

Barmouth North Promenade

Outline Business Case

Cyngor Gwynedd Council



Overtopping and coastal flooding experienced at Barmouth North Promenade in January 2014
(images copyright: Mike Alexander)

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Approvals Sheet

	Signature/Dates
Project Name	Barmouth North Promenade
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Local Authority approvals Head of Finance	
Welsh Government Review	
Welsh Government Approval Programme SRO	

Issue and revision record

Rev	Date	Originator	Checker	Approver	Description
1	18/12/18	R. Jenkinson	R. Campbell	R. Campbell	Strategic case for comment
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Comments sheet

Changes from SOC to OBC
Changes from OBC to FBC

Contents Page

Executive Summary

1. Strategic Case

- 1.1 FCERM strategic fit and context
- 1.2 Sustainability and well-being strategic fit and context
- 1.3 The flood or erosion problem/s and current management arrangements
- 1.4 Investment Objectives
- 1.5 Summary of potential opportunities and benefits from investment
- 1.6 Summary of potential risks, constraints and dependencies from investment
- 1.7 Stakeholder engagement (Strategic Case)

2. Economic Case

- 2.1 Critical Success Factors (CSFs)
- 2.2 Approach to options assessment
- 2.3 Identify Long List
 - 2.3.1 Using the Options Framework Filter to identify the Long List
- 2.4 Screen the performance of each measure
- 2.5 Identify the Short List
- 2.6 Assessment of Short List
 - 2.6.1 Engineering performance of Short List
 - 2.6.2 Sustainability and well-being performance of Short List
 - 2.6.3 Economic performance of Short List
 - 2.6.4 Financial performance of Short List
 - 2.6.5 Select the Preferred Option
- 2.7 Further development and testing of Preferred Option
 - 2.7.1 Outline Design and reassessment of costs
 - 2.7.2 Sensitivity Testing
 - 2.7.3 Detailed Design and reassessment of costs

2.8 Stakeholder engagement (Economic Case)

3. Commercial Case

- 3.1 Procurement Strategy
- 3.2 Key contract terms and risk allocation
- 3.3 Stakeholder engagement (Commercial Case)

4. Financial Case

- 4.1 Financial scale and breakdown
- 4.2 Funding sources
- 4.3 Funding timescales
- 4.4 Financial summary
- 4.5 Stakeholder engagement (Financial Case)

5. Management Case

- 5.1 Project management (including management of health, safety and well-being)
- 5.2 Change management
- 5.3 Benefits realisation
- 5.4 Risk Management
- 5.5 Post-project evaluation
- 5.6 Stakeholder engagement (Management Case)

Appendices

- A Economic Technical Assessment (Arup, 2019)
- B Modelling: Wave and Overtopping Modelling (ABPmer, 2019) and Inundation Modelling (Arup, 2019)
- C Coastal Processes Report (ABPmer, 2019) and Shoreline modelling – risk reduction assessment (ABPmer, 2021)
- D Geotechnical Desk Study (Arup, 2018)
- E Existing Structures Review (Arup, 2018)
- F Environmental Appraisal of Shortlist (Gwynedd Council, 2019)
- G Stakeholder Engagement Event (Gwynedd Council, 2019)
- H Quantified Project Risk Register (Arup, 2021)
- I Shortlisting Option Assessment:
 - Longlist and Shortlisting Matrices (Arup, 2019)
 - Option 3: Managed Realignment Technical Note (Arup, 2019)
 - Option 4: Beach Management Technical Note (ABPmer, 2019)
- J Preferred Option:

Barmouth North Promenade OBC

- Outline Drawings of Preferred Option (Arup, 2021)
 - Risks and Assumptions Register (Arup, 2021)
 - Preferred Option Costing (Arup & Gwynedd Council, 2021)
 - IEA of Preferred Option (Gwynedd Council, 2019)
- K Constraints and Opportunities Mapping (Arup, 2019)
- L SMP2 Policy Context (Arup, 2018)
- M Shortlisted Options Sketches (Arup, 2019)
- N Well-Being Mapping (Arup, 2019)
- O Option Selection Meeting Minutes
- P Barmouth North Promenade Outline Business Case Budget and Scheme Review (Ultimate Engineering Solutions Ltd, 2021)
- Q Emergency Repair Works (Kaymac Marine & Civil Engineering, March 2021)

Executive Summary

This Outline Business Case (OBC) seeks approval for the design development and consenting of phase 1 of a project to manage flood and coastal erosion risk to Barmouth North Promenade. The preferred approach is an adaptive pathway that involves investing now in actions to manage today's risks, monitoring the change in risk over time (such as the impact of climate change) and a plan to manage these changes. The preferred approach has a strong justification; with a benefit cost ratio conservatively estimated as 1:2.3. This excludes the benefit of preventing defence breaches. With defence residual life <10 years a breach is anticipated and modelling showed this would significantly increase baseline flood risk. The preferred approach reduces risk to life to people and reduces flood risk to 757 properties. Wider project benefits include safe-guarding and enhancing the health, amenity and recreational value of the area, and protecting a stretch of the Cambrian Coastal Railway.

Strategic Case

The town of Barmouth lies behind a long sandy and fine-shingle beach in Cardigan Bay. The promenade is a valued asset, providing access to the blue flag beach. The seafront provides the local population with leisure and recreational amenity. Tourism is important to the local economy; the small town attracts around 280,000 visitors annually¹. The seafront forms an important part of the town's visitor appeal.

The 1.2km study area comprises a mix of hard coastal defences (sheet piled wall, concrete revetment and wave recurve wall, with masonry setback walls). The defences run parallel with the promenade and adjacent Marine Parade.

The West of Wales Shoreline Management Plan 2 (SMP2) (2011) sets out the coastal management policy. In the short-term (Epoch 1 Year 0-20), the frontage is to continue to '*hold the line*'. However, due to implications of climate change, the present alignment was considered '*likely to become increasingly difficult to sustain*'. Therefore for the medium and long term the SMP2 sets out a change in approach to 'managed realignment'. The SMP2 notes; '*consideration should be given to widening the overall defence system in this area. This may require nearshore or shore connected structures to reduce wave energy but is also likely to require some future realignment of the defences, quite probably with the loss of property. This would require a more integrated approach to management, considering how the northern seafront could be developed to better advantage both in term of use and shoreline management.*' Adjacent policy areas (i.e. Llanaber and Barmouth South) are 'Hold the Line'. All three are intrinsically linked - forming a single flood-cell with interacting coastal processes.

The existing defences are in a poor condition. Should beach drawdown continue, then structural failure is increasingly a concern. Part of the promenade failed due to unsafe voiding beneath the promenade slab, requiring emergency stabilising repairs in 2020 and 2021. The repair works were emergency measures to extend the life of the existing structures until the preferred option is implemented. Beach levels decrease and defences deteriorate in condition towards the north of the study area. Studies conclude that overall foreshore bed levels along North Promenade are lowering and this lowering is expected to continue.

¹ Barmouth Tourism Estimates - Global Tourism Solutions (UK) Ltd, October 2018

The study area is at risk of coastal flooding. Overtopping occurs at the northern end of the promenade in 'benign' conditions i.e. median level tides, without surge, swell, low pressure or high winds. The most notable recent storm event (January 2014) forced the emergency evacuation of the Promenade café. Overtopping from this frontage caused extensive damage to the Cambrian coastal railway. The study area is also at risk from the tide-locking of two ordinary watercourse outfalls, and blockage/capacity of culverts. Flap valves on the outfalls have also failed, risking tidal ingress. In the absence of investment, 757 properties are predicted to have more than a 1 in 100 chance of flooding in any year. The rapid onset and depth of flooding presents a risk to life. Sea level rise due to climate change is predicted to accelerate, increasing the likelihood and severity of coastal flooding. By 2069 mean sea levels are predicted to have increased by 0.42m and by 2119 by 1.1m.



Figure 1. Coastal flooding experience during the January 2014 storms (© Mike Alexander, 2018)



Figure 2. Northern extents of promenade – exposed sheet pile, with beach drawdown



Figure 3. Storm damage in March 2020

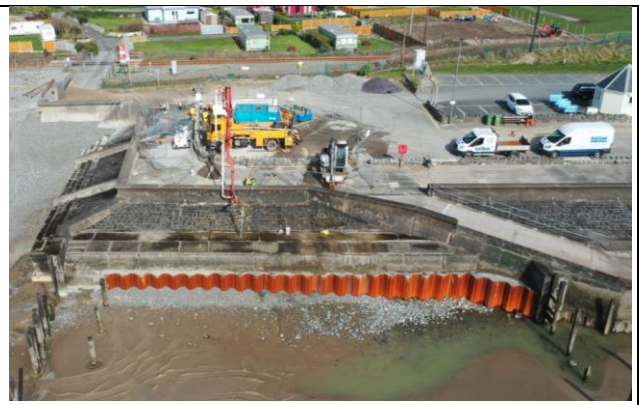


Figure 4. Emergency repairs in April 2021

Gwynedd Council seek a solution to reduce coastal flood and erosion risk to Barmouth North Promenade, whilst improving the amenity and environmental value of this section of coastline. Placemaking opportunities such as beach access, dwell spaces and facilities, and improved connectivity and wayfinding have the potential to leverage the less-used asset, broadening the appeal of Barmouth and reducing pressure on the popular South Promenade area.

The following Investment Objectives have been identified:

Table 1. SMART Investment Objectives

SMART	Objective description	Indicator	Timescale
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.	The Present Value of flood damages over the life-span of the scheme.	Project operation in 2022, with an adaptable programme of works in development spanning up to 2120.
2	To support, and where possible enhance, recreation and amenity value of the local area	Sustainability and well-being performance of Preferred Option at Detailed Design. Feedback from stakeholders.	During assessment and up to / following project operation in 2022. - accounting for key future milestones
3	To maintain, and where possible enhance, natural and historic environments.	Sustainability and well-being performance of Preferred Option. Environmental appraisal at Detailed Design.	During assessment and up to / following project operation in 2022 – accounting for key future milestones
4	To ensure marine amenity activities can continue to grow.	As above	As above
5	Ensure an affordable and deliverable whole life option through a partnership approach and contributions.	Benefits and Whole Life Cost of the Preferred Option	At OBC and Full Business Case Stages

Building on the investment case objectives outlined in the Strategic Case, the scheme will achieve the FCERM Critical Success Factors (CSF): Strategic fit and business needs, Value for money, Potential achievability, Supply side capacity and Potential affordability. The project will contribute to the Well Being of Future Generations Act (WBFGA) objectives through both first order (i.e. direct) and wider benefits.

Economic Case

Options Considered

Following Welsh Government's Flood and Coastal Erosion Risk Management (FCERM) Business Case Guidance (BCG); a Longlist of nine options (and sub-options) were identified and then screened against the investment objectives, CSFs and Options Framework Filter and criteria of: constructability, cost & performance, environmental impact and applicability (**Section 5**). Shortlisted options were developed into conceptual schemes for assessment. Sketches of the options are available in **Appendix M**.

Each of the shortlisted options were assessed against the Engineering performance, Sustainability and well-being performance, their Economic performance and their Financial performance. A summary shortlist appraisal matrix is located in **Appendix I**.

Table 2. Overview of shortlisted options

Option	Description	Performance	Supporting Information
1 Baseline	Business As Usual Gwynedd Council reactive maintenance is not able to address the significant defects with the existing defences. Walkaway residual life is estimated at ~10 years ² . Erosion at defence toe, loss of pile section and voids from loss of fines risks revetment failure and defence breach inundating the wider flood cell (Heol-Y-Llan housing estate and central Barmouth).	Discounted as significant risk to life and fails to meet objectives.	Appendix A: Economic Appraisal (Arup, 2019)
2 Betterment of existing defences	Works to address defects and extend the service of the existing defences. Improvements to defences: - Extend the life of the existing sheet piles with refurbishment works. - Raise the primary defences and add protection to the structure toe by a rock-toe or shingle beach profile (where material stability allows). - Strengthen and raise the set-back flood wall. - Improve demountable barriers and drainage. - Public-realm improvements including provision of dwell areas, beach access and connectivity to the wider community. With no strong material transport regime along the frontage, there appears limited case to repair the groynes and beach access could be improved.	Crest-raising restricted to 1.25m due to engineering and landscaping constraints. Standard of Protection (SOP) of up to 1in50 in 2069 ³ .	Appendix B – Wave Modelling and Overtopping Study (ABPmer, 2019) Appendix C Shoreline modelling – risk reduction assessment (ABPmer, 2021)
3 Beach Management and Associated Structures	Combination of rock breakwaters offshore and/or shore-linked groynes (rocks or refurbish existing) to hold placed beach material and dissipate wave energy. Coarser shingle beach recharge material introduced to provide sustainable beach level to protect the primary defences and reduce wave overtopping. Works to extend the life of the existing sheet piles required.	SOP up to 1in200 year in 2119.	Appendix I: Beach Nourishment Option Assessment (ABPmer, 2019)
4 New line of defence set back at the railway (i.e. Managed Realignment)	New line of defence setback whilst protecting railway, allowing the area directly behind the existing sea-wall to be subject to erosion with: Option 4a. Set back along promenade full length Option 4b. Set back along northern end of promenade with <i>(Beach management (similar to Option 3) protecting properties to south).</i>	SOP up to 1in200 year in 2119.	Appendix I: Managed Realignment Technical Note (Arup, 2019)

Benefits

In the absence of investment, economic damages from the baseline scenario to the nation over the 100-year appraisal period have been assessed (**Appendix A**) in accordance with FCERM-BCG; the Multi-Coloured Manual 2018; and the ‘Green Book’ (HM Treasury, 2018), as summarised below.

² Please refer to Barmouth OBC Appendix E: Arup, Existing Coastal Defence Assessment, 2019, for further information.

³ Based on indicative assessment of overtopping rates vs storage between the existing promenade and highway. SOP to be confirmed by further modelling.

Table 3. Summary of baseline economic damages

Component	(£k) Present Value Damages	Key areas of uncertainty
Flood Related Damages		
Flood damages to residential and non-residential properties, risks to life, vehicle damages, emergency services and utilities damages.	£99,767	Extents and severity of flooding. Defence failure/ breach due to defects such as voiding – currently excluded.
Erosion Related Damages		
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 ⁴ and safeguarding of this asset is imperative]	Significant cost uncertainties and lack of available data. Wider context/connectivity.
Recreational Benefits	[Excluded - the loss of Barmouth North Promenade may reduce the appeal of Barmouth]	North Promenade amenity interdependent on Barmouth South amenities.
Damage to utilities infrastructure (services replacement)	£100	Cost of diversion works & replacement services, timing.
Total	£99,867	
A precautionary and conservative approach has been applied to the assessment. Predicted rates of overtopping exceeded industry analytical methods and so modelling is only available for 2019 and 2069 epochs. The high degree of properties' value capping (due to the early onset of flooding) minimises the implication of this limitation on the business case. Significant potential damages are excluded due to uncertainties. In addition to excluded property erosion, loss of the Cambrian Coastal Railway and recreational benefits noted above; no breaches were represented. Baseline defence residual life is <10 years and sensitivity assessment showed breach impact would be significant.		

A summary of the cost of each shortlisted option is outlined below (see **Section 6.3**).

Table 4. Summary of shortlist option costs

	Option 2	Option 3	Option 4a	Option 4b	Notes - assumptions, source(s) and dates
OBC to construction (£k):					
Subtotal	£899	£2,516	£8,029	£5,983	30% Optimism Bias applied to 'OBC to Construction'
Construction (£k):					
Subtotal	£16,055	£56,492	£47,257	£31,539	60% Optimism Bias applied – applied to 'Construction' costs due to uncertainty pending further survey and design.
Future costs (scheme implemented at Year 0):					
Subtotal	£62	£2,864	£72	£72	60% Optimism Bias applied – due to uncertainty regarding future maintenance requirements
Total	£17,016	£61,872	£55,359	£37,594	

⁴ To provide a scale to the value of these assets, following the unprecedented storm damage in 2014, Network Rail undertook a programme to repair the section of the line from Barmouth to Pwllheli. The anticipated final cost for the full works to re-open the Cambrian coast railway was estimated to be in the region of £10m.

Option 3: Beach Management is costly. Significant quantities of beach material are required to build out the beach profile with ongoing long-term maintenance. The height of the crest is significant and may present consenting/construction issues.

Option 4: Managed Realignment is costly and has considerable uncertainty. There are significant risks to remove the existing defences and replace the defences inland. The situation of the Cambrian Railway and adjacent SMP2 Policy Areas ('Hold the Line') requires that a new defence alignment is constructed inland; whilst the existing defences cannot be abandoned without significant investment to be safely decommissioned. There is limited environmental gain and significant expenditure will be required to re-route the promenade and Wales Coast Path to maintain amenity. To realign the full length of study frontage (Option 4a) requires the removal of some ~57 existing properties. A suitable location to relocate properties is not identified. To realign the northern half of the study frontage (Option 4b) impacts on one commercial property. The northern frontage comprises undeveloped made-ground - further surveys and design are needed to scope decommissioning works. The southern developed frontage would require works to safeguard the existing properties, and beach management to 'Hold the Line' is proposed.

Best-practice adaptive pathways approach is proposed. This allows investing now in actions to manage today's risks, monitoring the change in risk over time (such as due to the impact of climate change) and managing these changes. A managed adaptive approach involves planning for multiple interventions and investments in the future, although the future choices and the timing of these interventions will be uncertain. The following pathways of combinations of short-listed options across the SMP2 policy epochs were appraised.

Table 5. Adaptive pathway scenarios considered for the economic assessment

Pathway	Epoch 1 0-20 years	Epoch 2 20-50 years	Epoch 3 50-100 years
A	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 4: Managed Realignment (SMP2) <i>Adaptive SOP 1 in 200</i>
B	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 4: Managed Realignment (SMP2) <i>Adaptive SOP 1 in 200</i>	
C	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>
D	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>	
E	Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>		
F	Option 2 + Option 3 <i>Adaptive SOP 1 in 200</i>		
G	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 4b: Managed Realignment (North Only) <i>Adaptive SOP 1 in 200</i>
H	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 4b: Managed Realignment (North Only) <i>Adaptive SOP 1 in 200</i>	

Table 6. Summary of Economic Appraisal (Please refer to Appendix A for details)

Pathway	PV Flood Damages	PV Flood Benefits	PV Costs	Benefit Cost Ratio	Incremental Benefit Cost Ratio
	(£k)	(£k)	(£k)		
Baseline	£99,867	£0			
Pathway G	£29,221	£70,304	£26,395	2.7	
Pathway A	£26,681	£58,409	£30,639	1.9	0.0
Pathway C	£29,229	£70,538	£31,384	2.2	0.0
Pathway H	£16,596	£82,929	£37,540	2.2	1.1
Pathway B	£16,194	£68,896	£46,949	1.5	0.0
Pathway D	£16,604	£83,163	£48,668	1.7	0.7
Pathway E	£16,604	£83,163	£62,453	1.3	0.0
Pathway F	£16,604	£83,163	£79,676	1.0	0.0

Capped present value damages avoided, the net benefit of implementing each option, and the project costs have calculated the benefit cost and incremental benefit cost ratios. To ensure a robust business case, a precautionary approach has been taken throughout, as such the benefits identified are considered conservative.

