Tarbert Flood Study

Phase 3: Options Screening Report

Project reference: 60578115

05th December 2019

Quality information

Prepared by	Checked by	Approved by
George Harley Senior Engineer	Walter Robison Senior Engineer	Dylan Huws Associate Director

Revision History

Revision	Revision date	Details	Authorized	Name	Position
1	17.04.2019	Rev1			
2	05.12.19	Rev2 – Final issue			

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared for:

Argyll and Bute Council
Helensburgh & Lomond
Civic Centre
38 East Clyde Street
Helensburgh
G84 7PG

Prepared by:

George Harley
Senior Engineer

AECOM Limited
1 Tanfield
Edinburgh
EH3 5DA
UK
T: +44 131 301 8600
aecom.com

Table of Contents

1. Introduction

1.1 Purpose of the report

Argyll and Bute Council (ABC) are looking to address coastal flood risk in the village of Tarbert. The Flood Risk Management (FRM) Act (Scotland 2009) provides the necessary statutory powers and potential funding to address this risk and also allows any measures promoted to enhance the local area. AECOM was commissioned to undertake a Flood Study (FS) for Tarbert. The study will propose new flood mitigation measures for coastal flooding. This will enable ABC to make an informed decision moving forward on the most economically, environmentally and socially viable options to alleviate coastal flooding in Tarbert.

At this point in the study, significant work has been carried out to understand the flood mechanisms affecting Tarbert and to identify constraints and opportunities with regard to potential flood mitigation options. Details of the work to date can be found in the Phase 1& 2 reports. The purpose of this report is to summarise the work that has been undertaken to inform the optioneering process. This includes developing a long list of potential solutions and screening this to a short list of feasible options which will be developed in more detail.

The scope of the report includes:

- Summarising the process to date
- Summary of baseline modelling results
- Mitigation options – Long list
- Option screening
- Preliminary Environmental Appraisal
- Public consultation event summary
- Mitigation options - Short list
- Next steps

1.2 The process

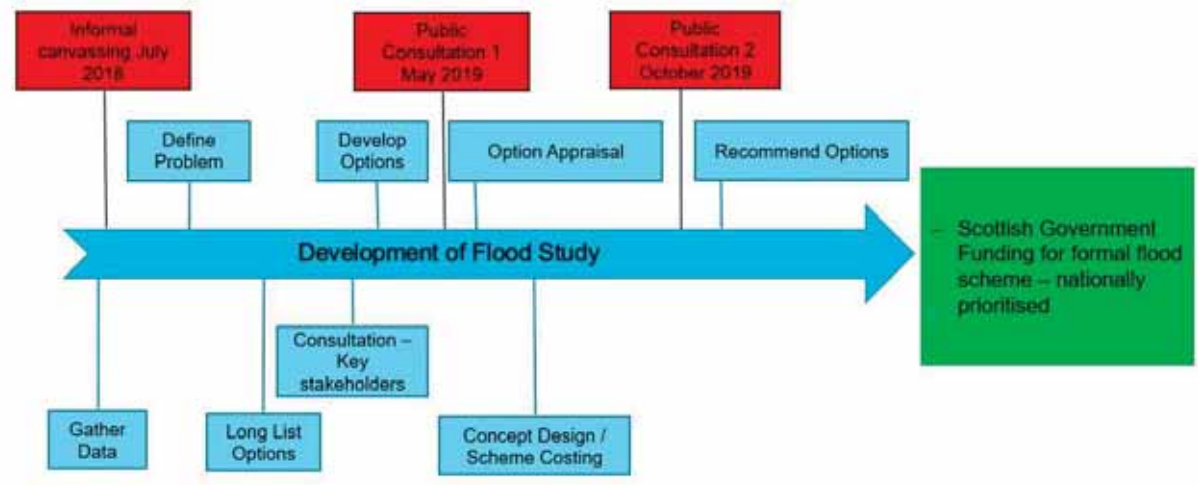


Figure 1-1 the study process

The project is being carried out in a phased approach in line with Scottish Environment Protection Agency (SEPA) and Scottish Government Guidance[1][2]. Figure 1-1 provides a high-level overview of the study development process.

Significant work has been carried out to understand the flood sources and mechanisms affecting Tarbert. During Phase 1 the existing available information was collated and a gap analysis undertaken to determine the quality of the data and what additional information was needed in order to undertake the assessment of flood risk.

At the start of the flood study process a public consultation was carried out with the residents of Tarbert to understand their experience of flooding in the area and to identify hotspots. This information can then be used to sense check any modelling outputs generated. Further public consultation will be held during Phase 4 to present the findings of this report and the community will be invited to provide feedback and comment on options identified to manage the flood risk identified.

The flood mechanisms and extents currently experienced in Tarbert were confirmed in Phase 2. This was achieved through long-term wave transformation modelling, joint probability and wave overtopping analyses. The findings of this stage are summarised in Section 2. In addition, a high level hydrologic and hydraulic assessment of two culverts with the potential to cause fluvial flooding within Tarbert was carried out to determine the level of service provided and comment on residual flood risk.

The report covers Phase 3 of the study; where the drivers of flooding and the scale of the problem are understood and options to mitigate flood risk can be proposed. The process has been informed by additional assessments including; ecological, environmental and planning desk studies to identify constraints to and opportunities for flood alleviation options.

Consultation has been a key part of the Phase 3 process. Statutory stakeholders such as SEPA, Tarbert Harbour Authority (THA) and Scottish Water (SW) have been involved through technical workshops.

This information has then been layered up to drive decision making in the optioneering process. The purpose of this report is to summarise the work that has been done to inform the optioneering and the next steps to develop the options.

The Scottish Government Guidance on Options Appraisal for Flood Risk Management sets out a clear approach to identify and prioritise mitigation measures. The following steps are highlighted:

[1] Options appraisal for flood risk management: Guidance to support SEPA and the responsible authorities, Scottish Government, May 2016.
[2] Local Authority flood study checklist, Version 2, SEPA, June 2017.

- Define the purpose of the appraisal and set objectives.
- Identify “long list” of potential measures
- Screen to create a “short list” of measures
- High level appraisal of short listed measures

AECOM have adopted this approach for Phase 3 of this study. A long list of potential measures to mitigate against the causes of flooding were identified. This report sets out the decision making behind the long list of options and also details how the short list has been created based on known feasibility issues. This approach ensures resources are expended on assessing the most suitable options which are most likely to give a return in flood risk benefit.

At the end of Phase 3 we will have a short list of potential options which will be developed through detailed modelling, outline design and cost benefit appraisal in Phase 4. The way forward will then be dependent on the option recommendations. If a formal scheme is determined to be the best option the finding of this study would be passed to SEPA for inclusion in the next round of SEPA FRM Strategies. The Strategies set out a prioritised list of actions for flood risk on a national scale.

If successful, the FS will then be submitted for approval to Scottish Government and the scheme details presented to the public for comment. Following this, detailed design will commence (this is unlikely to be before 2022) with funding statements compiled and approved prior to tender and construction. Based on the current scenario any successful scheme would be 80% funded centrally by the Scottish Government and 20% funded by Argyll and Bute Council.

2. Baseline Modelling Results - Summary

Tarbert is located in a wider Potentially Vulnerable Area (PVA) that has identified properties both at risk of fluvial and coastal flooding. ABC's primary reference document for actions for Tarbert is the Highland and Argyll Local Flood Risk Management Plan (LFRMP) 2016-2022. This Coastal Flood Study is being completed based on actions agreed in this LFRMP.

However, within the village of Tarbert, coastal flooding is identified as the main source of flooding and the Actions outlined in the PVA documentation focus around identifying coastal flood risk and developing coastal flood mitigation options. As this flood mechanism is the main source of flooding, it has formed all of the baseline flood assessment.

It should be noted that coastal flooding is the only source of flooding that was assessed in this study, and that fluvial flooding was not within the scope. However, a high level culvert capacity assessment of the two main fluvial culverts discharging into the harbour was carried to inform ABC maintenance and upgrade works. This document is called 'Tarbert Culvert Capacity Assessment'.

2.1 Coastal flooding

The main objective of the coastal modelling exercise is to establish the nearshore extreme wave and water level characteristics along the frontage at Tarbert. This included both still water levels and waves. In order to achieve this, AECOM has undertaken a numerical modelling study to investigate the existing and future (up to the year 2100) wave climate. The information on wave conditions and extreme sea levels was used to assess still water levels and provide wave overtopping volumes which were used to support the generation of inundation mapping.

A regional wave model of the wider Loch Fyne area was run to establish the offshore wave heights at Tarbert, under present day conditions. The Regional modelling results show that the wave climate at the entrance to Tarbert is generally small (less than 1m); a maximum significant wave height of 2.77 m are predicted over a period of 37 years. An extremes joint probability analysis of wave heights and levels shows that for present day conditions a significant wave height of 2.0 m could be expected for a 1% AEP event.

A local wave model, consisting of a more detailed model of Tarbert Harbour, was constructed under both a present day and with climate change for the 2100 epoch using boundary conditions established in the regional model. The local wave model was used to consider the wave heights within Tarbert at a much higher resolution. The findings from the present day show that wave conditions within Tarbert are negligible, with a 1% AEP event producing wave heights in the region of 0.4m. These small waves within the harbour show the energy dissipation effects of the shallow bathymetry and island structures in the harbour.

Wave overtopping is not the dominant source of coastal flooding and is therefore not considered a significant issue at Tarbert. Increases in still water levels as predicted in climate change scenarios represent the greatest source of flooding to the lower lying areas surrounding Tarbert.

The 0.5% AEP + climate change flood outline for Tarbert is shown in Figure 2-1 below. During this event, approximately 87 properties are affected, with depths ranging from 0.1m to 1.5m, with an average of around 1m depth. Due to the topography of Tarbert, a relatively high number of properties are still affected during less severe events. A total of 76 properties are affected during the 0.5% AEP present day, with 55 affected during the 2% AEP present day. Depths for these events range from 0.1m – 0.9m.

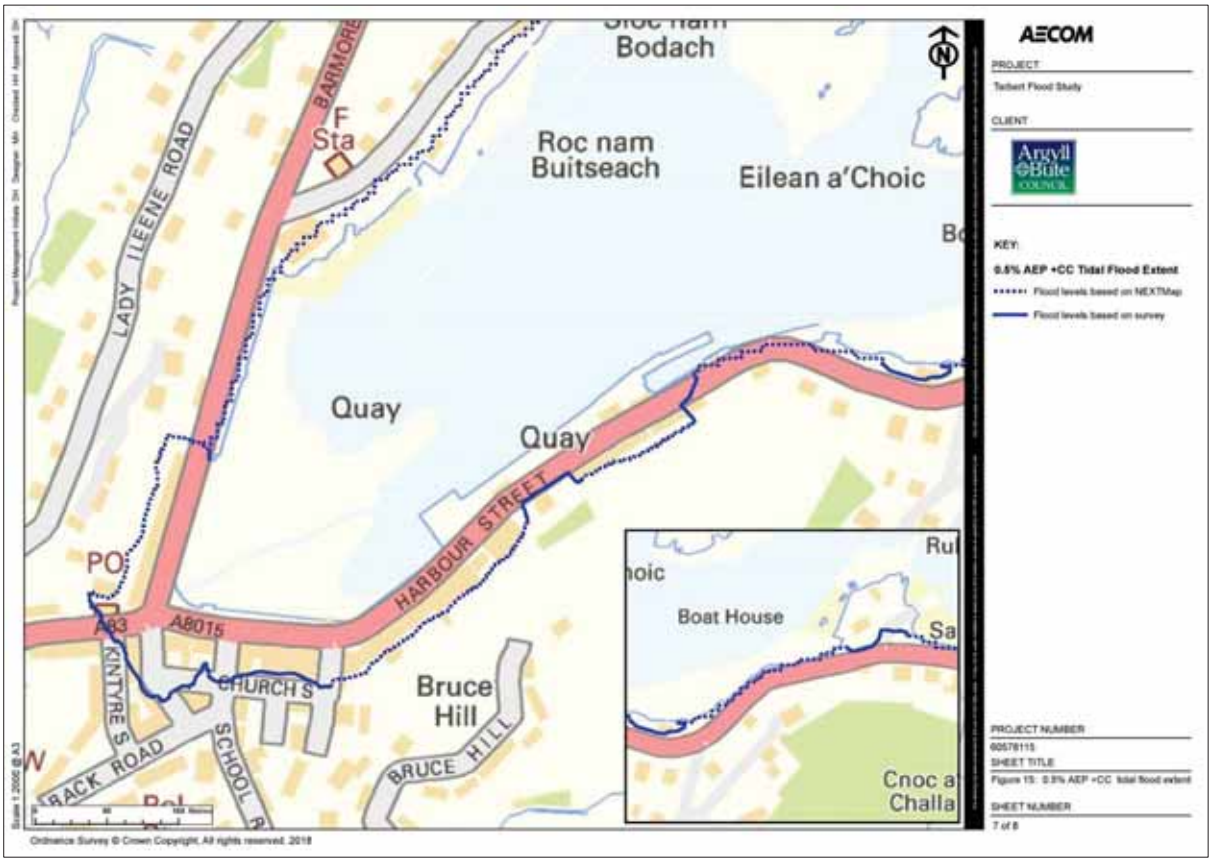


Figure 2-1 Baseline 200 year plus climate change flood extents for Tarbert coastal modelling

In the current day scenario, tidal flooding is seen to affect areas around the harbour wall and parking bays from the 50% AEP event (1 in 2year RP). As event magnitude increases, sections of Harbour Street, Barmore Road, Brunswick Street and Cambeltown Road as well as the harbour berthing areas become inundated. Areas to the north of Pier Road around the ferry terminal are also seen to be at flood risk.

During the climate change scenario many of the same areas are affected that were in the current day scenario, albeit more frequently. Due to the increase in sea levels of approximately 600mm, the current day 0.5% AEP event (a rare event) is seen to correspond to a 10% AEP event in 2100 meaning that the frequency of disruptive flooding will increase as 2100 approaches.

2.2 Long list – flood protection mitigation options

Scheme objectives provide a common goal and shared ambition for managing floods. As a PVA in the first round of SEPA FRM Strategies, flood risk objectives for the area have been set. As such this study has attempted to set objectives based on assessment of the underlying evidence of the causes and impacts of flooding.

Primary objectives for the Tarbert area are:

- Avoid an overall increase in flood risk as a result of climate change
- Reduce flood risk in Tarbert from coastal flooding

A range of structural and non-structural measures have been identified to achieve the objectives of the study in a way that is most sustainable. Measures look to address the flooding at source, along its pathways and protect the receptors of the flooding.

Natural Flood Management (NFM) measures include:

- Saltmarsh managed realignment
- Intertidal recharge to provide wave dissipation

Structural measures include:

- Direct defences
  - Flood wall along existing harbour boundary
  - Flood wall set back from existing harbour boundary (between footpath and road)
  - Flood wall constructed in front of the existing harbour wall (with potential land reclamation to provide improved construction access and additional amenity space around the harbour)
  - Demountable, moving (e.g. ‘flip up’), or self-raising flood wall
  - Combination wall based on traditional/demountable
  - Tidal barrage structure at the entrance to the natural harbour.
- Wave dissipation breakwater

Non-structural measures include:

- Individual Property Flood Protection
- Self help
- Improved flood warning
- Managed retreat
- Flood resilience

A summary of all options considered and the flood receptor they would benefit along with a unique ID is set out in Table 2.1.

Table 2.1 Long list of mitigation measures

Category	Measure	ID	Flood receptor (location)
NFM Options	Saltmarsh/managed realignment to provide wave dissipation	1.1	Address wave overtopping on Barmore Road, Harbour Street and the quay.
	Intertidal recharge to provide wave dissipation	1.2	Address wave overtopping on Barmore Road, Harbour Street and the quay.
Direct defences	Traditional coastal flood defences along existing harbour boundary.	2.1	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences.
	Traditional coastal flood defences along landward side of promenade (between promenade and road)	2.2	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences
	Flip-up/demountable coastal flood defences	2.3	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences
	Combination of traditional/demountable/coping stones etc.	2.4	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences.
	Tidal barrage to stop high sea levels entering the harbour area. This would likely run between the mainland and an island. Provision for boat access may also be required.	2.5	Protect the entire harbour area from extreme water levels by forming a barrier into the bay. The ferry port would not be protected by a barrage
Property Flood Protection	Small scale property interventions that could be employed when high sea levels are predicted. This would include measures such as flood doors and flood-proof airbricks. May be particularly appropriate at the Ferry terminal. Appropriate for flood levels up to 0.6m in depth.	3.1	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by this type of defences.
Wave dissipation	Breakwater placed further out from the harbour to dissipate waves and reduce overall height	4.1	Address wave overtopping on Barmore Road, Harbour Street and the quay.
Improved flood warning	This measure would aim to provide earlier warning of high sea levels so that residents could be more prepared. Likely to be either based on Met Office data or other tidal gauges on the Firth of Clyde.	5.1	Provide advanced warning of extreme water levels to aid preparation but does not provide any protection to properties. This could be applied to all properties in Tarbert.
Self help	The measure would aim to improve understanding of flooding issues and how to cope better.	6.1	Promote and implement self-help methods including flood insurance, community action groups, emergency planning and awareness raising. This could be applied to all properties in Tarbert.
Managed retreat	Setting up of a long term plan to move properties away from the harbour	7.1	All affected properties
Flood resilience	The measure would aim to improve building resilience to flooding making clear up easier and cheaper. This could include waterproof render and lifting of electrical sockets	8.1	All affected ground floor properties

Category	Measure	ID	Flood receptor (location)
Do nothing	This scenario assumes no future maintenance of flood defences or flood warning.	9.1	All affected properties
Land reclamation in conjunction with direct defences	Infilling of the mudflats in front of the existing harbour wall, to create more space, and to install a new flood wall to protect the harbour front properties	10.1	All affected properties

3. Long List Screening

The long list of options has been screened for technical, financial, legal and environmental feasibility. The purpose of this was to remove any potential measures that are clearly unfeasible or unrealistic at an early stage. Table 3.1 sets out the criteria that were used for screening out unfeasible or unrealistic options. The guidance of screening from long list to short list is set out within the Flood Risk Management (Scotland) Act 2009.

Table 3.1 Screening Criteria

Feasibility	Description	Metric
Technical	Removal of any measures that are not technically feasible. E.g. is land available for above ground storage	Categorical – Y/N based on scoring Expert Judgement
Legal	Removal of any measures that represent insurmountable legal issues including health and safety.	Categorical – Y/N based on scoring Expert Judgement
Financial	At this stage, is there evidence that the costs will be disproportionate compared to the benefits? Rapid assessment of cost estimates against key economic and social benefits. Please note this should not be a detailed cost benefit analysis.	Categorical – Y/N based on scoring Estimated build and maintenance costs of measure vs benefits to economy and key social impacts (risk to life/human health)
Environmental	Removal of any measure that had clear negative environmental impacts E.g. required construction on protected areas or reduced amenity and visual value	Categorical – Y/N based on scoring Expert Judgement and additional study findings

Expert judgement is used within this process to score each option for each criteria and as such will open option selection up to a degree of subjectivity. During this process consultation events with ABC, Tarbert Harbour Authority, SW and SEPA have been held in order to gather as many opinions as possible to inform the decision making process. These events are detailed in **Section 3.1**. Additional studies were also carried out to help inform the optioneering process and ensure all the information was available that was reasonably possible, in order to identify opportunities and constraints at this early stage. These studies are detailed in **Section 3.2**.

3.1 Stakeholder engagement

3.1.1 Argyll and Bute Council

Following completion of the baseline studies and site walkovers the long list was created by AECOM. To review the feasibility of the long list, ABC and AECOM held a workshop which enabled all of the relevant client personnel to input into the screening process. ABC technical and policy staff were in attendance and AECOM were able to gather feedback from the session. AECOM specifically asked ABC to comment on the technical, legal and financial feasibility of all options presented. All comments made were noted and are summarised in Table 8.1.

3.1.2 Scottish Water, Tarbert Harbour Authority, and SEPA

Having gained ABC's input to the long list, Scottish Water, Tarbert Harbour Authority (THA), and SEPA were then consulted. The consultation took the form of a half day workshop where AECOM brought all

the parties up to date on the project and then summarised the long list of options. The outputs from consultation with ABC were discussed and any additional points highlighted where necessary. All comments made during the workshop event were noted and are summarised in Table 8.1.

3.2 Additional studies

During this stage a broader consideration was made in terms of environmental considerations (human and natural) impacts. This has been addressed through our public consultation summarised in **Section 7** and through our Preliminary Ecological Appraisal and Planning screening exercise, the findings of which are summarised in **Section 5** of this report. A baseline Damages Impact Assessment has been undertaken and is provided in **Section 6** and **Appendix C** of this report.

These studies have provided more information on opportunities and constraints with regards to the environmental and economic impacts of the potential options and helped inform the appraisal of options to progress from the long list to the short list. The studies are summarised in the sections noted above and the full reports are within the appendices.

4. Ecological Preliminary Appraisal - Recommendations

Below are the recommendations taken from the Preliminary Ecological Appraisal. The full report can be found in **Appendix B**.

As the proposed development is in the preliminary stages of design, specific ecological recommendations cannot be made. Ecological receptors considered to be potentially relevant and which may represent a high level of constraint to the proposed development are identified below.

4.1 Nature conservation designations

4.1.1 Sound of Gigha pSPA

It is Scottish Government policy to treat pSPAs as if they were fully designated SPAs and the Sound of Gigha pSPA should be considered as thus. Proposed marine SPAs were scheduled for final submission to Government in February 2018, however no formal full designation has yet been announced at the time of writing. This study area is on the opposite coast of the Kintyre peninsula. All three species for which it is classified (wintering great-northern diver, eider and red-breasted merganser) can be found in coastal areas and feed on fish. Habitats within the study boundary therefore could provide functional to the SPA. The risk to this pSPA is the potential pollution to East Loch Tarbert which would cause direct harm to the pSPA bird species and could have a negative impact on their food source. Therefore, it is possible there may be a likely significant effect (LSE) which could affect the integrity of the pSPA. As a result, it is recommended that a Habitat Regulation Assessment Screening assessment is carried out in relation to any proposed scheme. SNH should be involved throughout the Screening process and approached for any relevant data they may hold. Strict pollution prevention measures would have to be put in place during construction to avoid such pollution events arising in the first instance.

4.1.2 Knapdale Loch SPA/SSSI

The study area holds the most southerly regular breeding population of black-throated diver in Britain and is of high productivity and European importance. This SPA/SSSI consists of multiple sites, the closest of which can be found 9.9 km west of the study area. The study area may be used as “functional land” for foraging by birds from the SPA/SSSI. Black-throated diver move to the coast in winter and feed on fish, therefore East Loch Tarbert may provide suitable habitat for these birds as multiple fish species have been recorded within the area. There is a risk of pollution to East Loch Tarbert which could have a direct negative effect on the birds themselves and the suitable prey within the loch which could affect the integrity of the SPA/SSSI. Therefore, it is recommended that an HRA Screening assessment is carried out in relation to any proposed scheme. SNH should be involved throughout the Screening process and approached for any relevant data they may hold. Mitigation such as strict pollution prevention measures would have to be put in place during construction of any scheme to avoid such pollution events arising in the first instance.

4.2 Notable habitats

Woodland within 2 km of the study area includes large areas of coniferous and deciduous woodland to the north and scattered areas of woodland to the south. Although these areas of broadleaved woodland are not notable, all broadleaved woodland has ecological value and there is a general presumption in planning policy against its removal without significant public benefit. Removal of any trees to facilitate any scheme should consequently be minimised. This is not likely to be a concern along the frontage of Tarbert.

