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Project title	Barmouth North Promenade OBC	Job number
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Subject	Barmouth North Promenade – Do-Something Option: Managed Realignment	

1 Introduction

Ove Arup and Partners (Arup) have been appointed in September 2018 by YGC, part of Cyngor Gwynedd Council (CGC) to deliver an Outline Business Case (OBC) for coastal flood and erosion risk management (FCERM) for the Barmouth North Promenade frontage.

Following the OBC ‘Option Shortlisting Workshop’ on the 22nd January 2019, three ‘Do-Something Options’ were identified from a potential long-list of FCERM measures at Barmouth North Promenade; of which one option includes Managed Realignment. This note looks to set out the option of Managed Realignment and its potential implications within the context of Barmouth North Promenade. It is intended to support the Barmouth North Promenade OBC ‘Economic Case’ and the associated assessment of the shortlist, to inform the selection of a ‘Preferred Option’.

1.1 Scheme context and location

Barmouth is located in Gwynedd on the west coast of Wales, north of the Afon Mawddach estuary. The study extents are defined as ‘Barmouth North Promenade’ as indicated in Figure 1 below. The North Promenade is the northmost section of the Barmouth developed frontage, extending from residential housing estate at Heol y Llan to the northern extent of the promenade wall. 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 secondary and tertiary setback walls. The existing coastal defences run parallel with the promenade adjacent to the Marine Parade.

Barmouth North Promenade experiences a number of issues relating to poor asset condition (the existing defences have a number of structural defects), flood risk (including significant overtopping, fluvial and surface water risks) and coastal erosion (overall foreshore bed levels along North Promenade are expected to continue lowering). For further information about the nature of the problem experienced at Barmouth North Promenade please refer to Section 2 of the OBC, which includes details of the appropriate appendices.

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Figure 1. Study extents and key features of note within Barmouth

2 SMP2 Policy Context

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 current Shoreline Management Plan 2 (SMP2) (2011) policy (Epoch 1) for the frontage of Barmouth North Promenade¹ 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*'. Neighbouring SMP2 Policy areas include:

- Barmouth South Promenade: 'Hold the Line'; lies adjacent to the centre of Barmouth and comprises the main amenity beach fronted by vegetated stabilised sand-dunes, Barmouth harbour and the access road to Barmouth.
- Llanaber: 'Hold the Line'; lies northwards comprising a managed shingle bank providing coastal protection to the railway.

¹ 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.

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Table 1. Summary of specific policies (SMP2 PDZ11, 2012)

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					

All three sections are intrinsically linked - forming a wider flood-cell, with interacting coastal processes. Hence, the SMP2 expresses that whilst the frontage at Barmouth is split over three areas, the policies should be considered and '*progressed as one overall area*'. The present commission only encompasses Barmouth North Promenade, however aims to consider the wider policy contexts.

For further information in-relation to the SMP2 Policy Context for Barmouth, please refer to **Appendix L**.

3 Managed Realignment in the context of Barmouth

The term *Managed Realignment* refers to the realignment of the sea defences to allow a previously protected area of land to be flooded by the tide. Defences can be strategically breached or decreased in height, set back landward, or removed. In many instances, Managed Realignment is typically seen as part of a long-term sustainable strategy to address sea-level rise. It is a relatively new approach, which provides opportunities to maximise wider environmental and socio-economic benefits, through providing new space for coastal habitats to develop.

3.1 Barmouth North Promenade Context

To inform the assessment of Managed Realignment at Barmouth North Promenade, an assessment of the tidal conditions versus the existing elevation and defence levels has been undertaken.

The 2019 ABPmer Coastal Process Assessment² identifies the following tidal conditions.