Preferred Way Forward

Option 2: Betterment of the existing defences provides the most economically favourable option and will achieve a 1in50 2069 SOP. It would safeguard the community and the recreational value of the promenade in the medium term.

Beyond 2069, managing coastal risk is increasingly challenging. The most economically favourable option is to transition to a form of managed realignment (to the northern extents only) with beach management activities to the south (i.e. Pathway G). This pathway approach:

- Allows the community to continue to gain tourism, social & well-being benefits from the promenade for a significant duration of the scheme.
- Safeguards residential properties (including social housing).
- Provides flexibility for the uncertainty of climate change. Option 2 can be monitored and the life-span of the promenade extended as much as possible. If sea-level rise and climate change occurs beyond expectations, this pathway retains flexibility for the community/scheme to be adapted as appropriate.
- Provides time for funding mechanisms to be developed which support schemes considering managed realignment.

Further design development has been carried out to reduce uncertainties associated with the preferred option for Epoch 1 works, Betterment of Existing Defences. The outline design, the construction and whole life cost and the optimism bias have been reviewed accordingly and prices updated to 2021. The Commercial Case and Financial Case in this document have been updated for the selected option.

Commercial Case

The next stage, subject to OBC approval, will be Full Business Case (FBC) preparation, including early contractor involvement, detailed design, consenting and the preparation of contract documents for construction. The FBC will be procured from the open market via Welsh Government's Sell2Wales website using the NEC4 Professional Services Contract.

The NEC4 Option A: a priced contract with activity schedule will be used to manage the works. All of the Employer's risk will be stated within the contract documents of the NEC4

contract. All remaining design risks will be stated in the designer risk assessment document which forms the part of the tender. During the contract the risk will be managed by using a risk management system.

Financial Case

We seek approval for Epoch 1 works. The updated preferred option cost is shown below.

- Epoch 1 to 2 - Option 2: Betterment of Existing Defences. Developed to an 'outline design' level (Appendix J).

Table 7. Preferred Option Costing

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
<i>OBC to Construction Subtotal</i>	<i>£969</i>	<i>£969</i>	<i>Assumed to occur in Year 0.</i>
Construction and Construction Support	£17,682	£17,682	PV Capital cost, based on estimate from ECI. Includes: ○ Preliminaries: 36 weeks at £25,000/wks. ○ Material stock piling: 52 weeks at £5,000/wks. ○ Profit + overheads: 10% of total direct cost + preliminaries + material stock piling ○ Quantified risk assessment 95%ile Construction Period: May 2022 to December 2022
Optimism bias	£4,597	£4,597	26% applied to 'OBC to Construction' and 'Construction' costs due to uncertainty pending design development and survey. Allowance for Network Rail BAPA included as Optimism Bias.
Quantified Risk Assessment 95%ile	£5,284	£5,284	Appendix H – Quantified Risk Assessment
<i>Subtotal</i>	<i>£23,248</i>	<i>£23,248</i>	
Future costs (maintenance)	£178	£403	PV Maintenance cost to include minor concrete repair works to sea wall, promenade and reseating of the rock armour and reinstatement of shingle.
Optimism bias	£107	£242	60% applied to 'OBC to Construction' and 'Construction' costs due to uncertainty pending survey and design.
Total	£23,533	£23,533	

- Epoch 3+ - Option 4a: Betterment of Existing Defences - form of managed realignment (to the northern extents only), with beach management activities to the south. Costs based on shortlisted scheme design.

Table 8. Preliminary Option Costing for Epoch 3

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
OBC to Construction Subtotal	£943	£4,142	
Capital Construction Costs (Year 50-55)	£3,116	£14,481	PV Capital cost, based on estimates from Tywyn coastal scheme. Includes: - Preliminaries, overheads and profit: 25% - Contingency (including inflation): 15% <i>Shingle beach recharge assumes majority of beach material from implementation of Option 2 is maintained and reinstated.</i>
Land purchase and compensation (Year 50)	£114	£516	- £250,000 land purchase costs (Gwynedd Council , 2018) - £250,000 commercial property purchase costs
Future Maintenance Costs (Year 50 – 100)	£92	£771	1 day/week for 45 weeks for £55/hr
Optimism Bias	£ 2,559	£ 11,946	60% applied to all costs due to future uncertainty.
Total	£ 6,824	£ 31,855	

- Combined Option Costs

Table 9. Combined Option Costing

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
Total	£ 30,357	£ 55,748	

Table 10. Economic summary of the preferred option

Economic Summary (100 year appraisal)	
Total PV Benefits (£k) (SOP 1 in 50 year – 2069)	£71,217
PV Cost	Option 2: £23,533 Combined: £30,357
Benefit Cost Ratio (Option 2)	3.0
Benefit Cost Ratio (Option 2 and Option 4a in epoch 3)⁵	2.3

Funding Sources

This financial case assumes that Welsh Government will fund onward capital costs for detailed design and construction at 85% through the Coastal Risk Management Programme. For the Full Business Case Stage, Gwynedd Council will match fund 15% of the cost through existing funds. No suitable match funding opportunities have been identified at present during discussions with Gwynedd Council's Economy and Communities Department.

⁵ BCR has decreased from Shortlisting Stage due to increased costs associated with Option 2; an optimism bias maintained as previous.

Table 11. Annualised project costs

Annualised Project Costs (undiscounted) - excluding maintenance		
Preferred Option - Project Summary (£k) Including Optimism Bias	Yr. 0 (2021/22)	Yr. 1 (2022/23)
- Staff	£52	£63
- Design Development and Capital cost (including inflation)	£854	£22,279
Annual Project Total	£906	£22,342
Cumulative Project Total	£906	£23,248

Management Case

YGC (Gwynedd Council's in-house consultancy) will manage this project on behalf of Gwynedd Council. The following table includes key project milestones for the implementation of Option 2: Betterment of Existing Defences.

Table 12. Project Milestones (for updated version of OBC v2.0)

Activity		Date (DD/MM/YYYY)
1	Submit OBC to WG	28/05/2021
2	Approval of OBC	14/06/2021
3	Procure Full Business Case	05/07/2021
4	Submit Full Business Case to WG	13/10/2021
5	FBC Approval	06/04/2022
6	Procure construction contract.	22/04/2022
7	Start of works on site	23/05/2022
8	Completion of works	04/01/2023

Benefits realisation & project evaluation

Performance on the project will be closely monitored via Project KPI results, project reviews and Client feedback at project closure stage (in accordance with Gwynedd Council's Performance Measurement and Monitoring procedure, SOP14). Lessons learned will be captured and recorded via Gwynedd Council's bespoke Project Management Software (KeyedIn) and be reviewed by the project team. On completion of the construction phase, the assets maintenance requirements, including monitoring will be conducted by YGC's FCERM unit on behalf of Gwynedd Council

Risk management

Gwynedd Council will identify, assess and control the risks that arise during the delivery of the project. A fully costed risk register has been produced as part of the uncertainty reduction exercise described in Section 7 and included in Appendix H.

Assurance

Gwynedd Council are committed to the successful delivery of the project. As noted in the Financial Case, Gwynedd Council has approved the inclusion of the Barmouth North Promenade Coastal Risk Management Programme within the County Asset Plan.

Recommendation

We recommend the project is approved with a non-discounted budget for Epoch 1 and 2 capital works (excluding maintenance) of £23,248k including optimism bias of £4,597k. The project will be funded by Welsh Governments CRMP (85%) and Gwynedd Council will match fund 15% of the cost through existing funds, subject to approvals.

Strategic Case

1. Introduction

This Outline Business Case (OBC) focuses on Barmouth North Promenade, located in Gwynedd on the west coast of Wales, north of the Afon Mawddach estuary. It seeks approval for the detailed design and consenting of essential works for the vulnerable North Barmouth promenade. It complies with the Welsh Government 2018 Flood and Coastal Erosion Risk Management (FCERM) Business Case Guidance (BCG) and associated Welsh Government policies.

The case for change is compelling, particularly with the onset of climate change and sea-level rise. Some 757 properties have greater than a 1 in 100 chance of coastal and/or surface water flooding in any year. The benefit cost ratio for the preferred option conservatively ranges from 2.3.

1.1 Location & context of Barmouth North Promenade

Barmouth is a town on the west coast of Snowdonia in Gwynedd (north-western Wales). The town lies adjacent to a long sandy and fine shingle beach, with a local harbour bordered by the picturesque Mawddach estuary and Cardigan Bay.

The seafront is a valued asset to both the local residents and visitors. The promenade provides leisure and recreation amenity including opportunities for walking, cycling and access to the blue flag beach. The area's character is drawn from the beach and promenade, forming part of the Wales Coast Path, and views across Cardigan Bay. The seafront hosts leisure activities including a small fairground, amusement arcades, kiosks, a land train and water sports. The seafront supports the town's significant tourism economy. Barmouth is a popular seaside resort attracting around 280,000 visitors annually⁶. Tourism is estimated to inject £42.7 million⁷ annually from visitor spending and local business supply chains and wholesalers.



Figure 5. Town of Barmouth and the Mawddach Estuary (© Copyright 2007 Visit Mid Wales)

⁶ Barmouth Tourism Estimates - Global Tourism Solutions (UK) Ltd, October 2018

⁷ Barmouth Tourism Estimates - Global Tourism Solutions (UK) Ltd, October 2018

The North Promenade is the northern section of the Barmouth beach frontage, extending from the residential housing estate at Heol y Llan to the northern extent of the promenade wall. The promenade forms part of the Wales Coastal Path however footfall is clustered to the south of Barmouth, with the North Promenade's limited amenities and beach access. This section of the frontage supports the amenity value of the full promenade, whilst providing coastal protection to the adjacent road, the low-lying Heol y Llan housing estate, the Cambrian Coast Railway Line, a skate-park and restaurant/café, the Hendre Mynach Caravan & Camping Park and the outfalls of two ordinary watercourses.

Neighbouring Barmouth South Promenade lies adjacent to the centre of Barmouth and comprises the main amenity beach. Northwards towards Llanbedr a managed shingle bank provides coastal protection to the railway. All three sections are intrinsically linked - forming a single floodcell and with interacting coastal processes.

1.1.2 Study Extents

The study extents are indicated in Figure 6 below. The study area comprises a mixture of hard defences, including a vertical sheet piled sea wall, a concrete platform, stone revetment and precast concrete wave recurve wall units, with setback flood walls.

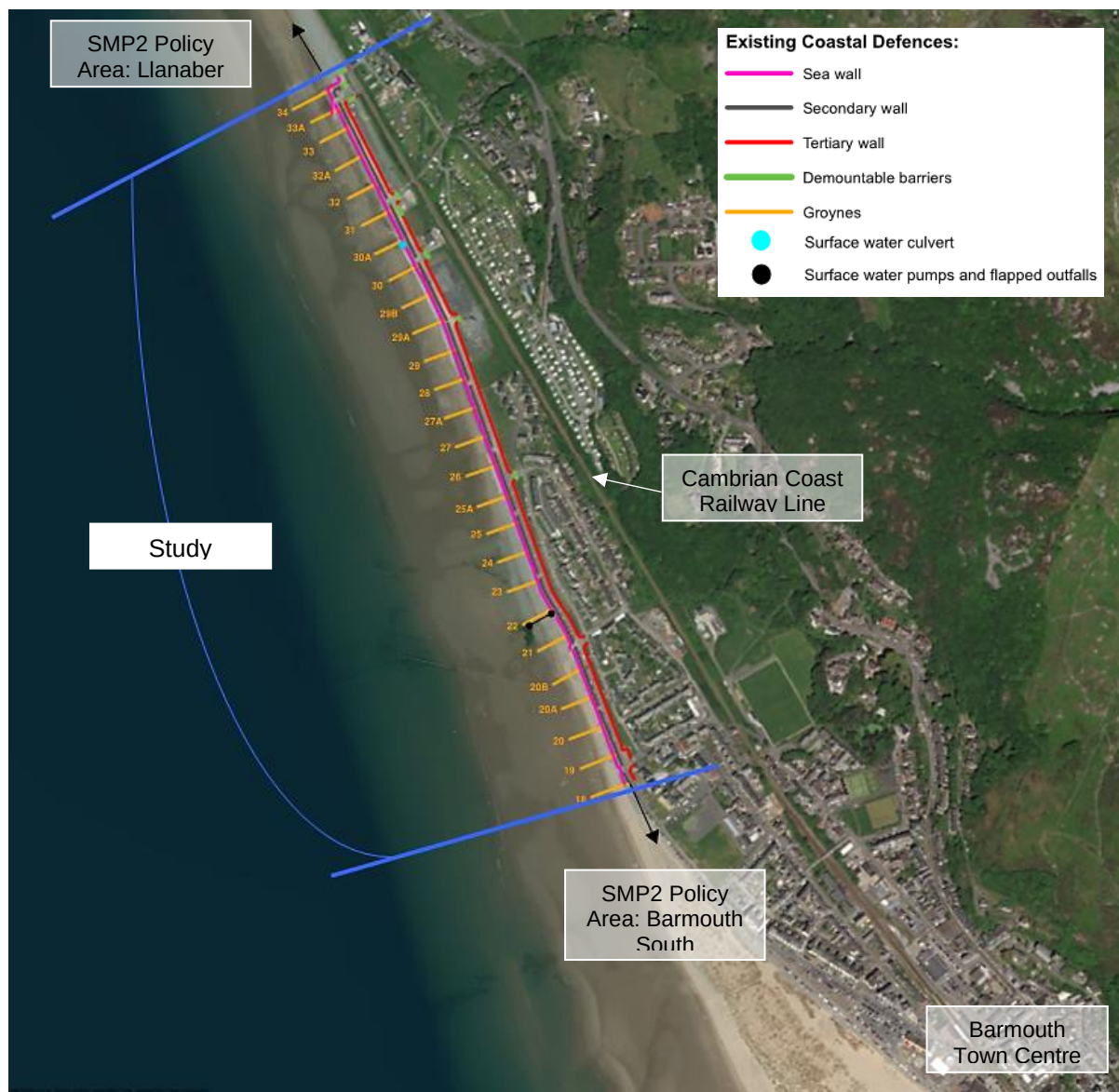


Figure 6. Study extents and key features of note within Barmouth

The northern end of the promenade is fronted by a shingle berm with failed timber groynes. The beach levels significantly decrease, and the defences deteriorate in condition, moving towards the northern extent of the study area. Beyond the study extent, the southern end of the promenade (SMP2 Policy Area: Barmouth South) is fronted by vegetated stabilised sand-dunes, and to the north (SMP2 Policy Area: Llanaber) a shingle berm protecting the Cambrian Railway Line. The existing coastal defences run parallel with the promenade adjacent to the Marine Parade. Coastal overtopping and flooding is experienced during storm events with temporary barriers deployed to prevent overland pathways through access points in setback flood walls (see **Section 4**).

1.2 Previous Studies

Studies previously completed have been used to inform and support the proposals outlined within this report, with key documents and sources including:

- Mott MacDonald, 2018 - *Barmouth North Promenade PAR Review*
- Civil Engineering Solutions, 2017 – *2017 PAR Update for Barmouth North Promenade*
- Kenneth Pye Associates Ltd, 2016 – *Barmouth Beach Blown Sand Management Options*
- Gwynedd Council , 2016 onwards – *Newsletters and FAQs for the neighbouring town of Fairbourne*
- Martin Wright Associates, 2014 – *2014 Project Appraisal Report (PAR) for Barmouth North Promenade*
- Haskoning UK Ltd, 2012 – *West of Wales Shoreline Management Plan 2 (SMP2)*
- Gwynedd Council Annual Monitoring data and reports, various dates from 2013 onwards

2. FCERM strategic fit and context

The following section sets out relevant national and local strategies or assessments, which outline the FCERM background and context to Barmouth North Promenade:

National Strategies, Policies and Assessments

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

This project has been identified as a candidate for further consideration as part of the Welsh Government's Coastal Risk Management Programme (CRMP). Plans for CRMP were announced by the Welsh Government in 2014 and are based around the use of long term borrowing and low interest rates by Welsh Government to support a programme of capital investment in coastal risk management infrastructure. Key details of the programme include:

- £150 million capital value investment, with construction scheduled 2018-2021
- focussed on managing coastal flood and erosion risk to properties people and infrastructure and enabling adaptation to climate change and implementation of SMP2 recommendations
- achieving wider additional and community benefits alongside reduced flood and erosion risk
- contributing across the breadth of Welsh Government Well-Being of Future Generation Act (WBFGA) Objectives but with emphasis on Objectives 6,7 and 8, and looking for wider benefits:
 - Objective 6. Support the change to a low carbon and climate resilient economy
 - Objective 7. Connect communities through sustainable and resilient infrastructure

- Objective 8. Support safe, cohesive and resilient communities

Shoreline Management Plan 2 (2011): The West of Wales Shoreline Management Plan 2 (SMP2) (2011) sets out the policy for coastal risk management across the region. Barmouth North Promenade is located within the SMP2 Management area 24 (MA24) and Policy Unit 15 (Barmouth North) of SMP Sub Cell 9 and Policy Development Zone (PDZ) 11. The future policy and approaches for management across this frontage are provided in **Table 2** and **Table 3** below:

Table 13. Sub cell 11 SMP2 - Policy and Approach

MA 24 BARMOUTH: From Porth Aberamffra to Llanaber Point

Policy Unit		Policy Plan			Comment
		2025	2055	2105	
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					

Table 14. Sub cell 11 SMP2 - Preferred Policies

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.

Please refer to Appendix L for full details of the SMP2 Context and Policy Direction for Barmouth North Promenade. In summary:

- The current policy (epoch 1) for the frontage of Barmouth North Promenade is to continue to 'hold the line'. Due to implications of climate change, the present alignment was considered likely to become 'increasingly difficult to sustain'. As such, for the medium and long term the SMP2 recommends a change in approach to 'managed realignment' however supporting commentary demonstrates the range of plausible options by noting '*consideration should be given to widening the overall defence system in this area. This may require nearshore or shore connected structures to reduce wave energy but is also likely to require some future realignment of the defences, quite probably with the loss of property. This would require a more integrated approach to management, considering how the northern seafront could be developed to better advantage both in term of use and shoreline management.*'
- The SMP timescales are less prescribed than indicated, with the policy change seen as a continual process. The SMP2 suggests opportunities for Managed Realignment should be developed within the medium term, with recognition that there is significant benefit in continuing to manage the frontage – noting '*in all probability works will be needed to the north Barmouth frontage towards the end of Epoch 1*'
- The SMP2 expresses that whilst the frontage is split over three areas, the policies should be considered and '*progressed as one overall area*' – due to the coastal process influences between each policy area.

