

PDZ 16. MENAI STRAIT :



Trwyn Maen Dylan to Garizim and Pen y Parc to Trwyn Penmon

CONTENTS

	Page
PDZ 16. MENAI STRAIT :	50
1 Local Description	53
2 Coastal Processes	60
3 Management Scenarios	69
4 Summary Comparison and Assessment of Baseline scenarios.	82
5 Discussion and Detailed Policy Development	87
6 Management Summary.	95

**Shoreline Management Plan Sub Cell 10
Baseline Location Map
Policy Development Zone 16 - Menai Strait**



Key			
	Existing Coastline and Chainage		Ramsar
	100 Year Recession Line with No Active Intervention		SAC
	Policy Development Zone		SPA
	Management Area		SSSI
	Policy Unit		NNR
	EA Flood Zone 3		Scheduled Monument



Definitions of Scenarios Considered in Policy Development

This section defines the various scenarios that are used throughout the discussion of the Policy Development Zone.

Sea Level Rise

It is recognised that there is a continuing uncertainty with respect to Sea Level Rise (SLR). Taking different SLR scenarios may affect the scale of impact or the timing of some changes, either in terms of sustainable management or in terms of impacts. In the discussion below of the baseline and alternative management scenarios, the Defra guidance on SLR has been generally been used. Where, in any specific area, the impact of SLR is felt to be significant and may change the context of management this discussion is held within a separate box, relevant to that section of text.

Management scenarios;

Unconstrained Scenario

Under this scenario, the behaviour of the coast is considered as if there were no man made defences, effectively if they were suddenly not there. Although recognised to be a totally theoretical scenario it does provide a better understanding of how we are influencing the coastal behaviour and therefore the stresses and broader scale impact that are introduced. This assists in assessing first how the coast might wish to change, but also in defining the limits of interaction which the SMP should be considering.

Baseline Scenarios

- **No Active Intervention (NAI) – Scenario 1**, where there would be no further work to maintain or replace defences. At the end of their residual life, structures would fail. There would be no raising of defences to improve standards of protection.
- **With Present Management (WPM)– Scenario 2**. This scenario applies the policies set in the SMP1 or, where relevant, takes updated or clarified policies, if subsequent work has been undertaken e.g. studies or strategies. In many locations, the approach to management defined by SMP1 only covers a 50 year period. Where this is so, the intent of how the coast is being managed has been assumed to apply into the future. It should be noted that WPM does not necessarily imply a Hold The Line approach throughout the zone, in many areas present management may be for a No Active Intervention approach or one of Managed Realignment.

The aim of the No Active Intervention is to identify what is at risk if defences were not maintained. In a similar way, With Present Management aims to examine how the coast may develop, identifying where there are benefits in this management approach or where there may be issues arising in the future.

At the end of this sub-section a brief summary and comparison of the economic risk for each of the baseline scenarios is provided, based on the MDSF analysis undertaken during the SMP (including other study findings where relevant). The baseline scenarios are also assessed in terms of how they address the overall objectives for the Zone. This comparison between the baseline scenarios sets the scene for discussing possible alternative management scenarios which better address all the issues. This discussion is provided in the subsequent sub-section.

Local Description

The zone is seen as two significant estuaries linked by the Menai Strait. To the west is Bae Caernarfon, a typical sand/shingle filled expanse of open low land, with major dune systems across the mouth of the estuary, protecting areas of estuary flood plain, both to north and south, behind. The Strait forms a typical funnel shaped estuary through to the narrows at the Swellies. To the east is Traeth Lafan and the Bangor Flats, forming the western part of Bae Conwy. The narrow gorge of the Swellies links the two areas. This link has a significant influence on the way in which these estuary systems behave, and this is discussed in the assessment of the process in the subsequent section.

To the north of the western estuary is the Malltraeth Sands and Cefni estuary, which, although linked in a broader sense by coastal processes, is also linked in terms of management by the potential flood risk impact on the southern central area of Ynys Mon.

Each area is described in more detail below, starting at the shoreline to the south of Bae Caernarfon..

The Southern Shoreline.

The southern shoreline of the western estuary merges into the area of low glacial clay cliffs at Dinas Dinlle and this generally low shingle fronted shoreline runs south to Trwyn Maen Dylan, a small headland south of the village of Pontllyfni. The cliffed frontage is cut by several small water courses: the Llyfni at Pontllyfni, the Llifon; part way along the frontage, and a smaller stream just one kilometre south of Dinas Dinlle. Each of the streams lie within relatively broad valleys that extend some way in land. The main A499 crosses a bridge at Pontllyfni, within the lower lying valley of the river. There are few properties at the shoreline and the land is generally open pasture.



The main access road to Dinas Dinlle runs from the A499 through to the village behind the Dinas Dinlle headland with the road and part of the village developed over the low lying ridge between the southern frontage and the large flood plain of the main estuary. The Dinas Dinlle headland is occupied by an important prehistoric hill front (Scheduled Ancient Monument).

The Outer Western Estuary and Malltraeth Sands



Dinas Dinlle

The main village area of Dinas Dinlle, just to the north of the headland, sits immediately to the rear of a defended shingle bank, at the start of the low dune, shingle frontage of the main estuary shoreline. A road runs along the back of the shoreline with the large low lying Foryd bay to the back. There are various properties and caravan parks within the general agricultural land, with the small settlement of Morfa Dinlle and the operational Caernarfon Airport to the north. The frontage

bellies out towards its northern end before sweeping round to the mouth of the Menai Strait at Fort Belan.

This defended shingle headland at Fort Belan acts both as the mouth of the Strait as well as the entrance to Foryd Bay. There is a small harbour in the lee of the headland. Foryd Bay is a sandy mud inlet formed between the large dune coastal feature and the old relic higher shoreline.

Across the mouth of the Menai Strait, to the north, is the equally massive expanse of dunes making up the Newborough Warren. At the shoreline is the Braich Abermenai Spit, running in to the estuary and enclosing the low lying sandy muddy expanse of Traeth Abermenai. The spit extends from the southern end of Traeth Llanddwyn bay. This bay is anchored at its northern end by Llanddwyn Island, a narrow rock headland with the remains of St Dwynwen's Church (Scheduled Ancient Monument). There is a small breakwater closing between to rock outcrops at the head of the island and a row of cottages situated behind the dune backed bay that has formed in the lee of the breakwater. These cottages were the Pilots' Houses; pilots having been required for the commercial shipping entering the Menai Strait through the shifting bank system at the mouth of the estuary. The land behind the island and running north into Malltraeth Sands forms the planation of the Newborough Forest, which has been developed right down to the dune backed foreshore.

The dunes and forest of Malltraeth Sands closes off much of the mouth of the Cefni estuary. This estuary has been an area of reclamation particularly between 1806 and



1812. The upper estuary has been closed off by a major embankment, along and behind which runs the A4080 (the main west coast road of Ynys Mon). The Cefni has been canalised all the way inland, virtually as far as Llangefni. The main A5/A55, from Menai through to Holyhead runs across the head of the old flood plain and the main railway line to Holyhead runs across the valley further seaward, some 1km upstream of the coastal embankment.

There are no significant settlements in the area of Newborough Warren and Forest, with the villages of Dwyran and Newborough set back on the higher ground behind the coastal system. There is the village of Malltraeth at the northern end of the Cefni causeway and this is built right up to the edge of the open estuary. There are various properties within the defended valley, which is also an important agricultural area.

Both the Dinas Dinlle area and the area of Newborough Warren are important for tourism. In the former area, this is very much for traditional family beach use associated with the sea front and facilities of the village. This beach is the nearest amenity sea front to Caernarfon and is important to the region. The Newborough Warren area, covering a large area, is more for active enjoyment of the natural coast and hinterland.

The whole area of the Menai Strait western estuary shoreline, together with Foryd bay, the channel of the Menai Strait, Newborough Warren, Traeth Abermenai, the Forest and

the Malltraeth Sands, is designated SAC. The headland at Dinas Dinlle is also designated SSSI, for its geological value.

The Western Part of the Menai Strait

Along the inner section of the Menai Strait through to Felinheli, the north and south shores of the estuary have starkly different characteristics. Along the southern shore, is the relatively high ground through to Caernarfon from Foryd bay. There is a road which runs around much of this area of higher ground. The road is typically at a level of 4m OD and sits immediately at the back of the narrow shingle foreshore, protected in places by lengths by a low sea wall. Over most of its length the road relies purely on a narrow width of grass bank for defence. The road continues along the shoreline as the old relic coastline cuts south, forming the eastern flank of Foryd Bay. The road runs from the western side of Caernarfon Harbour and is the main access to the Caernarfon Golf course and to various properties and farms on this quite remote headland west of Caernarfon. The road cuts in land just north of the valley of the Afon Gwyrfai, one of two larger rivers running into Foryd Bay. The Gwyrfai forms a small muddy estuary mouth, with a local area of hard geology extending over the foreshore, enclosing the small estuary to the north. Within this valley are collections of properties of Penrhyn Bach, Foryd and Hen Foryd. Another road runs to the coast south of the Afon Gwyrfai and runs behind the Bonc Foryd spit, which forms the southern control of the Afon Gwyrfai estuary, and part way along low backshore of Foryd Bay towards the second of the larger rivers at the head of Foryd Bay; the Afon Carrog. This whole area to the south east of Foryd Bay contains many farm properties with several holiday developments, as well as a significant number of small hamlets and properties. These settlements tend to be set back slightly from the present day flood plain of Foryd Bay.



Caernarfon is the main social and economic centre of this western section. The Afon Seiont meanders through the town in a steep valley, joining the main estuary through the harbour and beneath the imposing structure of Caernarfon Castle. Caernarfon, with its castle, is a World Heritage Site. The harbour and all along the estuary frontage has been developed, with the new marina and housing, and further east a new commercial centre.



The A487 runs east from the town set back to the crest of the gentle coastal slope. The muddy estuary foreshore is narrow with local areas of development and local defences in places. This includes minor works to the Caernarfon Industrial Estate and sewage works, and the Plas Menai National

Water Sports Centre. The sewage works are derelict and privately owned. There is an old landfill site, associated with the former works in the area, close behind local defence at the shoreline.

As the land rises to the higher central section of the Menai Strait, a minor road feeds down to the village of Y Felinheli. To the west of the village, which extends in a linear manner along the southern flank of the estuary, is the Dinas Camp prehistoric



promontory fort (Scheduled Ancient Monument). Y Felinheli (Port Dinorwic) is an old industrial port that has been re-developed with a new marina and water front properties through to the old locked port at the eastern end. At the western end of the village is a large boat storage area, with slipways and relatively undeveloped muddy and stony foreshore.

Further east, the Strait narrows, constrained by the harder geology of the central gorge. There are few

properties along the southern shoreline and the steeply rising coastal slope is owned by the National Trust. The Trust also owns the wooded northern shoreline with the Menai Centre and property of Plas Newydd.

Moving back seaward along the northern shore, the foreshore tends to be wider, with mud, sand and stones. There are few road access points to the shore; with a road down to Moel-y-don, with its old ferry slipway and distinct narrow low headland opposite Y



Felinheli on the southern bank. Other access points include various tracks, with the Llwybr Arfordirol Ynys Mon (Isle of Anglesey Coastal Path) running along short lengths of the shoreline. A minor road comes down the shoreline at Barras and this road runs along the low cliffed backshore through to Farm Park and the Mermaid Inn. Near the Inn is a narrow intertidal causeway out to the old ferry point opposite Caernarfon.

The SAC designation extends all the way through this section of the Strait and beyond through the gorge to include the eastern estuary mouth. Much of the northern shoreline is also designated as an Area of Outstanding Natural Beauty (AONB). The whole section of the Strait is important for water sports and recreational sailing. The southern side is quite heavily developed and is seen as being an important commercial aspect of the Menai Hub. The northern shore is important as a tourist resource but also has important commercial mussel and oyster beds.

The Swellies

The central section of the Menai Strait curves around as a gorge, with the two bridges; the western road and rail bridge (the Britannia Bridge) running between Capel-y-graig to Llanfair PG (Llanfairpwllgwyngyll), and the old A5 suspension bridge crossing to Porthaethwy (Menai Bridge) on Ynys Mon. Between the two bridges, and extending slightly beyond each bridge, is the area of the gorge called the Swellies. This narrow section of channel is notorious for its very high tidal flows connecting the east and west section of the Strait. On the northern side there is a small bay in the shelter of the Porthaethwy headland with several small rock outcrop islands. There are also two historically important fish weirs on the foreshore.

The Eastern Estuary

East of the suspension bridge, the Strait start to widen to form the eastern mouth of the estuary. In contrast to the western estuary the widening foreshore comprises muddy sand to the south around Bangor and it is the northern shoreline which is narrower with mud and rock. Immediately east of the Porthaethwy headland are several small rocky islands, connected to the shore by causeways. There are properties on each of the islands. There is a commercially significant mussel bed lying between Bangor Pier and Beaumaris.

The main channel stays close up against the rock cliffed northern shore and the main road runs along the cliff line through to Gallows Point. Gallows Point appears to be formed as a small relic shingle ridge at the point where the estuary widens; the northern shore sets back to form Beaumaris bay, the southern shore sets back to run in a more easterly direction behind the large expanse of Traeth Lafan. There is also an equivalent, but broader and lower, stony ridge running north from Penrhyn Castle headland on the southern side of the estuary.

There has been some settlement along Gallows Point and, during the initial consultation, it was reported that there was consideration of further development here. From Gallows Point the main road runs directly to the back of the slightly wider stony and muddy



Beaumaris

foreshore of Beaumaris Bay. The main town of Beaumaris is sat on a low flat head of land at the entrance to the inner section of the eastern Menai Strait. The town, with its castle at the eastern end is a World Heritage Site. Nearly all the sea front properties are listed buildings. The open area of the Green, seaward of the town, is a major aspect of the landscape and an important recreational area, with car park and promenade. There is also a Lifeboat Station at the western

end of the promenade alongside the pier, which is being redeveloped. The town, as well as being of significant cultural value, is one of the main tourist designations of the Island and is one of the essential elements making up the Menai Economic Hub.