Table 2. Tidal characteristics at Barmouth (Admiralty Tide Tables, 2018) and Extreme Sea Levels (ABPmer, 2019)

Reference Still Water Level (2019)	mAOD	AEP (%)	RP ³	2019	2060	2119
Highest astronomical tide	3.26	100	1	3.52	3.94	4.62
Mean high water springs (MHWS)	2.25	10	10	3.86	4.24	4.96
Mean high water neaps (MHWN)	1.26	0.1	100	4.15	4.57	5.25
Mean sea level (MSL)	0.28	0.5	200	4.24	4.66	5.37
Mean low water neaps (MLWN)	-0.54	0.01	1000	4.43	4.85	5.53
Mean low water springs (MLWS)	-1.74	Adjusted to represent sea-level rise as per Welsh Government (2017) climate change guidance ⁴				
Lowest astronomical tide (LAT)	2.14					

² Please refer to Barmouth North Promenade: Appendix C

³ Return Period

⁴ Welsh Government, (2017). Adapting to Climate Change: Guidance for Flood and Coastal Erosion Risk Management Authorities in Wales

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A typical long-section of elevation levels (mODN) has been extracted from publicly available LiDAR⁵ information, as indicated below. It is evident that the North Promenade and Cambrian Railway are set on man-made raised elevations. The natural profile is assumed be similar to that of the low-lying land behind the Cambrian Railway extending towards the shorefront.

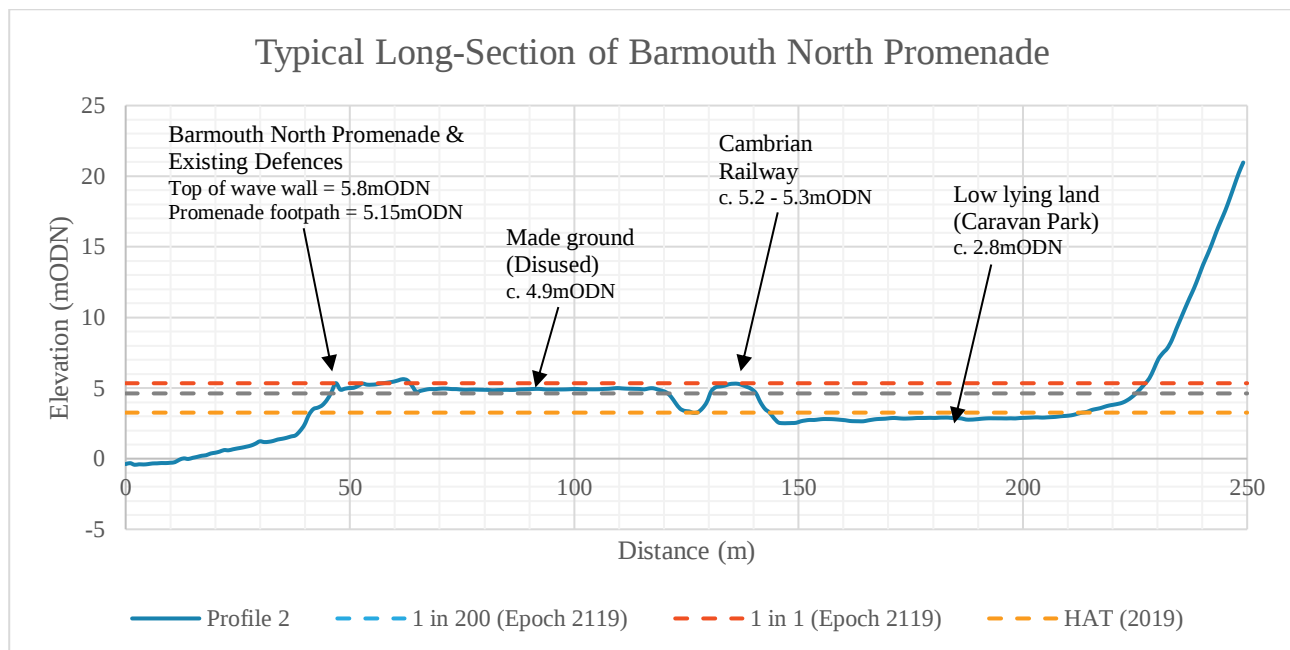


Figure 2. Typical long-section of Barmouth North Promenade (section parallel to Groyne 32, as per Figure 1)

Considering the above, several key risks associated with Managed Realignment are evident:

- Should the defence alignment be realigned, the Cambrian Railway and low-lying land behind the caravan park will become increasingly susceptible to tidal flooding and overtopping risks, particularly during storm events, over the 100-year appraisal period. This poses risks to the wider flood cell encompassing the neighbouring SMP2 'Hold the Line' Policy Areas of Barmouth South and Llanaber. Further interventions will be required, as discussed further below.
- The Arup (2019) Geotechnical Desk Study⁶ indicates the superficial deposits along the alignment of the promenade comprise Blown Sand, with 'sand fill' was placed beneath the Promenade to raise the ground level and this is likely to be locally sourced. Sandy soils are generally highly susceptible to wash out, particularly if they have a low fines content (silt and clay). As such, rapid erosion of the existing levels (from 40-140m) is expected to occur should a Managed Realignment approach be undertaken. It is expected an additional line of defence would be required to protect the Cambrian Railway, assets beyond this point and the neighbouring SMP2 'Hold the Line' Policy Areas.
- As the Promenade is set higher than present tidal levels (i.e. max. HAT, not considering future sea-level rise), significant land lowering and excavation would be required to promote or create inter-tidal habitats.

⁵ DTM LiDAR (1m resolution) (Source: uk.gov)

⁶ Please refer to Barmouth North Promenade: Appendix D

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3.2 Type of Managed Realignment

As indicated above, Managed Realignment can take a wide variety of forms. To determine the most appropriate approach, the table below considers the different types of schemes and their appropriateness to the Study Area.

Table 3. Type of Managed Realignment

Type of project ⁷	Assessment for Barmouth North Promenade
Bank realignment: involves the deliberate removal of existing defences or embankments to allow the waters of adjacent coasts or estuaries to inundate the land behind. This can involve: • Constructing a new flood defence line inland of the original • Promoting the creation of new areas of habitat • Removing the front sea wall either partially or wholly	Barmouth North Promenade sits within a wider urban flood cell, with significant strategic assets (e.g. the Cambrian Railway Line). As such, the construction of a new flood defence line inland of the original is required to afford appropriate protection to the neighbouring SMP2 policy units and key assets. It is envisioned the existing defences would need to be removed (wholly or partially) to ensure public safety in, what is, a popular coastal resort.
Breach: Involves deliberately breaching sections of the existing defences to allow waters to inundate the land behind through a defined gap. Controlled abandonment: Initial active management is undertaken (e.g. creation of new areas of habitat behind the defence line). Following which once natural defences have become established, maintenance of the existing is discontinued and they are allowed to fail.	Due to the presence of the Cambrian Railway Line and adjacent residential properties, a new defence alignment is required (as identified above). Hence, breaches, regulated tidal exchange are considered to be inappropriate. These approaches are likely to cause significant risks to the safety of the general public and local communities. Controlled or uncontrolled coastal flooding designed to occur behind the existing defences, will increase flood risk and risk to life to unacceptable levels for those living and working neighbouring the defences. In most cases, the approaches outlined are most suited to schemes where the primary purpose or main driver of the works is the creation of new intertidal habitats for ecological benefits. This is not considered to be the case at Barmouth North Promenade, where the primary objective is to manage flood and coastal erosion risk in an urban area – including Barmouth South.
Regulated tidal exchange: Encompasses a range of techniques for intertidal habitat creation beyond breaching of the existing defence line (e.g. sluice gates, weirs, pipes) to control regular tidal inundation. The old defence line requires maintenance.	As identified above, approaches which control tidal inundation without a supporting defence alignment are considered inappropriate in this context. Furthermore, as land-levels are higher than existing tidal levels, this limits opportunities for inter-tidal habitats without further land-lowering activities.

3.3 Extents of Managed Realignment

Within the context of a bank realignment approach, there are a series of locations (or extents) to which the defences could be set-back or realigned. Each with differing implications, which are examined below.

⁷ Source: Environment Agency, SC080039/R8, 2015

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Table 4. Extents of Managed Realignment

