Golspie Flood Protection Scheme

Sgeama Dìon Thuiltean Ghoillspidh

Introductions

Personnel

Today’s Presentation

Process so far

Flood Risk Management (Scotland) Act 2009

Flood Risk Management Strategy

Local Flood Risk Management Plan – Highland & Argyll

Return period

The return period is the average time period between the occurrence of flood flows of the same size. For example a 1 in **200 year** return period flow in any given river or stream will occur on average once every **200 years**.

Annual Exceedance

A **200 year flood** is a flood that event that has a 0.5% probability of occurring in any given year. In a similar manner a 100 year flood has a annual exceedance probability of occurrence of 1% and the 50 year has a 2%.

Coastal flood risk

Direct Inundation

Where still water level (tidal level + surge) exceed defence height; general ground levels are inundated by the sea

Wave Carryover

Still water levels are contained by defences. However waves result in flood water being carried over defences and low lying land being inundated

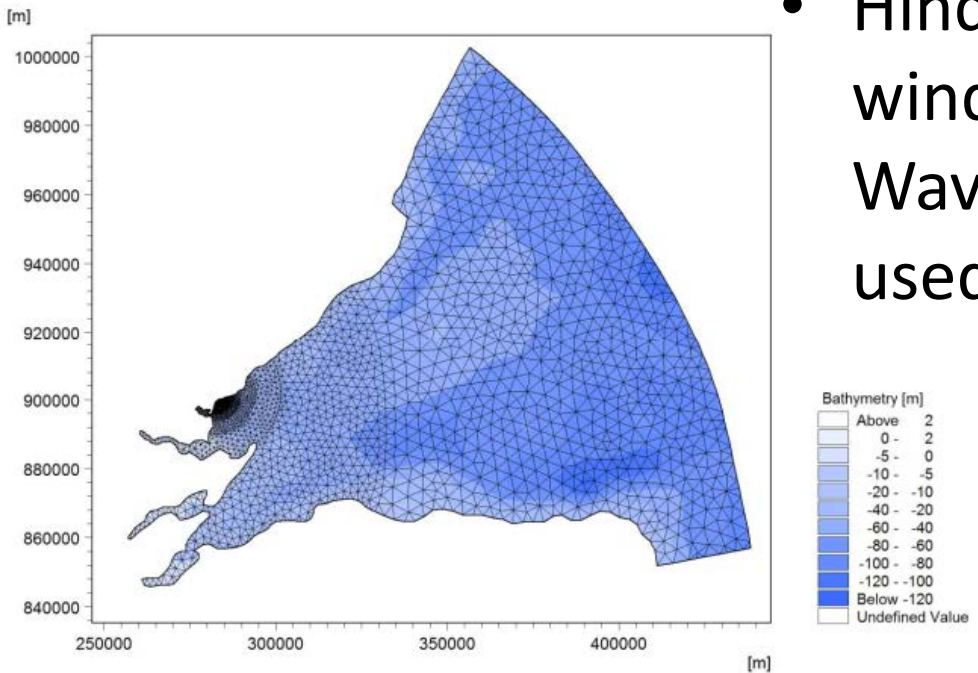
Extreme Sea Levels at Golspie

- The present day sea levels are calculated by adjusting the SEPA CFB dataset, with a baseline year of 2008, by adding for sea level rise.
- In order to consider climate change for the future time epoch in 100 years (2117), the present day extreme water levels were factored with UKCP09 95th percentile high emission scenario (including surge) sea level rise projections.
- The results show that the corresponding increase in sea level is approximately 870mm at Golspie

Golspie Extreme, Sea Levels		
	Water Level at present (m ODN)	Water Level m ODN) in 100 years
RP (years)	2017	2117
2	2.88	3.74
10	3.04	3.90
20	3.09	3.95
50	3.18	4.05
100	3.24	4.11
200	3.30	4.17
1000	3.46	4.34

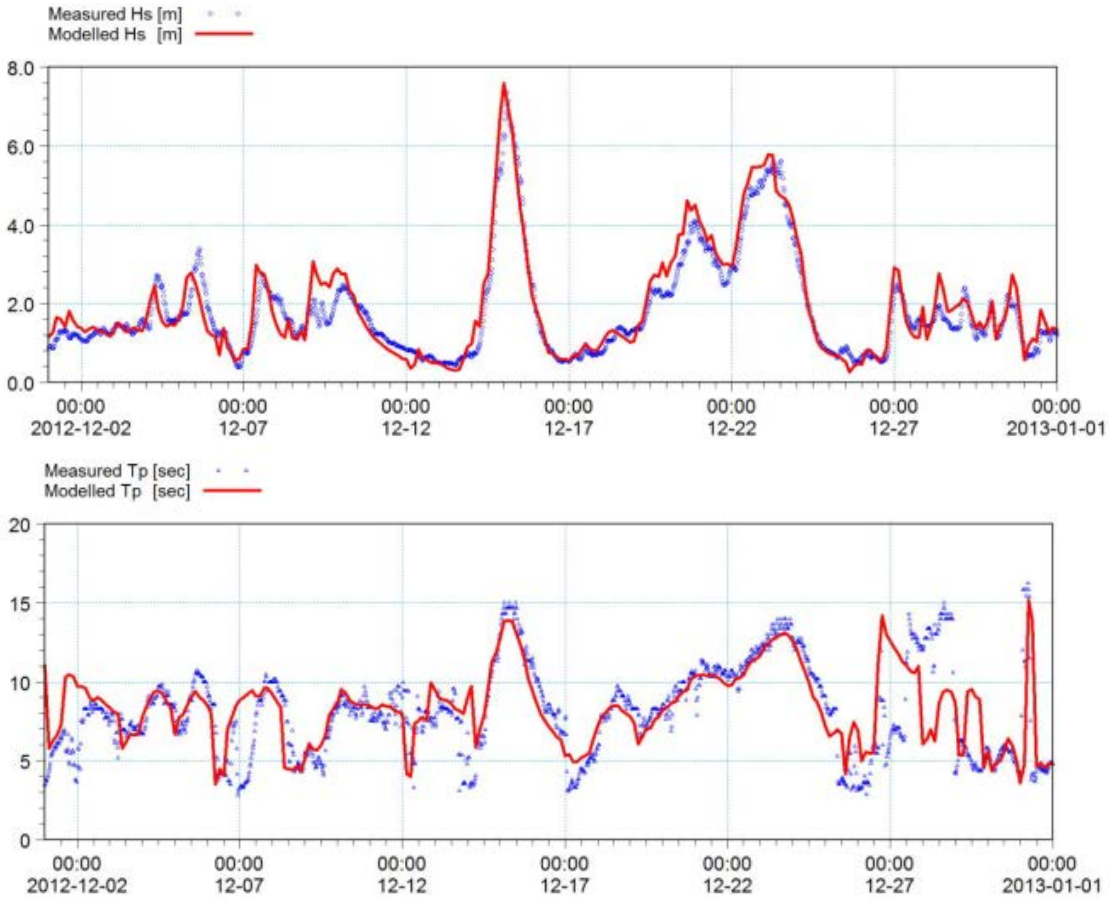
Wave Modelling

- Calibrated tidal and wave models - Mike21Flexible Mesh Spectral Wave (SW) model used tranform wave model towards Golspie from the offshore wave data points
  - Variable mesh resolution with enhanced mesh resolution along the Golspie coastal frontage
  - Hindcast offshore wave data and wind conditions – Met Office WaveWatch III (WW3)model data used. Data from 1980 - 2016