To the eastern end of the promenade is an old enclosed sea water swimming pool and sea front aquarium. This is now in a very dilapidated condition with failing sea walls. The coastal path runs along the promenade and follows the coast north along the shoreline.



Llanfaes

The B5109 runs north from the town behind a small drumlin that protrudes out over the foreshore. The road then runs directly at the back of the low coastal cliff as the main road to Llangoed and the rural area of Ynys Mon's south eastern Peninsula, out towards Trwyn Penmon and Puffin Island. At the northern end of the first bay north of Beaumaris is the medieval site of Friary at Llanfaes (Scheduled Ancient Monument), just at the lowest point of the road, where the road heads away from the

shoreline. There are several other Scheduled Ancient Monument fish weirs along the stony southern foreshore of peninsula. There are local areas where minor road come down to the back of the foreshore and there are groups of properties at Lleiniog and Penmon. There is a lighthouse at Trwyn Penmon, at the eastern end of this northern section of the zone.



Lleiniog

This northern side of the eastern mouth of the Menai Strait is important both for its outstanding natural beauty and, within this historic and cultural setting, for its residential areas, providing quite a unique element of the Menai Hub.

The foreshore and channel is designated SAC and the foreshore and land behind is designated SSSI both for its ecology and its geology.

To the south of the Eastern Menai Strait, is the city of Bangor. The city is an important administrative centre as well as having a University. Much of the centre of the city is



Bangor

situated on its high rock headland. Its sea front and port and marina areas are to the eastern side of the city. There is a local coastal road to properties running eastward from Garth Point, along the relatively wide muddy foreshore of the inner section of the Menai Strait. At Garth Point there is a small car park and, extending from the point, the New Pier and landing stage. Running south from the Point are various boat yards, running down to the low lying seafront along Hirael Bay with its

narrow beach area and recreational waterfront open space. Immediately behind the road is a relatively dense area of residential and commercial property, including the old bus depot. At the southern end of this shoreline is the valley of the Afon Cegin. Enclosing the bay is Porth Penrhyn and the old main dock area. This area is built out across the

foreshore, sheltering the main sea front area of the city. Traeth Lafan SPA and Ynys Seriol SPA are significant European protected sites in this area.

East of Porth Penrhyn, the coast is relatively natural, with the steep rocky headland of Penrhyn Castle fronted by the Bangor mud flats, through to the broad rocky area of foreshore opposite Gallows Point on the northern side of the estuary. Associated with this harder raised foreshore is the long post-medieval Ogwen Fish Weir (Scheduled Ancient Monument), extending out to low water.

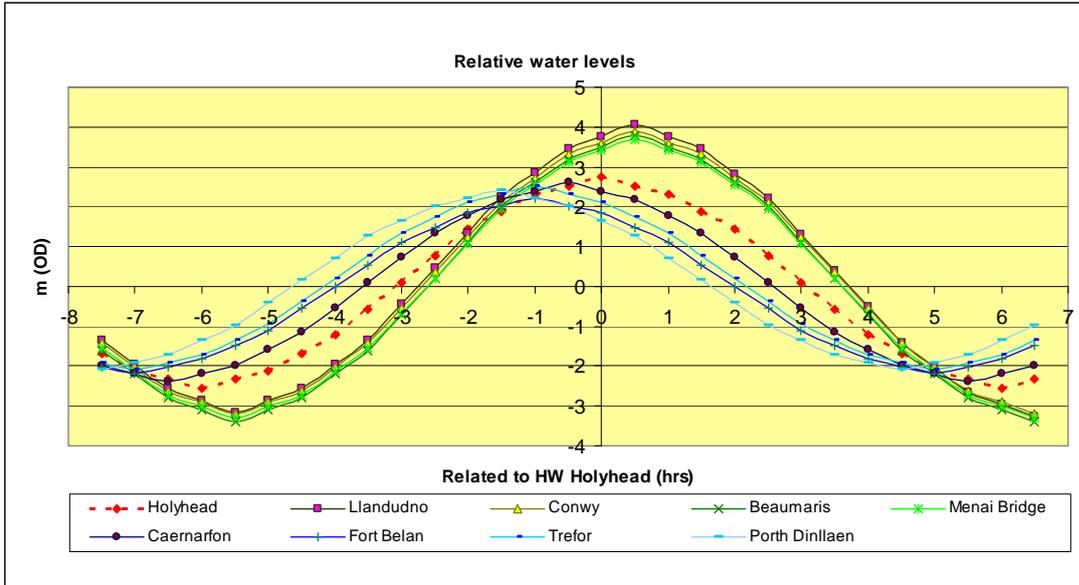
Beyond Penrhyn Castle headland the land drops in level, with the valley of Afon Ogwen and the gently rising land to the back of the main Traeth Lafan. The main railway line and A55 run to the back of this gently rising coastal slope. Several small streams run down from the rising land to the foreshore and the Afon Aber cuts down to the coast through the village of Abergwyngregyn through the harder stony fan headland of Morfa Aber.

From Morfa Aber the shingle backed shoreline forms several small bay shapes through to the significant shingle spit at the entrance to the Nant y Felin-fach, just west of Llanfairfechan. This stream also forms the Borough boundary between Gwynedd and Conwy. The boundary is approximately 0.6 km to the west of the outlet of the Nant y Felin-fach stream at the shoreline. It runs along the line of the stream down to the railway, then westerly along the railway before crossing the shoreline 600 m to the west. The railway line runs at its lowest level through the valley of the stream and the low lying area behind the spit. There is a major sewage works in the valley at this point.

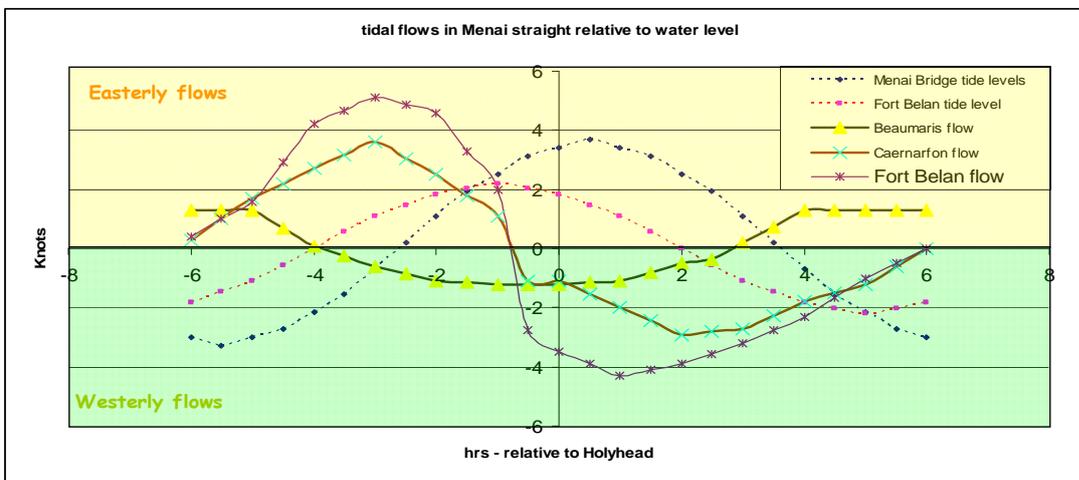
Much of the village of Llanfairfechan lies in the valley of the Afon Ddu behind the main road and railway line. The section of the village seaward of the road lies on the stony fan headland of the river. The north facing curve of the promenade runs into the emerging heavily defended headland of Penmaen Mawr (Pen-y-Clip), forming the eastern extent of this zone. The frontage comprises a shingle bank, held by groynes and backed by a sea wall. This important little sea front to the main village consists of a significant number of properties set back behind the promenade and a wide open area of land used as a car park and recreation area.

2 Coastal Processes

The behaviour of the Menai Strait strongly influences the majority of the area, particularly with respect to the peculiar tidal regime. This is discussed initially. The following plots highlight the variation in water levels to east and west of the Strait. Both the tidal range and timing are significant. It may be seen from the first plot that in terms of spring tidal range, high water is some 1.5m higher to the east, with low water being some 1.5m lower. This difference is, however, further emphasised by the lag in timing, with the tide curve lagging by around 1.5hrs on the eastern side.



As the tide begins to turn on the flood at the western end, the tide to the east is still falling, rapidly increasing the hydraulic gradient and resulting in increasing flow through the whole area of the Strait from west to east. As the western tide reaches high water, the eastern tide continues to rise. At high water on the eastern side the hydraulic gradient from east to west is at a maximum. Flow into the Strait, therefore, continues from the east over the high water period. This gradient is maintained throughout the eastern ebb, so that even when the tide is ebbing on the east, flow is still pulled into the Strait. Only as the eastern tide starts falling at a rate equivalent to this east west gradient does the flow in the eastern channel start moving towards the east. These effects can be seen in the plot taken from Admiralty Diamonds (tidal flows), below.



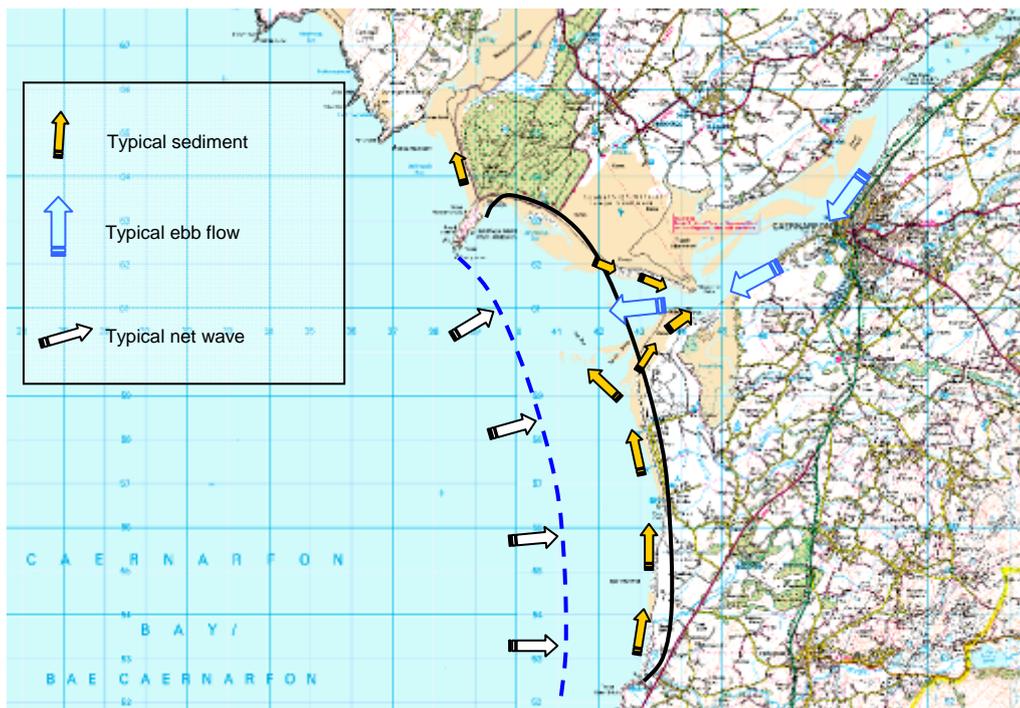
The strong westerly flow on the flood through the entrance at Fort Belan and past Caernarfon can be clearly seen, changing rapidly over high water. There is little high water stand in the western part of the estuary, with continual water movement allowing little opportunity for fine sediment to fall out over the main channel area. In addition, the flows through the western entrance are substantially greater on both flood and ebb than would be the case if this were a closed estuary. In effect, the hydraulic estuary is larger than defined by its physical area.

On the eastern side, over much of the high water period (both flood and ebb), the flow through the main channel is to the west, with flows over this period resulting in a bias over the upper foreshore. It is only when the flow has reached half tide and when the flow is predominantly in channel, that an easterly flow is generated out of the area. This tends to support the geomorphological evidence of finer sediment being carried in towards the estuary over the upper areas of foreshore.

How these effects will change with sea level rise is very uncertain. It is uncertain whether there will be any distortion of the relative tidal curves or distortion of the timing. One of the key influences in determining the flow pattern is the frictional affects through the narrow central gorge. It is across this section that the maximum hydraulic gradient is seen, giving rise to the very high flows within the Swellies. With sea level rise, there is the potential for this frictional affect to reduce. This could potentially give rise to greater discharge through the gorge, reducing the throttle affect, further increasing the volume of water and increasing the effective hydraulic tidal prism of the western estuary and increasing the high water ebb dominance of the eastern estuary entrance.

With this influence of the Strait in mind, the present day features of the open coast are discussed.

The offshore wave climate on the open western coast is dominated by energy from the southwest, although this is diffracted around the end of the Pen Llyn such that nearshore the dominant direction is more from the west. There is, however, a long fetch over the Irish Sea to the northwest and north and significant wave energy can come



from this sector. The headlands of Pen y parc and Llanddwyn Island provide significant shelter from the north, as may be seen in the general alignment of the foreshore in the diagram above. Without the presence of the Menai Strait, Caernarfon Bay would be backed by a wide sweeping curve of dune, generally held to the south by the slowly eroding harder glacial cliffs and sweeping around in the lee of Llanddwyn Island. The typical net wave energy would approach the shoreline, gradually changing in orientation from west, in the south, to more southwest in the shelter of the island, in the north.

