FORTH ESTUARY LOCAL PLAN DISTRICT

COASTAL FLOODING

The area of the Forth Estuary Local Plan District that is affected by coastal flooding[1] is shown in Figure 1. This Local Plan District has 375km of coastline stretching from Fife Ness in the north to the Scottish Borders in the south. The coastline includes the Firth of Forth and areas of coast exposed to the North Sea. Several urban areas are situated along the coastline including Grangemouth, Bo'ness, Edinburgh, Musselburgh, North Berwick and Eyemouth. Altogether there are 22 Potentially Vulnerable Areas in this Local Plan District that have a risk of coastal flooding (Figure 1).

Impacts of coastal flooding

Within the Local Plan District approximately 1,700 residential properties and 340 non-residential properties are at a medium likelihood of coastal flooding. The Annual Average Damages in the district are approximately £4.0 million. It is estimated that 97% of residential and non-residential properties at a medium likelihood of coastal flooding are location within the Potentially Vulnerable Areas.

Main urban centres and infrastructure at risk

The main urban areas with a risk of coastal flooding can be seen in Table 1. Table 1 shows the number of residential properties at risk and the Annual Average Damages caused by coastal flooding. This includes damages to residential properties, non-residential properties, transport and agriculture. Figure 2 shows the distribution of Annual Average Damages throughout the Local Plan District.

Locations	Number of residential properties at a medium likelihood of flooding	Annual Average Damages
Grangemouth	670	£520,000
Musselburgh	380	£660,000
Kincardine	150	£350,000
Culross	130	£320,000
Airth	110	£670,000
Eyemouth	60	£240,000
Edinburgh	30	£100,000
Inverkeithing-North Queensferry	20	£42,000
North Berwick	20	£13,000
South Queensferry	10	£20,000
Carron-Carronshore	<10	£110,000
Dunbar and West Barns	<10	£26,000
Anstruther-Pittenweem	<10	£22,000
Prestonpans, Cockenzie & Port Seton	<10	£20,000
Limekilns	<10	£6,000

[1] The term coastal flooding is used under the Flood Risk Management (Scotland) Act 2009, but can also be referred to as tidal flooding in estuaries and river channels that are influenced by tidal flows.

Locations	Number of residential properties at a medium likelihood of flooding	Annual Average Damages
Bo'ness	<10	£2,000

Table 1: Main urban centres with a risk of coastal flooding[2]

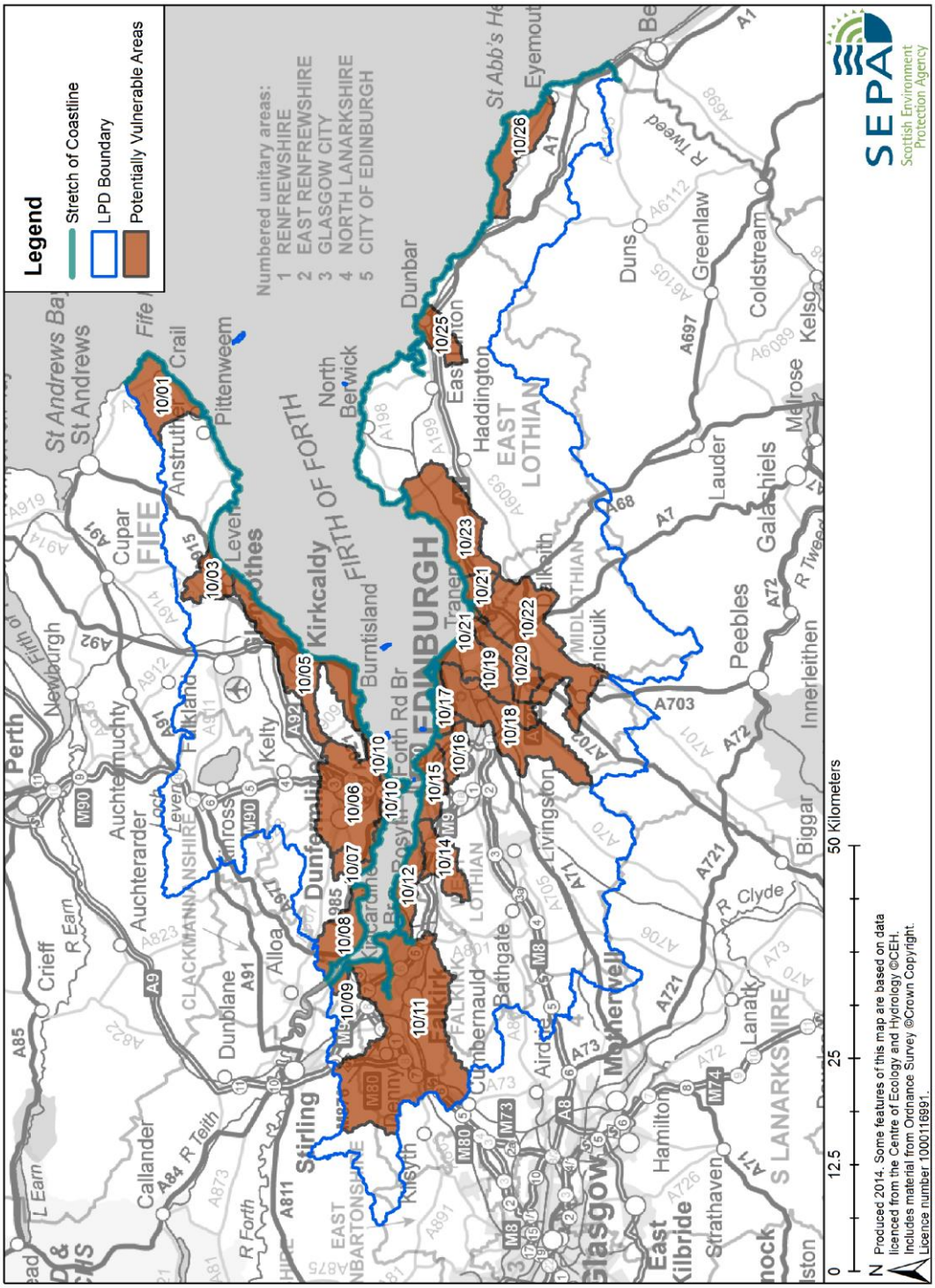

Figure 1: Forth Estuary Local Plan District coastal area and Potentially Vulnerable Areas with a risk of coastal flooding

[2] Table 1 does not show properties at risk if they are protected by a formal flood protection scheme with a known standard of protection of 1 in 200 years.

