Flood Risk Management Strategy

Orkney Local Plan District

This section provides supplementary information on the characteristics and impacts of river, coastal and surface water flooding. Future impacts due to climate change, the potential for natural flood management and links to river basin management are also described within these chapters.

Detailed information about the objectives and actions to manage flooding are provided in Section 2.

Section 3: Supporting information

3.1 Introduction

In the Orkney Local Plan District, coastal flooding is reported across two distinct coastal areas. River flooding and surface water flooding are reported across the whole Local Plan District.

A summary of the number of properties and Annual Average Damages from river, coastal and surface water flooding is outlined in Table 1.

	Total number of properties at risk[1]	Annual Average Damages	Local authority
River Catchments			
Orkney Islands river catchment	40	£150,000	Orkney Islands Council
Coastal flooding			
Orkney South Isles and Mainland coastal area	950	£2.7 million	Orkney Islands Council
Orkney North Isles coastal area	170	£1.2 million	Orkney Islands Council
Surface water flooding			
Orkney Local Plan District	190	£170,000	Orkney Islands Council

Table 1: Summary of flood risk from various sources within the Orkney Local Plan District

[1] Total number of residential and non-residential properties at risk of flooding

3.2 River flooding

Orkney Local Plan District

This chapter provides supplementary information on river flooding at the catchment level. It provides an overview of the catchment's natural characteristics, flood risk and the existing actions to manage flooding. It outlines the likely impact of climate change and the potential for natural flood management.

Detailed information about the objectives and actions to manage flooding are provided in Section 2.

Catchment overview

Much of the land in Orkney consists of improved or rough grassland and the fertile soils are also well suited to arable forming. The islands have a cool, temperate climate with an average annual rainfall of between 500mm and 1200mm.

There are no major rivers in the Orkney Islands (Figure 1). River catchments are generally small and respond rapidly to rainfall. In agricultural areas some burns have been straightened to act as additional field drainage.

There are eight Potentially Vulnerable Areas:

- Sanday (03/01)
- Stronsay (03/02)
- Orkney Mainland North (03/03)
- Stromness (03/04)
- Kirkwall (03/05)
- Hoy (03/06)
- South Ronaldsay (03/07c)
- Westray (03/08c).

These are spread across the islands with three located on Orkney Mainland, three on the North Isles, and two on the remaining South Isles.

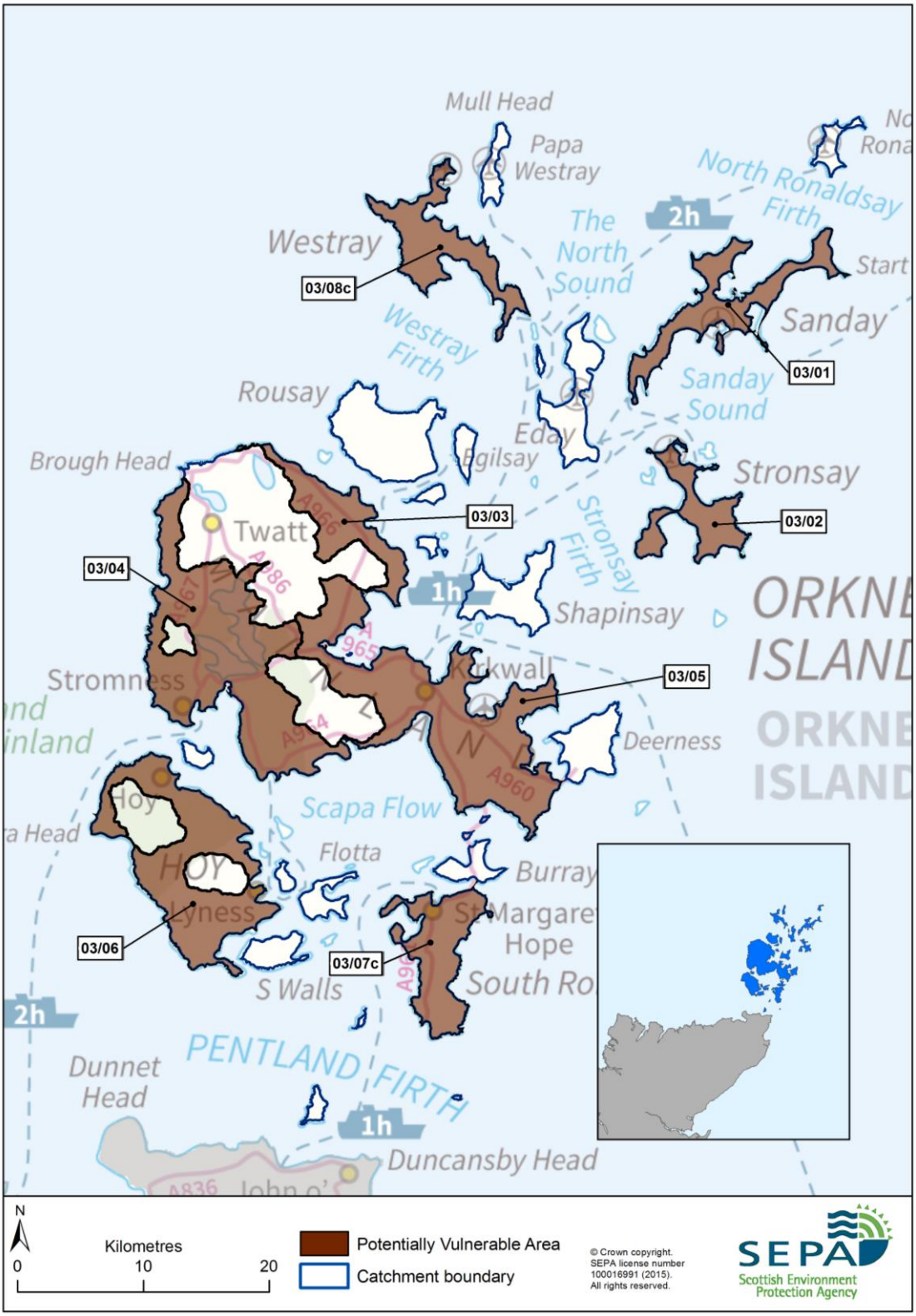

Figure 1: Orkney Islands river catchment group and Potentially Vulnerable Areas

Flood risk in the catchment

Main areas at risk

There are approximately 30 residential properties and 10 non-residential properties at risk of river flooding in the Orkney Islands. Approximately 25% of the residential and 50% of the non-residential properties at risk of river flooding are located within the Potentially Vulnerable Areas. The properties at risk are spread across the island with no particular location where river flood risk is concentrated.

