Whole Town Consultation Event - March 2022

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East Lothian Council

Musselburgh Flood Protection Scheme
11 August 2022

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1. Background and Purpose

Musselburgh Flood Protection Scheme (the Scheme) is being promoted by East Lothian Council (ELC) under the Flood Risk Management (Scotland) Act 2009. Jacobs was appointed by ELC in December 2017 to develop a scheme for Musselburgh, with the aspiration to provide protection against coastal and fluvial flood events with a 0.5% Annual Exceedance Probability (AEP) (also known as a 1 in 200-year event) plus an allowance for climate change plus a strategy for future flexibility. The project to deliver the Scheme is being undertaken in stages and is currently in Stage 4: outline design.

Through extensive scientific analysis undertaken during the previous stage, the project team determined that physical defences along the River Esk and the Forth Estuary are an essential part of the preferred scheme[1] to deliver the above reduction in Musselburgh's flood risk. The overall aim of the Scheme's consultation is therefore to enable the community of Musselburgh to have an influence on what form those defences take, as well as provide feedback on emerging bridge replacement and active travel proposals.

As part of its consultation strategy, the project team delivered a 'Whole Town' consultation event from 10:00 until 20:00 on 8th March 2022 in the Brunton Theatre in Musselburgh. The purpose of this report is to summarise the event, review the feedback provided, and address some of the themes of discussions.



Figure 1: Photographs of the event in progress

[1] The preferred scheme represents a snapshot in time of the development of the Scheme's eventual design and is the result of the option appraisal process conducted during stage 3 of the project. The preferred scheme was approved by ELC's Cabinet in January 2020. An explanation of this process and a copy of the Preferred Scheme Report is available on the project's website at www.musselburghfloodprotection.com

2. The Event

2.1 Overview

The event was set up in Venue 1 at the Brunton Theatre, the largest event space and capable of accommodating up to 500 people. The aim of the event was to provide information about the Scheme to attendees, enable them to ask questions one-to-one with members of the project team, and empower them to submit feedback about the proposals.

2.2 Project Team

The event was delivered by the members of the project team and ELC staff shown in Table 1:

Name	Organisation	Role
Tom Reid	East Lothian Council	Head of Infrastructure
Alan Stubbs	East Lothian Council	Project Executive
Alex Coull	East Lothian Council	Flooding Officer
Conor Price	CPE Consultancy	Project Manager
Gregor Moodie	Turner & Townsend	Assistant Project Manager
Rachael Warrington	Turner & Townsend	Liaison Officer
John Wallner	CPE Consultancy	GIS Analyst
Jim Baxter	Jacobs	Project Delivery Manager
Steven Vint	Jacobs	Senior Technical Advisor
Ewan Miller	Jacobs	River Engineering Discipline Lead
Jeni Rowe	Jacobs	Landscape Architecture Discipline Lead
Danny McCluskey	Jacobs	Environmental Discipline Lead

Table 1 List of team members staffing the event

2.3 Presentation Boards

There were twenty-eight presentation boards (a copy of which is included in Appendix A). The first group of boards outlined the project's governance, timeline, approach to consultation, and approach to consenting. The second group of boards described the option appraisal process carried out during Stage 3 of the project and the preferred scheme resulting from this. The third group of boards outlined Musselburgh's flood risk, and the project's approach to Environmental Impact assessment, Carbon, and Nature-based Solutions. The fourth group of boards focused on possible forms of bridges, flood defences, access and landscaping. The fifth and final group of boards summarised the feedback received from previous public consultation events.

2.4 Flood Mapping and Animations

A projector and screen were set up to present interactive mapping of Musselburgh's flood risk, with a dedicated member of the project team available to navigate the Geographic Information System (GIS) interface (shown in Figure 2). This enabled attendees to see, for any chosen location in the town, the present-day river or coastal flood risk, as well as the future river or coastal flood risk with an allowance for climate change. Animations of the 0.5% AEP[2] river and coastal flood events with an allowance for climate change were also available, to demonstrate how a flood would be expected to spread across the town over the duration of the design storm.

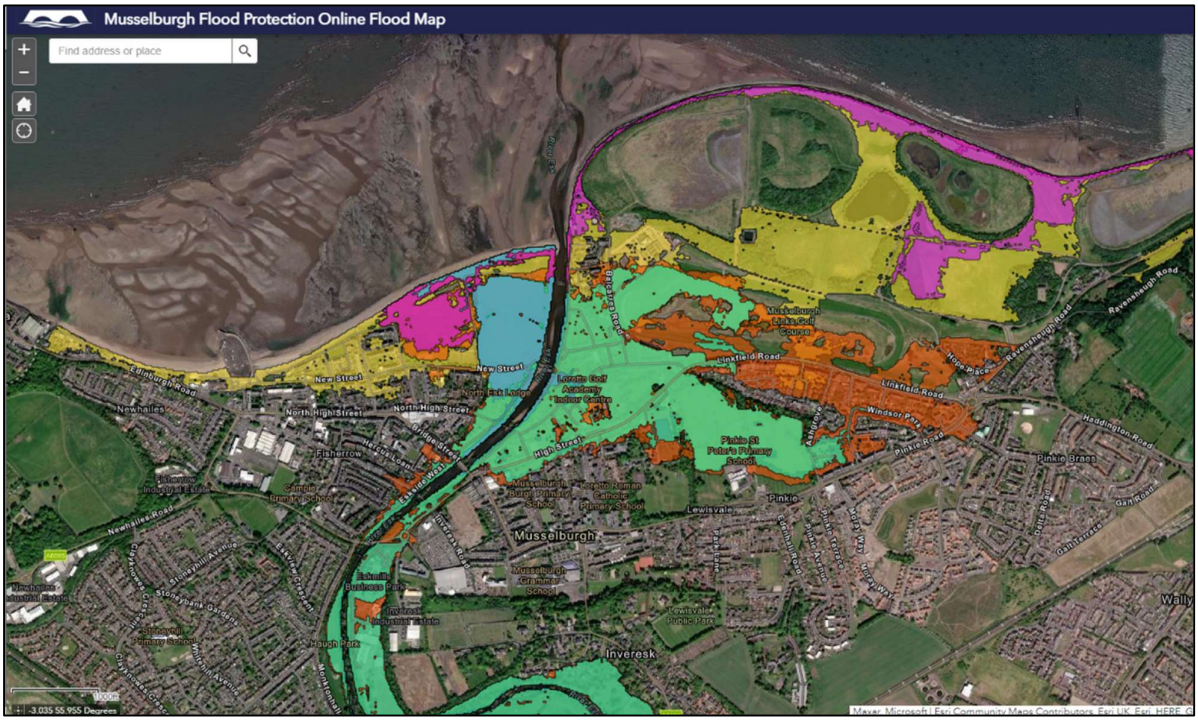


Figure 2 Screenshot of GIS mapping interface available to view during the event

2.5 Event Partners

The following partner organisations and entities also had presentation spaces at the event:

- East Lothian Council Emergency Planning – the team responsible for deploying existing temporary defences adjacent to the Electric Bridge in Musselburgh
- Musselburgh Active 'Toun'– an East Lothian Council infrastructure project, developing a range of proposals aimed at encouraging more people to walk, wheel and cycle in and around Musselburgh
- Floodline - a service operated by the Scottish Environment Protection Agency (SEPA) to provide live flooding information and advice on how to prepare for or cope with the impacts of flooding
- Scottish Flood Forum - an independent organisation which works with local authorities and their partners in raising community awareness, promoting self-help and developing community groups

The aim of having event partners was to inform the public about work that others are doing which closely aligns with the development of the Scheme.

[2] A full explanation of the statistical terminology used in modelling Musselburgh's flood risk is available on the project's website at: www.musselburghfloodprotection.com

3. Feedback

3.1 Attendance

Attendees were greeted by a member of the project team at the entrance to the event. They were asked to sign in and were invited to join the project's stakeholder mailing list if they had not previously done so. A total of 462 members of the public were recorded as having attended. This compares to 210 members of the public who attended Public Exhibition No. 1 over two days in July 2019. An additional 177 attendees joined the stakeholder mailing list, taking its total to 658.

Official attendance at the event on 8th March 2022

462 people

3.2 Questionnaire responses

Attendees were encouraged to complete a questionnaire (a copy of which is included in Appendix B) after viewing the presentation boards and speaking to members of the project team. A total of 326 questionnaires were completed and returned during the event. The questionnaire was also made available on the project's website for those who were unable to attend the event in person. They were invited to complete the questionnaire after viewing the event's presentation boards, which were also made available on the website. The closing date for submission of the online questionnaire was 22nd March 2022.

Number of questionnaires completed during the event	Number of questionnaires completed online
326 questionnaires	**26 questionnaires**

Question 1 - Which age group do you fit into?

This question was asked to understand the age distribution of respondents and identify any significant gaps in representation to inform future public events. Figure 3 below shows the distribution of respondents by age group.

More than 75% of respondents at the event were fifty years of age or older.

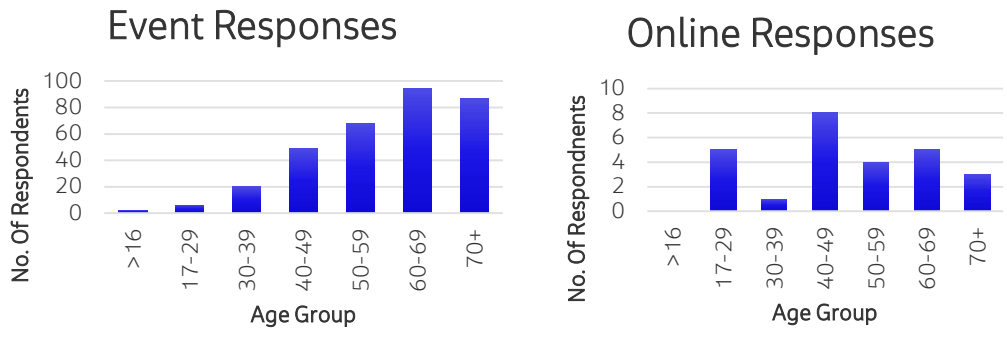


Figure 3 Distribution of respondents by age group

Question 2 - What is your postcode?

This question was asked to understand the distribution of where respondents, both at the event and online, came from, and to identify any specific areas of Musselburgh which were less well represented to inform future public events. The results (shown in Figure 4) indicate a good distribution of respondents from across Musselburgh, with higher representation from Eskside West, New Street, and Promenade. This is to be expected since these areas would by directly affected during the construction works, and it demonstrates that previous local area consultations have been effective in raising awareness of the Scheme in these locations. Meanwhile, the Goosegreen area was less well represented and further work is required to engage with this location.

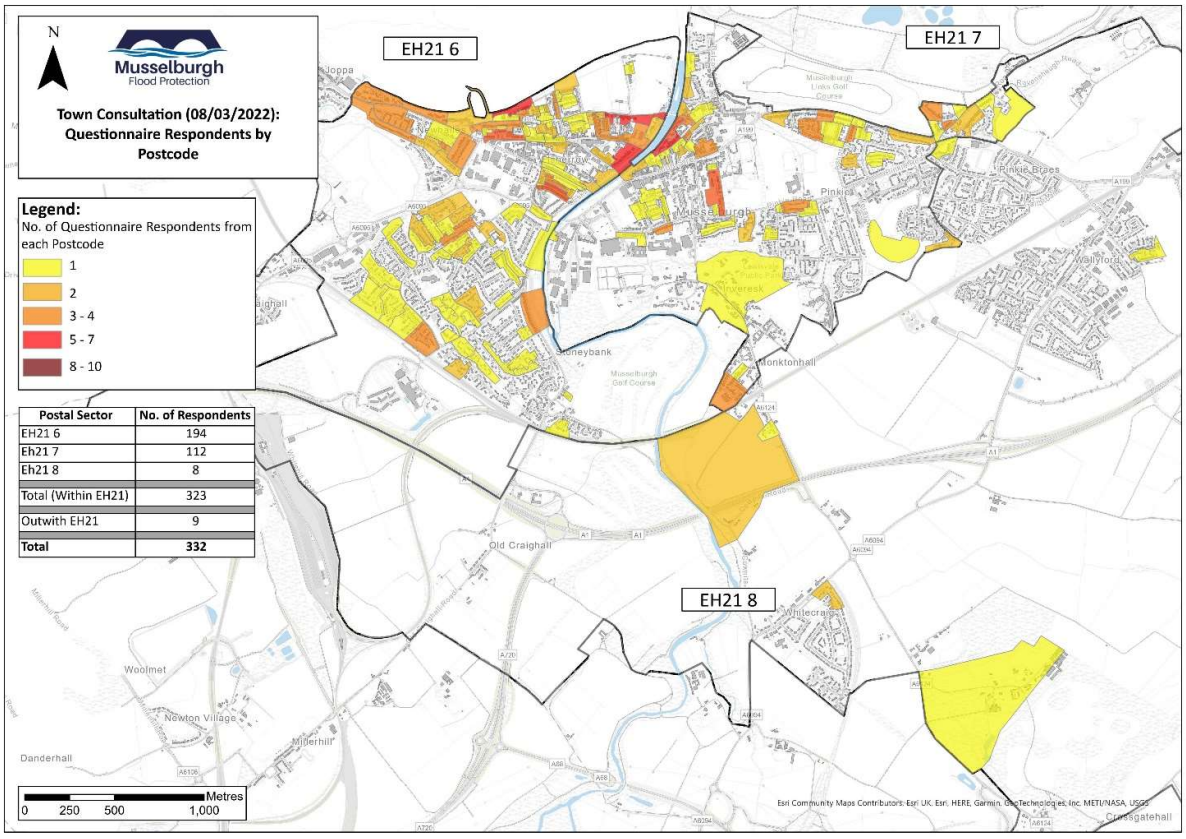


Figure 4 Distribution of respondents by home address

Question 3 - Do you agree that Musselburgh has a flood risk?

The project's scientific analysis clearly confirms that Musselburgh has a flood risk. The result of this analysis was presented at the event and broadly matches the latest flood maps on SEPA's website[3]. This question was asked to determine the degree to which respondents agreed with and trusted the scientific analysis, and Figure 5 indicates their response.

91% of respondents at the event agreed that Musselburgh has a flood risk.

