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4 Alternatives Considered

4.1 Introduction

The EIA Directive requires an EIAR to contain:

> *'A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.*

4.2 Flood Relief Scheme Development Process

The development of the proposed Flood relief scheme has been a multi staged process with consideration of a wide range of alternatives in order to arrive at the final flood relief scheme design.

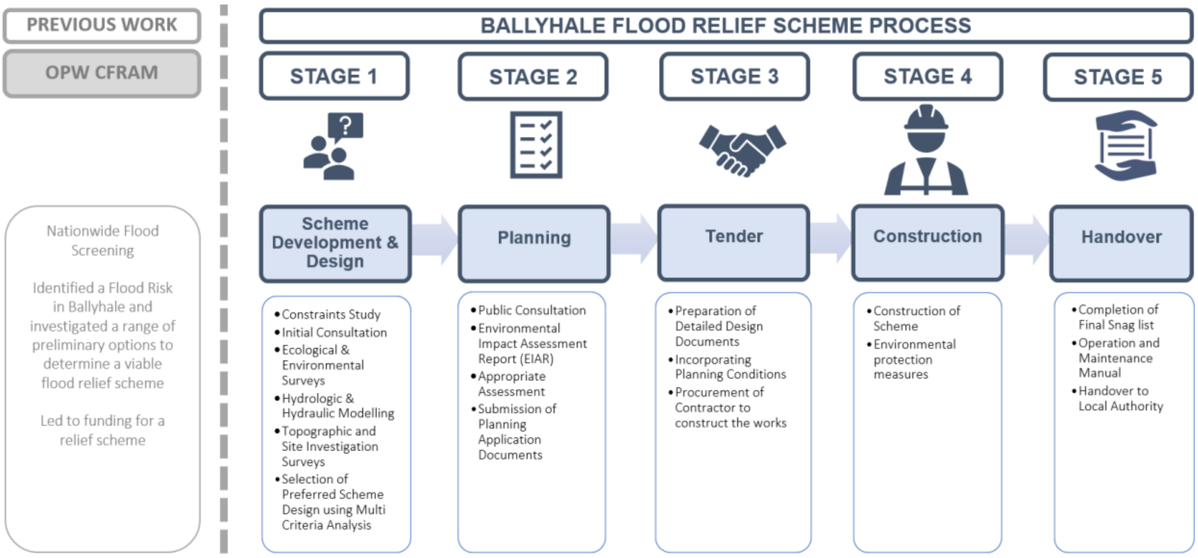

Figure 4-1: Flood Relief Scheme Development Process

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

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

This Chapter provides a summary of the consideration of alternatives processes with more detailed information provided within the individual project documents. These supporting project documents are available on the project website at https://www.kilkennycoco.ie/eng/services/roads/flood-relief/ballyhale-flood-relief-scheme/.

4.3 Option Assessment Methodology

The general approach to Options Assessment and Selection is outlined in Figure 4-2 below.

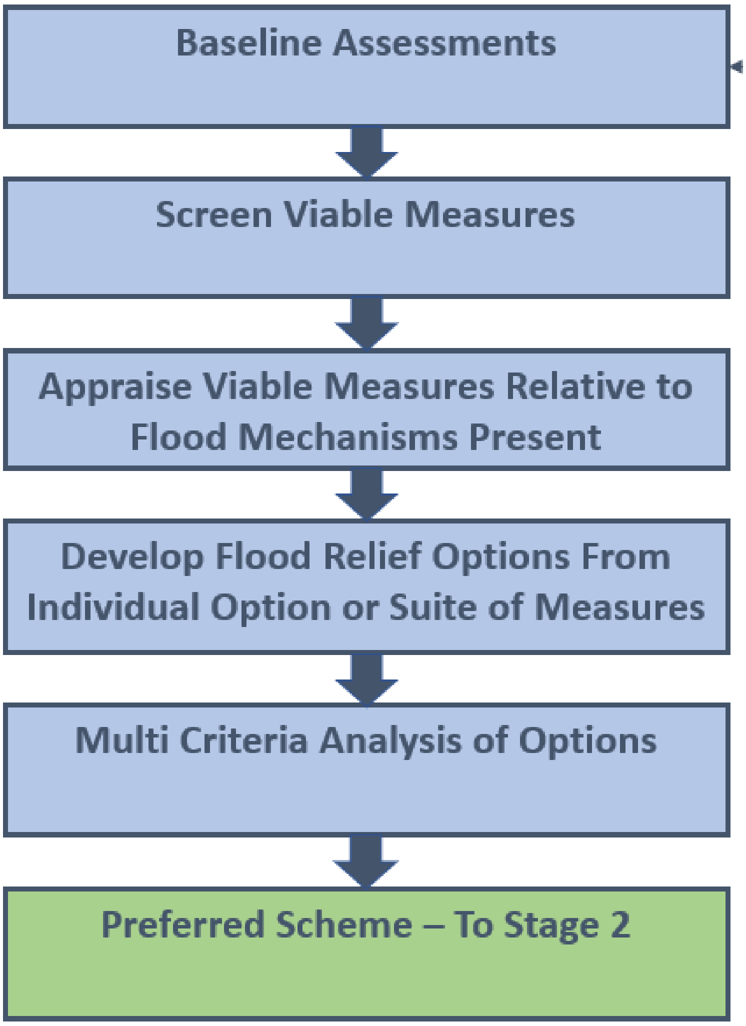

Figure 4-2: Options Assessment and Selection Process

In order to develop a suitable flood relief scheme, it is vital to accurately establish the existing baseline Environmental and Flood Risk conditions at the site.

The existing environment was assessed initially in the form of a Constraints Report which establishes key environmental sensitivities and constraints which may affect the design of relief options. Baseline assessments for each relevant environmental topic are presented within this EIAR.

A detailed topographical and river survey of the site has been carried out to capture existing conditions and to provide data for the design of relief works.

The design flood flows at the site were established via the Hydrology Report. A detailed 1D-2D hydraulic model of the watercourse, structures, and surrounding lands has been developed using Infoworks ICM software as described in the Hydraulics Report. This hydraulic model recreates the river system in the study area and simulates the predicted flooding for a range of return periods. The models are validated against previous flood records. This determines the existing flood mechanisms and flood extents in the town and can be used to simulate the effect of relief options. The model outputs can also be used to estimate the economic damages from flooding.

The next step is to screen a variety of Flood Risk Management techniques to establish which may be viable or unsuitable for the site in question.

The viable measures are then assessed in more detail to determine their suitability to address the specific flood mechanisms in the subject site.

A number of potential relief design options are then developed based on the preceding assessments. These may use a single technique or a combination of measures as appropriate.

The various options are then subject to a Multi Criteria appraisal in order to select the most suitable option which balances Social, Economic, Environmental and Technical considerations.