Economic activity and infrastructure at risk

The Annual Average Damages from river flooding are approximately £150,000. This is estimated to be 4% of the total damages for the Orkney Local Plan District. The damages are distributed as follows:

- 59% residential properties (£87,000)
- 12% agriculture (£18,000)
- 11% non-residential properties (£17,000)
- 9% roads (£13,000)
- 6% emergency services (£10,000)
- 2% vehicles (£2,700)

Figure 2 shows the location of Annual Average Damages from river flooding across the area.

Table 1 shows the approximate numbers of further infrastructure assets which are at risk of flooding within this catchment.

	Number at risk	Further detail
Community facilities	0	n/a
Utility assets	<10	Electricity substations
Roads (excluding minor roads)	110 locations	Notably the A986 and A966
Railway routes	n/a	n/a
Agricultural land (km^2)	12	n/a

Table 1: Infrastructure and agricultural land at risk of river flooding

Designated environmental and cultural heritage sites at risk

There are approximately 30 cultural heritage sites with a risk of river flooding. These include scheduled monuments, gardens and designed landscapes, conservation areas and World Heritage Sites.

Approximately 31km^2 of designated environmental area is at risk of being impacted by river flooding across the Orkney Islands. The areas affected include Special Areas of Conservation, Special Protection Areas, and Sites of Special Scientific Interest. Some of the sites affected include those at Lochs of Harray and Stenness, Orkney Mainland and Hoy.

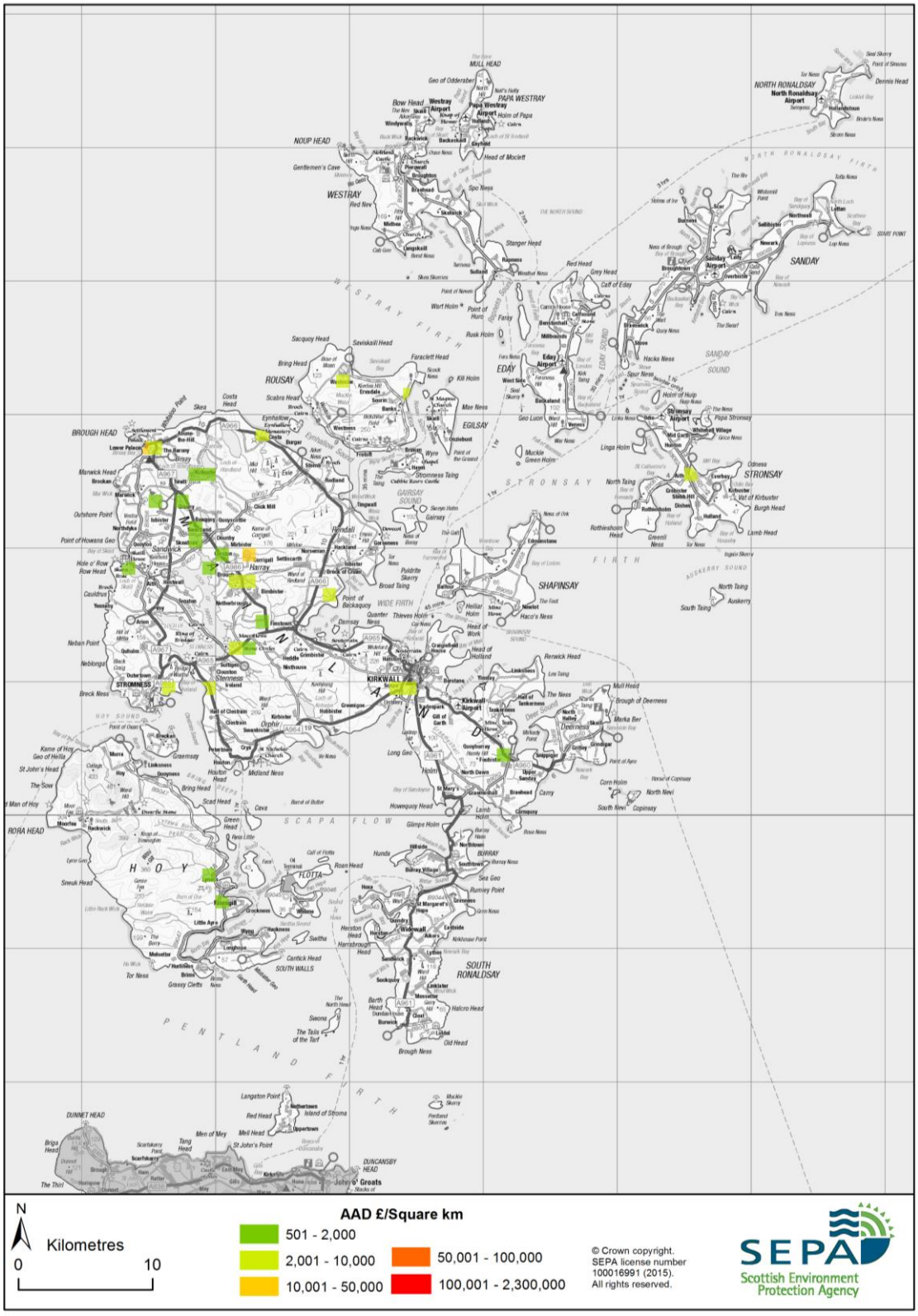

Figure 2: Annual Average Damages from river flooding

History of river flooding

There have been a number of localised floods from small burns. During a severe storm event in October 2006, roads and adjacent properties were flooded due to burns bursting their banks at the following locations:

- Willowburn, Kirkwall
- Muddisdale Burn, Kirkwall
- Otterswick, Papdale East, Kirkwall
- A960 at Wideford Brae (Wideford Burn) near Kirkwall Airport
- Millburn, Hoy
- Millburn, Garson, Stromness
- Millburn on A965 at Tormiston
- Kirkhouse Mill, South Ronaldsay
- Maitlands Burn, Finstown
- Cromarty Square, St Margaret's Hope
- Crantit Burn, St Ola
- A964 at Kirbister Mill, Orphir

Other instances of river flooding occurred between 2001 and 2014 when there was flooding from burns recorded at the following locations:

- Mill Bay, Stronsay
- Millburn, Stromness
- A965 at Saverock Junction, Hatston
- Cromarty Square, St Margaret's Hope
- A960 at Wideford Brae (Wideford Burn), near Kirkwall Airport
- Muddisdale Burn, Kirkwall
- Crantit Burn, St Ola

Managing flood risk

A range of public bodies have responsibility for managing flood risk in Scotland and they are working closer than ever before to target action in the areas where the greatest benefit can be gained. Members of the public also have a role to play and are the first line of defence against flooding by taking action to protect themselves and their property from flooding. Further information about roles and responsibilities is provided in Section 1.

Existing actions that are in place to manage flood risk and that are in addition to the information presented in Section 2 are described below.

Orkney Islands Council has an inspection and maintenance regime in place to help manage flood risk. Identified watercourses are inspected annually for potential future problems which may cause flooding. This includes checking inlet pipes and grills for debris, checking overgrown vegetation and examining the geometry of the burn for potential blockages. There is a schedule for checking and clearing 23 culverts throughout Orkney once a week in the summer and twice a week in the winter (October to April). Over the last decade investment has been made into upgrading headwalls and gratings into culverted watercourses.

Bags are made available for filling with sand locally in advance of flooding to the communities that may be affected.

Climate change and future flood risk

The UK Climate Projections (UKCP09) predicts that climate change may lead to warmer and drier summers, warmer and wetter winters with less snow, and more extreme temperature and rainfall. The predicted increase in rainfall and river flows may increase the potential for river flooding.

Under the UKCP09 high emissions scenario for 2080, average peak river flows for the Orkney Islands may increase by 41%[1]. This would potentially increase the number of residential properties at risk of river flooding from approximately 30 to 50. The number of non-residential properties at risk is not likely to increase significantly.

The predicted increases in flood risk are solely based on the impact of a changing climate on the magnitude of flooding; they do not take into account any potential increase due to population change, development pressures or urban creep, nor do they take into account any mitigation as a result of actions contained in this or future Flood Risk Management Strategies.

Potential for natural flood management

The assessment of the potential for natural flood management is shown on SEPA's flood maps (http://www.sepa.org.uk/environment/water/flooding/flood-maps/). The maps indicate the potential for runoff reduction, floodplain storage and sediment management. They show areas where natural flood management could be effective and where further detailed assessment should take place. This information was used to identify where local authorities could include natural flood management as part of flood risk management schemes and studies. The proposed schemes and studies are listed in the relevant Potentially Vulnerable Area chapters of this document.

Runoff reduction

There are areas of potential for runoff reduction identified, many of which overlap with moorlands. These represent significant areas of generally high quality peatland, which has high biodiversity and carbon storage value. These areas already have value for runoff reduction and generally will not require or benefit from peatland restoration measures. Other potential runoff reduction measures, such as tree planting, would be inappropriate in such areas. There may be scope along the margins of the moorlands to reduce the speed of drainage into adjacent agricultural land through small scale tree planting or restoring / blocking canalised ditches.

Floodplain storage

Only Mainland has significant areas of potential for floodplain storage, particularly in the west of the island. The only Potentially Vulnerable Area that has significant areas of potential, either within it or upstream is Stromness (03/04).

The most appropriate opportunities for enhanced floodplain storage for Orkney would be through retention of existing wetlands; restoration of the linkages between fragmented wetlands; restoration of canalised burns flowing into or out of existing lochs and wetlands, and restoration of more natural wetland vegetation along the margins of the larger lochs. This could not only have flood risk management benefits but would also have additional biodiversity benefits through the recreation of habitat linkages.

[1] From the study 'An assessment of the vulnerability of Scotland's river catchments and coasts to the impacts of climate change' (CEH, 2011)

Sediment management

The only river system in the Orkney catchment which has data on sediment management is Loch of Harray. It is unlikely that there will be significant flood risk improvements through sediment management measures in this catchment.

3.3 Coastal flooding

Orkney Local Plan District

This section provides supplementary information on flooding for coastal areas. It provides an overview of the natural characteristics of the coast, a summary of flood risk within the coastal area and a brief history of flooding. It also outlines the likely impact of climate change and the potential for natural flood management.

Information about the objectives and actions to manage flood risk are provided in Section 2.

In the Orkney Local Plan District, coastal flooding is reported across two coastal areas (Figure 1).

Figure 1: Coastal areas within the Orkney Local Plan District

Coastal flooding
Orkney South Isles and Mainland

Coastal overview

The Orkney South Isles and Mainland coastal area includes Mainland, Hoy, South Walls, South Ronaldsay, Burray, Flotta, Graemsay, Cava, and other isles (Figure 1). It has a coastline with a length of approximately 430km. The majority of towns and villages are located close to the coast.

The western coastlines of Mainland Orkney and of Hoy are characterised by high sea cliffs, with lower more variable cliffs along the eastern coastline. There is very little dissipation of wave energy due to the deep water being close to the coastline. There are few beach areas which are mainly restricted to pocket beaches that are constrained between cliffs or rock platforms.

The northern coastline of Mainland Orkney is characterised by a low rock platform which is near continuous in the west and intermittent to the east where outcrops act as hinge points for the formation of beach areas, for example within Inganess Bay and Deer Sound. Wave conditions are less severe here due to the presence of numerous islands to the north and shallow water which provide shelter and dissipate much of the offshore wave energy.