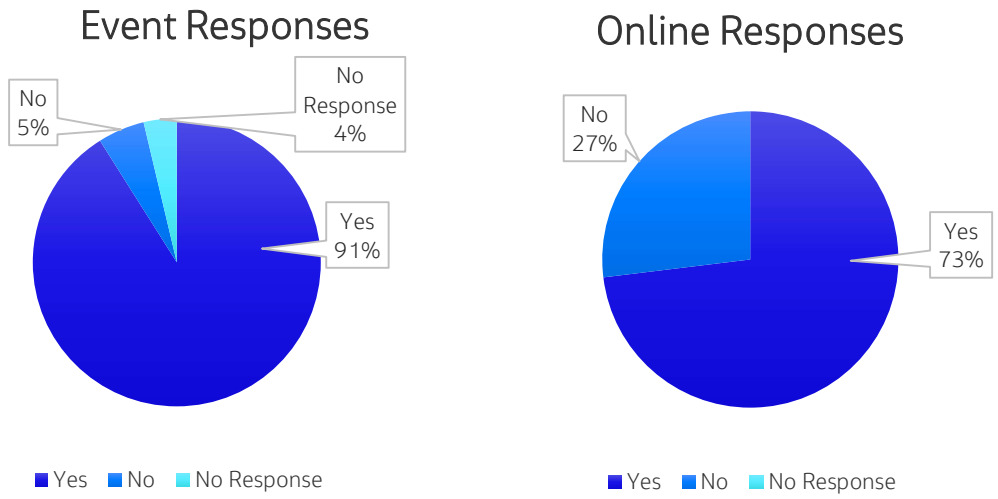


Figure 5 Do you agree that Musselburgh has a flood risk?

Question 4 - Do you support the provision of a flood protection scheme for Musselburgh?

This question is the primary indicator for support of the Scheme at this time, notwithstanding that the Scheme has only been defined to a conceptual level so far and the level of support may vary as the outline design progresses.

87% of respondents at the event supported the provision of a flood protection scheme for Musselburgh.

[3] https://map.sepa.org.uk/floodmaps

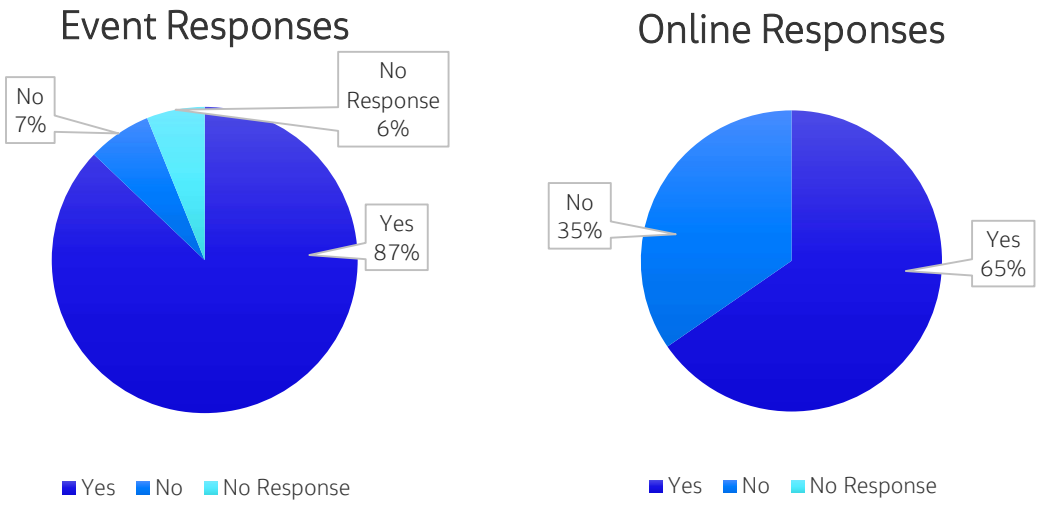


Figure 6 Do you support the provision of a flood protection scheme for Musselburgh?

Question 5 - Do you agree that such a flood protection scheme should include an allowance for climate change?

Allowing for climate change means constructing defences to a higher level now such that they are more likely to still provide the desired standard of protection at a given date in the future when sea levels are expected to be higher, river flows are expected to be greater, and rainfall is expected to be more intense.

This question was asked to gauge whether respondents supported the concept of not only protecting against present-day flood risk but also providing an equivalent flood risk reduction for future generations living in a more extreme climate. Notwithstanding this, the question of how much allowance for climate change should be incorporated in the Scheme remains an ongoing consideration (See Section 3.3.2).

85% of respondents at the event supported the inclusion of an allowance for climate change.

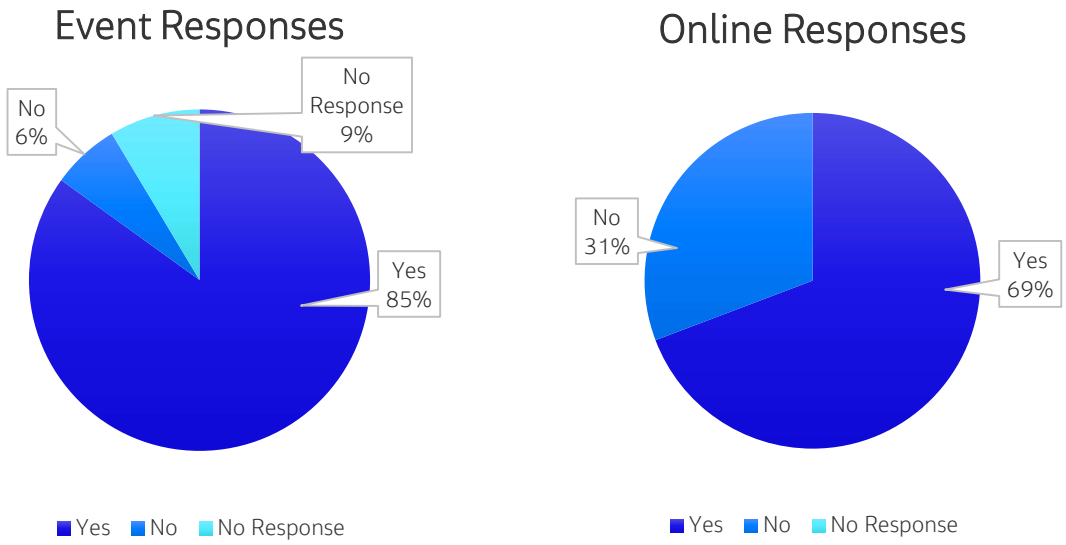


Figure 7 Do you agree that a flood protection scheme for Musselburgh should include an allowance for climate change?

Question 6 - For each of the following locations, please rate the factors in order of priority that you think the designers should consider when designing the scheme

This question asked respondents to consider the Scheme's design in terms of waterside access, visual appearance, environmental impact, cost, and space for recreation. It then asked respondents to place these factors in their personal order of importance (from one to five) for five local areas within the Scheme. The aim was to understand how respondents' priorities might differ depending on location, and how this might influence Jacobs' approach to the outline design.

Several responses assigned equal importance to more than one factor. This was not the intent of the question, which was to introduce the concept that difficult choices must be made during the design and certain factors will have to be prioritised over others. The results presented below are therefore based on responses that graded from one through to five, both at the event and online.

The responses indicate very little variation in perceived importance depending on location. As shown in Table 2 and Figure 8, respondents consistently rated environmental impact as the most important consideration in the design of the Scheme across all locations except Fisherrow (where coastal access was considered marginally more important). As shown in Table 3 and Figure 9, respondents consistently rated cost as the least important consideration.

Location	Waterside Access for the public	Visual Appearance	Environmental Impact	Cost	Space for recreation and amenity
Edinburgh Road Area	24%	19%	44%	6%	7%
Eskmills Area	21%	12%	52%	7%	8%
Esksides Area	22%	32%	36%	3%	8%
Fisherrow Area	37%	18%	35%	2%	8%
Goosegreen Area	22%	23%	40%	6%	9%
Mountjoy Area	26%	19%	41%	3%	11%
Average	**25%**	**20%**	**41%**	**4%**	**8%**

Table 2 Respondents' most important design consideration for each local area

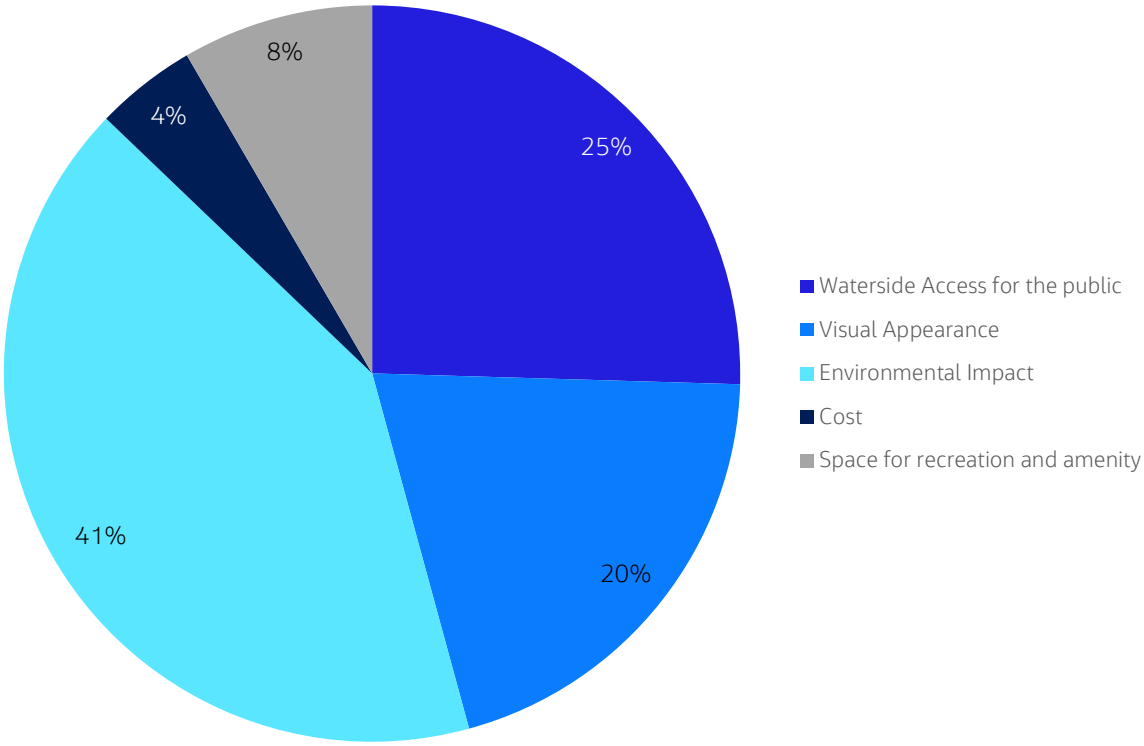


Figure 8 Respondents' most important design consideration, averaged over all local areas

Location	Waterside Access for the public	Visual Appearance	Environmental Impact	Cost	Space for recreation and amenity
Edinburgh Road Area	14%	8%	3%	56%	20%
Eskmills Area	16%	9%	2%	49%	24%
Esksides Area	9%	3%	4%	65%	19%
Fisherrow Area	7%	8%	4%	67%	14%
Goosegreen Area	20%	5%	2%	55%	17%
Mountjoy Area	13%	7%	2%	64%	13%
Average	**13%**	**7%**	**3%**	**59%**	**18%**

Table 3 Respondents' least important design consideration for each local area

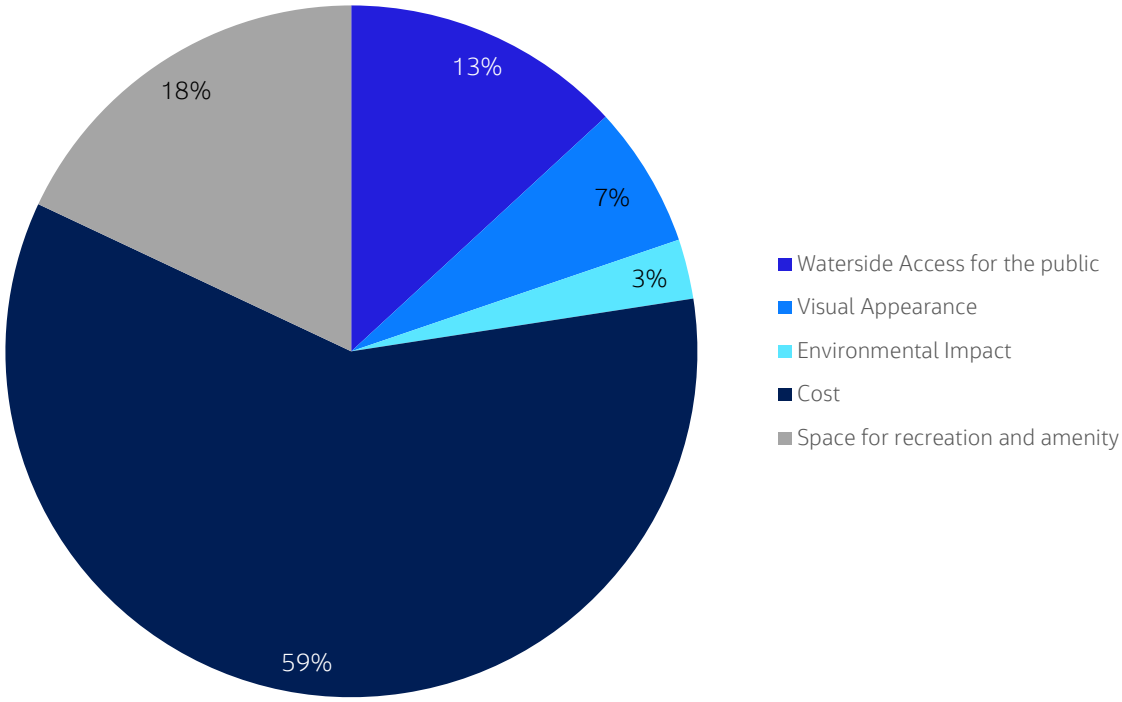


Figure 9 Respondents' least important design consideration, averaged over all local areas

Question 7 - For each of the following locations, please indicate your order of preference for the form of replacement bridge

This question asked respondents to consider their preferred form of footbridge from a choice of three types for each of the following locations: Ivanhoe footbridge, Shorthope Street footbridge, and Goosegreen footbridge. The choice of footbridge types given are shown in Figure 10 below. Furthermore, at the event it was highlighted that, through joint consideration of opportunities with Musselburgh Active 'Toun' project, there is an emerging opportunity to relocate the Goosegreen crossing to the mouth of the River Esk.

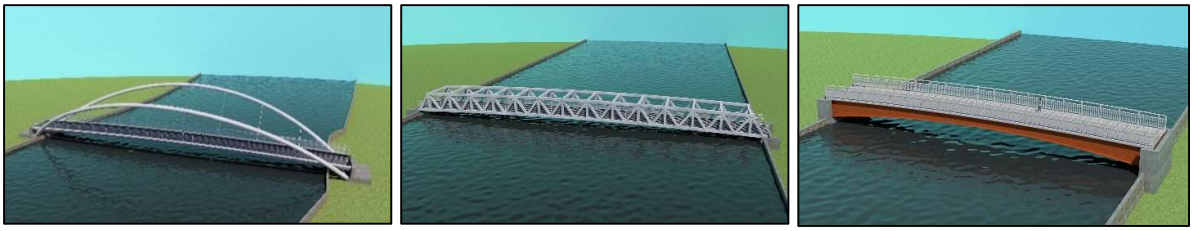


Figure 10 Possible forms of footbridge (left to right: 1. steel hybrid butterfly arch bridge; 2. steel modified Warren truss bridge; and 3. composite timber-steel multi-girder bridge)

As shown in Figure 11 below, respondents' first preference for Ivanhoe footbridge was evenly split between a steel hybrid butterfly arch bridge (39%) and a composite timber-steel multi girder bridge (42%), with significantly less support (19%) for a modified Warren truss bridge.

