

Technical Note

Project:	Aberaeron Coastal Defence Scheme		
Subject:	Coastal Squeeze Assessment		
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Document history

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1. Introduction

This document sets out the assessment of coastal squeeze for the Aberaeron Coastal Defence Scheme ('the Scheme'). The Scheme is being developed by Ceredigion County Council (CCC), to provide protection from coastal flooding to the town of Aberaeron. The Scheme comprises five elements, which are interlinked as integral parts to the overall flood defence scheme. The scheme elements are:

- Construction of a new rock breakwater extending out from the North Pier.
- Refurbishment and re-building of the pier-head of South Pier, including grouting repairs of the walls.
- Flood wall construction at the following locations:
 - Removal of the existing set back flood wall along Quay Parade/Pen Cei and reconstruction of a new masonry and glass wall, as well as grouting repairs of the existing quayside wall;
 - Raising of the existing River Aeron flood wall between the rear of the Monachty Hotel and the A487 referred to as the River Aeron wall; and
 - Construction of a new masonry and glass wall flood wall between Pwll Cam and the Monachty Hotel (and connecting with the existing adjacent River Aeron flood wall between the Monachty Hotel and A487).
- Construction of a flood gate at Pwll Cam inner harbour.
- Improvements to the existing defences on South Beach:
 - Replacement of existing timber groynes;
 - Replacement and extension of the existing rock revetment; and
 - Beach renourishment.

The Scheme has a 1 in 200 year design return period for wave overtopping within the harbour, with the rock revetment on South Beach having a 1 in 200 year standard of protection. The Scheme also provides a 1 in 1,000 year standard of protection against extreme sea levels for the design life (100 years) of the Scheme. The design of the Scheme has been carried out in line with the requirements of the Welsh Government for the development of residential areas in relation to flood risk (TAN15, Welsh Government 2014), as well as in line with guidance for flood and coastal erosion risk management and adaptation to climate change (Welsh Government, 2017).

The relevant Shoreline Management Plan (SMP2) for Aberaeron is the West of Wales Shoreline Management Plan 2¹. Aberaeron is in Coastal Area C, Section 4 – New Quay Head to Sarn Gynfelyn. The Scheme is located in Policy Development Zone 8 (PDZ8) – Aberaeron Plateau².

The Scheme sits in two policy units – Aberaeron South Beach (8.2) and Aberaeron Harbour (8.3). The policies for the SMP2 are shown in Figure 1-1 and their locations are shown in Figure 1-2. The policies for Aberaeron North Beach (8.4) are also shown, as this is immediately adjacent to the Scheme and with the same PDZ.

¹ West of Wales Coastal Group, 2012, West of Wales Shoreline Management Plan, <https://www.grwparfordirolgorllewincymru.cymru/page/home-page>

² <https://www.grwparfordirolgorllewincymru.cymru/sites/default/files/2019-06/4c3%20-%20Section%204%20Coastal%20Area%20C%20PDZ8.pdf>

8.2	Aberaeron South Beach	HTL	HTL	MR	Maintain defences, consider realignment southern end of the defence in the future. Long term management of this area would be linked to long term management of Aberaeron North.
8.3	Aberaeron Harbour	HTL	HTL	HTL	Maintain and raise existing defences over the period of the SMP. Future management would need to consider the real possibility of major change in this approach. The need for such change would critically depend on the rate of sea level rise.
8.4	Aberaeron North Beach	HTL	HTL	HTL	As above

Figure 1-1 - SMP2 policies relevant to the Scheme (excerpt from West of Wales SMP2, 2012)