The solutions developed in this proposal look to recognise the long-term aspirations of the SMP2, with consideration of short to medium term adaptive options along the frontage.

NRW's Flood Risk Assessment Wales (FRAW) (2018): NRW's Flood Risk Assessment Wales (Figure 7 below) shows modelling indicates much of the land immediately landward

Table 15. Objectives of the Local Flood Risk Management Strategy

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): The Plan sets out the strategy and aims for development and land use in the area covered by the Anglesey and Gwynedd Planning Authorities and includes policies to implement the strategy and aims over a period of 15 years (2011 to 2026). This vision for the JLDP is “*Strengthen communities in Gwynedd and Anglesey*”. Of particular note is the following policy area:

• **POLICY ARNA 1: COASTAL CHANGE MANAGEMENT AREA:**

A Coastal Change Management Area (CChMA) is identified in Appendix 6 (see Table 16) of which Barmouth North Promenade is identified within. Key extracts of the policy are outlined below:

- New Residential Development - Proposals for new, replacement or conversion dwellings will be refused in the CChMA.
- Relocation of Existing Permanent Dwellings in the Countryside: Proposals for the relocation of existing permanent dwellings in the countryside located in the CChMA predicted to be affected by coastal erosion and/or flood risk will be permitted provided they conform to the associated criteria.
- New or Existing Non-Residential Buildings: New non-residential development (e.g. beach huts, cafes, leisure activities, campsites etc.) will be permitted within the CChMA during the second indicative policy epoch (2026 – 2055),
- New or Replacement Coastal Defence Scheme: Proposals for new or replacement coastal defence schemes will only be permitted where it can be demonstrated that the works are consistent with the SMP2 approach for the frontage with no adverse impact on the environment.
- Managing Development: Planning conditions will be applied, or a planning obligation will be secured where there is a need to limit/amend the planned life of a development or seasonal use.

Table 16. Appendix 6: Coastal Change Management Area of the JLD

SMP2 Policy Boundaries				Preferred Policies		
PDZ	Man	PU	Policy Name	Policy Comments	2025	2055
11	24	PU11.15	Barmouth North	This many include the relocation of properties	HTL	MR

Key further policies relevant to the scheme include:

Table 17. Key policies relevant to the scheme

Policy Details	Project Alignment
STRATEGIC POLICY PS 4: SUSTAINABLE TRANSPORT, DEVELOPMENT AND ACCESSIBILITY: <i>Development will be located to minimise the need to travel. The Councils will support improvements that maximise accessibility for all modes of transport, but particularly by foot, cycle and public transport.</i>	The frontage at North Promenade accommodates active travel and the Wales Coastal Cycle Path. The scheme will look to protect and promote active travel throughout.
STRATEGIC POLICY PS 5: SUSTAINABLE DEVELOPMENT: <i>Development will be supported where it is demonstrated that they are consistent with the principles of sustainable development.</i>	The scheme will be aligned to the principles of sustainable development.
STRATEGIC POLICY PS 6: ALLEVIATING AND ADAPTING TO THE EFFECTS OF CLIMATE CHANGE: <i>Proposals will only be permitted where it is demonstrated that they have fully taken account criteria associated with alleviating and adapting to the effects of climate change.</i>	The scheme is assessed across a 100 year time-frame – with consideration made to the alleviation/ adaption to climate change and rising sea levels.
STRATEGIC POLICY PS 14: THE VISITOR ECONOMY: <i>Whist ensuring compatibility with the local economy and communities and ensuring the protection of the natural, built and historic environment the Councils will support the development of a year-round local tourism industry.</i>	The scheme will consider opportunities to protect, and where possible enhance, the visitor economy in Barmouth (see Project Objective 2)
STRATEGIC POLICY PS 19: CONSERVING AND WHERE APPROPRIATE ENHANCING THE NATURAL ENVIRONMENT <i>the Councils will manage development so as to conserve and where appropriate enhance the Plan area's distinctive natural environment, countryside and coastline, and proposals that have a significant adverse effect on them will be refused unless the need for and benefits of the development in that location clearly outweighs their value.</i>	The scheme will maintain, and where possible enhance, natural and historic environments – with consideration to this Strategic Policy (see Project Objective 3).

Local FCERM Programmes

There a number of wider local FCERM schemes within the area, which the development of this scheme acknowledges:

- Viaduct Gardens – Located to the southeast of Barmouth South frontage, where the Cambrian Coast railway passes over the shoreline on a concrete viaduct. A FCERM Project Appraisal Report (PAR) for the frontage was originally prepared in December 2004 and updated in March 2017. The interaction between the main Barmouth floodcell and the Viaduct Garden flood cell was considered and discounted. An OBC is under preparation.
- Barmouth South Promenade - A Barmouth Sand Management Project and associated assessments were prepared by Gwynedd Council and Kenneth Pye Associates Ltd in 2016. This identified potential future management options for discussion amongst members of the Sand Management Group and other stakeholders.
- Fairbourne - a village to the south of Mawddach estuary with significant concerns over the future sustainability of coastal defences and an SMP2 policy of 'Managed Realignment'.

3. Sustainability and well-being strategic fit and context

The following section outlines the wider sustainability and well-being contexts of Barmouth and the North Promenade.

3.1. Well-Being Strategic Fit

Socio-demographic context⁹:

Barmouth has a population of approximately 2,500. The population of Barmouth as a whole, is older than the national average, with over 22.8% of the population over the age of 65 years old (compared to 18.3% for Wales). A higher proportion of homes are rented than the national average, both socially (20.5%) and privately (25.6%). Of these households, 35.8% have no access to a car (compared to 22.9% for Wales) indicating the importance of public transport to the local area.

Tourism is considered vital to the economy of Barmouth. The majority of residents are employed within accommodation & food services (19.1%), retail (18.8%) and health & social work (17.2%).

National and local policies and strategies:

Well-being of future generations (Wales) Act 2015: The Well-being of Future Generations Act (WBFGA) was introduced in 2016 to ensure Welsh public policy and spending is sustainable and safeguards the interests of today's and future generations. The Act features a series of overarching Well Being Goals as shown in **Figure 8**.

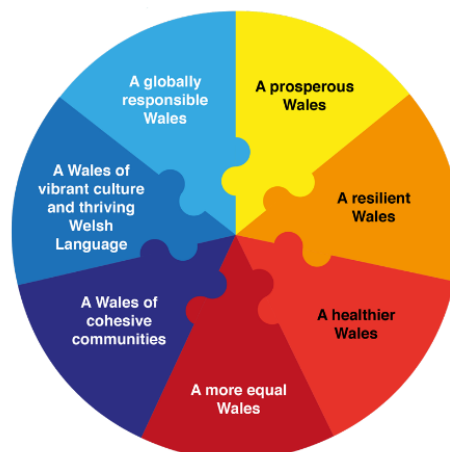


Figure 8. The Well Being Goals

Vibrant and Viable Places (2013): This document is the Welsh Government's regeneration framework. Coastal communities are identified as one of the three priority themes. They face challenges with lost 'footfall and lustre' because of the changing pattern of UK holiday trade although opportunities exist to take advantage of new kinds of tourism including visitors linked to the Welsh Coastal Path.

The North Wales Regional Tourism Strategy (2010 – 2015): undertaken by Tourism Partnership North Wales emphasizes the need to promote distinctive strengths, to invest in product excellence, to provide an outstanding experience for visitors and to work together in partnership with local stakeholders.

⁹ Statistics are based on the 2011 census. Data has been obtained from the Gwynedd Country Council website: <https://www.gwynedd.llyw.cymru/en/Council/Documents---Council/Key-statistics-and-data/Area-Profiles---Gwynedd-and-comparable-areas/Meirionnydd/Ward-Profile-Barmouth.pdf>

Anglesey and Gwynedd Joint Local Development Plan (2017): The JLDP notes a number of key challenges for the Gwynedd as a whole:

Table 18. Key challenges faced by the county of Gwynedd

Key challenges for the region:			
Demographic	Social	Economic	Environmental
An aging population , impact of holiday/secondary homes on communities and housing market, losing young residents who are economically active, insufficient supply of housing (with current houses old or of poor design), limited capacity of settlements to deal with additional housing.	Promoting opportunities for people to live healthy lives and have reasonable access to health care , areas with high levels of various types of deprivation , access to facilities and community services , leisure facilities and formal/ informal entertainment including access to the countryside.	Responding to business development and employment needs of existing / new employers, declines in the prosperity and vitality of town centres; improving and managing the ' all year ' tourist provision in the area in a sustainable way.	Mitigate and adapt to the effects of climate change, need to protect and whenever possible, improve the natural environment , habitats and species of the area, make the best use of the comparatively low levels of brownfield sites.

3.2. Sustainability and Environmental Strategic Fit

Designated Sites and Biodiversity

Pen Llyn a'r Sarnau SAC is approximately 171m south-west from the site, and runs adjacent to the length of the promenade (see Figure 9 below). SACs are strictly protected environmental sites designated under the EC Habitats Directive, any works which impact on or are within these extents will be subject to considerable consultation and approval with NRW and wider authorities.

Rivers (e.g. the two ordinary watercourses outfalls in the frontage) are a Welsh Priority Habitat and River Corridors have a Gwynedd council Biodiversity Habitat Action Plan. Proposals which involve works within the channel of the watercourse, could result in temporary disturbance of this habitat type and potential pollution both within or beyond the boundaries of the site. The sand dune system at South Barmouth is also a priority habitat and a Gwynedd Biodiversity Habitat Action Plan, works within North Barmouth will need to consider wider the impacts on this neighbouring habitat.

Several important local species require consideration during the schemes development including: otters (due to presence of ordinary watercourses), watervoles (unlikely to be present), bats (habitats in culverts) and nesting birds (within the sand-dune system – particular care is required during bird nesting season – April-August). As such, specific considerations to activities around the watercourses, the beach environment (along the full frontage) and trees should be made.

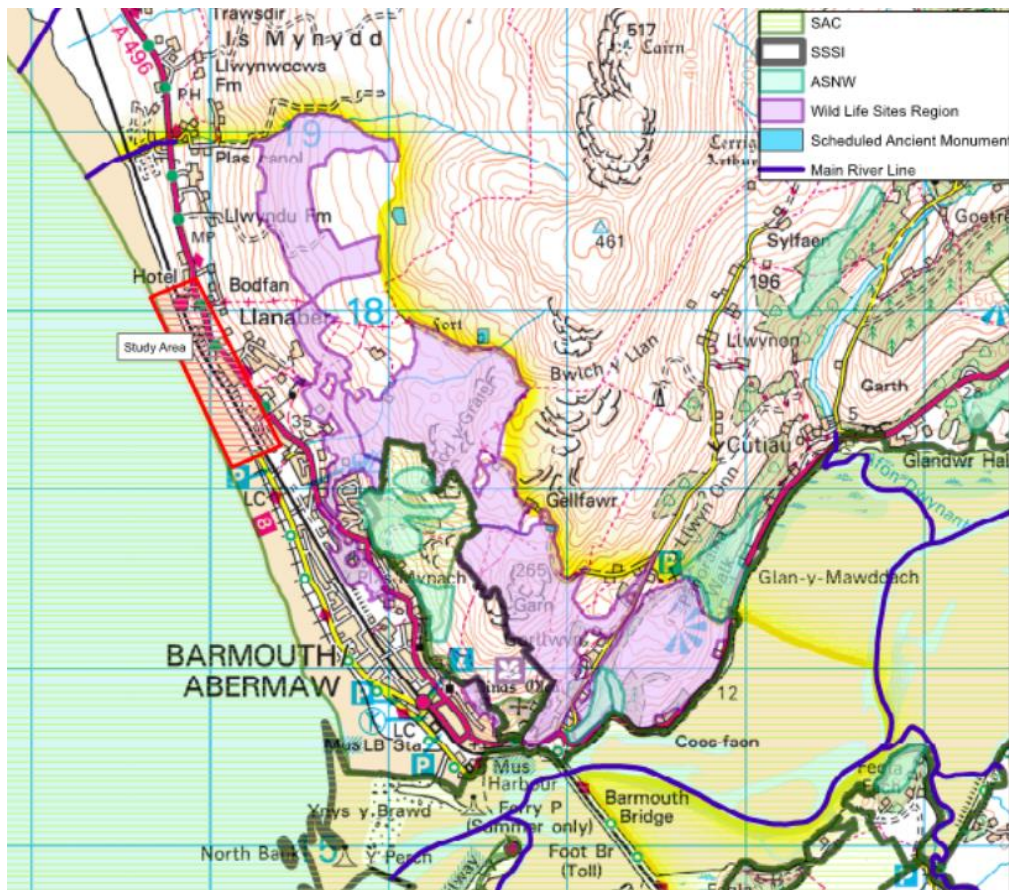


Figure 9. Environmental Appraisal

Please refer to the Gwynedd Council Environmental Baseline in **Appendix F** for further information.

4. The flood and erosion problems and current management arrangements

Barmouth's sea defences originally reportedly date from the 1900-1920s. Further improvements in 1930s included timber groynes and a concrete revetment. A sheet pile toe was added in 1956 due to scouring and lowering of beach levels. The concrete wave recurve wall was added between 1972 and 1974, with refurbishment of the timber groynes and shingle beach nourishment. A small sand-shingle beach fronts the northern end of the promenade.



Figure 10. The concrete wave recurve wall with shingle foreshore at southern end (Arup, 2018)

Inland, there is a 'defacto' flood wall situated on the landward side of Marine Parade. This wall has demountable stop logs across access points to help contain overtopping. The stop

logs at Heol-y-Llan have been formalised and permanently block access. The walls' unreinforced masonry construction is prone to failure during storm events, with resultant loose masonry presenting a further hazard. Low-lying land immediately to the north of the Heol y Llan housing estate provides some storage for overtopped water.

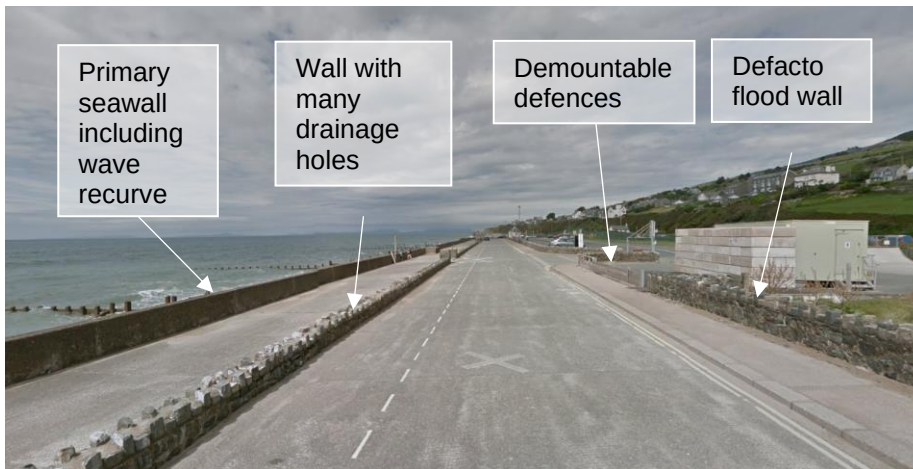


Figure 11. Walls adjacent to the promenade (Google, 2018)

A shingle berm to the north of the promenade provides some protection to the Cambrian railway line and is maintained by Network Rail. To the south, the beach width increases considerably and a vegetated stabilised sand-dune system has formed along the frontage since the 1970s. The dune growth is attributed to construction of the causeway linking the former Ynys y Brawd island (at Barmouth South frontage) to the mainland, which artificially closed a northern channel at the mouth of the Mawddach Estuary. The dunes are partially levelled to maintain an open amenity beach and, conversely, wind-blown sand is a nuisance and maintenance liability.



Figure 12. Shingle berm providing protection to the railway line at the north of the promenade (Arup, 2018)



Figure 13. Sand dune system protecting the southern end of the promenade from wave action (Arup, 2018)

4.1.1 Flood risk and coastal erosion

Flood Risk

Barmouth, and in particular, its north promenade is at risk of coastal flooding and erosion. It is commonplace to see overtopping at the north-most end of the promenade in what could be described as relatively “normal” conditions ie median level tides, without surge, swell, low pressure or high winds. Recent winter storms have highlighted overtopping can be significant, as highlighted in the examples below for December 2014 and October 2017.



Figure 14. Overtopping of promenade at Barmouth in 10th December 2014 (Image: Daily Post Wales)



Figure 15. Wave overtopping at North Barmouth during Storm Brian (21st October 2017) (Image: youtu.be/gVtJ8t7T7uQ)

Most notably, were the January 2014 storms, where significant volumes of water overtopped the coastal defences (as highlighted in Figure 16 and Figure 17). The NRW Flood Investigation Report (2014) noted significant damage along a large stretch of the coastline including both North and South Barmouth, in particular the Promenade Café and Barmouth Harbour where residents had to be evacuated.



Figure 16. Coastal flooding experience during the January 2014 storms (© Mike Alexander, 2018)



Figure 17. Coastal flooding experienced around the Heol-Y-Llan housing estate during the January 2014 storms (© Mike Alexander, 2018)

Whilst there are no Main Rivers in the study area, sources of local flood risk have been identified – NRW Flood Maps indicate a large extent of the study area is shown to be at High Risk (>1 in 30 annual chance) of surface water flooding. In particular, there are two watercourses (non-main river) noted to flow into the study area from the east, which discharge to the sea via a pumped surface water system with flap valve and a separate screened culvert (assumed a further non-return valve or structure is located further upstream). Several flap valves have failed.

In the absence of investment, 757 properties have more than a 1 in 100 chance of flooding in any year. The rapid onset and depth of flooding presents a risk to life.

Coastal Erosion

The Coastal Process Assessment (2019) in **Appendix C** indicates that there is not a strong transport regime along the frontage. Hard outcrops may provide some protection to the southern extents of frontage. Whilst to the north, there was a general lowering of foreshore levels between 2006 and 2014, although changes remained limited at the north-most end of the frontage. Extensive lowering occurred offshore (40-140m) in 2013 and 2014 (a period notable for a number of intense storms); however, some foreshore levels increased along the frontage. Overall foreshore bed levels along North Promenade are lowering and this lowering is expected to continue. The lack of coarser material in the upper foreshore along North Promenade is likely to have accelerated the rate at which the foreshore has lowered, with additional wave energy being reflected off the sea wall.

Future beach evolution is difficult to predict but assuming No Active Intervention (NAI), erosion is predicted by the SMP2 to continue at North Promenade totalling between 30m and 120m over the appraisal period. Based on the average SMP2 lateral erosion rates over a 100 year period, beach levels could decrease by up to 0.7m for northern study extents. The rate of erosion is likely to increase with sea level rise, which will result in larger waves reaching the promenade and in turn increasing beach lowering.