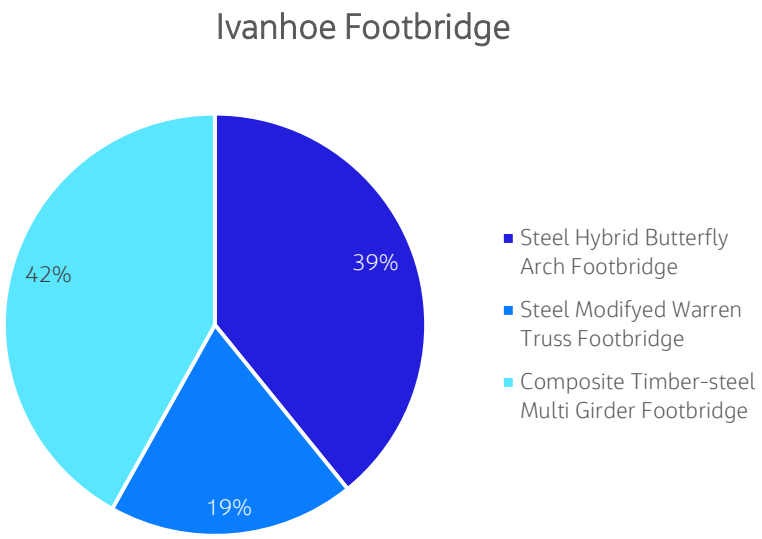


Figure 11 Respondents' preferred form for Ivanhoe footbridge

As shown in Figure 12 belowFigure 11, 51% of respondents preferred a steel hybrid butterfly arch for Shorthope Street footbridge.

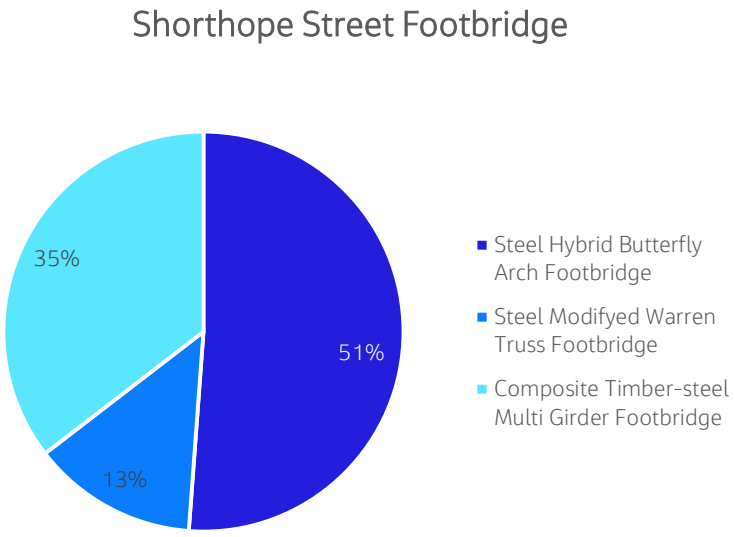


Figure 12 Respondents' preferred form for Shorthope Street footbridge

As show in Figure 13 below, 52% of respondents preferred a steel hybrid butterfly arch for Goosegreen footbridge.

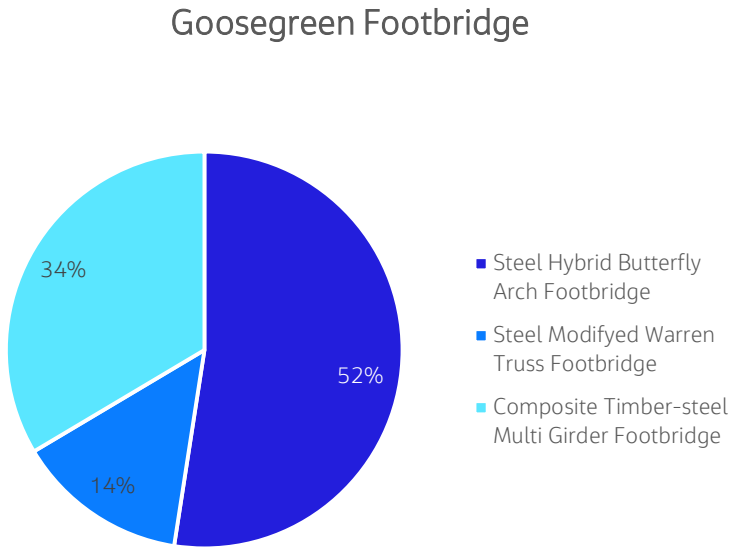


Figure 13 Respondents' preferred form for Goosegreen footbridge

Question 8 - If Electric bridge is to be replaced, would you prefer that the new bridge is a) only suitable for pedestrians & cyclists; or b) capable of being opened to motorised vehicles in the future?

The previous question concerned the replacement of existing footbridges. In contrast, the existing Electric bridge could carry vehicular traffic but is currently only open to cyclists. The project team has no preference for what types of traffic can cross this bridge now or in the future, as long as the form of the new structure reduces flood risk. Question 8, therefore, was asked to understand what future capability respondents thought a replacement bridge at this location should have.

As shown in Figure 14 below, 59% of respondents thought that a replacement bridge at this location should only be suitable for pedestrians and cyclists.

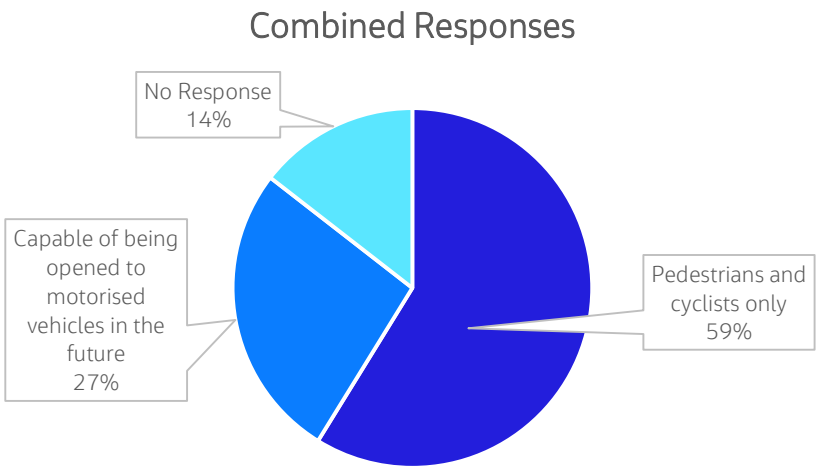


Figure 14 Respondents' preference for the replacement of Electric bridge

Question 9 - Do you have any further thoughts or comments you would like to provide?

This final question gave respondents the opportunity to provide any further feedback which they felt was not sufficiently addressed by the other questions. As this was an open question, no statistics were derived from it, but the responses were considered in the context of 'emerging themes'.

3.3 Emerging Themes

For the purposes of this report, 'emerging themes' means the appearance of patterns in attendees' feedback relating to one or more central concepts. These may be inferred from responses to the questionnaire or directly from conversations that the project team had with attendees at the event. The following sections focus on themes which are relevant to the development of an outline design based on the preferred scheme, and, where appropriate, attempt to address the questions that the public may have raised.

3.3.1 Source of responses to the Questionnaire

Responses to questions 3-5 indicate a notable difference of opinion between respondents at the event and those online. Online respondents generally indicated lower support for the Scheme and higher scepticism about flood risk and allowance for climate change. However, only 26 questionnaires, or 7% of the total, were completed online, meaning the views of each individual in this group have a greater bearing on the outcome.

Several inferences could be made about these trends. Those attending the event were able to ask the project team questions, which may have dispelled their concerns and increased their understanding and level of support. Conversely, those who were less comfortable engaging directly with the project team may have been more likely to complete the questionnaire online and would have had less opportunity to increase their understanding of the Scheme and have their concerns resolved.

326 responses, or 93% of the total, were received during the event, therefore this dataset is considered more reliable as an indicator of the views of the wider community.

3.3.2 Climate Change

Responses to the questionnaire indicate broad support for the scheme to include an allowance for climate change, with 85% of respondents at the event in favour. Meanwhile, conversations with the project team during the event suggests a more nuanced range of views. While people generally accepted that climate change was occurring, there was considerable variation in how much allowance for climate change they thought should be constructed.

There were various reasons for this variation. Some felt that the high emissions scenario projected in UKCP18 was too pessimistic, and the probability of it occurring was too low to justify the higher defences required to protect against it. Related to this, some felt that a lower allowance for climate change should be constructed initially and that this should be raised if more extreme climate change occurs in the future. In stark contrast, a small number of people felt that UKCP18 was not onerous enough and that a greater allowance for climate change happening quicker than predicted should be incorporated in the scheme.

There was some confusion among attendees about the difference between, 'an allowance for climate change', and 'a strategy for future flexibility'. Including an allowance for climate change would mean building defences to a higher height now so that they would protect against a 0.5% AEP event at a chosen date in the future when conditions are expected to be more extreme due to climate change. In comparison, providing future flexibility would mean designing the defences' foundations so that they could be raised in height in the future in response to climate change, but without constructing them to this height initially.

Opinions about building defences higher now or enabling them to be raised later may be affected by considerations such as visual impact of defences, availability of future funding, and risk of defences being overtopped. Concerns about visual impact may presuppose that higher defences cannot be integrated into the existing built environment through good landscape design and would thus become an eyesore. Concerns about future funding may presume that funding to raise defences will be more difficult to obtain in the future. Finally, concerns about overtopping of defences may suppose that if the decision to raise defences is only taken once climate change occurs, there would be a greater risk that the flood would occur before the work is carried out.

3.3.3 Environmental Impact

Several attendees asked about the requirement for the project to carry out an Environmental Impact Assessment (EIA), when this would be done, and when it would become available to the public. There was broad consensus, as confirmed by responses to the questionnaire, that environmental impact should be an

important consideration in the design of the Scheme. Some people felt that the environmental impact of multiple options should be assessed to inform which options are taken forward.

Consideration of the possible environmental impact of various options has taken place since Stage 3 of the project. Jacobs' environmental specialists as well as regulatory stakeholders contributed to the option appraisal process, providing feedback to designers on environmental constraints and opportunities as appropriate. This is explained in the presentation boards in Appendix A.

At the beginning of Stage 4 of the project, Jacobs' environmental specialists proposed that an EIA should be screened in, and this was confirmed by ELC's planning service. The environmental topics on which detailed assessment are required were identified through the scoping process and include:

- Population and Human Health (impacts on humans and features important to their health and wellbeing)
- Biodiversity (impacts on terrestrial and aquatic habitats and species)
- Noise and Vibration (impacts on humans, protected species and built heritage features)
- Landscape and Visual (impacts on landscape character, views and cultural assets)
- Water Environment (impacts on ground, surface, fluvial and coastal waterbodies)
- Soils, Geology and Contamination (focus on contamination risks)
- Air Quality (primarily impacts from construction dust)
- Climate (to align with new and emerging policy on reducing carbon emissions)
- Cultural Heritage (impacts on conservation areas, listed buildings and potential archaeology)
- Traffic and Transportation (mostly construction traffic)
- Cumulative Effects (between topics and combined impacts with other development)

Throughout the outline design process Jacobs' environmental specialists will work with its designers to avoid or reduce significant effects where possible through appropriate selection of design solutions, construction methods and technologies. The actual assessment of the Scheme's impacts can only commence once an outline design is sufficiently developed such that there is something quantifiable to assess. The full EIA process and outcomes will be presented in an EIA Report, which will be made available to the public when the Scheme is published during Stage 5 of the project in accordance with the statutory requirements. The report will summarise how the Scheme is likely to impact each of the above topics, identify any feasible mitigation to avoid or reduce significant effects and list all unavoidable residual effects and applicable monitoring measures.

It would not be proportionate or an appropriate use of public funds to carry out this detailed level of environmental assessment at the options appraisal stage; instead, options were qualitatively assessed by a group of specialists. The options were retained or discounted based on their collective professional judgement of numerous design considerations, including environmental impact.

3.3.4 Design Considerations

Question 6 in the questionnaire introduced the public to the concept of multiple design considerations influencing what form the Scheme may take. Design considerations are factors, such as environmental impact or cost, whose relative importance must be taken into account by the designer when making design decisions. Some considerations are complimentary, but many are conflicting, and the solution chosen is often considered the 'least worst', which involves a trade-off or compromise between numerous design considerations. For example, a solution with the lowest environmental impact may have the highest cost and take the longest time to construct. The solution eventually chosen may therefore have a moderate environmental impact, moderate cost, and medium construction duration.

The project team took the opportunity to introduce these concepts during their conversations with attendees. Some people acknowledged the importance of finding compromises, but others naturally attributed higher

importance to the considerations that would affect them directly, such as retention of trees and on-street parking outside their homes. Overall, responses to the questionnaire identified environmental impact as being respondents' most important consideration across most locations. This may be purely altruistic, or due to a greater awareness of environmental issues in recent times, or it may be that respondents associate a healthy environment with personal wellbeing. Whatever the reason, the project team supports the importance of minimising the environmental impact of the Scheme.

Notably, respondents to the questionnaire overwhelmingly indicated cost as their least important design consideration. This contrasts with the views of a small number of vocal individuals who were critical of the estimated cost of the Scheme, or certain elements of it, during previous consultation events. While the affordability of the Scheme and the value provided by it is very important to its funding partners, this public feedback is clear and gives the project team a greater understanding of the opinion of the wider community.

3.3.5 Height and Level of Defences

Many conversations at the event related to the height and form of physical defences being proposed. Attendees were eager to understand what height the defences would have to be to provide the desired standard of protection and how this was calculated.

Before considering defence heights at different locations, it is important to distinguish between the level of a defence and its apparent height. While the level of the top of the defence may not vary over a considerable distance to reflect the design flood levels, its apparent height might. This is because the ground level may rise and fall along the length of the defence, and its height is measured relative to this. Figure 15 below demonstrates the effect of changes in ground level resulting in a change of defence height.