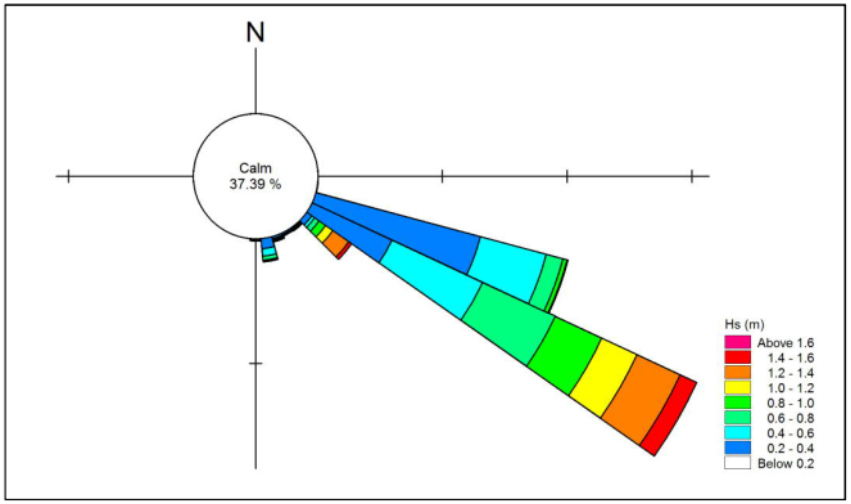


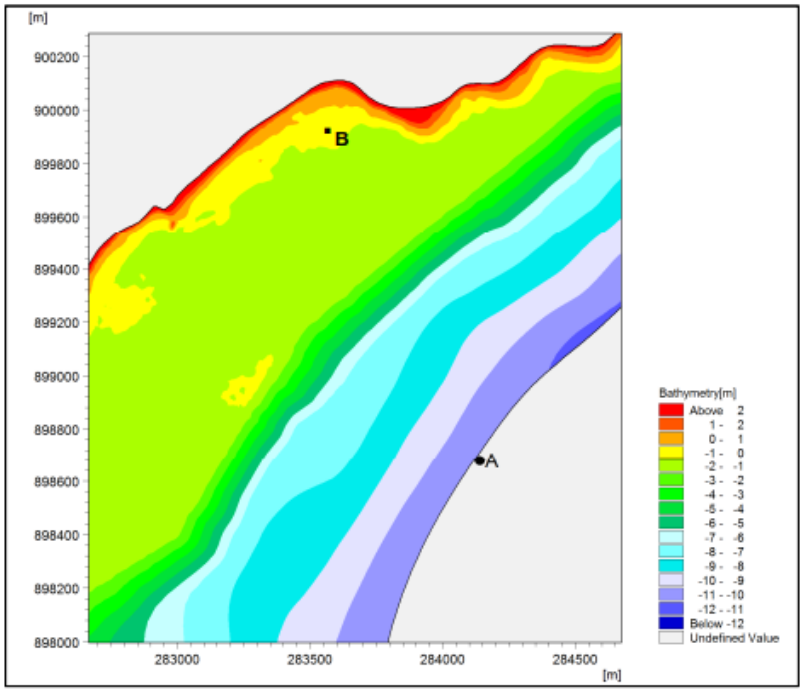
Calibration of Wave Model

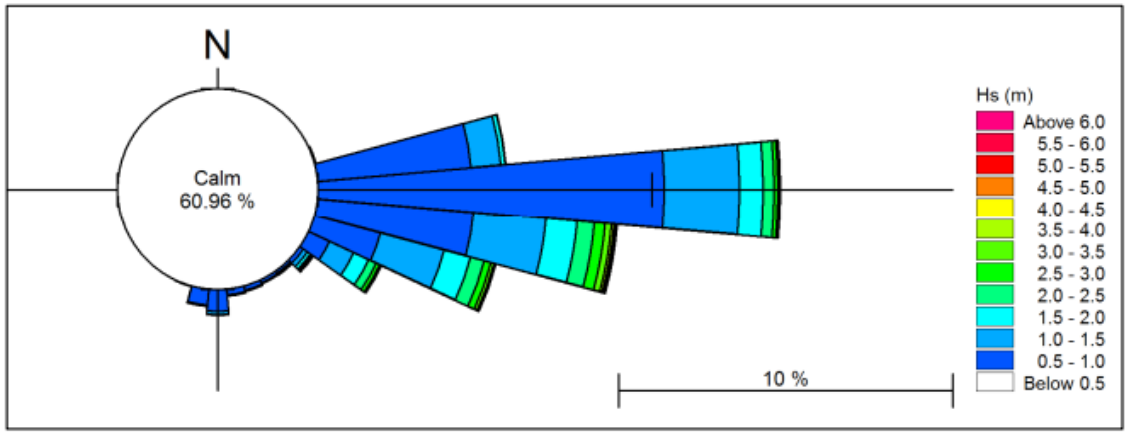
- Wave model calibrated against data from the Moray Firth Wave buoy from the Cefas Wave Net service.
- Wave buoy located some 36km east of Golspie
- Calibrated for 3 storm events: 2011, 2012 and 2014



