

South Western CFRAM Study

Preliminary Options Report UoM 20

July 2016

The Office of Public Works



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The Office of Public Works

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Contents

Chapter	Title	Page
	Executive Summary	i
1	Introduction	1
1.1	Background	1
2	Description of the Unit of Management	4
2.1	Spatial Scales of Assessment	4
2.2	Spatial Scales of Assessment for Unit of Management 20	4
3	Screening of Possible Flood Risk Management Methods	5
3.1	General	5
3.2	Screening of Possible Flood Risk Management Methods	5
3.3	Screening of UoM scale FRM Methods	7
3.3.1	Do Nothing / Existing Regime / Do Minimum	7
3.3.2	Structural Measures (Current Risk)	7
3.4	Screening of Sub-Catchment scale FRM Methods	7
3.5	Screening of AFA scale FRM Methods	7
3.5.1	Do Nothing / Existing Regime	7
3.5.2	Do Minimum (e.g. Infilling of gaps etc.)	7
3.5.3	Dunmanway – Improve Existing Defences	8
3.5.4	Dunmanway – Relocate Properties	8
3.5.5	Inishannon – Fluvial Storage	8
3.5.6	Inishannon – Flow Diversion	8
3.5.7	Inishannon – Improve Existing Defences	8
3.5.8	Inishannon – Relocate Properties	8
3.5.9	Inishannon – Channel or Flood Defence Maintenance Works	9
3.5.10	Schull – Flood Forecasting	9
3.5.11	Schull – Improve Existing Defences	9
3.5.12	Schull – Relocate Properties	9
3.5.13	Schull – Channel or Flood Defence Maintenance Works	9
4	Possible Flood Risk Management Measures	10
4.1	General	10
4.2	Non-Structural Measures	10
4.2.1	Planning Control	11
4.2.2	Building Regulations / Planning Conditions	11
4.2.3	Sustainable Urban Drainage Systems (SUDS)	12
4.2.4	Flood Forecasting and Warning	13
4.2.5	Public Awareness	17
4.2.6	Individual Property Flood Resilience	17
4.2.7	Land Use Management	18

4.2.8	Emergency Response Planning _____	18
4.3	Structural Measures _____	19
4.3.1	General _____	19
5	Development of Potential Flood Risk Management Options for AFAs	20
5.1	General _____	20
5.2	Dunmanway, Co. Cork _____	20
5.2.1	Possible FRM Measures _____	21
5.2.2	Potential FRM Measures _____	29
5.2.3	Potential FRM Options _____	29
5.3	Inishannon, Co. Cork _____	30
5.3.1	Possible FRM Measures _____	31
5.3.2	Potential FRM Measures _____	34
5.3.3	Potential FRM Options _____	34
5.4	Schull, Co. Cork _____	35
5.4.1	Possible FRM Measures _____	35
5.4.2	Potential FRM Measures _____	43
5.4.3	Potential FRM Options _____	43
6	Environmental Assessment	44
6.1	General _____	44
7	Stakeholder Input	45
7.1	Draft Flood Mapping Public Consultation Days _____	45
7.2	Flood Risk Management Measures _____	45
7.3	Preliminary Options PCDs _____	46
8	Flood Risk Assessment	47
8.1	General _____	47
8.2	Receptors _____	47
8.3	Flood Risk Maps _____	56
8.3.1	Inhabitants Maps _____	56
8.3.2	Economic Activity Maps _____	56
8.3.3	Economic Risk Density Maps _____	56
8.3.4	General Risk Maps _____	61
9	Estimates of Cost	62
9.1	Flood Forecasting and Warning Systems _____	62
9.2	Structural Options _____	63
10	Appraisal of Options	64
10.2	Global and Local Weightings _____	65
10.3	MCA Scoring _____	68

10.4	Measures Being Undertaken under Other Policy Areas	70
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11	Selection of Preferred Options	71
11.1	Preferred Flood Risk Management Options – UoM	71
11.2	Preferred Flood Risk Management Options – AFAs	72
11.2.1	MCA Scores	72
11.2.2	Feedback Provided on Options	73

Appendices	75
Appendix A. Estimate of Costs	76
Appendix B. Drawings of Potential FRM Options	77
Appendix C. Draft SEA Options Appraisal Report	78
Appendix D. Draft Screening for Appropriate Assessment under the Habitats Directive	79
Appendix E. Climate Change Adaptability	80
Appendix F. Multi Criteria Assessment	81
F.1 Local Weighting Data	82
F.2 MCA Matrices	83

Figures

Figure 4.1:	Dunmanway – Dirty River – Proposed Gauges	15
Figure 4.2:	Dunmanway – Brewery River – Proposed Gauges	16
Figure 5.1:	Dunmanway – Current Scenario Fluvial Flood Extents	20
Figure 5.2:	Dunmanway – Location of Storage Areas	22
Figure 5.3:	Dunmanway – Reduction in Flood Extent	24
Figure 5.4:	Dunmanway – Location of Bridges	25
Figure 5.5:	Dunmanway – Conveyance – Replacement of Bridges	26
Figure 5.6:	Dunmanway – Location of Flow Diversion Culvert	27
Figure 5.7:	Dunmanway – Flood Defences	28
Figure 5.8:	Inishannon – Current Scenario Fluvial Flood Extents	30
Figure 5.9:	Inishannon – Current Scenario Tidal Flood Extents	31
Figure 5.10:	Inishannon – Increase Conveyance – Removal of Old Ford Crossing and Channel Island	32
Figure 5.11:	Inishannon – Flood Defences	33
Figure 5.12:	Schull – Current Scenario Fluvial Flood Extents	35
Figure 5.13:	Schull – Increase Conveyance – Schull Stream (Paved Area & Culvert)	36
Figure 5.14:	Schull – Storage Areas	37
Figure 5.15:	Schull – Flow Diversion Culvert	39
Figure 5.16:	Schull – Flood Defences	40
Figure 5.17:	Schull – Culvert	41
Figure 5.18:	Schull – Flood Defences – Alternative Culvert Route	42
Figure 8.1:	Typical Damage / Probability Curve (Annual Average Flood Loss Curve)	57

Tables

Table 1.1:	Report Structure	3
Table 3.1:	Screening of Possible Flood Risk Management Methods	6
Table 4.1:	SSAs Suitable for Flood Forecasting	13

Table 4.2:	Dunmanway – Flood Forecasting Infrastructure	14
Table 4.3:	Individual Property Flood Resilience	18
Table 7.1:	Draft Flood Mapping PCDs	45
Table 7.2:	Flood Risk Management – Public Opinion	45
Table 7.3:	Details of Public Consultation Days	46
Table 7.4:	Public Preference for Potential Options	46
Table 8.1:	Flood Risk Receptors	47
Table 8.2:	Flood Probabilities	48
Table 8.3:	Risk to Society: Nr. of Inhabitants	49
Table 8.4:	Risk to Society: Nr. of Residential Properties	49
Table 8.5:	Risk to Society: Nr. of High Vulnerability Properties	50
Table 8.6:	Risk to Society: Nr of Social Amenity Sites	50
Table 8.7:	Risk to Cultural Heritage: Nr. of NIAH Buildings	51
Table 8.8:	Risk to Cultural Heritage: Nr. of RMPs	51
Table 8.9:	Risk to the Economy: Nr. of Non-Residential Properties	52
Table 8.10:	Risk to the Economy: Nr. of Roads	52
Table 8.11:	Risk to the Economy: Nr. of Utilities	53
Table 8.12:	Tidal Flood Risk – Clonakilty	54
Table 8.13:	Tidal Flood Risk – Inishannon	55
Table 8.14:	Annual Average Damage €	57
Table 8.15:	List of properties with damages exceeding €0.5M or a PVd greater than 1% of the Total AFA PVd	58
Table 8.16:	Summary of Damages & Benefit of Scheme Benefit	60
Table 8.17:	Benefit of Implementing a Flood Forecasting & Warning System	61
Table 9.1:	Estimate of Costs – Flood Forecasting and Warning Systems	62
Table 9.2:	Estimate of Costs for Potential Options	63
Table 10.1:	Flood Risk Management Objectives	64
Table 10.2:	Global Weighting of Flood Risk management Objectives	65
Table 10.3:	Local Weighting	67
Table 10.4:	MCA Scoring	68
Table 11.1:	MCA Scores for Potential Options	72
Table 11.2:	Public Preference for Potential Options	73

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 20 (The Bandon / Skibbereen 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 20 are set out below.

- Planning Control
- Building Regulations
- SUDS
- Flood Forecasting and Warning Systems
 - Inishannon – build on existing Bandon Flood Early Warning System
- Public Awareness
- Individual Property Flood Resilience
- Land Use Management

The preferred Flood Risk Management Options for each of the AFAs in UoM 20 include those measures listed above and those measures listed below.

The preferred option for Dunmanway as identified in the MCA is Flood Defences. However, this option and all other potential options are not cost beneficial.

The preferred option for Inishannon as identified in the MCA is Flood Defences. As an interim measure, before the preferred option is implemented, the installation of flood forecasting and warning system that ties into the existing Bandon Flood Early Warning System would be of benefit in Inishannon.

The preferred option for Schull as identified in the MCA is the construction of a Culvert on the Schull Stream and Flow Diversion on the Meenvane Stream. The preferred route for the culvert is in the back of gardens along the route of the existing stream as opposed to locating the culvert in the road.

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 Viable Structural measures
5. Development of Potential Flood Risk Management Options for AFAs	<ul style="list-style-type: none"> Description of Viable FRM Options
6. Environmental Assessment	<ul style="list-style-type: none"> Assessment of environmental impacts of Viable FRM Options
7. Stakeholder Input	<ul style="list-style-type: none"> Principal outputs and findings of design hydrology Preliminary design flows and hydrographs for hydraulic modelling
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 Viable 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 (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)

Within the CFRAM Study, the screening, assessing and developing of flood risk management 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 20

Within UoM 20 the River Bandon could be considered as a Sub-Catchment SSA as Dunmanway and Inishannon have been identified as AFA's. However, hydraulically the AFA's are far removed and the town of Bandon is located between the AFAs. Bandon is not included in SW CFRAM Study as a separate study has already been undertaken for this town. Therefore, no Sub-Catchment SSAs are considered within UoM 20.

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

Based on the above, UoM 20 is split into 2 Spatial Scales of Assessment (SSAs). These are:

- The Unit of Management (UoM)
- Areas for Further Assessment (AFAs)
 - Clonakilty
 - Dunmanway
 - Inishannon
 - Schull

It should be noted that the development of preliminary options for Clonakilty has been progressed prior to the preparation of this report due to significant flood events in June 2012. The development of preliminary options for Clonakilty are contained in a separate report.

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 20.

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 20. 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		
			Dunmanway	Inishannon	Schull
Do Nothing	Not Viable	N/A	Not Viable	Not Viable	Not Viable
Existing Regime	Not Viable	N/A	Not Viable	Not Viable	Not Viable
Do Minimum	Not Viable	N/A	Not Viable	Not Viable	Not Viable
Non-structural Measures					
• Planning Control	Viable	N/A	Viable	Viable	Viable
• Building Regulations	Viable	N/A	Viable	Viable	Viable
• SUDS	Viable	N/A	Viable	Viable	Viable
• Flood Forecasting	Viable	N/A	Viable	Viable	Not Viable
• Public Awareness	Viable	N/A	Viable	Viable	Viable
• Individual Property Flood Resilience	Viable	N/A	Viable	Viable	Viable
• Land Use Management	Viable	N/A	Viable	Viable	Viable
Structural Measures (Future Risk)					
• Strategic Development Management	Viable	N/A	Viable	Viable	Viable
Structural Measures (Current Risk)					
• Fluvial Storage	Not Viable	N/A	Viable	Not Viable	Viable
• Flow Diversion	Not Viable	N/A	Viable	Not Viable	Viable
• Increase Conveyance	Not Viable	N/A	Viable	Viable	Viable
• Flood Defences	Not Viable	N/A	Viable	Viable	Viable
• Improve existing defences	Not Viable	N/A	Not Viable	Not Viable	Not Viable
• Relocate Properties	Viable	N/A	Not Viable	Not Viable	Not Viable
• Localised protection works	Not Viable	N/A	Viable	Viable	Viable
Channel or Flood Defence Maintenance Works	Viable	N/A	Viable	Not Viable	Not Viable
Other Works	-	N/A	Not Viable	Not Viable	Not Viable

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 20 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

As outlined in Section 2.2 there are no sub-catchments within UoM 20.

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

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.

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 a viable measure as it is not applicable.

3.5.3 Dunmanway – Improve Existing Defences

The existing flood defences in Dunmanway already provide the required standard of protection to the 1% AEP fluvial event. The flood risk identified in Dunmanway under this study is to areas which are currently undefended. Therefore, improving existing defences is not a viable measure as it is not applicable.

3.5.4 Dunmanway – Relocate Properties

There are 7 residential and 21 non-residential properties at risk from flooding in the 1% AEP flood event in Dunmanway. The potential benefit in Dunmanway is €792,000. It is not economically viable to relocate the at risk properties as to do so would cost more than the €28,000 available for each property.

3.5.5 Inishannon – Fluvial Storage

There are no suitable locations upstream of Inishannon to store the volume required to reduce the flood risk. The peak flow upstream of Inishannon for the 1% AEP event is 398m³/s. To reduce the peak flow to the 10% AEP event (228m³/s) for which Inishannon is still at flood risk would require a storage area of 739,600m² with a depth of water of 5m.

In addition, a fluvial storage area with control structure would increase rivers levels and flood risk upstream in areas already at significant risk. This measure is not applicable.

3.5.6 Inishannon – Flow Diversion

Due to the magnitude of flows in the River Bandon (398m³/s for the 1% AEP event) and its location within a valley it is not economically feasible to divert flows.

3.5.7 Inishannon – Improve Existing Defences

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

3.5.8 Inishannon – Relocate Properties

There are 24 Nr. residential properties and 17 Nr. non-residential properties at risk from the design event. The scheme benefit is approx. €3.2M. It is not economically viable to relocate properties at a cost of €77k 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.

3.5.9 Inishannon – Channel or Flood Defence Maintenance Works

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

3.5.10 Schull – Flood Forecasting

Flood forecasting is unlikely to be an effective measure due to the catchments rapid response to rainfall which is less than 0.5 hours. This measure is not applicable.

3.5.11 Schull – Improve Existing Defences

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

3.5.12 Schull – Relocate Properties

There are no isolated properties at risk within Schull. There are 25 residential and 22 non-residential properties at risk in Schull. The potential benefit in Schull is €8.9 million. It is not economically viable to relocate this number of properties as the amount available for each property is €189,000 which is less than the market price for residential properties.

3.5.13 Schull – Channel or Flood Defence Maintenance Works

Schull 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.

A report on the Spatial Planning and Flood Risk has been prepared for the UoM. This report is included in Appendix G.

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 developments (and where possible redevelopment), should apply the principles of SUDS.

A separate Strategic SUDS report has been prepared for UoM 20 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		
Dunmanway	> 6 Hours (on Bandon)	Rain gauges River level gauges Build on existing Bandon Flood Early Warning System
Inishannon Fluvial	> 6 Hours	Build on the existing Bandon Flood Early Warning System
Inishannon Tidal	> 6 Hours	Use the existing OPW storm surge forecasting system to predict high tide levels.
UoM		
River Bandon	> 6 Hours	Build on the existing Bandon Flood Early Warning System Use the existing OPW storm surge forecasting system to predict high tide levels.

Source: UoM 20 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 Dunmanway

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

Table 4.2: Dunmanway – Flood Forecasting Infrastructure

Equipment	Quantity
Rain Gauges	6
River Level Gauge (Hydrometric Gauging Station)	4

Figure 4.1: Dunmanway – Dirty River – Proposed Gauges

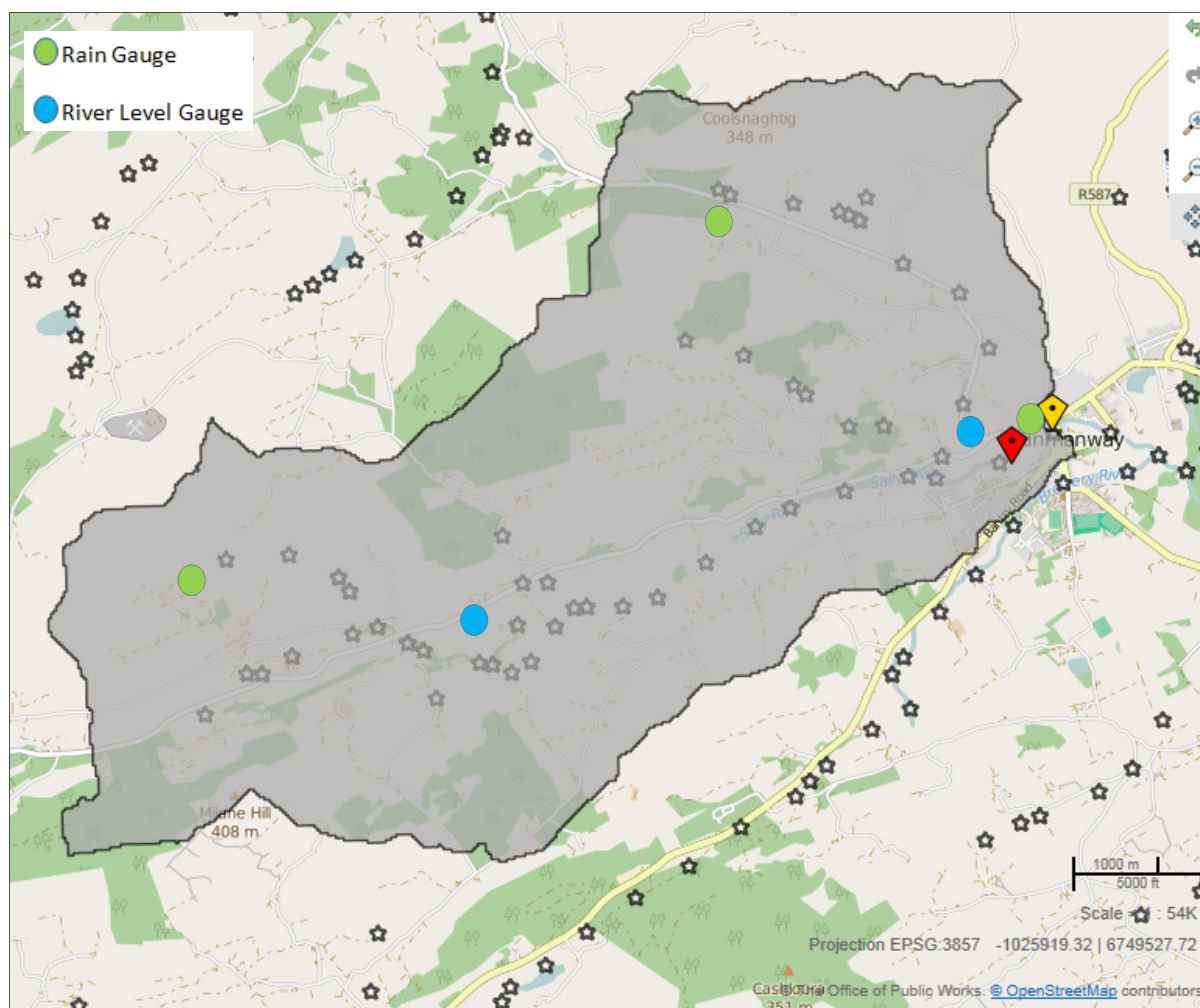
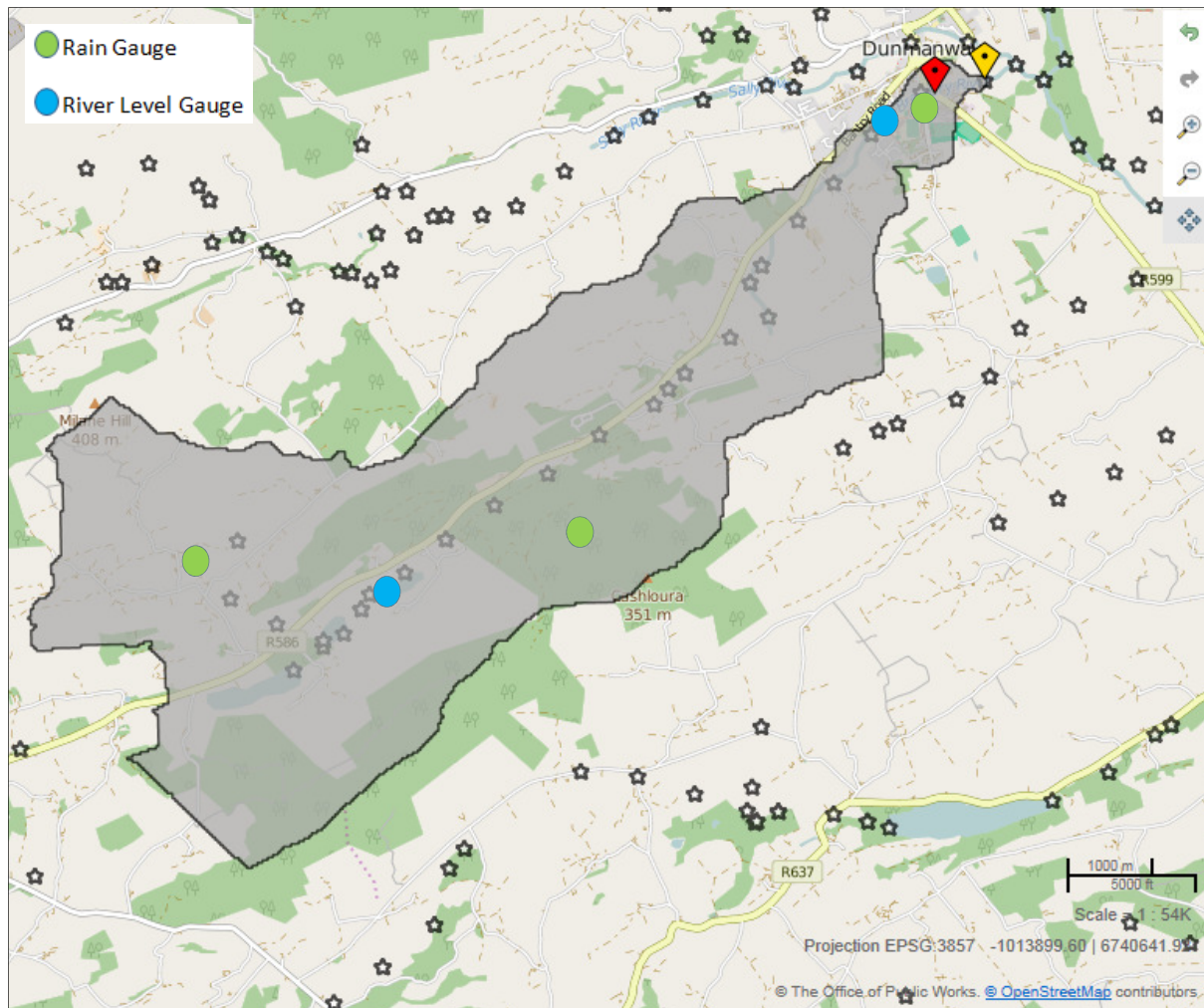


Figure 4.2: Dunmanway – Brewery River – Proposed Gauges



The infrastructure listed and shown above would also be required for a Sub-Catchment scale forecasting system which would build on the existing Bandon Flood Early Warning System (FEWS).

Cost estimates for the proposed flood forecasting and warning systems are included in Section 6.0.

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 20 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 4.3 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 4.3: 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
Dunmanway	7	21	791,541	28,269	4,240	N
Inishannon	26	17	3,152,279	73,308	10,996	Y
Schull	25	22	8,917,474	189,733	28,460	Y

This analysis indicates that Individual Property Flood Resilience is a viable option for Inishannon and Schull. 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 recognised 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 4.4 below.

Table 4.4: Possible Structural Measures

AFA	Dunmanway	Inishannon	Schull
Fluvial Storage	Y	N	Y
Flow Diversion	Y	N	Y
Increase Conveyance	Y	Y	Y
Flood Defences	Y	Y	Y
Improve Existing Defences	N	N	N
Relocate Properties	N	N	N
Localised Protection Works	Y	Y	Y
Other works	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

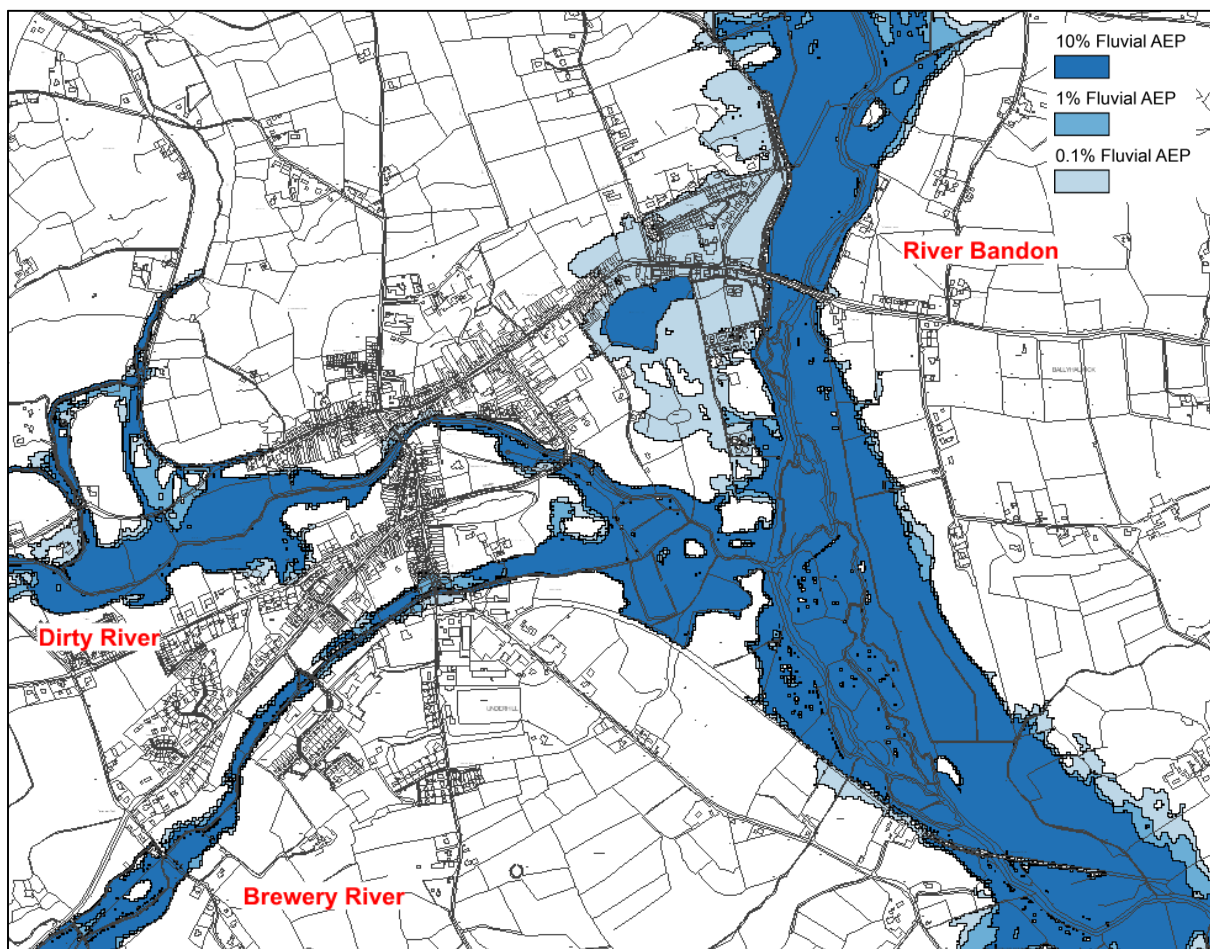
5.1 General

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 20.

5.2 Dunmanway, Co. Cork

Dunmanway is located at the confluence of the River Bandon and its tributaries the Brewery and Dirty Rivers in County Cork. Dunmanway is at risk of fluvial flooding. The AFA and the existing fluvial flood risk are highlighted in Figure 5.1.

Figure 5.1: Dunmanway – Current Scenario Fluvial Flood Extents



5.2.1 Possible FRM Measures

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

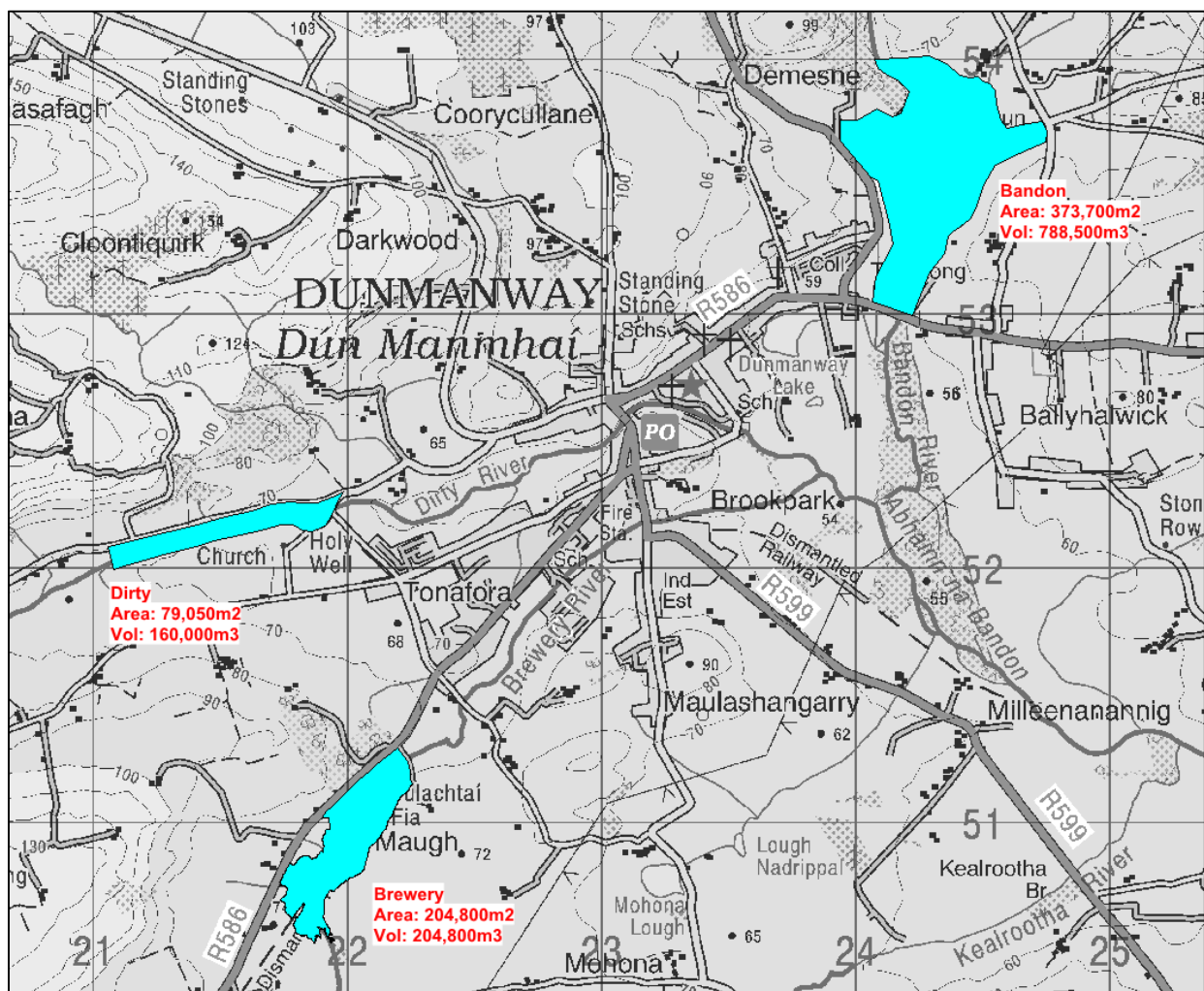
- Storage
- Increase Conveyance
- Flow Diversion
- Flood Defences (Fluvial)

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

Dunmanway is located at the confluence of the River Bandon and its tributaries the Brewery and Dirty Rivers. Potential locations for the storage of fluvial flows were identified on each of the rivers 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: Dunmanway – Location of Storage Areas



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.

The peak flow in the Dirty River at the storage location for the 1% AEP event is 17.32m³/s which results in flooding along the watercourse and through the town at Bridge Street. The storage area on the Dirty River is 79,050m² and has a capacity of approx. 160,000m³ which can limit the outflow to approx. 10.05m³/s. This equates to the peak of the 20% AEP event.

The peak flow in the Brewery River for the 1% AEP event is 13.13m³/s which results in flooding along the watercourse and at Brewery Bridge. The storage area on the Brewery River is 204,800m² and has a capacity of approx. 204,800m³ which can limit the outflow to approx. 7.75m³/s. This equates to the peak of the 20% AEP event.

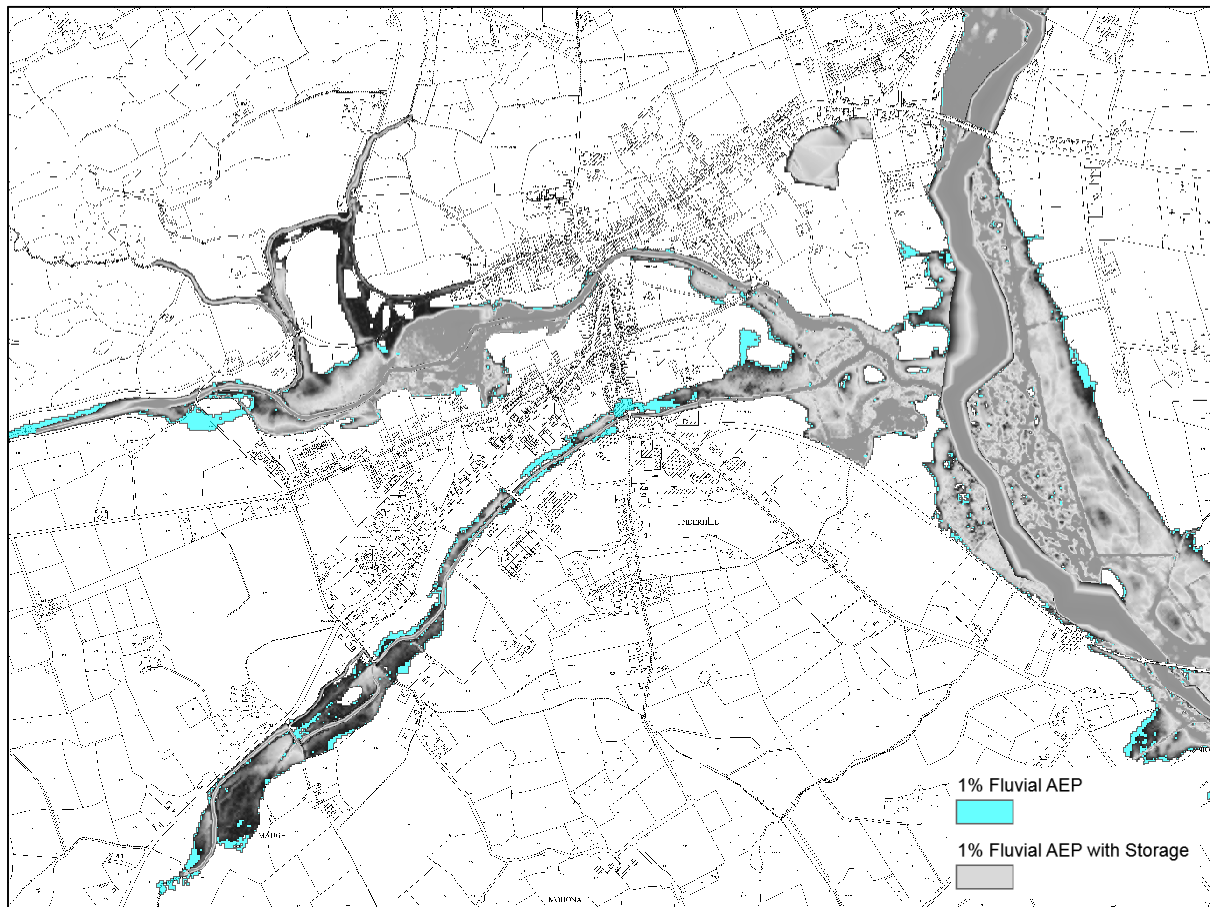
The Dirty and Brewery rivers are tributaries of the River Bandon which can have a backwater impact on the tributaries. In order to maximise the effectiveness of the storage on the Dirty and Brewery rivers, storage was also considered for the River Bandon to reduce the peak flow as much as possible.

The River Bandon has a peak flow of 147.43m³/s for the 1% AEP event immediately upstream of the confluence with the Dirty River. The storage area identified on the Bandon River is 373,700m² and has a capacity of approx. 788,507m³. This allows for the peak flow to be reduced to 118.77m³/s (2% AEP peak flow) during the design event.

Hydraulic modelling with each of the three storage areas in place was carried out for the 1% AEP event. The key results are as follows:

- A minor reduction in flood extent along the River Bandon with a maximum reduction in water level of 0.002m upstream of the confluence with the tributaries.
- A minor reduction in flood extent along the Dirty River with roads and properties still flooding. A maximum reduction in water level of 0.307m. Properties still flooding at Bridge Street.
- A reduction in flood extent along the Brewery River and no flooding of properties at Brewery Bridge. A reduction in water level of 0.417m.

Figure 5.3: Dunmanway – Reduction in Flood Extent



Based on this assessment storage on the River Bandon has a negligible impact on water levels and is not a viable measure. Storage on the Dirty River does not mitigate the fluvial flood risk and is not deemed to be a viable measure.

Storage on the Brewery River achieves the required standard of protection for the 1% AEP fluvial event along the watercourse and is deemed to be a viable measure.

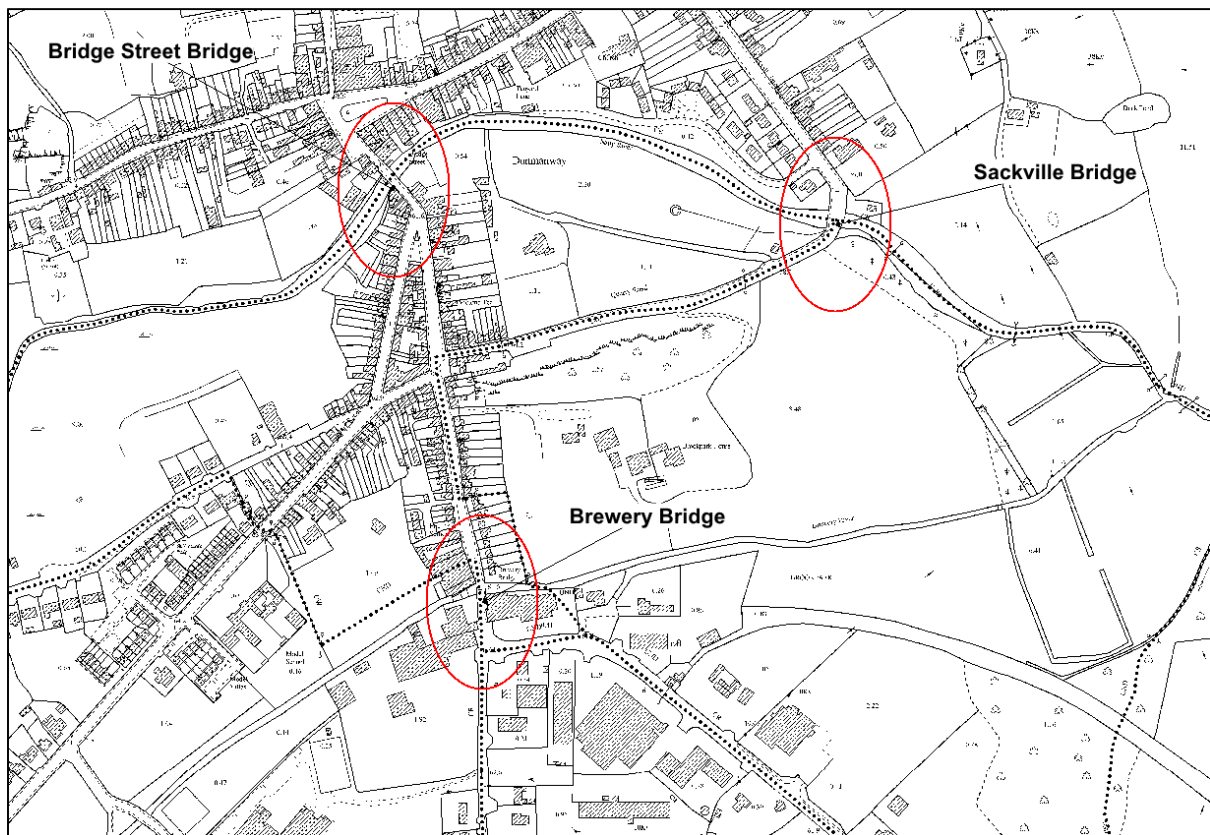
5.2.1.2 Increased Conveyance – Replace Bridges

This measure aims to mitigate the flood risk by improving the conveyance of critical structures. The following bridges have been identified for replacement:

- Brewery Bridge
- Bridge Street Bridge
- Sackville Street Bridge

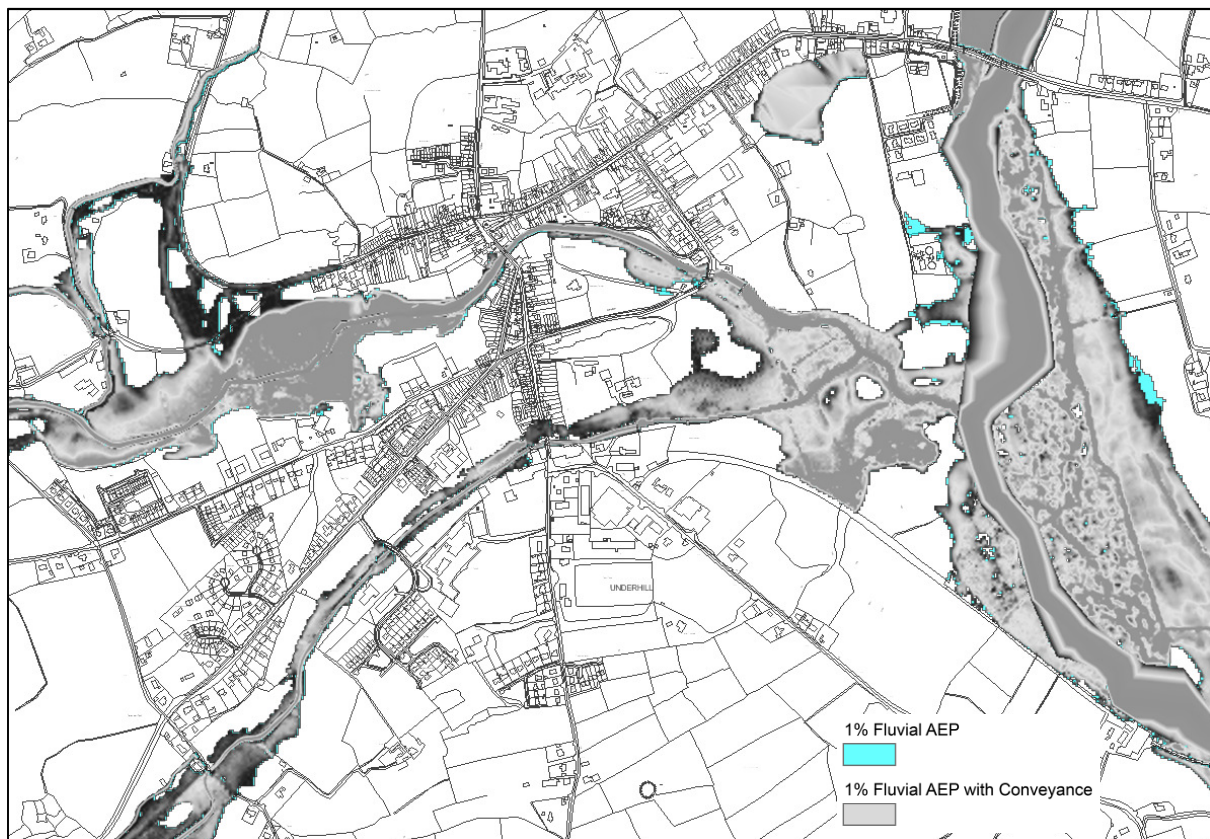
All three bridges are currently arch bridges with piers restricting flow in the channel. This measure aims to achieve the maximum improvement in conveyance by replacing the arch bridges with single span bridges with the soffit level set as high as possible. The removal of these bridges was not considered as they are key infrastructure within the town. Figure 5.4 shows the location of the bridges.