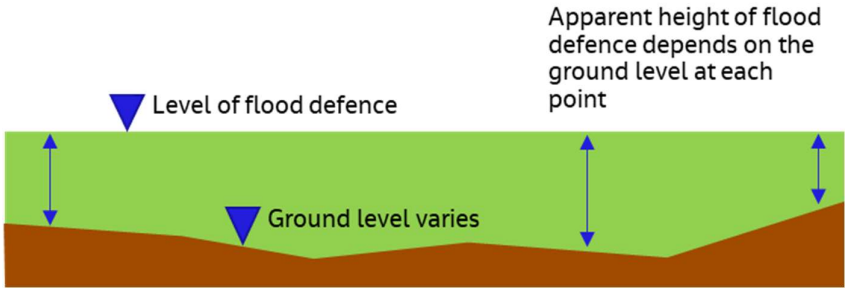


Figure 15 Front elevation of a flood defence to demonstrate the distinction between its level and height

No decision has been taken yet about the form of defence at any location. This will happen during the outline design. Along the river, the level of the top of the defences is affected by their position but not by their form. This is because the more the defences narrow the river, the more constrained the flow will be and therefore the higher the water level will reach. Meanwhile, along the coast, the level of top of the defences is primarily affected by their form. This is because the coastal defences are required to protect against waves overtopping and the shape of the defence plus the foreshore in front of it affects how high it needs to be to achieve this.

Figure 16 below represents the different components which are added together to determine the required level of the defences.

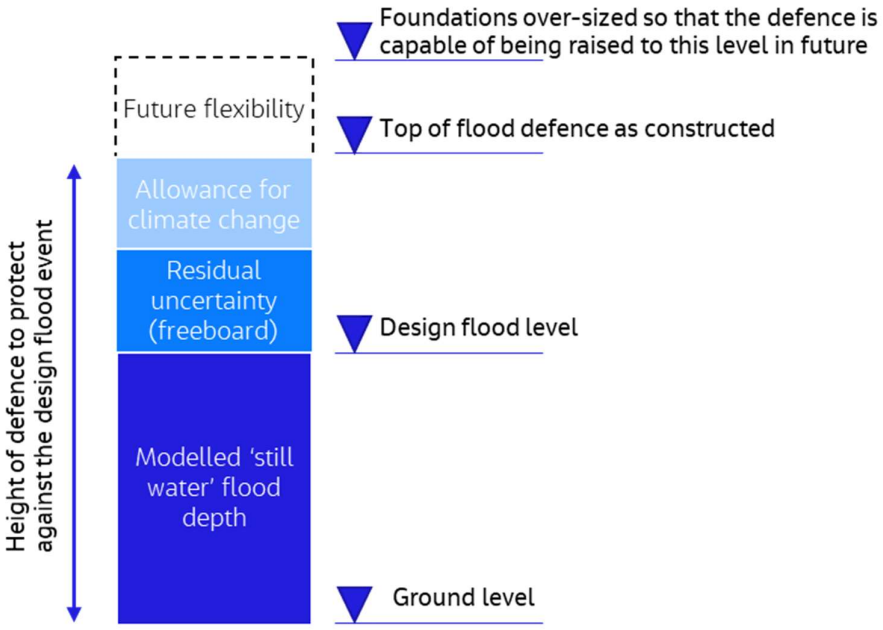


Figure 16 Components in determining the height of physical defences

The design flood event is whichever event is chosen by the Project Team to be protected against. It is an event with a magnitude that has a certain probability of occurring in any given year, based on historical data. For this Scheme, the project objectives identify ELC's aspiration to protect against a design flood event that has a 0.5% probability of occurring in any given year (Annual Exceedance Probability, or AEP) based on present-day river flows and sea levels. The standard of protection is therefore a scheme which would prevent an event of this magnitude from flooding the town, and is yet to be confirmed.

The design flood level is the level that the Scheme's hydraulic model[4] predicts the river would rise to during the design flood event when contained by defences on either side. This is notably higher than the level the river would reach during the same event but without defences in place, as the floodwater would then be able to spread across the floodplain.

Freeboard is an allowance, or factor of safety, added on top of the design flood level. This is a well-established approach in the field of flood risk management, and is done in recognition that, as in any form of scientific analysis, uncertainty can result from errors in the input data or limitations in accuracy of the model. For example, historical records of river flows are limited by the accuracy of the river gauging station's equipment and random errors can occur due to the complexity of the natural environment it is in. Furthermore, as with any scientific model, the hydraulic model of Musselburgh is a simplified representation of the catchment to determine flood levels for a given event. The actual flood level could vary slightly from that predicted because the natural processes which occur are far more complex than any scientific model could exactly replicate. Adding freeboard to the height of a physical defence means its design is robust enough to cope with reasonable deviations in the actual water level compared to that predicted by a model.

An allowance for climate change is included in recognition that the severity and probability of flooding may change during the design life of the Scheme. As global atmospheric temperatures rise due to the warming effects of greenhouse gases, sea levels are expected to rise and weather patterns are expected to become more severe. This means that a flood event of a certain magnitude would become more likely to occur in the future than it would today. In the case of Musselburgh, results based on the high emissions scenario (RCP8.5 95%ile) in UKCP18 suggest that a flood of the magnitude of the present-day 0.5% AEP event would be four times more likely to occur in 100 years' time. Allowing for climate change would therefore mean protecting

[4] An explanation of the hydraulic model is available on the project's website at: www.musselburghfloodprotection.com

against an event of greater magnitude but with the same probability of occurrence at a future date as the present-day design flood event has now.

As stated in the section above on climate change, future flexibility means designing a flood defence so that it could be raised in height at some point in the future, but without initially constructing it to the higher height. The defence could be designed to be raised by an arbitrary amount, such as 0.5 metres, or it could be designed to be raised to a specific level, such as a further 50 years' worth of climate change allowance.

Information on the proposed heights and levels of the physical defences will be communicated as the outline design progresses.

3.3.6 Replacement of Bridges

Many conversations at the event related to the proposed replacement of certain bridges over the Esk. Attendees' questions focused on the reasons for doing this, the benefits, and what the alternatives were. Underlying concerns often centred on perceptions of cost and value for money.

The preferred scheme identified five conceptual components, shown in Figure 17 below:

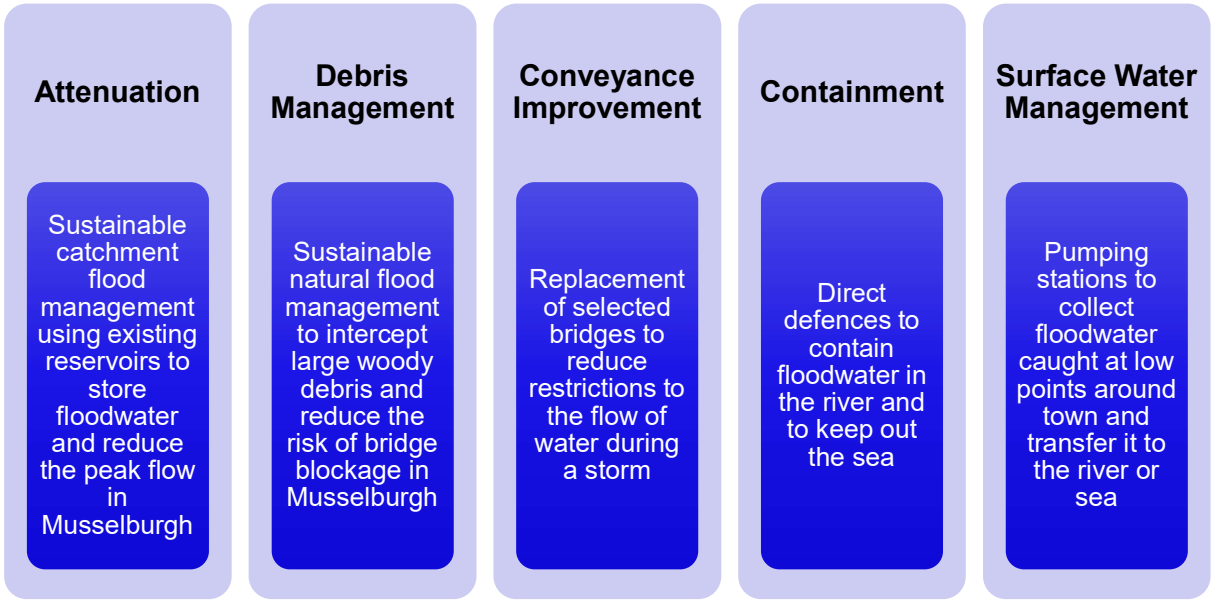


Figure 17 Preferred Scheme components

Scientific analysis determined that physical defences, or containment, along the River Esk would be an essential part of the Scheme. Attenuation, debris management, and conveyance improvement were therefore established as complementary measures which could reduce the height and extent of physical defences required.

Several of the existing bridges over the River Esk have a risk of being blocked by debris during a storm, which would lead to earlier onset of flooding. While the proposed debris management upstream would reduce this risk, it would not eliminate the risk altogether since the riverbanks between the debris trap and the bridges still contain woodland. It is also possible that some debris could accumulate prior to a storm and not yet have been removed, thereby reducing the effectiveness of the debris trap. Furthermore, for operational reasons it would be impractical to locate the debris trap further downstream. Replacing the most at-risk bridges with new single span structures above the flood level would therefore further reduce the risk from debris and enable the physical defences on the riverbanks to be lower as a result.

As well as the risk from debris, the shape of some of the existing bridges would also restrict flow when the river is higher. This is because during a flood the in-stream piers would throttle the flow of the river and the bridge decks would be below the water level, further throttling the flow. The bridges which present the greatest restriction to flow are the Shorthope Street footbridge, the Electric bridge and the Goosegreen footbridge. Replacing these with new single span structures above the flood level would therefore further

reduce the height of physical defences on the riverbanks over and above the reduction in height attributed to debris management.

The aforementioned existing bridges, with or without physical defences on the riverbanks, would be under water during the design flood event. With defences in place, if the existing bridges were retained, floodgates would have to be placed at either end to contain floodwater in the river and the crossings would be inaccessible until the flood receded. Replacing the bridges with new structures above the flood level would therefore mean that the bridges could remain in use during a flood. This has clear benefits for the community.

As well as benefits for flood risk reduction, there are other reasons to replace certain bridges over the River Esk. The Musselburgh Active 'Toun' project is developing a range of proposals aimed at encouraging more people to walk, wheel and cycle in and around Musselburgh. Part of this would involve widening some bridges to better accommodate cyclists and pedestrians. By considering both projects' aims together, achieving flood risk reduction and increased user functionality, multiple funding streams can be secured which would present greater value for the community and more efficient use of public money than both projects independently.

The alternative to replacement of bridges would involve accepting the risks they present and designing the remaining parts of the Scheme accordingly. Additional attenuation was considered and deemed undeliverable, and further debris management would not address the issue of restriction to flow. The remaining options would be to either reduce the standard of protection that the Scheme provides or construct higher physical defences on the riverbanks to compensate for debris blockage and restriction to flow. Retaining the existing bridges would also fail to realise the multiple benefits from the Active 'Toun' project The risk that some or all of the bridges would be damaged or washed away during the design flood event would also still exist.

3.3.7 Landscape Design

Prior to the consultation event, it was already understood by the project team that the existing landscape along the River Esk and the coastline is valued greatly by the community. These areas are used widely for exercise, relaxation, enjoying wildlife, and simply for appreciating the view. Many attendees asked how these things might be affected by the Scheme, both during construction and permanently.

There are significant benefits from reducing Musselburgh's flood risk, and there is a cost associated with achieving those benefits. The cost may be thought of in terms such as: how much money the Scheme would cost to construct and maintain, how much disruption there would be during construction, or how much permanent change there would be to the landscape. Some attendees suggested that any change whatsoever to the town's landscape would be unacceptable to them and insisted that alternative solutions to physical defences in the town should be used, such as tree-planting in the catchment and offshore barriers.

Through scientific analysis, the project team is resolved that Musselburgh cannot practicably be protected against the 0.5% AEP flood event without physical defences in the town, which would result in changes to the landscape. The project team, however, is confident that those changes are worth the benefits that the Scheme would provide. The Scheme's design should therefore ensure that, while changing the landscape, its character and amenity value is preserved.

ELC recognises the importance of the town's landscape to the success of the Scheme and has included an enhanced allowance for landscape design at this early stage of the project. Jacobs' design team includes landscape architects, who recognise that the Scheme is more than just a series of physical defences. They will aim to embed those defences into the landscape in a sensitive manner through the appropriate use of materials, planting and spatial design. They will consider the routes taken by people passing through the landscape, where they enter and exit an area, where they stop or congregate, and how they use different spaces.

It may be that the Scheme's landscape design could be considered a success if, 10 years after its completion, a visitor to the town did not recognise the defences as being a flood protection scheme, and merely saw them as a part of the wider landscape.

3.3.8 Nature-based Solutions

A common topic of conversation during the event, prompted by recent media coverage, was whether nature-based solutions could be a viable alternative to engineered defences in the town. This topic was addressed in

one of the presentation boards included in Appendix A. A number of nature-based solutions were considered during the option appraisal process, and this was followed up with two studies[5] into the feasibility of natural flood management and working with nature to reduce flood risk. An additional study into the feasibility of dunes as physical flood defences along parts of the coast is also currently being undertaken.

It is understandable that the public would prefer the use of natural or nature-based solutions instead of more obviously engineered alternatives. It is also understandable that the public would prefer to be protected from flooding through the use of measures constructed elsewhere, either in the catchment or offshore, so that there was no impact or change to the town itself. Scientific analysis, however, indicates that nature-based solutions by themselves would not be capable of protecting Musselburgh against a 0.5% AEP flood event, and that no other solution, natural or engineered, would avoid the need for physical defences along the River Esk and the coast.

While physical defences are essential to protecting Musselburgh against the 0.5% AEP flood event, other sustainable and catchment-based measures are also proposed, such as debris management and attenuation. These complimentary measures will reduce the height and extent of physical defences required. As the outline design progresses, further natural or nature-based solutions may also be identified to compliment the engineered measures. These may contribute to the Scheme's overall flood risk reduction, or they may provide other desirable benefits such as habitat creation or biodiversity enhancement.

The project team recognises that the design of the Scheme is not a binary choice between natural or engineered measures. Instead, it is appropriate to incorporate a range of complimentary measures which, together, are sustainable, robust and effective in providing the desired standard of protection.

[5] These documents are available on the project's website at: www.musselburghfloodprotection.com

4. Conclusion

The 'Whole Town' consultation event was officially attended by 462 people on the 8th of March 2022. Of these attendees, 326 completed the questionnaire, with an additional 26 completed online. Across all responses, there was a high level of recognition for Musselburgh's flood risk, and high level of support for a scheme with an allowance for climate change. There was some divergence between the in-person and online responses, with greater levels of support shown from the in-person responses.

With respect to the replacement of bridges, the steel hybrid butterfly arch footbridge was preferred for Shorthope Street footbridge and the Goosegreen footbridge. For the Ivanhoe footbridge, the preference was broadly tied between the steel hybrid butterfly arch and the composite timber-steel multi-girder. For the Electric Bridge, most respondents advocated that a replacement bridge at this location should only be suitable for pedestrians and cyclists.

