



West of Wales Shoreline Management Plan 2

Section 4. Coastal Area D

November 2011

Final

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West of Wales Shoreline Management Plan 2

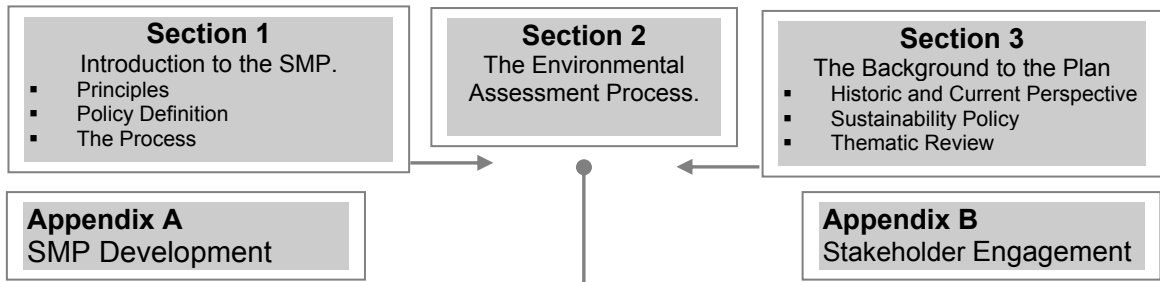
Coastal Area D,

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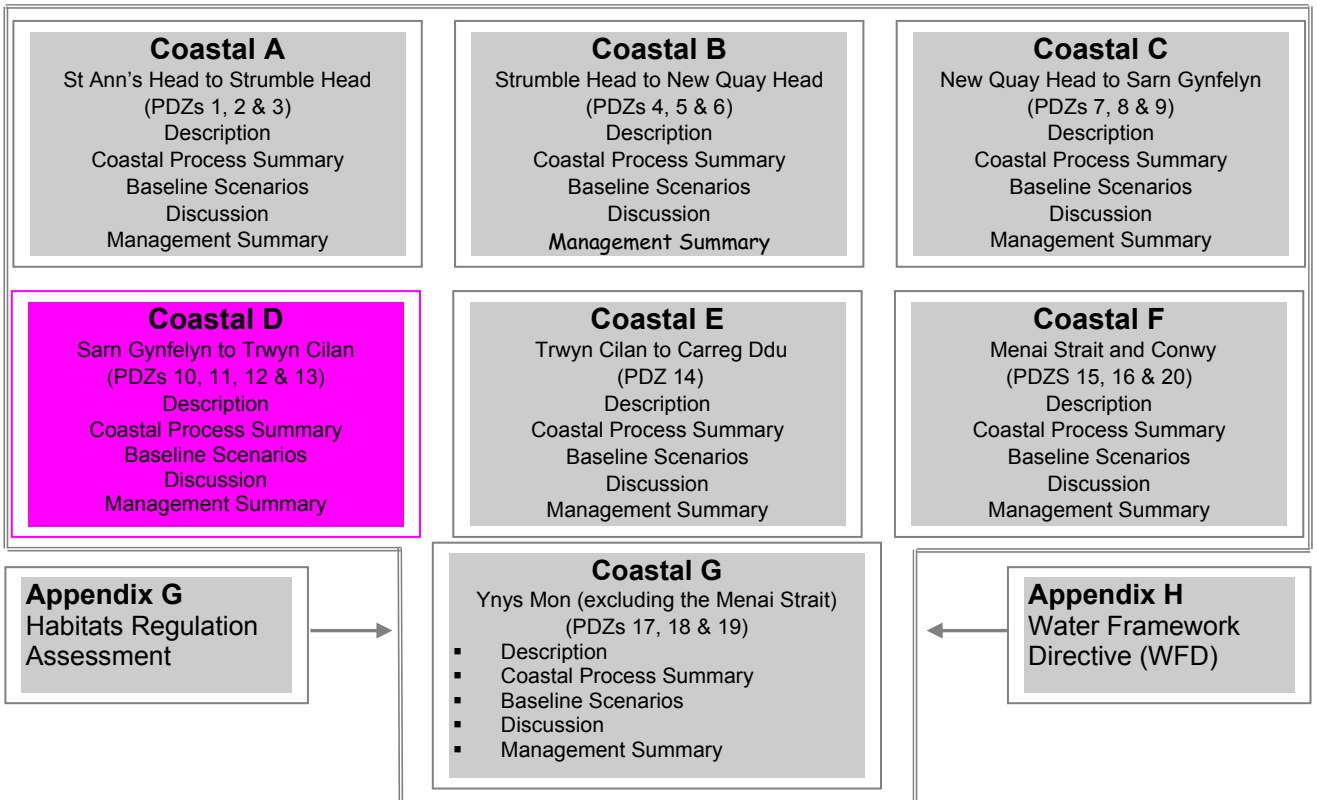
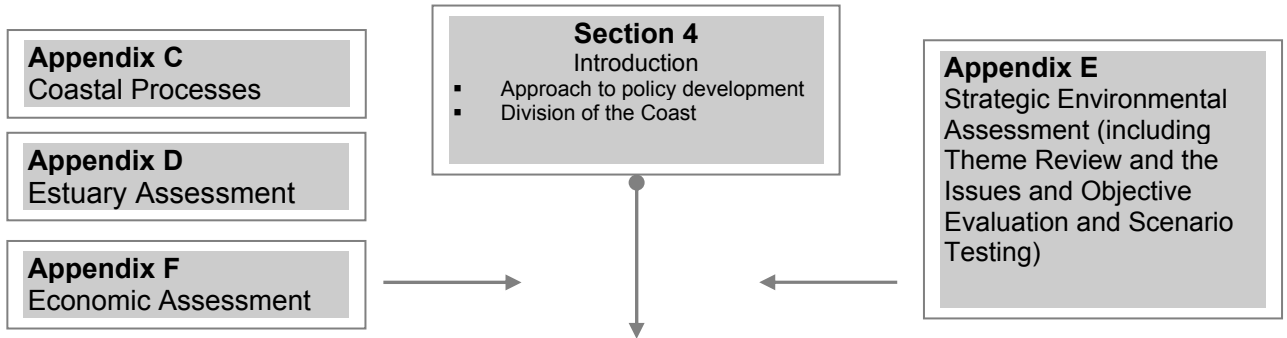
Sarn Gynfelyn to Trwyn Cilan