Climate Change

Sea level rise due to climate change is predicted to accelerate, increasing the likelihood and severity of coastal flooding. By 2069 mean sea levels are predicted to have increased by 0.42m and by 2119 by 1.1m. Therefore, there is greater likelihood for higher waves to reach the defences at increased frequency, and hence an expected increase in wave overtopping, flood risk and potential sea wall damage.

4.1.2 Condition of Assets

The existing defences have a number of structural defects (see **Appendix E**):

- At the northern end of the promenade, the corner wall appears to be undermined, with significant fill material loss beneath the promenade slab.
- Toe sheet piles at the northernmost 200m are exposed with evidence of section loss and severe abrasion of the concrete encasement.
- A residual life of less than 10 years is reasonable to assume.

Should foreshore bed levels continue to lower, then this increases the risk of structural failure and global instability of the structure from sheet pile toe exposure and wash-out of fines.



Figure 18. North-most end of promenade – concrete mass subject to significant deterioration



Figure 19. Northern extents of promenade – exposed sheet pile, with signs of draw down

Further structural defects are noted. The wave recurve structure appears to be minimal, limiting its ability to reduce wave overtopping, with discontinuities in the structure (i.e. two ramps along the frontage) providing pathways for coastal flooding. The concrete steps are in very poor condition and closed to the public due to safety concerns. There is no safe access to the north of the beach and entrapment at high tide is a risk.

Cracks and missing expansion-joint fillers along the sea-wall and slab suggest movement or settlement has occurred. Intrusive surveys in 2014 found the promenade slabs rest on granular material susceptible to wash-out of unsealed joints – further undermining the stability of the frontage.



Figure 20. Promenade subject to cracking – notable void present at north-most end of the promenade.



Figure 21. Groynes in very poor condition with limited impact on beach material movement

The groynes in the north have limited function having being subject to substantial degradation, with the loss of timber panels from exposed sections. The groynes in the south are almost completely covered in sediment.

The setback flood walls (with associated demountable stop logs) are non-structural masonry walls with minimal resistance to impacts. Previous events (i.e. 2014/2015 storms) highlight the vulnerability of this structure to damage – with the walls being knocked down and in a

state of disrepair. This, along with unflapped drainage routes, provide further entry points for flood waters.

The condition of the northern area of the North Promenade deteriorated during extensive overtopping during March 2020. Voiding and material loss behind the sea defences led to a collapse (see Figure 22 and Figure 23).



Figure 22. Damage to sea defences and collapse of the promenade at the north corner and return of Barmouth North Promenade in March 2020.

Emergency repairs to the north corner and end return of the North Promenade were completed between Autumn 2020 and Spring 2021. The location of the emergency works is indicatively shown in drawing ARP-XX-EP-DR-CS-0001-GA in Appendix J. Some 30m of new sheet pile wall were installed in front of the existing sheet pile toe and concrete was poured in between the new and the existing sheet pile toe. Voids of up to 1.5m to 2.0m depth were filled. The repair works were emergency measures are short-term (design life <10 years) and aim to extend the life of the existing structures until the main scheme takes place. Refer to Appendix Repair Works to North Promenade in Barmouth – Method Statement and Risk Assessment (Kaymac, February 2021) and repair drawings



Figure 23 Emergency repairs in April 2021

In conclusion, without appropriate action, the ongoing deterioration of the frontage structures and sheet pile section loss, coupled with the wash-out of material (due to overtopping from storm events) is likely to lead to failure of the sea-wall and revetment structures. This breach

in the defences will cause significant coastal flooding. Climate change will exacerbate the rate of deterioration. Further discussion of the Walkaway and Business As Usual Scenarios are discussed in Section 3 – Economic Case.

4.2 Existing maintenance arrangements

Gwynedd Council undertake adhoc remedial works along the frontage supported by regular inspections, particularly following storm damage. These minor repairs include filling of voids, sealing of joints and mortar replacement.

In March 2010 it was discovered that there was a void beneath the concrete slab at the north end of the promenade which further investigation revealed to be a large void requiring immediate attention. Emergency works were instigated and concrete was placed to fill the void at a cost of £30k.

Emergency short-term repairs were also completed in Autumn 2020 and Spring 2021 (see Section 4.1).

5. Investment Objectives

The following Investment Objectives have been identified as priorities for the scheme at Barmouth North Promenade:

Table 19. SMART Investment Objectives for Barmouth North Promenade

SMART	Objective description	Indicator	Timescale
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.	The Present Value of flood damages over the life-span of the scheme.	Project operation in 2022, with an adaptable programme of works in development spanning up to 2120.
2	To support, and where possible enhance, recreation and amenity value of the local area	Sustainability and well-being performance of Preferred Option at Detailed Design. Feedback from stakeholders.	Up to and following project operation in 2022. - accounting for key future milestones
3	To maintain, and where possible enhance, natural and historic environments.	Sustainability and well-being performance of Preferred Option. Environmental appraisal at Detailed Design.	Up to and following project operation in 2022 – accounting for key future milestones
4	To ensure marine amenity activities can continue to grow.	As above	As above
5	Ensure an affordable and deliverable whole life option through a partnership approach and contributions.	Benefits and Whole Life Cost of the Preferred Option	At OBC and Full Business Case Stages

6. Summary of potential opportunities and benefits from investment

The preferred option will reduce the long-term flood risk to both people and properties along the Barmouth seafront, bringing the area into line with its SMP2 policy of ‘hold the line’, with the longer-term considerations towards ‘managed retreat’. The project will provide a framework for Gwynedd Council to *manage* the risk of flood risk, coastal erosion and structural failure of the primary coastal defences, providing an adaptive platform to manage

future change of the coastline due to the increasing pressures associated with coastal erosion and climate change.

Moving towards the SMP2 Policy of 'Managed Retreat' may result in the planned removal of some properties directly adjacent to Barmouth North Promenade. This process will need to be sensitively managed, however will avoid the social and well-being implications of the baseline alternative and offers opportunities.

Please refer to **Appendix K** for details of the Benefits Mapping outlining opportunities for wider benefits associated with the scheme at Barmouth North Promenade. Key opportunities exist within economic, social, environmental and political spheres.

7. Summary of potential risks, constraints and dependencies from investment

Constraints

National

- Welsh Government project contribution of no higher than 85% of detailed design and construction costs.
- Welsh Government current construction timeframe is over three years starting 2018-19.

Local

The project is highly constrained; however the northern half of the North Promenade frontage differs from the southern half. Please refer to **Appendix K** for details of the Constraints Mapping outlining significant constraints which include:

- Adjacent SMP2 'Hold the Line' Policy Units 11.14 of Llanaber and 11.16 South Barmouth – ensuring that the scheme does not increase coastal risk to these locations, with management activities continued.
- The Cambrian Line Railway (National Rail asset) – protection must be afforded to the railway line to ensure connectivity between Barmouth, associated coastal towns and the wider UK rail network, and aligning with the JLDP of supporting sustainable transport and railway links.
- Heol-Y-Plas housing estate in the southern half of the study area benefits to some extent from existing defences. Sensitive engagement is required throughout the project.
- The nearshore Pen Llyn a'r Sarnau Special Area of Conservation (SAC) is environmentally sensitive. Works to encroaching seawards (e.g. offshore breakwaters) must minimise habitat loss or degradation. Significant environmental appraisals would be required.

Risks

A detailed costed risk assessment is included in **Appendix H** and is discussed within the management case. The high level risks associated with project delivery include:

Table 20. Key Project Risks

Key Project Risk	Mitigation Measure
Works required adjacent to Cambrian Railway, to north of promenade to prevent outflanking	Assume partnership working. Principles have been discussed at NR and YGC meeting. Business Case assumes no line possession required and minimal BAPA costs.

Key Project Risk	Mitigation Measure
Works are likely to attract high public Interest – particularly with consideration of the future policy of 'Managed Retreat'	Extensive and ongoing stakeholder engagement is recommended. Opportunities to align proposals with wider objectives will be sought.
Accommodating the future policy of 'Managed Retreat' whilst limiting impacts on neighbouring policy areas of Llanaber and Barmouth South (including wider floodcells) and considering public health and safety.	Approach considers coastal risk management for Policy Unit 11.15, with consideration of adjacent Policy Unit 11.14 and 11.16 recognising the SMP2 rationale. Safety of the public and maintaining the vitality of Barmouth will be paramount within decision making.
Increase in construction costs.	Recommend early contractor involvement to support Full Business Case and detailed design. Place orders early to a fixed price; noting increase in fuel levy will increase material prices above inflation.
Failing to reach 85% funding leading to delays in construction.	YGC to identify funding sources and to plan procurement to accommodate programme constraints.
Discharge of planning conditions which require additional mitigation work (and associated design) requirements.	Pre-app early during design development, public engagement and consultation planned
Marine licence approval condition/requirements which require potential re-design, programme delays and additional costs	Involve NRW, Marine Licencing and GCC highways and carry out surveys early during the design period.
Significant flood or erosion event occurs in advance of FBC completion.	Ongoing monitoring. Complete surveys early.
Ground and structural conditions are worse than assumed increasing cost and delays to programme.	GI to include inspection proving as-built arrangement and UXO assessment
Seasonal restrictions on works with potential constraints and delays to programme in order to manage public relations	YGC to consider constraints
Unknown construction details of existing defences leading to changes to design increasing construction cost/programme. Condition and performance of existing structures – no complete construction drawings available for existing structure and no intrusive investigation has been completed.	Undertake structural investigation.
Environmental impact, ecological survey identifies presence of protected experience and/or unknown archaeology is encountered during construction leading to increased costs and delay to programme due to mitigation of environmental impacts, additional surveys, mitigation amendments or non-viability of scheme in worst case.	Carry out screening and surveys early in design period to avoid potential delays. Progress actions identified from screening process as part of obtaining necessary approvals and consents.
Contaminated ground identified on site, requiring removal leading to increased costs to deal with or dispose of material where necessary.	Carry out a robust ground investigation.

8. Stakeholder engagement (Strategic Case)

Please refer to Section 8 in the Economic Case for details of the stakeholder engagement.

Economic Case

The project will reduce coastal risk to Barmouth North Promenade by addressing currently failing coastal defences. The economic case has been appraised in accordance with the following standard guidance for the appraisal of FCERM projects:

- Welsh Government 2018 FCERM Business Case Guidance
- FCERM A Manual for Economic Appraisal 2013 ('The Multi-Coloured Manual') and accompanying Handbook.
- HM Treasury's Green Book (2018) and associated supplementary guidance.
- Welsh Government's climate change guidance for risk management authorities (2016).

A full explanation of the methodology used to build up the economic case is outlined in **Appendix A**. For full outputs of the long-listing and short-listing process, please refer to **Appendix I**.

1. Critical Success Factors (CSFs)

Building on the investment case objectives outlined in the Strategic Case, the critical success factors are outlined below.

Table 21. Critical Success Factors

No	Critical Success Factor	Further Definition
1	Strategic Fit and Business Needs	• Adapting to climate change • Delivery of National Strategy and Shoreline Management Plan objectives • Council support • Alignment with local Well-being plans • Consideration of SMP2 policy • Enhance promenade
2	Value for Money	• Protect and enhance the Welsh economy by avoiding flood damage to residential and commercial properties and economic assets and infrastructure. • Positive Net Present Value • Minimise operational demands
3	Potential Achievability	• Council capacity to manage projects • Key project stakeholders are supportive of proposals
4	Supply side capacity	• Supply side capability to deliver affordable solution within time-frame
5	Potential Affordability	• Achievable within current or anticipated Welsh Government and Council's funding settlements and borrowing powers • Further efficiency savings identified in FBC

2. Approach to options assessment

With reference to the FCERM BCG, the following approach to the options assessment was undertaken:

1. **Site visit and start-up workshop with Gwynedd Council** (November 2019)
2. **Definition of Options Framework Filter**
3. **Identify Long-List of Options:** *Longlisting Workshop (November 2019) with Gwynedd Council , Arup and ABPmer – supported by:*
 - Definition of baseline ('Walkaway' and 'Business As Usual' scenarios)
 - Screening matrix of long-list options against the Investment Objectives, CSFs and Options Framework Filter
 - Screening matrix of long-list options against constructability, cost & performance, environmental impact and applicability.
4. **Identify Shortlisted Options:** *Shortlisting Workshop (January 2019) with Gwynedd Council , Arup and ABPmer*
5. **Assessment of Shortlisted Options** – supported by:
 - Public stakeholder engagement (March, 2019)
 - Economic assessment
 - Assessment of shortlisted options against engineering, economic, environmental, social & well-being and financial performance.
6. **Selection of Preferred Option:** *Preferred Option Selection Workshop (April 2019) held with Gwynedd Council*
7. **Development of Preferred Option**, including option review workshop (June 2019)

A number of studies (**Appendix A - Appendix L**) were undertaken to support the options assessment process.

3. Identify Long List

3.1 Using the Options Framework Filter to identify the Long List

The following table provides a summary of the Options Framework Filter developed to identify the Longlist of Options.

Table 22. Options Framework Filter

Key	Meets in full	Meets in part (Investment Objectives only)	Does not Meet
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		FCERM specific guidance	Walkaway	Business As Usual	Do Something			
					Intermediate Option	Intermediate Option	Intermediate Option	Do Maximum
Scope	“What” Potential coverage of the project	Spatial Scale	nil	Assets in place (SOP unknown)	Property Level Protection	Local Flood Defence	Shoreline Management - Individual	SMP - All Management Units
		Temporal Scale (e.g. Standard of Protection)	nil	Assets in place (SOP unknown)	1 in 20 year SOP (+CC)	1 in 75 year SOP (+CC)	1 in 200 year SOP (+CC)	1 in 1000 year SOP (+CC)
Service solution	“How” in terms of delivering the potential scope of the project	Current and Core Services: FCERM activities Desirable Services: NFM Optional Services: wider initiatives, e.g. regeneration tourism, etc.	Current services: Stop maintaining of existing assets	Core Services: Maintain existing flood defences	Core + Desirable Services: Construct and maintain new flood and erosion defences	Core + Desirable Services: Construct and maintain new flood defences plus deliver NFM	Core + Desirable + Optional Services: Construct and maintain new flood defences plus deliver NFM plus create amenity area	
Service delivery	“Who” in terms of delivering the potential scope of the project		nil	Assets in place (SOP unknown)	Local Framework: RMA Project team plus local consultants and contractors	Wales framework: RMA project team plus Wales-wide consultants and contractors	UK/EA framework: RMA project team plus open tender and OJEU	
Service implementation	“When” in terms of delivering the potential scope of the project		0	Continue Current Activities	< 1 year	1-2 years	3-4 years	5 + years
Funding	The “funding” required for delivering the potential scope, solution, service delivery and implementation path for the project.	Liaise with Welsh Government Flood Branch on potential funding sources and prioritisation.	0	Revenue funding (public)	Capital funding (public)	Capital funding (public) via innovative funding mechanism (e.g. CRMP)	Capital funding (public) external contributions	

3.2 Identify measures to deliver the Long List

The long list captures broad options from experience of coastal erosion risk management solutions. Please refer to Section 4 (below) for details of the longlist of options selected.

4. Screen the performance of each measure

Options were appraised considering the constraints on the neighbouring SMP2 'Hold the Line' Policy Areas (Barmouth South and Llanaber). The long list appraisal process included:

- Screening of options against the investment objectives, CSFs and Options Framework Filter
- Consideration of the condition of existing structures, expected coastal processes, environmental issues, constructability, and estimated lifetime costs for the 100 year appraisal period.

Baseline Scenario (Appendix A)

Walkaway (Do-Nothing) Scenario: The sea wall and revetment are in a poor condition. In the absence of maintenance, progressive structural failure of the sea-wall and revetment is reasonable to assume, with the northern most area at greatest risk. Coupled with continued beach drawdown (to the north), increasing frequency and severity of overtopping (due to climate change), there is an increasing risk of undermining of the defence structures through washout of infill material and/or progressive failure of the sheet pile toe and/or stability failure due to beach draw-down. The residual life of the sea-wall and revetment is <10 years.

Business As Usual (Do-Minimum) Scenario: The present Gwynedd Council maintenance and beach management regime involves an 'as and when' programme of inspection and maintenance, including minor repairs. Measures to protect or replace the sheet pile section and arrest the abrasion/ corrosion are likely to be significant and are not a Business As Usual intervention.

Long-List Options and Screening

The longlist of engineering options are listed in **Appendix I** and summarised in the table below. The options have considered the SMP2 Policy of 'Hold the Line' in the short-term and 'Managed Realignment' over the medium to long-term.

Table 23. Longlist screening table [Positive in green, negative in red]

Ref	Option	Constructability	Cost & Performance	Environmental Impact	Applicability (Design life, amenity/recreation and stakeholder acceptability)
1 & 2	Baseline: Walkaway and Business As Usual On-going deterioration will lead to failure of the sea-wall and revetment and a breach in the defences affecting the wider floodcell (encompassing the Heol-Y-Llan housing estate and central Barmouth).	Failure of promenade and high probability of flood incident.	Regular monitoring of erosion processes & management required over the appraisal period. Works required to ensure public safety along the promenade (as a result of the loss of the assets).	The walk away option could lead to environmental impacts on the Pen Llyn ar Sarnnau SAC, the presence of the existing unmaintained infrastructure and defences would prevent a natural regression of the foreshore. The failure of the existing surface water and foul drainage systems could also lead to pollution marine incidents.	Loss of promenade amenity and does not meet OBC objectives.
Betterment of Existing Defences					
3	A. Business As Usual (++) Extend life-span of existing structure and general improvements through works to sheet piled toe of structure and improvements to the flood walls.	Likely to be locally sourced and relatively easily constructed.	Would not provide betterment to existing standard of protection despite significant cost.	No significant environmental impacts are predicted as part of this option.	Not considered to be suitable for lifetime of project as independent option. Maintains amenity value of frontage, with opportunity to improve public realm, aesthetics and landscaping.
	B. Business As Usual (++) Improvements to standard of protection of primary and flood walls through a range of measures, including raising the height, improving foundation and profile, and additional works to the toe of the structure.	Likely to be locally sourced. Issues with access to the beach to be considered. Disruption to the use of the promenade during Construction.	Aims to reduce rate of overtopping and on-going hazards to the promenade. Costs likely to be lower than other options. May not provide protection to the frontage over the 100 year appraisal period.	No environmentally sensitive receptors have been noted landward. A rock revetment could impact on beach habitat directly adjacent to the Pen Llyn ar Sarnnau SAC. Assessment is required as part of a Habitat Regulations Assessment (HRA).	Not considered to be suitable for lifetime of project as independent option. Maintains amenity value of frontage, with wider opportunities. Height of sea-wall raising works may be limited by visual amenity constraints.
Beach Management & Associated Structures					
4	A. Offshore Rock Breakwaters and Beach Recharge (coarser material)	Substantial work required. Tidal working restrictions will apply (and possibly seasonal to reduce impact on amenity). Potential	Options are likely to be expensive, and require an element of maintenance activities over the appraisal period.	Challenges with constructing the structures (on the shoreline/seabed) due to the presence of the SACs and	Magnitude of construction determined by level of protection required.

