

# 01 River Thurso Flood Protection Study

## Sgrùdadh Dìon Thuiltean Abhainn Theòrsa

Welcome to the public consultation event for the River Thurso Flood Protection Study. The purpose of the event is to bring you up to date with the work we've been doing and the list of options to mitigate flood risk we are considering. The Highland Council would like your views on these options at an early stage. This will ensure the study takes everything into account and identifies an appropriate way to manage fluvial and coastal flood risks from the River Thurso and the sea.

### Why are we here?

In 2011, SEPA produced the National Flood Risk Assessment which investigated all sources of flooding as well as the likely impact of climate change. The assessment identified that Thurso was potentially at risk of coastal and river flooding and further investigation was required.

### What have we done so far?

Work to date has consisted of the following:

- Joint probability assessment of coastal and fluvial flooding;
- Coastal modelling to calculate wave climate and extreme sea levels;
- Linked 1D/2D modelling of the River Thurso and coastal inundation;
- Topographical surveys of the study area;
- Stakeholder meeting with statutory bodies;
- Environmental survey.

At this point we want to present the baseline flood risk in the town and offer some potential solutions to protect vulnerable areas from future flooding. Your views will help us identify an appropriate way to manage coastal and fluvial flood risk in Thurso.

### What are the aims of this event?

- To describe the nature of the coastal and river flooding in Thurso;
- To tell you about the work that has been done so far;
- To show you what options we are considering;
- To explain the next steps in the process.

### How can you provide your feedback?

A questionnaire is available for you to leave your comments.

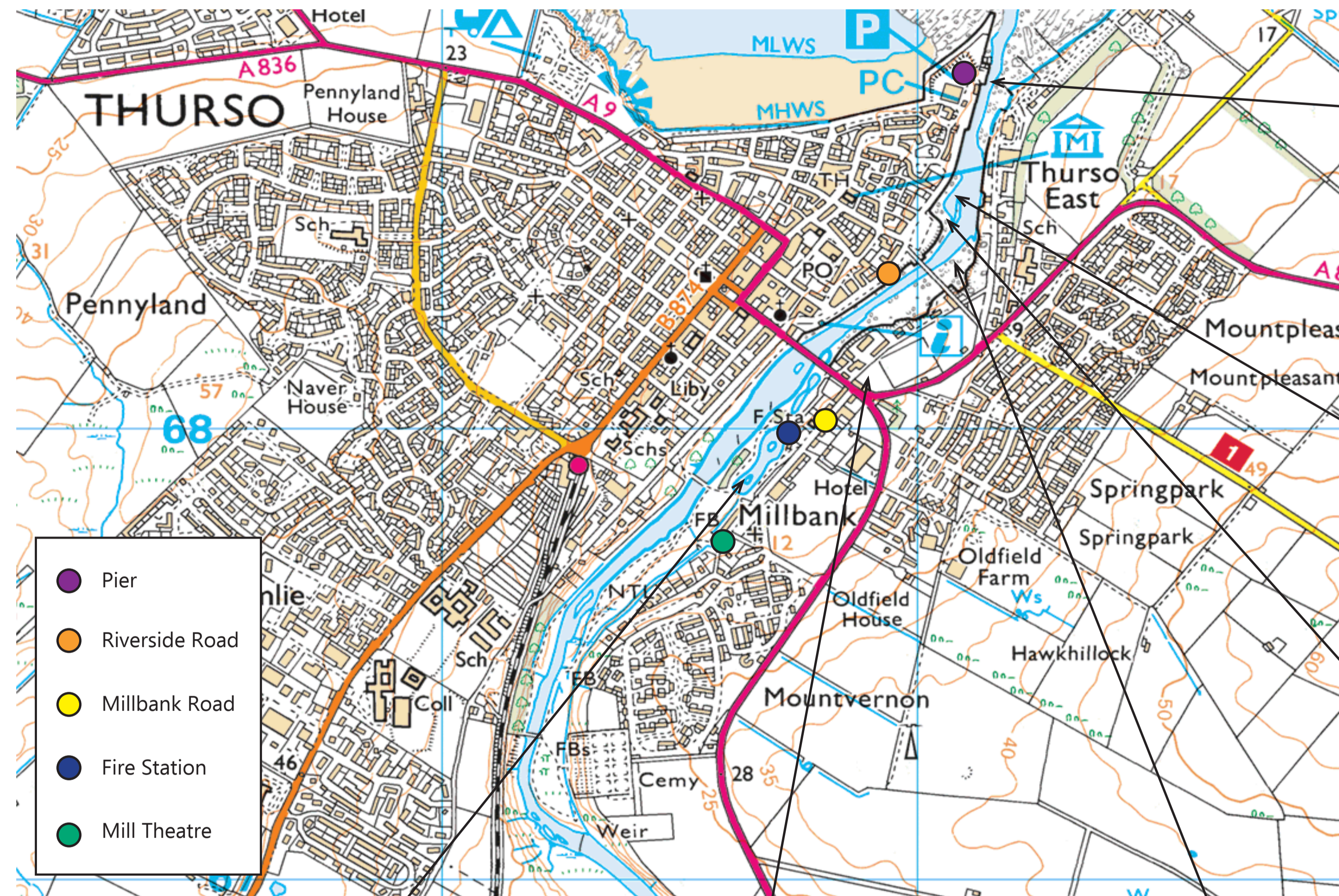
Please browse through the information provided on the display posters. Our team is here to answer any questions you may have.



# 02 Historic Flooding

There is a recent history of tidal and river flooding in Thurso which includes:

- December 2014:**  
 Flooding knocked out low wall next to spillway.
- October 2006:**  
 Extensive flooding occurred to residential and non-residential properties. Cemetery footbridge was washed away and subsequently replaced and the Mill Theatre suffered from heavy flooding.
- January 2005:**  
 A tidal flood affected a number of commercial and residential properties after the River Thurso breached its banks north of Thurso Bridge.
- October 2004:**  
 Roads and gardens flooded from a variety of sources including from the river.



# 03 What is the scale of the flood risk?

## Defining the fluvial and coastal flood risk

Thurso is potentially at risk from a number of flooding sources:

- Fluvial – flooding from overflowing rivers;
- Coastal – direct tidal inundation from high sea levels; wave carryover.