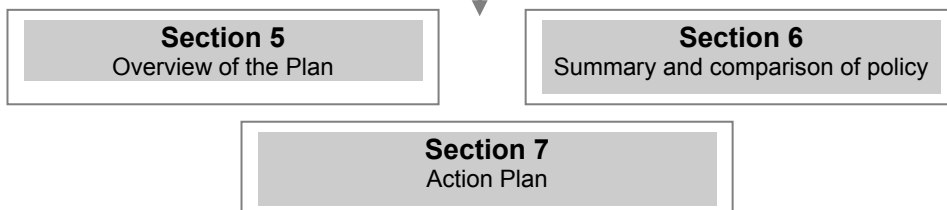
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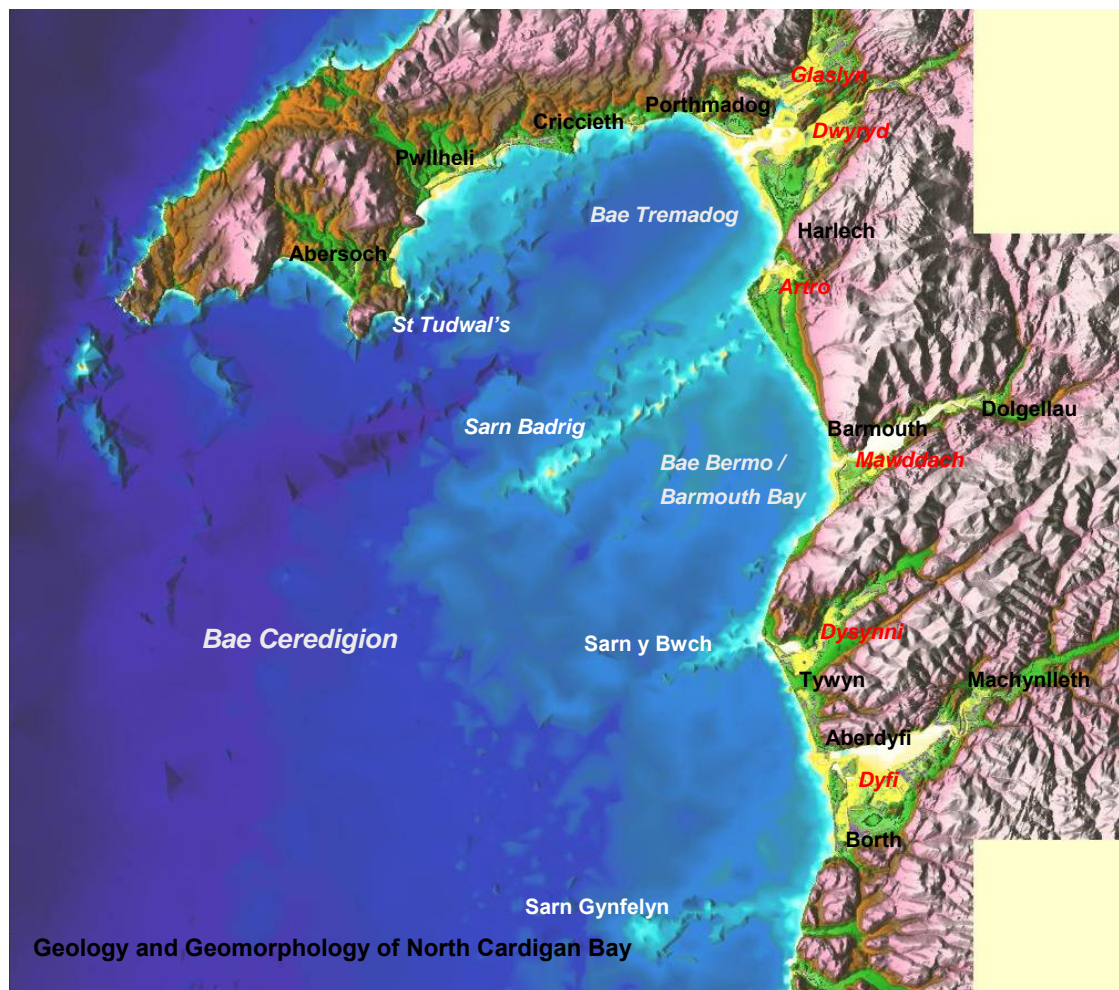
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4D.1 GENERAL DESCRIPTION

1.1 Character

(Further detail for the area is covered in Appendix D with individual features of the coast identified in Appendix E.)

This coastal area includes the northern mountainous coastline of Cardigan Bay; cut through by the major estuaries of the Dyfi, Dysynni and the Mawddach, through the low-lying valley of the Dwyrdd and Glaslyn and on to the southern shoreline of the Llŷn Peninsula. Human development along the shoreline and within the estuaries has been strongly influenced by the topography of the area and the natural development of the coast.



Over the southern and central section of the area, the main historic centres of development focus around the estuaries: with Machynlleth and Dolgellau at the head of the Dovey and the Mawddach, and Aberdyfi, Tywyn, Barmouth, Harlech and Porthmadog built at the mouths of the estuaries. Harlech, with its Castle built on the high cliff line, is now a World Heritage site, with its views over the estuaries. The area around Harlech is designated as a Historic Landscape Area and this extends over Porthmadog and over much of the coast down to Tywyn. Newer settlements such as Borth and Fairbourne have developed on the lower lying land created by the sediment infill of the estuaries and other villages such as: Tonfanau, Llwyngwriol, Friog, Llanaber,

Llanddwywe, Llanenddwyn, Llandanwg and Talsarnau are strung out along the often narrow coastal zone between the shoreline and the steeply rising, sparsely populated hinterland.

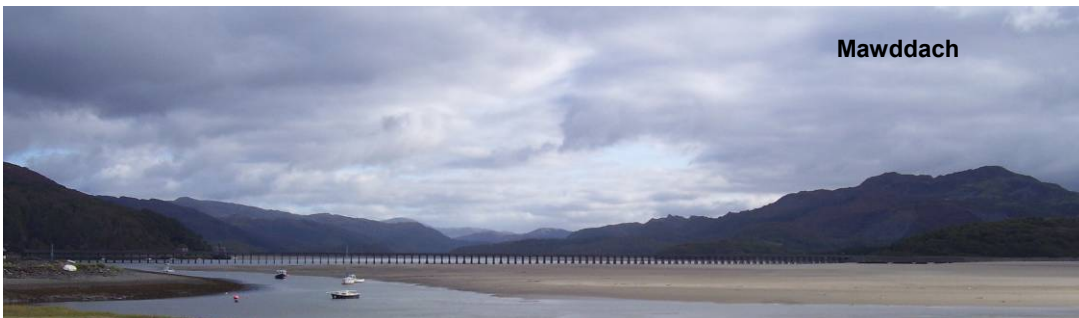
The transport routes interlink these settlements are similarly constrained along the back of the shoreline. The main north south road through the region runs generally in land of the coast. The road from the south (A487) runs from Aberystwyth through to Machynlleth, only running for a short distance along the southern side of the Dyfi Estuary at Glan Dyfi. This main trunk road continues in land of the coastal mountains to Dolgellau, remaining well in land through to Gellilydan, where it then follows down the valley of the Dwryd, through Penrhyndeudraeth and across the Cob, across the mouth of the Glaslyn to Porthmadog. The B4353 runs across the old flood plain of the Dyfi to provide access to Borth and Ynyslas.