Figure 5.4: Dunmanway – Location of Bridges



The arch bridges in the hydraulic model were all replaced with single span bridges. The model indicated that there was an extremely minor reduction in the 1% AEP flood extent with a maximum reduction in flood depth of 0.01m which occurred on along the Dirty River. Figure 5.5 highlights the minor reduction in flood extent. This measure is not deemed to be a viable measure individually or in combination as the reduction in flood extent / level / risk is minimal.

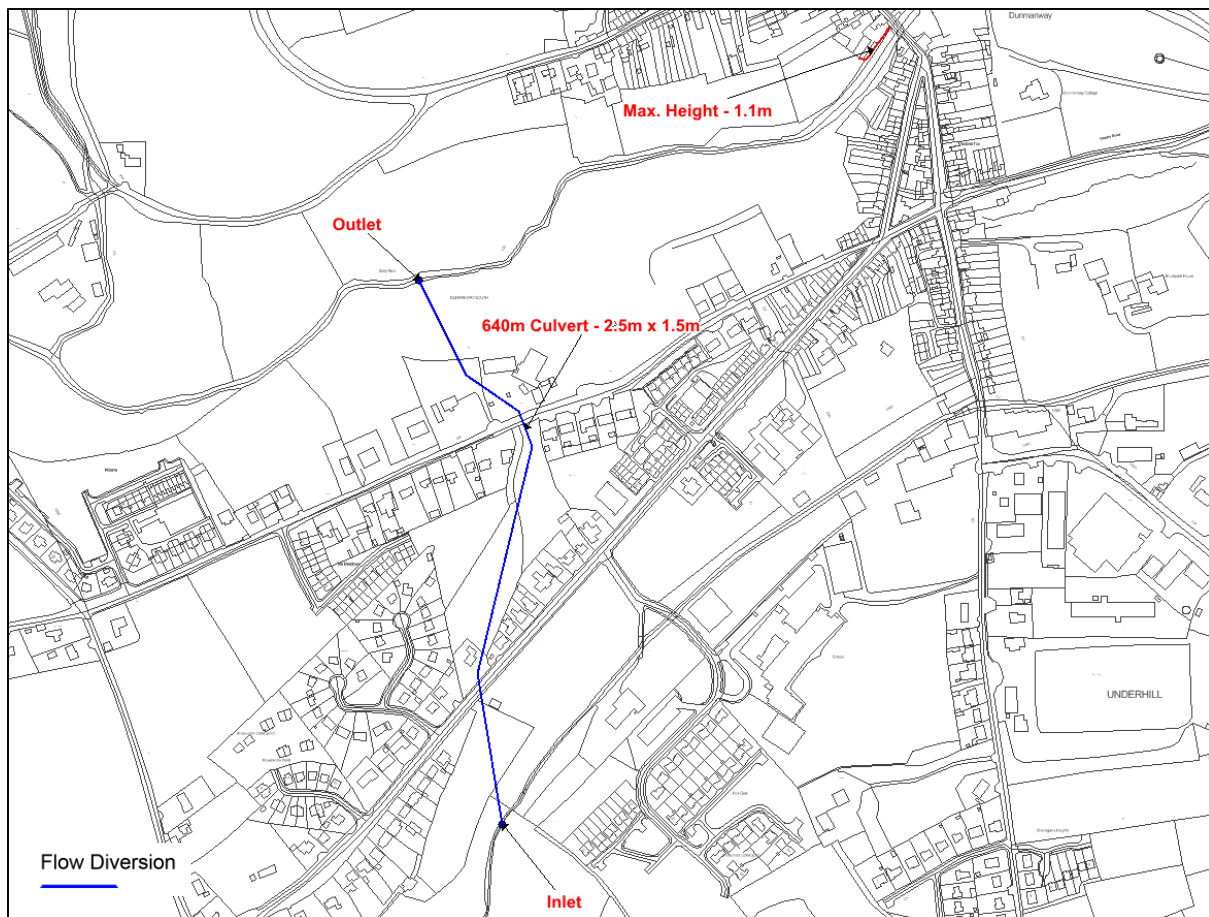
Figure 5.5: Dunmanway – Conveyance – Replacement of Bridges



5.2.1.3 Flow Diversion

This measure aims to mitigate flood risk along the Brewery River by diverting flows to the Dirty River. Figure 5.6 shows the location of the flow diversion culvert.

Figure 5.6: Dunmanway – Location of Flow Diversion Culvert



The peak flow in the Brewery River for the 1% AEP event is 13.13m³/s which results in flooding along the watercourse and at Brewery Bridge. Properties are shown as flooding at Brewery Bridge for the 5% AEP event. It is proposed to divert all flows above 8.82m³/s (peak flow for the 10% AEP event) to the Dirty River. This equates to a peak flow of 4.31m³/s being diverted to the Dirty River during the design event.

The proposed route is 640m long and based on existing bed levels at the inlet and outlet (61.1070m OD / 57.8614m OD) a minimum culvert size of 2.5m x 1.5m. Based on the Lidar data, the proposed route would involve a dig of greater than 6m over the majority of its length.

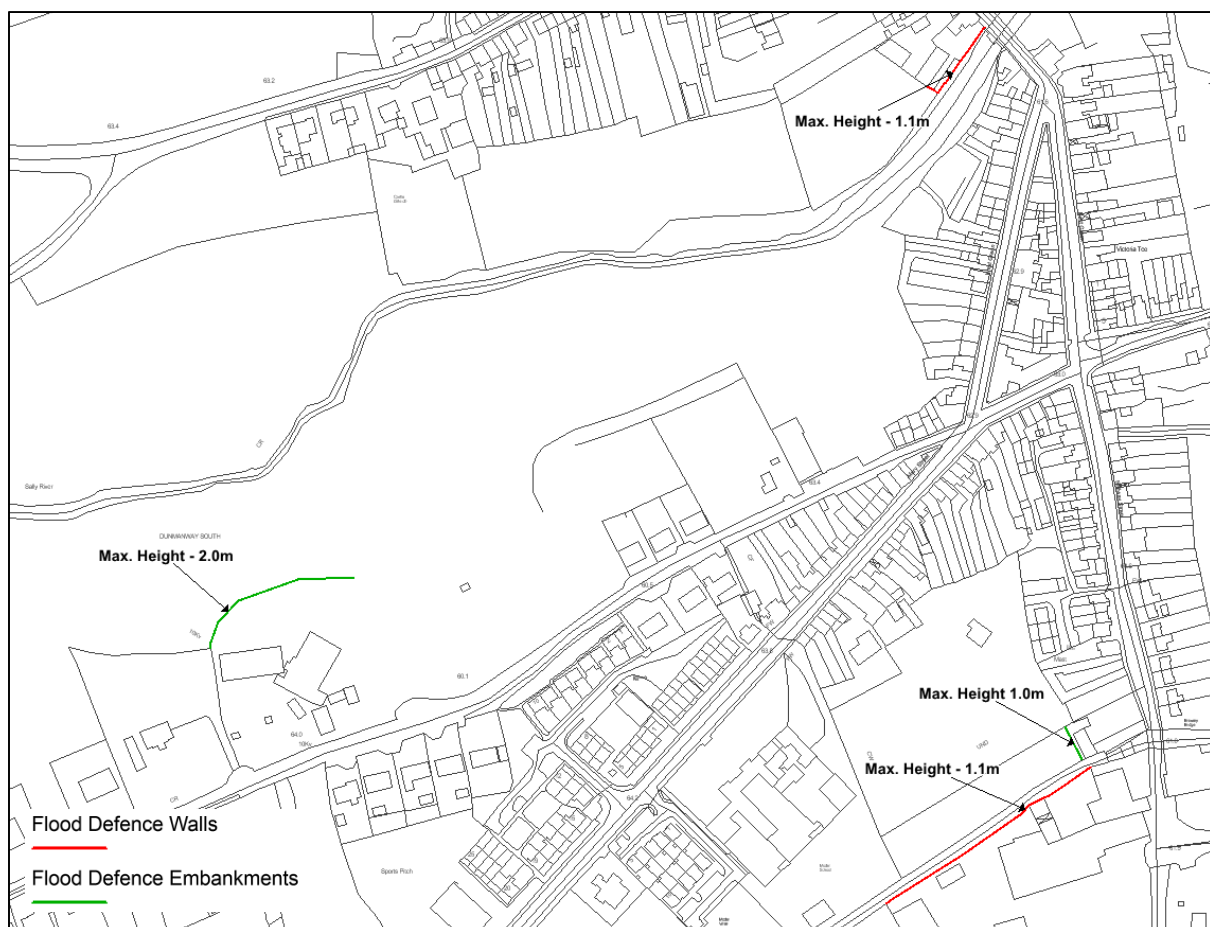
The hydraulic modelling of the proposed diversion indicates that the measure fully mitigates the flood risk along the Brewery River. However, there is a minor increase in flood extent along the Dirty River with a maximum increase in depth of 0.15m. The diversion does not result in the flooding of additional properties on along the Dirty River.

This measure is deemed to be viable for mitigating flood risk along the Brewery River.

5.2.1.4 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 5.7.

Figure 5.7: Dunmanway – Flood Defences



The hydraulic modelling of the proposed flood defences indicates that the measure fully achieves the required standard of protection for the 1% AEP fluvial event. This measure is deemed to be a viable measure / option.

5.2.2 Potential FRM Measures

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

- Storage – Brewery River
- Flow Diversion – Brewery River
- Flood Defences / Localised Protection Works

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 on Brewery River / Flood Defences on Dirty River
- Option 3 – Flow Diversion of Brewery River / Flood Defences on Dirty River

5.3 Inishannon, Co. Cork

Inishannon is located along the River Bandon and is at risk of both fluvial and tidal flooding. However, the greater risk is from fluvial flooding. The AFA and the existing flood risk for fluvial and tidal flooding are highlighted in Figures 5.8 and 5.9.

Figure 5.8: Inishannon – Current Scenario Fluvial Flood Extents

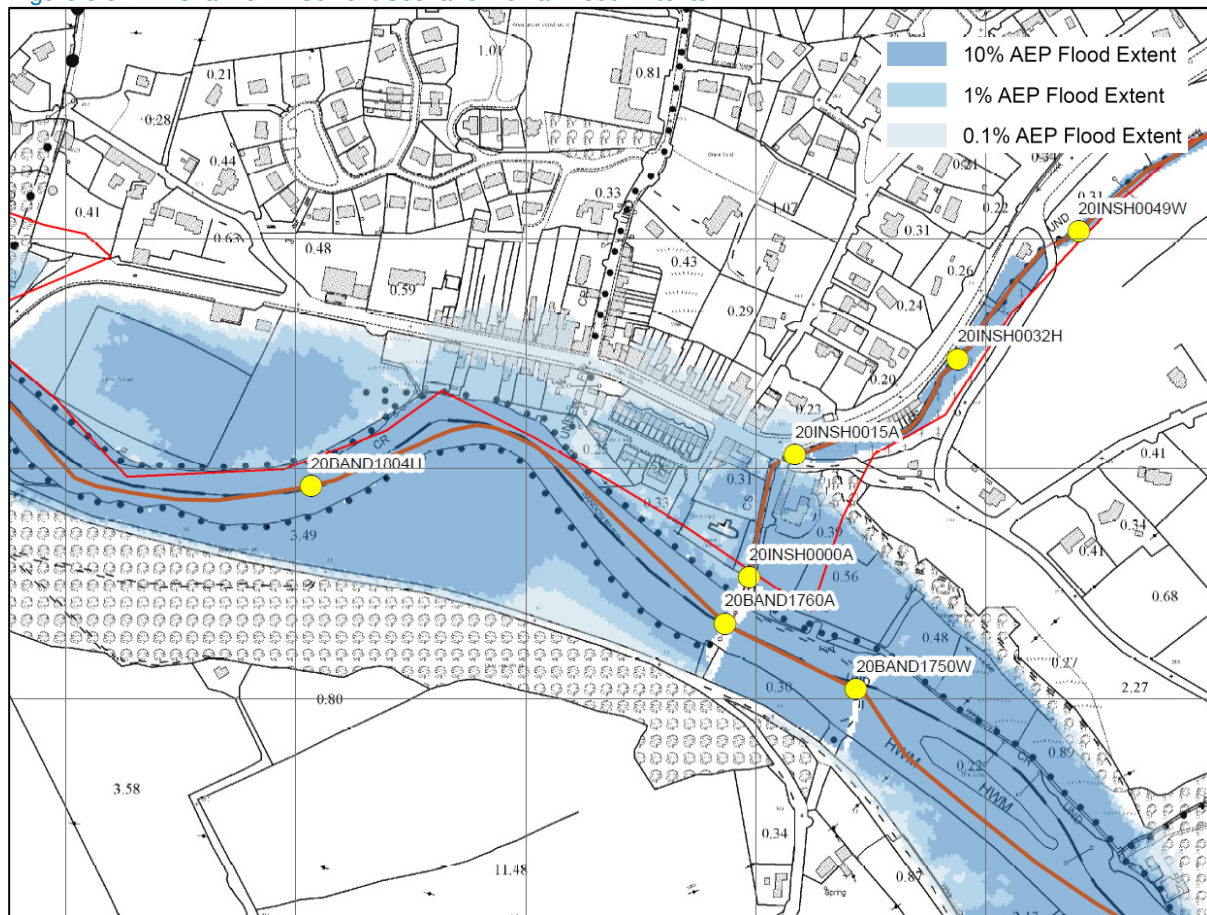
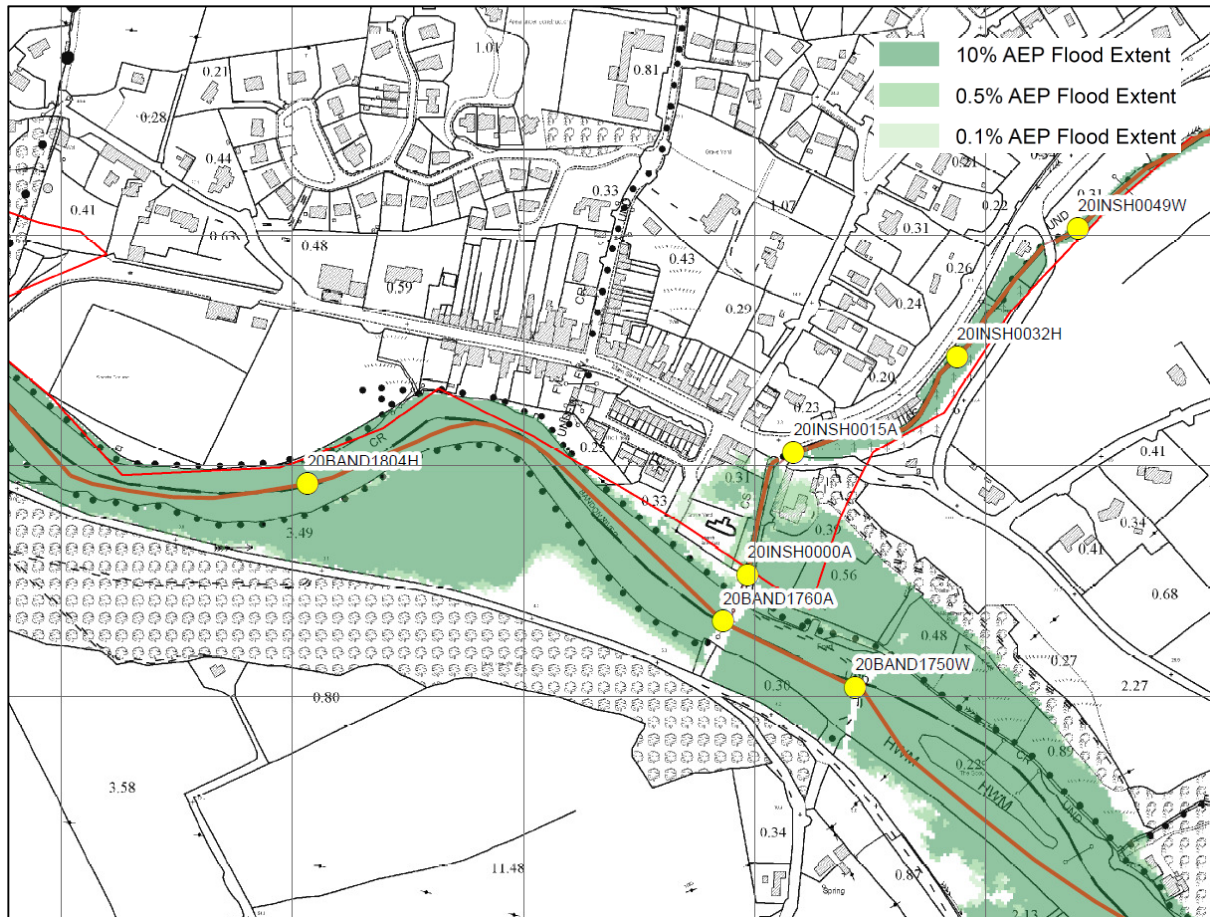


Figure 5.9: Inishannon – Current Scenario Tidal Flood Extents



5.3.1 Possible FRM Measures

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

- Increase Conveyance
- Flood Defences (Fluvial / Tidal)

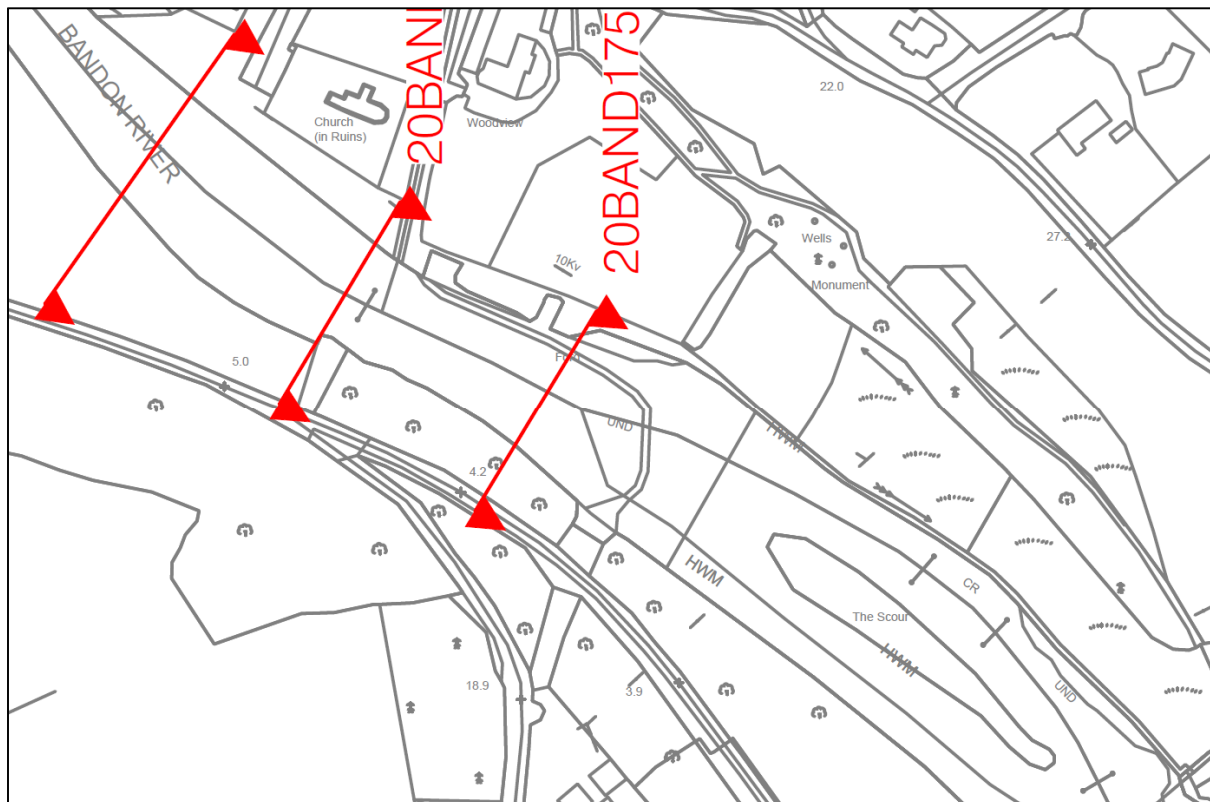
The possible measures were reviewed and assessed further to determine if they were applicable and viable. The measures were modelled individually to determine their effectiveness and impact.

5.3.1.1 Increase Conveyance – Removal of Old Ford Crossing and Channel Island

Immediately downstream of the town the capacity of the channel is reduced by the old ford crossing and a significant island within the channel known as The Scour. These are shown in Figure 5.10.

This measure aims to improve channel capacity by removing the old ford crossing and the island within the channel.

Figure 5.10: Inishannon – Increase Conveyance – Removal of Old Ford Crossing and Channel Island

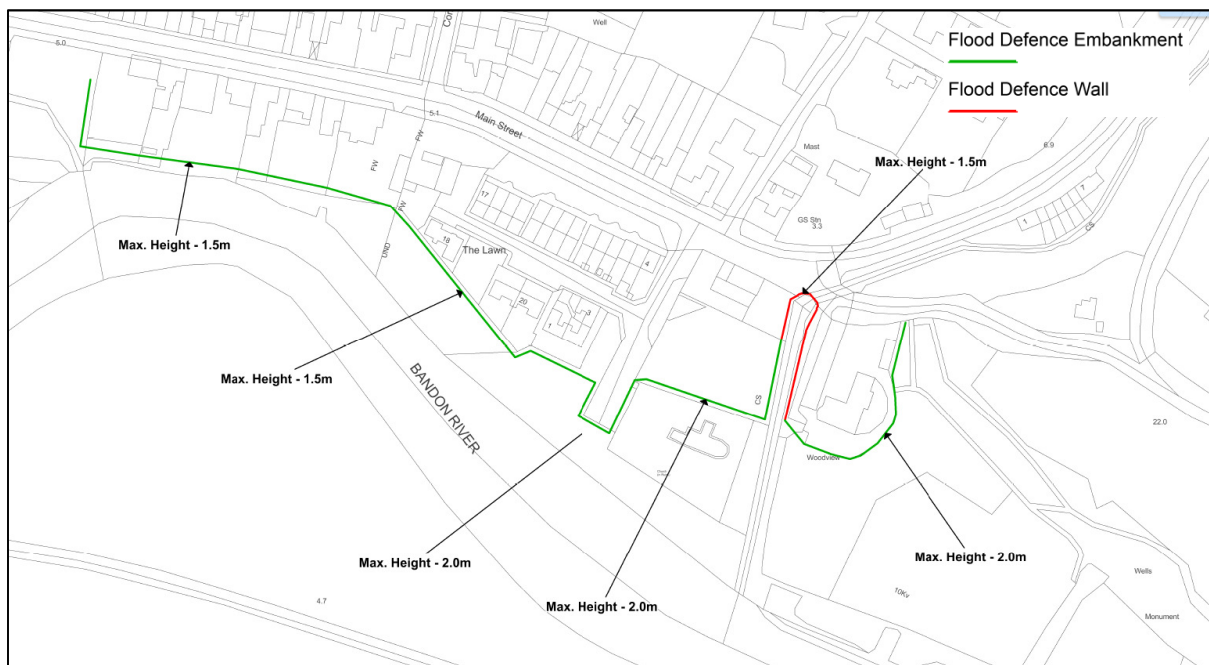


The island and the old ford crossing were removed from the hydraulic model which determined that there was no significant reduction in flood extent, depth or duration. This is due to the crossing and island being drowned by the MHWS tide. The maximum decrease in water level was 0.0812m at the old crossing. This measure is not deemed to be a viable measure individually or in combination as the reduction in flood extent / level / risk is minimal.

5.3.1.2 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 maximum height of the defences is shown in Figure 5.11.

Figure 5.11: Inishannon – Flood Defences



The hydraulic modelling of the proposed flood defences as outlined in Figure 5.11 indicates that the measure fully achieves the required standard of protection for the 1% AEP fluvial event and the 0.5% AEP tidal event. 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

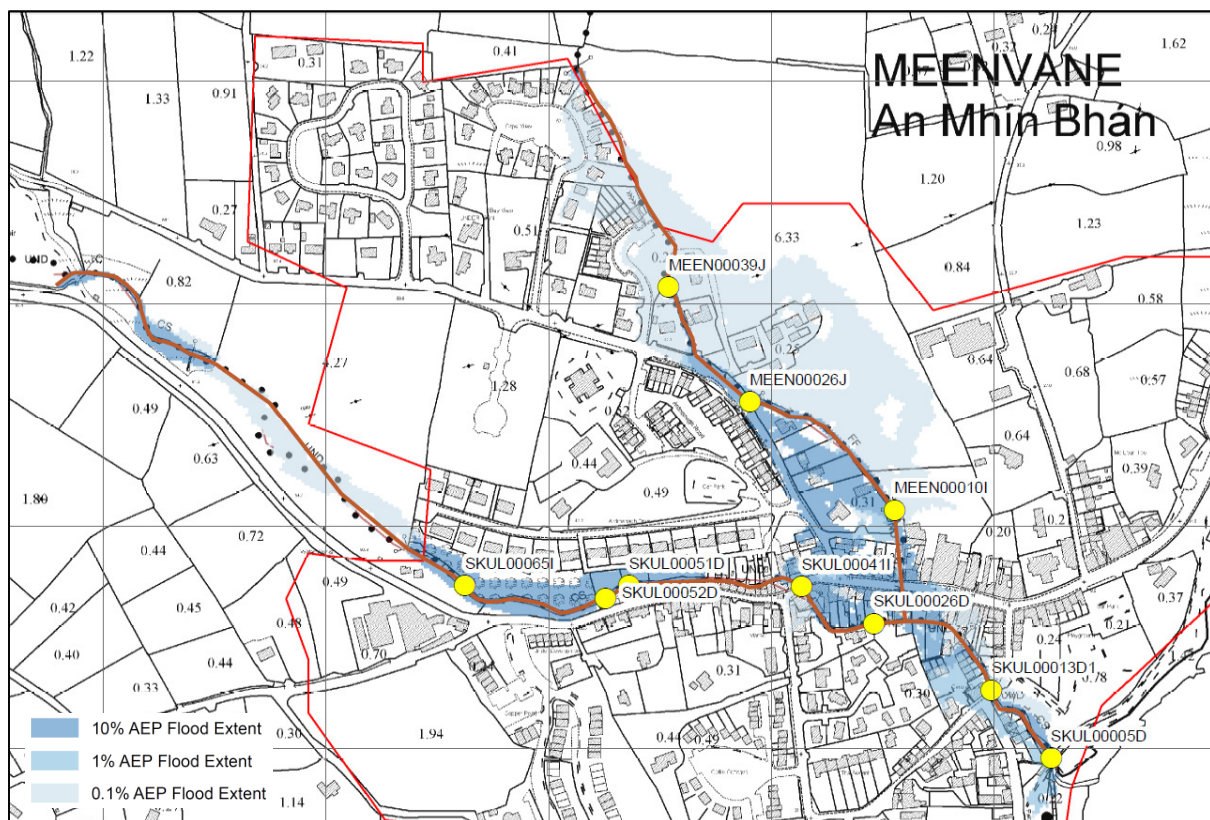
Based on the assessment of the potential (viable) FRM measures and detailed hydraulic modelling of the combined measures, the following are potential FRM options. Full outline drawings are included in Appendix B for each of the potential options.

- Option 1 – Flood Defences

5.4 Schull, Co. Cork

Schull is located on the coast at the confluence of the Schull and Meenvane streams and is at risk of fluvial flooding. Due to its elevation, Schull is not at risk of tidal flooding. The AFA and the existing fluvial flood risk are highlighted in Figure 5.12.

Figure 5.12: Schull – 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:

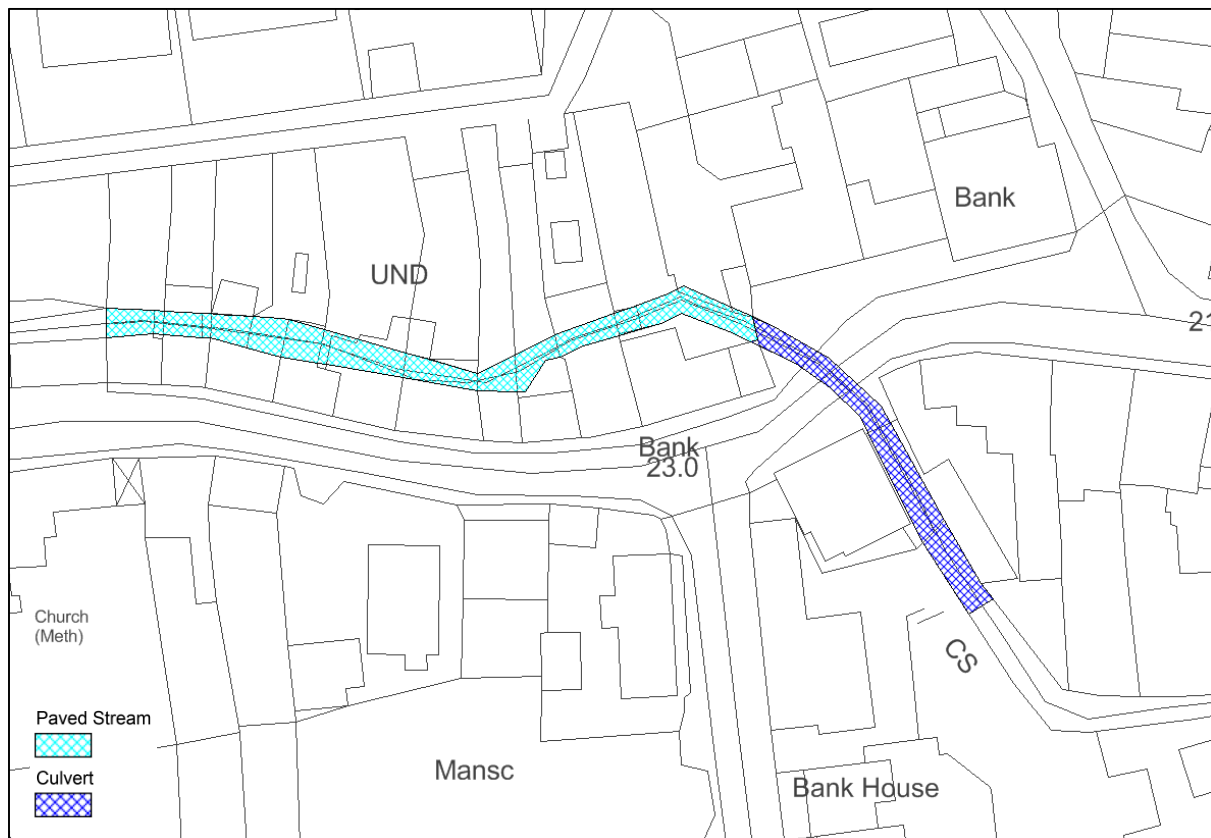
- Increase Conveyance
- Storage
- Flood Defences

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.

5.4.1.1 Increase Conveyance – Schull Stream (Paved Area & Culvert)

The culvert on the Schull Stream crosses Main Street at the Bunratty Inn. This culvert has developed from an existing bridge crossing and has effectively been extended 80m upstream by landowners paving over the stream to the rear of their properties. This is shown in Figure 5.13. There are also a number of manholes along this section. The paving and manholes are not watertight and flows exit these structures when the culvert capacity is reached and the structures are subject to surcharging.

Figure 5.13: Schull – Increase Conveyance – Schull Stream (Paved Area & Culvert)



It was not possible to gain access to the culvert to carry out a detailed survey. The hydraulic model assumes that the inlet dimensions (2.05m wide x 1.0m high) at the paved section are constant throughout. However, the manhole and culvert coefficients have been calibrated to reproduce the existing flooding up through the paving and along Main Street.

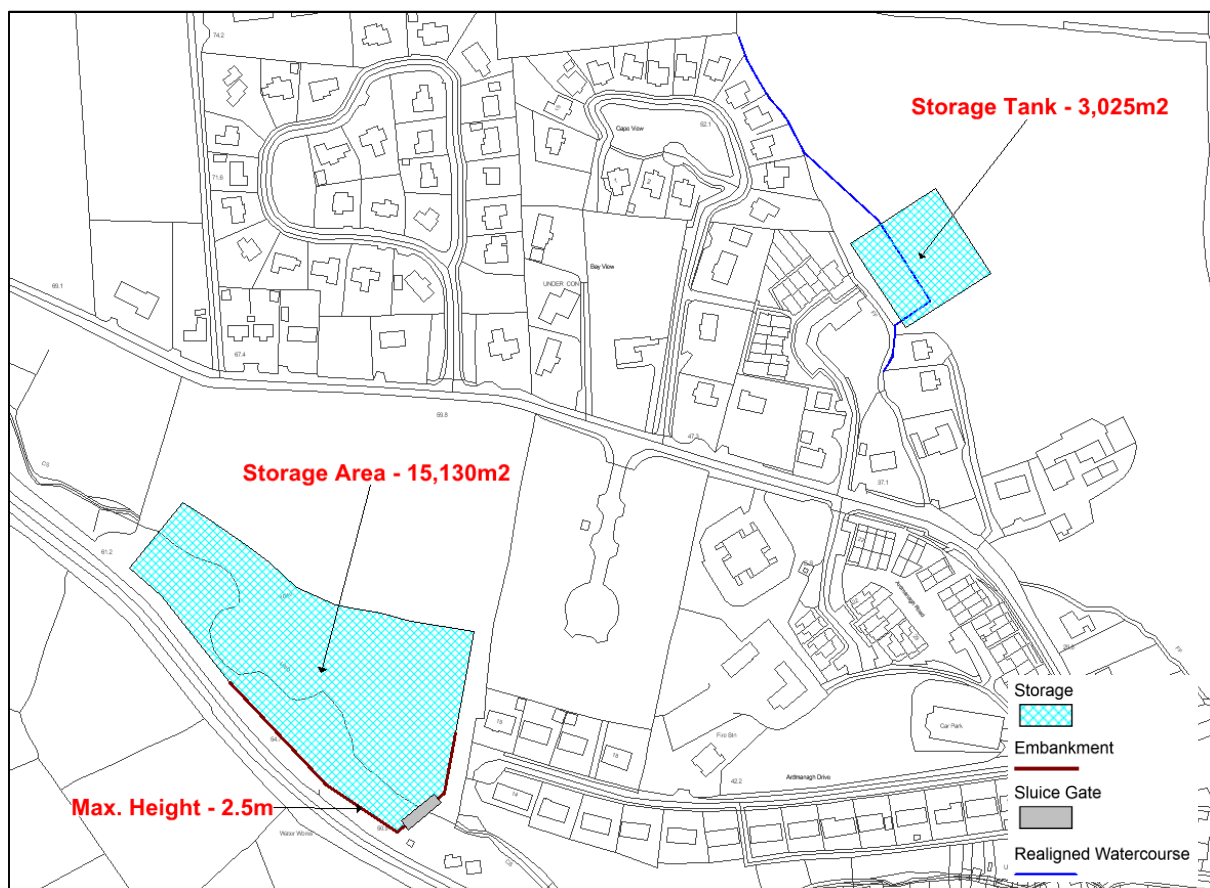
This measure aims to mitigate the flood risk by increasing conveyance through the culvert. In the hydraulic model the capacity of the existing culvert and paved section was doubled. However, the results indicate that there is still surcharging and flooding at the Bunratty Inn.

Due to site restrictions and the proximity of the culvert to a number of buildings it is extremely unlikely that any works could be carried out to achieve the increased capacity simulated in the hydraulic model. Therefore, conveyance is not deemed to be a viable measure.

5.4.1.2 Storage

Schull is located at the confluence of the Schull and Meenvane streams. An assessment of the storage required to mitigate the flood risk on both watercourses was carried out and suitable locations for storage identified. The locations and size of the storage areas are shown in Figure 5.14.

Figure 5.14: Schull – Storage Areas



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 the flood growth curve have been made.

The peak flow in the Meenvane Stream for the 1% AEP event is 1.9m³/s which results in flooding along the watercourse and through the town. The proposed storage area has a capacity of 12,000m³ and can reduce the peak flow for the 1% AEP event to 0.9m³/s. This equates to the peak flow for the 50% AEP event.

On Meenvane Stream there are no suitable locations to utilise the topography for storage. Therefore, it will be necessary to construct a storage / attenuation tank. The proposed tank is 3,025m² (55m x 55m) and 4m deep with an invert level of 42m OD Malin. The tank is located on a slope which will require excavation of approx. 5m at the upstream side. The tank will operate like a backdrop manhole where the inlet and outlets will tie in with existing bed levels. The stream will be diverted into the tank at the upstream end at approx. 46m OD Malin and drop 4m within the tank where it will discharge to the watercourse at the existing bed level of 42m OD Malin. This approach is required due to the slope of the stream and the site.

The peak flow in the Schull Stream for the 1% AEP is 4.2m³/s which results in flooding of the town. The proposed storage area is 15,130m² and has sufficient capacity to reduce the peak flow to 1.5m³/s. This is less than the peak flow for the 50% AEP event.

The proposed location for storage on the Schull Stream aims to utilise the existing topography. However, it will require excavation within the proposed area to lower ground levels to ensure there is sufficient capacity. The existing ground level at the downstream end is 48.5m OD Malin and 54.5m OD Malin at the upstream end. There is a small area to the north of the proposed site where the existing ground level is 58.6m OD Malin. The proposed storage area has an invert level of 48.5m OD Malin with a top of water level of 50.5m OD Malin an embankment level of 51.0m OD Malin. The maximum embankment height is 2.0m.

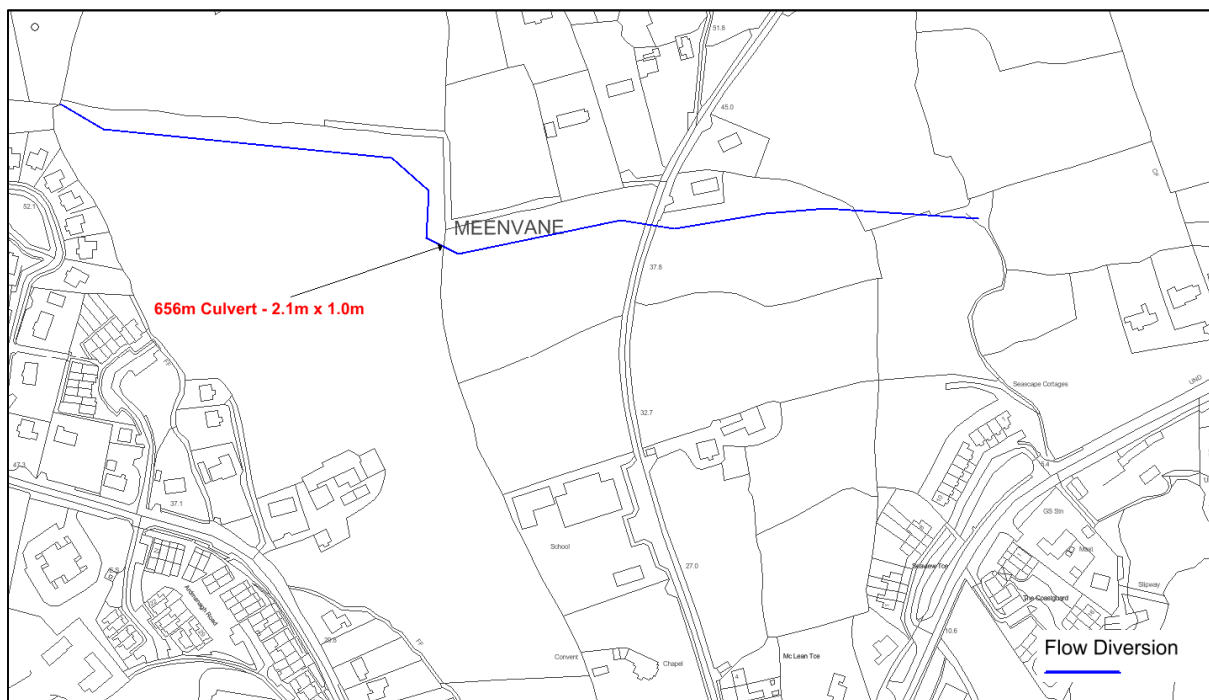
Hydraulic modelling of the storage areas was carried out which resulted in no flooding through the town. Due to the slope of the Meenvane and the type of storage, there is no impact on water levels upstream. The proposed storage area on the Schull Stream is located within 200m of the upper extent of the modelled watercourse. As a result the impact of the storage area upstream cannot be confirmed. However, based on site visits and the existing ground profile it is unlikely that storage would have any significant impact upstream.

Based on this assessment, storage on the Schull and Meenvane streams are viable measures.

5.4.1.3 Flow Diversion

This measure aims to mitigate the flood risk by diverting the flow from the Meenvane Stream away from the town discharging to a separate water course. Figure 5.15 shows the location and proposed route of the flow diversion culvert.

Figure 5.15: Schull – Flow Diversion Culvert



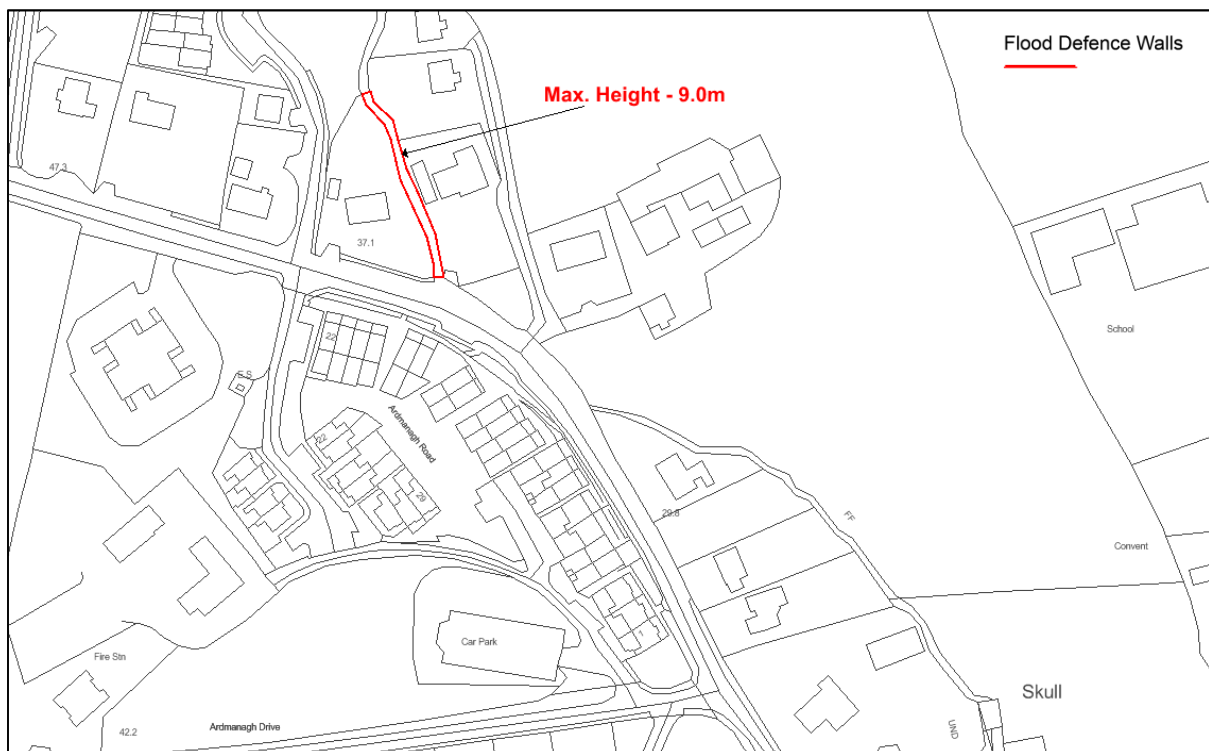
The peak flow in the Meenvane Stream for the 1% AEP event is 1.9m³/s which results in flooding along the watercourse and through the town. It is proposed to divert the stream to a separate watercourse using a 2.1m wide by 1.0m high culvert. The proposed route has been selected to minimise the amount of excavation required while also reducing the impact on landowners. The average depth of excavation is 2.5m with a maximum depth of 5m. The 656m culvert will discharge to an existing watercourse which may require some regrading works.

