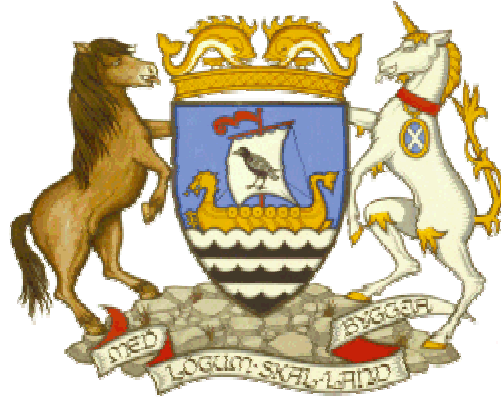


Shetland Islands Council



Seventh Biennial Flood Report November 2009

To
The Scottish Government

1. Introduction

- 1.1 This report specifies the measures Shetland Islands Council considers necessary to prevent or mitigate flooding of land within Shetland and is published to meet the requirements of the Flood Prevention (Scotland) Act 1961 as amended by the Flood Prevention and Land Drainage (Scotland) Act 1997 (“the Act”).
- 1.2 This report details:
- (i) All measures that Shetland Islands Council considers it requires to take to prevent or mitigate flooding of land in its area.
 - (ii) All measures that Shetland Islands Council has taken to prevent or mitigate such flooding since publication of the previous Biennial Report;
 - (iii) Floods that have occurred since the publication of the previous Biennial Report.

2. Background

- 2.1 The Act places duties on Shetland Islands Council, which can be summarised as follows;
- To assess watercourses from time to time to ascertain whether or not any such watercourse is likely to cause flooding of non-agricultural land; where it appears that any watercourse is in a condition which is likely to cause flooding of land, not being agricultural land and that the exercise of any power mentioned in section 2 (1)(a) of the Act would substantially reduce the likelihood of such flooding, the Council shall exercise that power accordingly.
 - To prepare and publish biennial reports specifying (a) the measures the Council considers it requires to take to prevent or mitigate the flooding of land in its area, (b) the measures which the Council has taken since the publication of their previous Biennial Report to prevent or mitigate the flooding of such land; and (c) all occurrences of flooding of such land since that date.
- 2.2 This 7th Biennial Report addresses the statutory requirements of the Act and provides an update on the work that has been undertaken since the previous report.

3 Flood Risk Management and Coastal Protection

3.1 Prevention and Mitigation Measures: -

- 3.1.1 The Roads Service has undertaken several improvements to roads culverts around the road network over the past 2 years. This involved the redesign and construction of several large and medium sized drainage culverts and cross drains. Road drainage improvements have been carried out where required, having been prioritised against other demands. Basic maintenance work and improvements to watercourses have been carried out to reduce the likelihood of flooding to properties and land.
- 3.1.2 All channels for the conveyance of water, whether naturally occurring or engineered, require continual monitoring and maintenance to ensure their efficiency and integrity. Some watercourses are often no more than old field-ditches that have not been cleared for many years. Blockages formed by water borne debris are often cleared by natural processes, however, at times of heavy rainfall a blockage of a watercourse could result in localised flooding events. In many instances the flooded area is agricultural land and outwith the remit placed on Shetland Islands Council by the Act. Shetland Islands Council continues to monitor the ditches that are likely to affect protected buildings.
- 3.1.3 **Appendix 1** is a list of the reported incidents of flooding as reported to both the Planning Service and the Roads Service since the previous report. Analysis of these reported incidents illustrates that much flooding occurs due to the temporary blockage of roadside ditches or piped watercourses and uncontrolled runoff from fields. The majority of flooding affects roads rather than “protected buildings”. As such, the appropriate action to resolve an incident is undertaken by the Council’s Roads Service under the powers of the Roads (Scotland) Act 1984.
- 3.1.4 All culverts, road cross drains and roadside ditches are inspected as part of the roads inspectors’ routine safety inspections and more frequently after unduly severe weather/storm conditions. When a new cross drain, culvert or bridge is installed, the watercourse in which it is to be placed is assessed to ensure that the infrastructure is designed to be fit for purpose.
- 3.1.5 Culverting of streams and burns is a long standing practice commonly associated with urban expansion and often regarded by those undertaking a development as an acceptable means of gaining land by removing landscape features. The use of culverts is a well-established approach to deal with

watercourses during development and their justification is rarely questioned. Culverts, however, pose maintenance challenges and blockages may result in flooding.

- 3.1.6 The Development Plans service is continuing with its survey of watercourses that are likely to be affected by pressures for future development. This work will ensure that a coordinated and planned approach is undertaken when considering the disposal of surface water run off. This should result in less likelihood of flooding of new settlements, as there will be adequate infrastructure, designed to an adequate capacity, to dispose of surface water. A 1 in 200 year event is considered when designing new infrastructure. The survey work undertaken so far has targeted areas under the greatest development pressure to enable Shetland Islands Council to determine the likelihood of a flood threat or risk. This involves site assessments to assess general condition; faults that may lead to flooding and measures that would reduce flood risk. Once complete, this study will ascertain the capacity of watercourses to carry surface water discharge from proposed developments.
- 3.1.7 Policies within the Shetland Structure Plan and Local Plan require that proposed developments should not be subject to flooding or cause flooding of adjacent property. In the assessment of planning applications our increased knowledge of watercourses and their characteristics, development “hot spots” and historical flooding have encouraged the Council to require developers to demonstrate that their development will not be a flood risk. Developers are being encouraged to apply the principles of Sustainable Drainage as these techniques reduce the surface water discharge to a more natural flow rate that can be managed by the existing infrastructure. This focus on Sustainable Drainage has been pursued as a result of the production of the “Sustainable Urban Drainage Manual” (Woods Ballard B; Kellagher R et al. 2007). SUDs are encouraged in all new developments as they ensure that the existing capacity of watercourses is not overloaded unnecessarily. Since the 6th report the Planning Service has produced an advice note providing guidelines on Flood Risk Assessments.
- 3.1.8 It is now widely accepted that climate change will result in wetter winters and drier summers and the frequency and impact of storms is predicted to be greater. Advice suggests that infrastructure that would once have been designed to withstand a 1 in 100 year event should henceforth be designed to withstand a 1 in 200 year event (i.e. an event with a 0.5% chance of being equalled or exceeded in any year). This will result in infrastructure better suited to future requirements and increase its “design life” or functionality.

- 3.1.9 The implementation of Structure Plan and Local Plan policies by the Council, as part of the assessment of planning applications, ensures that the best approach is taken to safeguard existing and new development against flooding.

3.2 Coastal Flooding

- 3.2.1 Analysis of the historical reported incidents of flooding illustrate that the most common source of flooding was inundation by the sea. Analysis of the reported incidents in the current period illustrates that coastal inundation is still an issue however the majority of incidents are the result of a combination of heavy rainfall and insufficient or poorly maintained drainage infrastructure. Coastal flooding events occur when an unusually high tide affects low lying property, the worst effects resulting when the high tide coincides with a severe weather incident. Again, climate change predictions indicate the severity and frequency of storms will increase resulting in some of the present infrastructure failing to cope with large? storm surges.
- 3.2.2 Isostatic adjustment should also be considered when coastal flooding is being examined. With the retreat of the ice sheets after the last Ice Age 20,000 years ago, land and sea levels around the UK coastline have been slowly readjusting due to the release of this enormous weight. Appendix 2 shows the latest findings produced and published by Durham University into isostatic land movement.
- 3.2.3 The United Kingdom Climate Impacts Programme has recently released the UK Climate Projections (UKCP09). The Projections contain information on observed and future climate change based on the latest scientific understanding. As part of the projections data is available on relative sea level rise around the UK with the results combining absolute sea level rise and isostatic land movement.
- 3.2.4 For the purpose of this report the three available scenarios were run on grid cell id 2180, centred on the location of the Lerwick tide gauge: Latitude 60.154, Longitude -1.140. Appendix 3 shows the results of the analysis and provides the full range of findings in graphical form.
- 3.2.5 Taking the figure for 50% probability the 3-emission scenarios show relative sea level rises by 2100 of

Low emissions	0.437m
Medium emissions	0.513m
High emissions	0.606m

3.2.6 Tidal levels have been recorded in Lerwick since 1956. At present The Proudman Oceanographic Laboratory records and monitors levels at 15-minute intervals using 2 full-tide and one mid-tide measuring systems which are housed in a GRP building above the harbour wall at the entrance to the small boat harbour, Lerwick.