Bank realignment	Considerations (+) or (-)
Option 1: Defence-line set back to the Caravan park	(+) Most opportunity for creation of habitats (noting limitations as outlined) (-) Impacts on wider policy areas of Barmouth South and Llanaber. (-) Loss of significant resident properties and the caravan park. (-) Requires the loss or diversion of the Cambrian Railway. This is a strategic transport link - a diversion would be of major cost or its would have significant economic and social implications. <u>This approach is not considered appropriate.</u>
Option 2a: Defence-line set back to the Cambrian Railway transitioning into Barmouth South (as indicated in Figure 3 below)	(+) Affords protection to the Cambrian Railway (+) Habitat creation opportunities (although minimal, due to tidal levels < existing land levels) (-) Loss of existing residential properties – both economic, social and political implications for local communities. (-) Relocation of existing community - noting uncertainty around appropriate compensation/relocation funding mechanisms. (-) Relocation of existing recreational facilities (i.e. skatepark, Promenade Café) and car-parking facilities at the northern extents of the promenade.
Option 2b: Defence-line set back to the Cambrian Railway + existing extents affording protection to the Hoel-Y-Llan Housing Estate are maintained (as indicated in Figure 3 below)	(+) Affords protection to the Cambrian Railway (+) Affords protection to existing properties and maintains spatial extents of existing communities (-) Minimal habitat creation or observable benefit achieved due to limited extents of retreat. As above, tidal levels < existing land levels restrict opportunities for inter-tidal habitats. (-) Likely to require additional structures (e.g. rock groynes) or measures to the existing defences to ensure protection is maintained to the housing estate over the 100 year appraisal period. This will increase option costs. Uncertainties around the extent to which the estate can be protected. (-) Relocation of existing recreational facilities (i.e. skatepark, Promenade Café) and car-parking facilities at the northern extents of the promenade.

Figure 3 defines indicative extents for Managed Realignment at Barmouth North Promenade (Option 2a and Option 2b):

- The Option 2a extents are defined as per the 2011 SMP2 indicative policy boundary for Barmouth North Promenade. This indicates protection afforded to the Cambrian Railway, whilst a series of properties would be affected within the Hoel-Y-Llan Housing Estate.
- Option 2b affords protection to the housing estate through the existing defence line. This approach would effectively compartmentalise the study area into two spatial schemes: ‘Managed Realignment’ to the north, and ‘hold the line’, i.e. betterment and maintenance of the existing defences, to the south. This approach is likely to require beach management activities (i.e. groynes and beach renourishment) to the remaining extents (i.e. dotted green line).

Further option development and assessment is required to define the most appropriate extents. This needs to be supported by on-going stakeholder consultation and input/direction from YGC.

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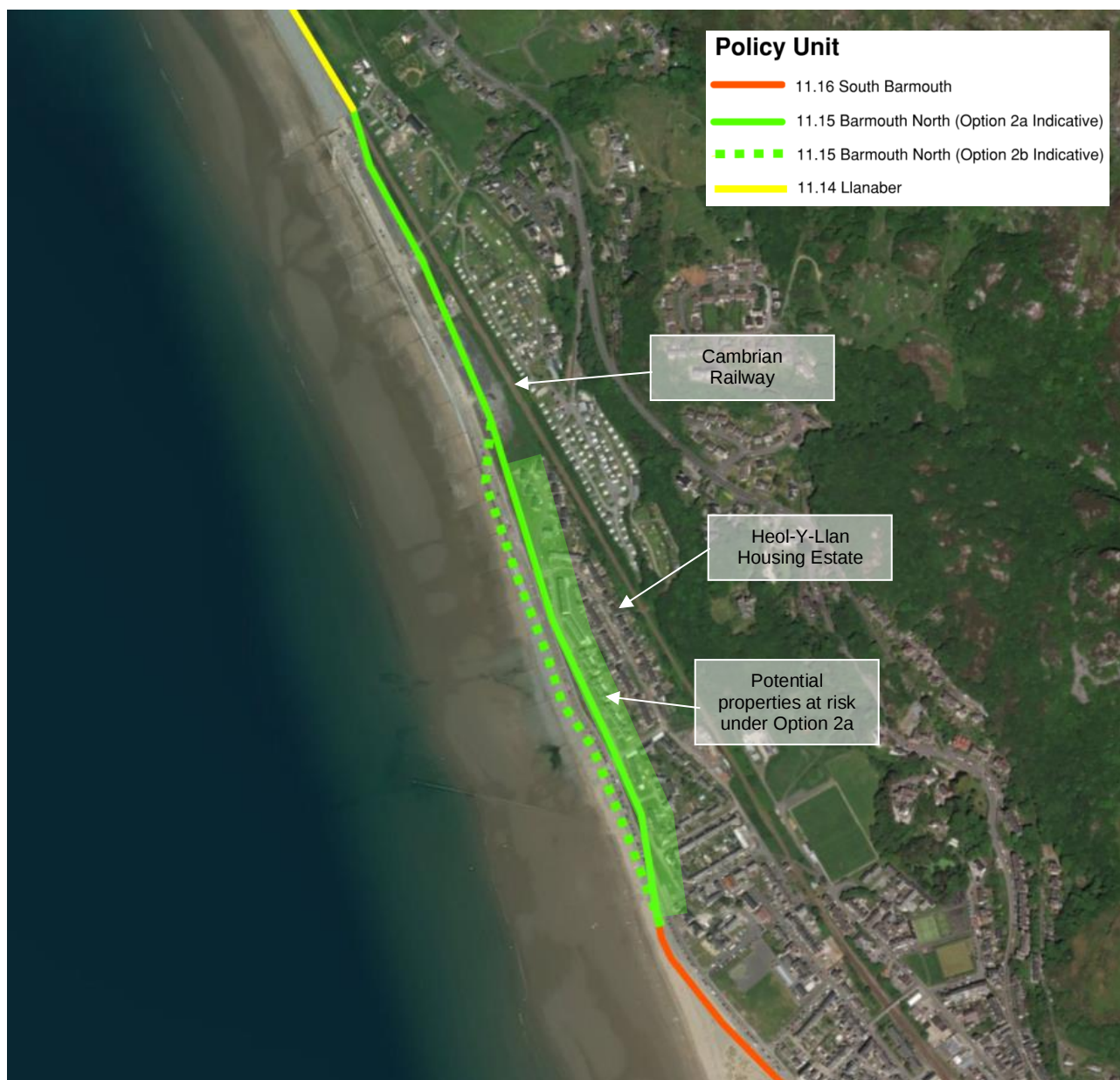