With the Menai Strait forming this major estuary mouth, this shape is distorted. The flood flow entering the mouth of the estuary tends to allow both wave action and tidal flow to move sediment into the mouth, creating the very compact morfa on the southern side and the thin spit to the north. The ebb flow within the estuary tends to be dominant to the southern side of the Strait along the relatively hard Caernarfon frontage, driving sediment out as a bar or nose to the southern side of the estuary. This in turn allows the Morfa Dinlle frontage to belly out as the large feature enclosing Foryd Bay. On the northern side there appears to be far lower ebb flow allowing sediment moving in to the estuary mouth on the flood to accumulate as Traeth Abermenai and the muddy sandy banks on the characteristic of the northern side of the estuary.



The slightly harder low cliffs to the south have tended to resist erosion to some degree, with the stony sediment fans of the local streams further resisting erosion of the back shore and creating the various minor headlands.

This has interrupted the weak sediment drift along the upper foreshore but has little influence on the more general sand transport north over the lower foreshore and nearshore area.

This is noted as the apparent by-passing of sediment of the southern nearshore defence structures at Dinas Dinlle.

At the northern end of the bay, Traeth Llanddwyn forms a relatively stable bay shape but with loss of sand into the estuary. Some sediment would be recycled from the estuary into the nearshore area, feeding the bay. However, within this process there will be considerable variation and the dune system requires width to adapt to these changes in processes. This is constrained at present by the tree planting that has stabilised the dune system.

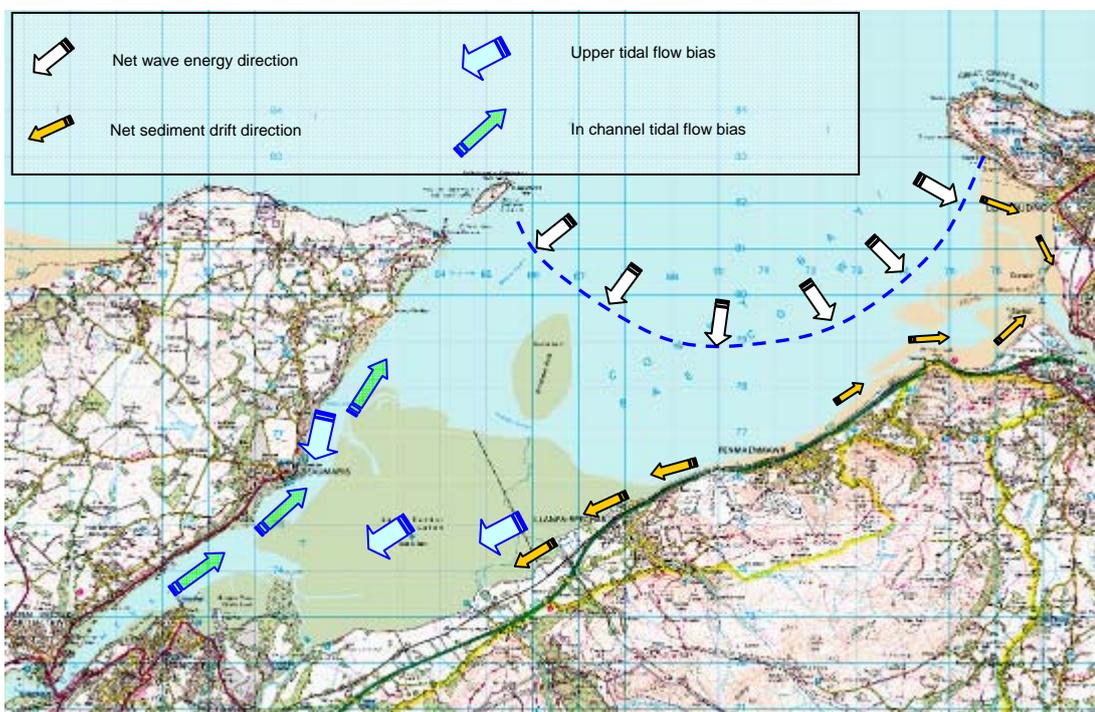
North of Llanddwyn Island, the frontage is again relatively stable but with a weak drift in towards the entrance of the Malltraeth Sands.

It is difficult to predict future change with any certainty because of the uncertainty associated with the Menai Strait. Some increase in tidal prism of the Menai is inevitable, purely from the perspective that there would be increased depth and increased flooded area. It also seems probable that the effective hydraulic estuary prism will increase as discussed earlier. The net impact would be larger flows through the estuary mouth, with the potential to widen the mouth, increase the volume of sand brought into the estuary, but also the potential to generate a larger ebb sediment system.

The impact of sea level rise on the open shoreline would be to roll the shoreline back. There would be increased pressure, allowing the coast to erode.

Within the Menai Strait, flows would increase but because of the distribution of flow across the width of the channel and the constraint imposed on the local direction of flow, it would be along the Caernarfon frontage that this increased pressure would be felt. The northern side of the western estuary would still gain shelter from the spit, although with the increased width of the estuary mouth there might be less shelter along the northern flank of the estuary. This may be compensated to a degree by increased volume of sand entering the estuary, increasing the infill to Abermenai Traeth and feeding the intertidal channel banks.

The eastern end of the Menai Strait acts more as a typical wide mouthed, funnel shaped, estuary, but with the significant tidal distortion discussed earlier. This is explored with reference to the conceptual model in the diagram below.



The offshore wave climate is far more strongly influenced by the shelter provided by Ynys Mon, with a west and north wave climate entering Conwy Bay between the Great Orme and Trwyn Penmon. Waves refract and diffract within this outer entrance, fanning out such that the dominant wave energy acts in towards the eastern mouth of the Menai Strait. Over the upper tide, this wave direction is supported by the net ebb dominance of the flow regime. This postulated overall energy direction is supported by the presence of the large accumulation of sediment forming Traeth Lafan and at the shoreline by the small wave driven shingle features along the Llanfairfechan shoreline. The level of Traeth Lafan tends to limit wave action further west. The broad stony feature extending from the Penrhyn Castle headland tends to further concentrate flow into the mouth of the Strait, reinforcing the natural channel of the Afon Ogwen.

On the northern shoreline, Beaumaris Point acts as an equivalent but higher pinch point with respect to the westerly upper tidal flow.

Over the lower period of the tide, when flows are to the east, the main Menai channel is fixed to the northern side of the estuary, with this channel acting as a barrier to coarser sediment supply to the upper foreshore. This whole northern frontage is swept by wave action supported by the westerly dominant upper tide flow regime. It is only beyond Beaumaris that sand can be retained within the slight embayments of the coast running out to Black Point.

Gallows Point then becomes an interesting feature of this section of the coast. It would appear to be a wave dominant feature of the upper foreshore. It is uncertain to what degree the upper sedimentary feature is supported by rock or underlying harder geology, although it does appear to be located at the transition between the higher cliff of the inner estuary and the lower ground to the east. Potentially, under a more normal estuary regime, it might have developed further as a spit. However, with the easterly channel flow on lower tide levels, any extension of the feature has probably been curtailed by the dominant easterly flow.

With sea level rise, it would be anticipated that flows both to the west on the upper tide and to the east, within the channel, will increase. This together with the higher wave energy supported by higher water levels would tend to increase the potential for sediment to be transported in towards the estuary over the wider area, with stronger channel flow on the lower tide. It might then be expected that there would be increased pressure on the Llanfairfechan frontage but also growth over Traeth Lafan. The northern shore would be under greater pressure generally for erosion and the channel, which might still be expected to remain on the northern side, would continue to act as a barrier to sediment supply to the beaches.

POTENTIAL BASELINE EROSION RATES

In assessing erosion and recession in the future allowance has been made for sea level rise and this is discussed in appendix C. This is also discussed briefly following the table. Where there are softer cliffs or shorelines suffering erosion, the rate of erosion is likely to increase with SLR. This might be by a factor of 1.7 to 2.5 times the existing base erosion rate, over the 100 years. Where there are more stable features, such as the established dunes of the western estuary there would be a natural roll back of the beach potentially in the order of 10m to 40m, depending on the nature of beach and the coast behind. On the southern side of the eastern estuary, where there is a more gentle transitional slope to higher ground behind, water level would tend to progress in land, in effect retreating the shoreline

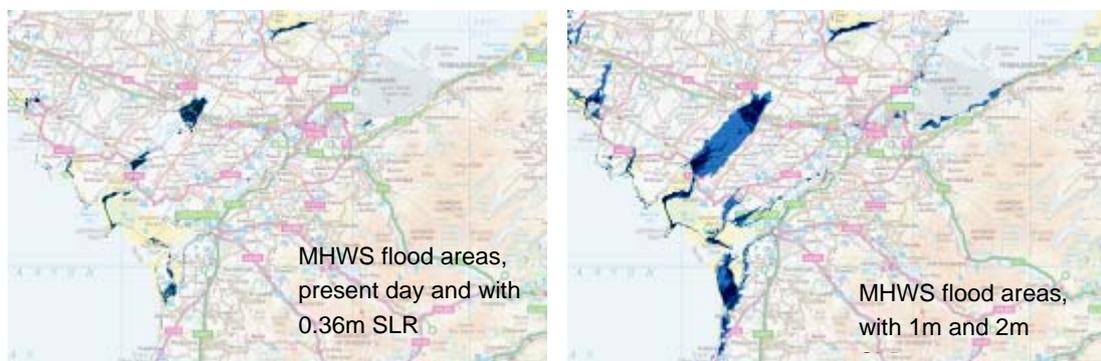
Location	NAI Base Rate (m/yr)	Notes	100yr. Erosion range (m)
Pontllyfni	0.05	Shoreline will roll back with SLR	20 - 30
Morfa Dinlle	0.05 – 0.3	Shoreline will roll back with SLR	20 - 100
Llanddwyn Bay	0.15	Shoreline will roll back with SLR	30 - 70
Abermenai Dunes	0.15	Subject to estuary behaviour	10 - 20
Menai Strait S	0.05 – 0.2	Depends on local nature of the shore with respect to SLR	0 - 50
Menai Strait N	0 – 0.05	Depends on local nature of the shore with respect to SLR	0 - 25
Beaumaris	0.2 – 0.4	Following failure of defences	30 - 80
Traeth Lafan	0 – 0.05	Principally affected by SLR	5 - 50
Llanfairfechan	0.2	Following failure of defences	25 - 70

Base rates have been assessed from monitoring and historical data. The range of potential erosion is assessed in terms of variation from the base rate and sensitivity in potential sea level rise. Further detail on erosion rates together with erosion maps are provided in Appendix C.

FLOODING

In terms of flood risk to the overall area, at present, the larger flood risk areas are to the west. Plots of normal tidal flood risk areas are shown for present day levels together with an indication of MHWS flood risk with 0.36m sea level rise, and for MHWS flood risk areas for 1m and 2m sea level rise.

It may be seen that flood risk at present is mainly within the defended area of the Cefni and in the area of Foryd Bay. There is more local flood risk at the entrance to the Afon Ogwen, east of Bangor. More extreme water levels increases the areas of risk, with substantial increase in risk area within the Cefni, Foryd bay and at Pontllyfni, with flooding potentially affecting the main road. There is more extreme event flooding in areas of Dwyran, Caernarfon, Y Felinheli, Bangor and areas around Llanfairfechan and Beaumaris. In the latter two locations there is also significant risk of flooding due to wave overtopping on extreme events.



With a one metre sea level rise over the 100 years, there is risk of more severe flood risk along much of the Foryd Bay area even on normal tidal levels. The flood risk to the defended area of the Cefni increases substantially with areas of the valley being below normal high waters. There is also a significant increase in risk to properties at Malltraeth, locally to the sea front at Caernarfon and Y Felinheli and the low lying area of Bangor would be at risk over normal high tide.

Impact of different Sea Level Rise Scenarios

Under a 2m SLR, flood risk would increase in all the above areas. In addition the eastern part of Beaumaris and sections of local coastal roads out towards Penmon would now be at risk from normal high water levels. At Llanfairfechan, much of the sea front property would be at similar risk with the potential for normal tidal flooding to the main railway line and the A55.

EXISTING DEFENCES

Over much of the western coastal area there are limited local defences, specifically at Pontllyfni, Dinas Dinlle and at Fort Belan. On the northern section of the open coast the dune line is unmanaged. Defences at Dinas Dinlle (constructed in 1994) are in the form of cross shore control structures, acting to retain a beach, and a linear defence in front of the village. The southerly breakwater has retained sediment in front of the Dinas Dinlle headland. Beyond the northern structure the shoreline is significantly set back.

One of the most significant defences in the area is across the Cefni Estuary. There is a major embankment, through which the river is sluiced. There are local defences to the village of Malltraeth at the northern end. The river is canalised over much of its length further in land.

Within the mouth of the Menai Strait there are flood defences around much of the western side of Foryd Bay, preventing flooding of the largely agricultural land between the bay and the dune fronted coast.

Along the northern shore of the Menai, there are low walls protecting the coast road and



property from erosion. These defences run out at Barras and the only other area of local defence is then at Moel-y-don, opposite Y Felinheli, although individual properties may have minor works to their frontages.

Along the southern shore of the western Menai Strait, there are

local defences to the road and land around the headland to the west of Caernarfon. There are far more substantial defences all the way along the Caernarfon frontage. These walls vary from the more substantial wall to the harbour area and new development to the old walls at the eastern end, which are in relatively poor condition.

Between Caernarfon and Y Felinheli there are local walls and defences to property and the industrial estate and sewage works, including defence to the area of landfill. At Y



Felinheli, defences to the western end are generally in quite poor condition in front of the boat storage area and waste ground. The old defences around the harbour have been improved and there are local flood defences set back to specific areas of property. This general improvement extends through to the old inner harbour and the lock gates.

Within the central gorge there are only local defences to

property. Harder, more continuous protection is provided to the northern shoreline of the eastern estuary entrance beyond Porthaethwy. These comprise various seawalls, quays and slipways and include protection to local areas of the islands and to the causeways to the islands. Further east, there is a continuing piecemeal of defences to properties seaward of the main coastal road. It is only at Gallows Point and along Beaumaris bay, running around as the main access to Beaumaris, that a more formal defence is provided to this low section of the coast. The wall at the back of the generally muddy bay acts both as coast protection and flood defence to the road against wave overtopping and more extreme water levels.

