

Project title	Barmouth North Promenade	Job number 264326
Meeting name and number	Barmouth Option Selection Discussion	File reference
Location	Gwynedd Offices	Time and date 26 March 2019
Purpose of meeting		
Present	Rosemary Jenkinson (Arup) Paz Arteijo (Arup) Owain Griffith (YGC)	Robin Campbell (Arup)
Apologies		
Circulation	Those present	

Action

1. Introduction

Purpose of the meeting was to discuss the work undertaken by Arup to and a discussion of the preferred option based on the present information available. The options shortlisted for the Barmouth North Promenade proposal include:

- Option 1 – Baseline (Walkaway & Business As Usual)
- Option 2 – Betterment of existing defences
- Option 3 – Beach management, supported by groyne or breakwater structures
- Option 4 – Managed Realignment

Please refer to Appendix A for the Option Selection Workshop Slides.

2. Strategic Case

A recap of the OBC Strategic Case was provided. Key discussion points included:

- FCERM strategic fit and context: National – highlighting SMP2 Policy for Barmouth noting that in the ‘Medium Term – develop strategy to look at opportunities for Managed Realignment at North Barmouth’.
- FCERM strategic fit and context: Local – As per the Anglesey and Gwynedd Joint Local Development Plan (JLDP) - Barmouth North Promenade is located within a Coastal Change Management Area (CChMA). Extents of the CChMA are considered to be the SMP2 Policy boundary for Barmouth North Promenade.

Prepared by Rosemary Jenkinson

Date of circulation

Date of next meeting

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Action: YGC to confirm boundaries of the CChMA for Barmouth.

YGC

- Sustainability and well-being strategic fit: Pen Llyn a'r Sarnau is a significant environmental constraint.
- Investment Objectives: Key objective for YGC is to identify the best option available, then consider a 'Plan B' if that option isn't deliverable or affordable.

3. Economic Case

An overview of OBC Economic Case was provided by Arup. Arup provided a recap of the process to select the shortlisted options. Highlighting spatial and temporal considerations in the option selection process.

An overview of the economic appraisal of the shortlist was provided:

- Overtopping and Inundation modelling has been undertaken for the return periods and epochs. This indicates extensive coastal flooding (>2m) for a number of return periods; particularly around the caravan park for the lower return periods extending down to the Heol-Y-Llan housing estate and the neighbouring land behind the Cambrian Railway for the higher return periods.
- Baseline Benefits Summary:
 - (Slide 22): A significant number of properties are at risk; up to 760 properties at risk for a 1in200 year event from present day onwards.
 - (Slide 22): A precautionary approach has been undertaken to defining the damages/benefits associated at Barmouth North Promenade. A minimum/maximum has been defined based on the certainty around the figures available. At present minimum of £66,583,00 is considered to damages avoided. Defining the economic impact of the Cambrian Railway or recreation/tourism would require another detailed study.
 - (Slide 23): The benefits associated with the Standard of Protection have been defined; for example: an option providing a 1in200 year SOP in 2069 would provide a minimum benefit of £53,716,000.
- Key comments from the Do Something Options Review:
 - Option 2 – Betterment of existing defences

(Slide 24) Due to uncertainties about the stability of beach material along the frontage, it is proposed to extend the rock toe along the whole of the frontage, with the use of a shingle beach profile noted as an opportunity for future consideration.

A low flood wall to the north of the study area is required to avoid outflanking and ensure protection to the wider flood cell at Barmouth.

(Slide 28) The tertiary wall is proposed to be re-built. As overtopping from the primary defences is still envisioned to occur, the crest of the tertiary wall will define the SOP that can be achieved. The alignment of the wall and

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height are a decision for YGC – which may be based on amenity, cost, impovigin commercial viability of land (i.e. no need for a TAN15 assessment) or SOP.

- Option 3 – Beach management

Three options have been developed by ABPmer to illustrate the options and associated costs available. Each provides an SOP of 1in200 up to 2119 and the same maintenance requirements. The crest levels to achieve a SOP up to 2119 are significant: 7.1m+ beach crest and 7.6m+ structures crest – issues raised over amenity/viability without further works to existing defences.

- Option 4 – Managed Realignment

Setting back the line of defences would encourage a larger more sustainable beach profile (i.e. reduce overtopping and potential maintenance requirements). The SOP achieved is subject to further design / requirements of YGC.

Arup highlighted the SMP2 envisioned extents for Barmouth North Promenade; these extents show loss of some properties from the Heol-Y-Llan housing estate.

- Review of costs:

(Slide 32) The option costs are significant, with Option 2 (Betterment) the most affordable option available. The option costs are sensitive to material rates – these are high compared to previous schemes. YGC noted there are no significant licenced sources material in the local area – previous schemes have used Porthmadog for rocks (up to a certain size) and St Marlow for larger material.

Further work is required to finalise the costs:

Action: YGC to provide information to support the land purchase & compensation costs associated with Option 4. YGC to provide relevant information related to Fairbourne. YGC

Action: Arup to update Option 3 costs to account for full decommissioning of the existing defences. YGC noted they would struggle to find a landfill to accommodate the removed material and this remains a key risk. Arup

Action: Arup to update site investigation and survey costs for Option 2 and 3. Arup

Action: YGC to provide existing and proposed staff costs, if available. Or provide an estimate. YGC

4. Preferred Option and Next Steps

Based on affordability, environmental and well-being considerations, the preferred option is: Option 2 – Betterment of existing defences. YGC would need to have a

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conversation with Welsh Government around the acceptance of a solution providing a lower SOP.

Next steps include:

Action: Arup to circulate economic report for YGC to review. Arup to finalise option costs and calculate the BCR and IBCRs associated with the options and the adaptive pathway approach. Arup

Action: Arup to develop preferred option to inform a more robust understanding of the costs associated with Option 2. Arup

Action: YGC to engage with NRW to understand requirements in relation to the SAC. YGC

Action: YGC to consider engagement with the general public following the selection of the preferred option. YGC

Action: YGC to review the Welsh Coastal Groups Forum Guidance to the SMP2 Policy Change Process and identify where Arup may be able to provide future support. YGC

Barmouth North Promenade OBC

Option Selection Workshop

Workshop Objectives

- Review of shortlisting
 - Baseline scenario
 - Outline of shortlisted options
 - Reminder of design life, spatial extents and spatial variation

→ Preferred Do-Something Option:

Strategic Case

1. Context



2. FCERM strategic fit and context

National:

National Strategy for Flood and Coastal Erosion Risk Management in Wales (2010)

Shoreline Management Plan 2 (2011)

MA 24 BARMOUTH: From Porth Aberamffra to Llanaber Point

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
11.14	Barmouth South	HTL	HTL	HTL	
11.15	Barmouth North	HTL	MR	MR	This may include relocation of properties
11.16	Llanaber	HTL	HTL	HTL	This needs to be considered in term of management to the above policy unit.

Key: HTL - Hold the Line, A - Advance the Line, NAI - No Active Intervention
MR - Managed Realignment

PREFERRED POLICY TO IMPLEMENT PLAN:

From present day	Maintain existing defences.
Medium term	Develop strategy to look at opportunities for MR at north Barmouth.
Long term	Maintain defences.

NRW's Flood Risk Assessment Wales (FRAW) (2018)



NRW's Flood Risk Map for Barmouth North Promenade

2. FCERM strategic fit and context

Local

North West Wales Catchment Flood Management Plan (CFMP) (2010):

- Barmouth is located in Sub-area 7 - Coastal Lowlands
- Policy Option 3 - Areas of low to moderate flood risk where we are generally managing existing flood risk effectively
- The ambition is “*to ensure actions are appropriate and proportionate to the risks, now and in the future. Maintenance of defences will continue, but it may not be justifiable to replace them or to increase their height in the future*”.

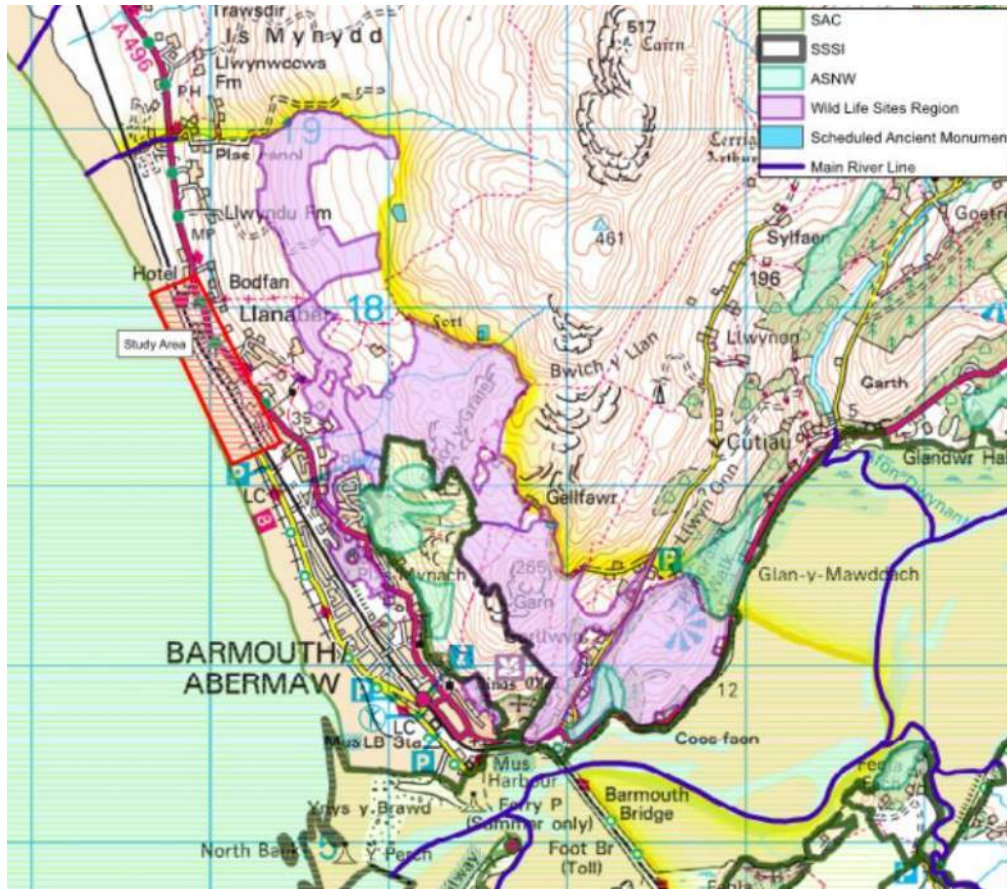
Gwynedd Council Local Flood Risk Management Strategy (2013):