The A493 runs along the northern edge of the Dyfi, around the peninsula between the Dyfi and the Mawddach, running back up the Mawddach to Dolgellau. The A496 runs along the northern shore of the Mawddach around the coast through Barmouth and Harlech and back up the valley of the Dwryd.

The main West Wales railway runs from Birmingham, through Shrewsbury, to Machynlleth, where it divides at Dyfi Junction. The southern branch runs across the flood plain of the Dyfi, through Borth and on to Aberystwyth. The northern branch crosses the Dyfi at Dyfi Junction and then follows the route of the road along the northern edge of the Dyfi, linking to various villages and towns through to Fairbourne on the southern side of the Mawddach. It crosses the Mawddach over the now restored trestle bridge and again links the towns and villages along the whole length of the coast, crossing the Dwryd and the Glaslyn through to Porthmadog and along the southern Llŷn Peninsula to Pwllheli.

These transport routes have become a major feature of the coastline, essentially linking the string of settlements and providing their link with the rest of Wales and England. The railway line in particular gives access to the coast to sustain its strong tourist industry and is now developing as a freight service from Porthmadog.



Along the Southern Llŷn, there is a similar pattern of development along the coastline, with the main towns and villages of Criccieth, Pwllheli, Llanbedrog and Abersoch all at the shoreline. There are newer settlements such as Abererch and Morfa Bychan, which is built behind the sand dunes of the Glaslyn/Dwryd estuaries. Critically, however, in this area the more gently rising hinterland supports a greater degree of rural

development, in land, with a network of smaller roads running parallel to and interlinking with the main A497 coastal road. This coastal road tends to run some way back from the coast through all the major towns. The railway, however, runs for much of its length directly at the back of the shoreline.

In both areas there is a strong link between settlement and the shoreline. Aberdyfi, Barmouth, Porthmadog, Pwllheli and Abersoch all have important harbours or moorings. In particular the harbours of Pwllheli and Porthmadog have had major investment in improving their harbours as centres for recreational boat use as well as supporting the more traditional local commercial and fishing effort. Pwllheli and Abersoch are seen as a nationally significant watersports centres, providing an important diversity of use. The other harbours provide vitality and attraction to the centre of each settlement.

Much of the hinterland and coastal area is under agricultural use, with the predominant use being pasture land, from the rough pasture on the higher grounds to improved grassland to the gentler coastal slopes and estuary floor. This agricultural industry underpins the local economy and cultural value of the area. This landuse together with the superb natural environment and open beaches equally underpins the established and growing tourist industry. This industry in part is characterised by the watersports and recreational boat use, but is also dependent on the major holiday parks and caravan



parks along the coast. Significant investment has been made in this area. There are important local sites along much of the southern section of coast, with major holiday centres at Ynyslas and Aberdyfi, Tywyn, Llwyngwrl and between Barmouth and Harlech. Along the Llŷn shoreline development of holiday centres tends to be more focussed at Morfa

Bychan, west of Pwllheli and north of Abersoch. There is a significant amount of tourist accommodation within the towns and villages and individual hotels and guest houses, particularly scattered around the estuaries. In some areas the tourist industry is the main stay supporting shops and facilities within the villages that then provide essential services to the local residents and the broader agricultural communities.

A further major attraction for tourism as well as being an important local resource are the well established links golf courses in the area; these include the courses at Borth, Aberdyfi, Harlech, Pwllheli and Abersoch. While each is a separate entity, the combination of courses offers a significant attraction. Each course provides important local employment.

The influence of the coastal tourism extends in land supporting tourism in the major towns such as Machynlleth and Dolgellau. This part of Wales in particular provides an important coastal resource to centres of the West Midland and Northwest regions of England.

A major attraction of the coastal area is the natural environment. The whole coastal area lies within the international Marine SAC designation of Pen Llyn a'r Sarnau/**Llŷn Peninsula** and the Sarnau. The central area forms part of Snowdonia National Park, who are the planning authority for a large proportion of the coast and the important sandy beaches of both the southern section and the Llŷn are an essential resource. In addition to the natural landscape is the importance of the coastline and estuaries as

being a functioning system, inherently important for its ecology and landforms as well being an important educational resource. The Dyfi is designated as an SPA and Ramsar site and the SAC designation extends in land over all the main estuaries and some of the major sand dune areas (other areas of the sand dunes are designated as part of the Morfa Harlech and Morfa Dyffryn SAC). Within the Dyfi, in particular, is the unique feature of the Cors Fochno raised bog. With only minor exception, the whole coast is designated as SSSIs with important ecological, geological and geomorphological features. This natural environment also has significant direct economic value in sustaining the important shellfish, lobster and crab and more general fishing stock. The estuaries are important as spawning grounds for Bass and many of the rivers are significant for salmonoids.

There is a long history of human interaction with the coast and this complements the present day cultural values and understanding of the area. Clearly the Castles at Harlech and Criccieth are most obvious examples of this, but archaeological evidence well predates these medieval features of the historic landscape. There are several prehistoric hill forts, all set back on the higher ground of the coast, and specific archaeological finds and submerged forests on the foreshore at Borth, Tywyn, Llwyngwrl, Talybont and Traeth Crugan all demonstrate the progressive change in the coastline. The area has been in the past linked to the tales of Cantref y Gwaelod, the lost land of Wales, which, even if much embellished, provides an understanding of how, with past sea level rise and erosion of the coast, land has been lost to the sea and how communities have had to adapt. More recent use has been the various mining activities at Barmouth and Abersoch and the important and still active slate quarrying in the Ffestiniog and Porthmadog area. Associated with this was the construction of the Cob across the Glaslyn providing the route for the still important Ffestiniog railway and resulting in the major change in behaviour of the main estuary.