The flow diversion is deemed to be a viable measure.

5.4.1.4 Flood Defences – Meenvane Stream

This measure aims to protect properties through the construction of flood defences. These defences include walls along the Meenvane Stream. The locations and heights of the flood defence walls are shown in Figure 5.16.

Figure 5.16: Schull – Flood Defences



The hydraulic modelling of the proposed flood defences as outlined in Figure 5.16 indicates that the measure does mitigate flooding on the Meenvane Stream and as a result, reduces flooding in the town.

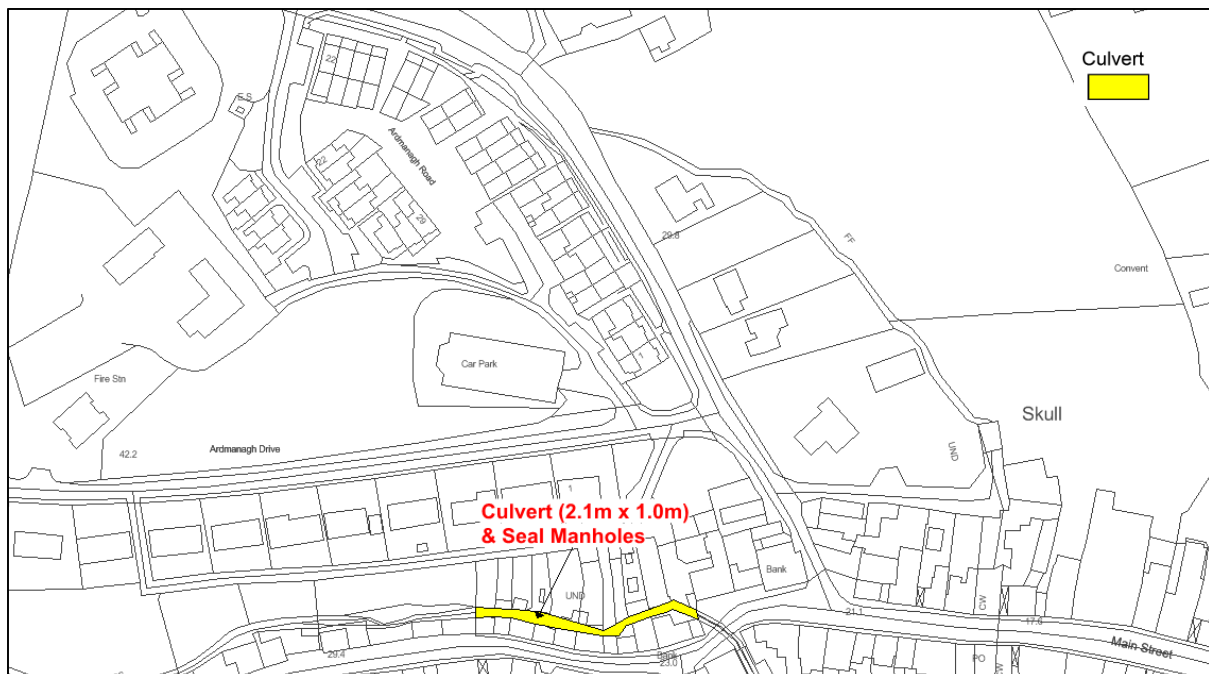
This measure does not reduce flooding on the Schull Stream which continues to flood the town. Therefore, this measure is not deemed viable individually but in combination with works on the Schull Stream it could form a viable option.

However, the required walls are 9.0m high. Such defences along a narrow stream are not technically or socially feasible and are not deemed viable.

5.4.1.5 Culvert – Schull Stream

This measure aims to mitigate the flooding along the Schull Stream and through the town by replacing the paved areas to the rear of properties with a new culvert. The location of the culvert is shown in Figure 5.17.

Figure 5.17: Schull – Culvert

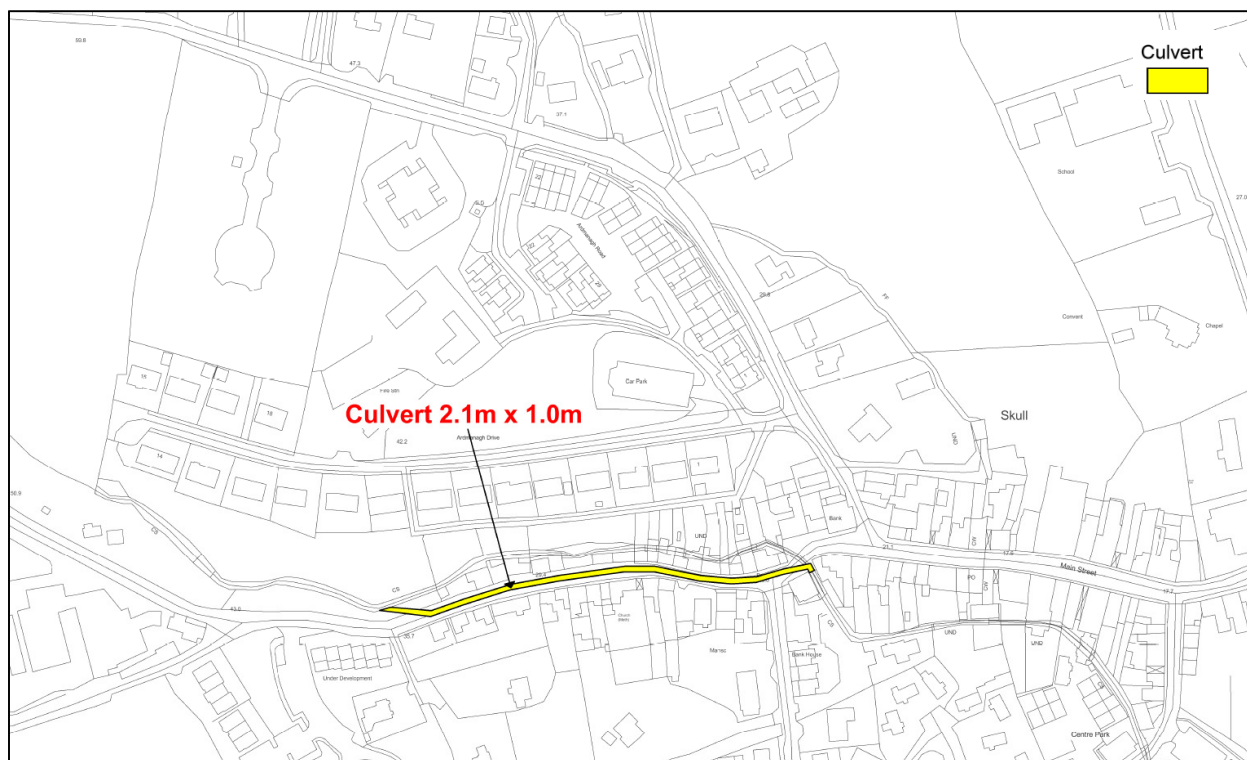


The culvert on the Schull Stream has developed from an existing bridge crossing and has effectively been extended 80m upstream by landowners paving over the stream to the rear of their properties. There are also a number of manholes along this section. The paving and manholes are not watertight and are subject to surcharging. It is proposed to replace the paved section with a culvert (2.1m x 1.0m) and seal the existing manholes to prevent surcharging.

The hydraulic modelling of the proposed culvert as outlined in Figure 5.17 indicates that the measure removes flooding along the Schull Stream and reduces flooding through the town. The proposed culvert has no impact on flooding or water levels in the upstream reach of the Schull Stream. However, this measure does not reduce flooding on the Meenvane Stream which continues to flood the town. This measure is not deemed viable individually, however in combination with works on the Meenvane Stream it could form a viable option.

As an alternative to the culvert route proposed in Figure 5.17, which is to the rear of properties, a proposed route along the main street was also examined.

Figure 5.18: Schull – Flood Defences – Alternative Culvert Route



5.4.2 Potential FRM Measures

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

- Storage – Schull Stream
- Storage – Meenvane Stream
- Flood Defences – Meenvane
- Culvert – Schull Stream
- Flow Diversion – Meenvane Stream

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 – Storage
- Option 2 – Storage (Schull Stream) / Flow Diversion (Meenvane Stream)
- Option 3 – Culvert (Schull Stream – Route 1) / Storage (Meenvane Stream)
- Option 4 – Culvert (Schull Stream – Route 1) / Flow Diversion (Meenvane Stream)
- Option 5 – Culvert (Schull Stream – Route 2) / Storage (Meenvane Stream)
- Option 6 – Culvert (Schull Stream – Route 2) / Flow Diversion (Meenvane Stream)

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) 20 between December 2014 and February 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 20 AFAs are shown in Table 7.1 below.

Table 7.1: Draft Flood Mapping PCDs

AFA	Date	Venue	Nr of Attendees
Dunmanway	10 th of February 2015	Parkway Hotel	1
Inishannon	13 th of February 2015	Parish Hall, Inishannon	1
Schull	17 th of February 2015	The Parish Hall, Schull	6

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?
Innishannon	Dredging. Flood plain management
Dunmanway	Channel maintenance. Maintenance of lake outlet, especially reed growth
Schull	Bigger pipes
	Keep river and culverts clean
	Keep drains clean
	Attention to river and pipes at top end of town
	Maintenance of drains and water tables
	Culvert maintenance

7.3 Preliminary Options PCDs

Stakeholder workshops were held on 3 and 4 November to discuss the proposed options with Local Authority Staff.

On 1 and 2 December 2015 PCDs were held to display various Flood Risk Management Options in each of the UoM 20 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
Dunmanway	1 st December 2015	The Parkway Hotel	1
Inishannon	1 st December 2015	The Parish Hall	6
Schull	2 nd December 2015	The Parish Hall	6

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 20 AFAs. Their responses are summarised in Table 7.4 below.

Table 7.4: Public Preference for Potential Options

AFA	Option	Nr of Preferences Received	Rank
Dunmanway	Flood Defences	1	2
	Storage and Flood Defences	1	1
	Flow diversion and Flood Defences	1	4
	Do Nothing	1	3
Inishannon	Flood Defences	2	1
	Do Nothing	2	2
Schull	Storage	1	5
	Storage and Flow Diversion	1	3
	Culvert and Storage	1	2
	Culvert Diversion and Culvert	7	1
	Do Nothing	2	4

8 Flood Risk Assessment

8.1 General

Flood risk mapping for the UoM 20 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 20 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 numbers were calculated by counting the number of receptors that existed in a location that had a positive depth of flooding. 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%
Clonakilty	0	126	140	297	350	420	456	546	22	258	291	353	454	487	532	571	330	529	580
Dunmanway	6	6	6	6	20	20	31	258	6	6	14	20	20	87	263	311	20	325	238
Inishannon	3	6	6	6	53	67	73	134	6	14	53	67	76	98	137	143	67	129	143
Schull	11	53	53	70	70	70	118	123	70	70	70	123	123	129	154	168	123	160	190

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%
Clonakilty	0	45	50	106	125	150	163	195	8	92	104	126	162	174	190	204	118	189	207
Dunmanway	2	2	2	2	7	7	11	92	2	2	5	7	7	31	94	111	7	116	85
Inishannon	1	2	2	2	19	24	26	48	2	5	19	24	27	35	49	51	24	46	51
Schull	4	19	19	25	25	25	42	44	25	25	25	44	44	46	55	60	44	57	68

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%
Clonakilty	0	1	1	1	2	5	5	5	1	1	1	2	5	5	5	5	1	5	5
Dunmanway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inishannon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Schull	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%
Clonakilty	0	3	4	6	6	11	11	12	2	6	6	7	11	11	12	12	6	12	12
Dunmanway	0	0	0	0	0	0	0	5	0	0	0	0	0	0	5	6	0	6	2
Inishannon	0	0	0	0	0	0	1	3	0	0	0	0	1	2	3	3	0	2	3
Schull	0	0	1	1	1	1	2	2	1	1	1	2	2	2	2	2	2	2	2

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%
Clonakilty	0	11	16	48	54	67	139	148	6	35	45	60	84	101	111	148	48	88	148
Dunmanway	0	0	0	0	0	0	2	5	0	0	0	0	1	3	6	8	0	3	9
Inishannon	0	1	3	6	7	9	9	18	4	6	7	11	13	13	18	18	9	18	18
Schull	0	8	9	9	9	9	10	13	9	9	10	11	12	14	14	15	14	14	15

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%
Clonakilty	0	0	0	1	1	3	3	3	1	1	2	3	3	3	3	3	1	3	3
Dunmanway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Inishannon	1	1	1	3	6	7	7	7	1	3	5	6	7	7	7	8	7	7	8
Schull	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%
Clonakilty	1	37	40	94	105	142	159	201	22	83	92	108	155	172	192	240	102	180	241
Dunmanway	11	11	13	14	18	21	23	68	11	14	15	20	23	27	69	74	20	79	59
Inishannon	0	2	4	4	15	17	26	39	4	13	15	16	26	29	39	42	17	37	42
Schull	2	19	22	22	22	22	31	32	22	23	24	32	32	33	35	37	32	35	40

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%
Clonakilty	0	2	6	8	10	10	10	10	2	6	6	8	10	10	10	10	8	10	10
Dunmanway	0	0	2	4	5	6	6	8	0	2	2	4	5	7	8	8	8	8	8
Inishannon	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	4
Schull	0	0	0	3	3	3	3	3	4	4	3	3	3	4	4	4	4	4	4

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%
Clonakilty	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
Dunmanway	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Inishannon	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Schull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

In addition to fluvial flood risk, Clonakilty and Inishannon in UoM 20 are at risk from tidal flooding. Table 8.12 and 8.13 below list the receptors at risk from tidal flooding in these AFAs.

Table 8.12: Tidal Flood Risk – Clonakilty

Receptor	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%	0.5%	0.1%
Inhabitants	87	109	112	199	277	325	339	400	333	336	400	417	445	456	465	507	487	585	582
Residences	31	39	40	71	99	116	121	143	119	120	143	149	159	163	166	181	174	209	208
High Vulnerability Properties	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
Archaeological sites	3	3	3	5	6	6	6	6	6	6	6	6	6	6	7	7	7	11	10
Architectural Sites	6	10	12	21	23	33	35	54	36	48	52	57	69	69	77	78	80	99	99
Non-residential properties	34	35	37	56	72	85	95	138	95	110	135	146	154	159	174	185	206	226	227
Roads	5	5	7	9	10	11	13	13	10	12	15	15	15	15	15	16	20	21	23
Utilities	0	0	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	2

Table 8.13: Tidal Flood Risk – Inishannon

Receptor	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%	0.5%	0.1%
Inhabitants	3	3	6	6	6	6	6	6	6	6	8	8	14	22	28	50	56	67	70
Residences	1	1	2	2	2	2	2	2	2	2	3	3	5	8	10	18	20	24	25
High Vulnerability Properties	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Archaeological sites	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Architectural Sites	0	1	1	1	2	3	4	5	5	5	6	6	6	6	6	7	7	9	9
Non-residential properties	1	2	2	2	2	2	3	4	4	4	11	11	12	12	12	14	14	16	20
Roads	1	2	2	2	2	2	3	4	4	4	11	11	12	12	12	14	14	16	20
Utilities	0	0	0	1	1	1	1	1	11	1	1	1	1	1	1	1	1	1	1

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 number of people per house was taken from CSO data. For UoM 20 the average occupancy 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 numbers 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 20 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.

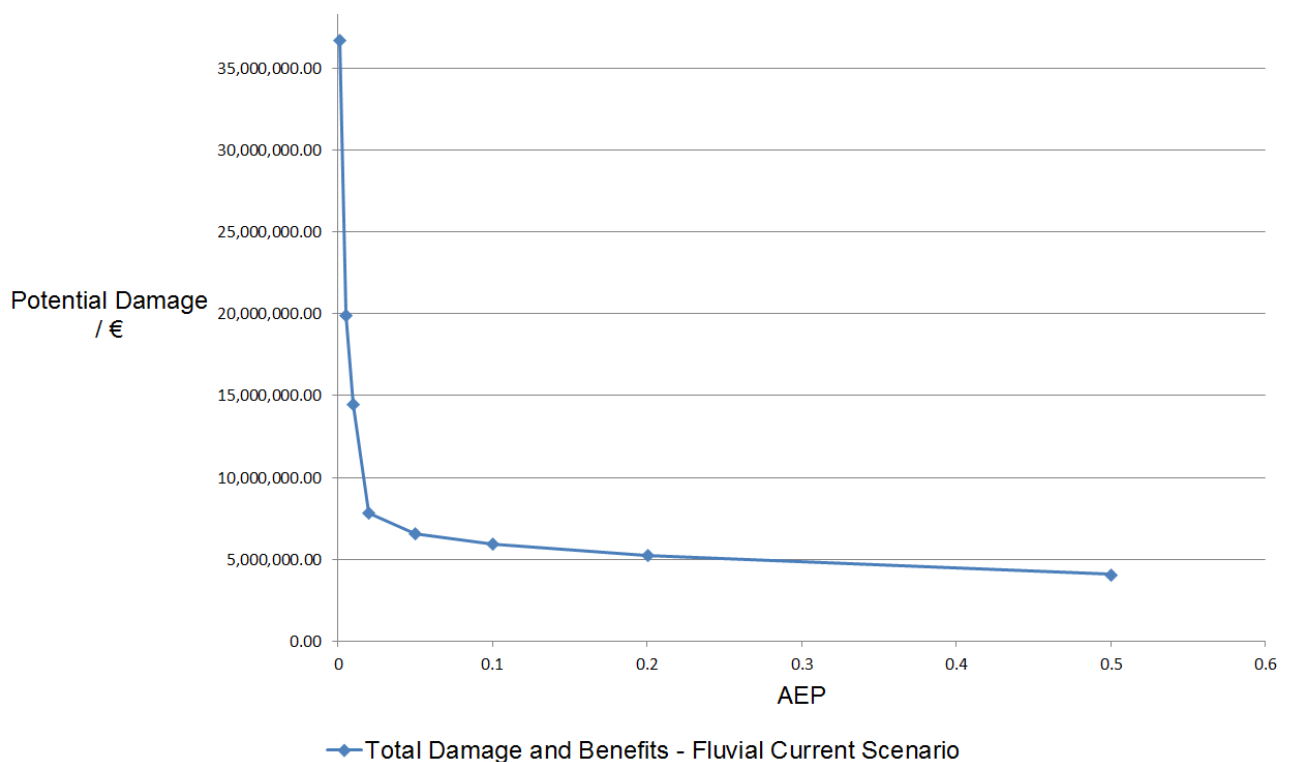
8.3.3.1 Annual Average Damage

The potential economic damage that could be caused by flooding was calculated for every property in each of the UoM 20 AFAs. The damage to a property is related to the type, use and/or 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 8.14 below.

Table 8.14: Annual Average Damage €

AFA	Current Scenario €	Mid-Range Future Scenario €	High End Future Scenario €
Clonakilty	6,575,567	16,936,945	23,962,864
Dunmanway	1,016,801	1,371,822	2,297,187
Inishannon	198,822	1,017,731	1,969,123
Schull	639,879	1,260,437	1,812,405

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 8.15 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 8.15: 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 - 1% of Total
Dunmanway	Semi	507544	42,359.80	0.00	2.07%
	Semi	507771	55,030.92	0.00	2.89%
	Semi	508004	37,214.50	0.00	1.90%
	Semi	508486	38,500.82	0.00	2.80%
	Semi	508488	56,891.55	0.00	2.76%
	Terrace	507728	44,934.68	0.00	10.45%
	Mill	507572	360,248.58	0.00	3.91%
	Office	508174	29,550.48	0.00	25.07%
	RetailWH	507982	192,945.37	0.00	1.09%
	School	507900	352,320.02	0.00	1.99%
	Shop	508675	213,879.87	0.00	2.59%
	Warehouse	507739	22,273.51	0.00	14.42%
	Warehouse	508066	44,334.62	0.00	3.39%
	Warehouse	508105	49,188.68	0.00	2.14%
Inishannon	Bungalow	1520445	103,668.96	0.00	1.66%
	Bungalow	1734950	99,700.99	0.00	1.41%
	Bungalow	1736752	101,684.98	0.00	1.64%
	Bungalow	1736753	103,668.96	0.00	1.71%
	Bungalow	1736754	106,062.27	0.00	1.84%
	Detached	1736812	121,364.56	72,667.84	10.54%
	Semi	1520461	75,392.88	0.00	1.40%
	Semi	1736818	42,359.80	25,571.88	16.88%
	Shop	1736758	194,336.09	0.00	2.52%
	Shop	1736857	602,384.04	201,558.55	40.44%

AFA	Property Type	Object ID	Fluvial Damages 0.1% AEP €	Tidal Damages 0.1% AEP €	PVd - 1% of Total
Schull	Shop	1736881	348,374.13	0.00	1.02%
	Storage	1735048	71,055.60	16,283.58	3.30%
	Bungalow	3332306	23,952.00	0.00	2.88%
	Detached	3332307	34,252.50	0.00	3.18%
	Detached	3332561	68,309.81	0.00	3.63%
	Detached	3332596	89,870.70	0.00	4.59%
	Detached	3332601	24,234.50	0.00	2.47%
	Semi	3332066	57,511.76	0.00	3.34%
	Semi	3332077	34,421.03	0.00	1.83%
	Semi	3332078	31,627.56	0.00	2.34%
	Semi	3332253	50,409.04	0.00	2.70%
	Semi	3332781	28,834.10	0.00	1.34%
	Terrace	3332177	20,248.44	0.00	1.40%
	Terrace	3332212	19,141.78	0.00	1.39%
	Terrace	3332383	34,171.52	0.00	1.33%
	Terrace	3332607	22,803.69	0.00	1.36%
	Terrace	3332612	30,469.45	0.00	1.46%
	Terrace	3332631	38,758.80	0.00	1.37%
	Terrace	3332728	30,469.45	0.00	1.37%
	Bank	3332672	33,550.63	0.00	2.90%
	Library	3332573	46,838.67	0.00	1.75%
	Pub	3332169	52,687.12	0.00	2.74%
	Pub	3332196	37,496.31	0.00	1.42%
	Pub	3332729	61,557.99	0.00	3.05%
	Restaurant	3332723	29,626.80	0.00	1.04%
	Restaurant	3332783	41,615.54	0.00	2.75%
	Shop	3332060	6,778.02	0.00	1.01%
	Shop	3332061	19,841.63	0.00	2.68%
	Shop	3332162	118,855.13	0.00	6.96%
	Shop	3332211	73,044.35	0.00	4.18%
	Shop	3332220	18,615.24	0.00	1.12%
	Shop	3332223	35,012.62	0.00	2.49%
	Shop	3332638	50,475.98	0.00	3.23%
	Shop	3332782	111,753.26	0.00	9.84%

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 8.16. 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 8.16: Summary of Damages & Benefit of Scheme Benefit

AFA	AAD €	PVd	Capped PVd	Benefit of Scheme (Damage Avoided) €
Dunmanway	77,539.46	1,665,717.03	1,312,637.79	791,841.01
Inishannon	198,822.23	4,271,135.82	4,073,636.74	3,152,279.82
Schull	639,879.03	13,745,999.46	9,561,227.17	8,917,474.13

Table 8.17 lists the benefit or damage avoided by implementing a flood forecasting and warning system.

Table 8.17: Benefit of Implementing a Flood Forecasting & Warning System

Spatial Scale of Assessment	Infrastructure	Benefit € (13% of PVd)
AFA		
Dunmanway	Rain gauges	216,543.21
	River level gauges	
	Build on existing Bandon Flood Early Warning System	
Inishannon Fluvial	Build on the existing Bandon Flood Early Warning System	454,984.89
Inishannon Tidal	Use the existing OPW storm surge forecasting system to predict high tide levels.	100,262.76
Sub-Catchment		
Dunmanway / Bandon / Innishannon	Rain gauges and river level gauges to cover the Brewery and Dirty River in Dunmanway	771k +
	Build on existing Bandon Flood Early Warning System	
	Use the existing OPW storm surge forecasting system to predict high tide levels.	
UoM		
River Bandon	Build on the existing Bandon Flood Early Warning System	771k +
	Use the existing OPW storm surge forecasting system to predict high tide levels.	

Source: UoM 20 Hydraulics Report

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 8.17 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 20. 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

SSA	Infrastructure	Benefit € (13% of PVd)	Estimated Cost / €
AFA			
Dunmanway	6 Nr. Rain Gauges 4. Nr. River Level Gauges (Hydrometric Station)	216,543.21	778,025.00
Inishannon Fluvial	Build on the existing Bandon Flood Early Warning System	454,984.89	< 400k
Inishannon Tidal	Use the existing OPW storm surge forecasting system to predict high tide levels.	100,262.76	<100k
Sub-Catchment			
Dunmanway / Bandon / Innishannon	Rain gauges and river level gauges to cover the Brewery and Dirty River in Dunmanway Build on existing Bandon Flood Early Warning System Use the existing OPW storm surge forecasting system to predict high tide levels.	771k +	> 800k
UoM			
River Bandon	Build on the existing Bandon Flood Early Warning System Use the existing OPW storm surge forecasting system to predict high tide levels.	771k +	> 800k

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

Details of the existing forecasting systems are not readily available to fully assess the additional infrastructure required to include Inishannon. However, based on the damages avoided and economies of scale, building on the existing systems for Inishannon is likely to be a viable measure.

Extending the flood forecasting and warning system to a sub-catchment and UoM scale is not viable as demonstrated by the cost of setting up a system for Dunmanway alone.

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

AFA	Option	Estimated Cost / €	Benefit of Scheme €
Dunmanway	Flood Defences	991,163.19	791,841.01
	Storage (Brewery River) / Flood Defences (Dirty River)	1,687,249.54	
	Flow Diversion (Brewery River) / Flood Defences (Dirty River)	3,782,471.47	
Inishannon	Flood Defences	1,493,273.46	3,152,279.82
Schull	Storage	12,846,068.49	8,917,474.13
	Storage (Schull) / Flow Diversion (Meenvane)	9,930,492.53	
	Culvert (Schull – Route 1) / Storage (Meenvane)	5,645,832.71	
	Culvert (Schull – Route 1) / Flow Diversion (Meenvane)	3,119,159.47	
	Culvert (Schull – Route 2) / Storage (Meenvane)	5,645,832.71	
	Culvert (Schull – Route 2) / Flow Diversion (Meenvane)	3,119,159.47	

As highlighted in Table 9.2 there is no cost beneficial option for Dunmanway and two of the potential options for Schull are also 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	Dunmanway	Inishannon	Schull	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	2.04	5	AAD / €75,000
2(b)(i)	5	4.15	5	Based on calculated assessment, adjusted by professional judgement
2(c)(i)	1.25	5	0	Based on calculated assessment, adjusted by professional judgement
2(d)(i)	0	1.25	2.92	By professional judgement assisted by local advice
3(a)(i)	2.4	2.24	5	Based on calculated assessment, adjusted by professional judgement
3(a)(ii)	0	0	0	Based on calculated assessment, adjusted by professional judgement
3(b)(i)	0.13	0.18	2.63	Based on calculated assessment, adjusted by professional judgement
3(b)(ii)	5	5	5	Based on calculated assessment, adjusted by professional judgement
4(a)(i)	5	5	5	Constant
4(b)(i)	4	0	5	By professional judgement assisted by local advice
4(c)(i)	4	4	5	By professional judgement assisted by local advice
4(d)(i)	5	2	1	By professional judgement assisted by local advice
4(e)(i)	0	3	4	By professional judgement assisted by local advice
4(f)(i)	1	0	3	By professional judgement assisted by local advice
4(f)(ii)	1	3	3	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 6.

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 20 are set out below:

- Planning Control
- Building Regulations
- SUDS
- Flood Forecasting and Warning Systems
 - Inishannon – build on existing Bandon Flood Early Warning System (FEWS)
- Public Awareness
- Individual Property Flood Resilience
- Land Use Management

11.2 Preferred Flood Risk Management Options – AFAs

11.2.1 MCA Scores

The Scores achieved by each viable option under consideration are listed in Table 11.1 below. The rank of each option is determined by the MCA Benefit Cost Ratio. 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
Dunmanway							
Do Nothing	-	-	-195.00	-195.00	0.00	0.00	4
Flood Defences	991,163.19	791,841.01	719.35	1819.35	725.76	0.80	1
Storage & Flood Defences	1,687,249.54	791,841.01	854.35	1854.35	506.36	0.47	2
Flow Diversion & Flood Defences	3,782,471.47	791,841.01	524.35	1424.35	138.63	0.21	3
Inishannon							
Do Nothing	-	-	-440.00	-440.00	0.00	0.00	2
Flood Defences	1,493,273.46	3,152,279.82	729.17	1992.17	530.49	2.11	1
Schull							
Do Nothing	-	-	-48.00	-48.00	0.00	0.00	5
Storage	12,846,068.49	8,917,474.13	1009.01	1959.01	78.55	0.69	4
Storage & Flow Diversion	9,930,492.53	8,917,474.13	1009.01	1809.01	101.61	0.90	3
Culvert & Storage	5,645,832.71	8,917,474.13	1148.01	1998.01	203.34	1.58	2
Culvert & Flow Diversion	3,119,159.47	8,917,474.13	1073.01	1773.01	344.00	2.86	1

11.2.2 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 Preferences Received	Rank
Dunmanway	Flood Defences	1	2
	Storage and Flood Defences	1	1
	Flow Diversion and Flood Defences	1	4
	Do Nothing	1	3
Inishannon	Flood Defences	2	1
	Do Nothing	2	2
Schull	Storage	1	5
	Storage and Flow Diversion	1	3
	Culvert and Storage	1	2
	Culvert and Flow Diversion	7	1
	Do Nothing	2	4

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:

11.2.2.1 Dunmanway

The preferred option identified in the MCA is Flood Defences. There was limited feedback provided at the Dunmanway PCD which indicated that the public preference was for Flood Storage and Flood Defences. However, there is no cost beneficial option for Dunmanway.

11.2.2.2 Inishannon

The preferred option identified in the MCA is Flood Defences. There was limited feedback provided at the Inishannon PCD which indicated that the public agreed with the preferred option indicated in the MCA. As an interim measure, before the preferred option is implemented, the installation of flood forecasting and warning system that ties into the existing Bandon Flood Early Warning System would be of benefit in Inishannon.

11.2.2.3 Schull

The preferred option identified in the MCA is the construction of a Culvert on the Schull Stream and Flow Diversion on the Meenvane Stream. The feedback provided at the Schull PCD indicated that the public agreed with the preferred option indicated in the MCA. At the PCD the attendees were given the choice of two culvert routes. The preferred route was in the back of gardens along the route of the existing stream as opposed to locating the culvert in the road.

Appendices

Appendix A. Estimate of Costs	76
Appendix B. Drawings of Potential FRM Options	77
Appendix C. Draft SEA Options Appraisal Report	78
Appendix D. Draft Screening for Appropriate Assessment under the Habitats Directive	79
Appendix E. Climate Change Adaptability	80
Appendix F. Multi Criteria Assessment	81

Appendix A. Estimate of Costs

Summary

UoM	20	Optimism Bias	35.94%
AFA	Dunmanway	Site Investigation Estimate	€ 50,000.00
Option	1 - Flood Defences	Preliminaries	18%
Description	Flood Defences / Localised Protection Works	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	€ 390,733.81	€ 1,653.71	€ 392,387.53
2	Embankments	€ 31,857.54	€ 8,704.52	€ 40,562.06
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

€ 422,591.35	€ 10,358.23	€ 432,949.58
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Basic Construction Costs	€ 422,591.35
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Preliminaries	€ 76,066.44
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Optimism Bias	€ 179,223.48
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Construction Costs (Excl VAT)	€ 677,881.27
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Design Fees	€ 88,124.56
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Σ Construction Costs and Fees	€ 766,005.83
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Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 67,788.13
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Allowance for Compensation and Land Acquisition	€ 67,788.13
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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 Costs	€ 10,358.23
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PV O&M Costs - Optimism Bias	€ 3,722.87
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Σ Other Items	€ 225,157.36
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Option Cost for Cost Benefit Analysis	€ 991,163.19
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CFRAM Unit Cost Development Project					
Optimism Bias Calculator					
Prepared by:	MM	Date:	December 2015		
Site Reference:		Site Name:	Dunmanway 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>	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	
		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	
Budgetting	2	Medium	50%	Default risk value	
Other	1	Medium	50%	Default risk value	
Project Specific					
Design Complexity	2	Low	30%	Small scheme with low complexity - short sections of walls and embankments	
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	
Ground conditions	3	Medium	50%	Unknown	
Health and Safety	3	Low	30%	Small scale 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	
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 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, works out of sight with low 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	Low	30%	Low number of stakeholders and interferences	
Flood events during construction	3	Medium	50%	History of flooding	
Other	1	Very Low	10%	None	
	68	41%			
Weighting to apply: 0.432				Minimum Optimism Bias: 10%	
				Maximum Optimism Bias: 70%	
				Calculated Optimism bias: 36%	

1. Walls

2. Embankments

3. Demountable Barrier

3a. Flood Gate

4. In-Channel Excavation

Total Excavation Costs € 0.00

5. Excavation on Land

6. Weir Construction

7. Weir Removal

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14. Hydrometric Gauging Stations		Number of Units	Maintenance Select H/L	Rate	Capital Cost of Units	PV Rate	PV Costs
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
Category	Comments				(€)	(€)	(€)	(€)
				Capital Cost	€ 0.00	PV Cost	€ 0.00	€ 0.00
				Total Cost		€ 0.00		

16. Pumping Stations		Number of Units	Rate	Capital Cost	Operation Cost	Running Cost	PV Cost
Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
0.02 m3/s							
0.05 m3/s							
0.1 m3/s							
0.5 m3/s							
1.0 m3/s							
2.0 m3/s							
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
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
Description of Bank Protection				(m)	(€/m)	(€)	(€)	(€)
	Fluvial	High						
				Capital Cost	€ 0.00	PV Cost	€ 0.00	€ 0.00
				Total Cost		€ 0.00		

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

Summary

UoM	20	Optimism Bias	37.53%
AFA	Dunmanway	Site Investigation Estimate	€ 50,000.00
Option	2 -Storage	Preliminaries	17%
Description	Storage on Brewery River / Flood Defences on Dirty River	Design Fees	13%
		Compensation and Land Acquisition	15%
		Archaeology and Environmental	10%
		Art Allowance	€ 25,500.00

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 236,595.35	€ 1,014.55	€ 237,609.90
2	Embankments	€ 418,392.26	€ 39,498.67	€ 457,890.93
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	€ 17,038.00	€ 46,365.04	€ 63,403.04
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

€ 672,025.61	€ 86,878.25	€ 758,903.86
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Basic Construction Costs	€ 672,025.61
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Preliminaries	€ 114,244.35
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Optimism Bias	€ 295,082.49
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Construction Costs (Excl VAT)	€ 1,081,352.45
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Design Fees	€ 140,575.82
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Σ Construction Costs and Fees	€ 1,221,928.27
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Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 108,135.25
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Allowance for Compensation and Land Acquisition	€ 162,202.87
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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 Costs	€ 86,878.25
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PV O&M Costs - Optimism Bias	€ 32,604.90
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Σ Other Items	€ 465,321.26
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Option Cost for Cost Benefit Analysis	€ 1,687,249.54
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CFRAM Unit Cost Development Project

Optimism Bias Calculator

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Dunmanway 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> 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
Procurement	Weight	Select from Dropdown 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
Budgetting	2	Medium 50%	Default risk value
Other	1	Medium 50%	Default risk value
Project Specific			
Design Complexity	2	Medium 50%	Large storage area upstream with minor wall works in the town
Degree of Innovation	2	Medium 50%	Standard and proven methods
Technology	2	Medium 50%	Flow control structure
Services	3	Low 30%	Unknown - large amount of services not expected
Ground conditions	3	Medium 50%	Unknown - critical at storage area
Health and Safety	3	Low 30%	Large storage area but no unusual risks associated with works
Other	1	Medium 50%	Risks associated with storage area
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 critical
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 and interferences - but critical to 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	Medium 50%	No anticipated delays associated with permits, consents or approvals
Amenity and art	1	Low 30%	Small scheme, works out of sight with low number of stakeholders
Contaminated land	3	Medium 50%	Unknown
Archaeology	3	Low 30%	Unknown - small scheme which can be adequately scoped
Other	1	Medium 50%	Specific risks with storage area
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 and interferences - but critical to storage area
Flood events during construction	3	Medium 50%	History of flooding
Other	1	Very Low 10%	None
	68	45%	
Weighting to apply: 0.459			Minimum Optimism Bias: 10% Maximum Optimism Bias: 70% Calculated Optimism bias: 38%

AFA: Dunmanway
Option: 2 -Storage

1. Walls

Select Wall Type from Dropdown	Comments	(m)	(m)	(€/m)	(€)	H/L	(€/m)	(€)
Retaining Wall, Urban with sheet piling, >100m in length (€/m)		120.35	1.10	€ 1,965.89	€ 236,595.35	Average	€ 8.43	€ 1,014.55
						Average		
						Average		
						Average		
						Average		
						Average		
						Average		
						Average		
						Average		
						Average		
				Capital Cost	€ 236,595.35	Total PV Cost		€ 1,014.55
				Total Cost		€ 237,609.90		

2. Embankments

Select Embankment from Dropdown	Comments	Select Yes/No	(m)	3.0m (m)	(€/m)	(€)	Select H/L	(€/m)	PVC - Length (€)
Rural clay embankment (€/m) 100 - 1,000m	Embankment with an average height of 4.2m at the attenuation reservoir	Yes	558.82	4.20	€ 748.71	€ 418,392.26	Average	€ 70.68	€ 39,498.67
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
Capital Cost						€ 418,392.26		Total PV Cost	€ 39,498.67
								Total Cost	€ 457,890.93

3. Demountable Barrier

Select Demountable Barrier Span from Dropdown	Comments	(m)	Yes/No	(mm)		(€/m)	(€)	(€/m)	(€)
						Capital Cost	€ 0.00	Total PV Cost	€ 0.00
								Total Cost	€ 0.00

3a. Flood Gate

Select Flood Gate from Dropdown	Comments		(m)	(m)	(€/gate)	(€)	(€/gate)	(€)
					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

[illegible]

	Volume of Dredging	Rate	Cost of Dredging
		Select a Rate from Dropdown	
Dredging	(m³)	(€/m³)	(€)
		Total Cost	€ 0.00

Total Excavation Costs € 0.00

5. Excavation on Land

Select Excavation Type from Dropdown	Comments	(m³)	(€/m³)	(€)
		Total Cost	€ 0.00	

6. Weir Construction

Select Weir Height from Dropdown	Comments	20m (m)	(€/m)	(€)	Select H/L Average	(€/weir)
Capital Cost				€ 0.00	Total PV Cost	€ 0.00
					Total Cost	€ 0.00

7. Weir Removal

Description of Weir	(m)	(€/m)	(€)
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[illegible]

8. Bridges

8. Bridges					
	Remove or Replace	Area of Bridge	Rate	Cost of Construction	PV Costs
Description of Bridge	Select Yes/No	(m ²)	(€/m ²)	(€)	(€/bridge)
			Capital Cost	€ 0.00	€ 0.00
			Total Cost		€ 0.00

9. Bridge Underpinning

9. Bridge Underpinning		Length of Bridge	Rate	Cost of Construction
Choose a suitable bridge from dropdown	Comments	(m)	(€/m)	(€)
		Total Cost	€ 0.00	

10a. Culverts (Rural)

10a. Culverts (Rural)									
	Disposal of Spoil	Ground Type	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Cost
	Select	Select	Select	Select				Select	
Description of Culvert		Soil/Rock	(m)	(m)	(m)	(€/m)	(€)	H/L	(€/m)
								Average	
						Capital Cost	€ 0.00	Total PV Cost	€ 0.00
						Total Cost		Total Cost	€ 0.00

10b. Culverts (Urban)

10b. Culverts (Urban)									
Description of Culvert	Culvert Select New/Replacement	Invert Select (m)	Culvert Size Select (m)	Length of Culvert (m)	Rate (€/m)	Cost of Construction (€)	Maintenance Costs Estimate Select H/L (€/m)	PV Rate (€/m)	PV Cost (€)
							High		
							Average		
							Low		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
Capital Cost						€ 0.00	Total PV Cost		€ 0.00
							Total Cost		€ 0.00

10c. Culverts (Headwall)

10c. Culverts (Headwall)		Length of Culvert	Culvert Size	Rate	Cost of Construction
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

11. Sluice Gates		Size Select	Maintenance Select	Operation Select	Maintenance Costs Estimate Select H/L	Capital Cost (€)	PV Cost (€)	Total Cost (€)
Select Gate Type	Comments							
Sluice Gates		1500	Woodland/open public or open non public locations with lower debris loads	Electric Operation	Average	€ 17,038.00	€ 46,365.04	€ 63,403.04
Capital Cost						€ 17,038.00	PV Cost	€ 46,365.04
Total Cost							Total Cost	€ 63,403.04

12. Road Raising

Note cost is to raise road by 600mm

12. Road Raising		Length of Road	Cost of Construction	Cost of Construction
Road Details		(m)	(€)	(€)
Total Cost			€ 0.00	€ 0.00

13. Individual Property Protection

13. Individual Property Protection		Factor Select	Number of Units	Rate	Cost of Works	PV Rate	PV Cost
Property Type	Comments			(€)	(€)	(€)	(€)
Detached							
Semi-Detached							
Terraced							
Flat							
Residential average							

Shop							
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
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
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
Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
0.02 m3/s							
0.05 m3/s							
0.1 m3/s							
0.5 m3/s							
1.0 m3/s							
2.0 m3/s							
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
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
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
Manhole Type	Comments		(€)	(€)
		Total Cost	€ 0.00	

Summary

UoM	20	Optimism Bias	36.82%
AFA	Dunmanway	Site Investigation Estimate	€ 50,000.00
Option	3 - Flow Diversion	Preliminaries	16%
Description	Flow Diversion of Brewery River / Flood Defences on Dirty River	Design Fees	13%
		Compensation and Land Acquisition	10%
		Archaeology and Environmental	10%
		Art Allowance	€ 25,722.38

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 438,821.98	€ 1,422.81	€ 440,244.79
2	Embankments	€ 28,927.94	€ 7,186.13	€ 36,114.06
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	€ 1,152,911.88	€ 200,179.98	€ 1,353,091.86
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

€ 1,620,661.79	€ 208,788.92	€ 1,829,450.71
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Basic Construction Costs	€ 1,620,661.79
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Preliminaries	€ 259,305.89
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Optimism Bias	€ 692,270.45
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Construction Costs (Excl VAT)	€ 2,572,238.13
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Design Fees	€ 334,390.96
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Σ Construction Costs and Fees	€ 2,906,629.09
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Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 257,223.81
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Allowance for Compensation and Land Acquisition	€ 257,223.81
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Site Investigation	€ 50,000.00
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Art Allowance	€ 25,722.38
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PV O&M Costs	€ 208,788.92
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PV O&M Costs - Optimism Bias	€ 76,883.45
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Σ Other Items	€ 875,842.38
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Option Cost for Cost Benefit Analysis	€ 3,782,471.47
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CFRAM Unit Cost Development Project**Optimism Bias Calculator**