3.2.7 Analysis of its recorded data shows the highest recorded tide in Lerwick as 1.819m Above Ordnance Datum (AOD) Lerwick. This occurred at 12:30pm on the 11th January 1993 during the period commonly referred to as 'the Braer Storm'.

3.2.8 If the aforementioned figure for High emissions of 0.606m is added to this it is fair to assume that by 2100 the sea level in and around Lerwick could reach as high as 2.425m AOD Lerwick in extreme atmospheric conditions.

3.2.9 MHWS - Mean high water springs

The height of mean high water springs is the average throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.

MHWS AOD (Lerwick)

HARBOUR	Current Level	Resultant level by 2100		
		Low	Medium	High
Lerwick ¹	0.930m	1.367m	1.443m	1.536m
Fair Isle ⁴	1.280m	1.717m	1.793m	1.886m
Scalloway ²	0.760m	1.197m	1.273m	1.366m
Sullom Voe ³	0.900m	1.337m	1.413m	1.506m
Mid Yell ⁵	1.020m	1.457m	1.533m	1.626m
Baltasound ⁴	1.020m	1.457m	1.533m	1.626m

¹ Ref: <http://www.pol.ac.uk/ntslf/tgi/portinfo.php?port=lerw.html>

² Admiralty Chart 3294 ³ Admiralty Chart 3298 ⁴ Admiralty Chart 3299 ⁵ Admiralty Chart 3292

3.2.10 The resultant figures do not include wave action, storm surges, and atmospheric conditions or take account of natural voe characteristics all of which are assessed on an individual site-by-site basis.

3.2.11 Practical application of these findings vindicates the Structure Plan requirement for the submission of a Flood Risk Assessment in support of any planning application for proposed development below the 5m contour.

4. Flood Risk Management (Scotland) Act 2009

- 4.1 The Flood Risk Management (Scotland) Act 2009 was passed by Parliament on May 13, 2009 and received Royal Assent on June 16th 2009. The Act will be introduced in various phases over the next year with the first commencement on 26 November 2009. This new legislation places new responsibilities on Local Authorities, SEPA and Scottish Water.
- 4.2 Local authorities will be responsible for preparing 'local flood risk management plans' with SEPA responsible for the preparation of district plans. These plans will include the preparation of maps of bodies of water and sustainable urban drainage systems in our areas. Local authorities are given discretion about the scale at which they identify and map these items however Scottish Ministers may specify the form and content of the maps through further regulation.
- 4.3 In areas where there are ongoing issues requiring intermittent maintenance interventions it will be necessary to produce a schedule of planned clearance and repair works, including information on when further assessments should be undertaken. Similarly Local Authorities are required to assess where a body of surface water could give rise to a risk of flooding, and where this is the case, to consider whether clearance or repair works could reduce that risk. A publicly available schedule must be prepared describing those clearance and repair works, including information as to the timing of the next assessment.
- 4.4 The Act creates a new criminal offence of intentionally or recklessly damaging flood protection work carried out by a local authority, including schemes under the 1961 Act. The 2009 Act repeals both the 1961 and 1997 Acts but until such time as those repeals come into force the provisions of both Acts remain.
- 4.5 New rights of entry are provided to allow Local Authorities to carry out flood protection works either as part of a flood protection scheme or otherwise, to carry out maintenance of such works or to carry out investigations. Rights of entry to support work to prepare local flood risk management plans are also provided.
- 4.6 Section 42, which amends regulation 24 of the Town and Country planning (Development Management Procedure) (Scotland) Regulations 2008, places an obligation on planning authorities, where an application for a development is likely to increase the number of properties at risk of flooding, to require the applicant to provide the planning authority with an assessment of flood risk.