The main Beaumaris frontage is protected by a continuous low wall and there are low flood banks to the back of the area of the Green. At the eastern end of the frontage there is an old failing wall to the disused pool and aquarium.

The road through to Llanfaes runs directly to the back of the low foreshore and the road is provided with defence against erosion and flood risk. There are local defences to property further along the coast towards Penmon at Aberlleiniog and Porth Penmon,

On the southern side of the eastern Menai Strait, there are local defences through towards Garth Point, with more formal continuous defence starting along the coastal road west of the point. Defences are nearly continuous, but varied, around the corner past the boat yard, becoming more formal in front of the low lying recreational area at Hirael Bay. These defences primarily provide flood defence to the property behind, but also act as a promenade. There is protection to the main A5122 and a sluice to the Afon Cegin at the corner by Porth Penrhyn. Porth Penrhyn is a manmade harbour area.

Generally to the east of Bangor, there is a private estate wall, which is in poor condition to the eastern side of Penrhyn Castle headland, running through to the Afon Ogwen. Beyond here, through to the Afon Aber, there are no formal defences to the gently rising land. At Morfa Aber there are local embankments to the Nature Reserve.

There are some small sections of embankment at Glan-y-Mor Elias, with a sea wall and groyne to the western end of Llanfairfechan, running through to the sea wall and groyne system along the main Llanfairfechan promenade, providing a section of 4km of defence. This area of protection runs into the main defence of the railway and A55.

UNCONSTRAINED SCENARIO

Under this scenario the behaviour of the coast is considered as if there were no man made defences, effectively if they were suddenly not there. Although recognised to be a totally theoretical scenario it does provide a better understanding of how we are influencing the coastal behaviour and therefore the stresses and broader scale impact that are introduced. This assists in assessing first how the coast might wish to change but also in defining the limits of interaction which the SMP should be considering.

Generally over western part of the frontage the behaviour of the coast under this scenario would not be significantly different at the larger scale. Without defences there would be a gradual retreat of the frontage to the south of Dinas Dinlle. Over the short to medium term, the shoreline would be held very much in the present position by the various sections of more resistant foreshore and backshore cliffs. Over the longer term, with sea level rise, erosion rates would increase. Also with sea level rise, as discussed earlier there would be significant risk to the main road at the back of Pontllyfni.

In the absence of defence, the shoreline at Dinas Dinlle would have already set back, despite the control imposed by the headland to the south. It is likely that the narrow shoreline ridge would have breached and that on regular events there would be overtopping and flooding to the back of Foryd Bay. As the shoreline rolls back the ridge would re-develop creating a more continuous ridge some 50m behind the existing shoreline. With sea level rise the whole frontage to the north would roll back further. The future evolution of the entire southern spit would critically depend of the hydraulic response within the Menai Strait. However, it is suggested that the dune line might be brought forward if more substantial ebb banks are developed at the entrance.

Over the northern section of the western estuary, existing processes would continue under this scenario. With sea level rise, while the estuary mouth would attempt to widen, it is really the northern spit where the impact of this is likely to be felt most. The Spit is likely to curve more in towards the estuary. This would place more pressure on the hinge between the spit and Traeth Llanddwyn, with this section of coast setting back

more substantially. This could increase drift south along the more stable beach area. The precise behaviour of this section would again depend on the behaviour of the estuary and the degree to which sediment is re-supplied to the lower foreshore on the ebb. The general trend, however, would be for increased roll back.

Within the Malltraeth area, if there were no defence at the main causeway, there would be substantial change in the whole bay. The tidal prism of the estuary system would increase and there would be considerable infill of the area with sediment. This would take sediment from the large forested dune system at the open coast, while also attempting to widen the estuary mouth. The system would over time re-establish equilibrium but obviously with significantly increased flood risk within the main valley.

Within the Menai Strait, the main structure of the estuary is held geologically. Without defences, there would be a loss of substantial areas to Caernarfon and Y Felinheli as the shoreline adjusted locally to a natural shoreline. Similarly, through the Swellies and along much of the northern coast there would be a general set back and local failure of the coastal edge. At Beaumaris, there could be more substantial change. As the promenade at the Green sets back there would be greater exposure of the foreshore to the west. Increased pressure both in terms of wave action and flow could result in long term erosion of the order of 100m.

Over the southern side of the estuary there would also be significant change. In the absence of the large Porth Penrhyn, Bangor would be open to significantly increased wave exposure. Furthermore the absence of defence at Garth Point would modify the flow in this area such that, with the change due to the loss of Port Penrhyn and the loss of control at Beaumaris, there could be significant change in the behaviour of the flow and potentially channel positions.

Further east, the only major change would be at Llanfairfechan. In the absence of the promenade and more specifically the headland to the Afon Llanfairfechan, the coast would be subject to considerable erosion. While this would provide additional shoreline sediment feed to the west, it would also increase pressure for erosion on the face of the next promontory to the east. The coast would gradually work back generally with risk of loss to other areas of the town, the railway and the road.

KEY INTERACTION WITH DEFENCES



From the above it may be seen that the main interaction between defences and the underlying process are at the open coast. At Dinas Dinlle the defence, particularly that to the northern end of the village, is resulting in loss of shoreline sediment immediately to the north, even though to the southern end the structure is evidentially allowing sediment bypass. Effective flood defence of the road is however set back here and there is under no immediate

risk. With sea level rise, the pressure for the frontage to roll back, together with increased drift will exacerbate the problem.

The embankment at Malltraeth is clearly having a major impact. However, the natural system has established a relative position of equilibrium and there is no significant pressure, beyond that of maintaining the defence in line with sea level rise.

The defences within the Menai Strait, in general, are not strongly influencing processes. It is only at the eastern end as the estuary opens out that the interaction with defences is more evident. The sea wall or the headland at Beaumaris is seen as having a strong influence of both exposure to the rest of the frontage and potentially on the behaviour of the main channel. It is uncertain to what degree the curious Gallows Point may have an impact but this could be a critical location with respect to the flow regime.

At Llanfairfechan the promenade and headland is potentially reducing drift to the west but is also acting to reduce exposure of the coast behind and to the east.

3 Management Scenarios

3.1 No Active Intervention – Baseline Scenario 1.

In assessing the overall behaviour of the zone and in considering the key interaction with current management it is possible to divide the coast into the six principal areas for discussion of this scenario and that of With Present Management:

- Outer western estuary of the Menai Strait
- Malltraeth and the Cefni estuary
- Inner western section of the Menai Strait
- South eastern shore of Ynys Mon
- Bangor
- Llanfairfechan and the shoreline to Traeth Lafan

Outer western estuary of the Menai Strait

Under this scenario the southern section of cliffed shoreline would continue to erode. The process, as at present would be relatively low over the first two epochs but would increase with sea level rise. There would be some risk to properties at the headland at Pontllyfni, potentially toward the end of the second epoch. The main risk in this area is at present flooding but with this principally being to agricultural land; only one property is identified at risk at present. With sea level rise of 1m this would increase to potentially 5 properties and on more extreme events flooding to the north could link around the back of Dinas Dinlle.

Impact of different Sea Level Rise Scenarios

Under a 2m SLR, flood risk would increase significantly such that the properties identified above would be subject to flooding on an annual basis. Potentially also there could be flood risk to the main A499 on extreme events.

The continued erosion of the cliffs would provide important sediment supply to the coast to the north. There would be continued erosion loss of the Dinas Dinlle headland. This would be slowed significantly by the structure to the south of the village and this structure is likely to remain as a control on the shoreline for potentially the next 50 to 75 years. The structure would also provide a degree of control to the shoreline to the south, although with sea level rise, there is likely to be increased pressure on the backshore linear defence. Quite probably, without improvement, the defence might fail during the second epoch. At present the area behind, if undefended, is at risk under a 1:10 to 1:50 year event. Under this scenario, with failure of defences at the village and damage due

to overtopping of defences to Foryd Bay it is likely that there would be regular inundation to much of the main area behind the dunes by the end of epoch 1.

With sea level rise, the set back dune line is likely to result in breaches to the front face defence during epoch 3. Much of the area, with the exception of areas of the old airfield would be inundated on normal high water.

Impact of different Sea Level Rise Scenarios

Under a 2m SLR, flood risk would increase significantly. Regular normal tide inundation might occur within the next 50 years and the whole area including the airfield would be subject to regular inundation.

As the front face of the dunes is allowed to behave in a natural manner, however, it might be expected that dune ridges would develop and areas within the general flood plain would accrete with wind blown sand. While the agricultural use of the area would be diminished, the coastal feature could be maintained. Potentially access could be maintained to Fort Belan. There would be some erosion due to the loss of defence to this area and the area would be under greater risk of flooding. The area of Foryd Bay would tend to accrete, maintaining this as an important intertidal area.

There would increased flood risk to the road, properties and farm land along the eastern side of Foryd Bay.

Impact of different Sea Level Rise Scenarios

There would be a step change in flood risk between a 1m and 2m sea level rise to the road and the eastern side of Foryd Bay. Areas now or even under a 1m SLR scenario would only be affected on more extreme events. With a 2m SLR scenario, the road, with its level generally at 4m OD would be flooded on normal spring tides.

To the northern side of the western estuary the spit and dune would tend to roll back but would continue to function as an important recreational area, together with its significant ecological function. There would be some increase flood risk to the lower lying areas of Dwyran and to the minor road to the coast. The trees planted within the dune will still stop natural response of the shoreline and this could become more significant as the coast attempts to adapt naturally.

Malltraeth and the Cefni estuary

The embankment is assessed as having a standard of defence between 1; 50 and 1:100 at present day levels. Even with minimum maintenance, this structure might act as a flood defence for the next 50 years, with the level of defence reducing to somewhere in the order of 1:5 years. With regular overtopping the defence would eventually fail during epoch 3 and the main valley would be subject to flooding. Flooding under a 1m scenario would extend over much of the valley and through to the road and railway on a 1:10 to 1:50 year event. There would be significant impact to the outer estuary as described in the unconstrained scenario.

Impact of different Sea Level Rise Scenarios

Under a 2m SLR, the failure of the embankment might be brought forward to potentially year thirty. During the course of epoch three the valley floor could become fully tidal on MHWS.

Inner western section of the Menai Strait

Defences would, without maintenance, fail along the Caernarfon frontage and at Y Felinheli, and along the road on the northern side of the estuary over the second epoch,. Sections of the Caernarfon sea front could be lost with the potential risk to both new development and the commercial centre. Flooding would still be a significant risk. In addition, some 20 properties could be at early risk of flooding with this number increasing significantly with sea level rise. Under this scenario there would be substantial loss of important areas of the town.

At Y Felinheli the main risk would be that of flooding. As the sea front structures deteriorated the rear flood walls would be at risk. With sea level rise there would be a significant increased risk to the main shore road and potential increased risk to property.

Impact of different Sea Level Rise Scenarios

Under a 2m SLR, there would be significant properties at risk from flooding on MHWS both within Caernarfon and Y Felinheli.

To the northern side of the estuary, at present, the road provides important local access. This would be at risk from failure of the wall and erosion. The road is already at risk from flooding on more extreme events. This would become a regular occurrence over high water with a 1m sea level rise.

Impact of different Sea Level Rise Scenarios

This is an area where, under a 2m SLR, there would be a substantial increase in area at flood risk from normal high waters. The whole road and properties behind would be at risk on a regular basis.

South eastern shore of Ynys Mon

The main risk over much of this area from Porthaethwy through to Black Point would be local flooding and loss of protection to individual properties and the road. There is a much larger scale issue at Beaumaris.

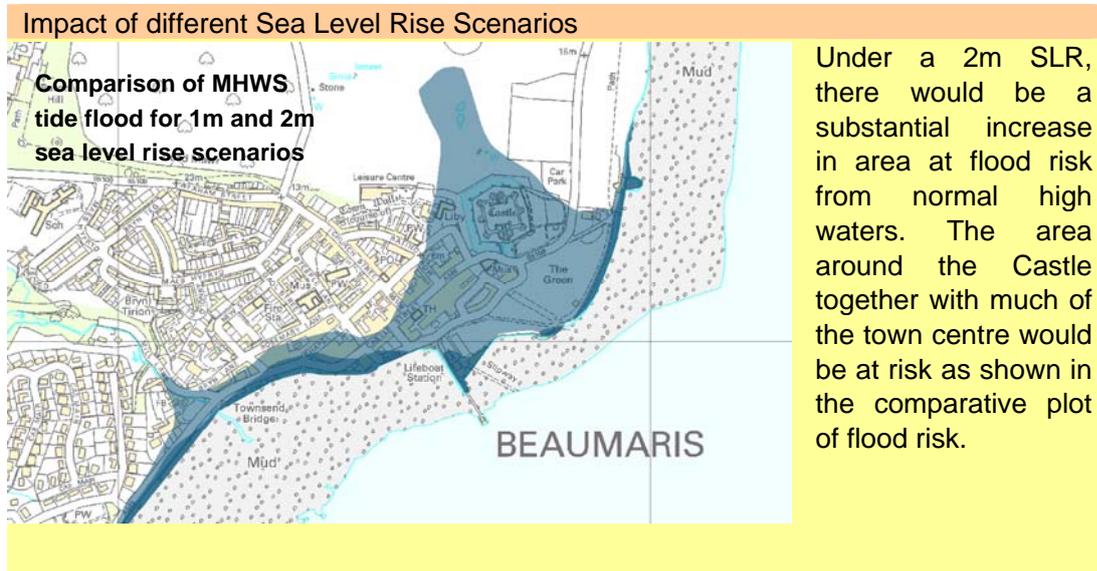
In terms of the coastal road, there would be increased risk of flooding at the Afon Cadnant and potential failure of defences along the Ffordd Cadnant. To the northeast of



Beaumaris there is significant risk of losing the road through Llanfaes, through to Llangoed. This is also the main road through to the Penmon headland. This road could be lost to erosion during epoch 2 and flooding during epoch 3. There would be a similar loss to minor roads to Penmon village.