Barmouth North Promenade OBC

	B. Groynes and Beach Recharge (coarser material)	issues with sources of materials, transportation (e.g. by road or barge) and access to site (particularly when working inter-tidal zones).	They may potentially provide a better performance of reducing overtopping than Option 3.	sensitive habitats. Assessment is required as part of a Habitat Regulations Assessment (HRA).	Maintains amenity value of promenade. May limit walking along the shore-front. Potentially unattractive rock structures along the frontage.
	Managed Realignment				
5	A. New line of defence set back at the caravan park	Substantial work required, particularly in terms of the removal of the existing defences and relocation of existing residential properties.	Could be a long-term FCERM solution for Barmouth.	Loss of the existing hinterland habitat. Existing habitat is generally of low ecological value being largely developed.	Loss of Network Rail line— require an act of Parliament through legislation. The Railway is a major strategic transport link for Gwynedd.
	B. New line of defence set back at the Network Rail line		Of significant cost and associated risks. Works required to ensure public safety following decommissioning of existing defences and protect the neighbouring SMP2 Policy Units.		Whilst the amenity value of the promenade in this location will be lost, there may be an increase in the width of the shore-front providing a different amenity value.
	C. No further defence structure		Beach rollback expected to retreat to natural levels. Considered to be a walkaway scenario. Some active intervention and structures required to transition to SMP2 Policy Areas of Hold the Line.		As above. Option could pose significant risk to public health and safety without associated measures.
	Other Options				
6	Beach re-charge with material from Barmouth South Promenade	Likely to be locally sourced and relatively easily constructed.	Reduces protection to adjacent SMP2 policy areas. Significant maintenance costs as the fine material is expected to be drawn down rapidly.	Impacts on Pen Llyn ar Sarnau SAC would need to dully assessed and understood as part of the Habitats Regulations Assessment.	Maintains amenity value of promenade.
7	Sand Engine	Substantial work required. Tidal working restrictions will apply (and possibly seasonal to reduce impact on amenity). Potential issues with sources of materials, transportation and access to site.	A sand engine has potential to work from a coastal process viewpoint. The performance and requirements for on-going maintenance will have less certainty.	Significant environmental considerations (SACs) mean this option may not be viable. Intensive amount of environmental analysis and assessment required.	Increase in the width of the shore-front providing a different amenity value.
8	Property Level Protection	This option is discounted as it doesn't align with the Options Framework Filter or CSFs. However, it is recognised as potentially a complimentary option to support wider measures within the long-listing.			
9	Shoreline Management All Units	Beyond scope of Barmouth North Promenade OBC.			

5. Identify the Short List

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

The positive and negative technical issues associated with long-listed engineering options were also considered. The Shortlisted Options were selected within a workshop (January 2019) involving Gwynedd Council, Arup and ABPmer. The appraisal table is provided in **Appendix I** and summarised below.

Key	Meets in full	Meets in part	Does not Meet
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Table 24. Shortlist screening table

Ref	Description	Options Framework Filter	Investment Objectives	CSFs	Commentary	Shortlist or Discount
1&2	Baseline				Walkaway residual life is estimated at ~10 years. Does not safe-guard the local community at Barmouth in the long-term.	Economic Baseline
3	Betterment of Existing Defences		May not afford protection over 100 year appraisal		Option should be seeking an improvement/ betterment from the scheme as opposed singular options just extending the life-span.	Shortlisted
4	Beach management with supporting structures		May have limited affordability and environmental implications		Groynes/off-shore structure could be effective if used in conjunction with additional beach material. There are a number of option configurations to afford protection to sea-wall and revetment.	Shortlisted
5	Managed Realignment		May have limited affordability and environmental implications		Due to climate change and the SMP2 Policy, this option is a long-term solution. A new line of defence set back at the Network Rail Line is the most viable approach. There are concerns around the benefits available.	Shortlisted:
6	Beach re-charge with material from Barmouth South Promenade				The dune material is unsuitable for nourishment on this frontage. The majority of the sediment in the dunes is fine and would likely be drawn down and transported rapidly.	Discounted
7	Sand Engine				Not appropriate due to the associated high maintenance cost and long-term sustainability issues.	Discounted
8	Property Level Protection				Limited FCERM protection. This option is discounted as it doesn't align with the CSFs. Potentially a complimentary option to support wider measures within the long-listing.	Discounted
9	Shoreline Management All Units				Beyond scope of Barmouth North Promenade OBC. Option is discounted as it doesn't align with the Options Framework Filter or CSFs.	Discounted

It is recognised that each of these options may have varying life-spans across the 100-year appraisal period and SMP2 Policy Epochs.

6. Assessment of Short List

Overview of options

An overview of the proposed short-listed schemes is outlined below. **Appendix M** provides illustrations of the shortlisted options.

Table 25. Overview of shortlisted options

Option		Description
1	Baseline	Business As Usual Gwynedd Council reactive maintenance is not able to address the significant defects with the existing defences. Walkaway residual life is estimated at ~10 years ¹⁰ . Erosion at defence toe, loss of pile section and voids from loss of fines risks revetment failure and defence breach inundating the wider floodcell (Heol-Y-Llan housing estate and central Barmouth).
2	Betterment of existing defences	Works to extend the life-span and improve the standard of protection of the existing defences: • Extend the life of the existing sheet piles with refurbishment works. • Raise or replace the primary seawall (depending on structural condition and hydraulic performance) and flood wall. • Add protection to the structure toe in the form of a rock-toe or shingle beach profile (where stability allows). • Improve demountable barriers and drainage improvements
3	Beach Management and Associated Structures (i.e., groynes/breakwaters)	Combination of rock breakwaters offshore and/or shore-linked groynes to hold the placement of beach material and dissipate wave energy offshore. Coarser shingle beach re-charge material would be introduced to promote and encourage a sustainable beach level. Works to extend the life of the existing sheet piles required.
4	New line of defence set back at the railway (i.e., Managed Realignment)	New line of defence to protect the railway line, allowing the area directly behind the seawall to be subject to erosion. Options include: • Option 4a: Defence line set back along full length of promenade (as per 2011 SMP2) • Option 4b: Defence line set back along northern end of promenade only (protecting residential properties). Beach management (similar to Option 3) protecting properties to south.

6.1 Engineering performance of Short List

Following the selection of the shortlisted options, a full technical review was undertaken. A summary is provided below.

Table 26. Engineering performance of shortlisted options

Option		Commentary	Supporting Information
1	Baseline	No intervention. Evaluated as a baseline option for the economic appraisal.	Appendix A: Economic Appraisal (Arup, 2019)
2	Betterment of existing defences	The crest of the defences is presently 5.8mAOD. Visual amenity constraints mean the primary defences can be raised by 450mm to a crest level of 6.25mAOD (1.25m in height) ¹¹ . This would reduce overtopping to <200l/s/m for all 1in200 year events up to 2069, subject to further detailed modelling. Gwynedd Council would be required to restrict access to the promenade during overtopping conditions as this is significantly in excess of guidance for publicly accessible locations.	Appendix B – Wave Modelling and Overtopping Study (ABPmer, 2019)

¹⁰ Please refer to Barmouth OBC Appendix E: Arup, Existing Coastal Defence Assessment, 2019, for further information.

¹¹ As outlined in Appendix B, to achieve an overtopping rate of < 200 l/s/m (EuroTop, 2018) for all events up to a 1in200 year event (2119), a 7mAOD crest height (2m in height) is required.

		The flood wall is proposed to be structurally re-built to 6.25-7mAOD - to contain overtopping waters between the highway and the primary defences. <u>These works would support a Standard of Protection (SOP) against flood risk to properties of up to 1in50 annual chance events up to 2069¹².</u> Beyond Epoch 2 (2069) further measures may be required to manage an increasing risk of flooding due to climate change.	
3	Beach Management and Associated Structures (i.e. groynes/breakwaters)	The minimal beach profile for a nourished beach is a beach crest height of 6mAOD (2019) to 7.1mAOD (2119) and a crest width of 15m. Structures may be a form of rock groynes and/or offshore breakwaters. Although sediment losses are not considered to be significant, allowances for beach loss should form part of the on-going maintenance. The coastal process effects of the options on the adjacent shorelines is likely to be minimal. Local effects would need to be investigated as part of design development. <u>This option would provide 1in200 year + CC SOP up to 2119¹³,</u> subject to further detailed modelling. A crest of 7.1mAOD is significantly higher than the existing promenade, issues around visual amenity and practically may require a lower crest level and SOP to be provided.	Appendix I: Beach Nourishment Option Assessment (ABPmer, 2019)
4	New line of defence set back at the railway (i.e., Managed Realignment)	The option will replace the existing defences and set them back further in-land (managed realignment) to protect the Railway Line to encourage a larger more sustainable beach profile (reducing the risk of overtopping and maintenance activities). The SOP achieved is expected to be defined by the new line of defence. <u>It is envisioned a SOP of 1 in 200year + CC to 2119</u> would be achievable. Groynes are likely to be required to afford protection to the neighbouring policy units. Challenges around decommissioning of existing defences and land-use will need to be overcome. <i>Option 4a</i> would require several existing residential and commercial properties may need to be re-located. <i>Option 4b</i> likely to require beach management (similar to Option 3) to protect properties to south.	Appendix I: Managed Realignment Technical Note (Arup, 2019)

6.2 Sustainability and well-being performance of Short List

A summary of the sustainability and well-being performance of the shortlisted options is provided below. Please refer to **Appendix N** for a summary of how each option contributes towards the delivery of the Well-Being of Future Generations Act Goals and Ways of Working.

Table 27. Sustainability and well-being of shortlisted options

Option	Commentary	Additional Supporting Information
1 Baseline	Does not safeguard the local community at Barmouth in the long-term and poses a significant risk to life without further intervention. This approach does not align with the FBFGA Well-Being Goals. It would have negative implications on the prosperity, resilience, health, equality, cohesive communities, culture and global well-being by putting Barmouth North Promenade and adjacent SMP2 Policy units at risk of flooding and coastal erosion.	

¹² Based on indicative assessment of overtopping rates vs storage between the existing promenade and highway. SOP to be confirmed by further modelling.

¹³ Based on the performance of the shingle/cobble bank to the north of the study area during the January 2014 storm event (understood to have an AEP of around 0.5%).

2	Betterment of existing defences	No significant environmental impacts are predicted as part of this option – any construction impacts are minimal and temporary. Option protects Barmouth North Promenade and maintains health & well-being and recreational benefits the promenade affords. Provides opportunities to further improve the amenity and environmental value of the promenade.	Appendix F: Environmental Appraisal (Gwynedd Council, 2019)
3	Beach Management and Associated Structures (i.e., groynes/breakwaters)	Any offshore structure is likely to be placed within the Pen Llyn ar Sarnau SAC could result direct habitat loss and change the localised sediment movement. A full assessment would be required as part of a Habitat Regulations Assessment (HRA) for the option. Implementation of this option would protect the communities at Barmouth and maintain social and recreational benefits. There are issues around visual amenity constraints. The use of groynes and offshore breakwaters may reduce the amenity and recreational value of the northern extents of the foreshore through limiting access.	
4	New line of defence set back at the railway (i.e., Managed Realignment)	The managed re-alignment of the foreshore would lead to some loss of the existing hinterland habitat which is generally of low ecological value being largely developed. There is a limited opportunity to increase marine habitats. Option 4a could involve the loss of up to ~57 ¹⁴ local residential and commercial properties (including the Heol-Y-Llan Housing Estate). This could have negative implications on the local communities' health (e.g. mental health and stress, particularly for vulnerable residents), community cohesion (e.g. dissatisfaction and split of treatment between Barmouth North and South) and loss of local culture. Option 4b affects one commercial property and may provide an opportunity to minimise these impacts. During the public consultation event (25th March 2019), residents highlighted the full length of the promenade is considered a significant asset – both from a tourism and amenity perspective.	Appendix I: Managed Realignment Technical Note (Arup, 2019) Appendix F: Environmental Appraisal (Gwynedd Council, 2019)

6.3 Economic performance of Short List

The assessment of benefits has been undertaken in accordance with the Welsh Government (Trial) Flood and Coastal Erosion Risk Management appraisal guidance (FCRM-AG) issued in 2018; Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities issued in December 2017; the Multi-Coloured Manual 2018, and the 'Green Book' (HM Treasury, 2018). Figures in the Multi-Coloured Manual have been updated to April 2021 values using the Consumer Price Index available from the Office for National Statistics. Full details of the economic appraisal are provided in **Appendix A**.

To support the economic appraisal, hydraulic modelling (**Appendix B**) determined inundation flood extents and characteristics, including:

- **Baseline:** Modelled Business As Usual as the 'Baseline' Scenario (2019, 2069 and 2119 Epochs) and sensitivity testing of the Walkaway scenario. Prediction sensitivity to breaches in walls¹⁵ was tested and demonstrated. For the modelled 'Baseline' Scenario, the primary wall is assumed to remain in-situ; a conservative approach.
- **Do-Something Options:**
 - Option 2 (Betterment of Existing Defence) scenarios were modelled to test options to reduce the risk of overtopping across the three epochs (2019, 2069 and 2119)¹⁶, assessing residual surface water / ordinary watercourse flood risk.

¹⁴ As identified within Flood Cell 3 – Please refer to Appendix A for further information.

¹⁵ Up to four stretches of breaches included within the modelled scenarios for the flood walls.

¹⁶ Appendix B: ABPmer Wave Modelling Study

- Desk-top studies examined Option 3 (Beach Management) and Option 4 (Managed Realignment)¹⁷.
- A range of SOPs (1 in 50, 1 in 100 and 1 in 200 for 2019 and 2069) were modelled to inform a cost-benefit analysis. Residual annual average damages of these options are calculated allowing for residual surface water flood risk during events of a lesser magnitude.
- Predicted rates of overtopping exceeded industry analytical methods and so modelling is only available for 2019 and 2069 epochs. The high degree of properties' value capping (due to the early onset of flooding) reduces the implication of this limitation on the business case.

6.3.1 Baseline Scenario Damages (Appendix A)

As described in **Section 4**, the residual life of the sea-wall and revetment is estimated to be <10 years. On-going deterioration will lead to failure of the sea-wall and revetment, leading to a breach in the defences and associated risks of tidal and overtopping inundation. Existing highway drainage, culverts and outfalls (including flap-valves) will cease to operate effectively and exacerbate drainage issues causing flooding upstream. Beyond the initial loss of the promenade, the potential erosion rates for Barmouth North Promenade have been estimated in the SMP2 by Royal Haskoning are predicted to be between 30 and 120m¹⁸ over the appraisal period.

The following related monetary benefits/damages avoided have been identified, conservatively not considering the impact of breaches/failures:

Flooding (coastal and fluvial/pluvial)

- **Flooding to the wider flood-cell of Barmouth North Promenade;** including Barmouth South (SMP2 Policy Unit 11.14) and Llanaber (SMP2 Policy Unit 11.16). Table 26 summarises the number of properties likely to be affected by flooding over the appraisal period. Despite current operation/ maintenance activities some 757 properties have greater than a 1 in 100 chance of coastal and/or surface water flooding in any year.

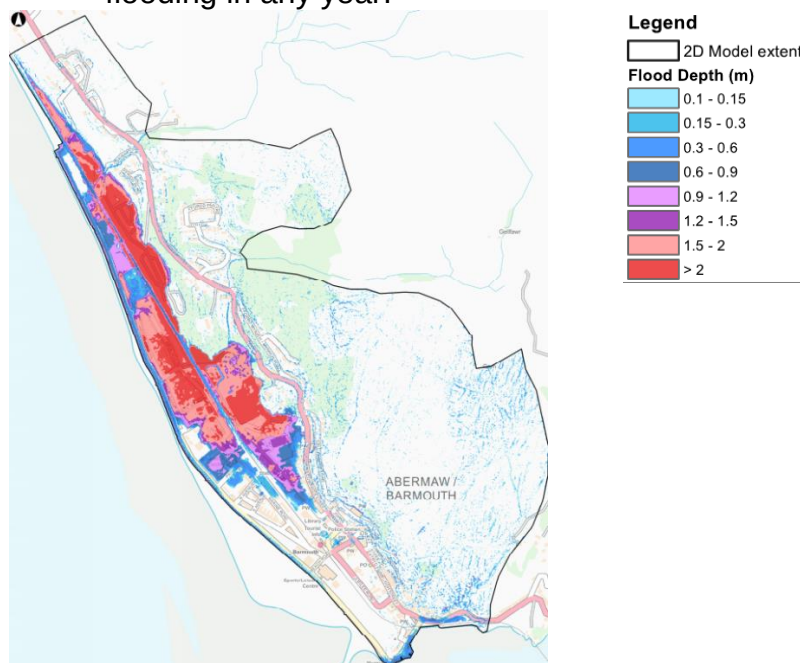


Figure 24. Baseline Flood Depths (2019) Combined 1 in 200 year event

¹⁷ **Appendix I:** Beach Nourishment Option Assessment (ABPmer, 2019) and **Appendix I:** Managed Realignment Technical Note (Arup, 2019)

¹⁸ Assuming no active intervention (NAI) at Barmouth and the surrounding areas (refer to Appendix A for further information).

Table 28. Baseline (assuming no breach) property count for the epochs including climate change¹⁹

	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	>757	>760	>761	>261	>261	>538	>757	>760	>761

Continued **erosion** of the frontage causing recession of the shoreline and:

- **Loss of properties due to erosion:** There are up to 60 properties within the anticipated erosion band over the next 100 years. Most of the properties affected are residential.
- **Cambrian Coast Railway:** Provides a strategic public transport link to coastal towns in west Wales, including Barmouth. Disruptions to this asset would have heavy economic and social implications to the wider county of Gwynedd. Loss of railway service beyond Barmouth would affect 17 stations with considerable social well-being, health and community cohesion implications. It will limit communities' and tourists' ability to access neighbouring services/facilities and maintain social connections. Reducing public transport links is against the objectives of the Anglesey and Gwynedd JLDP (2016-2026).
- **Loss of recreational value of Barmouth North Promenade:** The loss of Barmouth North Promenade and car-parking facilities would reduce the visitor appeal of Barmouth as a whole due to the unsightly nature of the northern extents.
- **Damages to highways and utilities infrastructure:** Two non-main river outfalls (and pumping station) are likely to required replacement once they have failed.