Nearshore Wave results

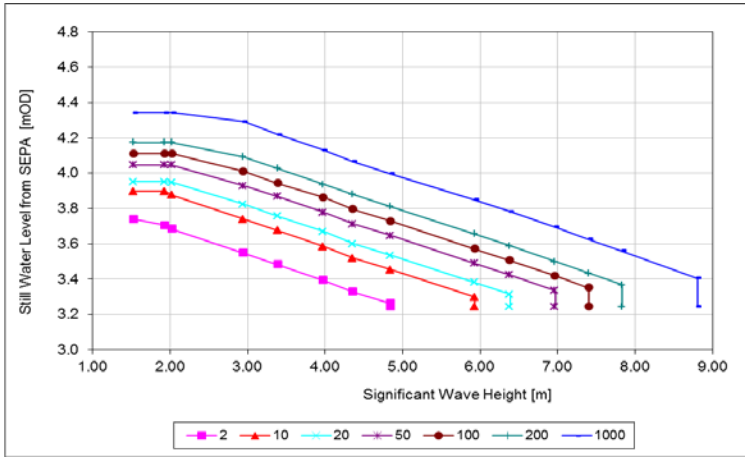




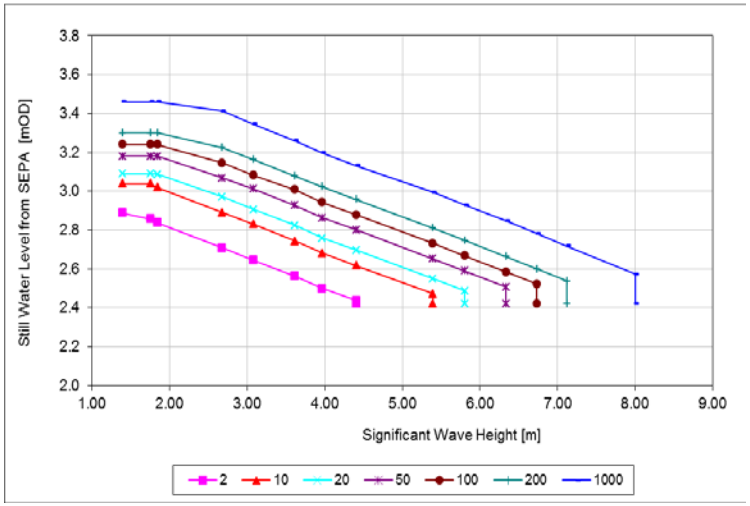


Extreme Sea Levels and Wave Action

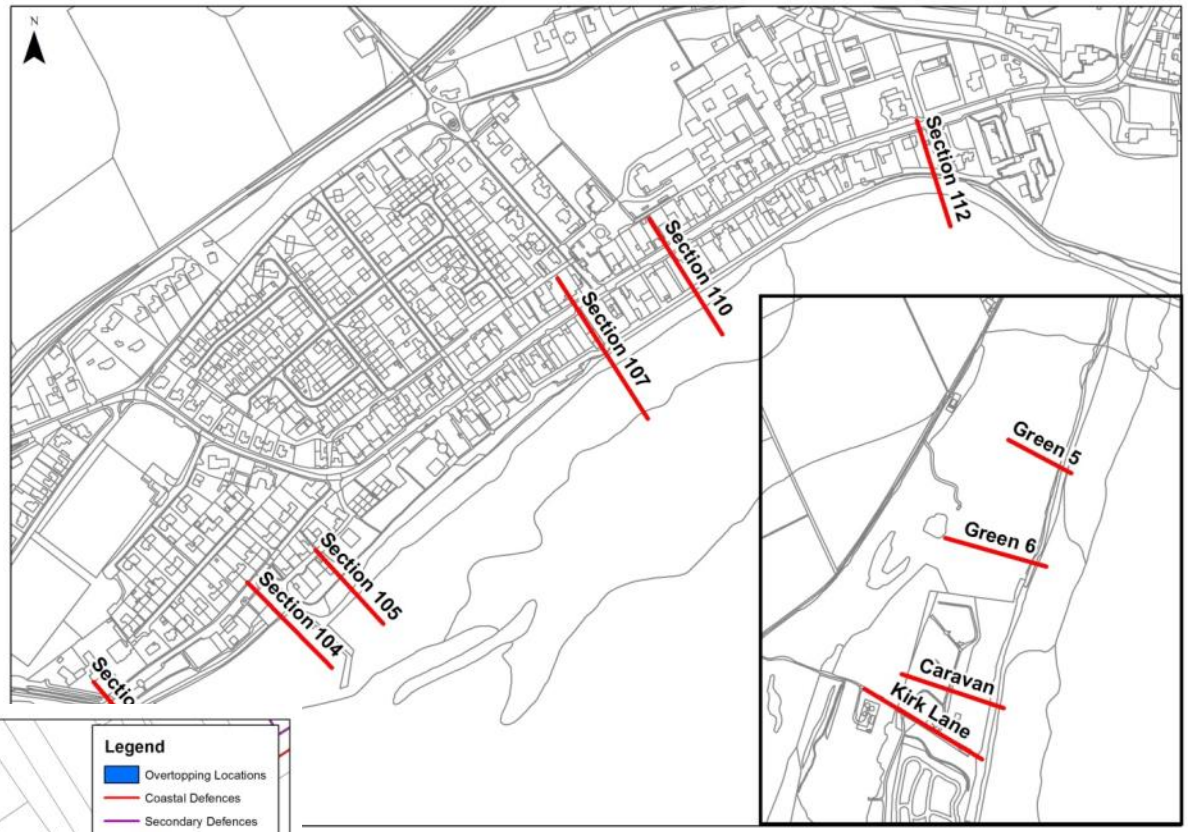
Joint probability distribution of wave and sea level at -11.0m contour line (present day)

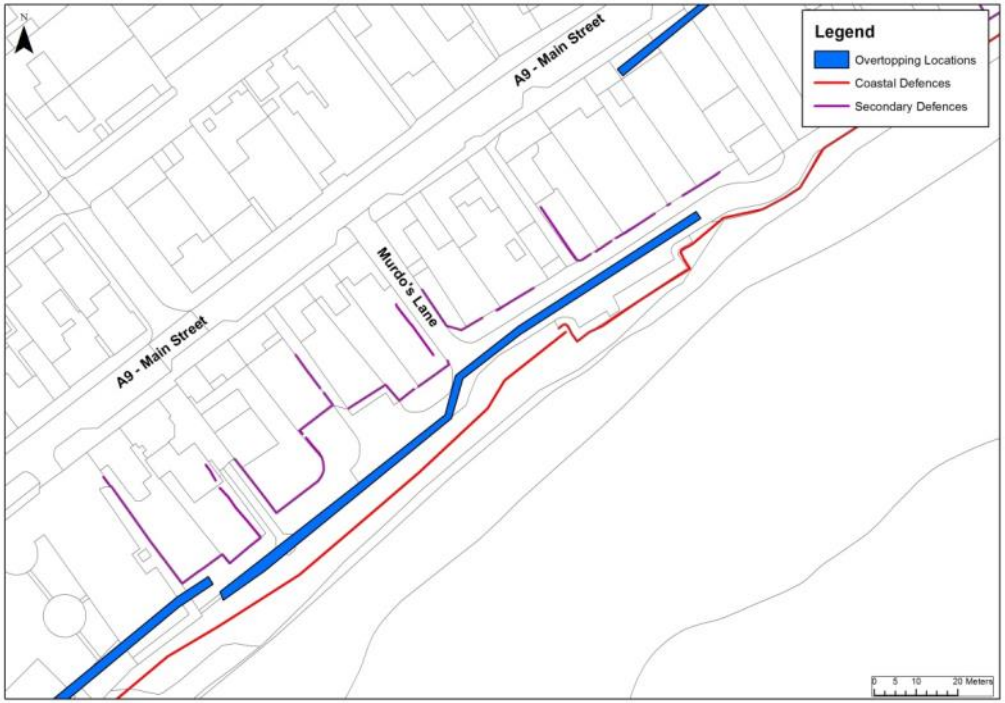


Joint probability distribution of wave and sea level at -11.0m contour line (climate change, high emissions 95th percentile)



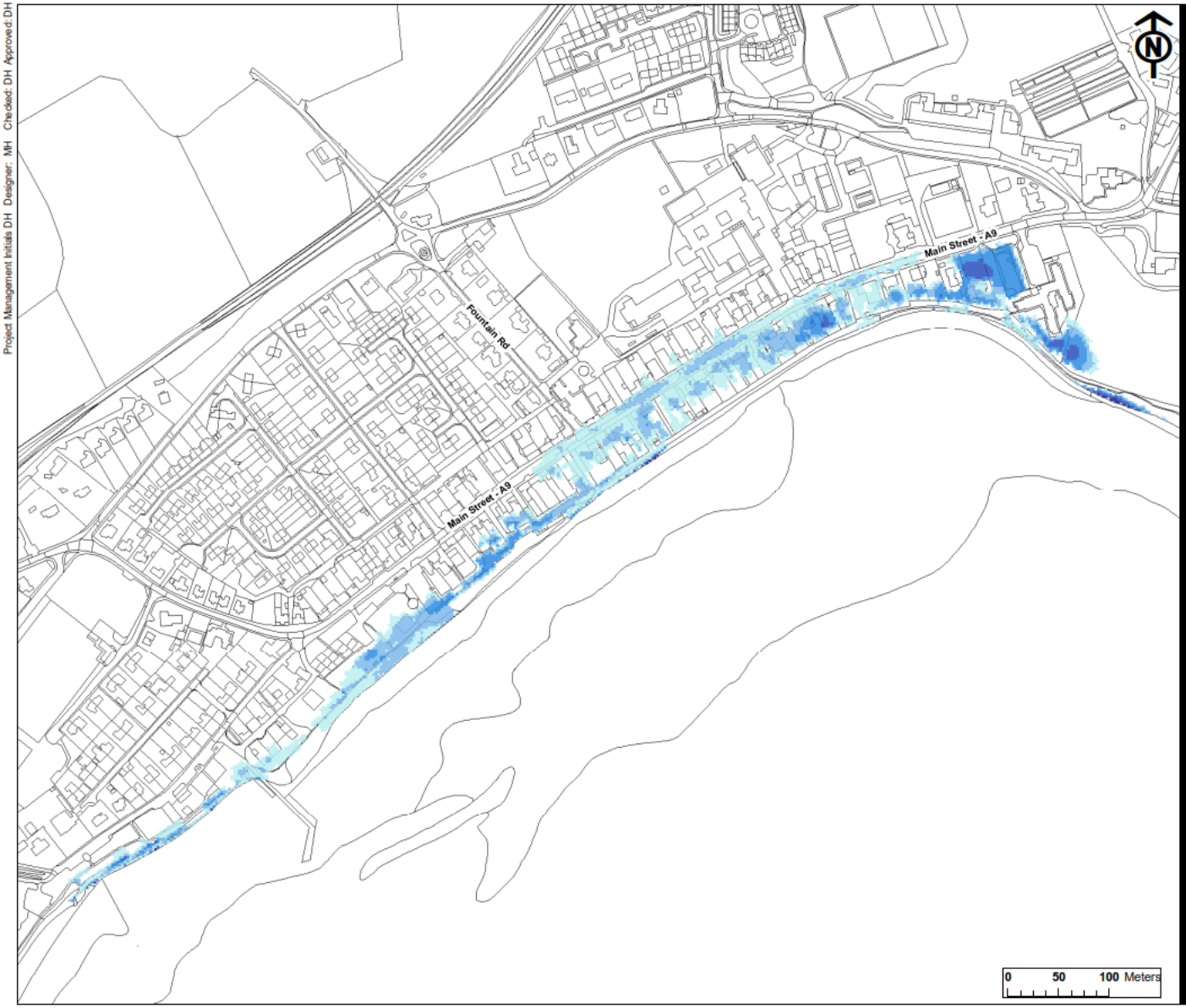
Wave overtopping assessed based on Eurotop assessment for various shoreline cross sections