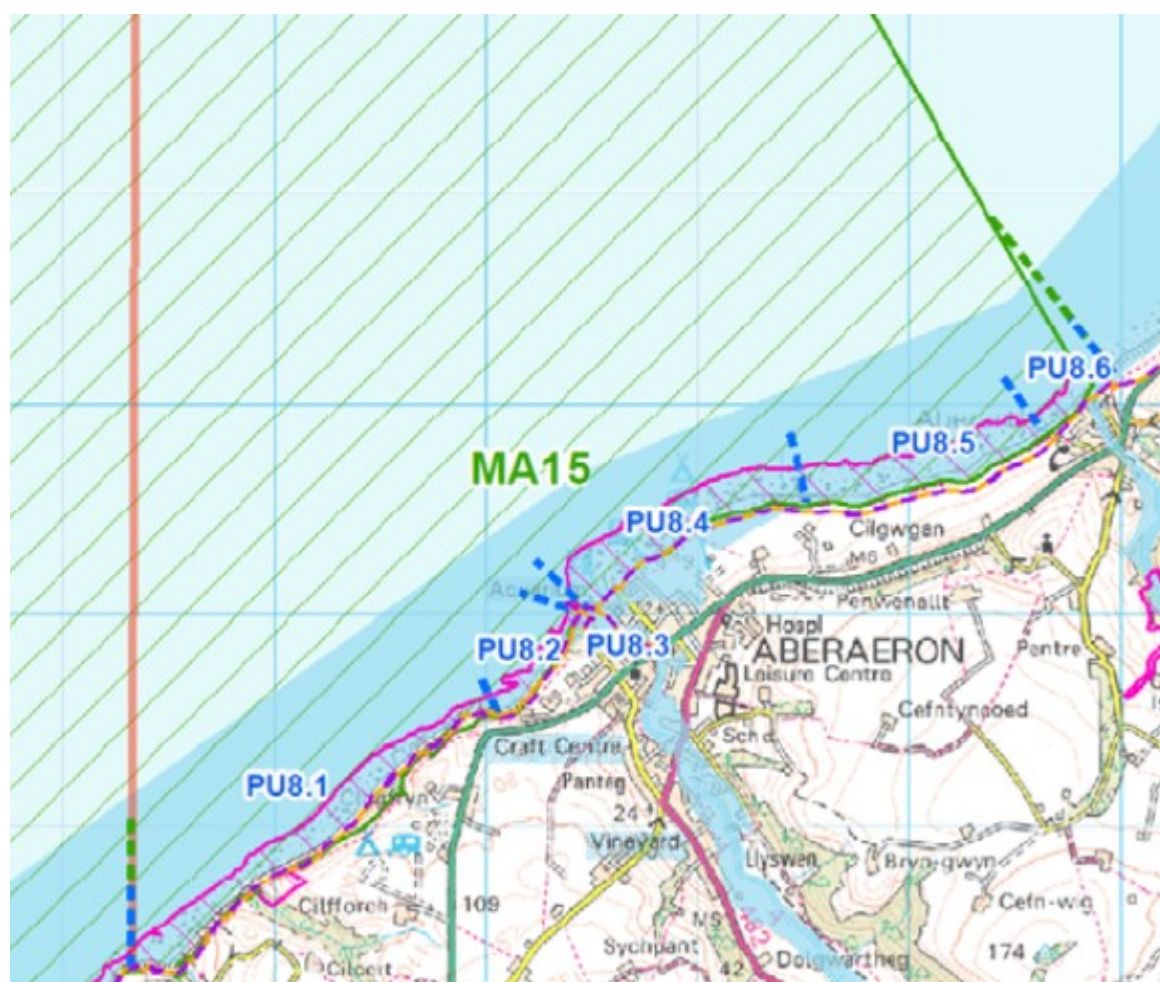


Figure 1-2 – Location of SMP2 policies relevant to the Scheme (excerpt from West of Wales SMP2, 2012)

This assessment has been carried out following Natural Resources Wales (NRW) Guidance Note GN 062³, which sets out the steps to be followed in assessing coastal squeeze. It has also been informed by the Joint Flood and Coastal Erosion Risk Management Research and Development Programme report *What is coastal squeeze?* (2021)⁴. The Guidance Note (GN 062) uses the definition of coastal squeeze identified in the *What is coastal squeeze?* report.

2. Screening Step 1

This section sets out the questions and answers set out in Screening Step 1 of GN 062.

Question no.	Question	Policy Unit	
		8.2 Aberaeron South Beach	8.3 Aberaeron Harbour
1	Is there a plan or project to undertake works to a structure or an activity occurring which implements hold the line and / or maintains the current shoreline positions (this can include works to the landward side of a defence)?	YES	YES

The answer to Question 1 is **YES** for both policy units. The assessment therefore proceeds to Question 2.