Figure 3. SMP2 Policy Extents and potential extents for managed realignment

3.4 Timing of Managed Realignment

The SMP2 notes there are '*uncertainties in terms of the timings of the proposed changes*' for the policy area for Barmouth (M.A. 24 – PDZ11). As recognised generally within the SMP2, the defined epochs within Table 1 (above) are considered to be less prescribed than indicated, and dependant on the rate of sea-level rise. The policy change is seen as a continuous process (as opposed to one step change in approach).

With the overtopping and inundation modelling assessments in **Appendix B**, indicating over the longer-term it is likely to become economically unfeasible to defend the frontage. This presents two pathways to implementation:

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- An adaption pathway approach, which considers investing in a scheme to extend the life and/or provide an increased standard of protection along frontage now, moving to Managed Realignment over the longer-term. This would extend the life of the frontage for as long as is considered practical (e.g. up to Epoch 3). However, will increase costs through requiring significant capital expenditure (e.g. equivalent of an FCERM scheme) before Managed Realignment is implemented.
- An adaption pathway approach, which limits activities to the existing defences and supports a move towards Managed Realignment. Timing based on monitoring of frontage (e.g. deterioration of existing defences) and sea-level rise/overtopping experienced. This is likely to be of lesser capital costs, however brings forwards the onset of Managed Realignment towards Epoch 2.

Further discussion with YGC and key stakeholders (e.g. Network Rail) is required to define the preferred approach.

4 Impacts

The impacts of Managed Realignment at Barmouth North Promenade are outlined further below.

4.1 Engineering Performance

Managed Realignment is seen as a means of providing long-term sustainable and effective flood and coastal erosion defence. Presently, significant overtopping is experienced at the northern extents of the promenade. This will increase in severity over the 100 year appraisal period, due to climate change and sea-level rise, for example:

- Overtopping rates 2019: 163 l/s/m for a 0.5% AEP (1:200 year)
- Overtopping rates 2119: 255 l/s/m for a 0.5% AEP (1:200 year) (*i.e. + 54% for this AEP*)⁸

With the significant volumes of overtopping experienced at Barmouth North Promenade anticipated to increase, over the long-term it is likely to become un-feasible to continue defend the frontage with significant capital and operational expenditure in defence structures and beach management. In this instance, Managed Realignment provides the only means of ensuring a sustainable and effective flood and coastal erosion strategy. This is not without significant economic and wider implications, as discussed further below.