Within the Local Plan District a number of utility assets, community facilities and transport routes have a medium likelihood of coastal flooding. The approximate numbers include:

- Utility assets:
    - 40 energy production sites
    - <10 radar sites
    - <10 control buildings

- Community facilities:
    - <10 schools

- Transport routes:
    - 18 roads (13 A roads affected at 69 locations, 5 B roads affected at 30 locations)
    - 1 railway route (Fife circle, Dalmeny to Winchburgh and Haymarket West Junctions, affected at 3 locations).

Economic activity

The Annual Average Damages caused by coastal flooding in the Forth Estuary district are approximately £4.0 million. This consists of:

- 54% residential properties (£1,650,000 direct damages, £500,000 indirect damages)
- 32% non-residential properties (£1,300,000 direct damages)
- 6% emergency services (£250,000 indirect damages)
- 4% roads (£170,000 direct damages)
- 3% vehicles (£100,000 direct damages)
- 1% agriculture (£25,000 direct damages).

Out of the economic damages assessed the highest damages are to residential properties followed by damages to non-residential properties.

Higher damages are seen around the Musselburgh area due to the large number of both residential and non-residential properties along the coastline.

Higher damages in Rosyth are identified largely due to the industrial units located in and around Rosyth Dockyard.

The greatest number of properties at risk is in Grangemouth. Industrial areas around Grangemouth, Kincardine and Culross also contribute to high damage values.

Higher damages can be seen in the Airth area due to the large number of residential properties along the coastline.

Higher damages in Eyemouth are due to commercial and business properties around the harbour.

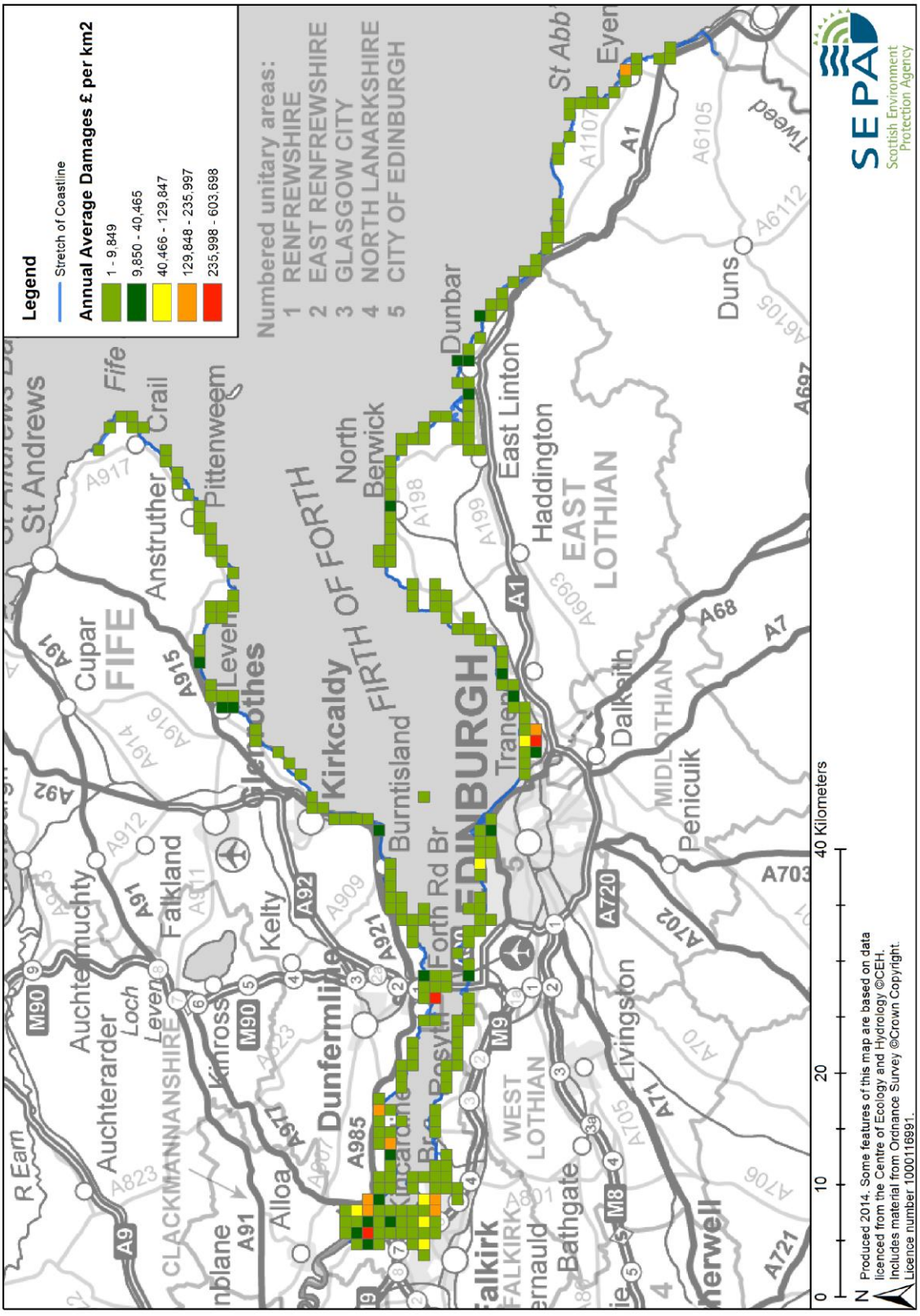

Figure 2: Annual Average Damages from coastal flooding

History of coastal flooding

The following flood events have been identified as having significant coastal influence by local authorities and SEPA's historical flood database:

- 04 January 2014: A tidal surge combined with a storm surge affected coastal areas across the east of Scotland, particularly around the Forth Estuary
- 05 December 2013: A North Sea surge of 1.0m in height combined with a high spring tide of 5.4m caused flooding along the east coast. Eyemouth was affected with almost all of Harbour Road inundated. Approximately 10 properties were flooded, which is less than may have been expected as a result of council and property owner preventative action
- 15 December 2012: A combination of wind and high tides caused large waves and coastal flooding along the east coast of Scotland. There was significant damage to North Berwick Harbour and damage to the communal slipway at Dunbar Harbour
- 30 and 31 March 2010: A tidal surge coinciding with the highest mean tides of the year caused extensive flooding along the east coast of Scotland. The Firth of Forth was one of the worst affected areas, affecting Leith, Musselburgh, Prestonpans, Port Seton, Kirkcaldy, Dunbar, Eyemouth and North Berwick. Impacts included flooding of properties, damage to harbours, seawalls, Kirkcaldy Esplanade and roads. Edinburgh City Council estimating the cost to repair damages in the region of £650,000
- 14 October 2010: Flooding from wave overtopping from the sea occurred at the Promenade, Musselburgh and the picnic areas at White Sands in Dunbar. Minor erosion to the coastal walkway at Prestonlinks, Prestonpans also occurred
- 22 October 2002: A storm caused combined fluvial and coastal flooding in Eyemouth. Impacts included flooding of properties in Harbour Road and the High Street. Sea levels at Eyemouth were at 3.128m
- 1978: A tidal flood event caused flooding of farmland to the west and east of Airth. Damage to the seawall occurred at Blackness and flooding to Victoria Sawmills, Thomson and Balfour in Bo'ness. Flooding at Bothkennar resulted in a partial reconstruction of the bund on the Carron being necessary. This event also affected the Grangemouth laundry, Dalgrain Road and the Grangemouth old town area
- 01[8] March 1969 Esplanade flooded under two feet of water, 2 boats sunk in Kirkcaldy harbour. Transport services interrupted
- 30 September 1959: Grangemouth Docks flooded with highest tides on record at 4.47m
- 04 April 1958: 40 families evacuated in Kirkcaldy. Homes and businesses flooded, cars washed away and civil infrastructure damaged. Flooding affected other areas along the Fife coastline including Anstruther (Shore Street) and Pittenweem. Portobello promenade and nearby houses were also flooded during this event
- 01 October 1947: Waves up to 30 feet affected Kirkcaldy with properties and cars damaged from flood waters
- 17 October 1898: Newhaven Pier in Edinburgh washed away
- 28 November 1897: It was recorded that at North Berwick sailors drowned with many shipwrecks and damage to boats and roads
- 1881: the "Eyemouth Disaster" when 191 fisherman died at Eyemouth
- 1877: Sea wall washed away between Portobello and Joppa.

Areas of environmental and cultural importance at risk of flooding

Within the Local Plan District approximately 55 cultural heritage sites have a medium likelihood of coastal flooding. This includes 30 Scheduled Monuments, 20 Gardens and Designated Landscape Sites, 4 Battlefield Sites and 1 World Heritage Site.

Approximately 12 environmental sites have a medium likelihood of coastal flooding. This includes 1 Special Area of Conservation, 5 Special Protection Areas and 6 Sites of Special Scientific Interest.

Managing flood risk along the coastline

Many organisations work together to manage flood risk. Individuals also have a responsibility for taking action to protect themselves and their property from flooding. Further information on the roles of different organisations in flood risk management and details on what individuals or businesses can do to prepare for flooding can be found in the leaflet 'Prepare for flooding - a guide for residents and businesses' available on the SEPA website www.sepa.org.uk

Actions that are in place to manage coastal flood risk in the Local Plan District are described below.

Flood protection schemes

There are 3 formal flood protection schemes to reduce the risk of coastal flooding:

- Bo'ness - Coastal flood protection scheme, construction was completed in 2011 and has a standard of protection of 1 in 200 years
- Grangemouth - The Grange Burn flood protection scheme serves the area of Grangemouth - This is mainly a river protection scheme but also has some coastal protection benefits. It commences at an overflow on the Grange Burn immediately downstream of the M9 Motorway and Beancross Road. It discharges to the River Avon immediately upstream of Wholeflats Road Bridge. It has an unknown standard of protection
- Prestonpans - The Prestonpans coastal flood protection scheme has a standard of protection of 1 in 200 years.

Other actions exist that are not formal flood defences but may reduce the impact of coastal flooding. This may include other structures and natural features. These other actions can be seen in the Appendix in Table A1.

Coastal flood warning schemes

SEPA's Floodline service provides flood alerts and flood warnings throughout Scotland to the public and to organisations that have flooding related duties.

Flood alerts are issued over wide geographical areas (normally matching local authority boundaries). Information is used from the Met Office and SEPA to determine if flooding is possible within the flood alert area.

Where SEPA has a river or coastal flood monitoring system, flood warnings can be issued for a local target area that can more accurately predict the likelihood and timing of flooding.

There are 19 coastal flood warning target areas within the Forth Estuary Local Plan District, as shown in Table 2 and Figure 3. Table 2 shows the total number of properties within a flood warning target area and the percentage of properties that have registered to receive flooding warnings directly from SEPA. Please note that this is not the number of properties at risk of flooding.

Flood Warning Target Area (FWTA)	Number of properties within FWTA	% of properties registered – January 2014
Anstruther to Elie	124	15
Blackness	24	8
Burntisland to Aberdour	26	15
Culross, Longannet ans Kincardine	615	9
Dunbar including West Barns	198	30
Eyemouth Coastal	88	20
Grangemouth	1,340	12
Granton and Leith	3,545	7
Kinghorn	50	6
Kirkcaldy	156	7
Leven and Methil	285	9
Lower Largo	38	39
Musselburgh Coastal	2,085	13
North Berwick	48	58
North Queensferry and Inverkeithing Bay	184	15
Portobello Esplanade	162	10
Prestonpans, Cockenzie and Port Seton	297	10
Rosyth, Limekilns and Charlestown	106	13
Torryburn and Newmills	29	10

Table 2: Flood warning target areas

Awareness raising campaigns and community flood action groups

SEPA and the local authorities work closely with many other organisations that have flooding related duties. These include the police, fire and rescue services, the Scottish Government, Scottish Flood Forum and local coastal partnerships. SEPA and the local authorities, often in partnership with these organisations, undertake various awareness raising campaigns that include community events, information leaflets, educational plays in schools, the use of social media and advertising.