Overtopping locations based on locations of coastal defences and secondary wave carry over defences

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



AECOM

PROJECT
Golspie Flood Study

CLIENT
The Highland Council
Comhairle na Gàidhealtachd

Key:

1 in 10yr Flood Extent

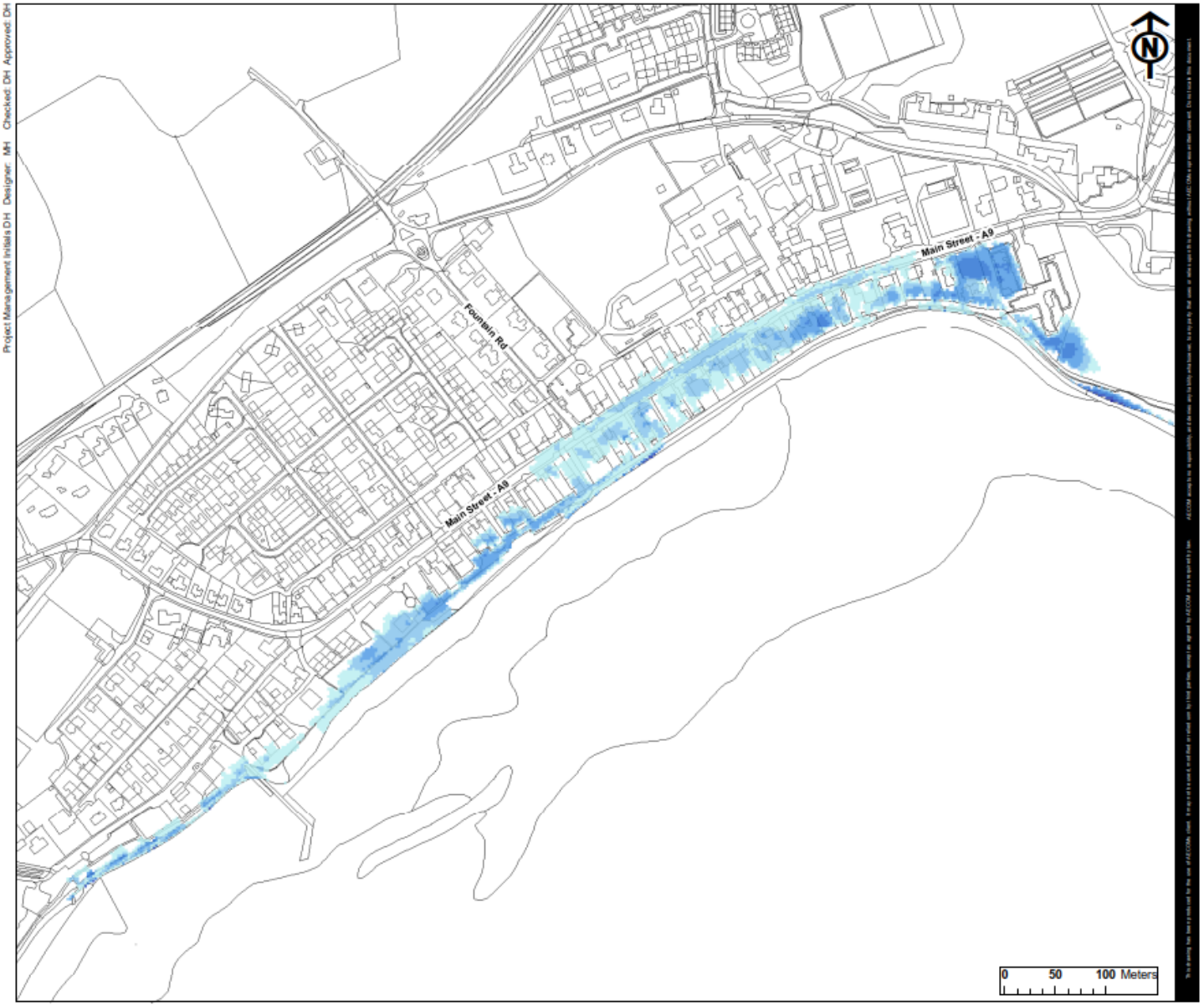
(m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 1.45

PROJECT NUMBER
60539712

SHEET TITLE
Figure 5: 1 in 10yr Flood Extent - Golspie Town

SHEET NUMBER
2 of 9



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

AECOM

PROJECT
Golspie Flood Study

CLIENT
The Highland Council
Comhairle na Gàidhealtachd

Key:

1 in 50yr Flood Extent

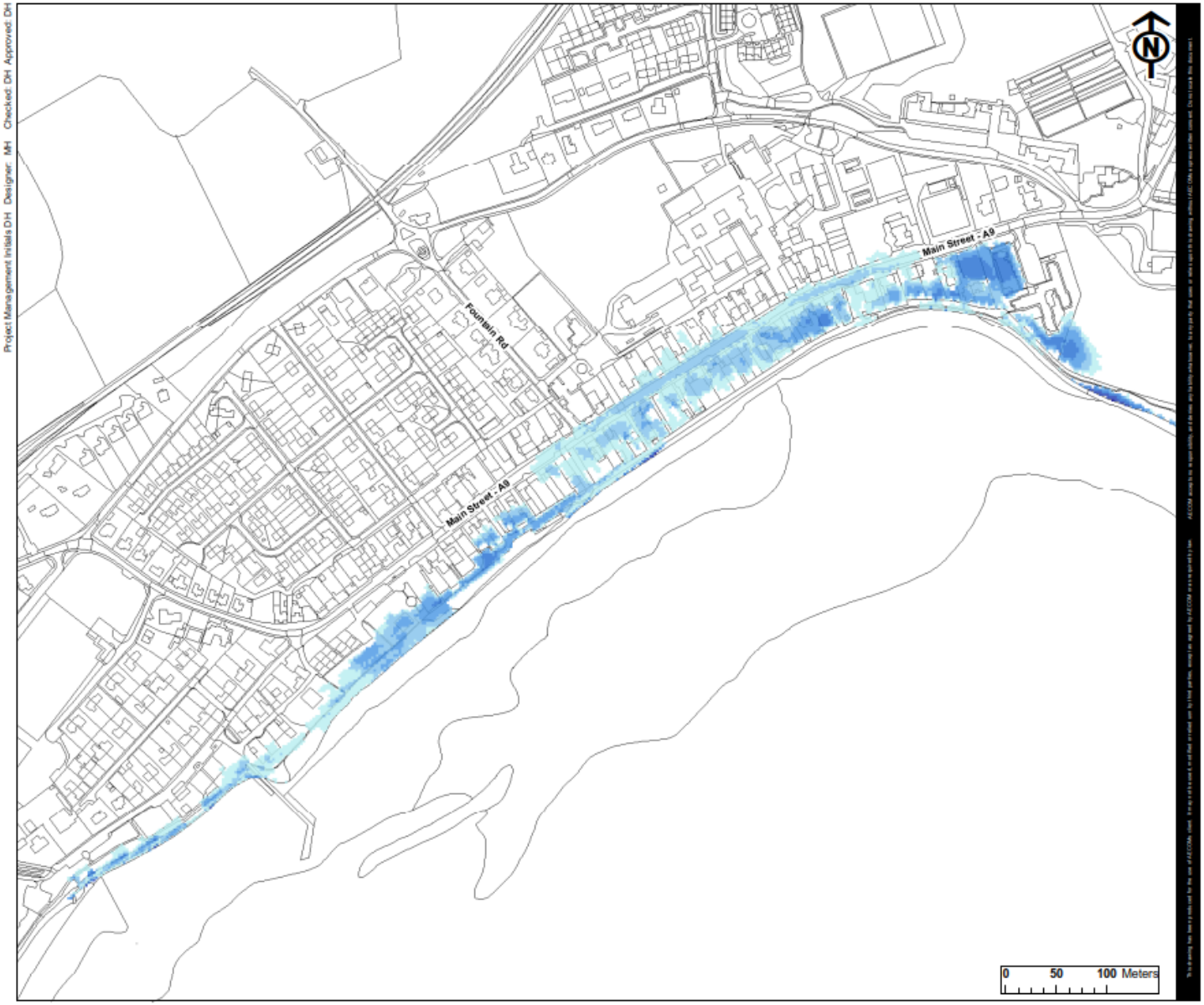
(m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 1.58

