also assess the potential for significant increases in this risk due to climate change, ongoing development and other pressures that may arise in the future.

1.1 SW CFRAM Study Process

The overarching aims of the SW CFRAM Study are as follows:

- Identify and map the existing and potential future flood hazard;
- Assess and map the existing and potential future flood risk; and,
- Identify viable structural and non-structural options and measures for the effective and sustainable management of flood risk in the South Western River Basin District.

In order to achieve the overarching aims, the study is being undertaken in the following stages:

- Data collection;
- Hydrological analysis;
- Hydraulic analysis;
- Development of flood maps;
- Strategic Environmental Assessment and a Habitats Directive Appropriate Assessment;
- Flood risk assessment of people, economy and environment;
- Development and assessment of flood risk mitigation options; and,
- Development of the Flood Risk Management Plan (FRMP).

The resultant FRMP will set out recommendations for the management of existing flood risk and the potential for significant increases in this risk due to climate change, ongoing development and other pressures that may arise in the future.

The South Western River Basin District is split into five Units of Management (UoM). These Units follow watershed catchment boundaries and do not relate to political boundaries. The Units are as follows;

- The Blackwater Catchment (UoM 18)
- The Lee / Cork Harbour Catchment (UoM 19)
- The Bandon / Skibbereen Catchment (UoM 20)
- The Dunmanus / Bantry / Kenmare Bay Catchment (UoM 21)
- The Laune / Maine / Dingle Bay Catchment (UoM 22)

1.2 Report Structure

Table 1.1: Report Structure

Chapter	Key Contents of Chapter
1. Introduction	<ul style="list-style-type: none"> Context of the Study The SW CFRAM process and aims Scope of Work
2. Description of the Unit of Management	<ul style="list-style-type: none"> Description of study area Description of spatial scales of assessment
3. Screening of Possible Flood Risk Management Measures	<ul style="list-style-type: none"> Description of the screening process Outcome of the screening process
4. Possible Flood Risk Management Measures	<ul style="list-style-type: none"> Description of non-structural FRM measures Description of Structural measures
5. Development of Potential Flood Risk Management Options for AFAs	<ul style="list-style-type: none"> Description of potential FRM options
6. Environmental Assessment	<ul style="list-style-type: none"> Assessment of environmental impacts of potential FRM options
7. Stakeholder Input	<ul style="list-style-type: none"> Summary of public consultations undertaken Summary of feedback received at public consultations
8. Flood Risk Assessment	<ul style="list-style-type: none"> Description of the flood risk assessment process Description of receptors Description of flood risk maps
9. Estimate of Costs	<ul style="list-style-type: none"> Estimate of costs of potential options
10. Appraisal of Options	<ul style="list-style-type: none"> Description of the derivation of local weightings Description of the multi criteria analysis process
11. Selection of Preferred Options	<ul style="list-style-type: none"> Description of preferred options

2 Description of the Unit of Management

2.1 Spatial Scales of Assessment

The South Western River Basin District covers an area of approximately 11,160 km². The Study Area includes most of County Cork, large parts of Counties Kerry and Waterford, along with small parts of the counties of Tipperary and Limerick. The Study Area contains over 1,800 km of coastline along the Atlantic Ocean and the Celtic Sea. There are five Units of Management within the South Western River Basin District, which are listed below:

- The Blackwater Catchment (UoM 18)
- The Lee / Cork Harbour Catchment (UoM 19)
- The Bandon / Skibbereen Catchment (UoM 20)
- The Dunmanus / Bantry / Kenmare Bay Catchment (UoM 21)
- The Laune / Maine / Dingle Bay Catchment (UoM 22)

Within the CFRAM Study, the screening, assessing and developing of Flood Risk Management (FRM) methods and options is to be considered on a range of Spatial Scales of Assessment (SSAs) that shall include:

- The Units of Management (UoM)
- Each Sub-Catchment within the Unit of Management
- Areas for Further Assessment (AFAs)
- Individual Risk Receptors (IRRs)

2.2 Spatial Scales of Assessment for Unit of Management 19

Within UoM 19 the River Lee from Ballingeary to Inchigeelagh forms a Sub-Catchment SSA where measures and options have potential to benefit both AFAs.

No IRRs have been identified within the South Western RBD and as such are not considered.

Based on the above, UoM 19 is split into 3 Spatial Scales of Assessment (SSAs). These are:

- The Unit of Management (UoM)
- Sub-Catchment
 - Ballingeary / Inchigeelagh
- Areas for Further Assessment (AFAs)
 - Ballingeary
 - Inchigeelagh
 - Castlemartyr
 - Killeagh

However, based on the Flood Risk Assessment and Mapping described in this report there is low risk in Killeagh and there are no structural flood risk management options proposed.

3 Screening of Possible Flood Risk Management Methods

3.1 General

A flood risk management option consists of one or, more commonly, a combination of flood risk management (FRM) methods or measures. The OPW have identified a range of possible FRM methods that could apply to areas at risk from flooding. The screening of possible FRM methods to determine their applicability and viability is carried out in this section.

3.2 Screening of Possible Flood Risk Management Methods

A preliminary assessment was carried out to identify which Flood Risk Management (FRM) methods were applicable to each of the SSAs within UoM 19.

The applicability and viability of each of the FRM methods was considered in terms of the following criteria:

- Applicability to the SSA
- Economic (potential benefits, impacts, likely costs etc.)
- Environmental (potential impacts and benefits)
- Social (impacts on people, society and the likely acceptability of the method) and
- Cultural (potential benefits and impacts upon heritage sites and resources)

The viability of each of the methods was assessed to a preliminary degree only. The purpose of the screening process was to identify the FRM methods that are clearly not applicable or viable within UoM 19. The FRM methods considered and the outcome of the screening process are shown in Table 3.1 below.

Table 3.1: Screening of Possible Flood Risk Management Methods

Measures / Methods	UoM	Sub-Catchment		AFA		
	19	Ballingeary / Inchigeelagh	Ballingeary	Inchigeelagh	Castlemartyr	Killeagh
Do Nothing	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable	Viable
Existing Regime	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable	Viable
Do Minimum	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable
Non-structural Measures						
• Planning Control	Viable	Viable	Viable	Viable	Viable	Viable
• Building Regulations	Viable	Viable	Viable	Viable	Viable	Viable
• SUDS	Viable	Viable	Viable	Viable	Viable	Viable
• Flood Forecasting	Viable	Viable	Viable	Viable	Viable	Viable
• Public Awareness	Viable	Viable	Viable	Viable	Viable	Viable
• Individual Property Flood Resilience	Viable	Viable	Viable	Viable	Viable	Viable
• Land Use Management	Viable	Viable	Viable	Viable	Viable	Viable
Structural Measures (Future Risk)						
• Strategic Development Management	Viable	Viable	Viable	Viable	Viable	Viable
Structural Measures (Current Risk)						
• Fluvial Storage	Viable	Viable	Viable	Not Viable	Not Viable	Not Viable
• Flow Diversion	Not Viable	Not Viable	Viable	Not Viable	Viable	Not Viable
• Increase Conveyance	Not Viable	Viable	Not Viable	Viable	Viable	Not Viable
• Flood Defences	Not Viable	Not Viable	Viable	Viable	Viable	Not Viable
• Improve existing defences	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable
• Relocate Properties	Viable	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable
• Localised protection works	Not Viable	Not Viable	Viable	Viable	Viable	Not Viable
Channel or Flood Defence Maintenance Works	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable	Not Viable
Other Works	-	-	-	-	-	-

3.3 Screening of UoM scale FRM Methods

3.3.1 Do Nothing / Existing Regime / Do Minimum

These measures are not viable due to the significant flood risk within UoM 19 to the economy and society for extreme events in the current and future scenarios.

3.3.2 Structural Measures (Current Risk)

Structural measures are typically not applicable to UoM scale SSAs due to cost and the likely significant social and environmental impacts of such works. Also, within UoM scale SSAs there are areas and receptors which are less vulnerable to flooding. Structural measures are more appropriate and applicable to AFA scale SSAs.

However, structural measures such as upstream storage and relocation of properties can be viable structural measures on a UoM scale.

3.4 Screening of Sub-Catchment scale FRM Methods

3.4.1 Do Nothing / Existing Regime / Do Minimum

These measures are not viable due to the significant flood risk within UoM 19 to the economy and society for extreme events in the current and future scenarios.

3.4.2 Structural Measures (Current Risk)

Structural measures are typically not applicable to Sub-catchment scale SSAs due to cost and the likely significant social and environmental impacts of such works. Also, within Sub-catchment scale SSAs there are areas and receptors which are less vulnerable to flooding. Structural measures are more appropriate and applicable to AFA scale SSAs.

However, structural measures such as upstream storage, increase conveyance and relocation of properties can be viable structural measures on a Sub-Catchment scale.

3.5 Screening of AFA scale FRM Methods

This section details each of the non-viable measures which have been screened out from further assessment. The remaining viable Flood Risk Management measures are assessed further in Chapter 4 and Chapter 5.

3.5.1 Do Nothing / Existing Regime

For the majority of the AFAs these measures are not viable due to the significant flood risk to the economy and society for extreme events in the current scenario and for future scenarios.

However, as part of the Flood Risk Assessment and Mapping, Killeagh was identified as having a low existing risk as there are no properties within the 1% AEP fluvial event. As a result, Killeagh has been excluded from the development of FRM Options on the basis that there is a low likelihood of achieving a cost-beneficial solution and/or the low priority that would be given to the AFA for any such works. Therefore, for Killeagh, the Do Nothing / Existing Regime are viable measures while all other structural measures are deemed to be not economically viable.

3.5.2 Do Minimum (e.g. Infilling of gaps etc.)

Within the AFAs considered there are no identifiable points or locations where minimum works such as infilling of gaps etc. would lead to a reduction in flood risk. Therefore, the do minimum approach is not applicable.

3.5.3 Ballingearry – Increase Conveyance

Ballingearry is located at the confluence of the River Lee and its tributary the Bunsheelin. The Bunsheelin is a steep flashy catchment and increasing conveyance along the watercourse or at structures will increase flooding in Ballingearry. Increasing conveyance along the River Lee will have limited impact as Lough Allua is located approximately 2.2km downstream of Ballingearry and the lake dictates the flood level in Ballingearry. For the 1% AEP event the level at Ballingearry is 85.94m OD Malin (Sule_52298), the upstream level at the Lough is 85.9m OD Malin (Sule_49937) and downstream level is 85.89m OD Malin (Sule_44100). The Lough is approximately 5.5km in length which results in only a 0.05m difference in level over 7.7km. The measure of improving the conveyance capacity of the River Lee at what is locally known as “The Ford” was considered. As this is located upstream of Lough Allua and the lake level dictates the flood level in Ballingearry this measure is not considered to be applicable. However, increasing conveyance at Inchigeelagh Bridge is considered under measures for Inchigeelagh.

3.5.4 Ballingearry – Improve Existing Defences

There are no existing flood defences in Ballingearry. This measure is not applicable.

3.5.5 Ballingeary – Relocate Properties

There are no isolated properties at risk within Ballingeary. This measure would require relocation of 21 Nr. residential and 25 Nr. non-residential properties. Relocating this number of properties from Ballingeary would not be socially viable as to do so would significantly alter the social fabric of this town.

3.5.6 Ballingeary – Channel or Flood Defence Maintenance Works

Ballingeary does not have an existing channel scheme or flood defence scheme to maintain. This measure is not applicable.

3.5.7 Inchigeelagh – Fluvial Storage

There are no suitable locations to store the required flow between Ballingeary and Inchigeelagh. Lough Allua is located between Ballingeary and Inchigeelagh and is a source of flooding due to backwater in the lake. Fluvial storage is not applicable.

3.5.8 Inchigeelagh – Flow Diversion

Due to the magnitude of flows in the River Lee (111m³/s for the 1% AEP event) and its location within a valley it is not feasible to divert flows. Flow diversion is not applicable.

3.5.9 Inchigeelagh – Improve Existing Defences

There are no existing flood defences in Inchigeelagh. This measure is not applicable.

3.5.10 Inchigeelagh – Relocate Properties

There are no isolated properties at risk within Inchigeelagh. This measure would require relocation of 14 Nr. residential and 14 Nr. non-residential properties. Relocating this number of properties from Inchigeelagh would not be socially viable as to do so would significantly alter the social fabric of this town.

3.5.11 Inchigeelagh – Channel or Flood Defence Maintenance Works

Inchigeelagh does not have an existing channel scheme or flood defence scheme to maintain. This measure is not applicable.

3.5.12 Castlemartyr – Fluvial Storage

There is no suitable location for storage upstream of Castlemartyr. In addition, the existing ground conditions are karst which include significant caves and swallow holes. The existing karst geology would require lining of the storage area which is not economically or environmentally viable. Fluvial storage is not applicable.

3.5.13 Castlemartyr – Improve Existing Defences

There are no existing flood defences in Castlemartyr. This measure is not applicable.

3.5.14 Castlemartyr – Relocate Properties

There are no isolated properties at risk within Castlemartyr. This measure would require relocation of 13 Nr. residential and 16 Nr. non-residential properties. The scheme benefit is approx. €3M. It is not economically viable to relocate a property at a cost of €103k per property. It would cost considerably more to relocate non-residential properties / businesses which may also suffer from moving away from the town centre. This measure is not economically viable.

3.5.15 Castlemartyr – Channel or Flood Defence Maintenance Works

Castlemartyr does not have an existing channel scheme or flood defence scheme to maintain. This measure is not applicable.

4 Possible Flood Risk Management Measures

4.1 General

A flood risk management option consists of one or, more commonly, a combination of flood risk management methods / measures. This section assesses the possible flood risk management measures as screened in Table 3.1.

4.2 Non-Structural Measures

Non-structural measures such as Land Use Management, Natural Flood Management, Green Infrastructure etc. are terms used to cover a suite of measures that are intended to reduce flood risk by working with natural systems and, where possible, provide environmental benefits. While in small catchments they can effectively manage flood risk to a certain degree in their own right, in larger catchments they can work in a complimentary way with other measures to achieve flood risk management targets.

Due to the time required to initiate, establish and prove the flood risk management targets of such measures, they are not deemed viable to mitigate the current flood risk and any potential reductions in flood risk should not be considered when developing other options based on structural measures.

Where there is existing flood risk, the implementation of non-structural measures such as Planning Control, SUDS etc. at any spatial scale of assessment will not mitigate flood risk, unless those measures are retrospectively applied. As this is unrealistic and not economically viable, such non-structural measures can only be applied to new development to maintain the status quo of the current flood risk scenario or mitigate future flood risk. The application of non-structural measures such as individual property resilience, public awareness and flood forecasting, to redevelopment or new development may reduce potential damage costs.

The non-structural measures described in this section are complimentary to structural measures and should be implemented as national policy to the SSAs where appropriate. However, at this stage they should not be considered in the development of options based on structural measures.

4.2.1 Planning Control

In November 2009, the Guidelines on the Planning System and Flood Risk Management, jointly developed by DECLG and the OPW, were published under Section 28 of the Planning Acts. These Guidelines provide a systematic and transparent framework for the consideration of flood risk in the planning and development management processes, whereby:

A sequential approach should be adopted to planning and development based on avoidance, reduction and mitigation of flood risk.

A flood risk assessment should be undertaken that should inform the process of decision-making within the planning and development management processes at an early stage.

Development should be avoided in floodplains unless there are demonstrable, wider sustainability and proper planning objectives that justify appropriate development and where the flood risk to such development can be reduced and managed to an acceptable level without increasing flood risk elsewhere (as set out through the Justification test).

The proper application of the Guidelines by the planning authorities is essential to avoid inappropriate development in flood prone areas, and hence avoid unnecessary increases in flood risk into the future. The flood mapping provided as part of the FRMP will facilitate the application of the Guidelines.

In flood-prone areas where development can be justified (i.e., re-development, infill development or new development that has passed the Justification Test), the planning authorities can manage the risk by setting suitable objectives or conditions, such as minimum floor levels or flood resistant or resilient building methods.

4.2.2 Building Regulations / Planning Conditions

The risk of damage to properties from flooding can be mitigated by the use of appropriate construction techniques and materials. For example the damage caused to an internal wall of a property by flooding can depend on the materials and methods of its construction. A timber stud partition covered with plasterboard with low level electrical wiring would have to be completely replaced following immersion in flood water. However, a solid concrete block wall covered with tiles and high level electrical wiring on the other hand would only have to be washed down following a flood.

If for a particular town or high flood probability areas, certain building regulations or planning conditions were adopted that ensured structures were flood resilient through specified construction methods, building fabrics and uses, a decrease in the risk of damage could be achieved. The question of whether such regulations or planning conditions could be imposed upon developers, business owners or householders in flood prone areas would need to be addressed if this were to be brought forward as a flood risk management measure.

A link to a UK guidance document “Improving the Flood Performance of New Buildings” prepared by the Department for Communities and Local Government is provided below.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7730/flood_performance.pdf

4.2.3 Sustainable Urban Drainage Systems (SUDS)

Sustainable Urban Drainage (SUDS) involves the management of surface water run-off from developments in a manner which attempts to replicate the natural behaviour within catchments and watercourses, which is typically achieved through attenuation.

Within existing urban or developed areas there is typically little space available for the attenuation of storm water flows to a degree which would mitigate or reduce current flood risk. Therefore, it is not considered practical to implement SUDS for the mitigation of current risk at any SSA. However, within all SSAs every new development (and where possible redevelopment), should apply the principles of SUDS.

A separate Strategic SUDS report has been prepared for UoM 19 outlining potential SUDS measures in the AFAs. These measures focus on areas that are zoned for future development.

4.2.4 Flood Forecasting and Warning

Flood forecasting is a means of providing advanced warning of an impending flood event. A reliable advance warning system allows protective measures to be put in place and protective actions to be carried out in advance of a flood event. These actions and measures can reduce the damage caused in a flood event.

Flood forecasting is not a possible FRM measure at all SSAs. This is because the time between transmitting a flood forecast in which the authorities have reasonable confidence and the arrival of flood waters may not be long enough for people to take effective action to reduce flood damage. The minimum time to take effective action is deemed to be 6 hours. This time limit is set on the basis that once rainfall has been recorded it can take up to 2 hours to run a complex model and get meaningful forecasts. Following this forecast it is assumed that it can take people up to 3 hours to travel to their home or business and take the necessary measures to protect their property from flooding.

Flood forecasting and warning has been identified as a possible FRM measure for the SSAs highlighted in Table 4.1. Table 4.1 highlights the time to peak for the critical event (Fluvial = 1% AEP event / Tidal = 0.5% AEP event) and summarises the infrastructure required to implement a flood forecasting and warning system. The infrastructure required is based upon the layout of the catchment and the arrangement of watercourses that could contribute to flood flows. Gauges are located at critical locations in the catchment so that data on precipitation and rising river levels can be collected and analysed to feed into the forecasting system.

The accuracy of the forecasting system will depend on the number of river level and rain gauges collecting data. The more gauges there are the greater the accuracy of the system. The cost and complexity of the system will also increase with more gauges. This will give more accurate forecasts but it will take longer for the system to generate them.

Table 4.1: SSAs Suitable for Flood Forecasting

Spatial Scale of Assessment	Time to Peak of Event	Infrastructure
AFA		
Ballingeary	> 6 Hours	River level gauges (downstream at Lough Allua) Connect to Lower Lee Flood Warning System
Inchigeelagh	> 6 Hours	River level gauges (upstream at Lough Allua) Connect to Lower Lee Flood Warning System
Castlemartyr	> 6 Hours	Rain gauges River level gauges
Killeagh	> 6 Hours	Rain gauges River level gauges
Sub-Catchment		
Ballingeary / Inchigeelagh	> 6 Hours	River level gauges (Lough Allua) Connect to Lower Lee Flood Warning System
UoM		
River Lee / Cork Harbour	> 6 Hours	River level gauges (Lough Allua) Connect to Lower Lee Flood Warning System Use the existing OPW storm surge forecasting system to predict high tide levels.

Source: UoM 19 Hydraulics Report

An equation to estimate the impacts of flood warnings on flood damages has been developed by Green & Penning-Rowsell. This equation determines that the estimated actual flood damage avoided owing to flood warnings is approximately 13% of potential damages.

4.2.4.1 Ballingeary

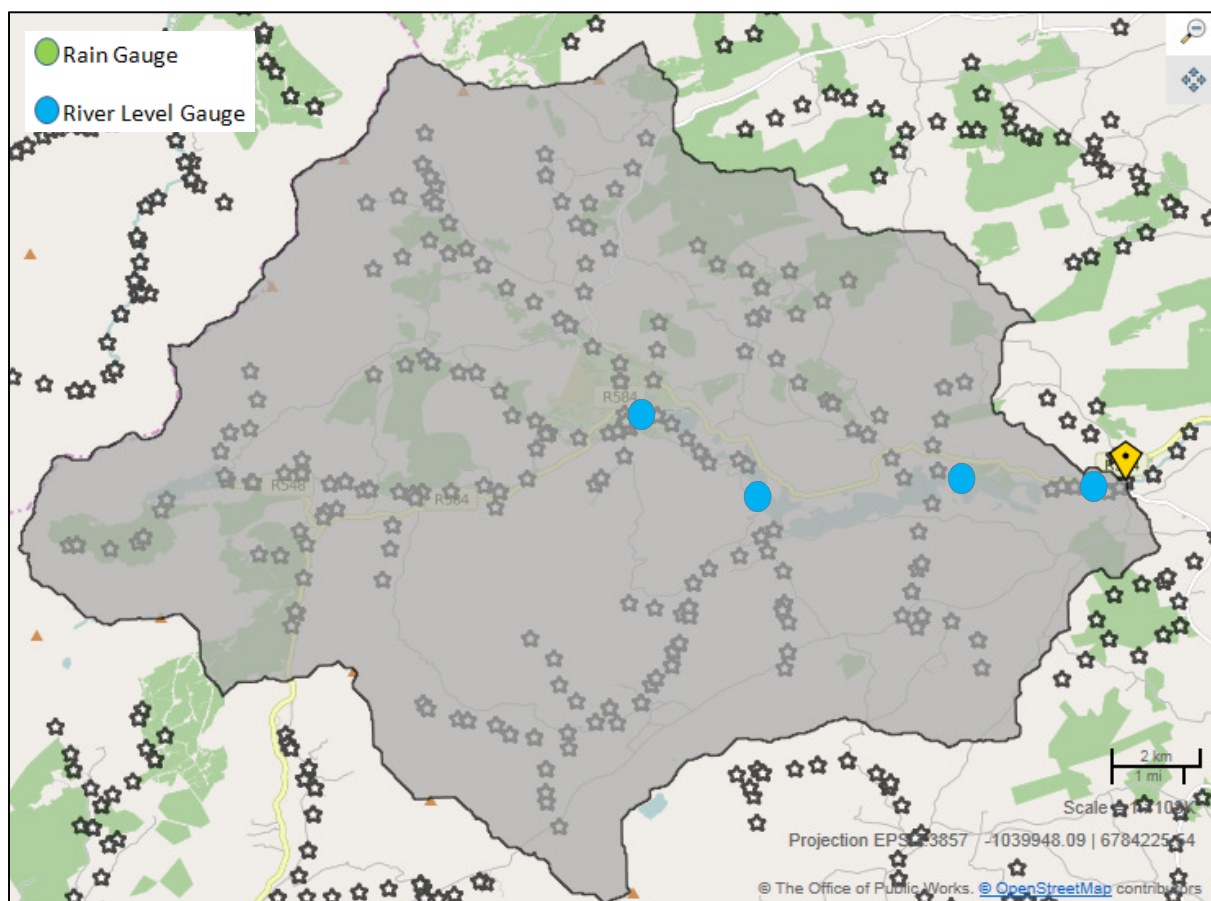
In Ballingeary flood warning would be ineffective for flooding caused by overland flow in the upper reaches of the Bunsheelin as this source of flood risk is driven by small flashy catchments. However, flood warning would be more effective for flooding arising from backwater in Lough Allua (River Lee) where forecast rainfall could be linked to the level in the Lough.

The infrastructure required for a flood forecasting and warning system in Ballingeary (AFA) is listed in Table 4.2 and the proposed locations are shown in Figure 4.1.

Table 4.2: Ballingeary – Flood Forecasting Infrastructure

Equipment	Quantity
Rain Gauges	0
River Level Gauge (Hydrometric Gauging Station)	4

Figure 4.1: Ballingeary – Lough Allua – Proposed Gauges



4.2.4.2 Inchigeelagh

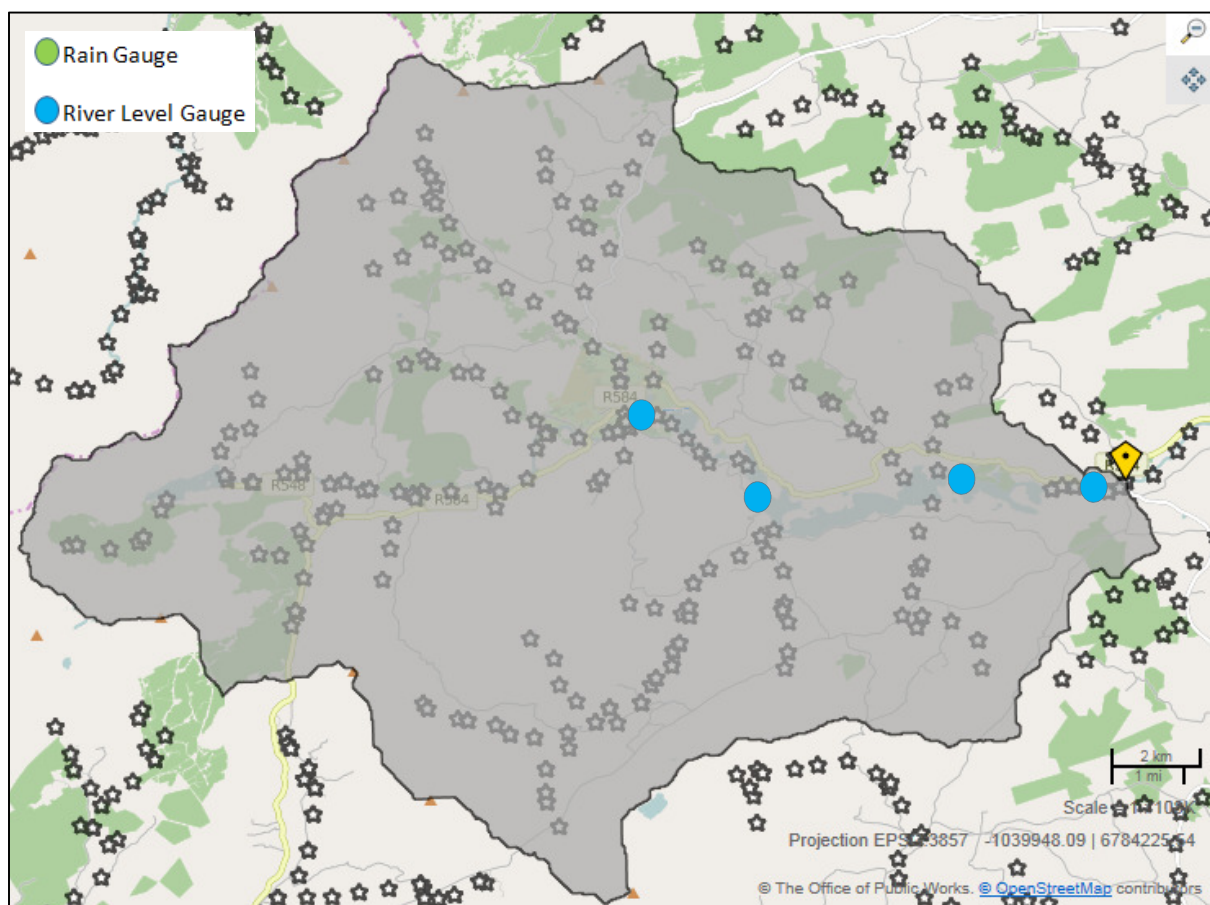
As is the case in Ballingeary, flood warning in Inchigeelagh would be more effective for flooding arising from Lough Allua (River Lee) where forecast rainfall could be linked to the level in the Lough.

The infrastructure required for a flood forecasting and warning system in Inchigeelagh (AFA) is listed in Table 4.3 and the proposed locations are shown in Figures 4.2.

Table 4.3: Inchigeelagh – Flood Forecasting Infrastructure

Equipment	Quantity
Rain Gauges	0
River Level Gauge (Hydrometric Gauging Station)	4

Figure 4.2: Inchigeelagh – Lough Allua – Proposed Gauges



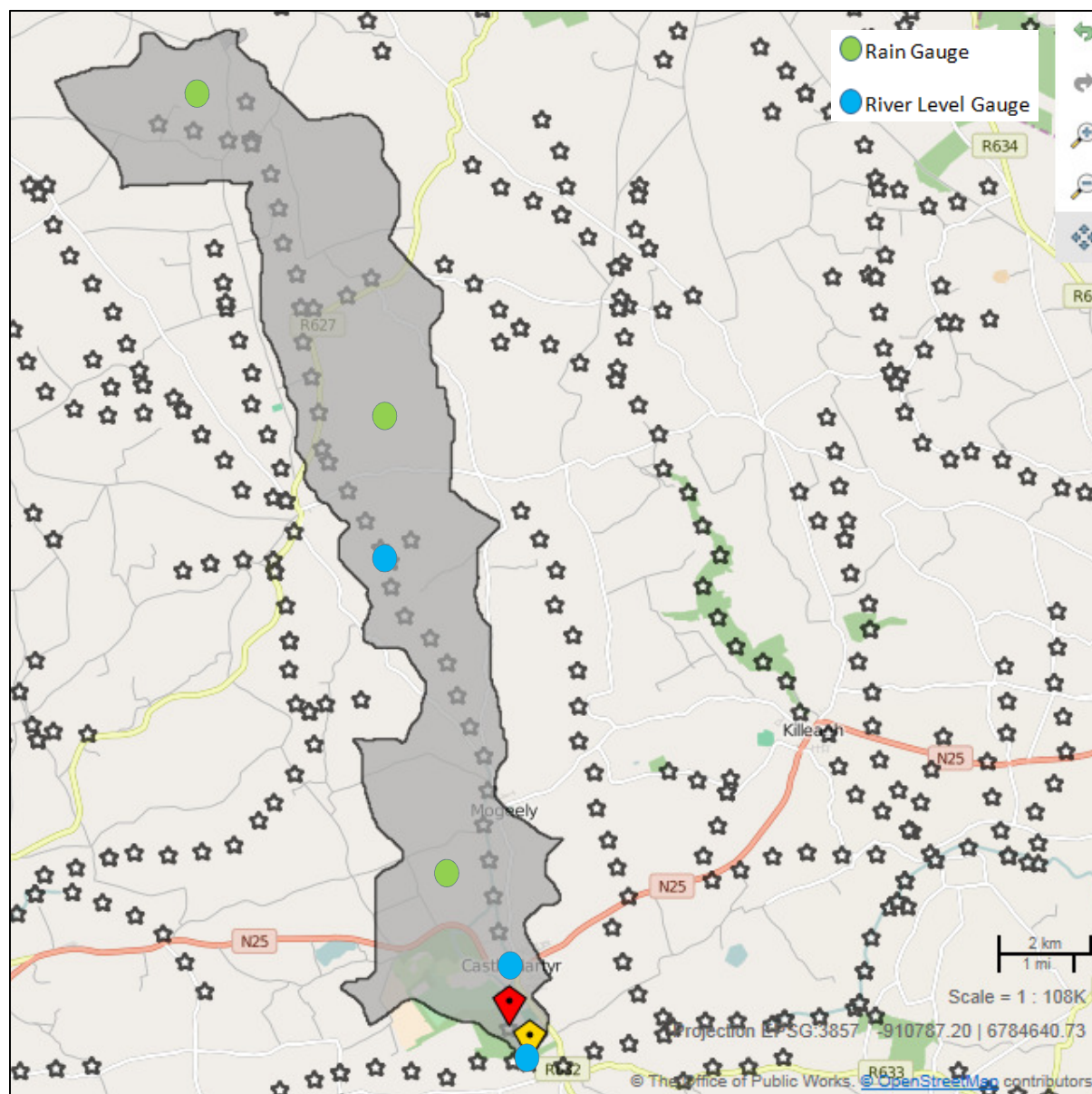
4.2.4.3 Castlemartyr

The infrastructure required for a flood forecasting and warning system in Castlemartyr (AFA) is listed in Table 4.4 and the proposed locations are shown in Figures 4.3.

Table 4.4: Castlemartyr – Flood Forecasting Infrastructure

Equipment	Quantity
Rain Gauges	3
River Level Gauge (Hydrometric Gauging Station)	3

Figure 4.3: Castlemartyr – Proposed Gauges



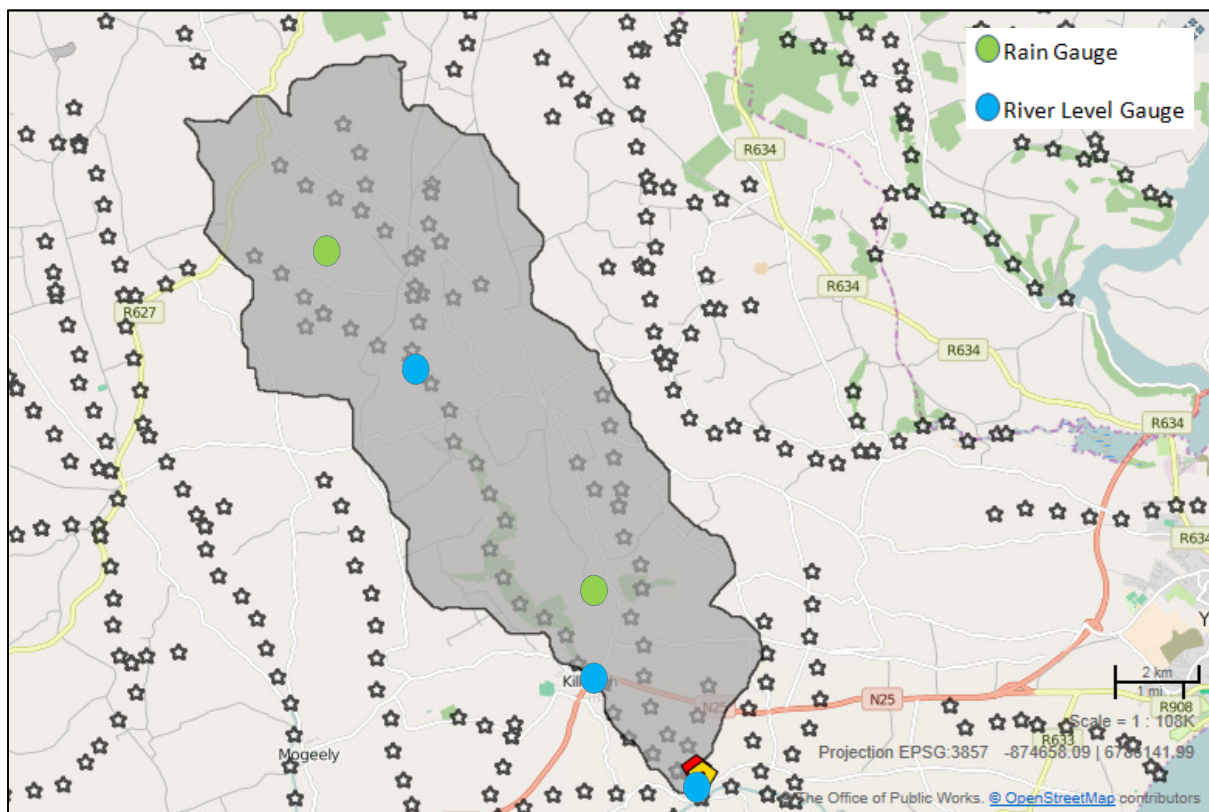
4.2.4.4 Killeagh

The infrastructure required for a flood forecasting and warning system in Killeagh (AFA) is listed in Table 4.5 and the proposed locations are shown in Figures 4.4.

Table 4.5: Killeagh – Flood Forecasting Infrastructure

Equipment	Quantity
Rain Gauges	2
River Level Gauge (Hydrometric Gauging Station)	3

Figure 4.4: Killeagh – Proposed Gauges



The infrastructure listed and shown above would also be required for a UoM / Sub-Catchment scale forecasting system which would build on the Lower Lee Flood Warning System.

Cost estimates for the proposed flood forecasting and warning systems are included in Section 9.0.

4.2.5 Public Awareness

Many of the measures to mitigate and manage flood risk and the potential consequences for flooding will involve the public at large. It is therefore important that the public is made aware of where to find information, what the information means and what actions the public and business owners can take to reduce the damage that would occur to their properties, possessions and interests in the event of a flood.

Public awareness measures will engender the public's recognition of the potential of the risk of flooding and the potential consequences thereof. Knowing in advance means that actions can be taken in a timely manner.

Measures to increase and promote public awareness include:

- Identifying the areas prone to flooding
- Information on measures to be implemented to reduce and / or manage the risk of flooding
- Measures in place to provide advance warning of flooding
- Establishment of methods to interface with the public and in particular the owners of vulnerable properties, i.e. workshops and meetings, Facebook, Twitter, text messaging, newsprint, websites, etc.

Flood risk maps and flood hazard maps have been produced for the UoM 19 AFAs. The dissemination of this information to the public will increase awareness.

4.2.6 Individual Property Flood Resilience

It is possible to reduce the damage caused by flooding to a property by carrying out works that make the property more flood resilient. Such works could include replacing porous floor and wall coverings with tiles or other non-porous finishes or raising electrical sockets to a level above the design flood level. Table 4.6 below shows the number of properties at risk from the 1% (or 0.5% for coastal flooding) AEP flood event in each AFA, the potential benefit achievable in each AFA and the total budget available for flood resilience works in each property. This budget is the benefit for the design event divided by the number of properties at risk. When account is taken of Optimism Bias (40%), preliminaries (32%) and design fees (13%) the total construction cost includes 85% of the available budget relates to non-construction costs. This means that only 15% of the total budget is available for the construction of flood resilience measures. This basic flood resilience budget indicates if individual property flood resilience is a viable option in each AFA. It is assumed that a basic budget of €7,500 is required for each property in order for it to be viable.

Table 4.6: Individual Property Flood Resilience

AFA	Residential Properties at Risk	Non-residential Properties at Risk	Capped Benefit €	Total IPFR budget €	Basic IPFP budget €	Viable Y/N
Ballingeary	21	25	14,882,358.26	323,529.53	48,529.43	Y
Inchigeelagh	14	14	4,681,767.44	167,205.98	25,080.90	Y
Castlemartyr	13	7	2,394,238.74	119,711.94	17,956.80	Y
Killeagh	0	0	0.00	0.00	0.00	N

This analysis indicates that Individual Property Flood Resilience is a viable option for Ballingeary, Inchigeelagh and Castlemartyr. This flood risk management measure should be explored further if no structural flood risk management measures are found to be viable for these AFAs.

4.2.7 Land Use Management

Land Use Management can be utilised as a non-structural measure to prevent or reduce the impact of flooding on properties, roads and other critical infrastructure. Land Use Management includes strategies to control overland flow, such as improving agricultural and forestry practices in key catchment areas. Local natural flood management measures such as the creation of wetlands or forestry to retain overland flow could also be adopted.

4.2.8 Emergency Response Planning

Well prepared and executed emergency response plans can significantly reduce the impact of flood events, particularly for human health and welfare.

The Framework for Major Emergency Management was developed in 2005 and was adopted by Government decision in 2006. Its purpose is to set out common arrangements and structures for front line public sector emergency management in Ireland. The Framework is based on the internationally recognized systems approach that, in essence, proposes an iterative cycle of continuous activity through five stages of emergency management:

- Hazard Identification
- Mitigation
- Preparedness
- Response
- Recovery

Under the Framework, Local Authorities are designated as the lead agency for co-ordinating the response to severe weather events, and each Local Authority should have, as a specific sub-plan of its Major Emergency Plan, a plan for responding to severe weather emergencies, whether a major emergency is declared or not. The other principal response agencies should include sub-plans for responding to notifications from the Local Authorities of severe weather warnings.

A Guide to Flood Emergencies (MEM Guidance Document 11, July 2013) has been published to assist the Principal Response Agencies in meeting their responsibilities, under the Framework for Major Emergency Management, and to deliver on the responsibilities of the OPW and the Local Authorities with respect to emergency planning as set out in the Report of the Flood Policy Review Group. The Guide provides advice on the development and implementation of consistently effective flood emergency response and short-term recovery planning by the Principal Response Agencies and others, and includes a template plan.

4.3 Structural Measures

4.3.1 General

As highlighted above, a flood risk management option consists of one or, more commonly, a combination of flood risk management methods / measures. Therefore, please note that some of the following structural measures may be required in combination to provide a potential flood risk management option that will mitigate both fluvial and tidal flood risk.

The possible flood risk management measures for each of the AFAs being considered are detailed in Table 4.7 below.

Table 4.7: Possible Structural Measures

AFA	Ballingeary	Inchigeelagh	Castlemartyr	Killeagh
Fluvial Storage	Y	N	Y	N
Flow Diversion	Y	N	Y	Y
Increase Conveyance	N	Y	Y	Y
Flood Defences	Y	Y	Y	Y
Improve Existing Defences	N	N	N	N
Relocate Properties	N	N	N	N
Localised Protection Works	Y	Y	Y	Y
Channel or Flood Defence Maintenance Works	N	N	N	N
Other works	N	N	N	N

Details of the possible flood risk management measures and how they can be combined into potential options are included in Section 5.

5 Development of Potential Flood Risk Management Options for AFAs

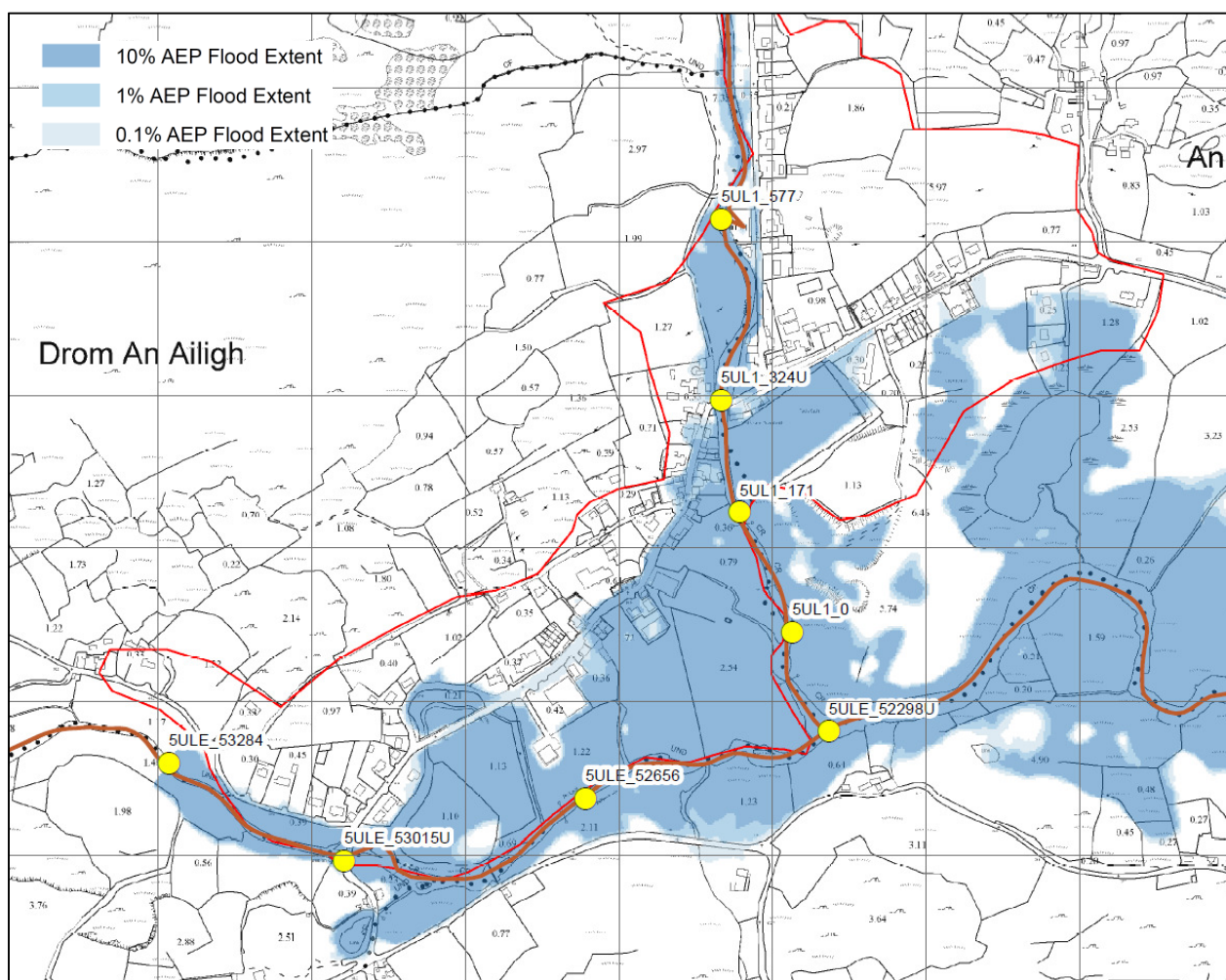
5.1 General

A Flood Risk Management (FRM) option consists of one, or more commonly a combination of FRM measures. This section outlines the development of the potential Flood Risk Management (FRM) options for each of the AFA's within UoM 19.

5.2 Ballingearry, Co. Cork

Ballingearry is located along the upper reach of the River Lee in County Cork. Ballingearry is at risk of fluvial flooding. The AFA and the existing fluvial flood risk are highlighted in Figure 5.1.

Figure 5.1: Ballingearry – Current Scenario Fluvial Flood Extents



5.2.1 Possible FRM Measures

As outlined in Section 3.0, the screening process identified the following potentially viable flood risk mitigation measures:

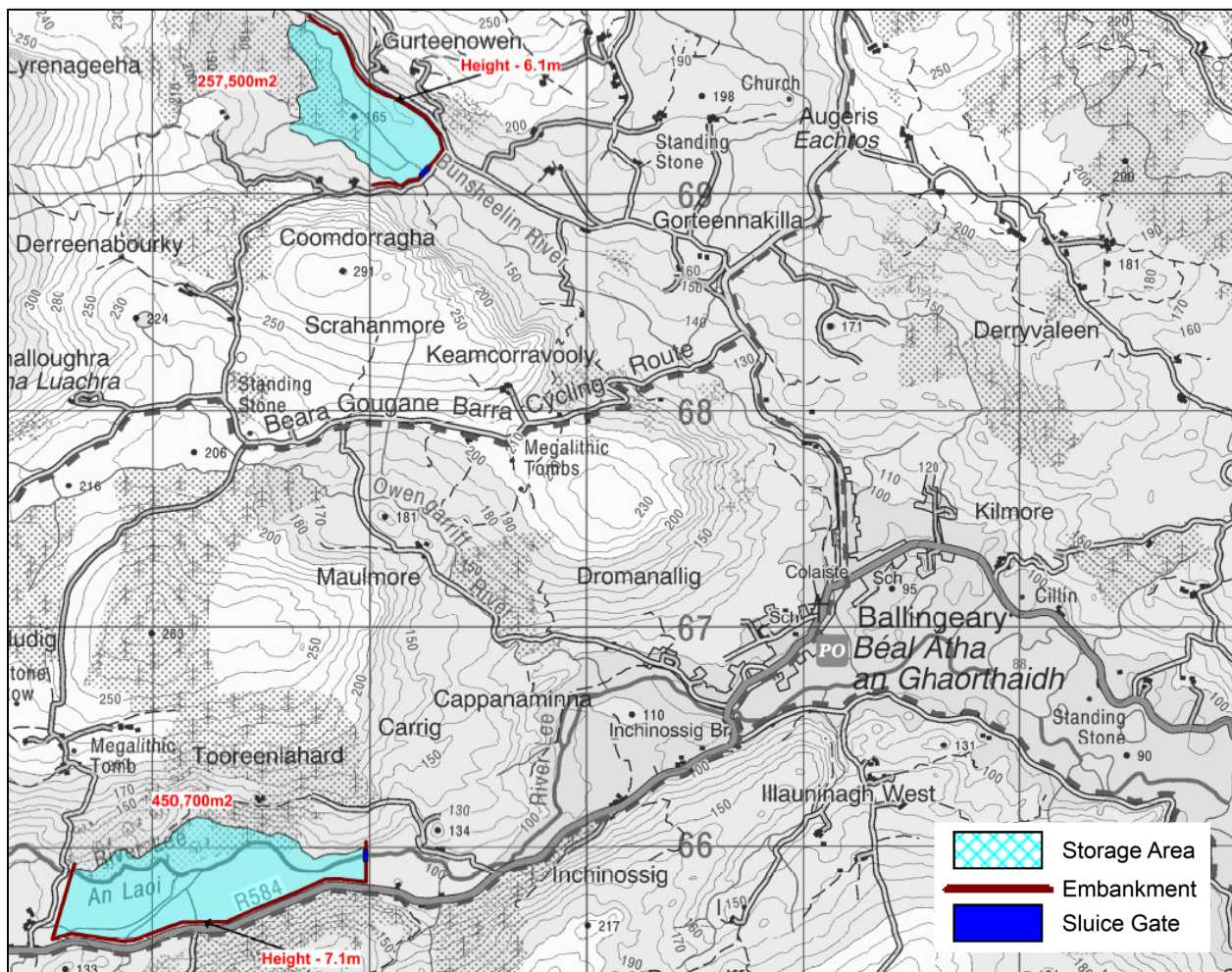
- Storage
- Flow Diversion
- Flood Defences

The possible measures were reviewed and assessed further to determine if they were applicable and viable. The measures were modelled individually to determine their effectiveness and impact.

5.2.1.1 Storage

Ballingeary is located at the confluence of the River Lee and its tributary, the Bunsheelin. Flooding occurs in Ballingeary for the 50% AEP fluvial event. Potential locations for the storage of fluvial flows were identified on both watercourses and an assessment of the available storage capacity was carried out. The locations of the potential storage areas are shown in Figure 5.2.

Figure 5.2: Ballingeary – Storage Measure



The required capacities of the storage areas are derived using the catchment hydrology as applied in the hydraulic modelling. No allowances for uncertainties in the estimate of the index flood flow or flood growth curve have been made.

Flooding occurs on the River Lee for the 50% AEP event (Q_{med}). The peak flow in the River Lee for the 1% AEP event is $83.5\text{m}^3/\text{s}$ which results in significant flooding. The storage area on the River Lee is $450,700\text{m}^2$ and has a capacity of $2,953,595\text{m}^3$ which can limit the outflow to less than Q_{med} .

Flooding occurs on the Bunsheelin for the 50% AEP event (Q_{med}). The peak flow in the Bunsheelin for the 1% AEP event is $51\text{m}^3/\text{s}$ which results in significant flooding. The storage area on the Bunsheelin is $257,500\text{m}^2$ and has a capacity of $1,439,021\text{m}^3$ which can limit the outflow to less than Q_{med} .

The proposed storage areas were modelled individually and in combination to determine the full extent of any benefit or impact.

The hydraulic modelling of storage on the River Lee alone shows a significant reduction in flood extent with an average reduction in water levels of approx. 0.4m . However, as shown in Figure 5.3, it does not achieve the required standard of protection with a number of properties along the Lee and Bunsheelin still flooding. Storage on the River Lee is not a viable measure individually.

The hydraulic modelling of storage on the Bunsheelin alone shows a significant reduction in flood extent with an average reduction in water levels of approx. 0.48m . As shown in Figure 5.4, this measure fully mitigates flooding along the Bunsheelin and reduces flooding through the town. However, there are a number of properties in the town still flooding. Storage on the Bunsheelin is not a viable measure individually.

The hydraulic modelling of storage on both the River Lee and the Bunsheelin together results in a significant reduction in flood extent with an average reduction in water levels of approx. 0.95m . As shown in Figure 5.5, this measure fully mitigates flooding along the River Lee and the Bunsheelin, achieving the required standard of protection. Storage on the River Lee and Bunsheelin is deemed to be a viable measure / option.