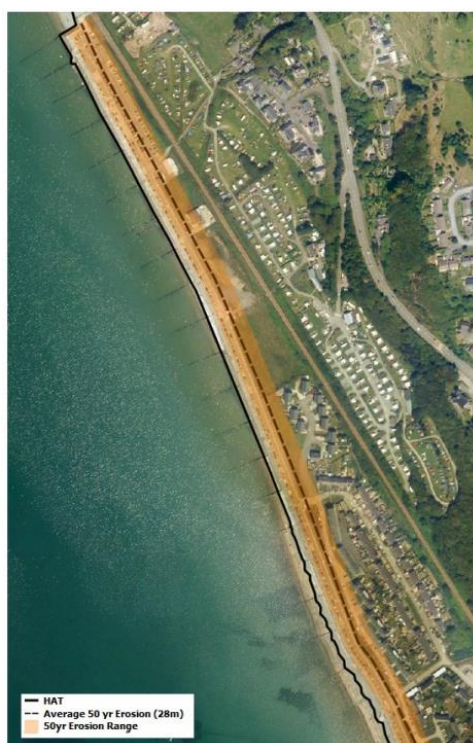


Figure 25. Potential erosion over 50 year period based on SMP2 NAI scenario

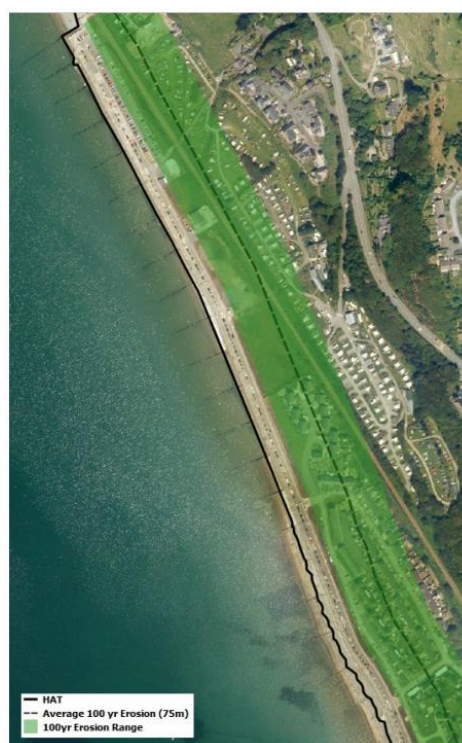


Figure 26. Potential erosion over 100 year period based on SMP2 NAI scenario

¹⁹ Note that the number of properties incurring damage in the present day for the 1 in 200yr and 1 in 1000yr event greatly exceeds that of CC2069 and CC2119. This is due to the scenarios modelled, and the limitations encountered in assessing wave overtopping as discussed in both the wave and inundation modelling reports.

²⁰ 35.8% of Barmouth residents have no access to a car (2011 Census)

In terms of economic benefits from coastal flood and erosion risk management that are admissible by the Multi Coloured Manual are summarised below.

Table 29. Summary of benefits economic appraisal

Component	(£k) Present Value Damages	Key areas of uncertainty
Flood Related Damages		
Flood damages avoided – related to damages to residential and non-residential properties, risks to life, vehicle damages, emergency services and utilities damages.	£99,767	Extents and severity of flooding. Defence failure/breach due to defects such as voiding.
Erosion Related Damages		
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 ²¹ and safeguarding of this asset is imperative]	Due to significant cost uncertainties, 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.
Damage to utilities infrastructure (services replacement)	£100	Cost of diversion works & replacement services.
Total	£99,867	
A precautionary and conservative approach has been applied to the assessment. Predicted rates of overtopping exceeded industry analytical methods and so modelling is only available for 2019 and 2069 epochs. The high degree of properties' value capping (due to the early onset of flooding) minimises the implication of this limitation on the business case. Significant potential damages are excluded due to uncertainties. In addition to excluded property erosion, loss of the Cambrian Coastal Railway and recreational benefits noted above; no breaches were represented. Baseline defence residual life is <10 years and sensitivity assessment showed breach impact would be significant.		

6.3.2 Do-Something Options Benefits (Appendix A)

Within the economic assessment, each option assessed represents a different standard of protection (onset of flooding, with allowance for residual uncertainty or freeboard). The resulting capped present value damages (PVD) associated with the options are shown in the table below.

Predicted rates of overtopping exceeded industry practice methods and so modelling is only available for 2019 and 2069 epochs.

²¹ To provide a scale to the value of these assets, following the unprecedented storm damage in 2014, Network Rail undertook a programme to repair the section of the line from Barmouth to Pwllheli. The anticipated final cost for the full works to re-open the Cambrian coast railway was estimated to be in the region of £10m.

Table 30. Summary of predicted present value (discounted) benefits of avoided flood and erosion damages and intangible benefits over appraisal period (2019-2119) of options constructed on a precautionary basis

Standards of Protection	NPV	Present Value
	(£k)	(£k)
Baseline	99,867	0
1 in 200 yr. (2019)	32,371	67,396
1 in 100 yr. (2019)	37,662	62,104
1 in 50 yr. (2019)	89,774	9,992
1 in 200 year (2069)	16,604	83,162
1 in 100 year (2069)	12,855	86,912
1 in 50 year (2069)	29,229	70,538

Managed Realignment

Benefits have been defined for Do-Something Option 4a: Managed Realignment (SMP2) and Option 4b: Managed Realignment (North Only) implemented now (Year 0) or in Epoch 2 (Year 20). The flood damages/benefits associated with the lost/relocated properties have been excluded. The assessment illustrates damages within Year 0-20 are significant, supporting the justification of implementing a solution in Epoch 1.

Table 31. Summary of predicted present value (discounted) benefits

Standards of Protection, Managed Realignment	NPV	Present Value
	(£k)	(£k)
MR (SMP2) - 1 in 200 year (2069)	16,194	68,896
MR (SMP2) – 1 in 50 year (2069)	26,681	58,409
MR (North Only) - 1 in 200 year (2069)	16,596	82,929
MR (North Only) – 1 in 50 year	29,229	70,296
MR (SMP2) – 1 in 200 year implemented in Epoch 2 (Year 20)	Property damage <i>only</i> ²² equates to £46,174	Property benefits <i>only</i> equates to £10,945
MR (North Only) – 1 in 200 year implemented in Epoch 2 (Year 20)	Property damage <i>only</i> equates to £55,256	Property benefits <i>only</i> equates to £10,985

²² An initial assessment was undertaken for the property damages only (i.e. excluding emergency services, utilities, vehicle damage and risk to life). Due to this assessment, this option was not taken forward for further economic assessment and consideration.

6.3.4 Additional Benefits



Figure 27. Barmouth Beach²³

A review of the wider benefits associated with Barmouth North Promenade has been undertaken. Please refer to **Appendix K** to review the plan mapping the Wider Benefit opportunities. Key highlights are outlined below:

- **Health and Well-Being:** Beaches and promenades can play an important part in facilitating physical activity. Intangible health benefits reflect the longer term personal impact of flooding on the health and wellbeing of those affected.
- **Construction and employment:** During construction the scheme is likely to generate approximately 13.3 jobs per £1million spend. Training and apprenticeships will help to make sure that young people living in Barmouth and indeed other parts of Gwynedd are able to benefit directly from the scheme. Local procurement where possible will help to ensure that wider supply chain benefits are remain within North Wales where possible and help to support local businesses.
- **Amenity and Recreational Value:** Tourism is a major component of the local economy, a scheme would look to safeguard the wider town and provide opportunities for improving the promenade and access to the beach.

Placemaking opportunities such as beach access, dwell spaces and facilities, and improved connectivity and wayfinding have the potential to leverage the less-used asset, broadening the appeal of Barmouth and reducing pressure on the popular South Promenade area.

6.3.5 Costs

The present value preliminary cost of each option has been calculated using the discount rates included in Defra's Supplementary Note to Operating Authorities (Revisions to economic appraisal procedures arising from the new HM Treasury "Green Book", March 2018).

Scheme delivery costs were estimated based on recent FCERM scheme unit cost information, collated by the Environment Agency. This information was supplemented by information from recent Welsh coastal and Gwynedd Council schemes (e.g. Tywyn (2011)). The inspection and future maintenance costs have been developed based on the present regime undertaken by Gwynedd Council .

²³ <http://www.visitmidwales.co.uk/Barmouth-Barmouth-Beach/details/?dms=3&venue=1162790>

Table 32. Proposed scheme preliminary costs (PV £k)

	Option 2	Option 3	Option 4a (Full Study Area)	Option 4b (North Only)	Notes - assumptions, source(s) and dates
OBC to construction:					
Staff costs (Gwynedd Council)	£73	£73	£146	£146	Project management costs (Gwynedd Council , 2019)
Site investigation and surveys	£60	£40	£5,021	£1,874	
Consultants' fees (Outline and Detail Design)	£502	£1,765	£865	£961	Assume 5% of capital construction cost for detailed design stage
Early Contractor Involvement	£25	£25	£25	£25	One off cost
Other costs (specify)	£32	£32	£120	£120	Includes marine licence, consent, monitoring and stakeholder engagement
Optimism Bias	£207	£581	£1,853	£1,381	30% applied to 'OBC to Construction'
Subtotal	£899	£2,516	£8,029	£5,983	
Construction:					
Construction costs	£10,035	£35,307	£17,291	£19,212	PV Capital cost, based on estimates from Tywyn coastal scheme (2011). Includes: - Preliminaries, overheads and profit: 25% - Contingency (including inflation): 15% Option 4: New line of defence estimated from: EA - SC080039 Cost Estimation for Coastal Protection (2007). Includes decommissioning costs.
Utility diversions	-	-	-	-	No diversions anticipated as part of the scheme, based on initial review
Land purchase & compensation	-	-	£12,244	£500	Option 4: Managed Realignment - Assume 57 properties (Option 4a) and 1 property (Option 4b) compensated at value of property in 2019. Assumption subject to further review at detailed design. - £250,000 land purchase costs (Gwynedd Council , 2019)
Optimism Bias	£6,021	£21,184	£17,722	£11,827	60% applied – due to uncertainty pending ongoing study and further survey requirements.
Subtotal	£16,055	£56,492	£47,257	£31,539	
Future costs (scheme implemented at Year 0):					
Maintenance (PV)	£38	£1,790	£45	£45	
Future construction (PV)	-	-	-	-	
Optimism Bias	£23	£1,074	£27	£27	60% applied – as detailed above
Subtotal	£62	£2,864	£72	£72	
Total	£17,016	£61,872	£55,359	£37,594	

It is recognised:

- The SMP2 Policy for Barmouth North Promenade recommends moving towards a policy of 'Managed Realignment' in Epoch 2 (from Year 20).
- Overtopping is significant at Barmouth, therefore the Do-Something Options' focus is to reduce flood risk to property, as opposed to alleviating overtopping.

- A combination of Do-Something options may offer additional or enhanced benefits (particularly those with a shorter life-span).

Therefore, best-practice adaptive pathways approach has been followed. This allows investing now in actions to manage today's risks, monitoring the change in risk over time (such as due to the impact of climate change) and managing these changes. A managed adaptive approach involves planning for multiple interventions and investments in the future, although the future choices and the timing of these interventions will be uncertain.

The following pathways of combinations of short-listed option across the SMP2 policy epochs were appraised. It is recommended that this process is developed further at the next stage to define detailed pathways which include monitoring and evaluation processes, key milestones or trigger points and associated downstream pathways.

Table 33. Adaptive pathway scenarios considered for the economic assessment

Table 55: Adaptive pathway scenarios considered for the economic assessment			
	Epoch 1 0-20 years	Epoch 2 20-50 years	Epoch 3 50-100 years
Pathway A	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 4: Managed Realignment (SMP2) <i>Adaptive SOP 1 in 200</i>
Pathway B	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 4: Managed Realignment (SMP2) <i>Adaptive SOP 1 in 200</i>	
Pathway C	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>
Pathway D	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>	
Pathway E	Option 3: Beach Management <i>Adaptive SOP 1 in 200</i>		
Pathway F	Option 2 + Option 3 <i>Adaptive SOP 1 in 200</i>		
Pathway G	Option 2: Betterment of defences <i>Precautionary SOP reducing to 1 in 50 by 2069</i>		Option 4b: Managed Realignment (North Only) <i>Adaptive SOP 1 in 200</i>
Pathway H	Option 2: Betterment of defences <i>SOP 1 in 200 in 2019</i>	Option 4b: Managed Realignment (North Only) <i>Adaptive SOP 1 in 200</i>	

6.3.6 Benefit Summary (Appendix A)

Capped PVD damages, the net benefit of implementing each of the options, and the project costs have been used calculate the benefit cost ratios. Benefit-cost ratios are provided below in Table 34. A precautionary approach has been taken throughout, as such the benefits identified are considered conservative.

Table 34. Benefit Summary Table

Pathway	PV Flood Damages	PV Flood Benefits	PV Costs	Benefit Cost Ratio	Incremental Benefit Cost Ratio
	(£k)	(£k)	(£k)		
Baseline	£99,867	£0			
Pathway G	£29,221	£70,304	£26,395	2.7	
Pathway A	£26,681	£58,409	£30,639	1.9	0.0
Pathway C	£29,229	£70,538	£31,384	2.2	0.0
Pathway H	£16,596	£82,929	£37,540	2.2	1.1
Pathway B	£16,194	£68,896	£46,949	1.5	0.0
Pathway D	£16,604	£83,163	£48,668	1.7	0.7
Pathway E	£16,604	£83,163	£62,453	1.3	0.0
Pathway F	£16,604	£83,163	£79,676	1.0	0.0

The economically preferred approach is Pathway G, which offers a Benefit Cost Ratio of at least 1:2.7.

6.4 Financial performance of Short List

Each of the Options were assessed against opportunities for wider funding contribution. Interventions that also provide wider benefits, especially community benefits, are more likely to be able to attract third-party funding – as outlined below.

Table 35. Financial performance of option

Option		Commentary
1	Baseline	Significant damages risks to property, life and the wider tourist town of Barmouth.
2	Betterment of existing defences	Option of least cost in terms of capital and operation costs. Option looks to afford protection to the frontage over the medium term. Opportunities for third party funding appear limited, although potentially most attractive.
3	Beach Management and associated structures	Option looks to afford protection to the frontage over the medium to long term, however is still of significant cost (higher than Option 2). Opportunities for third party funding appear limited.
4	New line of defence set back at the railway	High capital and decommissioning costs. Significant risks associated with funding structures and mechanisms. Option is likely to require government support and funding (i.e. relocation of community) to take forward.

Gwynedd Council consider there are limited external funding options for Barmouth North Promenade. It is recommended this is revisited at Detailed Design.

6.5 Select the Preferred Option

A collaborative workshop, with Gwynedd Council, ABPmer and Arup was undertaken in April 2019 to select the preferred option. This was informed by the public stakeholder engagement event (**Section 8**). A summary shortlist appraisal matrix in **Appendix I**.

In summary:

- A 'Walkaway' or 'Business As Usual' approach was discounted as it does not safeguard the local community at Barmouth in the long-term, and poses a significant risk to life without further intervention.
- Option 3: Beach Management is costly. Significant quantities of beach material are required to build out the beach profile with ongoing long-term maintenance. The height of the crest is significant and may present consenting/construction issues.

- Option 4: Managed Realignment has limited gain due to the limited land gained seaward as a result of the realignment, at the expense of a significant number of properties and assets. There are significant risks to remove the existing defences and replace the defences inland. The situation of the Cambrian Railway and adjacent SMP2 Policy Areas ('Hold the Line') requires that a new defence alignment is constructed inland; whilst the existing defences cannot be abandoned without significant investment to be safely decommissioned. Habitat creation and wider benefits appear constrained by limited land-gain. Significant expenditure will be required to re-route the promenade and Wales Coast Path to maintain amenity. To realign the full length of study frontage (Option 4a) requires the removal of some ~57 existing properties. To realign the northern half of the study frontage (Option 4b) reduces the impact to one commercial property. The northern frontage comprises undeveloped made-ground - further surveys and design are needed to scope decommissioning works. The southern developed frontage would require works to safeguard the existing properties, and beach management to 'Hold the Line' is proposed.
- The promenade is at significant risk of failure (i.e. considered <10 year life-span remaining), with early on-set of flooding. As such, there is a need to undertake significant works now, which are considered beyond a 'Business As Usual' scenario. Gwynedd Council (2019) confirmed they have now closed the promenade at the north-most end due to public safety fears.

Preferred Approach:

Option 2: Betterment of the existing defences provides the most economically favourable option and is anticipated to achieve a 1in50 2069 SOP. It would safeguard the community and the recreational value of the promenade in the medium term.

Beyond 2069, managing coastal risk is increasingly challenging. The most economically favourable option is to transition to Option 4b - a form of managed realignment (to the northern extents only), with beach management activities to the south. This pathway approach:

- Allows the community to continue to gain tourism, social & well-being benefits from the promenade for a significant duration of the scheme.
- Safeguards residential properties (including a number of social housing properties).
- Provides flexibility for the uncertainty of climate change. Option 2 can be monitored and the life-span of the promenade extended as much as possible. If sea-level rise and climate change occurs beyond expectations, this pathway retains flexibility for the community/scheme to be adapted as appropriate.
- Provides an extended time-frame for funding mechanisms to be implemented which support managed realignment schemes.

Therefore, there is a positive economic, environmental, social and financial case which justifies undertaking work along the frontage in the medium term (Epoch 1 and 2), transitioning to a form of managed realignment in the long-term (Epoch 3).

7. Further development and testing of Preferred Option

We are seeking the approval of Epoch 1 works. As such, Option 2: Betterment of Existing Defences has been developed to an 'outline design' level. Please refer to **Appendix J** for full details and outline drawings. A scheme considering transitioning to managed realignment is expected to be developed in the future and as such, remains at shortlisted scheme design.

Since the last issue of this OBC, further work has been carried out to reduce uncertainties associated with the preferred option for Epoch 1 works, Betterment of Existing Defences. The outline design, the construction and whole life cost and the optimism bias have been reviewed accordingly. The additional work included:

- Shoreline modelling to investigate the likely stability of the nourished beach to be built to protect the primary sea wall. Please refer to Appendix C for full details.
- Geophysical Surveys to investigate the current condition of the defences surface with a focus on identifying the location and characterisation of shallow voids.
- Quantified risk assessment for the project. Please refer to Appendix H for full details.
- Early Contractor Involvement whose input focused on buildability, construction cost and quantified risk assessment. Please refer to Appendix P for full details.

7.1 Outline Design and Reassessment of Costs (Appendix J)

Wave loading at Barmouth North Promenade is expected to be significant. Initially the preferred option involved improvements to raise the primary wave wall and enhance the wave recurve. However without full construction information or surveys on the existing primary wall (see limitations below), the business case cannot assume such works would not destabilise or undermine the performance of the existing defences. As the primary wall withstands significant storm events at present²⁴, to avoid disturbance/destabilisation a new set back flood wall structure is proposed aligned between the promenade/highway to reduce overtopping beyond the promenade. The preferred option proposes some works to the north of the site owned by Network Rail (NR), it is assumed that NR will contribute to the scheme in-kind through partnership agreement i.e. costs currently exclude BAPA and provisions for line possession.