Appendix 1 - Reported incidents of flooding Nov 2007 – Nov 2009

LOCATION: Berry Road, Scalloway

CC Area: Scalloway

Grid Ref: 440367, 1140091



INCIDENT: Localised flooding event around road channel

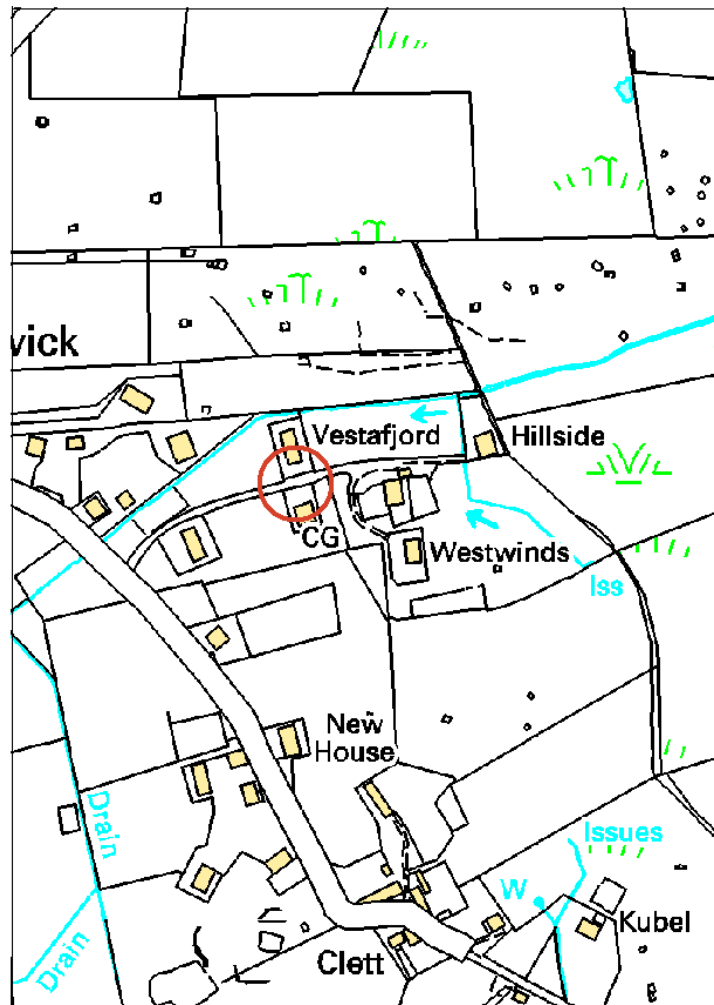
Date: November 2007

Action Taken: Area ditched and cross drain installed to alleviate flooding

LOCATION: Hillside, Whalsay

CC Area: Whalsay

Grid Ref: 454443, 1161594



INCIDENT: Excessive water running down carriageway into garden

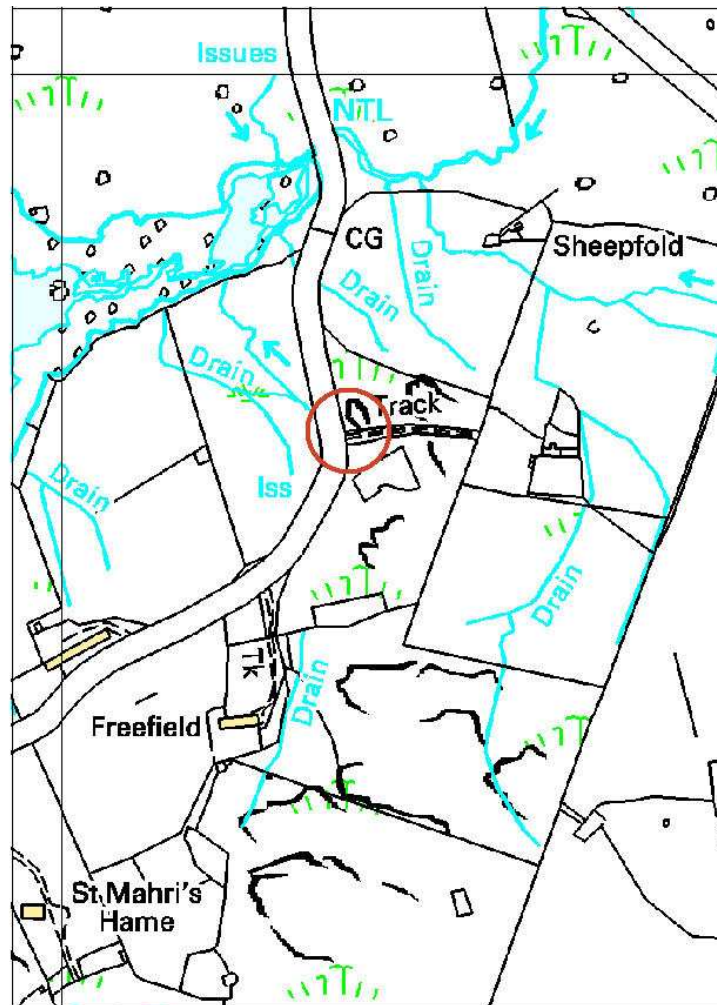
Date: March 2008

Action Taken: French drain installed in road verge, piped across road and into field and drained to burn

LOCATION: Browland, Bridge of Walls

CC Area: Walls & Sandness

Grid Ref: 427189, 1150800



INCIDENT: Localised flooding

Date: June 2008

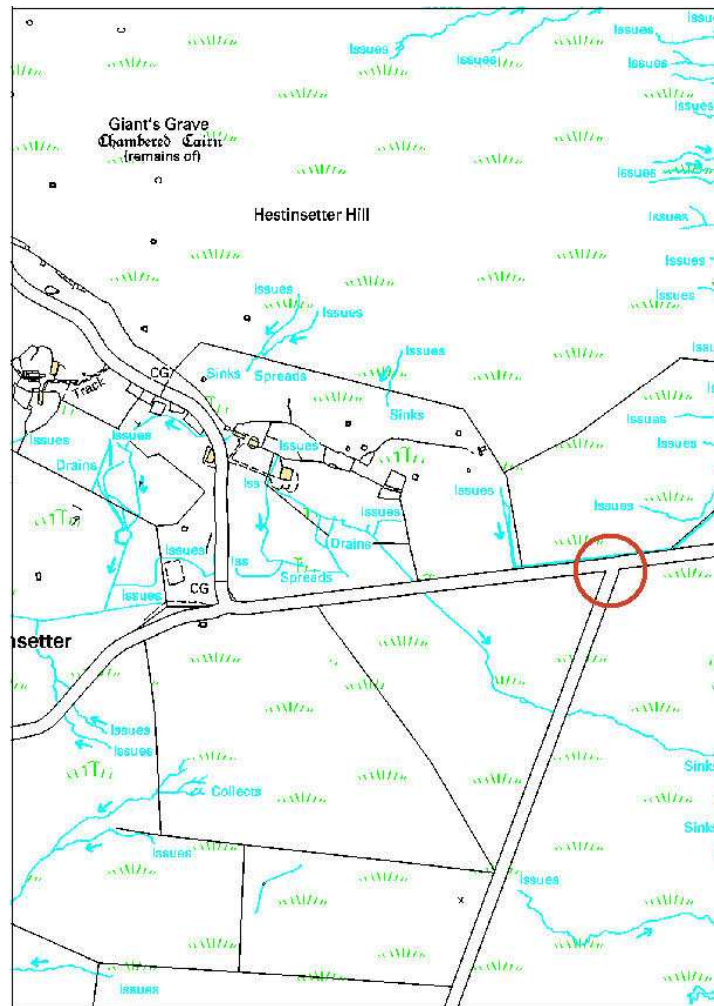
Action Taken: Existing ditch cleared out and extended.

Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Westerskeld - Hestingsetter Junction

CC Area: Sandsting & Aithsting

Grid Ref: 429784, 1145245



INCIDENT: Localised flooding

Date: September 2008

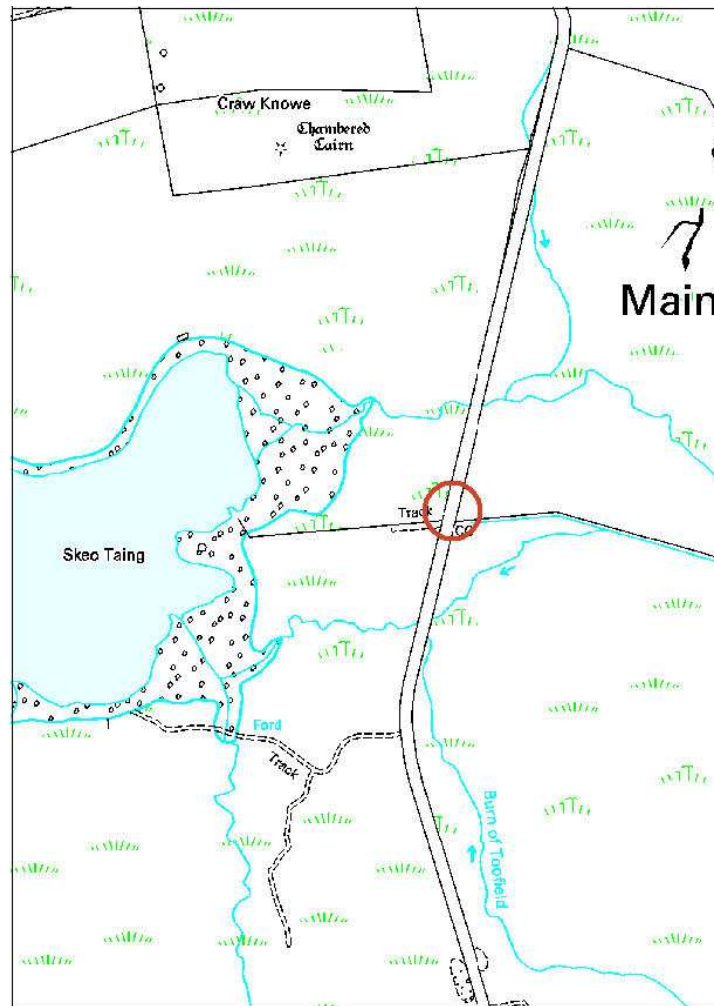
Action Taken: Excavate and install 150mm perforated drain and Type 4 to stop water issuing over road.

Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Between Selivoe and Hestingsetter.