Flood risk is defined in terms of return period. The return period is the average time period between occurrences of conditions of the same magnitude. For example a 1 in **100 year** return period sea level will have a 1 in **100**, or **1%** chance of happening in any given year.

We have used computer modelling to estimate the likelihood of flooding in Thurso from high sea levels and wave carryover. High sea level describes the still water level for a given return period. Wave carryover refers to the rate of flow landwards as a result of a wave breaking over a defence.

The high sea levels and wave overtopping water were combined with the flood flows in the River Thurso in the hydraulic modelling. Flood flows in the River Thurso were calculated with the use of local flow data obtained from the Halkirk gauging station.

The modelling allowed us to see which areas may be at risk providing estimates of flood extents and depths for a range of return periods.

The modelling results indicated that the fluvial and coastal flooding events were found to be largely independent. A number of scenarios were compared which showed clear fluvial reaches and coastal reaches.

Generally flooding is more critical in the upstream reaches of the river near the cemetery during high fluvial flows, whereas downstream nearer the coast flooding is more critical during high tidal flows.



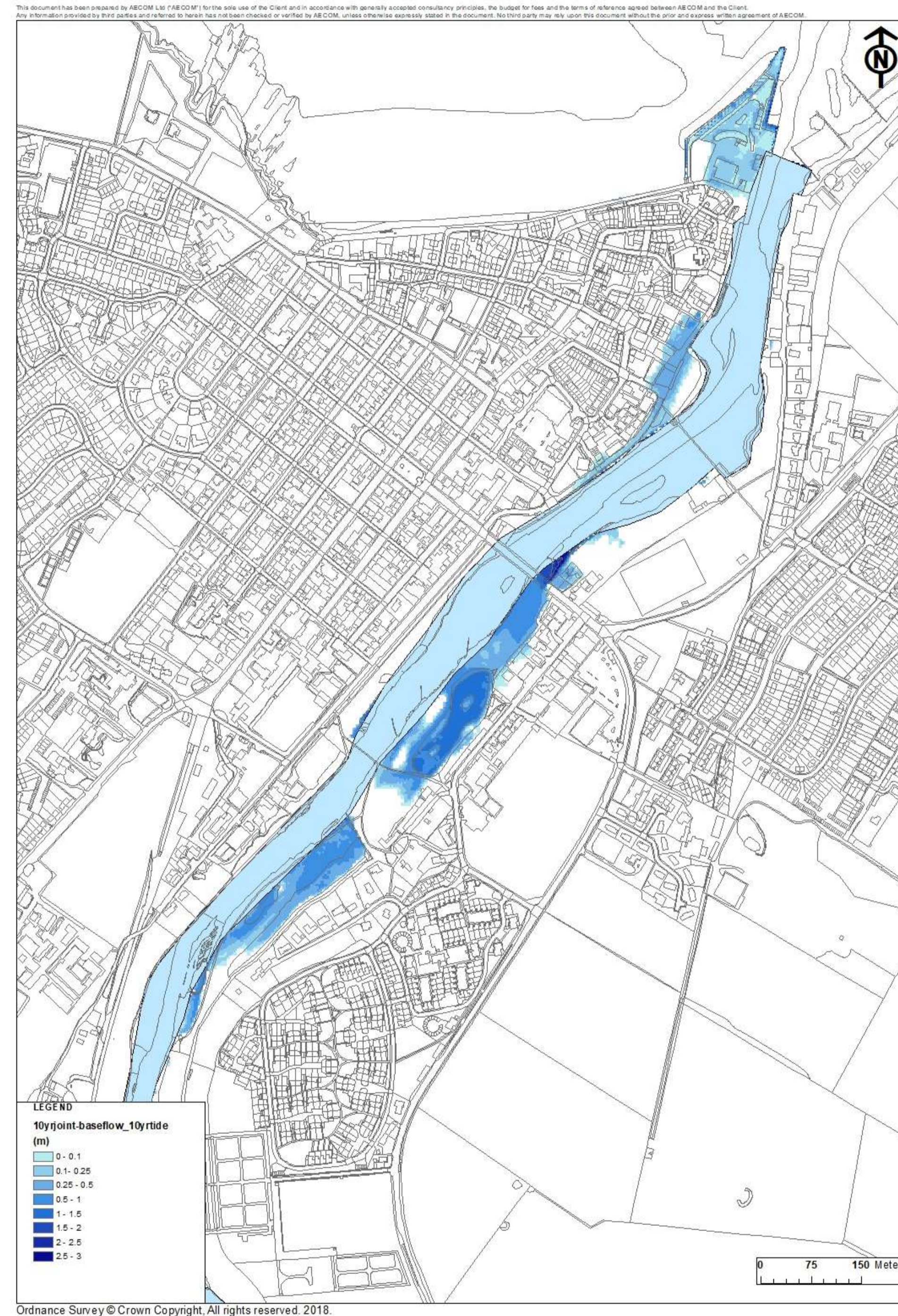
River Thurso hydraulic catchment - Halkirk gauge