The final form of the preferred option is outlined below:

Table 36. Preferred Option Details

	Design Details	Extents	Quantities
Rock toe or shingle beach profile	• Rock revetment to provide protection to sheet piles. • Assumed 1-3t rock, with an underlayer of 100-300kg rock (to be confirmed at detailed design) • Total depth of 2.4m below top of revetment to minimise scour and on-going beach draw down. Where coastal processes allow, a shingle beach profile is to be implemented to protect the frontage and reduce overtopping.	0.8km of 1.2km promenade. Extent of rock toe vs. shingle beach profile to be determined at detailed design.	Rock toe: 9,900t Underlayer: 2,800t (Assumed 400m extents) <i>Supply, transport and placement of 3 – 6t rock by barge. Floating plant or jack-up barge for rock placement.</i> Shingle: 72,400m³ (Assumed 600m extents)

²⁴ The 2014 January storm event was indicated to be a 1in200 year event.

	Design Details	Extents	Quantities
	Includes refurbishment of culverted outfall and reinstatement of flap valve.		<i>Supply, transport and placement of material (shingle) by road.</i>
Alternative primary wall (at the location of the current promenade highway wall)	- Alternative primary wall to be rebuilt and raised by 600mm to 6.25mAOD (450mm above the height of the existing primary wall) - Total height 1.1m - Cast in-situ reinforced concrete stem wall with mass foundation - Reinstatement of promenade and highway. - Drainage improvements.	Full length of promenade	N/A
Flood wall	- Flood wall to be rebuilt and raised by 450mm to 6.85mAOD - Total height 1.25m - Cast in-situ reinforced concrete stem wall with masonry cladding - Reinstatement of pavement and highway. - Allowance for landscaping - Demountable flood defences (x2)	Full length of promenade	N/A
Refurbishment of sheet piles	- Sheet piles (length to be determined) to be constructed adjacent to existing sheet piles where there is significant degradation and exposure. - Concrete binding and capping beam to be constructed to tie into the existing structure.	515m	N/A
Other	- Allowance for remediation works for voiding of promenade (as per Gwynedd Council cost estimate) - Allowance for additional flood mitigation measures north of site extents (in conjunction with Network Rail)	To be developed at detailed design	
Opportunities	- Improved access and seating facilities - Finish of structures - Incorporation of art installation or educational features - Environmental enhancement of study area - Further amenity or wider benefits	To be developed at detailed design	

Additional maintenance activities likely to be required:

- Inspections (annually)
- Minor concrete repairs to primary and flood walls (every 20 years)
- Maintenance of rock armour (every 20 years)
- Allowance for beach re-nourishment and reinstatement (every 50 years) (c. £100k of shingle assumed).

2.1.4 Environmental Considerations

An Initial Environmental Appraisal (**Appendix J**) has been undertaken for the preferred option and outlines a series of recommendations. No significant environmental implications are expected as a result of the scheme. Direct habitat loss from the SAC will not occur. However, a further detailed assessment will be required to understand the nature of any indirect impacts on the SAC caused by the import of beach material and the effect of the new rock revetment on the beach.

EIA screening and a Marine licence will be required as work will take place within mean high water tables and is considered beyond 'maintenance and reconstruction' activities. It is recommended that landscape impacts (including views out to sea), are discussed with the Local Planning Authority as the design develops. The scheme design should further look to minimise impact on local wildlife sites or the impact will need to be successfully mitigated in liaison with Gwynedd Council's biodiversity unit.

Opportunities to integrate ecological enhancements to the new and existing coastal defences will be explored during detailed design. Opportunities will be limited in locations most exposed to wave action, however areas for artificial rocky-reefs, rockpools, crevices and rough surfaces to enable more biodiverse communities to thrive.

Gwynedd Council are looking to consult with NRW to discuss the preferred option and the scoping assessment required for the scheme.

7.1.2 Wider Benefits

The scheme will protect and maintain the existing promenade for both recreational and amenity use by tourists and local residents. It further provides the opportunity to refurbish or enhance aspects of the promenade. There are opportunities to generate clusters of activity along the coastline to break monotony and attract users beyond the town centre.

The updated OBC has allowed for a high level public realm's enhancement budget to provide four dwell areas placed strategically with enhanced facilities. Placemaking opportunities such as beach access, dwell spaces and facilities, and improved connectivity and wayfinding have the potential to leverage the less-used asset, broadening the appeal of Barmouth and reducing pressure on the popular South Promenade area. The vision, strategy and detailed interventions are to be determined in the next stage, informed by stakeholder engagement.

7.1.3 Limitations and Recommendations

Please refer to **Appendix J** for the risks and design assumptions register. Key recommendations are below:

- There is limited information on construction details of the existing revetment (1950s) and sea-wall (constructed subsequently). It is recommended that intrusive/non-intrusive surveys are undertaken at detailed design to understand the performance of primary wall and revetment. The scheme's proposals should be revised accordingly.
- Physical modelling is required at detailed design to understand the wave loading expected to be experienced at Barmouth North Promenade over the design life of the scheme. Decision making will be required in relation to allowed damage to walls and return period for structural capacity design (i.e. SOP the scheme can provide).
- Significant residual overtopping to the promenade is predicted. Gwynedd Council will need to monitor and close the promenade / highway during significant storm events.
- A full adaptive pathway should be developed at the next stage – defining milestones, trigger points and monitoring requirements. Proposals for a form of managed

realignment should be developed in further detail. Early and extensive stakeholder engagement is recommended to minimise any negative implications.

7.1.4 Reassessment of Costs

As a result of the design development, a reassessment of the scheme's costs and the economic performance is outlined below. This is supplemented by the costs for Option 4b: Managed Realignment which are based on the shortlisting option scheme development.

Table 37. Preferred Option Costing

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
Council staff costs	£115	£115	Gwynedd Council costs (2021 weekly rate)
Consultant fees	£506	£506	Assume 5% of construction cost for detailed design stage. Costs to include further detailed modelling to support the detailed design analysis.
Cost consultant	£19	£19	1 day/week for 45 weeks for £55/hr
Site investigation/survey	£78	£78	- o Trial pits along the promenade for the proposed primary/flood wall and at existing sheet pile - o Structural coring of the existing wall - o Beach windowless sampling, plus boreholes to inform the settlement analysis and foundation details of the proposed rock armour. Will also inform temporary works design and sheet pile refurbishment. Includes 10% contingency.
Utility Diversions	£0	£0	No diversions anticipated, based on initial review. QRA allows for protection of sea outfall.
Early Contractor Involvement	£25	£25	Approach informed by procurement model.
Other	£33	£33	Marine licencing and stakeholder engagement
Optimism bias	£193	£193	26% applied to 'OBC to Construction' costs due to uncertainty pending ongoing study and further survey.
<i>OBC-Construction Subtotal</i>	<i>£969</i>	<i>£969</i>	<i>Assumed to occur in Year 0.</i>
Construction and Construction Support	£17,682	£17,682	PV Capital cost, based on estimate from YGC's Early Contractor Advisor. Includes: - o Preliminaries: 36 weeks at £25,000/wks. - o Material stock piling: 52 weeks at £5,000/wks. - o Profit + overheads: 10% of total direct cost + preliminaries + material stock piling - o Quantified Risk Assessment 95%ile (Appendix H). Construction Period: May 2022 to December 2022
Optimism bias	£4,597	£4,597	26% applied to 'OBC-Construction' and 'Construction' costs due to uncertainty pre- survey and design.
<i>Subtotal</i>	<i>£23,248</i>	<i>£23,248</i>	
Future costs (maintenance)	£178	£403	PV Maintenance cost to include minor concrete repair works to sea wall, promenade and reseating of the rock armour and reinstatement of shingle.
Optimism bias	£107	£242	60% applied to 'OBC to Construction' and 'Construction' costs due to uncertainty pending ongoing study and further survey.
Total	£23,533	£23,893	

Note, that costs have been refined from shortlisting stage.

Table 38. Preferred Option Costing for Future Managed Realignment (as per shortlisted costs)

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
Staff costs (Gwynedd Council) (Year 50-55)	£32	£147	Project management costs (Gwynedd Council , 2019)

Site investigation and surveys (Year 50)	£562	£2,462	Option 4: Managed Realignment – EA: SC080039 Cost Estimation for Managed Realignment; suggests that although highly variable, the average pre-implementation costs associated with design, surveys, modelling and consultation are 17% of the total cost.
Consultants' fees (Outline and Detail Design) (Year 50)	£330	£1,448	Assume 10% of construction cost for detailed design stage (based on Environment Agency guidance for Local Authority schemes >£1m)
Early Contractor Involvement (Year 50)	£6	£25	One off cost to include drawings review, based on previous project experience.
Other costs (specify)	£14	£60	Includes marine licence, consent, monitoring and stakeholder engagement
OBC to Construction Subtotal	£943	£4,142	
Capital Construction Costs (Year 50-55)	£3,116	£14,481	PV Capital cost, informed by Tywyn coastal scheme costs. Includes: - Preliminaries, overheads and profit: 25% - Contingency (including inflation): 15% <i>Shingle beach recharge assumes majority of beach material from implementation of Option 2 is maintained and reinstated.</i>
Land purchase and compensation (Year 50)	£114	£516	- £250,000 land purchase costs (Gwynedd Council, 2018) - £250,000 commercial property purchase costs
Future Maintenance Costs (Year 50 – 100)	£92	£771	1 day/week for 45 weeks for £55/hr
Optimism Bias	£ 2,559	£ 11,946	60% applied to all costs due to future uncertainty.
Total	£ 6,824	£ 31,855	

Table 39. Combined Option Costing

Proposed Scheme	PV Costs (£k)	Non Discounted Costs (£k)	Comments
Total	£ 30,357	£ 55,748	

The economic appraisal of the preferred option is based on the assumption the scheme will provide a minimum 1in50 (2069) SOP across the appraisal period. As indicated above, modelling at the next stage is required to further define the scheme's SOP.

Table 40. Economic summary of the preferred option

Economic Summary (100 year appraisal)	
Total PV Benefits (£k) (SOP 1 in 50 year – 2069)	£71,217
PV Cost	Option 2: £23,533 Combined: £30,357
Benefit Cost Ratio (Option 2)	3.0
Benefit Cost Ratio (Option 2 and Option 4a in epoch 3)²⁵	2.3

7.2 Sensitivity Testing

Sensitivity testing has been incorporated throughout the OBC development process – including the wave, overtopping and hydraulic modelling and economic analysis. The sensitivity testing below shows that a robustly viable adaption pathway option remains, if:

²⁵ BCR has decreased from Shortlisting Stage due to increased costs associated with Option 2; an optimism bias maintained as previous.

- Costs were to increase by 20%

Table 41. Sensitivity to cost increase

Sensitivity Analysis		
Total PV Benefits (£k)	£71,217	
PV Cost + 20% (£k)	£36,429	Increased Total PV Cost by 20%
Benefit Cost Ratio	2.0	

- Benefits were to decrease by 20%

Table 42. Sensitivity to cost increase

Sensitivity Analysis		
Total PV Benefits (£k)	£56,973	Total PV Benefits reduced by 20%
PV Cost (£k)	£30,357	
Benefit Cost Ratio	1.9	

8. Stakeholder engagement (Economic Case)

This OBC has been developed working closely with Gwynedd Council and stakeholders to understand their concerns and decide how best to go forward.

On March 25th 2019 a public stakeholder engagement event was undertaken in collaboration with NRW. The objectives of the event were to:

- Highlight the risks at Barmouth North Promenade to the general public and stakeholders.
- Communicate the work being undertaken by Gwynedd Council and Welsh Government to address the risks at Barmouth North Promenade and allow feedback from the general public on the shortlisted options proposed.

The event comprised:

- Morning information session: A briefing on Barmouth North Promenade was given to all relevant parties from public service organisations outside of Gwynedd Council (including Network Rail, Local Councillors, NRW etc). All participants recognised the need to sustain and improve the flood defence at the north promenade and gave their support to the scheme.
- Afternoon public drop in event: The event was well attended by over 45 local residents. General feedback was that the public support the need to improve the defences at Barmouth North Promenade. Key points included:
 - Historical and present-day observations around flood risk and coastal erosion – supporting the validation of the inundation modelling results (Appendix B).
 - Residents recognised the increasing vulnerability of the northern extents of the existing defences and were concerned about the implications of long timescales before any action is taken.
 - The North Promenade is an asset valued by the general public (both for amenity, recreation and health benefits). Concerns were raised regarding the negative effect that neglecting the North Promenade would have on tourism and the economy of Barmouth town. The car-parking facilities to the northern end of the town are considered vital to alleviating overcrowding from tourism during summer months.
 - Option 2 (Betterment of Existing Defences) was considered the preferred option as it minimises disruption to the beach (a vital asset to the town).

Concerns were raised regarding options which restricted access along the beach and had visual implications along the shoreline.

Please refer to **Appendix G** for further details of the stakeholder engagement event. Gwynedd Council are undertaking on-going consultation with Network Rail and NRW.

Residents and other interested groups will be engaged with further during the detailed design and consenting phase.

Commercial Case

This chapter establishes the Commercial Case for the works and explains what is to be procured, the strategy by which it will be procured in an open and sustainable manner and how this will deliver long-term sustainability and community benefits.

This chapter concentrates on the commercial aspects of the construction phase of the project as the main costs are associated with this phase. The next stage, subject to OBC approval will be the completion of a Full Business Case (FBC), which will include detailed design, consenting and the preparation of contract documents for construction. The FBC will be delivered in the same way as the OBC, with Ymgynghoriaeth Gwynedd Consultancy (YGC) representing Gwynedd Council as the client and consultancy services procured from the open market via Welsh Government's Sell2Wales website using the NEC4 Professional Services Contract.

1. Procurement Strategy

The construction work will be procured from the open market via the Welsh Government's Sell2Wales website. advantages of using Sell2Wales include:

- a simplified system where you can document tendering opportunities;
- access to procurement services in one place;
- easier communication between buyers and suppliers;
- contribute to a more transparent tendering process;
- contribute to greater savings and efficiencies, and;
- provide a secure environment for the procurement process.

Gwynedd Council must ensure compliance with Directive 2014/24/EU of the European Parliament. The current EU procurement threshold for Works carried out under the Public Contract Regulations 2015 is £4,104,394. As the Works required for this contract are estimated above this, the Works will need to be published in the Official Journal of the European Union (OJEU).

Procurement method

The procurement process shall be divided into two stages; the Pre-qualification questionnaire (PQQ, Stage 1) and the Tender (Stage 2). The PQQ will consist of a pass/fail section and a question section. The pass/fail section will evaluate the interested contractor's performance against the following on a pass/fail basis:

- Supplier Acceptability;
- Economic/Financial Standing;
- Capacity & Capability;
- Management;
- Equal Opportunities;
- Sustainability, and;
- Health and Safety.

The question section of the PQQ will require the contractor to demonstrate:

- Relevant experience and specific examples of contracting using the NEC4 Engineering and Construction Contract, and;
- Past experience in similar works.

The PQQ will be assessed by three members of Gwynedd Council staff and this process will filter the interested contractors down to a maximum of five.

The successful contractors will then be entered into the Tender stage, which will consist of a Commercial (70% of tender score) and Quality (30% of tender score) element. Contractors will have four weeks to reply to the tender.

Commercial (Cost) Assessment

The commercial (cost) element will consist of the works information, which will include:

1. Specification
2. Activity Schedule (to be priced by the contractor)
3. Contract Drawings
4. Standard Detail Drawings
5. Environmental Information
6. Environmental Commitments Register
7. Pre-Construction Information

The commercial (cost) scoring will be assessed on the priced submission. Each submitted tender will be analysed to ensure that any anomalies are highlighted and any queries will be raised with the tenderers. The tenderer must convince the Employer that their commercial (cost) submission is realistic. Any anomalies in prices will be drawn to the attention of the Procurement Officer, who may ask tenderers to explain the situation. If the price is deemed unrealistic following a clarification process, the tender may be rejected.

The tenderer with the lowest bid will receive the highest percentage before weighting, with those above pro-rated. The price score will be carried forward to the final tender assessment.

Quality (Technical) Assessment

The quality scoring threshold ranges from 30 marks out of the 100 available, before weighting adjustment, to zero against any one of the quality questions.

The quality section will be assessed on the quality of the submissions and marks will be awarded based on the quality assessment score chart and the quality tender assessment. The tenderer must convince the Employer that the quality standards interpreted from their tender documents are achievable.

The Employer needs to be satisfied that the tenderer's proposals meet its requirements and will use its discretion to decide whether, and if so how, any proposal fails to comply with the requirements of the specification. Any quality statement that fails to meet the Employer's quality requirements will not be considered further.

Final Tender Assessment

The quality and commercial submissions will be weighted with the following ratio and the two resultant scores will be combined:

Quality (Technical) Weighting = 30%: Commercial (Cost) Weighting = 70%

The highest marked quality score will be given maximum quality weighting and resultant quality scores will be pro-rata. The lowest commercial score will be given the highest commercial weighting and resultant commercial scores will be calculated on a pro-rata basis.

After the contractor has been appointed a pre-start meeting can be held and construction work can commence.

2. Key contract terms and risk allocation

2.1 Contract length

The anticipated contract length for the construction works is approximately 12 months.

2.2 Potential risk allocation

The NEC4 Option A: a priced contract with activity schedule will be used to manage the works. Option A is best suited for the works as the works information will be well established and most of the risk will fall with the contractor (see figure 4.2.1). The use of the NEC4 contracts, which are endorsed by the ICE and used extensively across the public sector, facilitates the identification and management of risks as appropriate to the nature of the contract itself.

2.3 Contract Stakeholders

The main stakeholders within the contract are:

- The Employer (*i.e.* Gwynedd Council) – provides the Works Information;
- The Project Manager (*i.e.* YGC) – appointed by the Employer, acts as;
- The Supervisor – appointed by the Employer to inspect quality, searches for defects and most importantly issues the completion, and;
- The Contractor – appointed after successful tender. The Contractor provides the Works in accordance with the Works Information.

The NEC contract states that the Employer, the Contractor, the Project Manager and the Supervisor shall act as stated in the contract and in the spirit of mutual trust and co-operation.

2.4 Contract Risk Allocation

With an NEC4 Option A contract the contractor offers to provide the works described in the contract for a sum of money. The contract provides for certain risks to be carried out by the Employer which will result in the lump sum being adjusted if additional and/or a reduction in works occur.

The activities are normally outlined by the contractor since he is the one who knows what activities will be carried out. Each activity is priced as a lump sum by the contractor, which is the amount paid when he has completed the activity. In pricing an activity, the contractor takes responsibility for estimating quantities and resources, and assessing and pricing risks that they own.

