

Earby Beck FAS Phase 3

Stage 2 - Longlist to Shortlist Options Technical Note

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1. Introduction

1.1 Background

AECOM Limited has been commissioned by Pendle Borough Council (PBC) to conduct the second stage of an Options Development and Appraisal to support the development of a potential Outline Business Case (OBC) for Phase 3 of the Earby Beck Flood Alleviation Scheme (FAS).

This technical note documents the longlist to shortlist options process of identifying potential flood risk management measures which could be implemented to reduce the risk of flooding within Earby. The options identification focuses on the Earby Beck and Wentcliff Brook catchments, located in the Pennine region of northern England, which are characterised by steep topography, rural land use, and a history of river and surface water flooding. Earby Beck flows through the town of Earby, where flood risk is exacerbated by constrained channel capacity and culverted sections. Wentcliff Brook, meanwhile, traverses more agricultural terrain and likely due to the catchments steep characteristics results in it contributing significantly to peak flows due to rapid runoff from this upstream catchment.

Historical flood events in Earby have demonstrated the vulnerability of both residential and commercial properties, particularly where watercourses interact with urban infrastructure. In response to the flooding, a pre-feasibility study was completed by JBA in 2007 to better understand the risk of flooding from Main Rivers and determine the technical and economic viability of developing a FAS for the town. The Environment Agency (EA) then completed a Full Business Case for Phase 1 of the Earby Beck FAS, which led to the refurbishment of Victoria Clough culvert. Following this, the EA also led the production of a Strategic Outline Case (SOC) and the subsequent OBC for Stage 2. The Options Appraisal Report (OAR) produced from at the OBC justified further improvements to the existing flood defences within Earby. These improvements were made in the form of the construction of a new flood wall along New Cut and the creation of a new earth embankment on Hill Top Lane. Phase 2 of the works were delivered in collaboration with AECOM, the EA and PBC in 2022.

Along with these capital schemes there has been some investment in Property Flood Resilience (PFR) across Earby for properties at residual risk of flooding. Currently the scale of PFR within Earby and the condition of it varies. The town also has community flood wardens who are trained volunteers responsible for helping and preparing communities at risk of flooding.

In 2024 PBC were awarded £2.5 million from the UK Government's Frequently Flooded Allowance. Currently only £200,000 of the funding has been released to complete feasibility works for the design of the scheme. The remainder of the funding would then be released upon the conclusion that Earby FAS Phase 3 would be economically feasible. Currently Phase 3 is at Stage 2, having successfully justified there is still a significant flood risk to Earby from this catchment area in Stage 1.

1.2 Aims

The aims of this technical note are as follows:

- To define the flood risk mechanisms and impacts of flooding within Earby Beck to develop suitable longlist flood control measures; and
- Determine the technical, economic and financial feasibility of potential flood risk management measures to develop a shortlist of options.

1.3 Investment Objectives

The Flood and Coastal Erosion Risk Management – Appraisal Guidance (FCERM-AG)¹ recommends that objectives are set at the initial stages in the appraisal process. The identification of objectives provides a clear direction for the selection of a range of options to be taken forward for assessment. Objectives are set by reference to government policy the duties, standards, and targets of operating authorities, and from stakeholder engagement.

The objectives of the scheme have been defined as follows:

1. To reduce fluvial flood risk from the Wentcliff Brook its tributaries;
2. To adopt a whole catchment approach in the development of the scheme proposals;
3. To ensure that the scheme proposals do not adversely impact on flood risk elsewhere; and
4. To balance the potential impacts, risks, and benefits to people, infrastructure, the environment, cultural heritage, and the economy.

1.4 Properties at Risk of Flooding

As part of Stage 1 of Earby Beck FAS Phase 3 hydraulic modelling was undertaken to support an initial baseline economic assessment. The methodology and mapped outputs of each model are detailed within the Baseline Definition Report produced for Stage 1 of the OBC. GIS processing was undertaken using properties from the National Receptor Database (NRD) dataset and the modelled flood depths and extents to identify properties at risk and the potential impact of fluvial flooding.

To identify properties at potential risk of internal flooding (i.e. where flood depth exceeds the property threshold), a threshold of 0.15m has been applied to residential properties, and 0.1m to commercial properties. These thresholds represent an assumed average value for the type of property and were derived from a visual review of thresholds during the site visit held 14/02/2025. The thresholds account for existing features, such as doorsteps and raised threshold entrances.