Figure 5.3: Ballingeary – River Lee Storage Measure Flood Extent

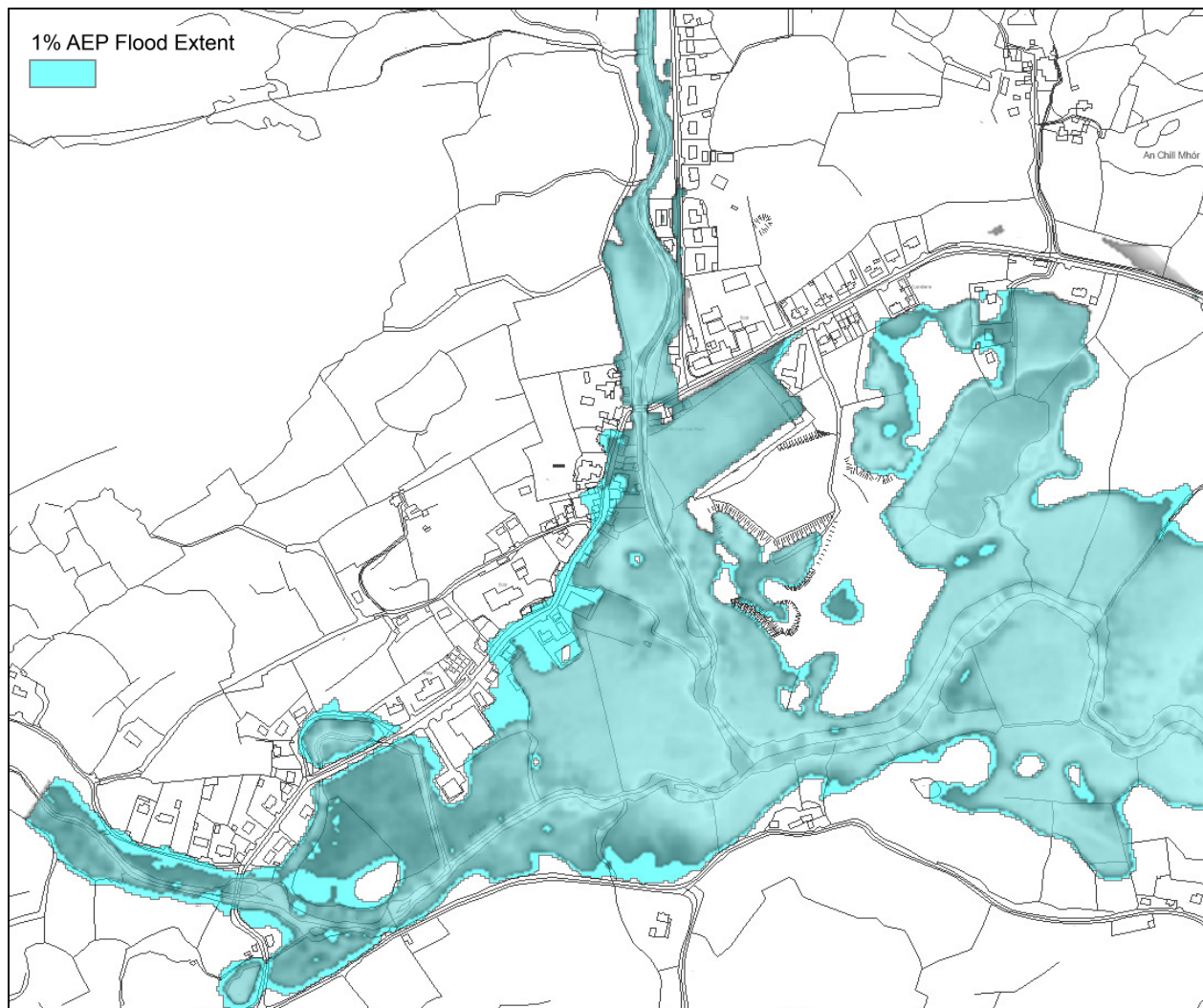


Figure 5.4: Ballingeary – Bunsheelin Storage Measure Flood Extent

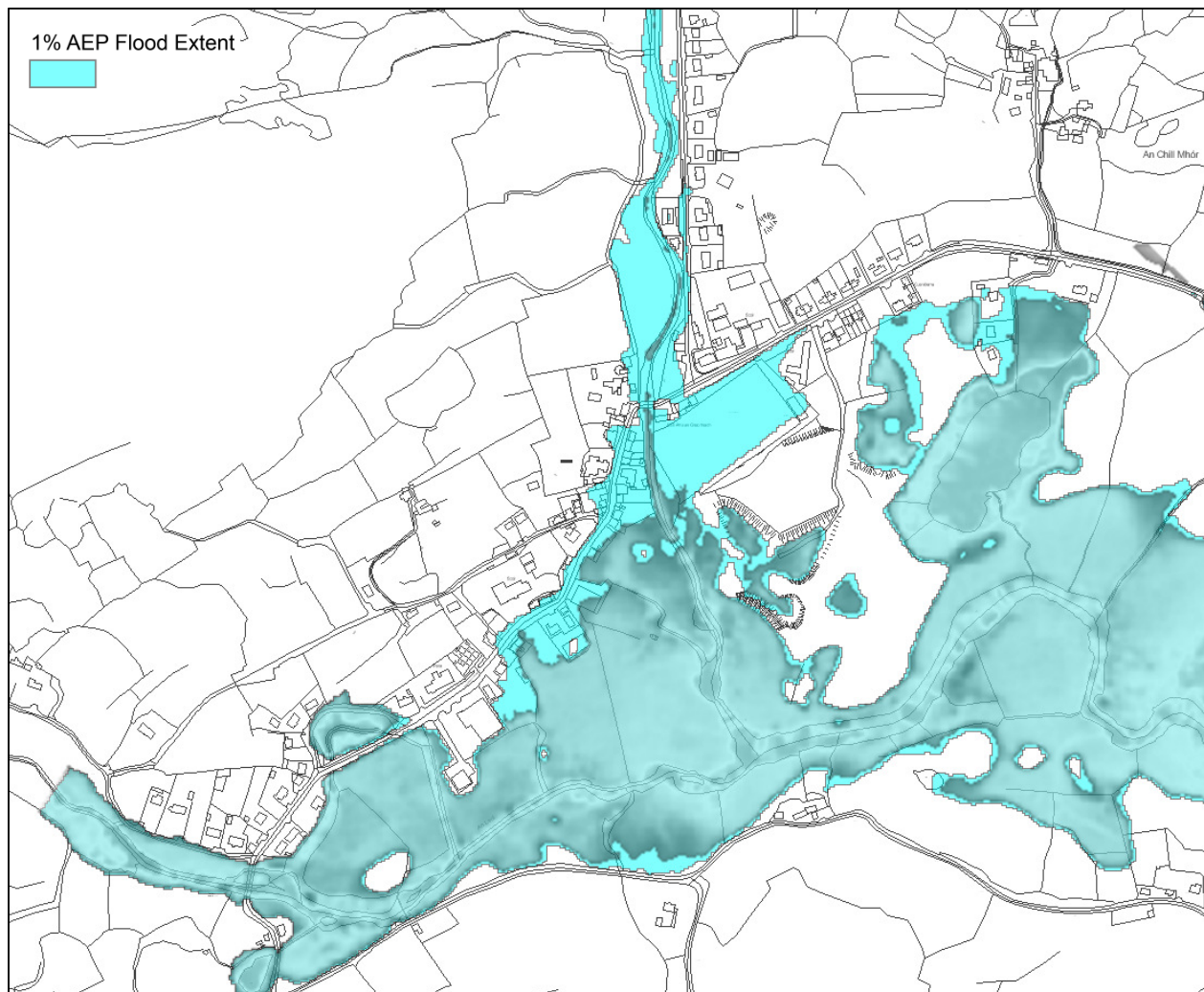
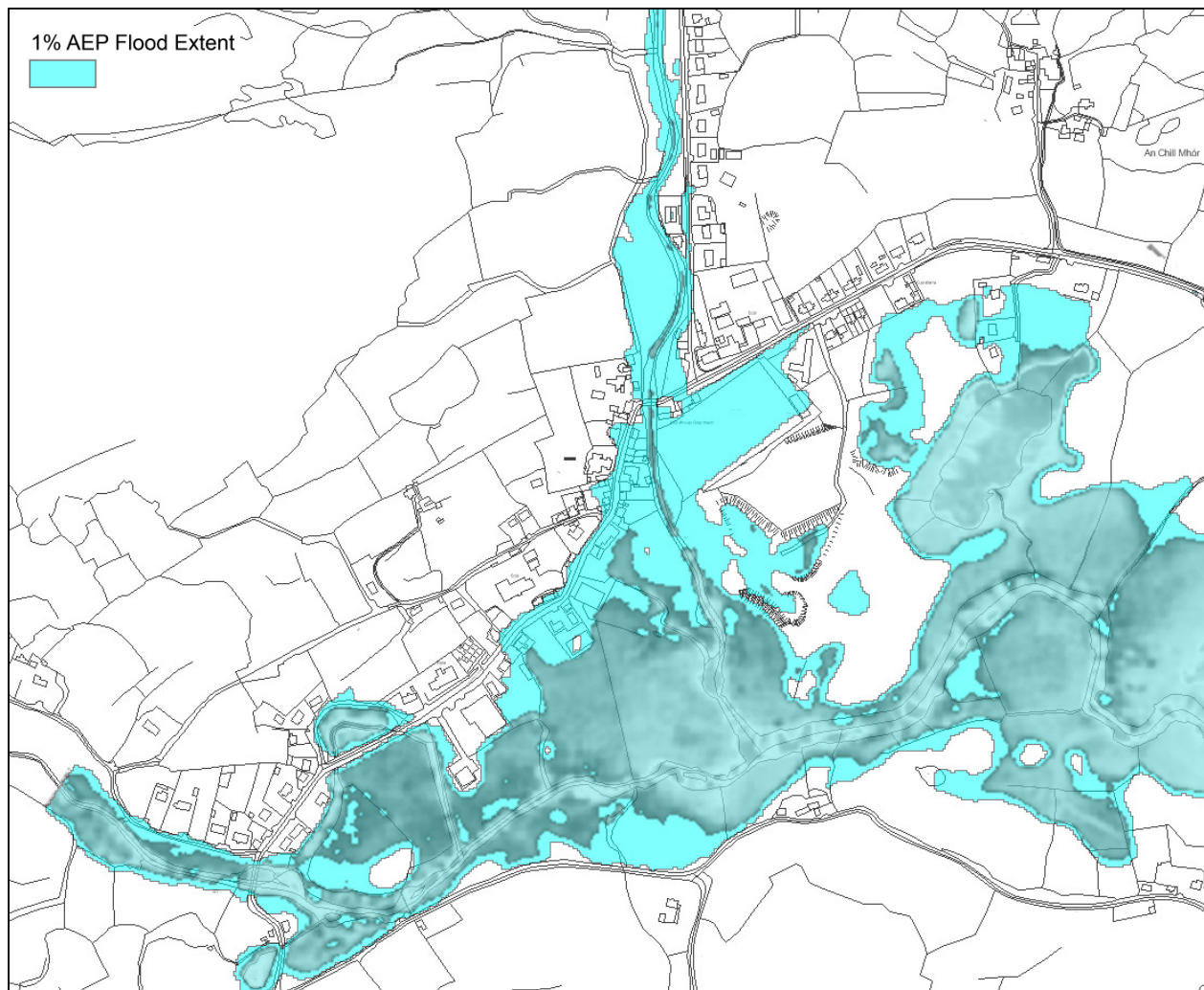


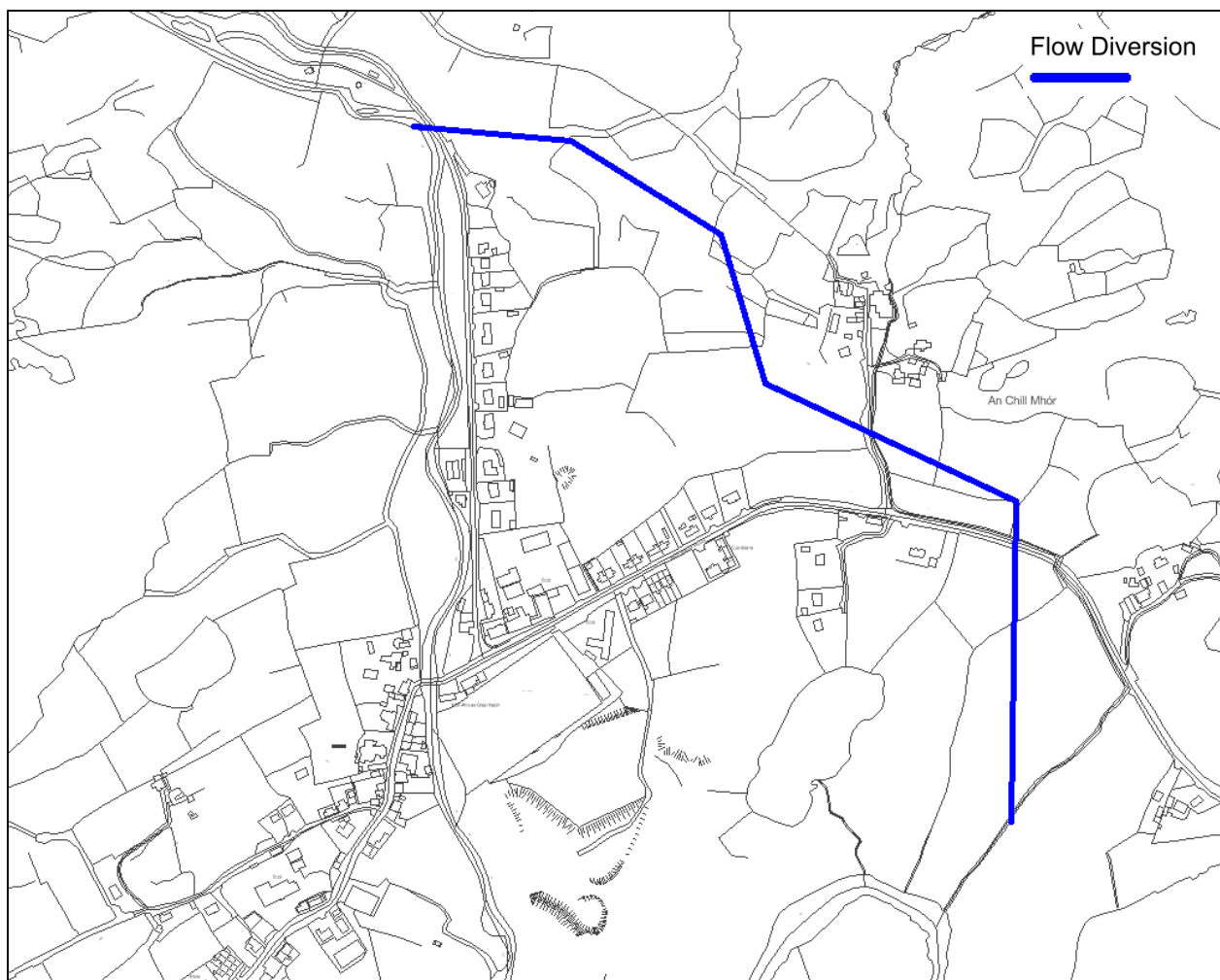
Figure 5.5: Ballingeary – River Lee & Bunsheelin Storage Measure Flood Extent



5.2.1.2 Flow Diversion

This measure aims to mitigate the flooding in Ballingeary by diverting flow from the Bunsheelin around the town and discharging to the River Lee downstream. The proposed route is shown in Figure 5.6.

Figure 5.6: Ballingeary – Flow Diversion Measure



The peak flow in the Bunsheelin for the 1% AEP event is 51m³/s. Flooding occurs on the Bunsheelin and through the town for the 50% AEP event where the peak flow is 24m³/s. This measure aims to limit flow through the town to less than the 50% AEP event by diverting all excess flows through the flow diversion culvert. The proposed culvert is 2.4m wide by 2.1m high and approx. 1.2km long.

The hydraulic modelling of the proposed flow diversion indicates that the measure reduces the flood extent and depth of flooding along the Bunsheelin. However, some properties along the Bunsheelin still flood and this measure does not mitigate flood risk from the River Lee. This measure does not achieve the required standard of protection and is not deemed to be a viable measure as flood defences would still be required along the Bunsheelin and the Lee.

This measure considers the mitigation of flood risk through the construction of flood defences. These defences include walls and embankments. The locations and heights of the defences are shown in Figure 5.7.

This map illustrates the flood defence infrastructure along the River Liffey. The river is shown as a winding waterway. Flood defence walls are highlighted in red, and flood defence embankments are highlighted in green. A blue diamond symbol marks the location of the Storm Water Pump Station. Numerous height annotations are provided for specific sections of the walls and embankments, indicating the elevation of the defence structure. The map also shows surrounding residential areas with buildings and streets, as well as some open fields and a large body of water (likely a lake or reservoir) to the right.

Legend:

- Storm Water Pump Station (Blue Diamond)
- Flood Defence Walls (Red Line)
- Flood Defence Embankments (Green Line)

Height Annotations:

- Height - 1.1m
- Height - 1.1m
- Height - 1.1m
- Height - 1.1m
- Height - 1.4m
- Height - 1.35m
- Height - 1.6m
- Height - 1.5m
- Height - 1.8m
- Height - 1.8m
- Height - 1.5m
- Height - 0.9m
- Height - 1.1m
- Height - 1.35m
- Height - 1.6m
- Height - 1.8m
- Height - 2.5m

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5.2.2 Potential FRM Measures

Based on the review and hydraulic modelling the following are deemed to be potential FRM measures:

- Storage
- Flood Defences

5.2.3 Potential FRM Options

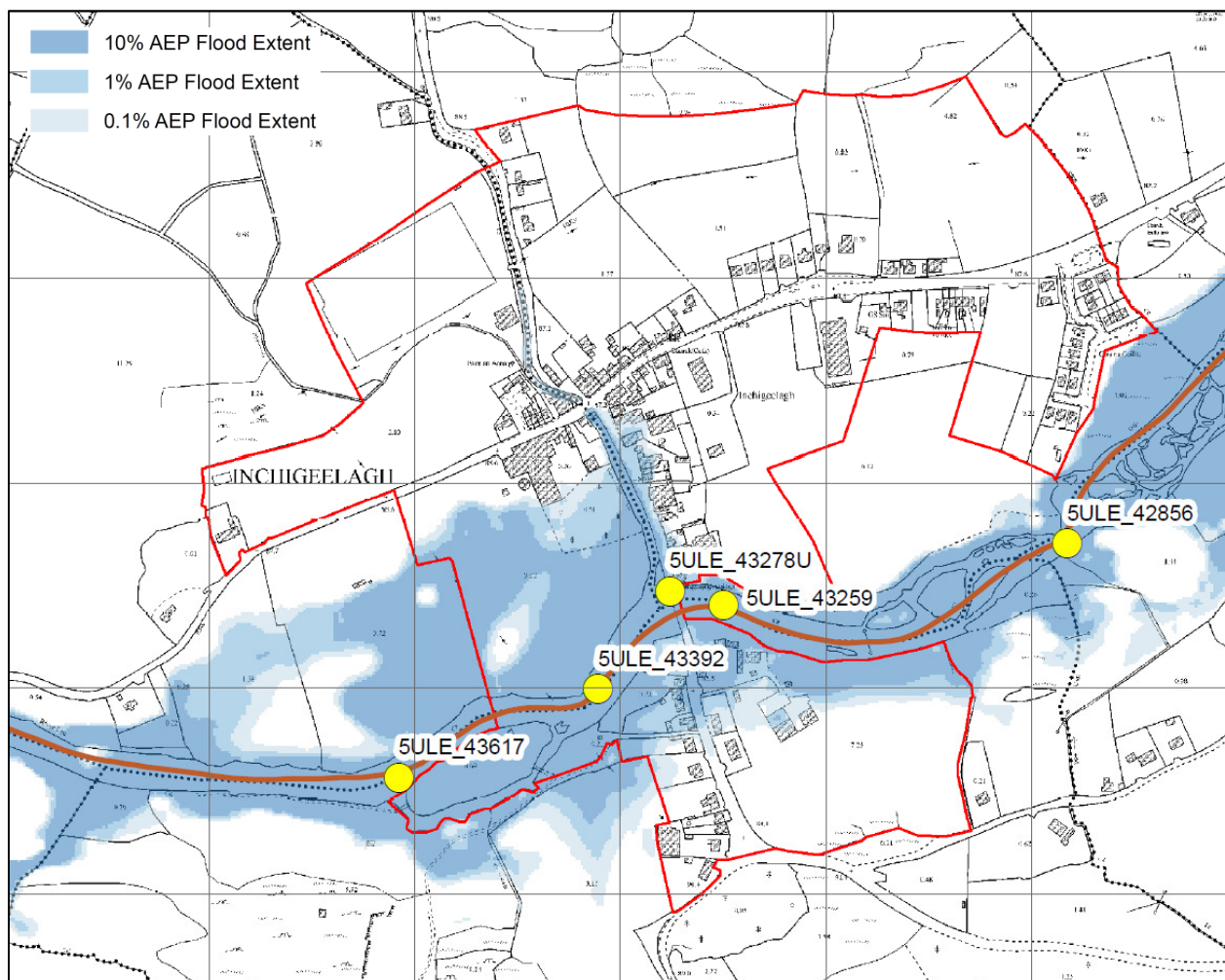
Based on the assessment of the potential (viable) FRM measures and detailed hydraulic modelling of the combined measures, the following are potential FRM options. Full outline drawings are included in Appendix B for each of the potential options.

- Option 1 – Flood Defences
- Option 2 – Storage

5.3 Inchigeelagh

Inchigeelagh is located along the River Lee in County Cork, approx. 8km downstream of Ballingeary. Inchigeelagh is at risk of fluvial flooding. The AFA and the existing fluvial flood risk are highlighted in Figure 5.8.

Figure 5.8: Inchigeelagh – Current Scenario Fluvial Flood Extents



5.3.1 Possible FRM Measures

As outlined in Section 3.0, the screening process identified the following possible flood risk mitigation measures:

- Increased Conveyance
- Flood Defences

The possible measures were reviewed and assessed further to determine if they were applicable and viable. The measures were modelled individually to determine their effectiveness and impact.

5.3.1.1 Increased Conveyance – Removal of Rock

Based on feedback received during the Public Information Day in Inchigeelagh, Inchigeelagh Bridge was identified as a critical structure which restricts the channel capacity. This measure aims to mitigate the flood risk by improving the conveyance of the bridge.

The existing bridge is an old arch bridge with seven arches and six piers restricting flow in the channel. There is an accumulation of stones and a high bedrock level at some of the arches. This measure aims to improve the conveyance of the bridge by removing the stones and other debris along with lowering the bed level under the bridge.

The hydraulic model indicated that there was an extremely minor reduction in water level of 0.02m upstream of the bridge during the 1% AEP event. There was no reduction in flood extent. This measure is not deemed to be a viable measure.

5.3.1.2 Increased Conveyance – Removal of Rock & Replacement of Bridge

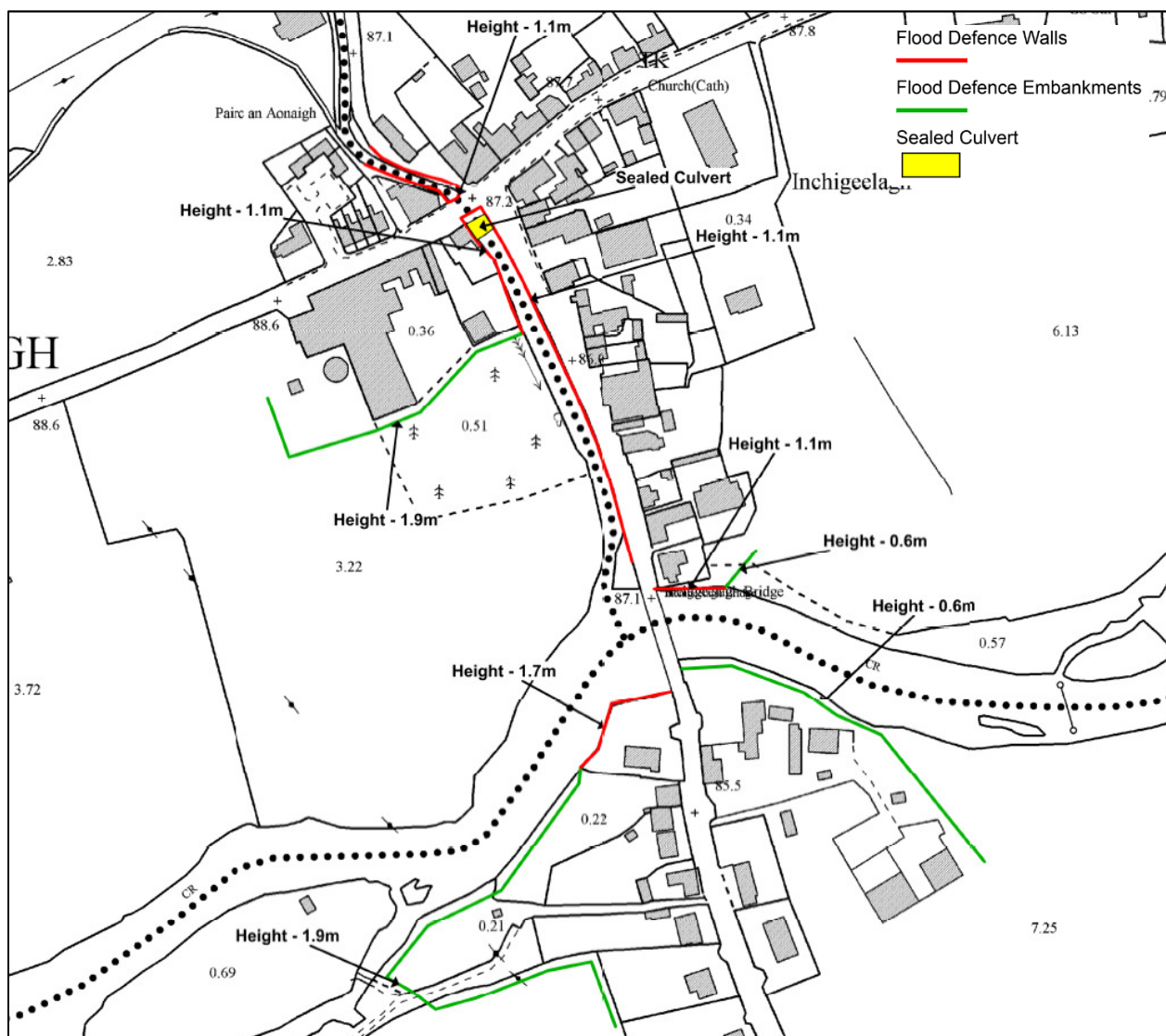
This measure aims to achieve the maximum improvement in conveyance by removing the debris, lowering the bedrock and replacing the arch bridge with a single span bridge with the soffit level set as high as possible. The removal of the bridge was not considered as it is significant regional route.

The hydraulic model indicated that there was an extremely minor reduction in water level of 0.09m upstream of the bridge during the 1% AEP event, with an increase of 0.05m downstream. There was no reduction in flood extent. This measure is not deemed to be a viable measure.

5.3.1.3 Flood Defences

This measure considers the mitigation of flood risk through the construction of flood defences. These defences include walls and embankments. The locations and heights of the defences are shown in Figure 5.9. It should be noted that where flood walls are proposed, these will replace any existing walls.

Figure 5.9: Inchigeelagh – Flood Defence Measure



The hydraulic modelling of the proposed flood defences as outlined in the above figure indicates that the measure fully achieves the required standard of protection for the 1% AEP fluvial event. The maximum increase in water level of 0.05m occurs immediately upstream of the bridge with water levels reducing by 0.03m immediately downstream. This is deemed to be a viable measure / option.

5.3.2 Potential FRM Measures

Based on the review and hydraulic modelling the following are deemed to be potential FRM measures:

- Flood Defences

5.3.3 Potential FRM Options

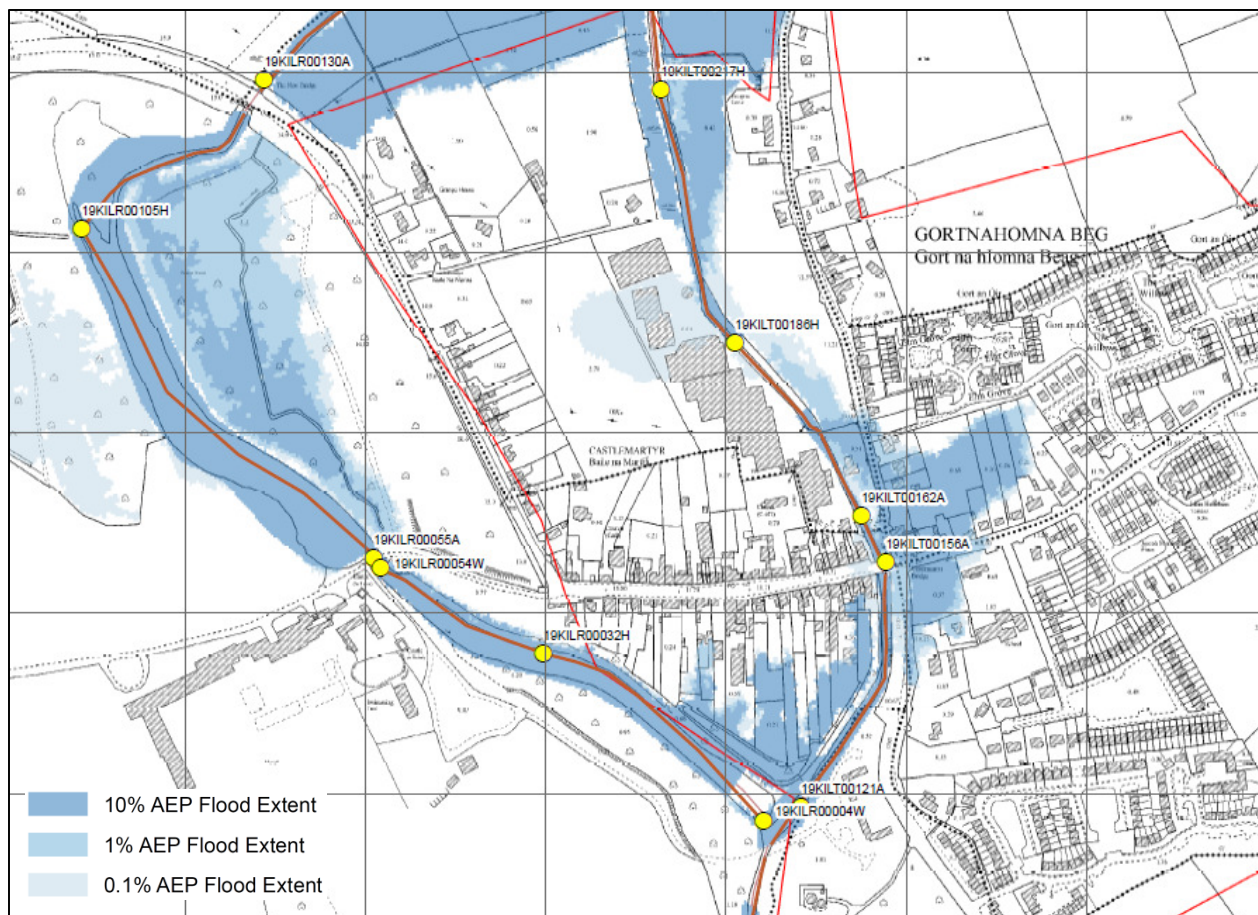
Based on the assessment of the potential (viable) FRM measures and detailed hydraulic modelling of the combined measures, the following are potential FRM options. Full outline drawings are included in Appendix B for each of the potential options.

- Option 1 – Flood Defences

5.4 Castlemartyr

Castlemartyr is located along the Kiltha River in County Cork. Castlemartyr is at risk of fluvial flooding. The AFA and the existing fluvial flood risk are highlighted in Figure 5.10.

Figure 5.10: Castlemartyr – Current Scenario Fluvial Flood Extents



5.4.1 Possible FRM Measures

As outlined in Section 3.0, the screening process identified the following possible flood risk mitigation measures:

- Increase Conveyance
- Flood Defences (Fluvial)
- Flow Diversion

The possible measures were reviewed and assessed further to determine if they were applicable and viable. The measures were modelled individually to determine their effectiveness and impact.

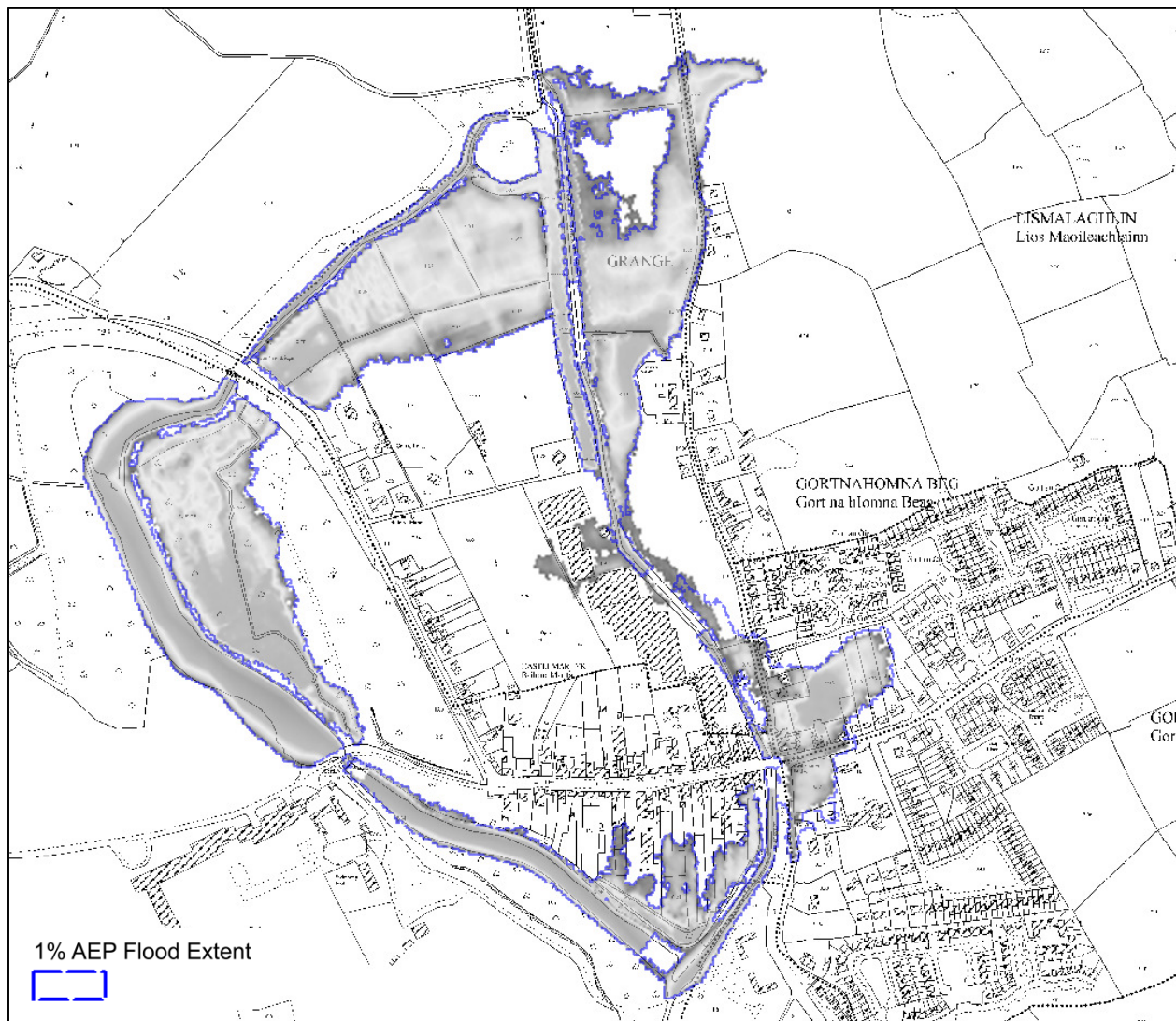
5.4.1.1 Increased Conveyance – Replace Bridges

As part of the hydraulic modelling for the flood risk mapping, Castlemartyr Bridge was identified as a critical structure which restricts the channel capacity. This measure aims to mitigate the flood risk by improving the conveyance of the bridge.

The existing bridge is an old arch bridge with piers restricting flow in the channel. This measure aims to achieve the maximum improvement in conveyance by replacing the arch bridges with a single span bridge with the soffit level set as high as possible.

The arch bridge in the hydraulic model was replaced with a single span bridge. The model indicated that there was an extremely minor reduction in the 1% AEP flood extent on the Kiltha with a maximum reduction in flood depth of 0.12m which occurred immediately upstream of the bridge. This measure is not deemed to be a viable measure individually or in combination as the reduction in flood extent / level / risk is minimal.

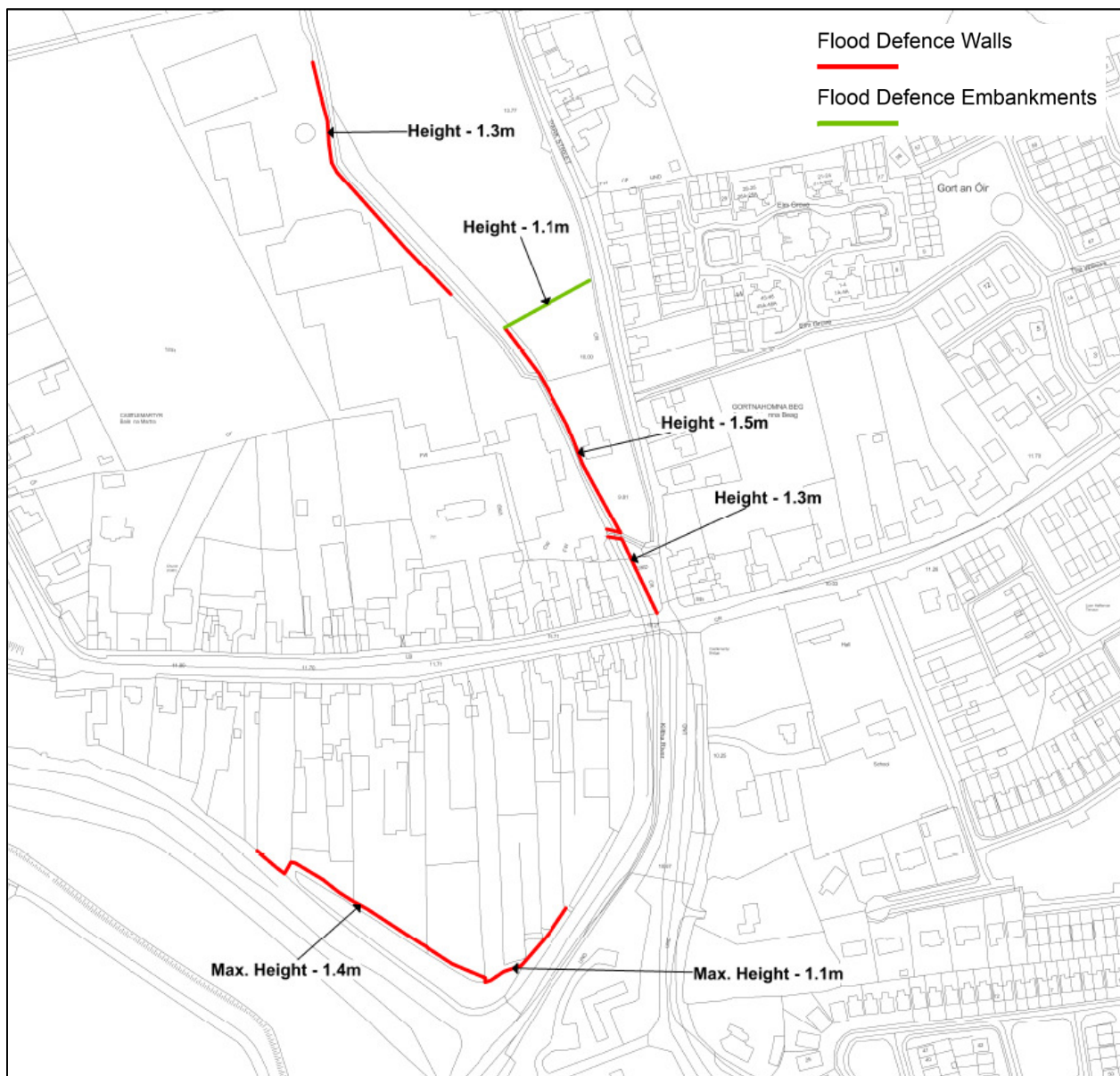
Figure 5.11: Castlemartyr – Conveyance Measure Flood Extent



5.4.1.2 Flood Defences

This measure considers the mitigation of flood risk through the construction of flood defences. These defences include walls and embankments. The locations and heights of the defences are shown in Figure 5.12.

Figure 5.12: Castlemartyr – Flood Defence Measure

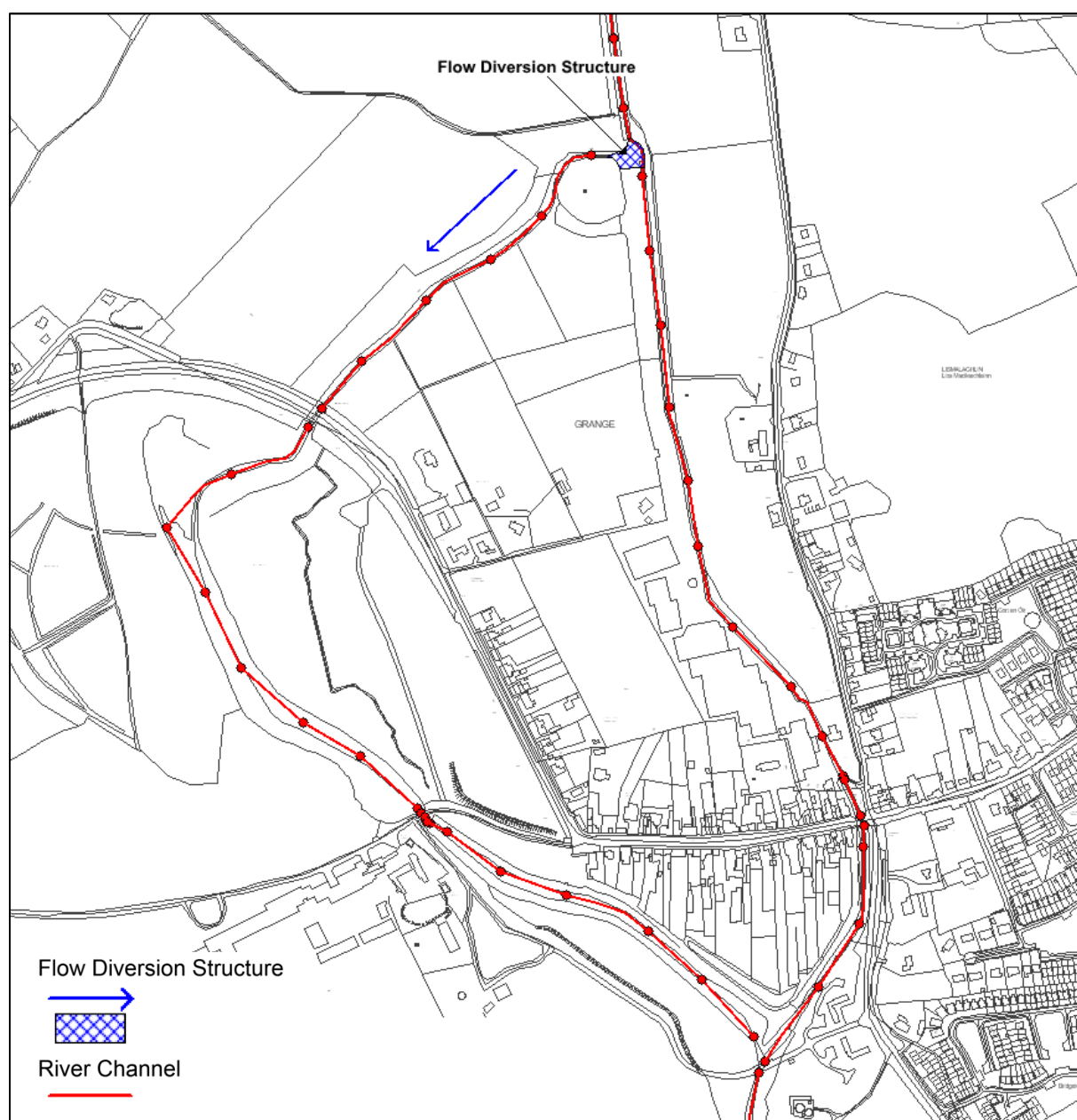


The hydraulic modelling of the proposed flood defences as outlined in the above figures indicates that the measure fully achieves the required standard of protection for the 1% AEP fluvial event. The average increase in water level is 0.01m with the maximum increase in water level of 0.34m occurring at the footbridge just upstream of Castlemartyr Bridge on the N25. This is deemed to be a viable measure / option.

5.4.1.3 Flow Diversion

This measure aims to mitigate the flood risk by diverting flow from the Kiltha River around the town through the existing bypass channel. The existing bypass channel is a historic feature which was created to bring flows into the grounds of the castle (now hotel).

Figure 5.13: Castlemartyr – Flow Diversion Measure



The flooding in Castlemartyr occurs due to the insufficient capacity of the channel and Castlemartyr Bridge. This measure aims to limit flow through the town to the 50% AEP (7m³/s approx.) by diverting all excess flows through the bypass channel.

The hydraulic modelling of the proposed flow diversion indicates that the measure is viable as it mitigates the flooding through the town for the 1% AEP fluvial event. However, there is still some flooding to properties at the downstream end of the town at the confluence of the bypass channel and the Kiltha River. This is deemed to be a viable measure.

5.4.2 Potential FRM Measures

Based on the review and hydraulic modelling the following are deemed to be potential FRM measures:

- Flood Defences
- Flow Diversion

5.4.3 Potential FRM Options

Based on the assessment of the potential (viable) FRM measures and detailed hydraulic modelling of the combined measures, the following are potential FRM options. Full outline drawings are included in Appendix B for each of the potential options.

- Option 1 – Flood Defences
- Option 2 – Flow Diversion & Flood Defences

6 Environmental Assessment

6.1 General

Refer to Appendix C for Draft SEA Options Appraisal Report and Appendix D for Draft Habitats Directive Screening (for Appropriate) Assessment.

7 Stakeholder Input

7.1 Draft Flood Mapping Public Consultation Days

Public Consultation Days (PCDs) were held in Unit of Management (UoM) 19 in January 2015. The purpose of the PCDs were to present the public with the Draft Flood Maps that have been prepared as part of the South Western CFRAM Study, to seek their feedback on those maps and on the Flood Risk management Objectives that apply to this area.

Details of the Public Consultation days held in the UoM 19 AFAs are shown in Table 7.1 below.

Table 7.1: Draft Flood Mapping PCDs

AFA	Date	Venue	Nr of Attendees
Ballingeary	27 th of January 2015	Ballingeary GAA Club	25
Inchigeelagh	27 th of January 2015	Iveleary GAA Club	23
Castlemartyr	23 rd of January 2015	St. Joseph's National School	14
Killeagh	23 rd of January 2015	Killeagh Community Hall	13

7.2 Flood Risk Management Measures

At the Draft Flood Mapping PCDs, attendees were asked to indicate what they thought should be done to manage flood risk in their AFAs. The responses are shown in Table 7.2 below.

Table 7.2: Flood Risk Management – Public Opinion

AFA	What needs to be done to manage flood risk?
Ballingeary	<p>Clean the River Lee. Cut the trees stopping the water flowing.</p> <p>Additional Information In 1998, a group of farmers got together and hired a track machine. They clean the river 2km downstream in an area called The Ford. Trees were also cut. Work back then cost £200. The result was the village in Ballingeary did not flood for next 9 years.</p> <p>The farmers who own the land at The Ford are totally agreeable to cleaning the river again. This work has also got the all-clear from the Inland Fisheries Board and the Parks and Wildlife.</p> <p>High ground flood water arrives very quickly to Ballingeary now and it needs to flow to Lough Allua faster to remove threat of flooding</p> <p>Each flood seems to be different. - which river brings the most water - both rivers bog ? - wind direction</p> <p>Have heights of floods tracked with timer in different locations from Inchigeelagh up each river? I think it would show where the bottleneck is over a number of floods</p> <p>Deepen river channel</p> <p>Cut trees on the river bank</p> <p>Since they cleared Bunsheelin and Lee 3-4 years ago, things improved a lot.</p> <ol style="list-style-type: none"> 1. No more buildings to be erected 2. More widening of rivers 3. Maybe put up a wall on the riverside <p>Education of landowners and residents, especially farmers, concerning dangers of altering waterways, i.e., straightening bends and unscientific dredging in rivers</p>
Inchigeelagh	<p>Put flood barriers in the island</p> <p>Yearly trees on river bank maintenance</p> <p>The overhanging trees and debris in the bed of the River Lee should be cleared, especially as it flows into the village by Inchigeelagh.</p> <p>Remove all blockages from river, small islands and trees</p> <p>Remove all obstacles along river, e.g., rocks, small islands, trees, etc.</p> <p>Rural maintenance</p> <p>Regulate Inniscarra Dam more carefully</p> <p>Continue annual river clearance works, including dredging; tree-cutting; treatment of cut tree "stumps" and continuous maintenance; village walls to be repaired also, i.e., an extension (2014) of satisfactory project needed.</p>
Killeagh	<p>Regular cleaning of the Womenagh River</p>

7.3 Preliminary Options PCDs

On the 4th November 2019 and the 29th February 2016 stakeholder workshops were held with Local Authority Engineers to discuss the emerging preferred options. Feedback received at this workshop was used to revise the proposed options in advance of the Public Consultation Days.

Between November 2015 and February 2016 PCDs were held to display various Flood Risk Management Options in each of the UoM 19 AFAs under consideration. Details of the PCDs are shown in Table 7.3 below.

Table 7.3: Details of Public Consultation Days

AFA	Date	Venue	Nr of Attendees
Ballingeary	17 th February 2016	Ballingeary GAA Club	31
Inchigeelagh	18 th February 2016	Iveleary GAA Club	21
Castlemartyr	26 th November 2015	St. Joseph's National School	4

At the Preliminary Options PCDs Attendees were asked to indicate their preference for the Flood Risk Management Options under consideration in each of the UoM 19 AFAs. Their responses are summarised in Table 7.4 below.

Table 7.4: Public Preference for Potential Options

AFA	Option	Nr of Rank 1 Received	Rank
Ballingeary	Flood Defences	3	1
	Storage	0	-
	Do Nothing	0	-
Inchigeelagh	Flood Defences	4	1
	Storage	0	2
	Do Nothing	0	3
Castlemartyr	Food Defences	1	2
	Flow Diversion & Flood Defences	2	1
	Do Nothing	0	3

8 Flood Risk Assessment

8.1 General

Flood risk mapping for the UoM 19 AFAs and Medium Priority Watercourses (MPWs) has been undertaken as part of this Study. The mapping includes the receptors that are at risk from flooding in the following categories:

- Society
- The Environment
- Cultural Heritage
- The Economy

The Flood Risk Maps for UoM 19 are included in an Annexe to the Preliminary Options Report: Annex I, Flood Risk Maps.

8.2 Receptors

Examples of the receptors in each of these categories are included in Table 8.1 below:

Table 8.1: Flood Risk Receptors

Category	Receptor
Society	People
	Homes
	Fire Stations
	Garda Stations
	Hospitals
	Care centres
The Environment	Protected Areas
	Pollution Sources
Cultural Heritage	Protected Archaeological Sites
	Protected Buildings
The Economy	Business Premises
	Roads
	Railway
	Ports
	Utilities

The numbers of receptors at risk from flooding in each AFA and each MPW are listed in tables 8.3 to 8.12 below. These tables indicate the receptors at risk from the current scenario, the Mid-Range Future Scenario (MRFS) and the High End Future Scenario (HEFS) and are split into the Annual Exceedance Probability of the flooding concerned.

Annual Exceedance Probability, henceforth referred to as AEP, is a term used throughout this report and the wider CFRAM studies to refer to the rarity of a flood event. The probability of a flood relates to the likelihood of an event of that size or larger occurring within any one year period. For example, a one in hundred year flood has a one chance in a hundred of occurring in any given year; 1:100 odds of occurring in any given year; or a 1% likelihood of occurring. This is described as a 1% annual exceedance probability (AEP) flood event.

Table 8.2 converts the 'return periods' to %AEP for key flood events as a reference to previous studies.

Table 8.2: Flood Probabilities

% Annual Exceedance Probability (%AEP)	Odds of a Flood Event in Any Given Year	Chance of a Flood Event in Any Given Year or Previous 'Return Period'
50%	1:2	1 in 2
20%	1:5	1 in 5
10%	1:10	1 in 10
5%	1:20	1 in 20
2%	1:50	1 in 50
1%	1:100	1 in 100
0.5%	1:200	1 in 200
0.1%	1:1000	1 in 1000

Table 8.3 below lists the number of Inhabitants at risk from fluvial flooding in each AFA.

Table 8.3: Risk to Society: Nr. of Inhabitants

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	17	36	45	50	53	59	62	78	31	50	53	53	62	62	76	78	53	73	81
Castlemartyr	0	14	28	31	36	36	39	48	14	31	36	36	36	42	45	50	36	45	53
Inchigeelagh	6	20	25	34	36	39	42	62	20	28	36	39	39	39	56	62	36	50	62
Killeagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	6

Table 8.4 below indicates the number of Residential Properties at risk from fluvial flooding in each AFA.

Table 8.4: Risk to Society: Nr. of residential properties

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	6	13	16	18	19	21	22	28	11	18	19	19	22	22	27	28	19	26	29
Castlemartyr	0	5	10	11	13	13	14	17	5	11	13	13	13	15	16	18	13	16	19
Inchigeelagh	2	7	9	12	13	14	15	22	7	10	13	14	14	14	20	22	13	18	22
Killeagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2

Table 8.5 below lists the number of high vulnerability properties at risk from fluvial flooding in each AFA. High vulnerability properties include Hospitals, Nursing Homes, Schools, Prisons, Camping / Halting sites.

Table 8.5: Risk to Society: Nr. of High Vulnerability Properties

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	0	0	0	0	1	1	1	2	0	0	0	1	1	1	2	2	1	2	2
Castlemartyr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inchigeelagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Killeagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8.6 below lists the number of Social Amenity Sites at risk from fluvial flooding in each AFA

Table 8.6: Risk to Society: Nr. of Social Amenity Sites

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	1	2	2	2	2	2	2	3	2	2	2	2	2	2	2	3	2	2	1
Castlemartyr	0	0	0	0	1	1	1	1	0	0	0	1	1	1	1	1	1	1	0
Inchigeelagh	0	0	0	0	0	1	1	1	0	0	0	1	1	1	1	1	0	1	0
Killeagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8.7 below lists the number of properties on the National Inventory of Architectural Heritage at risk from fluvial flooding in each AFA

Table 8.7: Risk to Cultural Heritage: Nr. of NIAH Buildings

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2
Castlemartyr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inchigeelagh	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1	1	2
Killeagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8.8 below lists the number of Archaeological Monuments at risk from fluvial flooding in each AFA.

Table 8.8: Risk to Cultural Heritage: Nr. of RMPs

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
Castlemartyr	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
Inchigeelagh	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Killeagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8.9 below lists the number of Non-Residential Properties at risk from fluvial flooding in each AFA

Table 8.9: Risk to the Economy: Nr. of Non-Residential Properties

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	9	18	22	22	24	25	26	30	16	22	22	24	26	26	27	30	24	27	30
Castlemartyr	0	4	5	5	7	9	12	16	4	5	6	7	11	13	15	18	7	15	19
Inchigeelagh	1	2	3	5	11	14	15	22	2	3	8	13	14	14	18	22	12	17	23
Killeagh	0	0	0	0	0	0	1	1	0	0	0	0	1	1	1	2	0	1	2

Table 8.10 below lists the number of Roads at risk from fluvial flooding in each AFA

Table 8.10: Risk to the Economy: Nr. of Roads

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	1	2	2	2	3	3	3	3	2	2	3	3	3	3	3	3	3	3	3
Castlemartyr	0	1	2	3	3	3	3	3	1	3	3	3	3	3	3	3	3	3	3
Inchigeelagh	1	1	1	1	2	2	2	2	1	1	2	2	2	2	2	2	1	2	2
Killeagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 8.11 below lists the number of Utilities at risk from fluvial flooding in each AFA

Table 8.11: Risk to the Economy: Nr. of Utilities

AFA	Current Scenario								Mid-Range Future Scenario								High End Future Scenario		
	50%	20%	10%	5%	2%	1%	0.5%	0.1%	50%	20%	10%	5%	2%	1%	0.5%	0.1%	10%	1%	0.1%
Ballingeary	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Castlemartyr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inchigeelagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Killeagh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

8.3 Flood Risk Maps

Flood Risk Maps have been prepared to represent the various receptors at risk from flooding in each of the AFAs and MPWs. These maps are described in the following sections below.

8.3.1 Inhabitants Maps

Maps have been prepared to represent the number of people at risk from flooding of various frequencies. The numbers of people per house was taken from the CSO data. For UoM 19 the average occupancy rate is 2.8 people per house. For each AEP flood extent the number of residential properties at risk was counted and multiplied by that occupancy. The number of people at risk are represented as a density per hectare on the maps.

8.3.2 Economic Activity Maps

The types of economic activity at risk from flooding in UoM 19 are shown on the economic activity risk map. The types of activities considered are:

- Property
- Infrastructure
- Rural Land Use
- Economic

8.3.3 Economic Risk Density Maps

Maps have been prepared to represent the economic risk from flooding of various frequencies. The economic risk is represented on the maps as a density of the Annual Average Damage value per hectare.