The preferred option is then brought forward for further refinement, assessment and progression through the planning process.

4.3.1 *Initial Screening of Flood Risk Management Options*

The purpose of this step is to act as a high-level screening of options, to assess the option's viability in relation to certain criteria, namely: Applicability to Relevant Area, Social, Economic, Environmental and Cultural.

Certain FRM methods would simply not be applicable to certain flood risk circumstances and were rejected on this basis. The flood risk management options which were subject to the screening process in the Options Report are contained in Table 4.1.

Table 4-1: Initial Screening of Flood Risk Management Options (Extract from Options Report)

Flood Risk Management Option	Applicability	Social Screening	Economic Screening	Environmental Screening	Cultural Screening	Screening Result
Do Nothing	×					Not Viable
Do Minimum	×					Not Viable
Maintenance Programme	✓	✓	✓	✓	✓	Viable
Flood Forecasting and Warning	×					Not Viable
Individual Property Protection	×					Not Viable
Property Relocation	×					Not Viable
Land Use Management	×					Not Viable
Improvement of Channel Conveyance	✓	✓	✓	✓	✓	Viable
Overland Flood Paths	×					Not Viable
Rehabilitation of Existing Defences	×					Not Viable
Pumping	×					Not Viable
Upstream Flood Storage	✓	✓	✓	✓	✓	Viable
Flow Diversion Structure	✓	✓	✓	✓	✓	Viable
Culverting	×					Not Viable
Hard Defences	✓	✓	✓	✓	✓	Viable
Debris Control Measures	✓	✓	✓	✓	✓	Viable
Natural Retention Measures	✓	✓	✓	✓	✓	Viable

4.3.2 Non-Viable Flood Risk Management Options

Further to the initial screening in Table 4.1, the non-viable flood risk management options have been described in more detail as to why the options are classed as non-viable.

- Do nothing – this scenario is defined as the option involving no future flood defence works or the continuation of existing maintenance of existing defences/ channels. Therefore, the existing flood risk persists and may increase in the study area. This is not considered a sustainable option as the risk of flooding within Ballyhale persists and this option does not meet the needs of residents and business of Ballyhale. Therefore, this option was ruled out during the screening stage.
- Flood Forecasting and Warning - Flood warning and early warning does not reduce hazard, but generally can reduce risk and can play a significant role in flood defence. Forecasting can reduce risk to human life, but extensive infrastructure damage will still occur. Given the small catchment size and given that Ballyhale is only approximately 1.5km downstream of the watercourse headwaters there is no suitable location far enough upstream to place a gauge which would provide enough warning for the village. Therefore, this option was ruled out during the screening stage. The use of Met Eireann Weather warnings may have some applicability to the inspection and maintenance plans for the overall works.
- Individual Property Protection – this scenario is defined as the option involving individual protection in the form of demountable barriers and non-return valves on drains for each of the properties effected by the flood risk in Ballyhale. The current flood paths within the town of Ballyhale are too extensive for the use of individual property protection. Therefore, this option was ruled out during the screening stage.
- Property Relocation - this scenario is defined as the relocation of affected properties at flood risk to where there is no flood risk. While this scenario can be beneficial for single properties or a small cluster of properties it is impractical to move a large section of the town of Ballyhale. Therefore, this option was ruled out during the screening stage.
- Land Use Management – This scenario is defined as the management of land use to direct development to low flood risk areas and to reduce pressure on drainage systems. This is possible during the formation of statutory plans to ensure lands zoned for development is directed to suitable locations outside

floodplains. It also includes development objectives in statutory plans to reduce runoff from new developments. While this option can be used to reduce future flood risk, it does not have any effect of the current flood risk in Ballyhale. This is not considered a viable option as it would have minimal effect on the current flood risk. Therefore, this option was ruled out during the screening stage.

- Overland Flood Paths – this scenario is defined as the creation of overland flood paths to alleviate the flooding in Ballyhale. This option is not considered viable as one of the current issues is overland flooding of the main street in Ballyhale. There is no feasible overland flood route which would not coincide with existing development. Therefore, this option was ruled out during the screening stage.
- Rehabilitation of Existing Defences – this scenario is defined as the inspection and remedial repairs to existing flood defences in Ballyhale. This option is not considered a viable option as there are no current formal flood defences in Ballyhale. Therefore, this option was ruled out during the screening stage.
- Pumping – this scenario is defined as the pumping of excess water from the watercourse in Ballyhale to a point further downstream during the design flood event. This would require the construction of a pumping station upstream of the area at risk as well as a channel or piped system to transport the water. The option is not considered a viable option on a main stream channel such as the Ballyhale River as this measure would have significant negative environmental impacts and would have very significant operation and maintenance costs. Therefore, this option was ruled out during the screening stage.
- “Culverting” – this scenario is defined as the culverting of the stream through the town of Ballyhale. This option is not considered viable as there are already several culverts on the stream that are causing problems due to structure incapacity. This would require much of the already culverted steam to be removed and replaced with new culverts. Due to the number of culverts required to be replaced and the significant development in the direct vicinity of the stream this option is not viable. This option would also have significant operational and maintenance costs. Therefore, this option was ruled out during the screening stage.

4.3.3 Appraisal of Potentially Viable Flood Risk Management Options

Further to the Initial Screening carried out, the following options were taken forward as potentially viable flood risk management options.

Do Minimum

This option is brought forward as a baseline to compare the other Flood Management Options to show the benefits of each viable option. This scenario is defined as involving no new future flood defence works but allows any current maintenance and inspection regimes to continue. This is in order to maintain the existing standard of protection via any existing maintenance schemes.

Flow Diversion

The “Flow diversion” scenario is the creation of a new channel or culvert to divert excess flood flows from the existing channels. The flow entering the flow diversion would be regulated such that the capacity of the existing watercourse system is not exceeded and therefore a flow diversion structure to redirect flows would be required. It is envisioned that flow would only be directed to the diversion route during extreme floods beyond the capacity of the existing watercourses.

This method would be most applicable to flood mechanisms in the centre of the village which are driven by channel incapacity and restrictions along the watercourse. The flow diversion would seek to remove the excess flow from a point before the flood risk area and safely convey the flow to a suitable downstream location.

The hydraulic analysis undertaken within the hydraulics report has indicated that there is sufficient capacity to convey the 10% AEP (10 year) year peak flow though the village without resulting in property damage. The flow entering the village for this event has been estimated at approximately 3.34 m^3/s. The estimated peak flow for the design standard 1% AEP (100 year) event is approximately 5.4 m^3/s, therefore the capacity of the Flow Diversion route would be required to be approximately 2.0 m^3/s.