Properties identified at risk of flooding within the model typically reflect those impacted by fluvial flow routes, across the various Annual Exceedance Probability (AEP) design simulations. The majority of this fluvial flooding water results from out of bank flow along the Earby Beck. However, there are currently a number of uncertainties with the modelled results due to limitations such as representation of existing flood defences, the peak flow estimates along New Cut and with storm duration sensitivity.

A range of AEP events were simulated within the hydraulic models, including Present Day (PD) and Climate Change (CC) scenarios. The number of properties at risk during the PD Do Nothing and Do Minimum are shown separately in **Table 1-1** and **Table 1-2** below.

Table 1-1 - Properties at Risk of Flooding - Do Nothing PD

Property Type	AEP Event %						
	50	5	3.3	2.5	1.33	1	0.5
Residential	7	30	35	39	45	85	106
Non-Residential	2	8	9	9	20	24	39
Total	12	38	44	48	65	109	145

Table 1-2 - Properties at Risk of Flooding - Do Minimum PD

Property Type	AEP Event %						
	50	5	3.3	2.5	1.33	1	0.5
Residential	2	19	24	28	37	43	102
Non-Residential	2	7	9	9	9	9	36
Total	4	26	33	37	46	52	138

2. Longlist Measures

2.1 Longlist measures Development

Following a review of the baseline flooding assessment, a longlist of flood risk management measures was developed. Potential flood risk management measures were considered on the basis of baseline model outputs (i.e. flow pathways and flood depths), the spatial distribution of properties at risk and characteristics of the area (i.e. topography, urban density and open space).

The longlist measures are categorised under five strategic approaches to flood risk management, as outlined in **Figure 2-1**. The source, pathway and receptor model was applied, to develop a range of measures at various scales (e.g. catchment-wide and property level). The Do Nothing and Do Minimum scenarios were included in the longlist.

A total of 12 longlist measures were developed, excluding the Do Nothing and Do Minimum scenario. Further detail of the longlist measures is presented in **2.2 Longlist of Measures**. All longlist measures will be presented within a Longlist to Shortlist Workshop held between members of PBC and the AECOM project team on 28/08/2025.