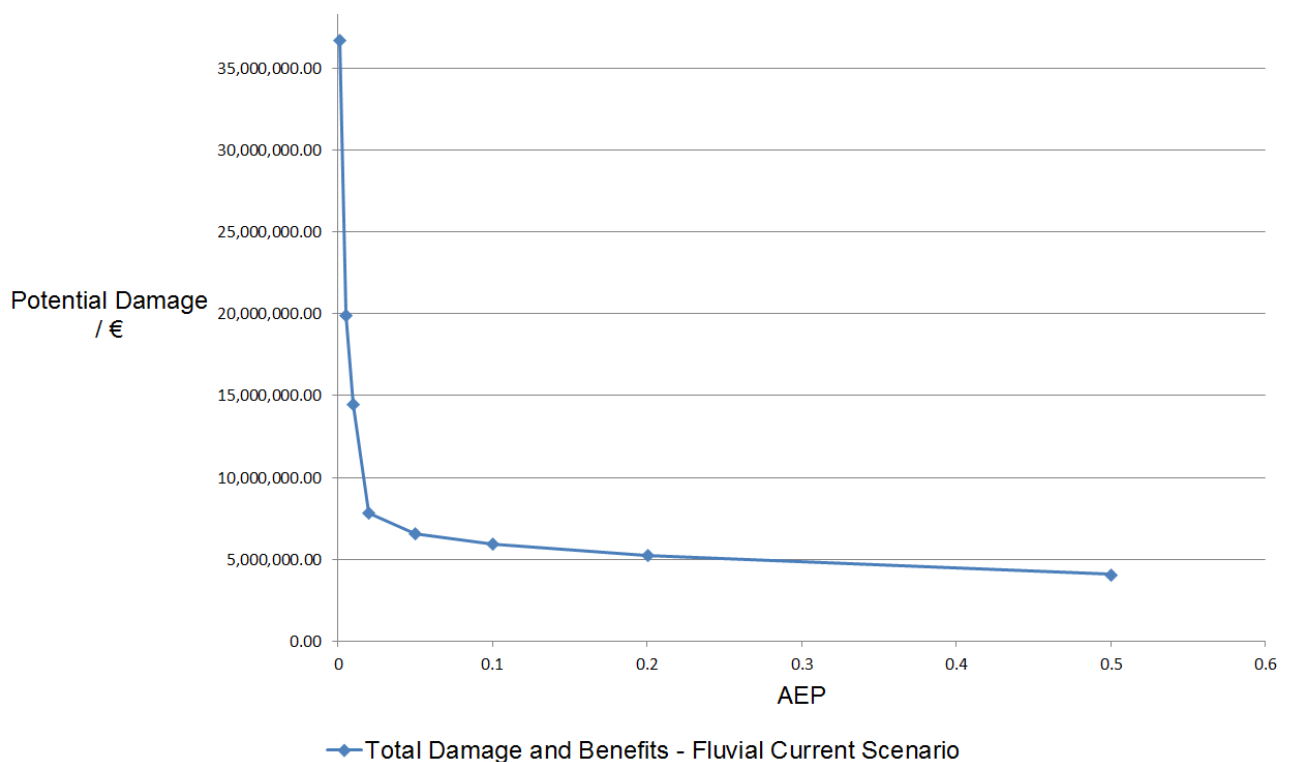
8.3.3.1 Annual Average Damage

The potential economic damage that could be caused by flooding was calculated for every property in each of the UoM 19 AFAs. The damage to a property is related to the type, use, area and the predicted depth of flooding within the property. It is possible to calculate the damage that could arise from a series of floods of different Annual Exceedance Probability (AEP). Using these damage values the Annual Average Damage for the AFA can be calculated by measuring the area under the Damage / Probability Curve.

For each property, the depth of flooding was extracted from the hydraulic model for the full range of design scenarios (i.e. 50% AEP to 0.01% AEP for both fluvial and tidal flooding). Using the research from the FHRC Multi-coloured Handbook, damage costs were calculated for each property for the range of scenarios.

The damage costs are based on property type and/or area. The total damages for each design scenario were summed and plotted on the annual average flood loss curve which is shown in Figure 8.1. The area under the curve is the Annual Average Damage (AAD).

Figure 8.1: Typical Damage / Probability Curve (Annual Average Flood Loss Curve)



The Annual Average Damage for each AFA is listed in Table 8.12 below.

Table 8.12: Annual Average Damage €

AFA	Current Scenario €	Mid-Range Future Scenario €	High End Future Scenario €
Ballingeary	1,103,883.41	1,456,523.65	1,680,751.90
Inchigeelagh	338,783.45	582,430.14	738,232.18
Castlemartyr	152,431.58	336,169.68	369,252.72
Killeagh	1,375.40	4,077.29	4,606.72

8.3.3.2 Present Value Damage (PVd)

The Present Value Damage (PVd), based on a scheme that will have to be renewed after 50 years and a discount rate of 4%, has also been calculated. The PVd is calculated for each individual property in order to allow capping of PVd values where the PVd exceeds the current market value of the property.

Where a property's estimated potential damage for an event of 0.1% AEP is equal to or exceeds €0.5M, a threshold survey was carried out as a spot check on the ground level as determined by the DTM. Where a discrepancy was noted, the damage assessment was updated and damages recalculated. Spot checks were also carried out on properties where the PVd of a property is 1% or more of the total PVd for the AFA.

Table 8.13 lists all properties with damages for the 0.1% AEP event exceeding €0.5M or with a PVd greater than 1% of the Total AFA PVd

Table 8.13: List of properties with damages exceeding €0.5M or a PVd greater than 1% of the Total AFA PVd

AFA	Property Type	Object ID	Fluvial Damages 0.1% AEP €	Tidal Damages 0.1% AEP €	PVd - % of Total
Ballingeary	Detached	2814	79,684.21	N/A	1.38%
	Detached	2873	108,716.44	N/A	3.12%
	Detached	1135002	79,684.21	N/A	1.28%
	Detached	1135134	91,046.94	N/A	2.65%
	Detached	1135281	77,369.21	N/A	2.10%
	Detached	1135303	77,369.21	N/A	1.45%
	Detached	1135343	78,526.71	N/A	2.24%
	Semi	1135035	71,186.62	N/A	2.39%
	Semi	1135121	64,188.67	N/A	2.32%
	Semi	1135237	55,651.13	N/A	1.92%
	Semi	1135248	58,391.94	N/A	2.18%
	Terrace	1135190	50,774.92	N/A	1.31%
	Terrace	1135191	51,325.38	N/A	1.44%
	Terrace	1135282	50,224.46	N/A	1.25%
	Cafe	1135078	107,489.35	N/A	1.79%
	ComCentre	1135252	69,798.79	N/A	1.51%
	Filling	1135243	67,710.28	N/A	1.35%
	Filling	1135053	154,956.66	N/A	9.20%
	Shop	1135184	384,163.80	N/A	4.25%
	Shop	1135209	427,602.05	N/A	15.07%
	Shop	1135227	175,802.64	N/A	2.94%
	Storage	1135054	32,691.72	N/A	1.75%
	Warehouse	1134992	173,621.47	N/A	13.48%
	Warehouse	1135146	224,888.72	N/A	14.34%
Inchigeelagh	Detached	981998	92,223.18	N/A	7.88%
	Detached	982026	91,046.94	N/A	7.46%

AFA	Property Type	Object ID	Fluvial Damages 0.1% AEP €	Tidal Damages 0.1% AEP €	PVd - % of Total
	Detached	982042	92,223.18	N/A	7.61%
	Detached	982051	87,246.87	N/A	7.11%
	Detached	982053	83,311.13	N/A	2.26%
	Detached	982077	110,948.64	N/A	9.28%
	Detached	982112	89,870.70	N/A	7.59%
	Detached	982127	85,934.96	N/A	4.58%
	Detached	982146	85,934.96	N/A	4.49%
	Detached	982147	89,870.70	N/A	7.29%
	Terrace	982048	50,774.92	N/A	1.22%
	Terrace	982181	50,774.92	N/A	1.22%
	Office	982063	107,430.77	N/A	1.54%
	Pub	982012	101,982.56	N/A	1.12%
	Shop	982097	103,806.20	N/A	1.17%
	Shop	982138	153,888.22	N/A	22.60%
	Warehouse	982136	353,273.21	N/A	2.00%
Castlemartyr	Bungalow	1604702	58,775.23	N/A	1.20%
	Bungalow	1604909	67,628.81	N/A	9.88%
	Detached	1604750	77,369.21	N/A	11.61%
	Detached	1604825	76,211.70	N/A	12.35%
	Detached	1604826	68,309.81	N/A	4.30%
	Detached	1604854	77,369.21	N/A	11.47%
	Detached	1604891	68,309.81	N/A	6.66%
	Detached	1604893	75,054.20	N/A	11.93%
	Detached	1605089	61,565.42	N/A	1.49%
	Semi	1605065	55,030.92	N/A	8.31%
	Semi	1605166	58,391.94	N/A	8.12%
	Terrace	1605024	20,248.44	N/A	3.82%
	Terrace	1605167	52,095.44	N/A	5.33%
	Storage	1604790	9,218.41	N/A	1.18%

Following the survey spot check, adjustments were made as required and property damages were capped. For Residential properties, the damages were capped at the market value of the property and non-residential properties were capped at ten times the rateable value of the property. The capping process was carried out in line with Guidance Note 27. Market values for residential properties were determined within each AFA. Typical capping values for residential properties are as follows:

- Detached = €250k - €300k
- Semi-detached = €150k - €250k
- Terrace = €100k - €150k

The annual average damage and present value damages for each of the AFAs is listed in Table 8.14. The benefit of a flood risk management option (Scheme) was also calculated which is the damage avoided by implementing a scheme to the required Standard of Protection (SOP).

Table 8.14: Summary of Damages & Benefit of Scheme Benefit

AFA	AAD €	PVd	Capped PVd	Benefit of Scheme (Damage Avoided) €
Ballingeary	1,103,883.41	23,713,827.31	15,956,640.50	14,882,358.26
Inchigeelagh	338,783.45	7,277,808.72	5,264,669.58	4,681,767.44
Castlemartyr	152,431.58	3,274,563.43	2,652,969.98	2,394,238.74
Killeagh	1,375.40	29,546.68	29,546.68	0.00

It is clear from Table 8.14 that there is low potential damage in Killeagh and that there is no benefit in implementing a scheme as damage only occurs for events greater than the standard of protection.

Table 8.15 lists the benefit or damage avoided by implementing a flood forecasting and warning system.

Table 8.15: Benefit of Implementing a Flood Forecasting & Warning System

Spatial Scale of Assessment	Infrastructure	Benefit € (13% of PVd)
AFA		
Ballingeary	River level gauges (downstream at Lough Allua) Connect to Lower Lee Flood Warning System	3,082,797.55
Inchigeelagh	River level gauges (upstream at Lough Allua) Connect to Lower Lee Flood Warning System	946,115.13
Castlemartyr	Rain gauges River level gauges	425,693.25
Killeagh	Rain gauges River level gauges	3,841.07
Sub-Catchment		
Ballingeary / Inchigeelagh	River level gauges (Lough Allua) Connect to Lower Lee Flood Warning System	€4M +
UoM		
River Lee / Cork Harbour	River level gauges (Lough Allua) Connect to Lower Lee Flood Warning System Use the existing OPW storm surge forecasting system to predict high tide levels.	€4M +

Source: UoM 19 Hydraulics Report

It is clear from Table 8.15 that a flood forecasting and warning system is not viable for Killeagh due to the low potential damages and benefits. The benefit of implementing a flood forecasting and warning system at the sub-catchment and UoM scale is likely to be greater than shown in Table 8.15 as it has the potential to reduce damages along MPWs and other watercourses not assessed as part of this study. However, there is a corresponding cost increase due to additional gauges etc.

8.3.4 General Risk Maps

General Risk Maps have been prepared for each of the watercourses modelled in UoM 19. These maps show the receptors at risk and the flood extents for three AEPs. The general risk maps are categorised by Flood Risk Receptor type. That is;

- Society
- The Environment
- Cultural Heritage
- The Economy

The AEPs of flooding shown on the general Risk Maps are the 10% AEP, the 1% AEP and the 0.1% AEP.

9 Estimates of Cost

9.1 Flood Forecasting and Warning Systems

The cost of the flood forecasting and warning systems were calculated using the rates and methods contained in the Unit Cost Database developed by the OPW for use in the CFRAM studies. The estimates in Table 9.1 include costs for specifications, site surveys, gauging and telemetry equipment, forecast model setup and development along with training, operation and maintenance. In addition, in order to take account of the high level nature of the estimate and include for unseen costs, optimism bias is included in these estimates. The costs are exclusive of VAT. Full details of the costs are included in Appendix A.

Table 9.1: Estimate of Costs – Flood Forecasting and Warning Systems

Spatial Scale of Assessment	Infrastructure	Benefit € (13% of PVd)	Estimated Cost / €
AFA			
Ballingeary	4 Nr. River Level Gauges (Hydrometric Station) Connect to Lower Lee Flood Warning System	3,082,797.55	560,195.00
Inchigeelagh	4 Nr. River Level Gauges (Hydrometric Station) Connect to Lower Lee Flood Warning System	467,510.84	560,195.00
Castlemartyr	3 Nr. Rain Gauges 3 Nr. River Level Gauges (Hydrometric Station)	425,693.25	621,659.00
Killeagh	2 Nr. Rain Gauges 3 Nr. River Level Gauges (Hydrometric Station)	3,841.07	617,339.00
Sub-Catchment			
Ballingeary / Inchigeelagh	4 Nr. River Level Gauges (Hydrometric Station) Connect to Lower Lee Flood Warning System	4M +	560,195.00
UoM			
River Lee / Cork Harbour	4 Nr. River Level Gauges (Hydrometric Station) Connect to Lower Lee Flood Warning System	4M +	< 800k

From Table 9.1 it can be seen that flood forecasting is not a viable measure for Castlemartyr or Killeagh.

Details of the Lower Lee Flood Warning System are not readily available to fully assess the additional infrastructure required to include the Ballingeary / Inchigeelagh Sub-Catchment. However, based on the damages avoided and economies of scale, building on the Lower Lee Flood Warning System is likely to be a viable measure.

It should be noted that the implementation of a measure / option at another SSA (i.e. AFA flood relief scheme) has the potential to reduce the benefit of a flood forecasting and warning system. Depending on the standard of protection this could be a significant reduction as the benefit would be reduced to less than 13% of the residual risk.

9.2 Structural Options

The cost of each viable option was calculated using the rates contained in the Unit Cost Database developed by the OPW for use in the CFRAM studies. This database contains rates for constructing various types of flood risk management measures depending on their height (depth), length and location.

The estimates in Table 9.2 below include costs for construction, maintenance, operation, land acquisition, and professional fees. In addition, in order to take account of the high level nature of the estimate and include for unseen costs, optimism bias is included in these estimates. The costs are exclusive of VAT. Full details of the costs are included in Appendix A.

Table 9.2: Estimate of Costs for Potential Options

SSA	Option	Estimated Cost / €	Benefit of Scheme €
AFA			
Ballingeary	Flood Defences	3,069,155.00	14,882,358.26
	Storage	18,785,087.24	
Inchigeelagh	Flood Defences	2,563,297.51	3,596,237.26
Castlemartyr	Flood Defences	1,443,787.19	2,394,238.74
	Flow Diversion & Flood Defences	3,539,582.25	
Sub-Catchment			
Ballingeary / Inchigeelagh	Storage	18,785,087.24	14,882,358.26
			3,596,237.26
			18,478,595.52

From Table 9.2 it can be seen that the storage option for Ballingeary AFA and the Ballingeary / Inchigeelagh Sub-catchment is not cost beneficial. Also, the flood defence option for Castlemartyr is not cost beneficial.

10 Appraisal of Options

The effectiveness and potential impacts of each of the potential options is assessed using a Multi Criteria Analysis, (MCA). This MCA process assigns a score for each option that relates to how effective that option is in terms of achieving set goals under a set of objectives. The MCA can then be used to guide the decision on which particular option is the preferred option to manage flood risk in a particular area.

10.1 Flood Risk Management Objectives

The effectiveness of each of the potential options is measured in terms of how it achieves a set of Flood Risk Management Objectives. These objectives are split into a number of categories. These are:

- Technical
- Economic
- Social
- Environmental

Some of these objectives are further split into sub-objectives, where this is not the case the sub objective is the same as the objective. The Objectives and Sub objectives are shown in Table 10.1 below.

Table 10.1: Flood Risk Management Objectives

Criteria		Objective	Sub-Objective
1 Technical	a	Ensure flood risk management options are operationally robust	i) Ensure flood risk management options are operationally robust
	b	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options	l) Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options
	c	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	i) Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change
2 Economic	a	Minimise economic risk	i) Minimise economic risk
	d	Minimise risk to transport infrastructure	i) Minimise risk to transport infrastructure
	c	Minimise risk to utility infrastructure	i) Minimise risk to utility infrastructure
	d	Minimise risk to agriculture	i) Minimise risk to agriculture
3 Social	a	Minimise risk to human health and life	i) Minimise risk to human health and life of residents
			ii) Minimise risk to high vulnerability properties
	b	Minimise risk to community	i) Minimise risk to social infrastructure and amenity
			ii) Minimise risk to local employment
4 Environmental	a	Support the objectives of the WFD	i) Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.

Criteria	Objective	Sub-Objective
B	Support the objectives of the Habitats Directive	i) Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.
	c Avoid damage to, and where possible enhance, the flora and fauna of the catchment	i) Avoid damage to or loss of, and where possible enhance, nature conservation sites and protected species or other know species of conservation concern.
	d Protect, and where possible enhance, fisheries resource within the catchment	i) Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.
	e Protect, and where possible enhance, landscape character and visual amenity within the river corridor	i) Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.
	f Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	i) Avoid damage to or loss of features, institutions and collections of architectural value and their setting.
		ii) Avoid damage to or loss of features, institutions and collections of archaeological value and their setting.

:Source ; GN28

10.2 Global and Local Weightings

In order to take account of the relative importance of some objectives in comparison other objectives, each sub-objective is given a Global Weighting. These global weightings are set at a national level and are the same across all of the CFRAM Studies.

The Global Weightings for each sub objective are shown in Table 10.2 below.

Table 10.2: Global Weighting of Flood Risk management Objectives

Objective Ref	Sub Objective	Global Weighting
1(a)(i)	Ensure flood risk management options are operationally robust	20
1(b)(i)	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options	20
1(c)(i)	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	20

Objective Ref	Sub Objective	Global Weighting
2(a)(i)	Minimise economic risk	24
2(b)(i)	Minimise risk to transport infrastructure	10
2(c)(i)	Minimise risk to utility infrastructure	14
2(d)(i)	Minimise risk to agriculture	12
3(a)(i)	Minimise risk to human health and life of residents	27
3(a)(ii)	Minimise risk to high vulnerability properties	17
3(b)(i)	Minimise risk to social infrastructure and amenity	9
3(b)(ii)	Minimise risk to local employment	7
4(a)(i)	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	16
4(b)(i)	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	10
4(c)(i)	Avoid damage to or loss of, and where possible enhance, nature conservation sites and protected species or other know species of conservation concern.	5
4(d)(i)	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	13
4(e)(i)	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	8
4(f)(i)	Avoid damage to or loss of features, institutions and collections of architectural value and their setting.	4
4(f)(ii)	Avoid damage to or loss of features, institutions and collections of archaeological value and their setting.	4

Source: GN28

In order to take cognisance of the local perspective on the relative importance of objectives, each sub objective is also given a local weighting. Local weightings vary from 0 for not locally important to 5 for very important locally.

During the Draft Flood Mapping Public Consultation Day (PCD) the public were invited to consider each of the sub-objectives and provide a weighting on its importance. The local weightings listed below, which have been used in the MCA, are based on an assessment of the importance of these sub-objectives which has been informed by the input of the public at the PCD.

The Local Weighting for each FRM objective is shown in Table 10.3 below. The table also outlines the manner in which the Local weighting is derived. In some instances the Local Weighting is determined through local consultation. In other instances they are calculated based upon the number of receptors affected. The data used for calculating the local weighting are included in Appendix F1.

Table 10.3: Local Weighting

Sub Objective	Ballingeary	Inchigeelagh	Castlemartyr	Calculation Method
1(a)(i)	5	5	5	Constant
1(b)(i)	5	5	5	Constant
1(c)(i)	5	5	5	Constant
2(a)(i)	5	2.97	1.29	AAD / €75,000
2(b)(i)	5	5	5	Based on calculated assessment, adjusted by professional judgement
2(c)(i)	5	0	0	Based on calculated assessment, adjusted by professional judgement
2(d)(i)	0	4	0	By professional judgement assisted by local advice
3(a)(i)	5	4.78	3.2	Based on calculated assessment, adjusted by professional judgement
3(a)(ii)	1.05	0	0	Based on calculated assessment, adjusted by professional judgement
3(b)(i)	5	0.25	0.5	Based on calculated assessment, adjusted by professional judgement
3(b)(ii)	5	5	4.9	Based on calculated assessment, adjusted by professional judgement
4(a)(i)	5	5	5	Constant
4(b)(i)	0	0	1	By professional judgement assisted by local advice
4(c)(i)	2	2	4	By professional judgement assisted by local advice
4(d)(i)	4	4	2	By professional judgement assisted by local advice
4(e)(i)	3	3	3	By professional judgement assisted by local advice
4(f)(i)	0	0	3	By professional judgement assisted by local advice
4(f)(ii)	3	3	2	By professional judgement assisted by local advice

Source: GN 28

10.3 MCA Scoring

Each sub objective has a basic requirement and an aspirational target associated with it. The basic requirement for each sub objective equates to a no change scenario. That is the status quo before the FRM option is adopted. The aspirational target in most cases is set to the highest achievement that is reasonably possible against the sub-objective in implementing the FRM option. The performance of each FRM option is measured against the basic and aspirational targets for each sub objective and assigned a score in accordance with the principals in Table 10.4 below.

Table 10.4: MCA Scoring

Option Performance	Score
Meets Aspirational Target	5
Partially Achieving Aspirational Target	Score in proportion to performance
Meeting Basic Requirement (No Change)	0
Just Failing Basic Requirement	Score in proportion to performance
Fully Failing Basic Requirement	-5
Totally Failing Basic Requirement (Option Illegal or Totally Unacceptable)	-999

In the MCA the technical objectives measure if an option is robust in terms of operation. Higher scores are allocated to options that do not rely on mechanical, electrical or human intervention to operate effectively. Examples of such interventions include sluice gates, storm water over pumping, or erection of demountable barriers. The technical objectives also consider if the options can be constructed safely and if they can be adapted to future changes.

The adaptability of each option to the possible impacts of climate change is assessed through a qualitative decision tree. This involves identifying what flood risk management measures might be required in the future, what is required now and ensuring that decisions made now are adaptable to permit an effective and efficient transition to the management of potential future flood risk. The decision tree is a graphical representation of how the option can be adapted over time and of the scores given to each option. The decision trees are included in Appendix C.

The scoring for a given option reflects the cost and the degree of difficulty and potential impacts of future adaptations that would be necessary to maintain the Standard of Protection of the option under the MRFS and/or HEFS, whereby the greater the cost, difficulty and impact, the lower the score. The decision tree and scores for each SSA are included in Appendix E. The scores from the decision trees are used in the MCA.

The measurement of the performance of the options against the objective to avoid economic damage is measured in terms of the percentage of economic damage avoided by that option. Certain receptors in Coastal AFAs are at risk from fluvial and tidal flooding. On the basis of historical flood records it can be

said that these flooding mechanisms are independent of each other. For this reason when assessing the potential damage to properties in Coastal AFAs this report considers that the total potential damage is equal to the total potential fluvial damage added to the total potential tidal damage. Similarly when assessing the damage avoided by a particular option the total damage avoided is equal to the total fluvial damage plus the total tidal damage avoided. When calculating the percentage reduction in damage for a particular option this is calculated relative to the total potential damages in the town. The economic objectives also measure the performance of the option in terms of reducing the risk to transportation routes, utility infrastructure and agricultural land.

The social objectives in the MCA include the reduction of flood risk to people, high vulnerability properties such as hospitals and fire stations and to social infrastructure and amenities. Under social objectives the MCA also measures the performance of the option to reduce the risk to local employment in relation to the number of non-residential properties at risk.

Under the Environmental criteria the MCA measures the performance of the option under environmental headings such as:

- Promote achievement of good status in waterbodies
- Avoiding damage to protected habitats
- Minimising the risk of environmental pollution
- Avoid damage to the flora and fauna of the catchment
- Avoid damage to fisheries habitats
- Protect landscape character and visual amenity within the river corridor
- Avoid damage to features of architectural value
- Avoid damage to features of archaeological importance

Once all of the options have been analysed with reference to their performance against each of the sub-objectives the MCA score for each criteria can be calculated. This is done by multiplying the score for each sub objective by the Global and the local Weighting and then by summing the weighted scores for all the sub objectives under that criteria.

The **MCA Benefit Score** is calculated by adding the weighted score for the Economic, Social and Environmental Criteria together. This score represents the net benefits of the option.

The **Option Selection MCA Score** is calculated by adding the weighted scores of all the criteria together. This score includes the technical score and therefore includes all of the aspects that should be taken into account in considering the preferred option for a given location.

The **Total Construction Cost €** is the cost of the FRM option as outlined in Section 9.

The **MCA Benefit – Cost Ratio** is calculated by dividing the **MCA Benefit Score** by the cost of the option. This is a numerical but non monetised ratio that indicates the overall benefits that can be delivered per euro of investment.

The **Economic Benefit €** is the cost of the damage avoided for the FRM Option.

The **Economic Benefit – Cost Ratio** is calculated by dividing the cost of the damage avoided by adopting the FRM Option by the cost of the option. This is the traditional method used by OPW in assessing the economic case for proceeding with a flood relief scheme. In general terms a flood relief scheme would be considered economically viable if the benefit cost ratio is greater than 1.

10.4 Measures Being Undertaken under Other Policy Areas

Flood related measures being undertaken under other policy areas have the potential to have an impact on flood risk in the UoM. The relevant policy areas may relate to EU Directives 85/337/EEC (EIA Directive), 96/82/EC (Seveso II Directive), 2001/42/EC (SEA Directive) and 2000/60/EC (Water Framework Directive).

11 Selection of Preferred Options

11.1 Preferred Flood Risk Management Options – UoM

The preferred Flood Risk Management Options selected for inclusion in the Flood Risk Management Plan for UoM 19 are set out below:

- Planning Control
- Building Regulations
- SUDS
- Flood Forecasting and Warning Systems
 - Build on Lower Lee Flood Warning System
- Public Awareness
- Individual Property Flood Resilience
- Land Use Management

The non-structural measures highlighted above do not mitigate existing flood risk. However, they should be implemented as national policy to the SSAs to minimise future risk.

11.2 Preferred Flood Risk Management Options – Ballingearry / Inchigeelagh Sub-Catchment

In addition to the options selected for the UoM, the preferred options selected for inclusion in the Flood Risk Management Plan for the Ballingearry / Inchigeelagh Sub-Catchment are set out below:

- Flood Forecasting and Warning Systems
 - River Level Gauges along with forecast rainfall to predict flooding from Lough Allua
 - Build on Lower Lee Flood Warning System

As described in Section 9.1, the benefit of a flood forecasting and warning system may be reduced through the implementation of a measure / option at another SSA (i.e. AFA flood relief scheme). Therefore, the timing of other measures / options must be considered when implementing a flood forecasting and warning system.

As highlighted in Section 5.0, increase conveyance is not a viable measure for the Ballingearry / Inchigeelagh sub-catchment.

The potential storage option for the Ballingearry / Inchigeelagh Sub-Catchment is not cost beneficial as highlighted in Section 9.2.

11.3 Preferred Flood Risk Management Options – AFAs

11.3.1 MCA Scores

The Scores achieved by each potential option under consideration are listed in Table 11.1 below. Details of the MCA undertaken for each AFA are contained in Appendix F.

Table 11.1: MCA Scores for Potential Options

AFA / Option	Cost Estimate €	Capped Scheme Benefit €	MCA Benefit Score	Option Selection MCA Score	MCA Benefit Cost Ratio (Millions)	Economi c Benefit Cost Ratio	Initial Rank
Ballingeary							
Do Nothing	-	-	-264.00	-264.00	0.00	0.00	3
Flood Defences	3,069,155.00	14,882,358.26	1692.30	2792.30	551.39	4.85	1
Storage	18,785,087.24	14,882,358.26	1418.30	2318.30	75.50	0.79	2
Inchigeelagh							
Do Nothing	-	-	-44.00	-44.00	0.00	0.00	2
Flood Defences	2,563,297.51	3,596,237.26	1424.97	2524.97	555.91	1.40	1
Castlemartyr							
Do Nothing	-	-	-36.00	-36.00	0.00	0.00	3
Flood Defences	3,539,582.25	2,394,238.74	624.98	1524.98	176.57	0.68	2
Flow Diversion & Flood Defences	1,443,787.19	2,394,238.74	704.98	1304.98	488.28	1.66	1

11.3.2 Feedback Provided on Options

At the public consultations for Preliminary Flood Risk Management Options the public were asked to rank the potential options in terms of their preference. The feedback received is included in Table 11.2 below.

Table 11.2: Public Preference for Potential Options

AFA	Option	Nr of Rank 1 Received	Rank
Ballingeary	Flood Defences	3	1
	Storage	0	-
	Do Nothing	0	-
Inchigeelagh	Flood Defences	4	1
	Storage	0	2
	Do Nothing	0	3
Castlemartyr	Food Defences	1	2
	Flow Diversion & Flood Defences	2	1
	Do Nothing	0	3

The selection of the preferred Flood Risk Management Option for each of the AFAs is based on the MCA and the feedback provided during the public consultation. The preferred options for each of the AFAs are listed below:

11.3.2.1 Ballingeary

The preferred option identified in the MCA is Flood Defences. The feedback provided at the Ballingeary PCD indicated that the public agreed with the preferred option indicated in the MCA.

11.3.2.2 Inchigeelagh

The preferred option identified in the MCA is Flood Defences. The feedback provided at the Inchigeelagh PCD indicated that the public agreed with the preferred option indicated in the MCA.

11.3.2.3 Castlemartyr

The preferred option identified in the MCA is Flow Diversion and Flood Defences. The feedback provided at the Castlemartyr PCD indicated that the public agreed with the preferred option indicated in the MCA.

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Appendix A. Estimate of Costs

Summary

UoM	19	Optimism Bias	38.59%
AFA	Ballingeary	Site Investigation Estimate	€ 50,000.00
Option	1 - Flood Defences	Preliminaries	17%
Description	Flood Defences	Design Fees	13%
		Compensation and Land Acquisition	10%
		Archaeology and Environmental	10%
		Art Allowance	€ 25,500.00

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 884,429.86	€ 3,321.76	€ 887,751.62
2	Embankments	€ 201,448.66	€ 55,473.57	€ 256,922.23
3	Demountable Walls and Gates	€ 0.00	€ 0.00	€ 0.00
4	In-Channel Excavation	€ 0.00	€ 0.00	€ 0.00
5	Excavation on Land	€ 0.00	€ 0.00	€ 0.00
6	Weirs	€ 0.00	€ 0.00	€ 0.00
7	Weir Removal	€ 0.00	€ 0.00	€ 0.00
8	Bridges	€ 0.00	€ 0.00	€ 0.00
9	Bridge Underpinning	€ 0.00	€ 0.00	€ 0.00
10	Culverts	€ 0.00	€ 0.00	€ 0.00
11	Sluice Gates	€ 0.00	€ 0.00	€ 0.00
12	Road Raising	€ 0.00	€ 0.00	€ 0.00
13	Individual Property Protection	€ 0.00	€ 0.00	€ 0.00
14	Hydrometric Gauging Stations	€ 0.00	€ 0.00	€ 0.00
15	Flood Forecasting	€ 0.00	€ 0.00	€ 0.00
16	Pumping Stations	€ 130,200.00	€ 208,972.48	€ 339,172.48
17	Channel Maintenance	€ 0.00	€ 0.00	€ 0.00
18	Bank Protection	€ 0.00	€ 0.00	€ 0.00
19	Manhole Sealing	€ 0.00	€ 0.00	€ 0.00

€ 1,216,078.53	€ 267,767.80	€ 1,483,846.33
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Basic Construction Costs	€ 1,216,078.53
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Preliminaries	€ 206,733.35
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Optimism Bias	€ 549,037.99
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Construction Costs (Excl VAT)	€ 1,971,849.87
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Design Fees	€ 256,340.48
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Σ Construction Costs and Fees	€ 2,228,190.35
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Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 197,184.99
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Allowance for Compensation and Land Acquisition	€ 197,184.99
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Site Investigation	€ 50,000.00
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Art Allowance	€ 25,500.00
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PV O&M	€ 267,767.80
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PV O&M Optimism Bias	€ 103,326.87
----------------------	--------------

Σ Other Items	€ 840,964.64
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Option Cost for Cost Benefit Analysis	€ 3,069,155.00
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CFRAM Unit Cost Development Project

Optimism Bias Calculator

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Ballingearry 1 - Flood Defences

Project risk components that influence total project cost	Weight 1-3 (3 being a higher weight)	Risk value (0-100%) 0% = no risk 100% = risk expected and not mitigated		Key:	<div><div></div>Default weighting defined by OPW for all CFRAM projects</div> <div><div></div>Default risk value defined for all CFRAM projects</div> <div><div></div>Automated function cell (no input required)</div> <div><div></div>User defined - risk value, comments, justification</div>
		Select from Dropdown			
Procurement	Weight	Risk score		Comment/justification	
Complexity of Contract Structure	1	Medium	50%	Default risk value	
Late Contractor Involvement in Design	2	Medium	50%	Default risk value	
Poor Contractor Capabilities	1	Medium	50%	Default risk value	
Government Guidelines	1	Medium	50%	Default risk value	
Dispute & Claims Occurred	3	Medium	50%	Default risk value	
Information Management	1	Medium	50%	Default risk value	
Budgeting	2	Medium	50%	Default risk value	
Other	1	Medium	50%	Default risk value	
Project Specific					
Design Complexity	2	Medium	50%	Scheme with low complexity - embankments, walls and pump station	
Degree of Innovation	2	Low	30%	Standard and proven methods	
Technology	2	Medium	50%	Pump station and associated equipment required	
Services	3	Medium	50%	Unknown - large amount of services not expected in rural area	
Ground conditions	3	Medium	50%	Unknown	
Health and Safety	3	Low	30%	Scheme with no unusual risks associated with works	
Other	1	Medium	50%	Surface water drainage and pump stations	
Client Specification					
Inadequacy of the Business Case	3	Medium	50%	Default risk value	
Large No. of Stakeholders	2	High	70%	Large number of stakeholders	
Funding Availability	2	Medium	50%	Default risk value	
Project Management Team	1	Medium	50%	Unforeseeable	
Poor Project Intelligence	2	Medium	50%	Potential risk - same for all AFAs	
Other	1	Very Low	10%	None	
Environment					
Public Relations	2	High	70%	Large number of stakeholders and interferences	
Site Characteristics	2	Medium	50%	Presence of invasive non-native species unknown	
Environmental Impact	3	Medium	50%	No significant environmental impacts	
Permits / Consents / Approvals	2	Medium	50%	No anticipated delays associated with permits, consents or approvals	
Amenity and art	1	Low	30%	Rural scheme with large number of stakeholders	
Contaminated land	3	Medium	50%	Unknown	
Archaeology	3	Low	30%	Unknown - small scheme which can be adequately scoped	
Other	1	Very Low	10%	None	
External Influences					
Political	3	Medium	50%	Default risk value	
Economic	2	Medium	50%	Default risk value	
Legislation / Regulations	1	Medium	50%	Default risk value	
Multiple river users / stakeholders	2	Medium	50%	Large number of stakeholders and interferences	
Flood events during construction	3	High	70%	History of frequent flooding	
Other	1	Very Low	10%	None	
	68	46%			
Weighting to apply: 0.476				Minimum Optimism Bias: 10%	
				Maximum Optimism Bias: 70%	
				Calculated Optimism bias: 39%	

1. Walls

[illegible]

2. Embankments

[illegible]

3. Demountable Barrier

3. Demountable Barrier							Length of Wall	With Ground Beam Installation	Height	Additional Costs	Wall Length for Maintenance	Rate	Cost of Wall	PV Maintenance Rate
No.	Select Demountable Barrier Span from Dropdown	Comments	(m)	Select Yes/No	Select (mm)	Select	Select	(€/m)	(€)	(€/m)				
								Capital Cost	€ 0.00					

3a. Flood Gate

[illegible]

4. In-Channel Excavation

4. In-Channel Excavation		Urban or Rural	Volume of Excavation	Rate	Cost of Excavation
No. Select Excavation Type from Dropdown	Comments	Select	Min 100m ³ Max 1,000m ³ (m ³)	(€/m ³)	(€)
				Total Cost	€ 0.00

No. Dredging	Volume of Dredging (m ³)	Rate (€/m ³) Select a Rate from Dropdown	Cost of Dredging (€)
		Total Cost	€ 0.00

Total Excavation Costs € 0.00

5. Excavation on Land		Volume of Excavation	Rate	Cost of Excavation
No. Select Excavation Type from Dropdown	Comments	(m³)	(€/m³)	(€)
		Total Cost		€ 0.00

6. Weir Construction		Width of Weir	Rate	Capital Cost of Weir	Maintenance Costs Estimate	PV Cost/Weir
No. Select Weir Height from Dropdown	Comments	Min 10m Max 20m	(€/m)	(€)	Select H/L	(€/weir)
		(m)			Average	
		Capital Cost		€ 0.00	Total PV Cost	€ 0.00
				Total Cost	€ 0.00	

7. Weir Removal		Length of Weir	Rate	Cost of Construction
No. Description of Weir	(m)	(€/m)	(€)	
		Total Cost	€ 0.00	

8. Bridges		Remove or Replace	Area of Bridge	Rate	Cost of Construction	PV Costs
No. Description of Bridge		Select Yes/No	(m²)	(€/m²)	(€)	(€/bridge)
		Capital Cost		€ 0.00	€ 0.00	
				Total Cost	€ 0.00	

9. Bridge Underpinning		Length of Bridge	Rate	Cost of Construction
No. Choose a suitable bridge from dropdown	Comments	(m)	(€/m)	(€)
		Total Cost	€ 0.00	

10a. Culverts (Rural)		Disposal of Spoil	Ground Type	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert		Select	Select Soil/Rock	Select (m)	Select (m)	(m)	(€/m)	(€)	Select H/L	(€/m)	(€)
			Soil	2.5					High		
									Average		
									Low		
									Average		
									Average		
									Average		
									Average		
									Average		
									Average		
		Capital Cost						€ 0.00		Total PV Cost	€ 0.00
								Total Cost	€ 0.00		

10b. Culverts (Urban)		Culvert	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert		Select New/Replacement	Select (m)	Select (m)	(m)	(€/m)	(€)	Select H/L	(€/m)	(€)
								High		
								Average		
								Low		
								Average		
								Average		
								Average		
								Average		
								Average		
								Average		
		Capital Cost					€ 0.00		Total PV Cost	€ 0.00
								Total Cost	€ 0.00	

10c. Culverts (Headwall)		Length of Culvert	Culvert Size	Rate	Cost of Construction
No. Description of Culvert	(m)	Select (m)	(€/m)	(€)	
		Capital Cost	€ 0.00		
Overall Capital Cost		€ 0.00	Overall PV Cost	€ 0.00	
				Overall Cost	€ 0.00

11. Sluice Gates		Size Select	Maintenance Select	Operation Select	Maintenance Costs Estimate Select H/L	Capital Cost	PV Cost	Total Cost
No. Select Gate Type	Comments					(€)	(€)	(€)
						Capital Cost	€ 0.00	€ 0.00
						PV Cost		€ 0.00
						Total Cost		€ 0.00

12. Road Raising		Length of Road	Cost of Construction	Cost of Construction
Note cost is to raise road by 600mm				
No. Road Details		(m)	(€)	(€)
		Total Cost	€ 0.00	€ 0.00

13. Individual Property Protection		Factor Select	Number of Units	Rate	Cost of Works	PV Rate	PV Cost
No. Property Type	Comments			(€)	(€)	(€)	(€)
1 Detached							
2 Semi-Detached							
3 Terraced							
4 Flat							
5 Residential average							
6 Shop							
7 Office							
					Capital Cost	€ 0.00	€ 0.00
					PV Cost		€ 0.00
					Total Cost		€ 0.00

14. Hydrometric Gauging Stations		Number of Units	Maintenance Select H/L	Rate	Capital Cost of Units	PV Rate	PV Costs
No. Hydrometric Gauging Station	Comments			(€)	(€)	(€)	(€)
					Capital Cost	€ 0.00	€ 0.00
					PV Cost		€ 0.00
					Total Cost		€ 0.00

15. Flood Forecasting		Signage Select Yes/No	Maintenance Select	Number of Units	Rate	Cost of Construction	PV Cost	PV Cost
No. Category	Comments				(€)	(€)	(€)	(€)
						Capital Cost	€ 0.00	€ 0.00
						PV Cost		€ 0.00
						Total Cost		€ 0.00

16. Pumping Stations		Number of Units	Rate	Capital Cost	Operation Cost	Running Cost	PV Cost
No. Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
1 0.02 m3/s							
2 0.05 m3/s							
3 0.1 m3/s		1	€ 130,200.00	€ 130,200.00	€ 80,429.30	€ 17,873.18	€ 98,302.48
4 0.5 m3/s							
5 1.0 m3/s							
6 2.0 m3/s							
7 3.0 m3/s							
			Capital Cost	€ 130,200.00		PV Cost	€ 208,972.48
			Total Cost			Total Cost	€ 339,172.48

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17. Channel Maintenance		Length of Channel	Rate	Maintenance Costs
No. Channel Type	Comments	(m)	(€)	(€)
			Total Cost	€ 0.00

18. Bank Protection		Fluvial/Coastal Select	Maintenance Select	Length	Rate	Cost of Construction	PV Rate	PV Cost
No. Description of Bank Protection				(m)	(€/m)	(€)	(€)	(€)
	Fluvial	High						
						Capital Cost	€ 0.00	€ 0.00
						PV Cost		€ 0.00
						Total Cost		€ 0.00

19. Manhole Sealing		No. of Manholes	Rate	Cost of Construction
No. Manhole Type	Comments		(€)	(€)
			Total Cost	€ 0.00

Summary

UoM	19	Optimism Bias	43.88%
AFA	Ballingeary	Site Investigation Estimate	€ 150,000.00
Option	2 - Storage	Preliminaries	7%
Description	Storage	Design Fees	13%
		Compensation and Land Acquisition	15%
		Archaeology and Environmental	15%
		Art Allowance	€ 51,000.00

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 0.00	€ 0.00	€ 0.00
2	Embankments	€ 8,174,745.76	€ 238,340.63	€ 8,413,086.39
3	Demountable Walls and Gates	€ 0.00	€ 0.00	€ 0.00
4	In-Channel Excavation	€ 0.00	€ 0.00	€ 0.00
5	Excavation on Land	€ 0.00	€ 0.00	€ 0.00
6	Weirs	€ 0.00	€ 0.00	€ 0.00
7	Weir Removal	€ 0.00	€ 0.00	€ 0.00
8	Bridges	€ 0.00	€ 0.00	€ 0.00
9	Bridge Underpinning	€ 0.00	€ 0.00	€ 0.00
10	Culverts	€ 0.00	€ 0.00	€ 0.00
11	Sluice Gates	€ 50,270.82	€ 92,730.07	€ 143,000.89
12	Road Raising	€ 0.00	€ 0.00	€ 0.00
13	Individual Property Protection	€ 0.00	€ 0.00	€ 0.00
14	Hydrometric Gauging Stations	€ 0.00	€ 0.00	€ 0.00
15	Flood Forecasting	€ 0.00	€ 0.00	€ 0.00
16	Pumping Stations	€ 0.00	€ 0.00	€ 0.00
17	Channel Maintenance	€ 0.00	€ 0.00	€ 0.00
18	Bank Protection	€ 0.00	€ 0.00	€ 0.00
19	Manhole Sealing	€ 0.00	€ 0.00	€ 0.00

€ 8,225,016.58	€ 331,070.70	€ 8,556,087.28
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Basic Construction Costs	€ 8,225,016.58
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Preliminaries	€ 575,751.16
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Optimism Bias	€ 3,861,983.96
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Construction Costs (Excl VAT)	€ 12,662,751.70
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Design Fees	€ 1,646,157.72
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Σ Construction Costs and Fees	€ 14,308,909.42
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Other Items

Allowance for Archaeology and	€ 1,899,412.75
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Allowance for Compensation and	€ 1,899,412.75
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Site Investigation	€ 150,000.00
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Art Allowance	€ 51,000.00
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PV O&M	€ 331,070.70
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PV O&M Optimism Bias	€ 145,281.61
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Σ Other Items	€ 4,476,177.82
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Option Cost for Cost Benefit Analysis	€ 18,785,087.24
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CFRAM Unit Cost Development Project

Optimism Bias Calculator

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Ballingeary 2 - Storage

Project risk components that influence total project cost	Weight 1-3 (3 being a higher weight)	Risk value (0-100%) 0% = no risk 100% = risk expected and not mitigated		Key:	<div><div></div>Default weighting defined by OPW for all CFRAM projects</div> <div><div></div>Default risk value defined for all CFRAM projects</div> <div><div></div>Automated function cell (no input required)</div> <div><div></div>User defined - risk value, comments, justification</div>
		Select from Dropdown			
Procurement	Weight	Risk score		Comment/justification	
Complexity of Contract Structure	1	Medium	50%	Default risk value	
Late Contractor Involvement in Design	2	Medium	50%	Default risk value	
Poor Contractor Capabilities	1	Medium	50%	Default risk value	
Government Guidelines	1	Medium	50%	Default risk value	
Dispute & Claims Occurred	3	Medium	50%	Default risk value	
Information Management	1	Medium	50%	Default risk value	
Budgeting	2	Medium	50%	Default risk value	
Other	1	Medium	50%	Default risk value	
Project Specific					
Design Complexity	2	High	70%	Scheme based on two storage areas	
Degree of Innovation	2	Medium	50%	Standard and proven methods	
Technology	2	High	70%	Storage area controls, pump station and associated equipment required	
Services	3	Medium	50%	Unknown - large amount of services not expected in rural area	
Ground conditions	3	High	70%	Unknown - critical as there are two storage areas	
Health and Safety	3	Medium	50%	Two storage areas but no unusual risks associated with works	
Other	1	Medium	50%	Risks associated with two storage areas	
Client Specification					
Inadequacy of the Business Case	3	Medium	50%	Default risk value	
Large No. of Stakeholders	2	Very High	90%	Low number of stakeholders - critical stakeholders associated with storage area	
Funding Availability	2	Medium	50%	Default risk value	
Project Management Team	1	Medium	50%	Unforeseeable	
Poor Project Intelligence	2	Medium	50%	Potential risk - same for all AFAs	
Other	1	Very Low	10%	None	
Environment					
Public Relations	2	Very High	90%	Low number of stakeholders - critical stakeholders associated with storage area	
Site Characteristics	2	Medium	50%	Presence of invasive non-native species unknown	
Environmental Impact	3	Medium	50%	No significant environmental impacts	
Permits / Consents / Approvals	2	High	70%	Number of species of conservation importance present - Salmon	
Amenity and art	1	Low	30%	Rural scheme with remote storage area	
Contaminated land	3	High	70%	Unknown - risk associated with storage area	
Archaeology	3	Medium	50%	Unknown - extent of storage areas can be adequately scoped	
Other	1	Medium	50%	Risks associated with two storage areas	
External Influences					
Political	3	Medium	50%	Default risk value	
Economic	2	Medium	50%	Default risk value	
Legislation / Regulations	1	Medium	50%	Default risk value	
Multiple river users / stakeholders	2	Very High	90%	Low number of stakeholders - critical stakeholders associated with storage area	
Flood events during construction	3	High	70%	History of frequent flooding	
Other	1	Very Low	10%	None	
	68	54%			
Weighting to apply: 0.565				Minimum Optimism Bias: 10%	
				Maximum Optimism Bias: 70%	
				Calculated Optimism bias: 44%	

1. Walls

[illegible]

2. Embankments

[illegible]

3. Demountable Barrier

3. Demountable Barrier										
No.	Select Demountable Barrier Span from Dropdown	Comments	Length of Wall (m)	With Ground Beam Installation Select Yes/No	Height (mm) Select	Additional Costs Select	Wall Length for Maintenance Select	Rate (€/m)	Cost of Wall (€)	PV Maintenance Rate (€/m)
Capital Cost								€ 0.00		

3a. Flood Gate

[illegible]

4. In-Channel Excavation

<u>4. In-Channel Excavation</u>						Urban or Rural	Volume of Excavation	Rate	Cost of Excavation
				Select	Min 100m³ Max 1,000m³				
No.	Select Excavation Type from Dropdown	Comments			(m³)		(€/m³)	(€)	
							Total Cost	€ 0.00	

No.	Dredging	Volume of Dredging <small>(m³)</small>	Rate <small>Select a Rate from Dropdown € / m³</small>	Cost of Dredging <small>(€)</small>
			Total Cost	€ 0.00

Total Excavation Costs € 0.00

5. Excavation on Land		Volume of Excavation	Rate	Cost of Excavation
No. Select Excavation Type from Dropdown	Comments	(m³)	(€/m³)	(€)
		Total Cost	€ 0.00	

6. Weir Construction		Width of Weir	Rate	Capital Cost of Weir	Maintenance Costs Estimate	PV Cost/Weir
No. Select Weir Height from Dropdown	Comments	Min 10m Max 20m	(€/m)	(€)	Select	(€/weir)
		(m)			H/L	
					Average	
		Capital Cost	€ 0.00		Total PV Cost	€ 0.00
				Total Cost	€ 0.00	

7. Weir Removal		Length of Weir	Rate	Cost of Construction
No. Description of Weir	(m)	(€/m)	(€)	
		Total Cost	€ 0.00	

8. Bridges		Remove or Replace	Area of Bridge	Rate	Cost of Construction	PV Costs
No. Description of Bridge		Select Yes/No	(m²)	(€/m²)	(€)	(€/bridge)
		Capital Cost	€ 0.00		€ 0.00	
				Total Cost	€ 0.00	

9. Bridge Underpinning		Length of Bridge	Rate	Cost of Construction
No. Choose a suitable bridge from dropdown	Comments	(m)	(€/m)	(€)
		Total Cost	€ 0.00	

10a. Culverts (Rural)		Disposal of Spoil	Ground Type	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert		Select	Select Soil/Rock	Select (m)	Select (m)	(m)	(€/m)	(€)	Select	(€/m)	(€)
			Soil	2.5	(m)				H/L		
									High		
									Average		
									Low		
									Average		
									Average		
									Average		
									Average		
									Average		
									Average		
		Capital Cost	€ 0.00						Total PV Cost	€ 0.00	
										Total Cost	€ 0.00

10b. Culverts (Urban)		Culvert	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert	Select	Select	Select					Select		
	New/Replacement	(m)	(m)	(m)	(€/m)	(€)	H/L	(€/m)	(€)	
							High			
							Average			
							Low			
							Average			
							Average			
							Average			
							Average			
							Average			
Capital Cost						€ 0.00		Total PV Cost		€ 0.00
Total Cost								Total Cost		€ 0.00

10c. Culverts (Headwall)		Length of Culvert	Culvert Size	Rate	Cost of Construction
No. Description of Culvert	(m)	Select (m)	(€/m)	(€)	
		Capital Cost	€ 0.00		
		Overall Capital Cost	€ 0.00	Overall PV Cost	€ 0.00
				Overall Cost	€ 0.00

11. Sluice Gates		Size Select	Maintenance Select	Operation Select	Maintenance Costs Estimate Select H/L	Capital Cost	PV Cost	Total Cost
No. Select Gate Type	Comments					(€)	(€)	(€)
1	Sluice Gates	1800	Woodland/open public or open non public locations with lower debris loads	Electric Operation	Average	€ 25,135.41	€ 46,365.04	€ 71,500.44
2	Sluice Gates	1800	Woodland/open public or open non public locations with lower debris loads	Electric Operation	Average	€ 25,135.41	€ 46,365.04	€ 71,500.44
Capital Cost						€ 50,270.82	PV Cost	€ 92,730.07
							Total Cost	€ 143,000.89

12. Road Raising		Length of Road	Cost of Construction	Cost of Construction
No. Road Details		(m)	(€)	(€)
Total Cost			€ 0.00	€ 0.00

13. Individual Property Protection		Factor Select	Number of Units	Rate	Cost of Works	PV Rate	PV Cost
No. Property Type	Comments			(€)	(€)	(€)	(€)
1	Detached						
2	Semi-Detached						
3	Terraced						
4	Flat						
5	Residential average						
6	Shop						
7	Office						
Capital Cost					€ 0.00	PV Cost	€ 0.00
						Total Cost	€ 0.00

14. Hydrometric Gauging Stations		Number of Units	Maintenance Select H/L	Rate	Capital Cost of Units	PV Rate	PV Costs
No. Hydrometric Gauging Station	Comments			(€)	(€)	(€)	(€)
Capital Cost					€ 0.00	PV Cost	€ 0.00
						Total Cost	€ 0.00

15. Flood Forecasting		Signage Select Yes/No	Maintenance Select	Number of Units	Rate	Cost of Construction	PV Cost	PV Cost
No. Category	Comments				(€)	(€)	(€)	(€)
Capital Cost						€ 0.00	PV Cost	€ 0.00
							Total Cost	€ 0.00

16. Pumping Stations		Number of Units	Rate	Capital Cost	Operation Cost	Running Cost	PV Cost
No. Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
1	0.02 m3/s						
2	0.05 m3/s						
3	0.1 m3/s						
4	0.5 m3/s						
5	1.0 m3/s						
6	2.0 m3/s						
7	3.0 m3/s						
Capital Cost				€ 0.00		PV Cost	€ 0.00
				Total Cost		Total Cost	€ 0.00

17. Channel Maintenance		Length of Channel	Rate	Maintenance Costs
No. Channel Type	Comments	(m)	(€)	(€)
Total Cost			€ 0.00	

18. Bank Protection		Fluvial/Coastal Select	Maintenance Select	Length	Rate	Cost of Construction	PV Rate	PV Cost
No. Description of Bank Protection				(m)	(€/m)	(€)	(€)	(€)
		Fluvial	High					
Capital Cost						€ 0.00	PV Cost	€ 0.00
							Total Cost	€ 0.00

19. Manhole Sealing		No. of Manholes	Rate	Cost of Construction
No. Manhole Type	Comments		(€)	(€)
Total Cost			€ 0.00	

Summary

UoM	19	Optimism Bias	36.47%
AFA	Castlemartyr	Site Investigation Estimate	€ 50,000.00
Option	1 - Flood defences and flow diversion	Preliminaries	17%
Description	Flood defences and flow diversion	Design Fees	13%
		Compensation and Land Acquisition	10%
		Archaeology and Environmental	10%
		Art Allowance	€ 25,500.00

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 596,163.69	€ 2,056.06	€ 598,219.75
2	Embankments	€ 0.00	€ 0.00	€ 0.00
3	Demountable Walls and Gates	€ 0.00	€ 0.00	€ 0.00
4	In-Channel Excavation	€ 0.00	€ 0.00	€ 0.00
5	Excavation on Land	€ 0.00	€ 0.00	€ 0.00
6	Weirs	€ 0.00	€ 0.00	€ 0.00
7	Weir Removal	€ 0.00	€ 0.00	€ 0.00
8	Bridges	€ 0.00	€ 0.00	€ 0.00
9	Bridge Underpinning	€ 0.00	€ 0.00	€ 0.00
10	Culverts	€ 0.00	€ 0.00	€ 0.00
11	Sluice Gates	€ 17,037.99	€ 46,365.04	€ 63,403.03
12	Road Raising	€ 0.00	€ 0.00	€ 0.00
13	Individual Property Protection	€ 0.00	€ 0.00	€ 0.00
14	Hydrometric Gauging Stations	€ 0.00	€ 0.00	€ 0.00
15	Flood Forecasting	€ 0.00	€ 0.00	€ 0.00
16	Pumping Stations	€ 0.00	€ 0.00	€ 0.00
17	Channel Maintenance	€ 0.00	€ 0.00	€ 0.00
18	Bank Protection	€ 0.00	€ 0.00	€ 0.00
19	Manhole Sealing	€ 0.00	€ 0.00	€ 0.00
		€ 613,201.68	€ 48,421.09	€ 661,622.78
		Basic Construction Costs		€ 613,201.68
		Preliminaries		€ 104,244.29
		Optimism Bias		€ 261,656.76
		Construction Costs (Excl VAT)		€ 979,102.73
		Design Fees		€ 127,283.36
		Σ Construction Costs and Fees		€ 1,106,386.09

Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 97,910.27
Allowance for Compensation and Land Acquisition	€ 97,910.27
Site Investigation	€ 50,000.00
Art Allowance	€ 25,500.00
PV O&M	€ 48,421.09
PV O&M Optimism Bias	€ 17,659.46
Σ Other Items	€ 337,401.10

Option Cost for Cost Benefit Analysis € 1,443,787.19

CFRAM Unit Cost Development Project

Optimism Bias Calculator

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Castlemartyr 1 - Flood defences and flow diversion

Project risk components that influence total project cost	Weight 1-3 (3 being a higher weight)	Risk value (0-100%) 0% = no risk 100% = risk expected and not mitigated		Key:	<div>Default weighting defined by OPW for all CFRAM projects</div> <div>Default risk value defined for all CFRAM projects</div> <div>Automated function cell (no input required)</div> <div>User defined - risk value, comments, justification</div>
		Select from Dropdown			
Procurement	Weight	Risk score		Comment/justification	
Complexity of Contract Structure	1	Medium	50%	Default risk value	
Late Contractor Involvement in Design	2	Medium	50%	Default risk value	
Poor Contractor Capabilities	1	Medium	50%	Default risk value	
Government Guidelines	1	Medium	50%	Default risk value	
Dispute & Claims Occurred	3	Medium	50%	Default risk value	
Information Management	1	Medium	50%	Default risk value	
Budgeting	2	Medium	50%	Default risk value	
Other	1	Medium	50%	Default risk value	
Project Specific					
Design Complexity	2	Medium	50%	Small scheme with low complexity - flow diversion	
Degree of Innovation	2	Low	30%	Standard and proven methods	
Technology	2	Medium	50%	Flow control structure	
Services	3	Low	30%	Unknown - services not expected	
Ground conditions	3	Medium	50%	Unknown	
Health and Safety	3	Low	30%	Small scheme with no unusual risks associated with works	
Other	1	Very Low	10%	None	
Client Specification					
Inadequacy of the Business Case	3	Medium	50%	Default risk value	
Large No. of Stakeholders	2	Medium	50%	Low number of stakeholders but increasing flood risk	
Funding Availability	2	Medium	50%	Default risk value	
Project Management Team	1	Medium	50%	Unforeseeable	
Poor Project Intelligence	2	Medium	50%	Potential risk - same for all AFAs	
Other	1	Very Low	10%	None	
Environment					
Public Relations	2	Medium	50%	Low number of stakeholders but increasing flood risk	
Site Characteristics	2	Medium	50%	Presence of invasive non-native species unknown	
Environmental Impact	3	Medium	50%	No significant environmental impacts	
Permits / Consents / Approvals	2	Medium	50%	No anticipated delays associated with permits, consents or approvals	
Amenity and art	1	Low	30%	Small scheme with majority of works out of public sight	
Contaminated land	3	Medium	50%	Unknown	
Archaeology	3	Low	30%	Unknown - small scheme which can be adequately scoped	
Other	1	Very Low	10%	None	
External Influences					
Political	3	Medium	50%	Default risk value	
Economic	2	Medium	50%	Default risk value	
Legislation / Regulations	1	Medium	50%	Default risk value	
Multiple river users / stakeholders	2	Medium	50%	Low number of stakeholders but increasing flood risk	
Flood events during construction	3	Medium	50%	History of flooding	
Other	1	Very Low	10%	None	
	68	43%			
Weighting to apply: 0.441				Minimum Optimism Bias: 10%	
				Maximum Optimism Bias: 70%	
				Calculated Optimism bias: 36%	

1. Walls

1. Walls		Length of Wall	Height of Wall	Rate	Capital Cost of Wall	Maintenance Costs Estimate	PV Rate	PV Cost
No.	Select Wall Type from Dropdown	Comments	(m)	Min 0.6m Max 3.0m (m)	(€/m)	(€)	Select H/L (€/m)	PVC * Length (€)
1	Retaining Wall, Urban with sheet piling, <100m in length (€/m)		73.159	1.10	€ 2,060.26	€ 150,726.48	Average	€ 8.43 € 616.73
2	Retaining Wall, Urban with sheet piling, >100m in length (€/m)		170.739	1.40	€ 2,608.88	€ 445,437.20	Average	€ 8.43 € 1,439.33
							Average	
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2. Embankments

[illegible]

3. Demountable Barrier

[illegible]

3a. Flood Gate

[illegible]

4. In-Channel Excavation

4. In-Channel Excavation		Urban or Rural	Volume of Excavation	Rate	Cost of Excavation
		Select	Min 100m ³ Max 1,000m ³ (m ³)	(€/m ³)	(€)
No. Select Excavation Type from Dropdown	Comments				
				Total Cost	€ 0.00

Volume of Dredging		Rate	Cost of Dredging
No. Dredging	(m ³)	Select a Rate from Dropdown (€/m ³)	(€)
		Total Cost	€ 0.00

Total Excavation Costs € 0.00

5. Excavation on Land		Volume of Excavation	Rate	Cost of Excavation
No. Select Excavation Type from Dropdown	Comments	(m³)	(€/m³)	(€)
		Total Cost		€ 0.00

6. Weir Construction		Width of Weir	Rate	Capital Cost of Weir	Maintenance Costs Estimate	PV Cost/Weir
No. Select Weir Height from Dropdown	Comments	Min 10m Max 20m	(€/m)	(€)	Select H/L	(€/weir)
		(m)			Average	
		Capital Cost		€ 0.00	Total PV Cost	€ 0.00
				Total Cost		€ 0.00

7. Weir Removal		Length of Weir	Rate	Cost of Construction
No. Description of Weir	(m)	(€/m)	(€)	
		Total Cost		€ 0.00

8. Bridges		Remove or Replace	Area of Bridge	Rate	Cost of Construction	PV Costs
No. Description of Bridge		Select Yes/No	(m²)	(€/m²)	(€)	(€/bridge)
		Capital Cost		€ 0.00	€ 0.00	
				Total Cost		€ 0.00

9. Bridge Underpinning		Length of Bridge	Rate	Cost of Construction
No. Choose a suitable bridge from dropdown	Comments	(m)	(€/m)	(€)
		Total Cost		€ 0.00

10a. Culverts (Rural)		Disposal of Spoil	Ground Type	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert		Select	Select Soil/Rock	Select (m)	Select (m)	(m)	(€/m)	(€)	Select H/L	(€/m)	(€)
			Soil	2.5	(m)				High		
									Average		
									Low		
									Average		
									Average		
									Average		
									Average		
									Average		
									Average		
		Capital Cost						€ 0.00		Total PV Cost	€ 0.00
								Total Cost			€ 0.00

10b. Culverts (Urban)		Culvert	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert		Select New/Replacement	Select (m)	Select (m)	(m)	(€/m)	(€)	Select H/L	(€/m)	(€)
								High		
								Average		
								Low		
								Average		
								Average		
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								Average		
								Average		
								Average		
		Capital Cost					€ 0.00		Total PV Cost	€ 0.00
							Total Cost			€ 0.00

10c. Culverts (Headwall)		Length of Culvert	Culvert Size	Rate	Cost of Construction
No. Description of Culvert	(m)	Select (m)	(€/m)	(€)	
		Capital Cost		€ 0.00	
		Overall Capital Cost	€ 0.00	Overall PV Cost	€ 0.00
			Overall Cost		€ 0.00

11. Sluice Gates		Size Select	Maintenance Select	Operation Select	Maintenance Costs Estimate Select H/L	Capital Cost	PV Cost	Total Cost
No. Select Gate Type	Comments					(€)	(€)	(€)
1	Sluice Gates	1500	Woodland/open public or open non public locations with lower debris loads	Electric Operation	Average	€ 17,037.99	€ 46,365.04	€ 63,403.03
Capital Cost						€ 17,037.99	PV Cost	€ 46,365.04
						Total Cost		€ 63,403.03

12. Road Raising		Length of Road	Cost of Construction	Cost of Construction
No. Road Details		(m)	(€)	(€)
Total Cost			€ 0.00	€ 0.00

13. Individual Property Protection		Factor Select	Number of Units	Rate	Cost of Works	PV Rate	PV Cost
No. Property Type	Comments			(€)	(€)	(€)	(€)
1	Detached						
2	Semi-Detached						
3	Terraced						
4	Flat						
5	Residential average						
6	Shop						
7	Office						
Capital Cost				€ 0.00		PV Cost	€ 0.00
						Total Cost	€ 0.00

14. Hydrometric Gauging Stations		Number of Units	Maintenance Select H/L	Rate	Capital Cost of Units	PV Rate	PV Costs
No. Hydrometric Gauging Station	Comments			(€)	(€)	(€)	(€)
Capital Cost				€ 0.00		PV Cost	€ 0.00
						Total Cost	€ 0.00

15. Flood Forecasting		Signage Select Yes/No	Maintenance Select	Number of Units	Rate	Cost of Construction	PV Cost	PV Cost
No. Category	Comments				(€)	(€)	(€)	(€)
Capital Cost					€ 0.00		PV Cost	€ 0.00
							Total Cost	€ 0.00

16. Pumping Stations		Number of Units	Rate	Capital Cost	Operation Cost	Running Cost	PV Cost
No. Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
1	0.02 m3/s						
2	0.05 m3/s						
3	0.1 m3/s						
4	0.5 m3/s						
5	1.0 m3/s						
6	2.0 m3/s						
7	3.0 m3/s						
Capital Cost				€ 0.00		PV Cost	€ 0.00
						Total Cost	€ 0.00

17. Channel Maintenance		Length of Channel	Rate	Maintenance Costs
No. Channel Type	Comments	(m)	(€)	(€)
Total Cost			€ 0.00	

18. Bank Protection		Fluvial/Coastal Select	Maintenance Select	Length	Rate	Cost of Construction	PV Rate	PV Cost
No. Description of Bank Protection				(m)	(€/m)	(€)	(€)	(€)
		Fluvial	High					
Capital Cost						€ 0.00		PV Cost
								€ 0.00
						Total Cost		€ 0.00

19. Manhole Sealing		No. of Manholes	Rate	Cost of Construction
No. Manhole Type	Comments		(€)	(€)
Total Cost			€ 0.00	

Summary

UoM	19	Optimism Bias	37.18%
AFA	Castlemartyr	Site Investigation Estimate	€ 50,000.00
Option	2 - Flood defences	Preliminaries	16%
Description	Flood defences	Design Fees	13%
		Compensation and Land Acquisition	10%
		Archaeology and Environmental	10%
		Art Allowance	€ 25,943.36

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 1,621,014.51	€ 5,329.75	€ 1,626,344.26
2	Embankments	€ 9,364.37	€ 4,272.88	€ 13,637.25
3	Demountable Walls and Gates	€ 0.00	€ 0.00	€ 0.00
4	In-Channel Excavation	€ 0.00	€ 0.00	€ 0.00
5	Excavation on Land	€ 0.00	€ 0.00	€ 0.00
6	Weirs	€ 0.00	€ 0.00	€ 0.00
7	Weir Removal	€ 0.00	€ 0.00	€ 0.00
8	Bridges	€ 0.00	€ 0.00	€ 0.00
9	Bridge Underpinning	€ 0.00	€ 0.00	€ 0.00
10	Culverts	€ 0.00	€ 0.00	€ 0.00
11	Sluice Gates	€ 0.00	€ 0.00	€ 0.00
12	Road Raising	€ 0.00	€ 0.00	€ 0.00
13	Individual Property Protection	€ 0.00	€ 0.00	€ 0.00
14	Hydrometric Gauging Stations	€ 0.00	€ 0.00	€ 0.00
15	Flood Forecasting	€ 0.00	€ 0.00	€ 0.00
16	Pumping Stations	€ 0.00	€ 0.00	€ 0.00
17	Channel Maintenance	€ 0.00	€ 0.00	€ 0.00
18	Bank Protection	€ 0.00	€ 0.00	€ 0.00
19	Manhole Sealing	€ 0.00	€ 0.00	€ 0.00

€ 1,630,378.88	€ 9,602.63	€ 1,639,981.51
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Basic Construction Costs	€ 1,630,378.88
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Preliminaries	€ 260,860.62
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Optimism Bias	€ 703,096.10
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Construction Costs (Excl VAT)	€ 2,594,335.59
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Design Fees	€ 337,263.63
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Σ Construction Costs and Fees	€ 2,931,599.22
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Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 259,433.56
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Allowance for Compensation and Land Acquisition	€ 259,433.56
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Site Investigation	€ 50,000.00
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Art Allowance	€ 25,943.36
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PV O&M	€ 9,602.63
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PV O&M Optimism Bias	€ 3,569.92
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Σ Other Items	€ 607,983.03
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Option Cost for Cost Benefit Analysis	€ 3,539,582.25
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CFRAM Unit Cost Development Project

Optimism Bias Calculator

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Castlemartyr 2 - Flood defences

Project risk components that influence total project cost	Weight 1-3 (3 being a higher weight)	Risk value (0-100%) 0% = no risk 100% = risk expected and not mitigated		Key:	<div><div></div> Default weighting defined by OPW for all CFRAM projects</div> <div><div></div> Default risk value defined for all CFRAM projects</div> <div><div></div> Automated function cell (no input required)</div> <div><div></div> User defined - risk value, comments, justification</div>
		Select from Dropdown			
Procurement	Weight	Risk score		Comment/justification	
Complexity of Contract Structure	1	Medium	50%	Default risk value	
Late Contractor Involvement in Design	2	Medium	50%	Default risk value	
Poor Contractor Capabilities	1	Medium	50%	Default risk value	
Government Guidelines	1	Medium	50%	Default risk value	
Dispute & Claims Occurred	3	Medium	50%	Default risk value	
Information Management	1	Medium	50%	Default risk value	
Budgeting	2	Medium	50%	Default risk value	
Other	1	Medium	50%	Default risk value	
Project Specific					
Design Complexity	2	Medium	50%	Small scheme with low complexity - walls and a short section of embankment	
Degree of Innovation	2	Low	30%	Standard and proven methods	
Technology	2	Low	30%	No assets sensitive to technology	
Services	3	Medium	50%	Unknown - large amount of services not expected adjacent to watercourse except drainage outfalls	
Ground conditions	3	Medium	50%	Unknown	
Health and Safety	3	Low	30%	Small scheme with no unusual risks associated with works	
Other	1	Very Low	10%	None	
Client Specification					
Inadequacy of the Business Case	3	Medium	50%	Default risk value	
Large No. of Stakeholders	2	Medium	50%	Large number of stakeholders	
Funding Availability	2	Medium	50%	Default risk value	
Project Management Team	1	Medium	50%	Unforeseeable	
Poor Project Intelligence	2	Medium	50%	Potential risk - same for all AFAs	
Other	1	Very Low	10%	None	
Environment					
Public Relations	2	Medium	50%	Large number of stakeholders and interferences	
Site Characteristics	2	Medium	50%	Presence of invasive non-native species unknown	
Environmental Impact	3	Medium	50%	No significant environmental impacts	
Permits / Consents / Approvals	2	Medium	50%	No anticipated delays associated with permits, consents or approvals	
Amenity and art	1	Low	30%	Small scheme with majority of works out of public sight	
Contaminated land	3	Medium	50%	Unknown	
Archaeology	3	Medium	50%	Unknown - small scheme which can be adequately scoped	
Other	1	Very Low	10%	None	
External Influences					
Political	3	Medium	50%	Default risk value	
Economic	2	Medium	50%	Default risk value	
Legislation / Regulations	1	Medium	50%	Default risk value	
Multiple river users / stakeholders	2	Medium	50%	Large number of stakeholders and interferences	
Flood events during construction	3	Medium	50%	History of flooding	
Other	1	Very Low	10%	None	
	68	43%			
Weighting to apply: 0.453				Minimum Optimism Bias: 10%	
				Maximum Optimism Bias: 70%	
				Calculated Optimism bias: 37%	

1. Walls

[illegible]

2. Embankments

<u>2. Embankments</u>		Imported Material	Length of Embankment	Height of Embankment	Rate	Capital Cost of Embankment	Maintenance Costs Estimate	PV Rate	PV Cost
No.	Select Embankment from Dropdown	Select Yes/No	(m)	Min 1.0m Max 3.0m	(€/m)	(€)	Select H/L	(€/m)	PVC * Length
1	Rural clay embankment (€/m) < 100m	Yes	60.452	1.10	€ 154.91	€ 9,364.37	Average	€ 70.68	€ 4,272.88
							Average		
							Average		
							Average		
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							Average		
						Capital Cost	€ 9,364.37	Total PV Cost	€ 4,272.88
						Total Cost	€ 13,637.25		

3. Demountable Barrier

3. Demountable Barrier		Length of Wall	With Ground Beam Installation Select Yes/No	Height Select	Additional Costs Select	Rate (€/m)	Cost of Wall (€)	PV & Event Rate (€/m)	PV Including Events Costs (€)
No.	Select Demountable Barrier Span from Dropdown	Comments	(m)		(mm)				
						Capital Cost	€ 0.00	Total PV Cost	€ 0.00
						Total Cost		Total Cost	€ 0.00

3a. Flood Gate

3a. Flood Gate		No. of Flood Gates	Height Select (m)	Width Select (m)	Rate (€/gate)	Cost of Flood Gate (€)	PV & Event Rate (€/gate)	PV Costs (€)
No. Select Flood Gate from Dropdown	Comments							
Capital Cost						€ 0.00	Total PV Cost	€ 0.00
							Total Cost	€ 0.00
Overall Capital Cost						€ 0.00	Overall PV Cost	€ 0.00
							Overall Cost	€ 0.00

4. In-Channel Excavation

4. In-Channel Excavation		Urban or Rural	Volume of Excavation	Rate	Cost of Excavation
		Select	Min 100m ³ Max 1,000m ³ (m ³)	(€/m ³)	(€)
No. Select Excavation Type from Dropdown	Comments				
				Total Cost	€ 0.00

Volume of Dredging		Rate	Cost of Dredging
No. Dredging	(m ³)	Select a Rate from Dropdown (€/m ³)	(€)
		Total Cost	€ 0.00

Total Excavation Costs € 0.00

5. Excavation on Land		Volume of Excavation	Rate	Cost of Excavation
No. Select Excavation Type from Dropdown	Comments	(m³)	(€/m³)	(€)
		Total Cost	€ 0.00	

6. Weir Construction		Width of Weir	Rate	Capital Cost of Weir	Maintenance Costs Estimate	PV Cost/Weir
No. Select Weir Height from Dropdown	Comments	Min 10m Max 20m	(€/m)	(€)	Select H/L	(€/weir)
		(m)			Average	
		Capital Cost	€ 0.00		Total PV Cost	€ 0.00
				Total Cost	€ 0.00	

7. Weir Removal		Length of Weir	Rate	Cost of Construction
No. Description of Weir	(m)	(€/m)	(€)	
		Total Cost	€ 0.00	

8. Bridges		Remove or Replace	Area of Bridge	Rate	Cost of Construction	PV Costs
No. Description of Bridge		Select Yes/No	(m²)	(€/m²)	(€)	(€/bridge)
		Capital Cost	€ 0.00		€ 0.00	
				Total Cost	€ 0.00	

9. Bridge Underpinning		Length of Bridge	Rate	Cost of Construction
No. Choose a suitable bridge from dropdown	Comments	(m)	(€/m)	(€)
		Total Cost	€ 0.00	

10a. Culverts (Rural)		Disposal of Spoil	Ground Type	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert		Select	Select Soil/Rock	Select (m)	Select (m)	(m)	(€/m)	(€)	Select H/L	(€/m)	(€)
			Soil	2.5					High		
									Average		
									Low		
									Average		
									Average		
									Average		
									Average		
									Average		
									Average		
		Capital Cost	€ 0.00						Total PV Cost	€ 0.00	
										Total Cost	€ 0.00

10b. Culverts (Urban)		Culvert	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert	Select	Select	Select					H/L		
	New/Replacement	(m)	(m)	(m)	(€/m)	(€)		(€/m)	(€)	
								High		
								Average		
								Low		
								Average		
								Average		
								Average		
								Average		
								Average		
Capital Cost						€ 0.00		Total PV Cost		€ 0.00
								Total Cost		€ 0.00

10c. Culverts (Headwall)		Length of Culvert	Culvert Size	Rate	Cost of Construction
No. Description of Culvert	(m)	Select (m)	(€/m)	(€)	
		Capital Cost	€ 0.00		
		Overall Capital Cost	€ 0.00	Overall PV Cost	€ 0.00
				Overall Cost	€ 0.00

11. Sluice Gates		Size Select	Maintenance Select	Operation Select	Maintenance Costs Estimate Select H/L	Capital Cost	PV Cost	Total Cost
No. Select Gate Type	Comments					(€)	(€)	(€)
Capital Cost						€ 0.00	PV Cost	€ 0.00
						Total Cost		€ 0.00

12. Road Raising		Length of Road	Cost of Construction	Cost of Construction
Note cost is to raise road by 600mm				
No. Road Details	(m)	(€)	(€)	
Total Cost		€ 0.00	€ 0.00	

13. Individual Property Protection		Factor Select	Number of Units	Rate	Cost of Works	PV Rate	PV Cost
No. Property Type	Comments			(€)	(€)	(€)	(€)
1 Detached							
2 Semi-Detached							
3 Terraced							
4 Flat							
5 Residential average							
6 Shop							
7 Office							
Capital Cost					€ 0.00	PV Cost	€ 0.00
					Total Cost		€ 0.00

14. Hydrometric Gauging Stations		Number of Units	Maintenance Select H/L	Rate	Capital Cost of Units	PV Rate	PV Costs
No. Hydrometric Gauging Station	Comments			(€)	(€)	(€)	(€)
Capital Cost					€ 0.00	PV Cost	€ 0.00
					Total Cost		€ 0.00

15. Flood Forecasting		Signage Select Yes/No	Maintenance Select	Number of Units	Rate	Cost of Construction	PV Cost	PV Cost
No. Category	Comments				(€)	(€)	(€)	(€)
Capital Cost						€ 0.00	PV Cost	€ 0.00
						Total Cost		€ 0.00

16. Pumping Stations		Number of Units	Rate	Capital Cost	Operation Cost	Running Cost	PV Cost
No. Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
1 0.02 m3/s							
2 0.05 m3/s							
3 0.1 m3/s							
4 0.5 m3/s							
5 1.0 m3/s							
6 2.0 m3/s							
7 3.0 m3/s							
Capital Cost				€ 0.00		PV Cost	€ 0.00
				Total Cost		Total Cost	€ 0.00

17. Channel Maintenance		Length of Channel	Rate	Maintenance Costs
No. Channel Type	Comments	(m)	(€)	(€)
Total Cost			€ 0.00	

18. Bank Protection		Fluvial/Coastal Select	Maintenance Select	Length	Rate	Cost of Construction	PV Rate	PV Cost
No. Description of Bank Protection				(m)	(€/m)	(€)	(€)	(€)
	Fluvial	High						
Capital Cost						€ 0.00	PV Cost	€ 0.00
						Total Cost		€ 0.00

19. Manhole Sealing		No. of Manholes	Rate	Cost of Construction
No. Manhole Type	Comments		(€)	(€)
Total Cost			€ 0.00	

Summary

UoM	19	Optimism Bias	38.06%
AFA	Inchigeelagh	Site Investigation Estimate	€ 50,000.00
Option	1 - Flood defences	Preliminaries	20%
Description	Flood defences	Design Fees	13%
		Compensation and Land Acquisition	10%
		Archaeology and Environmental	10%
		Art Allowance	€ 25,500.00

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 690,797.73	€ 52,865.22	€ 743,662.95
2	Embankments	€ 116,701.56	€ 43,577.95	€ 160,279.51
3	Demountable Walls and Gates	€ 0.00	€ 0.00	€ 0.00
4	In-Channel Excavation	€ 0.00	€ 0.00	€ 0.00
5	Excavation on Land	€ 0.00	€ 0.00	€ 0.00
6	Weirs	€ 0.00	€ 0.00	€ 0.00
7	Weir Removal	€ 0.00	€ 0.00	€ 0.00
8	Bridges	€ 0.00	€ 0.00	€ 0.00
9	Bridge Underpinning	€ 0.00	€ 0.00	€ 0.00
10	Culverts	€ 0.00	€ 0.00	€ 0.00
11	Sluice Gates	€ 0.00	€ 0.00	€ 0.00
12	Road Raising	€ 0.00	€ 0.00	€ 0.00
13	Individual Property Protection	€ 0.00	€ 0.00	€ 0.00
14	Hydrometric Gauging Stations	€ 0.00	€ 0.00	€ 0.00
15	Flood Forecasting	€ 0.00	€ 0.00	€ 0.00
16	Pumping Stations	€ 130,200.00	€ 208,972.48	€ 339,172.48
17	Channel Maintenance	€ 0.00	€ 0.00	€ 0.00
18	Bank Protection	€ 0.00	€ 0.00	€ 0.00
19	Manhole Sealing	€ 0.00	€ 0.00	€ 0.00
		€ 937,699.29	€ 305,415.65	€ 1,243,114.94

Basic Construction Costs € 937,699.29

Preliminaries € 187,539.86

Optimism Bias € 428,252.78

Construction Costs (Excl VAT) € 1,553,491.92

Design Fees € 201,953.95

Σ Construction Costs and Fees € 1,755,445.87

Other Items

Allowance for Archaeology and € 155,349.19

Allowance for Compensation and € 155,349.19

Site Investigation € 50,000.00

Art Allowance € 25,500.00

PV O&M € 305,415.65

PV O&M Optimism Bias € 116,237.60

Σ Other Items € 807,851.64

Option Cost for Cost Benefit Analysis € 2,563,297.51

CFRAM Unit Cost Development Project

Optimism Bias Calculator

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Inchigeelagh 1 - Flood defences

Project risk components that influence total project cost	Weight 1-3 (3 being a higher weight)	Risk value (0-100%) 0% = no risk 100% = risk expected and not mitigated		Key:	<div><div></div> Default weighting defined by OPW for all CFRAM projects</div> <div><div></div> Default risk value defined for all CFRAM projects</div> <div><div></div> Automated function cell (no input required)</div> <div><div></div> User defined - risk value, comments, justification</div>
		Select from Dropdown			
Procurement	Weight	Risk score		Comment/justification	
Complexity of Contract Structure	1	Medium	50%	Default risk value	
Late Contractor Involvement in Design	2	Medium	50%	Default risk value	
Poor Contractor Capabilities	1	Medium	50%	Default risk value	
Government Guidelines	1	Medium	50%	Default risk value	
Dispute & Claims Occurred	3	Medium	50%	Default risk value	
Information Management	1	Medium	50%	Default risk value	
Budgeting	2	Medium	50%	Default risk value	
Other	1	Medium	50%	Default risk value	
Project Specific					
Design Complexity	2	Medium	50%	Scheme with low complexity - embankments, walls and pump station	
Degree of Innovation	2	Low	30%	Standard and proven methods	
Technology	2	Medium	50%	Pump station and associated equipment required	
Services	3	Medium	50%	Unknown - large amount of services not expected in rural area	
Ground conditions	3	Medium	50%	Unknown	
Health and Safety	3	Low	30%	Scheme with no unusual risks associated with works	
Other	1	Medium	50%	Surface water drainage and pump stations	
Client Specification					
Inadequacy of the Business Case	3	Medium	50%	Default risk value	
Large No. of Stakeholders	2	High	70%	Large number of stakeholders	
Funding Availability	2	Medium	50%	Default risk value	
Project Management Team	1	Medium	50%	Unforeseeable	
Poor Project Intelligence	2	Medium	50%	Potential risk - same for all AFAs	
Other	1	Very Low	10%	None	
Environment					
Public Relations	2	High	70%	Large number of stakeholders and interferences	
Site Characteristics	2	Medium	50%	Presence of invasive non-native species unknown	
Environmental Impact	3	Medium	50%	No significant environmental impacts	
Permits / Consents / Approvals	2	Medium	50%	No anticipated delays associated with permits, consents or approvals	
Amenity and art	1	Low	30%	Rural scheme with large number of stakeholders	
Contaminated land	3	Medium	50%	Unknown	
Archaeology	3	Low	30%	Unknown - small scheme which can be adequately scoped	
Other	1	Very Low	10%	None	
External Influences					
Political	3	Medium	50%	Default risk value	
Economic	2	Medium	50%	Default risk value	
Legislation / Regulations	1	Medium	50%	Default risk value	
Multiple river users / stakeholders	2	Medium	50%	Large number of stakeholders and interferences	
Flood events during construction	3	Medium	50%	History of flooding	
Other	1	Very Low	10%	None	
	68	45%			
Weighting to apply: 0.468				Minimum Optimism Bias: 10%	
				Maximum Optimism Bias: 70%	
				Calculated Optimism bias: 38%	

1. Walls

<u>1. Walls</u>		Length of Wall		Height of Wall	Rate	Capital Cost of Wall	Maintenance Costs Estimate	PV Rate	PV Cost
		(m)	(m)	Min 0.6m Max 3.0m	(€/m)	(€)	Select H/L	(€/m)	PVC * Length (€)
No.	Select Wall Type from Dropdown	Comments							
1	Retaining Wall, Urban with sheet piling, <100m in length (€/m)	0	1.10		€ 2,060.26	€ 0.00	Average	€ 8.43	€ 0.00
2	Retaining Wall, Urban with sheet piling, >100m in length (€/m)	187.012	1.10		€ 1,965.89	€ 367,645.77	Average	€ 8.43	€ 1,576.51
3	Retaining Wall, Urban with sheet piling, <100m in length (€/m)	60.579	1.10		€ 2,060.26	€ 124,808.43	Average	€ 8.43	€ 510.68
4	Retaining Wall, Urban with sheet piling, <100m in length (€/m)	32.059	1.10		€ 2,060.26	€ 66,049.84	Average	€ 8.43	€ 270.26
		Additional cost of €50 k to install a sealed culvert where the steel shop is located. This sum is based on professional judgement.							
6	Retaining Wall, Urban (with stone cladding), <100m in length (€/m)	60.234	1.10		€ 1,366.23	€ 82,293.69	Average	€ 8.43	€ 507.77
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
Capital Cost						€ 690,797.73		Total PV Cost	€ 52,865.22
								Total Cost	€ 743,662.95

2. Embankments

[illegible]

3. Demountable Barrier

[illegible]

3a. Flood Gate

[illegible]

4. In-Channel Excavation

4. In-Channel Excavation		Urban or Rural	Volume of Excavation	Rate	Cost of Excavation
No.	Select Excavation Type from Dropdown	Comments	Select Min 100m³ Max 1,000m³ (m³)	(€/m³)	(€)
				Total Cost	€ 0.00

No.	Dredging	Volume of Dredging	Rate	Cost of Dredging
		(m³)	Select a Rate from Dropdown (€/m³)	(€)
			Total Cost	€ 0.00

5. Excavation on Land		Volume of Excavation	Rate	Cost of Excavation
No. Select Excavation Type from Dropdown	Comments	(m³)	(€/m³)	(€)
		Total Cost		€ 0.00

6. Weir Construction		Width of Weir	Rate	Capital Cost of Weir	Maintenance Costs Estimate	PV Cost/Weir
No. Select Weir Height from Dropdown	Comments	Min 10m Max 20m	(€/m)	(€)	Select H/L	(€/weir)
		(m)			Average	
		Capital Cost		€ 0.00	Total PV Cost	€ 0.00
				Total Cost	€ 0.00	

7. Weir Removal		Length of Weir	Rate	Cost of Construction
No. Description of Weir	(m)	(€/m)	(€)	
		Total Cost	€ 0.00	

8. Bridges		Remove or Replace	Area of Bridge	Rate	Cost of Construction	PV Costs
No. Description of Bridge		Select Yes/No	(m²)	(€/m²)	(€)	(€/bridge)
		Capital Cost		€ 0.00	€ 0.00	
				Total Cost	€ 0.00	

9. Bridge Underpinning		Length of Bridge	Rate	Cost of Construction
No. Choose a suitable bridge from dropdown	Comments	(m)	(€/m)	(€)
		Total Cost	€ 0.00	

10a. Culverts (Rural)		Disposal of Spoil	Ground Type	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert		Select	Select Soil/Rock	Select (m)	Select (m)	(m)	(€/m)	(€)	Select H/L	(€/m)	(€)
			Soil	2.5					High		
									Average		
									Low		
									Average		
									Average		
									Average		
									Average		
									Average		
									Average		
		Capital Cost						€ 0.00		Total PV Cost	€ 0.00
								Total Cost	€ 0.00		

10b. Culverts (Urban)		Culvert	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
No. Description of Culvert		Select New/Replacement	Select (m)	Select (m)	(m)	(€/m)	(€)	Select H/L	(€/m)	(€)
								High		
								Average		
								Low		
								Average		
								Average		
								Average		
								Average		
								Average		
								Average		
		Capital Cost					€ 0.00		Total PV Cost	€ 0.00
								Total Cost	€ 0.00	

10c. Culverts (Headwall)		Length of Culvert	Culvert Size	Rate	Cost of Construction
No. Description of Culvert	(m)	Select (m)	(€/m)	(€)	
		Capital Cost	€ 0.00		
Overall Capital Cost		€ 0.00	Overall PV Cost	€ 0.00	
				Overall Cost	€ 0.00

11. Sluice Gates		Size Select	Maintenance Select	Operation Select	Maintenance Costs Estimate Select H/L	Capital Cost	PV Cost	Total Cost
No. Select Gate Type	Comments					(€)	(€)	(€)
Capital Cost						€ 0.00	PV Cost	€ 0.00
						Total Cost		€ 0.00

12. Road Raising		Length of Road	Cost of Construction	Cost of Construction
Note cost is to raise road by 600mm				
No. Road Details	(m)	(€)	(€)	
Total Cost		€ 0.00	€ 0.00	

13. Individual Property Protection		Factor Select	Number of Units	Rate	Cost of Works	PV Rate	PV Cost
No. Property Type	Comments			(€)	(€)	(€)	(€)
1 Detached							
2 Semi-Detached							
3 Terraced							
4 Flat							
5 Residential average							
6 Shop							
7 Office							
Capital Cost					€ 0.00	PV Cost	€ 0.00
					Total Cost		€ 0.00

14. Hydrometric Gauging Stations		Number of Units	Maintenance Select H/L	Rate	Capital Cost of Units	PV Rate	PV Costs
No. Hydrometric Gauging Station	Comments			(€)	(€)	(€)	(€)
Capital Cost					€ 0.00	PV Cost	€ 0.00
					Total Cost		€ 0.00

15. Flood Forecasting		Signage Select Yes/No	Maintenance Select	Number of Units	Rate	Cost of Construction	PV Cost	PV Cost
No. Category	Comments				(€)	(€)	(€)	(€)
Capital Cost						€ 0.00	PV Cost	€ 0.00
						Total Cost		€ 0.00

16. Pumping Stations		Number of Units	Rate	Capital Cost	Operation Cost	Running Cost	PV Cost
No. Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
1 0.02 m3/s							
2 0.05 m3/s							
3 0.1 m3/s		1	€ 130,200.00	€ 130,200.00	€ 80,429.30	€ 17,873.18	€ 98,302.48
4 0.5 m3/s							
5 1.0 m3/s							
6 2.0 m3/s							
7 3.0 m3/s							
Capital Cost				€ 130,200.00		PV Cost	€ 208,972.48
				Total Cost		Total Cost	€ 339,172.48

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17. Channel Maintenance		Length of Channel	Rate	Maintenance Costs
No. Channel Type	Comments	(m)	(€)	(€)
Total Cost			€ 0.00	

18. Bank Protection		Fluvial/Coastal Select	Maintenance Select	Length	Rate	Cost of Construction	PV Rate	PV Cost
No. Description of Bank Protection				(m)	(€/m)	(€)	(€)	(€)
	Fluvial	High						
Capital Cost						€ 0.00	PV Cost	€ 0.00
						Total Cost		€ 0.00

19. Manhole Sealing		No. of Manholes	Rate	Cost of Construction
No. Manhole Type	Comments		(€)	(€)
Total Cost			€ 0.00	

CFRAM Unit Cost Development Project

Method	Complex Forecast for Catchment		
Prepared by:	T. Donovan	Date:	23/02/2016
Checked by:	B. O'Connor	Date:	23/02/2016

Project reference	SWCFRAM	Project name:	Ballingeary / Inchigeelagh AFA
Base date for estimates (year 0)	Feb-2016	Construction Price Index (CPI)	1.000
Scaling factor (e.g. €m, €k, €)	€	Method Factor - to take into account particular site issues /constraints	1.00

This sheet should only be used when assessing single method options as double counting may occur when method costs are added. Costing of complex forecasting over a catchment will depend on the number of gauges, type of forecast model and degree of existing forecast systems (hardware/software). Indicative costs for each element of a forecast model are provided. Appraisers must enter the units required to generate a total cost.

Single Method Capital Cost Tool for complex forecast

Specification, site survey and administration	Typical Rate (€)		Quantity	Unit	Rate (€)	Total cost (€)	Comment/justification
	Lower	Upper					
Specification and procurement of system	€2,000	€4,000	No.	1	€2,000	€2,000	
Site visit to determine gauge locations	€2,000	€4,000	No.	1	€2,000	€2,000	
Warning area survey			No.			€0	
Gauging and telemetry							
Raingauges	€3,000	€4,000	No.	0	€3,000	€0	
River gauges	€4,000	€5,000	No.	4	€4,000	€16,000	
Forecast model set-up, calibration, configuration and testing							
Hydrological model build and calibration (PDM/routing)	€10,000	€35,000	No.	1	€15,000	€15,000	
Testing and configuration of system	€2,000	€5,000	No.	1	€2,000	€2,000	
Reporting	€3,000	€5,000	No.	1	€3,000	€3,000	
Forecasting system development							
Purchase of development of forecasting platform and licence costs	€40,000	€120,000	No.	1	€40,000	€40,000	
Computer hardware and backup systems	€5,000	€15,000	No.	1	€5,000	€5,000	
Web viewable forecast system (web server, licence, set up costs)	€60,000	€130,000	No.	1	€60,000	€60,000	
Design and plan of training package							
Design, preparation and documentation	€3,000	€8,000	No.	1	€3,000	€3,000	
Delivery and facilitation of training	€2,000	€4,000	No.	1	€2,000	€2,000	
Public awareness campaign							
% of full time equivalent at €30,000/year for year 1	N/A	N/A	%			€0	
Total costs						€150,000	
Apply update to unit rate (CPI) if appropriate (cell N15)						€150,000	
Enter appropriate preliminaries estimate (%) if applicable						0%	
Enter other applicable costs (€)						0	
Total capital cost (€)						€150,000	
Consider amendments based on site issues/constraints (cell N16)						€150,000	
Total capital cost (€)						€150,000	

Operation and Maintenance Cost Tool

Specification, site survey and administration	Typical Rate (€)		Quantity	Unit	Rate (€)	Total cost (€)
	Lower	Upper				
Raingauge maintenance and telemetry	€1,000	€2,000	No.	0	1000	€0
River gauge maintenance and telemetry	€1,000	€5,000	No.	4	1000	€4,000
Data (GPRS/GSM) costs	€200	€1,500	No.	1	200	€200
Forecasting management software shell maintenance	€5,000	€20,000	No.	1	5000	€5,000
Forecast model updates and re-calibration	€1,000	€2,000	No.	1	1000	€1,000
Hardware and backup system maintenance	€1,000	€2,000	No.	1	1000	€1,000
Total O&M cost (€)						€11,200

Other costs

Other costs (user defined - consider the need for additional longer term or intermittent costs)	€0
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Total PV Cost

Total PVC costs (see PVC calculator below)	€389,024
Optimism bias rate (from external sheet)	44%
Total Cost including Optimism Bias	€560,195

Whole life cost and Pvc analysis - for Complex Forecast for Catchment

Enter applicable costs (enabling, capital and O&M)

Enter year of capital works (all other costs start after this year)

Enter 'other' costs and frequency (e.g. replacement costs) if applicable

Enabling costs assume to start in year 0 (amend manually if required)

Enabling cost (€) (if applicable, may be sunk cost)	
Year of capital works (year)	0
Capital cost (€)	€150,000.0
Annual maintenance cost (€)	€11,200.0
Other cost (€)	€0.0
Other works frequency (years)	

Key

	Information
	Calculation
	Cost input

Discount rate:		4.0%	Present Value Factor: 22.341		Total Pvc (€k): 389024	
Cash sum		0	150000	548800	0	698800 389024
		Cost Elements				TOTALS:
year	Discount Factor	Enabling	Capital	Maint.	Other	Cash PV
0	1.000	0	150000			150000.0 150000.0
1	0.962			11200		11200.0 10769.2
2	0.925			11200		11200.0 10355.0
3	0.889			11200		11200.0 9956.8
4	0.855			11200		11200.0 9573.8
5	0.822			11200		11200.0 9205.6
6	0.790			11200		11200.0 8851.5
7	0.760			11200		11200.0 8511.1
8	0.731			11200		11200.0 8183.7
9	0.703			11200		11200.0 7869.0
10	0.676			11200		11200.0 7566.3
11	0.650			11200		11200.0 7275.3
12	0.625			11200		11200.0 6995.5
13	0.601			11200		11200.0 6726.4
14	0.577			11200		11200.0 6467.7
15	0.555			11200		11200.0 6219.0
16	0.534			11200		11200.0 5979.8
17	0.513			11200		11200.0 5749.8
18	0.494			11200		11200.0 5528.6
19	0.475			11200		11200.0 5316.0
20	0.456			11200		11200.0 5111.5
21	0.439			11200		11200.0 4914.9
22	0.422			11200		11200.0 4725.9
23	0.406			11200		11200.0 4544.1
24	0.390			11200		11200.0 4369.4
25	0.375			11200		11200.0 4201.3
26	0.361			11200		11200.0 4039.7
27	0.347			11200		11200.0 3884.3
28	0.333			11200		11200.0 3734.9
29	0.321			11200		11200.0 3591.3
30	0.308			11200		11200.0 3453.2
31	0.296			11200		11200.0 3320.4
32	0.285			11200		11200.0 3192.6
33	0.274			11200		11200.0 3069.9
34	0.264			11200		11200.0 2951.8
35	0.253			11200		11200.0 2838.3
36	0.244			11200		11200.0 2729.1
37	0.234			11200		11200.0 2624.1
38	0.225			11200		11200.0 2523.2
39	0.217			11200		11200.0 2426.2
40	0.208			11200		11200.0 2332.8
41	0.200			11200		11200.0 2243.1
42	0.193			11200		11200.0 2156.8
43	0.185			11200		11200.0 2073.9
44	0.178			11200		11200.0 1994.1
45	0.171			11200		11200.0 1917.4
46	0.165			11200		11200.0 1843.7
47	0.158			11200		11200.0 1772.8
48	0.152			11200		11200.0 1704.6
49	0.146			11200		11200.0 1639.9

CFRAM Unit Cost Development Project

Method	Complex Forecast for Catchment		
Prepared by:	T. Donovan	Date:	23/02/2016
Checked by:	B. O'Connor	Date:	23/02/2016

Project reference	SWCFRAM	Project name:	Castlemartyr AFA
Base date for estimates (year 0)	Feb-2016	Construction Price Index (CPI)	1.000
Scaling factor (e.g. €m, €k, €)	€	Method Factor - to take into account particular site issues /constraints	1.00

This sheet should only be used when assessing single method options as double counting may occur when method costs are added. Costing of complex forecasting over a catchment will depend on the number of gauges, type of forecast model and degree of existing forecast systems (hardware/software). Indicative costs for each element of a forecast model are provided. Appraisers must enter the units required to generate a total cost.

Single Method Capital Cost Tool for complex forecast

Specification, site survey and administration	Typical Rate (€)		Quantity	Unit	Rate (€)	Total cost		Comment/justification
	Lower	Upper				(€)	(€)	
Specification and procurement of system	€2,000	€4,000	No.	1	€2,000	€2,000		
Site visit to determine gauge locations	€2,000	€4,000	No.	1	€2,000	€2,000		
Warning area survey			No.			€0		
Gauging and telemetry								
Raingauges	€3,000	€4,000	No.	3	€3,000	€9,000		
River gauges	€4,000	€5,000	No.	3	€4,000	€12,000		
Forecast model set-up, calibration, configuration and testing								
Hydrological model build and calibration (PDM/routing)	€10,000	€35,000	No.	1	€10,000	€10,000		
Testing and configuration of system	€2,000	€5,000	No.	1	€2,000	€2,000		
Reporting	€3,000	€5,000	No.	1	€3,000	€3,000		
Forecasting system development								
Purchase of development of forecasting platform and licence costs	€40,000	€120,000	No.	1	€40,000	€40,000		
Computer hardware and backup systems	€5,000	€15,000	No.	1	€5,000	€5,000		
Web viewable forecast system (web server, licence, set up costs)	€60,000	€130,000	No.	1	€60,000	€60,000		
Design and plan of training package								
Design, preparation and documentation	€3,000	€8,000	No.	1	€3,000	€3,000		
Delivery and facilitation of training	€2,000	€4,000	No.	1	€2,000	€2,000		
Public awareness campaign								
% of full time equivalent at €30,000/year for year 1	N/A	N/A	%			€0		
Total costs						€150,000		
Apply update to unit rate (CPI) if appropriate (cell N15)						€150,000		
Enter appropriate preliminaries estimate (%) if applicable						0%		
Enter other applicable costs (€)						0		
Total capital cost (€)						€150,000		
Consider amendments based on site issues/constraints (cell N16)						€150,000		
Total capital cost (€)						€150,000		

Operation and Maintenance Cost Tool

Specification, site survey and administration	Typical Rate (€)		Quantity	Unit	Rate (€)	Total cost		Comment/justification
	Lower	Upper				(€)	(€)	
Raingauge maintenance and telemetry	€1,000	€2,000	No.	3	1000	€3,000		
River gauge maintenance and telemetry	€1,000	€5,000	No.	3	1000	€3,000		
Data (GPRS/GSM) costs	€200	€1,500	No.	1	200	€200		
Forecasting management software shell maintenance	€5,000	€20,000	No.	1	5000	€5,000		
Forecast model updates and re-calibration	€1,000	€2,000	No.	1	1000	€1,000		
Hardware and backup system maintenance	€1,000		No.	1	1000	€1,000		
Total O&M cost (€)						€13,200		

Other costs

Other costs (user defined - consider the need for additional longer term or intermittent costs)	€0	
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Total PV Cost

Total PVC costs (see PVC calculator below)	€431,707	
Optimism bias rate (from external sheet)	44%	
Total Cost including Optimism Bias	€621,659	

Whole life cost and Pvc analysis - for Complex Forecast for Catchment

Enter applicable costs (enabling, capital and O&M)

Enter year of capital works (all other costs start after this year)

Enter 'other' costs and frequency (e.g. replacement costs) if applicable

Enabling costs assume to start in year 0 (amend manually if required)

Enabling cost (€) (if applicable, may be sunk cost)	
Year of capital works (year)	0
Capital cost (€)	€150,000.0
Annual maintenance cost (€)	€13,200.0
Other cost (€)	€0.0
Other works frequency (years)	

Key

	Information
	Calculation
	Cost Input

Discount rate:		4.0%	Present Value Factor: 22.341		Total Pvc (€k): 431707	
Cash sum		0	150000	646800	0	796800 431707
		Cost Elements				TOTALS:
year	Discount Factor	Enabling	Capital	Maint.	Other	Cash PV
0	1.000	0	150000			150000.0
1	0.962			13200		12692.3
2	0.925			13200		12204.1
3	0.889			13200		11734.8
4	0.855			13200		11283.4
5	0.822			13200		10849.4
6	0.790			13200		10432.2
7	0.760			13200		10030.9
8	0.731			13200		9645.1
9	0.703			13200		9274.1
10	0.676			13200		8917.4
11	0.650			13200		8574.5
12	0.625			13200		8244.7
13	0.601			13200		7927.6
14	0.577			13200		7622.7
15	0.555			13200		7329.5
16	0.534			13200		7047.6
17	0.513			13200		6776.5
18	0.494			13200		6515.9
19	0.475			13200		6265.3
20	0.456			13200		6024.3
21	0.439			13200		5792.6
22	0.422			13200		5569.8
23	0.406			13200		5355.6
24	0.390			13200		5149.6
25	0.375			13200		4951.5
26	0.361			13200		4761.1
27	0.347			13200		4578.0
28	0.333			13200		4401.9
29	0.321			13200		4232.6
30	0.308			13200		4069.8
31	0.296			13200		3913.3
32	0.285			13200		3762.8
33	0.274			13200		3618.0
34	0.264			13200		3478.9
35	0.253			13200		3345.1
36	0.244			13200		3216.4
37	0.234			13200		3092.7
38	0.225			13200		2973.8
39	0.217			13200		2859.4
40	0.208			13200		2749.4
41	0.200			13200		2643.7
42	0.193			13200		2542.0
43	0.185			13200		2444.2
44	0.178			13200		2350.2
45	0.171			13200		2259.8
46	0.165			13200		2172.9
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48	0.152			13200		2009.0
49	0.146			13200		1931.7

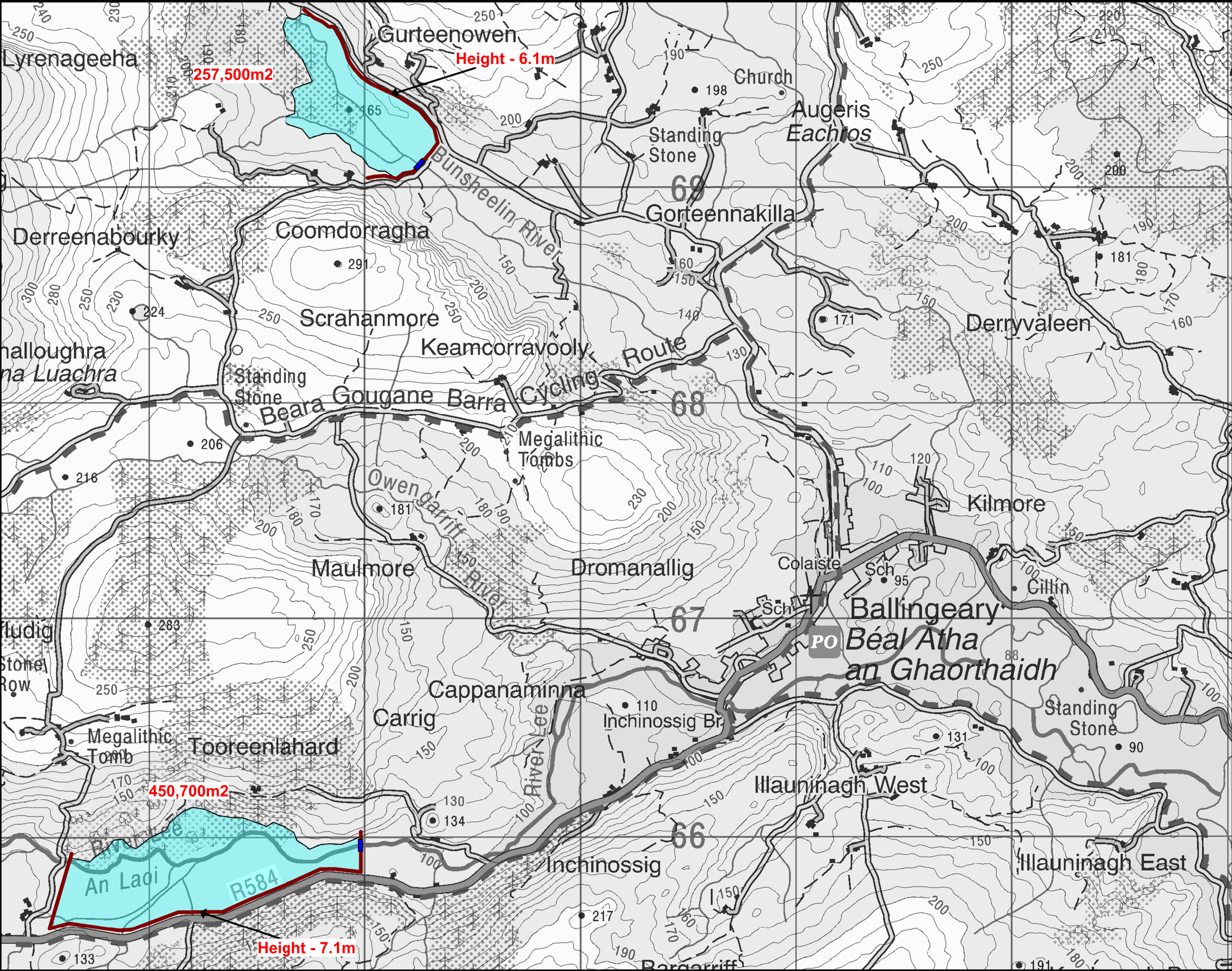
Appendix B. Drawings of Potential FRM Options



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100%

Drawing Scale: NTS	Plot Scale: 1:1 @ A3
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Storage Area

Embankment

Sluice Gate



Office of Public Works
Jonathan Swift Street
Trim, Co. Meath



Mott MacDonald Ireland
5 Eastgate Avenue
Little Island, Cork

Project : South Western CFRAM Study	
Map : Ballingeary Storage	
Map Type:	Preliminary Options
Source:	Fluvial Flooding
Map Area:	Urban Area
Scenario:	Current
Drawn by:	Tony Donovan
Checked by:	Barry O'Connor
Approved by:	Fintan McGivern
Map No.:	MMD-296235-E-DR-19-BY-202-P1
Sheet:	1 of 1
Drawing Scale:	NTS
Revision:	P1
Plot Scale:	1:1 @ A3



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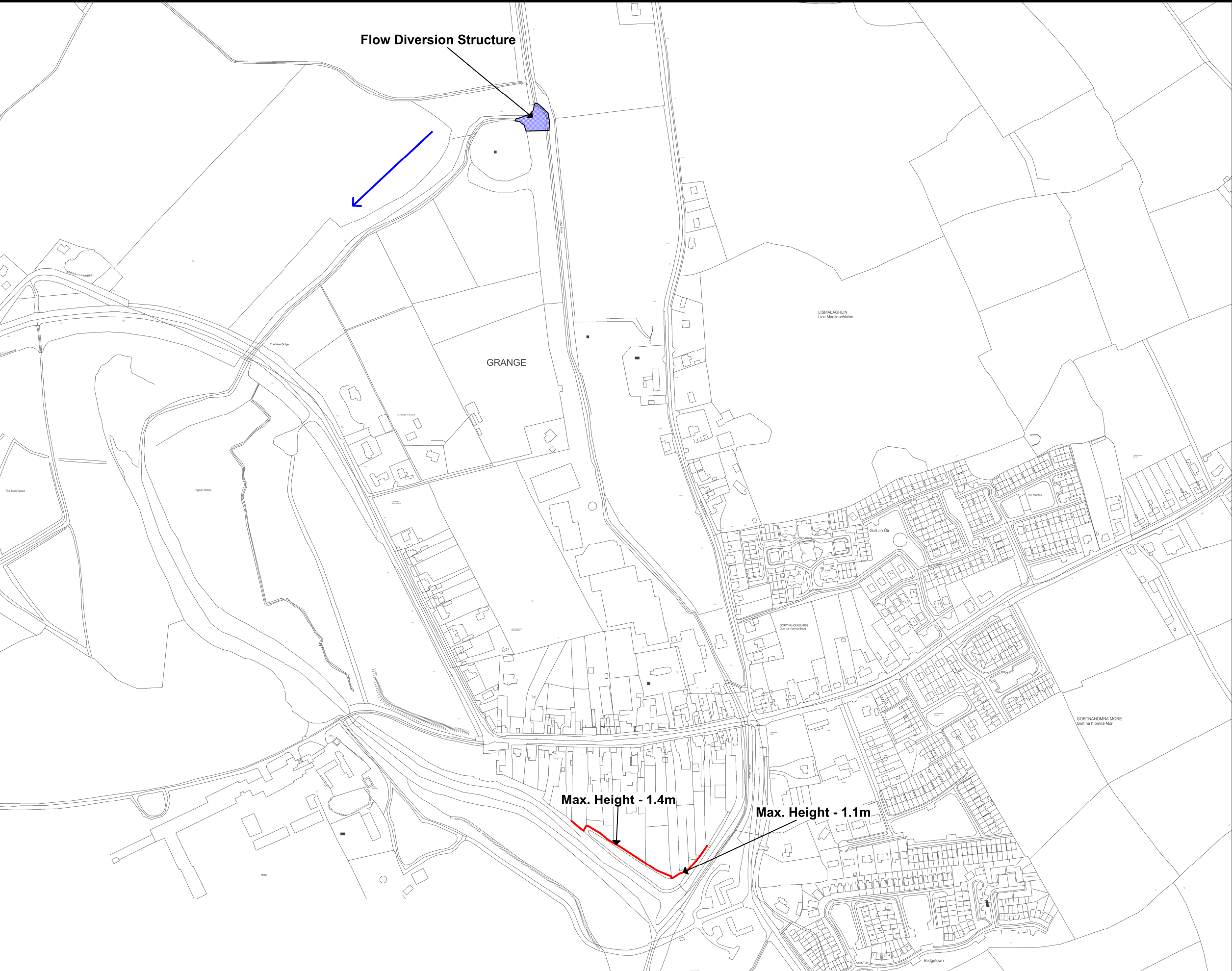


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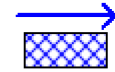
Flood Defence Embankments



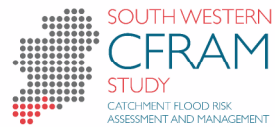
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Flow Diversion Structure



Flood Defence Walls



Office of Public Works
Jonathan Swift Street
Trim, Co. Meath



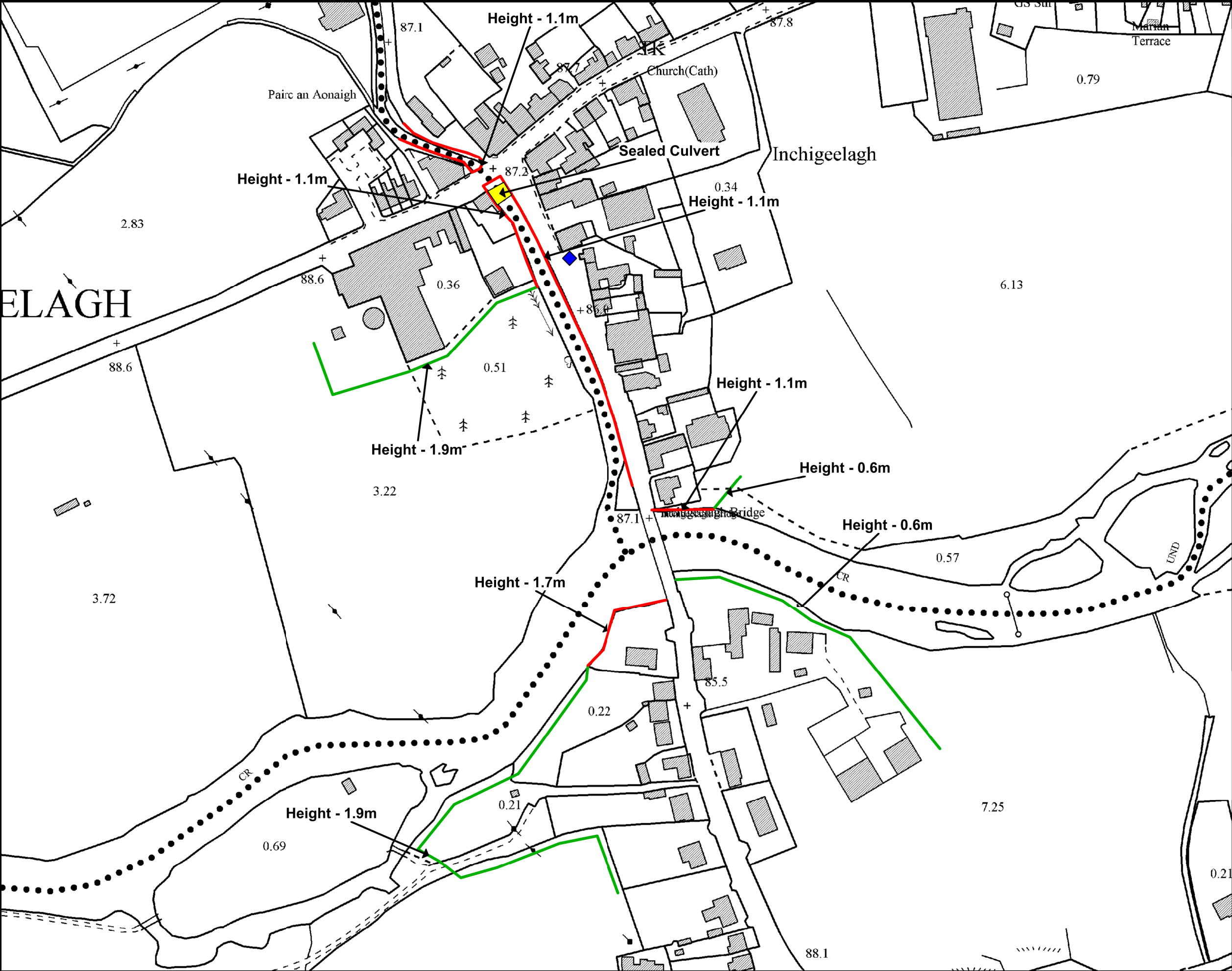
Mott MacDonald Ireland
5 Eastgate Avenue
Little Island, Cork

Project : South Western CFRAM Study	
Map : Castlemartyr Flow Diversion & Flood Defences	
Map Type:	Preliminary Options
Source:	Fluvial Flooding
Map Area:	Urban Area
Scenario:	Current
Drawn by:	Tony Donovan
Checked by:	Barry O'Connor
Approved by:	Fintan McGivern
Map No.:	MMD-296235-E-DR-19-CR-202-P1
Sheet:	1 of 1
Drawing Scale:	NTS
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Flood Defence Walls

Flood Defence Embankments

Sealed Culvert

Storm Water Pump Station



Office of Public Works
Jonathan Swift Street
Trim, Co. Meath



Mott MacDonald Ireland
5 Eastgate Avenue
Little Island, Cork

Project : South Western CFRAM Study	
Map : Inchigeelagh Flood Defences	
Map Type:	Preliminary Options
Source:	Fluvial Flooding
Map Area:	Urban Area
Scenario:	Current
Drawn by:	Tony Donovan
Checked by:	Barry O'Connor
Approved by:	Fintan McGivern
Map No.:	MMD-296235-E-DR-19-IH-201-P1
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Appendix C. Draft SEA Options Appraisal Report



South Western RBD CFRAM Study

SEA Options Appraisal Report
Unit of Management 19

June 2016

Office of Public Works

South Western RBD CFRAM Study

SEA Options Appraisal Report
Unit of Management 19

June 2016

Office of Public Works

Jonathan Swift Street
Trim
Co. Meath

Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
A	22nd February 2016	N. Roche R. Hallissey	P. Kelly	B. O'Connor	Issue for Client Review
B	28 th April 2016	N. Roche	P. Kelly	B. O'Connor	Update option
C	21 st June 2016	N. Roche	B O'Connor	F. McGivern	Final for consultation

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Executive Summary

The Office of Public Works (OPW) is undertaking six catchment-based flood risk assessment and management (CFRAM) studies to identify and map areas across Ireland which are at existing and potential future risk of flooding. Mott MacDonald Ireland Ltd. has been appointed by the OPW to assess flood risk and develop flood risk management options in the South Western River Basin District. This SEA Options Appraisal Report is one of a series of reports being produced as part of the South Western Catchment Flood Risk Assessment and Management Study (SW CFRAM Study). As part of the strategic environmental assessment (SEA) process to inform the development of the Flood Risk Management Plans this report has been prepared to assess the options to manage flood risk in Unit of Management 19 (Lee / Cork Harbour Catchment).