The standard of protection achieved by Managed Realignment is expected to be defined by the new line of defence. It is envisioned a standard of protection of 0.5% AEP (1:200year) + CC would be achievable for the remaining study extents. Depending on the extents of Managed Realignment and residual risk, works likely to be involved are outlined in the following table and detailed in a sketch in **Appendix I**.

⁸ Appendix B: ABPmer (2019) Wave Modelling, Extremes Analysis and Overtopping

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Process	Option 2a: Defence-line set back to the Cambrian Railway transitioning into Barmouth South	Option 2b: Defence-line set back to the Cambrian Railway + extents of the Heol-Y-Llan Housing Estate
Pre-Construction Costs	Initial design, management and administration costs; including surveys, extensive and on-going stakeholder (e.g. Local Housing Authorities, Network Rail) and community engagement by the Local Authorities.	
	Likely to require more intensive stakeholder engagement costs due to the requirement for compensation / relocation of existing residential properties.	Extensive works will need to be undertaken to define the standard of protection achievable to the existing residential properties and managed associated risks.
Monitoring	Monitoring and review activities associated within any adaption pathway approach implemented. Monitoring is required prior to construction, during construction and inundation and post-works.	
Decommission Activities: Extended sections of coastal defence are removed or to be made safe for the general public. <i>Otherwise, access will need to be restricted.</i>	- Removal or decommissioning of the existing defences (including sheet pile) and groyne structures throughout the study extents - Decommissioning of highway and promenade features	- Removal or decommissioning of the existing defences (including sheet pile) and groyne structures – only up to groyne 28 (i.e. 40% of existing defences) - Decommissioning of highway and promenade features
Project involves new line of defence or upgrading of existing defences	- New line of defence along the Cambrian Railway and Heol-Y-Llan housing estate - Replacement of two watercourse outfalls – including pumping station and outfall, and culverted watercourse	- New line of defence along the Cambrian Railway - Replacement of north watercourse culvert and associated storage - Works to extend the life-span and enhance the standard of protection of the existing defences to the south of the study extents (i.e. protecting the Heol-Y-Llan - May require additional structures (e.g. rock groynes) at the transition point between the new line of defence and the Heol-Y-Llan housing estate. - May require beach management activities (i.e. groynes and beach nourishment) to the remaining southern extents
Planned removal of people and assets at risk	- Land acquisition costs for land behind the defences - Compensation / relocation of Promenade Café and Car Park Owner - Compensation / relocation of residential property owners	- Land acquisition costs for land behind the defences - Compensation / relocation of Promenade Café and Car Park Owner
Operational and Maintenance	On-going operational and maintenance activities along new line of defence.	

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Table 5. Activities associated with Managed Realignment

4.2 Economic Performance

Of significant cost and associated risks, particularly in terms of the removal of the existing defences and relocation of existing residential properties. Please refer to OBC Appendix A: Economic Appraisal Report for a summary of the financial performance of this option.

Wider Economic Considerations:

Environmental: It is notable that the SMP2 policy of Managed Realignment is most likely to be beneficial in areas of low agricultural land or where the topography and neighbouring land-uses minimise the need for additional defences. In most instances, Managed Realignment is used to restore or create tidal habitats (e.g. salt marshes) compensating for habitats lost to development or coastal squeeze. Such creation can provide significant economic benefits, including ecosystem services such as recreation, enhanced carbon sequestration and improved biodiversity. Due to the limited extents of Managed Realignment the benefits achievable are considered to be limited.

Social, Well-Being and Recreation: Please refer to Section 4.4 for further details. The impacts outlined will have an economic cost on the area of Barmouth. With respect to the loss of recreational value of Barmouth North Promenade, the construction of a new defence line and loss of land should be examined to identify wider opportunities available.

Existing Defences: In general, in a populated area with existing hard defences, such as Barmouth, Managed Realignment requires 'decommissioning/relocation' which carry significant risks/costs that need to be managed carefully over the long-term.