Question no.	Question	Policy Unit	
		8.2 Aberaeron South Beach	8.3 Aberaeron Harbour
2	Would the habitats be able to migrate landwards in response to sea-level rise if there was no coastal structure or the management activity was stopped (i.e. the land behind the defence would be susceptible to flooding if the defence failed or would be expected to erode rapidly)? This includes land which is currently developed.	YES	YES

The following sites are located in the area of the Scheme (see Figure 2-1):

- Cardigan Bay / Bae Ceredigion SAC,
- West Wales Marine / Gorllewin Cymru Forol SAC,
- Northern Cardigan Bay / Gogledd Bae Ceredigion SPA,
- Llyn Peninsula and the Sarnau / Pen Llyn a'r Sarnau SAC,
- Cors Fochno and Dyfi Estuary SPA / Ramsar.

³ Natural Resources Wales, 2022, Assessment of Coastal Squeeze, Guidance Note GN 062

⁴ Defra, Welsh Government, Natural Resources Wales, Environment Agency, 2021, What is Coastal Squeeze, Joint Flood and Coastal Erosion Risk Management Research and Development Programme Project Report FRS17187, https://assets.publishing.service.gov.uk/media/6038fafde90e07055c14049b/FRS17187_What_is_coastal_squeeze_report_1.pdf

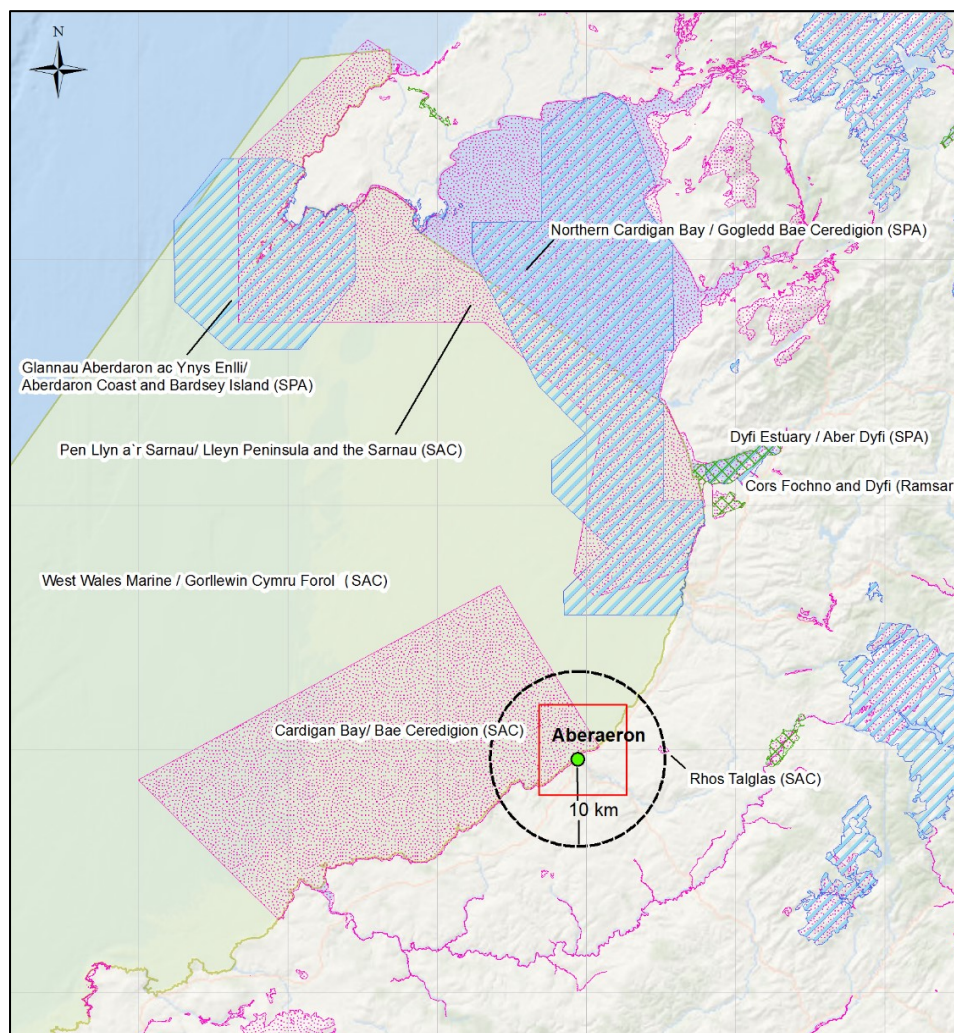


Figure 2-1 – Protected sites in the vicinity of the Scheme

Northern Cardigan Bay SPA, Pen Llyn a'r Sarnau SAC and the Cors Fochno and Dyfi Estuary SPA / Ramsar are too far from the Scheme for it to cause coastal squeeze, being 16km, 18km and 33km north of Aberaeron. The West Wales Marine SAC does not contain any Annex I habitats and is therefore not affected by coastal squeeze.