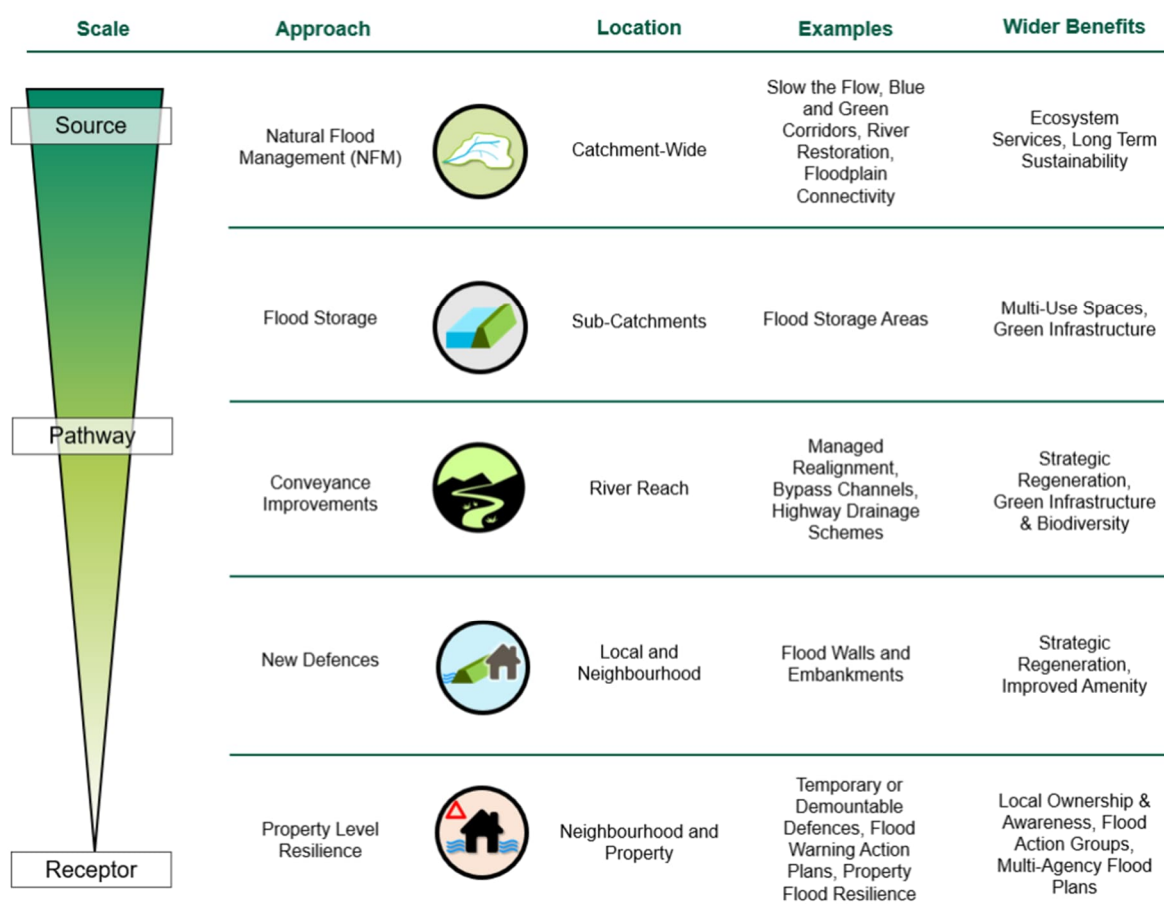


Figure 2-1 - Strategic Approaches to Flood Risk Management

2.2 Longlist of Measures

The longlist of measures for the Earby study area are detailed in **Table 2-1**. The Do Nothing and Do Minimum scenario were included as a longlist measure for the study area. The Do Nothing longlist measure represents a scenario where no further action is taken to maintain or repair existing assets. No additional flood risk measures are to be introduced. The Do Minimum longlist measure includes the basic maintenance of existing assets and infrastructure, however no additional flood risk measures are introduced.

Table 2-1 - Longlist of Flood Risk Management Measures

Longlist ID	Description	Approach
DN	Do Nothing	
DM	Do Minimum	
EARB001	Flood storage area in the lower Wentcliff Brook catchment upstream of Earby Waterfalls	
EARB002	A series of flood storage areas in the lower Wentcliff Brook catchment upstream of Earby Waterfalls.	
EARB003	Conveyance improvements by creating a bypass channel in the lower Wentcliff Brook catchment.	
EARB004	Deeping of the Earby Beck channel bed to increase the capacity along the river.	
EARB005	Property Flood Resilience (PFR) for properties that are at risk of flooding during a 5% AEP event.	
EARB006	NFM in the form of leaky dams in the upper Wentcliff Brook catchment.	
EARB007	NFM in the form of scallop bunds in the upper Wentcliff Brook catchment.	
EARB008	NFM in the form of woodland/hedgerows in the upper Wentcliff Brook catchment.	
EARB009	NFM in the form of gully blocking in the upper Wentcliff Brook catchment.	
EARB010	NFM in the form of woody debris dams in the upper Wentcliff Brook catchment.	
EARB011	NFM in the form of timber baffles in the upper Wentcliff Brook catchment.	
EARB012	NFM in the form of online ponds in the upper Wentcliff Brook catchment.	

2.3 Longlist Evaluation

Following the development of the longlist, a Multi-Criteria Analysis (MCA) was undertaken to assess all the measures and provide an efficient balanced summary of the themes and categories. The MCA is included in – Multi Criteria Analysis (**Appendix A**). The MCA details the key opportunities and constraints for each measure.

Figure 2-2 presents the full criteria against which the options have been assessed. The categories can be summarised as:

- **Flood Risk** – Would it reduce flood risk?
- **Technical** – Would it be technically achievable and constructible?
- **Economic** – Would the benefit exceed the costs? Is it affordable?
- **Social** – Would the community support or object to its implementation?
- **Environment** – Would it have a positive impact on the natural and built environment?
- **Health and Safety** – Could it be delivered safely?

Flood Risk Outcome Measures	Technical	Economic	Social	Environmental	Health and Safety
- Does the option meet the overall objective of reducing flood risk? - Would the delivery of the option result in increased flood risk elsewhere? - Would it help to achieve the local flood risk management objectives?	- Is it technically achievable and constructible? - Is the option robust and reliable? - What would the consequences of a failure be?	- Would the benefits exceed the costs? - Is the cost of the option within the available budget? - Would there be intangible or other non-financial benefits?	- Would the community benefit or suffer from the implementation of the option? - Are stakeholders likely to support the implementation of the option? - Does the option align with any established local planning strategies? - Does the option promote social cohesion?	- Would the option have a positive or negative impact on the natural environment and habitat? - Does the option align with any strategic environmental goals? - Is the option appropriate for any specific land-use designations (i.e. SSSI, AONB)?	- Could the option be delivered safely? - Could any risks be managed safely throughout the whole life cycle of the project? - Would there be any residual risks that cannot be safely managed?