Overland flooding upstream of the village is predicted from both the main channel and the tributary channel alongside the school. A suitable flow diversion on the main channel would still require works to the tributary channel. Therefore, flow diversion will be considered in combination with other options.

Flow diversion could represent a significant change to the natural river morphology and therefore would need careful consideration to avoid impact on Water Framework Objectives.

Hard Defences

The “Hard Defences” option is defined as the creation of physical barriers to prevent flood flows from entering an area and include flood walls and embankments. A review was carried out to determine the locations required for Hard Defences during a 1% AEP event.

It is considered that hard defences are likely to be appropriate to resolve the overland flow flood mechanisms identified upstream of the village as these appear to be driven by low bank levels along limited portions of the watercourse banks.

The flood mechanisms in the centre of the village are driven by watercourse incapacity issues which result in out of bank flooding into adjacent properties. The affected properties are largely located beyond the eastern bank of the channel and therefore hard defences on the eastern bank may be appropriate to protect these properties. It however noted that constructing new defences in this location would require the demolition and reconstruction of the existing boundaries for approximately 15 properties. Additionally, in a number of locations there are domestic bridges spanning the watercourse to domestic gardens/ land parcels at the other side of the watercourse. These accesses would likely be required to be removed which would sever access to these parcels. It is considered unlikely this significant impact to a large number of properties would be socially acceptable.

Construction of hard defences have the potential to impact floodplain ecology resulting from the direct construction in this zone, severance of riverine and adjoining terrestrial habitats and the loss of shading to the riparian zone.

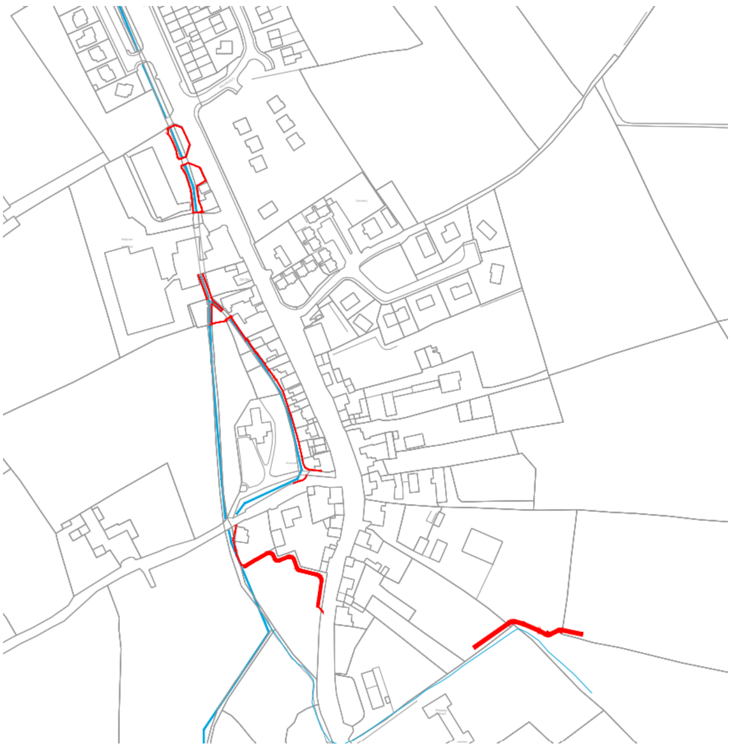

Figure 4-3: Concept Hard Defences Required

Hard defences are therefore considered to have applicability to resolve certain flood mechanisms affecting the village and were considered in conjunction with other measures.

Maintenance Programme

The “Maintenance Program” option is defined as the creation of an Inspection and Maintenance Regime. The maintenance programme would be a series of regular inspections as well as inspections pre and post storm events along the route of the channel. Remedial and preventative works would be undertaken to maintain existing channel capacity. The measure may also involve minor channel conveyance improvements. Local anecdotal evidence suggests that there were blockages of watercourse structures during previous flood events which have exacerbated flooding.

The aim of the maintenance programme would be to reduce the risk of blockage events within the watercourse channel and structures. The aim would be to engage the community to help in relation to these blockages and alert officials of problems with the watercourse.

Reduction of upstream impoundment reduced upstream siltation, increased sediment supply downstream, geomorphology of downstream bed and banks is likely to occur through sediment and vegetation management.

With a maintenance program in place the risk of blockage events would be reduced however flood mechanisms exist in Ballyhale in the absence of blockage and thus the maintenance program would not reduce the risk on its own. The program may reduce the residual risk from blockage events. Therefore, this option was considered in combination with other options.

Debris Control Measures

Debris Control Measures can take the form of screening devices which aim to capture debris carried in the watercourse in a safe location which minimises flood risk and facilitates easy removal. This prevents the debris passing through the watercourse and potentially causing blockage in a critical structure which can drastically impact flood levels and extents. Blockages of the various hydraulic structures that exist on the watercourse are known to have been a mechanism of flooding in the past.

Reduction of upstream impoundment reduced upstream siltation, increased sediment supply downstream, geomorphology of downstream bed and banks is likely to occur from Blockage Removal.

Since the flood risk is present in Ballyhale in the absence of any blockage event this measure will be unsuitable as a standalone measure but may have merits in combination with other measures to reduce residual blockage risk.

Improve Channel Conveyance

The river channel in Ballyhale has a number of culverts, weirs and restrictions which reduce the overall capacity of the channel. The “Improvement of Channel Conveyance” option would seek to remove flow restrictions and increase the flow capacity available within the watercourse system so that the design flow can be accommodated without flooding. This may involve removing or replacing structures affecting capacity, widening the channel, or modifying the channel gradient.

Hydraulic modelling and analysis to date has established a number of capacity constraints. Key constraints include;

- A number of weirs as are present on the watercourse which tend to reduce overall channel gradient and increase flood levels. Removal of weirs would have the potential to increase capacity and reduce flood levels.
- Various minor structures span the watercourse which tend to reduce capacity, increase blockage risk and inhibit maintenance. Removal of structures and reinstatement of natural river corridor morphology will provide a range of benefits where feasible.
- A long culvert is present under the industrial estate which presents a capacity restriction. This also results in fisheries impact and inhibits maintenance. It is noted however that an industrial building is constructed over the line of the culvert and therefore and works would require the demolition/replacement of the building and the compensation to the owners which is not considered to be economically viable.
- The existing Main St culvert at Hazelbrook is a twin arch structure which presents a capacity restriction and has poor inlet conditions due to a sharp inlet bend and siltation. Major works at this location are restricted since the culvert does not appear to directly cause any property flooding and since the bridge is a National Inventory of Architectural Heritage site.

Through the increase of channel conveyance there would be a natural increase in migration upstream and an increase of sediment supply downstream. Alterations to the channel to improve conveyance would also result in the loss of shading associated with the riparian zone.