The findings from this assessment of the flood risk management options against the objectives defined in the previously prepared SEA Scoping Report will be integrated into the decision-making process for the selection of the preferred measures and options to manage flood risk in Unit of Management 19. These measures and options will form the basis for the Flood Risk Management Plan for this Unit of Management.

The strategic environmental assessment has identified that the preferred alternatives are as set out below.

Table 1.1: Preferred Flood Risk Management Options (UoM 19)

AFA	Preferred Flood Risk Management Option
Castlemartyr	Option 1 (Flood Defence)
Ballingeary	Option 1(Flood Defence)
Inchigeelagh	Option 1 (Flood Defence)

These findings will be integrated into the overall multi-criteria analysis for the identification of the overall preferred flood risk management option in each AFA.

Once the preferred flood risk management option has been identified in each AFA the Draft Flood Risk Management Plan will be prepared. The next stage (Stage 3) of the strategic environmental assessment process involves the identification of the environmental impacts (including where appropriate mitigation measures) and recommending monitoring for the evaluation of the plan.

1 Introduction

1.1 General

Flood risk management in Ireland has historically focused on land drainage schemes for the improvement of agricultural land. The 1945 Arterial Drainage Act established a national drainage authority (the Office of Public Works) with the remit of implementing a national arterial drainage programme. The Arterial Drainage Act was amended in 1995 to include for the protection of urban areas suffering from flooding.

In 2004, the Irish Government adopted a new National Flood Policy for Ireland which shifted the emphasis in addressing flood risk away from arterial drainage and targeted towards the protection of agriculture and cities /towns liable to serious flooding and towards a waterbody catchment-based flood risk assessment (a similar catchment-based management approach to that already being implemented under the Water Framework Directive 2000/60/EC).

In 2007, the Floods Directive [2007/60/EC] was published which requires the establishment of a framework of measures to reduce the risks of flood damage. The Floods Directive was transposed into Irish law by the European Communities (Assessment and Management of Flood Risks) Regulations, 2010 (S.I. No. 122 of 2010). The Regulations identify the Office of Public Works (OPW) as the lead agency in implementing flood management policy in Ireland.

Catchment Flood Risk Assessment and Management (CFRAM) Studies

For the purpose of delivering on the components of the National Flood Policy and on the requirements of the European Union Floods Directive, the OPW, in conjunction with Local Authorities and stakeholders, is conducting a number of Catchment Flood Risk Assessment and Management (CFRAM) Studies. These studies are the core activity from which medium to long-term strategies for the reduction and management of flood risk in Ireland will be achieved.

For the purpose of delivering on the components of the National Flood Policy and on the requirements of the European Union Floods Directive, the OPW, in conjunction with Local Authorities and stakeholders, is conducting a number of Catchment Flood Risk Assessment and Management (CFRAM) Studies. These studies are the core activity from which medium to long-term strategies for the reduction and management of flood risk in Ireland will be achieved.

The overarching objectives of the CFRAM Studies are to:

- Identify and map the existing and potential future flood hazard within the study area;
- Assess and map the existing and potential future flood risk within the study area;
- Identify viable structural and non-structural options and measures for the effective and sustainable management of flood risk within the study area; and
- Prepare Flood Risk Management Plans (FRMPs) setting out recommendations to manage the existing flood risk and also the potential future flood risk which may increase due to climate change, development, and other pressures that may arise in the future. FRMPs will set out policies, strategies, measures and actions that should be pursued by the relevant bodies (including

the OPW, Local Authorities and other Stakeholders), to achieve the most cost-effective and sustainable management of existing and potential future flood risk within the study area, taking account of environmental plans, objectives and legislative requirements and other statutory plans and requirements¹.

The OPW has commissioned a CFRAM study for each of Ireland's seven River Basin Districts (RBDs)².

1.2 Overview of the South Western River Basin District

The South Western River Basin District (SWRBD) covers an area of approximately 11,160 km². The study area of the SWRBD includes most of county Cork, large parts of counties Kerry and Waterford along with small parts of the counties of Tipperary and Limerick. The study area contains over 1,800 km of coastline along the Atlantic Ocean and the Celtic Sea.

In total, six Local Authorities administer the regions within the SWRBD: Cork County Council, Cork City Council, Kerry County Council, Waterford City and County Council, Tipperary County Council and Limerick County Council. Much of the SWRBD is rural and the predominant land usage is agriculture. The SWRBD contains Cork City (pop. 119,418) and a number of other large towns such as Killarney (pop. 13,497), Mallow (pop. 7,864) and Bandon (pop. 6,640).

Figure 1.1: South Western River Basin District (SWRBD)



¹ The Floods Directive requires that Flood Risk Management Plans should take into account the particular characteristics of the areas they cover and provide for tailored solutions according to the needs and priorities of those areas, whilst promoting the achievement of environmental objectives laid down in Community legislation.

² River Basin Districts (RBDs) are the main units for the management of river basins and have been delineated by Member States under Article 3 of the Water Framework Directive (2000/60/EC). RBDs are areas of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters.

The South Western River Basin District is divided into the following five Units of Management (UoMs)³:

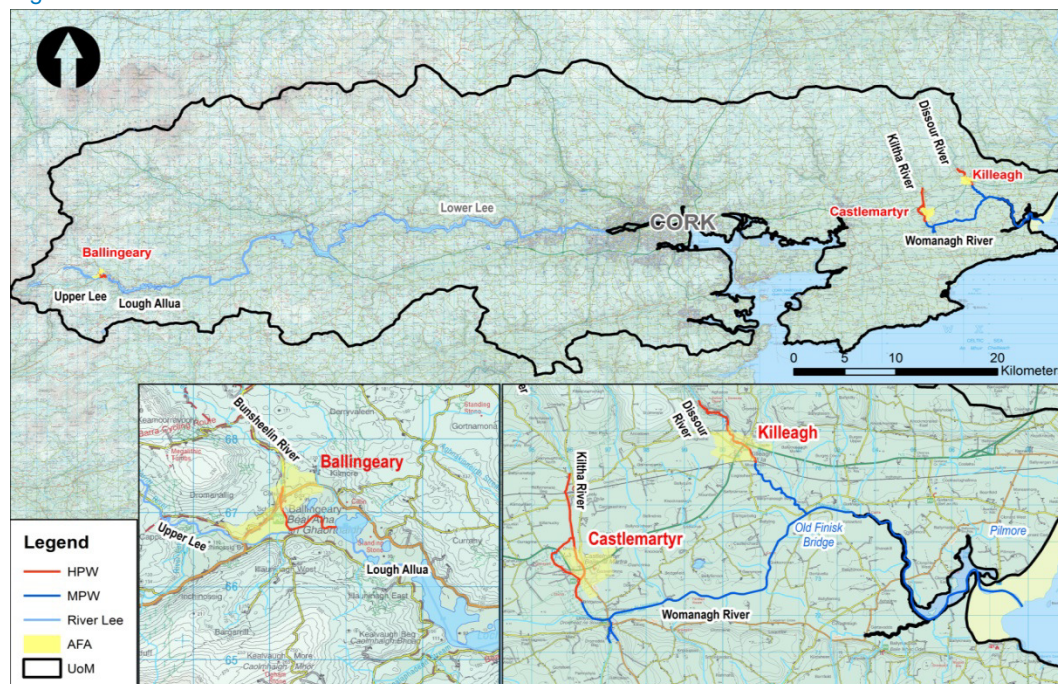
- The Munster Blackwater Catchment (UoM18);
- The Lee / Cork Harbour Catchment (UoM19);
- The Bandon / Skibbereen Catchment (UoM20);
- The Dunmanus / Bantry / Kenmare Bay Catchment (UoM21); and
- The Laune / Maine / Dingle Bay Catchment (UoM22).

Unit of Management 19, which forms part of the SWRBD, covers an area of approximately 2,145 km². The entire area of UoM 19 is within County Cork. The main rivers within UoM 19 are the Lee, Owenboy and Womagh. The OPW undertook a separate Catchment Flood Risk Assessment and Management (CFRAM) Study for the Lee Catchment which included all the main rivers and their tributaries draining into Cork Harbour (the Rivers Lee, Bride, Shournagh, Sullane, Owenboy, Glashaboy and Owennacurra). The town of Ballingeary in the upper reach of the Lee, which has been identified as an AFA and was not included in the Lee CFRAM. The SWRBD CFRAM therefore covers the entire Womagh River Catchment and also includes Ballingeary which was excluded from the Lee CFRAM. There are three Areas for Further Assessment (AFAs) within UoM19, these include Castlemartyr, Killeagh, and Ballingeary Inchingelagh. Killeagh AFA was ruled out of the optioneering process as it was determined that the risk of flooding is low. Associated with the AFAs is over 29km of high and medium priority watercourses. Based on the historical flood evidence, the key mechanisms for each of the AFA's are as follows:

- **Castlemartyr:** Flooding typically occurs due to the overtopping of river banks along the Kiltha River at Mogeely Road, as flow through Castlemartyr Bridge is constricted, causing water levels to rise upstream and flood the surrounding area.
- **Ballingeary and Inchingelagh:** Flooding typically occurs due to the overtopping of river banks along the River Lee and Bunsheelin River because the excess flows are unable to discharge into Lough Allua when water levels are raised by water from previous events. Ballingeary is also identified as at risk from pluvial flooding during intense rainfall events due to the limited capacity of the urban drainage network.

³ UoMs are representative of Hydrometric Area boundaries.

Figure 1.2: UoM 19



1.3 Purpose and Structure of this Report

Purpose

The CFRAM studies and Flood Risk Management Plans will be informed by a Strategic Environmental Assessment completed in accordance with the requirements of the SEA Directive (2001/42/EC), as transposed into Irish law through S.I. No. 435 and 436 of 2004 and S.I. No. 200 and 201 of 2011.

This report is a Strategic Environmental Assessment Options Appraisal Report and pertains to Unit of Management 19 (The Lee/Cork Harbour Catchment) the South Western River Basin District.

The purpose of this report is to:

- Review the environmental aspects associated with the alternative flood risk management options under consideration. Flood risk management options consist(s) of one or, more commonly, a combination of flood risk management (FRM) methods;
- Determine the benefits and impacts of the alternative options assessed and mitigation/environmental enhancement measures where considered appropriate;
- Evaluate and rank the alternative options against the Strategic Environmental Assessment (SEA) Objectives,

Indicators and Targets identified during the SEA Scoping Stage; and

- d) Identify the preferred flood risk management option from a strategic environmental assessment perspective.

Report Structure

Table 1.1: Report Structure

Chapter	Title	Purpose
1	Introduction	This chapter provides a broad background to the CFRAM Studies in the context of National Flood Policy and legislation. This section also sets out the purpose of the SEA Options Appraisal Study
2	Flood Risk Management Options	This chapter provides an overview of the processes associated with the identification of the preliminary flood risk management options and multi-criteria analysis.
3	Strategic Environmental Assessment	This chapter provides an overview of the SEA process and the relationship between CFRAM and SEA with a particular emphasis on the flood risk management options evaluation stage.
4	Appropriate Assessment	This chapter provides a brief overview of the AA process and the relationship between CFRAM and AA with a particular emphasis on the flood risk management options evaluation stage.
5	Castlemartyr	This chapter describes the flood risk management options for Castlemartyr and the identification of the preferred option from an SEA perspective.
6	Ballingeary	This chapter describes the flood risk management options for Ballingeary and the identification of the preferred option from an SEA perspective.
7	Inchigeelagh	This chapter describes the flood risk management options for Inchigeelagh and the identification of the preferred option from an SEA perspective
8	Conclusions and Next Steps	This chapter summarises the conclusion from the SEA Option Appraisal Study and the next steps in the SEA process.

2 Flood Risk Management Options

2.1 Introduction

A flood risk management option consists of one or, more commonly, a combination of flood risk management methods / measures. These methods/measures can be structural or non-structural in nature. The suitability of specific methods/measures needs to be reviewed on a case by case basis to ensure their appropriateness as all methods/measures may not be suitable in all circumstances.

Non-Structural Measures

Non structural measures can include one or a combination of some of the following;

Table 2.1: Non-Structural Measures

Measure	Description
Planning Control	This can include land-use development restrictions in statutory land-use plans (e.g. County/City Development Plans or Local Area Plans)
Building Regulations/Planning Conditions	This can involve requiring certain development/structures to be flood resilient through specified construction methods, building fabrics and uses (e.g. regulations relating to floor levels, flood-proofing, flood resilience, sustainable drainage systems, prevention of reconstruction or redevelopment in flood-risk areas, etc.);
Flood Forecasting	Flood forecasting is a means of providing advanced warning of an impending flood event. A reliable advance warning system allows protective measures to be put in place and protective actions to be carried out in advance of a flood event. These actions and measures can reduce the damage caused in a flood event.
Public Awareness	Public awareness measures include, for example; <ul style="list-style-type: none"> • Identification and disclosure of areas prone to flooding • Provision of information on the measures in place to provide advance warning of flooding • Establishment of methods to interface with the public and owners of vulnerable properties
Land-Use Management	Land Use Management includes strategies to control overland flow, such as improving agricultural and forestry practices in key catchment areas. Local natural flood management measures such as the creation of wetlands or forestry to retain overland flow could also be adopted.
Emergency Response Planning	Measures include strategic planning for the integrated response of the emergency services for flood risk and flood events

Structural Measures

Structural measures for flood risk management can include one or a combination of some of the following;

Table 2.2: Structural Measures

Flood Storage	Measures could include provision of flood storage/retardation system
Flow Diversion	This could include full diversion of provision of a by-pass channel/flood relief channel
Increased Conveyance	Measures could include in-channel works, floodplain earthworks, removal of constraints/constrictions or channel floodplain clearance.
Flood Defences	Flood defences can include such measures as walls, embankments or demountable defences
Improve Existing Defences	Existing defences could be repaired or gaps infilled.
Relocation of Properties	Existing properties could be relocated outside areas of flood risk
Localised Protection Works	This could involve such actions as minor raising of existing flood defences.
Flood Storage	Measures could include provision of flood storage/retardation system

2.2 Evaluating the Effectiveness of Flood Risk Management Options

Overview

The effectiveness of each of the viable flood risk management option (FRM) is measured in terms of how it achieve a set of Flood Risk Management Objectives through a process of multi-criteria analysis (MCA).

The objectives are split into a number of categories. These are;

- Technical;
- Economic;
- Social; and
- Environmental.

Some of the objectives within a particular category are further split into sub-objectives to provide clarity, particularly where individual objectives have multiple aspects associated with same.

Multi-Criteria Analysis Allocating Scores

Each sub objective has a basic requirement and an aspirational target associated with it. The basic requirement for each sub objective equates to a no change scenario. That is the status quo before the FRM option is adopted. The aspirational target in most cases is set to the highest achievement that is reasonably possible against the sub-objective in implementing the FRM option. The performance of each FRM option is measured against the basic and aspirational targets for each sub objective and assigned a score in accordance with the principles set out below.

Table 2.3: MCA Scoring

Option Performance	Score
Meets Aspirational Target	5
Partially Achieving Aspirational Target	Score in proportion to performance
Meeting Basic Requirement (No Change)	0

Option Performance	Score
Just Failing Basic Requirement	Score in proportion to performance
Fully Failing Basic Requirement	-5
Totally Failing Basic Requirement (Option Illegal or Totally Unacceptable)	-999

In the MCA the technical objectives measure if an option is robust in terms of operation. Higher scores are allocated to options that do not rely on mechanical, electrical or human intervention to operate effectively. Examples of such interventions include sluice gates, storm water over pumping, or erection of demountable barriers. The technical objectives also consider if the options can be constructed safely and if they can be managed effectively into the future.

The measurement of the performance of the options against the objective to avoid economic damage is measured in terms of the percentage of economic damage avoided by that option. When calculating the percentage reduction in damage for a particular option this is calculated relative to the total potential damages in the town. The economic objectives also measure the performance of the option in terms of reducing the risk to transportation routes, utility infrastructure and agricultural land.

The social objectives in the MCA include the reduction of flood risk to people, high vulnerability properties such as hospitals and fire stations and to social infrastructure and amenities. Under social objectives the MCA also measures the performance of the option to reduce the risk to local employment in relation to the number of non-residential properties at risk.

Under the environmental objectives the MCA measures the performance of the option as described below in accordance with the methodology as described in Chapter 3. This report has been prepared to describe the assessment of the FRM options against the environmental objectives.

Once all of the options have been analysed with reference to their performance against each of the sub-objectives the MCA score for each criteria can be calculated. This is done by multiplying the score for each sub objective by the Global and the Local Weighting and then by summing the weighted scores for all the sub objectives under that criteria.

Global and Local Weightings

In order to take account of the relative importance of some objectives in comparison other objectives, each sub-objective is given a Global Weighting. These global weightings are set at a national level and are the same across all of the CFRAM Studies. These weightings vary in value from 5 points to 30 points depending on their importance from a national perspective.

In order to take cognisance of the local perspective on the relative importance of objectives, each sub objective is also given a local weighting. Local weightings vary from 0 for not locally important to 5 for very important locally.

Multi-Criteria Analysis Overall Score

The **MCA Benefit Score** is calculated by adding the weighted score for the Economic, Social and Environmental Criteria together. This score represents the net benefits of the option.

The **Option Selection MCA Score** is calculated by adding the weighted scores of all the criteria together. This score includes the technical score and therefore includes all of the aspects that should be taken into account in considering the preferred option for a given location.

The **Total Construction Cost €** is the cost of the FRM option.

The **MCA Benefit – Cost Ratio** is calculated by dividing the **MCA Benefit Score** by the cost of the option. This is a numerical but non monetised ratio that indicates the overall benefits that can be delivered per euro of investment.

The **Economic Benefit €** is the cost of the damage avoided for the FRM Option

The **Economic Benefit – Cost Ratio** is calculated by dividing the cost of the damage avoided by adopting the FRM Option by the cost of the option. This is the traditional method used by OPW in assessing the economic case for proceeding with a flood relief scheme. In general terms a flood relief scheme would be considered economically viable if the benefit cost ratio is greater than 1.

3 Strategic Environmental Assessment

3.1 Introduction

The management of flood risk will be achieved through the implementation of measures which are selected to achieve an acceptable balance of environmental, social, and technical factors. As part of the process to select the measures, the evaluation of the alternatives from an environmental perspective is a key step in the Strategic Environmental Assessment process.

3.2 Overview of the SEA Process

The SEA process involves six key stages as follows:

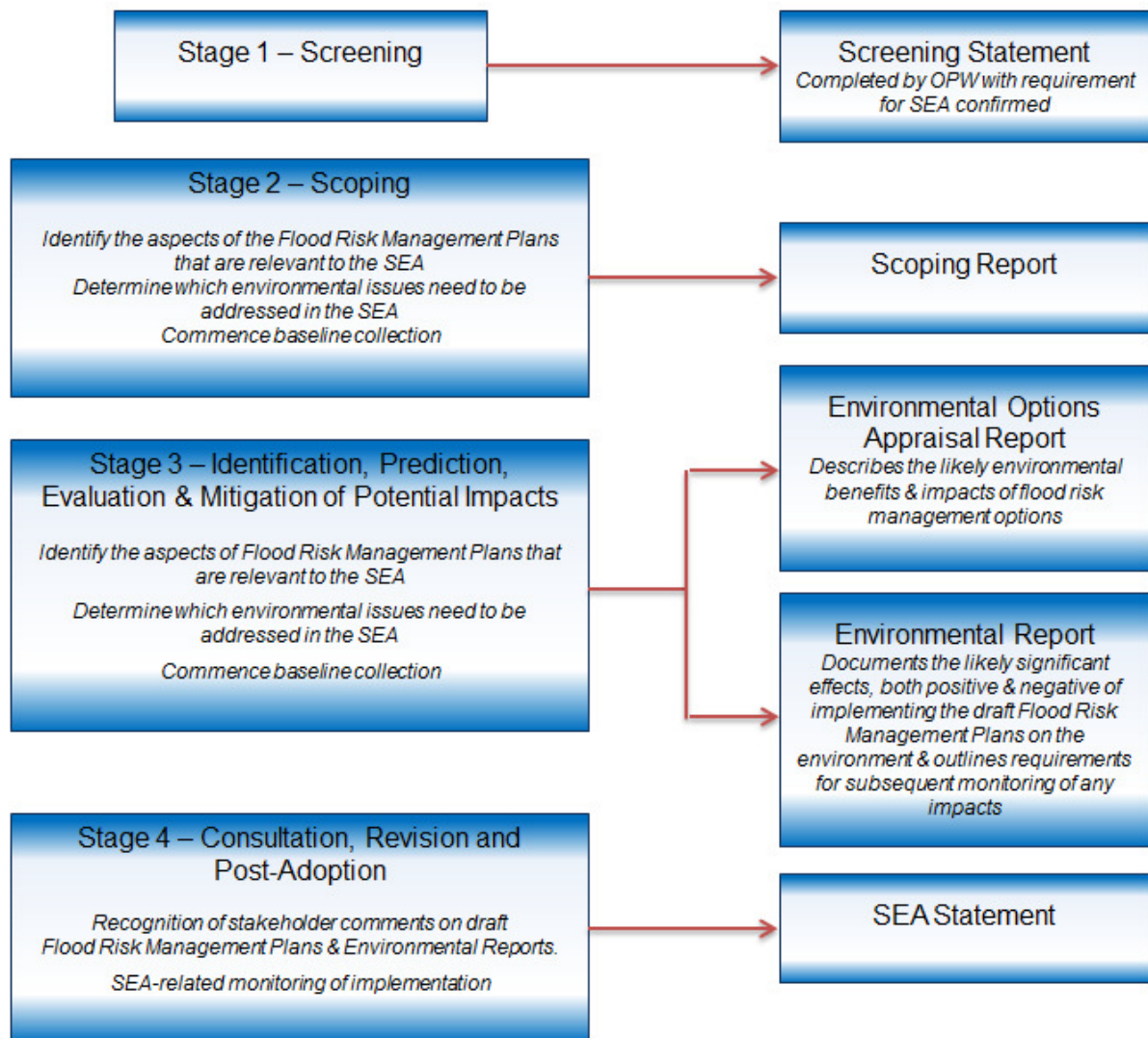
- **Screening** - the process of deciding whether the flood risk management plans would be likely to have significant environmental effects and as such would warrant a full SEA. The OPW conducted a screening assessment for the CFRAM studies in September 2011 which concluded that a full SEA is required.
- **Scoping** – Scoping determines the key environmental issues which are to be addressed in the Strategic Environmental Assessment. The scoping process set out a framework for the assessment of environmental effects resulting from a plan or programme and the generation of alternatives to ensure minimal environmental impact. The SEA process was completed in April 2015 following a consultation process with stakeholders.
- **Environmental Assessment and Environmental Report** – this is a key document in the SEA process as it outlines the likely significant effects on the environment of the Flood Risk Management Plan and recommends mitigation to address the significant adverse effects. The determination of the likely significant effects on the environment is based on a qualitative assessment under a series of Environmental Objectives. These environmental objectives are based on Environmental headings in Annex 2(f) of the *European Communities (Environmental Assessment of Certain Plans and Programmes) Regulations, 2004 (S.I. 435 of 2004)* as amended and include the following aspects:
 - Biodiversity;
 - Population;
 - Human health;
 - Fauna;
 - Flora;
 - Soil;
 - Water;

- Air;
- Climatic factors;
- Material assets;
- Cultural heritage including architectural and archaeological heritage;
- Landscape; and
- The inter-relationship of the above factors.

This document will also contain a history of the SEA process and how it was conducted with particular emphasis on stakeholder and public involvement;

- **Consultation on the Draft FRMP and SEA Environmental Report** – Consultation will be conducted with the relevant Environmental Authorities and also with the public. Both groups will be invited to make submissions in relation to the Draft Plan and Environmental Report. Submissions must be considered and the Environmental Report amended appropriately if deemed necessary;
- **SEA Statement** – From a legal and process perspective the production of the SEA Statement is the most important phase in the process. The function of the SEA Statement is to identify how the SEA process has influenced the plan. This requires careful scripting, particularly in the context of how differing opinions from consultees have been managed throughout the process. Another requirement of the SEA Statement is the inclusion of reasons for choosing the plan as adopted in light of the other reasonable alternatives considered.
- **Monitoring** - Monitoring requirements refer to the need to monitor the significant effects on the environment as a result of the implementation of the Flood Risk Management Plans. Monitoring begins with the adoption of the plan and continues for the duration of the plan.

Figure 3.1: Stages of SEA



3.3 SEA Objectives, Sub-Objectives and Targets

During the Scoping Stage, SEA objectives, sub-objectives and indicative targets were developed for each of the social and environmental criteria scoped into the study during this phase of the project. These objectives, sub-objectives and indicators have been developed to ensure that the SEA and multi-criteria flood risk management options appraisal focuses on those issues of relevance and significance to the

SWRBD. The SEA objectives align with the flood risk management objectives which have been developed on a national level through extensive consultation with stakeholders.

Table 3.1: SEA Objective, Sub-Objectives (and Targets)

Criteria	Objective	Sub-Objective	Example Indicator
Social	a Minimise risk to human health and life of residents	i Minimise risk to human health and life of residents	Number of residential properties at risk of flooding
		ii Minimise risk to high vulnerability properties	Number of high vulnerability properties at risk from flooding (e.g. hospitals, health centres, nursing and residential homes)
	b Minimise risk to community	i Minimise risk to social infrastructure and amenity	(i) Number of social infrastructure assets at risk from flooding (e.g. educational institutions, fire and Garda stations, Bord Gáis facilities). (ii) Number/length of key strategic transport assets at risk of flooding.
		ii Minimise risk to local employment	Number of non-residential properties at risk from flooding.
Environmental	a Support the objectives of the WFD	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	Likelihood to impact on water body status elements: <ul style="list-style-type: none"> • Biology; • Physico-chemical; • Hydrology and morphology; • Priority substances and priority hazardous substances.
	b Support the objectives of the Habitats Directive and Birds Directive	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, other protected sites, protected species and their key habitats, recognising relevant	(i) Area of internationally designated sites at risk from flooding and assessment of likely impact. (ii) Reported conservation status of internationally designated sites relating to flood risk management.

Criteria	Objective	Sub-Objective	Example Indicator
		landscape features and stepping stones.	
c	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	Avoid damage to or loss of, and where possible enhance, nature conservation sites and protected species or other known species of conservation concern	(i) Area of nationally designated sites at risk from flooding and assessment of likely impact, particularly where designated for Otter, White-clawed Crayfish or Freshwater Pearl Mussel (ii) Reported conservation status of nationally designated sites relating to flood risk management. (iii) Area/length of river within Freshwater Pearl Mussel sensitive areas where flood risk management actions are proposed, and assessment of likely impact.
d	Protect, and where possible enhance, fisheries resource within the catchment	Maintain existing and where possible create new fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species	(i) Area of suitable habitat supporting salmonid and other fish species (ii) Number of upstream barriers
e	Protect, and where possible enhance, landscape character and visual amenity within the zone of influence	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the zone of influence	(i) Length of waterway corridor qualifying as a landscape protection zone within urban areas (ii) Change of quality in existing scenic areas and routes (iii) Loss of public landscape amenities
f	Avoid damage and reduce risk of flooding to, or loss of, features, institutions and collections of cultural heritage importance and their setting	i Avoid damage and reduce risk of flooding to, or loss of, features, institutions and collections of	Number of architectural assets at flood risk and assessment of impact on their setting.

Criteria	Objective	Sub-Objective	Example Indicator
		architectural value and their setting	
	ii	Avoid damage and reduce risk of flooding to, or loss of, features, institutions and collections of archaeological value and their setting	Number of cultural heritage and archaeological assets at flood risk and assessment of impact on their setting.

Source: Mott MacDonald

3.4 Assessment of Alternatives

A key requirement for effective strategic environmental assessment is the evaluation of alternatives. The evaluation of alternatives from an SEA perspective is a key consideration in the determination of the best flood risk management option. This process has been described in detail in *Section 2.2 Evaluating the Effectiveness of Flood Risk Management Options*.

The Office of Public Works have published a Guidance Note under the National CFRAM Programme called *Option Appraisal and Multi-Criteria Analysis Framework (Revision C, April 2015)*. Appendix B to this guidance note includes a detailed description of each of the environmental objectives and the methodology for the environmental evaluation of the flood risk management options.

4 Appropriate Assessment

4.1 Introduction

Directive 2001/42/EC (Strategic Environmental Assessment Directive) requires that Strategic Environmental Assessment (SEA) must be carried out during the preparation stage of a Plan i.e. before the adoption of the Plan. When an Appropriate Assessment is being carried out for a plan it must be published concurrently/jointly with the SEA (as two separate reports). The outcomes and recommendations of each stage in the Appropriate Assessment process inform the Strategic Environmental Assessment and vice versa. It is important that the assessments be carried out in parallel in order that any environmental issues raised in each assessment can be considered as part of the other. Similarly, any mitigation or alternatives proposed must be addressed in both assessments.

Appropriate Assessment is specifically intended to determine the likely significant effects on European sites in view of their conservation objectives, and to ensure that no plan or project that would have adverse effects on the integrity of a European site is approved or adopted (unless in exceptional circumstances where the requirements of Article 6(4) of the Habitats Directive can be met). Appropriate assessment does not deal with all significant ecological issues of relevance to SEA, nor does it address all legal requirements in relation to the conservation and protection of ecological sites, habitats and species.

4.2 Habitats Directive Screening (for Appropriate Assessment)

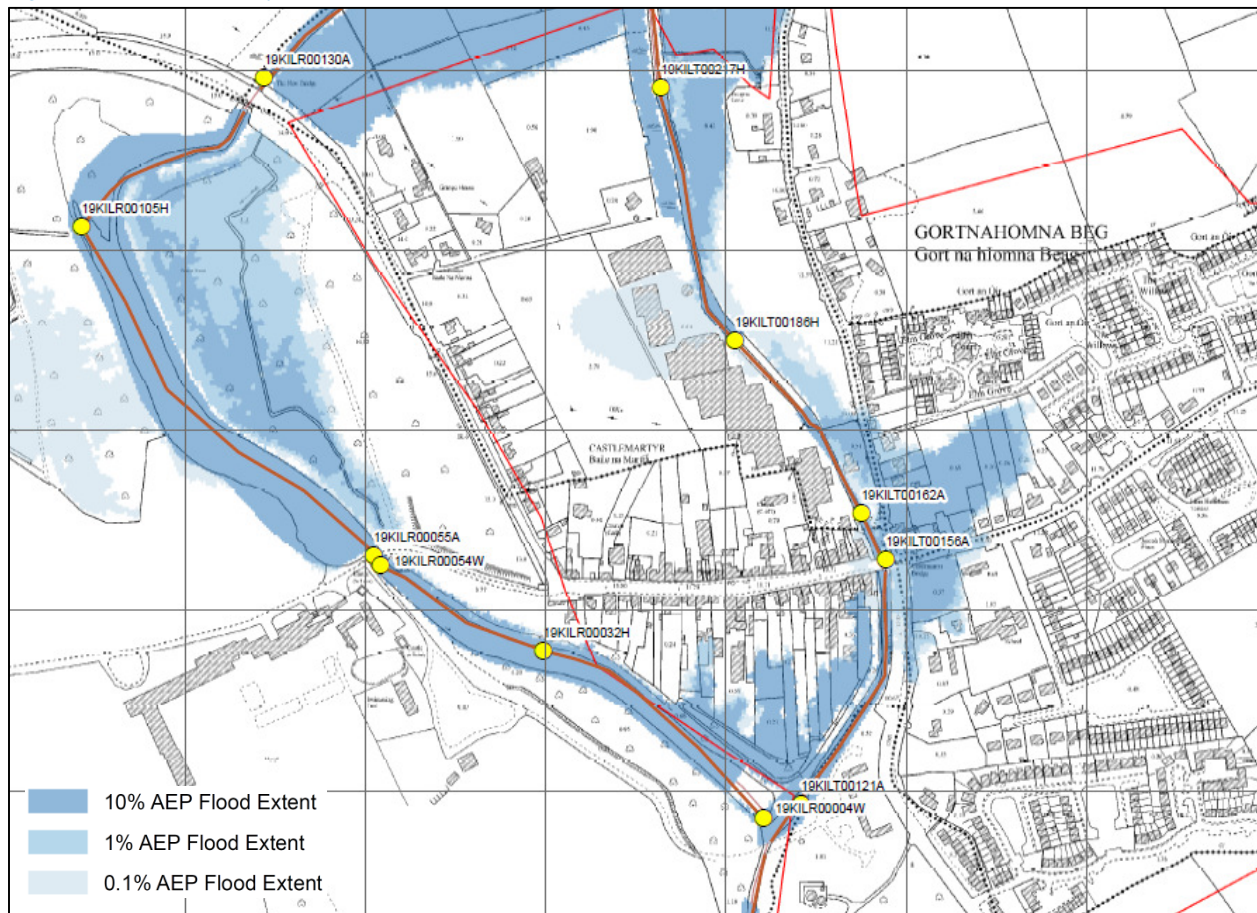
A separate draft Habitats Directive Screening (for Appropriate) Assessment has been developed to inform the Preliminary Options Report. The assessments have been included as an appendix to the Preliminary Options Reports.

5 Castlemartyr

5.1 Flood Risk

Castlemartyr is located on the confluence of the Kiltha River and Womanagh River in County Cork. The AFA and the existing fluvial flood risk are shown in Figure 5.1.

Figure 5.1: Castlemartyr Current Scenario Fluvial Flood Extents



5.2 Viable Flood Risk Management Options

A number of viable flood risk management options were identified and modelled to determine their effectiveness and impact. It should be noted that due to the strategic level of the assessment, the locations in which viable options may be constructed within the AFA may change at detailed design stage if an option is progressed through as a scheme. These are described below and illustrated in **Appendix A** of this report. Multi-criteria analysis (MCA) for each option was undertaken to assess if a preferred option could be established on environmental and social grounds. The detailed breakdown of SEA scoring for the purpose of this appraisal is provided in **Appendix B** of this report.

Option 1-Flood Defences This option includes the construction of flood walls and embankments ranging in height from 1.1m to 1.5m within the town. The locations and heights of the defences are provided in **Appendix A** of this report. The proposed flood defences fully achieve the required standard of protection for the 1% AEP fluvial event.

Option 2- Flood Defences and Flow Diversion – This option includes diverting excess flows (in excess of 7m³/sec) from the Kiltha River around the town through an existing bypass channel which is currently disused (Killamucky Stream). A new flow diversion structure is required to reconnect to the flow diversion channel. Flood walls will also be constructed within the town north of the confluence of the Killamucky stream and the River Kiltha ranging in height from 1.1m to 1.4m. The proposed flood defences fully achieve the required standard of protection for the 1% AEP fluvial event.

5.3

Environmental Sensitives

The key environmental sensitives of the Castlemartyr AFA are summarised below;

- The Womanagh River stretches from its source at Carrigour to its tidal outfall at Pilmore.
- The Kiltha River flows from Springfields/Mogeely southwards through Castlemartyr to join the Womanagh near Ladysbridge. Within Castlemartyr, a spring at Little Island diverts water from the Kiltha via the Castle, through the lake to re-join downstream of the town.
- The River Womanagh is classified as having a moderate to good water status under the Water Framework Directive (WFD) and is a considered sensitive body. Kilath is unclassified under the WFD.
- The rivers discharge into Youghal Bay a shellfish sensitive area designated under the European Communities (Quality of Shellfish Waters) Regulations 2006 as amended.
- The Castlemartyr AFA boundary does not overlap with any Natura 2000 site boundary. The Ballymacoda Bay Special Area of Protection (SPA) and Ballymacoda (Clonpriest and Pillmore) Special Area of Conservation (SAC) are located approximately 10km east of Castlemartyr. The Kiltha River (which flows through Castlemartyr) is hydrologically connected to Ballymacoda Bay via the Womanagh River.
- There are no significant polluting sources within the 1% Annual Exceedance Probability⁴ (AEP) flood extent.
- Womanagh River is not known as a river for high salmon/lamprey potential. There may be local fishing amenity value along the river.
- The village and surrounding area has a wealth of natural and built heritage. According to the Cork County Development Plan (2014), there are five buildings or other structures located within the village, which are entered in the Record of Protected Structures. These includes St. Anne's Church of Ireland and Castlemartyr Castle, which, along with its grounds and part of the village main street, are included

⁴ The Annual Exceedance Probability is the chance or probability of a flood event occurring annually and is usually expressed as a percentage. 1% AEP is event has a 1% chance of occurring in a year, so once in every 100 years.

as part of an Architectural Conservation Area. According to the Plan there is an objective to protect and enhance the special character of the area. These sites are not within the 1% AEP at risk from fluvial flooding.

- According to the Cork Development Plan (2014), Castlemartyr is located within an area characterised as “Broad Fertile Lowland Valley” landscape character type. This landscape character type is classified as having local value and medium sensitivity in its ability to accommodate change without adverse impact on its character and value. There are no scenic routes within the town.
- Receptors at risk from the 1% AEP flood extent within the AFA include:
 - 13 No. Residential properties
 - 9 No. Non-Residential properties
 - 1 No. Society Amenity Site
 - 3 No. Roads at risk
- There are no high vulnerability properties at risk from fluvial flooding within the AFA. There are no recorded or protected archaeological monuments or sites at risk 1% AEP within the AFA.

5.4 Environmental Assessment

Table 5.1 below provides a summary of the potential impacts arising from the proposed options as determined through the SEA assessment. In addition Table 5.1 below also highlights the requirement for mitigation measures for each option under each social and environmental objective. Table 5.1 should be read in conjunction with the SEA scoring matrix contained within **Appendix B**.

Table 5.1: Castlemartyr Options Scoring Matrix- Social and Environmental Objectives

SEA Objectives	Do nothing		Option 1		Option 2	
Social Objectives	Impact	Mitigation required	Impact	Mitigation required	Impact	Mitigation required
Human Health and life of residents	O	N	√√√	N	√√√	N
High vulnerability properties	O	N	O	N	O	N
Social infrastructure and amenity	O	N	√√	N	√√	N
Risk to local employment	O	N	√√√	N	√√√	N
Environmental Objectives						
WFD Directive	O	N	X	Y	X	Y
Birds and Habitats Directive	O	N	O	N	O	N
Flora and Fauna	O	N	X	Y	X X	Y
Fisheries	O	N	X X	Y	X	Y
Landscape	O	N	X	Y	X X	Y
Architectural Heritage	X X	Y	√√	Y	√	Y
Archaeological Heritage	O	N	√√	Y	√	Y

SEA Scoring Matrix

Score	Key	Description
+5	√√√	Achieving aspirational target
+4	√√	
+3	√√	Partly achieving aspirational target
+2	√	Exceeding minimum target
+1	√	
0	O	Meeting minimum target
-1	X	Just failing minimum target
-2	X	
-3	X X	Partly failing minimum target
-4	X X	
-5	XX X	Fully failing minimum target
-999.99	XX X	Unacceptable negative impact where feasible alternative exists

There are no significant polluting sources within the 1% Annual Exceedance Probability (AEP) flood extent within the Castlemartyr AFA. The construction stage of all measures could result in temporary negative impacts on the water body status, resulting from sedimentation, accidental pollution or loss of habitat in the absence of appropriate mitigation. However, *Option 2* will require in-stream works during the construction of the control structure in addition to the temporary impacts caused by disturbance to river bed and banks. This option will also result in permanent loss of river bed and bank within the footprint of the control structure. It is also considered that the diversion structure will not significantly alter the attainment of good water status in the long term.

Having regard to the requirements of the Habitats and Birds Directive, the AFA does not occur within any Natura 2000 site. There is no requirement for land take within a Natura 2000 site for the construction of the proposed measures. Potential removal of riparian habitat to accommodate the options will not impact the qualifying features of the SAC or SPA.

The Kiltha River is hydrologically connected to Ballymacoda Bay via the Womanagh River. Sediment release / accidental pollution of the Kiltha River could potentially enter the bay. The release of sediment into the bay is extremely unlikely to impact the qualifying features of the SAC. These habitats are habitually inundated with sediment during tidal exchanges and are adapted to such conditions. Pollutants e.g. concrete / oil leaks will be diluted by flows in the Kiltha River, the Womanagh River and also by estuarine water in the bay. It is highly unlikely that pollutants would reach the bay at such concentrations what would cause habitat damage.

All of the proposed options have the potential to cause disturbance to species of conservation importance , such as otters, and bats, through operational impacts generally associated with construction stage project, noise generated by the works and possibly artificial lighting that may be used in the darker evenings or in winter months in order to facilitate the construction works.

Option 1 includes the construction of extensive length of flood walls in the town, short term negative impacts are likely during the the construction including the possible removal of riparian habitat and riverside screen planting in order to facilitate the construction of the measures. Option 2 measures include a flow diversion for the Kiltha River. A new flow diversion structure will be required and the bypass channel will need to be cleared of debris / vegetation before coming on line. The proposed measure may result in the scouring in the Kiltha River at the bypass channel outlet and potential damage to habitat during the construction.

The protection of lamprey and salmon are not qualifying features within the Ballymacoda Bay SAC. Woamagh is not designated as a salmonid watercourse under the European Communities (Quality of Salmonid Waters) Regulations, 1988 and is not known as a river for high salmon/lamprey habitat potential. There may however be local fishing amenity value along the river. The flow diversion structure within *Option 2* will result in a permanent loss of fisheries habitat within the footprint of the structure.

The existing Kiltha River runs through Pigeon Wood. Pigeon Wood a long established woodland, is located immediately west of Castlemartyr AFA. This woodland comprises a mix of conifer plantation, broadleaf and mixed woodland. There are also areas which have been recently clear-felled. This is not Annex I habitat, it is outside the boundary of Natura 2000 sites and is not a qualifying feature. There is potential for destruction of woodland habitat to facilitate the access of machinery during the construction of the diversion structure.

In terms of the social objectives do something is always preferable, Options 1 and 2 achieve aspirational targets set out to minimise flood risk to residential properties and risk to the community within the AFA. Each of the options considered above score the same having regard to the protection the measures provide to human health and life of residents and protection provided to local employment within the AFA.

According to the Cork County Development Plan (2014), parts of the Castlemartyr main street are included within an Architectural Conservation Area (ACA), where it is an objective to protect and enhance the special character of the area. There are no protected buildings or recorded monuments and sites at risk within the 1% AEP extent within the AFA. All of the 'do something' options will however provide same protection for the town however there is no discernible difference between options in the context of potential impacts on the architectural setting and landscape value of the AFA. Option 1 includes the construction of flood walls within the town north of the confluence of the Killamucky stream and the River Kiltha ranging in height from 1.1m to 1.4m. There are a number of existing walls already within the town and the construction of the new defence walls are unlikely be notably different subject to a consistent visual appearance being integrated into the design process.

5.5 Preferred Flood Risk Management Option

On the basis of the detailed evaluation summarised above, Option 1 (Flood Defences) has been determined to be the preferred option.

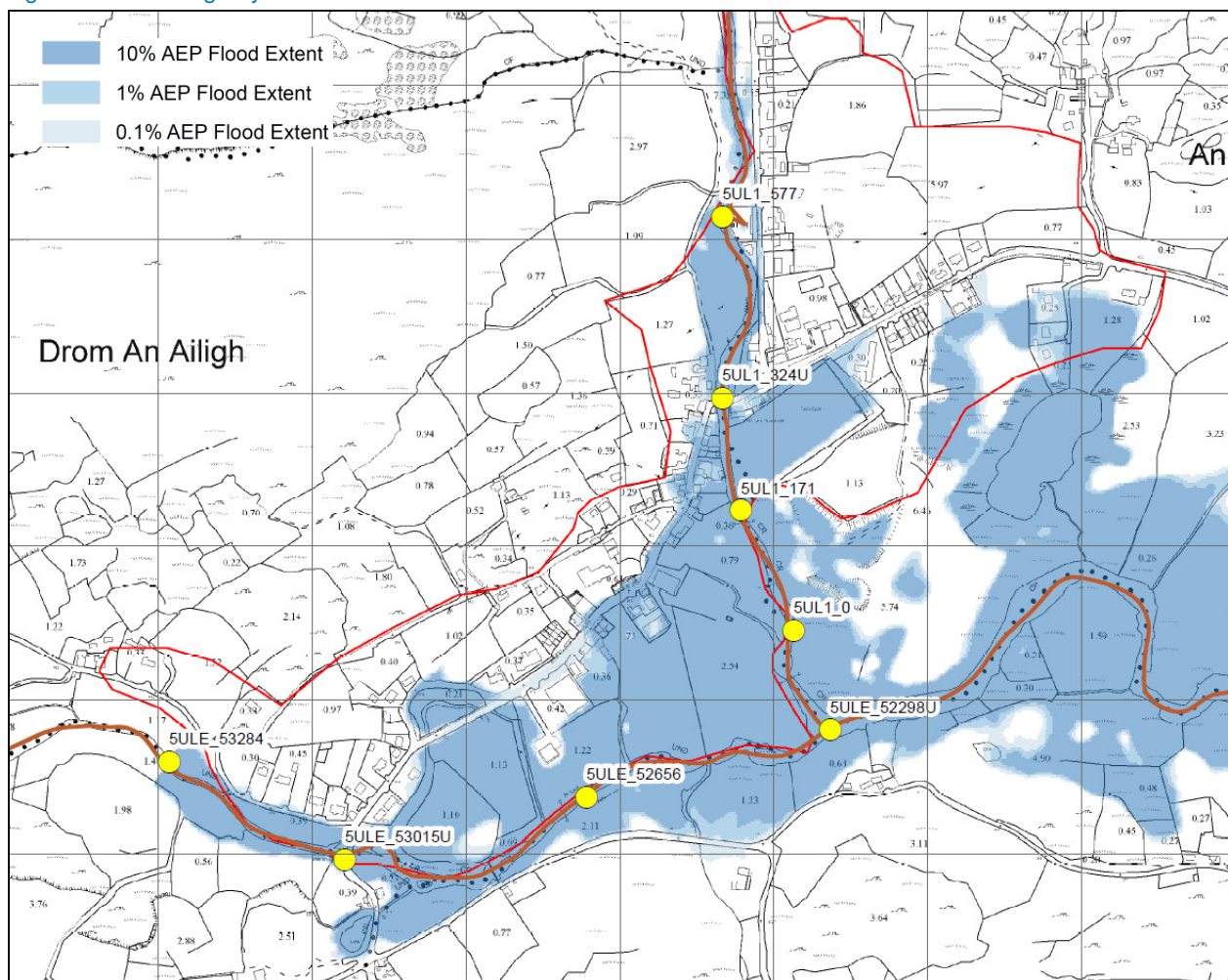
Mitigation actions are recommended for the identified negative effects. The key recommendation is that these negative impacts should be considered during the next stage of option development, when the alignment of the proposed defences and details of the option would be optimised through detailed design in order to limit impacts on the river channel and banks of the river.

6 Ballingeary

6.1 Flood Risk

Ballingeary is located along the upper reach of the River Lee in County Cork. Ballingeary is at risk of fluvial flooding. The AFA and the existing fluvial flood risk are shown in Figure 6.1.

Figure 6.1: Ballingeary – Current Scenario Fluvial Flood Extents



6.2 Viable Flood Risk Management Options

A number of viable flood risk management options were identified and modelled to determine their effectiveness and impact. It should be noted that due to the strategic level of the assessment, the locations in which viable options may be constructed within the AFA may change at detailed design stage if an option is progressed through as a scheme. These are described below and illustrated in **Appendix A** of this report. Multi-criteria analysis (MCA) for each option was undertaken to assess if a preferred option

could be established on environmental and social grounds. The detailed breakdown of SEA scoring for the purpose of this appraisal is provided in **Appendix B** of this report.

