Welcome to the public consultation event for the Tarbert Coastal Flood Study. The purpose of the event is to inform you of the work we have done so far and to gather your feedback on the preferred sustainable flood options.

**Why are we here?**

Tarbert, and the surrounding area, has been identified as a Potentially Vulnerable Area (PVA) by the Scottish Environment Protection Agency (SEPA). PVAs are defined as catchments identified to be significantly impacted by flooding either now, or in the future, as a result of climate change. In the case of Tarbert, the PVA assessment has found the primary source of flooding is from the sea.

AECOM have been commissioned by Argyll and Bute Council to investigate the extent of coastal flood risk and develop sustainable options to reduce this risk.

**What have we done so far?**

The Tarbert Flood Study commenced in May 2018 and we undertook our first public consultation event in July to gather local flood knowledge. Since then, we have been working to fully understand the coastal flood risk in Tarbert and how these risks could be minimised. We have done this by:

- Assessing the historic flood data and flood accounts
- Undertaking detailed coastal computer modelling
- Mapping the flood contours within Tarbert
- Developing a long list of viable flood options for Tarbert
- Selecting a short list of preferred options based on key criteria and in consultation with key stakeholders and the public
- Developing preferred solutions from the shortlist through economic, social and environmental appraisal.

At this point we want to consult with you on the preferred options. Your views will help us identify an appropriate way to manage coastal flooding in Tarbert now, and into the future.

**How to provide your feedback?**

A questionnaire is available for you to leave your comments. Alternatively, please email morag.hutton@aecom.com with any queries or comments.

Please browse through the information provided on the display posters. Our team is here to answer any questions you may have.
Defining the coastal flood risk

Flood risk can be defined in terms of Annual Exceedance Probability (AEP) or Return Period. Both refer to the probability of tidal conditions of the same magnitude occurring each year. For example, a 1 in 200 year Return Period sea level will have a 1 in 200, or 0.5% AEP chance of happening in any given year.

In order to assess coastal flooding in Tarbert, we have undertaken computer modelling of the harbour as well as the wider Loch Fyne area. The modelling utilised numerous topographic datasets and includes tidal conditions such as waves and tidal surge. This modelling has allowed us to establish extreme sea levels at Tarbert for a range of AEP events both now and in the future.

The extreme sea levels established in the coastal modelling were applied to mapping to produce a set of flood contour maps for all AEP events. The 0.5% AEP event flood contours, both current day and with climate change, are shown on this poster. A range of other AEP event flood contours can be viewed by speaking to one of the project team.

An indicative cross section through Barmore Road can also be seen on this poster. This aims to aid the visualisation of flood depths for a range of AEP events as well as highlighting the predicted impact of climate change on sea levels.

Flood risk in numbers for a 0.5% AEP event, with and without climate change

- 76 properties within the 0.5% AEP event present day flood extents in Tarbert
- 87 properties within the 0.5% AEP event + climate change flood extents in Tarbert
- Flood risk to a number of roads including the Barmore Road and Harbour Street

What about my property?

By all means look up your property on the flood maps shown here. You should remember, however, that the computer modelling was carried out on a large scale that is not specific to any one property. No detailed account is taken of localised features such as kerbs and garden walls etc. which in reality may affect localised flow paths.
03 What coastal options have we considered?

Once we confirmed the existing coastal flood risk using the latest modelling techniques and data, we looked at potential ways to reduce this risk by creating a long list of options.

**Setback coastal defence line**

It was assessed that a flood wall could be installed on the landward side of the promenade to protect Tarbert from tidal inundation whilst still maintaining a recreational walkway overlooking the sea.

Installing a wall would incur significant cost - this cost would need to be less than the damages saved by building the defence. Construction may also cause disruption due to the proximity of the defence to the main road. Furthermore, this could reduce Tarbert’s connection with the sea, although arguably less so than a wall along the existing defence line, and result in impacts on various environmental and social receptors.

**Raise coastal wall at existing defence line**

To prevent overtopping along the existing harbour extent, the coastal defence wall could be raised to create a barrier to wave carry over and inundation from high sea levels. This would increase the standard of flood protection for all receptors, but it would incur significant cost that would need to be offset by the damages saved as well as being highly disruptive due to the likely need to substantially re-build the existing defences. Furthermore, this could reduce Tarbert’s connection with the sea and result in impacts on various environmental and social receptors.

**Property Flood Protection (PFP)**

PFP can be employed to protect individual properties from flooding through pathways such as doors and windows, brickwork and sewage systems. This option would not address the source of flooding but could act as a resilience measure to protect individual properties against flooding up to 0.6m in flood depth. This upper limit on flood depth is predicted to be exceeded which limits the scope of protecting all properties. The success of PFP is also heavily dependent on the correct choice of PFP and its installation, operation and maintenance. Issues would arise with retrofitting these measures on listed buildings.