A summary of the emerging themes as outlined in Section 3 is presented below:

- **Climate Change** – In general, it was accepted that an allowance for climate change should be included within the Scheme. There was, however, considerable variation in how much allowance should be constructed. The potential to design the physical defences so they could be raised in the future was also mentioned on several occasions. The project team will consider these points as the outline design of the Scheme progresses.
- **Environmental Impact** – The process of considering the possible environmental impact of various options began during Stage 3 of the project. Throughout the Stage 4 outline design process, Jacobs' environmental specialists will work with its designers to avoid or reduce significant effects where possible. The formal assessment of the Scheme's impacts will commence once an outline design is sufficiently developed such that there is something quantifiable to assess. This will be presented in an EIA Report, which will published with the Scheme documents during Stage 5 of the project in accordance with the statutory requirements.
- **Design Considerations** – In general, the public considered environmental impact to be the most important consideration in the design of the Scheme, and cost to be the least important. The project team supports the importance of minimising the environmental impact of the Scheme, and this will be considered throughout the outline design.
- **Height and Level of Defences** – Several conversations concerned the difference between the level (related to the design flood level) of physical defences and their height (related to existing ground conditions). Additionally, discussions were held regarding how the level of the defences is reached, including the use of freeboard and the allowance for climate change. This links into the emerging theme of Climate Change.
- **Replacement of Bridges** – The public wished to understand the reasons for replacing certain bridges over the River Esk, the benefits of doing so and what the alternatives were. Replacing the identified bridges with new single-span structures would reduce the risk of blockage and improve conveyance during a flood. Doing so would reduce the height and extent of physical defences required, and would also ensure that access over the river would be maintained during a flood. Additionally, there is the opportunity to achieve multiple benefits by working in partnership with the Musselburgh Active 'Toun' project to provide replacement bridges that are wider than the current structures to better accommodate cyclists and pedestrians.
- **Landscape Design** – The Scheme will result in changes to the landscape to provide the desired level of protection, however, the project team will seek preserve the character and amenity of the area through appropriate design measures. This will include landscape design to embed the physical defences into the existing environment in a sensitive manner.
- **Nature-based Solutions** – These were considered but found to be ineffective on their own in protecting Musselburgh against the 0.5% AEP flood event. Physical defences were found to be an essential part of the Scheme, but complimentary natural or nature-based solutions may still be incorporated to achieve other benefits such as habitat creation or biodiversity enhancement.

5. Next Steps

Following the comprehensive period of public consultation between September 2021 and the event of 8th March 2022, the project team will now reflect on the feedback received and the themes emerging from this. They will consider how best to incorporate the public's aspirations into the Scheme where they are deemed achievable and consistent with the Scheme's objectives.

It is proposed that Jacobs will now commence the outline design of the Scheme. This will include determining the most appropriate form of flood protection measures for each location in the town. The determination will be made using the knowledge, experience and professional judgement of engineering, design and environmental professionals combined with an understanding of ELC's needs, the public's aspirations, and the advice of statutory stakeholders.

The next major public consultation event will be delivered once the outline design is developed to an extent that the project team can present its recommendations for specific flood protection measures at each location in Musselburgh. The public will then have an opportunity to provide feedback on these recommendations. During the outline design process, the project team will also consider ways to increase engagement with younger members of the public who had limited representation at the 8th March 2022 event.

Jacobs will then reflect on that feedback and further refine the outline design until the project team is satisfied that it represents the most practicable Scheme for Musselburgh. On completion of the outline design the project will then seek approval from Full Council[6] to proceed to Stage 5 of the project, which is the formal publication of the proposed Scheme under the Flood Risk Management (Scotland) Act 2009.

[6] Full Council is the meeting of all East Lothian Council's elected members

Appendix A. Presentation Boards

Musselburgh
Flood Protection

Musselburgh Area Consultation
Whole Town Event

Tuesday 8th March 2022, Brunton Theatre, Musselburgh

Event partners:

Musselburgh Active Toun Project

East Lothian Council Emergency Planning Team

Scottish Flood Forum

SEPA Flood Warning Team

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Musselburgh Area Consultation

Musselburgh
Flood Protection

8th March 2022

Welcome to this ‘Whole Town’ consultation event for Musselburgh Flood Protection Scheme. This event forms part of the Scheme’s community consultation programme which began in 2019 and which has included exhibitions, online meetings, local area evenings, newsletters, community information boards, and the project’s website.



The project aims to reduce the risk of flooding to Musselburgh from coastal, fluvial and pluvial sources of flooding. The scheme aims to provide protection against a flood event with a 0.5% Annual Exceedance Probability (AEP) (also known as a 1 in 200 year event) plus an allowance for climate change plus a strategy for future flexibility.





The project team has determined that physical defences are an essential part to delivering this reduction in Musselburgh’s flood risk. The purpose of today is to enable the community to have an influence on the form of those defences.

In response to questions raised during previous events, information is also provided about the project’s governance, programme, options appraisal process, environmental impact assessment, and use of nature-based solutions.



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Project Governance

Musselburgh Flood Protection

Oversight & decision-making

The organisational structure of the project was established at its outset to provide clear governance and oversight for delivering the flood protection scheme.

Full Council (ELC Elected Members)

Full Council considers reports submitted by Project Board and is ultimately responsible for decisions taken to progress the Scheme

Project Board (ELC Officers)

Project Board provides strategic oversight to the project. It considers recommendations made by its consultants and decides which should be reported to Full Council for approval

Turner & Townsend
Project Management consultant

Turner & Townsend provides project management services which include contract management, stakeholder management, financial management & general administration of the project.

Jacobs
Design consultant

Jacobs provides engineering, scientific and environmental expertise and is responsible for designing the Scheme. They make technical recommendations to the Project Board

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Project Stages and Timeline

Musselburgh Flood Protection

The project is currently in stage 4, and in accordance with its governance, approval of Full Council is required to progress from to the next stage. The graphic on the right highlights selected activities to be completed prior to progressing to stage 5.

Stage Gateways

- Stage 1 Establishment of the Project
- Stage 2 Review of Existing Studies
- Stage 3 Options Appraisal
- Stage 4 Outline Design
- Stage 5 Statutory Approval
- Stage 6 Detailed Design
- Stage 7 Procurement of the Main Contractor
- Stage 8 Construction
- Stage 9 Maintenance

Timeline of next activities in stage 4

- Local Area and Full Town consultation events — Spring 2022
- Review feedback from consultation events so far and develop opportunities register
- Commence outline design activities and establish new programme
- Present ongoing outline design to Full Council to reaffirm the process — Spring /summer 2023
- Public Exhibition no.2 to present the ongoing outline design and seek feedback
- Review feedback from consultation
- Finalise outline design and seek permission from Full Council to publish the Scheme — Winter 2023

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Public Consultation

Musselburgh Flood Protection

The project team considers public consultation to be key to the successful development of the Scheme, and this is actively encouraged by the Scottish Government under the Flood Risk Management (Scotland) Act 2009.

Since the inception of the project in 2016, the project team has engaged widely with members of the public, residents' associations, community groups, businesses, other council departments and statutory stakeholders. The contributions by these parties have already influenced the development of the Scheme and will continue to do so. The project team remains committed to developing the outline design of the Scheme through a consultative framework.

Public events to date

- Public Open Day & Call For Information – February 2019
- Public Exhibition No. 1 – July 2019
- Local Area Consultation: Edinburgh Road Area
- Local Area Consultation: Fisherrow Area
- Local Area Consultation: Mountjoy Area
- Local Area Consultation: Goosegreen Area
- Local Area Consultation: Esksides Area
- Local Area Consultation: Eskmills Area
- Local Area Consultation: Inveresk Area
- Door-to-door 'doorstep consultations
- Consultation on risk and options for the Inveresk Estate
- Local Area Consultation: Esk Corridor
- Local Area Consultation: Coastal Foreshore
- Local Area Consultation: Whole town event

Presentations to community groups & organisations

- Musselburgh & Inveresk Community Council
- Musselburgh Conservation Society
- Inveresk Village Society
- Fisherrow Harbour & Seafront Association
- Esk River Improvement Group
- Esk Valley Trust
- Musselburgh Business Partnership
- Eskmills Business Park
- Buccleuch Estates & Dalkeith Country Park
- Musselburgh Flood Protection Action Group

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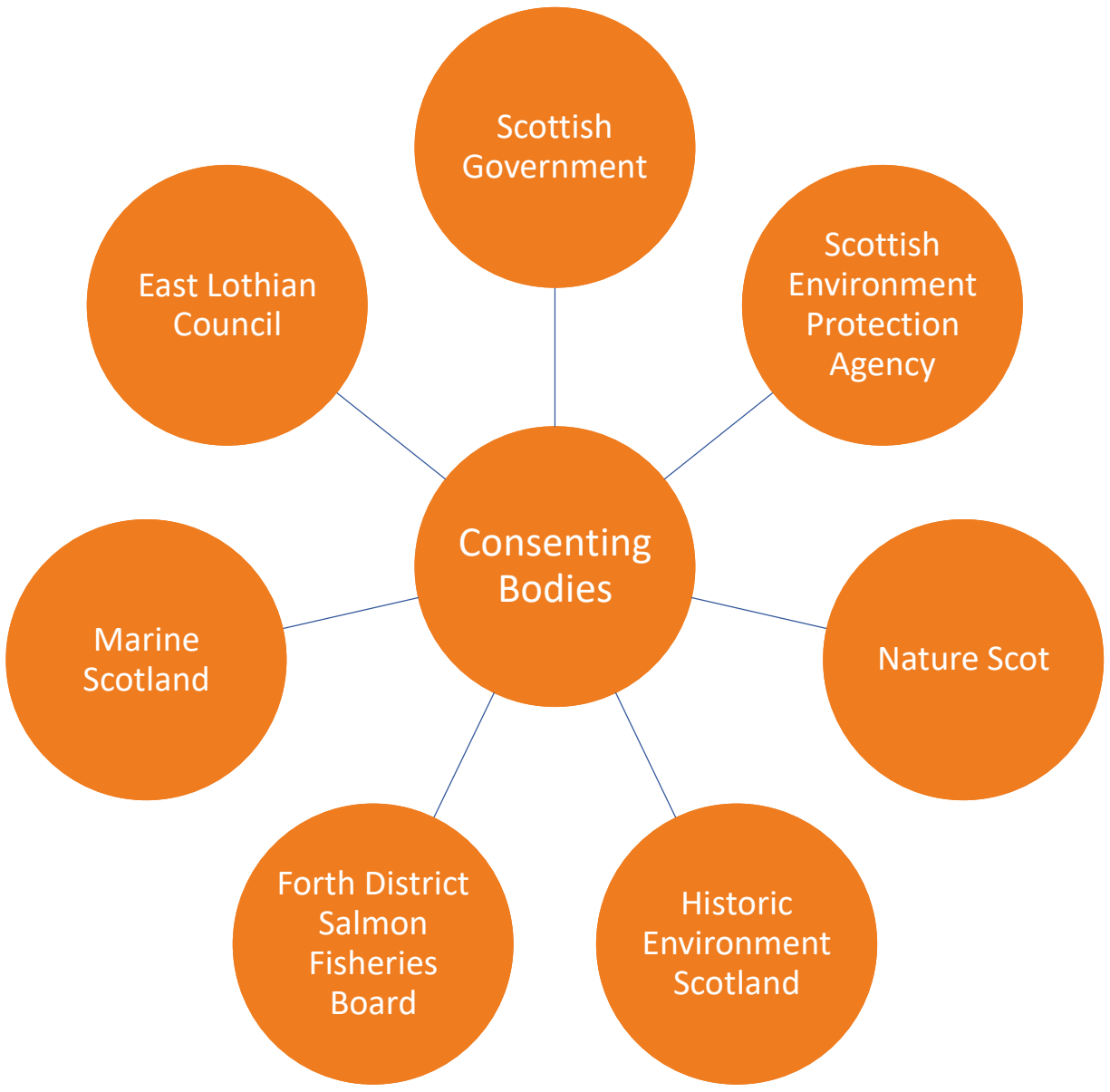
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Consenting & Statutory Bodies

Musselburgh Flood Protection

While statutory approval of the Scheme is sought under the Flood Risk (Scotland) Act 2009, the Scheme may also require other consents and licenses for certain activities. The project team is engaging with consenting bodies to ensure that the design of the Scheme meets the relevant requirements to obtain those consents and licenses at the appropriate time in the programme.





The project team also established a number of multi-organisation working groups. In doing so, they can seek the advice of technical specialists, statutory representatives and council officers. As the outline design evolves, the working groups help designers identify potentially significant environmental effects and determine what action may be required to avoid or mitigate them.

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The Options Appraisal Process

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Options appraisal is the process of considering many different ways of achieving a project's objectives. These are identified and evaluated against set criteria to narrow the list down to a manageable number which merit further consideration.

The appraisal process was *qualitative*, meaning it considered subjective characteristics rather than a *quantitative* assessment of numbers and data. For this reason the appraisal was conducted by a variety of specialists, from economists and engineers to ecologists and town planners, who together had the professional knowledge and experience to make an informed judgement. At this stage in a project it would be unmanageable and an inappropriate used of public money to collect, process and evaluate quantitative data on all of the options identified.

The remaining shortlisted options were then used to form a 'Preferred Scheme' or preferred combination of options. The project team is now consulting and engaging with the public and stakeholders to refine variations of those preferred options into an outline design.



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The ‘Preferred Scheme’

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The ‘Preferred Scheme’ is a term used to describe the outcome of the Options Appraisal Process. It is a snap-shot in time to demonstrate progress, and more importantly to determine the scope of the next stage – the Outline Design.

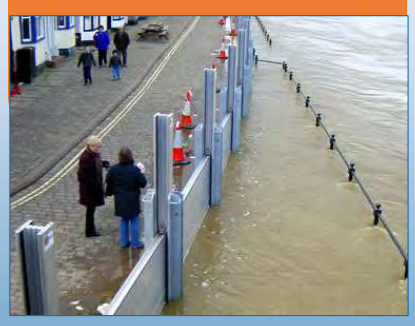
The ‘Preferred Scheme’ might be thought of as the assumed best combination of individual flood risk reduction concepts through which to achieve the Project’s Objectives. It was approved by a meeting of the Council’s Cabinet on 21st January 2021.

Approval of the ‘Preferred Scheme’ does not mean that the design has been carried out yet or that it has been approved under the Flood Risk Management (Scotland) Act 2009.

Following the current period of consultation, Jacobs will begin the outline design, using the ‘Preferred Scheme’ as a starting point together with feedback received from the public and other stakeholders.