# 04 What is the scale of the coastal flood risk?

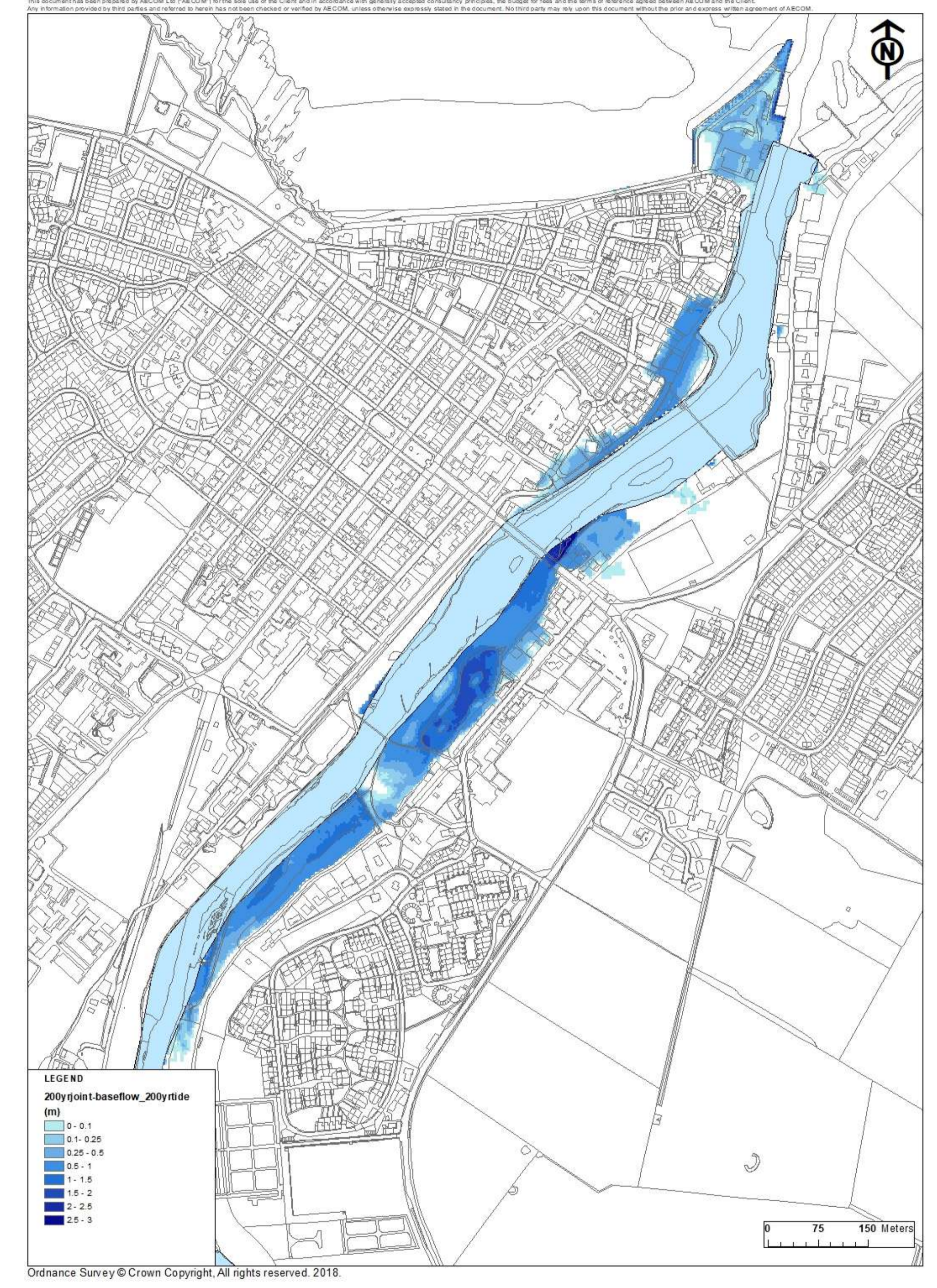
## Flooding mechanisms

The coastal dominant scenarios show flooding during the peak tide on the east bank of the River Thurso; however at lower depths than those experienced during the fluvial scenario. The most prominent difference is the occurrence of overtopping, most noticeable at the Pier.

Results show that the Mill Theatre and the Fire Station are vulnerable during both fluvial dominant and coastal dominant scenarios. Flooding is shown to approach Millbank Road during the fluvial dominant 200yr event but not during any of the lower present day return period scenarios. Key locations on the Pier are found to mainly be at risk of flooding during coastal dominant events due to wave overtopping.