It is unlikely that conveyance improvements can resolve all flood mechanisms in Ballyhale as a standalone measure however this option will be considered in combination with the other measures.

Upstream Flood Storage

The Upstream Flood Storage option is defined as the use of areas where flood water can be stored and then safely discharged at a controlled rate. The Upstream Storage option would involve the construction of a flow control to throttle pass-forward flows such that the capacity of the existing watercourse system downstream is not exceeded. An embankment/dam would be created at the flow control behind which flood waters could be temporarily stored for the period where peak incoming flows exceed the downstream capacity.

The hydraulic analysis undertaken within the hydraulics report has indicated that there is sufficient capacity to convey the 10% AEP (10 year) year peak flow though the village without resulting in property damage. The flow entering the village for this event has been estimated at approximately 3.34 m^3/s. The estimated peak flow for the design standard 1% AEP (100 year) event is approximately 5.4 m^3/s. An estimate of flood storage required has therefore been determined by applying an attenuated profile to the design Q100 inflow hydrograph and determining the volumetric difference between the attenuated and design profile (see Figure 4-4).

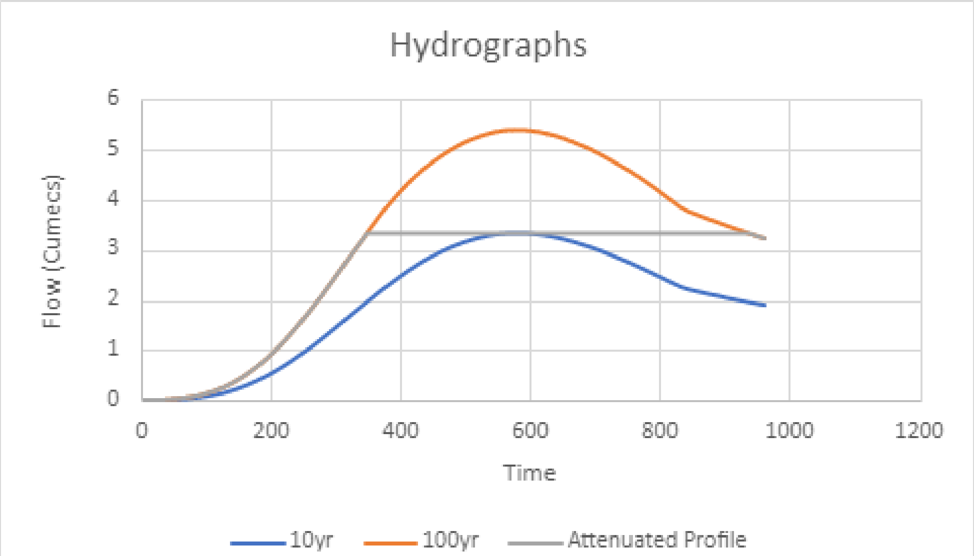

Figure 4-4: Attenuated Hydrograph

The analysis indicates that an attenuation volume in excess of 200,000m^3 is required to restrict Q100 flows to the Q10 peak. A review of potential storage locations has been undertaken to establish the viability of accommodating this volume. A defined topographic valley is present on the watercourse upstream of Ballyhale which may represent a suitable location. The storage volume mobilised by an embankment of up to 5m height across this valley has been established by comparison of a simulated water surface against topographic data (see figure below). This indicates that the area identified (approx. 3 ha) would only hold approximately 55,000 m³ and therefore a number of such storage locations would be required along the upstream catchment. The economic, social and environmental impacts of a number of major embankments and flood storage areas would be significant. Additionally, there would be significant operation and maintenance requirements of the control structures and also health and safety obligations in relation to impoundment structures. Therefore, this option shall not be considered as part of further option development.

Upstream flow impoundment, increased upstream siltation, reduced sediment supply downstream, geomorphological alterations of downstream bed and banks is likely to occur due to the creation of upstream flood storage.

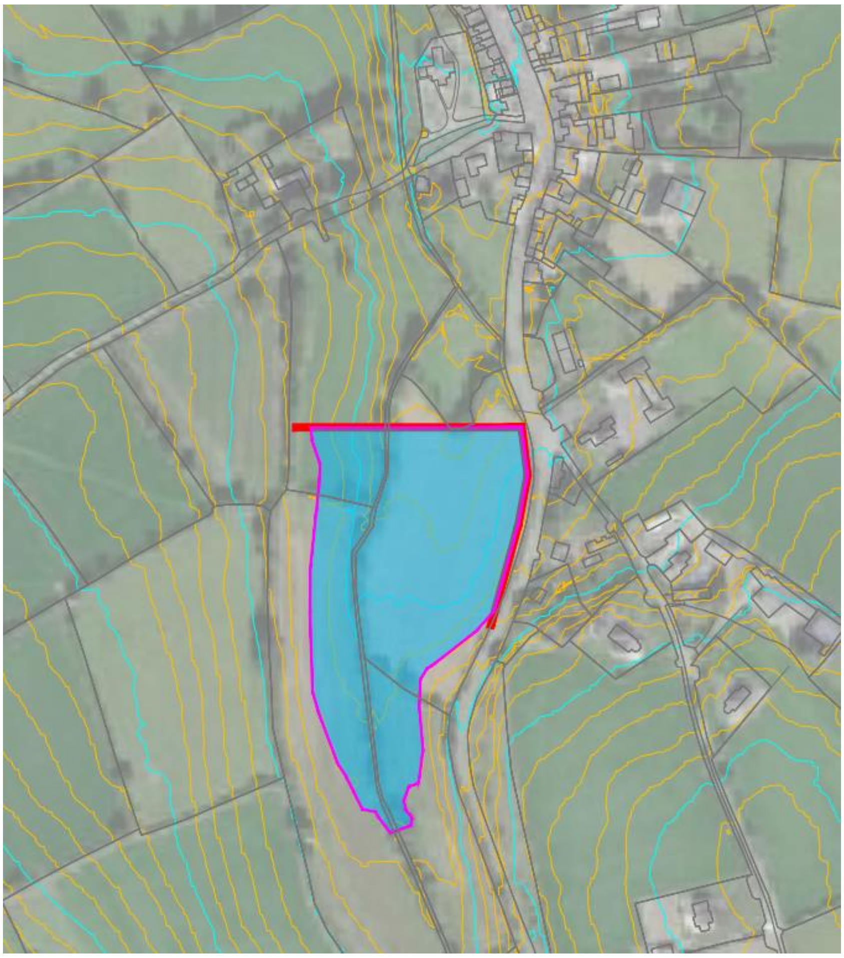

Figure 4-5: Concept Upstream Storage Location

<u>Natural Retention Measures</u>

The natural retention measures would entail a series of programmes to increase the natural water retention in the surrounding catchment of Ballyhale in order to reduce the peak flow rates such that flood risk is alleviated. In addition to reduction in flood risk, the measures may offer complementary benefits on biodiversity and water quality. Best practice guidance on Natural Retention Measures is included in the Scottish Environmental Protection Agency – Natural Flood Management Handbook.