The Preferred Scheme Components

Attenuation	Debris Management	Conveyance Improvement	Containment	Surface Water Management
Sustainable catchment flood management using existing reservoirs to store floodwater and reduce the peak flow in Musselburgh	Sustainable natural flood management to intercept large woody debris and reduce the risk of bridge blockage in Musselburgh	Replacement of selected bridges to reduce restrictions to the flow of water during a storm	Direct defences to contain floodwater in the river and to keep out the sea	Pumping stations to collect floodwater caught at low points around town and transfer it to the river or sea



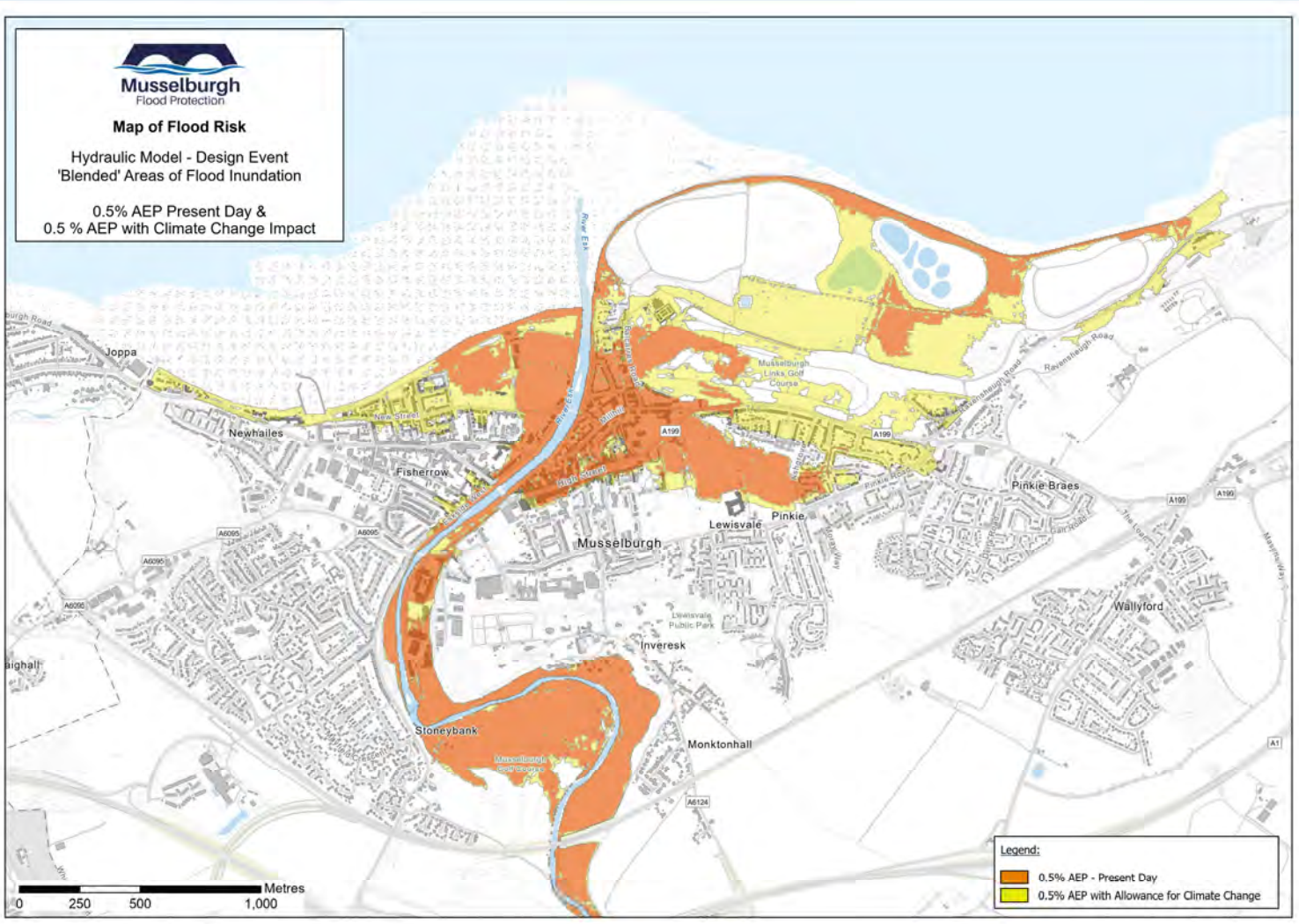
Musselburgh's Flood Risk

Musselburgh
Flood Protection

Present-day risk and the future risk due to climate change

The map below is the result of the hydraulic modelling carried out by Jacobs to determine Musselburgh's flood risk. It closely aligns with flood risk mapping independently carried out by SEPA and which is available to view on their website (www.sepa.org.uk).

The areas shaded orange are those at risk of flooding from a present-day 0.5% AEP event. The areas shaded yellow are the additional areas which could become at risk of flooding due to the effects of climate change during the design life of the Scheme.



The allowance for climate change is based upon the UKCP18 RCP8.5 95 percentile dataset. UKCP18 is the UK's most up-to-date set of climate change projections, published by the Met Office. RCP8.5 is the high emissions scenario, which represents a range of global mean temperature increases of between 3.2 °C. and 5.4°C by 2081 to 2100.

This is the dataset recommended for local authorities by SEPA in its document, *"Climate change allowances for flood risk assessment in land use planning (April 2019)".*

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Environmental Impact Assessment

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Consideration of potential environmental impacts began at the options appraisal stage, with Jacobs' environmental specialists and regulatory stakeholders providing advice on potential environmental opportunities and constraints of each of the options.

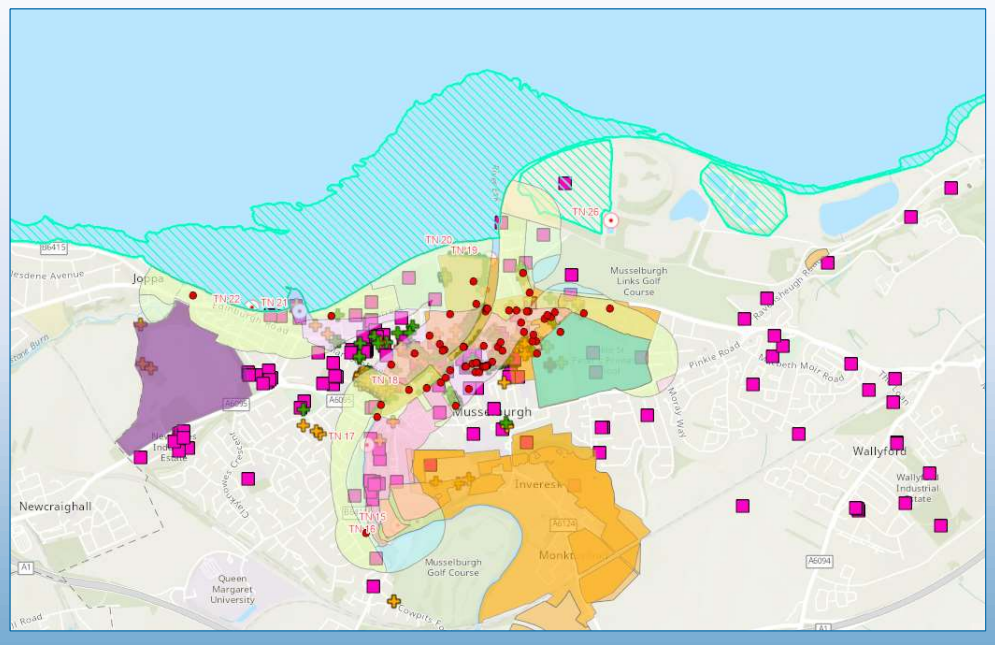
The Environmental Impact Assessment (EIA) process and outcomes will be documented in an EIA Report, which will be published at the statutory approvals stage. This will summarise the impact that the Scheme may have, identify any feasible mitigation to avoid or reduce significant effects and list all unavoidable residual effects and applicable monitoring measures.

It also helps identify consenting requirements and how the Scheme might best align with policy objectives such as reducing carbon emissions, achieving net benefits for biodiversity, or protecting cultural assets.

The EIA process therefore facilitates the development of a more environmentally sustainable Scheme for Musselburgh.

The EIA's topics, identified through its screening & scoping stages, will include:

- Population and Human Health
- Biodiversity
- Noise and Vibration
- Landscape and Visual
- Water Environment
- Soils, Geology and Contamination
- Air Quality
- Cultural Heritage
- Traffic and Transportation
- Cumulative Effects





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Net Zero Carbon & Embodied Carbon

Musselburgh Flood Protection

The Scheme's contribution to addressing climate change

Net Zero Carbon means reducing carbon dioxide (CO_2) emissions as far as possible and absorbing the remaining emissions through natural carbon sinks like forests, and new technologies like carbon capture.

Embodied carbon refers to the CO_2 emitted in the process of extracting, processing and transporting raw materials then processing them into a product. It is measured in tonnes of CO_2 equivalent (tCO_2e).

Climate change mitigation means reducing or eliminating society's CO_2 emissions to minimise the increase in global atmospheric temperatures.

C**limate change adaptation** means changing the way society behaves or is organised in order to live with the impacts of climate change. The Scheme is an example of climate change adaptation, where Musselburgh would be adapted to live in proximity to rising sea levels, increased river flows, and more intense rainfall.



Reducing the Scheme's embodied carbon

The Council recognises that it is not practicable to eliminate embodied carbon whilst also providing climate change adaptation without offsetting or buying carbon credits. There are, however, opportunities to reduce the Scheme's embodied carbon through innovative use of materials and construction methods.

Transportation of materials is a large component of embodied carbon in infrastructure projects. This can be reduced through the use of more locally-available materials. It may also be reduced through forms of construction which use less materials, or materials which have less embodied carbon per tonne.

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Nature-based Solutions

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Use of natural or nature-based features to provide or complement flood risk reduction

The term, ‘nature-based solutions’, can refer to a variety of concepts which deliver multiple benefits such as flood risk reduction, ecological habitat enhancement, or improved social amenity.

Some measures can directly reduce flood risk through attenuating flow in the catchment or reducing wave heights at the coast; others can enhance engineered structures through natural or nature-based features.

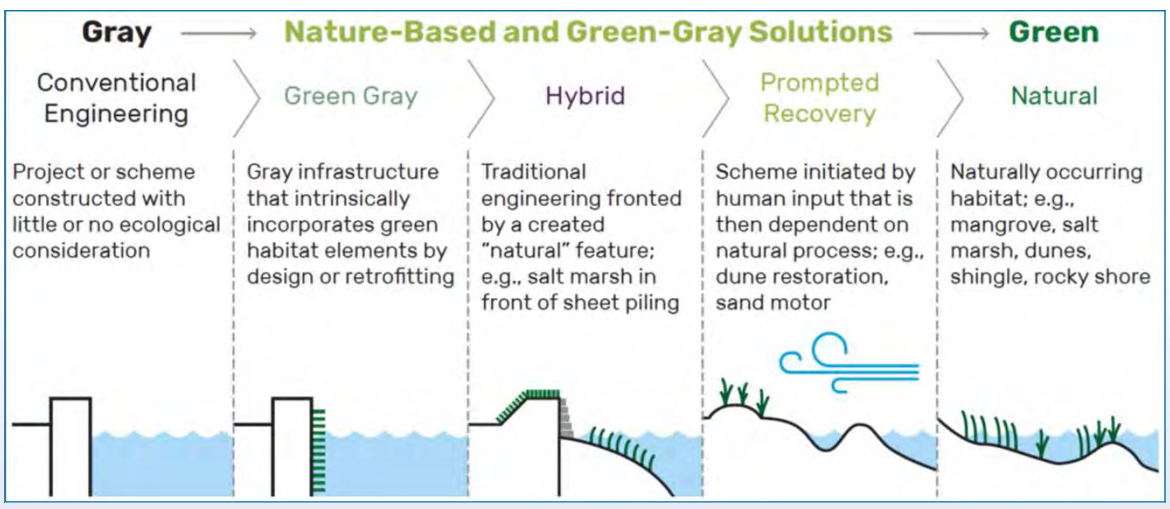
Natural features are those which, *“created or evolved over time through physical, biological, geological and chemical processes operating in nature”.*

Nature-based features are those which, *“mimic characteristics of natural features but [which] were created by human design, engineering, and construction to provide risk reduction.”*

The project team has determined that nature-based solutions on their own are insufficient to deliver the necessary flood risk reduction to Musselburgh, but that natural and nature-based features in combination with engineering solutions could deliver multiple benefits. These will be developed by Jacobs as part of the outline design.

Sustainable and resilient solutions are likely to include a combination of:

- Structural engineering
- Non-structural measures
- Natural features
- Nature-based features



Continuum of Nature-Based Techniques. Extract from *International Guidelines on Natural and Nature-Based Features for Flood Risk Management (2021).*

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Replacement Bridges

Musselburgh
Flood Protection

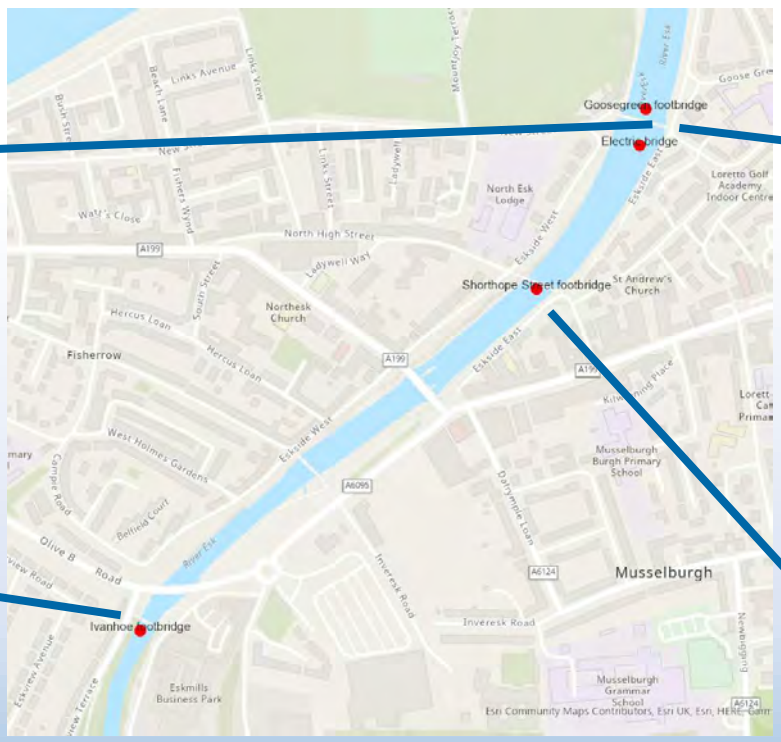
Improving conveyance, reducing risk, and adding amenity value

There are several reasons for proposing to replace certain bridges across the River Esk. The existing Shorthope footbridge, Electric bridge and Goosegreen footbridge are all multi-span bridges with low soffits (the underside of the deck). During a major storm their intermediate piers would restrict the flow of water and their soffit would become submerged, further restricting the flow. Finally, the combination of piers and a low soffit increases the risk of debris impact and blockage, resulting in the bridge acting like a dam and preventing its use. Defences on the riverbanks would therefore have to be higher to compensate, with alternative crossing used during a flood.