Coastal dominated 1 in 10yr flood map

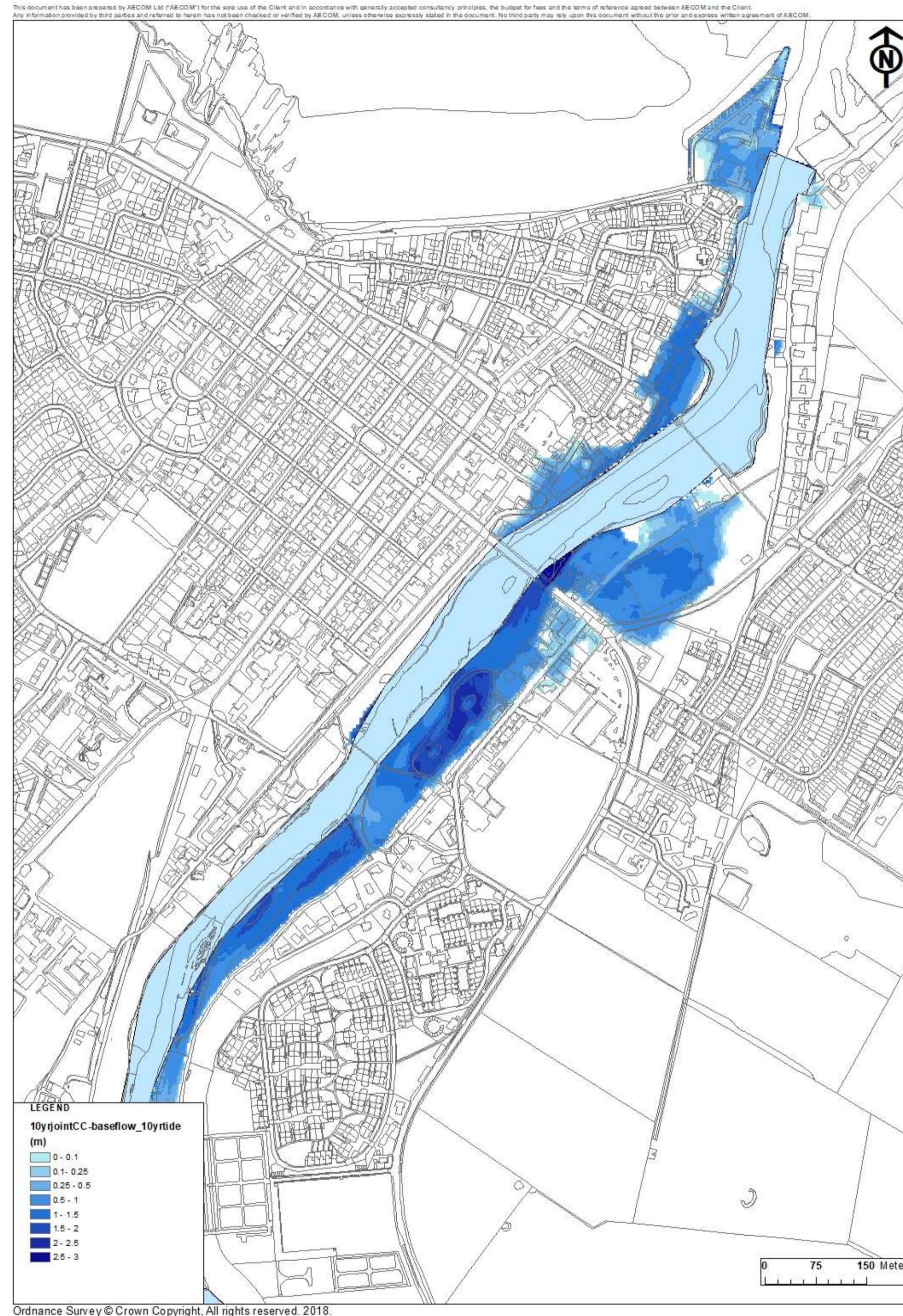


Coastal dominated 1 in 200yr flood map

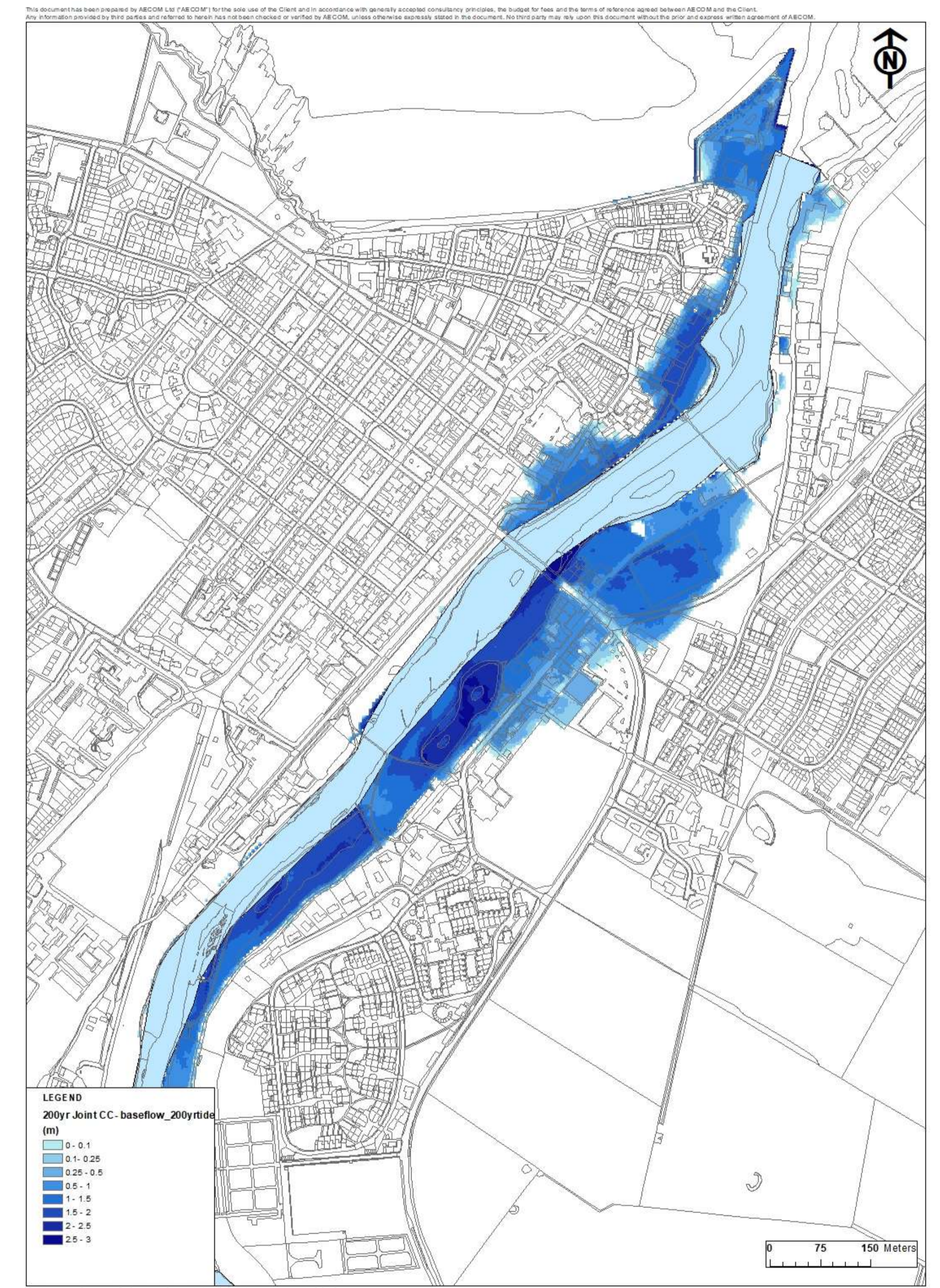
# 05 What is the scale of the coastal flood risk?

## Flooding mechanisms

Results of the climate change scenario show that water spills over Millbank Road, increasing the number of vulnerable properties. The extent and depths of flooding is increased when compared to the event without climate change. The extent at which flooding occurs over Riverside Road also greatly increases.