The Cardigan Bay SAC contains the following Annex I habitats as qualifying features of the site (but not a primary reason for selection) include:

- Sandbanks which are slightly covered by sea water all the time,
- Reefs,
- Submerged or partially submerged sea caves.

The Joint Flood and Coastal Erosion Risk Management Research and Development Programme report *What is coastal squeeze?* (2021)⁵ screens out a number of habitats where the concept of coastal squeeze would not apply. Subtidal sandbanks have been screened out in the report. While sea caves are not specifically screened out in the report, they are not included in the list of habitats that could be subject to coastal squeeze that are identified in the report. Nor are they present on any of the habitats that have been screened into the list of habitats that could be subject to coastal squeeze. The subtidal / partially subtidal nature of sea caves

⁵ What is Coastal Squeeze, 2021, Joint Flood and Coastal Erosion Risk Management Research and Development Programme Project Report FRS17187, https://assets.publishing.service.gov.uk/media/6038fafde90e07055c14049b/FRS17187_What_is_coastal_squeeze_report_1.pdf

means that they would not be affected by coastal squeeze. They are arguably not capable of transgressing landward in response to coastal squeeze. They are not considered further in this assessment.

Reefs are not specifically included in the list of habitats that could be subject to coastal squeeze, however, a number of habitats have been implicitly included because they are found on habitats that could be subject to coastal squeeze. Blue mussels and *Sabellaria alveolata* reefs are included in the list of implicitly included habitats.

As a result, the answer to Question 2 for both policy units is **YES**, as there are defences present that could prevent the landward migration of these habitats in the absence of these defences. The assessment therefore proceeds to Question 3.

Question no.	Question	Policy Unit	
		8.2 Aberaeron South Beach	8.3 Aberaeron Harbour
3	Is there a National Site Network designated site with Annex 1 habitats present in the area seaward of the defence? Note that the designated site does not need to be immediately adjacent to the proposed works or structure, and the site boundary could be nearby or lower down the shore.	YES	YES

The answer to Question 3 is **YES** for both policy units as *Sabellaria alveolata* is present in both policy units and blue mussels are present in policy unit 8.3.

Question no.	Question	Policy Unit	
		8.2 Aberaeron South Beach	8.3 Aberaeron Harbour
4	If the proposed works are in a 'Hold the Line' policy unit, does the Shoreline Management Plan HRA identify coastal squeeze losses? If the proposed works are in a 'No active intervention' or 'Managed realignment' policy then this question does not apply as coastal squeeze will not have been assessed for these policy types. For works which overlap or cross 2 policy units or more than one epoch you would need to consider the policies for all.	NO / NA	NO

The Habitats Regulations Assessments (HRAs) for the SMP2s in Wales identifies areas of intertidal habitat lost in the SACs and SPAs in Wales as a result of the preferred policies set out in the SMP2s. Figure 2-2 sets out these losses.

Designated Natura 2000 sites	Intertidal losses (Ha) in Wales			
	by 2025	2025 - 2055	2055- 2105	Total
Severn Estuary SAC/SPA	679*	1388*	3670*	5737*
Burry Inlet and /Carmarthen Bay SAC/SPA	59	163	411	636
Pembrokeshire Marine SAC	2	4	5	11
Lleyn Peninsula and the Sarnau SAC	40	150	111	301
Anglesey Coast Saltmarsh SAC	1	4	11	16
Menai Strait and Conwy Bay SAC	3	12	1	16
Dee Estuary SPA	0	140	454	594
Total	784	1861	4663	7310

Figure 2-2 – Area of intertidal habitat losses in Wales by protected site in Hectares (HA)

The HRA for the West of Wales SMP2 does not identify any intertidal habitat losses in the Cardigan Bay SAC. Clarification from NRW notes that the HRA applies to HTL policy units and epochs, based on ongoing management of existing structures.

The answer to Question 4 is **NO** for policy unit 8.3 (Aberaeron), as the policy is HTL for all three epochs.

The answer to Question 4 is **NO** for policy unit 8.2 (South Beach) for the 2025 and 2055 epochs as the policy is HTL for these epochs. Question 4 is **NOT APPLICABLE** to policy unit 8.2 for the 2105 epoch as the policy is MR and losses have not been considered in the SMP2 HRA. The assessment therefore proceeds to Screening Step 2 because there is potential for coastal squeeze to occur in the long term.