By replacing these bridges with new single-span structures that would be higher than the flood level, this improves conveyance and reduces the risk of blockage. This also means the defences required on each riverbank are lower.

While the Ivanhoe footbridge is already single-span, it also presents a restriction to flow during the more extreme storms as the floodwater would still reach its soffit. Raising it and possibly relocating it upstream would reduce the height of defences around Eskmills.

A multiple benefit also exists, whereby this Project and the Musselburgh Active Toun project could combine funding streams to deliver wider bridges which better accommodate pedestrians, cyclists and other wheeled users. This would improve active travel around the town and add amenity value beyond just flood risk reduction.







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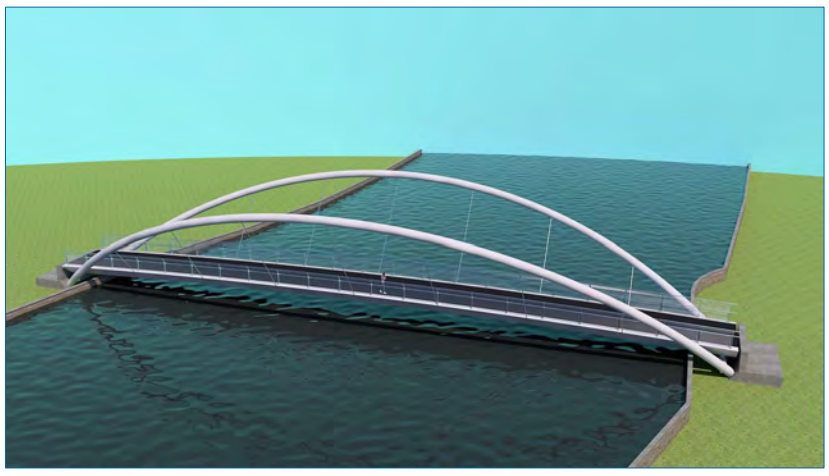
Replacement Bridges

Musselburgh Flood Protection

Possible forms of construction

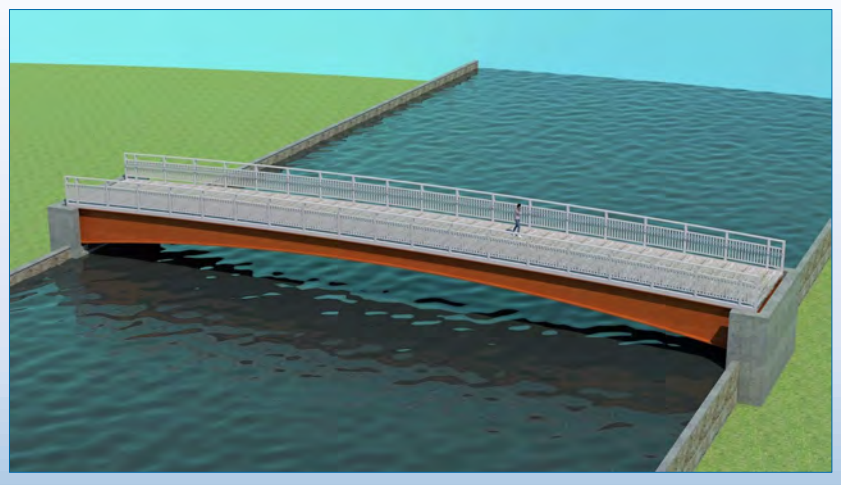
At previous consultation events the public asked to see what replacement footbridges might look like. In response, Jacobs has produced conceptual models of three different forms of footbridge construction which could achieve a single span crossing over the River Esk.

Following feedback from today's event, and in discussion with the planning service, the project team will make recommendations to Project Board with regard to a preferred form of bridge at each location.



Example of a steel hybrid butterfly arch footbridge

Example of a steel modified warren truss footbridge



Example of a composite timber-weathered steel multi girder footbridge

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Possible Forms of Flood Defence

Musselburgh Flood Protection

Sand dunes

These are typically natural coastal formations, which in some cases can also be artificially constructed to provide flood protection.

Advantages

- Can have a more natural appearance than other forms of flood protection.
- Can provide other environmental benefits such as biodiversity enhancement and habitat creation.
- Can be a sustainable solution if there is sufficient natural supply of sediment to replenish the dunes after storms.
- Can be combined with a hard engineered core to ensure continued flood protection in case they are eroded.

Disadvantages

- Requires an enormous quantity of sand. Sourcing this can have adverse environmental impacts.
- Artificial dunes are still an emerging science and there is less certainty about their performance during storms.
- Dunes change shape over time. They need regular inspection and replenishment after erosion. This would be a significant burden on the Council.
- Dunes need to be significantly larger than other forms of defence.



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Possible Forms of Flood Defence

Musselburgh Flood Protection

Flood embankments

Also known as levees or bunds, these are engineered mounds made from impermeable material such as clay. They may include a concrete or steel sheet pile core.

Advantages

- Can have a more natural appearance than other forms of flood protection
- Can include a footpath on the crest to give the public uninhibited views of the river or coast
- Generally lower cost than other forms of flood protection, but this is dependent on local supply of suitable clay material.
- Very low maintenance throughout their design life

Disadvantages

- Require significantly more space than other forms of flood protection. For example, a 1m high embankment with a 2.5m path on the crest would have at least a 9m wide footprint.
- Coastal embankments have to be higher than flood walls because their shape is less effective at reducing wave overtopping.
- Embankments may not be suitable for areas of poor ground conditions, where long-term settlement may be an issue.



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Possible Forms of Flood Defence

Musselburgh Flood Protection

Flood walls

These are static flood defences, which are usually made from reinforced concrete or steel sheet piles, and have substantial foundations below ground.

Advantages

- They usually have a smaller footprint than other forms of flood defence, leaving more space for amenity.
- They have no moving parts and require very little maintenance or inspection.
- They can have a variety of finishes such as stone cladding, brick cladding, or patterned concrete. In Musselburgh it is likely that within the conservation area they would have to be stone clad.
- They can include glass panels for improved visibility, or flood gates for accessing the river or coast.

Disadvantages

- Can be more visually intrusive unless designed carefully as part of a wider landscape plan.
- Can have more embodied carbon than other forms of flood defence, although this depends on local supplies of materials.
- They generally have a higher cost than flood embankments due to the time taken to excavate for foundations, fix reinforcement, pour concrete, curing, and cladding.





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Possible Forms of Flood Defence

Musselburgh Flood Protection

Hybrid embankments with an upstand wall

These are flood embankments with a low-height wall protruding from the crest

Advantages

- They have a smaller footprint than a standard flood embankment and a more natural appearance than a standard flood wall.
- No moving parts and very low maintenance throughout their design life.
- Can include a footpath on the crest like standard flood embankments.
- The upstand wall can include a wave return for coastal locations.
- The upstand could also incorporate demountables, glass panels or flood gates.

Disadvantages

- Higher cost than a standard embankment or standard flood wall due to more complex form of construction.
- While it has a smaller footprint than a standard embankment, it still has a larger footprint than a flood wall or barrier. It is therefore more suited where there is sufficient space available.
- Has similar disadvantages to the standard flood embankment described on a previous board.



David Wright / Humber Flood Defence Bank / CC BY-SA 2.0



Oliver Dixon / Ouse River Wall / CC BY-SA 2.0

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Possible Forms of Flood Defence

Musselburgh Flood Protection

Self-rising barriers

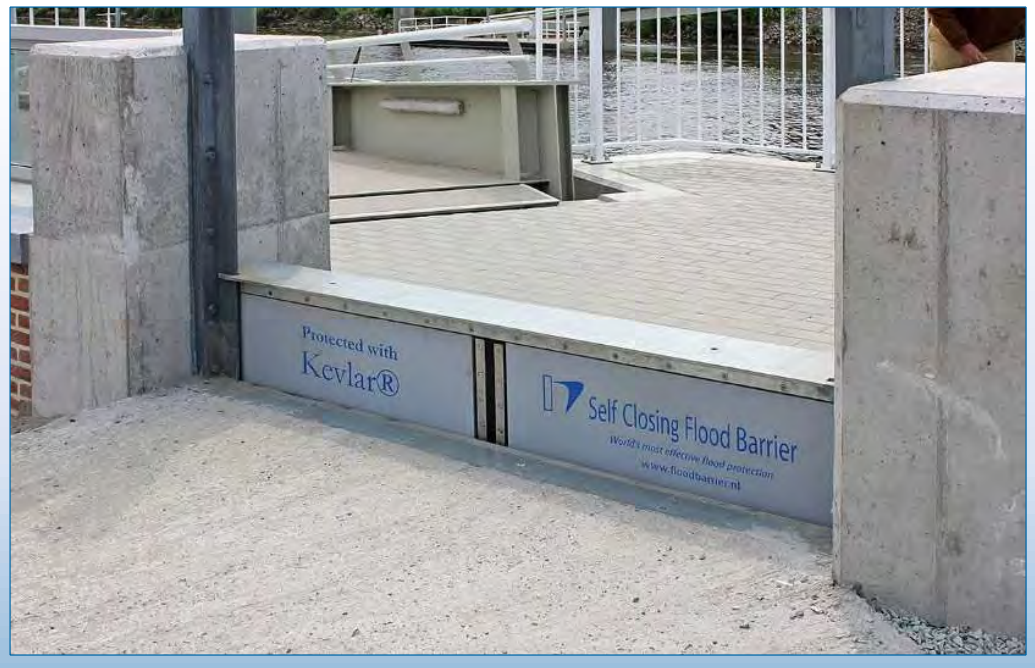
These are manufactured mechanical barriers which rise up out of the ground in response to floodwater, but which are normally hidden from view below ground.

Advantages

- When not in use, these are less visually intrusive than other forms of flood defence. Their housing can be flush with ground level or they can be designed to rise out from a lower fixed flood wall.
- They are designed to deploy automatically in response to rising flood waters. When the water levels recede after a storm, the barrier lowers automatically, thereby avoiding the need for human intervention.

Disadvantages

- Can be significantly more expensive than other forms of flood defence. May be suitable only over shorter lengths where visual impact or access is the critical consideration.
- They require regular inspection, testing and maintenance to keep them working. This would be a significant burden on the Council.
- Repairs and replacement parts could be less readily available in the future if a supplier changes its product range or goes out of business.





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Possible Forms of Flood Defence

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Demountable barriers

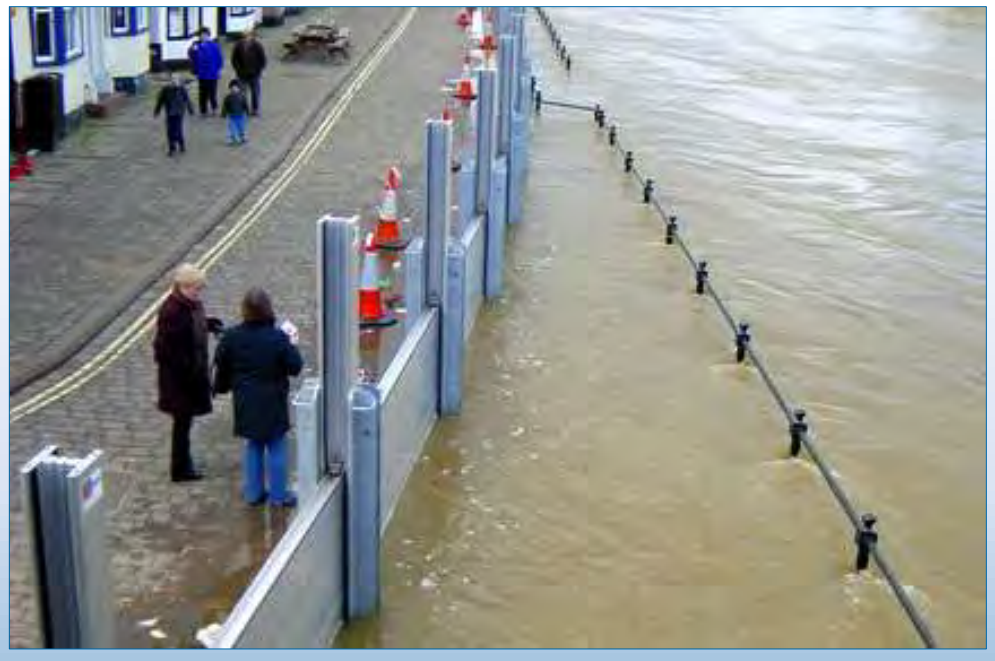
This is a form of temporary flood protection which can be assembled prior to a storm but is normally stored elsewhere when not in use.

Advantages

- Less visually intrusive than other forms of flood protection because they are only put in place when a storm is expected.
- Useful where regular access is required and a fixed defence would not be practical, such as an entrance to a building or across a road.

Disadvantages

- They require a significant number of trained people to deploy them before a storm, and to dismantle them afterwards.
- Generally limited to shorter lengths of defence where a permanent barrier would be impractical.
- They require regular inspection, testing and maintenance to keep them working. This would be a significant burden on the Council.
- When not in use, they require space to be stored, preferably close to where they are deployed.



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Coastal & Riverside Access

Musselburgh Flood Protection

Providing access for all in a new and improved water environment

Where flood defences are provided next to a river or coastline, it is important to maintain access so the public can continue to use the riverbank, park or beach.

Vehicle access is typically required to maintain these areas, such as grass cutting in parkland or maintenance of beaches.

The project team commits to maintaining access to as many of these areas in Musselburgh as practicable. The form of access will depend on what type of defence is to be crossed and its position relative to the water.