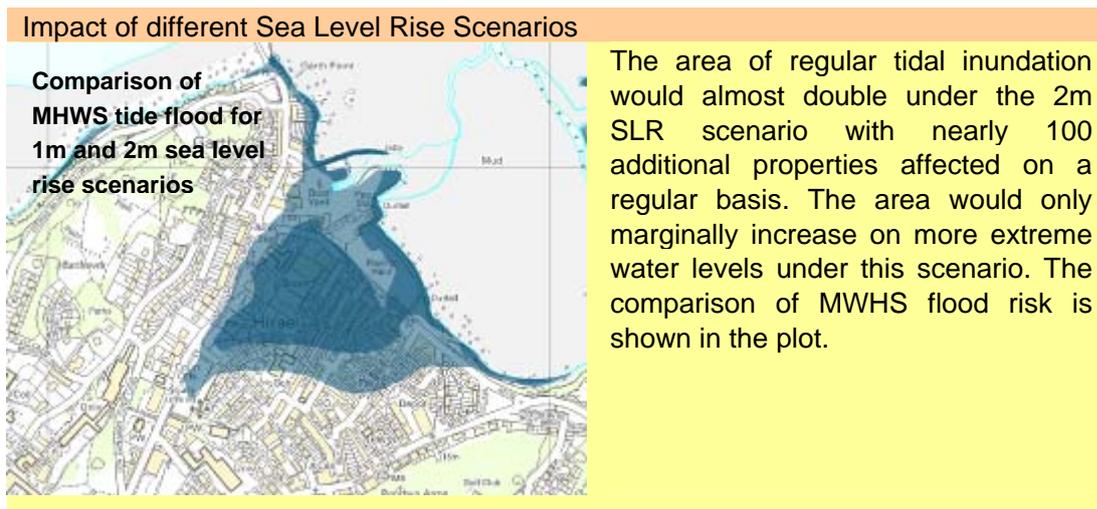
At Beaumaris, the main road is at present at risk from flooding on a regular basis where it enters the town at Chapel Street. Without maintenance the road would also be at risk from erosion potentially during epoch 2. This erosion could develop over the period of the SMP, resulting in the loss of property along half of Castle Street and loss of much of the sea front properties over the western end of the town. There is also potential for erosion to take out half the Green, together with the

lifeboat station. The reduction in width of the green would further increase risk of flooding to the eastern section of the town, together with the flood risk to the Castle. In effect, under this scenario, much of Beaumaris would be lost and certainly much of the core values of the town would be at continuing risk.



Bangor

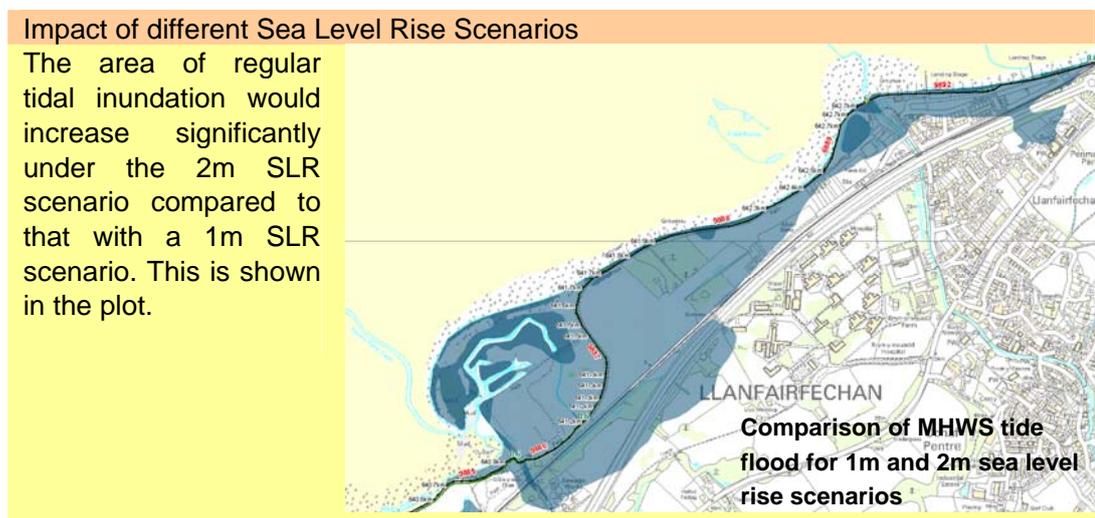
There would be general deterioration of defences over the whole sea front to the city. This could result in minor areas of loss particularly on the estuary frontage of Garth. However the main area of loss would be to the low lying area of Hirael. At present there are some 250 properties at risk in this area, together with one of the principal access roads into the city. Failure of defences generally over the next 2 epochs would result in significant on-going damage. With sea level rise, much of this area currently at risk on extreme water levels would be at risk on every spring tide.



The SMP mapping also identifies potentially significant flood risk to much of Porth Penrhyn.

Llanfairfechan and the shoreline to Traeth Lafan

The main area of erosion loss under this scenario would be at Llanfairfechan, however even here it is possibly not until epoch 3 that there would be any significant loss to property. Similarly, while there are areas at risk at present from extreme water level flooding, it would not be until epoch 3 that more regular flooding would impact on the sea front community. To the west of Llanfairfechan, the risk of flooding as existing defences are over topped would be in epoch 3, when flooding could impact on the A55 and the main railway line.



3.2 With Present Management – Baseline Scenario 2.

Table below sets out current policy and management approach for the zone based on SMP1 policy.

SMP 1			Subsequent Management Approach
No.	Unit	Policy	
Gwynedd/Ynys Mon			
1.6	Trefor to Dinas Dinlle	SHTL	
1.7	Dinas Dinlle	HTL	
1.8	Dinas Dinlle to Fort Belan	SHTL	
5.1	Fort Belan to Port Dinorwic (both sides)	SHTL	
5.1a	Traeth Melynog	DN	
5.1b	Foryd Bay	SHTL	
5.1c	Caernarfon	HTL	
5.1d	Port Dinorwic	HTL	
5.2	Port Dinorwic to Britannia Bridge (both sides)	SHTL	
5.3	Britannia Bridge to Menai Bridge (both sides)	SHTL	
5.4	Menai Pier to Bangor Pier (both sides)	SHTL	
5.5	Gazelle Hotel to Gallows Point (Anglesey side)	SHTL	
5.6	Beaumaris	HTL	

SMP 1			Subsequent Management Approach
No.	Unit	Policy	
5.7	Beaumaris to Black Point	SHTL	
5.8	Bangor Pier to Port Penrhyn (Hirael Bay)	HTL	
6.1	Port Penrhyn to Afon Ogwen	DN	
6.2	Afon Ogwen to Llanfairfechan (Lavan Sands)	DN	
6.3	Llanfairfechan to Pen-y-clip	HTL/MR	

In terms, therefore, of shoreline management the With Present Management approach is to continue to maintain and improve defences to the main areas of development and to local areas at risk through the policy of selectively holding the line.

The North West Wales Catchment Flood Management Draft Plan covers this PDZ as 4 different policy units. Extracts from the draft plan are presented below, setting out policy for each unit.

Policy unit 1: This unit covers Anglesey including all the river catchments draining the island. Mostly rural catchment consisting of the Anglesey AONB and the towns of Llangefni Holyhead and Amlwch.

There are a number of villages and small settlements where current flood risk management actions are carried out (e.g. Llangefni, Amlwch, Beaumaris, Llanfairpwll etc.). Policy 3 is the obvious policy choice for this policy unit. This will support the existing flood risk management activities, maintaining a relatively low flood risk across the whole island. Policy 3 will allow alternative flood risk management activities to be explored to maintain the current level of flood risk. There is likely to be an increase in the number of flood events as a result of climate change. However this flooding is unlikely to significantly increase the risk to people or disrupt community life considerably. We will continue to maintain the river channels and local flood defences to sustain the same level of flood risk across the all the locations at risk. There may be opportunities in some places to work with land owners and the local authorities to provide alternative and more sustainable options, such as increasing the area of woodland to reduce run-off and therefore maintain the same level of flood risk.

Policy 3 - Continue with existing or alternative actions to manage flood risk at the Environment Agency current level.

Policy unit 2: This unit covers the coastal strip from Bangor to Caernarfon extending inland to Pentir, Llanddeiniolon and Bethel. The main urban areas are Bangor and Caernarfon. Tidally influenced river flooding on the Afon Adda, Afon Cadnant and Afon Seiont. The tide level can prevent the discharge of river water to sea causing water in the channel to 'back-up' and overtop its banks.

Surface water and sewer flooding is the main flood risk in Bangor and Caernarfon. The Afon Adda is culverted as it flows through Bangor. Much of the Afon Cadnant is also culverted through Caernarfon. The complexities of the flood risk in these urban areas is not fully understood and therefore further detailed studies will need to be carried out before a policy 4 or 5 can be applied to this policy unit. Although the culvert system in Caernarfon was improved in the 1980's, the current condition of the system is unknown. Therefore before we can mitigate the affects of climate change, we need to gain a better understanding of the flooding mechanisms which cause the flood risk in this policy unit.

Secondly, we need to investigate the current condition of the culverts in order to determine whether there is a significant risk of flooding from the failure of this flood defence structure. Given the uncertainties regarding the flood mechanisms and flood risk, a policy 3 has been selected for the Bangor and Caernarfon policy unit with an action for further studies to be undertaken to improve our current understanding of the flood risk. This means we will continue to maintain the surface water drainage, sewer network and local flood defences to manage the flood risk at the current level. Using flood zone data, the flood risk in the policy unit was assessed as low to medium. Floodwaters from sewer flooding are shallow, low velocities and short lived. River floodwaters are also shallow in Bangor and shallow to moderate in Caernarfon, medium velocity and short-lived. Annual average damages are likely to remain the same under a policy 3.

Policy 3 - Continue with existing or alternative actions to manage flood risk at the Environment Agency current level.

Policy unit 3: Desach, Llifon, and Llyfni

These rivers have historic engineering in the river mouths, including shoal removal. The Afon Desach has been affected by the sand quarrying at Pant Glas nearby in the past. There is scope in the future for enhancement of this watercourse for flood risk and environmental benefits. Although the Llifon has been historically dredged, parts of it are now designated as a SPA and SSSI (not for riverine features), which will need to be taken into account if future flood risk management options were to change. The upper reaches of the Llyfni near Talysarn have been heavily modified which included the draining of Llyn Nantlle Isaf to facilitate slate quarrying activities.

Policy 2 - Reduce existing flood risk management actions (accepting that flood risk will increase over time). Note: this policy option involves a strategic increase in flooding in allocated areas, but is not intended to adversely affect the risk to individual properties.

Policy unit 10: This unit covers the urban area of Llanfairfechan. Tidally influenced fluvial flooding. Tide locking of the outfall on the Afon Ddu causes water in the channel to 'back-up' and overtop the riverbanks. The steep catchment of the Afon Ddu causes rapid run-off and deep fast flowing waters.

The flood risk in Llanfairfechan is too high. There are a large number of properties at risk from deep fast flowing river waters. 455 people are currently at risk and the town has a high SFVI score which means flooding will have high social consequences. An estimated 206 people are exposed to flood depths of approximately 1 to 2 metres and 28 people are exposed to depths greater than 2 metres. The total number of people at risk in the future increases significantly and approximately 1,040 people would be at risk as a result of climate change. The policy unit objectives are to reduce the number of people and properties at risk and reduce the flood damages in Llanfairfechan. In order to achieve this, a policy 5 has been selected. This means we intend to take further action to reduce the flood risk in this policy unit by looking to improve the level of channel maintenance, introduce a flood warning service, improve flood resilience measures for individual properties, install demountable and/or temporary flood defences through the town, carry out works to local flood defences and in the long-term, look to relocate properties away from the flood risk area in these policy units. This will go some way to reduce the number of people and properties at risk.

Policy 5 - Take further action to reduce flood risk.

This tends in terms of management of fluvial flooding to support the general approach of managing coastal risk more generally proposed by SMP1 to the main settlements. The exception is in the Pontllyfni area, where there is an intent to reduce effort in fluvial flood risk management. In several areas, such as Caernarfon, Bangor and Llanfairfechan, there is recognised to be an increased risk due to tidal locking of the rivers.

Taking the above approach as defining in general terms the With Present Management scenario, each area of the PDZ is discussed below.

Outer western estuary of the Menai Strait

At the southern end of this frontage there are local private defences to a small number



of properties at Pontllyfni. Even under the selectively hold the line policy of SMP1, there would be no intent to maintain these defences. The properties at the shoreline gain a considerable degree of protection from the low headland to the south, although there is still obvious pressure for erosion. As the headland erodes back, so the defence would be under greater pressure. Under this scenario of Present Management properties might be lost during epoch 2 as sea level rise increases this pressure

for rollback and erosion. While the rolling back of the shoreline generally would allow the low bank behind the shingle foreshore to be maintained, there would be increase flood risk to the sewage works and to the fish farm to the north of the river.

The same process would continue along the whole length of coast between Pontllyfni and Dinas Dinlle. The main issue would be that of flood risk in the long term with sea level rise linking through to the defended low lying area of the Afon Foryd behind the Dinas Dinlle headland. Under this scenario the intent would be to continuing defence to the area and, as such there might be an expectation that defences would need to be put in place to close off this flood route. Typically this might be a defence set well inland of the coast and, therefore not impacting on coastal processes. There would be a continuing supply of sediment which would help to feed the coast to the north.