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Dunmanway 3 - 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:	
					Default weighting defined by OPW for all CFRAM projects Default risk value defined for all CFRAM projects Automated function cell (no input required) User defined - risk value, comments, justification
		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	
Budgetting	2	Medium	50%	Default risk value	
Other	1	Medium	50%	Default risk value	
Project Specific					
Design Complexity	2	Low	30%	Small scheme with low complexity - flow diversion with short sections of walls and embankments	
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	
Ground conditions	3	Medium	50%	Unknown	
Health and Safety	3	Medium	50%	Small scale scheme but deep narrow excavations close to properties associated with flow diversion	
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 - deep excavation works close to properties	
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 and interferences - deep excavation works close to properties	
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, works out of sight with low 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%	Low number of stakeholders and interferences - deep excavation works close to properties	
Flood events during construction	3	Medium	50%	History of flooding	
Other	1	Very Low	10%	None	
	68	43%			
Weighting to apply: 0.447				Minimum Optimism Bias: 10%	
				Maximum Optimism Bias: 70%	
				Calculated Optimism bias: 37%	

1. Walls

2. Embankments

3. Demountable Barrier

3a. Flood Gate

4. In-Channel Excavation

Total Excavation Costs € 0.00

5. Excavation on Land

6. Weir Construction

7. Weir Removal

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

17. Channel Maintenance		Length of Channel	Rate	Maintenance Costs
Channel Type	Comments	(m)	(€)	(€)
Total Cost			€ 0.00	

<u>18. Bank Protection</u>							
	Fluvial/Coastal Select	Maintenance Select	Length (m)	Rate (€/m)	Cost of Construction (€)	PV Rate (€)	PV Cost (€)
Description of Bank Protection							
	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
Manhole Type	Comments		(€)	(€)
		Total Cost	€ 0.00	

Summary

UoM	20	Optimism Bias	35.94%
AFA	Inishannon	Site Investigation Estimate	€ 50,000.00
Option	1 - Flood Defences	Preliminaries	17%
Description	Flood walls and embankments	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	€ 249,263.65	€ 699.52	€ 249,963.17
2	Embankments	€ 131,885.45	€ 37,549.25	€ 169,434.70
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
Total		€ 511,349.10	€ 247,221.25	€ 758,570.35
		Basic Construction Costs		€ 511,349.10
		Preliminaries		€ 86,929.35
		Optimism Bias		€ 215,028.31
		Construction Costs		€ 813,306.76
		Design Fees		€ 105,729.88
		Construction Costs and Fees		€ 919,036.64
		Allowance for Archaeology and Environmental Mitigation Measures		€ 81,330.68
		Allowance for Compensation and Land Acquisition		€ 81,330.68
		Site Investigation		€ 50,000.00
		Art Allowance		€ 25,500.00
		NPV Operation & Maintenance		€ 247,221.25
		Optimism Bias - NPV O&M		€ 88,854.23
		Other Items		€ 574,236.83

Option Cost for Cost Benefit Analysis € 1,493,273.46

CFRAM Unit Cost Development Project						
Optimism Bias Calculator						
Prepared by:	MM	Date:	December 2015			
Site Reference:		Site Name:	Inishannon	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 style="display: flex; align-items: center;"> <div style="width: 15px; height: 10px; background-color: #ADD8E6; border: 1px solid black; margin-right: 5px;"></div> <div style="font-size: 0.8em;">Default weighting defined by OPW for all CFRAM projects</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 15px; height: 10px; background-color: #FF00FF; border: 1px solid black; margin-right: 5px;"></div> <div style="font-size: 0.8em;">Default risk value defined for all CFRAM projects</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 15px; height: 10px; background-color: #90EE90; border: 1px solid black; margin-right: 5px;"></div> <div style="font-size: 0.8em;">Automated function cell (no input required)</div> </div> <div style="display: flex; align-items: center;"> <div style="width: 15px; height: 10px; background-color: #FFD700; border: 1px solid black; margin-right: 5px;"></div> <div style="font-size: 0.8em;">User defined - risk value, comments, justification</div> </div>						
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	Low	30%	Small scheme with low complexity - embankments and short sections of walls						
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 in rural area						
Ground conditions	3	Medium	50%	Unknown						
Health and Safety	3	Low	30%	Small scale 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						
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 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 rural scheme with low 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	Low	30%	Low number of stakeholders and interferences						
Flood events during construction	3	Medium	50%	History of flooding						
Other	1	Very Low	10%	None						
	68	41%								
Weighting to apply: 0.432				<table border="1" style="width: 100%;"> <tr> <td>Minimum Optimism Bias:</td> <td>10%</td> </tr> <tr> <td>Maximum Optimism Bias:</td> <td>70%</td> </tr> <tr> <td>Calculated Optimism bias:</td> <td>36%</td> </tr> </table>	Minimum Optimism Bias:	10%	Maximum Optimism Bias:	70%	Calculated Optimism bias:	36%
Minimum Optimism Bias:	10%									
Maximum Optimism Bias:	70%									
Calculated Optimism bias:	36%									

1. Walls

2. Embankments

3. Demountable Barrier

3a. Flood Gate

4. In-Channel Excavation

Total Excavation Costs € 0.00

5. Excavation on Land

6. Weir Construction

7. Weir Removal

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14. Hydrometric Gauging Stations		Number of Units	Maintenance Select H/L	Rate (€)	Capital Cost of Units (€)	PV Rate (€)	PV Costs (€)
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 (€)
Category	Comments							
				Capital Cost	€ 0.00	PV Cost	€ 0.00	€ 0.00
				Total Cost		€ 0.00		

16. Pumping Stations		Number of Units	Rate (€)	Capital Cost (€)	Operation Cost (€)	Running Cost (€)	PV Cost (€)	Replacement Costs
Pumpstation Capacity	Comments							
0.02 m3/s								
0.05 m3/s								
0.1 m3/s		1	€ 130,200.00	€ 130,200.00	€ 80,429.30	€ 17,873.18	€ 98,302.48	110,670.00
0.5 m3/s								
1.0 m3/s								
2.0 m3/s								
3.0 m3/s								
				Capital Cost	€ 130,200.00	PV Cost	€ 208,972.48	
				Total Cost		€ 339,172.48		

17. Channel Maintenance		Length of Channel (m)	Rate (€)	Maintenance Costs (€)
Channel Type	Comments			
		Total Cost	€ 0.00	

18. Bank Protection		Fluvial/Coastal Select	Maintenance Select	Length (m)	Rate (€/m)	Cost of Construction (€)	PV Rate (€)	PV Cost (€)
Description of Bank Protection		Fluvial	High					
				Capital Cost	€ 0.00	PV Cost	€ 0.00	€ 0.00
				Total Cost		€ 0.00		

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

Summary

UoM	20	Optimism Bias	41.76%
AFA	Schull	Site Investigation Estimate	€ 50,000.00
Option	1 - Storage	Preliminaries	8%
Description	Storage areas to be provided for on northern and western ends of the town.	Design Fees	13%
		Compensation and Land Acquisition	15%
		Archaeology and Environmental	10%
		Art Allowance	€ 51,000.00

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 2,198,291.39	€ 1,857.58	€ 2,200,148.97
2	Embankments	€ 76,800.08	€ 13,563.93	€ 90,364.01
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	€ 3,554,256.83	€ 0.00	€ 3,554,256.83
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	€ 29,421.78	€ 15,109.15	€ 44,530.92
11	Sluice Gates	€ 50,270.00	€ 152,933.29	€ 203,203.29
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
		€ 5,909,040.08	€ 183,463.95	€ 6,092,504.02
		Basic Construction Costs		€ 5,909,040.08
		Preliminaries		€ 472,723.21
		Optimism Bias		€ 2,665,324.67
		Construction Costs (Excl VAT)		€ 9,047,087.95
		Design Fees		€ 1,176,121.43
		Σ Construction Costs and Fees		€ 10,223,209.38

Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 904,708.80
Allowance for Compensation and Land Acquisition	€ 1,357,063.19
Site Investigation	€ 50,000.00
Art Allowance	€ 51,000.00
NPV Operation & Maintenance	€ 183,463.95
Optimism Bias - NPV O&M	€ 76,623.18
Σ Other Items	€ 2,622,859.11

Option Cost for Cost Benefit Analysis € 12,846,068.49

CFRAM Unit Cost Development Project					
Optimism Bias Calculator					
Prepared by:	MM	Date:	December 2015		
Site Reference:		Site Name:	Schull	1 - 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:	Default weighting defined by OPW for all CFRAM projects
					Default risk value defined for all CFRAM projects
					Automated function cell (no input required)
					User defined - risk value, comments, justification
Procurement	Weight	Select from Dropdown 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 based on two storage areas - but they are minor watercourses	
Degree of Innovation	2	Medium	50%	Standard and proven methods	
Technology	2	Medium	50%	Storage area / tank controls	
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	High	70%	Low number of stakeholders - critical stakeholders associated with storage areas	
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%	Low number of stakeholders - critical stakeholders associated with storage areas	
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 remote storage areas	
Contaminated land	3	High	70%	Unknown - risk associated with storage areas	
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	High	70%	Low number of stakeholders - critical stakeholders associated with storage areas	
Flood events during construction	3	High	70%	History of frequent flooding	
Other	1	Very Low	10%	None	
	68		51%		
Weighting to apply:				Minimum Optimism Bias:	10%
				Maximum Optimism Bias:	70%
				Calculated Optimism bias:	42%

AFA: Schull
Option: 1 - Storage

1. Walls

Select Wall Type from Dropdown	Comments	Length of Wall	Height of Wall	Rate	Capital Cost of Wall	Maintenance Costs Estimate	PV Rate	PV Cost
		(m)	Min 0.6m Max 3.0m (m)	(€/m)	(€)	Select H/L	(€/m)	PVC * Length (€)
Retaining Wall, Urban with sheet piling, >100m in length (€/m)	Storage tank with 4 m high walls, rate for 4m high wall based on a similar interpolation for the increase in costs between a 2m high wall and a 3m high wall (multiplier of 1.45).	220.354	4.00	€ 9,976.18	€ 2,198,291.39	Average	€ 8.43	€ 1,857.58
						Average		
						Average		
						Average		
						Average		
						Average		
						Average		
						Average		
						Average		
Capital Cost					€ 2,198,291.39		Total PV Cost	€ 1,857.58
							Total Cost	€ 2,200,148.97

2. Embankments

Select EmbankmentI from Dropdown	Comments	Imported Material	Length of Embankment	Height of Embankment	Rate	Capital Cost of Embankment	Maintenance Costs Estimate	PV Rate	PV Cost
		Select Yes/No	(m)	Min 1.0m Max 3.0m (m)	(€/m)	(€)	Select H/L	(€/m)	PVC * Length (€)
Rural clay embankment (€/m) 100 - 1,000m		Yes	191.9	2.50	€ 400.21	€ 76,800.08	Average	€ 70.68	€ 13,563.93
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
							Average		
Capital Cost						€ 76,800.08		Total PV Cost	€ 13,563.93
								Total Cost	€ 90,364.01

3. Demountable Barrier

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

3a. Flood Gate

<u>3a. Flood Gate</u>		No. of Flood Gates	Height Select (m)	Width Select (m)	Rate (€/gate)	Cost of Flood Gate (€)	PV & Event Rate (€/gate)	PV Costs (€)
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 Excavation Type from Dropdown	Comments	Select	Min 100m³ Max 1,000m³ (m³)	(€/m³)	(€)
				Total Cost	€ 0.00
Volume of Dredging		Rate	Cost of Dredging		
Dredging	(m³)	Select a Rate from Dropdown (€/m³)	(€)		
		Total Cost	€ 0.00		
Total Excavation Costs € 0.00					

5. Excavation on Land

Select Excavation Type from Dropdown	Comments	Volume of Excavation	Rate	Cost of Excavation
		(m³)	(€/m³)	(€)
Excavation in soft soil and material taken to waste facility	First 1m assumed to be soft material	15130	€ 16.95	€ 256,453.50
Excavation in rock and material taken to waste facility	Remaining depth assumed to be rock material, with average depth being calculated from an average contour on the site	69447	€ 43.68	€ 3,033,531.77
Excavation in rock and material taken to waste facility	Excavation for rectangular storage tank, perimeter is 220m	6050	€ 43.68	€ 264,271.56
Total Cost				€ 3,554,256.83

6. Weir Construction

Select Weir Height from Dropdown	Comments	Width of Weir	Rate	Capital Cost of Weir	Maintenance Costs Estimate	PV Cost/Weir
		Min 10m Max 20m (m)	(€/m)	(€)	Select H/L	(€/weir)
					Average	

13. Individual Property Protection

		Factor Select	Number of Units	Rate	Cost of Works	PV Rate	PV Cost
Property Type	Comments			(€)	(€)	(€)	(€)
Detached							
Semi-Detached							
Terraced							
Flat							
Residential average							
Shop							
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
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
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
Pumpstation Capacity	Comments			(€)	(€)	(€)	(€)	(€)
0.02 m3/s								
0.05 m3/s								
0.1 m3/s								
0.5 m3/s								
1.0 m3/s								
2.0 m3/s								
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
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
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
Manhole Type	Comments		(€)	(€)
			Total Cost	€ 0.00

Summary

UoM	20	Optimism Bias	39.65%
AFA	Schull	Site Investigation Estimate	€ 50,000.00
Option	2 - Storage & Flow Diversion	Preliminaries	10%
Description	Storage area to be provided for on western end of the town. Flow diversion on northern end of the town	Design Fees	13%
		Compensation and Land Acquisition	15%
		Archaeology and Environmental	10%
		Art Allowance	€ 43,346.92

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 0.00	€ 0.00	€ 0.00
2	Embankments	€ 76,800.08	€ 13,563.93	€ 90,364.01
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	€ 3,289,985.27	€ 0.00	€ 3,289,985.27
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	€ 1,057,408.20	€ 200,179.98	€ 1,257,588.18
11	Sluice Gates	€ 25,135.00	€ 76,466.64	€ 101,601.64
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
		€ 4,449,328.55	€ 290,210.55	€ 4,739,539.10
		Basic Construction Costs		€ 4,449,328.55
		Preliminaries		€ 444,932.86
		Optimism Bias		€ 1,940,430.70
		Construction Costs (Excl VAT)		€ 6,834,692.11
		Design Fees		€ 888,509.97
		Σ Construction Costs and Fees		€ 7,723,202.08

Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 683,469.21
Allowance for Compensation and Land Acquisition	€ 1,025,203.82
Site Investigation	€ 50,000.00
Art Allowance	€ 43,346.92
NPV Operation & Maintenance	€ 290,210.55
Optimism Bias - NPV O&M	€ 115,059.95
Σ Other Items	€ 2,207,290.45

Option Cost for Cost Benefit Analysis € 9,930,492.53

CFRAM Unit Cost Development Project

Optimism Bias Calculator

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Schull 2 - Storage & 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></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
Procurement	Weight	Select from Dropdown 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
Budgetting	2	Medium 50%	Default risk value
Other	1	Medium 50%	Default risk value
Project Specific			
Design Complexity	2	Medium 50%	Scheme based on storage area and flow diversion
Degree of Innovation	2	Medium 50%	Standard and proven methods
Technology	2	Medium 50%	Storage area controls
Services	3	Medium 50%	Unknown - large amount of services not expected in rural area
Ground conditions	3	Medium 50%	Unknown - critical for storage area
Health and Safety	3	Medium 50%	Storage area and flow diversion but no unusual risks associated with works
Other	1	Medium 50%	Risks associated with storage area and flow diversion
Client Specification			
Inadequacy of the Business Case	3	Medium 50%	Default risk value
Large No. of Stakeholders	2	Medium 50%	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	Medium 50%	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	Medium 50%	No anticipated delays associated with permits, consents or approvals
Amenity and art	1	Low 30%	Rural scheme with remote storage areas
Contaminated land	3	Medium 50%	Unknown - risk associated with storage area
Archaeology	3	Medium 50%	Unknown - extent of storage area and flow diversion can be adequately scoped
Other	1	Medium 50%	Risks associated with storage area and flow diversion
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 - critical stakeholders associated with storage area
Flood events during construction	3	High 70%	History of frequent flooding
Other	1	Very Low 10%	None
	68	48%	
Weighting to apply: 0.494			Minimum Optimism Bias: 10% Maximum Optimism Bias: 70% Calculated Optimism bias: 40%

1. Walls

2. Embankments

3. Demountable Barrier

3a. Flood Gate

4. In-Channel Excavation

Total Excavation Costs € 0.00

5. Excavation on Land

6. Weir Construction

7. Weir Removal

Length of Weir	Rate	Cost of Construction
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8. Bridges		Remove or Replace	Area of Bridge	Rate	Cost of Construction	PV Costs
Description of Bridge	Select Yes/No	(m ²)	(€/m ²)	(€)	(€/bridge)	
			Capital Cost	€ 0.00	€ 0.00	
			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 Cost
	Select	Select	Select	Select				Select	
Description of Culvert		Soil/Rock	(m)	(m)	(m)	(€/m)	(€)	H/L	(€/m)
Culvert to divert flows	Surplus excavated material carted to licenced tip	Rock	4	2.1 x 1.0m	656	€ 1,611.90	€ 1,057,408.20	Average	€ 200,179.98
						Capital Cost	€ 1,057,408.20	Total PV Cost	€ 200,179.98
						Total Cost		Total Cost	€ 1,257,588.18

10c. Culverts (Headwall)		Length of Culvert	Culvert Size Select	Rate	Cost of Construction
Description of Culvert	(m)	(m)	(€/m)	(€)	
				Capital Cost	€ 0.00
Overall Capital Cost		€ 1,057,408.20	Overall PV Cost	€ 200,179.98	
			Overall Cost	€ 1,257,588.18	

<u>12. Road Raising</u>			
	Length of Road	Cost of Construction	Cost of Construction
Road Details	(m)	(€)	(€)
Total Cost		€ 0.00	€ 0.00

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Flat							
Residential average							
Shop							
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
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
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
Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
0.02 m3/s							
0.05 m3/s							
0.1 m3/s							
0.5 m3/s							
1.0 m3/s							
2.0 m3/s							
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
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
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
Manhole Type	Comments		(€)	(€)
		Total Cost	€ 0.00	

Summary

UoM	20	Optimism Bias	40.71%
AFA	Schull	Site Investigation Estimate	€ 50,000.00
Option	3 - Culvert & Storage	Preliminaries	14%
Description	Storage area to be provided for on northern end of the town. Manhole sealing and culvert on southern end of the town	Design Fees	13%
		Compensation and Land Acquisition	15%
		Archaeology and Environmental	10%
		Art Allowance	€ 38,000.00

Element Reference	Element	Capital Costs	PV O&M Costs	Total Costs
1	Walls	€ 2,198,291.39	€ 1,857.58	€ 2,200,148.97
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	€ 134,362.45	€ 30,218.29	€ 164,580.74
11	Sluice Gates	€ 25,135.00	€ 76,466.64	€ 101,601.64
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	€ 84,000.00	€ 0.00	€ 84,000.00
		€ 2,441,788.84	€ 108,542.52	€ 2,550,331.36
		Basic Construction Costs		€ 2,441,788.84
		Preliminaries		€ 341,850.44
		Optimism Bias		€ 1,133,104.93
		Construction Costs (Excl VAT)		€ 3,916,744.20
		Design Fees		€ 509,176.75
		Σ Construction Costs and Fees		€ 4,425,920.95

Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 391,674.42
Allowance for Compensation and Land Acquisition	€ 587,511.63
Site Investigation	€ 50,000.00
Art Allowance	€ 38,000.00
NPV Operation & Maintenance	€ 108,542.52
Optimism Bias - NPV O&M	€ 44,183.19
Σ Other Items	€ 1,219,911.76

Option Cost for Cost Benefit Analysis € 5,645,832.71

CFRAM Unit Cost Development Project**Optimism Bias Calculator**

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Schull 3 - Culvert & 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> 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
Procurement	Weight	Select from Dropdown 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
Budgetting	2	Medium 50%	Default risk value
Other	1	Medium 50%	Default risk value
Project Specific			
Design Complexity	2	Medium 50%	Scheme based on storage area and culvert replacement
Degree of Innovation	2	Medium 50%	Standard and proven methods
Technology	2	Medium 50%	Storage area controls
Services	3	High 70%	Unknown - potential for encountering services associated with culvert works
Ground conditions	3	Medium 50%	Unknown - critical for storage area
Health and Safety	3	High 70%	Narrow deep excavation and confined spaces associated with culvert works
Other	1	Medium 50%	Risks associated with storage area and culvert works
Client Specification			
Inadequacy of the Business Case	3	Medium 50%	Default risk value
Large No. of Stakeholders	2	Medium 50%	Low number of stakeholders - critical stakeholders associated with storage area and culvert
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 - critical stakeholders associated with storage area and culvert
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 remote storage areas
Contaminated land	3	Medium 50%	Unknown - risk associated with storage area
Archaeology	3	Medium 50%	Unknown - extent of storage area and flow diversion can be adequately scoped
Other	1	Medium 50%	Risks associated with storage area and culvert works
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 - critical stakeholders associated with storage area and culvert
Flood events during construction	3	High 70%	History of frequent flooding
Other	1	Very Low 10%	None
	68	49%	
Weighting to apply: 0.512		Minimum Optimism Bias: 10%	
		Maximum Optimism Bias: 70%	
		Calculated Optimism bias: 41%	

PV Cost

P

PV Including Events Costs

Cost of Excavation

Cost of Dredging

(€)

Cost of Excavation

(€)

PV Cost/Weir

7. Weir Removal			
	Length of Weir	Rate	Cost of Construction
Description of Weir	(m)	(€/m)	(€)
Total Cost			€ 0.00

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

9. Bridge Underpinning				
		Length of Bridge	Rate	Cost of Construction
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 Cost
Description of Culvert	Select	Select Soil/Rock	Select (m)	Select (m)	(m)	(€/m)	(€)	Select H/L	(€/m)
New culvert on southern end of town adjacent to Main Street	Surplus excavated material carted to licenced tip	Rock	2.5	2.1 x 1.0m	75.2	€ 1,254.06	€ 94,305.52	Average	€ 15,109.15
Culvert to feed storage tank	Surplus excavated material spread on site	Rock	2.5	1.05m dia	61.92	€ 475.16	€ 29,421.78	Average	€ 15,109.15
Capital Cost							€ 123,727.30	Total PV Cost	€ 30,218.29
Total Cost									€ 153,945.59

10b. Culverts (Urban)									
	Culvert	Invert	Culvert Size	Length of Culvert	Rate	Cost of Construction	Maintenance Costs Estimate	PV Rate	PV Cost
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
Description of Culvert	(m)	Select (m)	(€/m)	(€)
	1	2.1 x 1.0m	€ 10,635.15	€ 10,635.15
Capital Cost				€ 10,635.15
Overall Capital Cost		€ 134,362.45	Overall PV Cost	€ 30,218.29
			Overall Cost	€ 164,580.74

11. Sluice Gates								
		Size	Maintenance	Operation	Maintenance Costs Estimate	Capital Cost	PV Cost	Total Cost
Select Gate Type	Comments	Select	Select	Select	Select H/L	(€)	(€)	(€)
Sluice Gates		1800	Urban/suburban locations with high debris loads	Electric Operation	Average	€ 25,135.00	€ 76,466.64	€ 101,601.64
Capital Cost						€ 25,135.00	PV Cost	€ 76,466.64
Total Cost								€ 101,601.64

12. Road Raising			
	Length of Road	Cost of Construction	Cost of Construction
Road Details	(m)	(€)	(€)
Total Cost		€ 0.00	€ 0.00

13. Individual Property Protection							
		Factor	Number of Units	Rate	Cost of Works	PV Rate	PV Cost
Property Type	Comments	Select		(€)	(€)	(€)	(€)
Detached							

14. Hydrometric Gauging Stations

15. Flood Forecasting

16. Pumping Stations

17. Channel Maintenance

18. Bank Protection

19. Manhole Sealing

19. Manhole Sealing		No. of Manholes	Rate	Cost of Construction
Manhole Type	Comments		(€)	(€)
Manhole cover and reconstruction in reinforced concrete (deep manhole for greater surcharge)	Survey would need to be undertaken for number of manholes, conservative estimate of number of manholes	6	€ 14,000.00	€ 84,000.00
Total Cost				€ 84,000.00

Summary

UoM	20	Optimism Bias	39.12%
AFA	Schull	Site Investigation Estimate	€ 50,000.00
Option	4 - Culvert & Flow Diversion	Preliminaries	17%
Description	Flow diversion on northern end of the town, with manhole sealing and culvert being constructed on southern end of the town	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	€ 0.00	€ 0.00	€ 0.00
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	€ 1,183,619.18	€ 215,289.13	€ 1,398,908.30
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	€ 84,000.00	€ 0.00	€ 84,000.00
		€ 1,267,619.18	€ 215,289.13	€ 1,482,908.30
		Basic Construction Costs		€ 1,267,619.18
		Preliminaries		€ 215,495.26
		Optimism Bias		€ 580,159.47
		Construction Costs (Excl VAT)		€ 2,063,273.91
		Design Fees		€ 268,225.61
		Σ Construction Costs and Fees		€ 2,331,499.52

Other Items

Allowance for Archaeology and Environmental Mitigation Measures	€ 206,327.39
Allowance for Compensation and Land Acquisition	€ 206,327.39
Site Investigation	€ 50,000.00
Art Allowance	€ 25,500.00
NPV Operation & Maintenance	€ 215,289.13
Optimism Bias - NPV O&M	€ 84,216.04
Σ Other Items	€ 787,659.95

Option Cost for Cost Benefit Analysis € 3,119,159.47

CFRAM Unit Cost Development Project

Optimism Bias Calculator

Prepared by: AEP Date: December 2013
 Site Reference: Site Name: Schull 4 - Culvert & 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><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 Occured	3	Medium	50%	Default risk value	
Information Management	1	Medium	50%	Default risk value	
Budgetting	2	Medium	50%	Default risk value	
Other	1	Medium	50%	Default risk value	
Project Specific					
Design Complexity	2	Low	30%	Scheme based on flow diversion and culvert replacement	
Degree of Innovation	2	Low	30%	Standard and proven methods	
Technology	2	Low	30%	No assets sensitive to technology	
Services	3	High	70%	Unknown - potential for encountering services associated with culvert works	
Ground conditions	3	Medium	50%	Unknown	
Health and Safety	3	High	70%	Narrow deep excavation and confined spaces associated with culvert works	
Other	1	Medium	50%	Risks associated with flow diversion and culvert works	
Client Specification					
Inadequacy of the Business Case	3	Medium	50%	Default risk value	
Large No. of Stakeholders	2	Medium	50%	Low 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%	Low number of stakeholders	
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 remote storage areas	
Contaminated land	3	Medium	50%	Unknown	
Archaeology	3	Low	30%	Unknown - extent of flow diversion can be adequately scoped	
Other	1	Medium	50%	Risks associated with flow diversion and culvert works	
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	
Flood events during construction	3	High	70%	History of frequent flooding	
Other	1	Very Low	10%	None	
	68	47%			
				Minimum Optimism Bias:	10%
				Maximum Optimism Bias:	70%
Weighting to apply:		0.485	Calculated Optimism bias:		39%

1. Walls

2. Embankments

3. Demountable Barrier

3a. Flood Gate

4. In-Channel Excavation

Total Excavation Costs € 0.00

5. Excavation on Land

6. Weir Construction

7. Weir Removal

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		Capital Cost		PV Cost		Total Cost	
		€ 0.00		€ 0.00		€ 0.00	
14. Hydrometric Gauging Stations		Number of Units	Maintenance Select H/L	Rate	Capital Cost of Units	PV Rate	PV Costs
Hydrometric Gauging Station	Comments			(€)	(€)	(€)	(€)
		Capital Cost		€ 0.00		PV Cost	
						Total Cost	
						€ 0.00	



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

16. Pumping Stations		Number of Units	Rate	Capital Cost	Operation Cost	Running Cost	PV Cost
Pumpstation Capacity	Comments		(€)	(€)	(€)	(€)	(€)
0.02 m3/s							
0.05 m3/s							
0.1 m3/s							
0.5 m3/s							
1.0 m3/s							
2.0 m3/s							
3.0 m3/s							
		Capital Cost		€ 0.00		PV Cost	
						Total Cost	
						€ 0.00	

17. Channel Maintenance		Length of Channel	Rate	Maintenance Costs
Channel Type	Comments	(m)	(€)	(€)
		Total Cost		€ 0.00

18. Bank Protection		Fluvial/Coastal	Maintenance	Length	Rate	Cost of Construction	PV Rate	PV Cost
		Select	Select					
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
Manhole Type	Comments		(€)	(€)
Manhole cover and reconstruction in reinforced concrete (deep manhole for greater surcharge)	Survey would need to be undertaken for number of manholes, conservative estimate of number of manholes	6	€ 14,000.00	€ 84,000.00
		Total Cost		€ 84,000.00

	DONNACHADH O'BRIEN & ASSOCIATES CONSULTING ENGINEERS	
CFRAM Unit Cost Development Project		
Method	Complex Forecast for Catchment	
Prepared by:	Date:	
Checked by:	Date:	

Project reference	SWCFRAM	Project name:	Dunmanway AFA
Base date for estimates (year 0)	Jan-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	€3,000	€3,000	
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.	6	€3,500	€21,000	
River gauges	€4,000	€5,000	No.	4	€4,500	€18,000	
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	€5,000	€5,000	
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						€176,000	
Apply update to unit rate (CPI) if appropriate (cell N15)						€176,000	
Enter appropriate preliminaries estimate (%) if applicable						0%	
Enter other applicable costs (€)						0	
Total capital cost (€)						€176,000	
Consider amendments based on site issues/constraints (cell N16)						€176,000	
Total capital cost (€)						€176,000	

Operation and Maintenance Cost Tool

	Typical Rate (€)		Quantity	Unit	Rate (€)	Total cost (€)
	Lower	Upper				
Raingauge maintenance and telemetry	€1,000	€2,000	No.	6	1000	€6,000
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	No.	1	1000	€1,000
Total O&M cost (€)						€17,200

Other costs

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

Total PV Cost

Total PVC costs (see PVC calculator below)	€543,073
Optimism bias rate (from external sheet)	43%
Total Cost including Optimism Bias	€776,595

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)

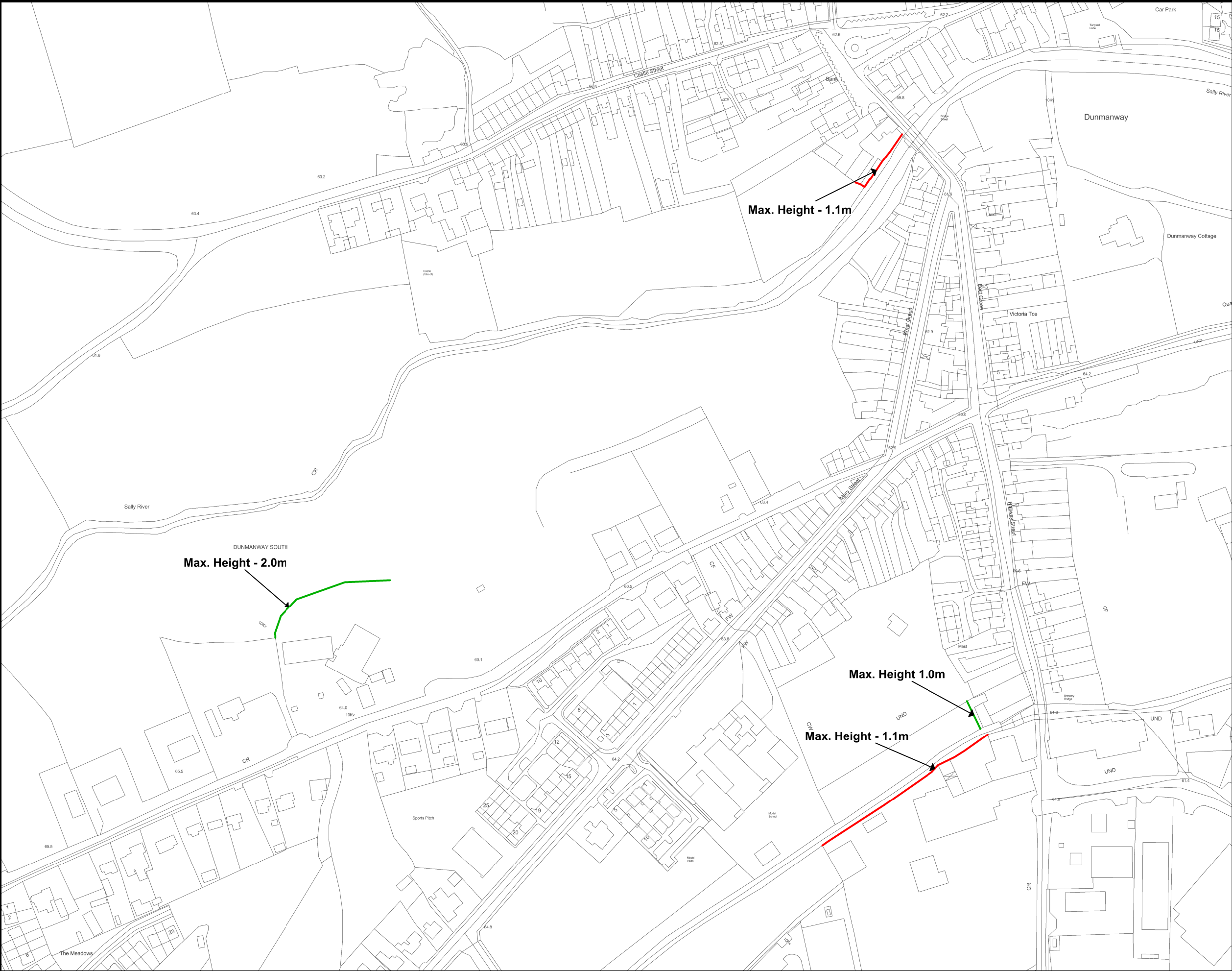
Enabling cost (€) (if applicable, may be sunk cost)	
Year of capital works (year)	0
Capital cost (€)	€176,000.0
Annual maintenance cost (€)	€17,200.0
Other cost (€)	€0.0
Other works frequency (years)	

Key

	Information
	Calculation
	Cost input

Discount rate:		4.0%	Present Value Factor: 22.341		Total PVC (€k): 543073	
Cash sum		0	176000	842800	0	1018800 543073
		Cost Elements				TOTALS:
year	Discount Factor	Enabling	Capital	Maint.	Other	Cash PV
0	1.000	0	176000			176000.0 176000.0
1	0.962			17200		17200.0 16538.5
2	0.925			17200		17200.0 15902.4
3	0.889			17200		17200.0 15290.7
4	0.855			17200		17200.0 14702.0
5	0.822			17200		17200.0 14137.7
6	0.790			17200		17200.0 13593.4
7	0.760			17200		17200.0 13070.6
8	0.731			17200		17200.0 12567.9
9	0.703			17200		17200.0 12084.5
10	0.676			17200		17200.0 11619.7
11	0.650			17200		17200.0 11172.8
12	0.625			17200		17200.0 10743.1
13	0.601			17200		17200.0 10329.9
14	0.577			17200		17200.0 9932.6
15	0.555			17200		17200.0 9550.5
16	0.534			17200		17200.0 9183.2
17	0.513			17200		17200.0 8830.0
18	0.494			17200		17200.0 8490.4
19	0.475			17200		17200.0 8163.8
20	0.456			17200		17200.0 7849.9
21	0.439			17200		17200.0 7547.9
22	0.422			17200		17200.0 7257.6
23	0.406			17200		17200.0 6978.5
24	0.390			17200		17200.0 6710.1
25	0.375			17200		17200.0 6452.0
26	0.361			17200		17200.0 6203.9
27	0.347			17200		17200.0 5965.2
28	0.333			17200		17200.0 5735.8
29	0.321			17200		17200.0 5515.2
30	0.308			17200		17200.0 5303.1
31	0.296			17200		17200.0 5099.1
32	0.285			17200		17200.0 4903.0
33	0.274			17200		17200.0 4714.4
34	0.264			17200		17200.0 4533.1
35	0.253			17200		17200.0 4358.7
36	0.244			17200		17200.0 4191.1
37	0.234			17200		17200.0 4029.9
38	0.225			17200		17200.0 3874.9
39	0.217			17200		17200.0 3725.9
40	0.208			17200		17200.0 3582.6
41	0.200			17200		17200.0 3444.8
42	0.193			17200		17200.0 3312.3
43	0.185			17200		17200.0 3184.9
44	0.178			17200		17200.0 3062.4
45	0.171			17200		17200.0 2944.6
46	0.165			17200		17200.0 2831.4
47	0.158			17200		17200.0 2722.5
48	0.152			17200		17200.0 2617.7
49	0.146			17200		17200.0 2517.7

Appendix B. Drawings of Potential FRM Options



Flood Defence Walls

Flood Defence Embankments



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 : **Dunmanway
Flood Defences**

Map Type: Preliminary Options

Source: Fluvial Flooding

Map Area: Urban

Scenario: Current

Drawn by: Tony Donovan

Checked by: Barry O'Connor

Approved by: Fintan McGivern

Map No.: MMD-296235-E-DR-20-DY-201-P1

Sheet: 1 of 1

Revision: P1

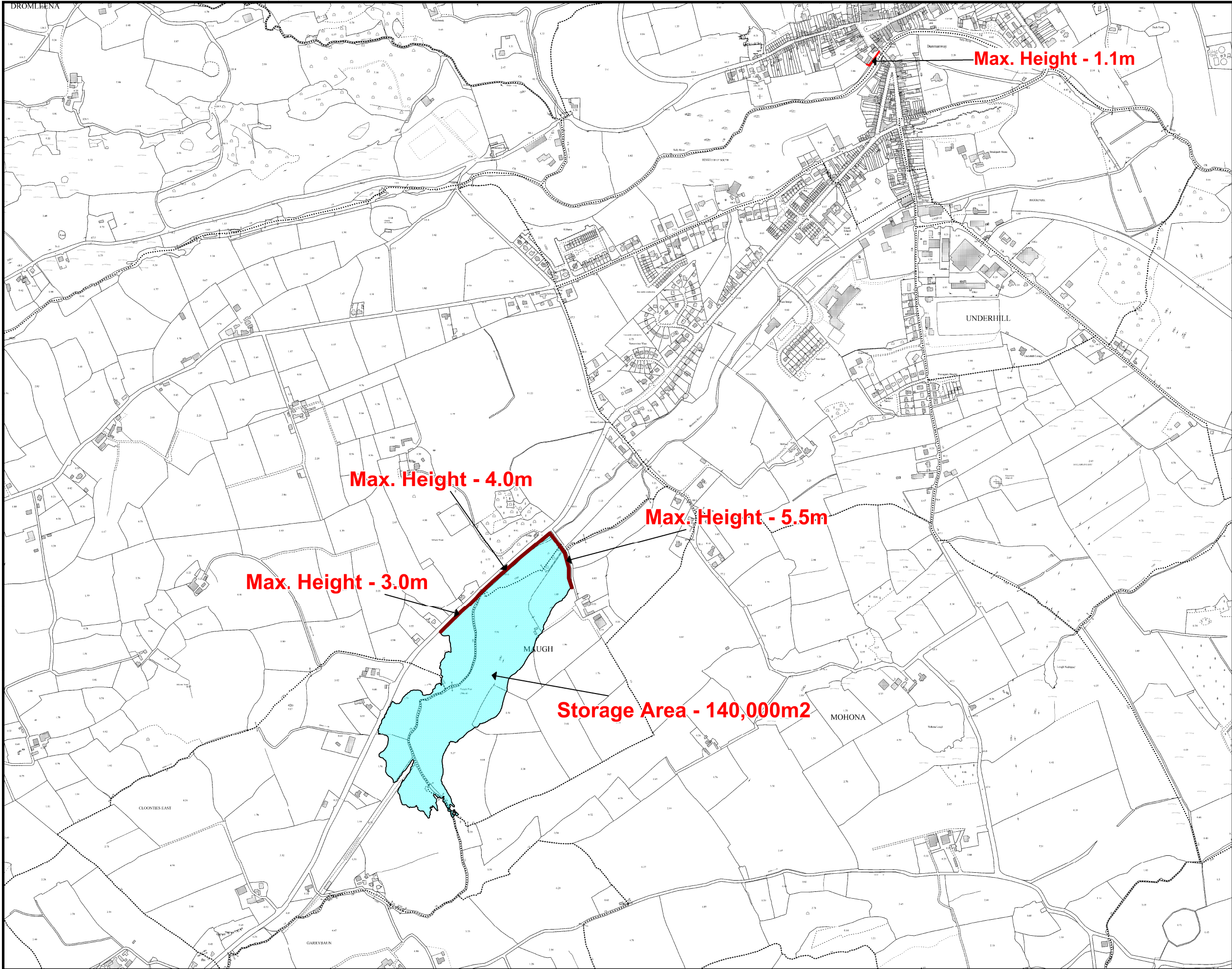
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Storage

Embankment with Sluice Gate

Storage Area

Flood Defence Walls



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



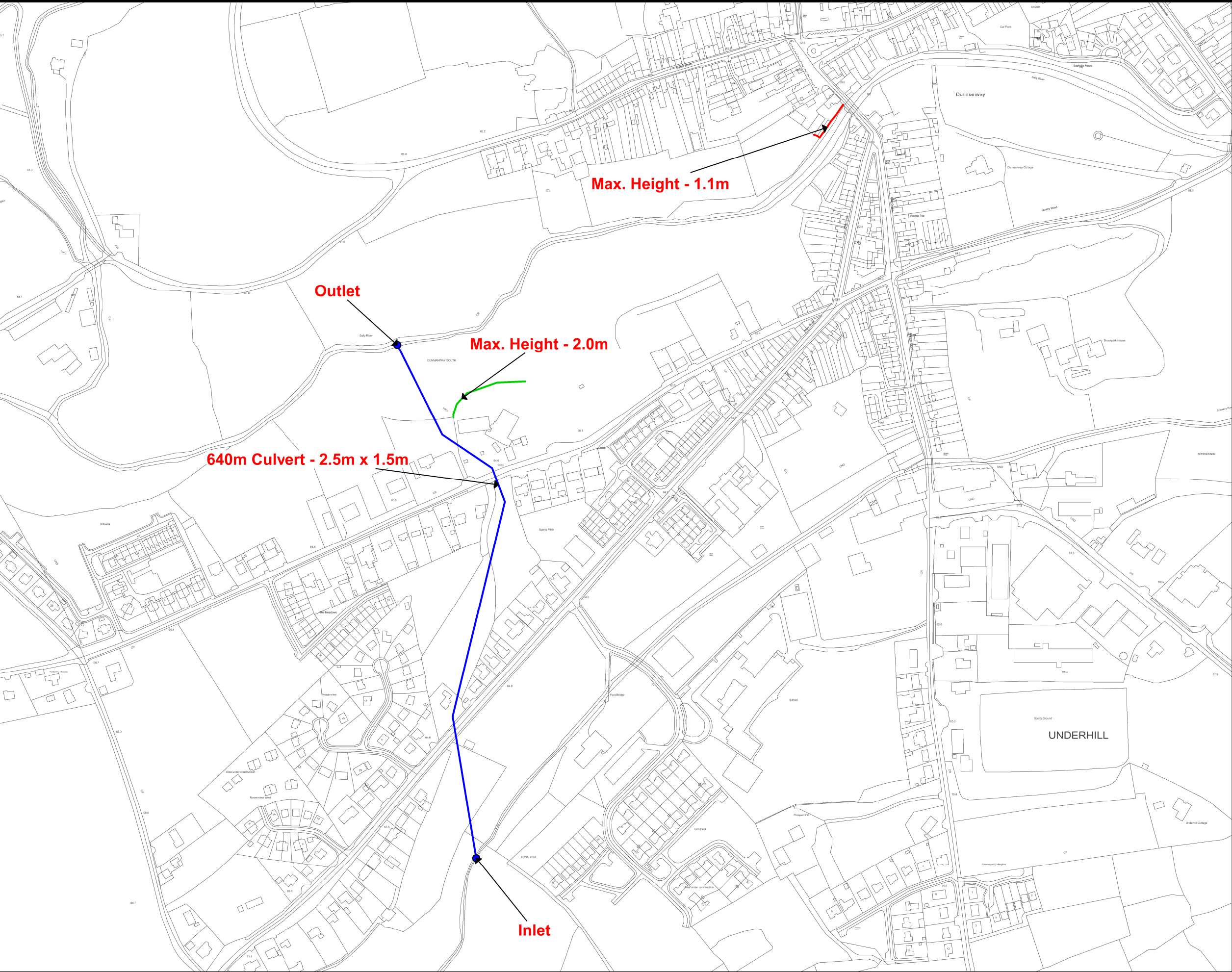
Mott MacDonald Ireland
5 Eastgate Avenue
Little Island, Cork