CC Area: Sandsting & Aithsting

Grid Ref: 428968, 1147039



INCIDENT: Localised flooding event

Date: September 2008

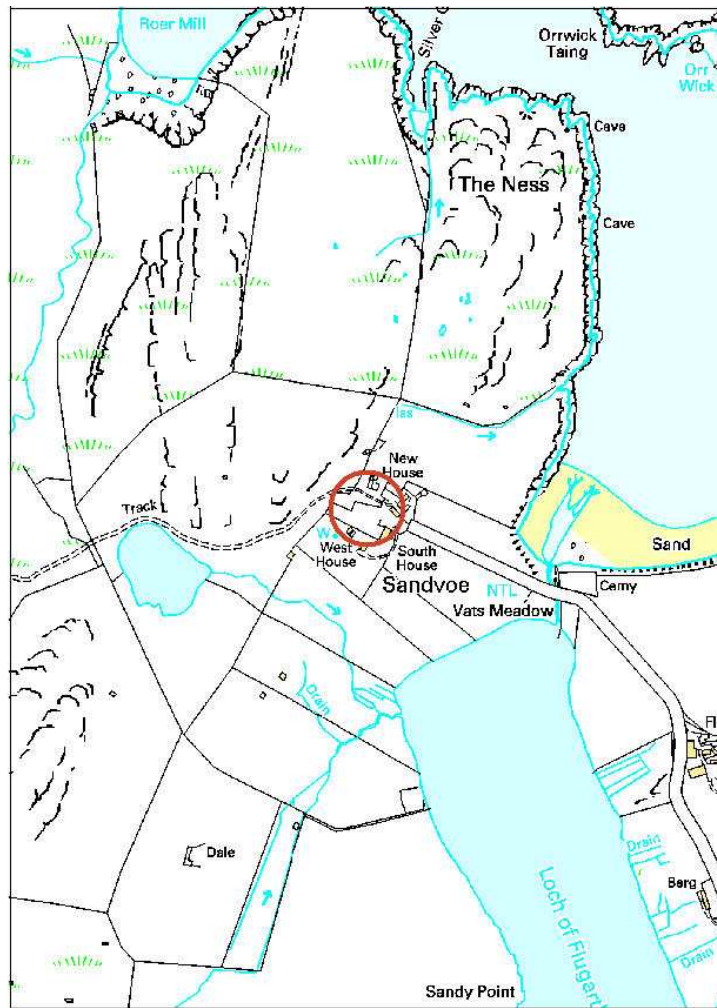
Action Taken: Clear ditch following flood.

Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Sandvoe, North Roe

CC Area: Northmavine

Grid Ref: 436093, 1190926



INCIDENT: Localised flooding event

Date: October 2008

Action Taken: New tar strip channel to edge of road to be run into new catchpit on existing drain. 2 new headwall to existing cross drains.

Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Isbister, Whalsay

CC Area: Whalsay

Grid Ref: 457437, 1164076



INCIDENT: Flooding at Isbister Hall

Date: November 2008

Action Taken: 65m of ditching. 15m French drain to catch spring

Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Marrister, Whalsay

CC Area: Whalsay

Grid Ref: 454385, 1164129



INCIDENT: Blocked Cross drain causing flooding

Date: November 2008

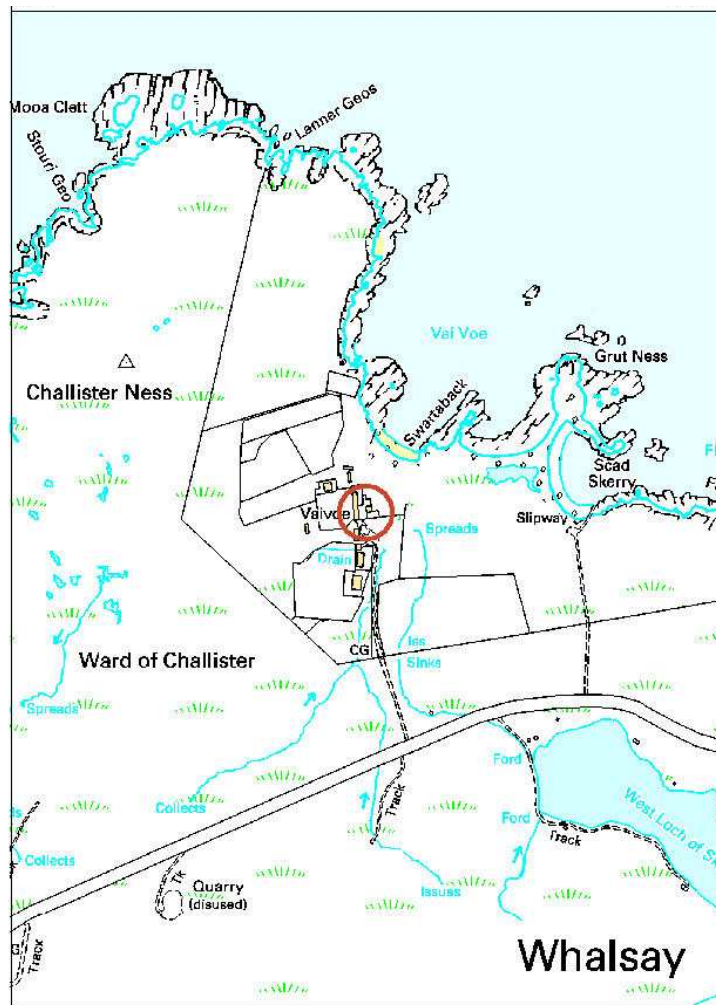
Action Taken: Cross drain replaced with correctly sized one

Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Vaivoe, Whalsay

CC Area: Whalsay

Grid Ref: 457582, 1166511



INCIDENT: Localised flooding

Date: November 2008

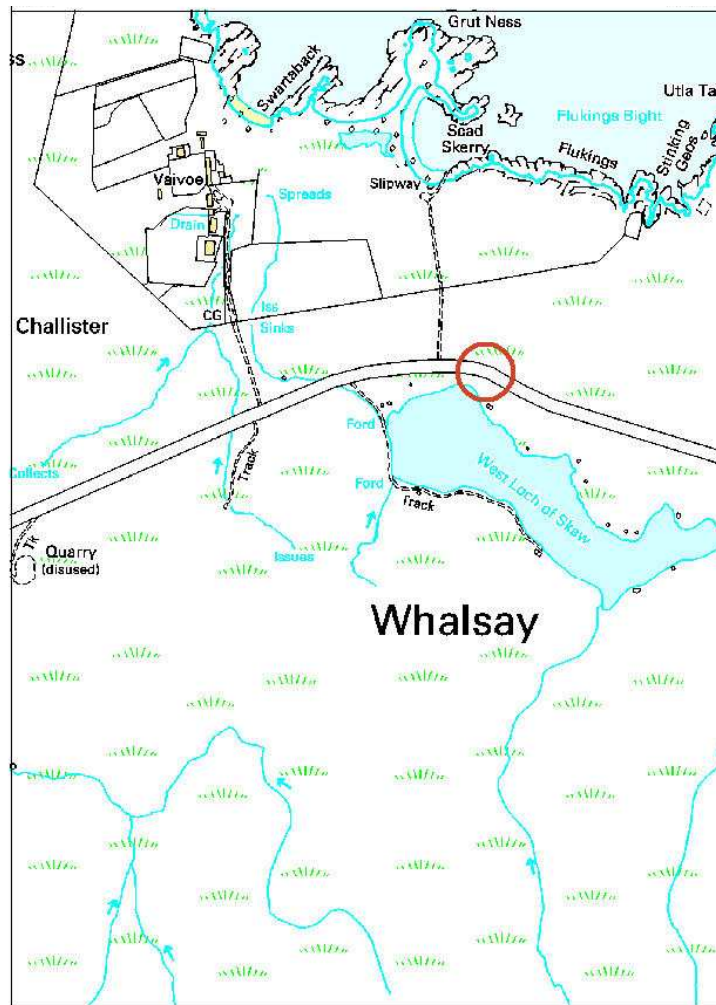
Action Taken: 15m French drain piped through road to existing ditch

Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Skaw Road, Whalsay

CC Area: Whalsay

Grid Ref: 457917, 1166263



INCIDENT: Localised flooding

Date: November 2008

Action Taken: Cut new ditch and divert in to peat banks. Access to be piped.