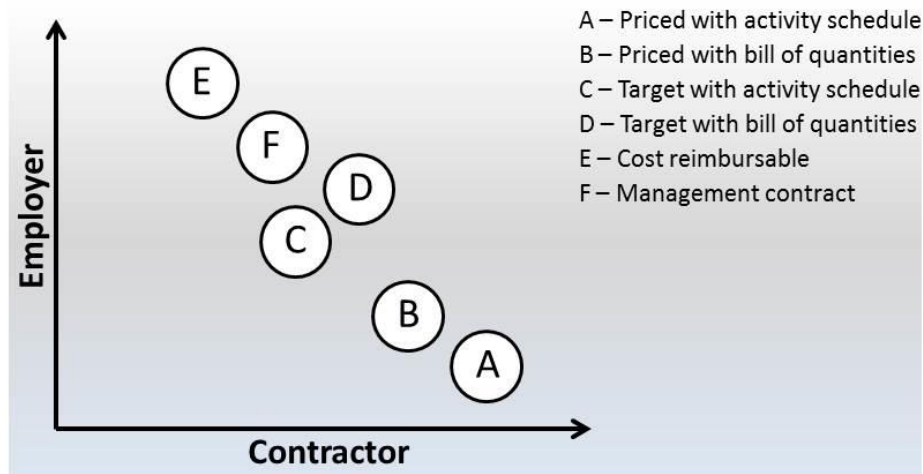


Figure 28: Risk allocation within NEC3 contracts A – F

All of the Employer's risk will be stated within the contract documents of the NEC4 contract. The Employer will aim to eliminate / reduce risks to the best of their ability at the design stage. All remaining design risks will be stated in the designer risk assessment document which forms the part of the tender. From the start date until the work is complete the Contractor will carry all risks that the Employer does not carry.

During the contract the risk will be managed by using a risk management system which includes a risk register, early warnings and risk review meetings that take place with stakeholder representatives. The Risk Register is a live document which will remain active for the duration of the works. The Risk Register, identifying the risks and their respective owners, will constantly be updated during the contract period.

3. Sustainability and Wellbeing procurement considerations

3.1 Sustainable Procurement Policy

The work will be procured in accordance with Gwynedd Council's Sustainable Procurement Policy and Guidelines 2011 and Procurement Strategy 2014-15. Through effective procurement and commissioning Gwynedd Council sustainably sources goods and services that ensure value for money for the people of Gwynedd.

The Council's aim is to undertake procurement activities in a responsible and sustainable manner and maximise opportunities to make the best possible use of its expenditure in terms of improving economic, environmental and social performance within Gwynedd. In order to achieve this, the following objectives have been established and will be adopted as part of the works procurement strategy:

1. Minimise our environmental impact through better selection and improved usage of goods, works and services;
2. Ensure that procurement activities are undertaken in such a way that all suppliers, including small and medium enterprises are encouraged to bid for council contracts;
3. Create an environment that provides opportunities to maximise the benefits arising from the inclusion and application of social criteria within procurement activities;
4. Ensure value for money assessments are based, where appropriate, on whole life costing and not just initial purchase price.

3.2 Ffordd Gwynedd

Ffordd Gwynedd is the name given to the “way” Gwynedd Council will ensure that it places the people of Gwynedd central to everything they do. It is a collection of working arrangements, behaviours and a culture which, together, allow Gwynedd Council to be confident that it always places the people of Gwynedd central to everything that it does.

3.3 Well-being of Future Generations Act

Under this Act Gwynedd Council must make sure that when making its decisions it takes into account the impact it could have on people living their lives in Gwynedd in the future by acting in a manner which seeks to ensure that the needs of the present are met without compromising the ability of future generations to meet their own needs. In achieving this, Gwynedd Council must apply the five Sustainable Development principles in its work, which will enable it to contribute to the seven national well-being goals. Procuring the work via Gwynedd Council's Sustainable Procurement Policy and the Ffordd Gwynedd principles will also enable Gwynedd Council to meet its obligations under the Well-being of Future Generations Act.

3.4 Community Benefits

Gwynedd Council believes that a sustainable approach to procurement is fundamental to ensuring that the benefit locally from third party spend is maximised and this approach will have a positive and long-lasting effect on its communities. Through implementation of the Welsh Government's Community Benefits Policy, Gwynedd Council can embed legacy benefits for its communities.

Community benefits associated with the construction of the works will also be considered via the procurement procedure as part of the tender assessment. The tender assessment will consider Cost and Quality aspects of each tender, and a percentage of the Quality score will be based on how the tenderer can deliver Community Benefits through the construction of the project.

4. Stakeholder engagement (Commercial Case)

Please refer to stakeholder engagement highlighted in the Economic Case.

Financial Case

1. Financial scale and breakdown

At this stage, we are seeking the approval of Epoch 1 works. The estimated cost of the preferred option and when they are likely to occur are outlined in the tables below:

Table 43. Annualised project costs

Annualised Project Costs (undiscounted) - excluding maintenance		
Preferred Option - Project Summary (£k) Including Optimism Bias	Yr. 0 (2021/22)	Yr. 1 (2022/23)
- Staff	£52	£63
- Design Development and Capital cost (including inflation)	£854	£22,279
Annual Project Total	£906	£22,342
Cumulative Project Total	£906	£23,248

It is recommended that Gwynedd Council undertake early contractor involvement early on in the next phase to define the costs in further detail.

2. Funding sources

Welsh Government Funding

This financial case assumes that Welsh Government will fund onward capital costs for detailed design and construction at 85% through the Coastal Risk Management Programme.

Local Funding

For the Full Business Case Stage, Gwynedd Council will match fund 15% of the cost through existing revenue funds.

Discussions have been held with Gwynedd Council's Economy and Communities Department and Network Rail concerning other potential match funding mechanisms. No suitable match funding opportunities, such as forthcoming investment programmes or grant funding were identified through discussions with Gwynedd Council's Economy and Communities Department. Network Rail have stated that their assets are currently in an acceptable condition with no major investment planned in the area, other than routine maintenance, in the near future. While discussions would continue with both parties during the design and development, a match funding contribution is considered unlikely at this stage.

Therefore, the most likely funding mechanism to achieve the 15% match funding contribution for the construction phase would be through the form of a loan taken out by Gwynedd Council through the existing prudential borrowing powers made available to Local Authorities by the Treasury. Gwynedd Council have approved the inclusion of Barmouth North Promenade Coastal Risk Management Project within the County Asset Management

Plan. This should allow 15% match funding of both the detailed design and construction phase of the project.

While the inclusion of the project with the Asset management plan confirms the Council's support of the project, the final decision on the Council's ability to match fund the construction phase of the project will be revised further when during the Full Business Case stage when detailed costs are known.

3. Funding timescales

Subject to OBC approval, the FBC stage would be undertaken within the 2021/22 financial year. Should the Full Business Case be approved, the construction phase would happen within the 2022/23 financial year.

4. Financial summary

A summary of the financial costs and funding requirements for the preferred option is outlined below.

Table 44. Financial Summary Table

Annualised Funding Profile (undiscounted) - excluding maintenance		
Annualised funding profile for preferred option (£k)	Yr. 0 (2021/22)	Yr. 1 (2022/23)
CRMP (85%)	£770	£19,761
Local (15%)	£136	£3,487
Project Total	£906	£23,248

5. Stakeholder engagement (Financial Case)

Please refer to Financial Case Section 2: Local Funding for details for the stakeholder engagement undertaken as part of the OBC development.

Management Case

This chapter explains how the project will be managed, including project governance, the project plan, engagement with stakeholders, how benefits will be realised and evaluated and how risks will be managed.

1. Project management (including management of health, safety and well-being)

1.1 Project structure and governance

YGC (Gwynedd Council's in-house consultancy) will manage this project on behalf of Gwynedd Council. A Project Director will be assigned to the project and will be responsible for its successful delivery and the key contact between the client and funding body/ies. The Project Director will appoint a Project Manager to manage the project and report back to the Project Director on progress and key issues via regular Project Status Reports. The Project Director will follow the process set out in Gwynedd Council's "Project Manager Selection Requirements" guidance note to ensure that the appointed Project Manager possesses the required skills, competencies and experience for the scale and nature of the work involved, as well as having the time capacity to deliver the project to the required timescale. As with the Project Manager, the project staff will be selected according to their skills and experience with regard to the requirements of the project, as well as their capacity to undertake the work within the required timescales.

1.2 Project team

The key roles and responsibilities of those anticipated to be involved in the project work and delivery are included in the following table:

Role / Responsibility	Name
Project Director	Rob Williams, YGC
Project Manager	Owain Ellis Griffith, YGC
CDM Principal Designer	TBC
Principal Engineer	TBC
Environmental Officer	Eifion Glyn Davies, YGC
Site Supervisor	TBC (YGC)
Community Liaison Officer	Lisa Goodier, YGC

If changes have to be made to key members of the project team we will follow the same process as at project initiation to ensure that the replacement person has a similar level of capability. We follow a similar process for the appointment and management of sub-consultants, whereby the selection process depends on the specific project requirements. For many routine matters such as ecological surveys, we have established relationships with local SMEs who have proven capability to meet quality and time constraints. Where project timescales allow, we advertise our requirements for sub-consultants on Sell2Wales. For most sub-consultant commissions we would issue an official order based on that supplier's standard terms and conditions, but for more significant commissions we would use the NEC4 Professional Services Short Contract or similar forms.

1.3 Project plan

Gwynedd Council implement and maintain a Quality Management System (QMS) which meets the requirements of ISO 9001:2015 and is subject to external certification assessments by BSI. A key requirement of the standard is to establish and implement processes for delivering consistent and effective levels of service to our clients. In order to

fulfil this Gwynedd Council have developed and implement a Project Management Procedure (SOP02) and bespoke Project Management Software (KeyedIn). SOP02 has been devised to enable the efficient and effective management of a wide range of projects and defines how Gwynedd Council will address the three key stages in the management of a project from inception to completion: Project Planning, Project Delivery and Project Closure. Project delivery includes the following fundamental processes:

- Establishing and maintaining a project management plan and programme
- Monitoring project progress and performing regular reviews
- Managing any variations to the originally agreed project baselines (e.g. budget, timescales, scope etc.)

A Project Management Plan will be established and maintained throughout the project and will include the project scope and objectives, task plan (programme), billing (contract lines), project deliverables and risks and issues registers.

The following table includes key project milestones which will form the basis of the project programme. All numbered activities will have a linear relationship with each other and will therefore form the critical path for the project.

Table 45. Project Milestones

Activity		Date (DD/MM/YYYY)
1	Submit OBC to WG	28/05/2021
2	Approval of OBC	14/06/2021
3	Procure Full Business Case	05/07/2021
4	Submit Full Business Case to WG	13/10/2021
5	FBC Approval	06/04/2022
6	Procure construction contract.	22/04/2022
7	Start of works on site	23/05/2022
8	Completion of works	04/01/2023

2. Contract and Change management

Gwynedd Council would manage all future development / construction stages of the project on behalf of Gwynedd Council. This includes the management of other parties engaged to complete specialist or resource intensive aspects that Gwynedd Council cannot service.

Gwynedd Council have considerable experience of using the NEC4 Professional Services Contract on a fixed price (activity schedule) or time charge basis, as well as a variety of other contract forms, and would be responsible for managing the contract over the life of the project. Our proactive approach to the role of NEC Project Manager ensures:

- That the Employer's aims for the project are identified at the outset along with the risks which could impact on these aims;
- That an appropriate procurement strategy is identified for the delivery of the Employer's aims taking account of the risks involved;
- That the Project Manager operates in a spirit of mutual trust and co-operation and encourages others to operate in the same manner;
- That the works are completed in accordance with the Works Information through tests, inspections, searches and the notification of defects to the Contractor;
- A programme is maintained in accordance with the contract that demonstrates the development of the scheme and also identifies the real impact of change;

- That compensation events are identified, managed and evaluated in accordance with the contract ensuring that all incidents are concluded at the time of identification;
- That early warning of any issues are notified and managed in accordance with the contract;
- That opportunities for value engineering are identified in order to maximise value for money and compensate for any cost increases generated from compensation events and identified in early warnings;
- That risks are identified and managed through the lifetime of the project;
- That all construction and fee costs are managed throughout the contract ensuring that cost certainty is delivered, and;
- That detailed records of the works are maintained.

3. Benefits realisation

Performance on the project will be closely monitored via Project KPI results, project reviews and Client feedback at project closure stage (in accordance with Gwynedd Council 's Performance Measurement and Monitoring procedure, SOP14). Performance will be reviewed periodically, including regular client meetings, during the project's lifetime; the frequency of these reviews will depend on the stage of the project.

At each key activity stage, shown in Section 6.1, the project team will meet to review performance and capture any lesson learnt to apply both to next stage of the project and future work. Lessons learned will be captured and recorded via Gwynedd Council 's bespoke Project Management Software (KeyedIn) and be reviewed by the project team. To ensure that relevant lessons learned are communicated the KeyedIn database will be available to all Gwynedd Council staff and will be subject to review.

Any performance issues will be dealt with, in the first instance, by the Project Manager. Should this not be possible the issue will be escalated to the Project Director. If the issue is deemed to be systematic or process-related it will be recorded as a Non-Conformity and investigated by the Management Systems Team (MST). The MST will determine the root cause and identify any corrective actions and measures required to prevent re-occurrence.

As well as monitoring our own performance during the project lifecycle through lessons learned and KPIs the performance of the contractor, sub-contractor and sub-consultants will also be scrutinized. This will be evaluated against their health and safety, quality of work, scheduling and environmental management on the project.

4. Risk Management

Table 20 in Strategic Case identifies the key project risk identified at OBC stage. A quantified risk register is included in Appendix H.

5. Post-project evaluation

On completion of the construction phase, the assets maintenance requirements, including monitoring will be conducted by Gwynedd Council 's FCERM unit on behalf of Gwynedd Council. It is recommended these feed into an adaptive pathway approach which monitors risk at Barmouth North Promenade and allows Gwynedd Council to determine appropriate measures over the lifespan of the scheme.

Whilst inspections of FCERM assets would monitor the ongoing performance of the structures, ad-hoc inspections following storm events would be the main test of whether the

key benefits of the project have been realised e.g. has the asset / structure withstood the storm and provided protection to residential properties (for example).

6. Assurance

Welsh Government

Welsh Government reviews of the project will be conducted at key decision points for approval of further funding. These will be:

- Progress to Detailed Design
- Progress from Detailed Design to Construction

Gwynedd Council

Gwynedd Council are committed to the successful delivery of the project.

As noted in the Financial Case, Gwynedd Council has approved the inclusion of the Barmouth North Promenade Coastal Risk Management Programme within the County Asset Plan. This should allow 15% match funding of the project in line with CRMP rules. Discussions will be required with WG to finalise funding mechanisms.

7. Contingency Plans

Should the preferred option not be considered or be realised within the current Coastal Risk Management Programme (CRMP), the contingency plan would be to investigate other sources of funding for the detailed design and construction phase and consider a phased approach to reduce the initial capital costs.

Note that the 'do minimum' option has not been considered as a contingency plan, as it will not deliver the required outputs.

In terms of project delivery, a costed project Risk Register will be established during the full business case stage and will be continually updated during the project's lifetime. Where specific risks have been identified mitigating actions will be taken and contingency plans developed as required in consideration of their potential impact and likelihood of occurrence. If the risks are such that contingency plans have been prepared the Project Manager will ensure they are budgeted for.

Contingency will be allocated within the project plan to allow for extra cost and time, especially regarding impact reduction of unforeseen issues. During preparation of the activity schedule contingency will also be added to individual tasks where considered prudent to do so. Different tasks will have different levels of contingency depending on the risk of each task's completion.

8. Stakeholder engagement (Management Case)

Stakeholder engagement has been undertaken during the OBC stage, as detailed in the Strategic Case. We will continue this through Full Business Case and Construction Stages.

When the Outline Business Case is approved by Welsh Government we will arrange an virtual exhibition, inviting stakeholders to give feedback on the emerging preferred option to inform detailed design. We will continue to draw on the communications support of both the Town Council and the Local Elected Member.

The communications plan will be updated for the construction phase, and a dedicated Gwynedd Council Community Liaison Officer will be allocated to work with the selected contactor and the stakeholders to ensure that all parties engaged appropriately.

Glossary of Abbreviations

Arup	Ove Arup and Partners Limited
CD	Chart Datum
CRMP	Coastal Risk Management Programme
DCWW	Dŵr Cymru Welsh Water
ECC	Engineering Construction Contract
ECI	Early Contractor Involvement
FCERM	Flood and Coastal Erosion Risk Management
FBC	Full Business Case
HAT	Highest Astronomical Tide
LDP	Local Development Plan
LiDAR	Light Detection And Ranging
MHWN	Mean High Water Neap
MHWS	Mean High Water Spring
mOD	meters relative to Ordnance Datum Newlyn
NEC	New Engineering Contract
OBC	Outline Business Case
PSC	Professional Services Contract
PV	Present Value
PWLB	Public Works Loan Board
SMP2	Shoreline Management Plan Second Edition
SOC	Strategic Outline Case
VAT	Value Added Tax
YGC	Ymgynghoriaeth Gwynedd Consultancy

Appendix

- A Economic Technical Assessment (Arup, 2019)**
- B Modelling: Wave and Overtopping Modelling (ABPmer, 2019) and Inundation Modelling (Arup, 2019)**
- C Coastal Processes Report (ABPmer, 2019) and Shoreline modelling – risk reduction assessment (ABPmer, 2021)**
- D Geotechnical Desk Study (Arup, 2018)**
- E Existing Structures Review (Arup, 2018)**
- F Environmental Appraisal of Shortlist (Gwynedd Council, 2019)**
- G Stakeholder Engagement Event (Gwynedd Council, 2019)**
- H Quantified Project Risk Register (Arup, 2021)**
- I Shortlisting Option Assessment:**
 - Longlist and Shortlisting Matrices (Arup, 2019)
 - Option 3: Managed Realignment Technical Note (Arup, 2019)
 - Option 4: Beach Management Technical Note (ABPmer, 2019)
- J Preferred Option:**
 - Outline Drawings of Preferred Option (Arup, 2021)
 - Risks and Assumptions Register (Arup, 2021)
 - Preferred Option Costing (Arup & Gwynedd Council, 2021)
 - IEA of Preferred Option (Gwynedd Council, 2019)
- K Constraints and Opportunities Mapping (Arup, 2019)**
- L SMP2 Policy Context (Arup, 2018)**
- M Shortlisted Options Sketches (Arup, 2019)**
- N Well-Being Mapping (Arup, 2019)**
- O Option Selection Meeting Minutes**
- P Barmouth North Promenade Outline Business Case Budget and Scheme Review (Ultimate Engineering Solutions Ltd, 2021)**
- Q Emergency Repair Works (Kaymac Marine & Civil Engineering, March 2021)**