Scheme-specific surveys will be required to determine the presence of protected or notable habitats. These surveys can only be conducted once the location and extent of the planned works has been identified. It should be noted that it is considered unlikely that existing broad leafed tree would be affected as part of any scheme considering the likely location of proposed coastal walls.

4.3 Protected and notable species

4.3.1 Bird species

Great northern diver, common eider, red-breasted merganser, black-throated diver black grouse and hen harrier have all been assessed as potentially using the study area. Further survey for these species may be required as part of any future Scheme.

4.3.2 Protected mammals

Red squirrel, pine marten, wildcat, bat species, badger, otter and water vole are assessed as being potentially present within the study area and therefore posing a medium to high level constraint to a future Scheme. However, given the coastal setting of Tarbert, it is unlikely that all of these identified species would be present. Additional survey will be required to inform this and protected species licences may be necessary.

4.3.3 Great Crested Newt

Suitable habitat for great crested newt may be present within 2km of the study area and therefore further surveys may be required as part of any future Scheme to confirm their presence/absence.

4.3.4 Invasive Non-Native Species (INNS)

There is potential for any future Scheme to impact the distribution of INNS and therefore further information should be gathered to identify the specific risks so that they can be mitigated.

4.3.5 Summary

A number of protected species including European Protected Species, those protected under the Wildlife and Countryside Act and other notable species including those which are non-native with the potential to be invasive have been recorded within the search area or have the potential to be present.

Given the above, a full suite of protected species and habitat surveys, including for the survey of non-native species, will be required to inform future stages of the project. As noted previously, given the nature of the flood scheme options, protected and invasive species associated with the intertidal area are likely to be of particular relevance. The scope for future surveys should be informed by this report but refined based on the specific locations and design of the development and should take the form of a full Preliminary Ecological Appraisal, involving site survey, and/or an Ecological Impact Assessment (EcIA) in accordance with CIEEM guidance.

4.4 General recommendations

Detailed mitigation measures will be based on the results of the surveys recommended above and the final design of the proposed works. Local planning policy requires that all development must be designed with cognisance of minimising impact on biodiversity and the natural environment.

For information, other general measures are likely to include the following:

- SEPA guidance should be strictly adhered to (and this will likely be a requirement as part of the necessary Water Environment (Controlled Activities) (Scotland) Regulations 2011 (‘CAR’) licence applications). SEPA Pollution Prevention Guidelines (PPGs) and Guidelines for Pollution Prevention (GPPs, which have now replaced some PPGs) should be strictly adhered to.
- Undertaking scrub and vegetation clearance outside the breeding bird season (March to August, inclusive) to avoid illegal obstruction/destruction of bird nests.

Production of a Construction Environmental Management Document (CEMD) and Construction Method Statements will be required (CMS, produced by the contractor and agreed with the relevant authority in advance of construction). This will detail site specific environmental effects, mitigation measures, timescales and responsibilities.

4.5 Enhancement

National planning policy outlines that the planning system should seek biodiversity benefits from new development where possible. Any future Scheme could incorporate a number of ecological enhancement measures and this concept should be built-in from an early stage and refined as the Scheme progresses. Suggestions for potential enhancement measure are outlined below:

- If non-native species are found to be present these will need to be managed, most likely through the production of an Invasive Species Biosecurity Management Plan (BMP). If such plans are required these would constitute an ecological benefit in themselves by cataloguing the species present and avoiding the further spread of such species.
- There is potential to widen the ecological benefit of managing non-native species by increasing their scope to the entire catchment (which in this area is not particularly large). A catchment-wide approach will have far-reaching ecological benefit and may help to address the risk of invasive-non-native species spreading back into the study area in the future.

5. Planning and Environmental Constraints

A high level desk study of any potential planning and environmental constraints was carried out. This was to inform the optioneering process by highlighting any areas of significance but also to potentially identify opportunities.

5.1 Environmental constraints

The desk study has highlighted several key environmental aspects that could impact the proposed options and should be considered when screening the long list of options. See **Figure 1, Appendix A** for the extents and location of these. The main constraints and opportunities to consider include:

- Conservation Area – much of the Tarbert waterfront is within a Conservation Area. This designation is assigned in order to protect the setting of the village around the natural harbour with horseshoe shaped wall and architecture. Any future Scheme within this area "must seek to preserve or enhance the character of the area" (ABC website [3]).
- Scheduled Monuments – there are two areas of scheduled monuments within Tarbert. These are Tarbert medieval burgh & environs and Meall Darroch settlement, both of which have cultural significance. Any proposed options within the vicinity of these monuments will take this into account and be designed so as not to impact upon them negatively.
- Woodland – areas of long established and ancient (semi natural) woodland have been identified around Tarbert. Ideally any options would look to avoid these areas.
- Listed Buildings – there are a number of Grade B and C listed buildings in Tarbert. The flood study is aiming to reduce flood risk to these properties however works that directly impact these buildings should be avoided. The harbour wall is also identified as Grade B listed and care should be taken to minimise impacts as a result of these scheme to this structure
- Historic contamination of the harbour should also be considered when assessing potential options as this could have an impact on constructability and local water quality.

5.2 Planning constraints

Several key planning constraints have been highlighted, that should be taken into account when screening the proposed long list of options; see **Figure 2, Appendix A**. The Local Development Plan for Argyll and Bute Council [4] was consulted and the main planning constraints and opportunities are summarised below:

- Open Space Protected Areas – These areas are set aside and are not to be developed. These include the recreation ground at Eastfield, a small strip of ground between the A83 and the harbour, and a large area around the castle. These areas should be considered when designing any scheme.
- Area for action – "areas which, subject to resource availability during the plan-period, will be the focus for partnership or community action. Area remits for these AFAs are being worked up in the Supplementary Information and Guidance report; these area remits may include investment and funding packages, land assembly and asset management programmes, development and redevelopment proposals, infrastructure provision and environmental enhancement proposals. Depending on circumstances, AFAs may coincide with other categories of sites such as potential development areas." For Tarbert the areas for actions are shown as:
  - AFA 13/1 Tarbert Harbour and Conservation Area - Strategic; harbour improvements; regeneration and environmental improvements
  - AFA 13/2 Tarbert – South Campbeltown Road/Back Street Local; land use rationalisation and redevelopment
- Potential Development Area – these are sites that have been identified as having potential to be developed for specified uses and those listed for Tarbert are outlined in Table 5.1 below

[3] https://www.argyll-bute.gov.uk/conservation-areas Accessed 10.04.2019
[4] Argyll and Bute Local Development Plan Written Statement, (Adopted March 2015). https://www.argyll-bute.gov.uk/sites/default/files/written_statement_0.pdf Accessed 15.04.2019

Table 5.1 Tarbert potential development areas

LDP Code	Site	Density
PDA 13/2	Lady Ileene Road Housing	Low
PDA 13/3	Barfad Eco-Housing (5)	Low
PDA 13/4	Glenfield Housing	High/medium/ low
PDA3002	Land east of Barfad	Low

Source: Argyll and Bute Local Development Plan

- Allocated Sites – sites within Tarbert which have been allocated for housing and business are outlined in Table 5.2 below.

Table 5.2 Tarbert development allocations

LDP Code	Site	No. Houses	Area (Ha)
H-AL 13/1	Lady Ileene Road Housing	31	
H-AL 13/2	Campbeltown Road Housing	30	
H-AL 13/4	Oakhill/Easfield Housing	50	
BI-AL 13/1	Glasgow Road		6.6

Source: Argyll and Bute Local Development Plan

- Town Centre – Tarbert town centre is listed as a Main Town Centre within the LDP.
- Established Business and Industry Area (EBIA) – these areas are “preferred locations for all scales of business and industry development, subject to the constraints of and appropriate capacity within the specific sites.” At Tarbert, there is a 1.24Ha EBIA outlined at the Indisutrial Estate, adjacent to the A83, Campbeltown Road.

From this desk based assessment it can be seen that there are several constraints within Tarbert that will require careful assessment should a scheme go ahead. Construction within areas designated as Conservation Areas and Open Space Protected Areas will require specialised design to ensure that the character of the setting is preserved. Whilst designations can provide constraints, they can also provide opportunities such as the ability to enhance designs to tie in with historic status using alternative funding packages. These opportunities should be drawn on if a scheme was to go ahead.

6. Baseline Damages Impact Assessment

6.1 Introduction

Flooding can have economic, social and environmental impacts. The aim of this section is to set out the results of the baseline impact assessment. The full results and methods are presented in the technical report in **Appendix C**.

6.2 Methods

The assessment process used here follows the Scottish Government guidance[5] and, as such, will be compatible with the aims of the Flood Risk Management (Scotland) 2009 Act. Whilst the Scottish Government guidance covers the main principles of the assessment set out below, the Multi-Coloured Manual (MCM)[6] and Multi-Coloured Handbook (MCH)[7] cover the detailed procedure and standard data used for the assessment.

The baseline damage assessment is based on a "do nothing" scenario. This allows for the benefits of "doing something" to be assessed at a later stage. Damages were estimated using the flood extents and depths from the hydraulic model. **Table 6.1** sets out the approach used for each component. A more detailed description of the proposed approach taken for selected receptors is included within the technical report.

Table 6.1 - Summary of economic damage assessment components

Receptor	Damage assessment approach
Economic impacts	
Residential properties	Included. Properties classified by type, age and regional social grading
Non-residential properties	Included. Properties classified by MCM code.
Vehicles	Included. Based on number of properties at risk (detailed information on number of vehicles within the study area is not readily available).
Evacuation	Included. Evacuation costs based on property type and flood depth (detailed local data is not readily available)
Distributional impacts	Included. Based on 2011 census data for Tarbert
Indirect impacts on non-residential properties	Applied as basic 3% uplift to direct damages
Local authority, emergency and recovery costs	Included. Uplift factor from MCM data.
Infrastructure	
Electricity and gas	Described
Water and waste water	Described
Telecommunications	n/a – no vulnerable infrastructure present within study area
Schools	n/a – none at risk of flooding within study area
Hospitals	n/a – none at risk of flooding within study area
Transport	
Road disruption	Described
Rail disruption	n/a – no infrastructure present within study area

[5] Scottish Government, 2016. Options appraisal for flood risk management: Guidance to support SEPA and the responsible authorities. Edinburgh: Scottish Government.
[6] Penning-Rowsell et al. (2013). Flood and Coastal Erosion Risk Management. A Manual for Economic Appraisal. Oxon: Routledge.
[7] Penning-Rowsell et al. (2017). Flood and Coastal Erosion Risk Management. A Handbook for Economic Appraisal. [Online] London: Middlesex University

Receptor	Damage assessment approach
Agriculture	n/a – none present within study area
Social impacts	
Risk to life	Described
Health	Monetised based on standard of protection provided.
Social vulnerability	Described
Recreation, community and way of life	Described
Environmental impacts	
Water environment	Described
Biodiversity, flora and fauna	Described
Air and soil	Described
Climatic factors	Described
Landscape	Described
Cultural heritage	Described

6.3 Results

The number of properties affected by flooding during a 'do nothing' scenario in the study area are shown in **Table 6.2**. The corresponding damages are shown in **Table 6.3**. These results do not include the impact of capping or write-offs, as those factors only get taken into account when damages are discounted over the appraisal period.

Table 6.2 - Number of properties affected by flooding in the study area

			Return period (years)							
Scenario	**Property Type**	2	5	10	20	50	100	200	1000
Present Day	Residential	0	0	5	9	9	14	14	17
	Non-Residential (NRP)	0	0	24	34	45	53	55	65
Climate Change	Residential	11	14	14	14	14	17	17	22
	Non-Residential (NRP)	43	53	56	61	65	65	67	73
Total no. of properties affected by flooding (including CC)		54	67	70	75	79	82	84	95

* Damages for residential properties start to be accrued when the water is within 300mm of the floor level as water enters the sub-floor area.

Table 6.3 - Baseline monetised flood damages by return period

Category		Return period (years)							
		2	5	10	20	50	100	200	1000
Residential	Direct	£0	£0	£53,945	£117,745	£169,690	£230,096	£275,026	£381,079
	Vehicles	£0	£0	£8,608	£17,216	£22,955	£28,694	£31,563	£40,171
	Indirect	£0	£0	£7,977	£14,680	£23,225	£32,387	£41,062	£61,216
	DIA	£0	£0	£13,483	£29,430	£42,414	£57,512	£68,742	£95,250
	Subtotal	**£0**	**£0**	**£84,013**	**£179,071**	**£258,284**	**£348,688**	**£416,393**	**£577,716**
NRP	Direct	£7,101	£42,321	£453,631	£998,666	£1,583,308	£2,121,461	£2,610,663	£3,860,004
	Indirect	£213	£1,270	£13,609	£29,960	£47,499	£63,644	£78,320	£115,800
	Subtotal	**£7,314**	**£43,591**	**£467,239**	**£1,028,626**	**£1,630,807**	**£2,185,105**	**£2,688,982**	**£3,975,804**
Other	Emergency	£760	£4,528	£54,311	£119,456	£187,571	£251,617	£308,769	£453,796
	Health	£0	£0	£4,034	£6,051	£9,077	£11,094	£11,094	£14,120
	Subtotal	**£760**	**£4,528**	**£58,345**	**£125,507**	**£196,648**	**£262,711**	**£319,863**	**£467,916**
Total		**£8,074**	**£48,119**	**£609,597**	**£1,333,204**	**£2,085,739**	**£2,796,504**	**£3,425,238**	**£5,021,436**

Average Annual Damages (AAD) are the expected value of damages within a typical year: ∑*Damages x Probability.* AAD is shown below calculated from current value damages and probability; and for future probability for the climate change horizons. Due to the frequency of flooding, a number of properties were considered to be written off (and were not included in the AAD total). The increased frequency of flooding with climate change means more properties are written off; it is therefore possible that AAD reduces with time. This is found to be the case in Tarbert, as shown in the table below. **Table 6.4** shows the AAD for the assessed climate change scenarios.

Table 6.4 - Baseline average annual damages

Category		Annual Average Damage	
		Current (without CC)	Climate Change
Residential	Direct	£16,269	£5,406
	Vehicles	£2,271	£758
	Indirect	£2,264	£614
	DIA	£4,066	£1,475
	Subtotal	**£24,871**	**£8,253**
Non-Residential	Direct	£135,631	£84,713
	Indirect	£4,069	£2,541
	Subtotal	**£139,699**	**£87,255**
Other	Emergency	£8,506	£5,047
	Health	£902	£269
	Subtotal	**£9,408**	**£5,316**
Total		**£173,978**	**£100,824**

Present Value Damage (PVD) represents the damages expected to be accumulated over the appraisal period (100 years). The total damages accrued are also “discounted” to a Present Value (see the full report in **Appendix C**). PVD is derived from the sum of all probability damages accrued, capped and discounted: ∑ (Damages x Probability) capped x discount rate. Where required, properties were written off in the year that the flood frequency is expected to exceed once every three years, with a discount factor applied where necessary. **Table 6.5** shows the present value damage per type for Tarbert and **Table 6.6** shows a summary of these results.

Table 6.5 Baseline present value damages by type

Category		PVD (without CC)	PVD CC
Residential	Direct	£573,577	£816,815
	Vehicles	£42,044	£38,401
	Indirect	£37,423	£33,853
	DIA	£70,399	£131,195
	Subtotal	**£723,443**	**£1,020,264**
NRP	Direct	£3,434,365	£3,986,355
	Indirect	£36,530	£46,746
	Subtotal	**£3,470,895**	**£4,033,102**
Other	Emergency	£428,850	£506,782
	Health	£17,860	£16,026
	Subtotal	£446,710	£522,807
Total		**£4,641,048**	**£5,576,173**

Table 6.6 Summary of PVD

Totals	Total PVD (CC)
Tarbert	5.6M

The study area was split into 'flood cells' – areas which flood from the same location(s) and which could potentially be protected independently. This allows for further investigations to focus on those areas which are most affected. A plan showing the location of the flood cells is included in **Appendix C, Appendix A.1**. **Table 6.7** shows the present value damage (PVD) for each flood cell.

Table 6.7. Baseline present value damages

Flood cell	Residential	Non-residential	Other	Total	Proportion of total
1	£816,449	£3,454,721	£712,171	£4,983,342	89.37%
2	£0	£84	£12	£96	0.00%
3	£0	£59	£8	£67	0.00%
4	£0	£355,067	£38,573	£393,640	7.06%
5	£0	£19,380	£2,655	£22,035	0.40%
6	£0	£85,615	£11,729	£97,345	1.75%
7	£366	£71,429	£7,855	£79,649	1.43%
Total	**£816,815**	**£3,986,355**	**£773,003**	**£5,576,173**	**100.00%**

The flooding impacts assessed in this report are broadly in line with the impacts experienced during historical flood events; the greatest impacts are located in those areas that have flooded most frequently in recent years. Key non-monetised impacts include flooding of roads and associated disruption, risk to life, damage to key community assets and pollution of watercourses. The frequency of such an event is expected to increase as a result of climate change.

The non-monetised impacts should also be taken into account as part of any appraisals and decision-making. Many properties within the Tarbert Conservation Area are at risk of flooding.

6.4 Sensitivity analysis

Uncertainty is an inherent quality in economic damages assessments, given the process involves layering together different datasets with their own individual uncertainties and simplifying assumptions across areas. MCM guidance recommends the use of sensitivity analysis to be aware of these uncertainties. The chosen method is in line with best practise and industry standard approaches which aim to provide a managed, efficient and conservative method to economic damages assessment.

The sensitivity analyses have shown there to be some uncertainty in flood damages, particularly the reliance on the modelling results and the climate change scenario which are themselves subject to uncertainty, meaning there is a degree of uncertainty in flood depths for this study. This is typical of a study of this kind.

The damages presented here are based on a best estimate of each of the variables; however, the potential for variation in the total damages (both positive and negative) needs to be borne in mind in any decision-making. As shown in the sensitivity analysis above, variations of +/- 25% would not be unexpected, this is typical of these studies.

Full details of the sensitivity can be found in the Baseline economic report in Appendix C.

7. Public information Gathering Event

A canvassing event was undertaken on the 6th of July 2018 to further verify the flood accounts provided by SEPA and ABC and to establish any additional flood history. The flood mechanisms noted above were verified during the event. Flood history included:

- High sea levels reach the top of the harbour wall approximately twice a year but do not spill out onto the road often
- Surface water flooding is an issue – mainly attributed to blocked road drains and ditches and tide locking. Flooding occurs frequently
- During the 1991 event, flooding was recorded as being up to 1m deep in some of the harbour adjacent properties
- The first properties to flood are the Ironmongers and neighbouring properties on the western side of the harbour and café Cadora on the eastern side of the harbour.

8. Scoring the Long List

To quantify the reasoning behind selection of the short list from the long list a high-level scoring system was developed. This considered stakeholder views and expert judgement on feasibility of technical, legal, financial and environmental aspects of the proposals. **Section 3** sets out the criteria used for screening out unfeasible or unrealistic options. Expert judgement was involved in making these decisions, which involved elements of subjectivity. However, by consulting main stakeholders and being transparent in our approach we have been able to appraise each measure fairly and consistently.

Each criteria, of which there were 4, was scored out of 5, with 5 being the highest available score and 1 being the lowest. The total available score is 20. A score of 5 was given to options that categorically had no obstacles whereas a score of 1 was given to options that had many obstacles already apparent that are thought to be substantially prohibitive. Where there were no real positives or negatives against an option, or a neutral effect was anticipated, it has been given a score of 3.

For example, if an option is clearly technically feasible it would score 5, and if legally there was no known obstacles such as land ownership it would also score a 5. If the option was going to be extremely costly and the expert's opinion was the impact would be limited, the score for cost would be 1 and finally if the option had a neutral impact on environmental factors it would score 3 giving a total score of 14, which could then be ranked against other options.

The scoring of the options is set out in **Table 8.1** along with the key decision points raised by Argyll and Bute Council, Tarbert Harbour Authority, Scottish Water, SEPA, and the public noted. Figure 8-1 displays the locations of the long list options. Where a score of 12 or more was achieved the option has been taken forward to the short list for more detailed assessment and appraisal during Phase 4. A summary table has also been provided (**Table 9.1**). Options highlighted in green in this table have been taken forward whilst those in red have been discounted and discussed in **Section 9.1.**