Option 1- Flood Defences- This option includes the construction of flood walls and embankments ranging in height from 0.7m to 1.5m within the town. The locations and heights of the defences are provided in **Appendix A** of this report. The proposed flood defences fully achieve the required standard of protection for the 1% AEP fluvial event.

Option 2-Storage- This option includes the construction of two flood storage areas on the River Lee and its tributary Bunsheelin of 450,700m² and 257,500m² respectively. This work will involve stream realignment, construction of embankments to contain flood waters and installation of a sluice gate to control flow from the storage.

6.3 Key Environmental Sensitivities

The key environmental sensitivities of the Ballingeary AFA are summarised below;

- The Bunsheelin stream and River Lee flows through Ballingeary. These watercourses are classified as good status under the WFD.
- The River Lee is designated as salmonid and considered a sensitive waterbody. Spawning grounds for salmonid are likely upstream along the River Lee. There is local fishing amenity value along the River Lee.
- There is one significant polluting source at risk from flooding in the 1% AEP.
- The AFA boundary does not overlap with any Natura 2000 site boundary. The Gearagh SPA and The Gearagh SAC are located approximately 15km southeast of Ballingeary. The sites are hydrological connected via the River Lee.
- According to the Cork County Development Plan (2014), the village occurs in a landscape character zone "Ridged and Peaked upland". The landscape value is considered to be high value and has a sensitivity of local importance.
- According to the Cork County Development (2014), the approach roads into the town are protected scenic routes.
- Receptors at risk from the 1% AEP flood extent within the AFA include:
 - 21 No. Residential properties
 - 25 No. Non-Residential properties
 - 2 No. Society Amenity Site
 - 3 No. Roads at risk
 - 1 No. High Vulnerability Properties
- There are no NIAH monuments at risk within the 1% AEP extent. The bridges within the town are RMP and these occur within the 1% AEP flood extent.

6.4 Environmental Assessment

Table 6.1 below provides a summary of the potential impacts arising from the proposed options as determined through the SEA assessment. In addition Table 6.1 below also highlights the requirement for mitigation measures for each option under each social and environmental objective. Table 6.1 should be read in conjunction with the SEA scoring matrix contained within **Appendix B**.

Table 6.1: Ballingear Options Scoring Matrix- Social and Environmental Objectives

SEA Objectives	Do nothing		Option 1		Option 2	
Social Objectives	Impact	Mitigation required	Impact	Mitigation required	Impact	Mitigation required
Human Health and life of residents	O	N	√√√	Y	√√√	Y
High vulnerability properties	O	N	O	N	O	N
Social infrastructure and amenity	O	N	O	N	O	N
Risk to local employment	O	N	√√	Y	√√	Y
Environmental Objectives						
WFD Directive	X	Y	√	Y	X	Y
Birds and Habitats Directive	O	N	O	N	O	N
Flora and Fauna	O	N	X	Y	X X	Y
Fisheries	X	Y	X	Y	X	Y
Landscape	O	N	O	N	X	Y
Architectural Heritage	O	N	O	N	O	N
Archaeological Heritage	O	N	O	N	√	Y

SEA Scoring Matrix

Score	Key	Description
+5	√√√	Achieving aspirational target
+4	√√	
+3	√√	Partly achieving aspirational target
+2	√	Exceeding minimum target
+1	√	
0	O	Meeting minimum target
-1	X	Just failing minimum target
-2	X	
-3	X X	Partly failing minimum target
-4	X X	
-5	XX X	Fully failing minimum target
-999.99	XX X	Unacceptable negative impact where feasible alternative exists

Having regard to the requirements of the Habitats and Birds Directive, the AFA does not occur within any Natura 2000 site. There is no requirement for land take within a Natura 2000 site for the construction of the proposed measures. Potential removal of riparian habitat to accommodate the options will not impact the qualifying features of the SAC or SPA..

The Bunsheelin stream, a tributary of the River Lee, flows through Ballingeary is hydrologically connected downstream to the Gearagh SAC. The release of sediment into the river is extremely unlikely to impact the qualifying features of the SAC. Pollutants e.g. concrete / oil leaks will be diluted by flows in the River Lee and its tributary. It is highly unlikely that pollutants would reach the Gearagh at such concentrations that would cause habitat damage. Therefore there are no preferences between the options having regard to potential impacts associated with the Birds and Habitats Directive objective.

Permanent fragmentation of linear riparian features resulting from the construction of very large embankments (e.g. 7m embankment in River Lee) which may deter commuting protected species from using an area. The construction of Option 2 will require significant instream works including the excavation of the river bed and bank material, a section of the river bed will be replaced by a concrete channel and walls such that the control structure can be anchored to the concrete. This will result in the loss of river bed and river bank within the footprint of the control structure.

The River Lee is designated as salmonid and is classified as having a good status under the WFD. The River Lee and its tributary are sensitive water bodies. There is one significant polluting source at risk from flooding in the 1% AEP. All of the options provide flood protection measures which assist in achieving the objectives of the WFD by prevent flooding. Spawning grounds for salmonid are likely upstream along the River Lee. Impacts on salmonid from sedimentation associated with instream works and construction of the embankments required for Option 2 are likely to be significant prior to mitigation. Having regard to the requirements of the WFD, Option 2 is the least preferred option.

Option 2 includes for the construction of a storage area, the proposed measures include the construction of 7m embankment, given the local topography this measure is likely to be visible from the scenic roads and will result in a permanent change in the landscape prior mitigation.

Option 1 includes the construction of flood walls within the town ranging in height from 0.7m to 1.5m. There are a number of existing walls already within the town and the construction of the new defence walls are unlikely be notably different subject to a consistent visual appearance being integrated into the design process.

In comparison to the Do-nothing scenario, in terms of the social objectives do something is always preferable. Each of the do something options considered above score the same in regard to the protection the measures provided to human health and life of residents and protection provided to local community within the AFA.

6.5 Preferred Flood Risk Management Option

On the basis of the detailed evaluation summarised above, Option 1 (Flood Defences) has been determined to be the preferred option.

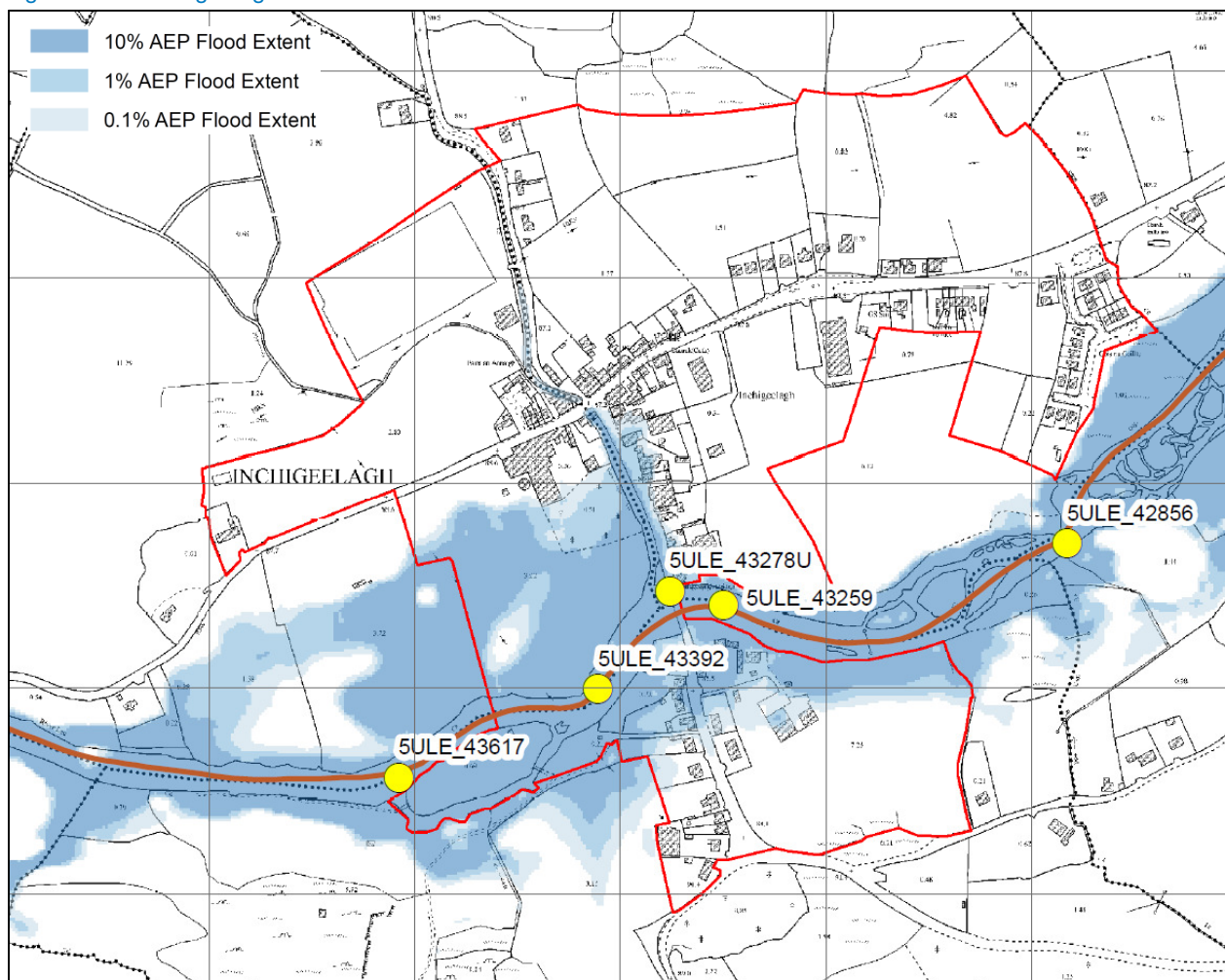
Mitigation actions are recommended for the identified negative effects. The key recommendation is that these negative impacts should be considered during the next stage of option development, when the alignment of the proposed defences and details of the option would be optimised through detailed design in order to limit impacts on the river channel and banks of the river.

7 Inchigeelagh

7.1 Flood Risk

Inchigeelagh is located along the River Lee in County Cork, approximately 8km downstream of Ballingeary. Inchigeelagh is at risk of fluvial flooding. The AFA and the existing fluvial flood risk are shown in Figure 7.1

Figure 7.1: Inchigeelagh – Current Scenario Fluvial Flood Extents



7.2 Viable Flood Risk Management Options

One viable flood risk management option was identified and modelled to determine its effectiveness and impact. This is described below and illustrated in **Appendix A** of this report. It should be noted that due to the strategic level of the assessment, the locations in which viable options may be constructed within the AFA may change at detailed design stage if an option is progressed through as a scheme. Multi-criteria analysis (MCA) for the option was undertaken to assess if a preferred option could be established on environmental and social grounds. SEA scoring for the purpose of this appraisal is provided in **Appendix B** of this report.

Option 1- Flood Defences; This option includes the construction of flood walls and embankments ranging in height from 0.6m to 1.9m within the village. This option also includes the sealing of an existing culvert within the village. The locations and heights of the defences are provided in **Appendix A** of this report. The proposed flood defences fully achieve the required standard of protection for the 1% AEP fluvial event.

7.3 Key Environmental Sensitives

The key environmental sensitives of the Inchigeelagh AFA are summarised below:

- The River Lee flows through Inchigeelagh AFA. This watercourse is classified as good status under the WFD.
- The River Lee is designated as salmonid and considered a sensitive waterbody. Spawning grounds for salmonid are likely upstream along the River Lee. River Lee is noted for its importance of fishery amenity value.
- There is one significant polluting source at risk from flooding in the 1% AEP.
- The Inchigeelagh AFA boundary does not overlap with any Natura 2000 site boundary. The Gearagh SPA and Gearagh SAC are located approximately 7km east of the village.
- According to the Cork County Development Plan (2014), the village occurs in a landscape character zone assigned as "Ridged and Peaked upland". The landscape value is considered to be high value and sensitivity of local importance.
- According to the Cork County Development Plan (2014), there are scenic routes on the approach road from Ballingeary.
- Receptors at risk from the 1% AEP flood extent within the AFA include:
 - 14 No. Residential properties
 - 14 No. Non-Residential properties
 - 1 No. Society Amenity Site
 - 2 No. Roads at risk
- There are no high vulnerability properties at risk from fluvial flooding within the AFA.
- There are no NIAH monuments at risk within the 1% AEP extent. There is one RMP within the 1% AEP extent.

7.4 Environmental Assessment

Table 7.1 below provides a summary of the potential impacts arising from the proposed options as determined through the SEA assessment. In addition Table 7.1 below also highlights the requirement for mitigation measures for each option under each social and environmental objective. Table 7.1 should be read in conjunction with the SEA scoring matrix contained within Appendix B.

Table 7.1: Inchigeelagh Options Scoring Matrix-Social and Environmental Objectives

SEA Objectives	Do Nothing		Option 1	
Social Objectives	Impact	Mitigation	Impact	Mitigation
Human Health and life of residents	0	N	√√√	0
High vulnerability properties	0	N	0	0
Social infrastructure and amenity	0	N	0	0
Risk to local employment	0	N	√√√	0
Environmental Objectives				
WFD Directive	O	Y	√	O
Birds and Habitats Directive	O	N	O	O
Flora and Fauna	X	Y	X	Y
Fisheries	O	Y	X	Y
Landscape	O	N	X	Y
Architectural Heritage	O	Y	O	Y
Archaeological Heritage	X	Y	O	Y

Source: Mott MacDonald

SEA Scoring Matrix

Score	Key	Description
+5	√√√	Achieving aspirational target
+4	√√	
+3	√√	Partly achieving aspirational target
+2	√	Exceeding minimum target
+1	√	
0	O	Meeting minimum target
-1	X	Just failing minimum target
-2	X	
-3	X X	Partly failing minimum target
-4	X X	
-5	XX X	Fully failing minimum target
-999.99	XX X	Unacceptable negative impact where feasible alternative exists

The 'do-something option', Option 1, can assist in contributing to maintaining the objectives of the Water Framework Directive by preventing flooding of the significant polluting source within the 1% AEP extent.

In the context of the Birds and Habitat Directive objective, it should be noted that there are no Natura 2000 sites within the AFA. The proposed works will have the potential to cause disturbance to species of conservation importance such as otters through operation of construction machinery and personnel, noise generated by the works and possibly artificial lighting that may be used in the darker winter months.

The River Lee is recognised as an important river for supporting salmon species and it is recognised as having high fishery value. The proposed works will not directly impact on the River Lee, however the works may require excavation of the bank of river during the construction stage. This would result in short term damage to habitat and emissions of sediment to the waterbody and downstream on the River Lee without appropriate mitigation measures being implemented. There is a potential need for access restrictions to the local fishery for during the construction stage.

The proposed measures within Option 1 will change the views across the river from the bridge, however the wall and embankments relatively low lying. The construction of the low lying walls along the river bank is unlikely to adversely impact on the views along the road. There is potential to include landscape planting as part of the design of the embankments. The proposed measures will likely change the existing landscape form in the short term during construction.

The construction of the low lying walls has potential impacts on the setting of the Church/Parish Hall (CO081-014001) within the AFA, however there are currently low lying stone wall parallel to the local road, the proposed measures will result in a height increase of approximately 0.5m and the measures will provide protection to this monument.

In comparison to the Do-nothing scenario, in terms of the social objectives do something is always preferable, the viable option, Option 1, exceeds the minimum targets set out to minimise flood risk to residential properties and risk to the community within the AFA.

7.5 Preferred Flood Management Options

On the basis of the detailed evaluation as summarised above, Option 1, on the Brewery River in combination with localised flood defences on the River Lee is considered to be the preferred option.

Mitigation actions are recommended for the identified negative effects. The key recommendation is that these negative impacts should be considered during the next stage of option development, when the alignment of the proposed defences and details of the option would be optimised through detailed design in order to limit impacts on the river channel and banks, particularly on water quality status of the river and setting of the protected monuments within the town.

8 Conclusions and Next Steps

8.1 Conclusions

The strategic environmental assessment has identified that the preferred alternatives are as set out below.

Table 8.1: Preferred Flood Risk Management Options (UoM 20)

AFA	Preferred Flood Risk Management Option
Castlemartyr	Option 1 (Flood Defences)
Ballingeary	Option 1 (Flood Defences)
Inchingeelagh	Option 1 (Flood Defences)

8.2 Next Steps

The findings from the strategic environmental assessment of the flood risk management options will be integrated into the overall multi-criteria analysis for the identification of the overall preferred flood risk management option in each AFA.

Once the preferred flood risk management option has been identified in each AFA the draft flood risk management plan will be prepared. The next stage (Stage 3 with reference Figure 3-1 in Chapter 3 of this report) of the strategic environmental assessment process involves the identification of the environmental impacts (including where appropriate mitigation measures) and recommending monitoring for the evaluation of the plan.

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A. AFA Option Drawings

Figure A.1: Castlemartyr Option 1 Flood Defences

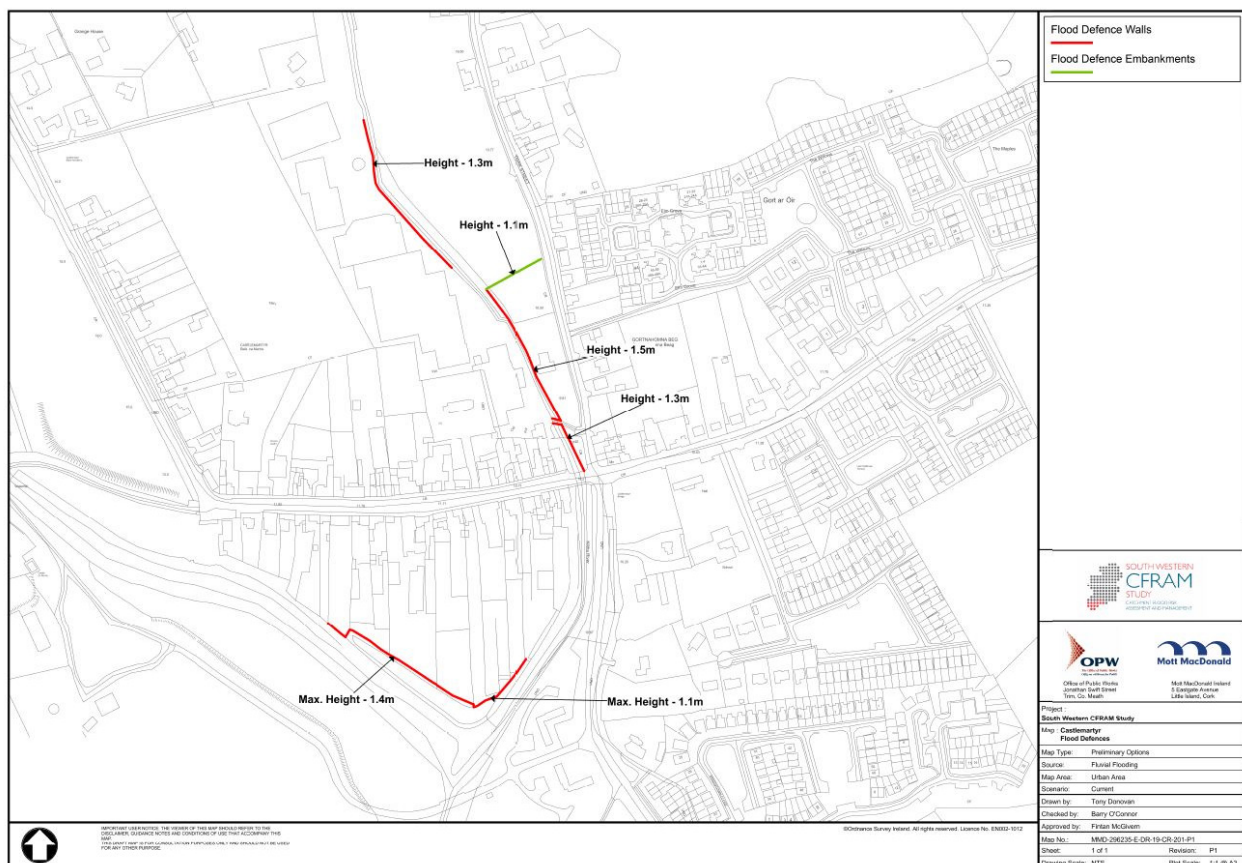


Figure A.2: Castlemartyr Option 2 Flow Diversion /Flood Defences

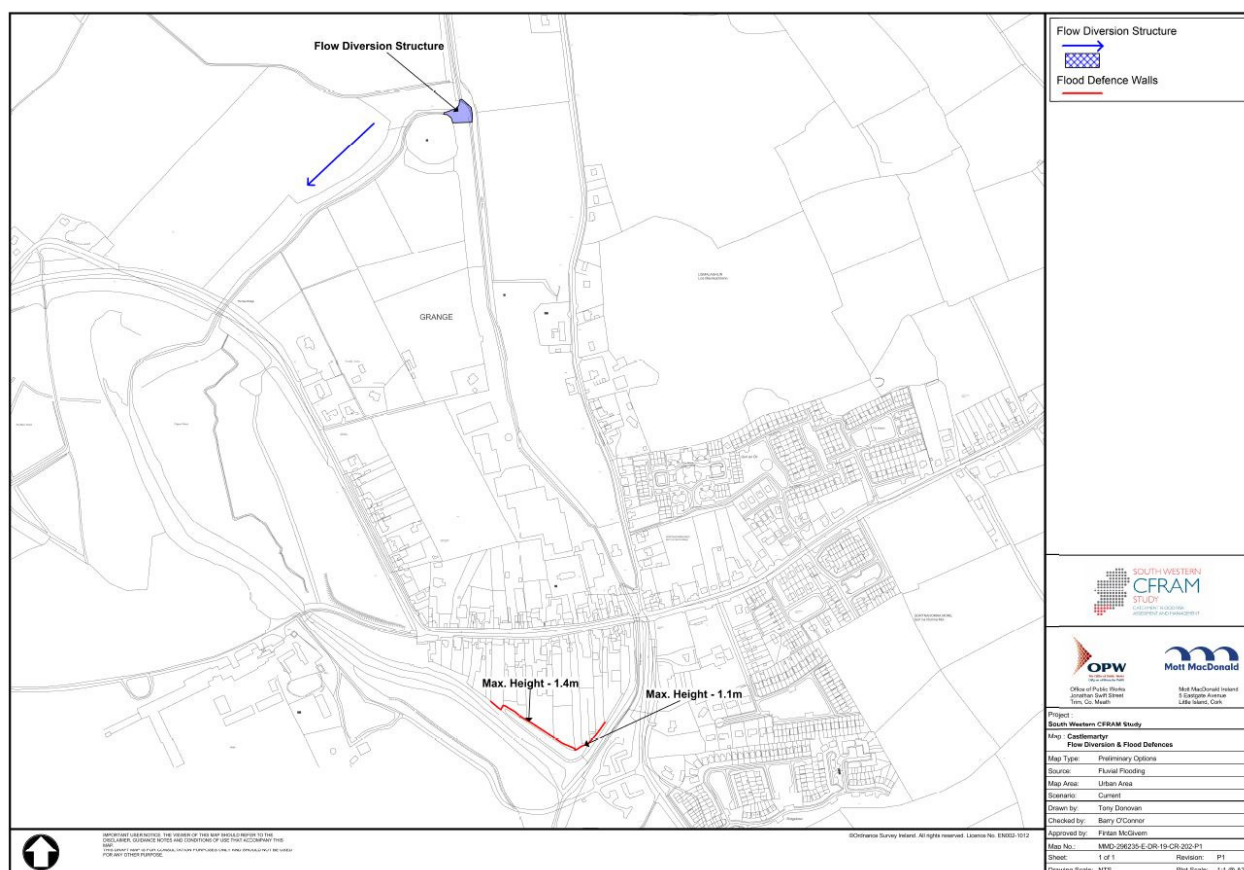


Figure A.3: Ballingearry Option 1 Flood Defences

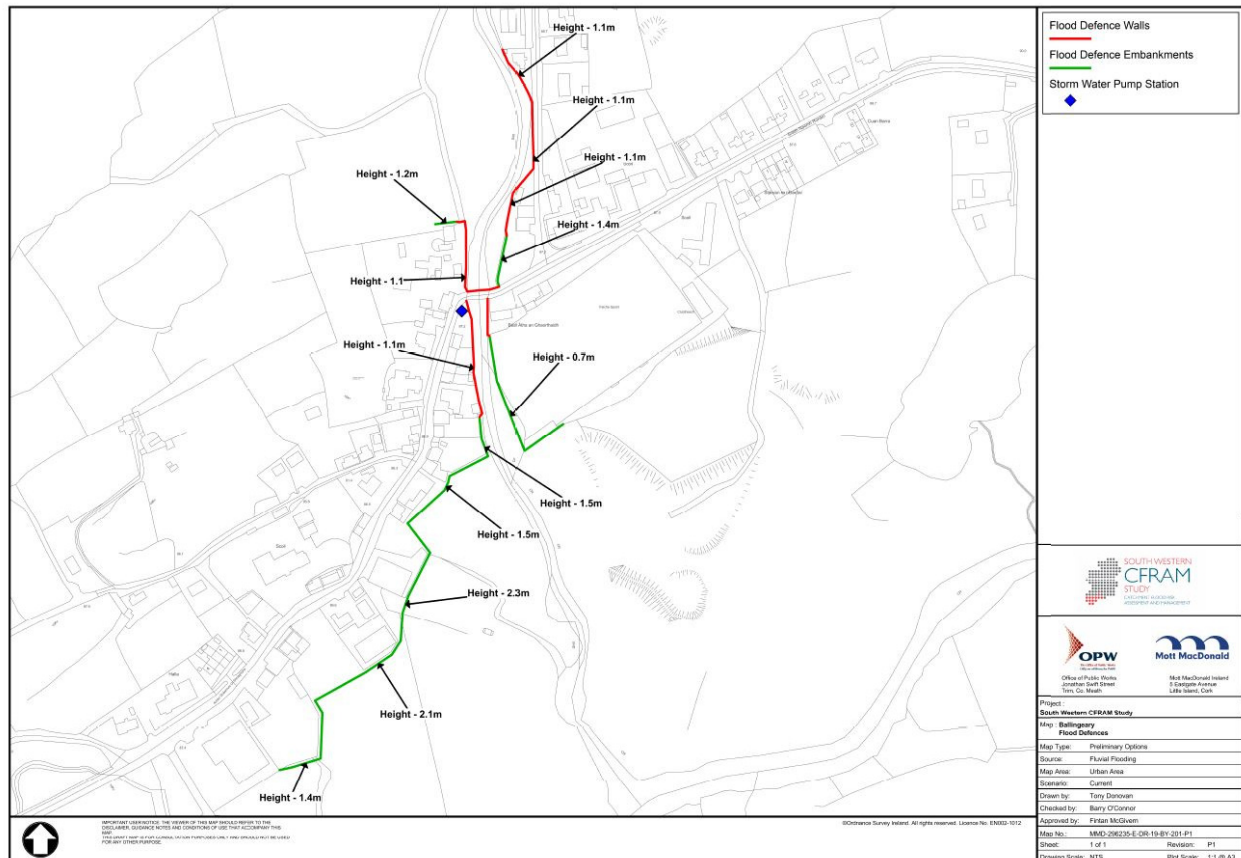


Figure A.4: Ballingeary Option 2 Flood Storage

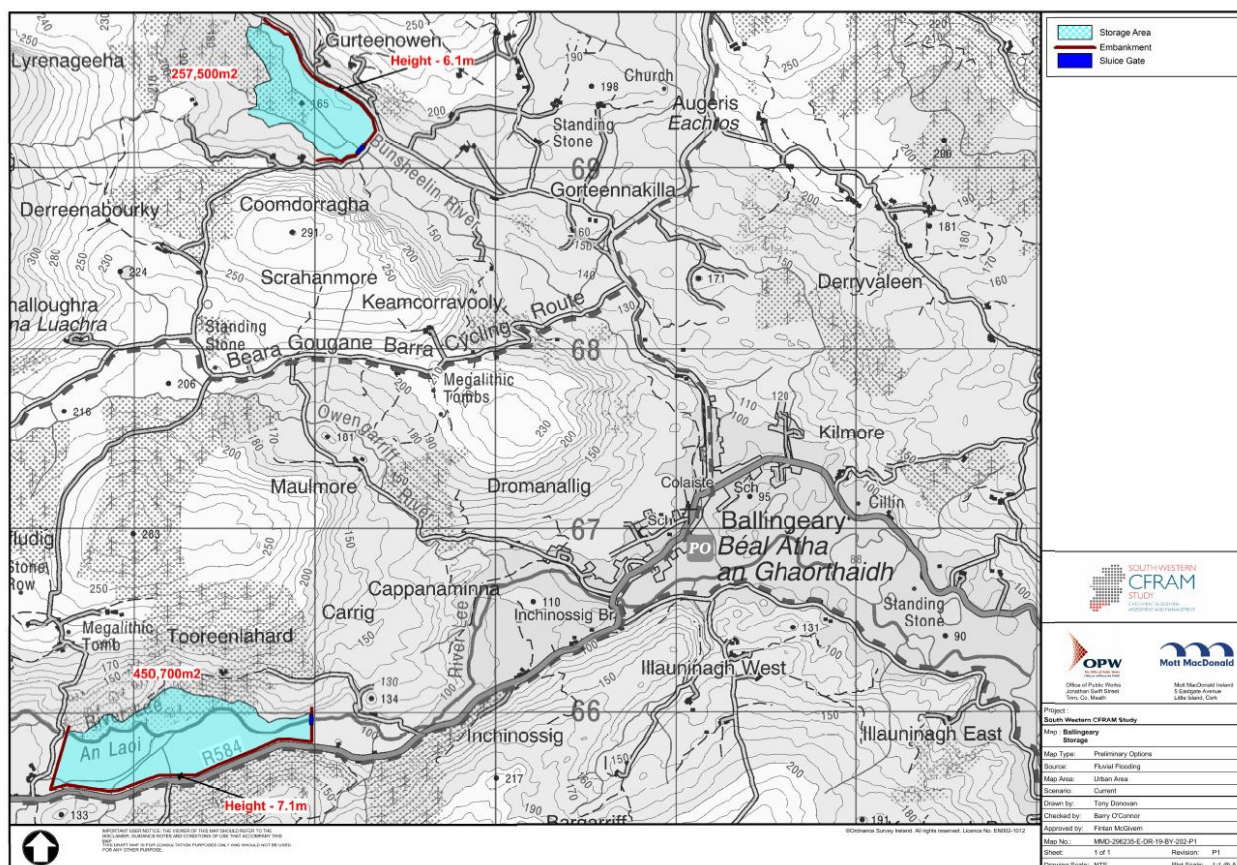
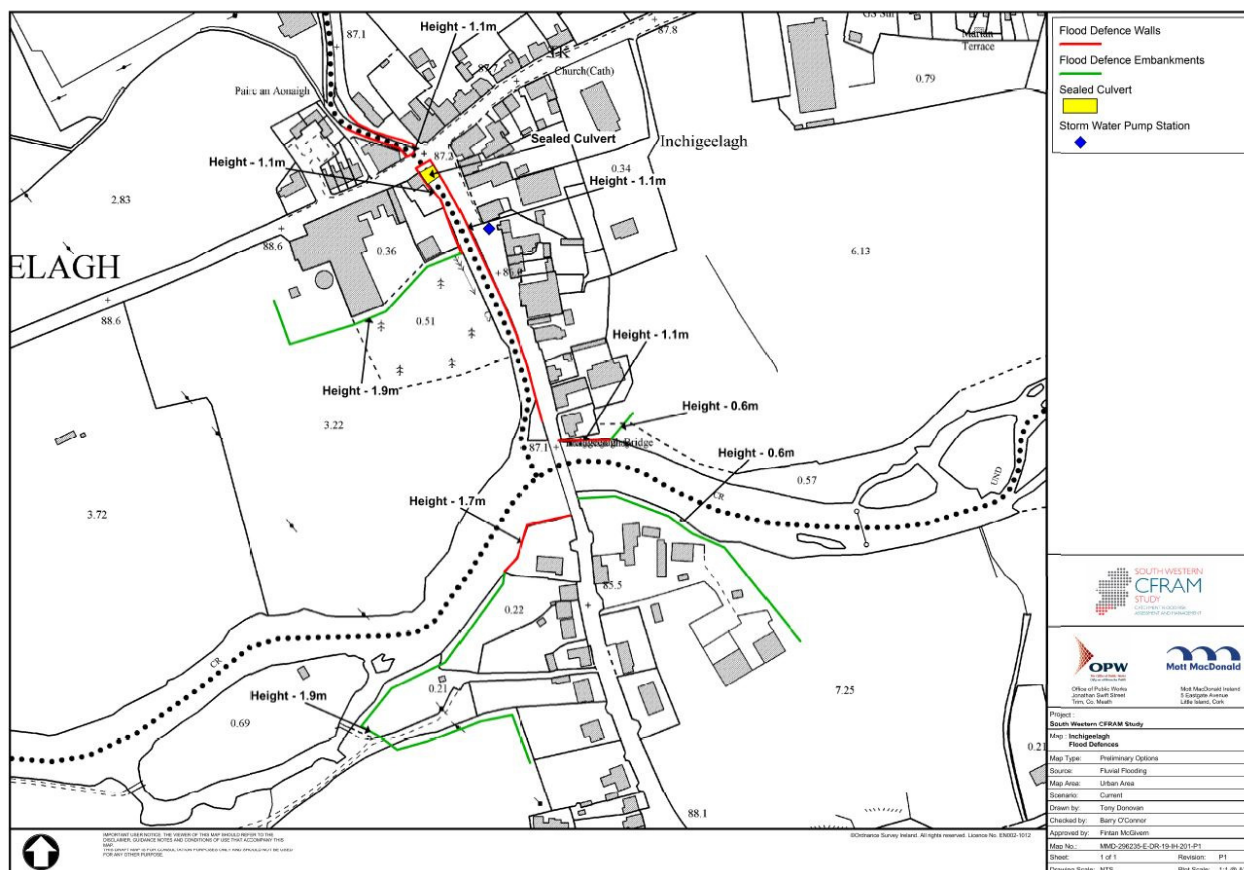


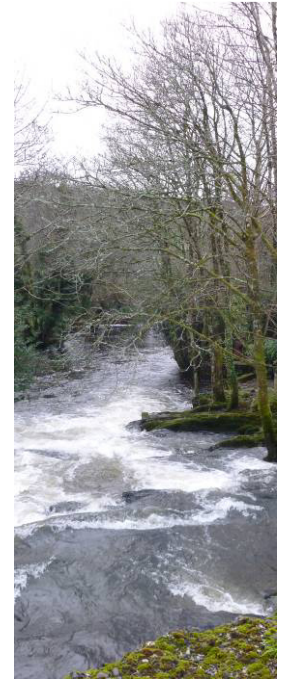
Figure A.5: Inchigeelagh Option 1



B. SEA scoring Matrix

Score	Key	Description
+5	√√√	Achieving aspirational target
+4	√√	
+3	√√	Partly achieving aspirational target
+2	√	Exceeding minimum target
+1	√	
0	O	Meeting minimum target
-1	X	Just failing minimum target
-2	X	
-3	X X	Partly failing minimum target
-4	X X	
-5	XX X	Fully failing minimum target
-999.99	XX X	Unacceptable negative impact where feasible alternative exists

Appendix D. Draft Screening for Appropriate Assessment under the Habitats Directive



South Western CFRAM Study

Screening for Appropriate Assessment: Lee -
Cork Harbour Catchment (UoM 19)

February 2016

Office of Public Works

South Western CFRAM Study

Screening for Appropriate Assessment: Lee -
Cork Harbour Catchment (UoM 19)

February 2016

Office of Public Works

Jonathan Swift Street
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Co. Meath

Issue and revision record

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B	23 February 2016	R. Mansfield	B. O' Conor	F. McGivern	Client comment

Information class: Standard

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Executive Summary

Introduction

The Office of Public Works (OPW) is the competent authority in Ireland for the implementation of the EU Floods Directive [2007/60/EC], which is transposed into Irish law by the European Communities (Assessment and Management of Flood Risk) Regulations, 2010. The Floods Directive requires Member States to:

- Identify areas of existing or foreseeable future potentially significant flood risk (referred to as Areas for Further Assessment - AFAs);
- Prepare flood hazard and risk maps for the AFAs;
- Prepare Flood Risk Management Plans by 22 December 2015, setting objectives for managing the flood risk within the AFAs and setting out a prioritised set of measures for achieving those objectives.

Mott MacDonald Ireland Ltd. was appointed by the OPW to undertake the above activities as part of the Catchment Flood Risk Assessment and Management Study (CFRAMs) for the South Western River Basin District.

The South Western River Basin District CFRAM study (and output Flood Risk Management Plans) will be informed by Appropriate Assessment, the requirement for which is derived from Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive). Appropriate Assessment is the process of determining whether the Flood Risk Management Plan is likely to pose a risk to the attainment or maintenance of conservation objectives for areas protected for their ecological value within the State (Natura 2000 sites - Special Areas of Conservation and Special Protection Areas), and the identification of alternatives or mitigation as appropriate.

One Flood Risk Management Plan will not be developed for the entire South Western River Basin District but rather, targeted individual plans will be produced on a waterbody catchment basis (Units of Management basis). The South Western River Basin District is broken down into five Units of Management:

- The Munster Blackwater Catchment (UoM18)
- The Lee / Cork Harbour Catchment (UoM19)
- The Bandon / Skibbereen Catchment (UoM20)
- The Dunmanus / Bantry / Kenmare Bay Catchment (UoM21)
- The Laune / Maine / Dingle Bay Catchment (UoM22)

UoMs are further broken down in to Areas for Further Assessment (AFAs). These are communities within an individual UoM with a quantifiable flood risk and include towns, villages and areas where significant development is anticipated. Associated with AFAs are high and medium priority watercourses. High priority watercourses are located within and 2km upstream of AFAs whereas medium priority watercourses are the interconnecting watercourses between AFAs or the coast.

Lee – Cork Harbour Catchment (UoM19)

The Lee-Cork Harbour Catchment covers an area of approximately 2,145 km². The entire area of UoM 19 is within County Cork. The main rivers within UoM 19 are the Lee, Owenboy and Womanagh. The OPW undertook a separate Catchment Flood Risk Assessment and Management (CFRAM) Study for the Lee Catchment which included all the main rivers and their tributaries draining into Cork Harbour (the Rivers Lee, Bride, Shournagh, Sullane, Owenboy, Glashaboy and Owennacurra). The town of Ballingeary in the upper reach of the Lee, which has been identified as an AFA and was not included in the Lee CFRAM. The SWRBD CFRAM therefore covers the entire Womanagh River Catchment and also includes Ballingeary which was excluded from the Lee CFRAM.

There are three Areas for Further Assessment (AFAs) within UoM19, these include Castlemartyr, Killeagh, and Ballingeary Inchingeelagh. Killeagh AFA was ruled out of the optioneering process as it was determined that the risk of flooding is low. Associated with the AFAs is over 29km of high and medium priority watercourses. Based on the historical flood evidence, the key mechanisms for each of the AFA's are as follows:

- **Castlemartyr:** Flooding typically occurs due to the overtopping of river banks along the Kiltha River at Mogeely Road as flow through Castlemartyr Bridge is constricted, causing water levels to rise upstream and flood the surrounding area.
- **Ballingeary and Inchigeelagh:** Flooding typically occurs due to the overtopping of river banks along the River Lee and Bunsheelin River because the excess flows are unable to discharge into Lough Allua when water levels are raised by water from previous events. Ballingeary is also identified as at risk from pluvial flooding during intense rainfall events due to the limited capacity of the urban drainage network.

Flood risk management options for the Lee-Cork Harbour UoM have provisionally been identified and can be summarised as:

- Upstream storage – using embankments coupled with a control structure on the watercourse to hold back water in order to limit the flow in the downstream watercourse;
- Flow diversion - interception of flood flows within a watercourse and diverting these flows through an artificial channel into another watercourse or into another section of the same watercourse;
- Flood Walls and Embankments - physical structures designed to contain floodwaters for a defined flood event;
- Flood forecasting - providing advance warning about the timing and scale of flooding by monitoring weather combined with watercourse flows and levels.

Natura 2000 Sites

The Castlemartyr AFA boundary does not overlap with any Natura 2000 site boundary. Flood risk management options in Castlemartyr are proposed for both the Womanagh River and Kiltha River. The Kiltha River (which flows through Castlemartyr) is hydrologically connected to Ballymacoda Bay SPA and Ballymacoda (Clonpriest and Pillmore) SAC via the Womanagh. The Ballymacoda Bay SPA and Ballymacoda (Clonpriest and Pillmore) SAC are located approximately 10km east of Castlemartyr.

The Ballingearry AFA boundary does not overlap with any Natura 2000 site boundary. Flood risk management options in Ballingearry are proposed for the River Lee, and its tributary Bunsheelin stream. The River Lee is hydrologically connected to the Gearagh SAC and Gearagh SPA, located approximately 15km downstream. Inchigeelagh AFA boundary does not overlap with any Natura 2000 site boundary. Flood risk management option in Inchigeelagh is proposed for the River Lee. The River Lee is hydrologically connected to the Gearagh SAC and Gearagh SPA.

Potential Impacts on Qualifying Features

Castlemartyr AFA

There are no potential impacts for the flood risk management works in the Castlemartyr AFA.

Ballingearry AFA

There are no potential impacts for the flood risk management works in the Ballingearry AFA. The AFA boundary does not overlap with any Natura 2000 site boundary.

Inchigeelagh AFA

The Inchigeelagh AFA boundary does not overlap with any Natura 2000 site boundary. The AFA boundary does not overlap with any Natura 2000 site boundary.

Significance of Impacts

No likely impacts have been determined on the Natura 2000 sites from the implementation of viable options in the Castlemartyr, Ballingearry and Inchigeelagh AFAs.

No likely significant effects on Natura 2000 sites are reasonably foreseeable as a result of the implementation of flood risk management measures in UoM 19.

1 Introduction

1.1 Flood Risk Assessment and Management in Ireland

Flood risk management in Ireland has historically focused on land drainage schemes for the improvement of agricultural land. The 1945 Arterial Drainage Act established a national drainage authority (the Office of Public Works) with the remit of implementing a national arterial drainage programme. The Arterial Drainage Act was amended in 1995 to include for the protection of urban areas suffering from flooding.

In 2004, the Irish Government adopted a new National Flood Policy for Ireland which shifted the emphasis in addressing flood risk away from arterial drainage (targeted towards the protection of agriculture and cities / town liable to serious flooding) and towards a waterbody catchment-based flood risk assessment (a similar catchment-based management approach to that already being implemented under the Water Framework Directive 2000/60/EC).

In 2007 the Floods Directive [2007/60/EC] was published which requires the establishment of a framework of measures to reduce the risks of flood damage. The Floods Directive was transposed into Irish law by the European Communities (Assessment and Management of Flood Risks) Regulations, 2010 (S.I. No. 122 of 2010). The Regulations identify the Office of Public Works (OPW) as the lead agency in implementing flood management policy in Ireland.

Catchment Flood Risk Assessment and Management (CFRAM) Studies

For the purpose of delivering on the components of the National Flood Policy and on the requirements of the European Union Floods Directive, the OPW, in conjunction with local authorities and stakeholders, is conducting a number of Catchment Flood Risk Assessment and Management (CFRAM) Studies. These studies are the core activity from which medium to long-term strategies for the reduction and management of flood risk in Ireland will be achieved.

The overarching objectives of the CFRAM Studies are to:

- Identify and map the existing and potential future flood hazard within the study area;
- Assess and map the existing and potential future flood risk within the study area;
- Identify viable structural and non-structural options and measures for the effective and sustainable management of flood risk within the study area;
- Prepare Flood Risk Management Plans (FRMPs) setting out recommendations to manage the existing flood risk and also the potential future flood risk which may increase due to climate change, development, and other pressures that may arise in the future. FRMPs will set out policies, strategies, measures and actions that should be pursued by the relevant bodies (including the OPW, Local Authorities and other Stakeholders), to achieve the most cost-effective and sustainable management of existing and potential future flood risk within the study area, taking account of environmental plans, objectives and legislative requirements and other statutory plans and requirements¹.

¹ The Floods Directive requires that Flood Risk Management Plans should take into account the particular characteristics of the areas they cover and provide for tailored solutions according to the needs and priorities of those areas, whilst promoting the

The programme for the delivery of flood risk management in Ireland comprises of the following phases:

- Preliminary Flood Risk Assessment, which was completed in 2011, identified areas of existing or foreseeable future potentially significant flood risk (referred to as 'Areas for Further Assessment'/AFAs);
- CFRAM Studies, which are being completed in the period 2011 to 2016;
- By mid 2016 draft Flood Risk Management Plans will be produced for each CFRAM study;
- The Flood Risk Management Plans will be implemented from 2016 onwards and will be reviewed on a rolling six-yearly cycle.

It should be noted that the detailed designs for flood risk management measures will not be developed as part of the Flood Risk Management Plans / CFRAM Studies but rather measures will be progressed on a scheme by scheme basis, outside of the scope of the CFRAM studies.

The OPW has commissioned a CFRAM study for each of Ireland's seven River Basin Districts (RBDs)². This report is an Appropriate Assessment produced in accordance with the Habitats Directive and pertains to the South Western River Basin District.

achievement of environmental objectives laid down in Community legislation.

² River Basin Districts (RBDs) are the main units for the management of river basins and have been delineated by Member States under Article 3 of the Water Framework Directive (2000/60/EC). RBDs are areas of land and sea, made up of one or more neighbouring river basins together with their associated groundwaters and coastal waters.

2 Appropriate Assessment

2.1 Statutory Requirement for Appropriate Assessment

Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive) is European Community legislation regarding nature conservation. The intention of the Directive is to aim to ensure biodiversity through the conservation of natural habitats and wild fauna and flora in Europe. The Habitats Directive was transposed into Irish law by the European Communities (Natural Habitats) Regulations, 1997 (S.I. No. 94/1997) which was subsequently revoked and replaced by the European Communities (Birds and Natural Habitats) Regulations 2011.

A network of sites of conservation importance hosting habitats and/or species identified in the Directives as needing to be either maintained at or returned to favourable conservation status have been identified by each Member State. These sites are known as the Natura 2000 network and in Ireland, Natura 2000 sites comprise areas designated as Special Areas of Conservation (SACs) and candidate Special Areas of Conservation (cSACs), and/or Special Protection Areas (SPAs) and candidate Special Protection Areas (cSPAs).

The Habitats Directive requires that where a plan or project is likely to have a significant effect on a Natura 2000 Site, while not directly connected with or necessary to the nature conservation management of the site, it shall be subject to 'Appropriate Assessment' to identify any implications for the site in view of the site's conservation objectives³.

Specifically Article 6(3) of the Habitats Directive states:

*Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to **appropriate assessment** of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*

The CFRAM studies will identify viable strategies and measures for flood risk management in Ireland, some of which will be within areas designated under the Natura 2000 network. The Flood Risk Management Plans developed under these studies **are not directly connected with or necessary to the management of any Natura 2000 sites**. Therefore, in the context of the Habitats Directive, the Plans must be subjected to Screening for Appropriate Assessment to determine whether the strategies or measures outlined therein are likely to have a significant effect on a Natura 2000 site, either alone or in

³ The NPWS is currently developing Conservation Management Plans for all SACs nationally. Objectives for the conservation of the features of interest for which the site is designated are set out in the Conservation Management Plans and the principal pressures impacting the achievement of Favourable Conservation Status are identified. Strategies to meet the objectives are also identified.

combination with other plans or projects. Where significant effects are determined to be likely the Plans are statutorily required to be subjected to Appropriate Assessment.

2.2 Appropriate Assessment – The Process

The European Commission in 2002 published guidance on the assessment of plans and projects significantly affecting Natura 2000 sites. This guidance provides details of the general approach to Appropriate Assessment. The guidance sets out a tiered/staged approach as summarised below:

Stage 1 - Screening for a likely significant effect: An initial assessment of the project or plan's effect on a European site(s). A description of the plan/project and the elements that have the potential to impact on Natura 2000 sites must be provided. The potential impacts and their significance must be assessed. If it cannot be concluded that there will be no significant effect upon a European site, an Appropriate Assessment is required; (*Note this report is a Stage 1 Screening Assessment*).

Stage 2 - Appropriate Assessment: The consideration of the impact on the integrity of the Natura 2000 site of the project or plan, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts. The output of this stage of Appropriate Assessment is a Natura Impact Statement (NIS) report;

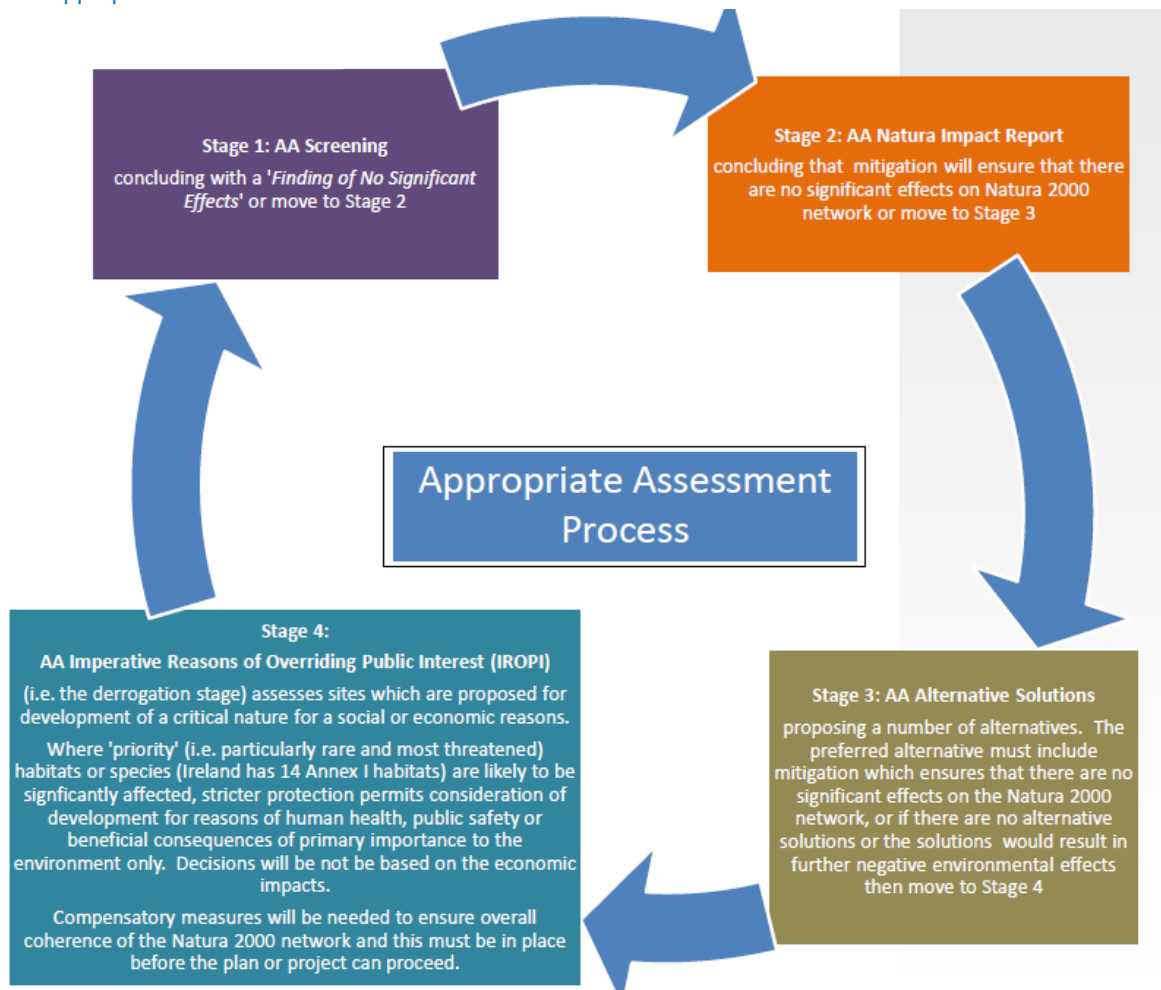
Stage 3 – Assessment of alternative solutions: The process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site (where mitigation cannot be achieved); and

Stage 4 – Assessment where no alternative solutions exist and where adverse impacts remain: Development of compensatory measures where, in the light of imperative reasons of overriding public interest (IROPI), it is deemed that the project or plan should proceed.

Each stage in the process determines whether a further stage is required. If, for example, the conclusions at the end of Stage 1 are that there will be no significant impacts on the Natura 2000 site, there is no requirement to carry out an Appropriate Assessment (Stage 2). The approach to Appropriate Assessment screening must however apply the precautionary principle i.e. where it cannot be definitively determined that a plan/project will not adversely impact the integrity of the Natura 2000 site then it must be assumed that there is potential for impact and a full Appropriate Assessment must be carried out.

The objective of the process is to provide adequate information, based on the best available scientific information, to inform the Competent Authority to enable them to conduct an assessment of whether the plan or project is likely to have a significant effect on the conservation objectives of the relevant Natura 2000 sites within the zone of influence. Where adverse impacts are identified mitigation measures necessary to avoid, reduce or offset such impacts must be prescribed.

Figure 2-1 Appropriate Assessment the Process



Source: West Regional Authority (WRA) in association with the Environmental Protection Agency (EPA) (2013) Draft 'SEA Resource Manual for Local and Regional Authorities'

2.3 Objective of Appropriate Assessment Screening

The objective of this Stage 1 Screening Assessment is to determine whether the South Western RBD Flood Risk Management Plans are likely to have adverse impacts on conservation objectives of Natura 2000 sites. The direct, indirect and in-combination ecological impacts of the proposed plan policies / measures on Natura 2000 sites are identified and the necessity to carry out a Stage 2 Appropriate Assessment is determined. The findings of this Stage 1 Screening Assessment are documented through this Screening Statement. The outcomes of the assessment are also summarised in a 'Screening Matrix' presented in Section 6.

The DEHLG Guidance (2009), '*Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities*' requires that the findings and recommendations of Appropriate Assessment informs the policies and strategies of the Plan.

Information contained in the Appropriate Assessment that will inform the South Western RBD Flood Risk Management Plans (FRMP) includes the following;

- the areas likely to be significantly affected by the plan;
- any existing environmental characteristics which are relevant to the plan including, in particular, those relating to any areas of a particular environmental importance, such as areas designated pursuant to Directives 79/409/EEC and 92/43/EEC;
- the environmental protection objectives and qualifying interests (established at international, Community or Member State level) which are relevant to the areas of the environment likely to be affected by the plan;
- the likely significant effects on the Natura 2000 sites, such as impacts on biodiversity, fauna, flora, soil, water, etc.
- the measures envisaged to mitigate against any significant adverse effects on the designated sites of implementing the plan; and
- alternatives to the proposals in the plan and their potential effectiveness in maintaining the conservation value of the site.

2.4 Methodology

This screening assessment has been prepared in accordance with all relevant guidance and legislation including:

- European Communities (Birds and Natural Habitats) Regulations 2011;
- NPWS (2012) Marine Natura Impact Statements in Irish Special Areas of Conservation. A Working Document.
- DEHLG (2009) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities [revised, February 2010];
- EC (2000) Managing Natura 2000 Sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC;
- EC (2001) Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC;
- EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC: Clarification of the concepts of alternative solutions and imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission.