**Breakwater**

Installation of a hard-engineered structure, set out from the harbour, could be used to dissipate wave energy offshore to reduce onshore wave heights.

However, based on the modelling, wave heights were seen to be relatively low, with the primary source of coastal flooding being still water levels. For this reason, a breakwater is unlikely to provide significant reductions in flooding to Tarbert.

**Natural Flood Management - Salt marshes/ beach recharge**

This option aims to reduce flood risk by creating a natural buffer for waves by dissipating wave energy and thus reducing wave heights before they reach the harbour. Natural Flood Management options are considered a sustainable approach to flood risk which could provide amenity value.

However, based on the modelling, wave heights were seen to be relatively low, with the primary source of coastal flooding being still water levels. For this reason, salt marshes or beach recharge are unlikely to provide significant reductions in flooding to Tarbert.

**Flood resilient properties**

Properties within the area designated as at risk of coastal flooding would be retrofitted with resilience measures. This option essentially accepts there is a flood risk and properties are adapted to better withstand flooding, with measures including lifting of electrical sockets and flood proof paint and flooring. There has been little uptake of this kind of solution in the UK; however, it is becoming more popular in areas where an engineered scheme is not appropriate or desired.

**Land reclamation**

Infilling of an area of the intertidal mudflats in front of the existing harbour wall to provide more space for coastal defence options such as a wall or embankment. The primary purpose of this land reclamation is for flood defence purposes; however, the additional land could also be used to create a multipurpose amenity area for the village.

Whilst this option provides better access and more space for the engineering works, and the potential to reduce the height of the defences, the connection to the sea and potential impacts on environmental and social receptors remain.

**Tidal Barrage**

A tidal barrage would seek to stop high sea levels entering the harbour area. This structure could run between the mainland and an island to reduce the overall length required. The tidal barrage would remain open for the majority of the year, only closing when high sea levels were forecasted.

It is likely that a structure of this scale would be extremely costly and would significantly affect the character and appeal of the area. In addition, it would likely impact local environmental and ecological receptors and potentially affect commercial interests.
04 How do we derive our preferred solutions?

The long list of potential options contains a large range of options, some of which will not be appropriate in every setting. This long list is screened based on a high-level assessment to form the short list which then undergoes further more detailed assessments.

**Long List to Shortlist Appraisal**

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**Economic Appraisals**

In order to obtain government funding, the economic benefits of an option should be greater than the costs. High level cost assessments were undertaken for each short listed option, considering both capital and whole life costs (maintenance, inspections etc.). These were then compared against our damage assessments, which calculate the costs that could be saved (benefits) by having a defence. This assessment included property damages, clean-up costs, emergency services etc. A Benefit-Cost Ratio (BCR) is then derived for each option. A BCR greater than 1 indicates that the benefits of having a defence are greater than the overall costs to build.

**Social and Environmental Appraisal of the Short List**

The Scottish Government also consider wider benefits of proposed options, with social and environmental value being increasingly realised. To appraise schemes based on social and environmental impacts we look at:

- How a proposed option can benefit community wellbeing, reduce risk to life and social vulnerability
- Climatic factors both during construction and operation
- Impacts on flora, fauna and biodiversity
- Effect on water, ecology, heritage, sensitive landscapes etc.

**Prioritisation of Options**

The holistic appraisal of options allowed us to determine the most appropriate flood mitigation option for Tarbert. Options with high BCR’s were compared with each other taking social and environmental factors into account. The preferred solution is therefore economically viable, whilst also providing potential for wider social and environmental benefits.
05 What are the findings of our assessments?

By undertaking the Long List to Short List screening process, we identified a range of options that could potentially alleviate coastal flooding in Tarbert. These options were then assessed further to ensure that the most suitable option was taken forward to be presented as the preferred solution to the Scottish Government.

Production of the Short List

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Economic Appraisals

The economic appraisal allows us to calculate a Benefit Cost Ratio (BCR) for each option. This is the ratio of the total damages avoided as a result of the option vs. the cost of each option and allows us to assess the overall flood reduction benefit of each option.

A cost for each option was calculated based on pricings taken from previous built schemes, including whole life material costs as well as scheme maintenance. The short listed options were seen to vary in cost from £400k - £9.1m.

The second part of establishing the BCR was to establish the total damages for Tarbert. The damage assessment of the baseline flood conditions showed that over 100 years, approximately £5.5m in damages would occur if no scheme was put in place.

The BCR for each of the short listed options can be seen on the table on this board. A BCR greater than 1 indicates the option is economically viable.