PROJECT NUMBER
60539712

SHEET TITLE
Figure 7: 1 in 50yr Flood Extent - Golspie Town

SHEET NUMBER
4 of 9



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

AECOM

PROJECT
Golspie Flood Study

CLIENT
The Highland Council
Comhairle na Gàidhealtachd

Key:

1 in 200yr Flood Extent

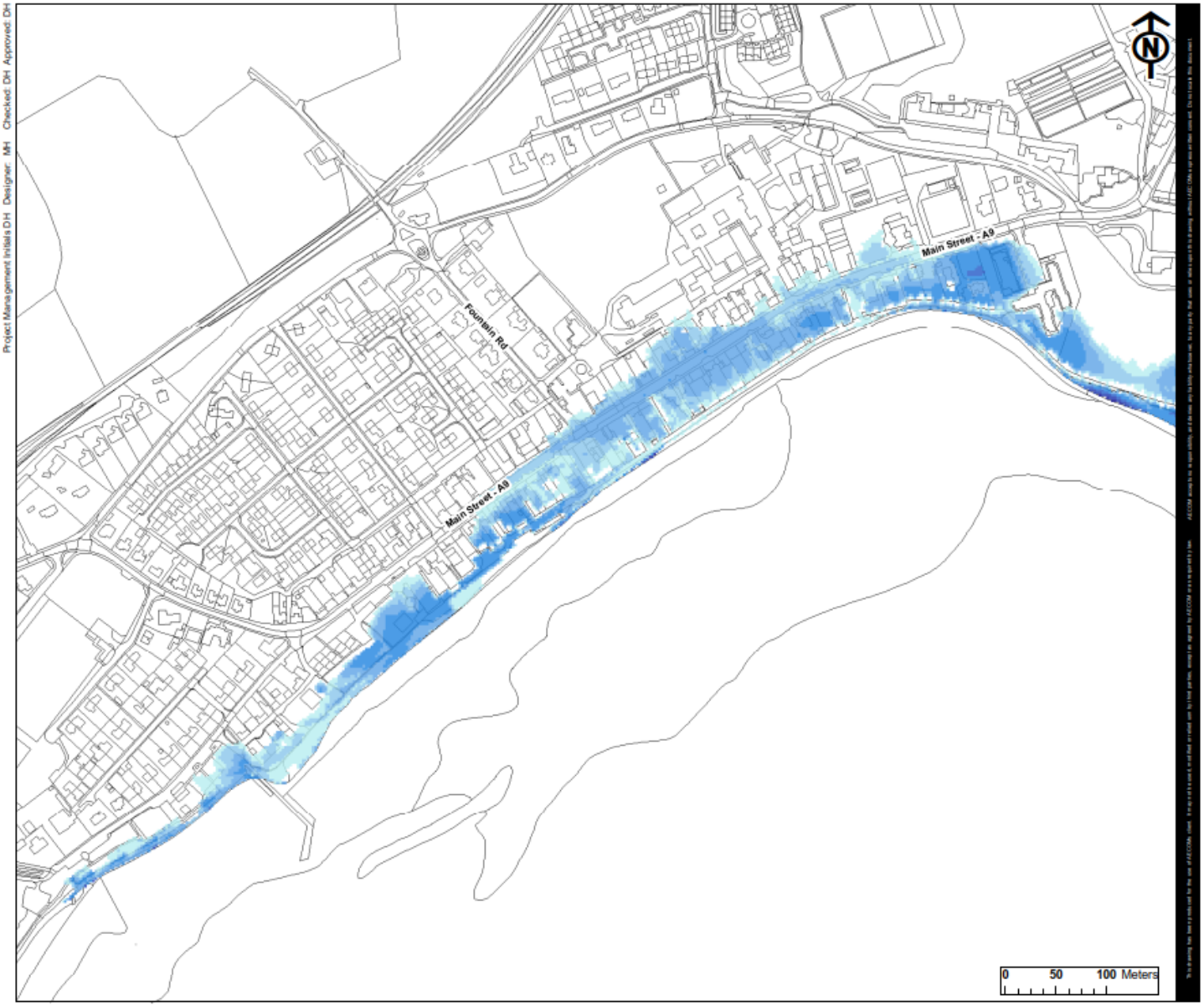
(m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 1.71

PROJECT NUMBER
60539712

SHEET TITLE
Figure 9: 1 in 200yr Flood Extent - Golspie Town

SHEET NUMBER
6 of 9



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

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PROJECT
Golspie Flood Study

CLIENT
The Highland Council
Comhairle na Gàidhealtachd

Key:

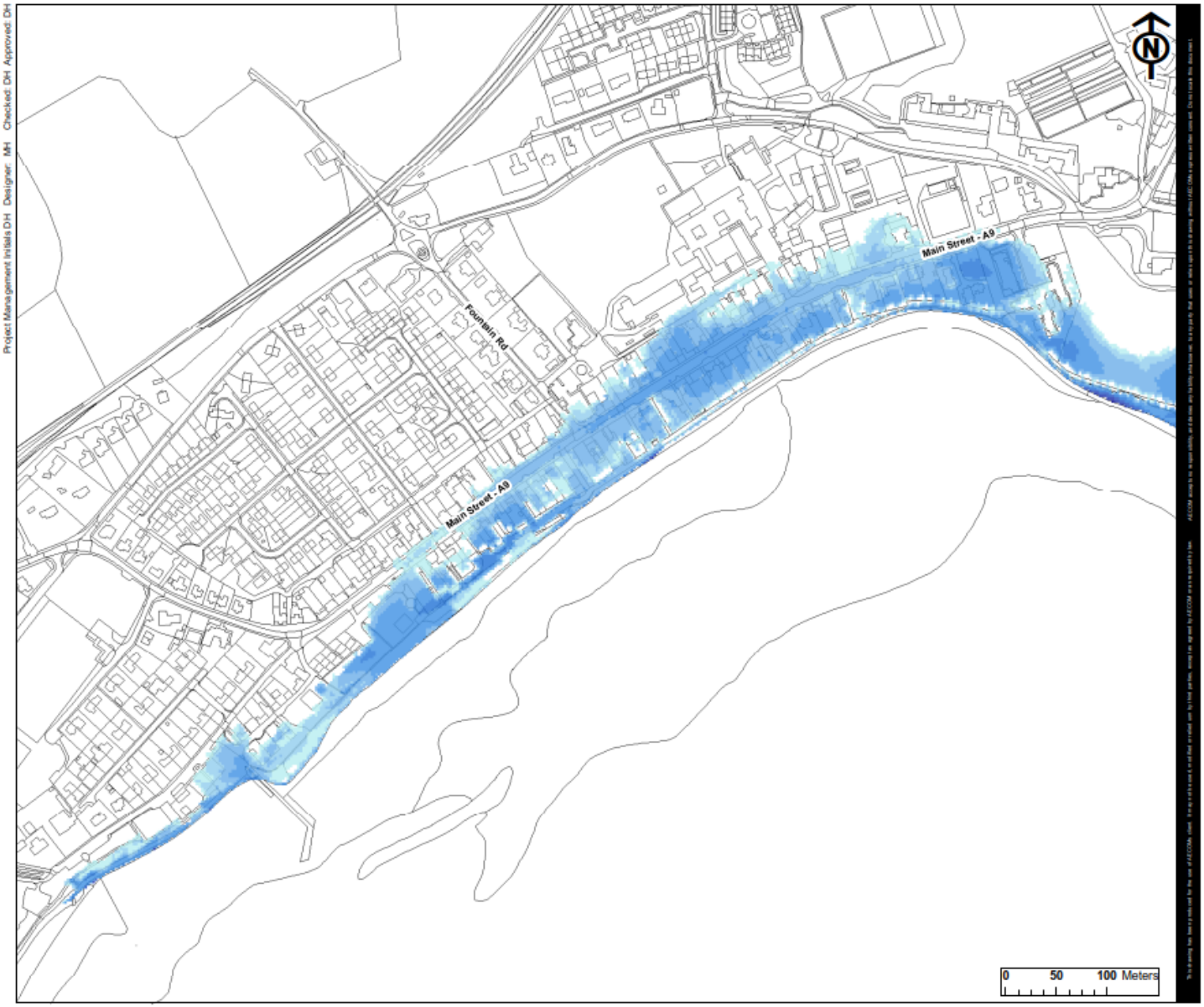
1 in 10yrCC Flood Extent
(m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.32