Project : South Western CFRAM Study	
Map : Dunmanway Storage & Flood Defences	
Map Type:	Preliminary Options
Source:	Fluvial Flooding
Map Area:	Urban
Scenario:	Current
Drawn by:	Tony Donovan
Checked by:	Barry O'Connor
Approved by:	Fintan McGivern
Map No.:	MMD-296235-E-DR-20-DY-202-P1
Sheet:	1 of 1
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Revision:	P1
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- Flow Diversion
- Flood Defence Walls
- Flood Defence Embankment



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Trim, Co. Meath



Mott MacDonald Ireland
5 Eastgate Avenue
Little Island, Cork

Project :
South Western CFRAM Study

Map : Dunmanway
Flow Diversion & Flood Defences

Map Type: Preliminary Options

Source: Fluvial Flooding

Map Area: Urban

Scenario: Current

Drawn by: Tony Donovan

Checked by: Barry O'Connor

Approved by: Fintan McGivern

Map No.: MMD-296235-E-DR-20-DY-203-P1

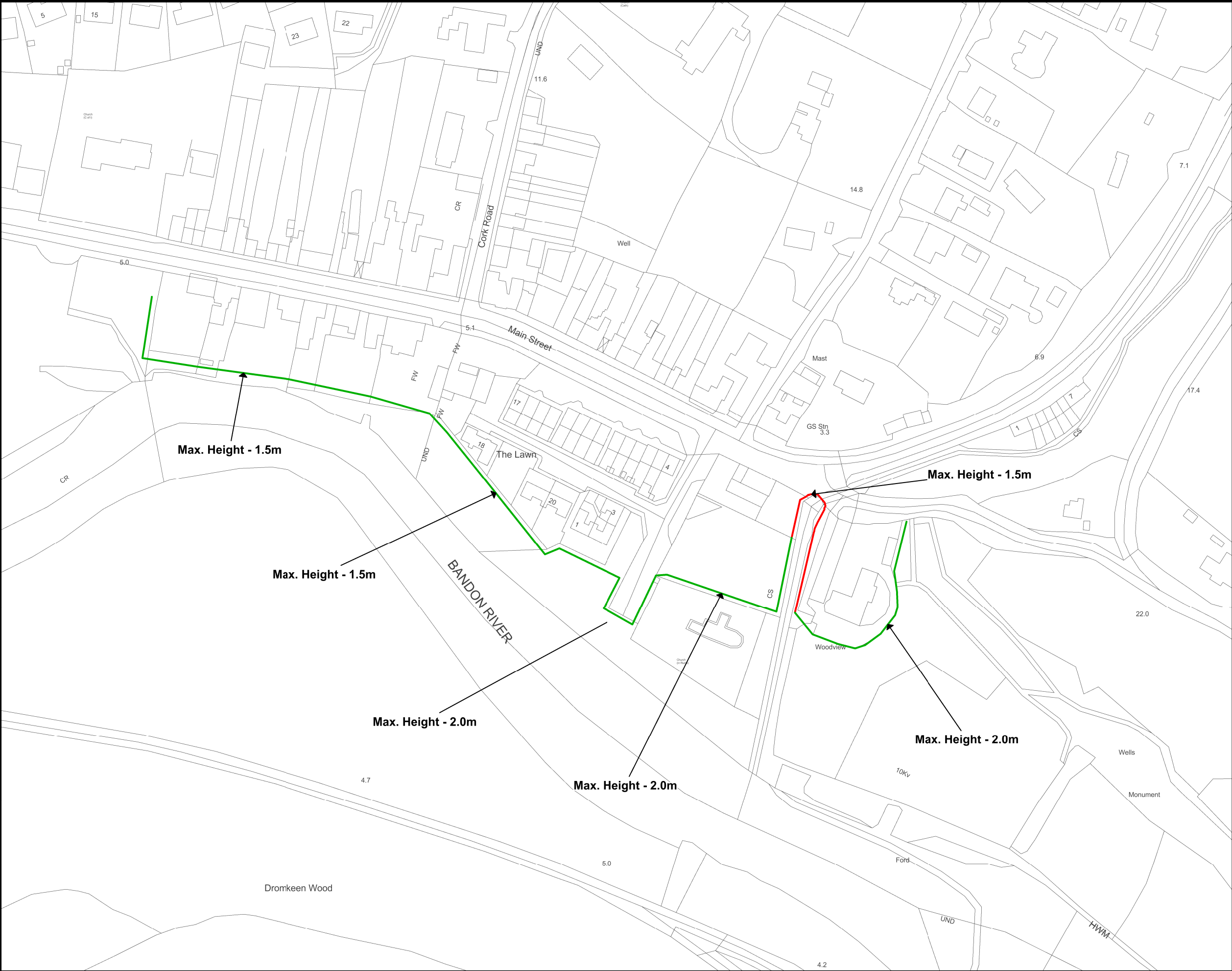
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Flood Defence Embankment

Flood Defence Wall



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



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5 Eastgate Avenue
Little Island, Cork

Project :
South Western CFRAM Study
Map : **Inishannon - Emerging Preferred Option**
Fluvial / Tidal Flood Defences

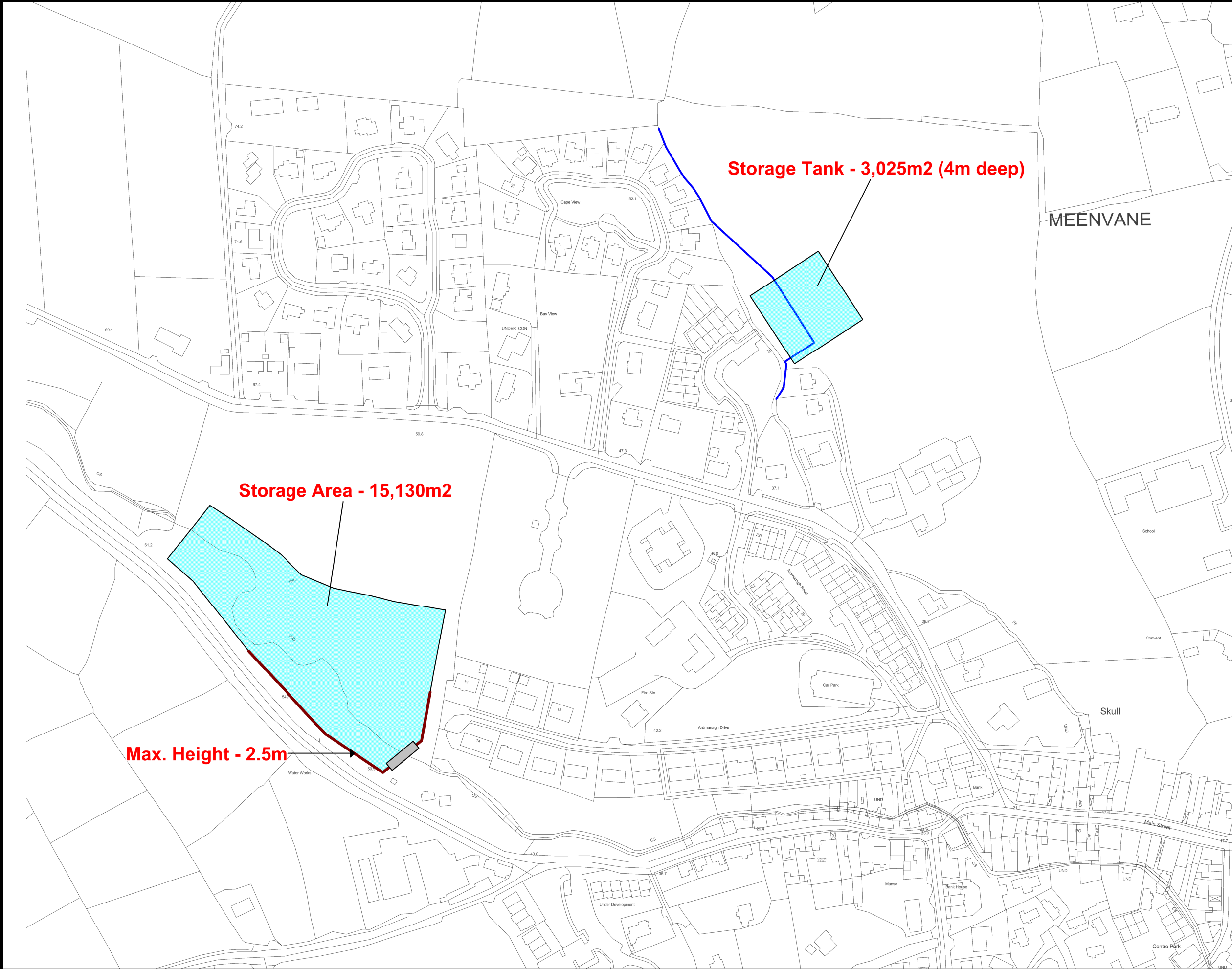
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Source: Fluvial & Tidal Flooding
Map Area: Urban
Scenario: Current
Drawn by: Tony Donovan
Checked by: Barry O'Connor

Approved by: Fintan McGivern
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- Storage
- Embankment
- Sluice Gate
- Realigned Watercourse



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Jonathan Swift Street
Trim, Co. Meath



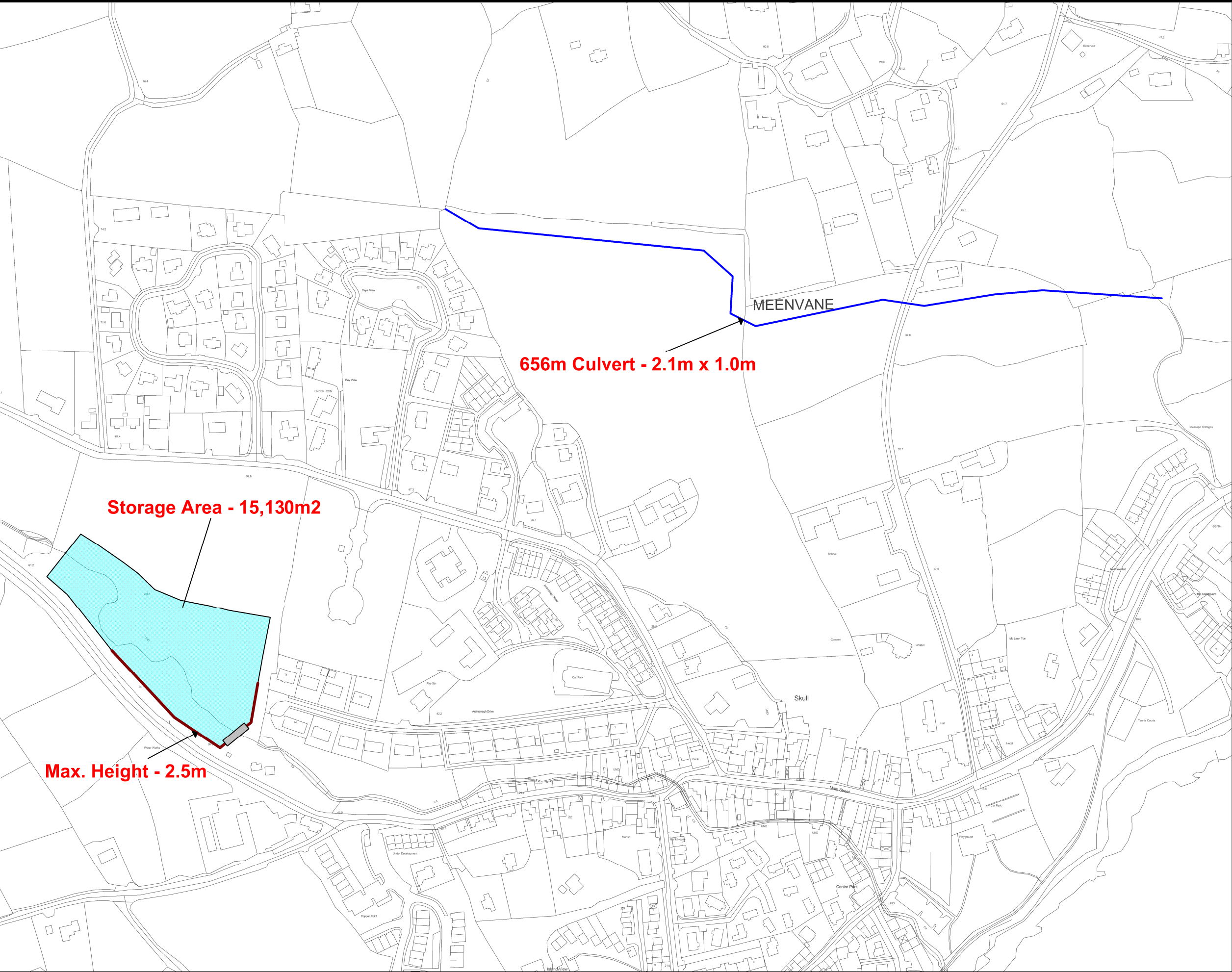
Mott MacDonald Ireland
5 Eastgate Avenue
Little Island, Cork

Project : South Western CFRAM Study	
Map : Schull Storage	
Map Type:	Preliminary Options
Source:	Fluvial Flooding
Map Area:	Urban
Scenario:	Current
Drawn by:	Tony Donovan
Checked by:	Barry O'Connor
Approved by:	Fintan McGivern
Map No.:	MMD-296235-E-DR-20-SL-201-P1
Sheet:	1 of 1
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Revision:	P1
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Storage



Embankment



Sluice Gate



Flow Diversion



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 : Schull

Storage & Flow Diversion

Map Type:

Preliminary Options

Source:

Fluvial Flooding

Map Area:

Urban

Scenario:

Current

Drawn by:

Tony Donovan

Checked by:

Barry O'Connor

Approved by:

Fintan McGivern

Map No.:

MMD-296235-E-DR-20-SL-202-P1

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Revision:

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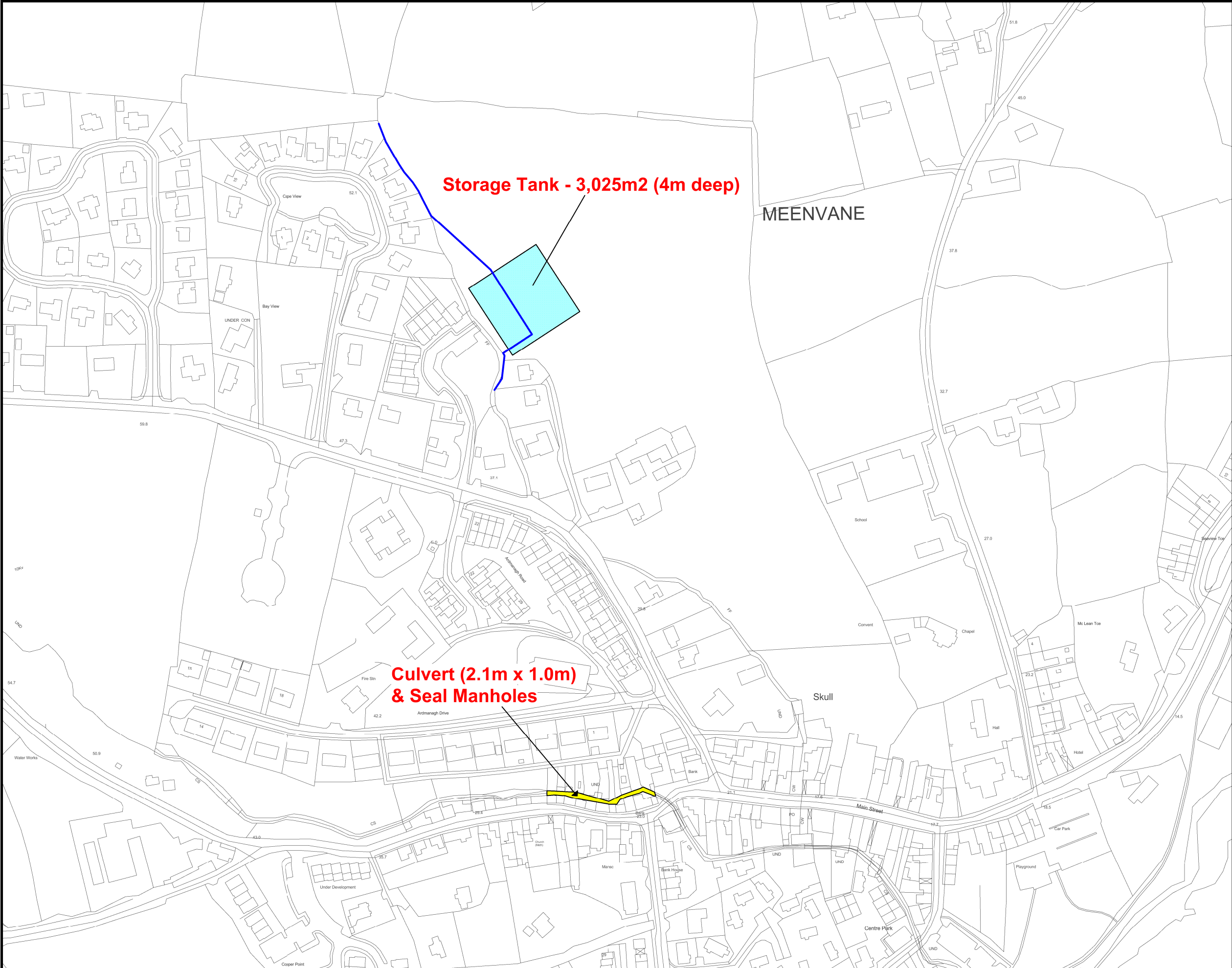
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- Storage
- Realigned Watercourse
- Culvert



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 : Schull
Culvert Route 1 & Storage

Map Type: Preliminary Options

Source: Fluvial Flooding

Map Area: Urban

Scenario: Current

Drawn by: Tony Donovan

Checked by: Barry O'Connor

Approved by: Fintan McGivern

Map No.: MMD-296235-E-DR-20-SL-203-P1

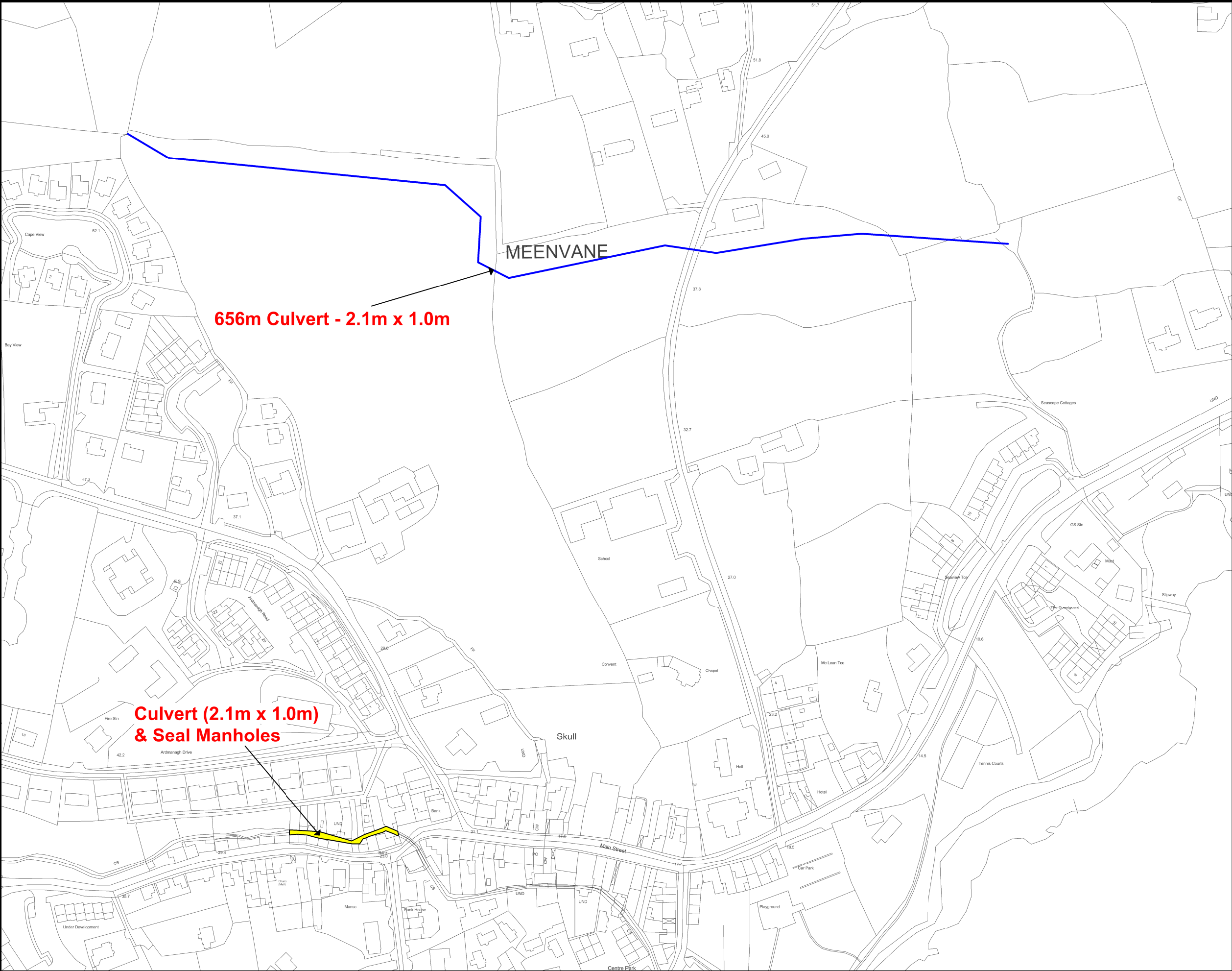
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Culvert



Flow Diversion



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 : Schull

Culvert Route 1 & Flow Diversion

Map Type: Preliminary Options

Source: Fluvial Flooding

Map Area: Urban

Scenario: Current

Drawn by: Tony Donovan

Checked by: Barry O'Connor

Approved by: Fintan McGivern

Map No.: MMD-296235-E-DR-20-SL-204-P1

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Revision:

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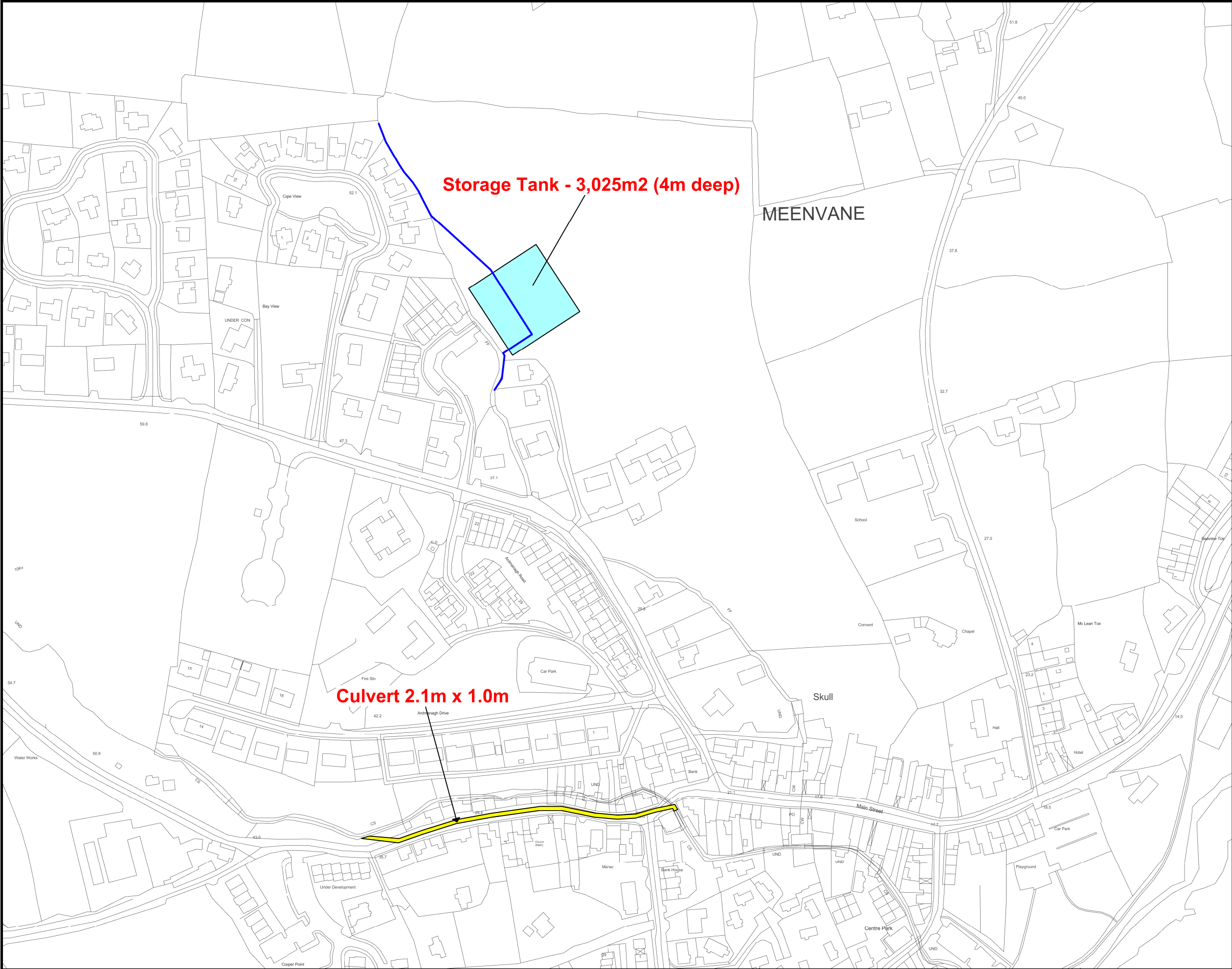
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- Storage
- Realigned Watercourse
- Culvert



Office of Public Works
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Mott MacDonald Ireland
5 Eastgate Avenue
Little Island, Cork

Project :
South Western CFRAM Study

Map : Schull
Culvert Route 2 & Storage

Map Type: Preliminary Options

Source: Fluvial Flooding

Map Area: Urban

Scenario: Current

Drawn by: Tony Donovan

Checked by: Barry O'Connor

Approved by: Fintan McGivern

Map No.: MMD-296235-E-DR-20-SL-205-P1

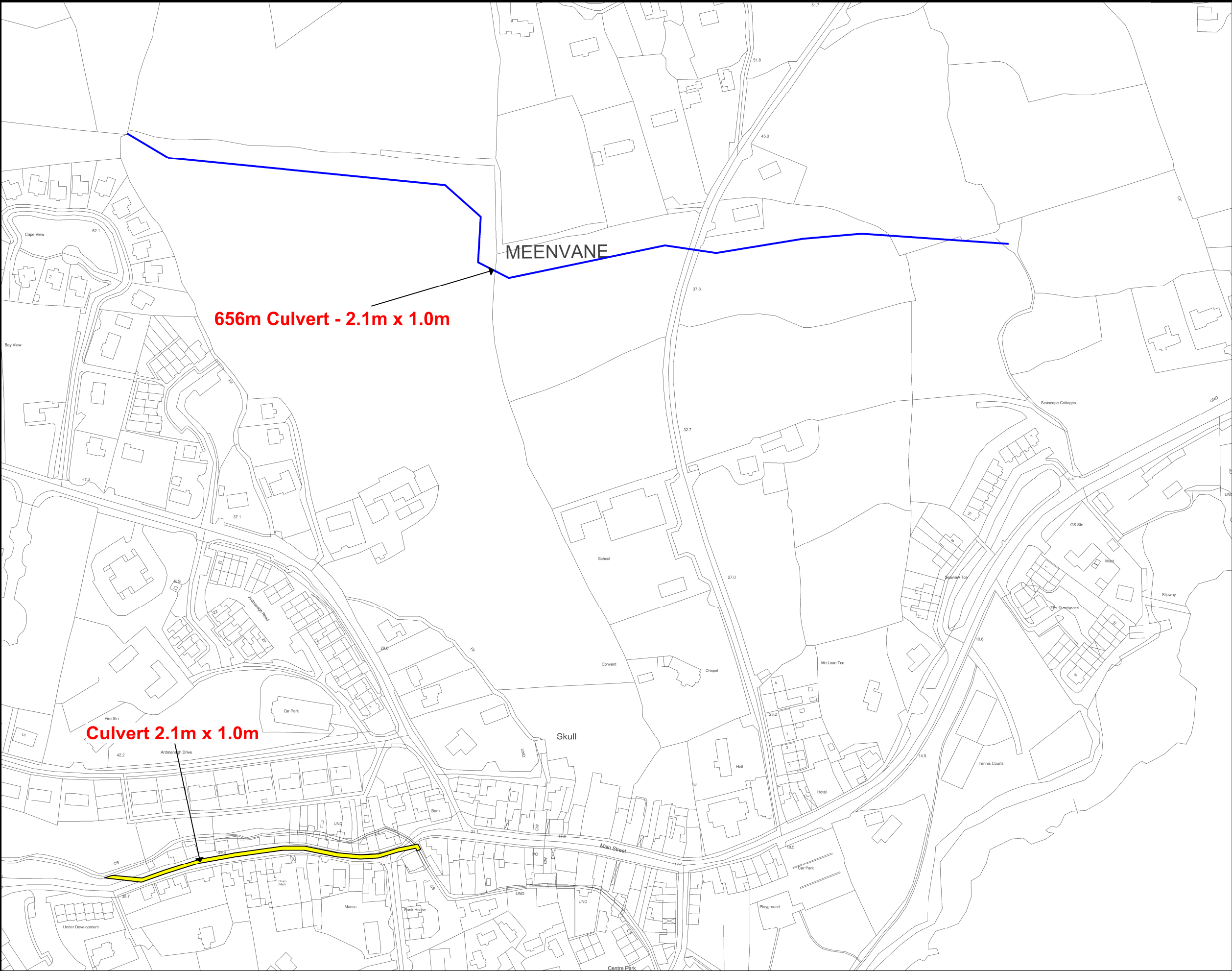
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Culvert



Flow Diversion



Office of Public Works
Jonathan Swift Street
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Mott MacDonald Ireland
5 Eastgate Avenue
Little Island, Cork

Project : South Western CFRAM Study	
Map : Schull Culvert Route 2 & Flow Diversion	
Map Type:	Preliminary Options
Source:	Fluvial Flooding
Map Area:	Urban
Scenario:	Current
Drawn by:	Tony Donovan
Checked by:	Barry O'Connor
Approved by:	Fintan McGivern
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Appendix C. Draft SEA Options Appraisal Report



South Western RBD CFRAM Study

SEA Options Appraisal Study
Unit of Management 20

June 2016

The Office of Public Works

South Western RBD CFRAM Study

SEA Options Appraisal Study
Unit of Management 20

June 2016

The Office of Public Works

Jonathan Swift Street,
Trim,
County Meath.

Issue and revision record

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

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Contents

Chapter	Title	Page
	Executive Summary	i
1	Introduction	1
1.1	General	1
1.2	Overview of the South Western River Basin District	2
1.3	Purpose and Structure of this Report	4
2	Flood Risk Management Options	6
2.1	Introduction	6
2.2	Evaluating the Effectiveness of Flood Risk Management Options	7
3	Strategic Environmental Assessment	10
3.1	Introduction	10
3.2	Overview of the SEA Process	10
3.3	SEA Objectives, Sub-Objectives and Targets	12
3.4	Assessment of Alternatives	14
4	Appropriate Assessment	16
4.1	Introduction	16
4.2	Habitats Directive Screening (for Appropriate Assessment)	16
5	Dunmanway	17
5.1	Flood Risk	17
5.2	Viable Flood Risk Management Options	18
5.3	Key Environmental Sensitivities	18
5.4	Environmental Assessment	19
5.5	Preferred Flood Risk Management Option	22
6	Inishannon	23
6.1	Flood Risk	23
6.2	Viable Flood Risk Management Options	25
6.3	Key Environmental Sensitivities	25
6.4	Environmental Assessment	26
6.5	Preferred Flood Risk Management Option	28
7	Schull	29
7.1	Flood Risk	29
7.2	Viable Flood Risk Management Options	29
7.3	Key Environmental Sensitivities	30

7.4	Environmental Assessment	31
7.5	Preferred Flood Risk Management Option	34
8	Conclusions and Next Steps	35
8.1	Conclusions	35
8.2	Next Steps	35
	Appendices	36
	Appendix A. AFAs Option Drawings	37
	Appendix B. SEA Scoring Matrix	45

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 20 (The Bandon / Skibbereen 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 20. 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 20)

AFA	Preferred Flood Risk Management Option
Dunmanway	Option 2 (Storage on Brewery River / Flood Defences on Dirty River)
Inishannon	Option 1(Flood Defences)
Schull	Option 3 (Culvert (Schull Stream)/Storage(Meenvane Stream)

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.

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.

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

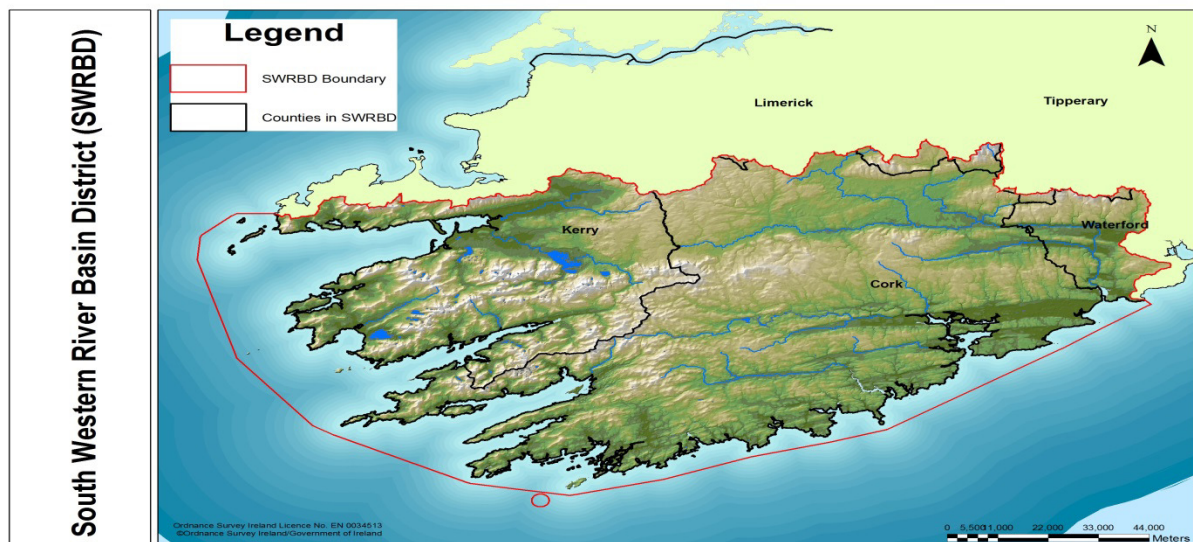
The OPW has commissioned a CFRAM study for each of Ireland's seven River Basin Districts (RBDs)².

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)



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);

achievement of environmental objectives laid down in Community legislation.

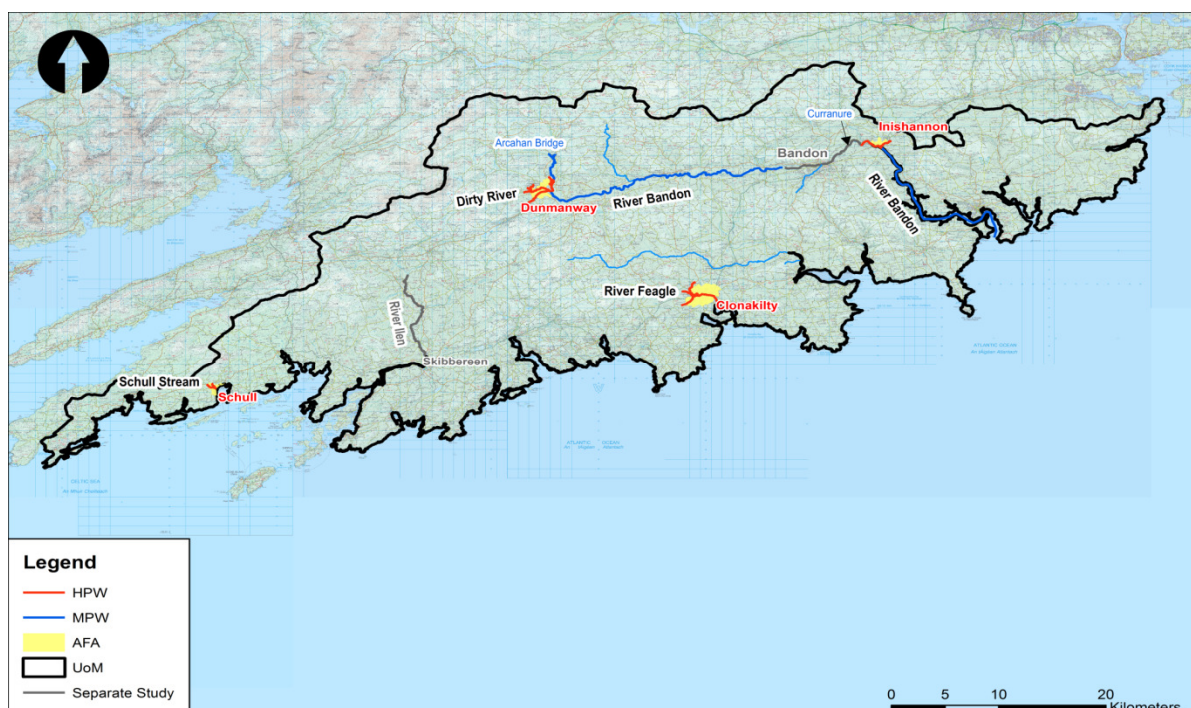
² River Basin Districts (RBDs) are the main units for the management of river basins and have been delineated by Member States under Article 3 of the Water Framework Directive (2000/60/EC). RBDs are areas of land and sea, made up of one or more neighboring river basins together with their associated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

³ UoMs are representative of Hydrometric Area boundaries.

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

Unit of Management 20, which forms part of the SWRBD covers an area of approximately 1,796 km². The entire area of UoM 20 is within County Cork. The main rivers within UoM 20 are the Bandon, the Ilan and the Argideen. There are four Areas for Further Assessment (AFAs) within UoM20 which include Dunmanway, Clonakilty⁴, Inishannon and Schull. Associated with the AFAs is over 46km of high and medium priority watercourse. Based on historical flood evidence, the key flood mechanisms in the UoM are tidal and fluvial.

Figure 1-2 UoM 20



⁴ It is of note that flood risk assessment and the development of management options for the town of Clonakilty was prioritised by the OPW as an accelerated works following significant flood events which occurred in 2012. The OPW have employed Mott MacDonald as consulting engineer to progress the preferred flood risk management option through statutory approval, detailed design and construction stages of development.

1.3 Purpose and Structure of this Report

1.3.1 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 20 (The Bandon / Skibbereen Catchment) the South Western River Basin District.

The purpose of this report is to:

- a) 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;
- b) Determine the benefits and impacts of the alternative options assessed and mitigation/environmental enhancement measures where considered appropriate;
- c) 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.

1.3.2 Report Structure

Table 1.2: 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 provided 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.

Chapter	Title	Purpose
5	Dunmanway	This chapter describes the flood risk management options for Dunmanway and the identification of the preferred option from an SEA perspective.
6	Inishannon	This chapter describes the flood risk management options for Inishannon and the identification of the preferred option from an SEA perspective.
7	Schull	This chapter describes the flood risk management options for Schull and the identification of the preferred option from an SEA perspective.
8	Conclusions and Next Steps	This chapter summarises the conclusions 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.

2.1.1 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

2.1.2 Structural Measures

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

Table 2.2: Structural Measures

Measure	Description
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

Measure	Description
	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.

2.2 Evaluating the Effectiveness of Flood Risk Management Options

2.2.1 Overview

The effectiveness of each of the viable flood risk management option (FRM) is measured in terms of how it achieves 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.

2.2.2 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
Just Failing Basic Requirement	Score in proportion to performance
Fully Failing Basic Requirement	-5

Option Performance	Score
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 SEA methodology as described in Chapter 3. This report has been prepared to describe the assessment of the FRM options against the environmental and social objectives.

The proposed measures may have separate positive and negative impacts under the same environmental objectives. In this case, the overall score for that environmental objective is the sum of the lowest negative score and the highest positive score. This can result in scenario's where although the overall score for an environmental objective is positive, there is a requirement for mitigation measures to ensure that the individual potential negative impacts of a measure is reduced as much as is feasible.

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 criterion.

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.