The following Natural Retention Measures were considered;

1. Land Drainage Channel Modifications - The surrounding catchment area is used for agricultural purposes and this land has a large amount of land drainage channels which drain directly into the Ballyhale River. This method would propose the modification of these land drainage channels to slow down and reduce the peak flows entering the Ballyhale River. This could be achieved with the installation of small barriers within the drainage channels to slow down the flow and reduce the peak flow within the Ballyhale River. This would reduce the effectiveness from an agricultural drainage perspective but would reduce flood rates and volumes.
2. Floodplain Planting – This method would involve the upstream planting of forestry along the floodplain of the river. Floodplain woodlands are thought to offer the greatest potential for downstream flood mitigation, although its value as a Flood Mitigation measure depends on the size of the floodplain.
3. Catchment Woodlands – Woodlands, hedgerows, and trees established with careful placement, can reduce peak runoff at field and small catchment scale, and could therefore make a contribution to slowing flows and reducing peak flows. In addition, woodland planting offers additional co-benefits such as biodiversity, amenity, soil stability, interception & uptake of nutrients and carbon sequestration.
4. Sediment Traps - The catchment that feeds into the Ballyhale River has been heavily modified. Much of the surrounding area has land drainage channels on the agricultural land. There is local anecdotal information that suggests that the siltation is an issue. One way that this could be alleviated is with sediment traps being installed in the land drainage channels to reduce both coarse and fine sediments input to the main channel. This would also help to slow the flows and alleviate the peak flows.
5. River Morphology and Floodplain Restoration – This is most applicable where the existing morphology of the river has been changed. The greatest potential to alter morphology is upstream of the village in agricultural lands however the channel does not appear to have been subject to historical changes or modification in this area. The Watercourses is heavily modified though the

village however the presence of existing development does not allow the re-creation of floodplain in this area.

6. Non-floodplain wetlands – This would involve the creation of wetlands outside of the existing floodplain as a way of slowing and storing flood water.
7. Instream Structures – These structures would aim to create areas of natural water retention and slow down the water flow through overland flooding. Instream structures are typically locally derived as cut timber from large trees. Wooden structures can be designed with varying levels of complexity ranging from one or two pieces of wood located across a channel to dozens of stacked logs secured to the riverbank.

It is noted that the majority of these measures need to be implemented at catchment scale and therefore require a high level of public buy-in and engagement across large number of landowners. Many measures also require a significant land take which can be at the expense of agricultural land use. It is also noted that many measures require a number of years of establishment before the effects on flood flows are realised (forestry, wetlands etc).

Land management and its impact on flood risk is currently an active topic of research in academic and government sectors. Detailed validation data to determine the specific impact of individual land management changes across a catchment are not currently available. Established approaches which can be reliably applied to current hydrological and hydrological modelling techniques to reflect land management changes are also not currently available.

In light of the above, Natural Retention Measures shall not be progressed as part of the primary measures for flood relief in Ballyhale.

There may be opportunities to separately implement pilot studies for certain measures within the Ballyhale catchment given its relatively small size and upstream agricultural land use. Should this be progressed, it is recommended that baseline flow and rainfall monitoring be established in advance of the measures being implemented to determine the current rainfall-response profile. Then data could continue to be collected during the establishment and operation of the measures to quantify the impact of the measures. This data may be useful for future flood relief schemes.

4.3.4 *Development of Flood Risk Management Options*

<u>*Option A*</u>

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

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

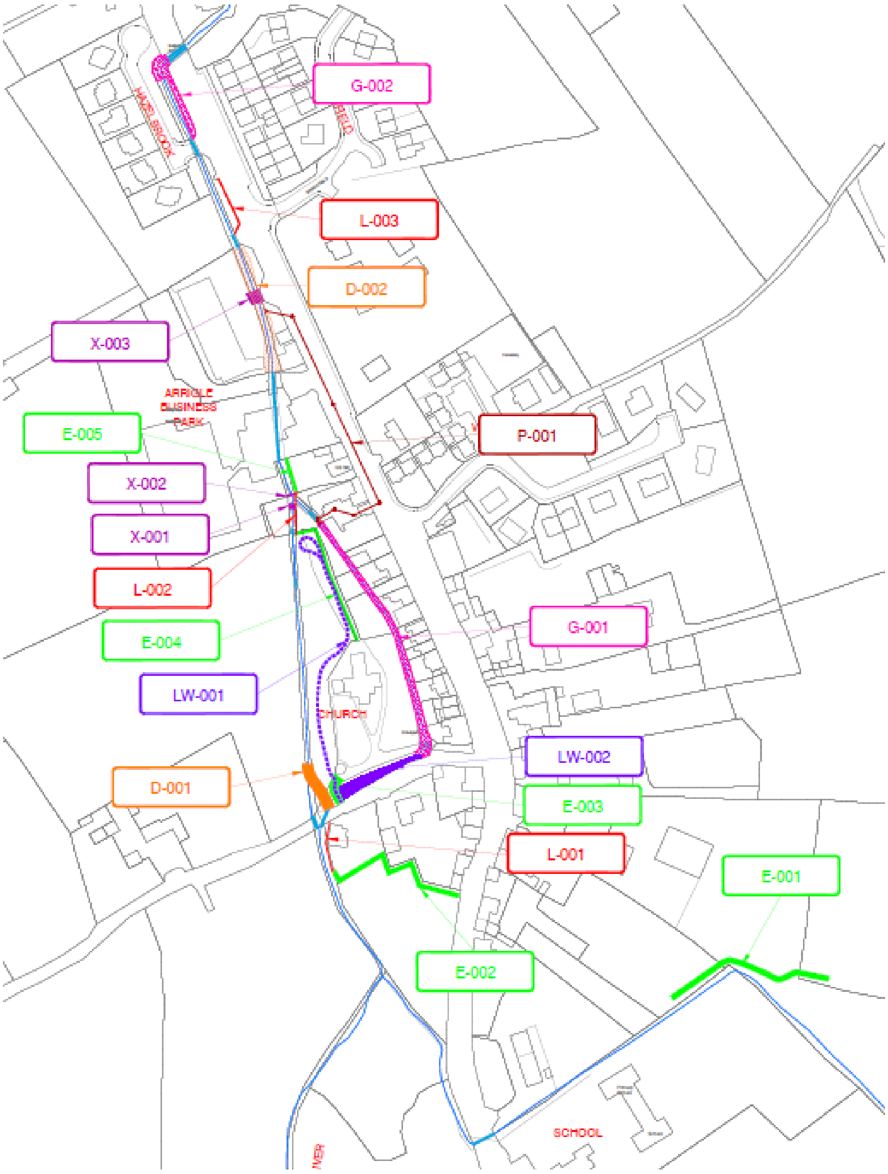

Figure 4-6: Concept Option A Layout

Option B

Option B aims to create an overflow diversion channel to provide a bypass route for flows in excess of the existing flow capacity though the village. It diverts the flow around the village and discharges to the Little Arrigle River. This option is similar to what was proposed in the original CRFAM Options report however the route has been amended to avoid the GAA grounds due to unacceptable social/cultural impacts.