3. Screening Step 2

Based on the conclusion of Screening Step 1, the only policy unit in which coastal squeeze could occur is Policy Unit 8.2 Aberaeron South Beach in the 2105 epoch, where the policy is MR. This policy unit and epoch has been taken forward for further assessment.

Question	Policy Unit
	8.2 Aberaeron South Beach
Are the proposed works considered to be maintenance?	NO

The proposed works on South Beach are:

- Replacement of existing timber groynes;
- Replacement and extension of the existing rock revetment; and
- Beach renourishment.

The replacement of the existing timber groynes could be defined as maintenance. The current groyne field is dilapidated and are predicted to collapse in the near future (within approximately three years). The replacement groynes will be of the same length, footprint and location as the existing groynes. They do not increase or improve the standard of protection. The design life of the groynes is 50 years, such that they would not be expected to exert an influence by the end of the 2105 epoch – their design life would extend to 2074, if the scheme was completed in 2024. The replacement of existing timber groynes will take place seaward of the toe of the existing line of the defence on South Beach. It will not prevent the landward migration of habitat. Their function to retain sediment on the beach may reduce the loss of habitat seaward of the rock revetment, potentially having a **reduction to coastal squeeze impacts**. The timber groynes are **excluded from further assessment**.

The beach nourishment will take place seaward of the toe of the existing line of the defence on South Beach. It will not prevent the landward migration of habitat. The proposed source of the material for the nourishment is from the footprint of the other works as part of the Scheme (such as within the footprint of the proposed new breakwater in the adjacent Policy Unit 8.3. Beach nourishment will slightly increase sediment on the beach and may reduce the loss of habitat seaward of the rock revetment, potentially having a reduction to coastal squeeze impacts in the short term. The small amount of beach nourishment is not likely to persist beyond the medium term 2055 epoch. It will, therefore, have no impact on coastal squeeze in the long term 2105 epoch. The beach nourishment is **excluded from further assessment**.

The presence of South Pier, while not in this policy unit, does exert an influence on South Beach. The reconstruction of South Pier may / may not be considered as maintenance. It does not increase the footprint or change the function or standard of protection of the structure. The 'extensive or complete replacement of a structure' could be considered a 'significant alteration' under GN 062, however the South Pier is not being 'replaced' but 'rebuilt' and will use historically appropriate materials and methods due to its listed status. South Pier is in a significant state of disrepair and at risk of imminent collapse. The head of the pier is has been fenced off from public access to for several years to manage health and safety risks posed by the structure. The loss of South Pier would pose a significant flood risk to the harbour.

The works to South Pier and the presence of the pier are designed to last beyond the end of the 2105 epoch. The primary aim of the reconstruction of South Pier is to prevent flooding of the harbour (policy unit 8.3), where the SMP policy is HTL for all three epochs and these impacts are not being considered here (see Screening Step 1, Question 4). In policy unit 8.2, South Pier artificially maintains a wide beach crest at the northern end of South Beach and providing a defence against erosion. As a structure that maintains beach levels, its presence does not prevent the landward migration of habitat. Nor should its continuing presence in the long term prevent the implementation of MR in policy unit 8.3. It is the infrastructure behind the beach (car park, properties, road, revetment) that would prevent the beach from migrating landward. The reconstruction of South Pier is **excluded from further assessment**.

The replacement and extension of the existing rock revetment **cannot be considered to be maintenance**. Under the scenario set out in GN 062, the rock revetment falls under **Option 4 – it could lead to coastal squeeze and is in a MR policy unit**.

Under Option 4, the need to change the SMP policy should be considered. The works in policy unit 8.2 Aberaeron South Beach are considered to be a medium term solution to provide protection until the need to implement MR in the long term SMP epoch. The current rock revetment is predicted to fail between approximately five and 15 years. This would lead to more regular flooding of properties on Beach Parade and areas towards the harbour, which are lower. A replacement / improvement to the revetment is, therefore, required to implement the HTL policy in policy unit 8.2 during the 2055 epoch and until the MR policy is implemented before the end of the 2055 epoch.