Coastal dominated 1 in 10yr flood map with climate change in 100 years

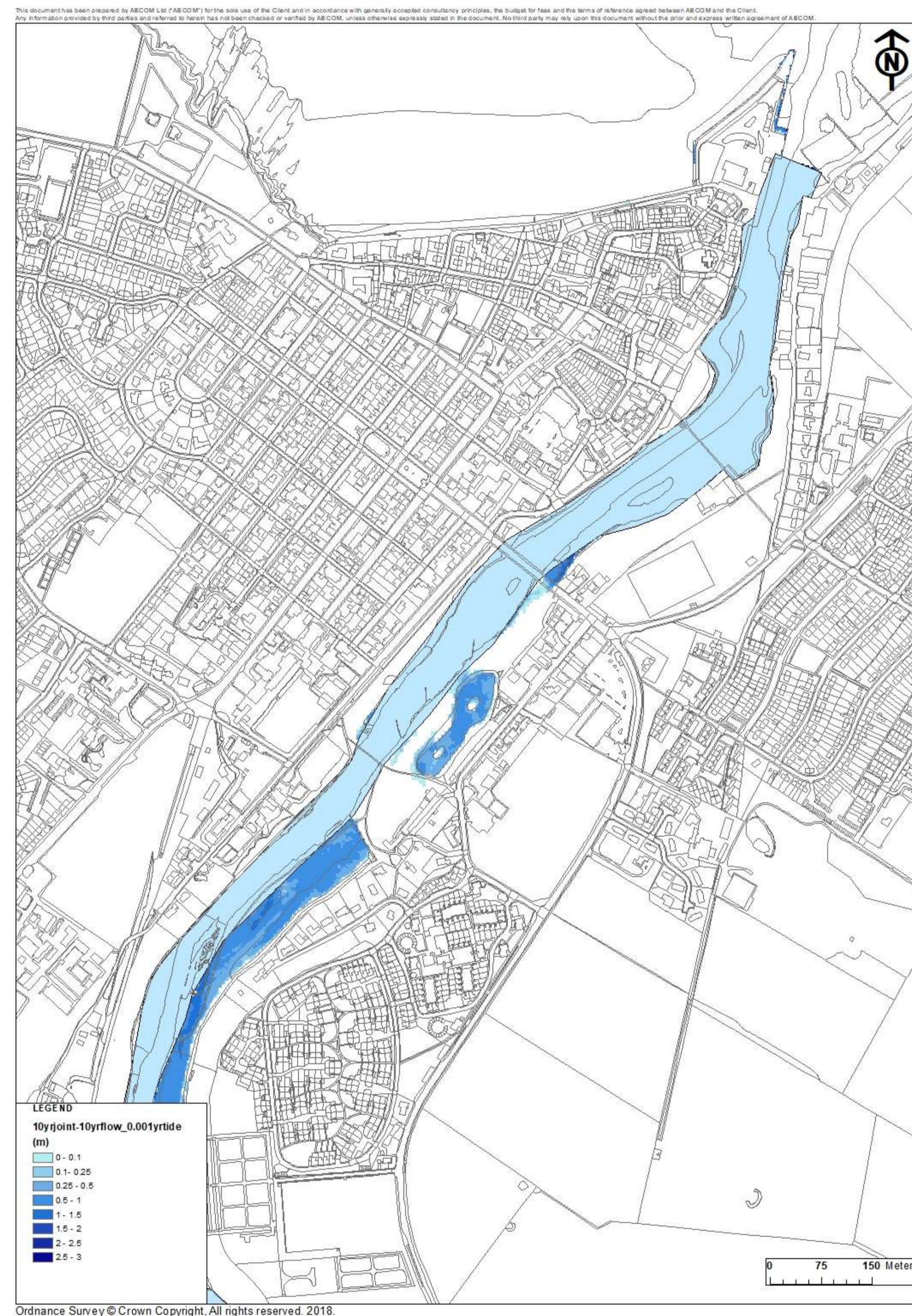


Coastal dominated 1 in 200yr flood map with climate change in 100 years

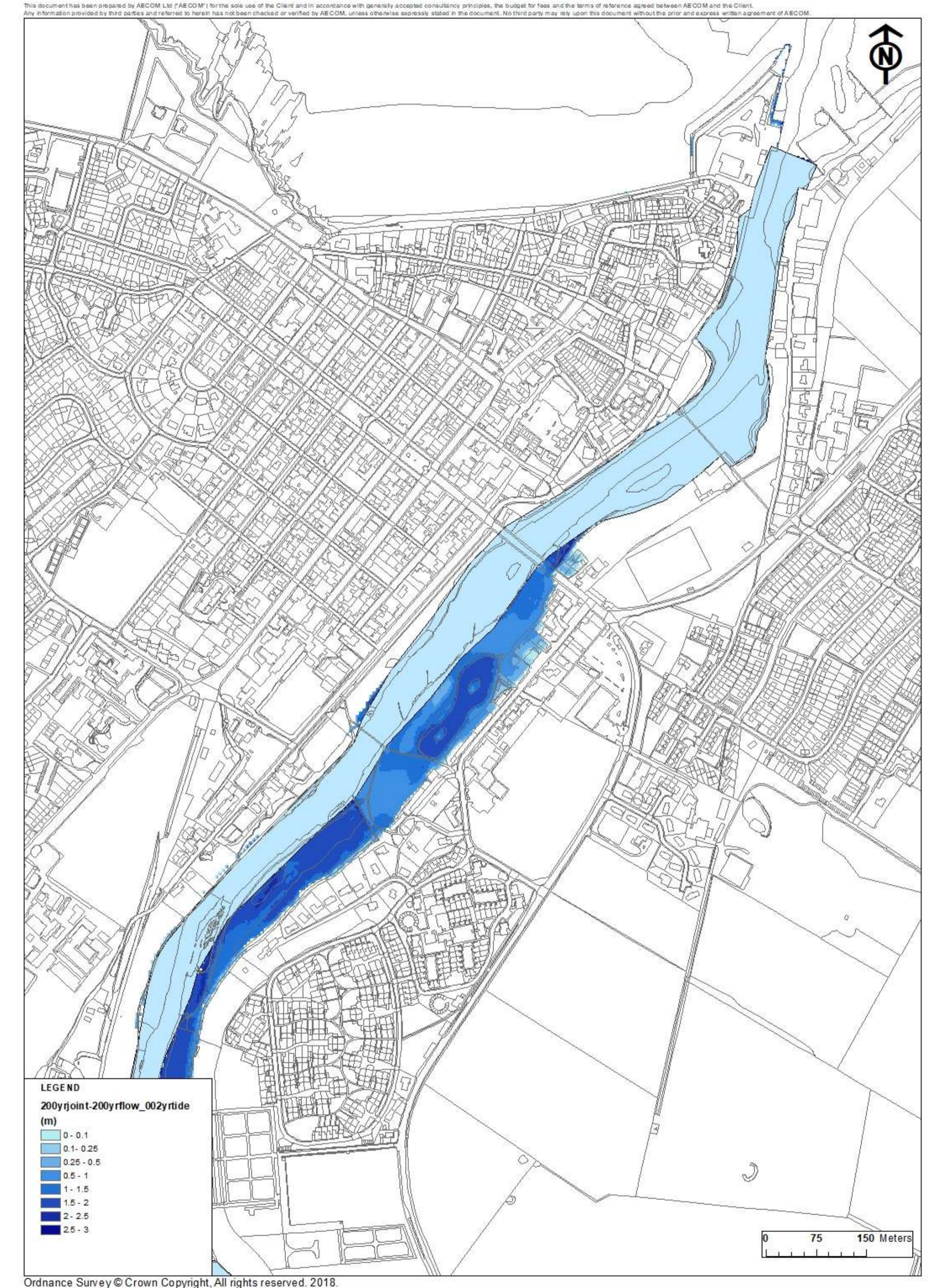
# 06 What is the scale of the fluvial flood risk?