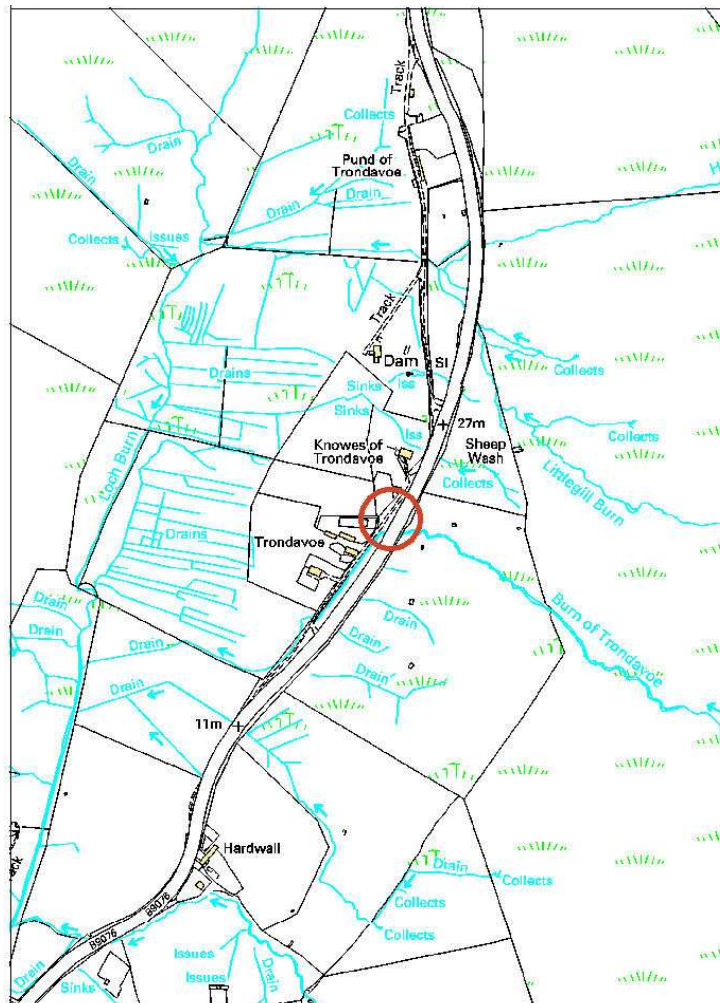
Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Trondavoe, Vaxter

Associated Watercourse: Burn of Trondavoe

CC Area: Delting

Grid Ref: 437611,1170527



INCIDENT: Water gathering at road edge and existing ditch flooding

Date: December 2008

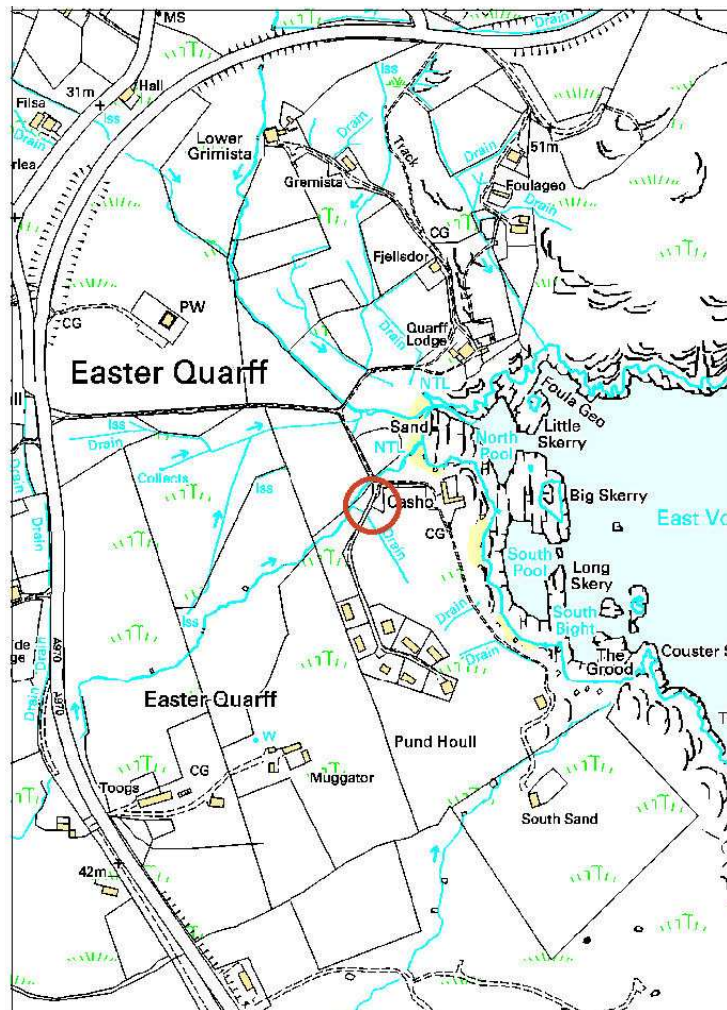
Action Taken: New ditch cut to alleviate flooding

Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Casho, Quarff

CC Area: Gulberwick, Quarff and Cunningsburgh

Grid Ref: 443102, 1135251



INCIDENT: Watercourse silting up

Date: January 2009

Action Taken: Gravel cleared from upstream end of culvert

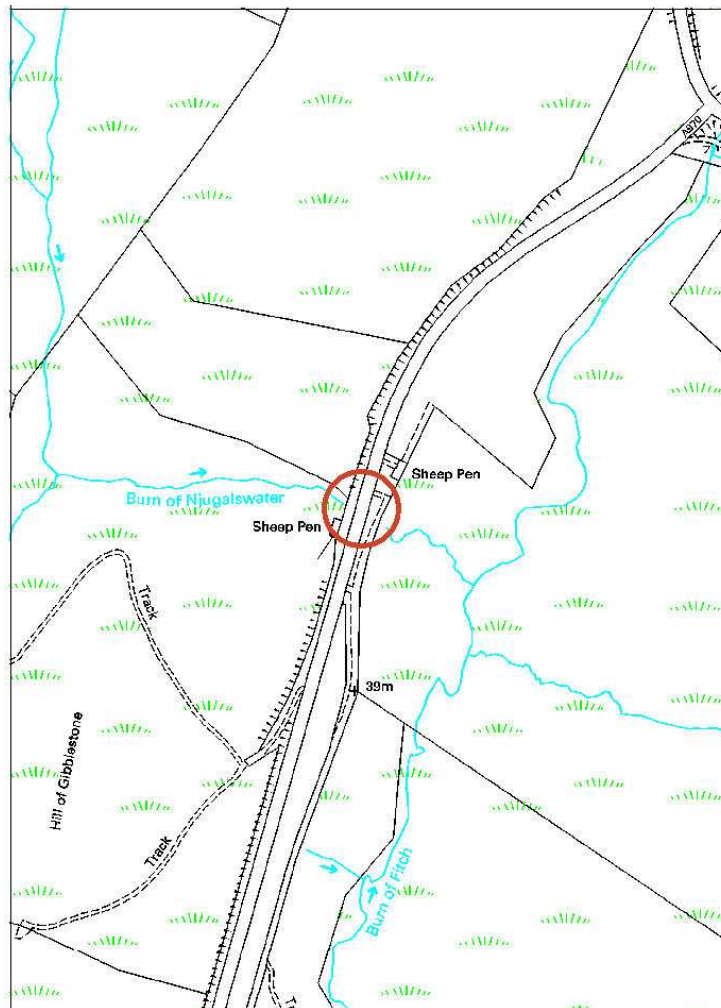
Map Extract: © Crown Copyright and database right 2009. All rights reserved. Ordnance Survey licence number 100024344.