The revetment would have a 1 in 200 year standard of protection (required by Welsh Government design standards) and a design life of 100 years. If the scheme were completed as planned in 2024, the revetment could still be in place and having a functional influence up until 2124 (as designed) and a residual influence beyond this. This does extend beyond the end of the 2105 epoch, however, to design a revetment of an exact design life to this date, while also meeting the required standard of protection is not practically feasible. The

design of the revetment does not, however, preclude or prevent the implementation of MR in the 2105 epoch, as the removal of rock revetment as part of any MR project is relatively straightforward.

There is currently nothing to suggest that the SMP policy needs to change, or that the 'SMP refresh' process currently underway proposes a change to the SMP policy.

The policy for this policy unit and epoch is still considered appropriate and there is **no need to change the SMP policy**.

The rock revetment has a design life of 100 years. If the scheme were built as planned in 2024, the revetment could still be in place and having a functional influence up until 2124 (as designed) and a residual influence beyond this. As a result, coastal squeeze could occur and there **may be a likely significant effect on the SAC**.

4. Step 3 – Appropriate Assessment

The conservation objectives for the Cardigan Bay SAC are shown in Table 4-1. This includes both Annex I habitats and supporting habitats necessary to achieve the conservation objectives for the Annex II species features.

Table 4-1: Cardigan Bay / Bae Ceredigion SAC

The habitat features designated as part of the Cardigan Bay / Bae Ceredigion SAC are as follows:

- Sandbanks which are slightly covered by sea water all the time;
- Reefs; and
- Submerged or partially submerged sea caves.

The species features designated as part of the Cardigan Bay / Bae Ceredigion SAC are as follows:

- Bottlenose dolphin (*Tursiops truncatus*);
- Sea lamprey (*Petromyzon marinus*);
- River lamprey (*Lampetra fluviatilis*); and
- Grey seal (*Halichoerus grypus*).

Table 4-2: Cardigan Bay / Bae Ceredigion Conservation Objectives for SAC Special Features

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.
Cardigan Bay / Bae Ceredigion Special Area of Conservation (NRW, 2017)
Habitat Features
Range
The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing. For the reef feature these include: • Intertidal bedrock reefs; • Intertidal cobble, pebble with <i>Sabellaria alveolata</i> (biogenic) reefs; • Subtidal bedrock reefs; • Subtidal pebble, cobble and boulder reefs; and • Sea caves.
Structure and function

The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded. Important elements include: • Geology; • Sedimentology; • Geomorphology; • Hydrography and meteorology; • Water and sediment chemistry; and • Biological interactions. This includes a need for nutrient levels in the water column and sediments to be: • At or below existing statutory guideline concentrations; and • Within ranges that are not potentially detrimental to the long-term maintenance of the features species populations, their abundance and range. Contaminant levels in the water column and sediments derived from human activity to be: • At or below existing statutory guideline concentrations; • Below levels that would potentially result in increase in contaminant concentrations within sediments or biota; and • Below levels potentially detrimental to the long-term maintenance of the feature species populations, their abundance or range taking into account bioaccumulation and biomagnification.
Typical Species The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include: • Species richness; • Population structure and dynamics; • Physiological health; • Reproductive capacity. • Recruitment; • Mobility; and • Range. As part of this objective it should be noted that: • Populations of typical species subject to existing commercial fisheries need to be at an abundance equal to or greater than that required to achieve maximum sustainable yield and secure in the long term; and • The management and control of activities or operations likely to adversely affect the habitat feature is appropriate for maintaining it in favourable condition and is secure in the long term.
Species Features
Populations The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Key parameters are: population size, structure, production, and condition of the species within the site. As a part of this objective for bottlenose dolphin and grey seal, it should be noted that contaminants derived from human activity are below levels capable of causing physiological damage or reproductive or immune suppressions.

Grey seal populations should not be reduced as a result of human activity.
Range
The natural species populations within the SAC are not being reduced, or likely to be reduced within the foreseeable future. As part of this objective for bottlenose dolphin and grey seal, it should be noted that: • Their range within the SAC and adjacent areas is not constrained or hindered; • There are appropriate and sufficient food resources for the species within the SAC and beyond; and • The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing.
Supporting habitats and species
The presence, condition, abundance and diversity of habitats and species required to support the qualifying feature species is such that the abundance, distribution and population dynamics of these species are stable or increasing, both within the site and beyond. Key considerations include: • Distribution • Extent. • Structure; • Function and quality of habitat; and • Prey availability and quality. As part of this objective it should be noted that: • The abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term; • The management and control of activities or operations likely to adversely affect the species feature is appropriate for maintaining it in favourable condition and is secure in the long term; • Contamination of potential prey species should be below concentrations potentially harmful to their physiological health; and • Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour.
Restoration and recovery
As part of this objective it should be noted that for the bottlenose dolphin populations should be increasing.