The inner coastline around Scapa Flow is typified by low rock platforms capped with thick boulder clay or peat deposits. Shingle and cobble fringe beaches are common. The entrances to Scapa Flow dissipate most of the offshore wave energy and as a result locally generated waves dominate.

There are five Potentially Vulnerable Areas:

- Orkney Mainland North (03/03)
- Stromness (03/04)
- Kirkwall (03/05)
- Hoy (03/06)
- South Ronaldsay[1] (03/07c).

[1] Note that South Ronaldsay was not designated as a Potentially Vulnerable Area in the National Flood Risk Assessment (NFRA), which was completed in 2011. Information provided by Orkney Islands Council confirmed a level of flood risk which has led to South Ronaldsay's designation as a candidate Potentially Vulnerable Area.

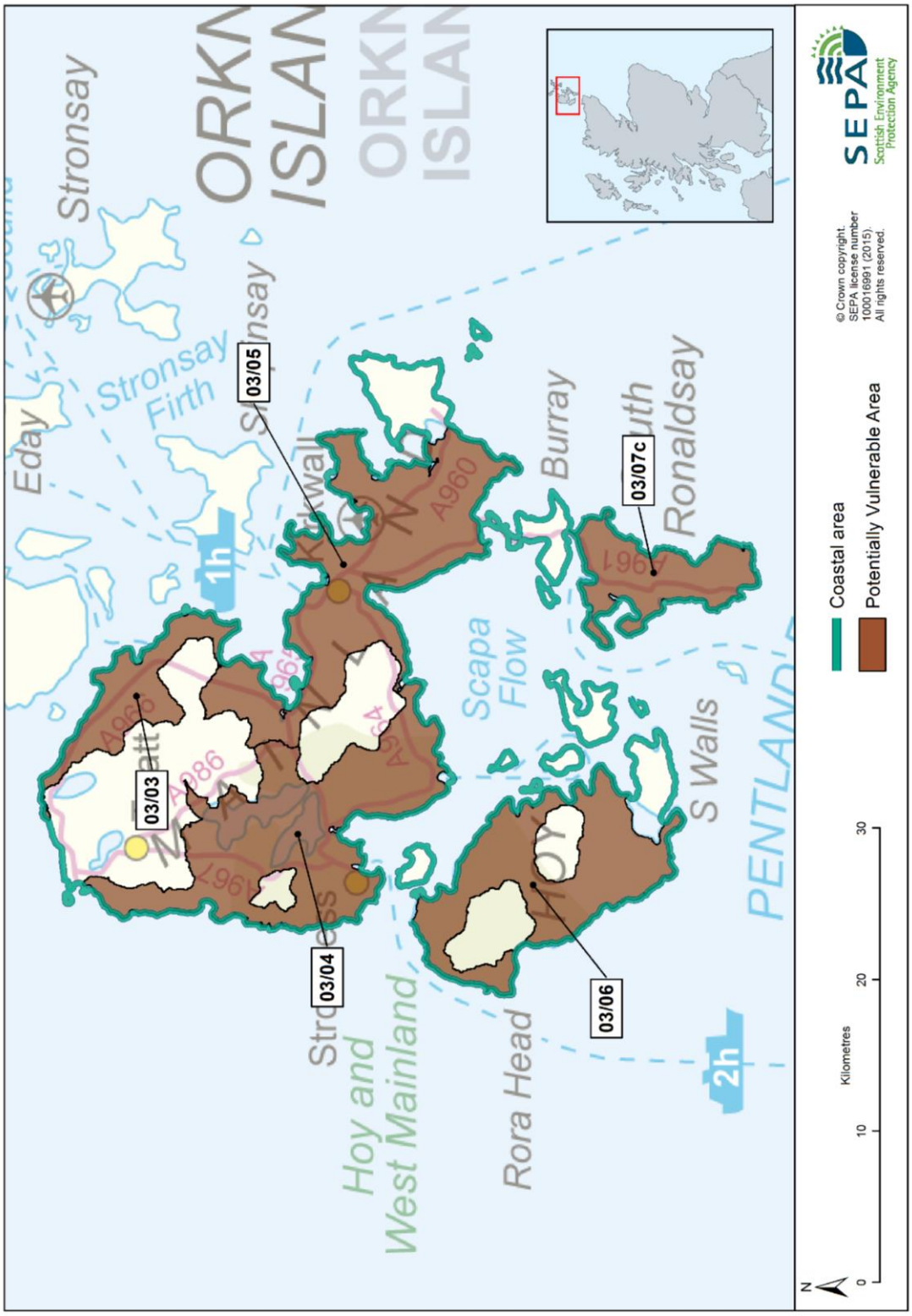

Figure 1: Location of Orkney South Isles and Mainland coastal area

Flood risk

Within the Orkney South Isles and Mainland coastal area, there are approximately 570 residential properties and 380 non-residential properties at risk of coastal flooding. Approximately 96% of properties at risk of flooding are located within Potentially Vulnerable Areas, of which the majority are located in Kirkwall (03/05).

Main areas at risk

The main area of coastal flood risk is in Kirkwall. However, there are pockets of coastal flood risk to residential properties across the South Isles. St. Margaret's Hope tends to be the first settlement to flood during a coastal storm.

The Potentially Vulnerable Areas that have more than 20 residential properties at risk of coastal flooding are shown in Table 1.

	Residential and non-residential properties at risk of coastal flooding	Annual Average Damages
Kirkwall	720	£2.0 million
Stromness	70	£140,000
South Ronaldsay	50	£83,000

Table 1: Main areas at risk of coastal flooding

Orkney Islands Council provided updated numbers of properties at risk of coastal flooding to reflect the impact of wave action on flood risk in some Potentially Vulnerable Areas. Where updated figures were verified by photographic or historical evidence they have been used. Wave action is otherwise not accounted for in the figures presented. It was not possible to update economic impact data, due to the lack of information on the scale of flooding or depth of flooding which are required to calculate the Annual Average Damages.