The area as a whole is described in the Wales Spatial plan as being an important economic hub centred through Porthmadog and Criccieth, essential for the economic well being of the northwest region. The major towns along the southern Llŷn Peninsula support this hub and provide essential services to the rural agricultural land use behind. Along the southern section of the coast, settlement is more linear, each village interlinking and being interdependent, with the main centres being at Towyn and Barmouth but with an essential link back into the towns of Dolgellau and Machynlleth. Borth and Ynyslas, while being strongly linked to Machynlleth, also have an important link to Aberystwyth to the south, supporting the important tourism of the area.

Maintaining the main road system along the coast, particularly over the southern area is vital to sustaining the settlements and the railway line running all the way through from Machynlleth to Borth and Aberystwyth, to the south, and through to Porthmadog and Pwllheli, to the north through all the coastal villages. This infrastructure supports both the aims of increasing sustainable public transport use and is an essential service supporting local and regional values in the area.

1.2 Physical Process Overview

(Further detail on coastal processes and geomorphology is provided in Appendix C).

EXPOSURE

Water levels: Water levels are relatively uniform over the area, reflecting the way in which the tide approaches up into Tremadog Bay. The levels at Porthmadog are just slightly higher on the spring tide as the momentum of the tide is confined into the estuary. There is a slightly different pattern to extreme water level information (taken from the North Wales Tidal Flood Mapping) . This may be due to the difference in methods used to determine water levels at Porthmadog and Barmouth (D&T RSRJPM) compared to the Graff Method used for other sites. The present values are nearly 1m higher than those determined during the 1991 NRA survey of Sea Defences. The main difference has been with the inclusion of the Barmouth data set; previous extreme values were taken either from Liverpool or Fishguard. Although the estimation of extreme water levels has significantly improved there is still a degree of uncertainty. There is evidence from modelling that the shape of the Dyfi distorts the tidal wave within the estuary, increasing velocities but also potentially increasing water levels further up the estuary.

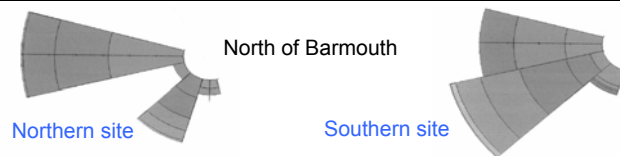
Location	Tide m. AOD				Extreme Levels (return period) m AOD			
	MLWS	MLWN	MHWN	MHWS	10 yr	50 yr	100 yr	200 yr
Aberdyfi	-1.74	-0.44	1.06	2.56	3.93	4.17	4.31	4.44
Barmouth	-1.74	-0.64	1.06	2.56	3.93	4.17	4.31	4.44
Porthmadog			0.96	2.66	3.79	4.03	4.17	4.32
Criccieth	-2.04	-0.64	0.96	2.56	4.01	4.26	4.41	4.55
Pwllheli	-1.94	-0.54	0.96	2.56	3.94	4.18	4.32	4.47
St Tudwalls Roads	-1.94	-0.64	0.86	2.36	3.63	3.86	4	4.13

Waves: The dominant wave direction is from the southwest. The inshore wave climate around the area varies significantly, both due to the local influence of headlands and the influence of the Sarns and due to the overall shape of the coast. At Borth the net energy direction is from the west with significant variation from a broad sector from southwest through to northwest. It is also noted that slight decadal variation can result in significant change in the direction of net energy. Between Aberdyfi and Tywyn net in shore wave energy tends to back more to the southwest. The plots below show two independent assessments of the wave climate at Aberdyfi and the inshore wave climate for Tywyn. While there appears to be significant shift, the local variation and variation between different modelling of the offshore wave climate is highlighted.



(Plots taken from Aberdyfi Dune System - Pye and Blott 2006.)

Further north, north of Barmouth wave modelling showed significant variation in inshore wave climate over a 4km length of the coast. This is shown in the following plot. (Barmouth Bay and Islarffordd Numerical Modelling 2005).



Modelling in 1995 covering from Harlech to Abersoch showed typical variation in inshore wave climate with a dominant WSW direction at Harlech, backing to SSW just west of Pwllheli, with the inshore climate falling off and predominately from the SE at Abersoch. This general assessment has been confirmed by more recent detailed modelling.

GEOMORPHOLOGY:

The modern behaviour of the coast, over the whole area, is influenced obviously by the hard geology but more significantly by the affects of glaciation and the massive release of sediment that occurred during the period of rapid sea level rise as the ice caps melted. The main influence on the southern section was the carving out of the major valleys, now forming the basis of the sediment infilled estuaries, the creation of the Sarns which shelter and influence the shoreline and the relatively thick glacial deposition over the harder geology. As erosion occurred so the harder geology of the Aberystwyth cliffs, the headland of Tonfanau and the relatively solid boulder clay headland of Mochras, at the root of the Sarn Badrig, have all come to the fore, anchoring the coastline and creating a strongly swash aligned shore. There are no major promontories acting as headlands across the net direction of wave energy and the alignment of the coast between each hard point is more akin (and very similarly aligned) to the obvious open bays of Hells Mouth and Aberdaron on the eastern end of the Llŷn Peninsula.



The same general shape is true for the natural development across the mouth of the Glaslyn and Dwyrdd at the head of Tremadog Bay. As erosion continued and continues along each frontage, so the influence of the estuaries, together with the locally emerging headlands have further subdivided the frontages. Ynyslas and the estuary mouth create a sub-bay to the south and the harder boulder clay ridge of Tywyn is starting to separate the entrance to the Dysynni to the north.

The Llanaber headland, emerging between the Mawddach and Morfa Dyffryn, similarly is creating two distinct frontages to the south and to the north. These changes are beginning to influencing local behaviour along each shorter section of the coast.

Along the South Llŷn northern frontage the form of the coast is different. The coast is held, with the St Tudwal's Headland actually providing shelter against the dominant wave direction, and subsequent hard rock headlands at Penbennar, Llanbedrog, Carreg y Defaid, Carreg yr Imbill, Pen-ychain, Criccieth and Carreg Ddu all creating a series of updrift/downdrift control points within which the oblique offshore waves have then carved our classic crenulate shaped bays.

In some cases such as Borth Fawr, Pwllheli and east of Criccieth these bays created barrier beaches to larger low lying land behind. The main inconsistency

in this general headland/bay shaped coast is in the area of the Afon Dwyfor where the broader area of high foreshore and the tougher glacial cliffs have resisted erosion.