The Objectives	Sub-objectives	
1. Reducing the consequences for individuals, communities, businesses and the environment from flooding and coastal erosion	1	Provide strategic leadership and direction at a local level
	2	Develop policies for effective land use management and enhanced development control procedures where appropriate.
	3	Establish regular maintenance schedules for flood and coastal erosion risk management assets.
2. Raising awareness of and engaging people in the response to flood and coastal erosion risk	4	Ensure that by 2026 everyone who lives in a flood risk area understands the flood risk they are subject to, the consequences of this risk and how to live with that risk
3. Providing an effective and sustained response to flood and coastal erosion events	5	Ensure the preparation and testing of Emergency Plans
	6	Respond to events in a timely and appropriate manner
	7	Facilitate recovery from flooding within the shortest possible timescales
4. Prioritising investment in the most at risk communities	8	Increase the use of alternative sources of funding for flood and coastal erosion risk management

Anglesey and Gwynedd Joint Local Development Plan (JLDP) (2017):

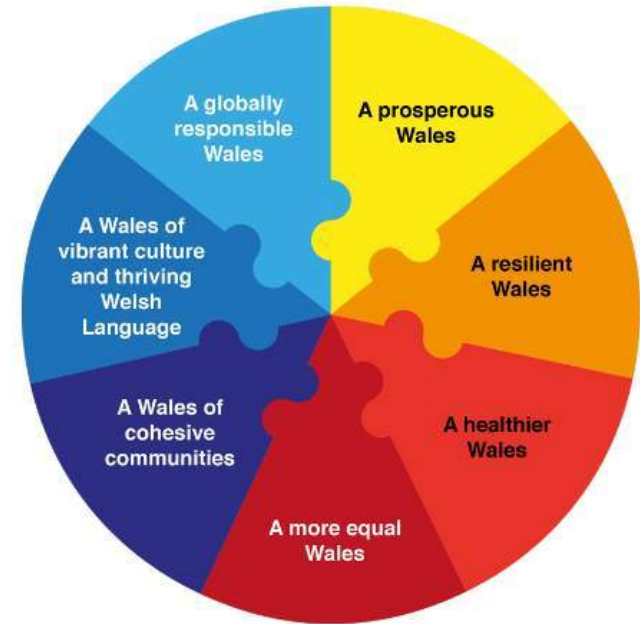
- Barmouth North Promenade is within a Coastal Change Management Area (CChMA); for example: New Residential Development - Proposals for new, replacement or conversion dwellings will be refused in the CChMA.

3. Sustainability and well-being strategic fit



Environmental Appraisal

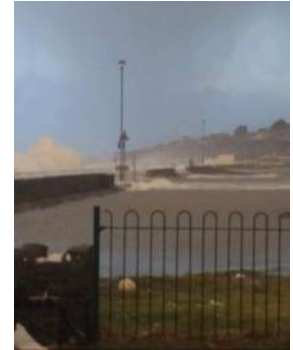
- Pen Llyn a'r Sarnau SAC - 171m south-west
- Two local watercourses are a Welsh Priority Habitat and River Corridors have a Gwynedd council Biodiversity Habitat Action Plan



Social and Well-Being:

- The North Wales Regional Tourism Strategy
- Vibrant and Viable Places (2013)
- Anglesey and Gwynedd Joint Local Development Plan (2017)

4. The flood or erosion problems



5. Investment Objectives

SMART	Objective description
1	To reduce the threat of coastal flood and erosion risk to people and property with due consideration of SMP2 policy to ensure the long-term resilience and vitality of the community.
2	To support, and where possible enhance, recreation and amenity value of the local area
3	To maintain, and where possible enhance, the environment.
4	To ensure marine amenity activities can continue to grow.
5	To ensure an affordable and deliverable whole life option through a partnership approach and contributions

6. Opportunities and Benefits



Wider Benefits:

Existing
Economic
Social
Environmental
Political
Stakeholders

Existing wider benefits the coastal defences sustain

Potential wider impacts or benefits a proposed scheme could have in the area

7. Constraints, risks and dependencies



Key Constraints:

Economic

Social

Environmental

Political

Stakeholders

Key constraints related to Barmouth North Promenade

Economic Case

1. Critical Success Factors

No	Critical Success Factor	Further Definition
1	Strategic Fit and Business Needs <i>How does the proposed option fit with the local flood risk strategy?</i>	Adapting to climate change Delivery of National FCERM Strategy objectives YGC support Alignment with local Well-being plans Hold the line, in support of the agreed SMP2 policy
2	Potential Value for Money <i>The option must represent value for money (i.e. the benefits must outweigh costs)</i>	Protect and enhance the Welsh economy by avoiding flood damage to properties and infrastructure. Positive Net Present Value Minimise operational demands
3	Supplier Capacity and Capability <i>The option must match the capacity to deliver of potential supplies.</i>	Supply-chain capability to deliver affordable solution within time-frame
4	Potential Affordability <i>The option must be eligible for funding from the intended Funding Organisation.</i>	Achievable within anticipated Welsh Government and CCS funding settlements and borrowing powers Further efficiency savings identified in FBC
5	Potential Achievability <i>The option must be physically possible to construct or deliver and the RMA must be able to maintain it in the long-term</i>	YGC capacity to produce and manage project Key project stakeholders are supportive of proposals

2. Approach to options assessment

Long-Listing and Short-Listing (Economic Case)

1. Options Framework Filter to identify the long-list
 - Should be applied to identify reasonable limits of the long-list
2. Identify measures to deliver the long-list
 - Using the Options Framework Filter, a range of potential measures should be identified (including natural processes)
 - RMA's may wish to consider 'source-pathway-receptor' concept
 - In developing a list of measures, it may become evident that there are opportunities for delivery of multiple benefits at or near the study area.
3. Screen the performance of each measure to inform shortlist
 - *Screen performance to reduce list of potential measures to a shorter list*
 - Following an objective-led appraisal approach, it is expected that **for a FCERM measure to be taken forward** for Short List consideration it should:
 - Be within the range of the Options Framework Filter
 - Meet, or be likely to meet, all CSFs
 - Achieve at least one of the Investment Objectives
 - Other considerations:
 - Recommended: high-level assessment of costs vs. likely benefits
 - Impact on connected habitats
 - Impact on well-being (reference to local well-being plan)
 - Qualitative screening of other measures

[Click for Guidance](#)

3. Identify longlist and 4. Screen Performance

Further level of screening:

Ref	SMP2 Policy	Option	Overview/Description	Constructability	Cost	Environmental Impact	Applicability / Amenity
2	Hold the Line	Business As Usual (+) – Extend life-span of existing structure and general improvements	Sub-option: Increase the design life of the sea-wall structure by improving the toe of the structure				
			Sub-option: Improve tertiary flood wall, demountable barriers and drainage improvements (secondary wall not considered appropriate)				
		Business As Usual (++) - Improvements to standard of protection of sea-wall	In addition to option 3a (where appropriate):				
			Sub-option: Higher vertical sea wall				
			Sub-option: Recurve wave wall to reduce rate of overtopping				
			Sub-Option: Add rock-armour/revetment type structure or larger beach material for protection				
3	Hold the Line	Offshore Rock Breakwaters and Beach Recharge	The construction of rock breakwaters offshore and coarser beach recharge material				
		Rock groynes and beach nourishment (revetment may be considered, as appropriate)	Shore-linked rock groynes to hold the placement of cobbles and larger material to protect the sea-wall and revetment. A revetment to reduce scour and abrasion. (If groynes are effective, then revetment is likely not to be required)				
4	Managed Realignment	Defence line-set further back	Sub-Option: New line of defence set back at the caravan park				
			Sub-Option: New line of defence set back at the Network Rail line				

Further considerations: Design life and Spatial Variation / Extents

5. Identify and 6. Assessment of Shortlist

- Baseline – ‘Walkaway’ / ‘Business as Usual’
- Option 2: Betterment of existing defences
- Option 3: Beach management and structures
- Option 4: Managed Realignment



- Engineering performance
- Sustainability and well-being performance
- Economic performance