Economic activity and infrastructure at risk

The Annual Average Damages from coastal flooding in the South Isles and mainland coastal area are approximately £2.7 million. This accounts for 64% of the damages for the Local Plan District from all sources of flooding. The damages are distributed as follows:

- 38% non-residential properties (£1.0 million)
- 36% residential properties (£960,000)
- 13% roads (£340,000)
- 7% emergency services (£200,000)
- 5% vehicles (£130,000)
- <1% agriculture (£10,000).

Figure 2 shows the location of Annual Average Damages from coastal flooding across the area.

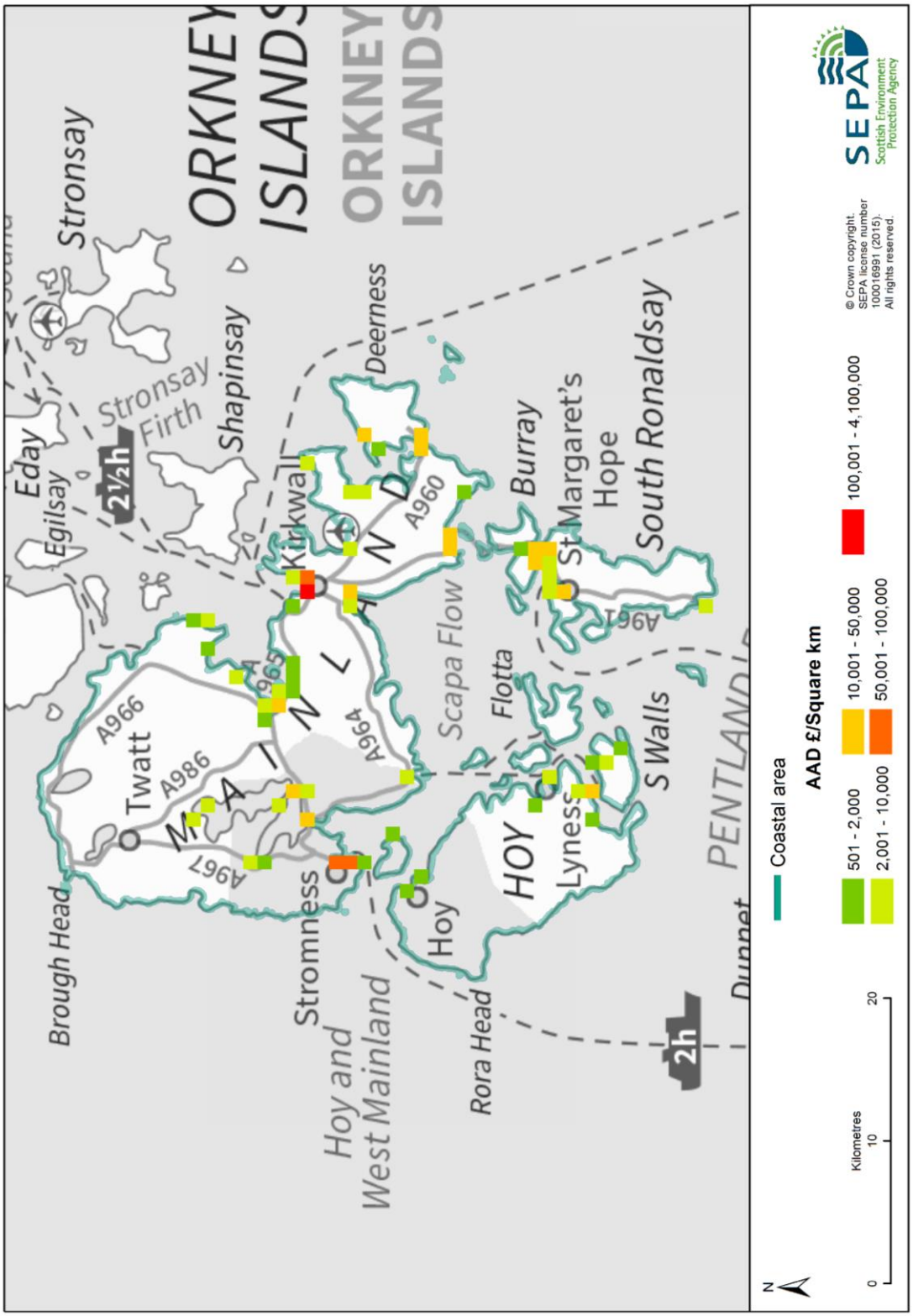

Figure 2: Annual Average Damages from coastal flooding

Table 2 shows further information about infrastructure and agricultural land at risk of coastal flooding.

	Number at risk	Further detail
Community facilities	<10	Includes; educational buildings and emergency services
Utility assets	10	Includes; electricity substations and telephone exchanges
Roads (excluding minor roads)	170	Notably; A965, A961 and A966 Causeway Hoy to South Walls
Railway routes	n/a	n/a
Agricultural land (km^2)	2	n/a

Table 2: Main areas at risk of coastal flooding

Designated environmental and cultural heritage sites at risk

There are approximately 41 designated cultural heritage sites at risk of coastal flooding. These sites include scheduled monuments, World Heritage Sites and listed buildings.

The main concern with cultural heritage sites in Orkney is their damage from or loss to coastal erosion. Impacts of coastal erosion are not considered as part of the work carried out under the Flood Risk Management (Scotland) Act 2009. However, it is recognised that there is a need to develop an integrated understanding of coastal erosion and flooding in future planning.

Approximately $2km^2$ of environmentally designated site is at risk of flooding. This includes sites at Hoy, Selwick, Lochs of Steness and Harray, Waulkmill, and the Bay of Skaill.

History of coastal flooding

The Orkney Isles have suffered frequent and sometimes significant coastal flooding. The most damaging coastal flood recorded to date was in 1953 with damages caused to residential and business properties, shops and water pipelines. Another significant flood was recorded in 2005, when extreme weather conditions caused a tidal surge coinciding with a high tide. Numerous properties were flooded throughout Orkney with several low lying coastal communities affected.

Orkney was affected by flooding in 2013 with various roads flooded. The Ayre Road on Hoy was damaged in this event.