An extensive data collection exercise was conducted as part of this Appropriate Assessment Screening. Available information utilised in the preparation of this report includes:

- Conservation Status Assessment Reports⁴ (CSARs), Backing Documents and Maps prepared in accordance with Article 17 of the Habitats Directive;

⁴ Every six years, Member States of the European Union are required to report on the conservation status of all habitats and species listed on the annexes of the Habitats Directive as required under Article 17 of the Directive. Ireland submitted our conservation

- Natura 2000 Site Synopsis, Data Forms and Conservation Objective Reports available from NPWS;
- Published and unpublished NPWS reports on protected habitats and species including Irish Wildlife Manual reports, Species Action Plans and Conservation Management Plans;
- Existing relevant mapping and databases e.g. waterbody status, species and habitat distribution etc. (sourced from the Environmental Protection Agency - <http://gis.epa.ie/>, the National Biodiversity Data Centre - <http://maps.biodiversityireland.ie> and the National Parks and Wildlife Services - <http://www.npws.ie/mapsanddata/>).

2.5 Statement of Authority

This Screening for Appropriate Assessment was prepared by Rita Mansfield. Rita is a Senior Ecologist [BSc. (Hons) Applied Ecology, University College Cork, 2003 and H.Dip Environmental Protection and Pollution Control, Sligo Institute of Technology, 2008] with over ten years' post graduate experience in public and private sector projects with the main focus being public infrastructure (water and waste water, roads, power). Rita has managed numerous Ecological Impact Assessments, Appropriate Assessments and environmental feasibility assessments of complex projects and land use plans. Rita has prepared ecological monitoring and mitigation guidance for the NRA for inclusion in their PPP and DB Contracts. Rita has undertaken and managed a wide range of field surveys including protected species surveys (e.g. badger, otter, red squirrel, bats, wetland birds, kingfisher, crayfish and lamprey), habitat surveys and biological and physicochemical water quality monitoring and habitat mapping.

2.6 Consultation

A National Workshop on Appropriate Assessment (AA) of Flood Risk Management Plans (FRMP) was held between the Office of Public Works (OPW), their consultants on the CFRAMs projects and the National Parks & Wildlife Service (NPWS) on the 28th January 2015. The NPWS outlined their expectations of the AA for the FRMPs as follows:

- The zone of influence of flood risk management options should be identified on a case by case basis using the Source-Pathway-Receptor approach;
- Any mitigation prescribed in the NIS should be specific and should be demonstrated to be achievable and effective;
- Consideration should be given to the construction impacts at Plan level;
- Appropriate Assessment must be based on scientific evidence;
- If an option for one AFA needs to go to IRPOI then it may be the case that the entire FRMP will need to go through IROPI;
- Care needs to be taken in how the fresh water pearl mussel is considered.

3 Description of the Plan

3.1 Flood Risk Management Plan

The Floods Directive [2007/60/EC] requires the establishment of a framework of measures to reduce the risks of flood damage. Catchment Flood Risk Assessment and Management (CFRAM) Studies have been commissioned to determine flood hazard and identify risk receptors that are susceptible to flooding in Ireland. Measures to mitigate risk (both existing and future) must also be determined. The outputs of the CFRAM studies are Flood Risk Management Plans (FMRPs). The purpose of the FMRPs are to set out policies, strategies, measures and actions that should be pursued by the relevant bodies to achieve the most cost-effective and sustainable management of existing and potential future flood risk.

One Flood Risk Management Plan will not be developed for the entire South Western River Basin District but rather, targeted individual plans will be produced on a waterbody catchment basis (Units of Management basis). The South Western River Basin District is therefore broken down into Units of Management (UoMs) for the purpose of implementing the Floods Directive.

UoMs are representative of existing Hydrometric Area boundaries constituting major catchments or river basins typically greater than 1,000km² and their associated coastal areas, or conglomerations of smaller river basins and their associated coastal areas.

Flood Risk Management Plans for each Unit of Management (UoM) in the South Western River Basin are due to be published in 2016.

The FRMPs shall include a prioritised set of actions and measures aimed at meeting defined flood risk management objectives for each UoM. The flood risk management objectives are set out under four categories (Technical, Economic, Social, and Environmental), and include objectives such as:

- Minimise health and safety risk of flood risk management options;
- Manage risk to agricultural land;
- Minimise risk to social amenity;
- Minimise the risk of environmental pollution;
- Avoid damage to, and where possible enhance, fisheries within the catchment.

A description of the flood risk management objectives which are particular to each UoM will be included in the Flood Risk Management Plans.

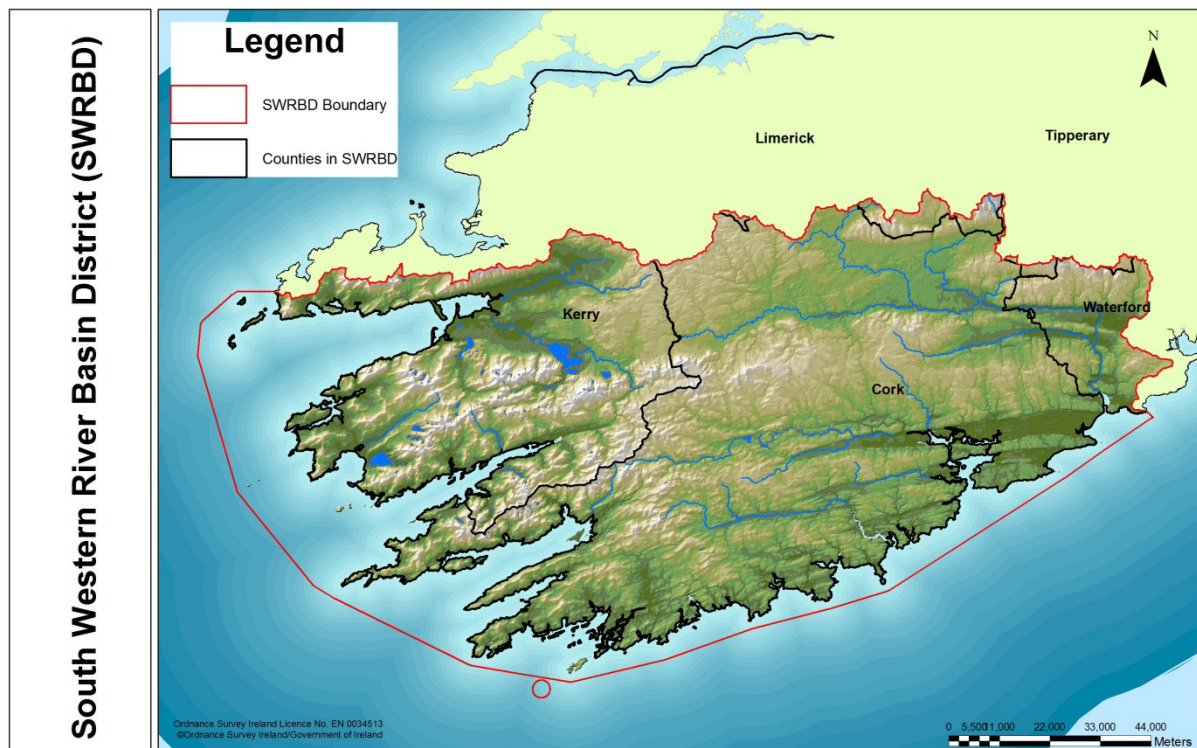
The Flood Risk Management Plans will demonstrate the indicative costs and benefits of the preferred actions and measures, the robust reasoning for the identification of a measure as a preferred option and the priority each measure should be afforded. The plans shall also recommended a programme of work (including a prioritised and costed programme of policies, strategies, actions and measures) to be implemented by the OPW, Local Authorities or other relevant bodies to mitigate flood risk in each UoM.

The FRMPs will influence, and will in turn be influenced by external statutory and non-statutory plans, strategies and policies and programmes. National and local policies relating to the protection of the environment must be considered in the development of the FRMPs. This process is conducted as part of the Strategic Environmental Assessment of the FRMPs.

3.2 Overview of the South Western River Basin District

The South Western River Basin District (SWRBD) covers an area of approximately 11,160 km² and includes most of county Cork, large parts of counties Kerry and Waterford along with small parts of the counties of Tipperary and Limerick. The SWRBD contains over 1,800 km of coastline along the Atlantic Ocean and the Celtic Sea.

Figure 3-1 South Western River Basin District (SWRBD)



3.2.1 Units of Management in the SWRBD

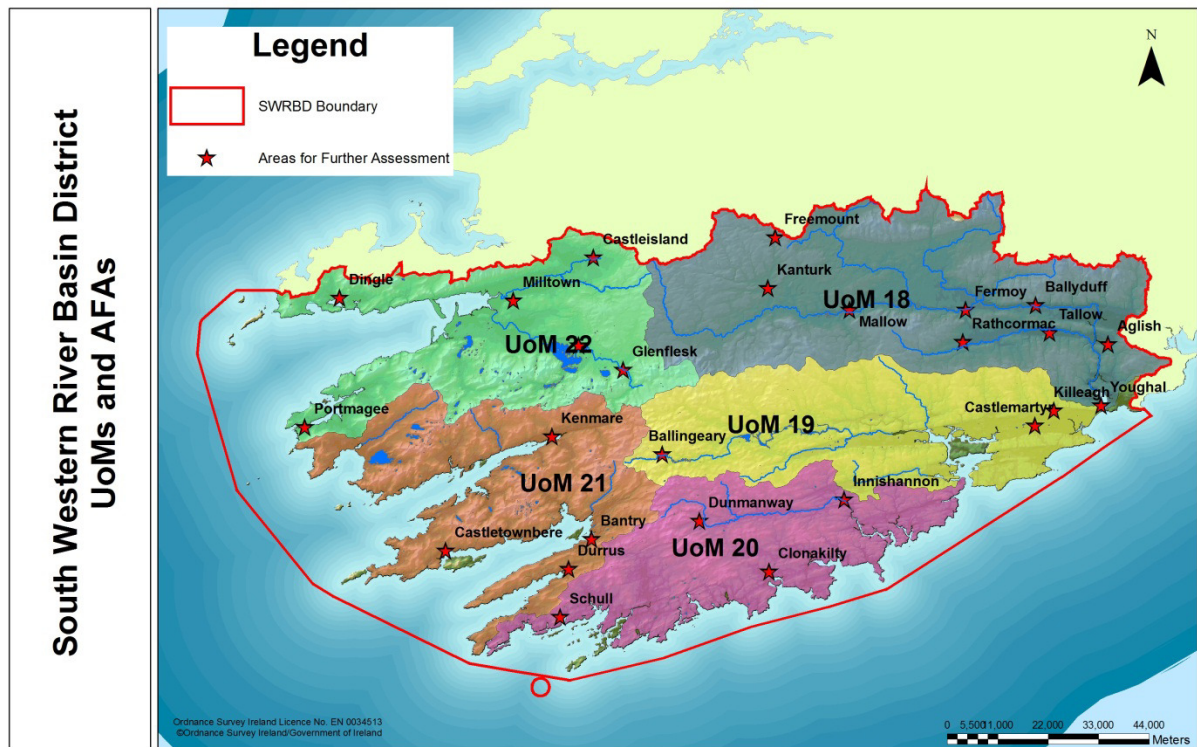
There are five Units of Management within the South Western River Basin District which follow watershed catchment boundaries rather than political boundaries. The Units are as follows;

- The Munster Blackwater Catchment (UoM18)
- The Lee / Cork Harbour Catchment (UoM19)

- The Bandon / Skibbereen Catchment (UoM20)
- The Dunmanus / Bantry / Kenmare Bay Catchment (UoM21)
- The Laune / Maine / Dingle Bay Catchment (UoM22)

UoMs are further broken down in to Areas for Further Assessment (AFAs). The SWRBD includes 26 Nr. Areas for Further Assessment (AFAs).

Figure 3-2 Units of Management and Areas for Further Assessment in the SWRBD



3.3 Flood Risk Management Options

The CFRAM study for the SWRBD is currently at the *options appraisal stage*, to identify the preferred measures and options to manage flood risk for each UoM in the SWRBD. Receptors to flood risk within each UoM in the SWRBD have been identified through detailed technical studies. The potential options to manage the flood risk of the various receptors have provisionally been identified and are currently being assessed for viability.

A flood risk management option consists of one, or more commonly a combination of, flood risk management measures. The suite of flood risk management options for consideration under the CFRAM study are presented in Table 3.1.

Table 3.1: Suite of Flood Risk Management Options

Option	Description
Do Nothing	Implement no new flood risk management measures and abandon any existing practices.
Existing Regime	Continue with any existing flood risk management practices, such as reactive maintenance.
Do Minimum	Implement additional minimal measures to reduce the flood risk in specific problem areas without introducing a comprehensive strategy - infill gaps in existing walls, maintain channel.
Non-Structural Measures	<p>Planning and development control measures (zoning of land for flood risk appropriate development, prevention of inappropriate incremental development, review of existing Local Authority policies in relation to planning and development and of inter-jurisdictional co-operation within the catchment, etc.);</p> <p>Building regulations (regulations relating to floor levels, flood-proofing, flood resilience, sustainable drainage systems, prevention of reconstruction or redevelopment in flood-risk areas, etc.);</p> <p>Sustainable urban drainage systems (SUDS);</p> <p>Installation of a flood forecasting and warning system and development of emergency flood response procedures;</p> <p>Targeted public awareness and preparedness campaign;</p> <p>Individual property flood resistance (protection / flood-proofing) and resilience;</p> <p>Land use management, including creation of wetlands, riparian buffer zones, etc.</p>
Structural measures	<p>Storage (single or multiple site flood water storage, flood retardation, etc.)</p> <p>Flow diversion (full diversion / bypass channel, flood relief channel, etc.)</p> <p>Increase conveyance (in-channel works, floodplain earthworks, removal of constraints / constrictions, channel / floodplain clearance, etc.)</p> <p>Construct flood defences (walls, embankments, demountable defences, etc.)</p> <p>Rehabilitate, improve existing defences</p> <p>Relocation of properties</p> <p>Localised protection works (e.g. minor raising of existing defences / levels).</p>
Channel or Flood Defence Maintenance Works / Programme	-
Other relevant works	-

Flood risk management options have been developed for each UoM in the SWRBD. All of the available options from the prescribed suite (Table 3.1) are not applicable to every UoM. Options appraisal involves the technical assessment⁵ of all options to determine those which are applicable and viable for each UoM and associated AFAs. Following the technical assessment a cost analysis of the viable options is conducted such that a preferred option (in terms of effectiveness, potential impacts, and cost) is determined.

The options proposed in the Flood Risk Management Plans are set at an appropriate scale which includes the following levels:

⁵ The effectiveness and potential impacts of each FRM option is considered in terms of the following criteria:

- Applicability to the area
- Economic (potential benefits, impacts, likely costs etc.)
- Environmental (potential impacts and benefits)
- Social (impacts on people, society and the likely acceptability of the method) and
- Cultural (potential benefits and impacts upon heritage sites and resources)

- Units of Management (UoM) – i.e. at river basin catchment level;
- Analysis Unit (AU) - these are sub-catchments or coastal areas within the Unit of Management;
- Areas for Further Assessment (AFAs) - these are communities within an individual UoM with a quantifiable flood risk and include towns, villages and areas where significant development is anticipated. Associated with AFAs are high and medium priority watercourses. High priority watercourses are located within and 2km upstream of AFAs whereas medium priority watercourses are the interconnecting watercourses between AFAs⁶.

3.4 The Lee – Cork Harbour UoM 19

The Lee / Cork Harbour Unit of Management covers an area of approximately 2,145 km². The entire area of UoM 19 is within County Cork. The main rivers within UoM 19 are the Lee, Owenboy and Womanagh.

The OPW undertook a separate Catchment Flood Risk Assessment and Management (CFRAM) Study for the Lee Catchment which included all the main rivers and their tributaries draining into Cork Harbour (the Rivers Lee, Bride, Shournagh, Sullane, Owenboy, Glashaboy and Owennacurra). The towns of Ballingearry and Inchigeelagh in the upper reach of the Lee, which have been identified as an AFA's and were not included in the Lee CFRAM. The SWRBD CFRAM therefore covers the entire Womanagh River Catchment and also includes Ballingearry and Inchigeelagh which were excluded from the Lee CFRAM.

The Lee CFRAM is subject to separate Appropriate Assessment and is therefore excluded from this study.

Womanagh Catchment

The Womanagh River stretches from its source at Carrigour to its tidal outfall at Pilmore, Youghal Bay. The Kiltha River flows from Springfields/Mogeely southwards through Castlemartyr to join the Womanagh near Ladysbridge. Within Castlemartyr, a spring at Little Island diverts water from the Kiltha via the Castle, through the lake to re-join downstream of the town. The Dower River and Ladysbridge Stream join the Womanagh before the Dissour River. The Dower River in particular is heavily dominated by karst and flows through swallow holes, creating a dry valley in its upper reaches. The Dissour River flows from Kilcronatmountain southwards through Glenane Beg Ravine before flowing through Killeagh town and joining the River Womanagh at Finisk Old Bridge.

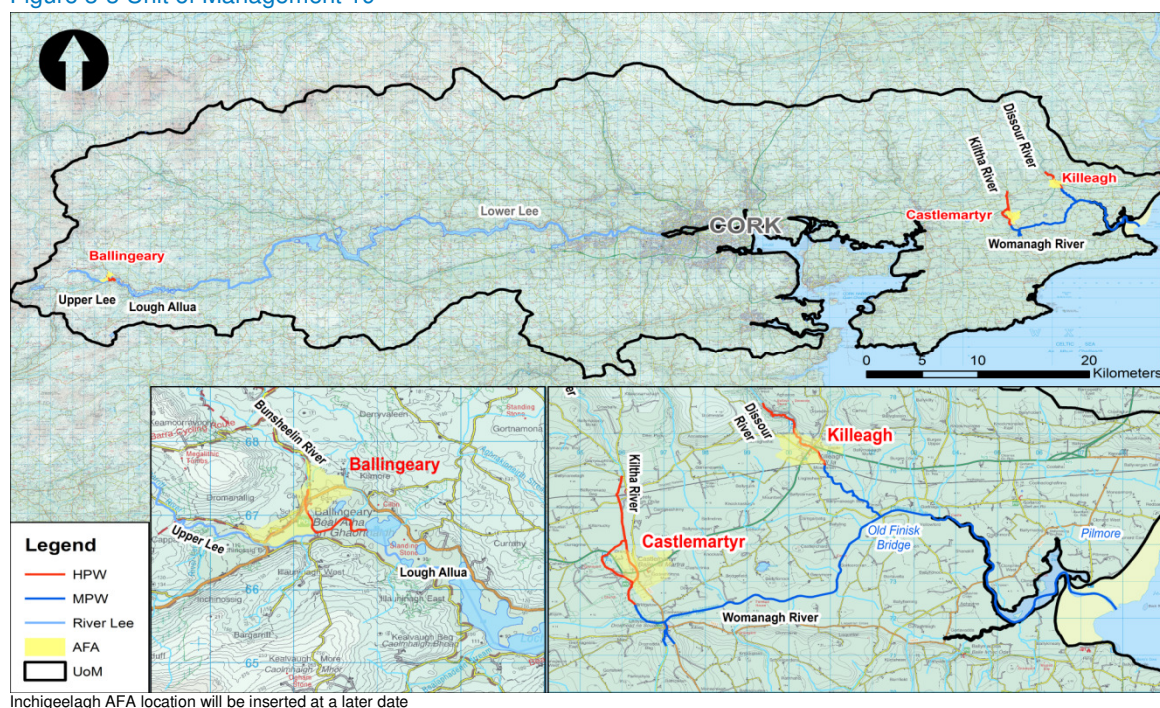
The Womanagh River can be considered tidal downstream of Finisk Old Bridge, some 10km inland. Downstream of Crompaun Bridge, the tidal channel widens to a more estuarine feature over 300m wide with several low-flow loop channels until its tidal outfall at Pilmore. There are large intertidal flats in the estuarine area which are inundated on most tides. The spit features at the tidal outfall protect inland areas from extreme wave action.

⁶ The designation of a watercourse as high priority or medium priority is not a reflection of how the watercourse is viewed in terms of its importance in flood risk management planning.

Ballingeary and Inchigeelagh

The Upper Lee flows from its source near Rosslougha in an easterly direction to the south of Ballingeary at Inchinossig Bridge and continues towards Cork. The Bunsheelin River flows through Ballingeary from the North to join the upper River Lee downstream of Inchinossig Bridge. The River Lee then flows in an easterly direction into Lough Allua and downstream to Inchigeelagh. The Bunsheelin River has a steep gradient of 1 in 35 reducing to 1 in 130 before entering the flat water body of Lough Allua.

Figure 3-3 Unit of Management 19



3.4.1 Areas for Further Assessment in UoM 19

There are three Areas for Further Assessment (AFAs) within Unit of Management 19. Associated with the AFAs is over 29km of high and medium priority watercourses.

Table 3.2: Areas for Further Assessment within Unit of Management 19

UoM	Name	Fluvial	Coastal
19	Killeagh	Yes	No
19	Castlemartyr	Yes	No
19	Ballingeary	Yes	No
19	Inchigeelagh	Yes	No

3.5 Flood Risk Management Options for the Lee - Cork Harbour UoM

Flood risk management options for the Lee - Cork Harbour UoM have been identified through option appraisal. Non-structural and structural options (as described in Table 3.1 of this report) will be combined to reduce the risk of damage to properties from flooding. Structural options are not viable for all AFAs however non-structural measures can be applied on a UoM basis.

This Appropriate Assessment Screening is carried out in conjunction with the option appraisal process such that potential environmental impacts of the various options are considered at option selection stage.

3.5.1 Non-Structural Measures

Planning Control

In November 2009, the Guidelines on the Planning System and Flood Risk Management, jointly developed by DECLG and the OPW, were published under Section 28 of the Planning Acts. These Guidelines provide a systematic and transparent framework for the consideration of flood risk in the planning and development management processes, whereby:

A sequential approach should be adopted to planning and development based on avoidance, reduction and mitigation of flood risk.

A flood risk assessment should be undertaken that should inform the process of decision-making within the planning and development management processes at an early stage.

Development should be avoided in floodplains unless there are demonstrable, wider sustainability and proper planning objectives that justify appropriate development and where the flood risk to such development can be reduced and managed to an acceptable level without increasing flood risk elsewhere (as set out through the Justification test).

The proper application of the Guidelines by the planning authorities is essential to avoid inappropriate development in flood prone areas, and hence avoid unnecessary increases in flood risk into the future. The flood mapping provided as part of the FRMP will facilitate the application of the Guidelines.

In flood-prone areas where development can be justified (i.e., re-development, infill development or new development that has passed the Justification Test), the planning authorities can manage the risk by setting suitable objectives or conditions, such as minimum floor levels or flood resistant or resilient building methods.

Building Regulations / Planning Conditions

The risk of damage to properties from flooding can be mitigated by the use of appropriate construction techniques and materials. For example the damage caused to an internal wall of a property by flooding can depend on the materials and methods of its construction. A timber stud partition covered with plasterboard with low level electrical wiring would have to be completely replaced following immersion in flood water. However, a solid concrete block wall covered with tiles and high level electrical wiring on the other hand would only have to be washed down following a flood.

If for a particular town or high flood probability areas, certain building regulations or planning conditions were adopted that ensured structures were flood resilient through specified construction methods, building fabrics and uses, a decrease in the risk of damage could be achieved. The question of whether such regulations or planning conditions could be imposed upon developers, business owners or householders in flood prone areas would need to be addressed if this were to be brought forward as a flood risk management measure.

Flood Forecasting

Flood forecasting is a means of providing advanced warning of an impending flood event. A reliable advance warning system allows protective measures to be put in place and protective actions to be carried out in advance of a flood event. These actions and measures can reduce the damage caused in a flood event.

Flood forecasting is not a viable Flood Risk Management Measure for all of the UoM 19 AFAs. This is because the time between transmitting a flood forecast the arrival of flood waters may not be long enough for people to take effective action to reduce flood damage. Flood warning is a viable option for each of the AFA's Castlemartyr , Ballingeary and Inchingelagh .

Public Awareness

Many of the measures to mitigate and manage flood risk and the potential consequences for flooding will involve the public at large. It is therefore important that the public is made aware of where to find information, what the information means and what actions the public and business owners can take to reduce the damage that would occur to their properties, possessions and interests in the event of a flood.

Measures to increase and promote public awareness include:

- Identifying the areas prone to flooding
- Information on measures to be implemented to reduce and / or manage the risk of flooding
- Measures in place to provide advance warning of flooding
- Establishment of methods to interface with the public and in particular the owners of vulnerable properties, i.e. workshops and meetings, Facebook, Twitter, text messaging, newsprint, websites, etc.

Land Use Management

Land Use Management includes strategies to control overland flow, such as improving agricultural and forestry practices in key catchment areas. Local natural flood management measures such as the creation of wetlands or forestry to retain overland flow could also be adopted.

Emergency Response Planning

Well prepared and executed emergency response plans can significantly reduce the impact of flood events, particularly for human health and welfare.

The Framework for Major Emergency Management was developed in 2005 and was adopted by Government decision in 2006. Its purpose is to set out common arrangements and structures for front line public sector emergency management in Ireland. The Framework is based on the internationally recognized systems approach that, in essence, proposes an iterative cycle of continuous activity through five stages of emergency management:

- Hazard Identification
- Mitigation
- Preparedness
- Response
- Recovery

Under the Framework, Local Authorities are designated as the lead agency for co-ordinating the response to severe weather events, and each Local Authority should have, as a specific sub-plan of its Major Emergency Plan, a plan for responding to severe weather emergencies, whether a major emergency is declared or not. The other principal response agencies should include sub-plans for responding to notifications from the Local Authorities of severe weather warnings.

A Guide to Flood Emergencies (MEM Guidance Document 11, July 2013) has been published to assist the Principal Response Agencies in meeting their responsibilities, under the Framework for Major Emergency Management, and to deliver on the responsibilities of the OPW and the Local Authorities with respect to emergency planning as set out in the Report of the Flood Policy Review Group. The Guide provides advice on the development and implementation of consistently effective flood emergency response and short-term recovery planning by the Principal Response Agencies and others, and includes a template plan.

3.5.2 Structural Measures

Structural flood risk management options for the Lee - Cork Harbour UoM are shown in Table 3.3. Options are presented in terms of the viable options considered for each AFA. Figures showing the viable flood risk management options are included in the Preliminary Options Report. It should be noted that these figures are indicative only. The locations in which viable options may be constructed within the AFAs may change at detailed design stage if an option is progressed through a scheme.

A preferred option for the AFAs will emerge following technical assessment and cost analysis of the viable options and following input from members of the public. Public input is gained through Public Consultation in December 2015 and January 2016.

Table 3.3: Structural Flood Risk Management Options for UoM 18

AFA	Viable Options
Killeagh	<ul style="list-style-type: none"> No viable measures are proposed.
Castlemartyr	<ul style="list-style-type: none"> Option 1- Flood defences and flow diversion - diverting excess flows (in excess of 7m³/sec) from the Kiltha River around the town through an existing bypass channel which is currently disused (Killamucky Stream). A new flow diversion structure will be required to reconnect to the flow diversion channel. Flood walls would also be constructed within the town north of the confluence of the Killamucky stream and the River Kiltha ranging in height from 1.1m to 1.4m Option 2- Flood walls and embankments ranging in height from 1.1m to 1.5m within the town.
Ballingeary	<ul style="list-style-type: none"> Option 1- Flood walls and embankments ranging in height from 0.7m to 1.5m within the village Option 2- Storage - Storm attenuation of flood waters on the River Lee and its tributary Bunsheelin through construction of storage areas of 450,700m² and 257,500m² respectively. This work will involve stream realignment, construction of embankments to contain flood waters and installation of a sluice gates to control flow from the storage -
Inchigeelagh	<ul style="list-style-type: none"> Option 1- Flood walls and embankments ranging in height from 0.6m to 1.9m within the village. This option also includes the sealing of a culvert within the village.

3.6 Flood Risk Management Options with Potential for Significant Effects on Natura 2000 Sites

Flood risk management measures, while having a positive social impact can have a negative environmental impact. The requirement for ecological protection can limit potential options for flood risk management. The South Western River Basin District contains a variety of habitats and species of conservation concern which are protected under national and European legislation. A flood risk management option is unlikely to emerge as the preferred option for an AFA where there is an associated significant impact on species or habitats for which Ireland has designated areas for their protection (i.e. Natura 2000 Sites).

The potential impacts of the structural and non-structural flood risk management options for UoM 19 are characterised hereunder.

3.6.1 Potential Impacts of Non-Structural Options in UoM 19

Periodic high (flood) and low (drought) flows are a natural element of river hydrology. The flora and fauna inhabiting a watercourse and its riparian zone will be adapted to the natural variation in flow and level which is typical of the system. An extreme flood event, outside of the river systems normal range, can have negative impacts on the ecology of the watercourse as follows:

- Prolonged submergence of riparian flora can result in damage to and loss of species, this can provide opportunity for colonisation by invasive species;
- Increase pollution of the watercourse due to high levels of runoff from land and increased erosion of river banks due to high flow velocities can lead to high sedimentation in the river which can have subsequent negative impacts on fishery habitat;
- Reduced biomass in the watercourse due to the washing out of macroinvertebrates and detritus which has subsequent impacts on populations of consumers in the watercourse;

With the exception of Land Use Management, non-structural measures will not restrain the flow of water during an extreme flood event. The implementation of these measures cannot therefore influence the current frequency, extent or depth of flooding. Impacts on an ecosystem from an extreme flood event will not be prevented by the implementation of non-structural measures. Non-structural measures can however prevent future exacerbation of flooding by ensuring that development within the catchment will not increase runoff to the watercourse through Planning Control.

Land Use Management aims at retaining / delaying runoff within a catchment such that a sudden increase in flows in a watercourse is not experienced / is limited. This option can have the effect of reducing the depth and extent of a flood event. There will be an associated reduction in the potential negative impacts on ecology. Land Use Management provides an opportunity to increase biodiversity through creation of woodland or wetland habitat in place of agricultural lands. This can have a long term positive impact.

Flood Forecasting requires the installation of gauges along a watercourse to measure level and flow. Typically river gauges are installed within a housing (usually a PVC pipe) strapped to a bridge. The bridge acts as a supporting structure to the gauge housing, thereby eliminated the requirement for bankside works. It is not always practical to site a river gauge at the location of a bridge, in which case a bank-side structure is required to support the gauge. The installation of a gauge and supporting structure can have the following impacts on the watercourse:

- permanent removal of riparian vegetation to accommodate the support structure;
- temporary disturbance of river bank and river bed during installation resulting in the release of sediment into the watercourse which can cause temporary deterioration in the quality of fishery habitat and can smother immobile flora and fauna in the watercourse;
- release of concrete into the watercourse (where the structure is not prefabricated) which can result in reduced water quality with subsequent negative consequences for the ecology of the watercourse;
- temporary noise and physical disturbance to species in proximity to the gauge site during installation;
- alteration of water turbulence / flow pattern in the immediate vicinity of the gauge structure which can result a change in erosion / deposition pattern locally and therefore a change in habitat.

3.6.2 Potential Impacts of Structural Options in UoM 19

The viable structural options identified for the management of for the extreme flood event within the UoM can be summarised as Flow Diversion and Flood Walls and Embankments. The potential impacts associated with each viable structural option are presented hereunder.

It should be noted that the options will have the effect of reducing the flood extents. Certain habitats have a dependence on flooding e.g. alluvial woodlands, a priority habitat protected under the Habitats Directive. Alteration of flood regime can negatively impact the distribution of flood dependent habitats and species.

Also all options will involve the use of machinery which is a potential source of environmental pollution through oil and fuel leaks.

Flow Diversion

Flow diversion involves the interception of flood flows within a watercourse and diverting these flows through an artificial channel into another watercourse or into another section of the same watercourse such that a reduction in water volumes is achieved within areas at risk of flooding.

Flow diversion has been identified as a viable option for the Kiltha River in Castlemartyr. It is proposed to use an existing flow bypass channel which is through Pigeon Woods west of the town centre. A new flow diversion structure will be required and the bypass channel will need to be cleared of debris / vegetation before coming on line. Potential environmental effects of flow diversion the Kiltha River include:

- Scouring in the Kiltha River at the bypass channel outlet with associated sediment suspension in the watercourse and river bed erosion;
- Attraction of fish into the bypass channel when it is in operation;
- Damage to habitat;

Flood Walls and Embankments

Flood Walls and Embankments are physical structures designed to contain floodwaters for a defined flood event. Floodwalls can be constructed from a variety of materials including concrete, brick / stone masonry and steel. Embankments are typically constructed from earth which is vegetated to protect against erosion.

The construction of flood walls and embankments has been determined to be a viable option in Castlemartyr, Ballingeary and Inchingelagh. The physical implementation of these structural measures within the AFA's can have the following impacts on protected habitats and species:

- Temporary release of sediment to the watercourse from embankments with subsequent effects on habitat quality;
- Temporary disturbance to species by noise and physical presence on site during construction;

- Introduction of invasive species, e.g. Japanese Knotweed, in the earth imported to site for embankments;
- Accidental spill of construction materials e.g. concrete for wall construction, which can have toxic effects on flora and fauna;
- Removal of riparian habitat to facilitate wall / embankment construction.

Flood Storage

Storage is provided upstream of a flood risk area in order to limit the flow in the downstream watercourse such that it does not overtop its banks. The storage area will come in to operation in times of flood flows. Implementation of flood storage requires the availability of land upstream of the flood risk area with suitable topography which can be allowed to flood during flood conditions in the river. A storage area is typically formed by constructing earth embankments perpendicular to the course of the river coupled with a control structure on the watercourse which will limit flows to that which can be accommodated downstream. The storage area is designed such that during flood flows the watercourse will overtop its banks into the surrounding lands within the storage area (which is contained by the earth embankments) and the control structure will ensure that flows downstream are maintained at levels which will not overtop the banks.

Flood Storage has been assessed as a viable option for:

- Ballingeary (on the River Lee and its tributary the Bunsheelin), comprising an area of 708,200m² within agricultural lands; and

Construction of the flood storage areas in Ballingeary will require that earth is brought to site for embankment construction. Potential significant environmental effects associated with the construction of embankments include:

- Sedimentation of the River Lee and its tributary the Bunsheelin. Sediment deposition in a watercourse can cause a temporary to short term reduction the quality of fishery habitat by infilling interstitial spaces in gravel beds. Sedimentation can reduce light penetration in the water column and can affect oxygen levels both in the river bed and in the free moving water thereby impacting river vegetation and river fauna. Sedimentation can block the gills of in-stream fauna.
- Dust deposition in proximity to the works due to wind blow from the earth used in embankment construction. Dust deposition on the foliage of protected flora or habitats can inhibit effective photosynthesis and transpiration. Dust deposition within a watercourse or on soil can affect the chemical composition and therefore potentially the ecology of the habitat.
- Permanent fragmentation of linear riparian features by construction of very large embankments (e.g. 7m embankment in River Lee) which may deter commuting protected species from using an area;
- Temporary disturbance of species protected under Annex II of the Habitats Directive by noise and physical presence on site;
- Introduction of invasive species, e.g. Japanese Knotweed, in the earth imported to site.

The storage areas will require a control structure (sluice gate / penstock) to be installed on the watercourse to ensure downstream flows are maintained below extreme flood levels. The installation of the control structure will require in-stream works. Installation of a sluice gate / penstock requires that bed and bank material is excavated and the section is replaced by a concrete channel and walls such that the control structure can be anchored to the concrete. Potential significant environmental effects associated with the installation of the control structure include:

- Permanent loss of river bed and river bank within the footprint of the control structure;
- Damage to river bed and bank due to machinery movement in-stream;
- Release of sediment in to the watercourse during installation caused by disturbance to river bed and banks (sedimentation effects are discussed in relation to the embankments above);
- Obstruction to fish passage within the river channel when the control structure is restricting flows;
- Isolation of fish within the flooded storage area in the event that flood waters subside rapidly;
- Creation of temporary wetland habitat within the storage area during flooding;

4 Characteristics of Natura 2000 Sites

4.1 Natura 2000 Sites within the Zone of Impact

Viable flood risk management options have been determined for the Castlemartyr, Ballingeary, and Inchingeelagh AFA's.

Castlemartyr is on the Kiltla River which flows into the Womanagh River which ultimately flows into Ballymacoda Bay SPA (Site code 004023) and the Ballymacoda (Clonpriest and Pillmore) SAC (Site code 000077).

Flood risk management options for Ballingeary and Inchingeelagh are proposed along the River Lee and its tributary the Bunsheelin. These AFA's do not occur within the boundary of any Natura 2000 sites, however the River Lee is hydrologically connected downstream to The Gearagh SAC (Site code 000108) and The Gearagh SPA (Site code 004109).

There is potential that impacts as described in Section 3.6 of this Screening Assessment could affect the qualifying features of the Ballymacoda Bay SPA, the Ballymacoda (Clonpriest and Pillmore) SAC, and the Gearagh SAC and SPA.

Ballymacoda Bay SPA (004023)

The site comprises of the estuary of the Womanagh River. The inner part of the site is well sheltered by a stabilised sandy peninsula (Ring peninsula) and includes the tidal section of the river as far as Crompaun Bridge. Sediments here are mostly muds or muddy sands, and salt marshes are well developed. The outer part of the site is well exposed and sediments here are mostly fine, rippled sands. An area of shallow marine water is included.

Ballymacoda Bay is the second most important site for wintering waterfowl on the south coast after Cork Harbour. The site has internationally important numbers of *Limosa limosa* and *Larus fuscus*, and is the most important site in the country for *Larus fuscus* during autumn. Nationally important numbers of a further 16 species are found in the site. Of particular note is that it holds 9.6% of the national total for *Pluvialis apricaria*, 9.2% of the total for *Pluvialis squatarola*, 4.3% for *Limosa lapponica* and 3.2% for *Calidris alpina*. Ballymacoda Bay is a regular site for passage waders such as *Philomachus pugnax*, *Calidris ferruginea* and *Numenius phaeopus*. It is also an important site for wintering gulls, especially *Larus canus*. The site provides both feeding and roosting areas for the waterfowl species and habitat quality for most of the estuarine habitats is very good.

Ballymacoda (Clonpriest and Pillmore) SAC (000077)

This site comprises the estuary of the Womanagh River. Intertidal flats are well represented, with a good diversity of macro-invertebrate species and range of intertidal biotopes. Atlantic salt meadows are particularly well developed and currently extending in parts of site. Salicornia and other annuals of intertidal sand and mud flats also occur. The site is very important for wintering waterfowl. Qualifying features are Estuaries [1130], Mudflats and sandflats not covered by seawater at low tide [1140], Salicornia and other

annuals colonizing mud and sand [1310] and Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330].

The Gearagh SAC (000108)

This site is located on the River Lee in Co. Cork, extending westwards and southwards from the Lee Bridge, which is about 1.5 km south of Macroom. It extends for about 7 km of river, to Dromcarra Bridge. The Gearagh occupies a wide, flat valley of the River Lee, on a bed of limestone overlain with sand and gravel. Qualifying features are Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation [3260], Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0], Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0] and *Lutra lutra* (Otter) [1355].

Gearagh still represents the only extensive alluvial woodland in Ireland or Britain, or indeed west of the Rhine in Europe. For this reason it is a unique site and has been designated also as a Statutory Nature Reserve. The international importance of the site is recognised by its designation both as a Ramsar site and as a Biogenetic Reserve. The reservoir is also a Wildfowl Sanctuary.

The Gearagh SPA (004109)

The boundary of the site overlaps to some extent with the Gearagh SAC. The site includes the Annahala lough. The qualifying features include: Wigeon (*Anas penelope*) [A050], Teal (*Anas crecca*) [A052], Mallard (*Anas platyrhynchos*) [A053], Coot (*Fulica atra*) [A125], and Wetland and Waterbirds [A999].

4.2 Likelihood of Impacts on Natura 2000 Sites

The likelihood of the potential impacts as described in Section 3.6 of this Screening Assessment affecting the qualifying features of the Ballymacoda Bay SPA and the Ballymacoda (Clonpriest and Pillmore) SAC and the Gearagh SAC and SPA are determined through Source-Pathway-Receptor assessment.

A review of available data was carried out to determine the presence of qualifying features of the Ballymacoda Bay SPA and the Ballymacoda (Clonpriest and Pillmore) SAC and the Gearagh SAC and SPA within the environs of the AFA's. Data reviewed included:

- Protected species spatial datasets for the SWRBD provided by NPWS
- Article 17 spatial data on protected habitats and species available through NPWS website
- Article 12 reporting data on breeding distributions and ranges of protected bird species available through NPWS website
- iWebs data
- National Survey of Native Woodlands 2003-2008 spatial data available through NPWS website
- Irish Semi-natural Grassland Survey spatial data available through NPWS website
- Coastal Monitoring Project 2004-2006 available through NPWS website
- Saltmarsh Monitoring Project 2006-2008 available through NPWS website
- Protected species data sourced through the National Biodiversity Data Centre

The likelihood of an impact occurring is characterised in accordance with the NRA (2009) classification:

- Near-certain: >95% chance of occurring as predicted
- Probable: 50-95% chance of occurring as predicted
- Unlikely: 5-50% chance of occurring as predicted
- Extremely unlikely: <5% chance of occurring as predicted

4.2.1 Castlemartyr AFA

Flood Walls and Embankments

The likelihood of potential impacts of constructing Flood Walls and Embankments in Castlemartyr on the qualifying features of the Ballymacoda (Clonpriest and Pillmore) SAC and the special conservation interests of the Ballymacoda Bay SPA are discussed hereunder.

The Castlemartyr AFA boundary does not overlap with any Natura 2000 site boundary. The Ballymacoda Bay SPA and Ballymacoda (Clonpriest and Pillmore) SAC are located approximately 10km east of Castlemartyr. There will be no requirement for land take within a Natura 2000 site for the construction of flood protection works. Therefore there is no potential for direct damage to Annex I habitat. Potential removal of riparian habitat to accommodate the works will not impact the qualifying features of the SAC or SPA. The conservation interests of the SPA are not known to roost or feed along riparian habitat.

The Kiltha River (which flows through Castlemartyr) is hydrologically connected to Ballymacoda Bay via the Womanagh River. Sediment release / accidental pollution of the Kiltha River could potentially enter the Bay. The release of sediment into the bay is extremely unlikely to impact the qualifying features of the SAC. These habitats are habitually inundated with sediment during tidal exchanges and are adapted to such conditions. Pollutants e.g. concrete / oil leaks will be diluted by flows in the Kiltha River, the Womanagh River and also by estuarine water in the bay. It is highly unlikely that pollutants would reach the Bay at such concentrations what would cause habitat damage.

Disturbance of wetland waterbirds for which the Ballymacoda Bay SPA is designated is highly unlikely given distance from site. The flight response distance (i.e. the point at which the bird moves away from a source of disturbance) varies between species, is greater during adverse weather, and depends on the acclimatisation of the birds to such disturbance. Wetland birds have been documented to tolerate noise levels at or below 70dB(A) (Institute of Estuarine & Coastal Studies, University of Hull, 2009). BS 5228-1:2009+A1:2014 prescribes typical noise level data for various construction plant and activities within 10m from source. The inverse square law⁷ can be applied to determine likely noise levels at varying distances from the Dundalk WWTP site (Table 4.1).

⁷ Inverse Square Law – For every doubling of the distance from the noise source, the sound pressure levels will broadly be reduced by 6 decibels (dB)

Table 4.1: Noise Levels, dB(A), at Various Distances from Construction Activities

Distance from Source (m)	Tracked excavator	Mixing cement - large lorry concrete mixer	Dumper Truck (empty)	Dumper Truck (tipping fill)	Breaking concrete	Dozer	Wheeled Loading Lorry
10	78	77	87	79	96	81	80
20	74	73	83	75	92	77	76
40	68	67	77	69	86	71	70
80	62	61	71	63	80	65	64
160	56	55	65	57	74	59	58
320	50	49	59	51	68	53	52
640	44	43	53	45	62	47	46
1280	38	37	47	39	56	41	40
2560	32	31	41	33	50	35	34

Based on BS 5228-1:2009+A1:2014

From Table 4.1, noise generated during construction will have diminished to tolerable levels for wetland birds [70dB(A)] within 320m of the works.

Flow Diversion

The existing flow diversion channel is through Pigeon Wood, an area long established woodland is located immediately west of Castlemartyr AFA. This woodland comprises a mix of conifer plantation, broadleaf and mixed woodland (Fossitt code WD1). There are also areas which have been recently clear-felled. There is potential for destruction of woodland habitat for the purpose of machinery access. This is not Annex I habitat, it is outside the boundary of Natura 2000 sites and is not a qualifying feature. Damage to Annex I habitat during construction of the flow diversion structure in the Kiltha River is extremely unlikely.

The Womanagh River and Kiltha River are not designated as salmonid and are not known to support populations of Annex II species e.g. lamprey, Atlantic Salmon, freshwater pearl mussel or white-clawed crayfish. There is no designation on the watercourses for the protection of these species and they are not qualifying features of the Ballymacoda (Clonpriest and Pillmore) SAC. Impact on fish will not negatively impact the conservation objectives of the SAC or SPA.

4.2.2 Ballingearry AFA

Flood Walls and Embankments

The likelihood of potential impacts of constructing Flood Walls and Embankments in Ballingearry on the qualifying features of the Gearagh SAC and SPA are discussed hereunder.

The Ballingearry AFA boundary does not overlap with any Natura 2000 site boundary. The Gearagh SPA and SAC are located approximately 15km east of Ballingearry. There will be no requirement for land take within a Natura 2000 site for the construction of flood protection works. Therefore there is no potential for direct damage to Annex I habitat. Potential removal of riparian habitat to accommodate the works will not impact the qualifying features of the SAC or SPA. Given the distance from the Natura 2000, , there will be no impacts on wetland waterbirds for which the Gearagh SPA is designated.

The Bunsheelin stream, a tributary of the River Lee, flows through Ballingearry is hydrologically connected downstream to the Gearagh SAC. The release of sediment into the river is extremely unlikely to impact the qualifying features of the SAC. Pollutants e.g. concrete / oil leaks will be diluted by flows in the River Lee and its tributary. It is highly unlikely that pollutants would reach the Gearagh at such concentrations what would cause habitat damage.

The proposed works occur approximately 15km from the SAC site boundary. There will be no impacts on the conservation objectives of otters.

Storage

The likelihood of potential impacts of flood storage areas on the River Lee and its tributary Bunsheelin Stream in Ballingearry on the qualifying features of the Gearagh SAC and SPA are discussed hereunder.

It is near certain that sediment resuspension and washing out will occur in the River Lee and its tributary Bunsheelin Stream during in-stream works and during the removal of riparian habitat to construct a control structure for flood storage areas. Also sediment runoff into the watercourse from embankments is probable given their proximity to the watercourse.

Damage to Annex I qualifying features is extremely unlikely given that the storage options are within terrestrial habitat outside the boundary of the SAC which is designated principally for woodland habitats. The storage areas are proposed within areas of improved agricultural grassland and scrub. Impacts on alluvial woodland and oak woodland are extremely unlikely. Watercourses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation are qualifying features of the Gearagh SAC. Very little survey work has been conducted on distribution of these species in Ireland. The release of sediment into the river is extremely unlikely to impact the qualifying features of the SAC. Pollutants e.g. concrete / oil leaks will be diluted by flows in the River Lee and its tributary. It is highly unlikely that pollutants would reach the Gearagh at such concentrations what would cause habitat damage.

The proposed works occur approximately 15km from the SAC site boundary. There will be no impacts on the conservation objectives of otters.

Potential removal of riparian habitat and hedgerows to accommodate the works will not impact the qualifying features of the SAC or SPA. There will be no disturbance of wetland waterbirds for which the Gearagh SPA is designated.

4.2.3 Inchigeelagh AFA

The likelihood of potential impacts of constructing Flood Walls and Embankments in Inchigeelagh on the qualifying features of the Gearagh SAC and SPA are discussed hereunder:

The Inchigeelagh AFA boundary does not overlap with any Natura 2000 site boundary. The Gearagh SPA and SAC are located approximately 7km east of the village. There will be no requirement for land take within a Natura 2000 site for the construction of flood protection works. Therefore there is no potential for direct damage to Annex I habitat. Potential removal of riparian habitat to accommodate the works will not impact the qualifying features of the SAC or SPA. There will be no disturbance of wetland waterbirds for which the Gearagh SPA is designated.

The River Lee is hydrologically connected downstream to the Gearagh SAC. The release of sediment into the river is extremely unlikely to impact the qualifying features of the SAC. Pollutants e.g. concrete / oil leaks will be diluted by flows in the River Lee and its tributary. It is highly unlikely that pollutants would reach the Gearagh at such concentrations what would cause habitat damage.

The proposed works occur approximately 7km from the SAC site boundary. There will be no impacts on the conservation objectives of otters.

4.2.4 Summary of Likely Impacts on the Ballymacoda Bay SPA, the Ballymacoda (Clonpriest and Pillmore) SAC and the Gearagh SAC and SPA

No likely impacts have been determined on the Ballymacoda Bay SPA and the Ballymacoda (Clonpriest and Pillmore) SAC from the implementation of viable options in the Castlemartyr AFA.

No likely impacts have been determined on the Gearagh SPA and the Gearagh SAC from the implementation of viable options in the Ballingearry and Inchigeelagh AFA.

5 Significance of Impacts on Natura 2000 Sites

5.1 General

The significance of an impact is relative to the existing condition/conservation status of a Natura 2000 site and to the scale of the impact in space and time.

Favourable conservation condition of an Annex I habitat is achieved when:

- its natural range, and area it covers within that range, are stable or increasing,
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable.

The favourable conservation condition of an Annex II species is achieved when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

5.2 Assessment of Significance

Where it is determined that a likely impact of flood risk management options will have a significant impact on a Natura 2000 site, the flood risk management options must be assessed through full Appropriate Assessment. The precautionary principle must be applied in determining significance of an impact. Where the significance of an impact cannot definitively be ascertained on the basis of the information available it is required to progress to full Appropriate Assessment i.e. an option cannot be screened out unless there is certainty that no significant impact is likely.

An assessment of potential impacts of the flood risk management options for Castlemartyr, Ballingeary, and Inchigeelagh AFA's identified that potential impacts (habitat destruction, disturbance to species and environmental pollution) are highly unlikely due to distance of qualifying features from the Natura 2000 sites and will not cause significant impacts on Natura 2000 sites.

No likely significant effects on the conservation objectives any Natura 2000 site is reasonably foreseeable as a result of the construction and operation of the viable flood risk management options.

6 Conclusions and Screening Statement

No likely significant effects on Natura 2000 sites are reasonably foreseeable as a result of the implementation of flood risk management measures in UoM 19.

Table 6.1: Screening Matrix for UoM 19

Screening Matrix	
Project	
Brief description of the project or plan	<p>Castlemartyr AFA:</p> <ul style="list-style-type: none"> Option 1- Flood defences and flow diversion - diverting excess flows (in excess of 7m³/sec) from the Kiltha River around the town through an existing bypass channel which is currently disused (Killamucky Stream). A new flow diversion structure will be required to reconnect to the flow diversion channel. Flood walls would also be constructed within the town north of the confluence of the Killamucky stream and the River Kiltha ranging in height from 1.1m to 1.4m Option 2- Flood walls and embankments ranging in height from 1.1m to 1.5m within the town. <p>Ballingeary AFA</p> <ul style="list-style-type: none"> Option 1-Flood walls and embankments ranging in height from 0.7m to 1.5m within the village Option 2- Storage - Storm attenuation of flood waters on the River Lee and its tributary Bunsheelin through construction of storage areas of 450,700m² and 257,500m² respectively. This work will involve stream realignment, construction of embankments to contain flood waters and installation of a sluice gates to control flow from the storage Flood Storage. <p>Inchigeelagh AFA</p> <ul style="list-style-type: none"> Option 1- Flood walls and embankments ranging in height from 0.6m to 1.9m within the village. This option also includes the sealing of a culvert within the village
Natura 2000 Site	
Brief description of the Natura 2000 site(s)	<p>Ballymacoda Bay SPA (004023)</p> <p>The site comprises of the estuary of the Womanagh River. The inner part of the site is well sheltered by a stabilised sandy peninsula (Ring peninsula) and includes the tidal section of the river as far as Crompaun Bridge. Sediments here are mostly muds or muddy sands, and salt marshes are well developed. The outer part of the site is well exposed and sediments here are mostly fine, rippled sands. An area of shallow marine water is included. Ballymacoda Bay is the second most important site for wintering waterfowl on the south coast after Cork Harbour. It is also an important site for wintering gulls, especially <i>Larus canus</i>. The site provides both feeding and roosting areas for the waterfowl species and habitat quality for most of the estuarine habitats is very good.</p> <p>Ballymacoda (Clonpriest and Pillmore) SAC (000077)</p>

Screening Matrix

This site comprises the estuary of the Womanagh River. Intertidal flats are well represented, with a good diversity of macro-invertebrate species and range of intertidal biotopes. Atlantic salt meadows are particularly well developed and currently extending in parts of site. Salicornia and other annuals of intertidal sand and mud flats also occur. The site is very important for wintering waterfowl. Qualifying features are Estuaries [1130], Mudflats and sandflats not covered by seawater at low tide [1140], Salicornia and other annuals colonizing mud and sand [1310] and Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330].

The Gearagh SAC (000108)

This site is located on the River Lee in Co. Cork, extending westwards and southwards from the Lee Bridge, which is about 1.5 km south of Macroom. It extends for about 7 km of river, to Dromcarra Bridge. The Gearagh occupies a wide, flat valley of the River Lee, on a bed of limestone overlain with sand and gravel. Qualifying features are Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation [3260], Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0], Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) [91E0] and *Lutra lutra* (Otter) [1355]. Gearagh still represents the only extensive alluvial woodland in Ireland or Britain, or indeed west of the Rhine in Europe. For this reason it is a unique site and has been designated also as a Statutory Nature Reserve. The international importance of the site is recognised by its designation both as a Ramsar site and as a Biogenetic Reserve. The reservoir is also a Wildfowl Sanctuary.

The Gearagh SPA (004109)

The boundary of the site overlaps to some extent with the Gearagh SAC. The site includes the Annahala lough. The qualifying features include: Wigeon (*Anas penelope*) [A050], Teal (*Anas crecca*) [A052], Mallard (*Anas platyrhynchos*) [A053], Coot (*Fulica atra*) [A125], and Wetland and Waterbirds [A999].

Assessment Criteria

Describe the individual elements of the project (either alone or in combination with other plans or projects) likely to give rise to impacts on the Natura 2000 site.