Figure 2-2 - Multi Criteria Analysis Categories and Criteria

Each measure is assigned a numerical score between +2 and -5 for each of the six evaluation criteria, as presented in **Figure 2-3**. This qualitative scoring system assumes a score of 0 is reflective of a neutral outcome, with a minus and positive score representing a negative and positive outcome, respectively. A -5 score is assigned for an unacceptable outcome.

-5	-2	-1	0	+1	+2
Unacceptable outcome	Severe negative outcome	Moderate negative outcome	Neutral outcome	Moderate positive outcome	High positive outcome

Figure 2-3 - Quantitative Scoring Assessment

A Red-Amber-Green (RAG) classification was applied to the longlisted options that are presented in based on their scoring identified in the MCA. The RAG represents the likelihood of a longlisted opportunities being taken forward to shortlist (Red = Unlikely, Yellow = Possible, Green = Likely).

The purpose of applying this classification is to help prioritise efforts and resources in investigating opportunities that are considered likely to provide the greatest benefits at this stage and assist with the development of a shortlist of options following the next stage of appraisal. It should be noted the classification is not intending to definitively 'rule out' an opportunity for further consideration or confirm that an opportunity is a deliverable flood risk management scheme. **Table 2-2** presents the RAG classification of each longlist measure, on the basis of the MCA scoring.

Table 2-2 - Longlist Measures - RAG Classification

Longlist ID	Description	RAG Classification
All Study Areas		
DN	Do Nothing	Unlikely
DM	Do Minimum	Possible
Lower Catchment		
EARB001	Flood Storage Area – Online area upstream on Earby Waterfalls	Likely
EARB002	Flood Storage Area – Series of online dams along Wentcliff Brook	Likely
EARB003	Conveyance Improvements – Bypass channel upstream of Earby Waterfalls along Wentcliff Brook	Unlikely
EARB004	Conveyance Improvements – Deeping of Earby Beck channel to provide more capacity.	Unlikely
EARB005	Property Flood Resilience – To affected properties in Earby	Possible
Upper Catchment		
EARB006	NFM - Leaky dams	Likely
EARB007	NFM – Scallop bunds	Likely
EARB008	NFM – Woodlands/Hedgerows	Likely
EARB009	NFM – Gully blocking	Likely
EARB010	NFM – Woody debris dams	Likely
EARB011	NFM – Timber baffles	Likely
EARB012	NFM –Online ponds	Likely

3. Shortlist Options

3.1 Options Development

A virtual options workshop was held on 11/09/2025 between PBC, EA and AECOM to discuss the outcomes of the longlist MCA and to discuss the potential shortlist options. The shortlist options discussed in the Workshop are presented in this section.

The shortlist was informed by the MCA, Longlist to Shortlist Workshop and internal discussions held with PBC and EA. The approach to shortlist development was proportionate to the potential damage (and benefits) which could occur because of flooding.

A total of 5 shortlist options were developed for Stage 2, as presented in **Table 3-1**. The shortlist comprises of the Do Nothing and Do Minimum scenario, and three 'Do Something' options. The Do Nothing scenario will form the baseline against which all other options are appraised.

The Do Something option represents active intervention beyond that of the existing flood risk management practices (such as programmed or reactive maintenance, and replacement of damaged assets). A singular, or combination of, longlist measure/s form the basis of the Do Something options. Longlist measures which were not used to form the Do Something shortlist option could be considered as part of another scheme and/or could be used to prompt discussions with stakeholders.

Table 3-1 - Shortlist Options

Shortlist Option	Longlist Measures	Description
Do Nothing	DN	No further action to be taken to maintain or repair existing assets. No additional flood risk measures are to be introduced.
Do Minimum	DM	Basic maintenance of existing assets and infrastructure. No additional flood risk measures are to be introduced.
Do Something 1	EARB001	Online flood storage area upstream of Earby Waterfalls.
Do Something 2	EARB002	Series of flood storage areas upstream of Earby Waterfalls.
Do Something 3	EARB006-0012	A combination of NFM measures in the upper catchment.