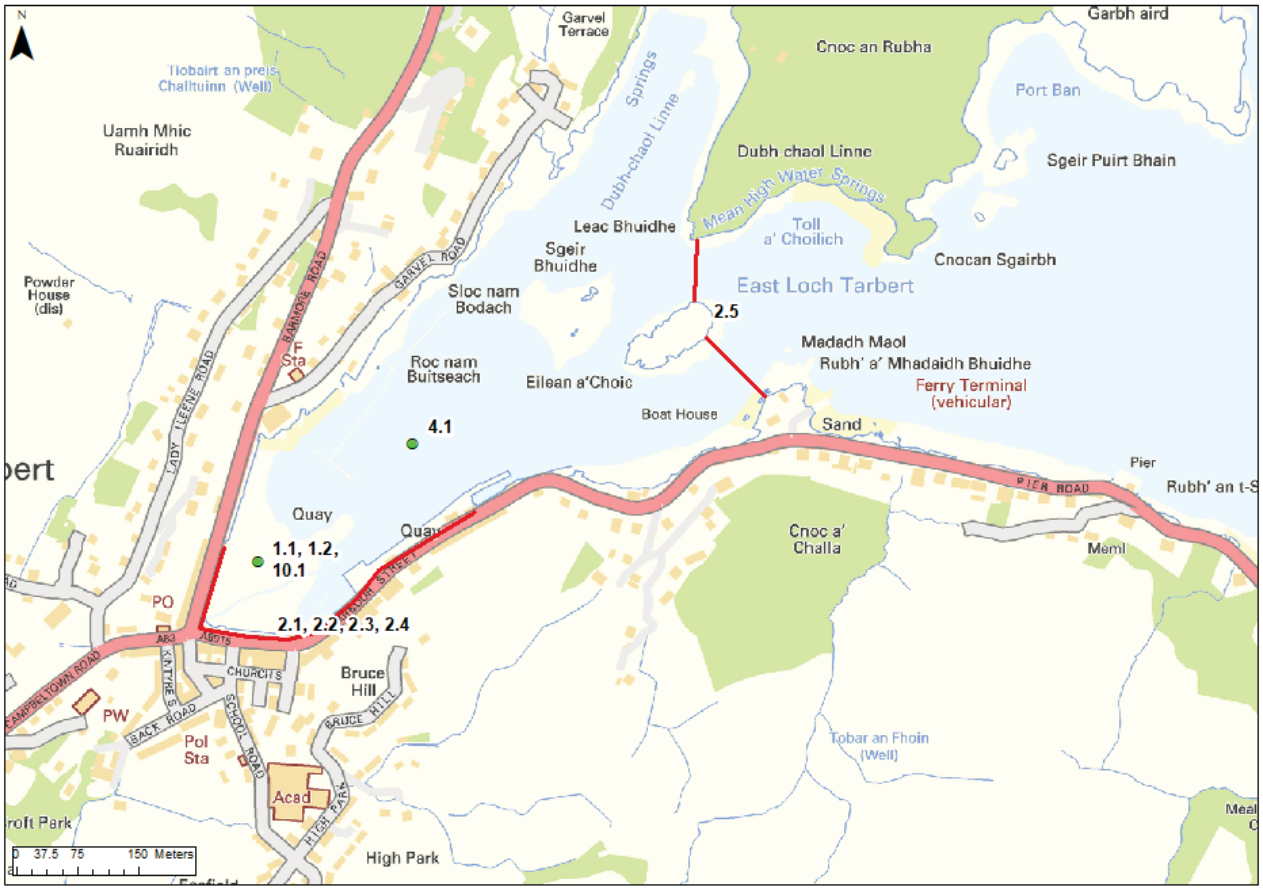


Figure 8-1: Long list option locations

Table 8.1 Long list screening & scoring

Category	Measure	ID	Flood receptor (location)	Feasibility – Technical	Feasibility - Legal	Feasibility - Cost	Feasibility – Environmental	Total Score
NFM Options	Saltmarsh/managed realignment to provide wave dissipation	1.1	Address wave overtopping on Barmore Road, Harbour Street and the quay.	• Feasible but difficult to implement as Tarbert is a working harbour • Houses and roads located close to harbour walls – extremely difficult to achieve appropriate gradients • May take time to establish and realise any benefits • Limited benefit against extreme water levels *1*	• Issues relating to boat passage and commercial usage • Potential land owner issues *1*	• Costly to remove existing walls and infrastructure • Material costs are likely to be relatively low • Relatively low ongoing maintenance *3*	• Could provide more connectivity with the sea • Improved habits in the bay area • Harbour is a historic structure • Ecological constraint – changing conditions for species identified in PEA *4*	9
	Intertidal recharge to provide wave dissipation	1.2	Address wave overtopping on Barmore Road, Harbour Street and the quay.	• Feasible but difficult to implement as Tarbert is a working harbour that requires adequate depths • Limited benefit against extreme water levels *1*	• Issues relating to boat passage and commercial usage • Potential land owner issues *1*	• Material costs are likely to be relatively low • Relatively low ongoing maintenance *3*	• Could provide more connectivity with the sea • May impact habits in the bay area • Harbour is a historic structure • Ecological constraint – changing conditions for species identified in PEA *3*	8
Direct defences	Traditional coastal flood defences along existing harbour boundary.	2.1	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences.	• Feasible • Harbour wall could provide foundations of works • The condition of the existing wall may impact how the defences can be constructed • Wall height may have to be limited so as not to provide a barrier to the sea or be too intrusive- this will minimise standard of protection • Access to working area is constricted by roads • Any works that raise defences could block flow from re-entering the channel – significant no. of flapped culverts required to maintain flow path – sea levels rise may impact drainage on the landward side of defence • Potential issues with existing services • Level required is challenging whilst maintaining feel of harbour town • HMP raised example of Kirkwall with glass topped defences to retain views - is this possible with pressure involved from waves and height of sea? • Existing walls are quite porous so would be a challenge to utilise existing as they are – reinstate or some kind of grouting. • Raising defences would also improve safety at car park where there is no buffer to water. *3*	• Issues relating to commercial usage at the quay – walls may block access • Road closures may be required • Potential land owner and land take issues • Maintenance would land with council for survey etc. but this would be minimal • Existing wall boundaries owned by THA who are supportive of direct defences • Crown estates ownership of sea bed to 12 nautical miles to be aware of *4*	• Costly - a significant length of defences (500m) is required • Significant height also required to protect to climate change which also increases costs • Potential significant cost for surface water pumping / back of wall drainage • Potential land take costs • Works to existing structures may be required • Existing wall is listed *2*	• Further cuts off the land from the sea • Habitats could be affected - surveys will reveal if this is a significant risk • Depending on height, the character of the area may be affected • Elements to encourage habitats and biodiversity could be included in the wall structure • Harbour is a historic structure • Potential impact on noted ecological constraints including otter, vole and Aquatic & invertebrate species. • Consultation with fisheries may be required. Impacts on Sound of Gigha pSPA & Knapdale Loch SPA/SSSI need to be considered as options progress *3*	12
	Traditional coastal flood defences along landward side of promenade (between promenade and road)	2.2	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences	• Feasible • The condition of the existing wall may impact how the wall can be constructed • Wall height may have to be limited so as not to provide a barrier to the sea or be too intrusive- this will minimise standard of protection • Access to working area is constricted • Any works that raise defences could	• Issues relating to commercial usage at the quay – walls may block access but may be less of an issue than in option 2.1 • Road closures may be required • Potential land owner and land take issues • Maintenance would land with council for survey etc. but this would be minimal	• Costly - a significant length of defences (500m) is required • Significant height also required to protect to climate change which also increases costs • Potential significant cost for surface water pumping / back of wall drainage • Potential land take costs • Works to existing structures may be	• Further cuts off the land from the sea • Habitats could be affected - surveys will reveal if this is a significant risk • Depending on height, the character of the area may be affected • Harbour is a historic structure but could be avoided more than in option 2.1 • Would allow prom to remain linked to sea Potential impact on noted	12

Category	Measure	ID	Flood receptor (location)	Feasibility – Technical	Feasibility - Legal	Feasibility - Cost	Feasibility – Environmental	Total Score
				block flow from re-entering the channel – significant no. of flapped culverts required to maintain flow path – sea levels rise may impact drainage on the landward side of defence • Potential issues with existing services *3*	• Existing wall and promenade owned by THA who are supportive of direct defences 4	required • Existing wall is listed *2*	ecological constraints including otter, vole and Aquatic & invertebrate species. • Consultation with fisheries may be required. Impacts on Sound of Gigha pSPA & Knapdale Loch SPA/SSSI need to be considered 3	
	Flip-up/demountable coastal flood defences	2.3	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences	• Feasible • Less extensively used and the suitability of their application in a tidal scenario would need to be fully assessed • Access to working area is constricted • Wall height could potentially be increased compared to traditional defences • Protection relies on defences being operated correctly • Potential issues with existing services • Potential to have a mix of traditional and flip up/demountable where appropriate to balance practicality and cost • Back of wall drainage needs would be more complex with auto-defences • May come close to new proposed SW sewers • H&S increased risk for someone to install defences in flood conditions 3	• May still be some issues relating to commercial usage at the quay although this would be reduced from traditional defence options • Road closures may be required • Potential land owner and land take issues • Existing wall and promenade owned by THA who are supportive of direct defences 4	• Costly - a significant length of defences (500m) is required and likely to be more expensive than traditional defences • Significant height also required to protect to climate change which also increases costs • Potential land take costs • Higher maintenance costs compared to traditional defences may impact whole life cost significantly • Potential to impact wildlife • Existing wall is listed *2*	• Would not cut off the land from the sea for the majority of time • Depending on height, the character of the area may be affected for a short time, but less intrusive than traditional defences • Harbour is a historic structure • Potential impact on noted ecological constraints including otter, vole and Aquatic & invertebrate species. • Consultation with fisheries may be required. Impacts on Sound of Gigha pSPA & Knapdale Loch SPA/SSSI need to be considered 3	12
	Combination of traditional/demountable/coping stones etc.	2.4	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences.	• Feasible • The condition of the existing wall may impact how the wall can be constructed • Access to working area is constricted but issues could be minimised by selecting most appropriate option • Varying defence type could address specific access issues • Potential issues with existing services but again could likely be minimised when compared to traditional defences 4	• Less significant issues relating to commercial usage at the quay – these areas would need to be considered separately • Road closures may be required • Potential land owner and land take issues • Existing wall and promenade owned by THA who are supportive of direct defences 4	• Costs could be reduced depending on combination of defences • Significant height still required to protect to climate change which increases costs • Potential cost for surface water pumping / back of wall drainage • Potential land take costs • Existing wall is listed *3*	• Potential to further cuts off the land from the sea • Depending on height, the character of the area may be affected • Elements to encourage habitats and biodiversity could be included in the wall structure • Harbour is a historic structure • Potential impact on noted ecological constraints including otter, vole and Aquatic & invertebrate species. • Consultation with fisheries may be required. Impacts on Sound of Gigha pSPA & Knapdale Loch SPA/SSSI need to be considered • Options could be tailored to produce best result 3	14
	Tidal barrage to stop high sea levels entering the harbour area. This would likely run between the mainland and an island. Provision for boat access may also be required.	2.5	Protect the entire harbour area from extreme water levels by forming a barrier into the bay. The ferry port would not be protected by a barrage	• Feasible • Islands within the harbour could reduce overall span required • Likely to be a complex design process • Offering a high standard of protection would result in an intrusive structure • Additional measures required to dictate when barrage would be employed. • Protection relies on defences being operated correctly	• Issues relating to commercial usage at the quay and access • Potential land owner and land take issues • Issues relating to deployment of the barrage and liability associated with this	• Significant length and height required - likely to be extremely costly • High maintenance costs • THA also indicated depths are significant which would substantially increase costs	• Character of the area and view will be impacted • Potential for free flow of water to be impacted causing standing water • Disruption of marine habitats during and post construction • Potential impact on noted ecological constraints including otter, vole and aquatic & invertebrate species. • Consultation with fisheries may be	6

Category	Measure	ID	Flood receptor (location)	Feasibility – Technical	Feasibility - Legal	Feasibility - Cost	Feasibility – Environmental	Total Score
				• Wouldn't be overly problematic from a navigation issue as a channel would still remain • THA bathymetry suggest 7 – 8m depth so very challenging *2*	*2*	*1*	required. Impacts on Sound of Gigha pSPA & Knapdale Loch SPA/SSSI need to be considered *1*	
Property Flood Protection	Small scale property interventions that could be employed when high sea levels are predicted. This would include measures such as flood doors and flood-proof airbricks. May be particularly appropriate at the Ferry terminal. Appropriate for flood levels up to 0.6m in depth.	3.1	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences.	• Feasible for some properties • Less feasible for depths over 0.6m which includes climate change scenarios • Relies on people to employ defences in advance • Properties are all unique so would require surveys to understand requirements • Resilience measure rather than prevention • SW have supplied PLP to some properties already • Could be a quick win in short term before CC impacts come into play • Many listed properties with non-standard requirements i.e flood doors would be v difficult due to misshapen door opens etc. 2	• Liability issues surrounding deployment • No council policy but could implement as part of a scheme if shown to be most cost-effective solution • Owners responsible for maintenance • Minimal land take or owner issues *3*	• Relatively inexpensive when compared to direct defence options • May achieve reasonable cost benefit at higher frequency events • Social cost in terms of stress associated with larger events in which PFP will not protect and with a lack of confidence in the reliability of these measures *3*	• No real positive or negative impacts *3*	12
Wave dissipation	Breakwater placed further out from the harbour to dissipate waves and reduce overall height	4.1	Address wave overtopping on Barmore Road, Harbour Street and the quay.	• Feasible • Would only protect against waves and not high water levels - limited impact in relation to flood risk • Adequate space although bathymetry would need to be inspected to determine if depths were appropriate • Does not address the main flood driver of high standing water levels • Impacts operation of the harbour *1*	• Potential land owner issues • Issues relating to commercial usage *2*	• Relatively inexpensive due to short lengths required • Low maintenance costs *4*	• Potential disruption of marine habitats • Potential to be visible at low or normal tides • Ecological constraint – changing conditions for species identified in PEA *2*	9
Improved flood warning	This measure would aim to provide earlier warning of high sea levels so that residents could be more prepared. Likely to be either based on Met Office data or other tidal gauges on the Firth of Clyde.	5.1	Provide advanced warning of extreme water levels to aid preparation but does not provide any protection to properties. This could be applied to all properties in Tarbert.	• Feasible if implemented in tandem with PFP – limited use by itself • Does not alleviate or reduce flooding but may reduce damage and risk • Would not require large scale monitoring or instrumentation • SEPA Flood warning in place – would be useful to know if this is well used and if we can engage people more during consultation • Generally felt that residents have a good understanding of tidal conditions and that existing flood warning is already used 2	• Issues relating to liability and confidence in warnings • Distribution of warnings can be problematic and impact on any benefits *2*	• Relatively inexpensive costs of instrumentation and monitoring • Costs associated with distributing warnings • Does not solve flooding and associated costs with clean up still in place *3*	• No real positive or negative impacts *3*	10
Self help	The measure would aim to improve understanding of flooding issues and how to cope better.	6.1	Promote and implement self-help methods including flood insurance, community action groups, emergency planning and awareness raising. This could be applied to	• Technically feasible • Could reduce damage and risk if residents are better prepared • Will not alleviate or reduce flooding but may reduce damage and risk • Community Council are active but not engaged with the coastal flood issue as much as more immediate surface	• Legalities of funding and ownership of local groups could be complex • Relatively low ongoing maintenance and running costs for the council	• Minimal costs relating to awareness and Community Action Group set up	• No real positive or negative impacts	14

Category	Measure	ID	Flood receptor (location)	Feasibility – Technical	Feasibility - Legal	Feasibility - Cost	Feasibility – Environmental	Total Score
			all properties in Tarbert.	water/sewer flooding concerns – something that can be improve at public engagement *4*	*3*	*4*	*3*	
Managed retreat	Setting up of a long term plan to move properties away from the harbour	7.1	All affected properties	• Technically feasible • Issues relating to character of town focussed around the harbour meaning relocation is unlikely to be accepted • Tarbert is a historic town of importance • Large percentage of properties in Tarbert affected • Establishing criteria for relocation is complex • Not very feasible for knock on effect to Islay etc. where this tourism route is key to wider national and local economy of ABC *1*	• Complexity around relocation – emotive topic and likely to have significant legal issues • Relatively low ongoing maintenance and running costs for the council • Compulsory purchase is time consuming and complex *1*	• Large number of properties affected with significant costs associated with land and property purchase • Large costs associate with purchase of land for relocation • Industries such as tourism would be negatively affected and causes associated issues. *1*	• Previously built up areas would have to be demolished and managed appropriately to create new habitats etc • Existing greenfield sites required for relocation • Potential for reconnection with the sea *3*	6
Flood resilience	The measure would aim to improve building resilience to flooding making clear up easier and cheaper. This could include waterproof render and lifting of electrical sockets	8.1	All affected ground floor properties	• Technically feasible • Will not reduce flooding but may reduce damage and risk • Resilience measure rather than prevention • Feeling this is a sensible option given Climate Change implications • Would need to be bespoke given uniqueness of property • Only small number of properties may be applicable • Scottish Government has done recent studies on this so there is an evidence base. NG to pass on. *4*	• Minimal land take or owner issues • All affected properties would need to be retrofitted to achieve maximum benefits *4*	• Relatively inexpensive when compared to direct defence options • May achieve reasonable cost benefit at higher frequency events • Social cost in terms of stress associated with flooding as this option does not reduce flood occurrence *3*	• No real positive or negative impacts *3*	14
Do nothing	This scenario assumes no future maintenance of flood defences or flood warning.	9.1	All affected properties	• Unfeasible – frequency of flooding in the future will become unsustainable *1*	• Council has a duty to implement and maintain flood protection actions *1*	• Costly in terms of clear up, repairs and road closures *1*	• Frequent flooding could impact the ecological and environmental aspects in Tarbert *1*	4
Land reclamation/direct defences	Infilling of an area of the intertidal mudflats in front of the existing harbour wall, to create more space to install a new flood wall to protect the harbour front properties – the main purpose of this land raising would be for flood protection purposes	10.1	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences	• Feasible • Not a standard approach but may be appropriate in Tarbert where the character is so focused on Harbour meaning it is difficult to develop a feasible traditional solution • Could improve safety at car park • Access is likely to be sufficient given construction in currently open space • Potentially fewer issues relating to existing harbour wall structure than traditional defences • Wall height may still need to be limited so it is not overly intrusive • More space to develop landscaped options rather than high sea walls • Stabilisation of land raising may be problematic given underlying material • Land raising more appropriate in coastal than fluvial situations 4	• Marine Scotland to be consulted • New public space here would possibly be locally and politically popular • Potential issues relating to commercial operation of harbour • Crown estate ownership of land *3*	• Material would be required for bringing new land up to appropriate level likely to be large volume of material and costly to import • Wall would still need to be constructed largely to same level as other traditional defence options – but costs could be reduced with landscaping options • Existing harbour wall is listed which could significantly impact on costs • Likely small land take costs 2	• Ecological constraint – changing conditions for species identified in PEA • Lack of public space for events in Tarbert which could be provided by this space • It will change the character of the town which could be positive or negative depending on design • Chance to incorporate better connectivity with the sea and create habitats 4	13

8.1 Long list scoring summary

A summary of the long list scoring is provided in Table 8.1 below. Options in green indicate those being carried forward to the short list, having a combined score of 12 or more; options in red are discounted with reasoning given in **Section 9.1**.

Table 8.2 Long list score summary table

Option Category	Measure	ID	Feasibility				Total Score
			Technical	Legal	Cost	Environmental	
NFM Options	Saltmarsh/managed realignment to provide wave dissipation	1.1	1	1	3	4	9
	Intertidal recharge to provide wave dissipation	1.2	1	1	3	3	8
Direct defences	Traditional coastal flood defences along existing harbour boundary.	2.1	3	4	2	3	12
	Traditional coastal flood defences along landward side of promenade (between promenade and road)	2.2	3	4	2	3	12
	Flip-up/demountable coastal flood defences	2.3	3	4	2	3	12
	Combination of traditional/demountable/ coping stones etc.	2.4	4	4	3	3	14
	Tidal barrage to stop high sea levels entering the harbour area. This would likely run between the mainland and an island. Provision for boat access may also be required.	2.5	2	2	1	1	6
Property Flood Protection	Small scale property interventions that could be employed when high sea levels are predicted. This would include measures such as flood doors and flood-proof airbricks. May be particularly appropriate at the Ferry terminal. Appropriate for flood levels up to 0.6m in depth.	3.1	3	3	3	3	12
Wave dissipation	Breakwater placed further out from the harbour to dissipate waves and reduce overall height	4.1	1	2	4	2	9
Improved flood warning	This measure would aim to provide earlier warning of high sea levels so that residents	5.1	2	2	3	3	10

Option Category	Measure	ID	Feasibility				Total Score
			Technical	Legal	Cost	Environmental	
	could be more prepared. Likely to be either based on Met Office data or other tidal gauges on the Firth of Clyde.						
Self help	The measure would aim to improve understanding of flooding issues and how to cope better.	6.1	4	3	4	3	14
Managed retreat	Setting up of a long term plan to move properties away from the harbour	7.1	1	1	1	3	6
Flood resilience	The measure would aim to improve building resilience to flooding making clear up easier and cheaper. This could include waterproof render and lifting of electrical sockets	8.1	4	4	3	3	14
Do nothing	This scenario assumes no future maintenance of flood defences or flood warning.	9.1	1	1	1	1	4
Land reclamation/direct defences	Infilling of an area of the intertidal mudflats in front of the existing harbour wall, to create more space, and to install a new flood wall to protect the harbour front properties	10.1	4	3	2	4	13

9. Short Listing

Following the screening exercise, the short listed options are set out in **Table 9.1**. A more detailed discussion of reasons for removing options is set out in **Section 9.1**.

The remaining short list has discounted options which are not considered to be technically, economically, environmentally or legally feasible. Those which remain will be investigated more thoroughly in terms of their performance with regard to flood risk which will be informed through detailed modelling and the benefits to be gained for each option in terms of economic damages avoided, environmental benefit from human and natural impacts and social benefits. A full options appraisal will be carried out following more detailed modelling of the short list so that options can be ranked and prioritised to find the most suitable solution considering all aspects.

9.1 Discounted options – justification

9.1.1 Saltmarsh/managed realignment

This option does not address the main flood mechanism caused by extreme still water levels.

9.1.2 Intertidal recharge

This option does not address the main flood mechanism caused by extreme still water levels.

9.1.3 Tidal barrage

The scale of engineeing works required to construct a barrage structure is considered to be cost prohibitive when compared against the potential economic benefit from flood risk reduction i.e. possible damages offset. Bathymetry of the channels where the barrage would potentially be located indicates that the any stucture would have to be founded at a significant depths (c. 7-8m). This resulted in the barrage being discounted through the long list scoring process. However, to provide an alternative to direct defences, this option was taken forward and developed in more detail to assess likely costs.

9.1.4 Wave dissipation

This option does not address the main flood driver of high still water levels and is considered to provide limited benefit.

9.1.5 Improved Flood Warning

Flood warning is already available, and widely used, in the area and it is not considered likely that improving it will materially alter advanced warning. Flood warning also does not alleviate flooding or reduce risk. It merely seems to reduce the impact of flooding as advance warning can be given.

9.1.6 Managed Retreat

This option is not considered feasible due to the extent of the shorefront affected and the type of the properties impacted. This area represents a defined conservation area and is the main commercial hub of Tarbert, centred on the harbour front. It is important for tourism and other economic activities. A managed retreat would effectively destroy the character and charm of the town which would be difficult to re-establish.

9.1.7 Do Nothing

This is not considered an option given the scale and likely increased frequency of flooding events predicted to occur over the next 100 years.

9.2 Shortlisted options

Table 9.1. Short List

Type of Measure	ID	Flood receptor (location)	Measure	Total Score
Direct defences	2.1	Low lying property on Balmore Road, Harbour Street and the quay and ferry terminal	Wall structure along harbour boundary	12
Direct defences	2.2	Low lying property on Balmore Road, Harbour Street and the quay and ferry terminal	Wall structure along landward side of the promenade	12
Direct defences	2.3	Low lying property on Balmore Road, Harbour Street and the quay and ferry terminal	Flip-up/demountable coastal flood wall structure	12
Direct defences	2.4	Low lying property on Balmore Road, Harbour Street and the quay and ferry terminal	Combination of traditional/demountable/coping stones etc.	14
Tidal barrage	2.5	Low lying property on Balmore Road, Harbour Street and the quay and ferry terminal	Tidal barrage to stop high sea levels entering the harbour area. Provision for boat access likely required.	6
Property Flood Protection	3.1	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay.	Small scale property interventions	12
Self help	6.1	All affected properties in Tarbert.	The measure would aim to improve understanding of flooding issues and how to cope better.	14
Flood resilience	8.1	All affected properties in Tarbert.	The measure would aim to improve building resilience to flooding making clear up easier and cheaper. This could include waterproof render and lifting of electrical sockets	14
Land reclamation/direct defences	10.1	Address flooding caused by extreme water levels on Barmore Road, Harbour Street and the quay. The ferry port could also be protected by traditional defences	Infilling of an area of the intertidal mudflats in front of the existing harbour wall, to create more space, and to install a new flood wall to protect the harbour front properties	13

10. Summary and Next Steps

A long list of options was created that looked at different ways to mitigate coastal flood risk within Tarbert. The long list was brought before key stakeholders including ABC, SW, SEPA and THA. This was to identify any possible reasons for the listed options to not be feasible and identify any missed opportunities at this stage. Input from these bodies along with desk studies to understand environmental, planning and ecological opportunities and constraints were used to inform the screening process.