2.2.3 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:

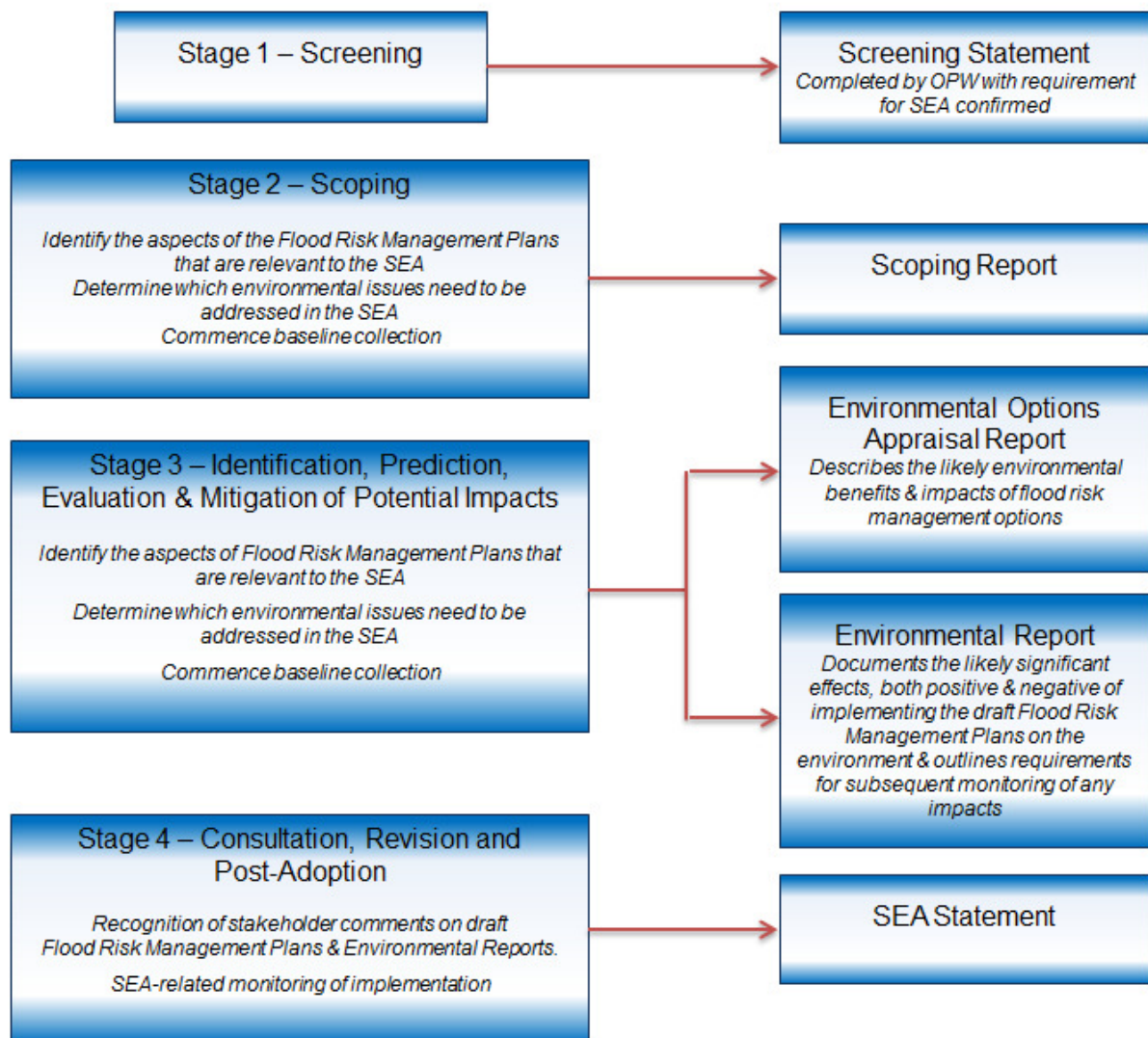
- **Screening** - the process of deciding whether the flood risk management plans would be likely to have significant environmental effects and as such would warrant a full SEA. The OPW conducted a screening assessment for the CFRAM studies in September 2011 which concluded that a full SEA is required.
- **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 landscape features and stepping stones.	(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.
	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	Avoid damage and reduce risk of flooding to, or loss of, features, institutions and collections of architectural value and their setting	Number of architectural assets at flood risk and assessment of impact on 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 has 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)

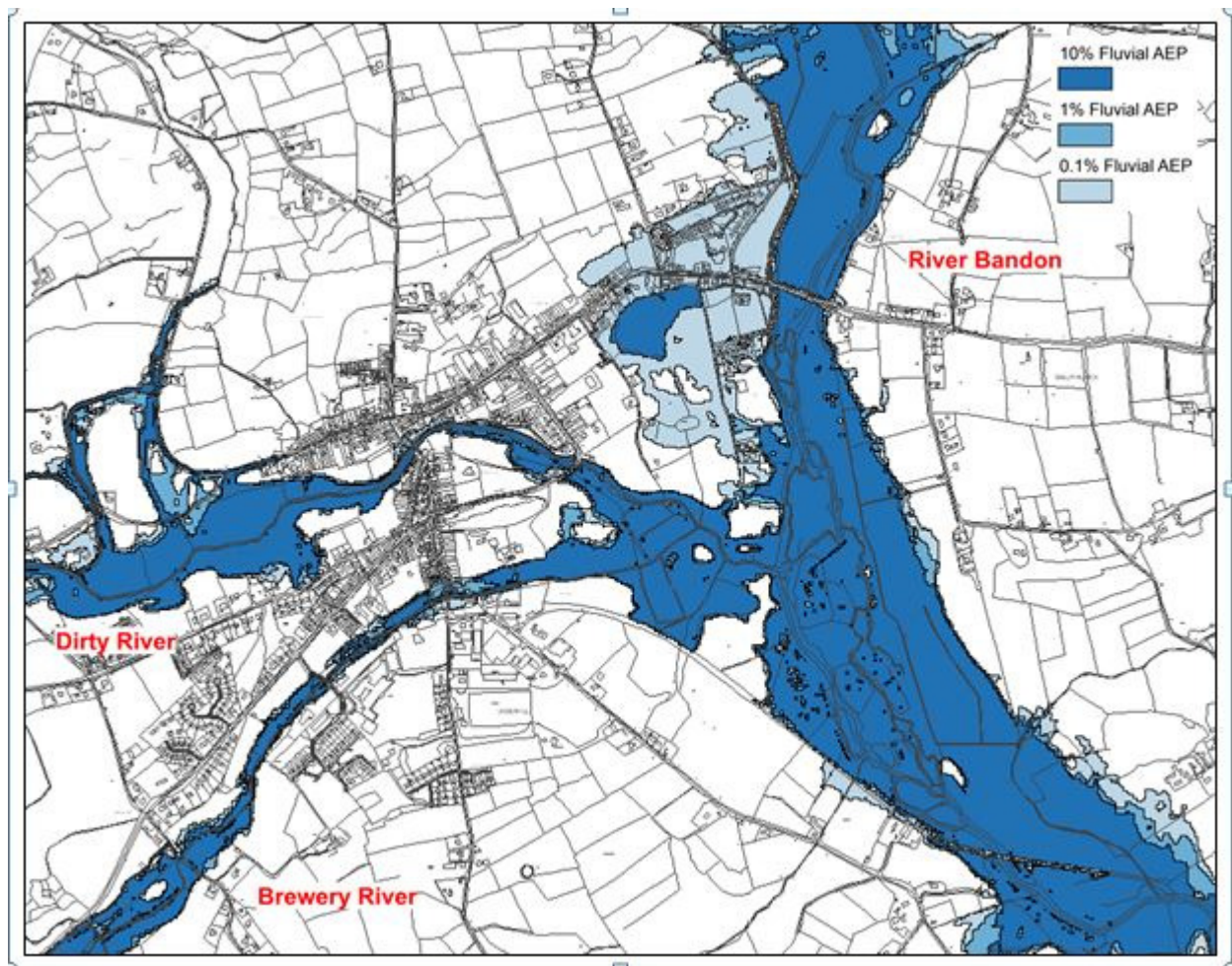
A separate draft Habitats Directive Screening (for Appropriate) Assessment has been developed to inform the Preliminary Options Report. The assessments have been included as an appendix to the Preliminary Options Reports.

5 Dunmanway

5.1 Flood Risk

Dunmanway is located at the confluence of the River Bandon and its tributaries (the Brewery and Dirty Rivers) in County Cork. Dunmanway is at risk of fluvial flooding. The AFA and the existing fluvial flood risk are depicted in Figure 5.1 below.

Figure 5.1: Dunmanway 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 considers the mitigation of flood risk through the construction of flood defences and localised protection works. These defences include walls and embankments. The locations and heights of the defences are provided in **Appendix A** of this report. The proposed flood defences fully achieves the required standard of protection for the 1% AEP fluvial event

Option 2 -Storage on Brewery River / Flood Defences on Dirty River- *This option considers the combination of an online storage area on Brewery River and the construction of flood defences along the River Dirty in the town at Bridge Street. A viable location for the storage of fluvial flows was identified on Brewery River which consists of a potential storage area of 204,800m². The proposed flood defences fully achieves the required standard of protection for the 1% AEP fluvial event.*

Option 3- Flow Diversion on Brewery River/ Flood Defences on Dirty River - This option aims to mitigate flood risk along the Brewery River by diverting flows to the Dirty River. The measure is considered in combination with the construction of local flood defences on Dirty River. The locations and heights of the defences are provided in **Appendix A** of this report. The proposed flood defences fully achieves the required standard of protection for the 1% AEP fluvial event.

5.3 Key Environmental Sensitivities

The key environmental sensitivities of the Dunmanway are summarised as follows;

- Dunmanway is located at the confluence of the River Bandon and its tributaries the Brewery and Dirty Rivers. The Dirty River and River Brewery and its tributaries are generally classified as having moderate status under the WFD and are at risk of not achieving good status. The rivers are not considered to be nutrient sensitive waterbodies.
- There are no significant polluting sources within the 1% AEP fluvial extent within the AFA;
- The Brewery and Dirty rivers are considered as part of the Bandon River Special Area of Conservation (SAC). The River Bandon SAC is designated for a number of Annex I habitats and Annex II species, the majority of which are aquatic or are dependent on flooding;

- The Bandon River is recognised as an important river to support brown trout and salmon species by Inland Fisheries Ireland. The river is not designated as a salmonid watercourse [under the European Communities (Quality of Salmonid Waters) Regulations, 1988]. IFI has developed a series of angling guides for Ireland which include on-shore angling vantage points at the River Bandon.
- Dunmanway is within the Bandon / Caha Freshwater Pearl Mussel (FPM) catchment. Sedimentation is a particular problem for Freshwater Pearl Mussel⁵. Targeted FPM surveys were conducted along the River Bandon in April 2013 as part of the CFRAM study for the SWRBD. The study findings showed good Freshwater Pearl Mussel (FPM) populations at and upstream of Long Bridge (for approximately 2km). There were no findings of mussels downstream of Long Bridge (note the FPM survey extended approximately 4km downstream of Long Bridge to beyond Bealboy Bridge). No live FPM were recorded on the Dirty River.
- According to the Cork County Development Plan (2014), there are no landscape sensitive areas within Dunmanway. The approach road to Dunmanway along Castle Street is designated a scenic route.
- Receptors at risk 1% AEP within the AFA:
 - 7 No. Residential Properties;
 - 21 No. Non-Residential Properties;
 - 6 No. Roads at risk.
- There are no designated architectural sites and building (NIAHs⁶) or recorded monuments and sites (RMPs⁷) at risk from the 1% AEP fluvial flood extent within the AFA. There are no high vulnerability properties or social infrastructure and amenity sites at risk from fluvial flooding 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** and summarised in the legend below.

⁵ E. A. Moorkens (1999) Conservation Management of the Freshwater Pearl Mussel (*Margaritifera margaritifera*). Part 1: Biology of the species and its present situation in Ireland. Irish Wildlife Manuals, No. 8

⁶ NIAH- National Inventory of Architectural Heritage Site.

⁷ The Record of Monument and Places (RMP) is a statutory list of all known archaeological monuments provided for in the National Monuments Acts. A (RPS) protected structure is a structure that a planning authority considers to be of special interest from an architectural, historical, archaeological, artistic, cultural, scientific, social or technical point of view

Table 5.1: Dunmanway Options Scoring Matrix – Social and Environmental Objectives

SEA Objectives	Do nothing		Option 1		Option 2		Option 3	
Social Objectives	Impact	Mitigation Required	Impact	Mitigation Required	Impact	Mitigation Required	Impact	Mitigation Required
Human Health and life of residents	O	N	√√√	Y	√√√	Y	√√√	Y
High vulnerability properties	O	N	O	N	O	N	O	N
Social infrastructure and amenity	O	N	O	N	O	N	O	N
Risk to local employment	O	N	√√√	Y	√√√	Y	√√√	Y
Environmental Objective								
WFD Directive	O	N	X	Y	X	Y	X	Y
Birds and Habitats Directive	O	N	X	Y	X	Y	X	Y
Flora and Fauna	O	N	O	Y	XX	Y	O	N
Fisheries	XX	Y	X	Y	√	Y	XX	Y
Landscape	O	N	X	Y	XX	Y	O	N
Architectural Heritage	O	N	O	N	O	N	O	N
Archaeological Heritage	O	N	O	N	O	N	O	N

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	XX	Partly failing minimum target
-4	XX	
-5	XX X	Fully failing minimum target
-999.99	XX X	Unacceptable negative impact where feasible alternative exists

There is potential for short term negative construction impacts resulting in discharges of elevated quantities of sediment to the waterbodies for all options if construction practices are not carefully managed. Lamprey is a qualifying feature of the Bandon River SAC. In the absence of mitigation, sediment can infill the interstitial spaces of spawning gravels leading to deterioration in habitat quality. Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation may also be represented within the river. Sedimentation or pollution of the watercourse at this location may result in deterioration of this habitat through inhibition of photosynthesis. The significance of impact can be mitigated against by appropriate staging of the works, provision of buffer/separation distances from sensitive habitats and provision of sediment controls on site.

Each of the proposed options includes the construction of a flood defence wall along the River Dirty. It is considered that the construction could result in accidental release of pollutants to the watercourses, but this can be mitigated through proper site management. The embankment in Dunmanway South is set back approximately 50m from the Dirty River. There is a sufficient vegetated buffer between the works and the river to capture any potential sediment runoff.

Option 3, has potential to cause sedimentation of the watercourses during culvert (inlet and outlet) construction and when excavating trenches near the watercourses. The addition of significant quantities of sediment to the river has potential implications for FPM in the Bandon River. It should be noted however that the FPM survey carried out on the Bandon River downstream of the confluence with the Brewery River, as part of the CFRAM study, found no evidence of FPM and as a result the conservation objectives for FPM cannot therefore be impacted.

The construction of the on line storage for Option 2 will have a recurring impact on the hydrology of the river the provision of the storage area will reduce flooding and risk of pollution downstream and within the River Bandon. It is noted that there are records (NBDC⁸) of badger within the woodland immediately beside the proposed storage area. Also the location has a high bat suitability index. The proposed works will have the potential to cause disturbance to species of conservation concern through physical presence of construction machinery and personnel, noise generated by the works and possibly artificial lighting that may be used in the darker winter months or during evening/night works.

There are no designated architectural sites and building (NIAHs) or recorded monuments and sites (RMPs) at risk 1% AEP fluvial flood extent within the AFA. All options will have a neutral effect on the archaeological and archaeological heritage within the town.

According to the Cork County Development Plan (2014) Dunmanway is located within an area characterised as “Broad Fertile Lowland Valley” landscape character type. The landscape type is deemed to be of medium value and medium sensitivity and of local value. All of the proposed options will have a neutral impact on the landscape amenity of the area.

⁸ National Biodiversity Data Centre

All of the options are similar in terms of these potential impacts on landscape amenity value. The proposed construction works will have short term impacts on the medium value landscape.

There are no high vulnerability properties or social infrastructure/amenity sites at risk from fluvial flooding within the AFA. Each of the options considered above score the same in regard to the protection the measures provide to human health and life of residents and protection provided to local employment within the AFA.

5.5 Preferred Flood Risk Management Option

On the basis of the detailed evaluation as summarised above, Option 2, 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 dependent fisheries.

6 Inishannon

6.1 Flood Risk

Inishannon is located along the River Bandon and is at risk of both fluvial and tidal flooding. However, the greater risk is from fluvial flooding. The AFA and the existing flood risk for fluvial and tidal flooding are depicted in Figure 6.1 and Figure 6.2 below.

Figure 6.1: Innishannon Current Scenario Fluvial Flood Extents

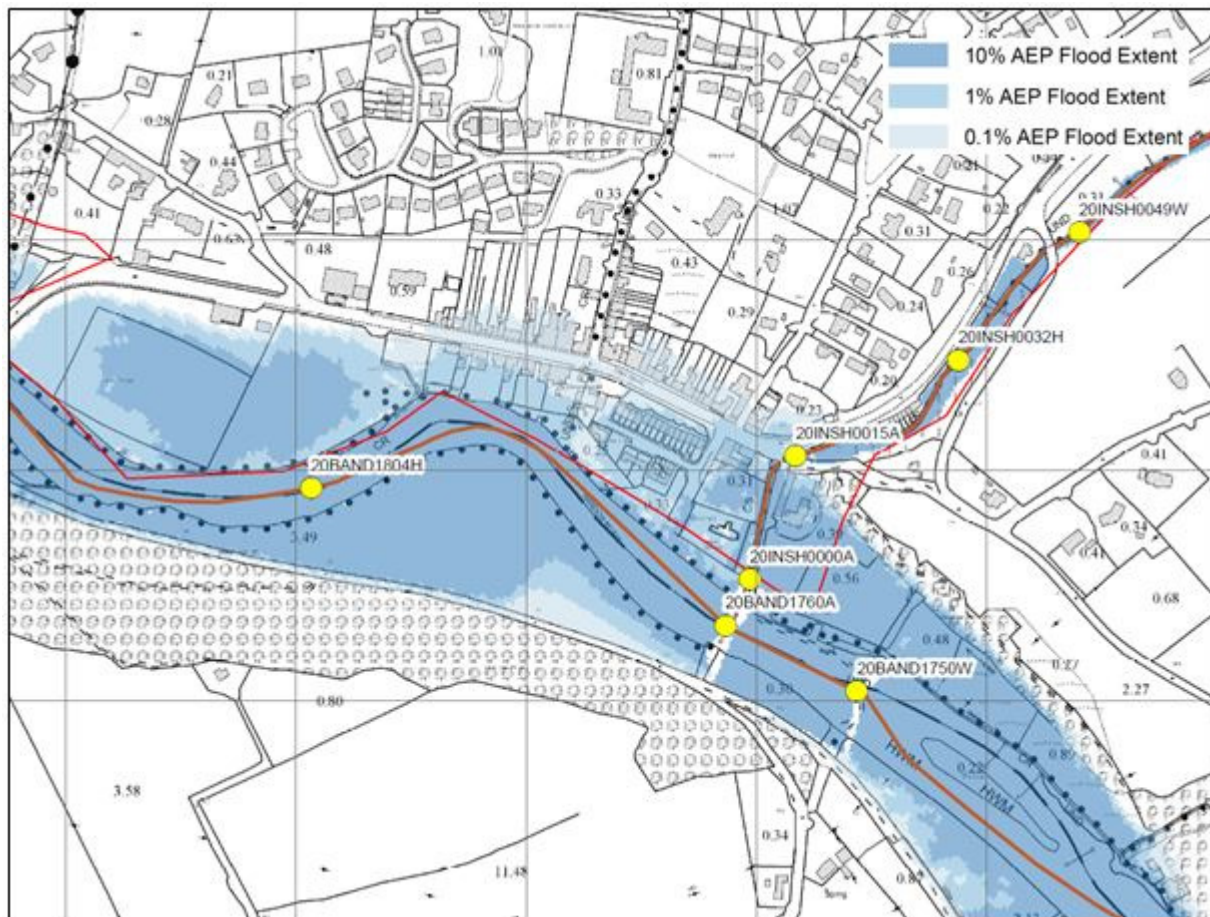
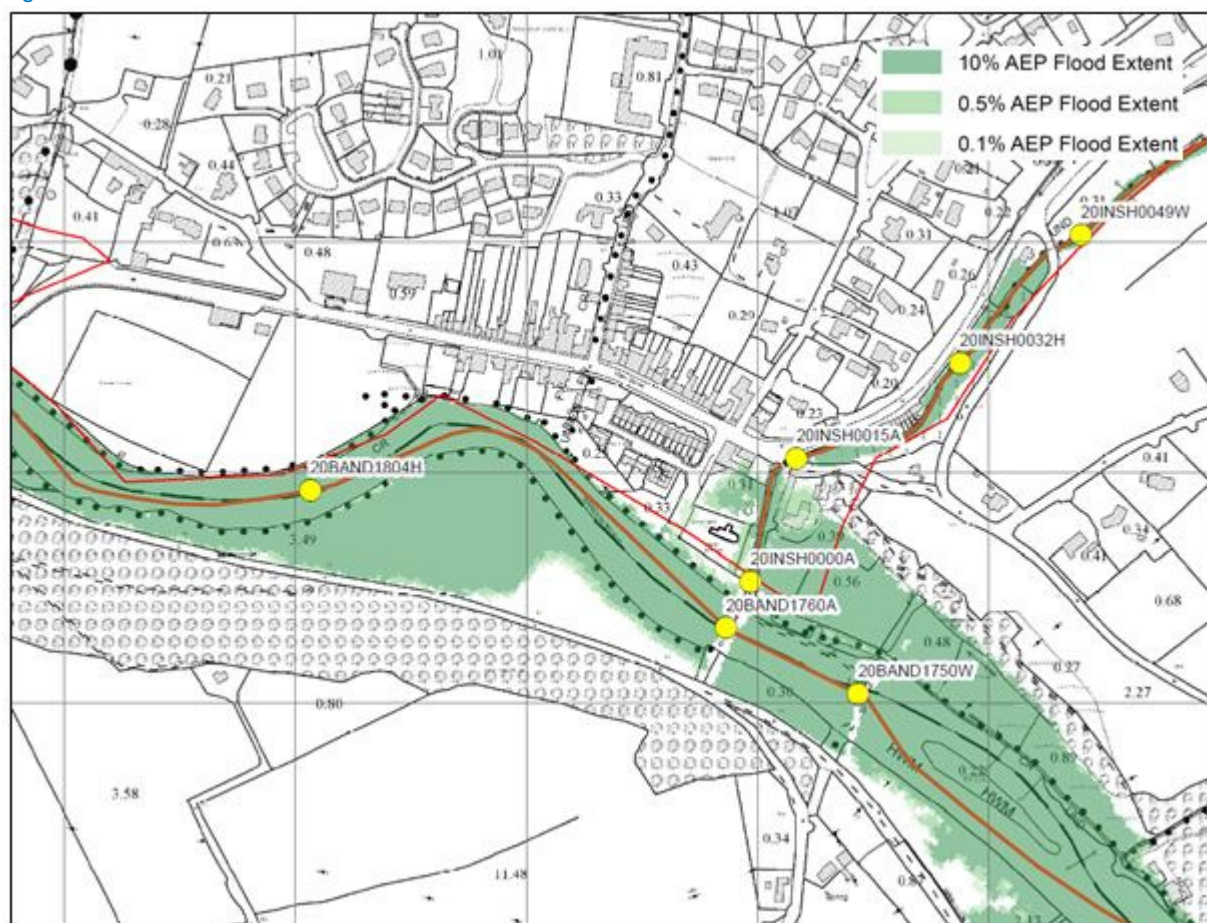


Figure 6.2: Inishannon Current Scenario Tidal Flood Extents



6.2 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 considers the mitigation of flood risk through the construction of flood defences and localised protection works. These defences include walls and embankments. The locations and maximum height of the defences is shown in **Appendix A** of this report. The proposed flood defences fully achieves the required standard of protection for the 1% AEP fluvial event and the 0.5% AEP tidal event.

6.3 Key Environmental Sensitivities

- Inishannon is located along the River Bandon and is at risk of both fluvial and tidal flooding. The Bandon River is classified as having a good water status under the WFD. It is considered a sensitive waterbody.
- There is large septic tank at risk from recurring flooding and in the absence of measures this significant polluting source in the town will result in recurring risk of flooding and impediment of ensuring a good water status within the WFD.
- It is noted that there are no Natura 2000 sites within the AFA. The Bandon River is recognised as an important river to support salmon species and important fishing potential.
- Inishannon is not located within an area designated for high value landscape. However the approach to the town is located along a scenic route (N71). The River Bandon valley is designated as a proposed Natural Heritage Area (pNHA). Innishannon is located within the lowland valley landscape character area and considered to be of local importance and medium sensitivity.
- Receptors at risk 1% AEP within the AFA:
 - 24 No. Residential Properties
 - 17 No. Non- Residential Properties
 - 7 No. RMP
 - 9 No. NIAH
 - 2 No. Roads at risk.
- Receptors at risk 0.5% AEP tidal extent within the AFA;
 - 2 No. Residential Properties

- 4 No. NIAH
 - 2 No. Roads at risk
- There are no high vulnerability properties or social infrastructure and amenity sites at risk from fluvial or tidal flooding within the AFA.

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: Inishannon Options Scoring Matrix –Social and Environmental Objectives

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

SEA Scoring Matrix

Score	Key	Description
+5	√√√	Achieving aspirational

+4	√√	target
+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	X X X	Fully failing minimum target
-999.99	X X 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 proposed measures will be set back from the river bank otters holts typically occur within close proximity or within the bankside of the rivers and therefore the measures will unlikely have any direct impact on otter holts in the vicinity of the river.

The River Bandon is recognised as an important river for support salmon species and it recognised as having significant fishery value. The proposed works will not directly impact on the River Bandon, however there is an embankment on the tributary within the town which may require excavation of the bank of stream during the construction stage. This would result in short term emissions of sediment to the waterbody and downstream on the River Bandon without appropriate mitigation measures being implemented. There is a potential need for access restrictions to the local fishery for during the construction stage.

Inishannon is not located within an area designated for high value landscape. The proposed measures are outside the pNHA boundary. Innishannon is located within the lowland valley landscape character area and considered to be of local importance and medium sensitivity. The proposed measures are not visible along the approach and through flow traffic within the town. The proposed measures include 2m high embankments to the rear of properties within the residential estate. Currently views from the rear of these properties are obscured by existing vegetation and screening within the extent of the pNHA. 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.

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.

6.5 Preferred Flood Risk Management Option

Option 1 is considered to be the preferred option. This option was selected as it provides flood protection for a number of designated architectural and archaeological sites of importance within the town.

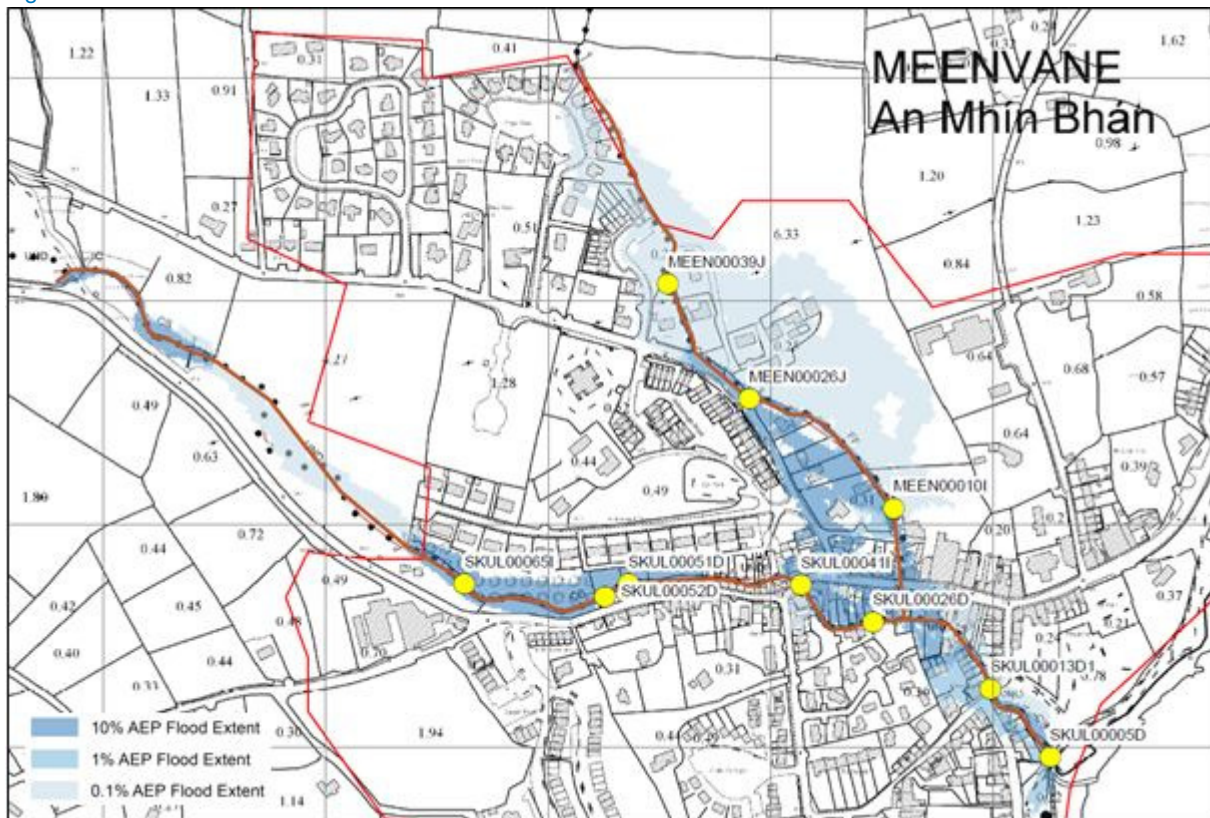
Mitigation actions are recommended for the identified negative effects. The key recommendation is that these negative impacts should be considered during the next stage of option development, when the alignment of the proposed defences and details of the option would be optimised through detailed design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

7 Schull

7.1 Flood Risk

Schull is located on the coast at the confluence of the Schull and Meenvane Streams and is at risk of fluvial flooding. Due to its elevation, Schull is not at risk of tidal flooding. The AFA and the existing fluvial flood risk are depicted in Figure 7.1 below.

Figure 7.1: Schull Current Scenario Fluvial Flood Extents



7.2 Viable Flood Risk Management Options

A number of viable flood risk mitigation 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. SEA scoring for the purpose of this appraisal is provided in **Appendix B** of this report.

Option 1 Storage Area (Schull Stream)/ Storage Tank (Meenvane Stream) – This option includes the construction of an online storage area on the Schull Stream and a storage tank on the Meenvane Stream. The proposed Schull Stream storage area is 15,130m². The proposed location for storage on the Schull Stream aims to utilise the existing topography. However, it will require excavation within the proposed area to lower ground levels to ensure there is sufficient capacity. On Meenvane Stream there are no suitable locations to utilise the topography for storage. Therefore, it will be necessary to construct a storage / attenuation tank. The proposed tank is 3,025m² and 4m deep with an invert level of 42m OD Malin. The tank is located on a slope which will require excavation of approx. 5m at the upstream side. The tank will operate like a backdrop manhole where the inlet and outlets will tie in with existing bed levels. The stream will be diverted into the tank at the upstream end at approx. 46m OD Malin and drop 4m within the tank where it will discharge to the watercourse at the existing bed level of 42m OD Malin. This approach is required due to the slope of the stream and the site. The proposed flood defences fully achieves the required standard of protection for the 1% AEP event.

Option 2- Storage (Schull Stream)/Diversion (Meenvane Stream) - This option includes for a combination of online storage on the Schull Stream and diversion of the Meenvane Stream. The storage area is approximately 15,130m². It is proposed to divert the stream to a separate watercourse using a 2.1m wide by 1.0m high culvert. The proposed option fully achieves the required standard of protection for the 1% AEP event.

Option 3 – Culvert (Schull Stream)/Storage (Meenvane Stream) - This option aims to protect properties through the construction of a culvert in the town in combination with storage tank on the Meenvane stream. The culvert on the Schull Stream has developed from an existing bridge crossing and has effectively been extended 80m upstream by landowners paving over the stream to the rear of their properties. There are also a number of manholes along this section. The paving and manholes are not watertight and are subject to surcharging. It is proposed to replace this section with a culvert (2.1m x 1.0m) and seal the existing manholes to prevent surcharging. The proposed option fully achieves the required standard of protection for the 1% AEP event.

Option 4- Culvert (Schull Stream)/Diversion (Meenvane Stream) – This option includes a combination of diversion of the Meenvane stream and a culvert in the town. The proposed option fully achieves the required standard of protection for the 1% AEP event.

7.3 Key Environmental Sensitivities

- The Schull Stream rises upstream of Schull (town) before flowing in a south easterly direction to enter various culverts through the town and outfall into Schull harbour by the slipway.
- The Meenvane Stream rises upstream of the Cape View estate and flows in a southerly direction before entering along culvert to join the Schull Stream south of Main Street.
- Schull is situated adjacent to Roaringwater Bay and Islands SAC. The site is designated for a number of Annex I habitats and Annex II species, the majority of which are aquatic or are dependent on regular inundation.

- The water body status of the Schull Stream and Meenvane Stream are not as yet classified under the WFD, however the Roaringwater bay is an SAC and classified as having a high water status. There are no significant polluting sources at risk from flooding within the AFA.
- According to the Cork County Development Plan (2014), Schull is located within an area classified as having a high landscape value. The approach to the town from Ballydehob and Lowertown are scenic routes. Schull is located within a very high value landscape of national importance and high sensitivity.
- Receptors at risk 1% AEP within the AFA:
 - 25 No. Residential Properties
 - 22 No. Non-Residential Properties
 - 1 No. Social Amenity Site
 - 9 No. NIAH
 - 2 No. Roads at risk
- There are no designated RMP's within the 1% AEP flood extent within the AFA. There are no high vulnerability properties at risk from fluvial within the AFA.

7.4 Environmental Assessment

The potential impacts arising for each of the proposed options has been assessed in detail in the Multi-criteria analysis which is in **Appendix C** of this document. 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.

Table 7.1: Schull Options Scoring Matrix – Social Objectives and Environmental Objectives

SEA Objectives	Do nothing		Option 1		Option 2		Option 3		Option 4	
Social Objective	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation	Impact	Mitigation
Human Health and life of residents	O	N	√√√	N	√√√		√√√		√√√	
High vulnerability properties	O	N	O	N	O	N	O	N	O	N
Social infrastructure and amenity	O	N	√√√	N	√√√	N	√√√	N	√√√	N

SEA Objectives	Do nothing		Option 1		Option 2		Option 3		Option 4	
Risk to local employment	O	N	√√	N	√√	N	√√	N	√√	N
Environmental Objective										
WFD Directive	O	N	XXX	Y	XXX	Y	XXX	Y	XXX	Y
Birds and Habitats Directive	O	N	O	N	O	N	O	N	O	N
Flora and Fauna	O	N	XX	Y	XX	Y	XX	Y	XX	Y
Fisheries	O	N	XXX	Y	XXX	Y	XXX	Y	XXX	Y
Landscape	O	N	XXX	Y	XXX	Y	XX	Y	XX	Y
Architectural Heritage	XX	Y	√√	Y	√√	Y	√√	y	√√	Y
Archaeological Heritage	X	N	O	N	O	N	O	N	O	N

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	XX	Partly failing minimum target
-4	XX	
-5	XXX	Fully failing minimum target
-999.99	XXX	Unacceptable negative impact where feasible alternative exists

The qualifying features of the Roaring Water Bay SAC are marine features. The proposed measures within each option are confined to inland areas and as such there is no potential for direct impact on the habitats and species of conservation importance. There are no likely impacts on the Annex I habitats that occur in Schull Harbour. Therefore there are no preferences between the options having regard to potential impacts associated with the Birds and Habitats Directive objective.

Having regard to the WFD Directive, there is no significant polluting source at risk from fluvial flooding. Each of the options however, will have potential for short term negative construction impacts resulting in emissions of sediment to the waterbodies if not effectively planned and managed.

An on-line storage area measure is considered for two options, option 1, and option 2 the construction of this storage area will result in permanent change in existing landscape form in the locality prior to mitigation.

An on-line storage tank on the Meevnane Stream is considered in combination with local flood protection measures for two options, option 1 and option 3. The proposed tank is 3,025m² (55mx55m) and 4m deep. The tank is located on a slope which will require excavation of approximately 5m at the upstream side. The tank will operate like a backdrop manhole where the inlet and outlets will tie in with existing bed levels. The stream will be diverted into the tank at the upstream end where it will discharge to the watercourse at the existing bed level. This approach is required due to the slope of the stream and the site. This measure will cause an obstruction to fish within the stream channel when the control structure is restricting flows.

It is noted that the Schull Stream may run along the rear gardens of a number of dwellings along Main Street. The culvert measure included in Option 3 and Option 4 is proposed on the Schull Stream, at a location where it crosses Main Street at the Bunratty Inn. This culvert has developed from an existing bridge crossing and has effectively been extended 80m upstream by landowners paving over the stream to the rear of their properties. There are also a number of manholes along this section. The paving and manholes are not watertight and flows exit these structures when the culvert capacity is reached and the structures are subject to surcharging, site restrictions and the proximity of the culvert to a number of buildings will result in significant temporary adverse impacts on these properties.

Option 2 and Option 4 includes a measure to divert the Meenvan Stream to a separate watercourse using a 2.1m wide by 1.0m high culvert. Once constructed the river diversion along the Meenvan Stream will be at ground level and will not be visible from the scenic route.

During the engineered nature of the waterbodies, Schull Stream and Meenvan Stream are unlikely to have any potential as juvenile habitat for fish species and potential impacts are limited. The option 1 and option 3 storage tank measure on the Meenvan Stream will result in a permanent loss of fisheries habitat and morphology of the stream. Whereas the extensive culvert measure proposed within option 2 and option 4 will result in a permanent diversion of flow and result in the loss of localised fisheries habitat and hydrological and morphology of both stream.

Once constructed the storage tank along the Meenvan Stream will be at ground level and given the local topography will not be visible from the scenic routes. Option 1 and Option 2 includes for the construction of a storage area, the proposed measures include the construction of 2.5m embankment along the Schull stream, given the local topography and the existing wide expansive views within the area this measure is likely to be visible from the scenic roads and will result in a permanent change in the landscape prior mitigation.

Each of the 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 employment within the AFA. There are no high vulnerability properties within the AFA therefore the score for the protection of this objective is neutral.

7.5 Preferred Flood Risk Management Option

In terms of the environmental objectives, do-nothing scenario is preferred. However, in terms of the social objectives do something is always preferable, each of the viable options achieve aspirational targets set out to minimise flood risk to residential properties and risk to the community within the AFA. On the basis of the evaluation included in Appendix C and summarised above, Option 3 is considered to be the preferred viable option in regard to the SEA objectives.

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 Roaring Water Bay SAC.

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
Dunmanway	Option 2 (Storage on Brewery River / Flood Defences on Dirty River)
Inishannon	Option 1(Flood Defences)
Schull	Option 3 (Culvert (Schull Stream)/Storage(Meenvane Stream)

8.2 Next Steps

The findings from the evaluation of alternatives having regard to the SEA objectives 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.

Appendices

Appendix A. AFAs Option Drawings	37
Appendix B. SEA Scoring Matrix	45

Appendix A. AFAs Option Drawings

Figure A.1: Dunmanway Option 1 Flood Defences/Localised Protection Works

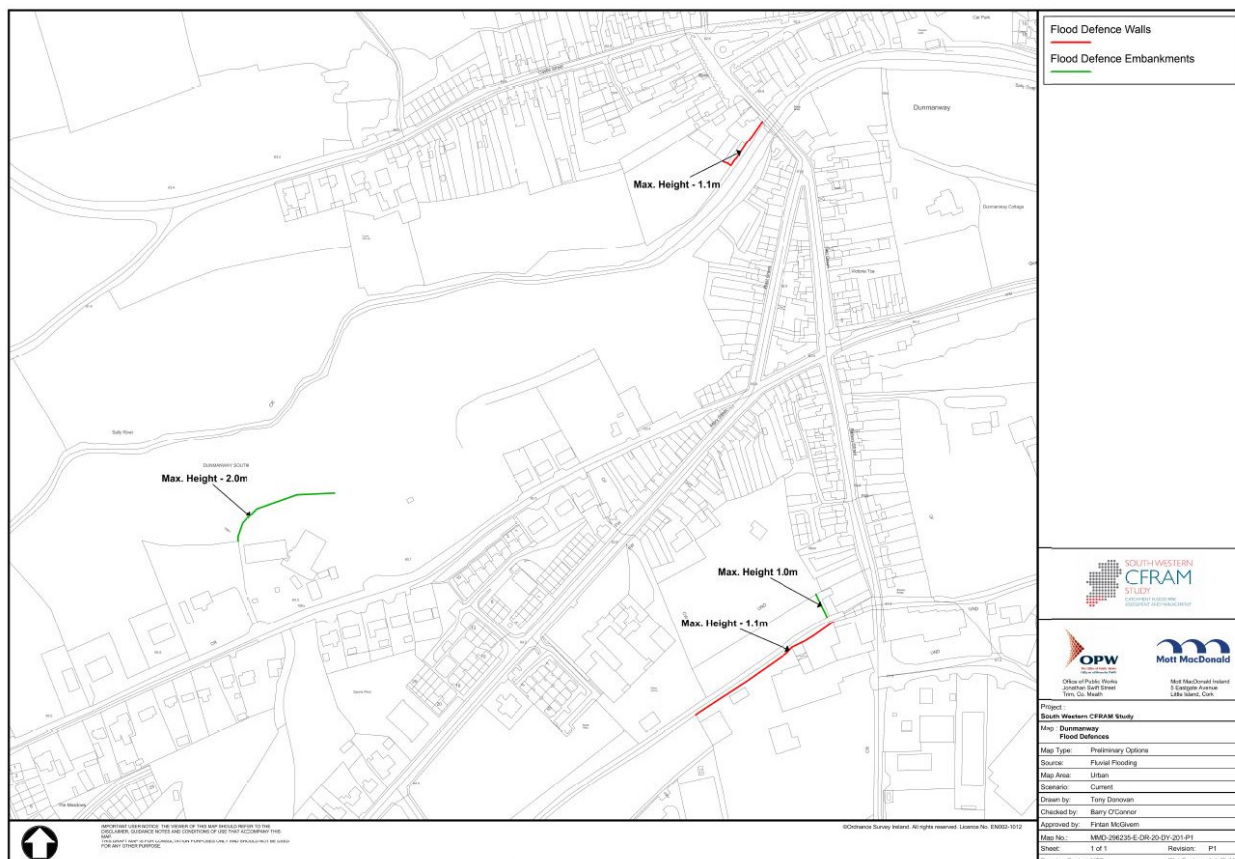


Figure A.2: Dunmanway Option 2 Storage on Brewery River/Flood Defences on Dirty River

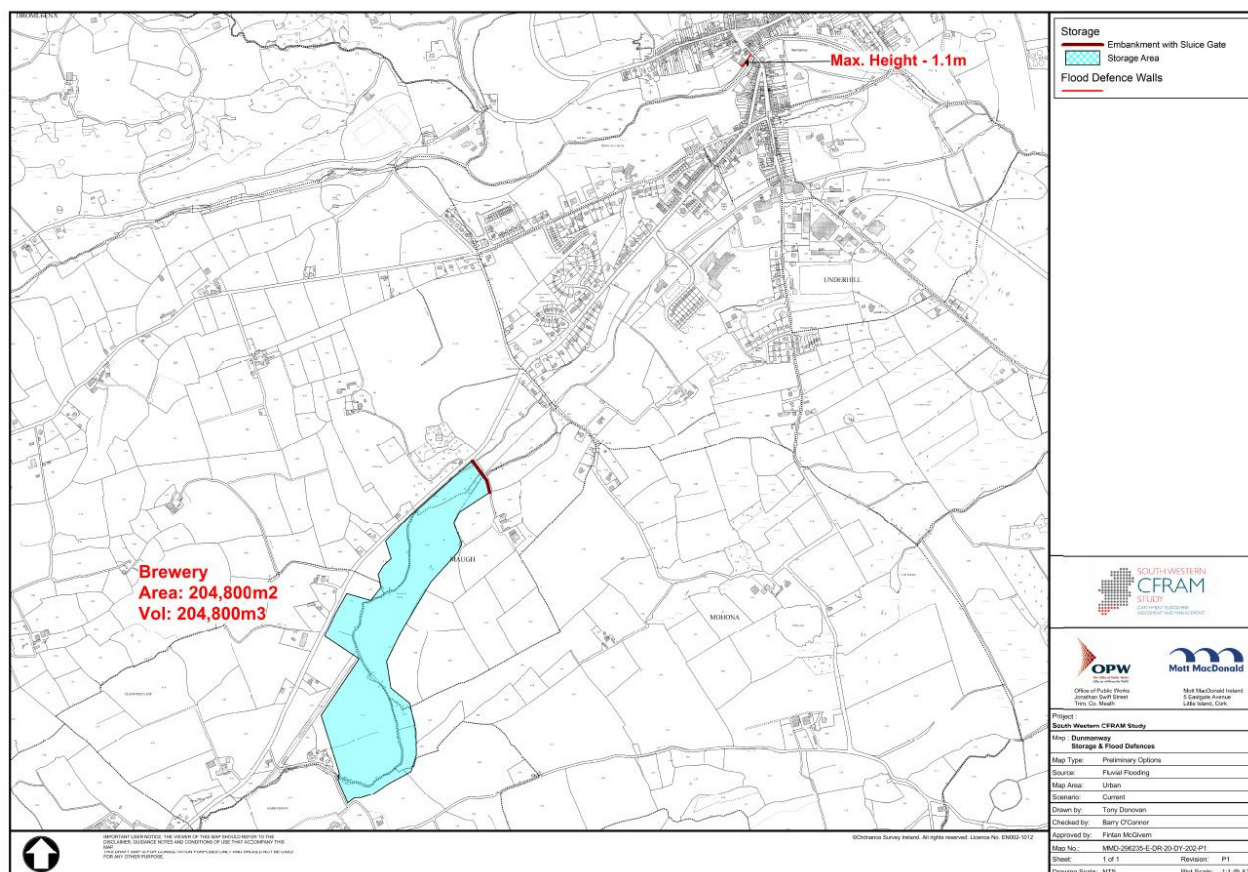


Figure A.3: Dunmanway Option 3 Flow Diversion on Brewery River/Flood Defences on Dirty River