Environmental Appraisal

Economically viable options should also show wider social and environmental benefits. This may result in options being taken forward that do not show the best economics, but provide high environmental benefits, and conversely may also mean than economically viable options are discounted for environmental reasons. Several short listed options were found to produce a positive BCR. Therefore, to identify the preferred option, these options were assessed in the environmental appraisal and some were discounted due to the high visual impact or operational issues.

<table>
<thead>
<tr>
<th>Option No.</th>
<th>Description</th>
<th>Costs</th>
<th>SoP (%AEP)</th>
<th>Damages Avoided (present value)</th>
<th>Benefit-Cost Ratio</th>
<th>Reason for discounting</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Direct defences: Existing defence line wall</td>
<td>£4.1m</td>
<td>0.5%+CC</td>
<td>£4.6m</td>
<td>1.08</td>
<td>Environmental assessment - high wall is likely to be detrimental to look and feel of historic town</td>
</tr>
<tr>
<td>2.2</td>
<td>Direct defences: Set back wall</td>
<td>£3.3m</td>
<td>0.5%+CC</td>
<td>£4.6m</td>
<td>1.33</td>
<td>Environmental assessment - high wall is likely to be detrimental to look and feel of historic town</td>
</tr>
<tr>
<td>2.3</td>
<td>Direct Defences: Flip up/demountable coastal flood wall</td>
<td>£3.0m</td>
<td>0.5%+CC</td>
<td>£4.6m</td>
<td>1.49</td>
<td>Environmental assessment - Difficult to implement as a larger stretch is required to be installed at potentially short notice</td>
</tr>
<tr>
<td>2.4</td>
<td>Direct defences: Combination of traditional/ demountable</td>
<td>£4.2m</td>
<td>0.5%+CC</td>
<td>£4.4m</td>
<td>1.05</td>
<td>Preferred option as reduces the intrusiveness of the scheme and is easier to employ demountable as more warning is afforded by the permanent structure.</td>
</tr>
<tr>
<td>2.5</td>
<td>Direct defences: Tidal Barrage</td>
<td>£9.1m</td>
<td>0.5%+CC</td>
<td>£4.7m</td>
<td>0.51</td>
<td>Economic assessment - Not economically viable</td>
</tr>
<tr>
<td>3.1</td>
<td>Property Flood Protection</td>
<td>£0.4m</td>
<td>4%</td>
<td>£3.1m</td>
<td>7.71</td>
<td>Potential to form part of a preferred solution to isolated properties not protected by formal scheme.</td>
</tr>
</tbody>
</table>
Tidal flooding often presents fewer potential flood options as the issues are largely related to water levels, rather than flow volume. Options are therefore largely focussed on blocking these high water levels from reaching properties.

**Direct defences**

A combination of permanent and demountable direct defences set back from the existing defence line will form part of the preferred option for Tarbert. This would involve a permanent low wall with a demountable wall on top. This option has been chosen based on the economic and environmental assessments and feedback from previous public consultations. The defences would tie in with high ground on either side of the harbour, totalling 515m of defence. Flood gates would be required to provide access to slipways, and to provide vehicle access to the seaward side of the harbour.

The combination of permanent and demountable defences is considered to lessen the adverse visual impacts associated with a high traditional wall. A permanent low wall providing a 2% AEP event SoP, would keep Tarbert’s connection with the harbour and provide increase flood protection. Additional protection would be provided (up to 0.5% + climate change AEP event) using demountable defences erected on top of the permeant wall. They would be stored locally and erected during times of forecasted extreme sea levels.

**PFP and flood resilience**

PFP could also be employed as part of a formal scheme to protect isolated properties that are not protected as part of the direct defence option.

In the short to medium term, PFP could play an important role in reducing coastal flood risk. Small scale property interventions, such as flood doors and windows, can protect properties from flood depths up to 0.6m. The protection provided by a single PFP installation will vary from property to property depending on the level it is installed at and has a design life of approximately 25-30 years. It was identified that a total of 13 isolated properties could be protected using PFP.

In tandem with PFP, flood resilience measures, such as raising sockets and using water resilient materials, could offer a means of further reducing flood damage to property.
07 What are the next steps?

A report containing details of the current and future flood risk and recommendations for the management of coastal flood risks in Tarbert has been produced. The results of this study will be compared to the results of other flood studies being undertaken across Scotland, and this will identify a priority list for flood protection works. This is a competitive process and prioritisation, and therefore flood scheme funding, is based on how economic the presented flood solutions are.

In the meantime, if you want to learn more about flood risk and how you can better prepare yourself, please ask the project team for information on written resources and flood related organisations.

How to provide your feedback?

The project team welcome your comments on the Tarbert Flood Study.

You can provide your feedback in various ways. A questionnaire is available for you to leave your comments today at the event. Alternatively, you can email morag.hutton@aecom.com with any queries or comments.