Managing flood risk

A range of public bodies have responsibility for managing flood risk in Scotland and they are working closer than ever before to target action in the areas where the greatest benefit can be gained. Members of the public also have a role to play and are the first line of defence against flooding by taking action to protect themselves and their property from flooding. Further information about roles and responsibilities is provided in Section 1.

Existing actions that are in place to manage flood risk and that are in addition to the information presented in Section 2 are described below.

Orkney Islands Council monitors the predicted tide and surge levels against the lowest defences of all the local coastal communities, issues warnings and deploys mobile defences when and where appropriate.

Bags are made available for filling with sand locally in advance of flooding to the communities that may be affected.

Climate change and future flood risk

UK Climate Projections (UKCP09) predicts that climate change may increase sea levels. The magnitude of sea level rise varies around the coastline.

For the UKCP09 high emissions scenario, the predicted average sea level increase for the Orkney South Isles and Mainland coastal area is 0.5m to 0.6m by 2080. This may increase the number of residential properties at risk of coastal flooding by approximately 24% and non-residential properties will increase by 28%. Coastal flood modelling by SEPA has not taken into account the impacts of a future climate on wave overtopping or storminess, which could increase the number of people affected by coastal flooding.

The predicted increases in flood risk are solely based on the impact of a changing climate on the magnitude of flooding; they do not take into account any potential increase due to population change, development pressures or urban creep, nor do they take into account any mitigation as a result of actions contained in this or future Flood Risk Management Strategies.

Potential for natural flood management

The assessment of the potential for natural flood management is shown on SEPA's flood maps (http://www.sepa.org.uk/environment/water/flooding/flood-maps/). The maps indicate the potential for wave attenuation and estuarine surge attenuation. They show areas where natural flood management could be effective and where further detailed assessment should take place.

This information was used to identify where local authorities could include natural flood management as part of flood risk management schemes and studies. The proposed schemes and studies are listed in the relevant Potentially Vulnerable Area chapters of this document.

Estuarine surge

No assessment of estuarine surge attenuation potential was carried out for Orkney.

Wave energy

There is potential for wave energy dissipation, and associated benefits to flood risk management, along much of the coastline. Along the northern coast of Orkney Mainland the potential areas are more continuous. There is potential for wave energy dissipation around the island of Hoy particularly in the south and west. Offshore features, particularly kelp beds, help to attenuate wave energy and the retention of these features is important in the sustainable management of flood risk in Orkney.

Coastal flooding
Orkney North Isles

Coastal overview

The Orkney North Isles coastal area includes Stronsay, North Ronaldsay, Westray, Mull Head, Eday, Shapinsay, Rousay, Sanday and other islands (Figure 1). It has a coastline with a length of approximately 425km. The majority of towns and villages are located close to the coastline.

The coastline varies greatly between the islands. It is generally characterised by sandstone cliffs of varying heights fronted by a low rock platform. The low rock platform tends to act as hinge points upon which bay type beaches develop.

There are many beach areas and some extensive dune systems. These are mainly composed of fine shell sand and found predominantly on Sanday. There are several beaches along the south west coasts of Shapinsay, Westray, and Stronsay that are derived from erosion of soft glacial till deposits and are primarily shingle. Most of the beach areas are relatively stable but are dependent on the existence of the shingle storm ridges either at the back of or underlying the sand. These ridges are very efficient in dissipating wave energy.

There are three Potentially Vulnerable Areas:

- Sanday (03/01),
- Stronsay (03/02),
- Westray (03/08c)[1].

Flood risk

Main areas at risk of coastal flooding

Within the Orkney North Isles coastal area, there are approximately 120 residential properties and 50 non-residential properties at risk of coastal flooding. Approximately 76% of residential and 62% of non-residential properties are located within Potentially Vulnerable Areas. The main areas of coastal flood risk to residential properties are in Kettletoft on Sanday and Whitehall on Stronsay.

[1] Note that Westray was not designated as a Potentially Vulnerable Area in the National Flood Risk Assessment (NFRA), which was completed in 2011. Information provided by Orkney Islands Council confirmed a level of flood risk which has led to South Westray's designation as a candidate Potentially Vulnerable Area