In addition the following community groups that help with flood resilience are known to operate within this Local Plan District:

- Burnmouth Resilient Community Group
- Coastal Regeneration Group for Port Seton and Cockenzie
- Cockburnpath Resilient Community Group
- Dunbar Shore and Harbour Neighbourhood Group
- East Lothian Biodiversity Group and Local Community Councils
- Eyemouth Resilient Community Group
- Friends of the River Tyne
- Musselburgh Waterfront Group
- North Berwick Environment Group
- St Abbs Resilient Community Group.

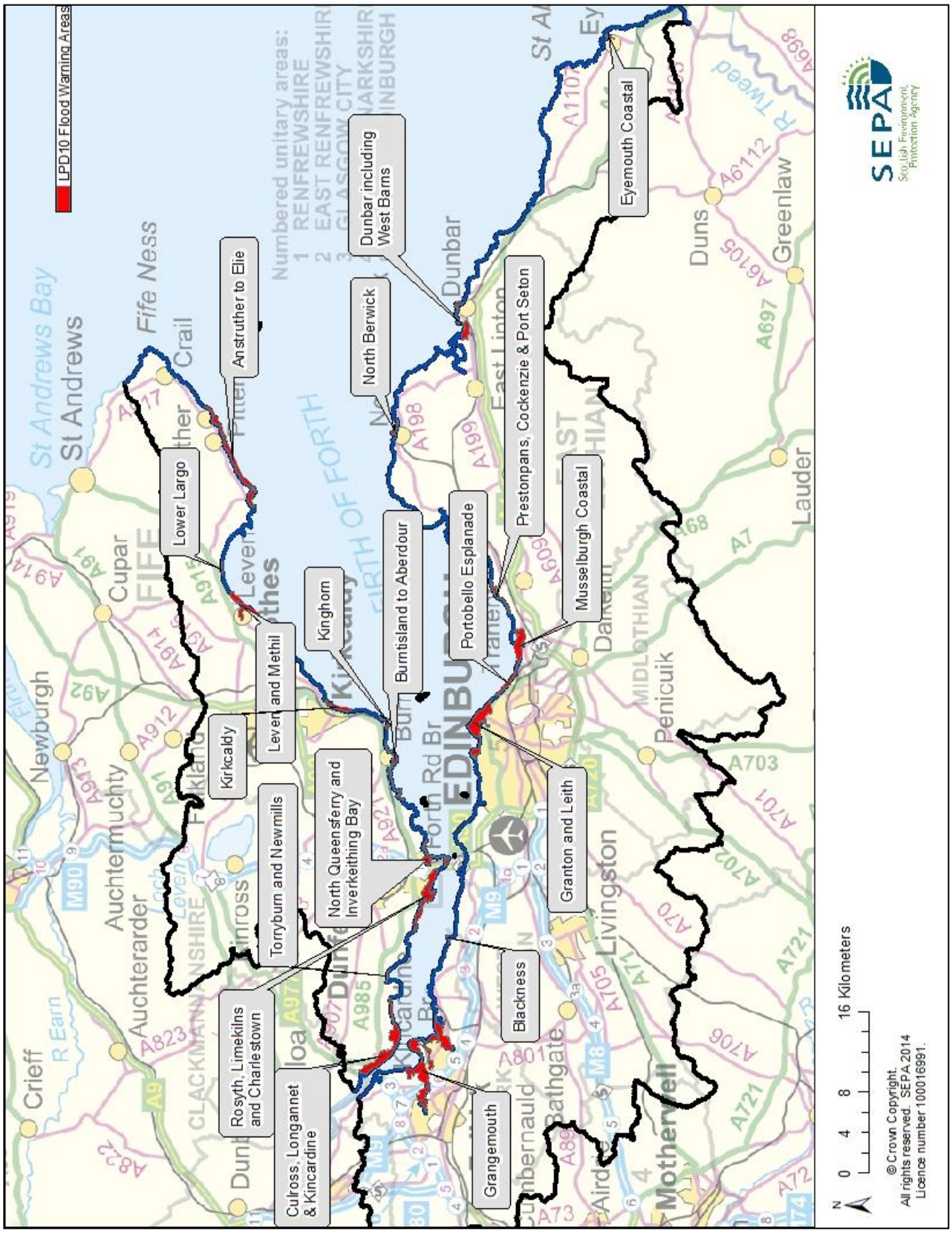

Figure 3: Flood warning target areas

Property level resilience/resistance

Some local authorities have their own policies regarding property level protection. Contact your local authority or view their website for more information.

The following incentives or subsidies have been put in place to provide property owners with property level resilience/resistance:

- East Lothian Council strategically deploys temporary flood barriers and sand bags when properties are threatened by flooding
- Fife Council provides Aquasacs for use in emergencies
- Scottish Borders Council operates a subsidised flood protection products scheme for residential and non-residential property owners in flood risk areas. Scottish Borders Council has provided and maintains dedicated sandbag stores in areas of flood risk to ensure sandbags are available to the public in the event of a flood
- The City of Edinburgh Council stores sandbags at key fire stations to be used in the event of flooding.

Flood risk management studies

The following coastal flood risk management related studies have been identified in the Local Plan District:

- East Lothian Shoreline Management Plan (East Lothian Council)
- Fife Shoreline Management Plan (Fife Council)
- St Abb's Head to River Tyne Shoreline Management Plan (Posford Dvivier,1998)
- Portobello Beach, Review of past performance and options for improvement (HR Wallingford, 2002)
- Granton Waterfront, Wave and water level conditions report (HR Wallingford, 2002)
- Coastal defence survey, East Lothian Shoreline Management Plan (2002)
- Causes of beach lowering at Dunbar, Eastern Scotland, UK (Maritime Engineering 01/2006;59(MA4):157-166 (Pontee, 2006))
- Grangemouth flood study (Sir Frederick Snow and Partners, 2006)
- Portobello seawall Standard of flood protection study (HR Wallingford, 2007)
- Eyemouth Seawall - Inspection, Testing and Options Report (Royal Haskoning,2009)
- Asset Management Plan (Edinburgh) (Jacobs, 2009)
- Grangemouth Flood Study (Halcrow Group Ltd, 2011 and 2012)
- SEPA Coastal Flood Warning Improvement Project Phase 3: Firth of Forth and Tay (Royal Haskoning, 2012)
- Review of coastal flooding documents (City of Edinburgh Council, 2013)
- Eyemouth Overtopping and Flood Study (Royal Haskoning, 2013).