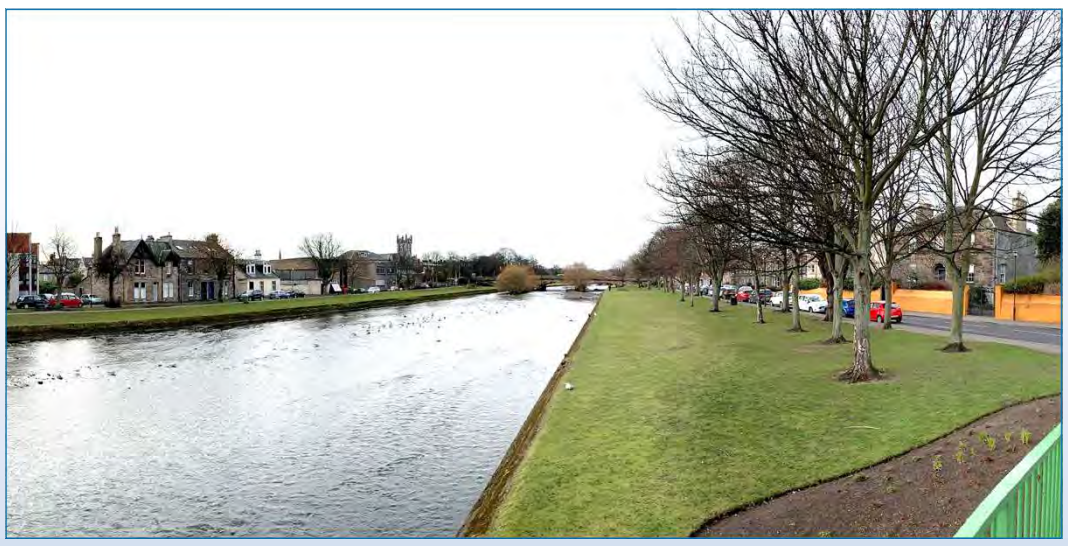
Maintaining or improving 'Access for All' is a key component of the landscape design strategy of the Scheme. Both ramped and stepped access will be provided to cater for pedestrians, cyclists, and other wheeled users where design standards and legislation requires this.



Example of a ramped path over a flood defence embankment



Example of a ramped access to a beach, over a sea wall and promenade



Possible opportunity to improve waterside access through changes to existing riverside structures on Eskside West



Example of a floodgate in a flood wall to maintain beach access for boats

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Enhanced Landscape Design

Musselburgh Flood Protection

Designing a scheme for the ‘Toun’ that becomes part of the town

Conceptual sketch of possible landscape design options at Mall Avenue



Conceptual sketch of possible landscape design options north of Roman Bridge

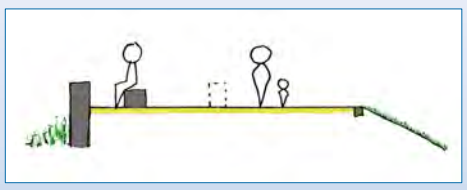
For any Scheme to be acceptable, it must work as part of the wider urban environment whilst also providing flood protection. For the majority of its design life, the Scheme will simply be another part of the landscape.

The Council recognises the importance for the design of the Scheme to be sympathetic to the surrounding landscape of Musselburgh. Jacobs’ design team comprises landscape architects working alongside engineers to develop a holistic design which meets the operational needs of the Council and the aesthetic aspirations of the community.

A flood protection scheme is a major infrastructure project, and its construction provides many opportunities to put back an improved and enhanced amenity space which is best suited to the needs of the community in the years to come. With match-funding via partner organisations, these opportunities could include enhancement of civic spaces, re-creation of natural habitats, or improvements to transportation links.

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Conceptual sketch of possible landscape design options for riverside areas



Conceptual sketch of possible landscape design options for coastal waterfront

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Next Steps for the Scheme

Musselburgh Flood Protection

The project team will now collate and reflect on the feedback received during today's event and those of the 8th and 9th February, as well as comments from those who have made contact through other means.

Jacobs will then commence the outline design of the Scheme, taking into consideration the feedback received, together with an understanding of the operational needs of the Council. Jacobs will then make recommendations to the Council for specific solutions at each location. The project team will then return to the Brunton Theatre to update the public on the work in progress.

Key considerations:

- What form of defence is most appropriate at each location in the town?
- What form of replacement bridge is most appropriate at each location?
- What are the main aesthetic, amenity, and environmental factors at each location?

We look forward to meeting you again at the next public consultation event.



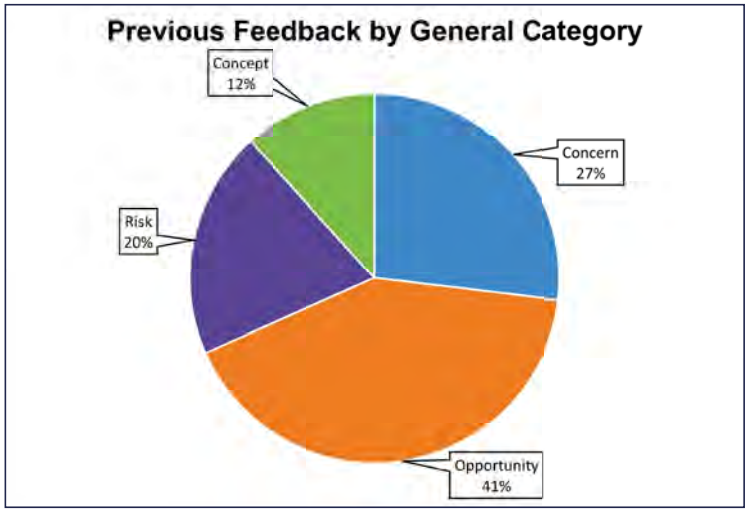
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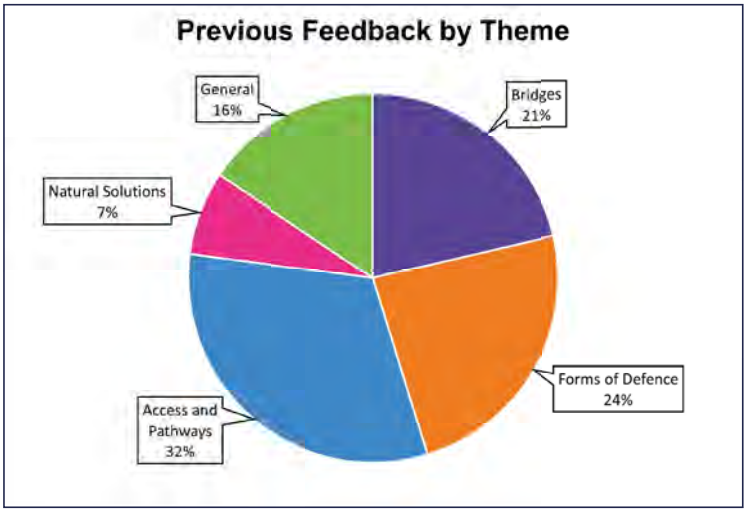
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Consultation Feedback to Date

The following analysis includes questions and comments relating to the Musselburgh Flood Protection Scheme, received by the project team. This information has come from approx. 316 comments from various public consultation sources.





Category

Each question / comment was anonymised and organised into 4 general categories:

Concern: Feedback that expresses a worry about short term or long term impact of the Scheme and / or the changes it may entail.
27% were categorised as a concern.

Opportunity: Suggestions on how to improve the Scheme design, scope or strategy.
41% were categorised as an opportunity.

Risk: Feedback that has the potential to directly or indirectly conflict with proposed outcomes of the Scheme, keeping in mind that Scheme design is still at early stages.
20% were categorised as a risk.

Concept: A question or comment that required further explanation or investigation into a theme related to the Scheme.
12% were categorised as a concept.

Theme

These questions / comments were also organised by theme – what the question or comment was actually referring to, falling into any of the 4 general categories described above. There are 5 themes:

Bridges: **21%** related to bridges.

Forms of Defence: **23%** related to forms of defence.

Access and Pathways: **32%** related to access and pathways.

Natural Solutions: **7%** related to natural solutions.

General Question / Comment: **16%** related to general questions / comments.

Feedback Word Clouds

Concern

The graphics on this board, known as 'word clouds', are an analysis of the frequency of relevant words that occurred in all 316 questions / comments received so far. The comments have been organised by general category (concern, opportunity, risk, and concept) and a word cloud has then be made for each of these categories. The relative size of each word relates to the number of times it has occurred within each of the four categories. The colours are purely aesthetic and do not relate to any categorisation of the data.



Feedback Word Clouds
Opportunities

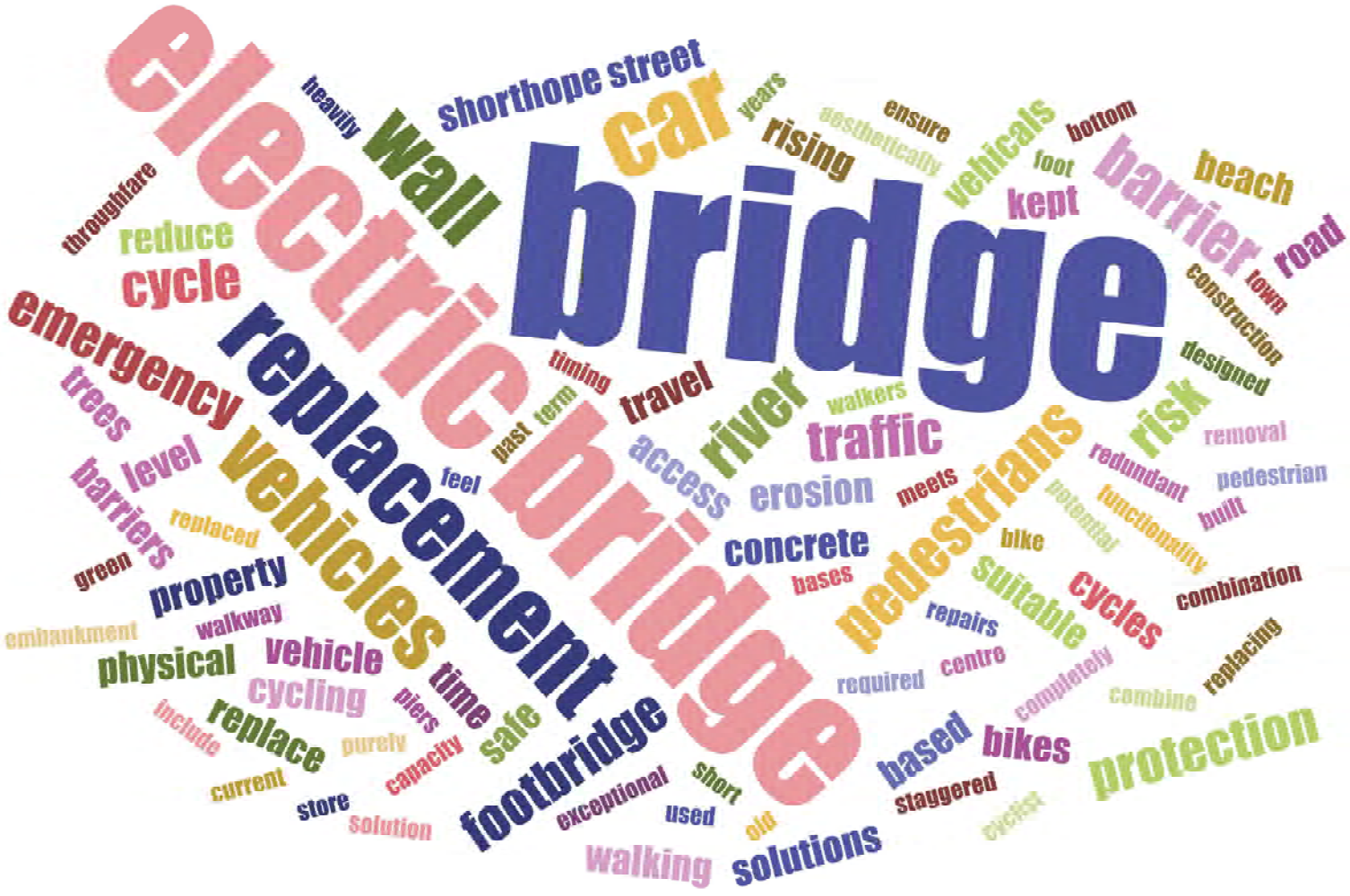
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Feedback Word Clouds

Risk

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Feedback Word Clouds

Concept

The graphics on this board, known as 'word clouds', are an analysis of the frequency of relevant words that occurred in all 316 questions / comments received so far. The comments have been organised by general category (concern, opportunity, risk, and concept) and a word cloud has then be made for each of these categories. The relative size of each word relates to the number of times it has occurred within each of the four categories. The colours are purely aesthetic and do not relate to any categorisation of the data.



Appendix B. Questionnaire

Local Area Consultation - Whole Town

8th March 2022 Questionnaire

Musselburgh Flood Protection

Thank you for your attendance today. The Project team would be very grateful if you could provide your thoughts on the Musselburgh Flood Protection Scheme, and the options shown today, by answering this Questionnaire. Please drop the questionnaire in the box when completed. Thank you for your feedback.

East Lothian Council is committed to protecting your privacy and we work in full compliance with Data Protection legislation. We will only share your personal data when you provide us with your explicit consent to do so, or when legally required. However we may share your details with carefully selected third party suppliers (data processors) working on our behalf. You have the right to access and update the data we have about you. Our Data Protection and Privacy Policy explains your rights, who has access to your data and how we safeguard your personal data.

Any responses you make to Equality, Diversity and Inclusion questions will be anonymised and used to ensure East Lothian Council is providing a fair and equitable service.

Alternative Formats:
Versions of this questionnaire can be supplied in Braille, large print, audiotape or in your own language. Please contact Customer Services if you require assistance on 01620827199.

Your Consent:

	Y	N
I agree that East Lothian Council can use my responses for research purposes and to inform the design of the Musselburgh Flood Protection Scheme.	☐	☐

About You:

Q1 Which age group do you fit into (please tick more than one box if multiple participants)?

Under 16 years ☐ 17 – 29 years ☐ 30 – 39 years ☐ 40 –49 years ☐

50 –59 years ☐ 60 –69 years ☐ 70 and Over ☐

Q2 What is your Post Code?

About the Scheme:

		Y	N
Q3	**Do you agree that Musselburgh has a flood risk?**	☐	☐
Q4	**Do you support the provision of a flood protection scheme for Musselburgh?**	☐	☐
Q5	**Do you agree that such a flood protection scheme should include an allowance for climate change?**	☐	☐

About the Design:

Q6 **For each of the following locations, please rate the factors in order of priority that you think the designers should consider when designing the scheme, with 1 being most important and 5 being least important.**

Location	Waterside access for the public	Visual Appearance	Environmental Impact	Cost	Space for recreation and amenity
Eskmills area					
Esksides area					
Goosegreen area					
Edinburgh Road area					
Mountjoy area					
Fisherrow area					

Q7 **For each of the following locations, please indicate your order of preference for the form of replacement structure, assuming that all will be suitable for pedestrians and cyclists, with 1 being most preferred and 3 being least preferred.**

Location	Steel Hybrid Butterfly Arch Footbridge	Steel Modified Warren Truss Footbridge	Composite Timber-steel Multi Girder Footbridge
Ivanhoe footbridge			
Shorthope Street footbridge			
Goosegreen footbridge			



Example of a steel hybrid butterfly arch footbridge



Example of a steel modified warren truss footbridge



Example of a composite timber-steel multi girder footbridge

Q8 **If Electric bridge is to be replaced, would you prefer that the new bridge is a) only suitable for pedestrians & cyclists; or b) capable of being opened to motorised vehicles in the future? Please tick one box only.**

A ☐ B ☐

Q9 **Do you have any further thoughts or comments you would like to provide?**