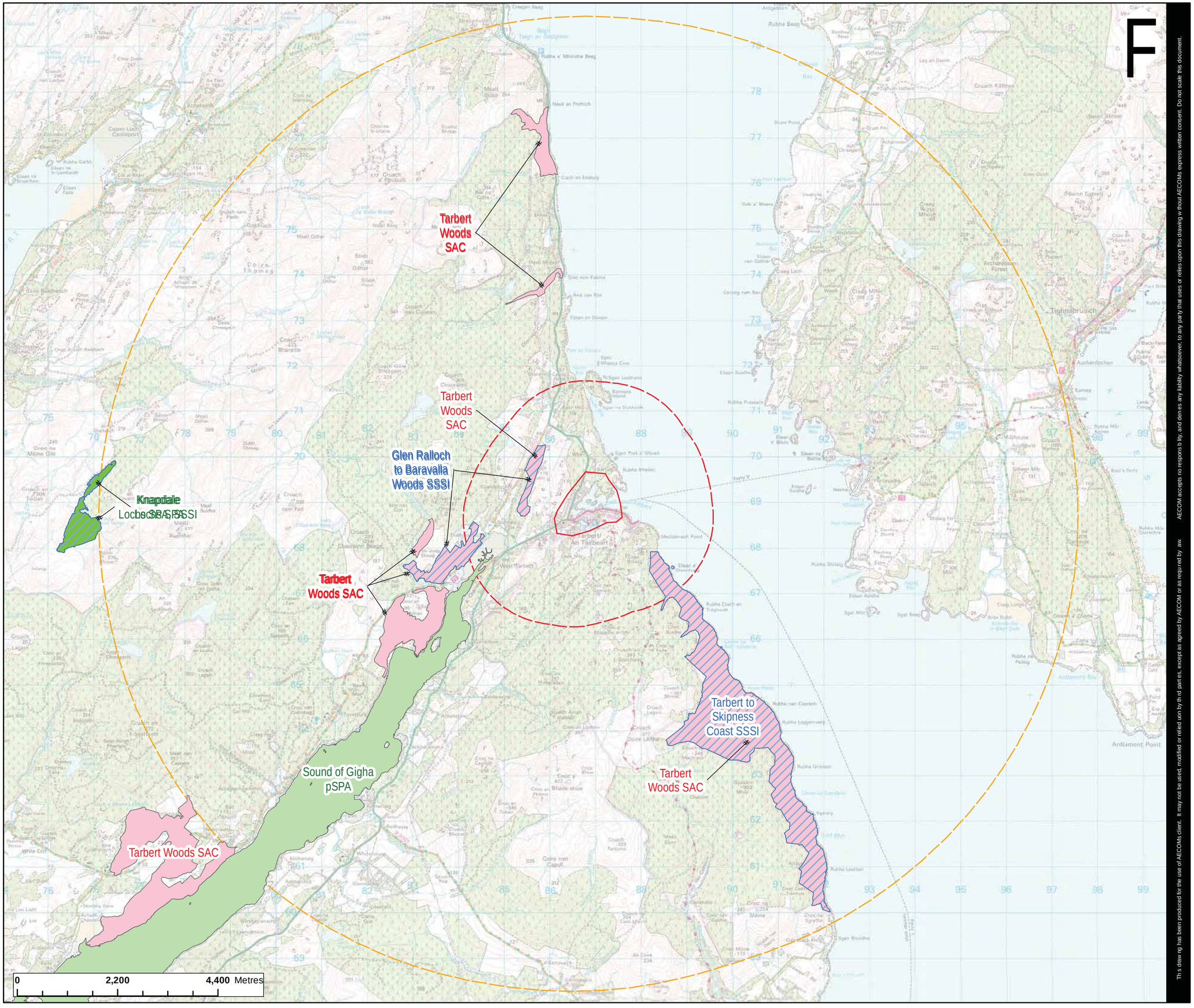
The options identified above could be proposed as standalone options or could be used in combination with multiple options. The next phase will look to take the short list and group options where appropriate and develop more detail to enable the high level costs to be established, assessment of the benefit and ranking of these final options.

Next steps are detailed below:

- Group options if appropriate in consultation with ABC,
- Model short listed options/group of options,
- Concept design of options,
- Cost options,
- Damage assessment post options,
- Cost benefit analysis – including economic, environmental and social appraisals,
- Produce appraisal summary tables,
- Report on findings in report and through public consultation; and,
- Identify preferred option (s)

Appendix A – Figures

Project Management Initials: DH Designer: MH Checked: HH Approved: DH



Scale 1:2000 @ A3

AECOM

PROJECT

Tarbert Flood Study

CLIENT

Argyll & Bute Council

KEY:

- Site boundary
- 2 km buffer
- 10 km buffer

Statutory designations

- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Potential Special Protection Area (pSPA)
- Sites of Special Scientific Interest (SSSI)

PROJECT NUMBER

60578115

Tarbert Flood Protection Scheme Desk-study

Figure 2: Location of Statutory Designated Sites

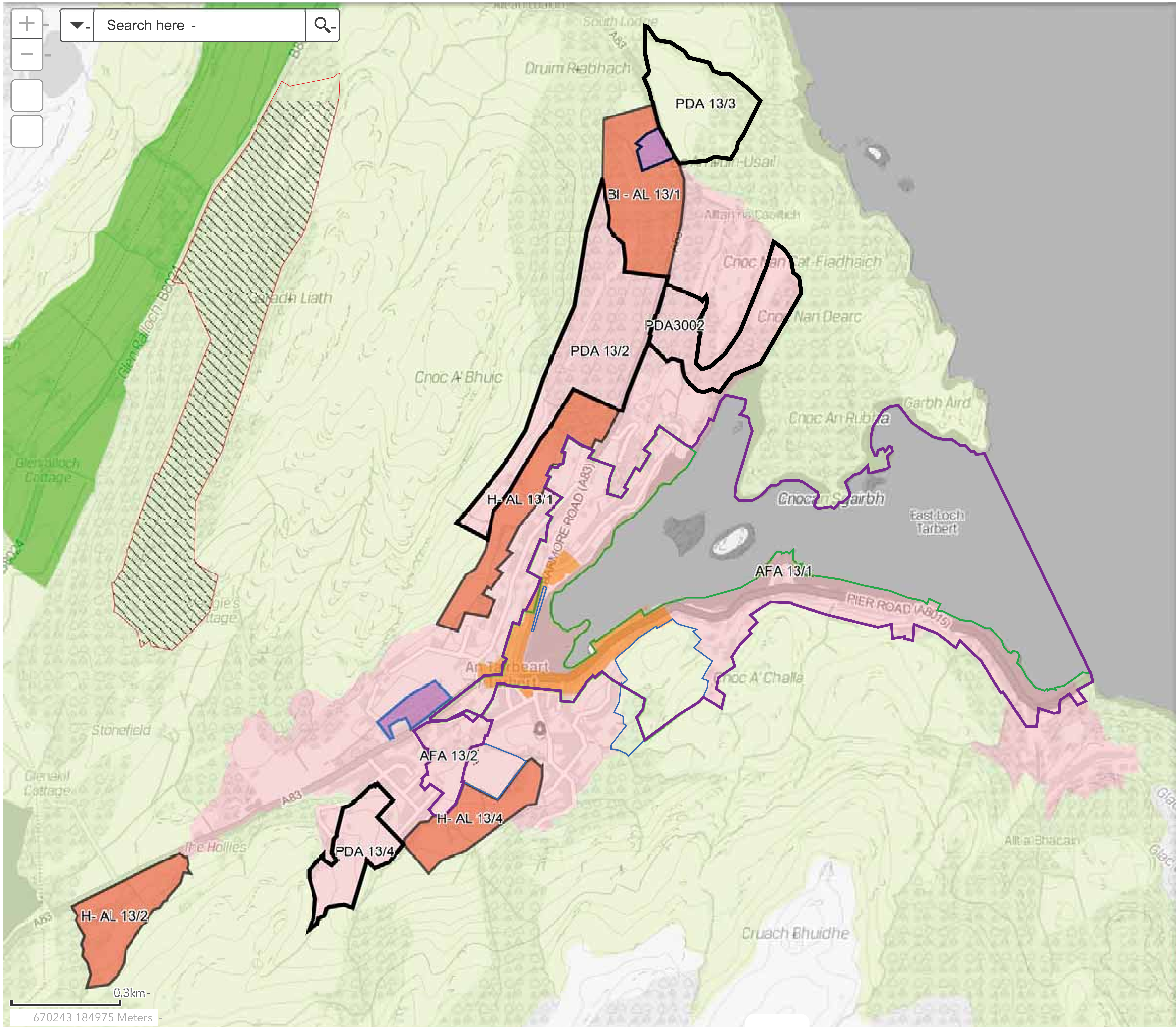
SHEET NUMBER

2 of 4

Argyll and Bute Local Development Plan 2015 App -

Click here for more information on the LDP

Search here -



Legend -

Area for Action -

Open Space Protection Area -

Allocation -

Potential Development Area -

Special Built Environment Area (SBEA) -

Conservation Area -

SSSI -

Town Centres -

- Main Town Centres -
- Edge of Centre -

Established Business and Industry Area -

Development Management Zones -

- Countryside Zone -
- Greenbelt -
- Rural Opportunity Area -
- Settlement Zone - Main Town -
- Settlement Zone - Key Settlement -
- Settlement Zone - Key Rural Settlement -

Appendix B – Ecology and Environmental Preliminary Appraisal

Tarbert Flood Study

Desk-based Preliminary Ecological Appraisal

Argyll and Bute Council

Project number: 60578115

22 March 2019

Quality information

Prepared by	Checked by	Verified by	Approved by
Claudia Ardrey Graduate Ecologist	Sara McBride Senior Ecologist	Tony Marshall MCIEEM Principal Ecologist	Sally Homoncik C.WEM Senior Geomorphologist

Revision History

Revision	Revision date	Details	Authorized	Name	Position

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared for: Argyll and Bute Council

Argyll and Bute Council

Prepared by:

AECOM
Apex 2
97 Haymarket Terrace
Edinburgh EH12 5HD, United Kingdom

T +44-(0)131-347-1100
aecom.com

Table of Contents

Figures

Tables

1. Introduction

AECOM has been commissioned by Argyll and Bute Council (ABC) to undertake a Flood Study for the town of Tarbert, Argyll and Bute (hereafter referred to as the 'Scheme').

The Study is in the early stages of development and detailed design of works required to alleviate flooding are not yet known. Therefore, this Report refers to a general proposed scheme area (hereafter referred to as "the Site") as defined on Figure 1. This area (central grid reference NR 86825 68939) encompasses part of East Loch Tarbert, Tarbert town and surrounding land and watercourses.

The purpose of this report is to provide a high level desk-based Preliminary Ecological Appraisal assessing the potential ecological risks and opportunities associated with the Scheme. The report identifies the scope of further work that would be required to progress the project including the submission of a planning application. High level recommendations are made on Scheme options for the avoidance or minimisation of the potential impacts of the Scheme on identified ecological receptors, and of potential enhancements to biodiversity and/or ecosystem services.

The approach applied when undertaking this appraisal accords with the Guidelines for Preliminary Ecological Appraisal published by the Chartered Institute of Ecology and Environmental Management (CIEEM) (CIEEM, 2013). The approach addresses relevant wildlife legislation and planning policy as summarized in Section 2 of this report, and is consistent with the requirements of British Standard 42020:2013 Biodiversity. Code of Practice for Planning and Development.

The purpose of the PEA was to:

- identify general habitat types present within the Scheme area and any areas immediately outside of the Scheme where there may be potential for direct or indirect effects (the "zone of influence");
- carry out an appraisal of the potential of the habitat types identified to support protected or notable species of fauna and flora; and,
- provide advice on any potential ecological constraints and opportunities, including providing recommendations for further field survey which may be required to inform the detailed design of the Scheme.

2. Wildlife legislation & planning policy

Wildlife legislation

The following wildlife legislation is potentially relevant to the proposed works:

- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive');
- Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive');
- Directive 2000/60/EC establishing a framework for Community action in the field of water policy (the 'Water Framework Directive' (WFD));
- Regulation (EU) No 1143/2014 on the prevention and management of the introduction and spread of invasive alien species ('Invasive Alien Species Regulation');
- Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland) (the 'Habitats Regulations');
- Wildlife & Countryside Act 1981 (as amended in Scotland) ('WCA');
- Nature Conservation (Scotland) Act 2004 (as amended);
- Wildlife & Natural Environment (Scotland) Act 2011 (as amended) ('WANE Act');
- Protection of Badgers Act 1992 (as amended in Scotland); and,
- Conservation of Salmon (Scotland) Regulations 2016 ('Salmon Regulations').

The above legislation has been considered when planning and undertaking this PEA using the methods described in Section 3, when identifying potential constraints to the proposed works, and when making recommendations for further survey and potential mitigation requirements, as discussed in Section 5. Compliance with legislation may require the attainment of relevant protected species licences prior to the implementation of the proposed works.

Further information on the requirements of the above legislation is provided as Appendix A.

National planning policy

Scottish Planning Policy (SPP) 2014 recognises the environment as a national asset offering opportunities for enjoyment, recreation and sustainable economic activity. In summary, the policy principles most relevant to nature conservation state that the planning system should:

- facilitate positive change while maintaining / enhancing distinctive landscape character;
- conserve and enhance protected Schemes and species, maintaining healthy ecosystems and the natural processes which provide important services to communities;
- protect and improve the water environment and soil;
- protect and enhance ancient woodland, hedgerows and trees with high ecology/landscape value; and,
- seek biodiversity benefits from new development where possible.

SPP also sets out the biodiversity duty of public bodies and the legislative requirements for protected sites and species.

It is also Scottish Government policy to treat Wetlands of International Importance (Ramsar site) in the same way as Natura 2000 sites (Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), and to treat candidate, potential or proposed Natura 2000 / Ramsar sites, as well as areas identified as compensation sites for adverse effects on these designations, as if they were fully designated.

Local planning policy

Relevant local planning policies for ABC are included in the Argyll and Bute Local Development Plan (LDP), adopted March 2015. This LDP includes the following policies relevant to nature conservation:

- Policy LDP STRAT 1 – Sustainable Development: states that in preparation of new development proposals, developers should seek to conserve and enhance the natural and built environment and avoid significant adverse impacts on biodiversity, natural and built heritage resources. They should also avoid having significant adverse impacts on land, air and water environment;
- Policy LDP 3 – Supporting the Protection, Conservation and Enhancement of our Environment: in all development management zones, Argyll and Bute Council will assess applications for planning permission with the aim of protecting, conserving and, where possible, enhancing the built, human and natural environment. There is extensive supporting guidance detailing the mechanism of this policy delivery;
- Policy LDP 5 – Supporting the Sustainable Growth of Our Economy: this policy in part aims to help deliver sustainable growth through focussing on regeneration activity and promoting environmental enhancement; and,
- Policy LDP 10 – Maximising our Resources and Reducing Our Consumption: ABC will support development proposals which seek to maximise resources and reduce consumption where they accord with (amongst others) minimising impact on the water environment, minimising impact on biodiversity and the natural environment, avoiding the loss of trees and woodland and avoiding the disturbance of carbon rich soils.

ABC has also produced a technical note for planners and developers to provide guidance and ensure that development meets the requirement to address and protect biodiversity in the planning and development process.

The Argyll and Bute Biodiversity Action Plan (BAP) (2010 to 2015) contributes to the biodiversity conservation aims, objectives and actions described at a national level and to the delivery of a number of other strategies and plans relevant to the biodiversity of the Council area. Specifically it details six ecosystem works programmes to be delivered by the plan and lists habitats and species selected for action. Habitats selected for action that may be relevant to the Development include upland oak *Quercus* woodland, lowland mixed deciduous woodland, rivers and blanket bog. Priority species for conservation action include Greenland white-fronted goose *Anser albifrons* ssp. *flavirostris,* black grouse *Tetrao tetrix,* osprey *Pandion haliatetus,* red squirrel *Scurius vulgaris,* otter *Lutra lutra* and soprano pipistrelle *Pipistrellus pygmaeus*. The 2010 to 2015 BAP has not yet been superseded but is currently being re-drafted.

The above planning policy has been considered when assessing potential ecological constraints and opportunities identified by the desk study and when assessing requirements for further survey and potential ecological mitigation, as described in Section 5.

3. Methods

This PEA was limited to desk-based study and no field survey was carried out to inform the assessment.

A desk study was carried out to identify nature conservation designations, and protected and notable habitats and species potentially relevant to the Scheme.

A stratified approach was taken during the desk study, based on the likely zone of influence of the various options for the Scheme on different ecological features and the maximum distances typically considered by statutory consultees. Accordingly, the desk study sought to identify:

- any international nature conservation designations within 10 km of the Site;
- other statutory nature conservations designations within 2 km of the Site;
- local non-statutory nature conservation designations within 1 km of the Site; and,
- protected / notable habitats and species within 2 km of the Site.

Combined, these areas are referred to as the 'Desk Study Area'. Statutory designations further afield were also considered if impacts were possible, such as on water-related features of interest via connecting watercourses, or if the features of interest included mobile species for which Scottish Natural Heritage (SNH) require wider search distances (such as geese).

Greenland white-fronted goose *Anser albifrons* ssp. *flavirostris* is known to utilise the Kintyre area, to the south of Tarbert, during the non-breeding season. To define the Desk Study Area in relation to this species, its local range was examined. In a report commissioned by SNH, Pendlebury *et al* (2011) identified that the core foraging range of Greenland white-fronted geese in Kintyre is between 5 – 8 km from roost sites. It was therefore considered reasonable to adopt a 10 km Desk Study Area in relation to SPAs designated for this species.

The desk study was carried out using the data sources detailed in Table 1. For the purposes of this PEA protected and notable habitats and species included:

- all species listed on Schedules 2 and 4 of the Habitats Regulations;
- all species listed on Schedules 1, 5 and 8 of the WCA;
- all species of birds listed on Annex I of the Birds Directive;
- all qualifying features of European designated sites within 10 km of the Site;
- species and habitats considered of principal importance for nature conservation in Scotland through inclusion on the Scottish Biodiversity List (SBL);
- priority habitats and key species in the Argyll and Bute BAP;
- species that are Nationally Rare, Nationally Scarce or listed in national or local Red Data Lists;
- bird species on the Red List of Birds of Conservation Concern (BoCC, Eaton *et al,* 2015); and,
- invasive non-native species of UK concern, such as those identified on Schedule 9 of the WCA (although this no longer legally applies in Scotland) and those considered species of EU concern under the EU Invasive Alien Species Regulation.

Table 1. Desk study data sources

Data source	Accessed	Data obtained
Natural England (NE) MAGIC webpage	05/02/2019	• International statutory designations within 10 km. • Other statutory designations within 2 km.
SNH Natural Spaces webpage	05/02/2019	• Dataset for Ancient Woodland in Scotland.
Argyll and Bute Council website	06/02/2019	• LDP policies relevant to nature conservation. • Local Biodiversity Action Plan (LBAP) information.
Scottish Environment Protection Agency (SEPA) River Basin Management Plan (RBMP) https://www.sepa.org.uk/data-	06/02/2019	• Status of waterbodies / watercourses.

Data source	Accessed	Data obtained
visualisation/water-environment-hub/		
NBN Atlas Scotland	11/02/2019	• Commercially available biological records.
Scotland's Environment Web https://www.environment.gov.scot/	06/02/2019	• Habitats and connectivity relevant to interpretation of planning policy and potential protected / notable species constraints.
Ordnance Survey (OS) 1:25,000 maps and aerial photography	17/02/2019	• Habitats and connectivity relevant to interpretation of planning policy and potential protected / notable species constraints.
		•

Limitations

Desk study information is dependent on people and organisations having submitted records for the area of interest. As such, lack of records for particular habitats or species does not necessarily mean they are absent from the area of interest. Similarly, the presence of records for particular habitats and species does not automatically mean they still occur within the area of interest or are relevant in the context of the Scheme.

Aerial photography and Google Street View imagery were utilised to glean an overview of habitats (and species) present within the Site. Google Street View Imagery was from 2016/2015 and aerial photography is from an unknown date. It is possible that habitats / conditions on Site have changed since these photos were taken. Furthermore, given the level of detail available from these sources, it is likely that some features on could not be viewed at all, or viewed in sufficient detail for robust appraisal.

The layer used from the Scotland's Environment webpage to distinguish the main habitat types within the desk-study area is made up of the best available national data classified according to the EUNIS (European Nature Information System). Consequently, smaller habitat areas may have been missed, therefore lack of habitat records does not necessarily mean they are absent and could still occur within the desk-study area.

Biological records information is dependent on records having been submitted for the area of interest. As such, a lack of records for particular habitats or species does not necessarily mean they are absent from the area of interest. Similarly, the presence of records for particular habitats and species does not automatically mean they still occur within the area of interest or are relevant. No specific data request was made to the local records centre (Argyll Biological Records Centre (ABRC)), however all records collated by this centre are available for commercial use on the NBN Atlas Scotland.

4. Results

Nature conservation designations

Statutory designations

Two statutory sites of international importance are located within 10 km of the Scheme. Tarbert Woods SAC is located 0.6 km west of the Scheme. The Sound of Gigha potential Special Protection Area (pSPA) is located 1.5 km south-west of the Scheme. .

Two Marine Protected Areas (MPA) are located within 20 km of the Scheme: Upper Loch Fyne and Loch Goil MPA and Loch Sween MPA, both sites are located over 14 km to the north and north-west of the Scheme.

Three Sites of Special Scientific Interest (SSSI) were found within 2 km of the Scheme: Glen Ralloch to Baravalla Woods, Tarbert to Skipness Coast and Knapdale Lochs (also a SPA). These sites area 0.6 km, 1.2 km and 9.9 km distant from the Scheme; respectively.

Table 2 details the reasons the statutory designated sites reported above have been designated, and describes their spatial relationship and connectivity to the Scheme. The sites are listed in descending order, with those closest to the Scheme listed first. Figures 2 and 3 illustrate the location of the statutory designations in relation to the Scheme.

Table 2. Statutory designated sites for nature conservation

Designation Name	Designation	Reason(s) for designation	Relationship to the Scheme
Tarbert Woods	SAC	Annex I habitat - old sessile oak woods. A large coastal strip of fragmented broad-leaved woodland exists in this site with good stand of old sessile oak woods which are very important for their oceanic bryophyte (moss and liverwort) communities.	This SAC is split into eight distinct areas all within 10 km of the Scheme. One section of this SAC is located 1.2 km directly south-east from the Scheme on the banks of East Loch Tarbert (this area is also designated as the Tarbert to Skipness Coast SSSI, see below). The town of Tarbert (and therefore the Scheme) is also located on the banks of this loch. 1.5 km of intervening coastal habitat exists between the scheme and site; therefore there is potential connectivity between these locations via the loch. Two sites north of the scheme contain watercourses that flow directly into Loch Fyne, which in turn flows into East Loch Tarbert. No direct connectivity between the Scheme and other parts of this SAC (including via watercourses) has been identified.
Glen Ralloch to Baravalla Woods	SSSI	Semi-natural ancient oak woodland which supports nationally and internationally important bryophyte and lichen assemblages.	This SSSI is split into two distinct areas 0.6 km, and 1.5 km west of the Scheme. Watercourses exist close to (and potentially within) the Scheme area which may drain into West Loch Tarbert, the banks of which are coincident with the boundary of the further away location of the SSSI. Therefore, connectivity may exist between the SSSI and the Scheme.
Tarbert to Skipness Coast	SSSI	Designated for upland oak woodland and bryophyte assemblage. The site contains a narrow strip of coastal woodland and wet heath.	1.2 km south-east of the Scheme. This site is directly connected to the Scheme via 1.5 km of coastal habitat along Loch Fyne and East Loch Tarbert.
Sound of Gigha	pSPA	Wintering populations of great northern diver *Gavia immer,* common eider *Somateria mollissima* and red-breasted merganser *Mergus serrator* of European importance.	This pSPA is located1.5 km south-west of the Scheme on the opposite coast of the peninsula. Watercourses exist close to (and potentially within) the Scheme area which may drain into West Loch Tarbert which is encompassed by the pSPA. Therefore, connectivity may exist between the SSSI and the Scheme. As this designation is still proposed and is not a finalised SPA, please note that pSPA boundaries may be subject to change prior to final approval.

Designation Name	Designation	Reason(s) for designation	Relationship to the Scheme
Knapdale Lochs	SPA, SSSI	The site holds the most southerly regular breeding population of black-throated diver *Gavia arctica* in Britain and is of high productivity and European importance.	This SPA/SSSI consists of multiple sites, the closest of which is 9.9 km west of the Scheme, no direct connectivity exists. East Loch Tarbert within the desk-study area may be used as "functional land" for foraging birds from the SPA/SSSI in winter.
Upper Loch Fyne and Loch Goil	MPA	A multi-feature MPA for seabed habitats.	14 km north with direct connectivity to the Scheme via Loch Fyne.
Loch Sween	MPA	A sea loch designated for burrowed mud, maerl beds, native oysters and sublittoral mud and mixed sediment communities.	16 5 km north-west of the Scheme. Intervening terrestrial land largely consists of upland habitats (likely to be heath and bog) and plantation woodland. No connectivity is likely via these habitats. Limited connectivity exists via the coast as Loch Sween connects with the Sound of Jura which connects to West Loch Tarbert.
Kintyre Goose Roosts	SPA	Five hill lochs with grassland and heath which supports an important population of Greenland White-fronted Goose *Anser albifrons flavirostris.*	The closest loch to the Scheme is situated 19.3 km south. Intervening land is largely woodland, grassland and heathland with areas of blanket bog. No connectivity has been identified and land within the Scheme area is unsuitable as functional land given the qualifying interests of the SPA.