3.2 Do Nothing

In accordance with the FCERM-AG, the Do Nothing scenario represents the baseline for the appraisal, which can be used to compare the relative successes of proposed risk management options. It is a hypothetical situation which assumes no action is taken to manage the flood risk or maintain any existing structures or assets in the area.

If this option were adopted, existing assets would begin to deteriorate over time and any damage would not be repaired. Blockages of bridges and culverts would not be cleared and would likely become increasingly blocked over time. This would likely accelerate the rate of asset degradation which would be further exacerbated by the anticipated effects of climate change. It is assumed that under this scenario, flood risk to Earby would be exacerbated over time.

3.3 Do Minimum

The Do Minimum scenario developed with the FCERM-AG assumes that repair maintenance is undertaken when required and flood warnings are issue, however no scheduled maintenance and asset refurbishment is undertaken. This scenario represents a situation of more gradual failure and deterioration of the flood risk management system as a result of reactive path and repair maintenance.

This would likely comprise of limited ad-hoc interventions and emergency works (e.g. to repair a collapsed culvert) rather than scheduled maintenance (e.g. regular clearance and inspection of the culvert). This approach is unsustainable in the long term and total asset deterioration would be expected, albeit at a later point in the appraisal period relative to the Do Nothing scenario.

3.4 Do Something 1

Do Something 1 proposes to build an online flood storage area in the lower Wentcliff Brook catchment, just upstream of Earby Waterfalls. This measure would likely provide the greatest SoP for properties currently at risk within Earby and could be a stand-alone option or delivered in combination with natural flood management in the upper catchment. The flood storage area would capture the flows from the steep upper catchment by attenuating water during peak rainfall events and releasing it slowly to prevent the risk to properties flooding downstream. The water would likely be retained by the construction of a large bund and flows passing via a culverted pipe along a similar path to the existing channel. The installation of a flow control device would be required on the upstream side to manage the flows released downstream.

This measure has the highest delivery and operational risks associated with it due to a number of factors. One of the main concerns is the potential size of a flood storage area which could result in this measure being classified as a large reservoir subject to provisions within the Reservoir Act 1975. This could enforce extra requirements throughout the lifecycle of the asset, increasing the whole lifecycle cost. In addition, it would result in a section of watercourse being culverted which would go against the Water Framework Directive.

Along with the capital risk, there would be significant technical challenges with mitigating/reducing the potential environmental impact of such a measure. There would be concerns with maintaining suitable fish and eel passage within the watercourse, ensuring the project meets Biodiversity Net Gain (BNG) requirements and potential habitat damage.

This measure would provide the highest SoP when compared to the other shortlist options given the volume of water the Flood Storage Area would be able to attenuate. Albeit this option would require the most capital investment and environmental impact compared to the other shortlist measures proposed.

3.5 Do Something 2

Do Something 2 is similar to Do Something 1 but would comprise a series of smaller storage areas that would work to attenuate and slow the flow of water downstream towards Earby. This would reduce the flood depths and the extent of out of bank flows during peak rainfall events.

This option focuses on increasing time to peak by slowing and attenuating flows during the higher flow events. The water would be retained in a series of online check dams which still allow for normal flows to pass but during high flow events they impede the flow, creating small reservoir behind the structure. This helps to increase the time to peak and reduce the intensity of flooding downstream. It can also act as a form of sediment control and potentially improve water quality downstream as it allows for pollutants to settle out before reaching the downstream waterways.

Similar to Do Something 1 this option would still be reliant on impounding structures, albeit it on a smaller scale. There is still risk with this option that it may negatively impact the aquatic life within the watercourse, such as a potential barrier for fish passage. In addition, it may be difficult to get landowner cooperation depending on the extent of this measure upstream and temporary flooding areas of their land. An issue may arise with the ongoing maintenance of this measure as it has the potential for blockages and sediment build up. Therefore it would be vital to work closely and cooperate with the landowners for such a measure.

It is likely that this shortlist option would provide a SoP in between the two other short list options. Further development of this measure, along with modelling will help provide an indication of the potential benefits in reducing flood risk within Earby.

3.6 Do Something 3

Do Something 3 proposes to introduce NFM measures in the upper catchment of Earby Beck within the Wentcliff Brook catchment. This would be a combination of multiple NFM measures which help provide a suitable level of protection for the catchment.