At Dinas Dinlle, under this scenario the intent would be to continue to defend the village and to maintain the defence to the flood area behind. This is also the intent of the selectively holding the line to Foryd Bay. In front of the village, to sustain such an approach would require increasingly larger defences both to retain sediment to the



beach area, but also to maintain a sensible level of defence against over topping and breach. The southern headland structure is likely to remain effective through to epoch 3. While the structure at the northern end would remain in place, its effectiveness would decrease and it would need to be raised inline with sea level rise. The backshore defence would need to be raised during epoch 2 and this would start to impact on current beach use. Over epoch 3, it

would be come increasingly difficult to maintain the line of defences and both structures would have to be increased in size.

There is already a significant step in the shoreline and as the natural shingle and dune to the north rolls back so defence would need to be increased to the north. The precise behaviour of the frontages would depend on the manner in which increased flows in the Menai Strait influence the development of the nearshore ebb banks system. To the rear of the area, within Foryd Bay there would be a need to increase the height of the embankment. The land around Morfa Dinlle, even now is, in some areas, below MHWS and the area at risk from normal tidal flooding would increase with sea level rise. So that with 1m sea level rise, sluicing would not be adequate and a pumped system of drainage would be required.

Impact of different Sea Level Rise Scenarios

Under a 2m sea level rise scenario pumped water level management might be required during epoch 3 with a need to raise defences and construct new defences over much of the northern extent of Foryd Bay.

Despite the anticipated capacity of Foryd Bay to accrete with sea level rise there would be significant coastal squeeze of existing habitat within this area designated as SAC. The need to reinforce the behind the dune face of the open coast would similarly impact of the SSSI. The management of the defence to the north of Dinas Dinlle Headland would have some impact of the geological exposure of the headland but would act to slow the erosion of the SAM feature.

The defence to Fort Belan would be retained but the area would be increasingly at risk from flooding. Access to the fort would be maintained along the coastal embankment.

The northern section of the open coast would continue to adapt as at present.

Malltraeth and the Cefni estuary

The embankment at the head of the Malltraeth Sand and across the Cefni estuary would continue to be maintained and raised. Failure to raise the defence would expose it to increased occurrence of severe overtopping with the probable failure of the defence. It seems probable that the river would need to be pumped to prevent flooding within the defended valley. Defences would need to be raised to prevent more extreme level flooding to the village of Malltraeth. There would be less significant issues of coastal squeeze as sea level rises, although there would be a transgression of mud flat and saltmarsh on the southern flank of the open estuary over the gently rising land behind Newborough Warren.

Inner western section of the Menai Strait

Current practice to manage the defence of the road around the headland between Foryd Bay and Caernarfon and along the southern eastern shoreline of Foryd Bay between the Afon Gwyrfai and the Afon Carrog is taken as a policy for holding the line, even though this is not specifically identified in SMP1 nor flood risk management of these rivers not covered by the CFMP. Over the short to medium term the relatively low erosion pressure and an acceptance of occasional flooding would indicate that defence could be managed through maintenance. In epoch 3, with 1m sea level rise this would require significant areas of improved defences.

Impact of different Sea Level Rise Scenarios

Under a 2m sea level rise scenario defence levels would have to be raised over the whole length of both roads as these roads become submerged under normal tides. This would require extensive raising of defended sections and construction of embankments over the remaining length.

There could be specific area of relatively extensive flood risk, including the farms of Cynfryn and Cefyn-ynysoedd, with sea level rise. Properties to the southern side of the Afon Gwyrfaï would also be at risk. Purely increasing defence to the road might not reduce flood risk to these properties.

Under this scenario, defence to Caernarfon would be maintained and improved. At



present the main areas at flood risk are to Slate Quay and to properties along Shirehall Street and Church Street. With sea level rise there would be increasing risk to the areas around Victoria Dock

Under this scenario defence levels would need to be raised and this may impact on the character of the water front. The CFMP has identified that in particular in the case of the Afon Cadnant, which is culverted through the town and

discharges into Victoria Dock, tidal locking is an issue. It is probable that this would become significantly worse.

Further east there are private defences and the With Present Management is to allow works to be undertaken to sustain these defences rather than action being taken by the coast protection authority. Maintaining these defences at Waterloo Port would mean raising the walls in the long term with sea level rise. It is unlikely the Flood and coast protection funding would be available for such improvement. At the Caernarfon Industrial Estate a potentially significant issue is the possible contaminated nature of fill behind the existing defences. There is, however, little flood risk affecting this area.

At Y Felinheli, the defences would be maintained and raised with sea level rise. This is seen as generally sustainable in that defences have been set back and measures incorporated within the new housing development. To maintain access along Glan y Mor would however require significant investment, which given the use of the area and the access provided by the road further in land is unlikely to be justified. Defence in this area is unlikely, however, to impact directly on the designated nature conservation area defined at low water, although this could have longer term implications as sea level rises.

The only significant area to the northern shoreline would be the road between Barras and the Mermaid Inn. Current practice would suggest an intent to continue to address flood risk to the road. With sea level rise this would require raising the defence level quite considerably. It is questionable whether this investment could be sustained and this approach, maintaining this access to property, which would itself not be at significant flood risk could result in increased vulnerability to property being cut off during more extreme conditions.

South eastern shore of Ynys Mon

Within the area of the Swellies, with the obvious exception of works to maintain support to the two bridges, the With Present Management approach is for No Active Intervention. There is some minor flood risk to gardens and potentially through to the pump station at the back of the Football ground. There is more significant risk to Church Island.

To the east of the suspension bridge, the With Present Management approach all the way through to Gallows Point is for selectively holding the line. This would require initially just maintenance of the existing patchwork and largely private defences but with an intent to increase defence levels in line with sea level rise to protect areas at flood risk. Although generally outside the international design SAC, some areas are within SSSI designations. Due to the generally steeply rising backshore, however, there is little impact associated with continued defence.

At Beaumaris, under this scenario, the approach would be to maintain and raise existing defences along the access to and around the town. This might be feasible over the short term and potentially into epoch 2. The road in places is already close to tide level and defences would, therefore, need to provide defence against direct flooding. This need would increase with sea level rise with an increased risk of ground water flooding. As sea level rises there would be a need to extend this approach more generally along the whole length of defence. There would be the potential for increased scour at the toe of the defence and this would need to be countered with either rock armour or increased depth to the toe of the wall. Increased wave overtopping would further increase the need for defence. Given the high economic and cultural value of the town it is probable that this increasing form of linear defence would be justified. There would be loss of the small areas of beach and this linear approach to defence, projected forward over the 100 year period of the SMP would have a significant impact on the landscape and amenity values of the area.

Impact of different Sea Level Rise Scenarios

Under a 2m sea level rise scenario defences would have to be raised typically by over 2m along much of the frontage. This would be accompanied by a need to reinforce defences quite significantly in terms of placing rock armour revetments. This process of reinforcing defences would accelerate significantly during epoch 3 and would set the form of defence into the future.

Further east, defence would continue, under the present policy of selectively holding the line, to the road and to properties out towards Penmon. Despite the fact that many of the bays are held as much by hard rock outcrops, defences locally would come under significantly greater pressure and would in places require raising. If this approach were then extended to protect all local areas of properties, the approach would start over possibly the third epoch to impact appreciably on the natural landscape, constraining the ability of the local bays to retain sediment and resulting in loss of amenity and deterioration of the natural values of the coast.

The approach would, however, continue to sustain the transport networks, maintaining access to the small communities. In the longer term this net work would become increasingly dependent on defence and increase the general vulnerability of communities becoming isolated during extreme events.

Bangor

There are only minor lengths of defence over much of the area between the suspension bridge and the Garth headland. With sea level rise there would be a need to significantly raise defences and this is unlikely to attract public funding given the limited assets at risk. The Selectively Hold the Line policy of SMP1 is therefore not considered to cover these areas. Only at Garth would there be continued defence. This is felt to be sustainable and although defences would need to be raised at the point, there is little long term flood risk.

Similarly, between Garth Point and the boat yard, under present policy this area would continue to be defended. The justification for defence may not receive full grant in aid but in principle this defence could be sustained in support of local property and the significant value in terms of supporting water use of the frontage.

The far more significant risk lies in the low lying area of Hirael. The area contains a substantial number of properties within the tidal flood plain. There is also an issue of fluvial flooding due to the potential for tidal locking. Under the 1m sea level rise scenario, the flood risk increases such that there is a basin within the area which would be at risk over normal high water. The intent to hold the line along this frontage would require significant raising of defences, probably during epoch 2. This need would continue to increase with time. There is a good width of open ground just behind the defences and this would be seen as being used to landscape raised defences to the area. Even so, the nature of the area is such that the in land basin is lower than the slightly higher ridge at the shoreline. Increasing defence would tend to accentuate this in land basin and, although quite potentially there may be economic justification for defence based on existing assets at risk, the approach increases the vulnerability of the area to sudden flooding on more extreme events. The area is quite obviously locally important to those living in the area. However, this would need to be balanced against the long term impact of increased vulnerability and the loss of the amenity area to the city as a whole.

Impact of different Sea Level Rise Scenarios

Under a 2m sea level rise scenario defence levels would have to be raised by 1m over epoch 2 to maintain a sensible defence given the overall vulnerability of the large in land basin. By the end of epoch 3 defences would have had to be raised by at least 2m, with a substantial increased risk of tidal locking under heavy rainfall events.

The approach at Porth Penrhyn would be to maintain the general defence to the harbour area. This provides important wave protection to the Hirael frontage as well as supporting important commercial and recreational water use. The structure also supports the western side of the Traeth Lafan. Potentially maintaining this defence would support the area of Traeth Lafan in accreting with sea level rise.

Llanfairfechan and the shoreline to Traeth Lafan

Over much of this length the With Present Management is for No Active Intervention. As such, this scenario is the same as for scenario 1, with some increase risk of flooding in areas such as the mouth of the Ogwen and the Afon Aber. With a 1m sea level rise there would be risk to property at the mouth of the Ogwen.

Impact of different Sea Level Rise Scenarios

Under a 2m sea level rise there would be regular tidal flooding to a large area of agricultural land and farm properties at Afon Ogwen. Between Afon Aber and Llanfairfechan, under this sea level rise scenario, under With Present Management there could be regular tidal inundation of the main railway line.

The defence along the promenade at Llanfairfechan, at the mouth of the river and along the embankment to the west of Llanfairfechan would all be held under this management scenario. Along the main sea front sediment drift would tend to increase and there would be a need to further reinforce the system of groynes and raise defences to the promenade. Current levels of defence are assessed as being in the order of 5m, providing a defence standard of 1:50 years against direct flooding. There is associated with this a substantial risk of flooding due to wave overtopping. Defences would need to be increased in level taking account of both causes of flooding over epoch 2. Further increase in defence level, raising defences potentially by 1.5m would be needed over epoch 3. Property within this area tends to be set back and at a slightly higher level than the promenade. The main risk to property is therefore from more extreme water levels and this would be the case even with 1m sea level rise. The main impact of raising defences would be on the amenity use and with the potential loss of the protective shingle bank.

Impact of different Sea Level Rise Scenarios

Under a 2m sea level rise there would be increased direct risk to property from normal tidal flooding and, with increased wave exposure it may not be possible to hold a beach in front of the promenade. The defence against direct flooding would also result in the need for higher defences along the banks of the river and this has the potential to increase the risk of tidal locking identified by the CFMP.

At the western end of the Llanfairfechan frontage land levels through to the railway line and the A55 tend to be critically lower. Defences would need to be raised under this management scenario. There would be increased wave exposure with sea level rise and associated with this loss of beach. In this area it seems unlikely that there would be significant increase in level of the Traeth Lafan as it is towards the easterly edge of this designated area (SPA and SAC) and with increased sea level rise there is the potential for a landward movement of the low water mark. Increasing defence in this area is likely to result in coastal squeeze.

Impact of different Sea Level Rise Scenarios

Under a 2m sea level rise there would be increased direct risk to property from normal tidal flooding and the potential for normal tidal flooding to the transport route to the rear. Under this management scenario defences would need to be raised during epoch 2 typically by 1m, with further effort over epoch 3.

4 Summary Comparison and Assessment of Baseline scenarios.

Table 1. Economic Assessment

The following table provides a brief summary of erosion damages determined by the SMP2 MDSF analysis for the whole PDZ. Further details are provided in Appendix H. Where further, more detailed information is provided by studies, this is highlighted. The table aims to provide an initial high level assessment of potential damages occurring under the two baseline scenarios.

ASSESSMENT OF EROSION DAMAGES

Epoch	0 -20 year		20 – 50 years		50 – 100 years		50 – 100 years (2m SLR)		PV Damages (£x1000)
	No. of properties:		No. of properties:		No. of properties:		No. of properties		
<i>Location</i>	<i>Res.</i>	<i>Com.</i>	<i>Res.</i>	<i>Com.</i>	<i>Res.</i>	<i>Com.</i>	<i>Res.</i>	<i>Com.</i>	
Pontllyfni	0	0	1	0	2	0	4	0	103
Dinas Dinlle	0	0	0	1	6	0	13	1	91
Malltraeth	0	0	0	0	4	1	4	1	60
Foryd Bay	0	0	1	0	3	0	4	0	118
Caernarfon	0	0	2	6	14	17	26	25	397
Y Felinheli	0	0	22	0	32	0	66	0	1,068
North Menai W	0	0	1	0	1	1	3	1	93
North Menai E	1	0	2	0	27	8	45	9	690
Beaumaris	0	0	1	1	7	9	16	21	354
Bangor	0	0	11	1	9	4	25	8	543
Llanfairfechan	0	0	0	1	3	0	29	1	43
Total for PDZ1									3,560
With Present Management	No. of properties		No. of properties		No. of properties		No. of properties		PV Damages (£x1000)
<i>Location</i>	<i>Res.</i>	<i>Com.</i>	<i>Res.</i>	<i>Com.</i>	<i>Res.</i>	<i>Com.</i>	<i>Res.</i>	<i>Com.</i>	
Pontllyfni	0	0	1	0	2	0	4	0	103
Dinas Dinlle	0	0	0	0	0	0	0	0	0
Malltraeth	0	0	0	0	4	1	4	1	60

Foryd Bay	0	0	0	0	0	0	0	0	0	0	0	0
Caernarfon	0	0	0	0	0	0	0	1	409	0	1	21
Y Felinheli	0	0	0	0	0	0	1	0	128	1	0	8
North Menai W	0	0	0	1	0	128	1	1	232	3	1	93
North Menai E	1	0	92	2	0	408	9	1	1276	10	1	596
Beaumaris	0	0	0	2	0	408	7	0	1129	9	0	227
Bangor	0	0	0	0	0	0	0	0	0	0	0	0
Llanfairfechan	0	0	0	0	0	0	0	0	0	0	0	0
Total for PDZ1											1,108	
Notes: PVD determined for 1m SLR in 100 yrs.												
Other information: Damages do not take account of significant amenity values nor roads and access within each area.												