## Flooding mechanisms

During fluvial dominant scenarios the River Thurso overtops the east bank prior to the Road Bridge. Water flows across the flood plain reaching the fire station before spilling over Millbank Road during extreme events. Flooding also occurs on the west bank during the flow peak, flowing on to Riverside Road.



Fluvial dominated 1 in 10yr flood map

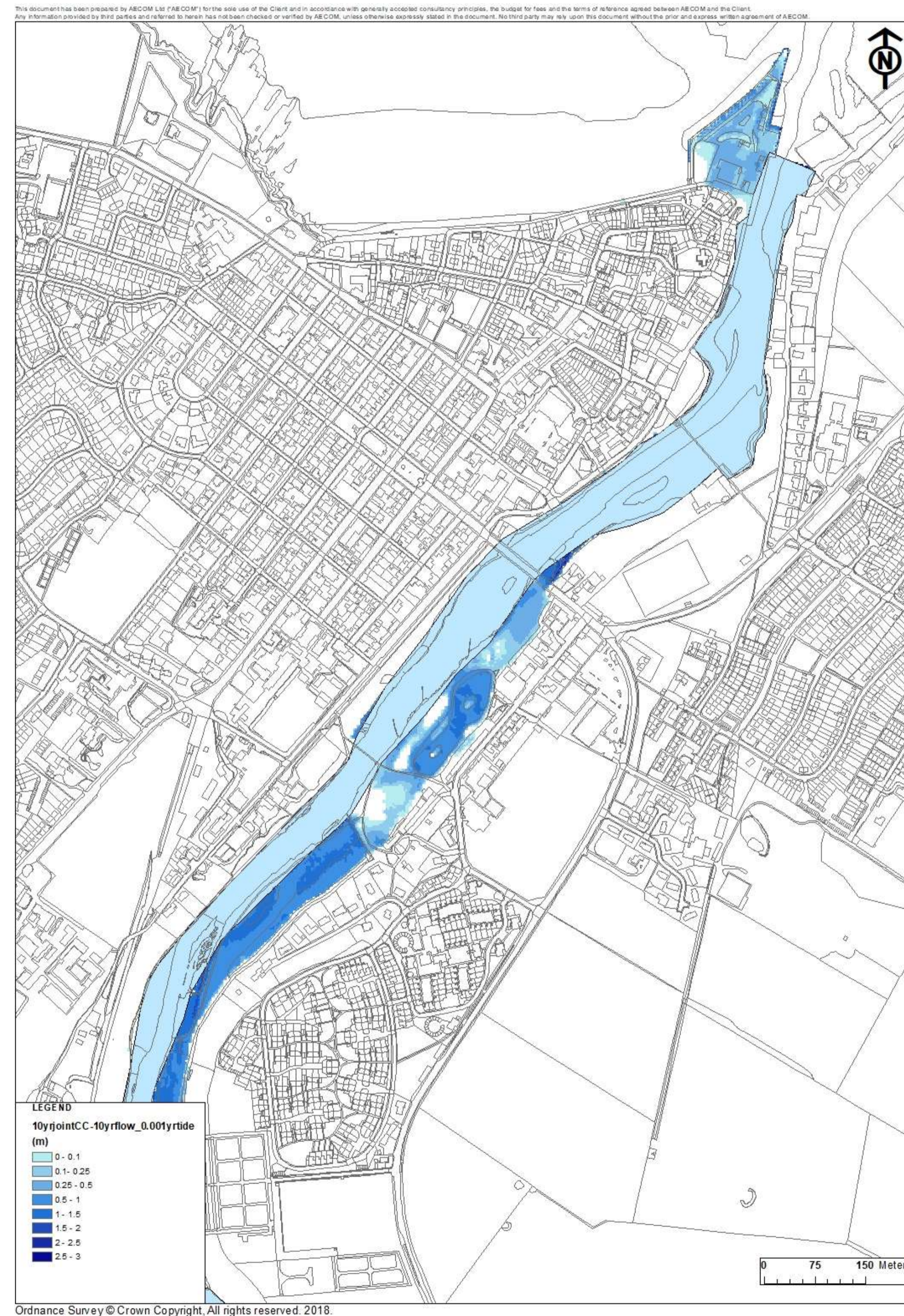


Fluvial dominated 1 in 200yr flood map

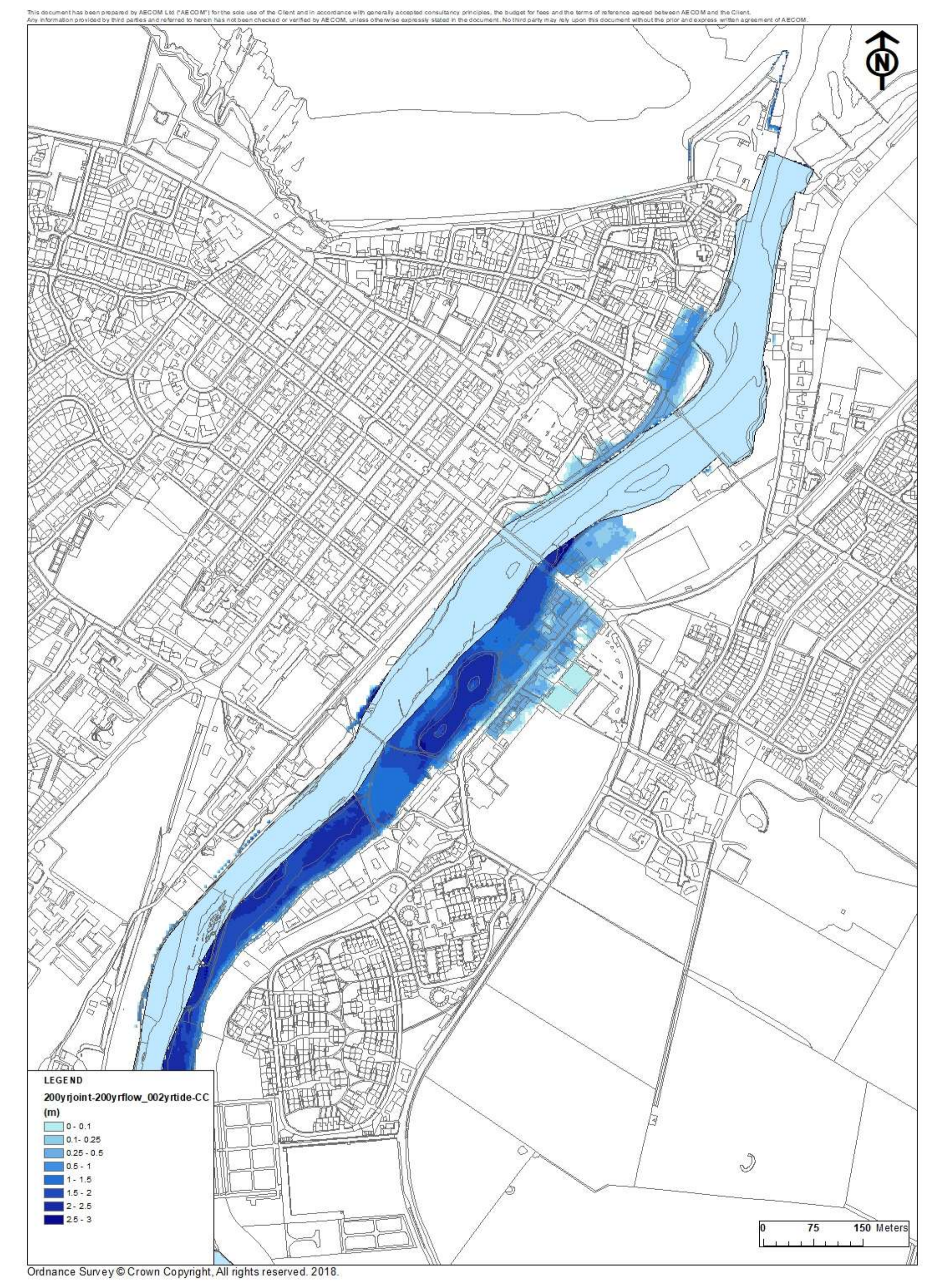
# 07 What is the scale of the fluvial flood risk?

## What about my property?

You may find that your property is located within some of the modelled flood extents for the different scenarios assessed through this Study, however, this