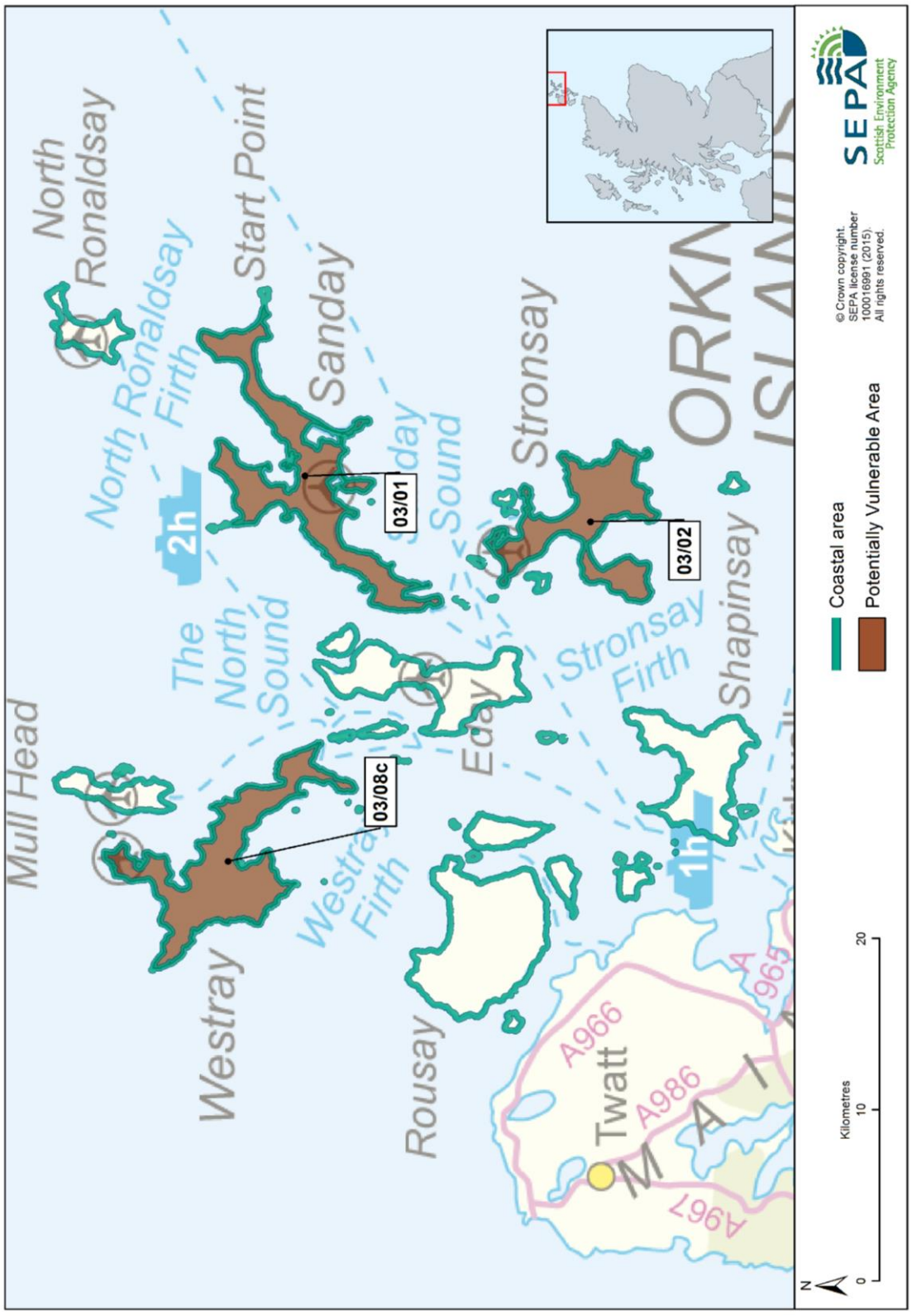

Figure 1: Orkney North Isles Coastal Area and Potentially Vulnerable Areas

Economic activity and infrastructure at risk

The Annual Average Damages from coastal flooding in the North Isles are approximately £1.2 million. This accounts for 28% of the damages for the Orkney Local Plan District from all sources of flooding. The areas that have the highest damages are around Whitehall village and the western areas of Stronsay, Kettletoft, across the north, central, and north-east of Sanday, and in the north of Westray at Pierowall. The damages are distributed as follows:

- 43% residential properties (£520,000)
- 33% roads (£390,000)
- 12% non-residential properties (£150,000)
- 6% emergency services (£70,000)
- 3% agriculture (£33,000)
- 3% vehicles (£33,000)

Figure 2 shows the location of Annual Average Damages from coastal flooding across the area.

There are approximately 90 road locations with a risk of coastal flooding. The main routes affected include the B9068, B9069, B9060, and B9066 and minor roads. Road access to community facilities, airports and ferry ports is critically important on the North Isles.

Designated environmental and cultural heritage sites at risk

There are approximately 43 cultural heritage sites at risk of coastal flooding. The majority are scheduled monuments, including prehistoric domestic and defensive sites, listed buildings and funerary sites.

The main concern with cultural heritage sites is their damage from or loss to coastal erosion. Impacts of coastal erosion are not considered as part of the work carried out under the Flood Risk Management (Scotland) Act 2009. However, it is recognised that there is a need to develop an integrated understanding of coastal erosion and flooding in future planning.

Approximately 8km^2 of environmentally designated site is at risk of flooding, including special areas of conservation, Special Protection Areas, and Sites of Special Scientific Interest. The sites at risk include those at Mill Bay, Rousay, Faray and Holm of Faray, East and Central Sanday, Northwall and Westray.

The main area in Orkney with respect to potential interaction of measures intended to reduce flood risk and designated natural heritage sites is Sanday. The Orkney Islands Local Advisory Group provided comments on the natural flood management screening outputs for Sanday. noting that, *'On Sanday considerable natural protection is already provided by extensive dune systems, sand and mud flats, salt marsh and shingle banks, which are generally in good condition such that we were not able readily to identify potential for enhancement.* Further it was also noted that for the Orkney Islands as a whole, '*We highlight the value of offshore features, particularly kelp beds, to attenuate wave energy and suggest that retention of these features be identified as having high potential'*.

Figure 2: Annual Average Damages from coastal flooding

History of coastal flooding

Whitehall in Stronsay suffers from coastal flooding to the roads and properties on a regular basis. In 1953 seafront roads and properties were flooded. There was significant damage to communities and flooding to properties in Whitehall, Kettletoft and Pierowall in January 2005. Whitehall in particular suffered coastal flooding in 2011, 2013 and 2014.

Managing flood risk

A range of public bodies have responsibility for managing flood risk in Scotland and they are working closer than ever before to target action in the areas where the greatest benefit can be gained. Members of the public also have a role to play and are the first line of defence against flooding by taking action to protect themselves and their property from flooding. Further information about roles and responsibilities is provided in Section 1.

Existing actions that are in place to manage flood risk and that are in addition to the information presented in Section 2 are described below.

Orkney Islands Council monitors the predicted tide and surge levels against the lowest defences of all the local coastal communities, issues warnings and deploys mobile defences when and where appropriate.

Climate change and future flood risk

UK Climate Projections (UKCP09) predicts that climate change may increase sea levels. The magnitude of sea level rise varies around the coastline.

For the UKCP09 high emissions scenario, the predicted average sea level increase for the Orkney North Isles coastal area is 0.5m by 2080. This may increase the number of residential properties at risk of coastal flooding by approximately 63%, and non-residential properties will increase by 35%. Coastal flood modelling by SEPA has not taken into account the impacts of a future climate on wave overtopping or storminess, which could increase the number of people affected by coastal flooding.

The predicted increases in flood risk are solely based on the impact of a changing climate on the magnitude of flooding; they do not take into account any potential increase due to population change, development pressures or urban creep, nor do they take into account any mitigation as a result of actions contained in this or future Flood Risk Management Strategies.