Although not specifically relating to coastal flooding, the following documentation may contain relevant information relating to coastal flood management:

- Water of Leith Flood Prevention Scheme modelling (model includes Fluvial and Coastal interface at Leith)
- Musselburgh Flood Study (Jacobs).

Climate change and future flood risk

UK Climate Projections (UKCP09) predicts future climate change may lead to increased sea levels. The predicted magnitude of sea level rise due to climate change varies around the coastline based on UKCP09 2080 horizon projections. SEPA's coastal flooding has been modelled as a still water level projection, without wave action. Therefore there has been no consideration of the impacts of future climate on wave overtopping or storminess which could increase the number of people affected by coastal flooding.

For the UKCP09 high emissions scenario, the predicted average increase around the Forth Estuary Local Plan District ranges from 0.47-0.5m by 2080. It is estimated that the medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 1,700 to approximately 4,300. The number of non-residential properties may increase from approximately 340 to approximately 1,300.

The predicted average sea level increase and the associated increase in coastal flood risk are outlined below:

Mid Firth of Forth (North and south coast from Clackmannanshire Bridge to North and South Queensferry)

The predicted average sea level increase is 0.47m by 2080. The medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 1,100 to approximately 1,900 and the number of non-residential properties from approximately 150 to approximately 700. The Grangemouth area is likely to experience the biggest increase in coastal flooding under this scenario.

North Queensferry to Fife Ness (Outer Firth of Forth)

The predicted average sea level increase is 0.49m by 2080. The medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 30 to approximately 140 and the number of non-residential properties from approximately 40 to approximately 170. The urban centres of Kirkcaldy and Buckhaven-Methil-Leven would also be affected by coastal flooding under this scenario.

South Queensferry to North Berwick (Outer Firth of Forth)

The predicted average sea level increase is 0.49m by 2080. The medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 480 to approximately 2,200 and the number of non-residential properties from approximately 100 to approximately 440. The largest increases in properties at risk will be seen in Edinburgh and Musselburgh with the urban centre of Cockenzie and Port Seton also being affected by coastal flooding under this scenario.

North Berwick to English border

The predicted average sea level increase is 0.50m by 2080. The medium likelihood plus climate change scenario may increase the number of residential properties at risk of coastal flooding from approximately 70 properties to approximately 130 properties and the number of non-residential properties from approximately 60 properties to approximately 80 properties.

Coastal processes

The Forth Estuary Local Plan District has 375km of coastline stretching from Fife Ness in the north to the Scottish Borders in the south. The coastline includes the Firth of Forth and the coastline from North Berwick to the English border exposed to the North Sea.

The Firth of Forth is the largest estuary on the east coast of Scotland and extends 95km from Stirling in the west, where the River Forth flows into the estuary, to Fife Ness in the east where it meets the North Sea. The Forth Estuary Local Plan District includes the mid and outer Firth of Forth.

The main influences of coastal flooding in the Firth of Forth are storm surges and locally generated waves. Due to the sheltering effects of the estuary the Firth of Forth is less affected by swell waves but the influence of these increases towards the outer Firth of Forth.

The coast from around North Berwick to the Scottish border is exposed to the North Sea. In this area storm surges, swell waves and locally generated waves all influence coastal flooding.

Sediments in the inner Firth of Forth are generally characterised by finer sediments and mud, creating habitats such as mudflats, salt marshes and reed beds. These habitats can be seen at Skinflats north of Grangemouth and the Alloa Inches. Over the last two hundred years, much of the mudflat areas of the inner and mid Firth of Forth have been drained and lost to allow agricultural and industrial development. Toward the outer Firth of Forth the sediments in the estuary become coarser creating habitats such as sandy beaches and dunes, as can be seen at Gullane Bay and Aberlady Bay.

SEPA has assessed where erosion is likely to affect actions to reduce the risk of coastal flooding and a summary is provided below. The assessment does not take into account existing coast protection or flood protection structures which may reduce susceptibility to erosion. Neither does it indicate areas that will erode or the timescales over which erosion could occur. For further information on the natural susceptibility of coastal erosion please contact SEPA.

Mid Firth of Forth (North and south coast from Clackmannanshire Bridge to North and South Queensferry)

Most of the coastline around the mid Firth of Forth has a medium and medium to high susceptibility to coastal erosion. Areas including to the west of Grangemouth, Bo'ness and Kincardine are particularly susceptible to coastal erosion. Although the areas around Grangemouth, Bo'ness and North Queensferry are shown to be naturally slightly more susceptible to coastal erosion, structures that may help manage coastal erosion are present along much of the coastline.

North Queensferry to Fife Ness (Outer Firth of Forth)

Most of the coastline along North Queensferry to Fife Ness has a low susceptibility to coastal erosion. However, Burntisland and Methil are considered to be more susceptible. Although the areas around Burntisland, Kirkcaldy and Methil are shown to be naturally slightly more susceptible to coastal erosion, there are a number of structures that may help manage coastal erosion present that mostly coincide with the urban areas of Kirkcaldy, Burntisland, Inverkeithing, Methil, Buckhaven and Anstruther.

South Queensferry to North Berwick (Outer Firth of Forth)

Most of the coastline along South Queensferry to North Berwick has a medium susceptibility to coastal erosion.However, there are isolated areas, notably between Leith and Portobello that are more susceptible to coastal erosion. Although the area around Edinburgh is shown to be naturally slightly more susceptible to coastal erosion, structures that may help manage coastal erosion are present particularly between Cramond and Prestonpans.

North Berwick to English border

Most of the coastline along North Berwick to the English border has a low to medium susceptibility to coastal erosion with areas including the coastline between Dunbar and Thorntonloch noted as being particularly susceptible to coastal erosion. Although the areas around Dunbar, St Abb's and Burnmouth are shown to be naturally more susceptible to coastal erosion, structures that may help manage coastal erosion are present in the West Barns area near Dunbar, at the Torness Nuclear Power Station, at St Abb's and at Burnmouth.