Drift

The principal difference between the sections of coast described above is in the way the headlands act to control sediment drift. Over the southern section the basic shape of the coast is orientated at right angles to the dominant wave direction, with the headlands emerging through the shoreline as that shoreline rolls back. Drift, apart from along the southern shoulder of each frontage would be expected to be weak, influenced locally by the estuaries and harder sections of the coast. Therefore:

- Along the Borth frontage there is seen very variable drift both to north and south but only limited net drift to the north.
- Between Tywyn and Dyfi there is a weak drift south, which is strongly influenced by the change in configuration at the mouth of the estuary and its ebb banks.
- Between Tywyn and Tonfanau the drift potential is to the north as the roll back of the shoreline is held by hard defences.
- Along the shoulder of cliffs the alignment of the shore is so oblique to the dominant wave direction that with the raised harder areas drift is relatively limited.
- Within the entrance to the Mawddach the drift is towards the entrance of the estuary, respectively to the north over the southern shoreline and to the south along the Barmouth frontage.
- Between Llanaber and Morfa Dyffryn, there is a very weak net northerly shoreline drift as the backshore effectively just wishes to roll back. The coast is effectively held slightly proud by the slight reef and ridge of higher ground at Tal-y-bont.
- With the slow erosion of the Mochras headland, but also due to the influence of the Sarn the coast would be expected to be in a continual and very gradual process of realignment and as such there would be more significant but weak net drift north.
- Along the Harlech and Morfa Bychan sections of coast, drift within the intertidal area is towards the centre of the bay. Drift over the upper shore is similarly towards the centre but strongly influenced by the interaction with the estuary.

Along the South Llŷn northern shoreline, the headlands significantly modify the waves approaching the shore. The typical behaviour, where the bay is well developed is for net drift divides to develop, with sediment tending to be carried into the lee of the headland and sediment to be moved west along the straighter eastern section of the bay. Where the crenulate shape is more truncated by the presence of hard cliffs the trend is for sediment drift to be net east over the whole frontage. An example of this is at Traeth Crugan to the west where the down drift face of Carreg Defaid is well forward of the idealised stable alignment. Even so, drift rates are generally not high and there is seen as being limited drift from one bay to the next. Within many of the bays there are local areas of rock, rock or glacial hard points on the fore, all of which influence drift in this relatively well aligned frontage. The most obvious area where this occurs is in between Penychain and Criccieth. Here the advance position of the shoreline should have a large drift system. In reality, there is limited material available and drift is significantly reduced by the harder, higher foreshore and the influence of the

Afon Dwyfor.

Erosion/ Accretion: Over much of the southern shoreline the trend is for erosion. This tends to be a relatively slow process and often sediment moved from one area can build in other areas due to differential rates of sediment transport. Much of the Borth frontage has tended to roll back with areas of erosion more at the northern end. Other areas under greatest risk are along the Penllyn frontage south of Tywyn and the Dysynni frontage to the north of the town, the general erosion of the cliffs along the frontage between Tonfanau and Friog and along the southern end of the Ro Wen, in front of Fairbourne. The section of coast north Llanaber through to Mochras has eroded back, although at the northern end there is evidence of embryo dune development reported.

The northern face of Mochras is continuing to erode gradually.

Along the South Llŷn northern shoreline there has always been a risk of erosion to the centre of Borth Fawr and more occasional episodes of erosion at the entrance to the Afon Soch and along the Warren. In the case of the Afon Soch this area tends to rapidly rebuild. The whole frontage of Traeth Crugan has a history of erosion but further along the Pwllheli frontage the beach has remained relatively stable and has had periods of accretion.

The main area of erosion in the bay to the east of Pwllheli is in the centre at Abererch. Erosion has been persistent along the Holiday park cliffs and along the railway frontage of the Afon Wen. East of Criccieth there has been slow erosion of the local clay cliffs and risk of shingle being thrown back over the bank to the railway line.

All the main estuaries have tended to accrete, although there has been some erosion of saltmarsh areas. At the mouth of the Dyfi there have in the past been large changes in the ebb bank system. This has allowed the southern dunes to the Penllyn frontage to accrete. Over the last several decades this nose has tended to remain quite static and the largest accretion has occurred within the mouth of the Dyfi at Aberdyfi.

The Mawddach has accreted significantly and, seemingly associated with this has been changes in the low water bank system of the ebb delta. The beach to the southern end of Barmouth has tended to accrete and this trend has increased since the closure of the northern run from the estuary. Associated with these changes have also been periods of accretion at the northern end to the Ro Wen.

One of the main areas of accretion has been at Morfa Harlech, where the dunes have tended to accrete substantially at the northern end. This has been strongly linked with the closure of the Glaslyn with the construction of the Cob reducing the tidal prism. The whole Glaslyn / Dwyryd system has also accreted with the development of mud flats and salting.

LONG TERM EVOLUTION:
(unconstrained)

In an unconstrained state the whole coast would tend to roll back, in some areas still actively eroding and adjusting to a more stable alignment. As this occurs new harder points would emerge changing the distribution of erosion and accretion. In an unconstrained scenario the Dyfi may increase its tidal prism and in doing so would tend to increase the size of its ebb tide delta, while also tending to draw sediment in to re-establish the balance. The increased ebb delta would impose greater control on the shoreline and there may be local areas of accretion.

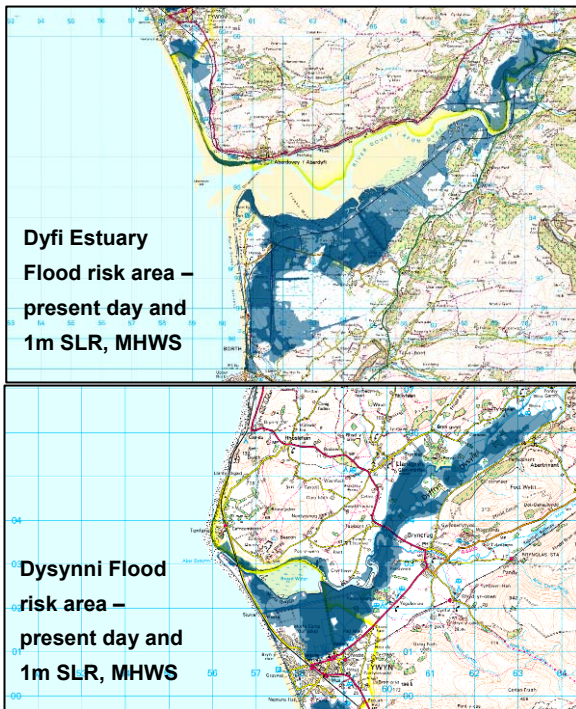
The emerging Tywyn headland would erode but at a slower rate than the coast to north and south. Across the Dysynni the shingle bank would retreat to form a lower more stable ridge across the estuary. Along the cliffed area to the north there would be slow erosion which would remove the railway line and potentially the road. Despite the increased sediment supply, the Ro Wen would erode and roll back to form a new shingle ridge with saltmarsh behind. This would result in the loss of Fairbourne.