Potential for natural flood management

The assessment of the potential for natural flood management is shown on SEPA's flood maps (http://www.sepa.org.uk/environment/water/flooding/flood-maps/). The maps indicate the potential for wave attenuation and estuarine surge attenuation. They show areas where natural flood management could be effective and where further detailed assessment should take place.

This information was used to identify where local authorities could include natural flood management as part of flood risk management schemes and studies. The proposed schemes and studies are listed in the relevant Potentially Vulnerable Area chapters of this document.

Estuarine surge

No assessment of estuarine surge attenuation potential was carried out for Orkney.

Wave energy

There is potential for wave energy dissipation along much of the coastline around the North Isles. It is understood that offshore kelp beds play an important role in reducing wave energy in Orkney. Offshore features, particularly kelp beds, help to attenuate wave energy and the retention of these features is important in the sustainable management of flood risk in Orkney.

On Sanday, considerable natural protection is already provided by extensive dune systems, sand and mud flats, salt marsh and shingle banks, which are generally in good condition. There are multiple natural heritage designations (SSSI, SPA, SAC and Ramsar) for marine and coastal features on and around Sanday and consequently development of any natural flood management projects would require careful consideration, in particular to assess impacts of projects at any one location on features in other locations.

3.4 Surface water flooding

Orkney Local Plan District

This chapter provides supplementary information on surface water flooding across the Local Plan District. It provides an overview of the main areas at risk and the history of surface water flooding. The predicted impacts on infrastructure are also identified. The impacts on environmental sites and agricultural land have not been assessed.

Information about the objectives and actions to manage flood risk are provided in Section 2.

Flood risk

Main areas at risk

There are approximately 60 residential properties and 130 non-residential properties at risk of surface water flooding in the Orkney Islands. 78% of the residential properties and 92% of the non-residential properties at risk are located in Kirkwall.

Orkney Islands Council considers that surface water flood risk is underestimated for Kirkwall. However, whilst there are good records of the extent of actual flooding there is no accurate record of the properties that have suffered from internal flooding. Orkney Islands Council is working with Scottish Water and SEPA to improve understanding of surface water flood risk in Kirkwall.

Economic activity and infrastructure at risk

Annual Average Damages in the Orkney Local Plan District from surface water flooding are estimated to be around £170,000 with the bulk of this (87%) attributed to Kirkwall. This accounts for 4% of the total flood damages for the Local Plan District. The damages are distributed as follows:

- 65% non-residential properties (£110,000)
- 21% residential properties (£38,000)
- 6% roads (£11,000)
- 8% emergency services (£13,000)
- <1% vehicles (£50).

Figure 1 shows the location of Annual Average Damages from surface water flooding across the Local Plan District. The most significant contributing area to the damages is Kirkwall.

Figure 1: Annual Average Damages from surface water flooding

Table 2 shows further information about infrastructure and agricultural land at risk of coastal flooding.

	Number at risk	Further detail
Community facilities	0	n/a
Utility assets	20	Includes; electricity substations and mineral/fuel extraction sites
Roads (excluding minor roads)	210 locations	Notably A960, A965, A964
Railway routes	n/a	n/a

Table 2: Main areas at risk of coastal flooding

Designated environmental and cultural heritage sites at risk

There are an estimated 30 cultural heritage sites at risk of surface water flooding in the Orkney Islands. All of these are scheduled monuments. It should be noted that cultural heritage, and in particular prehistoric sites in Orkney, are a major driver for the tourist industry, which is important to the economy of Orkney. Flood damages or disruption to access to historic sites will have a significant negative impact on the local economy.

The impact of surface water flooding on environmental sites has not been assessed and is assumed to be relatively low.

History of flooding

There have been a number of localised surface water floods. The most severe flood was in October 2006, which affected major roads in and around Kirkwall together with internal flooding to a large number of properties - including three schools. Orkney Islands Council considers that many cases of flooding were not reported. There have been a number of other localised floods, the most recent occurring in November 2013.

Managing flood risk

A range of public bodies have responsibility for managing flood risk in Scotland and they are working closer than ever before to target action in the areas where the greatest benefit can be gained. Members of the public also have a role to play and are the first line of defence against flooding by taking action to protect themselves and their property from flooding. Further information about roles and responsibilities is provided in Section 1.

Existing actions that are in place to manage flood risk and that are in addition to the information presented in Section 2 are described below.

In Kirkwall there is a system in place to divert the majority of storm water flows into the Peedie Sea. This acts to reduce the flood risk to low lying areas of Kirkwall which have historically been vulnerable to flooding. The Peedie Sea provides a balancing reservoir to store storm water during high tides, with the level in the Peedie Sea controlled by a series of automatic operating flap and stop valves.

Scottish Water has also invested in Kirkwall to reduce surface water flooding. In the early 1990s a new pumped system was installed adjacent to the west pier which eliminated the need to discharge the combined storm water and wastewater system

directly into Kirkwall Bay. In 2008, Scottish Water also refurbished the main combined sewer along Junction Road to remove issues associated with infiltration originating from the sea.

Surface water management priority areas

The areas at highest risk from surface water flooding nationally have been identified as priority areas. These priority areas were identified using SEPA flood models, supplemented with evidence from historic surface water floods and, where available, more detailed modelling carried out by local authorities. These priority areas require surface water management plans to be prepared, the details of which can be found within the Potentially Vulnerable Area chapters in Section 2.

Climate change and future flood risk

UK Climate Projections (UKCP09) predicts that climate change may lead to warmer and drier summers, warmer and wetter winters with less snow, and more extreme temperature and rainfall. The surface water modelling undertaken considered climate change scenarios with a 20% increase in rainfall intensity.

Under these conditions it is estimated that the number of residential properties at risk of surface water flooding may increase from approximately 60 to 80 and the number of non-residential properties from approximately 130 to 160.

The predicted increases in flood risk are solely based on the impact of a changing climate on the magnitude of flooding; they do not take into account any potential increase due to population change, development pressures or urban creep, nor do they take into account any mitigation as a result of actions contained in this or future Flood Risk Management Strategies.