has been done at a large scale and does not take into account localised features such as kerbs and garden walls which may affect localised flow paths. Nor does it take into account individual property levels which may be higher than predicated flood levels that have been determined through the modelling.




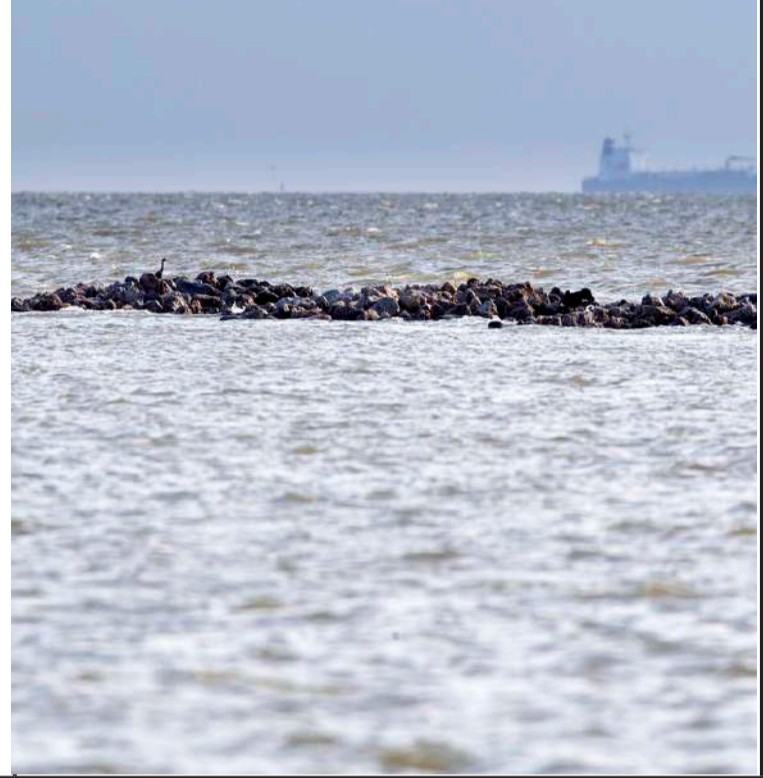

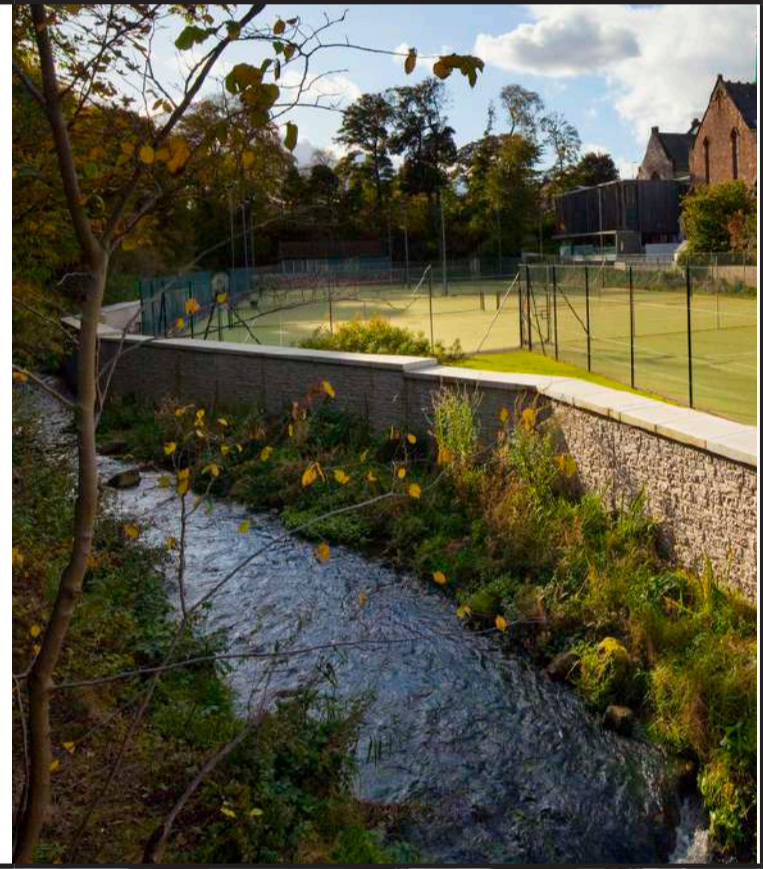



Fluvial dominated 1 in 10yr flood map with climate in 100 years



Fluvial dominated 1 in 200yr flood map with climate in 100 years

# 08 What options could be considered?

At this stage we are developing a long list of options to consider to mitigate against flood risk. No measures have been ruled out at this stage.