Potential for natural flood management

Further information on natural flood management is provided in the Local Plan District overview chapter and maps showing potential for natural flood management are available on the SEPA website (http://map.sepa.org.uk/floodmap/map.htm).

Mid Firth of Forth (North and south coast from Clackmannanshire Bridge to North and South Queensferry)

There is potential for estuarine surge attenuation to reduce flood risk in and around Kincardine and Rosyth. Along much of the mid Firth of Forth there is also medium potential for estuarine surge attenuation, particularly around parts of Grangemouth, Bo'ness and South Queensferry. There appears to be a greater potential for wave dissipation, which could provide possible flood risk benefits around Grangemouth and South Queensferry, with lesser potential at Bo'ness. The feasibility of implementing any natural flood management actions may however be limited due to the large amount of industry along this coastline.

North Queensferry to Fife Ness (Outer Firth of Forth)

Whilst the potential for estuarine surge attenuation along the North Queensferry to Fife Ness coastline is limited, there is potential for benefits around North Queensferry and Inverkeithing. The potential for wave dissipation is more widespread with medium to high potential along most of the coastline in this area.

South Queensferry to North Berwick (Outer Firth of Forth)

There is medium to high potential for estuarine surge attenuation to the west of Edinburgh at South Queensferry. There is also high potential for wave dissipation along most of the South Queensferry to North Berwick coastline.

North Berwick to English border

There is limited to no potential for estuarine surge attenuation along North Berwick to the English border, however there may be potential for wave dissipation in this area, particularly around Dunbar and within Berwickshire Potentially Vulnerable Area.

Links with river basin planning

North Queensferry to Fife Ness

There are 3 coastal water bodies in the North Queensferry to Fife Ness coastal area. All the water bodies are at good or better status. This means it is unlikely any opportunities to improve habitats will be prioritised. However, SEPA recognise there are gaps in our understanding of the condition of estuarine and coastal habitats and current classification may underestimate these impacts. Changes to water bodies identified as pressures in this coastal area include approximately 8.5km of shoreline protection structures and 1.5km of land reclaimed from the sea.

Mid Firth of Forth (North and south coast from Clackmannashire Bridge to North and South Queensferry)

There is 1 estuarine and 4 coastal water bodies in the Mid Firth of Forth coastal area. The Mid Forth Estuary water body is designated as heavily modified and requires actions to reach good ecological potential. Changes to water bodies identified as pressures in this coastal area include approximately 1.5km of flood protection structures and 9.5km of shoreline protection structures. There is also approximately 15.5km^2 of land reclaimed from the sea.

South Queensferry to North Berwick

There is 1 estuarine and 4 coastal water bodies in the South Queensferry to North Berwick coastal area. The Leith Docks to Port Seton water body is designated as heavily modified and requires actions to reach good ecological potential. Changes to water bodies identified as pressures in this coastal area include approximately 16.0km of shoreline protection structures and 4.0km of land reclaimed from the sea.

North Berwick to English border

There is 1 estuarine and 3 coastal water bodies in the North Berwick to English border coastal area. All the water bodies are at good or better status. This means it is unlikely that any opportunities to improve habitats will be prioritised. However, SEPA recognise there are gaps in our understanding of the condition of estuarine and coastal habitats and current classification may underestimate these impacts. Changes to water bodies identified as pressures in this coastal area include approximately 2.5km of flood protection structures and 2.0km of shoreline protection structures. There is also approximately 0.5km^2 of land reclaimed from the sea.

Appendix

Further information on existing actions

As well as the formal flood protection schemes, other actions exist that reduce the risk of coastal flooding in this Local Plan District. This includes existing structures and natural features listed in Table A1.

Location	Name of structure or natural feature	Description	Owned and/or maintained by
Cramond	Cramond mole	Masonry and concrete mole, sewer outfall	City of Edinburgh Council, Scottish Water
Eastfield	Coastal defence	Masonry wall and rock armour revetment	City of Edinburgh Council, Non local authority
Joppa	Coastal defence	Masonry wall and revetment, some rock armour. Pumping station.	City of Edinburgh Council, Scottish Water, Non local authority
Newhaven to Granton	Coastal defence	Masonry walls and revetment. Pumping station.	City of Edinburgh Council, Scottish Water
Portobello	Promenade and beach	Concrete wave wall & replenished beach	City of Edinburgh Council, Non local authority
Portobello, Leith and Granton	Coastal defence	Wave Return Walls	City of Edinburgh Council
Seafield	Coastal defence	Concrete wave wall, concrete and masonry revetment	City of Edinburgh Council, Non local authority
Silverknowes/Cramond	Promenade	Rock armour and concrete revetment, concrete wave wall.	City of Edinburgh Council
South Queensferry	Various, including buildings	Masonry and concrete walls. Coast Protection Act stops at Hound Point, on Dalmeny foreshore.	City of Edinburgh Council, Non local authority
West Shore Rd	Coastal defence	Masonry wall, concrete wall, rock armour	City of Edinburgh Council, Non local authority
Aberlady Bay	Coastal defence	Man-made: concrete, masonry wall. Natural: beaches, saltmarshes, mudflats. (approx. 5km in length)	East Lothian Council
Archerfield and Yellowcraig	Coastal defence	Man-made: none identified. Natural: shingle beach (approx. 3km in length)	East Lothian Council, Non local authority
Belhaven Bay	Coastal defence	Man-made: earthen embankment, masonry wall. Natural: sand beach, saltmarsh, mudflat (approx. 7km in length)	East Lothian Council
Broad Sands and West Links	Coastal defence	Man-made: gabions, timber wall. Natural: sand beach (approx. 3km in length)	East Lothian Council
Cockenzie and Port	Coastal defence	Man-made: harbours,	East Lothian Council,