The following flood damages have been determined through use of MDSF. These figures are aimed to indicate the level and impact of flood risk rather than being a detailed economic appraisal. In many areas substantial numbers of properties would be liable to flooding on the more frequent events both under NAI and WPM, a nominal write off value has been allowed in the table for properties at frequent risk; this generally excludes values at risk at present on a 1:1 year event, in 50 years time for the 1:10 year event and in 100 year time the 1:50 year event.

ASSESSMENT OF POTENTIAL FLOOD RISK

No Active Intervention	Flood risk tidal 2010			Flood risk tidal 2060			Flood risk tidal 2110			tidal risk 2m SLR		PVD (£x1000)
	No. of properties		AAD x £k	No. of properties		AAD x £k	No. of properties		AAD x £k	No. of properties		
	<1:10 yr.	>1:10 yr		<1:10 yr.	>1:10 yr		<1:10 yr.	>1:10 yr		<1:10 yr.	>1:10 yr	
<i>Location</i>												
Other	0	12	5	0	15	6	0	18	88	20	5	419
Pontllyfni and Foryd area	0	9	4	0	11	15	0	17	74	13	9	456
Caernarfon	0	20	8	0	26	19	0	42	33	0	84	409
Southern Menai, Y Felinheli	0	116	33	0	119	83	0	134	455	0	146	2741
Bangor	0	247	76	0	269	171	0	330	1013	0	375	6031
Traeth Lafan, Llanfairfechan	0	13	3.5	0	16	8	0	43	66	8	72	520
Beumaris to Penmon	0	149	185	0	184	242	90	181	2364	213	166	3672
Dwyran & Malltraeth	0	61	31	0	78	174	0	136	299	107	61	3043
Total for PDZ16											26396	
With Present Management	No. of properties		AAD x £k	No. of properties		AAD x £k	No. of properties		AAD x £k	No. of properties		PVD (£x1000)
<i>Location</i>	<1:10 yr.	>1:10 yr		<1:10 yr.	>1:10 yr		<1:10 yr.	>1:10 yr		<1:10 yr.	>1:10 yr	
Other	0	12	4	0	15	6	0	18	21	0	25	210
Pontllyfni and Foryd area	0	9	3	0	11	5	0	17	17	0	22	138
Caernarfon	0	20	4	0	26	6	0	42	22	0	84	195
Southern Menai, Y Felinheli	0	116	16	0	119	19	0	135	53	0	146	628
Bangor	0	247	35	0	269	39	0	330	107	0	388	1319
Traeth Lafan, Llanfairfechan	0	13	3.4	0	16	8	0	43	46	0	80	286
Beumaris to Penmon	0	150	44	0	183	56	0	270	145	0	377	1743
Dwyran & Malltraeth	0	61	17	0	78	22	0	116	76	0	168	740
Total for PDZ16											5192	

Table 2. General Assessment of Objectives

The following table provides an overall assessment of how the two baseline scenarios impact upon the overall objectives. Specific objectives are set out in more detail within Appendix E. The table aims to provide an initial high level assessment of the two baseline scenarios, highlighting potential issues of conflict. These issues are discussed in the following section, examining alternative management scenarios from which SMP2 policy is then derived.

STAKEHOLDER OBJECTIVE	NAI			WPM		
	Fails	Neutral	Acceptable	Fails	Neutral	Acceptable
Reduce risk to life						
Protect properties from flood and erosion loss						
Identify communities at risk and allow opportunity for adaptation						
Minimise the need for increasing effort and management of coastal defences						
Avoid reliance on defence particularly where there is a risk of catastrophic failure						
Maintain access to rural communities and support their connectivity to principal support centres.						
Maintain recreational use of beaches and bays						
Maintain access to the coast including car parking and facilities						
Maintain existing water sport activities and facilities within the Conwy and Menai Strait						
Maintain Bangor as a viable commercial centre and tourism centre in a sustainable manner.						
Maintain Beaumaris as historic and vital community and tourist destination in a sustainable manner.						
Maintain Caernarfon as historic and vital community, commercial centre and tourist destination in a sustainable manner						
Maintain character and integrity of coastal communities						
Maintain agricultural value of rural community						
Maintain agricultural industry and allow adaptation						
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						
Maintain the value of World Heritage sites						
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 and interest						

STAKEHOLDER OBJECTIVE	NAI			WPM		
	Fails	Neutral	Acceptable	Fails	Neutral	Acceptable
features within the context of a dynamic coastal system.						
Maintain and enhance educational and scientific understanding of geology and geomorphology						
Avoid damage to and enhance the natural landscape						
Maintain the human landscape and character of communities						
Maintain use of the A55 road and rail corridor.						
Maintain the main road links to the Pen Llyn						

5 Discussion and Detailed Policy Development

Quite clearly there are critical issues with both baseline scenarios. The conflict between objectives develops mainly over time, with the threat of sea level rise; it is very much in extending the current approach to management into the future where these difficulties arise. The need to reinforce and raise defences creates, in many areas, a much greater reliance on those defences and vulnerability of areas dependent on these defences.

This is seen most obviously in the area of Foryd Bay and Dinas Dinlle, in the Hirael Bay area of Bangor and more locally at Llanfairfechan. This reliance on existing defences, and the continuing process of increasing the size and level defences, also starts to impact on the use of the coast, creating a barrier between settlements and their shoreline, with loss of beaches and impacting on essential landscape and character of specific areas. This approach of hardening the coast also starts impacting on the nature conservation values, resulting in areas of coastal squeeze. Although quite locally specific these issues fail to deliver that broad level intent of creating “*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.*”

Quite obviously as well the baseline scenario of No Active Intervention fails to build upon the important economic values of the area, fails to support tourism and access to the shoreline and fails to support any opportunity for adaptation to the increased pressures that arise from sea level rise. There is a need for change but change in a managed manner.

The discussion of the baseline management scenarios does highlight that, while there are some areas where it is necessary to consider sections of the coast in an integrated manner and while there are larger scale interactions in terms of social, economic and physical behaviour that link across the whole area, in terms of shoreline management policy can developed at a more local level.

Outer western estuary of the Menai Strait

This is one area where there needs to be a very co-ordinated approach. The key issues are maintaining an overall coherent approach which will sustain the important natural function of the coast, avoiding setting a direction of management that would require ever increasing and an unsustainable approach to management, but importantly allowing opportunity for adaption of communities and existing use made of the area.

- There is likely to be significant change in behaviour of the estuary, with increasing flows into and out of the estuary. This will result in the mouth of the estuary wishing to widen. It will also result in change to the nearshore bank system at the mouth, which potentially, if allowed to develop naturally will tend to sustain the general shape of the dunes to the south.
- There will, however, be increasing pressure for the main section of this southern frontage and the frontage to the south of Dinas Dinlle to roll back. This roll back and erosion will maintain the important sediment supply to the system and maintain a more robust natural system.
- There would also be significantly greater flood risk in the area between the open coast and Foryd Bay. In the long term it is not considered sustainable to maintain, raise and extend defences to address this. Furthermore, to attempt to do so would have a significant impact on the internationally important nature conservation values.

This would be unacceptable and because of the problem of sustainability could not be sensibly argued to be an issue of overriding public interest. .

The overall approach has, therefore, to be to move towards a more natural development of this whole area.

This approach is considered in relation to individual areas.

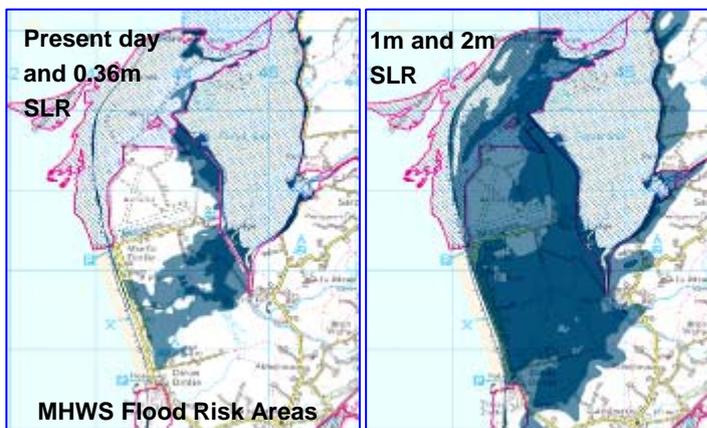
In the case of the southern cliffed section of the area, the overriding intent is not to intervene; to maintain the ability of the coast to roll back, thereby allowing development of the natural shingle ridge as a means of providing a low level of flood defence as at present. At Pontllyfni, there would be no intent to protect against further erosion and there would be loss of properties at the sea front. The existing private defences would come under increased pressure and while maintaining existing defences might be accepted, there would be no intent to allow improvement to these defences. To do so would start a process that would require further extension of the defence further north to prevent outflanking. This would not be economically justified and would start to influence the supply of sediment, sustaining natural adjustment of the shoreline. The policy for this area would be for No Active Intervention. During the first epoch it might be anticipated that local private defences could be maintained. As pressure on these defences increase there would this would need to be reviewed, but there would be no intent to allow improvement to defences. The Sewage works would be at greater risk from flooding during epoch 2 and there may be a need to review the need for flood defence to the main road in epoch 3.

Over the rest of this southern section of the coast, intent would be for no active intervention. In epoch 3, it is probable that with sea level rise, relatively large areas of land south of the village of Bodfan, just to the south of Dinas Dinlle, would be subject to regular tidal flooding. This much of this area is old marsh, reclaimed by drainage as pasture. There is evidence of regular overwash of the shingle backshore. This process would increase, with the potential for re-establishing a significant area of saltmarsh.

Impact of different Sea Level Rise Scenarios

With increasing sea level rise, there would be an increased risk of flooding through to the back of Foryd Bay. With 2m sea level rise, this flood risk could establish a flood route on normal tides, potentially cutting the road to Dinas Dinlle. Whether works were necessary to prevent this would need to be reviewed in the future.

The defence at Dinas Dinlle critically depends on the defence against flooding within Foryd Bay. This is not considered to be sustainable beyond epoch 2. At the shoreline,



defence would need to be substantially increased over epoch 2 and this is likely to result in loss of the beach and increasing vulnerability to the village. Maintaining this defence is, therefore, also not seen as being sustainable. The SMP approach for this area and the general area is, therefore, for managed realignment. The risk to the

village, both in terms of flood risk and in terms of erosion, increases progressively over time and as one moves north from Dinas Head. It is at this northern end of the village that there is the greatest interaction and set back of the coast to the north. Management at the southern end of the village at present does slow erosion to Dinas Head SAM, but still maintains exposure of the cliff. It does regulate but not stop sediment bypassing to the shoreline to the north. Management of this point, while recognising the potential need to adjust the alignment in the future, does also provide the opportunity to manage a transition between the high ground and the low lying sections of coast. This also provides the opportunity to manage to some degree the sustainable adaptation of the village. The intent would be to sustain the more traditional area of the village in the lee of the headland, potentially even, providing opportunity to retain parts of the Dinlle Caravan park, which is situated on slightly higher ground.

In terms of other interests to the north of Dinas Dinlle, managing a transition in the coast at the headland still maintains the opportunity to allow natural adaptation of the main section of the open coast. Consideration would need to be given as to how access could be managed as the road comes in conflict with the adjusting shoreline. The projection of erosion and flood risk would indicate that over the first two epochs the village of Morfa Dinlle, the airfield and some of the general land use could be sustained, potentially into epoch 3. Similarly access to and habitation of Fort Belan may also be sustainable. Much of the rate of change would depend critically on the rate of accelerating sea level rise.

Evidently, what the SMP is concluding would result in substantial change across the whole area. The SMP can only set out in broad terms the intent for future management. A detailed development and adaptation plan would be required involving the communities and interested parties in taking this forward.

In terms of specific policies delivering the SMP, the policy for the defence of Dinas Dinlle, and the defences within Foryd Bay would be to Hold the Line in epoch 1, The policy for other areas would be Managed Realignment. In epoch 2, the policy in all areas would change to Managed Realignment, moving in epoch 3 to a policy where the only significant management would be at Dinas Dinlle. This may require some additional flood defence to prevent flooding to the remaining southern area of the village.

Over the northern half of Caernarfon Bay the policy would be for No Active Intervention. The open coast should be encouraged to behave naturally as the most appropriate means of maintaining a robust system. This should examine the impact that forestry has in constraining the natural behaviour of the dunes. On Llanddwyn Island, the Pilot House properties are set back behind a substantial area of dune. This dune is sustained by the presence of the breakwater. Management of this area should be viewed from the perspective of maintaining the natural dune system with a general approach of No Active Intervention. This would not preclude local management measures to sustain the breakwater. The future flood risk to the main road and village of Dwyran would need to be considered locally in the face of potential sea level rise. The intent would be to manage this local flood risk to sustain the important access route and the village. This would not impact on the behaviour of the shoreline. Local management of flood risk to individual properties along the outer section of the Menai Strait would not be precluded subject to normal approvals.