PROJECT NUMBER
60539712

SHEET TITLE
Figure 11: 1 in 10yrCC Flood Extent - Golspie Town

SHEET NUMBER
8 of 9



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

AECOM

PROJECT
Golspie Flood Study

CLIENT
The Highland Council
Comhairle na Gàidhealtachd

Key:

1 in 200yrCC Flood Extent

(m)

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 2.58

PROJECT NUMBER
60539712

SHEET TITLE
Figure 12: 1 in 200yrCC Flood Extent - Golspie Town

SHEET NUMBER
9 of 9

Developing Options

Long List of Options

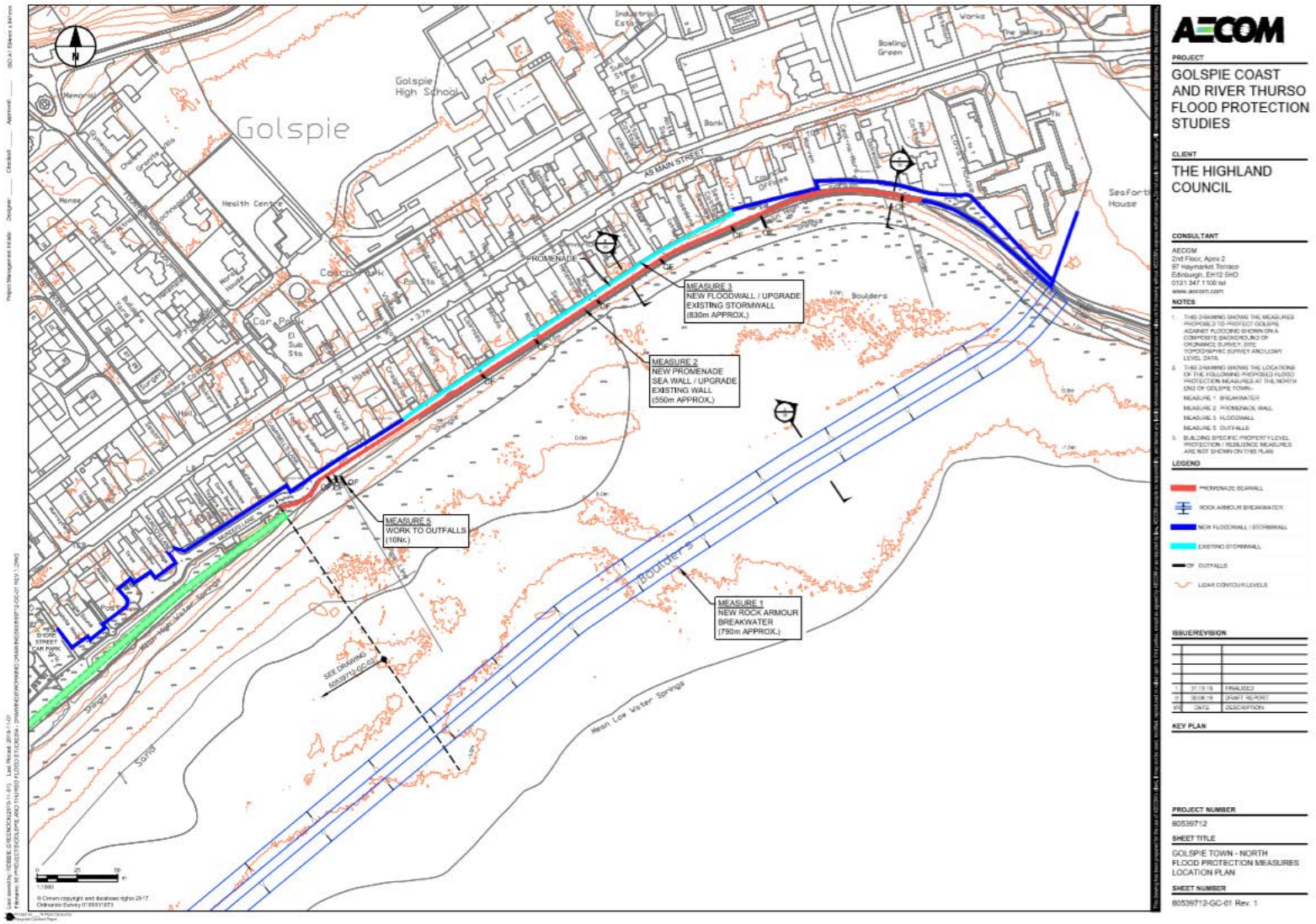
- Do nothing – allow the existing defences to deteriorate and standard of protection will reduce with time
- Do minimum – maintenance to maintain the current standard of protection
- Property Level Protection (PLP)

High Level Options

Potential measures to address flood mechanisms

- Direct Inundation
  - Raised coastal defence
  - Raised set back defence
    - Permanent or demountable
- Wave carry over
  - Beach nourishment to limit depth and wave height
  - Breakwater to reduce wave height at the coastline
  - Increased roughness to reduce wave carry over