NFM measures are intended for the upper reaches of the Wentcliff Brook catchment. The measures will centre upon restoration and enhancement of habitat and natural processes, as a means to reduce velocity and volume of flow conveyed downstream. This option will also allow collaboration with landowners to improve sediment

control and filtration of run off therefore preventing the loss of fertilisers and pesticides into watercourses. There is potential to contribute towards achieving WFD objectives for the river basin as a result of improved water quality. However, there may be possible private landowners that may be opposed to the NFM works on their land and as such there can be challenges around the ownership of assets and the responsibility of any future maintenance.

Due to the steep nature of the catchment and large areas of open space it lends itself well to several different NFM measures. These include online ponds, gully blocking and scallop bunds to help create wetland areas. At this stage in the appraisal process it is hard to quantify the SoP Do Something 3 would provide. Further refinement of the NFM measures would be required through concept design and hydraulic modelling to help identify the optimal combination of NFM for the catchment.

4. Summary

The shortlist options proposed for Stage 2 were selected on the basis of the MCA, the Longlist to Shortlist Workshop, site visits and ongoing discussions between PBC, EA and AECOM. Following the review of the property counts and potential constraints of the study areas, it was deemed that the most feasible scheme for the area was in the form of an NFM based solution. This form of flood risk management will deliver the best possible return on investment with the user of the frequently flooding allowance. Further appraisal is required to determine the viability of this options technical, economic and environmental viability, along with the other shortlist options presented in **Table 3-2**.

Table 3-2 - Shortlist Options

Shortlist Option	Longlist Measures	Description
Do Nothing	DN	No further action to be taken to maintain or repair existing assets. No additional flood risk measures are to be introduced.
Do Minimum	DM	Basic maintenance of existing assets and infrastructure. No additional flood risk measures are to be introduced.
Do Something 1	EARB001	Online flood storage area upstream of Earby Waterfalls.
Do Something 2	EARB002	Series of flood storage areas upstream of Earby Waterfalls.
Do Something 3	EARB006-0012	A combination of NFM measures in the upper catchment.

Appendix A – Multi Criteria Analysis

Long List of Flood Risk Management Measures

The RAG classification indicates the likelihood of the option being taken forward to short-list for further appraisal. It is not intended to reflect a detailed assessment of the technical feasibility of a scheme at this stage.