LOCATION: Burn of Njugalswater Culvert

Associated Watercourse: Burn of Njugalswater

CC Area: Scalloway

Grid Ref: 442632, 1141548



INCIDENT: Watercourse silting up due to restriction

Date: January 2009

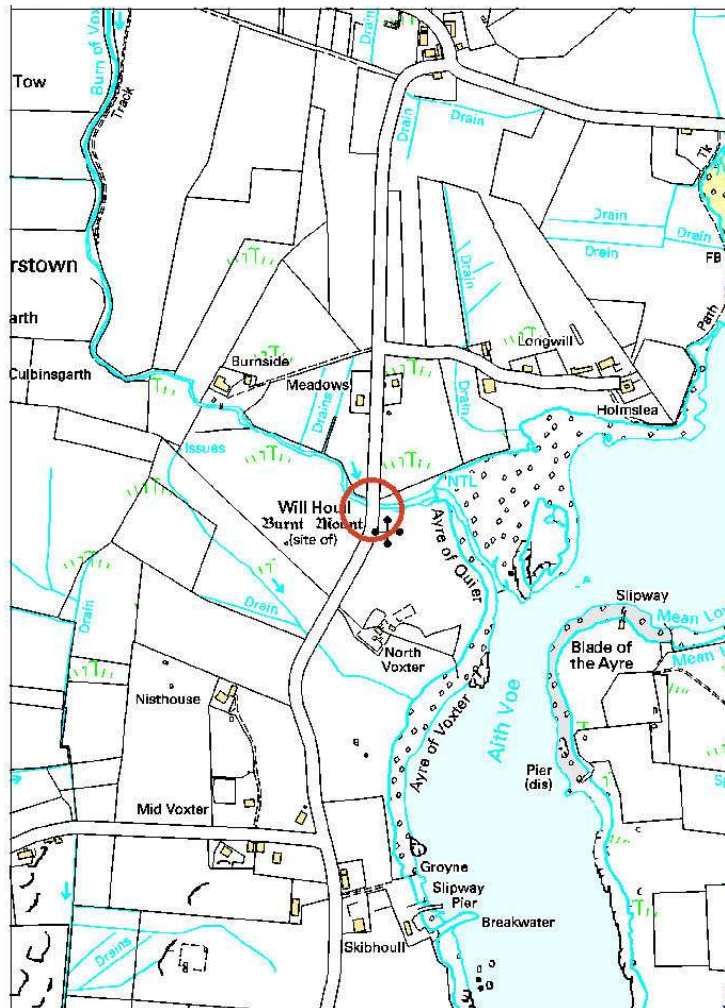
Action Taken: 4 large rocks removed from upstream end of culvert

LOCATION: Voxter, Cunningburgh

Associated Watercourse: Burn of Voxter

CC Area: Gulberwick, Quarff and Cunningburgh

Grid Ref: 443723, 1128903



INCIDENT: Erosion of bank

Date: May 2009

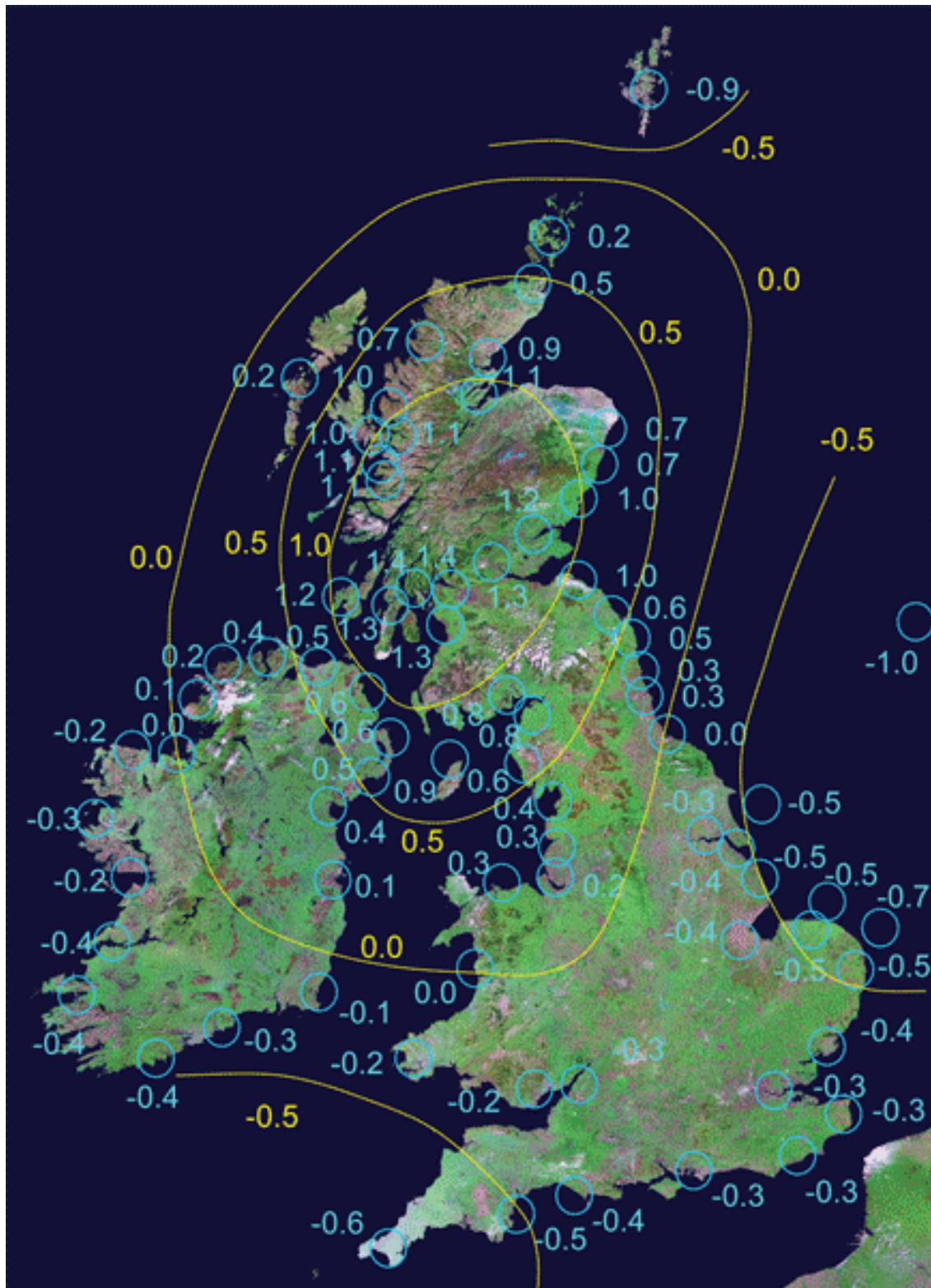
Action Taken: Rock armour placed

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Coast Protection and Flooding Grants Sep 2007 - Oct 2009

ADDRESS	GRANT STATUS	AMOUNT
Fairview, Tresta	Paid	£1,104.00
Banks Cottage, Unst	Paid	£2,282.32
4 Park Lane, Lerwick	Paid	£282.00
Sandsayre Pier, Sandwick	Awaiting info from applicant	N/A
Da Knowe, Lerwick	Awaiting info from applicant	N/A
The Taing, Reawick	Awaiting info from applicant	N/A
Shorehouse, Reawick	Awaiting info from applicant	N/A
Busta, Brae	Awaiting info from applicant	N/A
Bousta, Sandness	Awaiting info from applicant	N/A

Appendix 2:



Ian Shennan et al., 2009

Current rate of relative land- and sea-level change in the British Isles mm/year, showing relative land uplift as positive and relative subsidence as negative.