There would be greater separation between the system of the Mawddach and the section of coast to the north. This northerly frontage would continue to roll back.

In this unconstrained scenario the Cob would not be there and there would be massive change to the two estuary systems. It is probable that Morfa Harlech would be set back at its northern end and there would increased erosion at Morfa Bychan. The estuary would still tend to accrete.

The various bays to the north would deepen with potential breach through to the areas of low lying land. The basic shape of the coast would be retained by the hard headlands.

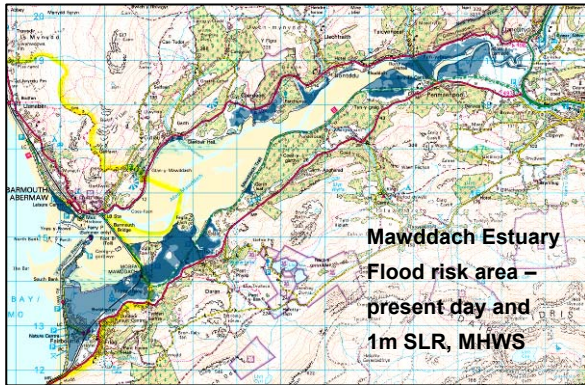
FLOOD RISK



While erosion and coastal change is an on going process along the whole coast there are very specific areas of significant flood risk, increasing substantially with sea level rise.

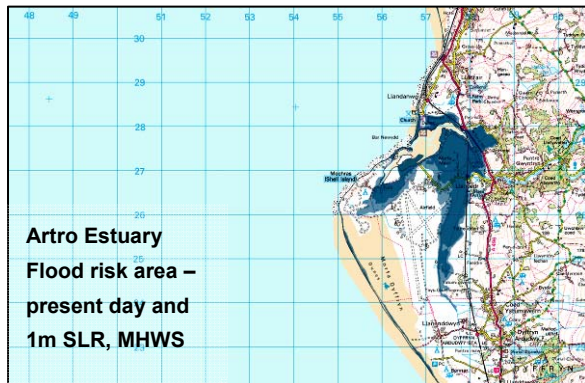
Large areas of the defended southern shore of the Dyfi Estuary are at present below MHWS. With 1m sea level rise this would increase to include the larger part of low lying land through to Pennal with increased food risk to the A487, overtopping of the railway embankment and loss of the B4353. Large areas of Borth would be at substantially greater flood risk. The Borth golf course and significant areas of the Aberdyfi Golf course would be below MHWS with 1m SLR

Within the Dysynni, again there are significant areas below MHWS. With sea level rise the area of normal flooding would increase more higher up the valley. Even under a sea level rise of 1m Tywyn would be well above normal tides.

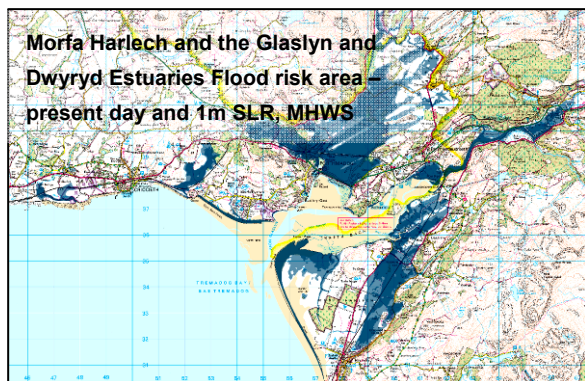


The main areas of flooding on the Mawddach are to the low lying land at the mouth of the estuary and further upstream close to Dolgellau. Much of the area of Fairbourne would be at risk under MHWS with 0.36m of sea level rise. With 1m sea level rise the whole area of the village would be below MHWS.

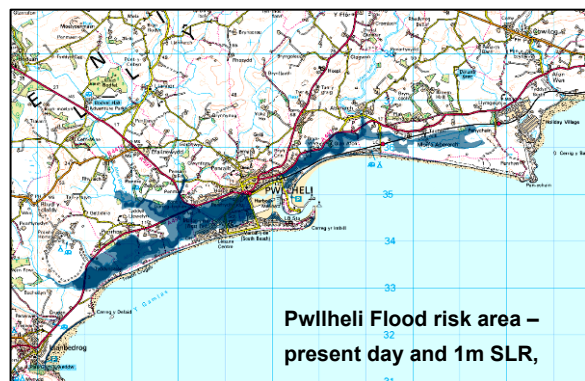
Further north of Barmouth, flooding areas of the low lying land south of Tal-y-bont would be at risk of normal tidal flooding with 1m sea level rise.



In the case of the Afon Artro current MHWS fills much of the estuary and the access road to Mochras. The area at flood risk under normal tidal flooding would not significantly increase with 1m sea level rise; the depth of flooding would however increase.



In the large twin estuary of the Glaslyn and Dwyryd substantial areas of defended land behind Morfa Harlech lie below MHWS. The present tidal level stays mainly within the channel of the Dwyryd but would extend well into and over reclaimed land on the Glaslyn; including areas around the station in Porthmadog. With 1m sea level rise the areas at risk from MHWS would extend further into the area around Harlech. The area at risk would increase within the Dwyryd and around Porthmadog and there would be increased risk of flooding to the railway line east of Criccieth.



There would be more local flood risk around the Afon Dwyfor which might impact on the railway line.

At Pwllheli areas of the Afon Erch, including both sections of the railway and the road are at risk from normal tidal flooding. The central valley behind the Cob and extending up both the valleys of the Afon Rhyd-hir and the Penrhos are situated within the MHWS flood risk area. With 1m sea level rise the extent and risk of increased depth of flooding occurs in all these areas.

At Abersoch the main flood risk is locally to the lower part of the town and to the low lying land and Golf Links behind Borth Fawr. The main road to the town would be at risk.

1.3 Present Management and Key Issues and Objectives

Existing management practice

The following table sets out SMP1 policy (developed over a 50 year period), how the coast has been subdivide into management units and, where relevant, where more recent decisions have been made, or where discussion is on going with respect to individual areas.