	<p><b>Do nothing</b></p> <p>Leave the defences as they are. This would result in the gradual deterioration of the defences and the standard of protection would decrease over time.</p>		<p><b>Wave energy dissipation</b></p> <p>Offshore breakwaters can be used to dissipate wave energy and change wave direction. A hard-engineered measure would involve installing a rubble breakwater some distance offshore to reduce the height and strength of waves before they break on the shoreline, reducing the volume of overtopping due to wave action and therefore reducing flood risk beyond the defence line. This would also reduce impact on existing defences. Additional ecological benefit can be added by installing living breakwaters, which can be designed to dissipate wave energy and encourage biodiversity.</p> <p>However, the flood risk benefits are limited as this measure would only reduce the impact of wave carryover and not direct tidal inundation when sea level is high.</p>
	<p><b>Do minimum</b></p> <p>Repairs and strengthening works could be made to the existing wave return wall and formalise the temporary defences on Riverside Road; and a stringent maintenance regime adopted to maintain the existing standard of protection. This option would strengthen the current defences and reduce their risk of failure. This would maintain the existing situation but would not reduce flood risk.</p>		<p><b>Direct defences within town</b></p> <p>Flood walls could be installed along the banks of the River Thurso to protect areas on or near the river flood plain. This would effectively restrict river water to the channel and natural undeveloped floodplain, but would raise the water level in the channel which may lead to flooding problems elsewhere.</p>
	<p><b>Raise coastal wall at existing defence line</b></p> <p>In order to prevent overtopping at the existing defence line, the coastal defence wall could be raised to create a barrier to wave carryover and inundation from high sea levels. This would offer an increase in the standard of flood protection for all receptors but it would incur significant cost and result in impacts on various environmental and social receptors.</p>		<p><b>Property Level Protection (PLP)</b></p> <p>PLP can be employed to protect individual properties from potential ingress of flood water through pathways such as doors and windows, brickwork and sewage systems. This option would not address the source of flooding but could act as a resilience technique to protect properties against flooding. The success of PLP is heavily dependent on the correct operation and maintenance procedure being applied. Issues would arise with retrofitting these measures on listed buildings.</p>
	<p><b>Raise a setback defence line</b></p> <p>Establish a secondary line of defence behind sea walls to provide an additional barrier to floodwaters and increase the standard of protection. This could be a permanent structure or embankment or a demountable structure such as quick-installation post and panels.</p> <p>This is an economical solution but, due to the setback nature, this option may not protect some receptors.</p>		



# 09 What are the next steps?

Development of a long list of options considering a very wide range of flood mitigation possibilities will be undertaken. From this, a short list will be identified utilising feedback from the Core Project Stakeholders and the public. Finally a preferred option will be identified following an assessment of the technical, economic and environmental considerations. As part of the scheme appraisal an economic assessment will be undertaken comparing the economic benefits of the scheme against the scheme cost.

A report containing details of the current flood risk and recommendations for the future management of river and coastal flood risks in Thurso will be produced. The results of this study will be compared to the results of other flood studies being undertaken in the Highlands and nationally over the next few years, and this will identify a priority list for flood protection works.

## How to provide your feedback?

The project team welcome your comments on the River Thurso Flood Protection Study.

You can provide it in various ways:

- Feedback form available at this exhibition;
- Speaking directly to the project team at the exhibition; or
- Contacting the Highland Council project team after the exhibition using the details adjacent.
- Details of the study will also be posted on the Highland Council website after the exhibition



## Contact information

Flood Risk Management Team

Development and Infrastructure Service,

The Highland Council,

Project Design Unit,

Council Offices,

Dingwall,

IV15 9QN

Tel no. 01349868800

Email: [FRM@highland.gov.uk](mailto:FRM@highland.gov.uk)

# 10 Responsibilities for flooding and self-help

You are the first line of defence against flooding. However public bodies have responsibilities too, and together we are working towards reducing the overall impacts of flooding in Scotland.

To find out more about all of our responsibilities please visit the following link:

<https://www.sepa.org.uk/environment/water/flooding/responsibilities-for-flooding/>

It is your responsibility to manage your own flood risk and protect yourself, your family, property and business. Being prepared by knowing what to do and who to contact if flooding happens, can help you reduce the damage and disruption flooding can have on your life.

The following information can assist you in managing your own flood risk:

## SEPA Flood maps



SEPA's flood maps are designed to help you understand how you could be affected by flooding. The maps show areas which are likely to flood from rivers, the sea and surface water.

These can be found online at:

<https://www.sepa.org.uk/environment/water/flooding/flood-maps/>

## Floodline

The best way to be prepared for flooding is to sign up for free, advance notice of flooding from Floodline. When you are signed up to Floodline and flooding is forecast in your area, we will send you a message by phone or text, advising that a Flood Warning or Flood Alert has been issued and where to go to find out more about the flooding situation. Sign up takes just a few minutes and all flood messages are free.

Sign up online at:

<https://www.sepa.org.uk/environment/water/flooding/floodline/>

## Five easy steps to prepare for flooding

1. Sign up to Floodline to receive free advance notice of when and where flooding might happen
2. Prepare a flood plan and put a family flood kit together so everyone knows what to do if flooding happens
3. Familiarise yourself with how to shut off gas, electricity and water supplies
4. Keep a list of useful contact numbers including your Floodline quickdial code
5. Consider flood protection products that could help to reduce the impact of flooding on your property and ensure your insurance provides adequate cover for flood damage