Location	Name of structure or natural feature	Description	Owned and/or maintained by
Seton		masonry property walls, concrete walls, rock armour. Natural: sand beach (approx. 2km in length)	Non local authority
Dunbar Cliffs	Coastal defence	Man-made: gabions, rock revetment, concrete walls, harbour. Natural: rock outcrops (approx. 1.5km in length)	East Lothian Council
Dunbar East Beach	Coastal defence	Man-made: concrete, masonry walls, groyne. Natural: rock outcrops, sand beach (approx. 1.5km in length)	East Lothian Council
Eastfield to River Esk (Musselburgh)	Coastal defence	Man-made: concrete/masonry walls (some of which are property walls). Rock armour. River training works at the River Esk. Natural: mudflats, beaches (approx. 2km in length)	East Lothian Council
Gosford Bay	Coastal defence	Man-made: masonry sea wall with gabions, rock revetment consisting of tank traps and tipped rubble. Natural: sand beach and rock platforms (approx. 6km in length)	East Lothian Council
Gullane Bay	Coastal defence	Man-made: none, although the dunes have been heavily modified and stabilised in the 1960's and 1970's. Natural: sand beach (approx. 5km in length)	East Lothian Council
Humlocks and Cockenzie Power Station	Coastal defence	Man-made: rock revetment, concrete wall, with rock armour protection at toe (approx. 1km in length)	East Lothian Council
North Berwick	Coastal defence	Man-made: timber wall, concrete/masonry walls, harbour, geotextile, rock revetment (tipped rocks) Natural: sand beach (approx. 2.5km in length)	East Lothian Council
Prestonpans	Coastal defence	Man-made: masonry or concrete walls (mainly property walls). A wide flat concrete platform covering pipes from the power station fronts the property walls. Natural: beach (approx. 1.5km in length)	East Lothian Council

Location	Name of structure or natural feature	Description	Owned and/or maintained by
The Cast (Prestonpans)	Coastal defence	Man-made: rock revetment (mix of rocks tipped at back of beach), gabions backed by geotextile matting. Natural: beach (approx. 1km in length)	East Lothian Council
Thorntonloch	Coastal defence	Man-made: rock revetment (tank-traps) and dune planting. Natural: sand beach (approx. 4.5km in length)	East Lothian Council
West Barns	Coastal defence	Natural: rock outcrops, pocket beaches (approx. 5.5km in length)	East Lothian Council
Winterfield Golf Course	Coastal defence	Man-made: gabions, rock revetment (consisting of anti-tank traps), masonry wall. Natural: rock outcrops (approx. 1.5km in length)	East Lothian Council
Bo'ness	Flood defences	Flood defence walls, bunds and harbour entrance works. Scheme under '61 Act	Falkirk Council
Grange Burn, Grangemouth	Flood defences	Burn embankments and flood relief channel. Scheme under the 1961 Act	Falkirk Council
Aberdour	Coastal defence	Masonry wall, masonry revetment	Fife Council, Non local authority
Aberdour to Silvershands	Coastal defence	Masonry harbour, docks, masonry embankment, cliff/escarpment, beach/foreshore	Fife Council, Non local authority
Craigfoot Walk to Kirkcaldy Harbour	Coastal defence	Concrete wall, concrete/masonry harbour/docks	Fife Council, Non local authority
Dysart	Coastal defence	Rock armour revetment	Fife Council
Dysart to West Wemyss Harbour	Coastal defence	Coal mining spoil cliff/escarpment, coal mining spoil embankment, shingle beach/foreshore, masonry wall	Fife Council, Non local authority
Kirkcaldy Harbour to Dysart Harbour	Coastal defence	Made ground beach/foreshore, bedrock cliff/escarpment, masonry/sheet pile harbour/docks	Fife Council, Non local authority
Leven	Coastal defence	Concrete sea wall, brickwork promenade	Fife Council
Ross Point to Pettycur Bay	Coastal defence	Harbour/docks, rock armour revetment, sand dunes, bedrock cliff/escarpment, masonry wall	Fife Council, Non local authority
North Queensferry to Preston Crescent	Coastal defence	Harbour/docks, masonry revetment	Fife Council, Non local authority

Location	Name of structure or natural feature	Description	Owned and/or maintained by
West Wemyss	Coastal defence	Masonry harbour/docks, rock armour revetment, concrete wall	Fife Council, Non local authority
Burnmouth (Cowdrait)	Cowdrait sea wall	Other structure (approx. 200m in length)	Scottish Borders Council
Eyemouth	Bantry sea wall	Coastal defence promoted under the Coast Protection Act 1948 (approximately 330m in length	Scottish Borders Council
Eyemouth	Wellsbrae sea wall	Other structure (approx. 80m in length)	Scottish Borders Council
Anstruther	Coastal defence	Masonry walls, masonry harbour/docks	Non local authority
Anstruther Easter to Crail	Coastal defence	Bedrock beach/foreshore, bedrock cliff/escarpment	Non local authority
Ash Lagoons (Musselburgh)	Coastal defence	Man-made: concrete sea wall (approx. 3km in length)	Non local authority
Bendameer Ho to Ross Point	Coastal defence	Rock armour revetment, concrete parapet wall	Non local authority
Braefoot Point	Coastal defence	Rock armour embankment, steel/concrete embankment	Non local authority
Braefoot Point to Aberdour	Coastal defence	Sand/shingle beach/foreshore, masonry wall	Non local authority
Buckhaven (East)	Coastal defence	Rock armour revetment, sheet piling harbour/docks	Non local authority
Buckhaven (West)	Coastal defence	Rock armour Revetment	Non local authority
Burnmouth (Cowdrait)	Cowdrait beach	Natural feature: shingle beach (approx. 180m in length)	N/A
Burnmouth (Partanhall)	Burnmouth Hill	Natural feature: rocky headland (approx. 239m in length)	N/A
Burnmouth (Lower)	Lower Burnmouth sea wall	Other structure (approx. 80m in length)	Non local authority
Burnmouth (Lower)	Burnmouth Harbour	Other structure	Non local authority
Burnmouth (Partanhall)	Partanhall sea wall	Other structure (approx. 190m in length)	Non local authority
Burnmouth (Ross)	Ross Point	Natural feature: rocky headland (approx. 135m in length)	N/A
Burnmouth (Ross)	Ross sea wall	Other structure (approx. 90m in length)	Non local authority
Charlestown	Coastal defence	Masonry revetment and masonry harbour/docks	Non local authority
Charlestown to Limekilns	Coastal defence	Concrete/masonry wall, masonry pier, gabion wall	Non local authority
Coldingham sands	Milldown point	Natural feature: rocky headland (approx. 148m in length)	N/A
Coldingham sands	Coldingham sands	Natural feature: dunes and sandy beach (approx. 500m in length)	N/A
Coldingham sands	Jock's Nose	Natural feature: rocky headland (approx. 569m in	N/A