SMP 1 No.	Management Unit	Policy	Subsequent Management Approach
Ceredigion			
16.1	Borth Cliffs	R	
16.2	Borth	HTL	Strategy for hold the line
16.3	Borth to Ynyslas	HTL	
16.4	Ynyslas	R	
17.1	Ynyslas Dunes	R	
17.2	Twyni Bach	R	
17.3	Aberdyfi		
17.4	Aberdyfi Dunes		
18.1	Borth Bog	HTL	
18.2	Dyfi Junction	HTL	
18.3	<i>Dyfi northern shore</i>		
Gwynedd			
1.1	Dyfi Junction to Gogarth Halt	DN	
1.2	Gogarth Halt to Penhelig	HTL	
2.1	Aberdyfi	HTL	
2.2	Aberdyfi Golf Course	R	
2.3	Penllyn	R	
2.4	Tywyn	HTL	Strategy for hold the line.
2.5	Morfa Gwyllt	HTL	
3.1	Tonfannau	DN	
3.2	Rola	HTL	
3.3	Llwyngwrl	R	
3.4	Friog Cliffs	HTL	
3.5	Ro Wen	HTL	
4.1	Morfa Mawddach	HTL	
4.2	Penmaenpool	HTL	
4.3	Glandwr	DN	
4.4	Barmouth Harbour	HTL	
5.1	Barmouth	HTL	
5.2	Sunnysands	DN	
5.3	Bennar	DN	
6.1	Shell Island	DN	
6.2	Llananwg	HTL	
6.3	Harlech	DN	
7.1	Talsarnau	DN	
7.2	Port Merion	DN	
7.3	Porthmadog Cob	HTL	
7.4	Blackrock sands	HTL	

SMP 1			Subsequent Management Approach
No.	Management Unit	Policy	
8.1	Criccieth Shingle Bank	HTL	
8.2	Criccieth	HTL	
8.3	Y Dryll	DN	
8.4	West Afon Dwyfor	DN	
8.5	Afon Wen	HTL	
9.1	Morfa Abererch	R	
9.2	Abererch	HTL	
9.3	Pwllheli Harbour	A	
9.4	Pwllheli South Beach	DN	
9.5	Traeth Crugan	HTL	
9.6	Llanbedrog	DN	
10.1	Mynydd Tir y Cwmwd	DN	
10.2	The Warren	HTL	
10.3	Abersoch	HTL	
10.4	Borth Fawr	DN	
11.1	Porth Ceiriad	DN	

Key: DN – do nothing, HTL – Hold the Line, SHTL – Selectively Hold the Line, R – Retreat, deferred – policy deferred subject to further monitoring or study.

Under SMP 1 policy the main towns would continue to be defended. This would also include Borth and Fairbourne. In many cases villages were not seen as being at risk from flooding or erosion over the 50 years of the SMP1 and, therefore, since there was no expectation of undertaking defence management the policy was for Do Nothing (or No Active Intervention). Significant areas were also given a policy of Do Nothing or retreat; areas such as Ynyslas, Penllyn and the Aberdyfi Golf course, Sunnysands, Morfa Abererch and Borth Fawr.

SMP2 considers management forward over the next 100 years, and this together with the significant threat of sea level rise means that policies have to be reviewed. This longer term perspective has identified significantly greater areas of risk. This is considered in terms of the key management issues identified in relation to the important values of the area.

Key Management issues

Large sections of the coast are managed and are going to come under increasing pressure due to erosion. On the open coast this pressure will mean that defences become more exposed, as, over the southern section of the area in particular, the shoreline to either side of the defence attempts to roll back and, where, over the northern section of coast the bays attempt to readjust their shape. This will result in loss of beaches, either quite simply as the defence line is held well in advance of the natural shoreline or where the defence forms a new headland, stopping sediment drift and creating down drift erosion. Where the shoreline is forming a natural barrier protecting low land behind, if the movement back of the coast is resisted, coupled to higher water levels, the potential for overtopping and breach to occur will reduce the level of the natural defence or lead to opening up of some large new flood plains. Even where the shoreline is allowed to retreat in other areas, the potential for opening up areas behind to inundation will increase.

Within the estuaries, there are also substantial lengths of flood defences. With sea level rise in particular, there will be increased squeeze of the upper estuary area against these defences. More significantly in term of the defence itself, there will be increased

overtopping which would if defences were not reinforced lead to rapid deterioration and long term failure. (With 1m sea level rise, a 1:100 year event under present day conditions becomes the equivalent of a 1:1 year event in 100 years time.) Many of the protected areas both on the open coast and within the estuaries are already at or below the level of normal tides, so that, even if defences were to be raised, the risk in terms of surface water flooding and the difficulty of drainage will increase. These areas would become increasingly vulnerable to major catastrophic failure of the defences. This then calls in to question the ability for areas to adapt to this sort of threat and the sustainability of continuing to raise defences.

The estuary and potential new inlets created by sea level rise can have a significant impact on the way the coast behaves. Continuing to defend areas reduces the tidal prism, leading to reduction in ebb delta systems and reducing the recycling of sediment to the coast as well as reducing, in some areas the way in which the estuary mouth has held the open coast forward. The man made constraint within the upper part of the estuaries can increase tidal locking of freshwater flows, potentially leading to increased flood risk beyond the tidal limits.

These various affects can also have a significant impact on the nature conservation of the area and impact adversely upon this vitally important resource and upon the equally important landscape. These are underpinning values, important from their inherent value to the ecology, education and scientific understanding, but also at the broader scale in supporting high quality of life and essential attractiveness of this part of Wales.

Considering more specifically the risks within the area, there are clearly some broad scale impacts that threaten the sustainable use of the whole area. In terms of transport links, there is a significant risk in terms of flooding and failure of the major rail link across the Dyfi and south to Aberystwyth. The railway line is also at risk north of Tywyn both from flooding and erosion, along the coast north of Tonfanau, across the Mawddach and through the valley behind Morfa Harlech through to Porthmadog. There are further risks to the line east of Criccieth, at Afon Wen and at Abererch. In terms of the road network, there are more local areas of risk, particularly where the roads cross the estuaries or run along side the estuaries, along the southern section of the coast. Along the northern section there are specific areas of risk along the Dwyrdd valley, across the Cob, to either side of Pwllheli and at Abersoch. Over the southern section through the Dyfi and again to the northern section of the coast, there is scope for realignment of the transport network, even though change would require significant new investment. However over the main southern section such scope would be very limited. There is a broad scale risk isolating communities and this risk has to be considered with respect to the whole area. The reduced accessibility particularly in terms of sustainable public transport would have major economic and social implications, affecting all areas of the community and the boarder economic value of tourism across the region and nationally.