ID	Flood Cell	Option Category	Option Description	Location	Key Opportunities	Key Constraints	MCA Evaluation Summary						Total Score	RAG Status
							Flood Risk	Technical	Capital costs	Stakeholders	Environment	Health & Safety		
DN	Earby	Maintenance	Do Nothing	Catchment wide	• N/A	• Will not reduce flood risk to the area • Increased risk of flooding, due to climate change • Existing flood risk management assets will deteriorate over time and could cause disruption	-2	0	0	-1	0	-1	-4	Unlikely
DM	Earby	Maintenance	Do Minimum	Catchment wide	• Maintains the status quo. The existing assets offers a varied standard of protection to properties in the catchment areas	• Level of flood risk within the catchment remains the same • The standard of protection will deteriorate over time due to climate change • Ad-hoc maintenance will be required • Major capital refurbishment will be required in future years	0	1	0	0	0	0	1	Possible
EARB001	Lower Catchment	Flood Storage	Installation of an online FSA in the upper catchment of Wentcliff Brook to reduce flows and delay the time to peak downstream in the town centre.	Earby Waterfalls	• Increases the storage of water in the upper catchment, reducing risk to properties within the lower catchment. • Can be used to help control flows and slowly release attenuated water downstream when the lower catchment has sufficient capacity.	• Technically challenging to implement with significant capital costs required to deliver the scheme. • High maintenance costs throughout the lifetime of the asset. • Potentially could cause damage to the surrounding habitat. • The site is located within a steep valley which could make access for construction difficult and increase risk. • Construction of an impounding structure may trigger Reservoirs Act 1975 • Requires the removal of a local playpark and could potentially have a negative effect on the local community socially. • Maintaining fish passage.	2	-1	-2	1	-1	2	1	Possible
EARB002	Lower Catchment	Flood Storage	Installation of a series of online dams along the lower catchment of Wentcliff brook to slow and attenuate flows. This will delay the time to peak flows in Earby town centre.	Earby Waterfalls	• Provides additional storage in the Wentcliff brook catchment • As storage is split over a series of impounding structures it is less likely to trigger the Reservoirs Act 1975.	• May not provide significant standard of protection for the capital cost required to deliver. • Regular maintenance is required to ensure flood storage areas are operating effectively. • There may be issues with securing the land for construction of a series of impounding structures. • High capital cost • Could damage potential habitats along the Wentcliff Brook catchment • Maintaining fish passage • Difficult to quantify the standard of protection that could be provided.	1	-1	-1	0	-1	0	-2	Unlikely
EARB003	Lower Catchment	Conveyance Improvements	Construction of a bypass channel in the lower Wentcliff Brook catchment to act as a flood relief channel. This could provide an alternative route for excess water to flow during high flow events.	Earby Waterfalls	• Can improve the biodiversity within the habitat with the creation of wetlands and riparian zones. • Could improve the overall river quality, reducing sediment and pollutant loads. • Can enhance the local area and create	• Technically challenging to implement due to the topography of the site. • Difficult to quantify the benefit of the bypass channel. • Unlikely to provide significant storage upstream of flood risk area. • Regular maintenance will be required to ensure it operates effectively through long spells of inactivity if flows are low along Wentcliff Brook. • Would likely require the addition of more interventions to provide a suitable standard of protection. • Moderate capital cost required.	0	-1	-1	0	1	-1	-2	Unlikely
EARB004	Lower Catchment	Conveyance Improvements	Increase the capacity of Earby Beck by lowering the channel bed to deepen the channel.	Earby Beck Channel	• Deeper channel can carry more water during high flow events, reducing the likelihood of overtopping and flooding downstream. • Can reduce flow resistance in the channel bed, allowing water to move more quickly downstream.	• Deepening of the channel will likely have a negative effect on aquatic habitats. • Could require additional modifications to infrastructure along the channel. • Significant capital cost required. • Likely to cause significant disruption to local residents as the channel runs through Earby town centre.	1	-2	-2	-2	-1	-1	-7	Unlikely
EARB005	Lower Catchment	Resilience	Property Flood Resilience	Properties throughout Earby	• Minimise the damage incurred to properties when flooding occurs. • Can allow for quicker reoccupation and less disruption for residents and businesses. • Cost effective	• Limited protection against significant flooding • Already known to be installed at a number of properties within the lower catchment. • Maintenance and usage of PFR is on the property owner. • Retrofit of older buildings can be technically challenging. • Could be challenging getting some home owners to implement PFR within their homes.	1	-1	1	-1	0	1	1	Possible
EARB006	Upper Catchment	Natural Flood Management	Leaky Dams - Aimed at slowing the flow of water by trapping water during high rainfall events and slowly releasing it.	Dark Lane, Thorton Highgate, Oak Slack, Thorton Moor	• Working with landowners to improve sediment control and reduce run off rates from the upper catchment. • Mimics natural processes, promoting sustainable nature based low impact flood control. • Can help retain water in the upper catchment which could improve grazing. • Cost-effective and technically feasible. • Could improve the natural habitat surrounding the NFM feature. • Aligns with national strategies in promoting nature base solutions to manage flood risk.	• Not suitable to handle extreme flood events or large volumes. • Hard to quantify the benefit and standard of protection achievable. • Required alongside other methods of NFM to provide sufficient benefit. • Installation on private it land may lead to stakeholder resistance. • Consent may be required from Natural England or the local authority as many areas or moorland are designated habitats.	1	1	1	0	1	1	5	Likely
EARB007	Upper Catchment	Natural Flood Management	Scallop Bunds - Impede/Disrupt surface/subsurface flows and retain water in localised surface pools.	Bleara Moor, Thorton Moor, Hare Hill	• Provide runoff interception and storage, which slow and temporarily store surface runoff. • Improve sediment control and reduce run off rates from the upper catchment. • Cost effective and technically feasible. • Could improve the natural habitat surrounding the scallop bunds.	• Limited capacity to store suitable levels of flood water during high flow events. • Performance depends on accurate placement and suitable topography. • Installation on private land may lead to stakeholder resistance. • Requires regular sediment removal to maintain functionality. • Consent may be required from Natural England or the local authority as many areas or moorland are designated habitats.	1	1	1	0	1	1	5	Likely
EARB008	Upper Catchment	Natural Flood Management	Woodlands/Hedgerows - Aimed at slowing the rate or overland surface flows before it enters river channels	Hodge Skye, Lower Verjuice, Fiddling Clough Laithe	• Can temporarily store high flows, reducing peak discharge downstream. • Work well in smaller catchments and during moderate flood events. • Helps with soil stabilisation and erosion control into the watercourses. • Supports biodiversity, carbon sequestration, air quality improvement and can add recreational value. • Can foster local involvement and awareness of flood risk.	• Difficult to quantify the benefit in terms of standard of protection provided. • Large area of planting required to ensure sufficient retention of water in the upper catchment and to account for trees that don't mature. • Delayed benefit and long term commitment which requires year to mature before delivering hydrological benefits. • Land use conflicts could arise with local landowners that may be opposed to a loss in agricultural land.	1	1	1	0	1	1	5	Likely