Notable habitats

Woodland included on the Ancient Woodland Inventory exists in the desk-study area as indicated on Figure 4. The only AWI woodland within the Scheme area is an area of long-established woodland of plantation origin adjacent to Cnoc Mor located on the north shore of East Loch Tarbert. Further afield extensive areas of ancient woodland of semi-natural origin exists (mostly to the west of the Scheme), including some associated with the designated sites described above. The majority of other AWI areas are long-established woodland of plantation origin, largely located to the north of the Scheme. Small pockets of other woodland on 'Roy' maps (i.e. woodland which exists on early OS mapping but which has not been continuously wooded since) can be found within 2 km of the Scheme, the closest area located 0.5 km to the west.

Based on this high level search the possible habitats listed under SBL (and also LBAP) that could exist within the Scheme area include upland oak woodland, upland mixed ash woods, lowland mixed deciduous woodland, native pine woodland, upland flushes, fens and swamps, streams, lowland and upland heath and lowland fens. These categories are all the subject of separate chapters within the LBAP, which stipulates actions to maintain and improve these habitats.

Aerial photography and web based searches indicate that the majority of habitats within the Scheme consist of coniferous plantation woodland and heathland with smaller areas of cultivated land.

Located throughout the Scheme area there are multiple waterbodies which flow down into East Loch Tarbert and potentially into West Loch Tarbert. Both lochs have been classified as having "good" water quality under Scottish Environment Protection Agency (SEPA) River Basin Management Plan.

Within the centre of the Scheme lies the town of Tarbert with small areas of green space in the form of residential gardens.

Protected and notable species

A list of protected and/or notable species for which records are held by the NBN Atlas Scotland, along with source accreditation, is provided in Appendix 2. Where records are referred to below, accreditation to the organisation which supplied the data (if known) is provided in brackets.

Mammals

Commercially-available records on the NBN Atlas Scotland indicate that red squirrel *Sciurus vulgaris,* listed under Schedule 5 of the Wildlife & Countryside Act 1981, have been recorded within the Scheme area. The most recent record was recorded to the north-west of the Scheme in 2012. Furthermore, potentially suitable habitat for red

squirrel is likely to be present within the area. This includes deciduous and coniferous plantation woodland to the north of the Scheme which is likely to provide sufficient resources for foraging and refuge.

The only other notable terrestrial mammal records returned from the NBN Atlas was Sika deer *Cervus nippon*. Sika deer are non-native to the UK and as such (under the WANE Act) it is an offence to release this species or allow it to escape from captivity – such actions are not relevant to this Study and as such this species is not considered further.

All UK bat species are European Protected Species (EPS) and many are on the Scottish Biodiversity List.. Habitats within the Scheme area are considered very likely to be suitable for foraging and commuting bats as they consist of woodland and urban areas connected via woodland edges, hedgerows, residential gardens and small watercourses / riparian vegetation. The shore and inner areas of East Loch Tarbert are also highly likely to be used by foraging and commuting bats. Woodland habitat may provide trees with bat roost suitability and aerial photography indicates some houses within Tarbert town are stone built with slate roofs and therefore could be suitable for roosting bats.

Pine marten *Martes martes* is listed on Schedule 5 of the WCA and the SBL. This species now has a wide range in parts of Scotland, including in Argyll, and favours mature woodland habitat with suitable tree cavities/similar features for resting and breeding. Potentially suitable habitats for this species include pockets of deciduous woodland across the desk-study area and an area of ancient woodland of plantation origin within the Scheme area (near Cnoc Mor on the north shore of East Loch Tarbert). Additionally, an area of coniferous woodland to the north-west of the Scheme which expands into the surrounding area is also potentially suitable.

Badger *Meles meles,* which is protected under The Protection of Badgers Act 1992 and is listed on the SBL, may be present. They are known to favour woodlands (particularly deciduous woodland), moorland and improved fields as they provide good foraging habitat. The majority of the habitats out with Tarbert town consist of pockets of woodland within heath and moorland. Furthermore, many of the wooded areas are located on slopes which would be suitable for badger setts. Therefore, it is possible badgers are within the Scheme.

Otter *lutra lutra* are EPS and listed on the SBL. Watercourses and adjacent habitats throughout the Scheme area could be used by otter for foraging, commuting and refuge. Otters may also use the coastal region adjacent to East Loch Tarbert. Areas that are restricted by culverts would be less suitable for otter as this would provide restrictions on movement.

Water vole *Arvicola amphibius* (protected by Schedule 5 of the WCA) favour grassy banks along slow moving rivers and streams and can also be present in marshland and upland habitats. Such habitat occurs throughout the Scheme area which may support populations of water vole.

Wildcat *Felis sylvestris* is an EPS and SBL species and a key species in the Argyll and Bute LBAP. The Scheme and surrounding area is at the southern extent of the known range of the wildcat which is generally described as being north of the highland fault line (Scottish Wildcat Action, 2015). The wildcat favours areas away from highly populated zones and requires a range of habitat types with woodland (including edge habitat), moorland and rough grazing being important. Due to the majority of the Scheme area being in / near the town of Tarbert this species is unlikely to be present within the zone of influence of the Scheme.

Birds

Records of eight notable bird species were found within the search area; all are included as red or amber under the Birds of Conservation Concern (BoCC) list (Eaton et al, 2015). Most of these species are considered to be common and widespread and due to the extent of the Scheme, and the variety of habitats contained within it (including buildings, hedgerows, woodland, heathland and coastal areas) it is likely that these species (amongst many other common species) are present and breed within the Scheme area. Two species were recorded to be present which are also included on the SBL, curlew *Numenius arquata* and lapwing *Vanellus vanellus*. Suitable breeding habitat for curlew includes rough ground and tussocky vegetation in upland habitats such as moorland, wet grassland and heath this moves towards coastal habitats during winter. Lapwings prefer open areas where vegetation is short and can be found within farmland, moorland, grassland, marshes and estuaries. Therefore, these species may be present within the Scheme area.

Schedule 1 (WCA) bird species for which suitable habitat exists within the Scheme area may include hen harrier *Circus cyaneus*. Hen harrier favour heather moorland and immature forest plantation in upland areas, such habitat exists around the peripheries of the Scheme area.

Habitat suitable to support black grouse (a SBL and BoCC red listed species) may also potentially be present. Black grouse favour a mixture of mature woodland and scrub layer with a patchwork of young trees with an understory of heather and bog areas with a diverse invertebrate population. Areas of woodland/heath habitat which may be potentially suitable are present in the south of the Scheme area.

As noted above there are several internationally designated sites for notable bird species within the wider scheme area. Such species include great northern diver, common eider, red breasted merganser and black throated diver. There is habitat present within the Scheme area (particularly East Tarbert Loch) which may be used by these bird species during the breeding, passage and over wintering periods.

Aquatic and invertebrate species

No commercially available records were found of protected or notable aquatic or invertebrate species (including fish species) within 2 km of the Scheme. Aerial photography and OS mapping indicate multiple small watercourses exist in the Scheme area. Even though no records of protected/notable species were returned, lack of records does not necessarily mean they are absent from the area. It is possible that watercourses within the Scheme area and East Loch Tarbert may represent suitable habitat to support notable fish and invertebrate species. Suitability of certain watercourses may be reduced as OS mapping indicates several are partially culverted beneath Tarbert town. Culverts can pose a significant barrier to fish movement, especially if perched or barred.

Amphibians & reptiles

No records of great crested newt *Triturus cristatus* or other notable amphibian species were found within 2 km of the Scheme. OS maps indicate a pond surrounded by heath and woodland within the Scheme area south of East Loch Tarbert near Tarbert Castle. This pond, however, does not appear on aerial photography. The watercourse flowing from the pond is culverted and appears to flow into East Loch Tarbert.

No records of protected or notable reptiles were found within 2 km of the Scheme. Adder *vipera berus* and common lizard *Zootoca vivipara* (both protected under the WCA) are widespread across Scotland and utilise grassland, woodland, heathland habitats; aerial photography indicates such suitable habitat is present within the Scheme area.

Lichen, Bryophyte and Algae species

Four species of lichen and 1 alga species have been recorded within 2 km of the Scheme, these are either included on the SBL or are Nationally Scarce. Four of the lichen species recorded (*Arthonia ilicina, Cladonia f coccifera s. lat., Micarea adnata* and *Hypotrachyna sinuosa)* occur in coastal woodlands in this region and are within the Tarbert to Skipness Coast SSSI and Tarbert Woods SAC. The algae species (*Phymatolithon calcareum)* was recorded 1.9 km north of the Scheme in coastal coniferous woodland and is mainly found in western woods on acidic bark and lignum. Coastal woodland potentially suitable for notable lichen species is present within the northern extent of the Scheme. No records of bryophyte species were returned however interrogation of SSSI and SAC citations highlight the importance of the general scheme area for notable bryophyte species. The Glen Ralloch Burn outwith the Scheme area to the north west is included in the SNH commissioned project 'Bryological assessment for hydroelectric schemes[1] in the West Highlands' (Averis *et al*, 2012). It was categorised as potentially important for notable oceanic bryophyte communities and four such species are currently confirmed as present. Habitats within the Scheme area (particularly riparian and woodland habitats) have potential to support populations of notable bryophytes.

Invasive non-native species

No records of non-native species (except from Sika deer – see above) were returned. However, given the extensive presence of such species throughout Scotland, including terrestrial and aquatic plants and invertebrates, it is possible that invasive non-native species may be present within the Scheme area.

[1] Although this assessment related specifically to hydro-electric schemes, flood schemes have the potential to result in changes in hydrology and therefore similar impacts.

5. Ecological constraints & recommendations

Approach to the identification of ecological constraints

Scottish Planning Policy and local planning policy (summarised in Section 2 of this report) specify requirements for the protection of features of importance for biodiversity, and requirements for the protection of sites of conservation importance. Planning policy is a material consideration when determining planning applications.

Compliance with planning policy requires that the proposed works considers and engages the following mitigation hierarchy where there is potential for impacts on relevant ecological receptors:

1. avoid features where possible;

2. minimise impact by design, method of working or other measures; and,

3. compensate for significant residual impacts, for example by providing suitable habitats.

This hierarchy requires the highest level to be applied where possible. The rationale for the proposed mitigation and/or compensation should be provided with planning applications, including sufficient detail to show that these measures are feasible and would be provided.

The likelihood of the relevant ecological features constraining the proposed works has been assessed with reference to the scale described in Table 5. The higher the importance of the ecological receptor for the conservation of biodiversity at national and local scales, the more likely it is to be a material consideration during determination of the planning application for the proposed works.

In pursuance of the objective within Scottish Planning Policy of providing biodiversity benefits where possible, consideration should be given (where appropriate) to scope for enhancement as part of the proposed works. This should represent biodiversity gain over and above that achieved through mitigation and compensation. Enhancement could be achieved on and/or off the Scheme.

Table 3. Scale of constraint to development

Likelihood	Definition
High	An actual or potential constraint that is subject to relevant legal protection and is likely to be a material consideration in determining the planning application (e.g. statutory nature conservation designations and European/nationally protected species). Further survey likely to be required (as detailed in this report) to support a planning application.
Medium	An actual or potential constraint that is covered by national or local planning policy and, depending on the level of the potential impact as a result of the proposed works, may be a material consideration in determining the planning application. Further survey may be required (as detailed in this report) to support a planning application.
Low	Unlikely to be a constraint to works or require further survey prior to submission of a planning application. Mitigation is likely to be covered under Construction Environmental Management Plan (CEMP) or precautionary working method statement (e.g. generic requirements for the management of nesting bird risks).

Constraints & recommendations: designations

Statutory designations

Tarbert Woods SAC

The qualifying features of the Tarbert Woods SAC comprise of Habitats Directive Annex 1 habitats consisting of a large strip of fragmented broadleaved woodland with a stand of old sessile oak woods, which are very important for their oceanic bryophyte communities. These communities are dependent upon aquatic features which may be affected by the Scheme. The SAC is split into multiple areas; the nearest location is 0.6 km west of the Scheme. Four areas are directly connected through water channels which either flow directly into East Loch Tarbert which is within the Scheme boundary, or contain water channels that flow into Loch Fyne that is directly connected to East Loch Tarbert. Given the distances involved and the Scheme being downstream of the SAC component areas, any pollution events are unlikely to be of a significant scale to affect this designation. As well as dilution effects, strict pollution prevention measures may have to be put in place during construction of the Scheme to avoid such pollution events occurring in the first place.

Given the above, the Tarbert Woods SAC is considered to pose a **Low** constraint to the Scheme.

Glen Ralloch to Baravalla Woods SSSI

Glen Ralloch to Baravalla Woods SSSI is split into two distinct areas, the closest of which is located 0.6 km west of the Scheme. It is comprised of semi-natural ancient oak woodland which supports nationally and internationally important assemblages of bryophytes and lichens. There is no direct connectivity through water channels from this area of the SSSI to the Scheme.

Given the above information the Glen Ralloch to Baravalla Woods is considered to be of **No** constraint to the Scheme.

Tarbert to Skipness Coast SSSI

The Scheme is designated for upland oak woodland and bryophyte assemblages and contains a narrow strip of coastal woodland and wet heath. The SSSI is 1.2 km south-east of the Scheme. There is connectivity from the Scheme to the SSSI via Loch Fyne. As the proposed works are for a flood defence scheme, the works will have a close association with this Scheme as it contains features listed which are dependent on the water environment. Due to the distance between the Scheme and the SSSI, any pollution events are unlikely to be of a significant scale to affect this designation. In addition to dilution effects, mitigation procedures such as strict pollution prevention measures would have to be put in place during construction of the Scheme to avoid such pollution events arising in the first instance.

Given the above, the Tarbert to Skipness Coast SSSI is considered to pose a **Low** constraint to the Scheme.

Sound of Gigha pSPA

It is Scottish Government policy to treat pSPAs as if they were fully designated SPAs and the Sound of Gigha pSPA should be considered as thus. Proposed marine SPAs were scheduled for final submission to Government in February 2018; however no formal full designation has yet been announced. Despite this, there is potential for this pSPA to be fully protected within the schedule for implementation of the Scheme. This Scheme is on the opposite coast of the Kintyre peninsula and is located 1.5 km south-west of the Scheme. All three species for which it is classified (wintering great-northern diver, eider and red-breasted merganser) can be found in coastal areas and feed on fish. Habitats within the Scheme boundary therefore could provide functional to the SPA. The risk to this pSPA is the potential pollution to East Loch Tarbert which would cause direct harm to the pSPA bird species and could have a negative impact on their food source. Therefore it is possible there may be a likely significant effect (LSE) which could affect the integrity of the pSPA. As a result it is recommended that an HRA Screening assessment is carried out in relation to the proposed Scheme. SNH should be involved throughout the Screening process and approached for any relevant data they may hold. Strict pollution prevention measures would have to be put in place during construction to avoid such pollution events arising in the first instance.

Given the above, the Sound of Gigha pSPA is considered to pose a **Medium** constraint to the Scheme.

Knapdale Loch SPA/SSSI

The Scheme holds the most southerly regular breeding population of black-throated diver in Britain and is of high productivity and European importance. This SPA/SSSI consists of multiple sites, the closest of which can be

found 9.9 km west of the Scheme. The Scheme may be used as “functional land” for foraging by birds from the SPA/SSSI. Black-throated diver move to the coast in winter and feed on fish, therefore East Loch Tarbert may provide suitable habitat for these birds as multiple fish species have been recorded within the area. There is a risk of pollution to East Loch Tarbert which could have a direct negative effect on the birds themselves and the suitable prey within the loch which could affect the integrity of the SPA/SSSI. Therefore it is recommended that an HRA Screening assessment is carried out in relation to the proposed Scheme. SNH should be involved throughout the Screening process and approached for any relevant data they may hold. Mitigation such as strict pollution prevention measures would have to be put in place during construction of the Scheme to avoid such pollution events arising in the first instance.

Given the above, the Knapdale Loch SPA/SSSI is considered to pose a **Medium** constraint to the Scheme.

Loch Sween MPA

Loch Sween MPA is approximately 16 km north-west of the Scheme. The MPA is a sea loch designated due to its burrowed mud, maerl beds, native oysters and sublittoral mud and mixed sediment communities. Given the distance involved, any pollution events are unlikely to be of a significant scale to affect this designation. As well as dilution effects, strict pollution prevention measures may be required during construction of the Scheme to avoid such pollution events occurring in the first place.

Under the legislation by which MPAs are protected (the Marine (Scotland) Act), Scottish Ministers must be notified by a public authority if *“the exercise of any of the authority’s functions, or an activity that the authority intends to carry out, will significantly hinder the conservation objectives of a MPA – unless guidance has been given previously”*.

The MPA is considered to pose a **Low** constraint to the Scheme and it is not considered necessary that such consultation under the Marine (Scotland) Act takes place.

Upper Loch Fyne and Loch Goil MPA

Upper Loch Fyne is a multi-feature MPA designated for seabed habitats and is located 14 km north of the Scheme with direct connectivity to the Scheme via Loch Fyne. Given this large distance any pollution events are unlikely to be of a significant scale to affect this designation. Furthermore, strict pollution prevention measures may be required during construction of the Scheme to avoid such pollution events occurring in the first place.

The MPA is considered to pose a **Low** constraint to the Scheme and a consultation with Scottish Ministers under the Marine (Scotland Act) is not considered necessary.

Kintyre Goose Roosts SPA

The only qualifying feature of this SPA is over-wintering Greenland white-fronted geese. The closest protected area to the Scheme is located 19.3 km south. Greenland white-fronted geese are found within freshwater, farmland and wetland habitats as well as intensively managed grasslands. None of these habitats were found within the Scheme or 2 km buffer zone.

Given the above, Kintyre Goose Roosts SPA is considered to pose **No** constraint to the Scheme.

Constraints and recommendations: habitats

An area of approximately 9.8 hectares of ancient woodland of plantation origin occupies the land to the north of the Scheme boundary. Scottish Planning Policy states that ancient woodland is important and irreplaceable, and that it should be protected and enhanced. Cognisance should be given to this fact during future stages of the Scheme, with ancient woodland loss avoided or minimised.

Woodland within 2 km of the Scheme includes large areas of coniferous and deciduous woodland to the north and scattered areas of woodland to the south. Although these areas of broadleaved woodland are not notable, all broadleaved woodland has ecological value and there is a general presumption in planning policy against its removal without significant public benefit. Removal of any trees to facilitate the Scheme should consequently be minimised.

These habitats are likely only to be important at no more than a local level and would represent a **Medium** constraint to the works.

Habitats described within the Argyll and Bute LBAP which may be affected by the proposed Scheme should be protected. LBAP habitats that may be present win proximity to the Scheme include upland oak woodland, upland

mixed ash woods, lowland mixed deciduous woodland, native pine woodland, upland flushes, fens and swamps, streams, lowland and upland heath and lowland fens. The Argyll and Bute LBAP priorities are to help protect, enhance, conserve and restore biodiversity.

These habitats pose a **Medium** level constraint to the Scheme. Scheme-specific surveys will be required to determine the presence of protected or notable habitats. These surveys can only be conducted once the location and extent of the planned works has been identified.

Depending on the proposed design of the Scheme, there is the potential for pollution events or uncontrolled sediment run-off to impact watercourses and in turn the species that utilise them. Control measures should be implemented during the works to minimise the risk of this occurring, including for example, the implementation of Pollution Prevention Guidelines (PPGs) and Guidance on Pollution Prevention (GPP) (www.netregs.org.uk/). Working practices to be adopted to prevent the pollution should be outlined in relevant Construction Method Statements, and agreed with the relevant body prior to works commencing.

In order to manage the delivery of any ecological mitigation and enhancement works during the construction phase of the proposed scheme a Construction Ecological Management Plan (CEMP) should be implemented

Constraints and recommendations: species

Mammals

Red squirrel

Records of red squirrel have been made within the Scheme boundary. A review of aerial images also suggests that there is suitable habitat for red squirrel in the vicinity of the Scheme. If the Scheme requires the removal of suitable woodland habitat, appropriate surveys would have to be conducted prior to any works taking place.

If the works were to negatively impact this species it would present a **Medium** level constraint to the scheme.

Pine martin and wildcat

No records of pine marten or wildcat were identified within the Scheme or 2 km search area. Suitable woodland habitat, however, is available for both pine marten and wildcat throughout the Scheme. If the Scheme involved the removal of this habitat, it would be appropriate to conduct surveys for both species.

If the works were to negatively impact these species, they may pose a **Medium** level constraint to the scheme.

Bats

Suitable features for bat roosting, foraging and commuting were found across the Scheme. If they are to be impacted by the final design of the Scheme (during construction or operation) any potential features suitable for bats should be subject to further assessment to investigate their use by bats. Depending on the feature this could take several forms. Surveys could include further ground-based investigations using an endoscope, survey of the features at height (using a ladder or climbing techniques) and/or dusk emergence / dawn re-entry surveys during the bat activity season. Activity surveys would also be beneficial in investigating the use of habitat present (within the sites with potentially suitable roost locations). A suitable survey programme should be devised and surveys should follow the guidelines published by the Bat Conservation Trust (BCT) in Collins (2016). All bat species are strictly protected under the Habitats Regulations and their presence is likely to be a material consideration during the planning process.

Therefore, depending on the proposed scheme bats (particularly their roosts) are considered to pose a **Medium** constraint to the scheme.

Badger

No badger records were found within the Scheme or 2 km desk-study area. Suitable habitat for badger, however, was found within the Scheme boundary and surrounding area.

Depending on the proposed works and given the potential presence of badger within the Scheme boundary and surrounding area, this species may pose a **Medium** level constraint to the scheme.

Otter and water vole

Suitable habitat for otter and water vole is likely to be present within the Scheme and 2 km desk-study area. Otters are strictly protected under the Habitats Regulations and water voles are protected under Schedule 5 of the WCA.

Given the probability of there being suitable habitat within the Scheme for otter and water vole, these species are likely pose a **High** level constraint depending on the proposed Scheme.

Birds

No records of great northern diver, common eider and red-breasted merganser were found within 2 km of the Scheme. The Sound of Gigha pSPA is located 1.5 km south-west of the Scheme. All three species, which are proposed qualifying features of this designation, are highly mobile and feed within coastal marine areas. The Scheme is within their distribution area and contains suitable habitat, with records of multiple fish species within East Loch Tarbert.

Knapdale Loch is designated as a SPA and SSSI as it holds the most southerly regular breeding population of black-throated diver. No suitable habitat was found within the Scheme or surrounding area for black-throated diver to breed, however suitable coastal habitat with multiple fish records indicate suitable feeding habitat for this species.

The suitable feeding habitat within the Scheme and surrounding area may operate as functional land associated with the relevant designations and therefore these species are considered to pose a potentially **Medium** constraint on the Scheme. Further survey for these species may be required.

Suitable habitats were found within the Scheme and surrounding area for black grouse. Suitable habitat for hen harrier is also likely to be present. Habitats within the Scheme and surrounding area are potentially suitable as foraging and breeding habitat. If the proposed works were to affect these areas, it is recommended that further surveys be conducted to search for the presence of these species.

These species could therefore pose a **Medium** constraint.

The closest Kintyre Goose Roost designated as an SPA can be found 19.3 km south of the Scheme. The sole qualifying feature of this SPA is over-wintering Greenland white-fronted geese. No suitable foraging or breeding habitat was found within the Scheme or surrounding area therefore it is unlikely Greenland white-fronted geese would utilise the area.