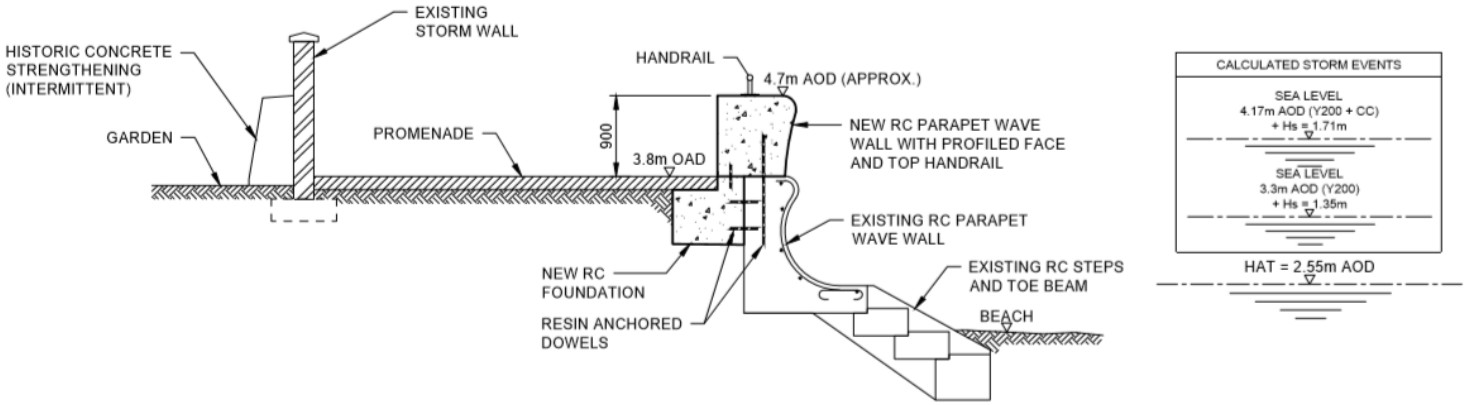
Measures Considered



Direct Defence

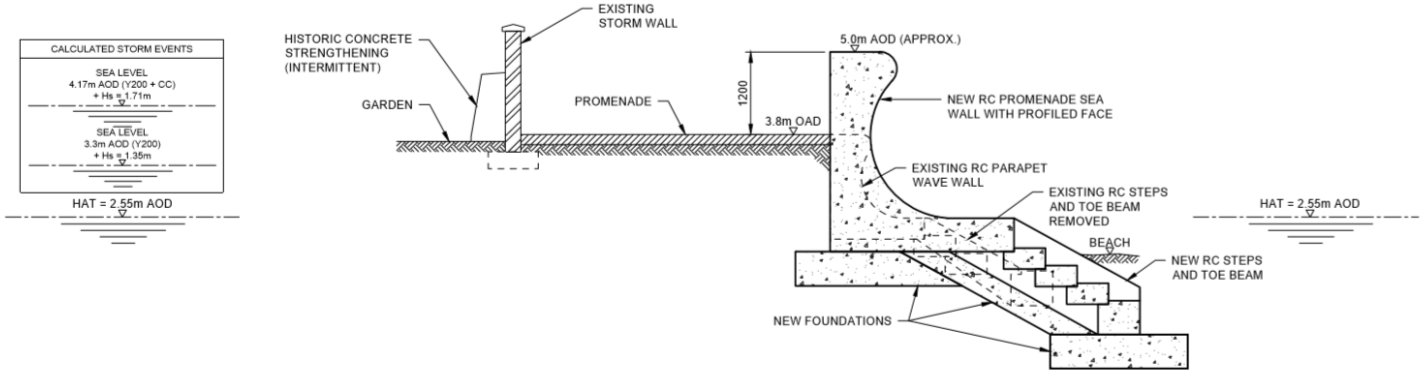
Raised defence height along existing defence line

Direct Defences (wave and tidal inundation)



SECTION B-B, MEASURE 2A - RAISED PROMENADE WALL

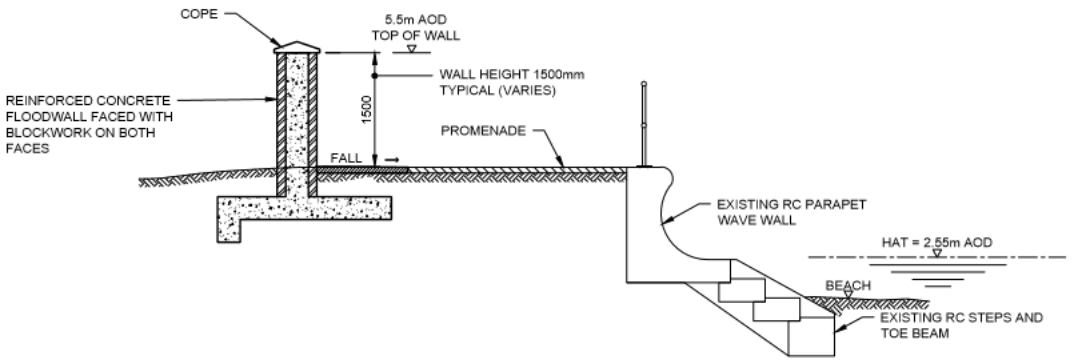
Scale 1:50



SECTION B-B, MEASURE 2B - NEW PROMENADE WALL

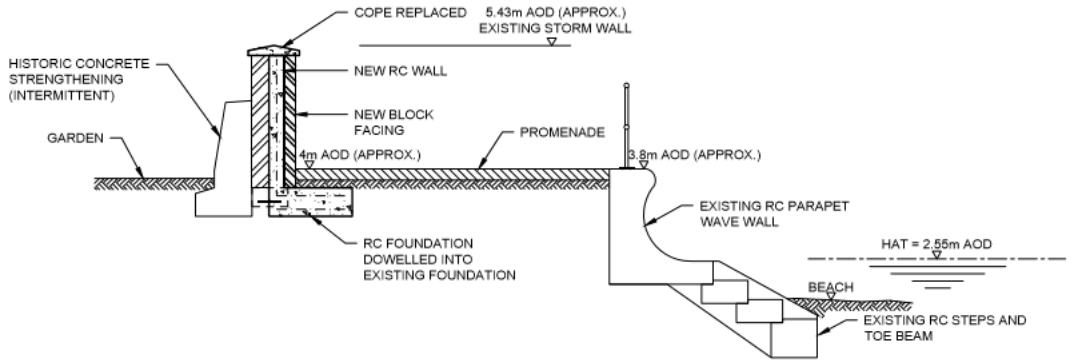
Scale 1:50

Direct Defences (wave and tidal inundation)



SECTION B-B, MEASURE 3A - NEW FLOOD WALL WITH NEW GATES

Scale 1:50



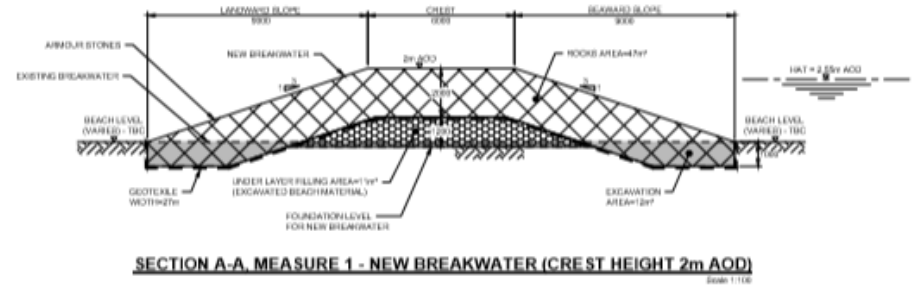
SECTION B-B, MEASURE 3B - STRENGTHENING EXISTING STORM WALL AND GATES

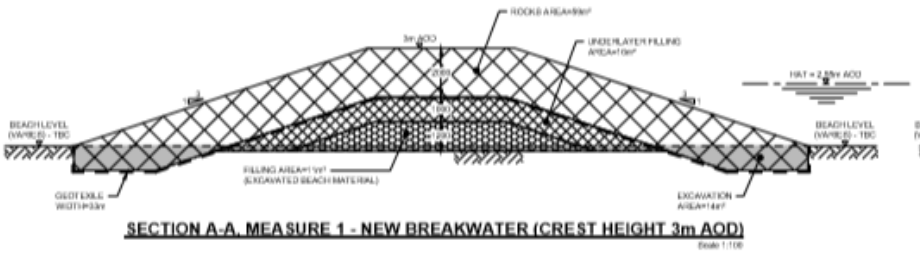
Scale 1:50

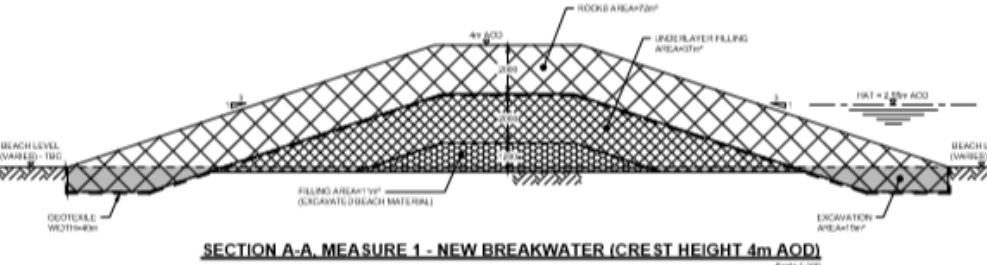
Wave Carryover




Breakwater to dissipate energy







What does a breakwater do to the wave carry over

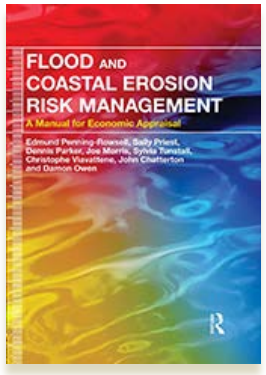
		Breakwater only	Breakwater and defences	Raised block
Breakwater crest level	Existing conditions	BW 3.0m	BW 3.0m	no BW
Defence crest level	3.8m	3.8m	4.6m	4.7m
2	24.5	0.1	0	6.9
10	42.0	0.5	0.1	12.8
20	49.2	0.9	0.1	15.3
50	63.9	2.2	0.3	20.4
100	75.5	3.6	0.5	24.6
200	88.7	5.6	0.8	29.4
1000	133.3	16.3	2.9	46.3

		Breakwater only	Breakwater and raised block	Breakwater and set back defences*	Breakwater and raised block
Breakwater crest level	Existing conditions	BW 3.0m	BW 3.0m	BW 3.0m	BW 4.0m
Defence crest level	3.8m	3.8m	4.6m	4.9m	4.6m
2	256.1	57.8	12.0	4.7	0.4
10	375.3	129.1	33.0	14.6	3.5
20	418.7	160.9	43.7	20.0	5.9
50	501.0	227.4	65.9	31.3	12.4
100	557.0	275.9	82.9	40.3	18.6
200	618.0	331.5	103.1	51.1	17.1
1000	820.2	530.0	178.8	93.2	67.5

How did we refine the options?