Further considerations: Design life and Spatial Variation / Extents

Economic Appraisal of Shortlist

Option 1: Baseline Definition

Ref	Option	Overview/Description	Comments	Proposed Modelling
1	Walkaway (Do nothing but monitor)	- Progressive structural failure of the sea-wall and revetment - Exposure and corrosion of the sheet piles will become more pronounced - Overall foreshore bed levels along North Promenade are lowering and this lowering is expected to continue at an accelerating pace → increase the exposure of the sheet pile toe → affecting the stability of the structure. - Frequent overtopping will be experienced → increasing wash-out of material from beneath the sea-wall and revetment structures → impact on the stability and performance of the highway and secondary and tertiary flood walls. - On-going deterioration will lead to failure of the sea-wall and revetment, leading to a breach in the defences and associated coastal flooding affecting the wider flood-cell - Existing highway drainage, culverts and outfalls (including flap-valves) associated with this section of the frontage will cease to operate effectivity	Residual life of the sea-wall and revetment is considered to be <10 years. Note, there is a high degree of uncertainty associated with this figure. In the absence of intervention, it is expected there will be a continued reduction in beach levels over the next 10 year period. There is a slight southerly near-shore drift of material, however this is very limited. It is noted that the winter storms of 2013/2014 caused a rapid reduction in beach levels. Future storms are expected to exacerbate beach levels significantly.	Proposed to model <i>baseline business as usual</i> and test sensitivity to: - Not operating tertiary flood wall gates/boards. - Measures to manage local sources of flooding not functioning - Additional breaches of the primary wave wall.
2	Business As Usual (Do minimum patch and repair)	- Existing 'as and when' programme of inspection and maintenance is continued by YGC on a more frequent basis. - Frequent overtopping is expected to continue, and increase in frequency and severity as a result of climate change. - Frequent repairs to the secondary and tertiary flood walls, and demountable flood barriers - Monitoring, trigger levels and actions plans required	Overall foreshore bed levels along North Promenade are lowering and this lowering is expected to continue. Increasing exposure of sheet pile toe will affect stability of structure. Measures to protect or replace the sheet pile section and arrest the abrasion/corrosion are likely to be significant and not considered a do-minimum intervention. Continued loss of the structural section means there is an expected residual life of <20 years.	

Baseline Definition:

Table 9 Overtopping rates for Barmouth North Promenade Northern Section (Profile 1)

AEP (%)	Return Period	Overtopping Rate (l/s/m)		
		Epoch 2019	Epoch 2069	Epoch 2119
Existing Defence (i.e. Do Minimum)				
100	1:1	29	38	112
10	1:10	88	123	196
2	1:50	126	173	230
1	1:100	145	191	242
0.5	1:200	163	209	255
0.1	1:1000	207	238	278

Hazard Type and Reason	Mean Discharge Q (l/s/m)
No damage to embankment/seawall if crest and rear slope are well protected.	50 – 200
No damage to embankment/seawall crest and rear face of grass covered embankment of clay.	1 – 10
Damage to paved or armoured promenade behind a seawall.	200
Damage to grassed or lightly protected promenade.	50

Source: EurOtop, 2007

Table 10 'Associated' overtopping rates for Barmouth North Promenade Southern Section (Profile 7)

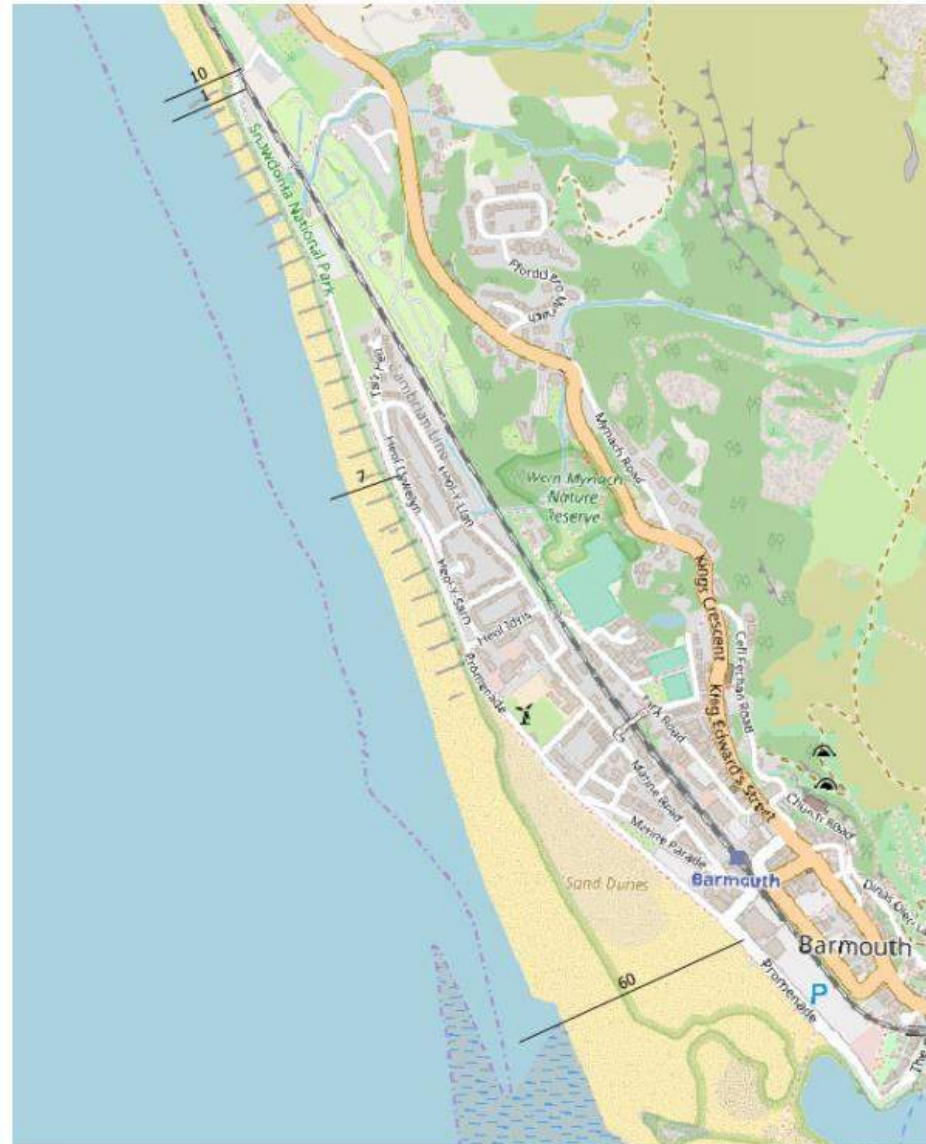
AEP/Return Period Event from Northern Section of North Promenade (Profile 1)		Associated Overtopping Rate (l/s/m)		
		Epoch 2019	Epoch 2069	Epoch 2119
100	1:1	10	18	39
10	1:10	22	38	82
2	1:50	31	69	95
1	1:100	48	71	98
0.5	1:200	46	72	117
0.1	1:1000	59	94	138

Table 11 'Associated' overtopping rates for shingle ridge (Profile 10)

AEP/Return Period Event from Northern Section of North Promenade (Profile 1)		Associated Overtopping Rate (l/s/m)		
		Epoch 2019	Epoch 2069	Epoch 2119
100	1:1	6	8	12
10	1:10	12	16	37
2	1:50	14	38	32
1	1:100	27	37	37
0.5	1:200	24	34	55
0.1	1:1000	26	38	76

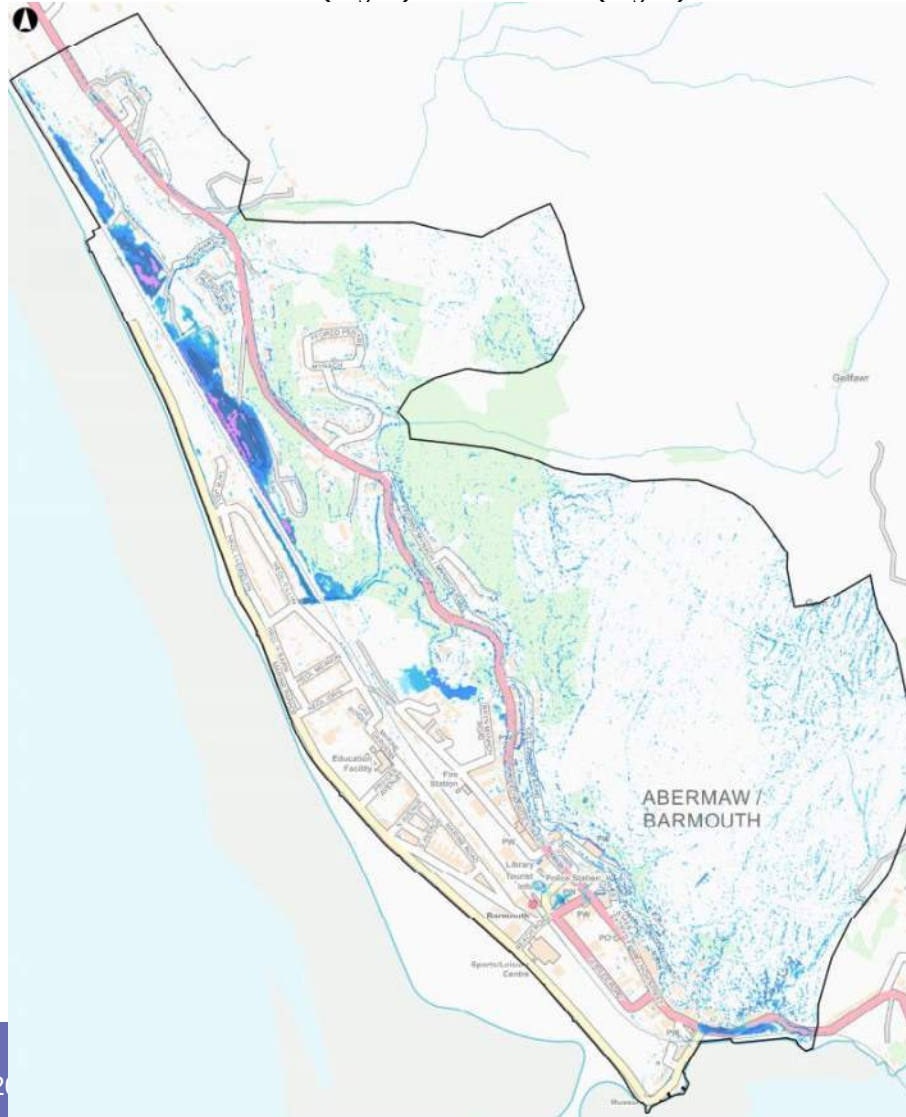
Table 12 'Associated' overtopping rates for Barmouth South (Profile 60)