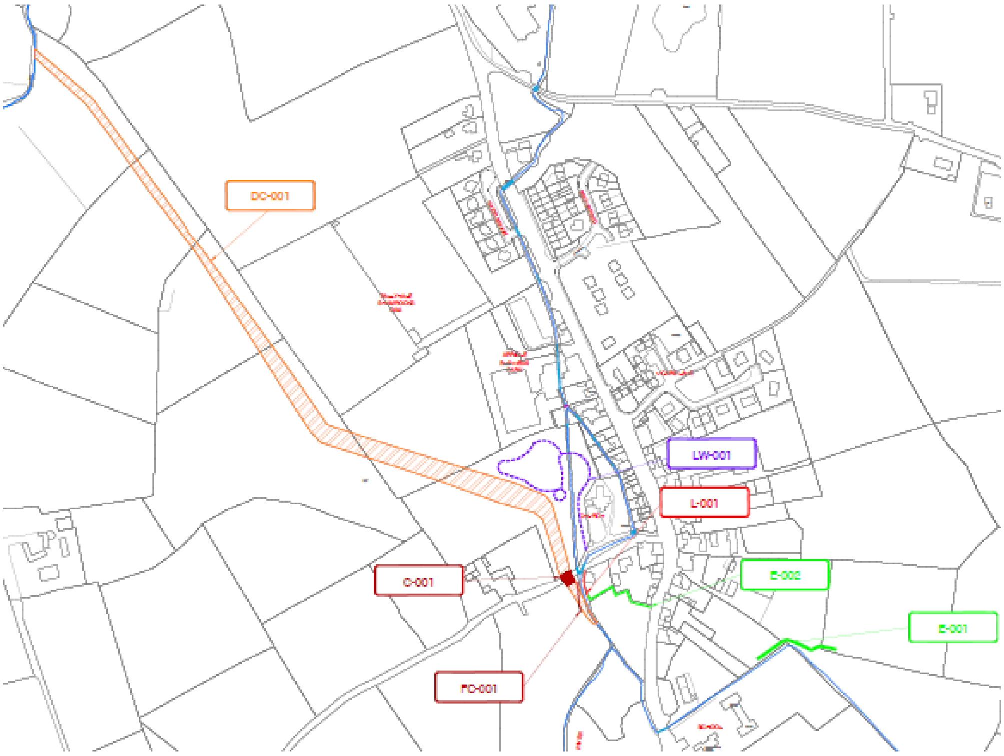

Figure 4-7: Concept Option B Layout

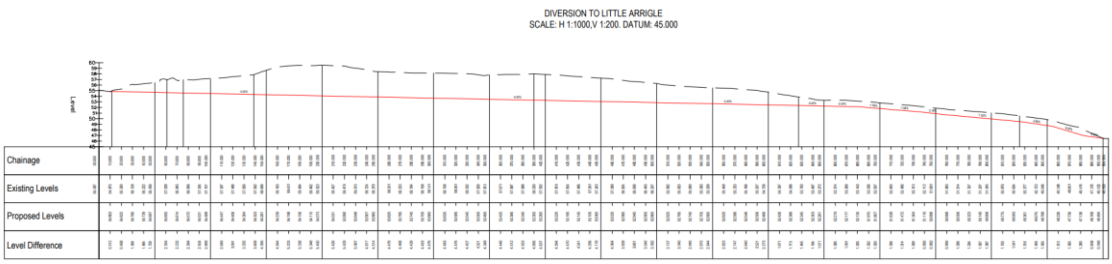

Figure 4-8: Option B Concept Longitudinal Section showing existing and proposed levels

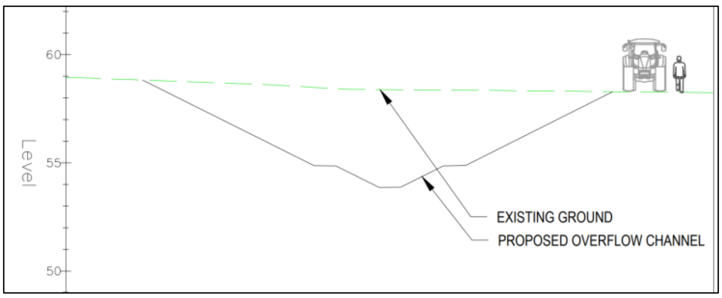

Figure 4-9: Concept Cross Section in deep cut section showing existing and proposed levels

Option C

Option C aims to create an overflow diversion channel to provide a bypass route for flows in excess of the existing flow capacity though the village. It diverts the flow around the village and discharges back into the Ballyhale River downstream of the village.