Appendix 3: UKCP09 Output emission scenarios

All of the projections in the marine report use the medium emission scenario. In this scenario the global mean surface temperature is expected to rise by around 1.7 – 4.4 °C during the 21st century as atmospheric carbon dioxide concentrations rise to around 700 ppm compared to present levels in the atmosphere of 387 parts per million.

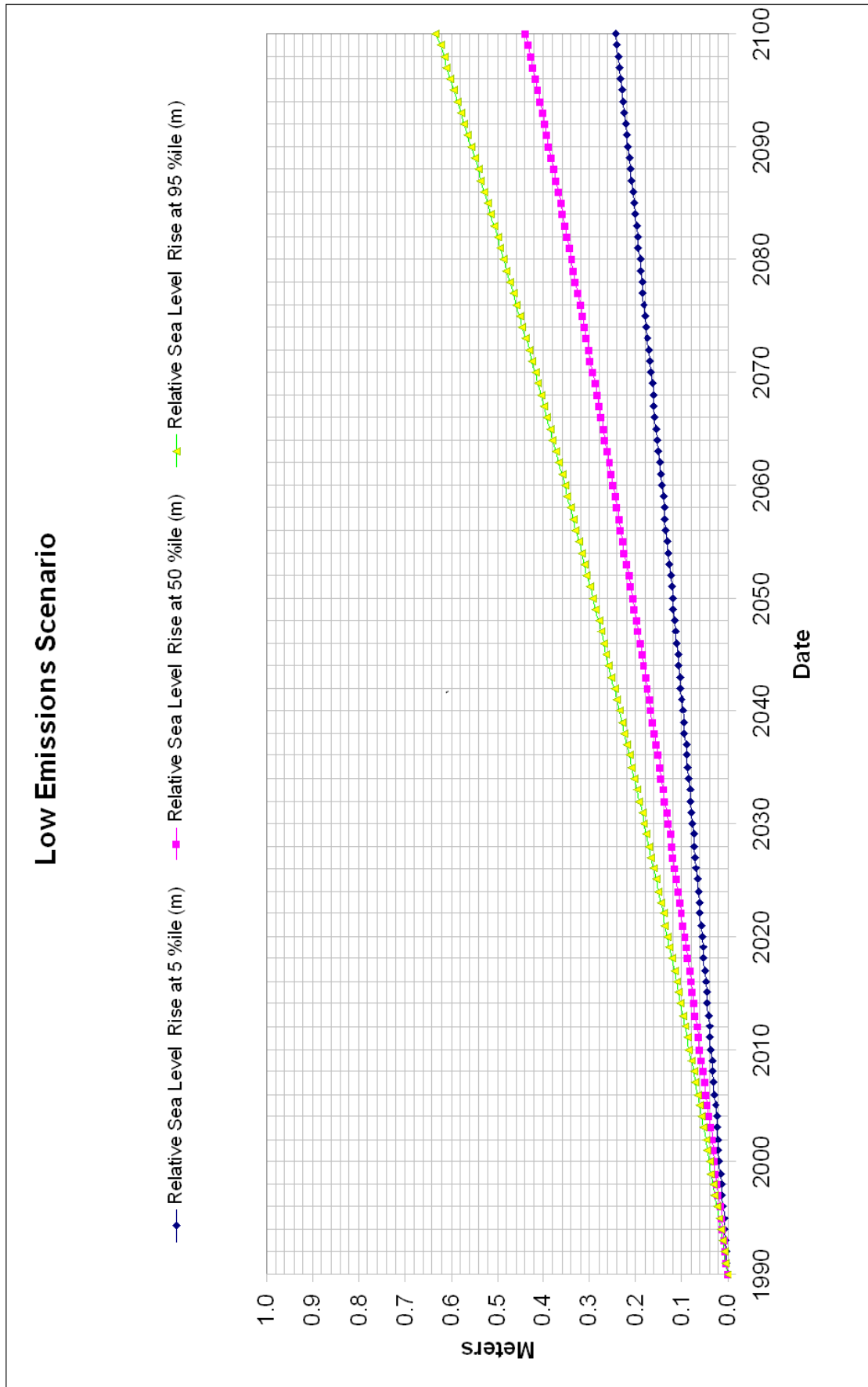
The low emission scenario represents a more integrated ecologically friendly world, characterised by clean and resource efficient technologies, and lower global greenhouse gas emissions.

The medium emission scenario describes a world that has rapid economic growth, quick spreading of new and efficient technologies, and a global population that reaches 9 billion mid-century and then gradually declines. It also relies on a balance between different energy sources.

The high emission scenario has similar economic and population trends as the medium emission scenario but more emphasis on power generation from fossil fuels.

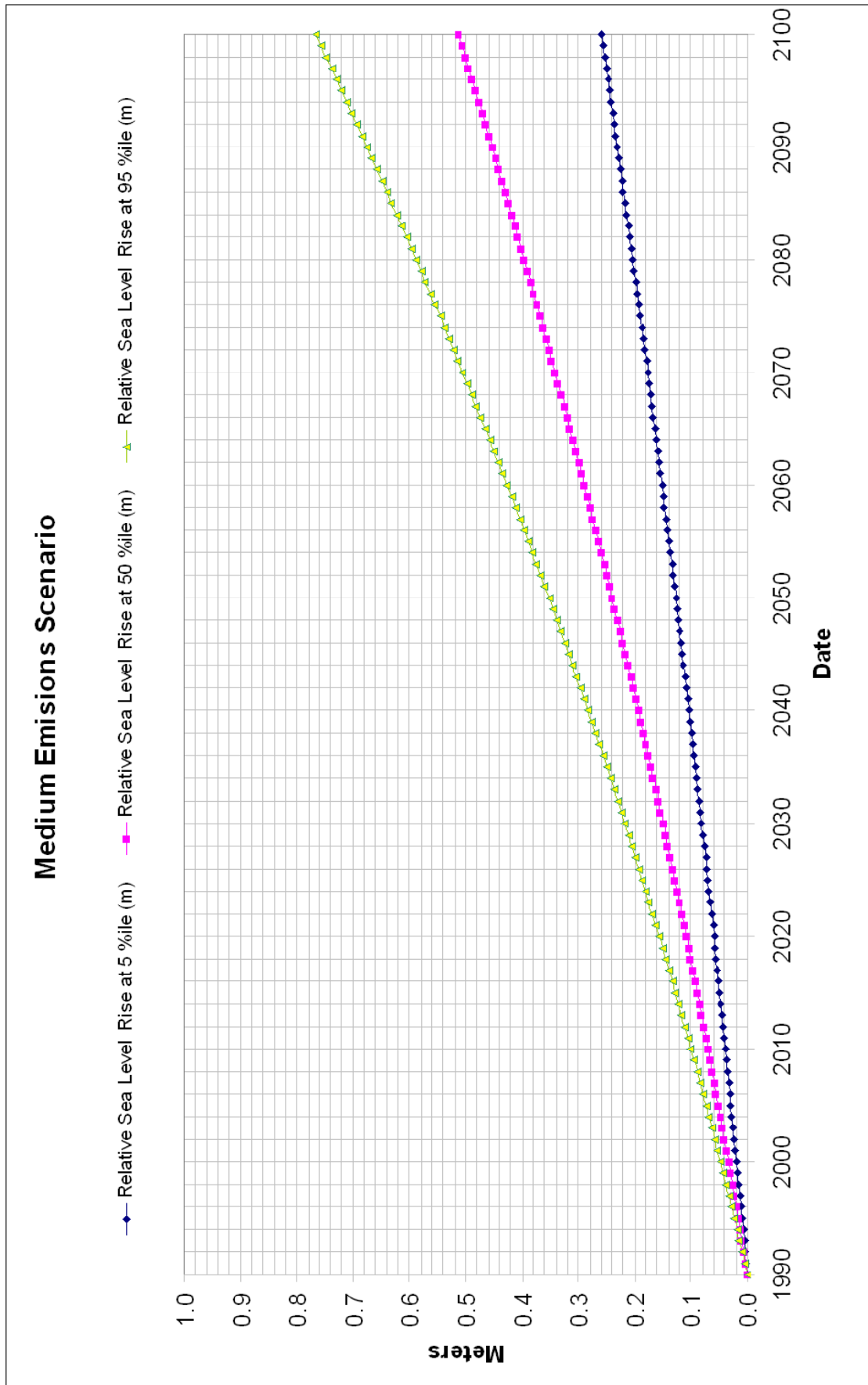
The sea level projections are not probabilistic but instead provide a frequency distribution of projections. This gives an estimate of the range of model results (from estimated 5th to 95th percentiles of 11 IPCC models, plus a central estimate).