As set out in Screening Step 1, subtidal sandbanks and sea caves have been identified as habitats to which the concept of coastal squeeze does not apply. The intertidal reef features and supporting habitat features are therefore considered further.

Figure 4-1 shows the intertidal and subtidal habitats present in the area of the Scheme.

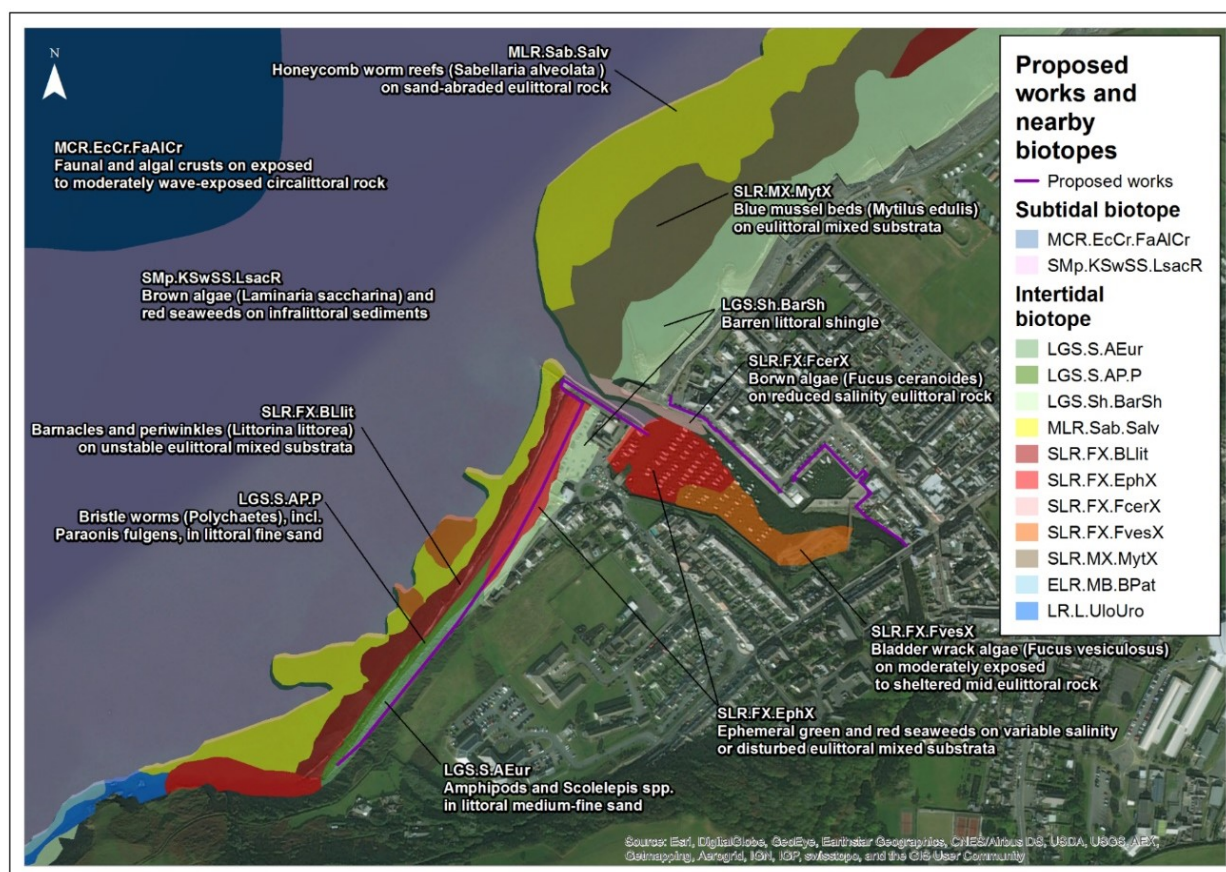


Figure 4-1 – Intertidal and Subtidal Habitat Map ⁶

The intertidal reef features could be affected in policy unit 8.2 during the 2055 - 2105 epoch. Any impacts as a result of coastal squeeze would only occur until the MR policy was not implemented or in the event that the MR policy was not implemented.