Stakeholders: The Cambrian Line is a railway that runs from Shrewsbury to Aberystwyth and Pwllheli, both on the west coast of Wales. Whilst boasting scenic views, the Cambrian Line also provides a strategic public transport link to a number of coastal towns in Wales, including Barmouth, for both tourists, residents and businesses. The line is owned and maintained by Network Rail, who presently undertake works to maintain protection in the adjacent SMP2 Policy area of Llanaber. Realignment of the defences (set back landward) will increase the risk of the asset to tidal and overtopping flood risk, beyond existing baseline. This is likely to pose a negative economic or financial implication on Network Rail.

4.3 Environmental Performance

The managed re-alignment of the foreshore would lead to some loss of the existing hinterland habitat, while this would need to be considered and assessed, the existing habitat is generally of low ecological value being largely developed. The re-alignment option would lead to a change in the existing conditions within the adjacent Pen Llyn ar Sarnnau SAC. Whilst these changes would need to fully understood as part of the HRA, they could potentially be deemed to be of conservation benefit to the SAC through the creation of a more natural bay feature and associated intertidal habitats. The extents to which habitat creation can be achieved appear to be constrained by the limited land gained seaward as a result of the realignment.

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4.4 Social & Well-Being

As detailed in Barmouth North Promenade OBC: **Appendix I**, each of the Do-Something Options (including Managed Realignment) have been assessed against the Welsh Government Future Generations (Wales) Act seven well-being goals and five ways of working.

In summary, Managed Realignment could involve the loss of local residential and commercial properties (including the Heol-Y-Llan Housing Estate). This is likely to 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. In particular, the Heol-Y-Llan Housing Estate is largely comprised of housing association properties. The loss of such assets is likely to impact some of the most vulnerable in society (e.g. low-incomes) and removes a series of affordable housing from the local area.

Although potentially minor compared to Barmouth South, there are likely to be recreational losses associated with the amenity of the promenade - footpath and National Cycle Route, the local skatepark, Promenade Café and car-parking facilities.

During the public consultation event (25th March, 2019), residents highlighted the full length of the promenade is considered a significant asset – both in terms of both in attracting tourists (main economy of the town) and providing amenity value for local residents and their wider families and grandchildren (beyond Barmouth). The northern extents are frequently used (daily) by locals for recreation, exercise, dog walking, land-train horse-riding and access to the beach. Implications on the North Promenade are seen as likely to impact on the wider town of Barmouth and the tourist economy.

Residents further highlighted the car-parking facilities to the northern end of the town are considered vital. Local residents noted they experience issues with overcrowding of tourists and lack of parking facilities during the summer months. Without the northern promenade this would exacerbate issues further.

Any future scheme should look to incorporate recreational and amenity features where possible, to negate any losses experienced. For example, inclusion of a promenade or community installations within the design, improving or enhancing public access to the foreshore or assess opportunities for car-parking facilities.

4.4.1 Community Engagement

The importance of getting the community involved and supporting the scheme at an early stage has been highlighted, both within a DEFRA 2008 study⁹ and local events at Fairbourne - where Managed Realignment is a policy being taken forward. The objective should be to engage the community in a way that enables a real input to shaping the scheme whilst not opposing a decision for Managed Realignment. Through taking a pro-active approach and informing the local community from the onset, the associated negative implications on health (e.g. mental health), culture and community cohesion can be minimised.

On 25th March, YGC undertook an initial consultation with the local residents and business owners on the shortlisted elements of the scheme so far. Approximately 47 people were in attendance, and attendees noted their concern about an option of managed retreat which involves the loss of the

⁹ DEFRA/EA Flood and Coastal Defence R&D Programme, Managed Realignment Review, 2008

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promenade. They highlighted their interest in being kept informed of the activities going forwards. It is recommended that YGC continue their engagement with the local community to keep them up to date with the OBC outcomes, next steps and anticipated programme going forward; particularly if Managed Realignment is taken forward as an element of the preferred option.