Appendix 3.1:



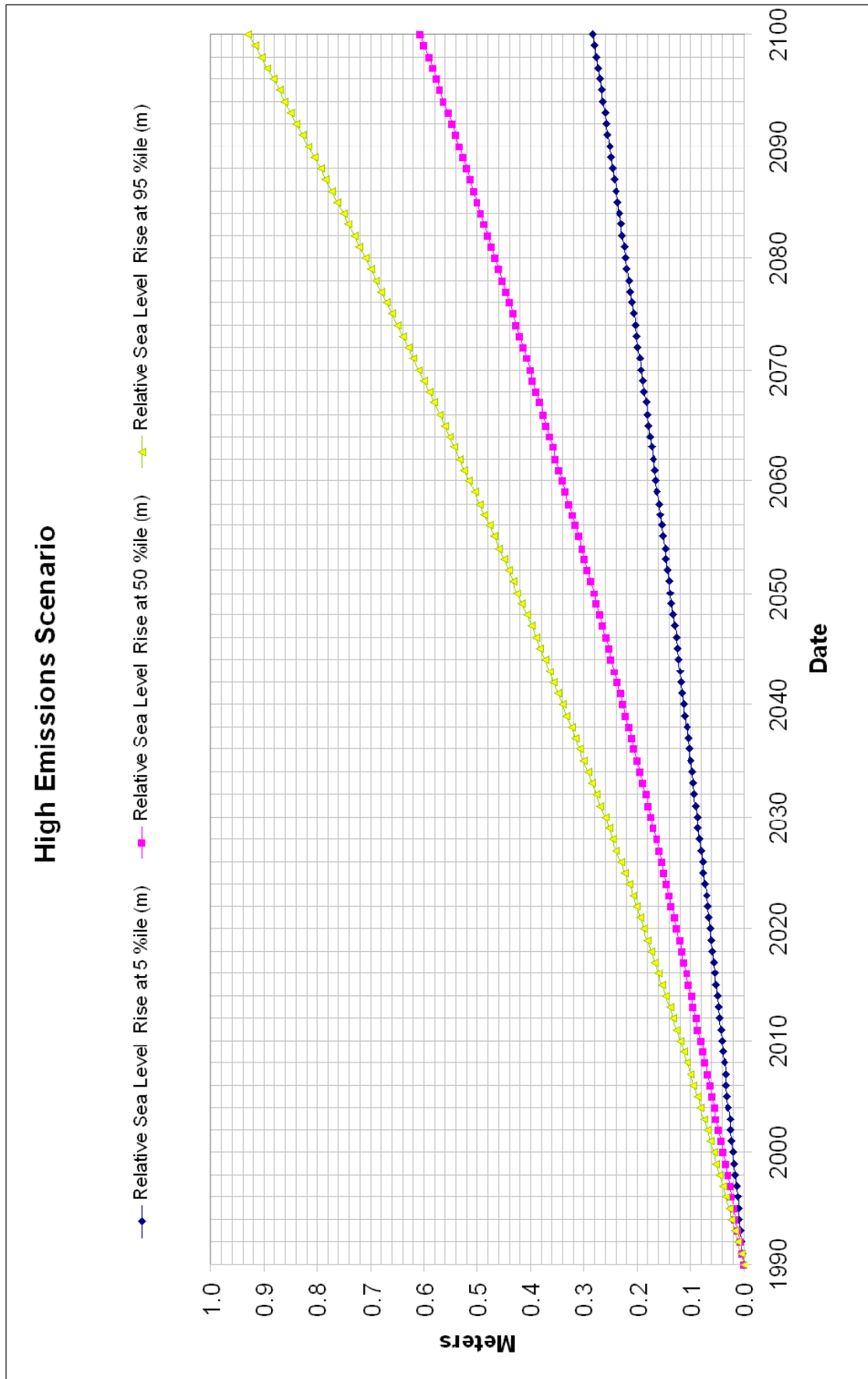
Appendix

3.2:



Appendix

3.3:



Low Emissions

	Relative Sea Level Rise at 5 %ile (m)	Relative Sea Level Rise at 50 %ile (m)	Relative Sea Level Rise at 95 %ile (m)
1990	0	0	0
2000	0.018	0.029	0.040
2010	0.037	0.060	0.084
2020	0.056	0.093	0.131
2030	0.077	0.129	0.181
2040	0.098	0.167	0.235
2050	0.120	0.206	0.293
2060	0.143	0.248	0.354
2070	0.167	0.292	0.418
2080	0.191	0.339	0.486
2090	0.217	0.387	0.557
2100	0.243	0.437	0.632

Medium Emissions

	Relative Sea Level Rise at 5 %ile (m)	Relative Sea Level Rise at 50 %ile (m)	Relative Sea Level Rise at 95 %ile (m)
1990	0	0	0
2000	0.019	0.033	0.048
2010	0.039	0.069	0.100
2020	0.059	0.108	0.157
2030	0.081	0.149	0.218
2040	0.103	0.193	0.283
2050	0.127	0.240	0.353
2060	0.151	0.289	0.427
2070	0.177	0.341	0.506
2080	0.203	0.396	0.588
2090	0.231	0.453	0.676
2100	0.259	0.513	0.767

High Emissions

	Relative Sea Level Rise at 5 %ile (m)	Relative Sea Level Rise at 50 %ile (m)	Relative Sea Level Rise at 95 %ile (m)
1990	0	0	0
2000	0.020	0.038	0.057
2010	0.041	0.080	0.119
2020	0.064	0.126	0.188
2030	0.087	0.174	0.261
2040	0.112	0.226	0.340
2050	0.138	0.281	0.425
2060	0.165	0.340	0.515
2070	0.193	0.401	0.610
2080	0.222	0.466	0.711
2090	0.252	0.534	0.817
2100	0.283	0.606	0.929