AEP/Return Period Event from Northern Section of North Promenade (Profile 1)		Associated Overtopping Rate (l/s/m)		
		Epoch 2019	Epoch 2069	Epoch 2119
100	1:1	-	-	-
10	1:10	-	-	< 1
2	1:50	< 0.1	< 1	< 1
1	1:100	< 0.1	< 1	< 1
0.5	1:200	< 1	< 1	< 1
0.1	1:1000	< 1	< 1	< 1

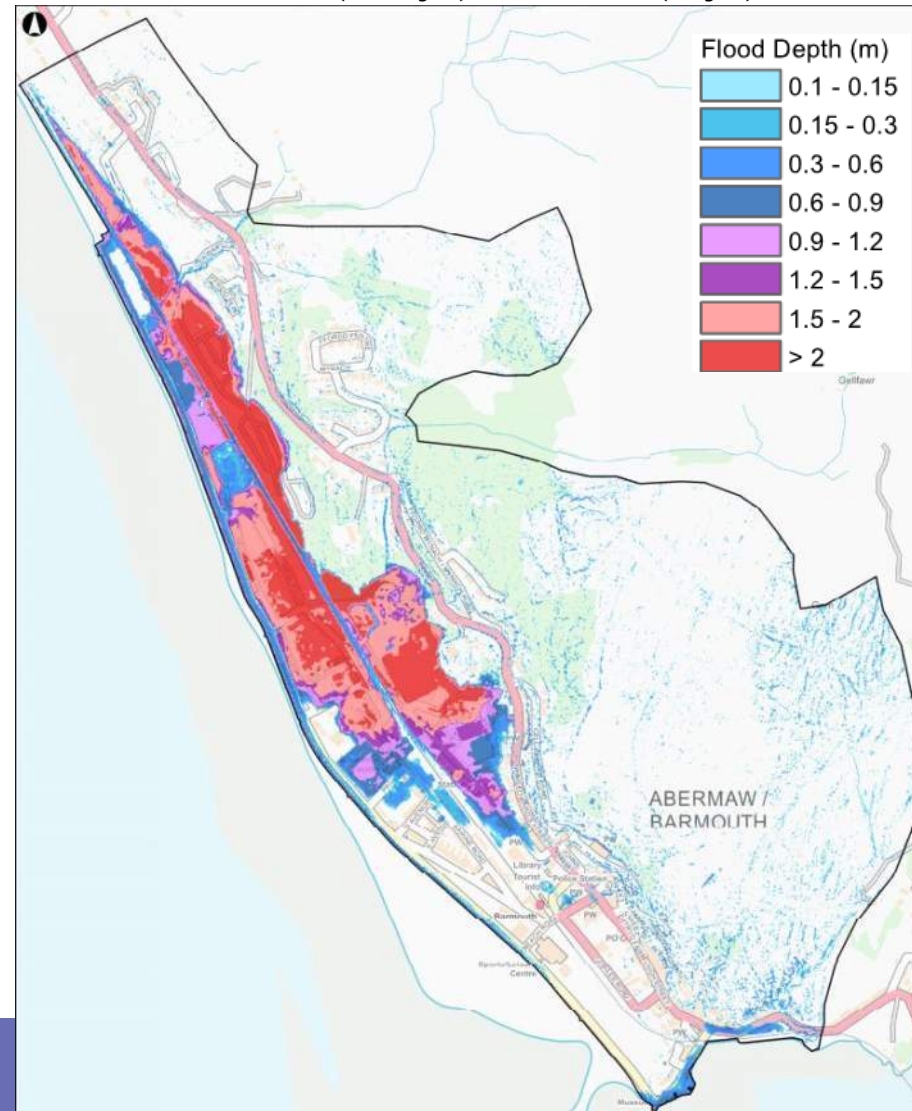


Baseline Inundation Modelling Results

2019 Coastal (1yr) Rainfall (0yr)



2019 Coastal (200yr) Rainfall (2 yr)



Baseline Definition:

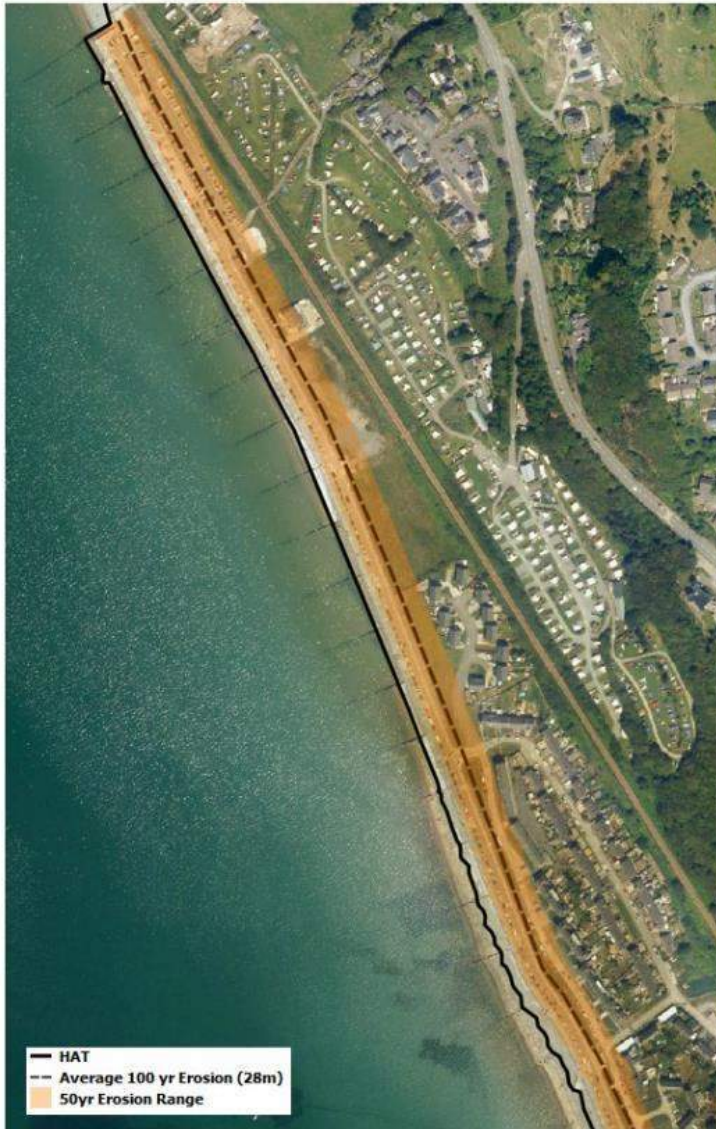


Figure 26 Potential erosion over 50 year period based on SMP2 NAI scenario

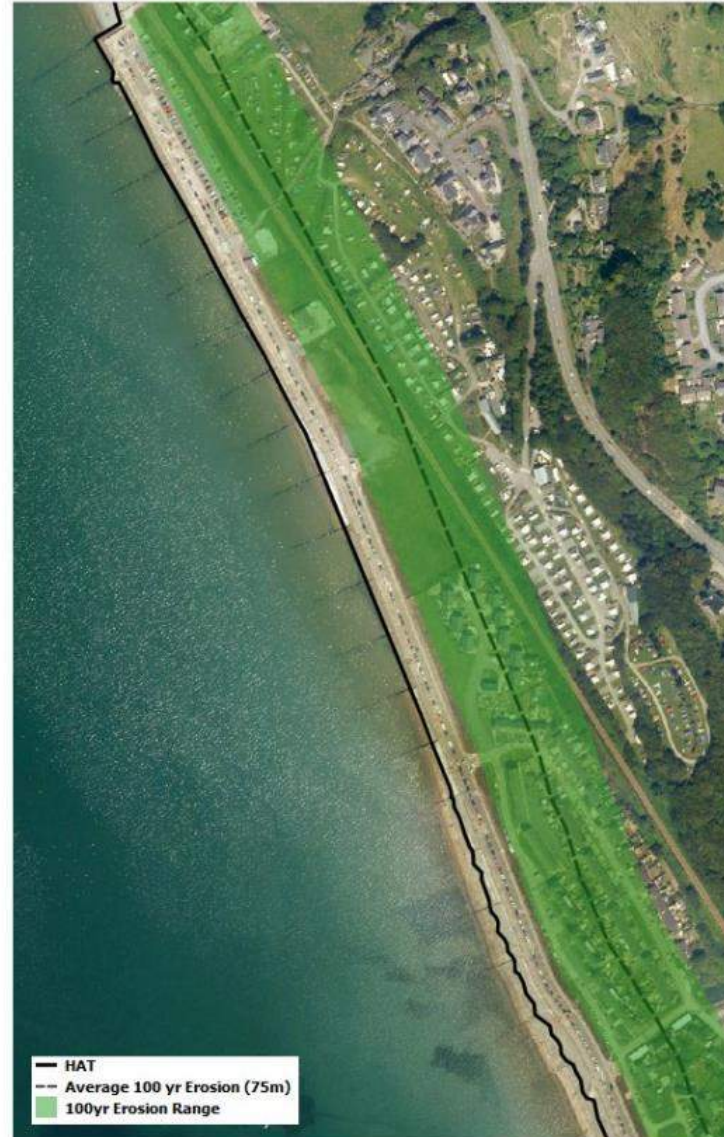


Figure 27 Potential erosion over 100 year period based on SMP2 NAI scenario

Economics – Benefit Summary

Property count for the epochs including climate change (worst case) for Baseline option

	NCC (Present day, no climate change (CC))						CC2069						CC2119					
Return Period	1	10	50	100	200	1000	1	10	50	100	200	1000	1	10	50	100	200	1000
Baseline	14	300	322	757	760	761	261	261	538	541	541	541	261		538	541	541	541

Component	Benefit Min (£k)	Benefit Max (£k)	Key areas of uncertainty
<i>Flood Related Damages</i>			
Flood damages avoided	£66,483	£99,767	Extents and severity of flooding
<i>Erosion Related Damages</i>			
Loss of properties	[Excluded – up to 60 properties affected]		High level of uncertainty associated with the rates of erosion.
Cambrian Coastal Railway	[Excluded - benefits of protecting this asset are likely to range in the £m's and safe-guarding of this asset is imperative]		Due to significant cost uncertainties and lack of available data, the benefits are considered qualitatively.
Recreational Benefits	[Excluded - the loss of Barmouth North Promenade may reduce the appeal of Barmouth]		Insufficient data to consider Barmouth North Promenade separate from Barmouth South, as such the benefits are considered qualitatively.
Damage to utilities infrastructure (services replacement)	£100	£100	Cost of diversion works & replacement services, timing
Total	£66,583	£99,867	

A number of potential benefits are excluded from this assessment at present due to uncertainties regarding the degree of confidence in a quantitative figure. As such, the 'Benefit Maximum' has the potential to increase significantly when considering the implications of property erosion, the Cambrian Coastal Railway and recreational or wider benefits.

Economics – Benefits for SOP

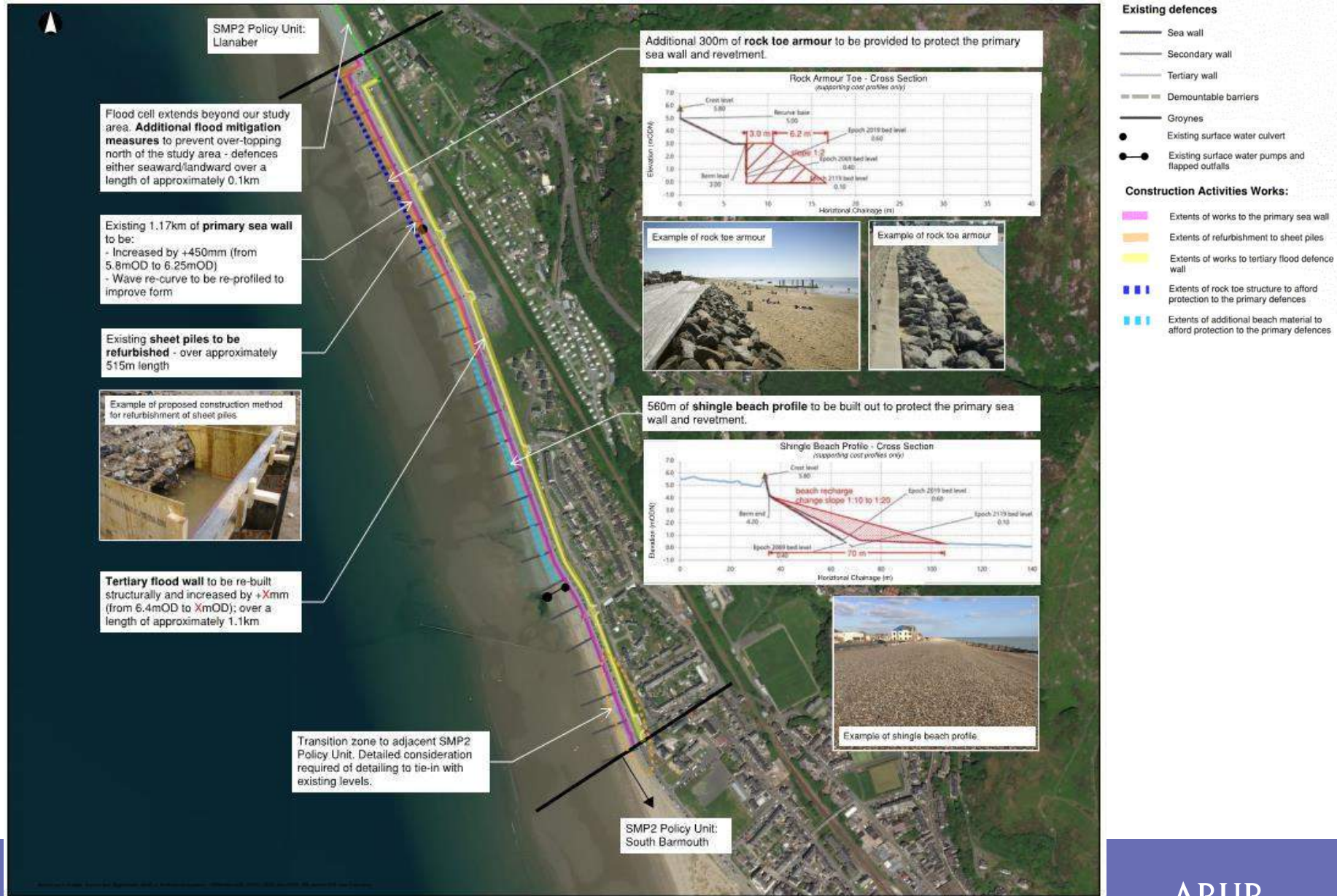
Option		Standard of Protection	
		Return Period	Climate Change Allowance
Baseline	Combination of Do Minimum and Do Nothing (see Inundation Modelling report for details)	Baseline (No SoP)	
Do Something Residual Risk	1	1 in 200yr	None
	2	1 in 100yr	None
	3	1 in 50yr	None
	4	1 in 200yr	50 years
	5	1 in 100yr	50 years
	6	1 in 50yr	50 years

Summary of flood damages provided with each Standard of Protection

Option	NPV		Present Value Benefits	
	Minimum Total Capped NPV (Property Damage) (£k)	Maximum Total NPV (Incorporating Property Damage, Emergency Services, Utilities, Vehicle Damage, Risk to Life) (£k)	Minimum Present Value Benefits (£k)	Maximum Present Value Benefits (£k)
Baseline	57,119	90,402	N/A	N/A
Option 1	23,195	32,371	43,288	67,396
Option 2	26,953	37,662	39,530	62,104
Option 3	60,386	89,774	6,096	9,992
Option 4	12,766	16,604	53,716	83,162
Option 5	9,433	12,855	57,050	86,912
Option 6	20,962	29,229	45,521	70,538

Do-Something Options

Option 2: Betterment of Existing Defences



ABPmer – Do-Something Modelling Results

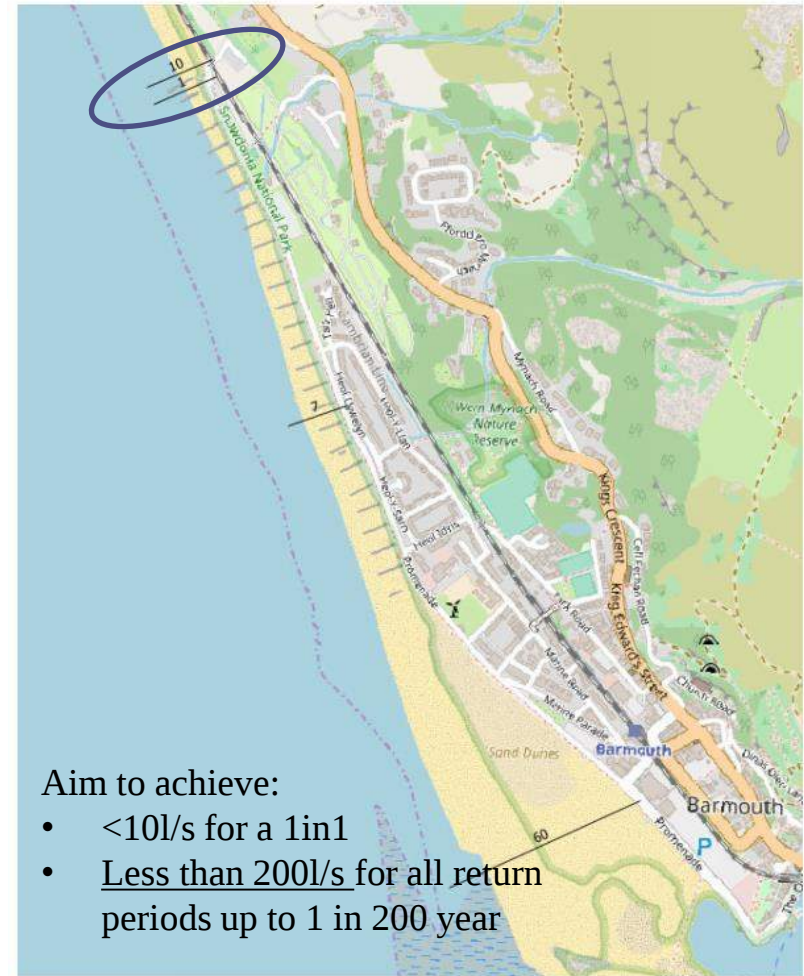
Indicative overtopping results:

Option 2: Betterment of Existing Defences

Profile 1:

- Raised crest level +Xmm
- Wave re-curve profile improved
- Rock toe defence added

AEP (%)	Return Period	Overtopping Rate (l/s/m)		
		Epoch 2019	Epoch 2069	Epoch 2119
Do Something (Crest Level 6 m)				
100	1:1	9	12	92
10	1:10	53	97	296
2	1:50	95	160	-
1	1:100	117	196	-
0.5	1:200	138	234	-
0.1	1:1000	206	-	-
Do Something (Crest Level 6.25 m)				
100	1:1	6	8	62
10	1:10	22	66	216
2	1:50	65	118	-
1	1:100	82	145	-
0.5	1:200	98	175	-
0.1	1:1000	149	247	-
Do Something (Crest Level 7m)				
100	1:1	1	2	11
10	1:10	6	14	79
2	1:50	13	31	135
1	1:100	17	41	156
0.5	1:200	21	49	180
0.1	1:1000	50	71	259



Aim to achieve:

- <10l/s for a 1in1
- Less than 200l/s for all return periods up to 1 in 200 year

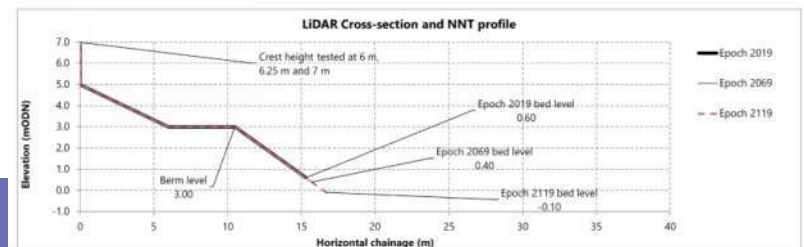


Figure 31. Profile 1: Do something

ABPmer – Do-Something Modelling Results

Indicative overtopping results:

Option 2: Betterment of Existing Defences

Profile 7:

- Raised crest level +Xmm
- Wave re-curve profile improved
- Shingle beach profile

Table 17 → Overtopping rates for Barmouth North Promenade Southern Section (Profile 7)†

AEP/Return Period-Event from Northern Section of North Promenade (Profile 1)‡		Associated Overtopping Rate (l/s/m)‡		
		Epoch 2019‡	Epoch 2069‡	Epoch 2119‡
Do Something (Crest Level 6 m)‡				
100‡	1:1‡	5‡	7‡	9‡
10‡	1:10‡	15‡	23‡	28‡
2‡	1:50‡	29‡	38‡	49‡
1‡	1:100‡	33‡	47‡	77‡
0.5‡	1:200‡	34‡	49‡	106‡
0.1‡	1:1000‡	52‡	67‡	null‡

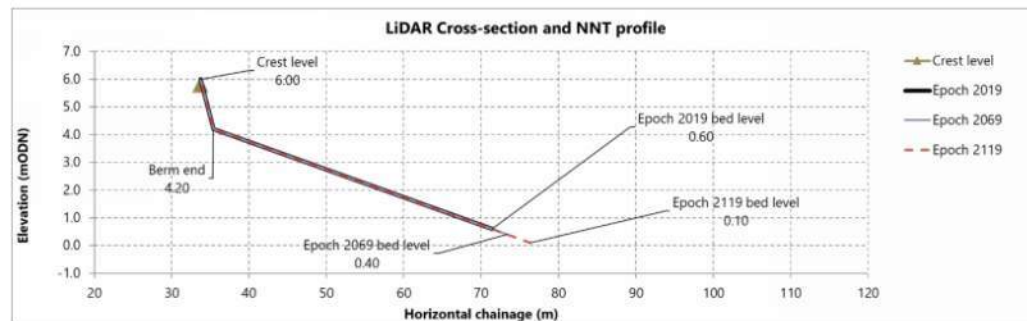
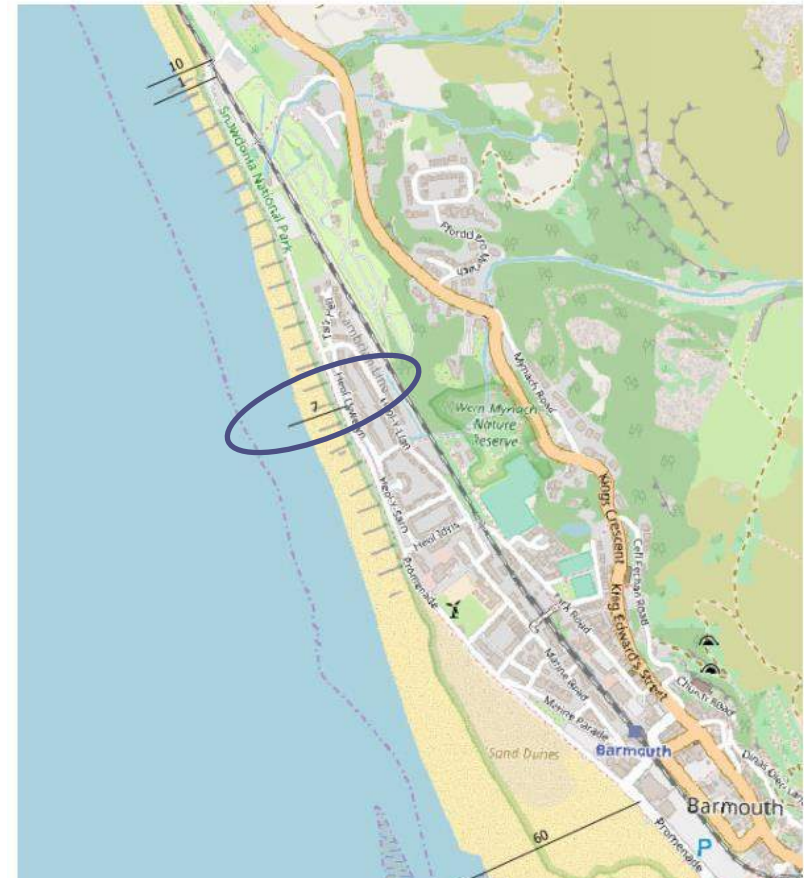


Figure 34. Profile 7: Do something

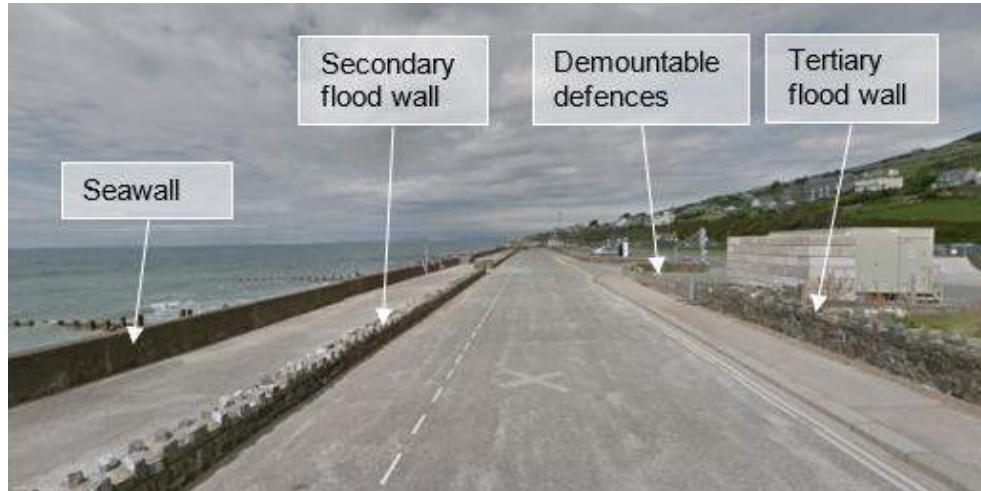


It is important to note that the 'associated' overtopping rates in Table 17 are related to AEP overtopping events at Profile 1 rather than a full count-back analysis undertaken for profile 7. Thus, the overtopping rates presented in Table 17 should be considered indicative for the given return period. The eleven events used to examine the associated overtopping for the 'Do something' Profile 7 scenario were derived from the Profile 1 'Do Something' 7 m crest height scenario, since this scenario resulted in the fewest number of null values.