From the information gathered this species would be **No** constraint to the proposed works.

There is potential for common breeding birds in all trees, scrub, ruderal / marginal vegetation and hedges. Active nests of all wild birds are protected under the WCA. A Construction Environmental Management Plan or precautionary working method statement should be produced to manage common nesting bird risks. Clearance of vegetation required to facilitate construction of the Scheme should ideally be undertaken outside the breeding bird season (generally taken to be March to August, inclusive) in order to minimise the risk of offences regarding active bird nests. Failing this, an ecologist with ornithological expertise should inspect vegetation prior to clearance, and where active nest(s) are present the ecologist should establish exclusion zones of appropriate size until such time as they consider the breeding attempt(s) to have finished.

Common breeding birds are considered to pose a **Low** level constraint to the Scheme.

Aquatic and invertebrate species

No commercially-available records on the NBN Atlas Scotland for protected or notable aquatic and invertebrate species were found within 2 km of the Scheme. Multiple narrow watercourses can be seen on aerial and OS maps flowing into East Loch Tarbert. The watercourses that flow into East Loch Tarbert identified on OS mapping appear to be culverted which may cause a barrier to fish, especially if the culverts are perched or barred. No further information, however, could be found using aerial and OS mapping.

It is recommended that the local fisheries group is consulted to investigate the potential presence of notable fish species, and to understand the local fisheries ecology such as runs / spawning periods. Such consultation may also be valuable to highlight the presence of non-native species of invertebrate (such as North American signal crayfish *Pacifastacus leniusculus*) or plant (such as New Zealand pigmyweed *Crassula helmsii*) which both have

the potential to be present (see below). Depending on the consultation data returned, further survey for fish species may be required.

As the Scheme works are inherently associated with water environments, the works could have adverse effects on fish or other aquatic features (if found to be present following the investigations described above), either directly or indirectly and during construction or operation. Once a detailed design is known, such potential effects should be fully investigated as part of an EcIA.

In view of the above, fish and other aquatic species are considered to be a **Medium** constraint to the proposed Scheme.

Amphibians and reptiles

No records of great crested newt, a European Protected Species, were found within 2 km of the Scheme. OS maps indicate a pond surrounded by heath and woodland within the Scheme immediately south of the Royal Castle of Tarbert. The watercourse flowing from the pond is culverted and appears to flow into East Loch Tarbert.

Habitat suitability Index surveys should be carried out on all waterbodies within 500 m of the Scheme. If suitable habitat is identified for great crested newt, further surveys including eDNA testing, bottle trapping and torching may be necessary to confirm their presence.

From this information, great crested newts may pose a **Medium** level constraint to the Scheme.

No commercially-accessible records of notable / protected reptiles were found within 2 km of the Scheme. Adder and common lizard are protected under the Wildlife and Countryside Act 1981 and prefer woodland, heathland and moorland. The Scheme is within the distribution area for adder and common lizard and from aerial photography; apparently suitable habitat can be seen within the Scheme. This consists of a mosaic of heathland, moorland and woodland towards the southern extent of the Scheme.

If suitable habitat were to be destroyed or disturbed by the Scheme, further surveys would be required.

Amphibian and reptile species are deemed to pose a **Low** constraint to the Scheme.

Lichen, algae and bryophytes

Notable lichen, algae and bryophyte species have been recorded within 2 km of the Scheme.

If the Scheme affects habitats with the potential to host notable lichen / algae / bryophyte communities, further survey (or consultation regarding survey requirements) for these species is recommended. Results of these surveys may inform the detailed design of the Scheme, or inform mitigation requirements.

Therefore, notable species / assemblages of lichens and bryophytes are considered to pose a **Low** level constraint to the Scheme.

Invasive non-native species

No records of non-native species (except of Sika deer – see above) were returned. However, given the extensive presence of non-native species (particularly of plants and invertebrates) throughout Scotland it is likely that certain species will be present within the Scheme.

Although no commercially-available NBN records were found for invasive aquatic species, they are of particular relevance given the nature of the proposed Scheme. However, given the extensive presence of these species throughout Scotland it is likely that certain species may occur within the Scheme and surrounding area. American signal crayfish may also be potentially present within the area alongside other less conspicuous non-native invasive species. It is therefore recommended that the local fisheries group is consulted to investigate the potential presence of such notable species. There is no dedicated biological recording group for the Kintyre area, however there are local groups (such as the Heart of Argyll Wildlife Organisation) and it is recommended that local groups are also approached for information. SNH will be consulted on the Scheme as part of the planning process, however pre-planning consultation with SNH is also recommended to highlight the presence of invasive species (or other notable species) as soon as possible.

There are considered to be two primary risks regarding the Scheme and invasive non-native species: the potential movement of invasive plant material during works (i.e. a direct effect), and effects associated with the

nature of the development which will involve amendments to watercourses, culverts and discharge locations which could facilitate new movement / increased movement of such species indirectly.

With regard to non-native plant species, if charged with committing an offence, it is a defence against prosecution to prove that all reasonable steps were taken and all due diligence exercised in attempting to avoid committing the offence. Therefore to demonstrate due diligence and avoid the accidental spread of the non-native species recorded, they should be encompassed within a Biosecurity Management Plan (BMP). Further surveys would be required in order to record the locations of relevant species (including consultation data), assess the risk they pose to the project (once a detailed design is chosen) and set out proportionate measures to be implemented to control these risks. Construction and operational risks should be considered. Careful consideration of species-specific management is also required as the species in question have differing methods and timings of dispersal. Where possible, works should aim to avoid invasive non-native species (plus a suitable buffer) entirely and appropriate biosecurity (cleaning of machinery etc.) must be described in the BMP and fully employed. The BMP must inform all stages of the work proposed, including preliminary tasks such as ground investigation.

Non-native invasive plant species are deemed to pose a **Medium** constraint to the Scheme.

Summary

A summary of the potential ecological constraints associated with the Scheme, and the further survey work and mitigation which may be required, is provided in Table 4 below.

This table excludes features for which no impact is considered possible, which includes Glen Ralloch to Baravalla Woods SSSI

Table 4. Summary appraisal of ecological constraints and recommended further action

				When is action likely to be required		
Feature	**Potential scale of constraint**	**Further action, including surveys and potential mitigation**	**Primary driver**	**To inform design**	**Before planning application**	**Pre-construction onwards**
Target Woods SAC	Low	Strict pollution prevention measures should be put in place during construction of the Scheme to avoid any pollution events.	Legislation		✓	✓
Tarbert to Skipness Coast SSSI	Low	Strict pollution prevention measures should be put in place during construction of the Scheme to avoid any pollution events.	Legislation		✓	✓
Sound of Gigha pSPA	Medium	HRA Screening in consultation with SNH. Further field work potentially required.	Legislation	✓	✓	✓
Knapdale Loch SPA/SSSI	Medium	HRA Screening in consultation with SNH. Further field work potentially required.	Legislation	✓	✓	✓
Loch Sween MPA	Low	Strict pollution prevention measures should be put in place during construction of the Scheme to avoid any pollution events.	Legislation		✓	✓
Upper Loch Fyne & Loch Goil MPA	Low	Strict pollution prevention measures should be put in place during construction of the Scheme to avoid any pollution events.	Legislation		✓	✓
Ancient woodland	Medium	Minimise woodland and tree removal Mitigate any tree loss through replacement with planting of native species within suitable habitat.	Planning policy	✓	✓	✓
LBAP habitats	Medium	Scheme-specific surveys including an initial Phase 1 survey will be required to determine the presence of protected or notable habitats once the location and extent of the planned works have been identified.	Planning policy	✓	✓	✓
Red squirrel	Medium	Depending on Scheme design, further surveys may be required.	Legislation	✓	✓	✓
Pine martin	Medium	Depending on Scheme design, further surveys may be required.	Legislation	✓	✓	✓
Bats	Medium	Depending on detailed design, features identified with bat roost potential should be subject to further survey if they will be impacted upon by construction or operation of the proposed Scheme.	Legislation	✓	✓	✓
Badger	Medium	Depending on Scheme design,	Legislation	✓	✓	✓

Feature	Potential scale of constraint	Further action, including surveys and potential mitigation	Primary driver	When is action likely to be required		
				To inform design	Before planning application	Pre-construction onwards
		further surveys may be required.				
Otter and water vole	High	Field survey likely to be required for both species.	Legislation	✓	✓	✓
Notable bird species	Medium	Species specific survey if relevant habitats will be affected. Implementation of specific mitigation.	Legislation	✓	✓	✓
Common breeding birds	Low	CEMP or precautionary working method statement to manage nesting bird risks. Ideally clear vegetation outside the breeding season (March – August, inclusive, for majority of common bird species). Otherwise carry out checks for active nests and exclude works as necessary until breeding finished.	Legislation			✓
Aquatic and invertebrate species	Medium	Conduct further consultation with local fisheries trust to investigate for the presence of notable species; refine fish mitigation if required. Further invertebrate surveys may be required depending on the scope of works.	Legislation	✓	✓	✓
Great crested newt	Medium	Depending on the scope of works surveys may be required of all waterbodies within 500m of the proposed scheme	Legislation	✓	✓	✓
Other amphibians and reptiles	Low	Survey / mitigation if suitable retile habitat will be affected.	Legislation	✓	✓	✓
Lichen, alga and bryophytes	Low	If suitable habitat for these species will be affected, consultation / further survey required. If significant assemblages present, specific mitigation to be implemented.	Planning policy	✓	✓	✓
Invasive non-native species	Medium	Consult local organisations and SNH to investigate for the presence of INNS, particularly aquatic species which are of particular relevance to the scheme. Further targeted field survey also likely to be required. Produce Biosecurity Management Plan which will include appropriate biosecurity measures.	Legislation	✓	✓	✓

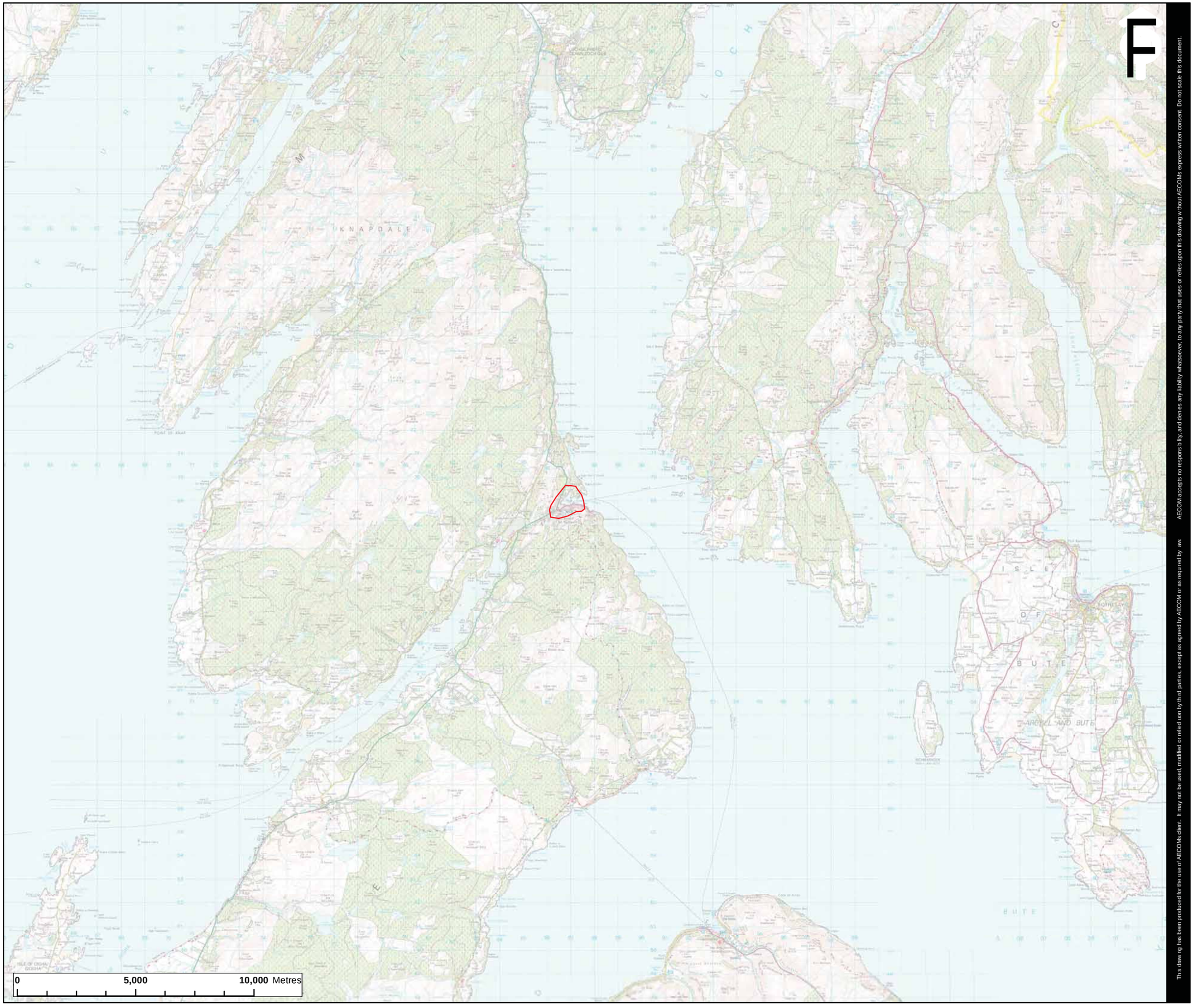
6. Enhancement

National planning policy outlines that the planning system should seek biodiversity benefits from new development where possible. The proposed Scheme could incorporate a number of ecological enhancement measures and this concept should be built-in to the Scheme from an early stage and refined as the Scheme progresses. Suggestions for potential enhancement measure are outlined below:

- The burns within the Scheme area may have a number of modifications such as culverts which may affect the presence of protected and notable species. Removing obstacles to migration (for both fish and mammals such as otter) and improving the immediate riparian habitat to improve connectivity could constitute significant ecological enhancement as part of the scheme.
- Vegetation planting upstream to attenuate and store water flow before it reaches the flood risk area could increase ecologically valuable habitat and could constitute significant ecological enhancement. Areas of proposed planting would have to be carefully selected to ensure a net gain in biodiversity is achieved, and that the natural function of ecologically valuable habitats is maintained (including land which may be functional to specially protected sites as noted above).
- If non-native species are found to be present these will need to be managed, most likely through the production of an Invasive Species Biosecurity Management Plan (BMP). If such plans are required these would constitute an ecological benefit in themselves by cataloguing the species present and avoiding the further spread of such species. There is potential to widen the ecological benefit of such plans by increasing their scope to the entire catchment(s) (which in this area is not particularly large). A catchment-wide approach will have far-reaching ecological benefit and may help to address the risk of invasive-non-native species spreading back into the Scheme area in the future.

7. Figures

Project Management Initials: DH Designer: MH Checked: HH Approved: DH



Scale 1:2000 @ A3

AECOM

PROJECT

Tarbert Flood Study

CLIENT

Argyll Bute COUNCIL

KEY:

Site boundary

PROJECT NUMBER

60578115

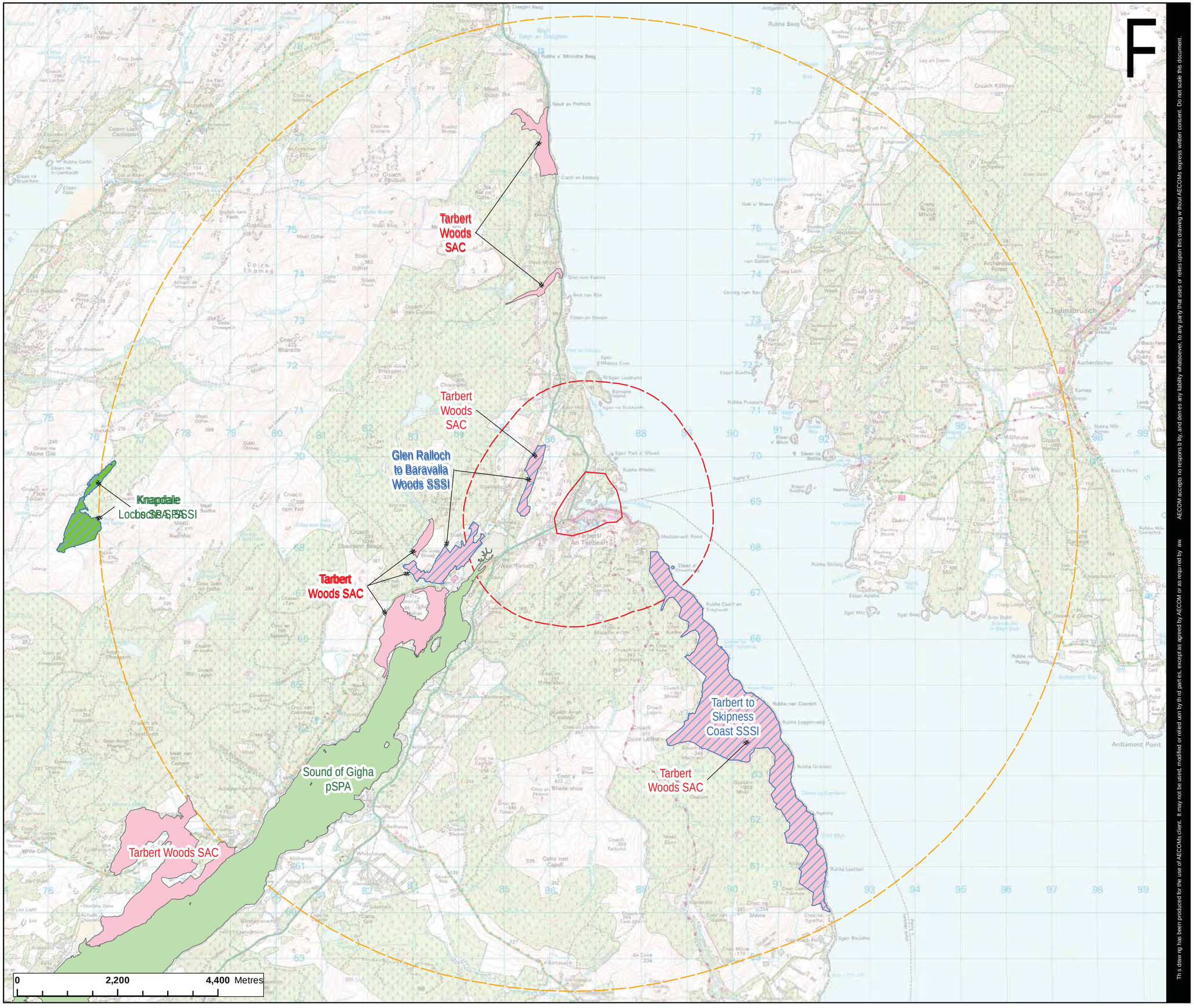
Tarbert Flood Protection Scheme Desk-study

Figure 1: Scheme location

SHEET NUMBER

1 of 4

Project Management Initials: DH Designer: MH Checked: HH Approved: DH



Scale 1:2000 @ A3

AECOM

PROJECT

Tarbert Flood Study

CLIENT

Argyll & Bute Council

KEY:

- Site boundary
- 2 km buffer
- 10 km buffer

Statutory designations

- Special Area of Conservation (SAC)
- Special Protection Area (SPA)
- Potential Special Protection Area (pSPA)
- Sites of Special Scientific Interest (SSSI)

PROJECT NUMBER

60578115

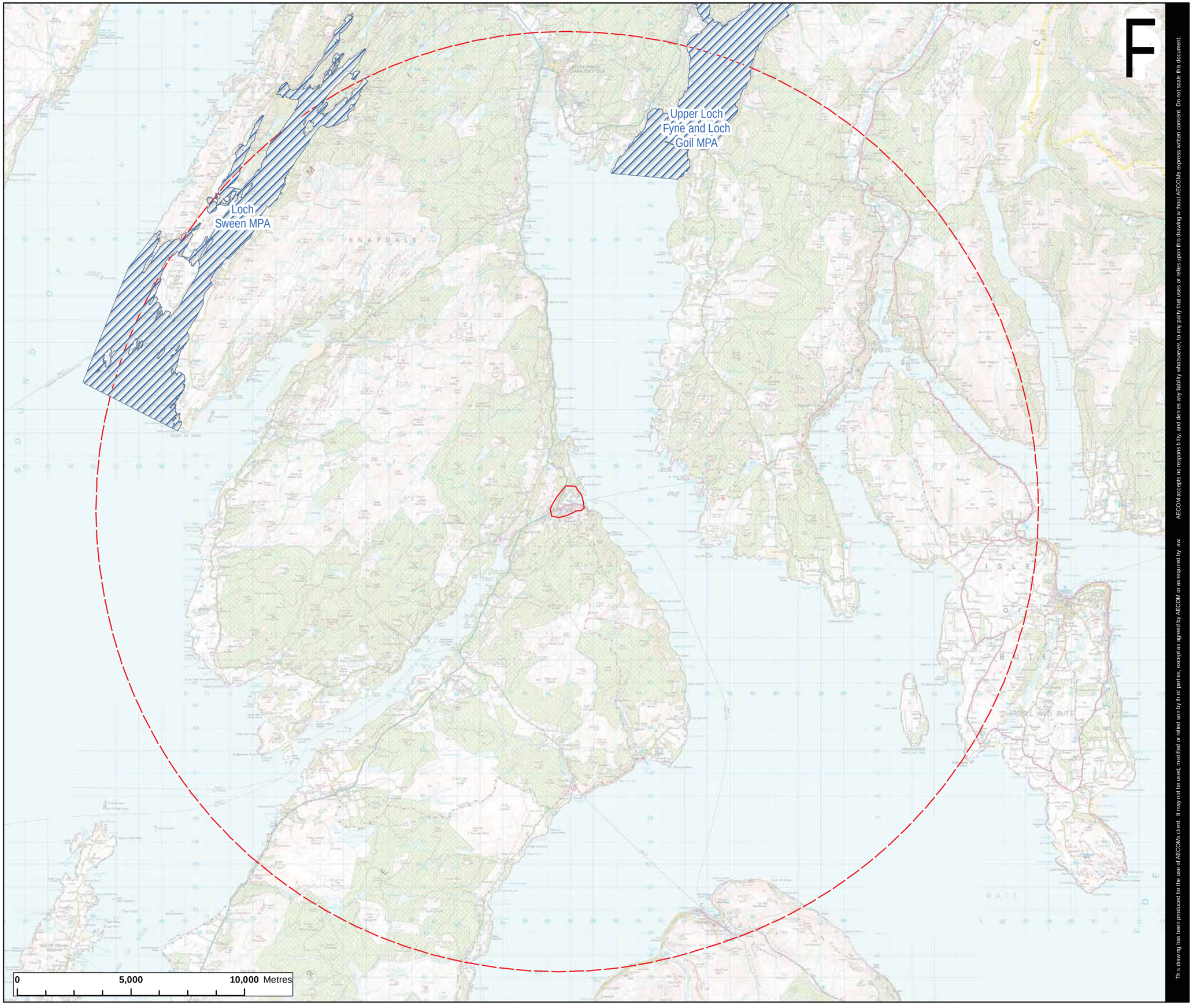
Tarbert Flood Protection Scheme Desk-study

Figure 2: Location of Statutory Designated Sites

SHEET NUMBER

2 of 4

Project Management Initials: DH Designer: MH Checked: HH Approved: DH



AECOM

PROJECT

Tarbert Flood Study

CLIENT

Argyll Bute COUNCIL

KEY:

- Site boundary
- 20 km buffer
- Marine Protected Area (MPA)

Scale 1:2000 @ A3

PROJECT NUMBER

60578115

Tarbert Flood Protection Scheme Desk-study

Figure 3: Location of Marine Protected Areas

SHEET NUMBER

3 of 4

Project Management Initials: DH Designer: MH Checked: HH Approved: DH

F

Tarbert

0 600 1,200 Metres

Scale 1:2000 @ A3

AECOM

PROJECT

Tarbert Flood Study

CLIENT

Argyll Bute Council

KEY:

- Site boundary
- 2 km buffer

Scottish Ancient Woodland Inventory (AWI)

- Ancient (of semi-natural origin)
- Long-established (of plantation origin)
- Other (on Roy map)

PROJECT NUMBER

60578115

Tarbert Flood Protection Scheme Desk-study

Figure 4: Location of Ancient Woodland

SHEET NUMBER

4 of 4

8. References

Averis, A.B.G., Genney, D.R., Hodgetts, N.G., Rothero, G.P. & Bainbridge, I.P. (2012). *Bryological assessment for hydroelectric schemes in the West Highlands – 2nd edition*. Scottish Natural Heritage Commissioned Report No.449b.