4.5 Political & Financial Performance

Policy Context: Barmouth North Promenade is identified as a Coastal Change Management Area (CChMA), within the Anglesey and Gwynedd Joint Local Development Plan (JLDP) (2016-2026). This means there are a number of planning restrictions on new, replacement or relocated developments (both residential and non-residential). Importantly, it is noted that no new residential buildings will be granted planning permission within Barmouth North Promenade, and non-residential developments will only be permitted within the second indicative SMP2 policy epoch (2026-2055), subject to further assessments. This means that beyond the existing life-span of the structures at present, there is expected to be limited new development. Over the longer-term, this is likely to lead to a natural decline in the Study Area, as existing dwellings cease to be replaced, and support the ambitions to move towards Managed Realignment.

Financial & Funding: There are number of obstacles to Managed Realignment. In a DEFRA 2008 study¹⁰ a key constraint identified was the *“lack of financial compensation (which in this context includes both land purchase and payment for the use of land) as the biggest obstacle to Managed Realignment. Under present legislation, landowners do not generally have any right to financial compensation where a decision is made to no longer defend their land”*. With compensation deemed a major barrier to implementing Managed Realignment, it is hard to envisage local public support unless it is felt that the cost of realignment has been shared equably. An alternative to providing individuals with compensation is to provide or incentivise relocation. Should this option be pursued, YGC are likely to need to investigate funding mechanisms for compensation and/or relocation of those affected with Welsh Government.

It is noted that wider funding opportunities may exist through the lens of habitat creation, and YGC should explore these with external environmental organisations to maximise any opportunities. Wider funding opportunities promoting recreational and social benefits should further be considered.

Political: A scheme which involves the loss or relocation of any properties is likely to be controversial or provoke strong local opinions, leading to significant risks to the future of a scheme and local community cohesion. With the neighbouring scheme at Fairbourne of ‘Managed Realignment’ in progress, any lessons learnt should be applied directly to Barmouth North Promenade and as noted above, early stakeholder consultation and a public education programme is a priority.

5 Key Risks

There are a number of key risks associated with the implementation of Managed Realignment, the main ones of which are highlighted below:

¹⁰ DEFRA/EA Flood and Coastal Defence R&D Programme, Managed Realignment Review, 2008

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- Implications of neighbouring SMP2 Policy Areas: The scheme will need to be defined to ensure the existing flood and coastal erosion protection afforded to the neighbouring SMP2 Policy Units is maintained. Particularly, Barmouth town towards the south.
- Capital Expenditure: significant risks are associated with the capital expenditure required, particularly considering:
 - Construction of new, and removal of the existing, defences. There are significant uncertainties with the scale, extent and cost of the activities associated. Extensive pre-construction works are likely to be required to manage this risk.
 - Compensation or relocation of those affected by the extents of the Managed Realignment proposed.
- Timings of Managed Realignment: the residual life-span of the existing structures is considered to be <10-20 years at the northern extents of the frontage. Significant storm events may accelerate deterioration. On-going monitoring will be required to ensure action is undertaken at an appropriate point to afford protection to the local residents and businesses in Barmouth. A substantial and robust Adaptive Pathway Approach should be developed.
- Overtopping and residual risk: Work will need to be undertaken to define overtopping and residual risks from the new line of the defence to the Cambrian Railway, the adjacent caravan park and the Heol-Y-Llan housing estate. Residual risks may be encountered and may define the proximity of structures adjacent to the defences. The existing fluvial outfalls will need to be replaced, with studies to ensure that associated flood risks are not increased.
- Public Safety: Significant works (including capital and operational expenditure) will be required to ensure the scheme and the associated structures are safe to general public. Otherwise access will need to be restricted.
- Surveys: Extensive engagement and surveys are likely to be required to ensure any below-ground assets have been identified and can be lost/diverted as part of the scheme.

6 Summary

Table 6. Summary of Managed Realignment at Barmouth North Promenade

Summary of impacts:	
Engineering Performance	Opportunity to provide a long-term sustainable FCERM scheme at Barmouth North Promenade.
Economic Performance	Of significant cost and associated risks, particularly in terms of the removal of the existing defences and relocation of existing residential properties. There is a perceived limited gain, for significant financial expenditure.
Environmental Performance	Potential opportunities to promote habitat creation, although this is considered to be limited.
Social & Well-Being	Potential negative implications on local residents and businesses, particularly without adequate consultation and support structures to facilitate Managed Realignment.
Political & Financial Performance	Significant risks associated with funding structures and mechanisms.

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