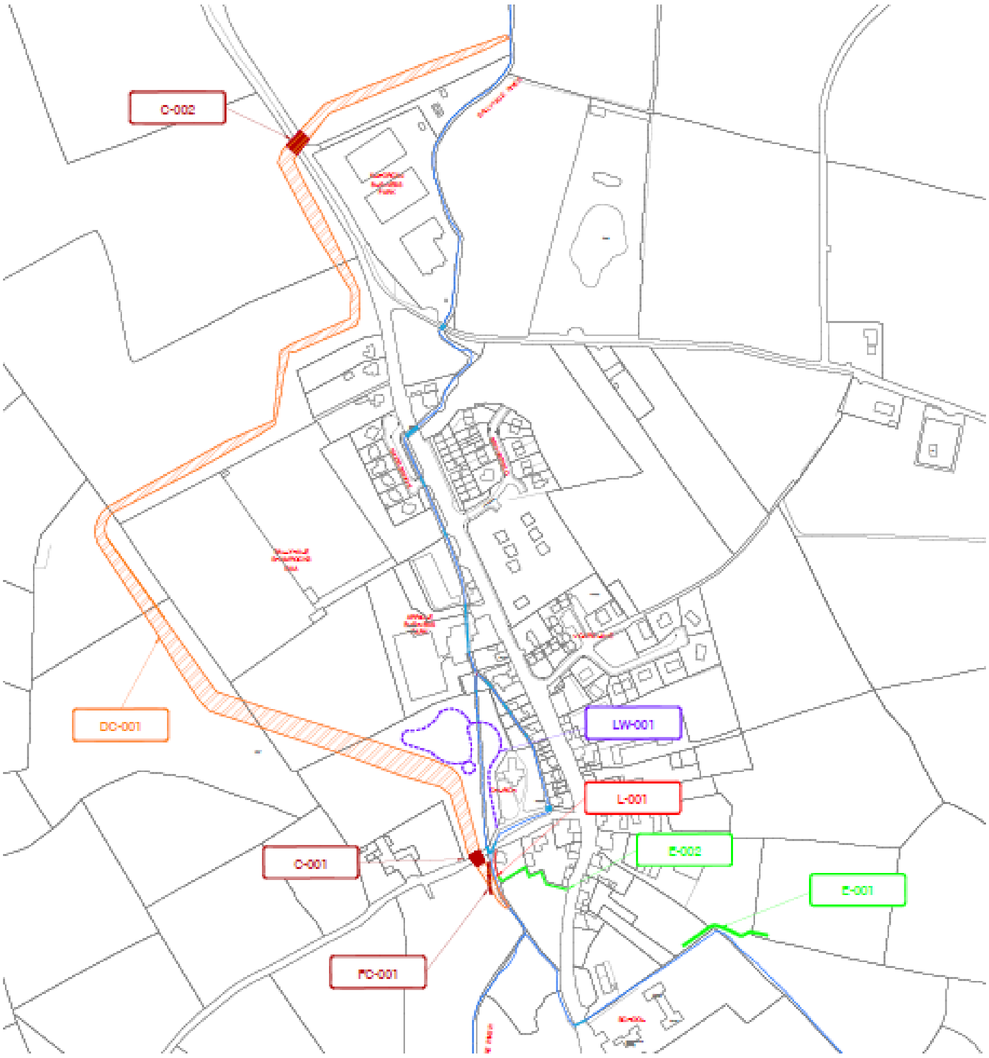

Figure 4-10: Concept Option C Layout (Refer to Appendix 4.4 for Additional Info)

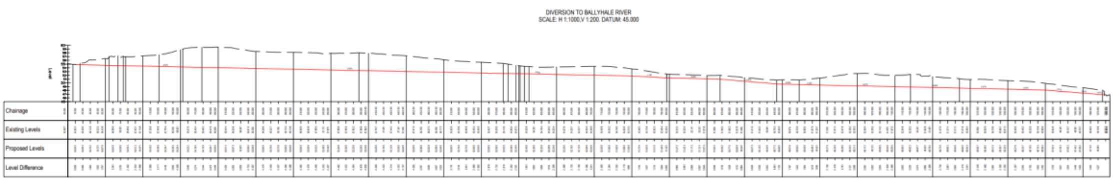

Figure 4-11: Option B Concept Longitudinal Section showing existing and proposed levels

Option D

Option D aims to create an overflow diversion pipe to provide a bypass route for flows in excess of the existing flow capacity though the village. It diverts the flow through a new pipe along the main street and discharges back into the Ballyhale River downstream of the village.

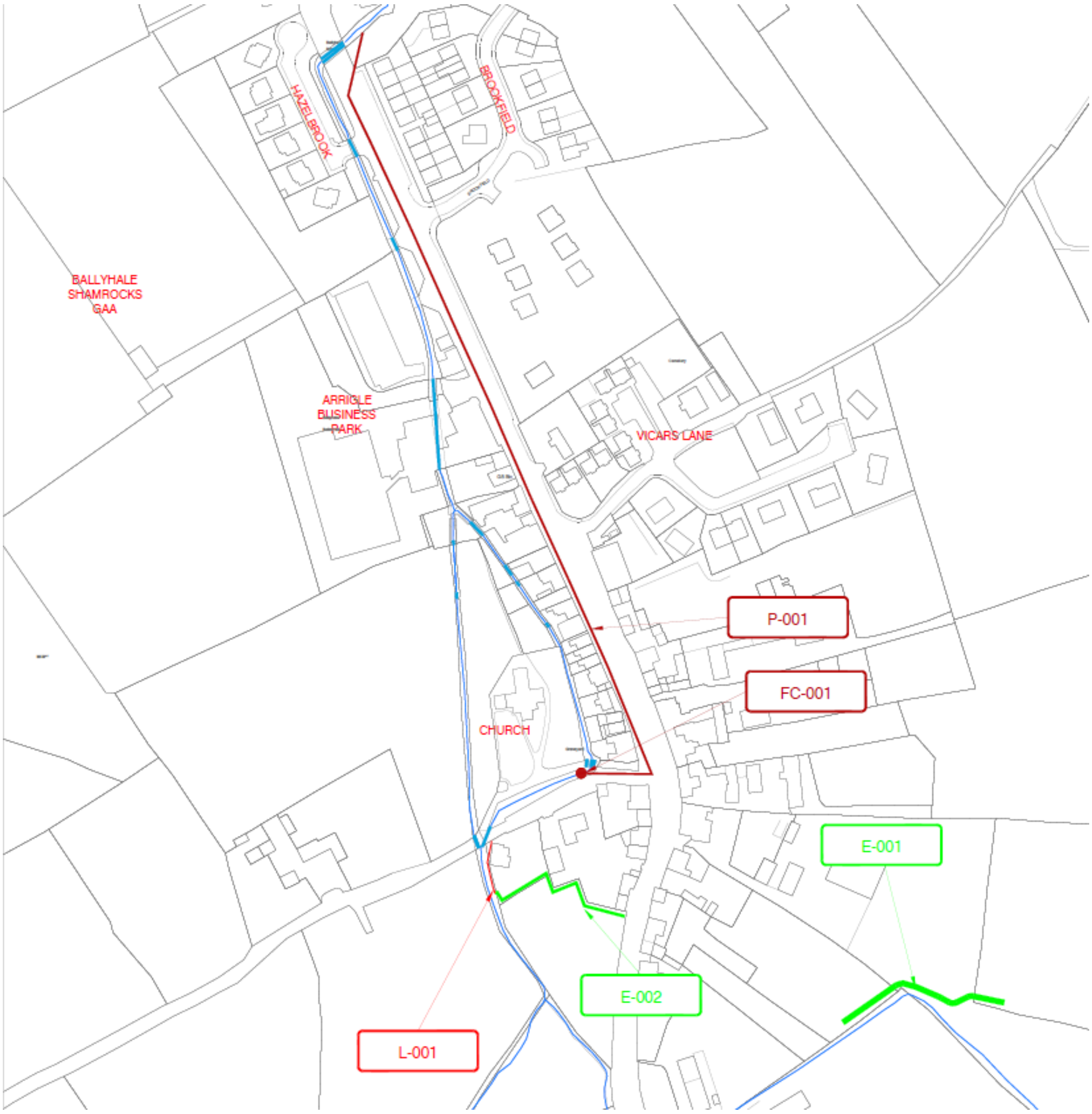

Figure 4-12: Concept Option D Layout (Refer to Appendix 4.4 for Additional Info)

4.3.5 Multi Criteria Appraisal (MCA)

In order to arrive at the preferred option, the Potentially Viable Options have been subjected to Multi Criteria Appraisal which seeks to take into account the impacts and benefits across various categories to provide for a holistic assessment. The MCA was carried out in line with the OPW's *"Technical Methodology Note - Option Appraisal and the Multi-Criteria Analysis (MCA) Framework*" and are assigned scores under four categories.