Collins J (ed.) (2016). Bat Surveys for Professional Ecologists: Good Practice Guidelines, 3rd Edition. The Bat Conservation Trust, London.

Eaton M, Aebischer N, Brown A, Hearn R, Lock L, Musgrove A, Noble D, Stroud D and Gregory R (2015). Birds of Conservation Concern 4: the population status of birds in the UK, Channel Islands and Isle of Man. British Birds 108, pp 708 – 746.

Forrester RW, Andrews IJ, McInerny CJ, Murray RD, McGowan RY, Zonfrillo B, Betts MW, Jardine DC and Grundy DS (eds.) (2007). The Birds of Scotland. The Scottish Ornithologists' Club, Aberlady.

Scottish Wildcat Action. 2015. Scottish Wildcat Action. [Online]. [17 February 2019]. Available from: http://www.scottishwildcataction.org/about-us/

Scottish Biodiversity List website (http://www.biodiversityscotland.gov.uk/advice-and-resources/scottish-biodiversity-list/).

SNH SiteLink website (http://gateway.snh.gov.uk/sitelink/index.jsp).

Willby, N. (2008). Risk assessment of the threat posed by existing populations of New Zealand Pygmyweed Crassula helmsii in Scotland. Scottish Natural Heritage Commissioned Report No.294.

Appendix A . Legislation and planning policy

This Appendix provides only a summary of relevant legislation and policy, covering only the most relevant aspects.

Conservation (Natural Habitats, &c.) Regulations 1994 (as amended in Scotland)

These Regulations ('the Habitats Regulations') implement Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive'), designating and protecting European Protected Species (EPS) and Natura 2000 sites. The latter comprise Special Protection Areas (SPAs) for birds, and Special Areas of Conservation (SACs) for other taxa and habitats. For EPS (including all bats, otter *Lutra lutra*, great crested newt *Triturus cristatus* and natterjack toad *Bufo calamita*) it is an offence to:

- Deliberately or recklessly kill, injure or take an EPS (or its eggs where applicable);
- Deliberately or recklessly disturb an EPS at a place of shelter, or elsewhere if this could impair its ability to breed or affect its local distribution; or,
- Damage, destroy or obstruct access to an EPS place of shelter (whether occupied or not).

Places of shelter include all bat roosts, otter holts and laying-up areas, and great crested newt foraging/hibernation habitat up to 500m from breeding ponds where connective habitat exists.

Actions which would be EPS offences can be licensed, if a) the reason is one of the specified purposes in Regulation 44(2), b) there is no satisfactory alternative, and c) the 'favourable conservation status' of the species is not compromised. Developments affecting Natura 2000 sites must be subject to a Habitats Regulations Appraisal (HRA), and site integrity must be maintained.

Wildlife & Countryside Act 1981 (as amended in Scotland) (WCA)

Nature Conservation (Scotland) Act 2004 (as amended)

Wildlife & Natural Environment (Scotland) Act 2011 (as amended) (WANE Act)

These Acts work together to protect birds and certain animals and plants, regulate non-native species, protect Sites of Special Scientific Interest (SSSIs) and place a duty on public bodies to further the conservation of biodiversity. The WCA implements Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive') and the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). For Schedule 5 animals (e.g. red squirrel *Sciurus vulgaris*, water vole *Arvicola amphibius*, pine marten *Martes martes* and wildcat *Felis sylvestris*) it is an offence to intentionally or recklessly (or knowingly cause or permit another person to):

- Kill, injure or take the animal (not currently applicable to water vole in Scotland);
- Damage, destroy or obstruct access to the animal's places of shelter; or,
- Disturb the animal whilst at a place of shelter.

Common reptiles are protected from intentional or reckless killing and injury.

For birds it is an offence to intentionally or recklessly:

- Kill, injure or take any wild bird or its eggs;
- Take, damage, destroy or interfere with the nest of any wild bird whilst in use or being built (or at any time for eagles), or obstruct/prevent any wild bird from using its nest; or,
- Disturb Schedule 1 birds at or near an active nest or lek, or their dependent young (or harass eagles, hen harrier or red kite at any time).

Actions which would be offences regarding wild birds cannot be licensed for development purposes. Some actions which would be offences affecting Schedule 5 species can be licensed for development purposes if there

is a) significant social, economic or environmental benefit and b) no satisfactory alternative. Developments affecting SSSIs are generally only allowed if there are reasons of national importance and site integrity will be maintained. Under the WANE Act it is an offence in Scotland to spread any non-native species in the wild (not only those on Schedule 9 of the WCA).

Protection of Badgers Act 1992 (as amended in Scotland)

It is an offence to: wilfully kill, injure or take a badger; intentionally or recklessly damage, destroy or obstruct a badger sett; or disturb a badger in a sett (or allow someone to do these things). A sett is any structure or place with signs of current use by badger. Some actions which would be offences can be licensed, but direct removal or killing of badgers cannot be licensed for development purposes.

EU Directive 2000/60/EC Water Framework Directive (WFD)

The WFD requires that water catchments are managed so that waterbodies and watercourses meet required standards. A consequence is that SEPA normally require developers to identify groundwater-dependent terrestrial ecosystems (GWDTEs) within 100m of roads/trenches or 250m of substantial constructions, and to avoid degradation of GWDTEs and surface waters. If avoidance is not possible, SEPA will require mitigation to minimise impacts, and may request planning conditions to guarantee it.

Regulation (EU) No 1143/2014 on the prevention and management of the introduction and spread of invasive alien species ('Invasive Alien Species Regulation')

This lists invasive non-native species of EU concern and sets out requirements for their management. EU regulations are applicable to member states without implementation through national legislation.

Conservation of Salmon (Scotland) Regulations 2016 ('Salmon Regulations').

These Regulations require the conservation status of salmon populations on catchments supporting them to be assessed yearly, and the numbers of salmon that may be killed (if any) to be determined. They also state that conservation plans may be agreed for conservation and management of salmon.

Scottish Planning Policy (SPP) 2014

SPP recognises the environment as a national asset offering opportunities for enjoyment, recreation and sustainable economic activity. In summary, the policy principles most relevant to nature conservation state that the planning system should:

- facilitate positive change while maintaining and enhancing distinctive landscape character;
- conserve and enhance protected sites and species, maintaining healthy ecosystems and natural processes which provide important services to communities;
- protect and improve the water environment and soil;
- protect and enhance ancient woodland, hedgerows and trees with high ecology/landscape value; and,
- seek biodiversity benefits from new development where possible.

SPP also sets out the biodiversity duty of public bodies and legislative requirements for protected sites and species. Note also that it is government policy to treat Ramsar sites in the same way as Natura 2000 sites (SACs and SPAs), and to treat candidate, potential or proposed Natura 2000 / Ramsar sites, and areas identified as compensation sites for adverse effects on these designations, as if they are fully designated.

Appendix B . Commercially available biological records from NBN Atlas

Table A1. Biological records from NBN Atlas in the past 20 years

Common name	Scientific name	Date of most recent record	Conservation status/legislation	Source
Mammals				
Red Squirrel	*Sciurus vulgaris*	2012	W&CA,Sch.5, SBL	Scottish Wildlife Trust - The Scottish Squirrel Database
Sika deer	*Cervus nippon*	2016	W&CA Sch.9	Argyll Biological Records Centre - Argyll Biological Records Dataset
Birds				
Common Gull	*Larus canus*	2009	BoCC: Amber	Royal Society for the Protection of Birds (RSPB)
Dunnock	*Prunella modularis*	2009	BoCC: Amber	RSPB
House Sparrow	*Passer domesticus*	2009	BoCC: Red	RSPB
Song Thrush	*Turdus philomelos*	2009	BoCC: Red	RSPB
Starling	*Sturnus vulgaris*	2009	BoCC: Red	RSPB
Curlew	*Numenius arquata*	2006	BoCC: Red, BirdsDir-A2.2, SBL	RSPB
Redshank	*Tringa totanus*	2006	BoCC: Amber, BirdsDir-A2.2, LBAP	RSPB
Lapwing	*Vanellus vanellus*	2006	BoCC: Red, BirdsDir-A2.2, SBL, LBAP	RSPB
Lichen				
-	*Arthonia ilicina*	2016	SBL	British Lichen Society
-	*Cladonia coccifera s. lat.*	2016	NS-includes	British Lichen Society
-	*Hypotrachyna sinuosa*	2016	SBL	British Lichen Society
-	*Micarea adnata*	2016	NS-includes	British Lichen Society
Alga				
-	*Phymatolithon calcareum*	2004	HabDir-A5, SBL	Seasearch

W&CA – Wildlife & Countryside Act 1981
SBL – Scottish Biodiversity List
RedList_GB_post_2001 - Red listing based on 2001 IUCN guidelines
BoCC – Birds of Conservation Concern 4, Amber or Red
BirdsDir-A2.2 – Birds Directive Appendix 2.2
NS-Includes - Gb: Nationally Scarce, Nationally Rare and Other Species

Appendix C – Baseline Damage Assessment

Tarbert Flood Study

Baseline Economic, Social and Environmental Impact Assessment- Technical Report

Project number: 60578115

Dec 2019

Quality information

Prepared by	Checked by	Verified by	Approved by
Hannah Hopkins Engineer	Mark Biesta Senior Engineer	Mark Biesta Senior Engineer	Dylan Huws Associate Director

Revision History

Revision	Revision date	Details	Authorized by	Position
1	April 2019	Draft for client comment		
2	Dec 2019	Final		

Distribution List

# Hard Copies	PDF Required	Association / Company Name

Prepared for:

Argyll and Bute Council
Helensburgh & Lomond
Civic Centre
38 East Clyde Street
Helensburgh
G84 7PG

Prepared by:

AECOM Limited
1 Tanfield
Edinburgh EH3 5DA
United Kingdom

T: +44 131 301 8600
aecom.com

Table of Contents

Figures

Tables

1. Introduction

1.1 Background

AECOM is working to explore options for managing flood risk within Tarbert on behalf of Argyll and Bute Council (ABC). An understanding of expected flooding impacts under the baseline scenario is required to enable screening of options and support further option development. This study concerns the coastal flood risk within Tarbert.

The aims of this assessment are to:

1. identify the areas of highest economic impacts and any points where there is a disproportional change in economic impacts relative to the change in probability (to determine where interventions should be focussed);

2. quantify the economic impacts of flooding expected over the appraisal period (to inform the scale of intervention that should be considered); and

3. provide a basis for identifying the potential benefits and impacts of any proposed options

This assessment covers economic, social and environmental impacts of flooding under the baseline scenario. It is not an Environmental Impact Assessment associated with any Flood Protection Scheme or other development. This document should be read in conjunction with the baseline modelling report[1] and a preliminary ecological appraisal[2].

[1] Tarbert Flood Study, AECOM.
[2] Preliminary Ecological Appraisal Report Tarbert, AECOM.

1.2 Study Area

The study area is shown in **Figure 1** below.

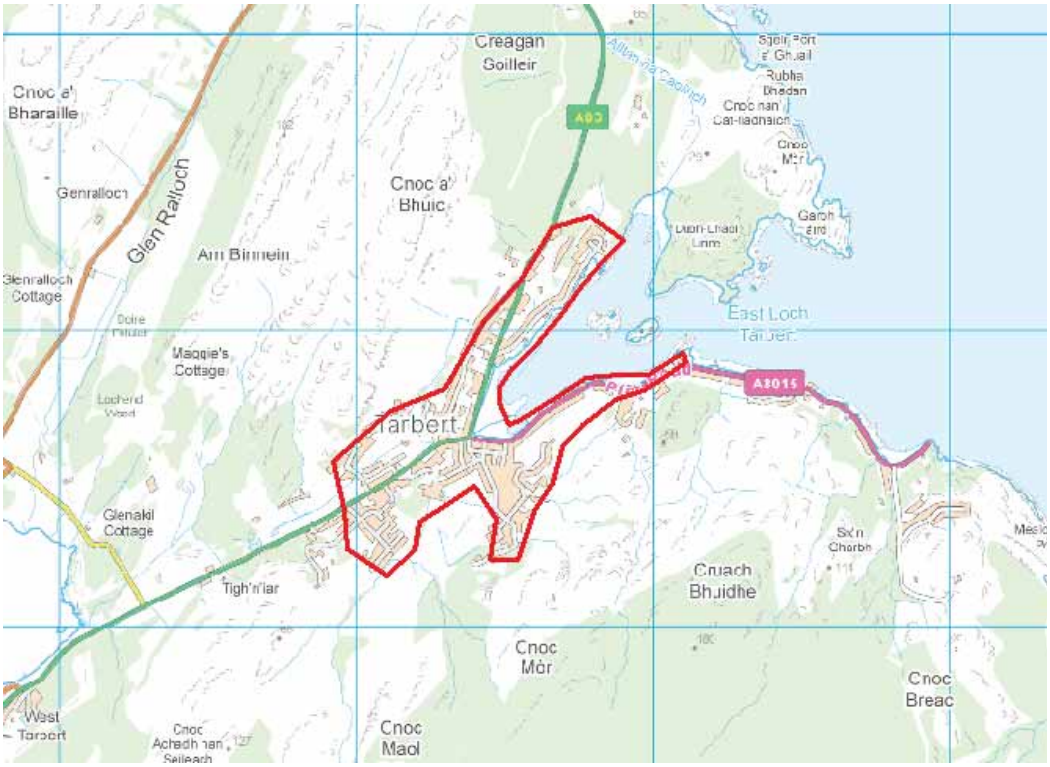


Figure 1. Study area

Tarbert is a village in the west of Scotland built around East Loch Tarbert, an inlet of Loch Fyne. In the 2001 census Tarbert had a recorded population of 1338. Tarbert extends over the isthmus which links the Kintyre peninsula to the West Loch Tarbert. The main employment sectors in the town are fishing and tourism.

2. Methodology

2.1 General

2.1.1 Available Information

The following data sources were used for this assessment.

Table 1. Available data

Data name	Source	Data description
SEPA receptor datasets (properties)	ABC	GIS dataset of assets within the study area, 2011 data, used to sense check specific area property assessment
Google Streetview and aerial imagery	Google	-
OS MasterMap	ABC	Ordnance Survey vector mapping
OS 50k mapping	AECOM	Ordnance Survey 1:50,000 scale raster mapping
NextMap data	ABC	NextMap digital terrain model.
Threshold level survey	ABC	Threshold level survey of vulnerable property threshold and ground levels

2.1.2 Legislation and Guidance

Flood risk management is governed by the Flood Risk Management (Scotland) 2009 Act. The Scottish Government has produced a guidance document describing the responsibilities of SEPA, local authorities and Scottish Water under the Act[3]. The document states that responsible authorities should “act with a view to reducing overall flood risk” (probability and consequence) in a sustainable way. ABC has included the development of a flood study in its Local Flood Risk Management Plan.

The process for developing flood study appraisals is outlined in Scottish Government appraisal guidance[4].This covers the economic, environmental and social aspects to be considered when promoting schemes under the Act. The Environment Agency has produced similar guidance[5] for England and Wales and is also a useful reference document. The assessment process used here follows the Scottish Government guidance and, as such, will be compatible with the aims of the Act.

Whilst the Scottish Government guidance covers the main principles of the assessment set out below, the Multi-Coloured Manual (MCM)[6] and Multi-Coloured Handbook (MCH)[7] cover the detailed procedure and standard data used for the assessment.

2.1.3 Proportionate Approach

The Scottish Government guidance requires that the level of detail in the assessment is proportionate to the stage of appraisal and the level of detail needed to differentiate between options. For low-cost flood risk management options, a full-scale assessment may not be justified.

[3] Scottish Government, 2011. Delivering Sustainable Flood Risk Management. Edinburgh: Scottish Government
[4] Scottish Government, 2016. Options appraisal for flood risk management: Guidance to support SEPA and the responsible authorities. Edinburgh: Scottish Government.
[5] Environment Agency, 2010. Flood and Coastal Erosion Risk Management Appraisal Guidance Appraisal Guidance. Bristol: Environment Agency
[6] Penning-Rowsell et al. (2013). Flood and Coastal Erosion Risk Management. A Manual for Economic Appraisal. Oxon: Routledge.
[7] Penning-Rowsell et al. (2017). Flood and Coastal Erosion Risk Management. A Handbook for Economic Appraisal. [Online] London: Middlesex University

2.1.4 Scenarios

The appraisal process requires consideration of the following scenarios:

- 'Do Nothing': walk away and cease all maintenance, repairs and similar activities. This may not be an acceptable option for Local Authorities due to their statutory obligations under the Act. In this case, the 'do minimum' option should be considered as the baseline.
- 'Do Minimum': this involves maintaining the existing situation. This can include general maintenance, repairs and watercourse clearance. The costs of the 'do minimum' option can be significant in areas with a high maintenance burden
- At a later stage of this project - 'Do Something': this involves the provision and maintenance of a flood risk management option. This includes both structural and non-structural measures.

2.1.5 Valuation of Costs and Benefits

All values should be in economic terms rather than financial:

- Financial takes situation from an individual's point of view whereas economic looks at the impact on the nation as a whole, noting that one person's loss can be another's gain. If, for example, a 10-year old TV is lost in a flood the financial cost would be the cost of replacing it with an equivalent new TV, whereas the economic cost would be the value of a 10-year old TV.
- VAT and other indirect taxes are included in financial costs, whereas they are not included in the economic case as they are simply transfers of money within the economy.

All benefits and costs over the entire life of the scheme require to be brought to a present value (PV). The current discount rates specified in the HM Treasury Green Book are 3.5% for years 0-30, 3% for years 31-75 and 2.5% thereafter. An appraisal period of 100 years is used to ensure all costs and benefits can be compared in an equitable manner. The choice of a 100 year period reflects the typical design life of the longest-lasting scheme elements. Some elements, such as mechanical and electrical components, may have a shorter lifespan and would therefore need to be replaced during the appraisal period.

Any historical valuations or costs are brought to a present-day value using an appropriate index. For example, historical property sales are converted to a current valuation using the House Price Index (HPI). Depth-damage data is brought to a present value using the Consumer Price Index (CPI).

2.1.6 Return Periods

The choice of return periods is an important factor in the assessment of damages. The aim of selecting return periods is to reasonably represent the "true" loss-probability curve (that is the loss-probability curve that would be generated if an infinite number of events were modelled). Higher-frequency events contribute the greatest proportion of damages, and it is therefore vital that there is good resolution of data for the lower return periods. A range of return periods were included in this assessment, ranging from more frequent flood events (2-year return period) up to low frequency flood events (1000 year return period). This provides a good representation of the loss-probability curve.

2.1.7 Capping of Damages and Write-offs

2.1.7.1 General Guidance

Scottish Government guidance (as for the other guidance referred to in this report) states that economic property losses should not exceed the current capital value of the property. Where damages exceed the market value, a cap is applied. Capping values should be the regional risk-free values of the property in question (i.e. the value of the property if there was no flood risk).

The MCM states that properties should be written off where the flood frequency exceeds, on average, once every three years. Since the modelling did not include the 3 year return period, a property was considered to be written off if the flood frequency was once every 2 years. Properties were written off at the cap values described below.

2.1.7.2 Residential Property

The MCM states that the risk-free regional (i.e. Scottish) average value should be used for capping residential property damages. For this assessment, residential property valuations were obtained from Registers of Scotland. It should be noted that this dataset is highly likely to include properties at risk of flooding; however the presence of a large number of additional properties should moderate their impact.

Table 2. Residential property values, Q3 2018

Property Type	Scotland Average (RoS)	Comment
Detached	£263,541	
Semi-detached	£168,221	
Terraced	£145,962	
Flat	£143,303	
Bungalow*	No data	£200,000 was used as an approximate valuation

**Data for bungalows is not specifically included by RoS; presumably bungalows are classified in terms of whether they are detached, semi-detached etc.*

2.1.7.3 Non-Residential Property

For non-residential properties, the MCH recommends rateable values are multiplied by 10 to derive approximate valuations. More detailed valuations can be estimated by multiplying the rateable values by (100 / rental yield). Rateable values were obtained from the Scottish Assessors Association website (www.saa.gov.uk). Yields were obtained from CBRE. Yield data is reported as a Scottish average and broken down by sector. It should be noted that there are significant fluctuations in rates both in time and location.

Table 3. Property yields, 2017

Sector	Yield (2017)
All property	7%
Offices	8.6%
Industrial	8.4%
Retail	4%

Source: CBRE Scotland Market view Q3 2017

The “all property” yield was used for all non-residential properties in this study. This is similar to the values reported in the MCH. Where the influence of this valuation is significant site surveys can be carried out to improve confidence.

Where rateable values were not available via the Scottish Assessors Association an average rateable value was applied. There is likely to be some uncertainty associated with these estimates, but this is considered to be a proportionate approach at this stage.

2.1.7.4 Other Property / Infrastructure

The MCH does not set out procedures to follow for capping non-property damages such as utilities. The Scottish Government guidance suggests that the maximum economic benefit should be limited to the cost of reconstructing the asset to avoid the flood risk (e.g. by raising or relocating). The cost should be depreciated to allow for the age of the existing asset. The guidance notes that the cost of raising or relocating these types of assets is likely to be extremely high and rarely less than the expected damages.

2.1.8 Climate Change

Climate change is expected to increase the incidence of severe weather events over the next 100 years. Scottish Government guidance on the Act[8] encourages the development of flood risk management solutions which are adaptable to future changes in the climate. The Scottish Government appraisal guidance recommends the use of judgement and up to date evidence to estimate the impacts of climate change on flood risk.

As agreed in the proposed methodology (AECOM, July 2018), climate change has been considered based on the current UKCP09 / Defra guidance on changes to relative sea levels, wind and wave climate in the future. The UKCP18 data was published after the climate change modelling had been undertaken. All data was downloaded from the Defra website (http://ukclimateprojections-ui.metoffice.gov.uk/ui/) Cell ID 12585 for Tarbert. Relative sea levels are shown to rise from a baseline year of 2018 based on the 'High Emissions Change Factor 95th percentile'.

Year	Increase in MSL [m] relative to 2008	Year	Increase in MSL [m] relative to 2008
2008	0	2068	0.37
2018	0.05	2078	0.45
2028	0.10	2088	0.53
2038	0.16	2098	0.63
2048	0.22	-	
2058	0.29	-	

The effect of climate change was incorporated into the assessment by applying the modelled climate change results

2.1.9 Existing Property-Level Flood Mitigation Measures

No information relating to existing property-level measures was made available by ABC. It is therefore considered appropriate not to account for property-level measures in this study.

[8] Scottish Government, 2011. Delivering Sustainable Flood Risk Management. Edinburgh: Scottish Government

2.2 Overview of Appraisal Approach

The table below sets out the approach used for each component. A more detailed description of the proposed approach taken for selected receptors is included below.