Long List of Flood Risk Management Measures

The RAG classification indicates the likelihood of the option being taken forward to short-list for further appraisal. It is not intended to reflect a detailed assessment of the technical feasibility of a scheme at this stage.

ID	Flood Cell	Option Category	Option Description	Location	Key Opportunities	Key Constraints	MCA Evaluation Summary						Total Score	RAG Status
							Flood Risk	Technical	Capital costs	Stakeholders	Environment	Health & Safety		
EARB009	Upper Catchment	Natural Flood Management	Gully Blocking - Peat dams are impermeable blocks aimed at trapping water, slowing the flow downstream and retaining more water in the peatland.	Bleara Moor, Thorton Moor	• Largely aimed at storing water within the upper catchment, rather than allowing the landscape to drain. This can help reduce the flows downstream during high rainfall events. • Can help to restore natural drainage and aid with the development of surrounding habitat. • Could be constructed using locally sourced on site material. • Reduces the potential for erosion runoff and minimises sediment transport downstream.	• Could be considered more expensive if materials have to be externally sourced as they typically have to be airlifted due to the ground conditions of the moorlands. • Consent may be required from Natural England or the local authority as many areas or moorland are designated habitats. • Technically challenging to design to suit site conditions to ensure effective water retention. • Hard to quantify the benefit and standard of protection achievable. • Required alongside other methods of NFM to provide sufficient benefit.	1	1	1	0	1	1	5	Likely
EARB010	Upper Catchment	Natural Flood Management	Woody Debris Dams - Strategically placed in-channel anchored wood dams to increase in-channel geomorphic processes, slow the flow of water and water storage.	Hodge Skye, Dodgson Lane,	• Reduce the rate of flow which can help to reduce peak flows allowing more time for infiltration upstream. • Reduces the potential for erosion runoff and minimises sediment transport downstream. • Natural looking measure of NFM than can easily blend into the surrounding environment. • Relatively low cost and easy to install.	• Only suitable for smaller catchments and would need to be integrated with additional measures in a larger catchment to provide significant benefit across the catchment. • Risk of mobilisation during high flow periods if debris is poorly anchored which can pose a hazard downstream. • Could potentially obstruct fish passage within the watercourse.	1	1	1	0	1	1	5	Likely
EARB011	Upper Catchment	Natural Flood Management	Timber Baffles - Timber baffles are permeable dams, suitable in wider gullies and are installed part way across the gully in a staggered pattern.	Thorton Moor	• Can reduce peak flows by slowing down the flow of water in streams, channels and ditches. • Relatively low cost and easy to install.	• Would have a limited impact on reducing flood risk as a whole within the catchment, would require additional measures to reduce flood risk in the catchment. • Consent may be required from Natural England or the local authority as many areas or moorland are designated habitats. • Technically challenging to ensure that the spacing and sizing does not lead to unintended flow acceleration or erosion around the baffles. • Can potentially alter habitats in sensitive areas.	1	1	1	0	1	1	5	Likely
EARB012	Upper Catchment	Natural Flood Management	Online Ponds - Water storage features that are hydraulically connected to the watercourse via side channel or within the channel. Aimed at slowing the flow of water downstream and increasing water storage during and initially after storm events.	Lower Bank Verjuice	• Can temporary store high flows, reducing peak discharge downstream. • Work well in smaller catchments and during moderate flood events. • Potential to improve water quality by trapping sediments upstream, improving downstream water quality. • Provide a multi functional land use space for the land owners. • Potential to create a wetland space which can enhance ecological connectivity and improve biodiversity.	• Finding a suitable location for an online pond in Wentcliff Brooks steep catchment. • Only suitable for smaller catchments and would need to be integrated with additional measures in a larger catchment to provide significant benefit across the catchment. • Difficult to quantify the flood risk benefit and would be more effective in combination with additional NFM measures. • Installation on private land may lead to stakeholder resistance.	1	1	1	0	1	1	5	Likely