1. Social
2. Economic
3. Environmental
4. Technical

The scores had specific minimum requirements and aspirational targets with the Potentially Viable Options scored on the benefits and impacts involved with each option. For each objective there was a Global and Local weighting assigned to the areas of Risk in Ballyhale. The weightings are presented in Table 4-2.

In considering the social dimension during the screening process, outcomes of consultation processes previously undertaken are considered, along with the application of professional judgement and experience in relation to the Social Objectives.

While the screening process is an indicative appraisal, it will make use of available information. The economic risk assessment undertaken will provide an envelope of potential economic benefits. On the basis, an indicative benefit – cost ratio for a method, in isolation or potential combination with other methods, can be determined. In assessing the potential benefits of a method, the standard of protection and the effectiveness of the method in reducing risk are considered in relation to the Economic Objectives.

The environmental screening made use of the SEA scoping and the other environmental assessment work done for the Ballyhale Flood Assessment. Screening considered the degree of detrimental impact on the site, the scope for mitigation and whether there are apparently viable and acceptable alternative approaches available in relation to the Environmental Objectives.

In considering the technical objectives, options are screened to ensure that the options are operationally robust, are minimized for health and safety risk and that the options are adaptable to future flood risk and the potential impacts of climate change.

Table 4-2 Global and Local Weights

CRITERIA		OBJECTIVE		SUB-OBJECTIVE		GLOBAL WEIGHTING	LOCAL WEIGHTING
1	Social	A	Minimise risk to human health and life	i	Minimise risk to human health and life of residents	27	3.13
				ii	Minimise risk to high vulnerability properties	17	2.5
		B	Minimise risk to community	i	Minimise risk to social infrastructure and amenity	9	5
				ii	Minimise risk to local employment	7	1
2	Economic	A	Minimise economic risk	i	Minimise economic risk	24	2.56
		B	Minimise risk to transport infrastructure	i	Minimise risk to transport infrastructure	10	2.25
		C	Minimise risk to utility infrastructure	i	Minimise risk to utility infrastructure	14	1
		D	Minimise risk to agriculture	i	Minimise risk to agriculture	12	3
3	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.	16	5
		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.	10	5

CRITERIA		OBJECTIVE		SUB-OBJECTIVE		GLOBAL WEIGHTING	LOCAL WEIGHTING
		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.	5	3
		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.	13	4
		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	8	1
		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.	4	2
				ii	Avoid damage to or loss of features, institutions and collections of archaeological value and their setting.	4	2
4	Technical	A	Ensure flood risk management options are operationally robust	i	Ensure flood risk management options are operationally robust	20	5
		B	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options	i	Minimise health and safety risks associated with the construction, operation and maintenance of flood risk management options	20	5
		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	20	5

Option A

Option A - Hard Defences and Conveyance Improvements – This option scored high in the Social and Economic Criteria Scores due to it removing the flood risk from the study area.

This option scored high in the environmental objectives relative to the other options due to its low impact on the surrounding landscape and habitats. However, it still would have a temporary negative impact within the stream due to construction elements.

This option scored high in the Technical Criteria as the works are readily adaptable at moderate cost to address potential future flood risk areas with the flood walls and embankments being designed to permit extension in height to maintain a standard of protection to address potential future flood risk areas.

Option B

Option B - Hard Defences & Flow Diversion to Little Arrigle – This option scored high in the Social and Economic Criteria Scores due to it removing the flood risk from the study area.

The low Environmental Score for this option is due to the impacts the diversion channel will have on the surrounding landscape. The diversion channel will remove flow from the Ballyhale Stream and displace this flow to the Little Arrigle. This will influence habitats in the Little Arrigle which makes up part of the River Barrow and River Nore SAC.

This option scored high in the Technical Criteria as the diversion channel is readily adaptable at moderate cost to address potential future flood risk areas.

Option C

Option C - Hard Defences & Flow Diversion to Ballyhale River – This option scored high in the Social and Economic Criteria Scores due to it removing the flood risk from the study area.

The low Environmental Score for this option is due to the impacts the diversion channel will have on the surrounding landscape. The diversion channel will remove flow from the Ballyhale Stream and displace to a location downstream.

This option scored high in the Technical Criteria as the diversion channel is readily adaptable at moderate cost to address potential future flood risk areas.

Option D

Option D - Hard Defences & Piped Flow Diversion – This option scored high in the Social and Economic Criteria Scores due to it removing the flood risk from the study area.

This option scored low due to the diversion pipe removing flow from a point in the stream and displacing it to a lower point downstream. This will have impacts on habitats within the stream.

The low Technical Score in relation to the other three options is due to the piped diversion route not being readily adaptable without significant cost. The option does not however hinder future interventions to address new potential future risk areas. This option also has a very low operational risk requiring regular monitoring and maintenance to check for blockages.

Table 4-3 below presents a comparative assessment of the option scoring.

Table 4-3- Comparative Scoring Table (Extract from Options Report)

Option	Criteria			
	1 Social	2 Economic	3 Environmental	4 Technical
Option A	894.78	489.404	-99	1000
Option B	894.78	489.404	-527	1100
Option C	894.78	489.404	-674	1100
Option D	894.78	489.404	-475	500

Table 4-4: Overall Option Scoring (Extract from Options Report)

Option	Option Selection MCA *[Sum of 1-4]*	MCA Benefit [Sum of 1-3]	PV Cost	Economic BCR
Option A	2285	1285.18	€1,800,000	2.29
Option B	1810	710.18	€2,500,000	1.65
Option C	1957	857.18	€3,300,000	1.25
Option D	1409	909.18	€2,100,000	1.93

Based on the tables above it can be seen that Option A has received the most advantageous scoring. This option

- Receives the Highest MCA Option Selection Score
- Receives the highest MCA Benefit Score

- Represents the lowest PV Cost
- Provides the Highest Economic BCR

Therefore, as set out in the Options Report, Option A was selected as the preferred option and has been developed into the flood relief scheme as currently proposed for planning.