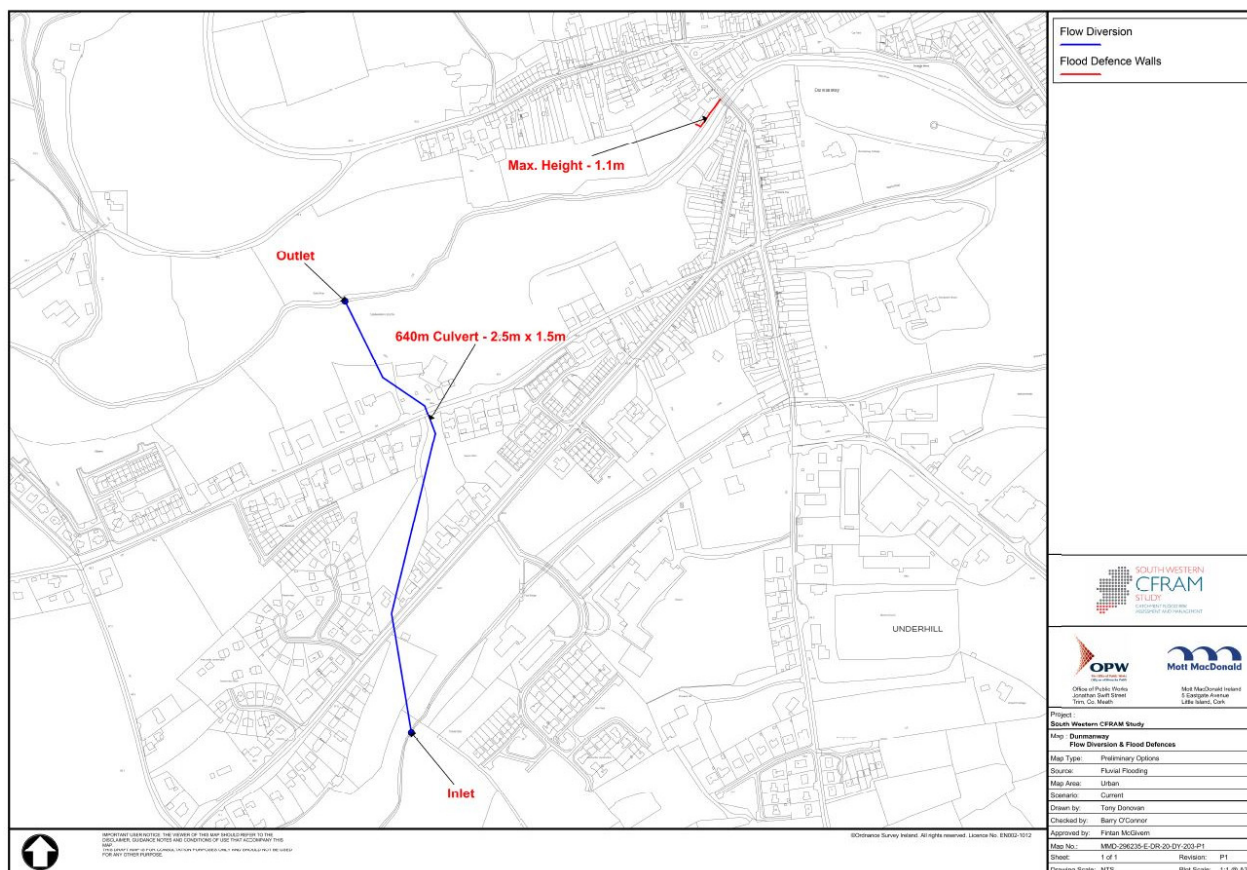


Figure A.4: Inishannon Option 1 Flood Defences/ Localised Protection Works

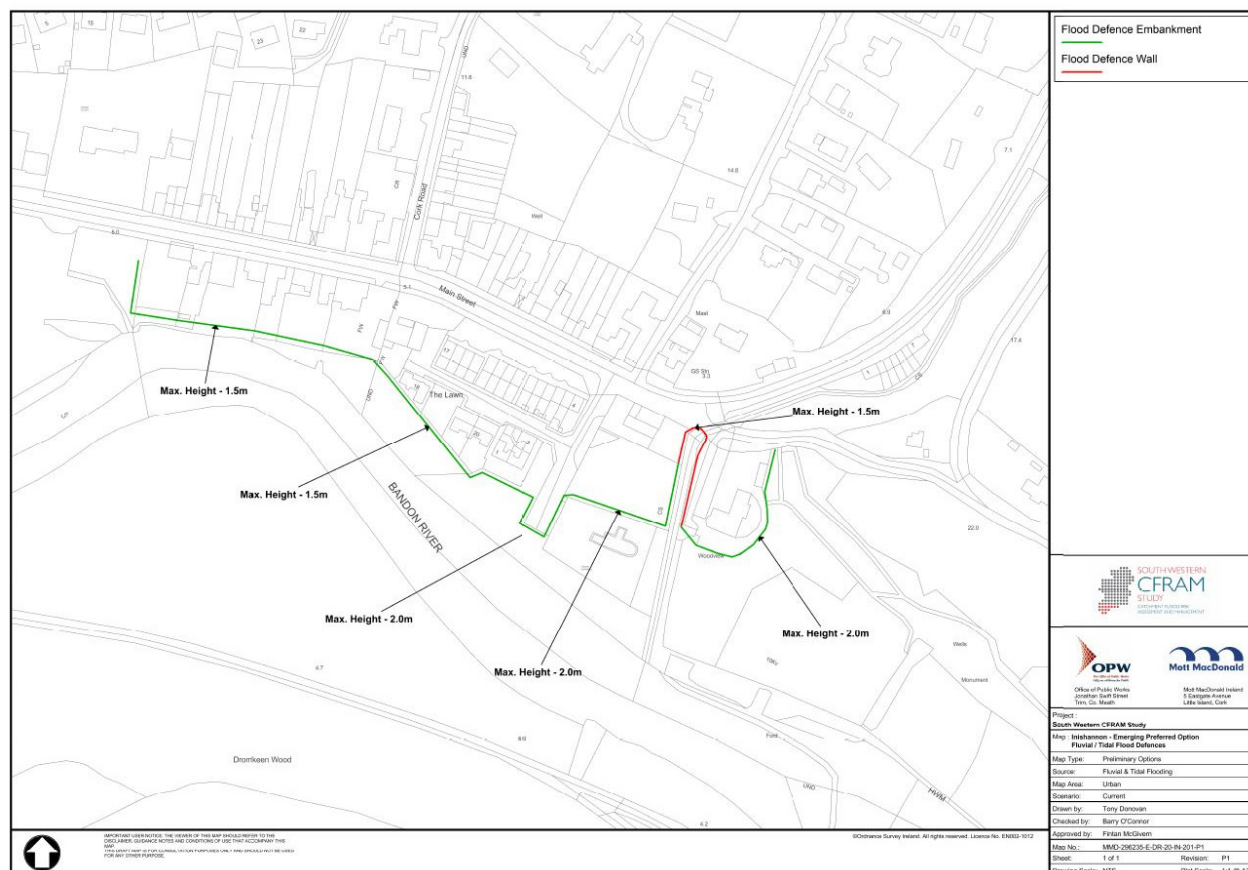
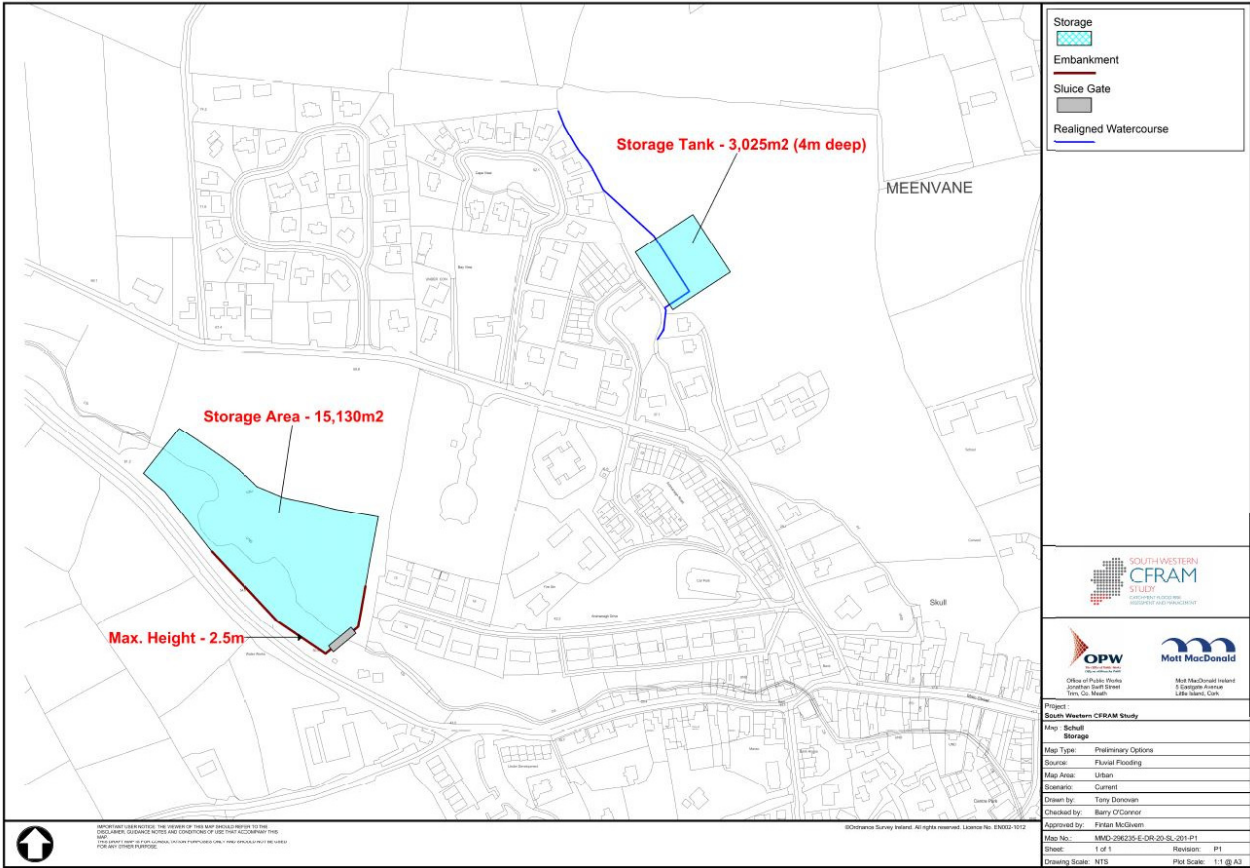


Figure A.5: Schull Option 1 Storage



Storage Area - 15,130m²

656m Culvert - 2.1m x 1.0m

Max. Height - 2.5m

MEENVANE

Legend:

- Storage
- Embankment
- Sluice Gate
- Flow Diversion

Project: South Western CFram Study

Map: Storage & Flow Diversion

Map Type: Preliminary Options

Source: Flood Flooding

Map Area: Urban

Scenario: Current

Drawn by: Tony Donovan

Checked by: Barry O'Connor

Approved by: Pádraig McDermott

Map No.: MMD-296235-E-OR-20-SS-202-P1

Sheet: 1 of 1

Revision: P1

OPW and Mott MacDonald are not responsible for the accuracy of the information provided in this map. The user must verify the accuracy of the information provided in this map for their own use.

Storage Tank - 3,025m² (4m deep)

Culvert (2.1m x 1.0m) & Seal Manholes

MEENVANE

Legend:

- Storage (Blue square)
- Realigned Watercourse (Blue line)
- Culvert (Yellow line)

South Western CEFAM Study

OPW
Office of Public Works
James's Gate, Dublin 8, Ireland

Mott MacDonald
Mott MacDonald Ireland
11, Leinster House, Dublin 2, Ireland

Project: South Western CEFAM Study

Map: Flood Defences & Storage

Map Type: Preliminary Options

Source: Flood Posing

Map Area: Urban

Scenario: Current

Drawn by: Terry Donohue

Checked by: Barry O'Connor

Approved by: Frances McDermott

Map No.: MWMD-256235-E-DR-20-SS-203-P1

Sheet: 1 of 1

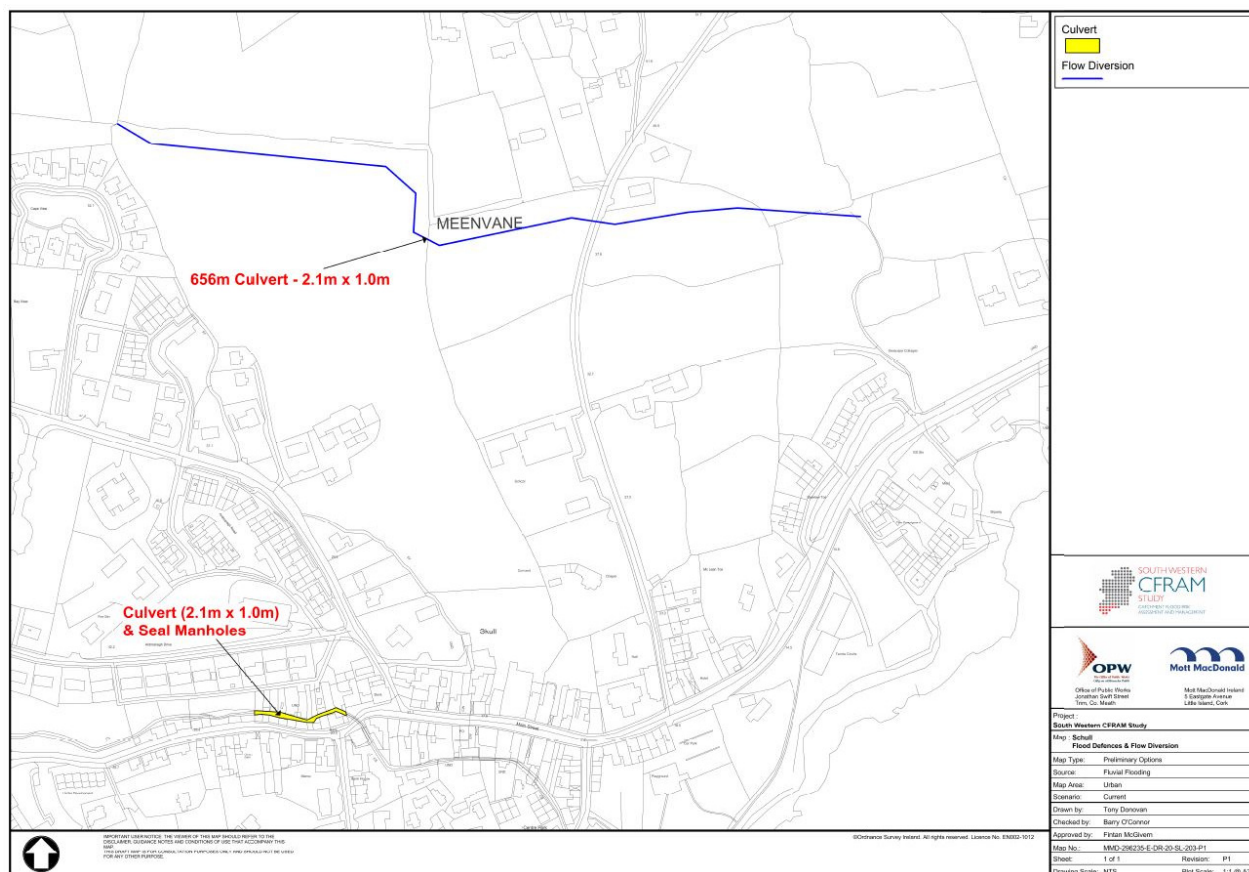
Revision: P1

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Figure A.8: Schull Option 4 Flood Defences (Schull Stream) / Flow Diversion (Meenvane Stream)



Appendix 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	X X X	Fully failing minimum target
-999.99	X X 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: UoM
20

December 2015

Office of Public Works

South Western CFRAM Study

Screening for Appropriate Assessment: UoM
20

December 2015

Office of Public Works

Jonathan Swift Street
Trim
Co. Meath

Issue and revision record

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B	22 December 2015	R. Mansfield	B. O' Connor	F. McGivern	

Information class: Standard

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Contents

Chapter	Title	Page
	Executive Summary	i
1	Introduction	4
1.1	Flood Risk Assessment and Management in Ireland	4
2	Appropriate Assessment	6
2.1	Statutory Requirement for Appropriate Assessment	6
2.2	Appropriate Assessment – The Process	7
2.3	Objective of Appropriate Assessment Screening	8
2.4	Methodology	9
2.5	Statement of Authority	10
2.6	Consultation	10
3	Description of the Plan	11
3.1	Flood Risk Management Plan	11
3.2	Overview of the South Western River Basin District	12
3.2.1	Units of Management in the SWRBD	12
3.3	Flood Risk Management Options	13
3.4	The Bandon - Skibbereen Catchment (UoM20)	15
3.4.1	Areas for Further Assessment in UoM 20	16
3.5	Flood Risk Management Options for Bandon / Skibbereen UoM	17
3.5.1	Non-Structural Measures	17
3.5.2	Structural Measures	18
3.6	Flood Risk Management Options with Potential for Significant Effects on Natura 2000 Sites	19
3.6.1	Potential Impacts of Non-Structural Options in UoM 20	20
3.6.2	Potential Impacts of Structural Options in UoM 20	21
4	Characteristics of Natura 2000 Sites	24
4.1	Natura 2000 Sites within the Zone of Impact	24
4.2	Likelihood of Impacts on Natura 2000 Sites	25
4.2.1	Innishannon AFA	25
4.2.2	Dunmanway AFA	25
4.2.3	Schull AFA	28
5	Significance of Impacts on Natura 2000 Sites	30
5.1	General	30
5.2	Assessment of Significance	30
6	Conclusions and Screening Statement	33

7	References	35
	Appendices	37
	Appendix A. Viable Flood Risk Management Options	38
	Figures	
	Figure 2-1 Appropriate Assessment the Process	8
	Figure 3-1 South Western River Basin District (SWRBD)	12
	Figure 3-2 Units of Management and Areas for Further Assessment in the SWRBD	13
	Figure 3-3 Bandon / Skibbereen UoM 20	16
	Tables	
	Table 3.1: Suite of Flood Risk Management Options	14
	Table 3.2: List of AFAs in the Bandon / Skibbereen UoM	16
	Table 3.3: Structural Flood Risk Management Options for UoM 20	19
	Table 5.1: Assessment of Significance of Impacts for Dunmanway AFA	31
	Table 6.1: Screening Matrix for UoM 20	33

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.

The Bandon - Skibbereen Catchment (UoM20)

The Bandon / Skibbereen Unit of Management (UoM 20) covers an area of approximately 1,796 km². The entire area of UoM 20 is within County Cork. The main rivers within the UoM are the Bandon, the Ilan and the Argideen.

The Bandon / Skibbereen UoM contains four Areas for Further Assessment (AFAs): Clonakilty, Dunmanway, Inishannon and Schull. Of these, Clonakilty CFRAM has been progressed as an accelerated works and is therefore excluded from this study.

Flood risk management options for the Bandon / Skibbereen UoM have been identified through option appraisal as follows:

AFA	Viable Options
Dunmanway	<ul style="list-style-type: none"> Food Defences / Localised Protection Works on the Brewery River and Dirty River ranging in height from 1m to 2m. Storage on Brewery River / Flood Defences on Dirty River – 140,000m² storage area in agricultural lands with embankment height ranging between 3m and 5m and including a flow control structure in channel. This is coupled with localised protection of properties off Bridge Street by one flood wall 1.1m in height. Flow Diversion of Brewery River into the Dirty River using culvert 640m in length principally through agricultural lands. This is coupled with Flood Defences on the Dirty River comprising one flood wall (1.1m in height) and one embankment (2m in height)
Inishannon	<ul style="list-style-type: none"> Flood walls and embankments within the town in proximity to the Bandon River ranging in height from 1.5m to 2m.
Schull	<ul style="list-style-type: none"> Storage areas on the Meevane Stream (3,025m² and 4m deep concrete chamber coupled with stream realignment) and the Schull Stream (15,130m² area with 2.5m earth embankment as retaining structure and sluice gate in channel for flow control). Storage area on the Schull Stream (15,130m² area with 2.5m earth embankment as retaining structure and sluice gate in channel for flow control) and Flow diversion on the Meevane Stream using culvert 656m in length through agricultural lands. Storage area on the Meevane Stream (3,025m² and 4m deep concrete chamber coupled with stream realignment) and manhole sealing and culvert on the Schull Stream Flow diversion on the Meevane Stream, with manhole sealing and culvert being constructed on the Schull Stream.

Natura 2000 Sites

Flood risk management options for Dunmanway are proposed for both the Dirty River and Brewery River. These rivers are tributaries of the Bandon River which is designated as a Special Conservation Area (Site Code 002171).

Flood risk management options for Innishannon are proposed along the Bandon River. The Bandon River is not designated a SAC at this point and is not hydrologically connected to any downstream Natura 2000 sites. There are no designated areas within the zone of impact of Innishannon AFA.

Flood risk management options for Schull are proposed for the Meevane Stream and the Schull Stream. These watercourses discharge into Schull Harbour which is part of Roaring Water Bay and Islands SAC (Site Code 000101).

There is potential that the qualifying features of the Bandon River SAC and the Roaring Water Bay and Islands SAC could be impacted.

Potential Impacts on Qualifying Features

Dunmanway AFA

The likelihood of sediment runoff and pollution impacts of flood risk measures on the Brewery River and Dirty River in Dunmanway on the qualifying features of the Bandon River SAC are summarised hereunder:

- Targeted Freshwater Pearl Mussel surveys were conducted along the River Bandon in April 2013 as part of the CFRAM study for the SWRBD. The study findings showed Freshwater Pearl Mussel populations at and upstream of Long Bridge (for approximately 2km). There were no findings of mussels below Long Bridge (note the pearl mussel survey extended approximately 4km downstream of Long Bridge to beyond Bealboy Bridge). No mussels were recorded on the Dirty River or the Brewery River. Direct impacts on pearl mussel from sediment runoff or from pollution are extremely unlikely;
- Impacts are unlikely but cannot be discounted in relation to interference with the glochidia stage in Freshwater Pearl Mussel life cycle;
- Impact on photosynthesis of floating river vegetation and smothering of vegetation;
- The suitability of habitat in the Brewery River at the proposed location for the storage area to support Brook lamprey is unknown. It is uncertain whether in-stream works will cause damage to Lamprey habitat through sedimentation or direct disturbance

Schull AFA

The likelihood of potential impacts of measures on the Meevane Stream and the Schull Stream in Schull on the qualifying features of the Roaring Water Bay SAC are summarised hereunder:

- Impacts are extremely unlikely given distance from SAC.

Significance of Impacts

No significant impacts of flood risk management measures were identified for the Schull AFA.

The significance of impacts on the Bandon River SAC from the Dunmanway flood management measures are summarised as:

- The significance of impact on Brook Lamprey in Dunmanway AFA is unknown given absence of data on the location of spawning habitat. Precautionary approach must be applied. It must be assumed that spawning habitat will be impacted by the storage and diversion options. Such an **impact is significant** in terms of achieving the conservation target of 'no decline in extent and distribution of spawning beds'.
- The full distribution of floating river vegetation in this site is currently unknown. Also the sub-types of this habitat are poorly understood and their typical species in Ireland have not yet been defined. **Significance of impact cannot be determined** in the absence of such information. The precautionary approach must be applied and Appropriate Assessment conducted.
- For Freshwater Pearl Mussel, sedimentation will not impact the conservation target for 'sufficient numbers of host fish in the catchment' however accessibility of host fish to glochidia could be impacted which is **significant** in terms of achieving the conservation target for recruitment.

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 June 2016 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 is 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;

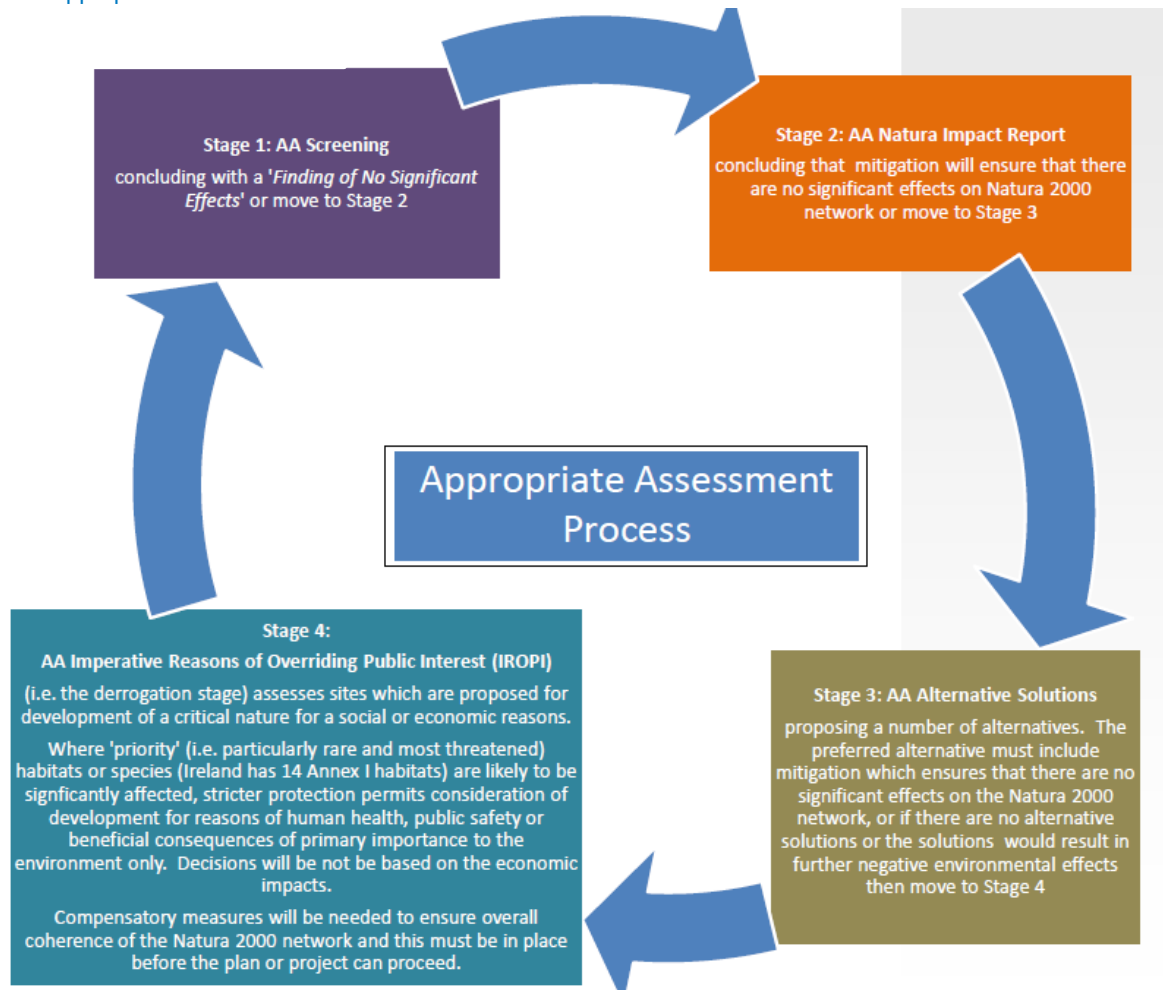
Stage 3 – Assessment of alternative solutions: The process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site (where mitigation cannot be achieved); and

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 Bandon - Skibbereen Catchment (UoM20)

The Bandon / Skibbereen Unit of Management (UoM 20) covers an area of approximately 1,796 km². The entire area of UoM 20 is within County Cork. The main rivers within the UoM are the Bandon, the Ilan and the Argideen.

Bandon Catchment

The River Bandon rises near Cullenagh Lake at Nowen Hill and flows eastwards to Derrynacagheragh, where it is joined by the Garrown River from the south and the Derragh Stream from the north. The Bandon flows south eastwards to Ardcahan Bridge where it is joined by the Caha River immediately upstream of the bridge. The River Bandon then flows in a southerly direction over the rapids at Derreens to Dunmanway, where the floodplain is separated from the tributaries of Dunmanway Lake by flood embankments as part of the Dunmanway Flood Alleviation Scheme. Within Dunmanway, the Dirty River and Brewery River join the main Bandon channel before flowing southwards to Bealaboy Bridge. Downstream of Bealaboy Bridge, the Bandon flows eastwards again to be joined by the River Blackwater (Caher) upstream of Ballineen, before flowing into Bandon Town. The Bridewell River is the major tributary within the town before the Bandon reaches the gauge at Curranure. The Bandon is then joined by the Brinny River and flows south again becoming increasing tidal until its outfall to the Celtic Sea at Kinsale.

The Bandon is tidally influenced downstream of Curranure becoming more estuarine as it reaches Kinsale. The bed and water level profile is effectively flat downstream of Rockhouse Creek due to the tidal conditions. The lower Bandon estuary is relatively narrow but has a number of tidal creeks with intertidal flats. The estuary and town of Kinsale are largely protected from extreme wave action by Preghane Point and Farmer Rock promontories.

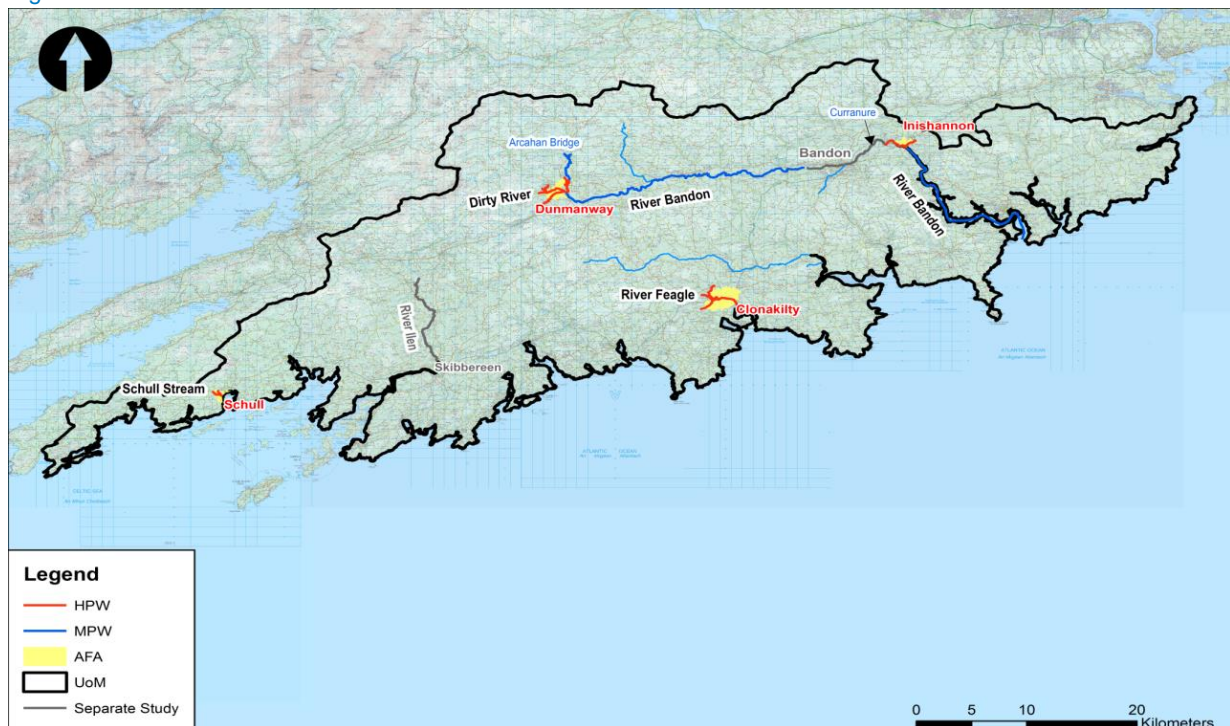
Schull Catchment

The Schull Stream rises less than 1km upstream of Schull (town) before flowing in a south easterly direction to enter various culverts through the town and outfall into Schull harbour by the slipway. The Meevane Stream rises upstream of the Cape View estate and flows in a southerly direction before entering along culvert to join the Schull Stream south of Main Street.

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.

At Schull, the harbour/bay area is open to extreme coastal conditions, although the orientation protects it from extreme wave action from the dominant south-westerly winds. There is a very limited intertidal zone as the coastline is formed by steep rocky foreshores.

Figure 3-3 Bandon / Skibbereen UoM 20



3.4.1 Areas for Further Assessment in UoM 20

The Bandon / Skibbereen UoM contains four Areas for Further Assessment (AFAs). Of these, Clonakilty CFRAM has been progresses as an accelerated works and is therefore excluded from this study. Associated with the AFAs is 46km of high and medium priority watercourse.

Table 3.2: List of AFAs in the Bandon / Skibbereen UoM

Name	Unique ID	Fluvial Flood Risk	Coastal Flood Risk	County	Easting	Northing	Contributing Area for Flows (km2 to 1 s.f.)
Clonakilty	200294	Yes	Yes	Cork	138000	41250	22
Dunmanway	200297	Yes	No	Cork	122250	52750	158
Inishannon	200298	Yes	No	Cork	155000	57000	513
Schull	200303	Yes	No	Cork	92500	31500	3

Flood risk assessment and the development of management options for the town of Clonakilty was prioritised by the OPW as an accelerated works following significant flood events which occurred in 2012.

The options for addressing the flood risk in Clonakilty have been determined and the OPW has employed a consulting engineering company for the detailed design of the flood risk management options for Clonakilty, which are:

- Flood-water storage in an artificial, embanked online storage area upstream of Clonakilty to reduce fluvial flood risk; and,
- On-land flood defences to reduce coastal flood risk.

A specialist environmental consultant has also been commissioned by the OPW to conduct a constraints study, Appropriate Assessment, and Environmental Impact Assessment for the Scheme.

The Clonakilty AFA is therefore excluded from this Screening for Appropriate Assessment.

3.5 Flood Risk Management Options for Bandon / Skibbereen UoM

Flood risk management options for the Bandon / Skibbereen 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

STANDARD TEXT WILL BE PROVIDED

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 20 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 in Dunmanway and Innishannon.

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

STANDARD TEXT WILL BE PROVIDED

3.5.2 Structural Measures

Structural flood risk management options for the Bandon / Skibbereen 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 Appendix A. 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 20

AFA	Viable Options
Dunmanway	<ul style="list-style-type: none"> Food Defences / Localised Protection Works on the Brewery River and Dirty River ranging in height from 1m to 2m. Storage on Brewery River / Flood Defences on Dirty River – 140,000m² storage area in agricultural lands with embankment height ranging between 3m and 5m and including a flow control structure in channel. This is coupled with localised protection of properties off Bridge Street by one flood wall 1.1m in height. Flow Diversion of Brewery River into the Dirty River using culvert 640m in length principally through agricultural lands. This is coupled with Flood Defences on the Dirty River comprising one flood wall (1.1m in height) and one embankment (2m in height)
Inishannon	<ul style="list-style-type: none"> Flood walls and embankments within the town in proximity to the Bandon River ranging in height from 1.5m to 2m.
Schull	<ul style="list-style-type: none"> Storage areas on the Meevane Stream (3,025m² and 4m deep concrete chamber coupled with stream realignment) and the Schull Stream (15,130m² area with 2.5m earth embankment as retaining structure and sluice gate in channel for flow control). Storage area on the Schull Stream (15,130m² area with 2.5m earth embankment as retaining structure and sluice gate in channel for flow control) and Flow diversion on the Meevane Stream using culvert 656m in length through agricultural lands. Storage area on the Meevane Stream (3,025m² and 4m deep concrete chamber coupled with stream realignment) and manhole sealing and culvert on the Schull Stream Flow diversion on the Meevane Stream, with manhole sealing and culvert being constructed on the Schull Stream.

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 20 are characterised hereunder.

3.6.1 Potential Impacts of Non-Structural Options in UoM 20

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 eliminating 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 20

The viable structural options identified for the management of for the extreme flood event within the UoM can be summarised as Storage, 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.

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 or which will allow the engineering of a suitable storage facility. A storage area / reservoir 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:

- Schull (on the Meevane Stream comprising a concrete tank / chamber 3,025m² and 4m deep coupled with stream realignment and on the Schull Stream comprising 15,130m² of agricultural lands with 2.5m earth embankment as retaining structure and sluice gate in channel for flow control).
- Dunmanway (on the Brewery River comprising a 140,000m² storage area in agricultural lands with embankment height ranging between 3m and 5m and including an in channel flow control structure)

Construction of the flood storage areas 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 watercourses. 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.
- Removal of riparian habitat within the footprint of the embankment;
- Temporary disturbance of protected species 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 / lamprey passage within the river channel when the control structure is restricting flows;
- Isolation of fish / lamprey within the flooded storage area in the event that flood waters subside rapidly;
- Creation of temporary wetland habitat within the storage area during flooding;

The Meenvane Stream in Schull will need to be realigned to facilitate the construction of the storage area. Stream realignment can impair the biological function of the waterbody through:

- permanent loss of fishery habitat within the diverted section of the watercourse;
- temporary release of sediment to the watercourse during construction;
- impairment to fish passage during construction.

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 in Dunmanway (from the Brewery River into the Dirty River) and in Schull (the Meenvane Stream). Potential environmental effects of flow diversion include:

- Increased flow volume and velocity in the waterbody receiving the diverted flows during storm events. This can cause bankside erosion and associated loss of habitat;
- Scouring of the bed of the waterbody receiving the diverted flows at the culvert discharge point resulting in possible loss of fishery habitat and sedimentation of the watercourse;
- Attraction of fish into the culvert when the culvert is in operation.
- Destruction of habitat for culvert construction.

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 Schull, Dunmanway and Innishannon. The physical implementation of these structural measures 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.

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 Dunmanway, Innishannon and Schull AFAs.

- Flood risk management options for Dunmanway are proposed for both the Dirty River and Brewery River. These rivers are tributaries of the Bandon River which is designated as a Special Conservation Area (Site Code 002171).
- Flood risk management options for Innishannon are proposed along the Bandon River. The Bandon River is not designated a SAC at this point and is not hydrologically connected to any downstream Natura 2000 sites. There are no designated areas within the zone of impact of Innishannon AFA.
- Flood risk management options for Schull are proposed for the Meevane Stream and the Schull Stream. These watercourses discharge into Schull Harbour which is part of Roaring Water Bay and Islands SAC (Site Code 000101).

There is potential that impacts as described in Section 3.6 of this Screening Assessment could affect the qualifying features of the Bandon River SAC and the Roaring Water Bay and Islands SAC.

Bandon River SAC (002171)

The site is important as it contains the Annex I priority habitat Alluvial Forests and the Annex I habitat Floating River Vegetation. The Annex I Bird - *Alcedo atthis* breeds within the site as do the Annex I animal species *Lampetra planeri*, and *Margaritifera margaritifera*. Water quality is very good and the site supports a large population of *Margaritifera margaritifera*. Cork Co. Council is considering designating the Bandon a salmonid River. The area below Long Bridge supports a rare form of wet woodlands on braided channel edges and islands.

Qualifying features of the SAC are: Freshwater pearl mussel (*Margaritifera margaritifera*) [1029], Brook lamprey (*Lampetra planeri*) [1096] Water courses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation [3260], Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0].

Roaringwater Bay and Islands SAC (000101)

Roaringwater Bay is a wide, shallow bay located in the south-west of Ireland. Roaringwater Bay has a wide variety of reef and sediment habitats that are subject to a range of wave exposures and tidal streams. The site is of significance for the occurrence of *Phocoena phocoena* with relative high abundances recorded, and presents high quality habitat for this marine mammal.

Qualifying features of the site are: Large shallow inlets and bays [1160], Reefs [1170], Vegetated sea cliffs of the Atlantic and Baltic coasts [1230], Harbour porpoise (*Phocoena phocoena*) [1351], Otter (*Lutra lutra*) [1355], Grey seal (*Halichoerus grypus*) [1364], European dry heaths [4030], Submerged or partly submerged sea caves [8330].

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 Bandon River SAC and the Roaring Water Bay and Islands SAC is determined through Source-Pathway-Receptor assessment.

A review of available data was carried out to determine the presence of qualifying features of the Bandon River SAC and the Roaring Water Bay and Islands SAC within the environs of Dunmanway and Schull. 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 Innishannon AFA

There are no designated areas within the zone of impact of the flood risk management options for the Innishannon AFA. There is therefore no potential for impacts on Natura 2000 sites.

4.2.2 Dunmanway AFA

Note: The Annex I priority habitat Alluvial Forest [91E0] is located below Dunmanway at the braided section of the Bandon River. Modelling carried out as part of the CFRAM study has determined that all viable flood management measures in Dunmanway will not influence the hydrological regime in the Bandon River. Impacts on Alluvial Woodlands are therefore extremely unlikely.

Flood Walls and Embankments

The likelihood of potential impacts of constructing Flood Walls and Embankments on the Brewery River and Dirty River in Dunmanway on the qualifying features of the Bandon River SAC are discussed hereunder.

The embankment location on the Dirty River is set back approximately 50m from the watercourse. It is unlikely that sediment runoff will enter the river given the vegetated buffer between the embankment and the watercourse. Sediment runoff to the Brewery River from the embankment is probable given the location immediately adjacent to the watercourse. The construction of the flood walls on the Dirty River and the Brewery River could result in accidental release of pollutants (concrete and oil/fuel leaks from machinery) to the watercourses.

Sediment runoff from embankment material and pollution during flood wall construction has potential to cause a significant impact on Freshwater Pearl Mussel which is particularly sensitive to elevations in siltation levels. The Freshwater Pearl Mussel Regulations require that there are no artificially elevated levels of siltation in pearl mussel habitat. The infilling of stable cobbles/gravels with sediment prevents oxygen movement into interstitial spaces and can lead to the death of juvenile mussels. Also adult mussels can suffer death due to a defensive response to water turbidity and pollution (they clam up and therefore cannot take up oxygen from the water). Targeted Freshwater Pearl Mussel surveys were conducted along the River Bandon in April 2013 as part of the CFRAM study for the SWRBD. The study findings showed Freshwater Pearl Mussel populations at and upstream of Long Bridge (for approximately 2km). There were no findings of mussels below Long Bridge (note the pearl mussel survey extended approximately 4km downstream of Long Bridge to beyond Bealboy Bridge). No mussels were recorded on the Dirty River or the Brewery River. Direct impacts on pearl mussel from sediment runoff or from pollution are extremely unlikely given the location of populations upstream of Long Bridge (upstream of the confluence between the Brewery / Dirty River with the Bandon River).

In considering the potential impacts of sedimentation and pollution on Freshwater Pearl Mussel, consideration must be given to the life cycle of this species. Freshwater Pearl Mussel can live for more than 100 years. Reproduction takes place through the release of sperm into the open water which is then inhaled by the female mussels. Glochidia (larva) are brooded by the females and then released into the open water in an event lasting one to two days between July and September (DEHLG, March 2010). A percentage of the glochidia will attach to the gills of passing host fish (typically brown trout and salmon in Ireland) where they will develop further. Once developed in to young mussels they will drop off and burrow into gravel where they will filter feed. Once mature, they will migrate downstream to coarser substrate. The free migration of fish species is important in ensuring reproduction of Freshwater Pearl Mussel. The glochidia stage in the Freshwater Pearl Mussel life cycle may be indirectly impacted if sedimentation inhibits migration of host fish. It is unlikely that sedimentation or accidental pollution would occur in coincidence with glochidia release (given the short time over which the event occurs) however it cannot be discounted.

Sediment can infill the interstitial spaces of Lamprey spawning gravels leading to deterioration in habitat quality. Pollution can impact spawning success. Suitable spawning habitat is not represented in the Bandon River downstream of Long Bridge. River substrate comprises of silted and compacted gravel and sharp cobble. Filamentous algal and macrophyte growth is evident (source, Pearl Mussel Survey, 2013). The substrate in the Brewery and Dirty Rivers downstream of the bridges within Dunmanway town comprises coarse cobbles. Suitable Brook Lamprey spawning habitat is absent. Impacts on Brook Lamprey spawning are therefore extremely unlikely within the Bandon, Dirty and Brewery Rivers.

Suitable juvenile Lamprey habitat (fine silty material) is well represented in the Bandon River downstream of the confluence with the Brewery River within the braided section of the river. It is probable that pollution would impact gill function of juvenile Lamprey in this location. However in considering the capacity of the watercourses to assimilate an accidental pollution incident, it is unlikely that toxic effects would be observed.

There are extensive areas of macrophyte growth downstream of Long Bridge, at the braided section of the Bandon River and also in the lower reaches of the Dirty and Brewery Rivers. Watercourses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation may be represented here. There are no in-stream works associated with this option therefore damage to habitat is extremely unlikely. Sediment may be released to the Brewery River during the works. Sediment deposition on vegetation can impact photosynthesis and can smother vegetation.