Table 4. Summary of Damage Assessment Components

Receptor	Damage assessment approach
Economic impacts	
Residential properties	Included. Properties classified by type, age and regional social grading
Non-residential properties	Included. Properties classified by MCM code.
Vehicles	Included. Based on number of properties at risk (detailed information on number of vehicles within the study area is not readily available).
Evacuation	Included. Evacuation costs based on property type and flood depth (detailed local data is not readily available)
Distributional impacts	Included. Based on 2011 census data for Tarbert
Indirect impacts on non-residential properties	Applied as basic 3% uplift to direct damages
Local authority, emergency and recovery costs	Included. Uplift factor from MCM data.
Infrastructure	
Electricity and gas	Described
Water and waste water	n/a – no vulnerable infrastructure present within study area
Telecommunications	n/a – no vulnerable infrastructure present within study area
Schools	n/a – none at risk of flooding within study area
Hospitals	n/a – none at risk of flooding within study area
Transport	
Road disruption	Described
Rail disruption	n/a – no infrastructure present within study area
Agriculture	n/a – none present within study area
Social impacts	
Risk to life	Described
Health	Monetised based on standard of protection provided.
Social vulnerability	Described
Recreation, community and way of life	Described
Environmental impacts	
Water environment	Described
Biodiversity, flora and fauna	Described
Air and soil	Described
Climatic factors	Described
Landscape	Described
Cultural heritage	Described

2.3 Economic Impacts

2.3.1 Residential and Non-Residential Properties

The property dataset was created using PVA data provided by ABC, a number of alterations were made to better represent the area. Additional fields were added to contain data for this assessment:

- **Flood cells**. The study area was divided into smaller zones that flood independently. This allows for the spatial distribution of damages to be understood and flood mitigation measures to be optimised to target those areas most at risk.
- **MCM code**. The basis of MCM codes was OS mapping and Google StreetView. Residential properties were categorised based on type and age. Non-residential properties were categorised based on their MCM category.
- **Floor areas**. These are only required for non-residential properties and were derived using OS mapping.
- **Floor levels**. Surveyed floor levels were applied.
- **Flood levels**. These were extracted from the coastal hydraulic model data, which gave maximum extreme water levels. Flood levels for properties were then extracted based on the maximum water levels within the property boundary.

Depth-damage data was taken from the MCH for the relevant flood duration (short), water types (salt) and warning (none). For residential property, the depth-damage data for individual social classes were aggregated into a single weighted average.

2.3.2 Distributional Impacts Analysis

Distributional impacts analysis is applied to reflect how the benefits of reducing flood risk affects individuals depending on their socio-economic group. The principle is that an extra pound is worth more to a person who has a lower income than someone who has a higher income. Distributional impacts require to be applied where necessary and practical.

In the case of Tarbert, there is a relatively high proportion of residents in approximated social grade C and DE compared to the national average. There is therefore a strong case for the inclusion of distributional impacts analysis and there is sufficient data available. The applied uplift factors are shown in the table below.

Table 5. Census data and distributional impacts analysis factors

	Number of people	AB	C1	C2	DE
Census data	382	8%	31%	37%	24%
Weighted factor	-	0.74	1.12	1.22	1.64
				Total weighted factor	1.25

Source: http://www.scotlandscensus.gov.uk/

2.3.3 Infrastructure and Transport – General

There are three types of losses associated with infrastructure: direct damages; wider economic impacts and wider less tangible impacts. The direct damages to all buildings affected are calculated within the non-residential property section. Additional losses and direct damages for infrastructure not associated with properties will be explored here. Categories identified in the MCM are: electricity and gas; water and waste water; telecommunications; schools; hospitals; roads; and rail.

The MCM states that assessments should be proportional to the impact of flooding on the asset and the significance of the asset. Although it may be *feasible* to assess the potential losses to a number of assets it may not be *cost-effective or necessary* to do so. The 5 step prioritisation process was followed for all identified infrastructure.

1. Identify those assets at risk of flooding
2. Determine the likelihood of flooding assets
3. Determine the criticality of the assets to flooding
4. Utilise a risk matrix for prioritisation (**Table 6**)
5. Assess the impact of resistance and resilience

Table 6. Risk Matrix

Impact	Significant	Medium Risk	High Risk	Very High Risk
	Moderate	Low Risk	Medium Risk	High Risk
	Low	Negligible Risk	Low Risk	Medium Risk
		Very low	Low Risk	Medium/High
		Likelihood		

2.3.4 Electricity and Gas

No substations were included in the asset database used for this assessment. It is therefore considered that the impact of flooding on the electricity network is small. Therefore, no further investigation / quantification was warranted.

Low likelihood, low impact. Overall risk: low.

2.3.5 Water and Wastewater

There are no water or wastewater treatment works and pumping stations within the study area. A pumping station is located adjacent to the pier and included within the dataset. All below-ground infrastructure is considered to be resilient to flooding. No further investigation is therefore required.

Overall risk: n/a.

2.3.6 Telecommunications

No telephone exchanges were included in the asset database used for this assessment. No further investigation was therefore warranted.

Overall risk: n/a

2.3.7 Schools

There is one school located with Tarbert, however it is not located with the area at risk of flooding and therefore no further investigation was required.

Overall risk: n/a

2.3.8 Hospitals

There is one medical practice located with Tarbert, however it is not located with the area at risk of flooding and therefore no further investigation was required.

Overall risk: n/a

2.3.9 Road Disruption

Several roads within the study area are at risk of flooding. The key factors for estimating traffic disruption costs include flood duration, the number of roads likely to be impacted and the importance

of those roads affected (i.e. whether a flood causes a significant knock-on effect to other parts of the network).

Of particular note is the A83, Barmore Road, which is the main through road for the Kintyre Peninsula.

Medium / high likelihood, moderate impact. Overall risk: high risk.

2.3.10 Rail disruption

There are no railways in the study area.

Overall risk: n/a

2.3.11 Agriculture

Although there are areas of agriculture just outside the edge of Tarbert, these are not the focus of this study.

Overall risk: n/a

2.4 Social Impacts

2.4.1 Risk to Life

The hazard associated with flooding is based on the depth and velocity of water. This, paired with the probability of flooding, can be used to assess the risk to life. Due to the restrictions within the modelling results, the overall risk to life for people in Tarbert has been described within this assessment.

2.4.2 Health

Flooding can have a wide range of impacts on health including stress and anxiety associated with flooding, physical health effects from contact with flood water and worry about future flooding. This is an area of active research and there is uncertainty associated with any methods used to quantify these impacts. The Scottish Government appraisal guidance refers to a 2004 Defra study[9]. This has since been superseded with research from 2012[10], which was used for this assessment.

2.4.3 Social Vulnerability

The effects of flooding will be felt differently by different people depending on a range of factors (e.g. age, health, income, home ownership) – this is known as social vulnerability. Flood disadvantage is the combination of social vulnerability and flood risk. The Scottish Government has produced maps showing the flood disadvantage across Scotland. These were used for this study to describe the social vulnerability to flooding in Tarbert.

2.4.4 Recreation, Community and Way of Life

Similar to health, flooding can have wide-ranging effects on the local community by disrupting recreational opportunities (e.g. football grounds, sports centres), causing flood damages to community facilities (e.g. town halls, libraries) and affecting day-to-day life (e.g. employment and shopping). There is insufficient evidence available to allow such impacts to be readily monetised and in any case the impact is not likely to be significant. These impacts will therefore be assessed based on a description of impacts.

[9] Defra (2004). Flood and coastal defence appraisal guidance. Supplementary note to operating authorities. Revisions to economic appraisal on: reflecting socio-economic equity in appraisal and appraisal of human-related intangible impacts of flooding. Defra: London.
[10] Ramsbottom et al. (2012). Climate change risk assessment for the floods and coastal erosion sector. Defra: London. Discussion also in Frontier Economics (2013). The economics of climate resilience: appraising interventions to diminish the mental health effects of flooding – a case study of Hull. Frontier Economics Ltd: London.

2.5 Environmental Impacts

The Scottish Government appraisal guidance describes the key categories against which flooding impacts can be assessed as follows (although other methods, such as ecosystem services, are also possible):

- Water environment
- Biodiversity, flora and fauna
- Air and soil
- Climatic factors
- Landscape
- Cultural heritage

It is understood that there are currently no pressing environmental issues associated with flooding at the site. The primary requirements for environmental appraisal are therefore to identify opportunities for environmental enhancement and assess environmental impacts associated with any flood mitigation options (thus allowing for impacts to be mitigated). For this appraisal, the environmental impacts are described unless there is an indication that impacts will be significant (in which case a formal Environmental Impact Assessment may be required).

3. Results

3.1 Baseline Monetised Damages

The number of properties affected by flooding are shown in **Table 7**. The corresponding damages are shown in **Table 8**. These results do not include the impact of capping or write-offs, as those factors only get taken into account when damages are discounted over the appraisal period.

Table 7. Number of properties affected by flooding in the study area

		Return period (years)							
Scenario	**Property Type**	**2**	**5**	**10**	**20**	**50**	**100**	**200**	**1000**
Present Day	Residential	0	0	5	9	9	14	14	17
	Non-Residential (NRP)	0	0	24	34	45	53	55	65
Climate Change	Residential	11	14	14	14	14	17	17	22
	Non-Residential (NRP)	43	53	56	61	65	65	67	73
Total no. of properties affected by flooding		54	67	70	75	79	82	84	95

* Damages for residential properties start to be accrued when the water is within 300mm of the floor level as water enters the sub-floor area.

Table 8. Baseline monetised flood damages by present day return period

		Return period (years)							
Category		**2**	**5**	**10**	**20**	**50**	**100**	**200**	**1000**
Residential	Direct	£0	£0	£53,945	£117,745	£169,690	£230,096	£275,026	£381,079
	Vehicles	£0	£0	£8,608	£17,216	£22,955	£28,694	£31,563	£40,171
	Indirect	£0	£0	£7,977	£14,680	£23,225	£32,387	£41,062	£61,216
	DIA	£0	£0	£13,483	£29,430	£42,414	£57,512	£68,742	£95,250
	Subtotal	**£0**	**£0**	**£84,013**	**£179,071**	**£258,284**	**£348,688**	**£416,393**	**£577,716**
NRP	Direct	£7,101	£42,321	£453,631	£998,666	£1,583,308	£2,121,461	£2,610,663	£3,860,004
	Indirect	£213	£1,270	£13,609	£29,960	£47,499	£63,644	£78,320	£115,800
	Subtotal	**£7,314**	**£43,591**	**£467,239**	**£1,028,626**	**£1,630,807**	**£2,185,105**	**£2,688,982**	**£3,975,804**
Other	Emergency	£760	£4,528	£54,311	£119,456	£187,571	£251,617	£308,769	£453,796
	Health	£0	£0	£4,034	£6,051	£9,077	£11,094	£11,094	£14,120
	Subtotal	**£760**	**£4,528**	**£58,345**	**£125,507**	**£196,648**	**£262,711**	**£319,863**	**£467,916**
Total		**£8,074**	**£48,119**	**£609,597**	**£1,333,204**	**£2,085,739**	**£2,796,504**	**£3,425,238**	**£5,021,436**

Average Annual Damage (AAD) is the expected value of damages within a typical year: ∑*Damages x Probability.* AAD is shown below calculated from current value damages and probability; and for future probability for the climate change horizons. Due to the frequency of flooding, a number of properties were considered to be written off (and were not included in the AAD total). The increased frequency of flooding with climate change means more properties are written off; it is therefore possible that AAD reduces with time. This is found to be the case in Tarbert. **Table 9** shows the AAD for the assessed climate change scenarios.

Table 9. Baseline average annual damages

		Annual Average Damage	
Category		**Current (without CC)**	**Climate Change**
Residential	Direct	£16,269	£5,406
	Vehicles	£2,271	£758
	Indirect	£2,264	£614
	DIA	£4,066	£1,475
	Subtotal	**£24,871**	**£8,253**
NRP	Direct	£135,631	£84,713
	Indirect	£4,069	£2,541
	Subtotal	**£139,699**	**£87,255**
Other	Emergency	£8,506	£5,047
	Health	£902	£269
	Subtotal	**£9,408**	**£5,316**
Total		**£173,978**	**£100,824**

Present Value Damage (PVD) represents the damages expected to be accumulated over the appraisal period (100 years). The total damages accrued are also “discounted” to a Present Value (see **Section 2.1.5**). PVD is derived from the sum of all probability damages accrued, capped and discounted: ∑ (Damages x Probability) capped x discount rate. Where required, properties were written off in the year that the flood frequency is expected to exceed once every three years, with a discount factor applied where necessary.

The study area was split into ‘flood cells’ – areas which flood from the same location(s) and which could potentially be protected independently. This allows for further investigations to focus on those areas which are most affected. A plan showing the location of the flood cells is included in **Appendix A.1**. **Table 10** shows the present value damage by type while shows the present value damage (PVD) for each flood cell. **Table 11** presents a summary of the present value damage, both with and without climate change.

Table 10. Baseline present value damages by type

Category		**PVD (without CC)**	**PVD CC**
Residential	Direct	£573,577	£816,815
	Vehicles	£42,044	£38,401
	Indirect	£37,423	£33,853
	DIA	£70,399	£131,195
	Subtotal	**£723,443**	**£1,020,264**
NRP	Direct	£3,434,365	£3,986,355
	Indirect	£36,530	£46,746
	Subtotal	**£3,470,895**	**£4,033,102**
Other	Emergency	£428,850	£506,782
	Health	£17,860	£16,026
	Subtotal	£446,710	£522,807
Total		**£4,641,048**	**£5,576,173**

Table 11. Summary of PVD

Totals	Total PVD (CC)
Tarbert	5.6M

Table 12. Baseline present value damages by cell

Flood cell	Residential	Non-residential	Other	Total	Proportion of total
1	£816,449	£3,454,721	£712,171	£4,983,342	89.37%
2	£0	£84	£12	£96	0.00%
3	£0	£59	£8	£67	0.00%
4	£0	£355,067	£38,573	£393,640	7.06%
5	£0	£19,380	£2,655	£22,035	0.40%
6	£0	£85,615	£11,729	£97,345	1.75%
7	£366	£71,429	£7,855	£79,649	1.43%
Total	**£816,815**	**£3,986,355**	**£773,003**	**£5,576,173**	**100.00%**

3.2 Baseline Non-Monetised Damages

3.2.1 Economic - Road Disruption

Access to Tarbert from the south is via Campbeltown Road (A83) which splits at the Harbour, continuing north as Barmore Road (A83) and east Harbour Street (A8015). The junction and both roads are at risk of flooding from the 2 year event. During more extreme events this could result in road closures.

- Barmore Road – potentially closed during a 10-year return period event or greater. Potential short diversion route via Lady Ileene Road. However, this is a steep and narrow road with 1 lane access at times.
- Harbour Street potentially closed during a 10-year return period event or greater. No available diversion route and would block access to Tarbert to Portavadie ferry route. However, it should be noted that during an extreme flooding event, the ferry would be unlikely to run.

There are two aspects of damages to roads which can be accounted for: direct damage to road infrastructure; and losses due to road traffic disruption.

Direct damages to road infrastructure vary depending on the type and scale of the damage, the type of road and the location of the required repair. Estimates are available from the MCM of unit costs for resurfacing roads from £15/m² for quiet roads to £50/m² for busier roads. Direct damages can occur if flooding causes lasting damage to the road. However, for flooding to cause lasting damage water would have to remain on the road for long periods of time or high velocities would have to be present. Neither of these criteria are met in the case of Tarbert and direct damages are therefore considered to be negligible.

The MCM provides framework to value traffic disruption. This is based on additional distance required when diverting. Diversion via Lady Ileene Road is short and would cause delays due to 1 lane access. However due to the estimated short duration of the road closure no further investigation was undertaken at this stage of the study.

Property damages can be affected by the waves caused by vehicles being driven along flooded roads. This impact has not been included in the numerical model and therefore has not been quantified in the assessment, however it could lead to further justification for road closures.

3.2.2 Social – Risk to Life

The flooding in Tarbert is formed by a combination of extreme sea level, waves and overtopping. The predominant risk to life in Tarbert during flooding events is caused by the high depths of flooding along the harbour roads.

Waves and overtopping can be very dangerous during storm events, however in Tarbert these are not as significantly life-threatening compared to the high-water levels.

3.2.3 Social – Social Vulnerability

The key areas in Tarbert at risk of flooding are predominantly non-residential and home to the key employers in the area. The risk of flooding in Tarbert therefore greatly impacts the flood disadvantage of Tarbert and the surrounding area.

3.2.4 Social – Recreation, Community and Way of Life

The following is a non-exhaustive list of community features that are affected by flooding to provide an indication of the range of social impacts of flooding. For the avoidance of doubt, this is not a site-specific flood risk assessment for each of the features noted.

It should be noted that as Tarbert is a coastal town built around the harbour and the tourism industry, flooding would seriously impact the recreation, community and way of life for the majority of residents.

Table 13. Community features at risk of flooding

Feature	Onset of flooding (return period in years)
Co-op	20
Harbour	2
Ferry Terminal	10
Tarbert Hotel	10
Anchor Hotel	20
Loch Fyne Gallery	20
Loch Fyne Fish Bar	10

3.2.5 Environmental

Separate environmental and ecological assessments have been carried out in order to identify constraints and opportunities relevant to the development of a FPS. A summary of key issues in terms of flooding impacts is provided here.

Water environment

The Loch Fyne Coastal Water Basin has an overall water status of ‘Good’ from 2007 to 2017. Therefore, the current level of flood risk is not considered to be affecting the water environment. Increased frequency of flooding could increase the likelihood of pollutants entering the natural environment.

Biodiversity, flora and fauna

The presence of a range of species, including protected species, should be expected within the study area. Localised habitats of birds and fish are likely to heavily impact local designated areas. Further detail can be found in the Tarbert Flood Study Preliminary Ecological Appraisal.

The current level of flood risk is not considered to be affecting biodiversity, flora and fauna however there are always opportunities for environmental enhancement as part of any flood mitigation proposals.

Air and soil

The current level of flood risk is not considered to be affecting air and soil.

Climatic factors

Flooding leads to greenhouse gas emissions through the following:

- Emissions during the flood response (vehicle movements, pumping etc.)
- Emissions embedded in replacement goods
- Emissions embedded in repair materials
- Emissions associated with additional energy use to dry out properties following a flood

Cultural heritage

Tarbert is a Conservation Area and is home to a number of Scheduled Monuments and Listed Buildings. Some of these buildings are directly affected by flooding. It is possible that repeated flooding would discourage investment in maintaining these properties and lead to an overall degradation of the Conservation Area.

Landscape

The current level of flood risk is not considered to be affecting the local landscape other than those issues discussed under cultural heritage.

3.3 Sensitivity Analysis

3.3.1 Single Large Damage Sources

The damage assessment is dependent on a large number of variables, each with its own level of reliability. Sensitivity testing is used to improve understanding of the potential variation of the damage values, and the influence this could have on the overall study outcome.

The total damages are distributed amongst 95 properties, both residential (22) and non-residential (73). Around 80% of property damages are associated with non-residential properties. There is a relatively even spread of damages across the properties, with three properties contributing the highest percentage of 7% each, these are the Tarbert Hotel, the Anchor Hotel and an operational Harbour building. Since there is no one single large (>10%) contributor to overall damages it was deemed at this stage that site surveys are not necessary. This also means that total damages would not be sensitive to uncertainty in the assumptions for any one property (such as property type, age or floor level). Instead, damages will be sensitive to any inherent uncertainty in the general MCM methodology such as climate change and translating model results into flood levels within properties.

Closer inspection of many of the highest contributors shows that the high proportion of damages is justified as many of the buildings and surrounding areas have experienced flooding in the past. Where possible many of the highest contributing properties have been sense checked to ensure their sensitivity is reduced.

3.3.2 Modelling Tolerance

The economic damages are sensitive to the modelling results. Therefore, many of the uncertainties highlighted within the modelling report continue to be embedded within this assessment. However, as discussed within the modelling report the approach is based on best practice and best available data and therefore acceptable. For details on potential sensitivity to changes in model results see the following section on flood depths.

3.3.3 Flood Depths within Properties

Flood depths are based on the difference between modelled water levels and the property floor level. The majority of thresholds with Tarbert have been surveyed and therefore the uncertainty is limited. Threshold levels for some of the properties were estimated based on their proximity to a surveyed property. Both levels have some level inherent uncertainty based on the methods used to derive them. A flood depth increases of just 100mm would increase total PV flood damages from £5.6M to £6.2M; an increase of 11%. Although in flood level terms 100mm is a large increase, there is more uncertainty in model results and an error of 100mm is possible. It is expected, however, that model results are broadly representative of actual flood events. Methods follow best practice using the best available data, so there is little scope for increasing confidence further.

3.3.4 Future Flood Risk

The increase in future flood risk associated with climate change was included in this assessment. There is significant uncertainty in the effects of climate change. If there was no change in flood frequency, then total PV flood damages would be £4.6M, a reduction of £1M (17%).

3.3.5 Capping and Write Offs

Given the frequency of flooding, damages for some properties were required to be capped; some properties were even considered to be written off. There is a reasonable degree of confidence in both the residential property valuations and non-residential property valuations, which used standard methods. However, there is less confidence in the properties that had no rateable value data and therefore had an averaged value applied. This is in line with the recommendations made by Chatterton[11], but reduces confidence in the results.

The effects of capping and write-offs are considerable during the climate change scenarios. This is when write-offs changes from a rare occurrence to a frequent one. During present day scenarios 6 properties are identified as being written off, during climate change this increase to 59 properties. The increase of write-offs during the baseline climate change scenario in Tarbert strengthens the case for intervention.

3.3.6 Summary

Uncertainty is an inherent factor in economic damages assessments, given the process involves layering together different datasets with their own individual uncertainties and simplifying assumptions across areas. MCM guidance recommends the use of sensitivity analysis to be aware of these uncertainties. The chosen method is in line with best practice and industry standard approaches which aim to provide a managed, efficient and proportional method to economic damages assessment.

The sensitivity analyses have shown there to be some uncertainty in flood damages, particularly the reliance on the modelling results and the climate change scenario, there is therefore a degree uncertainty in flood depths for this study. This is typical of a study of this kind.

The damages presented here are based on a best estimate of each of the variables; however the potential for variation in the total damages (both positive and negative) needs to be borne in mind in any decision-making. As shown in the sensitivity analysis above, variations of +/- 25% would not be unexpected.

[11] Chatterton (2016). National receptor dataset: property codes with prefix “9”. Published by Flood Hazard Research Centre, Middlesex University.

4. Conclusions

This assessment of economic, social and environmental impacts of flooding was carried out in accordance with Scottish Government guidance, using data from the Multi-Coloured Manual and other sources. Impacts covered the next 100 years if no intervention takes place to reduce the risk of flooding. This is a baseline scenario against which options can be evaluated.

The flooding impacts assessed in this report are broadly in line with the impacts experienced during historical flood events; the greatest impacts are located in those areas that have flooded most frequently in recent years. A total of 95 properties are expected to be flooded during a 1000-year return period flood event; 22 residential and 73 non-residential. The total monetised damages associated with a 1000-year event were estimated to be around £5M. Key non-monetised impacts include flooding of roads and associated disruption, risk to life, damage to key community assets and impacts on key employers. The frequency of such an event is expected to increase as a result of climate change.

The present value of monetised flood damages over the next 100 years was estimated to be £5.6M; this includes annual average damages of around £100k and the value of properties written off due to the high frequency of flooding in the future. The damages presented here are based on a best estimate of each of the variables; however the potential for variation in the total damages (both positive and negative) needs to be borne in mind in any decision-making. The aforementioned non-monetised impacts should also be taken into account as part of any appraisals and decision-making. Many properties within the Tarbert Conservation Area are at risk of flooding.

The findings from this assessment will be used in the in the decision-making process for selecting a preferred scheme option for Tarbert.

Appendix A .1 – Flood Cells

aecom.com