Economic appraisals:

- Economic benefits of an option should be greater than the costs. Benefit Cost Ratio greater than unity in order to show value for money.
- Our assessment included:
  - Property damages
  - Clean-up costs
  - Emergency services
  - Option costs



Social and environmental appraisals:

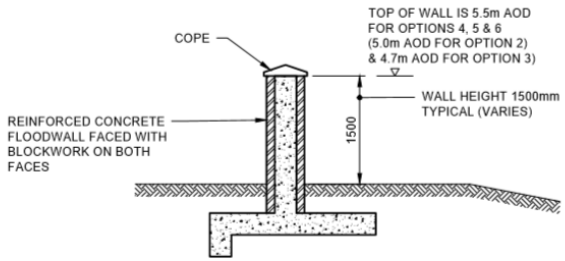
- Economically viable options should also show wider social and environmental benefits
- This may result in options being taken forward that do not show the best economics but are best when considering all factors or discounting options if very poor environmentally.

Cost and Benefits of Options

Option No.	Description	Total Benefit (present value)	Costs	Main Flood Cells Affected	SoP	No of properties protected to the Option SoP	Benefit-Cost Ratio
1	New Breakwater 3mAOD Crest	£2,714,031.00	£4,829,457.16	1	1000yr	60	0.56
2	Direct defences: New defences along present defence line (floodwall and embankment incl. gates)	£2,714,031.00	£6,030,663.59	1	1000yr	60	0.45
3	Direct defences: Raising of existing defences along present defence line (promenade and embankment, incl. gates)	£2,626,917.87	£1,286,721.59	1	200yr	60	**2.04**
4	Direct defences: New set back floodwall (incl. gates)	£2,714,031.00	£7,663,722.55	1	1000yr	60	0.35
5	Direct defences: Set back stormwall improvements (incl. gates)	£2,714,031.00	£5,376,988.49	1	1000yr	60	0.50
6	New Breakwater 3mAOD Crest with Direct Defences (improvements, new walls and gates)	£5,618,972.51	£9,837,763.24	1	200yr+CC	103	0.57
7	Floodgate Improvements	n/a	£1,356,823.63	1	n/a	n/a	n/a
8	New floodgate at alleyways only	n/a	£313,998.86	1	n/a	n/a	n/a
9	Localised coastal embankment raising in the Links area	£179,861.56	£5,138,297.74	3	2yr	3*	0.04
10	Property Level Protection and Resilience Measures	£1,148,986.57	£559,575.00	1,2,3	1000yr+CC 4nr properties, 200yr+CC 2nr properties, 100yr+CC 1nr property, 10yr+CC 4nr properties	11	2.05

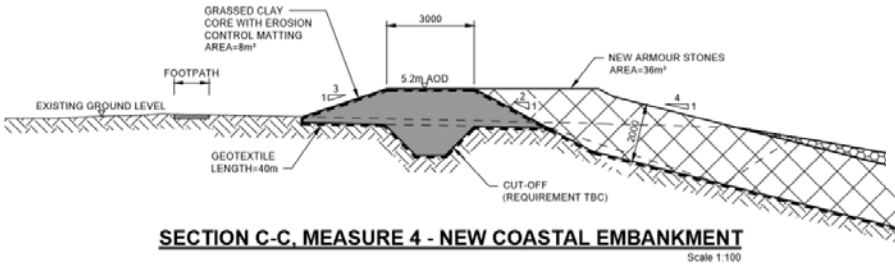
*Kart Track, caravan park and manager house, a section of the golf course would also be protected

Preferred Option



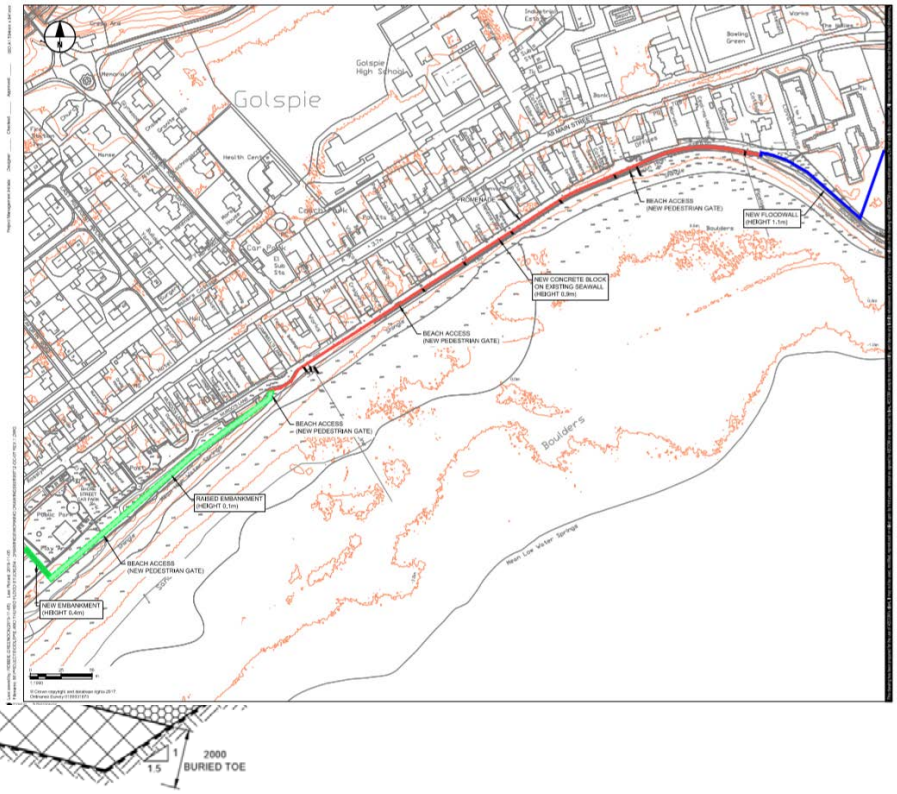
SECTION F-F, MEASURES 3A - NEW FLOOD WALL (EAST & WEST)

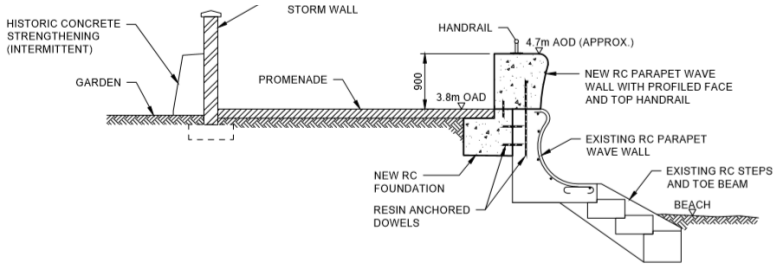
Scale 1:50

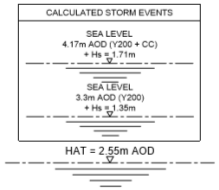


SECTION C-C, MEASURE 4 - NEW COASTAL EMBANKMENT

Scale 1:100







SECTION B-B, MEASURE 2A - RAISED PROMENADE WALL

Scale 1:50

Process going forward

National Prioritisation of Flood Schemes

Scottish Government Grant Funding

Best Opportunity to Scot Gov Grant

Scheme Development

Process going forward

Preferred Option submission to SEPA for National Prioritisation - (Dec 2019)

Finalisation of Prioritisation list – late 2020

Scottish Government Decision on future scheme funding – Dec 2020

(The following items are subject to obtaining funding)

Detailed Design and Flood Protection Scheme process – 2021 – 2025

Construction of scheme – 2026-2028