Option 2: Betterment of Existing Defences

SOP

- Dependent on primary defence overtopping vs. crest of tertiary wall



Epoch 2019	SOP
Wall crest (mCD)	
6	100
6.25	200
7	1000

Epoch 2069	SOP
Wall crest (mCD)	
6	10
6.25	50
7	1000

Epoch 2119	SOP
Wall crest (mCD)	
6	1
6.25	1
7	50

Note: Assumes c1.1m level of sea-rise / consideration of UKCP19

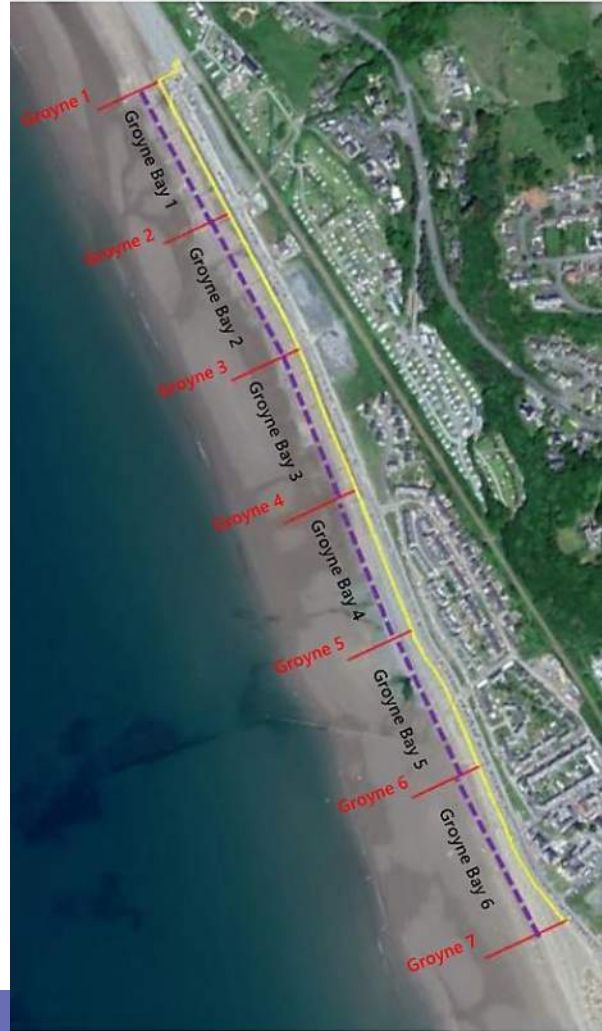
Option 3: Beach Management

- Groynes to contain nourished beach over full envelope
- Crest at +7.6m – extending out horizontally for 30-60m before sloping

- Two shore parallel breakwaters and two terminal groynes
- Crest at +7.6m



Option 1 – 4 groyne option (Background image from Google Earth)



Option 2 – 7 groyne option (Background image from Google Earth)



Option 3 – Terminal groynes and breakwaters option (Background image from Google Earth)

Option 3: Beach Management

1 in 200 SOP to 2119

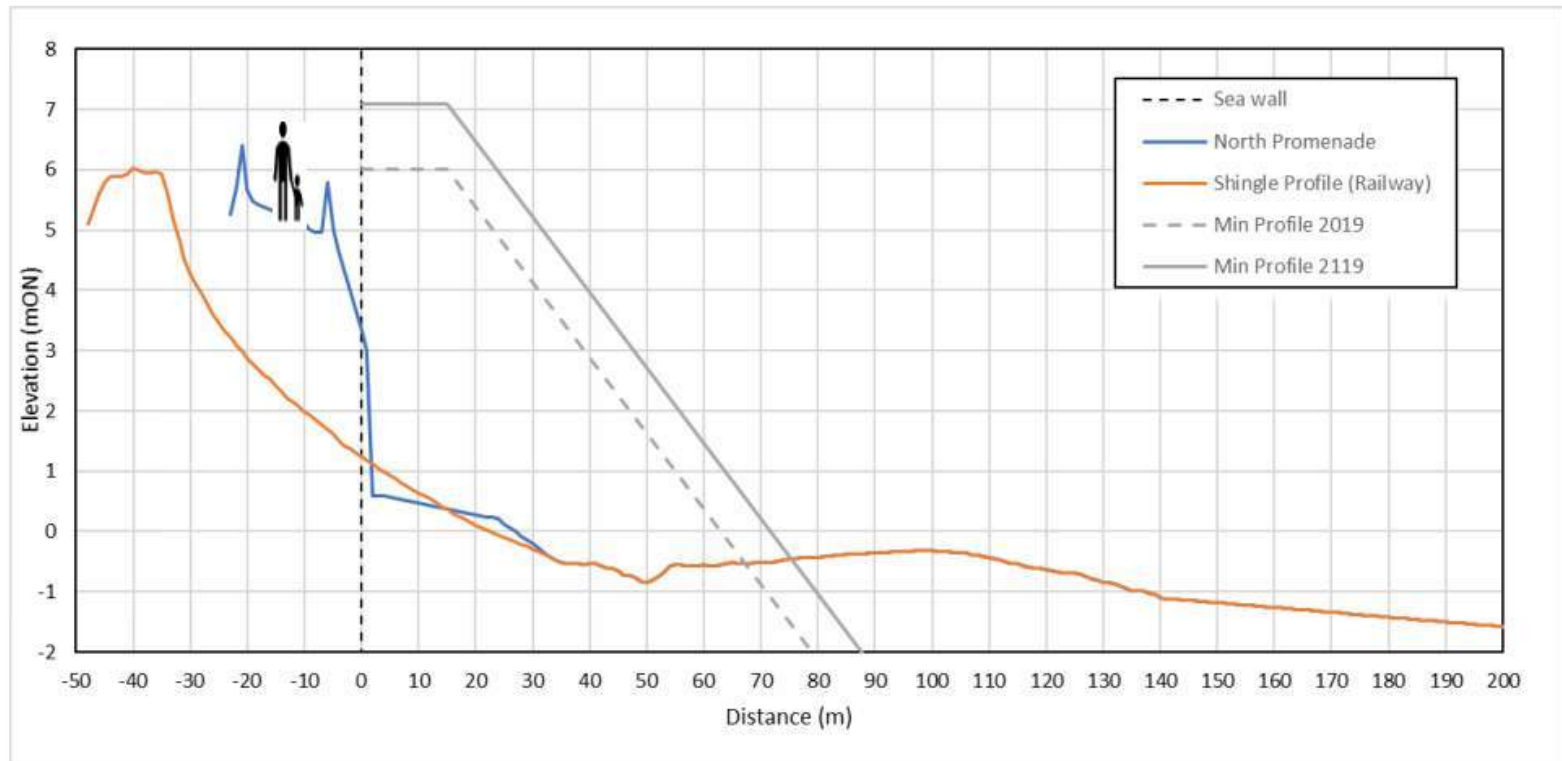
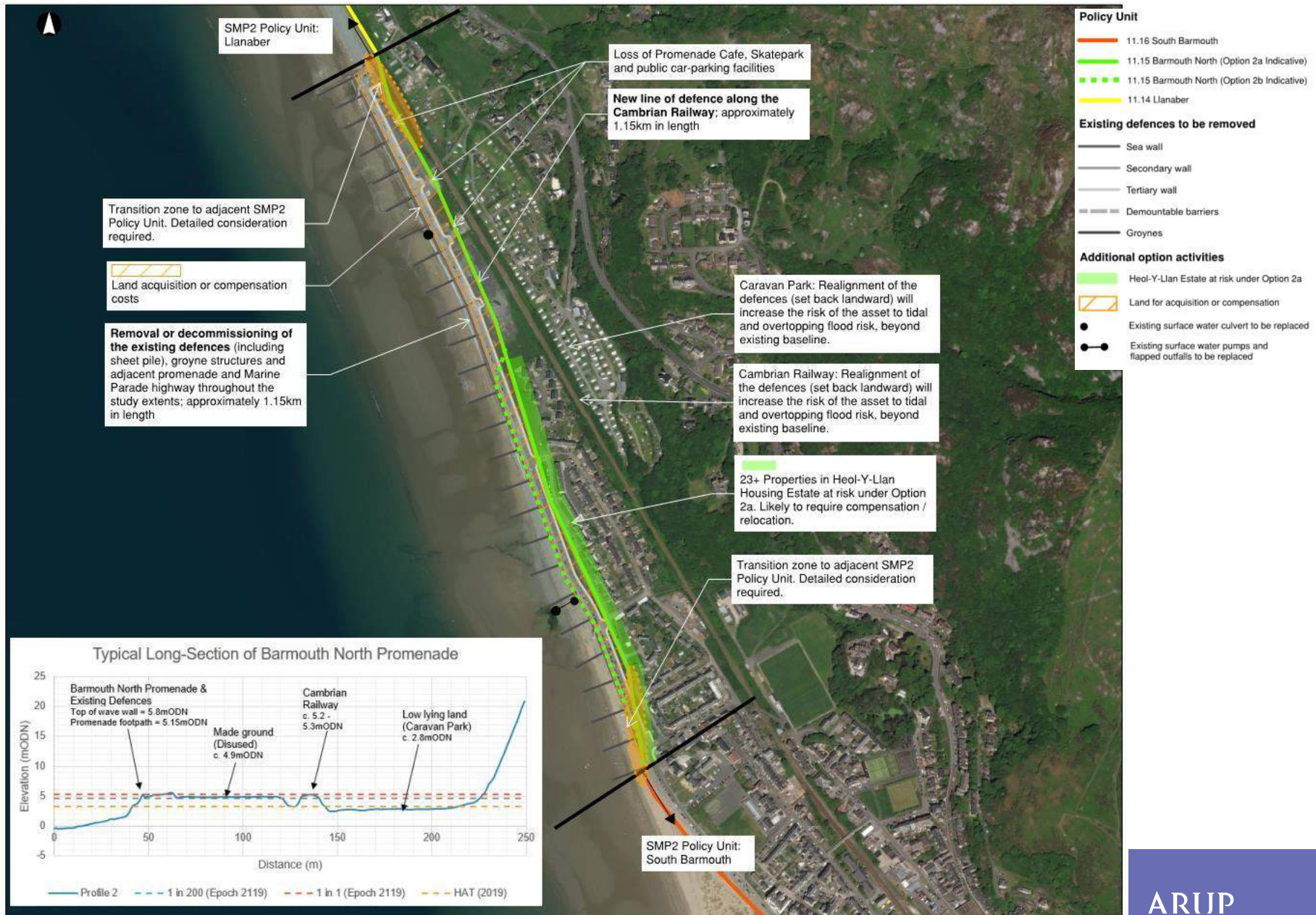