Location	Name of structure or natural feature	Description	Owned and/or maintained by
		length)	
Cove Harbour	Horse road rock	Natural feature: rocky headland (approx. 350m in length)	N/A
Cove Harbour	The Boyne dyke	Natural feature: rocky headland (approx. 60m in length)	N/A
Cove Harbour	Cove Harbour	Other structure	Non local authority
Crail	Coastal defence	Soil/bedrock, cliff/escarpment, masonry harbour/docks, masonry/concrete/gabion walls	Non local authority
Crombie Pier to Charlestown	Coastal defence	Masonry revetment	Non local authority
Dalmeny	Dalmeny foreshore	Natural, masonry revetment and walls at Barnbougle Castle	Non local authority
Dunbar Golf Course	Coastal defence	Man-made: masonry wall, gabions, rock revetment (tipped rocks) Natural: rock outcrops, pocket beaches (approx. 2km in length)	Non local authority
Earlsferry to Elie	Coastal defence	Masonry wall, sand/vegetation dunes, wall, masonry harbour	Non local authority
East of Pitenweem to Anstruther Wester	Coastal defence	Bedrock cliff/escarpment, bedrock beach/foreshore, concrete/masonry wall	Non local authority
East Wemyss	Coastal defence	Rock armour revetment	Non local authority
East Wemyss to Buckhaven	Coastal defence	Soil/vegetation embankment	Non local authority
Elie to St Monans	Coastal defence	Soil/bedrock cliff/escarpment	Non local authority
Eyemouth	Dulse Craig	Natural feature: rocky headland (approx. 110m in length)	N/A
Eyemouth	Eyemouth Harbour	Other structure: embankment and harbour walls	Non local authority
Eyemouth	Eyemouth beach	Natural feature: sandy beach beside the sea walls	N/A
Eyemouth	Kings Mount	Natural feature: rocky headland (approx. 120m in length)	N/A
Eyemouth	Hurter and Luff hard rocks	Natural feature: offshore rocks	N/A
Grangemouth Docks	Coastal structures	Masonry structures	Non local authority
Granton	Granton Harbour	Masonry and concrete walls and revetments	Non local authority
Kincardine to Preston Island	Coastal defence	Masonry revetment	Non local authority
Kinghorn Beach to Craigfoot	Coastal defence	Bedrock cliff/escarpment, masonry wall, concrete pier	Non local authority
Leith	Leith Docks	Various, with impounding sea lock	Non local authority

Location	Name of structure or natural feature	Description	Owned and/or maintained by
Leven to Lundin Links	Coastal defence	Gabion mattress embankment, sand/vegetation dunes, sand/timber dunes, masonry wall	Non local authority
Limekilns to Rosyth	Coastal defence	Soil/vegetation embankment	Non local authority
Lower Largo	Coastal defence	Masonry walls, masonry pier	Non local authority
Lower Largo to Earlsferry	Coastal defence	Sand/vegetation dunes, bedrock cliff/escarpment	Non local authority
Methil	Coastal defence	Concrete/masonry harbour/docks, concrete/masonry wall	Non local authority
North Queensferry	Coastal defence	Masonry walls, masonry railway pier, masonry town pier, gabion walls, bedrock cliff/escarpment	Non local authority
Pease Bay	Greenheugh Point	Natural feature: rocky headland (approx. 410m in length)	N/A
Pease Bay	Pease Bay	Natural feature: shingle beach with some erosion protection (beach approx. 270m in length)	N/A (erosion protection non local authority structure)
Pease Bay	Pease Sands	Natural feature: sandy beach with sand dunes (the bents) (approx. 660m in length)	N/A
Pettycur Bay to Kinghorn Beach	Coastal defence	Bedrock cliff/escarpment	Non local authority
Pittenween	Coastal defence	Masonry walls, masonry harbour/docks, bedrock cliff/escarpment	Non local authority
Preston Crescent to St Davids Bay	Coastal defence	Rock armour revetment	Non local authority
Preston Island	Coastal defence	Masonry revetment	Non local authority
Preston Island to Torryburn	Coastal defence	Masonry revetment and masonry wall	Non local authority
Rosyth to North Queensferry	Coastal defence	Harbour/docks, rock armour revetment	Non local authority
Silvershands to Bendameer Ho	Coastal defence	Masonry revetment, bedrock rock outcrops	Non local authority
St Abbs	Castle Rock	Natural feature: rocky cliffs (approx. 90m in length)	N/A
St Abbs	Black Craighead	Natural feature: rocky cliffs (approx. 190m in length)	N/A
St Abbs	Maw Carr	Natural feature: offshore rocks	N/A
St Abbs	St Abbs marine station sea walls	Other structure: (approx. 143m in length)	Non local authority
St Abbs	St Abbs Harbour	Other structure	Non local authority
St Abbs	Rockhouse sea wall	Other structure: (approx. 70m in length)	Non local authority
St Davids Bay to Braefoot Point	Coastal defence	Rock armour revetment, sand/shingle	Non local authority

Location	Name of structure or natural feature	Description	Owned and/or maintained by
		beach/foreshore	
St Monans	Coastal defence	Masonry/concrete walls, masonry harbour/docks	Non local authority
St Monans to Pittenween	Coastal defence	Bedrock/made ground cliff/escarpment, concrete/masonry outdoor pools	Non local authority
Torness Power Station	Coastal defence	Man-made: concrete revetment/wall with rock armouring (approx. 4.5km in length)	Non local authority
Torryburn to Crombie Pier	Coastal defence	Made ground embankment	Non local authority
West Wemyss to East Wemyss	Coastal defence	Sand/shingle beach/foreshore, made ground cliff/escarpment, rock armour revetment	Non local authority

Table A1: Actions and natural features that contribute to the management of coastal flooding