Storage Area

The likelihood of potential impacts of flood storage on the Brewery River in Dunmanway on the qualifying features of the Bandon River SAC are discussed hereunder.

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

Freshwater Pearl Mussel are absent from the Brewery River as confirmed through survey. Direct impacts on pearl mussel due to in-stream works on the Brewery River to accommodate the control structure are extremely unlikely given their absence. The likelihood of sedimentation impacting Freshwater Pearl Mussel is discussed above in relation to Flood Walls and Embankments on the Brewery River and will be similar for storage on the Brewery River i.e. impacts are unlikely but cannot be discounted in relation to interference with the glochidia stage in Freshwater Pearl Mussel life cycle.

Brook Lamprey are non-migratory, the adults move only short distances upstream to suitable spawning gravels (fine grade gravels). A coincidence of spawning habitat in close proximity upstream of juvenile habitat is therefore necessary for this species. The suitability of habitat in the Brewery River at the proposed location for the storage area to support Brook lamprey is unknown. It is uncertain whether in-stream works will cause damage to Lamprey habitat through sedimentation or direct disturbance or whether the control structure will act as a barrier to Lamprey migration. Likelihood of impact on Brook Lamprey is uncertain.

There are extensive areas of macrophyte growth downstream of Long Bridge, at the braided section of the Bandon River and also in the lower reaches of the Dirty and Brewery Rivers. Watercourses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation may be represented here. It is probable that in-stream works will cause habitat damage.

Flow Diversion

The likelihood of potential impacts of flow diversion of Brewery River into the Dirty River in Dunmanway on the qualifying features of the Bandon River SAC are discussed hereunder.

It is proposed to divert all flows above $8.82\text{m}^3/\text{s}$ (peak flow for the 10% AEP event) to the Dirty River. This equates to a peak flow of $4.31\text{m}^3/\text{s}$ being diverted to the Dirty River during the design event. When the diversion is in operation it is likely that river bed / bank material in the Dirty River will experience scouring.

The suitability of habitat in the Brewery River or the Dirty River for Brook Lamprey at the proposed locations of the culvert inlet and outlet is unknown. It is uncertain whether in-stream works during construction or scouring during operation will cause damage to Lamprey habitat through sedimentation or direct disturbance. Likelihood of impact on Brook Lamprey is uncertain.

Freshwater Pearl Mussel are absent from the Brewery and Dirty Rivers River as confirmed through survey. Direct impacts on pearl mussel are extremely unlikely. The likelihood indirect impacts on Freshwater Pearl Mussel through sedimentation is discussed above in relation to Flood Walls and Embankments on the Brewery River and will be similar for the flow diversion option i.e. impacts are unlikely but cannot be discounted in relation to interference with the glochidia stage in Freshwater Pearl Mussel life cycle.

There are extensive areas of macrophyte growth downstream of Long Bridge, at the braided section of the Bandon River and also in the lower reaches of the Dirty and Brewery Rivers. Watercourses of plain to montane levels with the *Ranunculus fluitantis* and *Callitriche-Batrachion* vegetation may be represented here. It is probable that in-stream works will cause habitat damage.

4.2.3 Schull AFA

Storage Areas

The likelihood of potential impacts of storage on the Meenvane Stream and the Schull Stream in Schull on the qualifying features of the Roaring Water Bay SAC are discussed hereunder.

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 coastal habitats (with the exception of European dry heaths. The storage areas are proposed within areas of improved agricultural grassland. Impacts on European dry heath are extremely unlikely.

There is potential for sedimentation of the Schull Stream and Meenvane Stream during construction of the storage areas. These watercourses have low fishery value and are unlikely to be a food source for Otter (a qualifying feature of the SAC). Indirect impact on foraging habitat for Otter is therefore extremely unlikely.

Otter habitat as mapped in the Roaring Water Bay Conservation Objectives Report represents a 10m terrestrial buffer along shoreline. This is not confirmed through field survey. The storage areas on the Schull Stream and Meevane Stream are outside of this buffer. It is unlikely that Otter use the habitat in

proximity to the storage areas given that Otter would have to pass through the village in order to commute to the marine feeding areas. The removal of riparian habitat within the footprint of the structures of the storage areas is extremely unlikely to impact Otter.

DAHG Draft Guidance (2012) sets out measures to minimise the risk of noise related impacts on aquatic mammals caused by maritime sound-producing operations or activities. The guidance specifies that operations should not commence if marine mammals are detected within a 500m radial distance of dredging / drilling activities. The Roaring Water Bay Conservation Objectives Report includes Schull harbour as Grey Seal and Harbour Porpoise habitat. Storage options are located in excess of 500m from the harbour. Noise impacts on Grey Seal and Harbour Porpoise are extremely unlikely.

Sediment release into the streams is likely to be washed into Schull Harbour. It is extremely unlikely that the Reef habitat in Schull Harbour will be impacted by sediment release given that subtidal and intertidal communities are regularly subjected to changes in turbidity due to tidal exchange and weather conditions.

Manhole Sealing and Culvert

The Schull Stream has low fishery value and is unlikely to support Otter. Engineering works to the stream will not alter the existing value of the habitat.

Flow Diversion

Impacts as discussed in relation to storage on the Meenvane Stream are applicable also to the Flow Diversion option.

5 Significance of Impacts on Natura 2000 Sites

5.1 General

An assessment of potential impacts of the flood risk management options for Dunmanway identified potential impacts for the Bandon River SAC. 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.

Site-specific conservation objectives have been developed for a proportion of Natura 2000 sites in Ireland. These site-specific conservation objectives provide detailed measurable targets relative to the ecology of individual species or habitats for which a site is designated which must be achieved or maintained in order to meet favourable conservation status. Site-Specific conservation objectives are not currently available for the Bandon River SAC. In the absence of site-specific conservation objectives, reference is made to other designated areas for which relevant species / habitat specific attributes, measures and targets have been established. These will act as a reference point from which an assessment of the potential for significant affects to conservation objectives can be made.

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 Dunmanway identified potential impacts for floating river vegetation and Freshwater Pearl Mussel from all viable options. Impacts for Brook Lamprey are uncertain in relation to the storage and flow diversion options. The significance of the likely impacts is assessed hereunder. The conservation objectives used in the assessment of significance are for the Blackwater Munster SAC as relevant.

Table 5.1: Assessment of Significance of Impacts for Dunmanway AFA

Qualifying Feature	Conservation Objectives	Impact Type	Significance of Impact
Brook Lamprey	<p>Distribution - Access to all water courses down to first order streams</p> <p>Extent and distribution of spawning habitat - No decline in extent and distribution of spawning beds</p> <p>Population structure of juveniles - At least three age/size groups present</p> <p>Juvenile density in fine sediment - at least 2/m²</p> <p>Availability of juvenile habitat - More than 50% of sample sites positive</p>	Damage to Lamprey spawning habitat through sedimentation or direct disturbance	Significance of Impact is uncertain given absence of data on location of spawning habitat. Precautionary approach must be applied. It must be assumed that spawning habitat will be impacted by the storage and diversion options. Such an impact is significant in terms of achieving the conservation target of 'no decline in extent and distribution of spawning beds'
Floating river vegetation	The full distribution of this habitat and its sub-types in this site are currently unknown. Also the sub-types of this habitat are poorly understood and their typical species in Ireland have not yet been defined. Significance of impact cannot be determined in the absence of such information.		
Freshwater Pearl Mussel	<p>Distribution – Maintain the length of channel from the most upstream records of the freshwater pearl mussel to the most downstream records of live mussels.</p> <p>Population – No Target</p> <p>Recruitment - The objective is to restore to 20% of the population equating to young mussels and %5 juvenile mussels.</p> <p>Adult mortality - No more than 5% decline from previous number of live adults counted; dead shells less than 1% of the adult population and scattered in distribution (considered to be natural loss).</p> <p>Habitat extent – No Target</p> <p>Water quality - restore high Water Framework Directive biological quality elements.</p> <p>Substratum quality – target is <5% filamentous Algae and macrophytes and achieve stable cobble and gravel substrate with very little fine material; no artificially elevated levels of fine sediment and good redox potential.</p> <p>Hydrological regime - Restore appropriate hydrological regimes such that 1) high flows can wash fine sediments from the substratum, 2) low</p>	The glochidia stage in the Freshwater Pearl Mussel life cycle may be indirectly impacted if sedimentation inhibits migration of host fish	Sedimentation will not impact the conservation target for sufficient numbers of host fish in the catchment however accessibility of host fish to glochidia could be impacted which is significant in terms of achieving the conservation target for recruitment.

Qualifying Feature	Conservation Objectives	Impact Type	Significance of Impact
	<p>flows do not exacerbate the deposition of fines and 3) low flows do not cause stress to mussels in terms of exposure, water temperatures, food availability or aspects of the reproductive cycle</p> <p>Host fish - Fish presence is considered sufficient in the catchment. The conservation objective is to maintain sufficient juvenile salmonids to host glochidial larvae.</p>		

6 Conclusions and Screening Statement

The assessment of impacts of flood risk management options in UoM 20 on Natura 2000 sites has determined that **significant impacts are likely or uncertain** for the Bandon River SAC.

Table 6.1: Screening Matrix for UoM 20

Screening Matrix	
Project	
Brief description of the project or plan	<p>Dunmanway AFA:</p> <ul style="list-style-type: none"> • Food Defences / Localised Protection Works on the Brewery River and Dirty River ranging in height from 1m to 2m. • Storage on Brewery River / Flood Defences on Dirty River – 140,000m² storage area in agricultural lands with embankment height ranging between 3m and 5m and including a flow control structure in channel. This is coupled with localised protection of properties off Bridge Street by one flood wall 1.1m in height. • Flow Diversion of Brewery River into the Dirty River using culvert 640m in length principally through agricultural lands. This is coupled with Flood Defences on the Dirty River comprising one flood wall (1.1m in height) and one embankment (2m in height)
Natura 2000 Site	
Brief description of the Natura 2000 site(s)	<p>The site is important as it contains the Annex I priority habitat Alluvial Forests and the Annex I habitat Floating River Vegetation. The Annex I Bird - <i>Alcedo atthis</i> breeds within the site as do the Annex I animal species <i>Lampetra planeri</i>, and <i>Margaritifera margaritifera</i>. Water quality is very good and the site supports a large population of <i>Margaritifera margaritifera</i>. Cork Co. Council is considering designating the Bandon a salmonid River. The area below Long Bridge supports a rare form of wet woodlands on braided channel edges and islands.</p> <p>Qualifying features of the SAC are: Freshwater pearl mussel (<i>Margaritifera margaritifera</i>) [1029], Brook lamprey (<i>Lampetra planeri</i>) [1096] Water courses of plain to montane levels with the <i>Ranunculus fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation [3260], Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i>, <i>Alnion incanae</i>, <i>Salicion albae</i>) [91E0].</p>
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.	Construction of flood walls and embankments, construction of storage area and construction of flow diversion on the Brewery River and the Dirty River which are hydrologically connected to the Bandon River SAC.
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:	Sedimentation of the watercourse and pollution by accidental spills and leaks of fuel / oils from machinery.
Size and scale;	Destruction of habitat due to in-stream works
Land-take;	
Distance from the Natura 2000 site or key features of the site;	
Resource requirements (water abstraction etc);	
Emissions (disposal to land, water or air);	

Screening Matrix	
<p>Excavation requirements; Transportation requirements; Duration of construction, operation, decommissioning etc; Other.</p>	
<p>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.</p>	<p>Possible reduction in spawning area for Brook Lamprey</p>
<p>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.</p>	<p>Possible destruction of Brook Lamprey habitat on the Brewery River with impacts for species density. Sedimentation of impacting photosynthesis and smothering floating river vegetation impacting species composition Impediment to movement of host fish upstream to pearl mussel populations during glochidia release due to sedimentation of the watercourse impacting reproductive success.</p>
<p>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.</p>	<p>Conservation target for Brook Lamprey is 'No decline in extent and distribution of spawning beds'. It is uncertain whether in-stream works will cause damage to spawning habitat in the absence of survey data. Destruction of habitat is a significant impact in terms of conservation objectives.</p> <p>Sedimentation of the watercourse, if it occurs at glochidia release could significantly impact the recruitment success conservation target for Freshwater Pearl Mussel in the Bandon River.</p>
<p>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.</p>	<p>Sedimentation is likely to significantly impact Freshwater Pearl Mussel in the Bandon River. It is unknown whether in-stream works will impact Brook Lamprey</p>

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Appendices

Appendix A. Viable Flood Risk Management Options	38
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Appendix A. Viable Flood Risk Management Options

Drawings of Options are contained in Appendix B of the Preliminary Flood Risk management Options Report

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
Dunmanway	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 0.6m. → or → or → or	→ 4 → → →	4.00
			Option 2 Storage (Brewery River) & Flood Defences	→ Brewery River - Adaptive Approach: increase size and capacity of storage area by increasing embankment heights (Score 2) → Dirty River - Adaptive Approach: increase height of existing defences by 0.6m (Score 4) → or → Brewery River - No Physical Provision: no change to storage areas so new flood defences required (Score 0) → Dirty River - Adaptive Approach: increase height of existing defences by 0.6m (Score 4) → or → or	→ 3 → 2 → → →	
			Option 3 Flow Diversion & Flood Defences	→ Brewery River - No Physical Provision: flow diversion cannot be adapted so new flood defences required (Score 0) → Dirty River - Adaptive Approach: increase height of existing defences by 0.6m (Score 4) → or → or → or	→ 2 → → → →	
						3.00
						2.00

Climate Change Adaptability

AFA	Development & Assessment of Strategies, Plans & Measures				Design & Implementation (Actions Required to Adapt to Climate Change)		Score	Final Score
Inishannon	→ <div>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</div>	→ <div>Suitable Approaches 1. Adaptive Approach 2. No Physical Provision</div>	→ <div>Option 1 Flood Defences</div>	→ <div>Adaptive Approach: Increase height of existing flood defences by 0.2m. Note: Additional increase in height of defences may be accommodated by freeboard.</div>	→ <div>4</div>	→ <div>4.00</div>		
			→ <div>or</div>	→ <div></div>				
			→ <div>or</div>	→ <div></div>				
			→ <div>or</div>	→ <div></div>				
			→ <div></div>	→ <div></div>	→ <div>0.00</div>			
			→ <div>or</div>	→ <div></div>				
			→ <div>or</div>	→ <div></div>				
			→ <div>or</div>	→ <div></div>				
			→ <div></div>	→ <div></div>	→ <div>0.00</div>			
			→ <div>or</div>	→ <div></div>				
			→ <div>or</div>	→ <div></div>				
			→ <div>or</div>	→ <div></div>				

Climate Change Adaptability

AFA	Development & Assessment of Strategies, Plans & Measures				Design & Implementation (Actions Required to Adapt to Climate Change)	Score	Final (Highest Score)					
Schull	→	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 Storage (Both Rivers)	→	Schull Stream - Adaptive Approach: increase size and capacity of Schull Stream storage area by increasing the height of the storage embankments (Score 4) Meenvane Stream - Adaptive Approach: increase size and capacity of Meenvane Stream storage area by increasing the volume of the storage tank (Score 3) or Schull Stream - Adaptive Approach: increase size and capacity of Schull Stream storage area by increasing the height of the storage embankments (Score 4) Meenvane Stream - No Physical Provision: no change to storage tank so new flood defences required (Score 0) or Schull Stream - No Physical Provision: no change to storage area so new flood defences required (Score 0) Meenvane Stream - Adaptive Approach: increase size and capacity of Meenvane Stream storage area by increasing the volume of the storage tank (Score 3) or Schull Stream - No Physical Provision: no change to storage area so new flood defences required (Score 0) Meenvane Stream - No Physical Provision: no change to storage tank so new flood defences required (Score 0)	→	3.5	→	3.50
							→	2				
							→	1.5				
							→	0				
					→	Option 2 Storage (Schull Stream) & Flow Diversión	→	Schull Stream - Adaptive Approach: increase size and capacity of Schull Stream storage area by increasing the height of the storage embankments (Score 4) Meenvane Stream - No Physical Provision: flow diversion cannot be adapted so new flood defences required (Score 0) or Schull Stream - No Physical Provision: no change to storage area so new flood defences required (Score 0) Meenvane Stream - No Physical Provision: flow diversion cannot be adapted so new flood defences required (Score 0) or or	→	2	→	2.00
							→	0				
							→					
							→					
					→	Option 3 Culvert & Storage (Meenvane Stream)	→	Schull Stream - No Physical Provision: culvert cannot be adapted so new flood defences required (Score 0) Meenvane Stream - Adaptive Approach: increase size and capacity of Meenvane Stream storage area by increasing the volume of the storage tank (Score 3) or Schull Stream - No Physical Provision: culvert cannot be adapted so new flood defences required (Score 0) Meenvane Stream - No Physical Provision: no change to storage tank so new flood defences required (Score 0) or or	→	1.5	→	1.50
							→	0				
							→					
							→					
→	Option 4 Culvert & Flow Diversión	→	Schull Stream - No Physical Provision: culvert cannot be adapted so new flood defences required (Score 0) Meenvane Stream - No Physical Provision: flow diversion cannot be adapted so new flood defences required (Score 0) or or or or	→	0	→	0.00					
		→										
		→										
		→										

Appendix F. Multi Criteria Assessment

F.1 Local Weighting Data

AFA: Dunmanway

Objective	Local Weighting	Rationale	Code
Technical			
Ensure flood risk management options are operationally robust	5.00	Constant, as per Guidance Note 28	1a1
Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	5.00	Constant, as per Guidance Note 28	1b1
Ensure flood risk management options are adaptable to future flood risk	5.00	Constant, as per Guidance Note 28	1c1
Economy			
Minimise economic risk	5.00	994495/75000	2a1
Minimise risk to transport infrastructure	5.00	Motorway 250() + National Primary 150() + (National Secondary 75() + Regional 25(0.001+.01) + Local Rural 10(.1+.05) + Local Urban 20(0.001+.02+.05+.1)	2b2
Minimise risk to utility infrastructure	1.25	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(.005) + Core Telecommunications Exchanges 100() + Non-Core Telecommunications Exchanges 25()	2c3
Manage Risk to Agriculture	0.00	Based on agriculture at risk	2d1
Social			
Minimise risk to human health and life of residents	2.40	Nr. at risk from 50% AEP 2*.5(2) + Nr. at risk from 20% AEP 2*.2() + Nr. at risk from 10% AEP 2*.1() + Nr. at risk from 5% AEP 2*.05() + Nr. at risk from 2% AEP 2*.02(5) + Nr. at risk from 1% AEP 2*.01() + Nr. at risk from .5% AEP 2*.005(4) + Nr. at risk from .1% AEP 2*.001(81)	3a1
Minimise risk to high vulnerability properties	0.00	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()	3a2
Minimise risk to social infrastructure and amenity	0.13	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() + Nr. at risk from .5% AEP 25*.005() + Nr. at risk from .1% AEP 25*.001(5)	3b1
Minimise risk to local employment	5.00	Nr. at risk from 50% AEP 5*.5(11) + Nr. at risk from 20% AEP 5*.2() + Nr. at risk from 10% AEP 5*.1(2) + Nr. at risk from 5% AEP 5*.05(1) + Nr. at risk from 2% AEP 5*.02(4) + Nr. at risk from 1% AEP 5*.01(3) + Nr. at risk from .5% AEP 5*.005(2) + Nr. at risk from .1% AEP 5*.001(45)	3b2
Environmental			

Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	5.00	Constant, as per Guidance Note 28	4a1
Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	4.00	Dirty River and Brewery River are tributaries of the Bandon River, designated a SAC for margaritifera, floating river vegetation, alluvial woodland and brook lamprey.	4b1
Avoid damage to and where possible enhance the flora and fauna of the catchment	4.00	Bandon River supports a number of protected species including otter (Annex IV) - otter are also likely to use the Dirty River and Brewery River. Common Kingfisher (Alcedo atthis) has been recorded on the Bandon River and Dirty River in proximity to Long Bridge. Atlantic salmon occur in the Bandon River and are likely to use the Dirty and Brewery Rivers.	4c1
Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	5.00	Brewery River and Dirty River are not considered itself to be a nutrient sensitive river, however it is a tributary of the River Bandon. The Bandon River is recognised as an important river to support salmon species	4d1
Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	0.00	No specific landscape designations	4'e1
Avoid damage to or loss of features, institutions and collections of architectural value and their setting and improve their protection from extreme floods.	1.00	There no designated sites directly at risk downstream	4f1
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.	1.00	There no designated sites directly at risk downstream	4f2

AFA: Schull

Objective	Local Weighting	Rationale	Code
Technical			
Ensure flood risk management options are operationally robust	5.00	Constant, as per Guidance Note 28	1a1
Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	5.00	Constant, as per Guidance Note 28	1b1
Ensure flood risk management options are adaptable to future flood risk	5.00	Constant, as per Guidance Note 28	1c1
Economy			
Minimise economic risk	5.00	489683/75000	2a1
Minimise risk to transport infrastructure	5.00	Motorway 250() + National Primary 150() + (National Secondary 75() + Regional 25(0.2) + Local Rural 10() + Local Urban 20(0.2+0.2+.005)	2b2
Minimise risk to utility infrastructure	0.00	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()	2c3
Manage Risk to Agriculture	2.92	Based on agriculture at risk	2d1
Social			
Minimise risk to human health and life of residents	5.00	Nr. at risk from 50% AEP 2*.5(4) + Nr. at risk from 20% AEP 2*.2(15) + Nr. at risk from 10% AEP 2*.1(6) + Nr. at risk from 5% AEP 2*.05(6) + Nr. at risk from 2% AEP 2*.02() + Nr. at risk from 1% AEP 2*.01() + Nr. at risk from .5% AEP 2*.005(17) + Nr. at risk from .1% AEP 2*.001(2)	3a1
Minimise risk to high vulnerability properties	0.00	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()	3a2
Minimise risk to social infrastructure and amenity	2.63	Nr. at risk from 50% AEP 25*.5() + Nr. at risk from 20% AEP 25*.2() + Nr. at risk from 10% AEP 25*.1(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(1) + Nr. at risk from .1% AEP 25*.001()	3b1
Minimise risk to local employment	5.00	Nr. at risk from 50% AEP 5*.5(2) + Nr. at risk from 20% AEP 5*.2(17) + Nr. at risk from 10% AEP 5*.1(3) + Nr. at risk from 5% AEP 5*.05() + Nr. at risk from 2% AEP 5*.02() + Nr. at risk from 1% AEP 5*.01() + Nr. at risk from .5% AEP 5*.005(9) + Nr. at risk from .1% AEP 5*.001(1)	3b2
Environmental			
Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	5.00	Constant, as per Guidance Note 28	4a1
Avoid detrimental effects to, and where possible enhance, Natura 2000 network, protected species and their key habitats, recognising relevant landscape features and stepping stones.	5.00	Schull is on Roaring Water Bay SAC	4b1
Avoid damage to and where possible enhance the flora and fauna of the catchment	5.00	Roaring Water Bay pNHA & OSPAR site.	4c1
Maintain existing, and where possible create new, fisheries habitat including the maintenance or improvement of conditions that allow upstream migration for fish species.	1.00	The Roaringwater bay SAC is not designated for lamprey / salmon and schull stream and meevan stream are have limited fishing potential	4d1
Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	4.00	Schull is located within the a very high value landscape of national importance and high sensitivity	4'e1
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	There are number of NIAH within schull	4f1
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	There are number of designated site within Schull	4f2

AFA: Innishannon

Objective	Local Weighting	Rationale	Code
Technical			
Ensure flood risk management options are operationally robust	5.00	Constant, as per Guidance Note 28	1a1
Reduce and where possible eliminate health and safety risks associated with the construction and operation of flood risk management options	5.00	Constant, as per Guidance Note 28	1b1
Ensure flood risk management options are adaptable to future flood risk	5.00	Constant, as per Guidance Note 28	1c1
Economy			
Minimise economic risk	2.04	153364/75000	2a1
Minimise risk to transport infrastructure	4.15	Motorway 250() + National Primary 150() + (National Secondary 75(.01) + Regional 25() + Local Rural 10() + Local Urban 17(.2)	2b2
Minimise risk to utility infrastructure	5.00	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(.2) + Core Telecommunications Exchanges 100() + Non-Core Telecommunications Exchanges 25()	2c3
Manage Risk to Agriculture	1.25	Based on agriculture at risk	2d1
Social			
Minimise risk to human health and life of residents	2.24	Nr. at risk from 50% AEP 2*.5(1) + Nr. at risk from 20% AEP 2*.2(1) + Nr. at risk from 10% AEP 2*.1() + Nr. at risk from 5% AEP 2*.05() + Nr. at risk from 2% AEP 2*.02(17) + Nr. at risk from 1% AEP 2*.01(5) + Nr. at risk from .5% AEP 2*.005(2) + Nr. at risk from .1% AEP 2*.001(22)	3a1
Minimise risk to high vulnerability properties	0.00	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()	3a2
Minimise risk to social infrastructure and amenity	0.18	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() + Nr. at risk from .5% AEP 25*.005(1) + Nr. at risk from .1% AEP 25*.001(2)	3b1
Minimise risk to local employment	5.00	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(2) + Nr. at risk from 5% AEP 5*.05() + Nr. at risk from 2% AEP 5*.02(11) + Nr. at risk from 1% AEP 5*.01(2) + Nr. at risk from .5% AEP 5*.005(9) + Nr. at risk from .1% AEP 5*.001(13)	3b2
Environmental			
Provide no impediment to the achievement of water body objectives and, if possible, contribute to the achievement of water body objectives.	5.00	Constant, as per Guidance Note 28	4a1
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	No Natura 200 sites	4b1
Avoid damage to and where possible enhance the flora and fauna of the catchment	4.00	Bandon river supports a number of protected species including otter (Annex IV). Bandon Valley pNHAs (001515 and 001740) - important for their wetlands. Margaritifera area upstream of Innishannon Br (beyond tidal influence)	4c1
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	River Bandon and its tributaries are sensitive bodies and recognised as important river to support salmon species and important fishing potential	4d1
Protect, and where possible enhance, visual amenity, landscape protection zones and views into / from designated scenic areas within the river corridor.	3.00	Innishannon is located within the lowland valley landscape character area and considered to be of local importance and medium sensitivity	4'e1
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	No designated sites at risk	4f1
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	There are a number of RPS directly at risk from flooding	4f2

F.2 MCA Matrices

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	2.04	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	4.15	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 production	Do not increase in negative impact of flooding on agricultural production	Provide the potential for enhanced agricultural production	12.00	1.25	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	2.24	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	0.18	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	-3.00	Inishannon is located along the river Bandon and is at risk of both fluvial and tidal flooding. The Bandon River is classified as having a good water status under the WFD. it is considered a sensitive waterbody. There is large septic tank at risk from recurring flooding and in the absence of measures this significant polluting source in the town will result in recurring risk of flooding and impediment of ensuring good water status within the WFD	-240.00
	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 Natura 2000 sites - no potential for impact	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 due to implementation of option	5.00	4.00	-3.00	Pollution associated with flooding (particularly the risk of WWTP flooding) and flood water flow velocities can impact saltmarsh habitat downstream resulting in localised habitat destruction (-3).	-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	-4.00	River Bandon and its tributaries are not considered sensitive bodies, however it is influenced by tidal flows and considered nutrient waterbodies and recognised as important river to support salmon species and important fishing potential. Do nothing scenario will result in recurring flooding risk and damage to or loss of habitats and potentially result in adverse impacts to fisheries through deposition debris or physical obstructions or sediments following a flooding event	-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 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	Inishannon is not located within an area designated for high value landscape. However the approach to the town is located along a scenic route (N71). The river Bandon valley is designated as a pNHA. Innishannon is located within the lowland valley landscape character area and considered to be of local importance and medium sensitivity. do nothing will have no impact on the landscape character or features.	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 setting 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	-2.00	There are a number of NIAH listed within the town and along the mainstreet including Innishannon House which are at low/moderate risk from recurring 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	-3.00	There are a number of RPS directly at risk from flooding, do nothing will result in the recurring and/or permanent loss of access to the sites	-36.00
Environmental Score										-440.00
MCA Benefit score										-440.00
Option Selection MCA Score										-440.00
MCA Benefit Cost Ratio										0.00
Economic Benefit Cost Ratio										0.00

Multi-Criteria Assessment							Option 1 - 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 used to control flood flows	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	3.00	Risk of falling from a height and drowning	300.00	
	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	4.00	Can easily be modified to cater for future flood events	400.00	
Technical Score								0.00		1200.00	
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	2.04	3.87	As calculated	189.88	
	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	4.15	4.45	As calculated	184.50	
	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	3.75	As calculated	262.50	
	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	1.25	0.00	As calculated	0.00	
Economic Score								0.00		636.88	
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	2.24	1.69	As calculated	102.06	
		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	0.18	0.00	As calculated	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	0.84	As calculated	29.23	
Social Score								0.00		131.29	
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	Inishannon is located along the River Bandon and is at risk of both fluvial and tidal flooding. However, the greater risk is from fluvial flooding. The River Bandon is classified as having a good water status under the WFD. (4) flood protection measures can assist in contributing to maintaining the objectives of the WFD by preventing flooding , which if flooded could result in the deterioration of water quality. (-2) short term impacts associated with construction of walls and embankments	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	No Natura 2000 sites - no potential for impact	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 due to implementation of option	5.00	4.00	-3.00	Inishannon is downstream of the Bandon Margaritifera Catchment. Flood defences will not impact on Margaritifera (0). Otter have been recorded in the locality and will be subject to disturbance during the works (-3). The defences are set back from the river bank therefore there is no potential for destruction of otter habitat (0).	-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	-2.00	River Bandon itself is not considered to be a nutrient sensitive river however Inishannon is influenced by tidal flows and considered to be nutrient sensitive waterbody. The tributary into the river at Inishannon is also sensitive (-2) The Bandon River is recognised as an important river to support salmon species and important fishing potential. The proposed works will not directly impact on the River Bandon however there is an embankment on the tributary may require excavation of the bank of stream during the construction stage this would result in short term emissions of sediment to the waterbody and downstream on the River Bandon without treatment . There is potential to temporary restrict local fishery access during construction.	-52.00	
	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	-2.00	Inishannon is not located within an area designated for high value landscape. However the approach to the town is located along a scenic route (N71). The river Bandon valley is designated as a pNHA. The proposed measures are outside the pNHA boundary. Innishannon is located within the lowland valley landscape character area and considered to be of local importance and medium sensitivity. The proposed measures are not visible along the approach and through flow traffic within the town. The proposed measures include 2m high embankments to the rear of properties within the residential estate. Currently views from the rear of these properties are obscured by existing vegetation and screening within the extent of the pNHA. 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.	-48.00	
	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 setting 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	3.00	There are a number of NIAH listed within the town and along the mainstreet including Innishannon House which are at low/moderate risk from recurring flooding. The proposed measures will reduce the risk of recurring flooding on these properties.	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 a number of RPS directly at risk from flooding, including church ruins and market house. (2) The proposed measures will reduce the risk of flooding	24.00	
Environmental Score										24.00	
MCA Benefit score										792.17	
Option Selection MCA Score										1992.17	
MCA Benefit Cost Ratio										0.0005	
Economic Benefit Cost Ratio										2.11	

Flood Risk Management Options

Schull

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	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	2.92	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	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	2.63	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	he Schull Stream rises upstream of Schull (town) before flowing in a south easterly direction to enter various culverts through the town and outfall into Schull harbour by the slipway. The Meevane Stream rises upstream of the Cape View estate and flows in a southerly direction before entering along culvert to join the Schull Stream south of Main Street. The water body status of the Schull Stream and Meevane Stream are not as yet classified under the WFD, however the Roaring water water is an SAC and classified as having a high water status (0) however there are no significant polluting sources at risk from flooding. The do nothing scenario would not contribute to the achievement of water body objectives.	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	5.00	0.00	no foreseen impact	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 due to implementation of option	5.00	5.00	0.00		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	1.00	0.00	no impact on fisheries	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	4.00	0.00	Schull is located within an area classified as having a high landscape value. The approach to the town from ballydehob and lowertown are scenic routes. Schull is located within the a very high value landscape of national importance and high sensitivity. The do nothing scenario will have no impact on the landscape character.	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 setting 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	Do nothing scenario will have continued risk of flooding to Schull town	-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	3.00	-1.00	There no designated sites directly at risk downstream from the proposed measures. The proposed measures will not change the setting of designated sites upstream. Do nothing scenario will have continued risk of flooding to Schull town and potential adverse impacts on unknown features within the town	-12.00
Environmental Score										-48.00
MCA Benefit score										-48.00
Option Selection MCA Score										-48.00
MCA benefit Cost Ratio										0.00
Economic Benefit Cost Ratio										0.00

Flood Risk Management Options | Schull

Multi-Criteria Assessment								Option 1 - Storage			
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	Little operational risk, other than a sluice gate and 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 drowning, electrocution and falling from a height	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	3.50	Limited scope to modify for an increase in future flood events	350.00	
Technical Score									0.00		950.00
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	4.77	As calculated (95.32 * 0.05)	571.92	
	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	4.58	As calculated	228.75	
	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	2.92	0.00	As calculated	0.00	
Economic Score									0.00		800.67
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	4.58	As calculated	617.76	
		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	2.63	4.52	As calculated	106.88	
		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	5.00	4.22	As calculated	147.70	
Social Score									0.00		872.34
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	-5.00	The Schull Stream rises upstream of Schull (town) before flowing in a south easterly direction to enter various culverts through the town and outfall into Schull harbour by the slipway. The Meevane Stream rises upstream of the Cape View estate and flows in a southerly direction before entering along culvert to join the Schull Stream south of Main Street. The water body status of the Schull Stream and Meevane Stream are not as yet classified under the WFD, however the Roaring water water is an SAC and classified as having a high water status. There are no significant polluting sources within the 1% AEP extent. (-2) short term impacts associated with construction of walls and embankments, storage tank and river diversion. On Meenvane Stream there are no suitable locations to utilise the topography for storage. Therefore, it will be necessary to construct a storage / attenuation tank. (-5)a section of Meevane Stream will be diverted to the storage tank. The tank will operate like a backdrop manhole where the inlet and outlets will tie in with existing bed levels and this will permanently change the morphology and hydrological regime of the stream. (-2) it will require excavation within the proposed area to lower ground levels to ensure there is sufficient capacity	-400.00	
	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	5.00	0.00	The qualifying features of the Roaring Water Bay SAC are marine features. Flood works shall be confined to inland areas and as such the potential for direct impact is limited (0). There is potential for sedimentation of the Schull Stream and Meevane Stream during construction of the storage areas, however given the available dilution in the bay, there is no potential for impact on the SAC (0).	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 due to implementation of option	5.00	5.00	-3.00	There is potential for the wooded scrub area north west of the proposed storage area (and also the wooded area south east) on the Schull stream to support badger. Badger has been recorded in the area. There is potential for localised disturbance (-3)	-75.00	
	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	1.00	-5.00	The Roaring water bay SAC is not designated for lamprey / salmon and Schull stream and Meenvane stream are unlikely to have any potential as juvenile habitat for fish species and potential impacts are limited. (-2)the construction of the measures on the tributary may require excavation of the bank of stream and diversion of the Meenvane stream and construction of tank and embankments during the construction stage this would result in short term emissions of sediment to the waterbody and downstream without treatment. the storage tank will result in a permanent loss of fisheries habitat and morphology of the stream (-5)	-65.00	
	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	4.00	-5.00	Schull is located within an area classified as having a high landscape value. The approach to the town from ballydehob and lowertown are scenic routes. Schull is located within the a very high value landscape of national importance and high sensitivity. (-1) Short term will result temporary construction of the measures. The proposed measures include a 2.5m embankment along the Schull stream, given the local topography this is likely to be visible from the scenic roads and will result in a permanent change in the landscape prior mitigation (-5). once constructed the storage tank along the Meenvane stream will be at ground level and will not be visible from the scenic route (0)	-160.00	
	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 setting 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	There are a number of NIAH buildings within Schull. The proposed measures will reduce the risk of flooding on Schull downstream.	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	3.00	0.00	There is one RMP noted downstream in Schull. The propose measures will have no impact on the risk of flooding on this site.	0.00	
Environmental Score										-664.00	
MCA Benefit score										1009.01	
Option Selection MCA Score										1959.01	
MCA benefit Cost Ratio										0.0001	
Economic Benefit Cost Ratio										0.69	

Flood Risk Management Options	Schull
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Multi-Criteria Assessment						Option 2 - Storage (Schull Stream) & Flow Diversion				
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	Little operational risk, other than a sluice gate and 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 drowning, electrocution and falling from a height	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	Limited scope to modify for an increase in future flood events	200.00
Technical Score							0.00			800.00
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	4.77	As calculated (95.32 * 0.05)	571.92
	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	4.58	As calculated	228.75
	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	2.92	0.00	As calculated	0.00
Economic Score							0.00			800.67
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	4.58	As calculated	617.76
		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	2.63	4.52	As calculated	106.88
		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	5.00	4.22	As calculated	147.70
Social Score							0.00			872.34
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	-5.00	The water body status of the Schull Stream and Meevane Stream are not as yet classified under the WFD. (-3) The 656m culvert will discharge to an existing watercourse which may require some regrading works. (-5) The diversion of flow from Meenvane stream to another river results in the permanent change in hydrological regime on both waterbodies. (-2) There are also short term negative impacts associated with the construction of storage area and culvert. This would result in significant emissions of sediment to the waterbody. There will be a requirement for a CEMP to ensure that there are no discharges from the construction works areas without prior treatment	-400.00
	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	5.00	0.00	The qualifying features of the Roaring Water Bay SAC are marine features. Flood works shall be confined to inland areas and as such the potential for direct impact is limited (0). There is potential for sedimentation of the Schull Stream and Meevane Stream during construction of the storage area and diversion, however given the available dilution in the bay, there is no potential for impact on the SAC (0).	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 due to implementation of option	5.00	5.00	-3.00	There is potential for the wooded scrub area north west and south east of the proposed storage area on the Schull stream to support badger. Also there is potential for habitat along the route of the diversion to the Meevane Stream to support badger. Badger has been recorded in the area. There is potential for localised disturbance (-3)	-75.00
	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	1.00	-5.00	The Roaring water bay SAC is not designated for lamprey / salmon and Schull stream and Meenvane stream are unlikely to have any potential as juvenile habitat for fish species.(-2)the construction of the measures on the tributary may require excavation of the bank of stream and diversion of the Meenvane stream a during the construction stage this would result in short term emissions of sediment to the waterbody and downstream without treatment. the extensive culvert will result in a permanent loss of localised fisheries habitat and morphology of the stream (-5)	-65.00
	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	4.00	-5.00	Schull is located within an area classified as having a high landscape value. The approach to the town from ballydehob and lowertown are scenic routes. Schull is located within the a very high value landscape of national importance and high sensitivity. (-1) Short term will result temporary construction of the measures. The proposed measures include a 2.5m embankment along the Schull stream, given the local topography this is likely to be visible from the scenic roads and will result in a permanent change in the landscape prior mitigation (-5).once constructed the storage tank along the Meenvane stream will be at ground level and will not be visible from the scenic route (0)	-160.00
	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 setting 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	There are a number of NIAH buildings within Schull. The proposed measures will reduce the risk of flooding on Schull downstream	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	3.00	0.00	There is one RMP noted downstream in Schull. The propose measures will have no impact on the risk of flooding on this site	0.00
Environmental Score										-664.00
MCA Benefit score										1009.01
Option Selection MCA Score										1809.01
MCA benefit Cost Ratio										0.0001
Economic Benefit Cost Ratio										0.90

Flood Risk Management Options	Schull
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Multi-Criteria Assessment								Option 3 - Culvert & Storage (Meenvane)		
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	Level of risk due to manhole sealing, sedimentation in storage tank	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	3.00	Risk of drowning and falling from a height	300.00
	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	1.50	Limited scope to modify for an increase in future flood events	150.00
Technical Score							0.00			850.00
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	4.77	As calculated (95.32 * 0.05)	571.92
	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	4.58	As calculated	228.75
	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	2.92	0.00	As calculated	0.00
Economic Score							0.00			800.67
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	4.58	As calculated	617.76
		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	2.63	4.52	As calculated	106.88
		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	5.00	4.22	As calculated	147.70
Social Score							0.00			872.34
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	-5.00	The Schull Stream rises upstream of Schull (town) before flowing in a south easterly direction to enter various culverts through the town and outfall into Schull harbour by the slipway. The Meevane Stream rises upstream of the Cape View estate and flows in a southerly direction before entering along culvert to join the Schull Stream south of Main Street. The water body status of the Schull Stream and Meevane Stream are not as yet classified under the WFD. (The culvert on the Schull Stream crosses Main Street at the Bunratty Inn. This culvert has developed from an existing bridge crossing and has effectively been extended 80m upstream by landowners paving over the stream to the rear of their properties (-1) short term impacts associated with construction of storage tank and culvert within the rear gardens of properties. (-5) On Meenvane Stream there are no suitable locations to utilise the topography for storage. Therefore, it will be necessary to construct a storage tank. (-3)a section of Meevane Stream will be diverted to the storage tank. The tank will operate like a backdrop manhole where the inlet and outlets will tie in with existing bed levels. (-2) it will require excavation within the proposed area to lower ground levels to ensure there is sufficient capacity	-400.00
	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	5.00	0.00	The qualifying features of the Roaring Water Bay SAC are marine features. Flood works shall be confined to inland areas and as such the potential for direct impact is limited (0). There is potential for sedimentation of the Meevane Stream during construction of the storage area, however given the available dilution in the bay, there is no potential for impact on the SAC (0).	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 due to implementation of option	5.00	5.00	0.00	No potential impacts from storage on the Meevane Stream (0) The Schull stream has low fishery value. Culverting the stream will have negligible impact on ecology (0)	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	1.00	-5.00	The Roaring water bay SAC is not designated for lamprey / salmon and Schull stream and Meenvane stream are unlikely to have any potential as juvenile habitat for fish species. (-2)the construction of the measures on the tributary may require excavation of the bank of stream and diversion of the Meenvane stream during the construction stage this would result in significant short term emissions of sediment to the waterbody and downstream without treatment. the storage tank will result in a permanent loss of fisheries habitat. (-5) The diversion of the Meenvane stream constitutes a permanent and intermittent negative impact to the hydrological regime of the stream. The construction of the culvert and sealed manholes are unlikely to have any impacts on the fisheries potential of the existing stream as the stream is largely culverted and engineered. (0)	-65.00
	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	4.00	-3.00	Schull is located within an area classified as having a high landscape value. The approach to the town from ballydehob and lowertown are scenic routes. Schull is located within the a very high value landscape of national importance and high sensitivity. (-3) Short term will result temporary construction of the measures. the storage area will result in permanent change in existing landscape form in the locality prior to mitigation. The proposed measures include a culvert along the Schull stream, given the local topography this is unlikely to be visible from the scenic roads, however it is noted that the stream may run along the rear gardens of a number of dwellings along main street. The culvert on the Schull Stream crosses Main Street at the Bunratty Inn. This culvert has developed from an existing bridge crossing and has effectively been extended 80m upstream by landowners paving over the stream to the rear of their properties. There are also a number of manholes along this section. The paving and manholes are not watertight and flows exit these structures when the culvert capacity is reached and the structures are subject to surcharging . once constructed the storage tank along the Meenvane stream will be at ground level and will not be visible from the scenic route. it is noted that the stream currently runs to the rear of existing dwellings along the main street	-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 setting 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	There are a number of NIAH buildings along the mainstreet within Schull. The proposed measures will reduce the risk of flooding on Schull downstream.	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	3.00	0.00	There is one RMP noted downstream in Schull. The propose measures will have no impact on the risk of flooding on this site	0.00
Environmental Score										-525.00
MCA Benefit score										1148.01
Option Selection MCA Score										1998.01
MCA benefit Cost Ratio										0.0002
Economic Benefit Cost Ratio										1.58

Flood Risk Management Options	Schull
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[illegible]