From approximately midway along South Beach, to the southern end of South Beach, the level of the hinterland rises and there is no capacity for the beach to migrate landward. Coastal squeeze would occur in the intertidal area only in the northern part of this policy unit, where the beach is backed by low lying land. In this area, the reef feature would continue to exist, but become subtidal. The overall scale and distribution of the reef feature as a whole will not decrease. There will be a small shift in the distribution of the component parts of the feature, until MR is implemented. Once MR is implemented, the beach would be expected to migrate landward and intertidal reef to be recreated, restoring any losses (i.e. they are temporary).

There is nothing to suggest that Ceredigion Council would not take steps to implement MR at an appropriate time in this location. The presence of properties and assets behind the line of the defence would require a proactive approach to remove them and implement an active MR policy in this location to ensure the risk to life and assets is appropriately managed. Ceredigion Council's active approach to considering implementing MR in other locations in the county provides evidence of their intent to follow the SMP policies, even in locations where this may prove challenging. The design of the proposed defences in this policy unit enable them to be dismantled relatively easily in the future – the rock can simply be removed.

Implementation of MR in the third epoch of the SMP is therefore mitigation against any temporary losses due to coastal squeeze. If MR is implemented as set out in the West of Wales SMP, there will be no coastal squeeze in this location and **no significant effect on the integrity of the site.**

⁶ (<https://naturalresources.wales/about-us/our-Schemes/marine-Schemes/habmap>)

In considering the supporting habitat for the species feature, the habitats that could be affected by coastal squeeze in Policy Unit 8.2 during the 2105 epoch are unlikely to affect the presence, condition, abundance and diversity of habitats and species required to support the species features of the site.

River lamprey and sea lamprey lay their eggs in clean river gravels and when hatched the larvae spend several years buried in sandy sediments feeding on organic matter before metamorphosing after 3-4 years (Maitland, 2003). Juveniles of both species migrate to estuaries and inshore waters where they feed parasitically on a range of fish species. Adult river lamprey are predominantly an estuarine and inshore species, whereas adult sea lamprey have a more oceanic distribution (Maitland, 2003). Adult river lamprey migrate through the SAC to reach the River Aeron on their spawning migration between October and December. Adult sea lamprey migrate through the site between March and June to reach the River Aeron. Juvenile sea lamprey migrate downstream during the site between December and June (NRW, 2017).

The River Aeron is outside of the designated Cardigan Bay SAC and is unlikely to be suitable for egg laying for lamprey. Any coastal squeeze in the policy unit will not affect the migration of either river or sea lamprey. Intertidal habitat fronting the rock revetment is shingle / cobble beach. This is not habitat that is used by lamprey, such that its loss as a result of coastal squeeze would have **no significant effect on the integrity of the site**.

Bottlenose dolphin are wholly subtidal, highly mobile and transient. Intertidal habitat fronting the rock revetment is shingle / cobble beach (shown as barren littoral shingle, and ephemeral green and red seaweeds on variable salinity or disturbed eulittoral mixed substrata in Figure 4-1). This is not habitat that is used by bottlenose dolphin or likely to be or likely to affect prey availability or quality. As such any loss as a result of coastal squeeze would have **no significant effect on the integrity of the site**.

Grey seals are also highly mobile and transient species. They are known for to pup on Aberaeron beaches during quiet periods. The NBN data records one sighting of grey seal in a 1km radius of Aberaeron (NBN Atlas, 2012), while CCC's biodiversity officer reports that at least one seal was seen on Aberaeron South Beach in 2020. While there is definitely potential for grey seal to use South Beach, the area of coastal squeeze is immediately adjacent to an inhabited area of the town and there is a public car park that backs the top of the beach, which is open to the public and used year round. It is very unlikely that this area is used regularly by seals for pupping and that it is the southern part of South Beach away from the town. The lack of regular seal sightings suggests that although there may be a loss of some habitat that could be used by seals, this area is not a key area of use and any loss in extent would not affect reproductive success at a population level. As a result, any coastal squeeze in this area would have **no significant effect on the integrity of the site**.

5. Conclusion

The coastal squeeze assessment has concluded that with the mitigation measures set out, there are **no significant effects** on the integrity of the site as a result of coastal squeeze that may occur in response to the Aberaeron Coastal Defence Scheme over the lifetime of the scheme.