In-stream works and removal of river bed and riparian habitat to accommodate flood management measures.
Sediment release to the watercourse due to works within and in proximity to rivers and streams.
Temporary disruption resulting from noise from construction machinery

Describe any likely direct, indirect or secondary impacts of the project (either alone or in combination with other plans or projects) on the Natura 2000 site by virtue of:

No likely impacts are determined for the Castlmartyr, Ballingearry or Inchigeelagh AFAs

Size and scale;

Land-take;

Screening Matrix	
Distance from the Natura 2000 site or key features of the site; Resource requirements (water abstraction etc); Emissions (disposal to land, water or air); Excavation requirements; Transportation requirements; Duration of construction, operation, decommissioning etc; Other.	No likely changes to the SAC / SPA are determined
Describe any likely changes to the site arising as a result of: Reduction in habitat area; Disturbance to key species; Habitat or species fragmentation; Reduction in species density; Changes in key indicators of conservation value (water quality etc); Climate change.	No likely changes to the SAC / SPA are determined
Describe any likely impacts on the Natura 2000 site as a whole in terms of: Interference with the key relationships that define the structure of the site; Interference with key relationships that define the function of the site.	No likely impacts are determined
Provide indicators of significance as a result of the identification of effects set out above in terms of: Loss; Fragmentation; Disruption; Disturbance; Change to key elements of the site.	No significant impacts are determined
Describe from the above those elements of the project or plan, or combination of elements, where the above impacts are likely to be significant or where the scale or magnitude of impacts is not known.	No significant effects have been determined

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Appendix E. Climate Change Adaptability

Climate Change Adaptability

AFA		Development & Assessment of Strategies, Plans & Measures				Design & Implementation (Actions Required to Adapt to Climate Change)		Score	Final Score			
Ballingeary	→	Sensitivity Based Approach Examine potential impacts of climate change (increased hazard and risk). Determine appropriate approaches for the design and implementation of measures. 1. Assumptive Approach 2. Adaptive Approach 3. No Physical Provision	→	Suitable Approaches 1. Adaptive Approach 2. No Physical Provision	→	Option 1 Flood Defences	→	Adaptive Approach: Increase height of existing flood defences (by 0.4m on Bunsheelin or 0.2m on Lee).	→	4	→	4.00
							→	or	→			
							→	or	→			
							→	or	→			
							→	or	→			
					→	Option 2 Storage	→	Adaptive Approach: Increase height of storage embankments and structures. Lee increase is 2m, Bunsheelin Increase is 1.7m	→	3	→	3.00
							→	No Physical Provision: Provide additional storage areas to store additional flow	→	0		
							→	or	→			
							→	or	→			
					→		→		→		→	0.00
							→	or	→			
							→	or	→			
							→	or	→			

Climate Change Adaptability

AFA		Development & Assessment of Strategies, Plans & Measures				Design & Implementation (Actions Required to Adapt to Climate Change)		Score	Final Score															
Inchigeelagh	→	Sensitivity Based Approach Examine potential impacts of climate change (increased hazard and risk). Determine appropriate approaches for the design and implementation of measures. 1. Assumptive Approach 2. Adaptive Approach 3. No Physical Provision	→	Suitable Approaches 1. Adaptive Approach 2. No Physical Provision	→	<div>Option 1 Flood Defences</div>	→	Adaptive Approach: Increase height of existing flood defences by 0.4m.	→	4	→	4.00												
							→	or	→															
							→	or	→															
							→	or	→															
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																			→	or	→			

Climate Change Adaptability

AFA	Development & Assessment of Strategies, Plans & Measures			Design & Implementation (Actions Required to Adapt to Climate Change)	Score	Final Score
Castlemartyr	Sensitivity Based Approach Examine potential impacts of climate change (increased hazard and risk). Determine appropriate approaches for the design and implementation of measures. 1. Assumptive Approach 2. Adaptive Approach 3. No Physical Provision	Suitable Approaches 1. Adaptive Approach 2. No Physical Provision	Option 1 Flood Defences	→ Adaptive Approach: Increase height of existing flood defences (Score 4) No Physical Provision: Construct 115m of new flood defences (Score 0) or → No Physical Provision: Construct flow diversion works or → or →	2 0 	2.00
			Option 2 Flow Diversion & Flood Defences	→ No Physical Provision: Construct new flood defences or → or → or →	0 	
				→ or → or → or →	 	
				→ or → or → or →	 	

Appendix F. Multi Criteria Assessment

F.1 Local Weighting Data

AFA: Ballingeary

Objective	Local Weighting	Code	Rationale
Technical			
Ensure flood risk management options are operationally robust	5.00	1a1	Constant, as per Guidance Note 29
Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	5.00	1b1	Constant, as per Guidance Note 29
Ensure flood risk management options are adaptable to future flood risk	5.00	1c1	Constant, as per Guidance Note 29
Economy			
Minimise economic risk	5.00	2a1	937936/75000
Minimise risk to transport infrastructure	5.00	2b2	Motorway 250() + National Primary 150() + (National Secondary 75() + Regional 25(.5) + Local Rural 10(.02) + Local Urban 20(.2)
Minimise risk to utility infrastructure	5.00	2c3	Power Stations 500() + HV Sub-Stations 250() + Gas Assets - High Priority 100() + Gas Assets - Medium Priority 25() + Water Treatment Plants 250() + WwTP and Primary Pumping Facilities 250(.5) + Core Telecommunications Exchanges 100() + Non-Core Telecommunications Exchanges 25()
Manage Risk to Agriculture	3.75	2d1	Based on agriculture at risk
Social			
Minimise risk to human health and life of residents	5.00	3a1	Nr. at risk from 50% AEP 2*.5(6) + Nr. at risk from 20% AEP 2*.2(7) + Nr. at risk from 10% AEP 2*.1(3) + Nr. at risk from 5% AEP 2*.05(2) + Nr. at risk from 2% AEP 2*.02(1) + Nr. at risk from 1% AEP 2*.01(2) + Nr. at risk from .5% AEP 2*.005(1) + Nr. at risk from .1% AEP 2*.001(6)
Minimise risk to high vulnerability properties	1.05	3a2	Nr. at risk from 50% AEP 0.5*() + Nr. at risk from 20% AEP 0.2*() + Nr. at risk from 10% AEP 0.1*() + Nr. at risk from 5% AEP 0.05*() + Nr. at risk from 2% AEP 0.02*50(1) + Nr. at risk from 1% AEP 0.01*() + Nr. at risk from .5% AEP 0.005*() + Nr. at risk from .1% AEP 0.001*50(1)
Minimise risk to social infrastructure and amenity	5.00	3b1	Nr. at risk from 50% AEP 25*.5(1) + Nr. at risk from 20% AEP 25*.2(1) + Nr. at risk from 10% AEP 25*.1() + Nr. at risk from 5% AEP 25*.05() + Nr. at risk from 2% AEP 25*.02() + Nr. at risk from 1% AEP 25*.01() + Nr. at risk from .5% AEP 25*.005() + Nr. at risk from .1% AEP 25*.001(1)
Minimise risk to local employment	5.00	3b2	Nr. at risk from 50% AEP 5*.5(9) + Nr. at risk from 20% AEP 5*.2(9) + Nr. at risk from 10% AEP 5*.1(4) + Nr. at risk from 5% AEP 5*.05() + Nr. at risk from 2% AEP 5*.02(2) + Nr. at risk from 1% AEP 5*.01(1) + Nr. at risk from .5% AEP 5*.005(1) + Nr. at risk from .1% AEP 5*.001(4)
Environmental			
Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	5.00	4a1	As per Guideline No. 28
Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	0.00	4b1	The AFA boundary does not overlap with any Natura 2000 site boundary
Avoid damage to and where possible enhance the flora and fauna of the catchment	2.00	4c1	Flora and Fauna of local importance. Otters recorded within 10km of AFA and River is salmonid
Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	4.00	4d1	The River Lee is a salmonid river. River is noted for its fishery potential.
Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	3.00	4'e1	The landscape value is considered to be high value and sensitivity with local importance. There are a number of protected scenic routes on the approach roads.
Avoid damage to or loss of features, institutions and collections of architectural value and their setting and improve their protection from extreme floods.	0.00	4f1	There are a no NIAH/RPS at risk from flooding
Avoid damage to or loss of features, institutions and collections of archaeological value and their setting and improve their protection from extreme floods where this is beneficial.	3.00	4f2	There are a number of protected bridges RMP's at risk from flooding

AFA: Inchigeelagh

Objective	Local Weighting	Code	Rationale
Technical			
Ensure flood risk management options are operationally robust	5.00	1a1	Constant, as per Guidance Note 29
Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	5.00	1b1	Constant, as per Guidance Note 29
Ensure flood risk management options are adaptable to future flood risk	5.00	1c1	Constant, as per Guidance Note 29
Economy			
Minimise economic risk	2.97	2a1	222765/75000
Minimise risk to transport infrastructure	5.00	2b2	Motorway 250() + National Primary 150() + (National Secondary 75() + Regional 25(0.02) + Local Rural 10() + Local Urban 20(.5)
Minimise risk to utility infrastructure	0.00	2c3	Power Stations 500() + HV Sub-Stations 250() + Gas Assets - High Priority 100() + Gas Assets - Medium Priority 25() + Water Treatment Plants 250() + WwTP and Primary Pumping Facilities 250() + Core Telecommunications Exchanges 100() + Non-Core Telecommunications Exchanges 25()
Manage Risk to Agriculture	4.00	2d1	Based on agriculture at risk
Social			
Minimise risk to human health and life of residents	4.78	3a1	Nr. at risk from 50% AEP 2*.5(2) + Nr. at risk from 20% AEP 2*.2(5) + Nr. at risk from 10% AEP 2*.1(2) + Nr. at risk from 5% AEP 2*.05(3) + Nr. at risk from 2% AEP 2*.02(1) + Nr. at risk from 1% AEP 2*.01(1) + Nr. at risk from .5% AEP 2*.005(1) + Nr. at risk from .1% AEP 2*.001(7)
Minimise risk to high vulnerability properties	0.00	3a2	Nr. at risk from 50% AEP 0.5*() + Nr. at risk from 20% AEP 0.2*() + Nr. at risk from 10% AEP 0.1*() + Nr. at risk from 5% AEP 0.05*() + Nr. at risk from 2% AEP 0.02*() + Nr. at risk from 1% AEP 0.01*() + Nr. at risk from .5% AEP 0.005*() + Nr. at risk from .1% AEP 0.001()
Minimise risk to social infrastructure and amenity	0.25	3b1	Nr. at risk from 50% AEP 25*.5() + Nr. at risk from 20% AEP 25*.2() + Nr. at risk from 10% AEP 25*.1() + Nr. at risk from 5% AEP 25*.05() + Nr. at risk from 2% AEP 25*.02() + Nr. at risk from 1% AEP 25*.01(1) + Nr. at risk from .5% AEP 25*.005() + Nr. at risk from .1% AEP 25*.001()
Minimise risk to local employment	5.00	3b2	Nr. at risk from 50% AEP 5*.5(1) + Nr. at risk from 20% AEP 5*.2(1) + Nr. at risk from 10% AEP 5*.1(1) + Nr. at risk from 5% AEP 5*.05(2) + Nr. at risk from 2% AEP 5*.02(6) + Nr. at risk from 1% AEP 5*.01(3) + Nr. at risk from .5% AEP 5*.005(1) + Nr. at risk from .1% AEP 5*.001(7)
Environmental			
Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	5.00	4a1	As per Guidelines No. 28
Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	0.00	4b1	The Inchigeelagh AFA boundary does not overlap with any Natura 2000 site boundary
Avoid damage to and where possible enhance the flora and fauna of the catchment	2.00	4c1	Flora and Fauna of local importance. River is salmonid
Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	4.00	4d1	The River Lee is a salmonid river. River is noted for its fishery amenity potential
Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	3.00	4'e1	The landscape value is considered to be high value and sensitivity with local importance.
Avoid damage to or loss of features, institutions and collections of architectural value and their setting and improve their protection from extreme floods.	0.00	4f1	There are no known NIAH/RPS at risk from flooding
Avoid damage to or loss of features, institutions and collections of archaeological value and their setting and improve their protection from extreme floods where this is beneficial.	3.00	4f2	There is an RMP at risk from flooding

AFA: Castlemartyr

Objective	Local Weighting	Code	Rationale
Technical			
Ensure flood risk management options are operationally robust	5.00	1a1	Constant, as per Guidance Note 29
Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	5.00	1b1	Constant, as per Guidance Note 29
Ensure flood risk management options are adaptable to future flood risk	5.00	1c1	Constant, as per Guidance Note 29
Economy			
Minimise economic risk	1.29	2a1	97074/75000
Minimise risk to transport infrastructure	5.00	2b2	Motorway 250() + National Primary 150(.1) + (National Secondary 75() + Regional 25(.05) + Local Rural 10(.2) + Local Urban 20()
Minimise risk to utility infrastructure	0.00	2c3	Power Stations 500() + HV Sub-Stations 250() + Gas Assets - High Priority 100() + Gas Assets - Medium Priority 25() + Water Treatment Plants 250() + WwTP and Primary Pumping Facilities 250() + Core Telecommunications Exchanges 100() + Non-Core Telecommunications Exchanges 25()
Manage Risk to Agriculture	0.00	2d1	Based on agriculture at risk
Social			
Minimise risk to human health and life of residents	3.20	3a1	Nr. at risk from 50% AEP 2*.5() + Nr. at risk from 20% AEP 2*.2(5) + Nr. at risk from 10% AEP 2*.1(5) + Nr. at risk from 5% AEP 2*.05(1) + Nr. at risk from 2% AEP 2*.02(2) + Nr. at risk from 1% AEP 2*.01() + Nr. at risk from .5% AEP 2*.005(1) + Nr. at risk from .1% AEP 2*.001(3)
Minimise risk to high vulnerability properties	0.00	3a2	Nr. at risk from 50% AEP 0.5*() + Nr. at risk from 20% AEP 0.2*() + Nr. at risk from 10% AEP 0.1*() + Nr. at risk from 5% AEP 0.05*() + Nr. at risk from 2% AEP 0.02*() + Nr. at risk from 1% AEP 0.01*() + Nr. at risk from .5% AEP 0.005*() + Nr. at risk from .1% AEP 0.001()
Minimise risk to social infrastructure and amenity	0.50	3b1	Nr. at risk from 50% AEP 25*.5() + Nr. at risk from 20% AEP 25*.2() + Nr. at risk from 10% AEP 25*.1() + Nr. at risk from 5% AEP 25*.05() + Nr. at risk from 2% AEP 25*.02(1) + Nr. at risk from 1% AEP 25*.01() + Nr. at risk from .5% AEP 25*.005() + Nr. at risk from .1% AEP 25*.001()
Minimise risk to local employment	4.90	3b2	Nr. at risk from 50% AEP 5*.5() + Nr. at risk from 20% AEP 5*.2(4) + Nr. at risk from 10% AEP 5*.1(1) + Nr. at risk from 5% AEP 5*.05() + Nr. at risk from 2% AEP 5*.02(2) + Nr. at risk from 1% AEP 5*.01(2) + Nr. at risk from .5% AEP 5*.005(3) + Nr. at risk from .1% AEP 5*.001(4)
Environmental			
Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	5.00	4a1	As per Guidelines No. 28
Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	1.00	4b1	The AFA boundary does not overlap with any Natura 2000 site boundary
Avoid damage to and where possible enhance the flora and fauna of the catchment	4.00	4c1	Otter are frequent in the area. Pigeon Wood, an area long established woodland
Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	2.00	4d1	The river is not classified as a salmonid river under the Salmonid Regulation and is not known as a river for high salmon/lamprey potential. There is local fishing value along the river
Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	3.00	4'e1	Castlemartyr is defined within the Cork County Development Plan" a Broad Fertile lowland valley". This landscape character type is classified as having local value and medium sensitivity and value
Avoid damage to or loss of features, institutions and collections of architectural value and their setting and improve their protection from extreme floods.	3.00	4f1	Castlemartyr is classified in the Cork County Development Plan as an area of architectural importance. There are a number of sites/features listed on the record of structures and NIAH within the town and potentially affected with a high to moderate vulnerability
Avoid damage to or loss of features, institutions and collections of archaeological value and their setting and improve their protection from extreme floods where this is beneficial.	2.00	4f2	Castlemartyr is of local archaeological value and vulnerability. There are no RMP at risk from flooding

F.2 MCA Matrices

AFA	Ballingeary
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Multi-Criteria Assessment								Do Nothing			
Criteria	Objective	Sub-Objective	Indicator	Basic Requirement	Aspirational Target	Global Weighting	Local Weighting	Score	Rationale	Wtd Score	
Technical	Ensure flood risk management options are operationally robust	Ensure flood risk management options are operationally robust	Level of operational risk of option- Degree of reliance on mechanical, electrical or electronic systems, or on human intervention, action or decision, for the option to operate or perform successfully, - Non-numeric			20.00	5.00	0.00	Do nothing option	0.00	
	Minimise health and safety risk of flood risk management options	Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	Degree of health and safety risk during construction and operation	Moderate to high, but acceptable and manageable, level of health and safety risk during construction, maintenance or operation	Negligible risk to health and safety during construction,maintenance or operation	20.00	5.00	0.00	Do nothing option	0.00	
	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	Ensure flood risk management options are adaptable to future flood risk	Sustainability and adaptability of the flood risk management measure in the face of potential future changes, including the potential impacts of climate change	Option should not hinder future interventions that may be required to manage potential future increases in risk	Option to provide for, or be adaptable to, the HEFS in terms of maintaining the standard of protection at no or negligible cost	20.00	5.00	0.00	Do nothing option	0.00	
Technical Score								0.00			
Economic	Minimise economic risk	Minimise economic risk	Annual Average Damage (AAD) expressed in Euro / year	AAD is not increased	100% reduction in AAD	24.00	5.00	0.00	Do nothing option	0.00	
	Minimise risk to transport infrastructure	Minimise risk to transport infrastructure	Length of infrastructure at risk from flooding in the 0.1% AEP event	Do not increase length of infrastructure at risk from flooding	Reduce the length of infrastructure at risk from flooding by 50%	10.00	5.00	0.00	Do nothing option	0.00	
	Minimise risk to utility infrastructure	Minimise risk to utility infrastructure	Utilities at risk from flooding	No increase number of utility receptors at risk from flooding	Reduce number of utility receptors at risk to 0	14.00	5.00	0.00	Do nothing option	0.00	
	Manage Risk to Agriculture	Manage Risk to Agriculture	Agricultural prodction	Do not increase in negative impact of flooding on agricultural production	Provide the potential for enhanced agricultural production	12.00	0.00	0.00	Do nothing option	0.00	
Economic Score								0.00			
Social	Minimise risk to human health and life	Minimise risk to human health and life of residents	Annual Average number of residential properties at risk from flooding	Number of residential properties at risk from flooding does not increase	Reduce the number of residential properties at risk from flooding to 0	27.00	5.00	0.00	Do nothing option	0.00	
		Minimise risk to high vulnerability properties	Number of high vulnerability properties at risk from flooding	Do not increase number of high vulnerability properties at risk from flooding	Reduce the number of high vulnerability properties at risk from flooding to 0	17.00	1.05	0.00	Do nothing option	0.00	
	Minimise risk to community	Minimise risk to social infrastructure and amenity	Number of social infrastructure receptors at risk from flooding	Do not increase number of social infrastructure receptors at risk from flooding	Reduce the number of social infrastructure receptors at risk from flooding to 0	9.00	5.00	0.00	Do nothing option	0.00	
		Minimise risk to local employment	Number of enterprises at risk from flooding	Do not increase number of enterprises at risk from flooding	Reduce the number of enterprises at risk from flooding to 0	7.00	5.00	0.00	Do nothing option	0.00	
Social Score								0.00			
Environmental	Support the objectives of the WFD	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	water body status	Provide no constraint to the achievement of water body objectives	Contribute to the achievement of water body objectives	16.00	5.00	-2.00	The Bunsheelin stream and River Lee flows through Ballingeary These are classified as good status under the WFD. The River Lee is designated as salmonid and considered sensitive. Spawning grounds for salmonid are likely upstream along the River Lee. There is one significant polluting source at risk from flooding in the 1% AEP. in the do nothing scenario this will continue to be at risk.	-160.00	
	Support the objectives of the Habitats and Birds Directives	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	Area of site at risk from flooding and qualitative Assessment of impact of option on habitat	No deterioration in the conservation status of designated sites as a result of flood risk management measures	Improvement in the conservation status of designated sites as a result of flood risk management measures	10.00	0.00	0.00	AFA do not occur within the boundary of any Natura 2000 sites. The Gearagh SPA and SAC are located approximately 15km east of Ballingeary. The sites are hydrological connected via the River Lee.	0.00	
	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	Avoid damage to and where possible enhance the flora and fauna of the catchment	Avoid damage to and where possible enhance, legally protected sites / habitats and other sites / habitats of national regional and local nature conservation importance	No deterioration on condition of existing sites due to implimentation of option	Creation of new or improved condition of existing sites due to implementation of option	5.00	2.00	0.00	Otters have not been recorded within 10km of the village. It is extremely unlikely that Otter use the habitat in proximity to the village. The River Lee is a salmonid river. Do nothing will have no signficiant long term impact on the value ecological of the river. potential short term impacts during flood event	0.00	
	Protect, and where possible enhance, fisheries resource within the catchment	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	Area of suitable habitat supporting fish. Number of upstream barriers	No loss of integrity of fisheries habitat. Maintenance of upstream accessibility	No loss of fishery habitat. Improvement of habitat quality / quantity. Enhanced upstream accessibility	13.00	4.00	-2.00	The River Lee is a salmonid river. River is noted for it importance of fishery potential.	-104.00	
	Protect, and where possible enhance, landscape character and visual amenity within the river corridor	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	Changes to reported conservation status of designated sites relating to flood risk management Extent of affected Natura 2000 site, NHA/pNHA or other affected National or International designations (e.g. Nature reserves and Ramsar sites), i.e. Area of re	1. No significant impact on landscape designation (protected site, scenic route/amenity, natural landscape form) within zone of visibility of measures 2. No significant change in the quality of existing landscape charecteristics of the receiving environment	1. No change to the existing landscape form. 2. Enhancement of existing landscape or landscape feature	8.00	3.00	0.00	The village occurs in a landscape character zone " Ridged and Peaked upland". The landscape value is considered to be high value and sensivity with local importance. There are a number of protected scenic routes on the approach roads.	0.00	
	Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	Avoid damage to or loss of features, institutions and collections of architectural value and their settin and improve their protection from extreme floods.	a) The number of architectural features, institutions and collections subject to flooding. b) The impact of flood risk management measures on architectural features, institutions and collections.	a) No increase in risk to architectural features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on architectural features, institutions and collections.	a) Complete removal of all relevant architectural features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of architectural features, institutions and collections importance arising from the implementation of the selected measures.	4.00	0.00	0.00	There are a no RPS at risk from flooding .	0.00	
		Avoid damage to or loss of features, institutions and collections of archaeological value and their setting and improve their protection from extreme floods where this is beneficial.	a) The number of archaeological features, institutions and collections subject to flooding. b) The impact of flood risk management measures on archaeological features, institutions and collections.	a) No increase in risk to archaeological features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on archaeological features, institutions and collections.	a) Complete removal of all relevant archaeological features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of archaeological features, institutions and collections importance arising from the implementation of the selected measures.	4.00	3.00	0.00	There are a number of protected bridges RMP's at risk from flooding.	0.00	
Environmental Score										-264.00	
MCA Benefit Score											-264.00
Option Selection MCA Score											-264.00
MCA benefit Cost Ratio											0.00
Economic Benefit Cost Ratio											0.00

Multi-Criteria Assessment								Do Nothing		
Criteria	Objective	Sub-Objective	Indicator	Basic Requirement	Aspirational Target	Global Weighting	Local Weighting	Score	Rationale	Wtd Score
Technical	Ensure flood risk management options are operationally robust	Ensure flood risk management options are operationally robust	Level of operational risk of option- Degree of reliance on mechanical, electrical or electronic systems, or on human intervention, action or decision, for the option to operate or perform successfully, - Non-numeric			20.00	5.00	0.00	Do nothing option	0.00
	Minimise health and safety risk of flood risk management options	Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	Degree of health and safety risk during construction and operation	Moderate to high, but acceptable and manageable, level of health and safety risk during construction, maintenance or operation	Negligible risk to health and safety during construction, maintenance or operation	20.00	5.00	0.00	Do nothing option	0.00
	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	Ensure flood risk management options are adaptable to future flood risk	Sustainability and adaptability of the flood risk management measure in the face of potential future changes, including the potential impacts of climate change	Option should not hinder future interventions that may be required to manage potential future increases in risk	Option to provide for, or be adaptable to, the HEFS in terms of maintaining the standard of protection at no or negligible cost	20.00	5.00	0.00	Do nothing option	0.00
Technical Score								0.00		0.00
Economic	Minimise economic risk	Minimise economic risk	Annual Average Damage (AAD) expressed in Euro / year	AAD is not increased	100% reduction in AAD	24.00	1.29	0.00	Do nothing option	0.00
	Minimise risk to transport infrastructure	Minimise risk to transport infrastructure	Length of infrastructure at risk from flooding in the 0.1% AEP event	Do not increase length of infrastructure at risk from flooding	Reduce the length of infrastructure at risk from flooding by 50%	10.00	5.00	0.00	Do nothing option	0.00
	Minimise risk to utility infrastructure	Minimise risk to utility infrastructure	Utilities at risk from flooding	No increase number of utility receptors at risk from flooding	Reduce number of utility receptors at risk to 0	14.00	0.00	0.00	Do nothing option	0.00
	Manage Risk to Agriculture	Manage Risk to Agriculture	Agricultural production	Do not increase in negative impact of flooding on agricultural production	Provide the potential for enhanced agricultural production	12.00	0.00	0.00	Do nothing option	0.00
Economic Score								0.00		0.00
Social	Minimise risk to human health and life	Minimise risk to human health and life of residents	Annual Average number of residential properties at risk from flooding	Number of residential properties at risk from flooding does not increase	Reduce the number of residential properties at risk from flooding to 0	27.00	3.20	0.00	Do nothing option	0.00
		Minimise risk to high vulnerability properties	Number of high vulnerability properties at risk from flooding	Do not increase number of high vulnerability properties at risk from flooding	Reduce the number of high vulnerability properties at risk from flooding to 0	17.00	0.00	0.00	Do nothing option	0.00
	Minimise risk to community	Minimise risk to social infrastructure and amenity	Number of social infrastructure receptors at risk from flooding	Do not increase number of social infrastructure receptors at risk from flooding	Reduce the number of social infrastructure receptors at risk from flooding to 0	9.00	0.50	0.00	Do nothing option	0.00
		Minimise risk to local employment	Number of enterprises at risk from flooding	Do not increase number of enterprises at risk from flooding	Reduce the number of enterprises at risk from flooding to 0	7.00	4.90	0.00	Do nothing option	0.00
Social Score								0.00		0.00
Environmental	Support the objectives of the WFD	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	Ecological status of water bodies	Provide no constraint to the achievement of water body objectives	Contribute to the achievement of water body objectives	16.00	5.00	0.00	The River Womanagh and Kilath are classified as having a moderate to good water status under the WFD. The waterbodies are considered sensitive bodies. The rivers discharges into Youghal Bay a shellfish sensitive area. Ballymacoda Bay is a SAC. The do nothing scenario would not contribute to the achievement of water body objectives. There are no significant polluting sources at risk from flooding. (0)	0.00
	Support the objectives of the Habitats and Birds Directives	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	Area of site at risk from flooding and qualitative Assessment of impact of option on habitat	No deterioration in the conservation status of designated sites as a result of flood risk management measures	Improvement in the conservation status of designated sites as a result of flood risk management measures	10.00	1.00	0.00	The Castlemartyr AFA boundary does not overlap with any Natura 2000 site boundary. No potential impacts are envisaged in the do-nothing scenario.	0.00
	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	Avoid damage to and where possible enhance the flora and fauna of the catchment	Avoid damage to and where possible enhance, legally protected sites / habitats and other sites / habitats of national regional and local nature conservation importance	No deterioration on condition of existing sites due to implimentation of option	Creation of new or improved condition of existing sites sites due to implimentation of option	5.00	4.00	0.00	The existing scenario has no distinguishable impact on the flora and fauna of the catchment	0.00
	Protect, and where possible enhance, fisheries resource within the catchment	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	Area of suitable habitat supporting fish. Number of upstream barriers	No loss of integrity of fisheries habitat. Maintenance of upstream accessibility	No loss of fishery habitat. Improvement of habitat quality / quantity. Enhanced upstream accessibility	13.00	2.00	0.00	Castlemartyr Woamangh is not classified as a salmonoid river is not known as a river for high salmon/lamprey potential. There may be local fishing value along the river.	0.00
	Protect, and where possible enhance, landscape character and visual amenity within the river corridor	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	Changes to reported conservation status of designated sites relating to flood risk management Extent of affected Natura 2000 site, NHA/pNHA or other affected National or International designations (e.g. Nature reserves and Ramsar sites), i.e. Area of re	1. No significant impact on landscape designation (protected site, scenic route/amenity, natural landscape form) within zone of visibility of measures 2. No significant change in the quality of existing landscape charactenistics of the receiving environment	1. No change to the existing landscape form. 2. Enhancement of existing landscape or landscape feature	8.00	3.00	0.00	castlemartyr is classified within the Development plan as been within a Broad Fertile lowland valley. This landscape character type is classified as having local value and medium sensitivity and value. There are no scenic routes within the town. Do nothing scenario will have no impact	0.00
	Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	Avoid damage to or loss of features, institutions and collections of architectural value and their settin and improve their protection from extreme floods.	a) The number of architectural features, institutions and collections subject to flooding. b) The impact of flood risk management measures on architectural features, institutions and collections.	a) No increase in risk to architectural features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on architectural features, institutions and collections.	a) Complete removal of all relevant architectural features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of architectural features, institutions and collections importance arising from the implementation of the selected measures.	4.00	3.00	-3.00	Castlemartyr is classified in the cork development plan as an area of architectural importance. There are a number of sites/features listed on the record of structures and NIAH within the town and potentially affected with a high to moderate vulnerability.	-36.00
		Avoid damage to or loss of features, institutions and collections of archaeological value and their setting and improve their protection from extreme floods where this is beneficial.	a) The number of archaeological features, institutions and collections subject to flooding. b) The impact of flood risk management measures on archaeological features, institutions and collections.	a) No increase in risk to archaeological features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on archaeological features, institutions and collections.	a) Complete removal of all relevant archaeological features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of archaeological features, institutions and collections importance arising from the implementation of the selected measures.	4.00	2.00	0.00	There are no RMP at risk from flooding	0.00
Environmental Score										-36.00
MCA Benefit Score										-36.00
Option Selection MCA Score										-36.00
MCA benefit Cost Ratio										0.00
Economic Benefit Cost Ratio										0.00

Flood Risk Management Options	Castlemartyr
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Multi-Criteria Assessment								Option 1 - Flow Diversion & Flood Defences		
Criteria	Objective	Sub-Objective	Indicator	Basic Requirement	Aspirational Target	Global Weighting	Local Weighting	Score	Rationale	Wtd score
Technical	Ensure flood risk management options are operationally robust	Ensure flood risk management options are operationally robust	Level of operational risk of option-Degree of reliance on mechanical, electrical or electronic systems, or on human intervention, action or decision, for the option to operate or perform successfully, - Non-numeric			20.00	5.00	4.00	Flood defences and flow diversion, no moving parts, potential for sedimentation	400.00
	Minimise health and safety risk of flood risk management options	Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	Degree of health and safety risk during construction and operation	Moderate to high, but acceptable and manageable, level of health and safety risk during construction, maintenance or operation	Negligible risk to health and safety during construction,maintenance or operation	20.00	5.00	2.00	Risk of falling from a height, drowning and electrocution	200.00
	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	Ensure flood risk management options are adaptable to future flood risk	Sustainability and adaptability of the flood risk management measure in the face of potential future changes, including the potential impacts of climate change	Option should not hinder future interventions that may be required to manage potential future increases in risk	Option to provide for, or be adaptable to, the HEFS in terms of maintaining the standard of protection at no or negligible cost	20.00	5.00	0.00	Not adaptable to climate change without additional flood defence works	0.00
Technical Score							0.00			600.00
Economic	Minimise economic risk	Minimise economic risk	Annual Average Damage (AAD) expressed in Euro / year	AAD is not increased	100% reduction in AAD	24.00	1.29	4.33	As calculated	134.48
	Minimise risk to transport infrastructure	Minimise risk to transport infrastructure	Length of infrastructure at risk from flooding in the 0.1% AEP event	Do not increase length of infrastructure at risk from flooding	Reduce the length of infrastructure at risk from flooding by 50%	10.00	5.00	4.08	As calculated	203.75
	Minimise risk to utility infrastructure	Minimise risk to utility infrastructure	Utilities at risk from flooding	No increase number of utility receptors at risk from flooding	Reduce number of utility receptors at risk to 0	14.00	0.00	0.00	As calculated	0.00
	Manage Risk to Agriculture	Manage Risk to Agriculture	Agricultural prodction	Do not increase in negative impact of flooding on agricultural production	Provide the potential for enhanced agricultural production	12.00	0.00	0.00	As calculated	0.00
Economic Score							0.00			338.23
Social	Minimise risk to human health and life	Minimise risk to human health and life of residents	Annual Average number of residential properties at risk from flooding	Number of residential properties at risk from flooding does not increase	Reduce the number of residential properties at risk from flooding to 0	27.00	3.20	4.77	As calculated	411.75
		Minimise risk to high vulnerability properties	Number of high vulnerability properties at risk from flooding	Do not increase number of high vulnerability properties at risk from flooding	Reduce the number of high vulnerability properties at risk from flooding to 0	17.00	0.00	0.00	As calculated	0.00
	Minimise risk to community	Minimise risk to social infrastructure and amenity	Number of social infrastructure receptors at risk from flooding	Do not increase number of social infrastructure receptors at risk from flooding	Reduce the number of social infrastructure receptors at risk from flooding to 0	9.00	0.50	3.75	As calculated	16.88
Minimise risk to local employment		Number of enterprises at risk from flooding	Do not increase number of enterprises at risk from flooding	Reduce the number of enterprises at risk from flooding to 0	7.00	4.90	4.67	As calculated	160.13	
Social Score							0.00			588.75
Environmental	Support the objectives of the WFD	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	Ecological status of water bodies	Provide no constraint to the achievement of water body objectives	Contribute to the achievement of water body objectives	16.00	5.00	-2.00	The River Womanagh and Kilath are classified as having a moderate to good water status under the WFD. The waterbodies are considered to be sensitive bodies. The rivers discharges into Youghal Bay a shellfish sensitive area. Ballymacoda Bay is a SAC. There are no significant polluting sources at risk from flooding. (-2) There are short term negative impacts associated with the construction. There is a permanent concrete structure being placed in the river which will have a permanent impact on the local flow and morphology. However it is not considered that this structure will significantly alter the attainment of good water status in the long term.	-160.00
	Support the objectives of the Habitats and Birds Directives	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	Area of site at risk from flooding and qualitative Assessment of impact of option on habitat	No deterioration in the conservation status of designated sites as a result of flood risk management measures	Improvement in the conservation status of designated sites as a result of flood risk management measures	10.00	1.00	0.00	The Castlemartyr AFA boundary does not overlap with any Natura 2000 site boundary. The Ballymacoda Bay SPA and Ballymacoda (Clonpriest and Pillmore) SAC are located approximately 10km east of Castlemartyr. There will be no requirement for land take within a Natura 2000 site for the construction of flood protection works. Therefore there is no potential for direct damage to Annex I habitat. Potential removal of riparian habitat to accommodate the works will not impact the qualifying features of the SAC or SPA. The Kiltha River (which flows through Castlemartyr) is hydrologically connected to Ballymacoda Bay via the Womanagh River. Sediment release / accidental pollution of the Kiltha River could potentially enter the Bay. The release of sediment into the bay is extremely unlikely to impact the qualifying features of the SAC. These habitats are habitually inundated with sediment during tidal exchanges and are adapted to such conditions. Pollutants e.g. concrete / oil leaks will be diluted by flows in the Kiltha River, the Womanagh River and also by estuarine water in the bay. It is highly unlikely that pollutants would reach the Bay at such concentrations what would cause habitat damage.	0.00
	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	Avoid damage to and where possible enhance the flora and fauna of the catchment	Avoid damage to and where possible enhance, legally protected sites / habitats and other sites / habitats of national regional and local nature conservation importance	No deterioration on condition of existing sites due to implimentation of option	Creation of new or improved condition of existing sites sites due to implimentation of option	5.00	4.00	-1.00	Potential removal of riparian habitat to accommodate the works will impact on the local flora and fauna of the catchment (-1)	-20.00
	Protect, and where possible enhance, fisheries resource within the catchment	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	Area of suitable habitat supporting fish. Number of upstream barriers	No loss of integrity of fisheries habitat. Maintenance of upstream accessibility	No loss of fishery habitat. Improvement of habitat quality / quantity. Enhanced upstream accessibility	13.00	2.00	-3.00	The Ballymacoda Bay SAC is not designated for lamprey / salmon. Castlemartyr Woamangh is not classified as a salmonoid river and is not known as a river for high salmon/lamprey potential. There may be local fishing value along the river. (-1). The measures will result in increase risk of flooding downstream of Castlemartyr and potential limiting access to fishing activity in the area during flooding. (-1) The construction of the measures on the river may require excavation of the bank of stream and diversion of the river during the construction stage this would result in significant short term emissions of sediment to the waterbody and downstream without treatment. The flood defence structure will result in a permanent loss of fisheries habitat. (-3) The diversion of the flow during high flow constitutes an intermittent negative impact to the hydrological regime of the river.	-78.00
	Protect, and where possible enhance, landscape character and visual amenity within the river corridor	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	Changes to reported conservation status of designated sites relating to flood risk management Extent of affected Natura 2000 site, NHA/pNHA or other affected National or International designations (e.g. Nature reserves and Ramsar sites), i.e. Area of re	1. No significant impact on landscape designation (protected site, scenic route/amenity, natural landscape form) within zone of visibility of measures 2. No significant change in the quality of existing landscape characteristics of the receiving environment	1. No change to the existing landscape form. 2. Enhancement of existing landscape or landscape feature	8.00	3.00	-1.00	castlemartyr is classified within the Development plan as been within a Broad Fertile lowland valley. This landscape character type is classified as having local value and medium sensitivity and value. There are no scenic routes within the town. existing vegetation will be removed to facilitate the construction of the structure. there are wide expansive views from the road . There will be short term impacts during construction and where is opportunity to design natural riparian around the structure.	-24.00
	Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	Avoid damage to or loss of features, institutions and collections of architectural value and their settin and improve their protection from extreme floods.	a) The number of architectural features, institutions and collections subject to flooding. b) The impact of flood risk management measures on architectural features, institutions and collections.	a) No increase in risk to architectural features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on architectural features, institutions and collections.	a) Complete removal of all relevant architectural features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of architectural features, institutions and collections importance arising from the implementation of the selected measures.	4.00	3.00	3.00	Castlemartyr is classified in the Cork Development Plan as an area of architectural importance. There are a number of sites/features listed on the record of structures and NIAH within the town and potentially affected with a high to moderate vulnerability. However these sites are not within 1%AEP risk. The proposed measures will however provide protection to the ACA.	36.00
		Avoid damage to or loss of features, institutions and collections of archaeological value and their setting and improve their protection from extreme floods where this is beneficial.	a) The number of archaeological features, institutions and collections subject to flooding. b) The impact of flood risk management measures on archaeological features, institutions and collections.	a) No increase in risk to archaeological features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on archaeological features, institutions and collections.	a) Complete removal of all relevant archaeological features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of archaeological features, institutions and collections importance arising from the implementation of the selected measures.	4.00	2.00	3.00	The proposed measures will have no impact on the risk of flooding on archeological heritage.	24.00
Environmental Score										-222.00
MCA Benefit Score										704.98
Option Selection MCA Score										1304.98
MCA benefit Cost Ratio										0.0005
Economic Benefit Cost Ratio										1.66

Flood Risk Management Options	Castlemartyr
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Multi-Criteria Assessment								Option 2 - Flood Defences		
Criteria	Objective	Sub-Objective	Indicator	Basic Requirement	Aspirational Target	Global Weighting	Local Weighting	Score	Rationale	Wtd score
Technical	Ensure flood risk management options are operationally robust	Ensure flood risk management options are operationally robust	Level of operational risk of option-Degree of reliance on mechanical, electrical or electronic systems, or on human intervention, action or decision, for the option to operate or perform successfully, - Non-numeric			20.00	5.00	5.00	Flood walls and embankments, no moving parts	500.00
	Minimise health and safety risk of flood risk management options	Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	Degree of health and safety risk during construction and operation	Moderate to high, but acceptable and manageable, level of health and safety risk during construction, maintenance or operation	Negligible risk to health and safety during construction,maintenance or operation	20.00	5.00	2.00	Risk of falling from a height, drowning and electrocution	200.00
	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	Ensure flood risk management options are adaptable to future flood risk	Sustainability and adaptability of the flood risk management measure in the face of potential future changes, including the potential impacts of climate change	Option should not hinder future interventions that may be required to manage potential future increases in risk	Option to provide for, or be adaptable to, the HEFS in terms of maintaining the standard of protection at no or negligible cost	20.00	5.00	2.00	Adaptable but new flood defence works required to defend against climate change scenario	200.00
Technical Score							0.00			900.00
Economic	Minimise economic risk	Minimise economic risk	Annual Average Damage (AAD) expressed in Euro / year	AAD is not increased	100% reduction in AAD	24.00	1.29	4.33	As calculated	134.48
	Minimise risk to transport infrastructure	Minimise risk to transport infrastructure	Length of infrastructure at risk from flooding in the 0.1% AEP event	Do not increase length of infrastructure at risk from flooding	Reduce the length of infrastructure at risk from flooding by 50%	10.00	5.00	4.08	As calculated	203.75
	Minimise risk to utility infrastructure	Minimise risk to utility infrastructure	Utilities at risk from flooding	No increase number of utility receptors at risk from flooding	Reduce number of utility receptors at risk to 0	14.00	0.00	0.00	As calculated	0.00
	Manage Risk to Agriculture	Manage Risk to Agriculture	Agricultural production	Do not increase in negative impact of flooding on agricultural production	Provide the potential for enhanced agricultural production	12.00	0.00	0.00	As calculated	0.00
Economic Score							0.00			338.23
Social	Minimise risk to human health and life	Minimise risk to human health and life of residents	Annual Average number of residential properties at risk from flooding	Number of residential properties at risk from flooding does not increase	Reduce the number of residential properties at risk from flooding to 0	27.00	3.20	4.77	As calculated	411.75
		Minimise risk to high vulnerability properties	Number of high vulnerability properties at risk from flooding	Do not increase number of high vulnerability properties at risk from flooding	Reduce the number of high vulnerability properties at risk from flooding to 0	17.00	0.00	0.00	As calculated	0.00
	Minimise risk to community	Minimise risk to social infrastructure and amenity	Number of social infrastructure receptors at risk from flooding	Do not increase number of social infrastructure receptors at risk from flooding	Reduce the number of social infrastructure receptors at risk from flooding to 0	9.00	0.50	3.75	As calculated	16.88
Minimise risk to local employment		Number of enterprises at risk from flooding	Do not increase number of enterprises at risk from flooding	Reduce the number of enterprises at risk from flooding to 0	7.00	4.90	4.67	As calculated	160.13	
Social Score							0.00			588.75
Environmental	Support the objectives of the WFD	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	Ecological status of water bodies	Provide no constraint to the achievement of water body objectives	Contribute to the achievement of water body objectives	16.00	5.00	-2.00	The River Womanagh and Kilath are classified as having a moderate to good water status under the WFD. The waterbodies are considered to be sensitive bodies. The rivers discharges into Youghal Bay a shellfish sensitive area. Ballymacoda Bay is a SAC. There are no significant polluting sources at risk from flooding. (-2) There are short term negative impacts associated with the construction	-160.00
	Support the objectives of the Habitats and Birds Directives	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	Area of site at risk from flooding and qualitative Assessment of impact of option on habitat	No deterioration in the conservation status of designated sites as a result of flood risk management measures	Improvement in the conservation status of designated sites as a result of flood risk management measures	10.00	1.00	0.00	The Castlemartyr AFA boundary does not overlap with any Natura 2000 site boundary. The Ballymacoda Bay SPA and Ballymacoda (Clonpriest and Pillmore) SAC are located approximately 10km east of Castlemartyr. There will be no requirement for land take within a Natura 2000 site for the construction of flood protection works. Therefore there is no potential for direct damage to Annex I habitat. Potential removal of riparian habitat to accommodate the works will not impact the qualifying features of the SAC or SPA. The Kiltha River (which flows through Castlemartyr) is hydrologically connected to Ballymacoda Bay via the Womanagh River. Sediment release / accidental pollution of the Kiltha River could potentially enter the Bay. The release of sediment into the bay is extremely unlikely to impact the qualifying features of the SAC. These habitats are habitually inundated with sediment during tidal exchanges and are adapted to such conditions. Pollutants e.g. concrete / oil leaks will be diluted by flows in the Kiltha River, the Womanagh River and also by estuarine water in the bay. It is highly unlikely that pollutants would reach the Bay at such concentrations what would cause habitat damage.	0.00
	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	Avoid damage to and where possible enhance the flora and fauna of the catchment	Avoid damage to and where possible enhance, legally protected sites / habitats and other sites / habitats of national regional and local nature conservation importance	No deterioration on condition of existing sites due to implementation of option	Creation of new or improved condition of existing sites sites due to implementation of option	5.00	4.00	-3.00	Potential removal of riparian habitat to accommodate the works will impact on the local flora and fauna of the catchment (-1) . This option has significantly more barriers required and so will result in a more significant impact	-60.00
	Protect, and where possible enhance, fisheries resource within the catchment	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	Area of suitable habitat supporting fish. Number of upstream barriers	No loss of integrity of fisheries habitat. Maintenance of upstream accessibility	No loss of fishery habitat. Improvement of habitat quality / quantity. Enhanced upstream accessibility	13.00	2.00	-1.00	TheBallymacoda bay SAC is not designated for lamprey / salmon. Castlemartyr Woamangh is not classified as a salmonoid river and is not known as a river for high salmon/lamprey potential. There may be local fishing value along the river. (-1). The measures will result in increase risk of flooding downstream of Castlemartyr and potential limiting access to fishing activity in the area during flooding. (-1) The construction of the measures on the river may require excavation of the bank of stream during the construction stage this would result in significant short term emissions of sediment to the waterbody and downstream without treatment.	-26.00
	Protect, and where possible enhance, landscape character and visual amenity within the river corridor	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	Changes to reported conservation status of designated sites relating to flood risk management Extent of affected Natura 2000 site, NHA/pNHA or other affected National or International designations (e.g. Nature reserves and Ramsar sites), i.e. Area of re	1. No significant impact on landscape designation (protected site, scenic route/amenity, natural landscape form) within zone of visibility of measures 2. No significant change in the quality of existing landscape characteristics of the receiving environment	1. No change to the existing landscape form. 2. Enhancement of existing landscape or landscape feature	8.00	3.00	-4.00	Castlemartyr is classified within the Development plan as been within a Broad Fertile lowland valley. This landscape character type is classified as having local value and medium sensitivity and value. There are no scenic routes within the town. existing vegetation will be removed to facilitate the construction of the structure. there are wide expansive views from the road . There will be short term impacts during construction however there may by opportunity to design natural riparian around the structure. This measure includes for a 1.1-1.4m high barrier is likely to need to remove existing riparian zone to facilitate the construction (-1) and there will be a permanent impact on the visual amenity in the town centre due to the proposed walls up to 1.5m in height	-96.00
	Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	Avoid damage to or loss of features, institutions and collections of architectural value and their settin and improve their protection from extreme floods.	a) The number of architectural features, institutions and collections subject to flooding. b) The impact of flood risk management measures on architectural features, institutions and collections.	a) No increase in risk to architectural features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on architectural features, institutions and collections.	a) Complete removal of all relevant architectural features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of architectural features, institutions and collections importance arising from the implementation of the selected measures.	4.00	3.00	2.00	Castlemartyr is classified in the cork development plan as an area of architectural importance. There are a number of sites/features listed on the record of structures and NIAH within the town and potentially. affected with a high to moderate vulnerability. The proposed measures will however provide protection to the ACA. There is potential setting impact by the proposed flood defences on the Castlemartyr bridge (-1)	24.00
		Avoid damage to or loss of features, institutions and collections of archaeological value and their setting and improve their protection from extreme floods where this is beneficial.	a) The number of archaeological features, institutions and collections subject to flooding. b) The impact of flood risk management measures on archaeological features, institutions and collections.	a) No increase in risk to archaeological features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on archaeological features, institutions and collections.	a) Complete removal of all relevant archaeological features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of archaeological features, institutions and collections importance arising from the implementation of the selected measures.	4.00	2.00	2.00	Castlemartyr is classified in the cork development plan as an area of architectural importance. There are a number of sites/features listed on the record of structures and NIAH within the town and potentially. affected with a high to moderate vulnerability. The proposed measures will however provide protection to the ACA. There is potential setting impact by the proposed flood defences on the Castlemartyr bridge (-1)	16.00
Environmental Score										-302.00
MCA Benefit Score										624.98
Option Selection MCA Score										1524.98
MCA benefit Cost Ratio										0.0002
Economic Benefit Cost Ratio										0.68

AFA	Inchegeelagh
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Multi-Criteria Assessment								Do Nothing		
Criteria	Objective	Sub-Objective	Indicator	Basic Requirement	Aspirational Target	Global Weighting	Local Weighting	Score	Rationale	Wtd Score
Technical	Ensure flood risk management options are operationally robust	Ensure flood risk management options are operationally robust	Level of operational risk of option- Degree of reliance on mechanical, electrical or electronic systems, or on human intervention, action or decision, for the option to operate or perform successfully, - Non-numeric			20.00	5.00	0.00	Do nothing option	0.00
	Minimise health and safety risk of flood risk management options	Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	Degree of health and safety risk during construction and operation	Moderate to high, but acceptable and manageable, level of health and safety risk during construction, maintenance or operation	Negligible risk to health and safety during construction,maintenance or operation	20.00	5.00	0.00	Do nothing option	0.00
	Ensure flood risk management options are adaptable to future flood risk, and the potential impacts of climate change	Ensure flood risk management options are adaptable to future flood risk	Sustainability and adaptability of the flood risk management measure in the face of potential future changes, including the potential impacts of climate change	Option should not hinder future interventions that may be required to manage potential future increases in risk	Option to provide for, or be adaptable to, the HEFS in terms of maintaining the standard of protection at no or negligible cost	20.00	5.00	0.00	Do nothing option	0.00
Technical Score								0.00		
Economic	Minimise economic risk	Minimise economic risk	Annual Average Damage (AAD) expressed in Euro / year	AAD is not increased	100% reduction in AAD	24.00	2.97	0.00	Do nothing option	0.00
	Minimise risk to transport infrastructure	Minimise risk to transport infrastructure	Length of infrastructure at risk from flooding in the 0.1% AEP event	Do not increase length of infrastructure at risk from flooding	Reduce the length of infrastructure at risk from flooding by 50%	10.00	5.00	0.00	Do nothing option	0.00
	Minimise risk to utility infrastructure	Minimise risk to utility infrastructure	Utilities at risk from flooding	No increase number of utility receptors at risk from flooding	Reduce number of utility receptors at risk to 0	14.00	0.00	0.00	Do nothing option	0.00
	Manage Risk to Agriculture	Manage Risk to Agriculture	Agricultural prodction	Do not increase in negative impact of flooding on agricultural production	Provide the potential for enhanced agricultural production	12.00	4.00	0.00	Do nothing option	0.00
Economic Score								0.00		
Social	Minimise risk to human health and life	Minimise risk to human health and life of residents	Annual Average number of residential properties at risk from flooding	Number of residential properties at risk from flooding does not increase	Reduce the number of residential properties at risk from flooding to 0	27.00	4.78	0.00	Do nothing option	0.00
		Minimise risk to high vulnerability properties	Number of high vulnerability properties at risk from flooding	Do not increase number of high vulnerability properties at risk from flooding	Reduce the number of high vulnerability properties at risk from flooding to 0	17.00	0.00	0.00	Do nothing option	0.00
	Minimise risk to community	Minimise risk to social infrastructure and amenity	Number of social infrastructure receptors at risk from flooding	Do not increase number of social infrastructure receptors at risk from flooding	Reduce the number of social infrastructure receptors at risk from flooding to 0	9.00	0.25	0.00	Do nothing option	0.00
		Minimise risk to local employment	Number of enterprises at risk from flooding	Do not increase number of enterprises at risk from flooding	Reduce the number of enterprises at risk from flooding to 0	7.00	5.00	0.00	Do nothing option	0.00
Social Score								0.00		
Environmental	Support the objectives of the WFD	Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	Ecological status of water bodies	Provide no constraint to the achievement of water body objectives	Contribute to the achievement of water body objectives	16.00	5.00	0.00	The River Lee is designated as salmonid and considered a sensitive waterbody spawning grounds for salmonid are likely upstream along the River Lee. There is one significant polluting source at risk from flooding in the 1% AEP. in the do nothing scenario this will continue to be at risk	0.00
	Support the objectives of the Habitats and Birds Directives	Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	Area of site at risk from flooding and qualitative Assessment of impact of option on habitat	No deterioration in the conservation status of designated sites as a result of flood risk management measures	Improvement in the conservation status of designated sites as a result of flood risk management measures	10.00	0.00	0.00	no impacts on Natura 2000 sites.	0.00
	Avoid damage to, and where possible enhance, the flora and fauna of the catchment	Avoid damage to and where possible enhance the flora and fauna of the catchment	Avoid damage to and where possible enhance, legally protected sites / habitats and other sites / habitats of national regional and local nature conservation importance	No deterioration on condition of existing sites due to implimentation of option	Creation of new or improved condition of existing sites sites due to implementation of option	5.00	2.00	-2.00	Otters have not been recorded within 10km of the village. It is extremely unlikely that Otter use the habitat in proximity to the village. The River Lee is a salmonid river. Do nothing will have no signifcant long term impact on the value ecological of the river. potential short term impacts during flood event	-20.00
	Protect, and where possible enhance, fisheries resource within the catchment	Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	Area of suitable habitat supporting fish. Number of upstream barriers	No loss of integrity of fisheries habitat. Maintenance of upstream accessibility	No loss of fishery habitat. Imnpovement of habitat quality / quantity. Enhanced upstream accessibility	13.00	4.00	0.00	The River Lee is a salmonid river. River is noted for it importance of fishery potential.	0.00
	Protect, and where possible enhance, landscape character and visual amenity within the river corridor	Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	Changes to reported conservation status of designated sites relating to flood risk management Extent of affected Natura 2000 site, NHA/pNHA or other affected National or International designations (e.g. Nature reserves and Ramsar sites), i.e. Area of re	1. No significant impact on landscape designation (protected site, scenic route/amenity, natural landscape form) within zone of visibility of measures 2. No significant change in the quality of existing landscape characteristics of the receiving environment	1. No change to the existing landscape form. 2. Enhancement of existing landscape or landscape feature	8.00	3.00	0.00	The village occurs in a landscape character zone " Ridged and Peaked upland". The landscape value is considered to be high value and sensivity with local importance. There is scenic routes on the approach road from Ballingeary.	0.00
	Avoid damage to or loss of features, institutions and collections of cultural heritage importance and their setting	Avoid damage to or loss of features, institutions and collections of architectural value and their settin and improve their protection from extreme floods.	a) The number of architectural features, institutions and collections subject to flooding. b) The impact of flood risk management measures on architectural features, institutions and collections.	a) No increase in risk to architectural features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on architectural features, institutions and collections.	a) Complete removal of all relevant architectural features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of architectural features, institutions and collections importance arising from the implementation of the selected measures.	4.00	0.00	0.00	There are a number of NIAH within the town. However these are not at risk from flooding.	0.00
		Avoid damage to or loss of features, institutions and collections of archaeological value and their setting and improve their protection from extreme floods where this is beneficial.	a) The number of archaeological features, institutions and collections subject to flooding. b) The impact of flood risk management measures on archaeological features, institutions and collections.	a) No increase in risk to archaeological features, institutions and collections at risk from flooding. b) No detrimental impacts from flood risk management measures on archaeological features, institutions and collections.	a) Complete removal of all relevant archaeological features, institutions and collections from the risk of harm by extreme floods. b) Enhanced protection and value of archaeological features, institutions and collections importance arising from the implementation of the selected measures.	4.00	3.00	-2.00	There are two RMP at risk (Bridge and Church) from flood event.	-24.00
Environmental Score										-44.00
MCA Benefit Score										-44.00
Option Selection MCA Score										-44.00
MCA benefit Cost Ratio										0.00
Economic Benefit Cost Ratio										0.00