Figure 5 Proposed minimum beach profile along with present day cross sections along Northern Promenade and Shingle Ridge to north (from composite DSM)

Option 4: Managed Realignment



Option Costs

(£k)	Option 2	Option 3	Option 4
	Do-something: Business As Usual (++)	Do-something: Offshore Rock Breakwaters and Beach Recharge	Do-something: Managed Realignment
OBC to construction:			
Staff costs (YGC)			
Site investigation and surveys	X	X	£2,939
Consultants' fees (OBC)	£0	£0	£0
Consultants' fees (Outline and Detail Design)	£466	£1,765	£1,729
Early Contractor Involvement	£25	£25	£25
Other costs (specify)	£0	£0	£0
Optimism Bias	£295	£1,074	£2,815
Subtotal	£787	£2,865	£7,508
Construction:			
Construction costs	£9,331	£35,307	£17,286
Utility diversions	-	-	-
Land purchase & compensation	-	-	X
Optimism Bias	£5,599	£21,184	£10,371
Subtotal	£14,930	£56,492	£27,657
Risk contingency:			
Future costs:			
Maintenance (PV)	£38	£1,790	£45
Future construction (PV)	-	-	-
Optimism Bias	£23	£1,074	£27
Subtotal	£62	£2,864	£72
Whole life project cost	£ 15,778	£ 62,221	£35,237

Economics – Benefits for SOP - REMINDER

Option		Standard of Protection	
		Return Period	Climate Change Allowance
Baseline	Combination of Do Minimum and Do Nothing (see Inundation Modelling report for details)	Baseline (No SoP)	
Do Something Residual Risk	1	1 in 200yr	None
	2	1 in 100yr	None
	3	1 in 50yr	None
	4	1 in 200yr	50 years
	5	1 in 100yr	50 years
	6	1 in 50yr	50 years

Summary of flood damages provided with each Standard of Protection

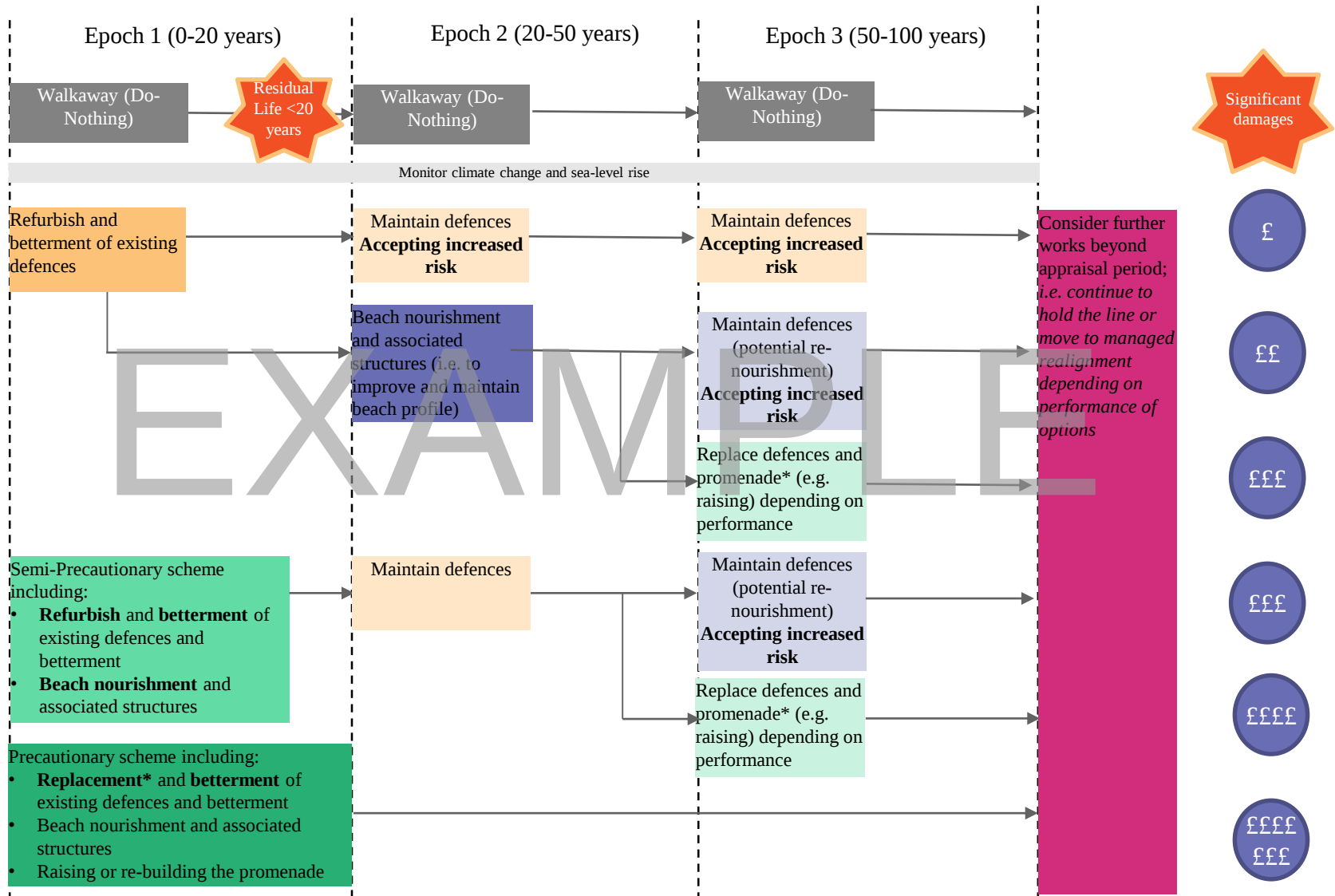
Option	NPV		Present Value Benefits	
	Minimum Total Capped NPV (Property Damage) (£k)	Maximum Total NPV (Incorporating Property Damage, Emergency Services, Utilities, Vehicle Damage, Risk to Life) (£k)	Minimum Present Value Benefits (£k)	Maximum Present Value Benefits (£k)
Baseline	57,119	90,402	N/A	N/A
Option 1	23,195	32,371	43,288	67,396
Option 2	26,953	37,662	39,530	62,104
Option 3	60,386	89,774	6,096	9,992
Option 4	12,766	16,604	53,716	83,162
Option 5	9,433	12,855	57,050	86,912
Option 6	20,962	29,229	45,521	70,538

Option Assessment

To be discussed:

Ref	SMP2 Policy	Option	Life-Span				Assessment				
			Epoch 1 (0-20 years)	Epoch 2 (20-50 years)	Epoch 3 (50-100 years)	Epoch 4 (beyond 2119)	Engineering Performance	Economic Performance	Environmental Performance	Social & Well-Being Performance	Financial Performance
2	Hold the Line	Extend Life-span and Betterment of Existing Defences					Only affords protection up to Epoch 3.	Strong business case, however of significant cost	Beyond maintenance and reconstruction – marine licence; SAC impacts	Maintains existing promenade; opportunities for improving promenade.	Least cost in terms of capital construction and operation.
3	Hold the line	Beach Management with Breakwaters & Groynes					Higher SOP than Option 2. Practicality / amenity constraints affording protection up to Epoch 3.	Strong business case, however of significant cost	EIA screening and Marine licence; SAC impacts	Maintains existing promenade, may impede access along foreshore.	Of higher cost than Option 2.
4	Hold the Line	Managed Realignment					Provides a long-term solution in response to climate change.	Buisness case / SMP2 policy (i.e. justification) is there. However, significant costs and risks.	Schedule 2 project under Town and Country Planning Reulations	Potential to impact local community negatively. Opportunities to create new defences and wider amenity.	Significant financial cost; risks around compensation and relocation of existing properties.

DRAFT Strategic decision pathway approach – i.e. design life of the options:



*Any options to replace the defences should consider setting them back further in-land (managed realignment) to encourage a larger more sustainable beach profile (i.e. to reduce overtopping and associated option requirements for maintenance). Challenges around land-use will need to be overcome.

Thank you