Loss to the major service centres such as Tywyn, Barmouth, Porthmadog, Criccieth, Pwllheli or Abersoch would reduce support to the associated villages and communities and would, in the case more specifically of the northern towns, impact on the economic regeneration hub of the southern Llŷn Peninsula.

In addition, loss of their seafronts, water sport facilities and the important harbours, together with loss in similar values in iconic villages such as Aberdyfi would significantly reduce the attraction of the area and lose the opportunity to sustain and improve the quality of tourism to the area. Associated with this is the important economic value brought to the area by lower cost holiday centres and the added value provided by the

various Golf Courses. Their inability to adapt to change on the coast would, in the case of the former, leave a major deficit in holiday accommodation and would call in to questions the ability of villages to support facilities such as shops, which support the local communities and support the surrounding rural areas. In the case of the latter, this would reduce employment throughout the year and have a major impact on both peak and out of season tourism, as well as the loss of an important local social activity.

The potential damage to the natural environment, the major risk of disruption to the transport system, the loss of underlying economic infrastructure and cultural and historic features and landscape and the diminishing ability to maintain employment and services to local communities all reduces the opportunity to support the overarching aims of the Wales Spatial Plan:

- with respect to the northern area to sustain – *‘A high-quality natural and physical environment supporting a cultural and knowledge-based economy that will help the area to maintain and enhance its distinctive character, retain and attract back young people and sustain the Welsh language’.*
- For the southern area - *‘High-quality living and working in smaller-scale settlements set within a superb environment, providing dynamic models of rural sustainable development, moving all sectors to higher value-added activities’*

There are areas where there is already significant risk, both from change in the coast and due to flood risk, and adaptation will be an essential part of managing the coast, if sustainable management is to be economically justified and is not to bring about significant damage to the landscape and the natural environment. The more recently developed villages of Borth and Fairbourne are very clear examples of this, as are the caravan parks and holiday centres actually at the coastal edge or the protection of agricultural land along the floor of many of the estuaries. However, such thinking also has to apply to other areas, even within major settlements such as Pwllheli.

The whole of this area of coast has strong links in terms of sustaining the economic strength and the sustainability of the social, cultural and natural environment. This has to be recognised in developing the SMP and in setting policy to deliver the plan. However, specific areas do maintain a degree of separation and have more locally interrelated specific issues. This rationale for sub-division is set out below.

Policy Development Zones

There is a different character between the southern section of the coast, the main economic hub of Porthmadog and the series of interlinked communities to the west along the Llŷn Peninsula. This provides an initial division while recognising the more strategic links in terms of transport routes and general interaction between aspects of tourism. Along the southern section of coast, it is the two main estuaries that provide the main core of each sub-system.

The area is, therefore, divided into four basic Policy Development Zones.

- PDZ10 Dyfi:**
Sarn Gynfelyn to Tonfanau
Chainage: 294km to 349km
- PDZ11 Barmouth and the Mawddach:**
Tonfanau to Traeth Dyffryn
Chainage: 349km to 407km.
- PDZ12 Coastal Snowdonia:**
Traeth Dyffryn to Pen y Chain
Chainage: 407km to 463km.
- PDZ13 The South Llŷn Bays:**
Pen y Chain to Trwyn Cilan
Chainage: 463km to 498km.

Overarching objectives are defined based on the overall principles upon which the SMP is developed and drawing together the various specific detailed objectives set out in the features and issues table contained within Appendix E. These overarching objectives aim to guide the assessment of different management scenarios and the development of individual SMP policies.

Overall Objectives

Principles	Objectives	Relevant to
To contribute to sustainable communities and development	<ul style="list-style-type: none"> • Reduce risk to life • Protect properties from flood and erosion loss. 	All All
To minimise reliance on defence and increase resilience of communities.	<ul style="list-style-type: none"> • Minimise the need for increasing effort and management of coastal defences • Avoid reliance on defence particularly where there is a risk of catastrophic failure. • Highlight areas where long term sustainability may be a significant issue and where there may need to be relocation. 	All All PDZ 10,11 & 13
To support an integrated approach to spatial planning, in particular recognising the interrelationships between:		
- centres of development and surrounding communities.	<ul style="list-style-type: none"> • Maintain connectivity along the estuaries to main centres in land • Maintain connectivity between local communities along the coast • Maintain Barmouth, Porthmadog, Criccieth and Pwllheli as critical centres 	PDZ 10, 11& 12 All All
- human activity and the natural and historic environment: in being essential for community identity, well being and vitality and in being highly significant for tourism and economic regeneration.	<ul style="list-style-type: none"> • Maintain recreational use of beaches and bays • Maintain access to the coast including car parking and facilities • Maintain access for boat use and associated water sport activity • Maintain the opportunity for sustainable adaptation of the main Golf Course • Maintain the opportunity for sustainable adaptation of the main Holiday centres 	All All All All All
To maintain and support the main centres of economic activity	Maintain the economic viability of Porthmadog/Pwllheli economic hub	PDZ12 & 13
To sustain the vitality and support adaptation of smaller scale settlements.	<ul style="list-style-type: none"> • Maintain character and integrity of coastal communities • Maintain the ability for adaptation and opportunity fro economic growth of small communities • Maintain agricultural value of rural community 	All All All
To support the cultural heritage and the use of the Welsh language.	<ul style="list-style-type: none"> • Identify risk and reduce risk of loss of heritage features where possible • Maintain historic landscape • Prevent disturbance or deterioration to historic sites and their setting 	All All All
To avoid damage to and seek opportunity to enhance the natural environment.	<ul style="list-style-type: none"> • Maintain or enhance the condition or integrity of the international (SAC, SPA) designated sites and interest features within the context of a dynamic coastal system. • Maintain or enhance the condition or integrity of the national (SSSI) designated sites 	All All

Principles	Objectives	Relevant to
	and interest features within the context of a dynamic coastal system. <ul style="list-style-type: none"> • Maintain and enhance educational and scientific understanding of geology and geomorphology. 	All
To maintain or enhance the high quality landscape.	<ul style="list-style-type: none"> • Avoid damage to and enhance the natural landscape. • Maintain the human landscape and character of communities 	All All
To sustain sustainable accessibility in terms of maintaining national and regional connectivity	<ul style="list-style-type: none"> • Maintain the critical road network • Maintain the critical rail network. 	All All

Note: All objectives would be assessed in each management scenario, not all objectives will necessarily be met.