Malltraeth and the Cefni estuary

The situation within this area is somewhat different from the open coast of Caernarfon Bay, discussed above. The embankment and causeway across the estuary, although having had a major influence on the development of the coast, does not really result in

excessive pressure on the coastal system. It is also seen as being sustainable over the next 100 years, even with the need to raise the defence level. This may, with current management practice within the enclosed estuary require that freshwater is pumped to avoid over bank flow. Alternatively, there could be a greater acceptance of freshwater flood risk, with an adaptation of land use to accommodate this. While it is accepted that allowing the sea defence to fail could open up a major new area for saline and transitional habitat. It would, however, also result in significant impact on the transport infrastructure which would then need to be addresses in terms of a new defence line. At present, and with the caveat relating to the possibility for adaptation to increased freshwater flooding, the policy in relation to the embankment is to Hold the Line.

The local defence to the village of Malltraeth could be maintained as part of maintaining the general defence to the estuary behind. However, with sea level rise there may be a need to reconfigure how local defence was managed.

The approach to the outer part of the estuary would be to allow natural development of the shoreline.

Inner western section of the Menai Strait

Despite the need to raise defences at both Caernarfon and Y Felinheli, there are important economic and social benefits in doing so. Maintaining the line of defence in these areas is not going to significantly influence the behaviour of the Menai Straits.

In Caernarfon, the CFMP has identified that there are issues associated with tidal locking of the culverted Afon Cadnant, and to some degree the Afon Seiont. The flood risk is to a core area of the old historic town making it difficult to adapt to increase flood risk. The intent would be to maintain and raise defences against tidal flooding. How then fluvial flooding is addressed would require further detailed study. Given that tidal locking is going to become far more of an issue, this should include consideration of diverting flow away from the harbour area, potential diverting the Cadnant through to the Seiont further up stream. There would need to be planning consideration of development around the area of Victoria Dock to encourage possible adaptation of property to be more resilient as far as possible.

At Y Felinheli, an overall policy would be for continued defence to the main new areas of development. To the western end of the development the overall approach would be to not to allow further development of defence which might lead on to increasing dependency. This area would be a policy of No Active Intervention. This would need to be co-ordinate with the approach to new development, but continuing to provide defence to the development area.

Between these two major areas of existing development, the approach would be to allow the shoreline to function naturally. Where there are existing defences, this overall approach of No Active Intervention would not preclude on-going maintenance with the expectation that this would be privately funded. There is a potential area of fill which due to the nature of the fill may require continued defence. However, even here the long term approach would be for No Active Intervention considering options for excavating fill material to avoid contamination.

This general approach of encouraging natural development of the shoreline would carry through to all other sections within this area of the Menai Strait. At Moel-y-don, opposite Y Felinheli, this would not preclude management of local defence to the cottages, but future flood risk may make this untenable by epoch 3. Along the road between Barras

and the Mermaid Inn, it is recognised that this is an important local access route to property and that there are a locally important oyster and mussel beds. Obviously, access to the Inn is equally important. Management and maintenance of the road wall is seen as important but, with sea level rise, typically over epoch 3, this will become increasingly difficult. Wholesale raising of defence levels along the road would engender a false expectation that this could be continued into the future. Policy in this area would look to change from that of holding the line to one of No Active Intervention within epoch 3. To sustain use of the frontage, there would be a need to establish new access routes from further in land.

The road around the headland west of Caernarfon could be maintained over the short to medium term. This approach would also apply to the frontage between the Gwyrfaï and Carrog estuaries to the east side of Foryd Bay. However, during epoch 3, there would be a substantial increased flood risk. To Hold the Line would result in progressive hardening up much, if not all of the frontage. This could impact on the designated site of Foryd Bay and set a course for further increase in defence into the future. The policy for this frontage would be to maintain existing defences to sections of the road over the first two epochs but to look to realign the access in the future. This would be subject to funding by the Highway Authority. In the future there would be increased flood risk to local areas of farm land and the potential flood risk to property.

South eastern shore of Ynys Mon

There would be no overall intent to defend frontages between the two bridges. Flood risk to the A5 and the pump station would need to be reviewed locally, in the future.

The area to the west of the suspension bridge, through to the Pont Cadnant, comprises as series of local, private defences, providing both protection against erosion and a level of flood protection to the main waterfront streets of Porthaethwy. The waterfront is an important historic part of the town, with several listed buildings. Even with sea level rise, flooding is relatively local but could extend back to affect Ffordd Y Paced, Ffordd Cynan and Stryd Fawr. The general approach would be to continue to maintain defence over the area but through supporting private funding. The area of the foreshore is an SSSI, associated with the rock outcrops and reefs. Works would need to be undertaken so as not to impact on this interest. Because of the strategic value of the area and amenity and cultural value the policy would be for Hold the Line but through collaborative funding.

Further east, the policy would revert to No Active Intervention, recognising that, along this frontage, defence is private with no broader strategic function. Defence in this area is unlikely to impact on the general coastal processes and as such the policy would not preclude private defence, subject to normal approval processes. The same attitude would be taken to Gallows Point. It has been reported that there is interest in developing a marina at Gallows Point. The whole of the Point is within the present flood risk area on more extreme events and flooding would become more frequent with sea level rise. The Point would appear to be, principally, a soft sediment feature, which has developed in association with a higher area of underlying intertidal glacial deposit, although there is also evidence of historical tipped landfill. Its head is clearly formed in response to tidal action and as such any reinforcing of the head is likely to influence tidal flows. If there were development of the Point, the potential impact of this would need to be considered as could impact on the areas such as Beaumaris and even across to the Traeth Lafan. The influence on tidal flow, which appears to be most significant on the ebb, would not necessarily be detrimental to Beaumaris and management of the Point might prove to be beneficial in developing a more adaptive approach to management of defence to

access to Beaumaris, discussed below. There are obviously other issues which would need to be considered in terms of spatial planning, not least the present and future flood risk.

Beaumaris presents some very specific issues for present and future management:

- The main access along the sea front is already at risk from tidal flooding, together with flood risk to properties at Chapel Street, Castle Street and over the area of the Green through to the Castle.
- With sea level rise, the extent of flood risk increases to cover much of the eastern end of the town under more extreme events and much of the coastal road through to the junction with Allt Goch Bach. Under a 2m sea level rise scenario there would be regular tidal flood risk to most areas seaward of Castle Street.
- Much of the area at risk is part of the Wold Heritage site, it is all within the designated AONB and many of the properties within the lower part of the town are listed buildings.
- The Green is an important amenity area and part of the essential open landscape of the Beaumaris seafront.
- The Lifeboat station is an important feature providing essential support to boat use in the broader area.

In addition:

- Much of the Green, which at present acts as an important area both for landscape flood defence and an area to stop flooding from wave overtopping, lies largely within the predicted erosion zone over the three epochs.
- The main coastal road and property around Chapel and Castle Street would all be subject to erosion.
- The existing defences will come under pressure in the future and maintaining these defences on their present line would result in raising and reinforcing defence to the point where the character of the frontage is changed to the detriment of the area.

The existing foreshore is generally swept clear of sediment both by wave action and by tidal flow and sediment supply to the foreshore is limited by the main channel running close to the shoreline. However, there are local areas where there is retention of sediment. This is clearly seen to both east and west of the lifeboat station and even as a small delta at the mouth of Nant-y-Felin running down from the Llyn Pen-y-parc reservoir. There is a clear ability for sediment to be retained, given the right conditions.

The clear intent is to maintain the town and sustain its important economic and cultural values. The main problem to the western end is in having the width to sustain a robust defence and to the east maintaining and using the width of the Green and the opportunity this provides for sustainable defence. There are options for addressing the main access problem in the future by developing the B5109 as the main access road to the town. This would not address issues associated with local access to the newer development of Cae Mair or to the cemetery at the western end of the town. This could potentially be overcome by creating a new access to the development from Mill Lane. This would create the potential for some additional width associated with the existing western sea front, even opening out the entrance to the Nant-y-Felin, allowing width for sediment to be retained.

There also seems potential for readjusting the shoreline, developing a small headland at the end of Castle Street, which would provide support to existing defence, would also create the opportunity to retain a wider raised foreshore in the area.

Around the area of the Green there is the potential both to use the area to landscape higher flood defences but also to realign the defence to support creation of an upper beach. This would need to be supported by some form of defence headland at the northern end of the Green to provide a transition between this and the naturally eroding coast further north.

Developing such ideas goes beyond the remit or sensible detail of the SMP. What does, however become apparent is that solutions to the difficult issues of managing flood and coastal erosion risk go well beyond of merely maintaining existing defences. Ideas need to be explored in an integrated manner, involving spatial planning, the highway authority and the local community as much as with the coastal protection authority and Environment Agency. In some places, such as to the eastern end of the Green, the defence is in poor condition. It would be important to maintain some form of defence here but this needs to be considered in terms of a larger strategy for the area. Therefore, while the threat is longer term, planning for future management needs to happen sooner.

The policy for the area would be to Hold the Line to both east and west of the town but to do so while considering options for realignment, potentially during epoch 2 but quite probably during epoch 3.

Further north along the coast, the intent would be to allow natural erosion to the length of cliff to the east of Beaumaris. While it may be possible and beneficial to undertake some realignment of the road frontage directly north of Beaumaris, the intent would be to maintain this important link to the Llangoed/Penmon peninsula. Holding the line here would also maintain the medieval site of Friary at Llanfaes as well as protecting the sewage works; neither of which are subject to significant flood risk.

From where the road cuts in land, along the coast running to the east to Penmon, the policy would be for No Active Intervention, supporting the important natural values of the coastline. There are local private defences and there is some protection locally to the road. These defences might be maintained and there might be local management subject to normal approvals and subject to no significant impact on the natural development of the shoreline.

Bangor

From the suspension bridge to the start of the Garth Headland there are few assets at risk either from erosion or flooding. Much of the cliff is designated SSSI. The policy for this frontage would be No Active Intervention. At the Garth headland there is more significant erosion risk and local flood risk to the various old dock areas to the east of the headland. The overall policy here would for Hold the line. The intent would be quite specifically to maintain the road, the amenity area of the Garth Point and access to the Pier. Over the dockland area the intent would be to sustain use of the area but specific approaches to defence would be taken at a local level and may require collaborative funding.

The more difficult area is that fronting the large flood area of Hirael. With the significant tidal flood risk, and taking account of the relatively large catchment area draining into the flood basin, it is not considered sustainable to maintain the shoreline defence over the period of the SMP. It is this argument of sustainability and increase vulnerability of properties in the area, despite the high present economic value, that drive this decision. Defence of the area may be reasonably anticipated to continue over the first two

epochs, however with sea level rise and the much higher risk of tidal locking, the policy in the third epoch would be for managed realignment.

To take this approach would require the support of spatial planning in terms of planning control, developing a plan for moving people and businesses from the area and in terms of future use of the area. There would also be a need to re-assess access currently along the sea front. There exists the possibility that this area could contribute to biodiversity and amenity value of the city. Such planning would need to consider how the frontage through to the Afon Cegin was developed, with the potential further adjustment of defences along the whole frontage.

The intent for the Porth Penrhyn frontage would be to Hold the Line. This would provide important protection to the Hirael frontage, delaying the need for realignment, but again the approach would need to be developed in conjunction with spatial planning and with collaborative funding beyond merely that of coast protection. The default policy for this area would be Managed Realignment, managing the deteriorating structure of the dock area solely with the intent to provide shelter to other areas of the coastline.

Llanfairfechan and the shoreline to Traeth Lafan

The main risk to property and people is at Llanfairfechan. There is also a flood risk to the main transport route in the currently undefended section of coast just west of Llanfairfechan. From Porth Penrhyn through to Llanfairfechan, the present policy is for No Active Intervention. The private defences in the Penrhyn Park area are in poor condition. There would be no intention to support their maintenance and the policy here would be for No Active Intervention.

On the eastern side of the Afon Ogwen, properties are at risk from flooding, particularly at the Spinnies and in the future at Aber-Ogwen. Both properties are at present above normal tide level. However, with 1m sea level rise the property of the Spinnies would be below this level; with 2m sea level rise Aber-Ogwen would also be affected by normal tides. There would be no intention to provide formal defence to this area. At Aber-Ogwen there might be the potential for local defence securing the property over the period of the SMP. At the Spinnies, it is felt that from epoch 2 the increasing risk of tidal flooding may make local defence impractical. In other areas, along this frontage, there would no intent to provide formal defence to farmland. To do so would establish a trend for defence which is not felt to be sustainable in the long term. Allowing natural adjustment of the coast would support the nature conservation values associated with the internationally important Traeth Lafan and presents opportunity for the development of transitional habitat between the foreshore and the rising land behind.

To the west of Llanfairfechan, just seaward of Madryn, there is a present day flood risk to the railway line. It is uncertain to what degree the railway line is actually at risk and this needs to be examined further. In the future this risk increases. The intent would be to defend or raise the railway line, but with the intent that such defence was set back, allowing the shoreline to develop naturally. This approach to defence would continue to the east, where the Nant-y-Felin-Fach cuts through the shoreline behind the large shingle spit. The defences to area to the east of the stream, through to the Llanfairfechan headland is currently in poor condition and provide limited protection to land behind. The intent would be to allow the historic defences to fail and realign defences back to protect the railway line, the sewage works and the A55. This approach is consistent with the approach to the west in allowing a move towards natural readjustment of the shoreline.

Along the Llanfairfechan promenade, the present approach to defence is based strongly on the ability to retain a healthy shingle foreshore in front of the hard defence line. This provides important defence to the promenade and against risk of wave overtopping. In the future it will become increasingly difficult to maintain this line of defence and there is the potential for more direct flooding to property, principally at the eastern end.

The outflow fan of glacial deposits at the mouth of the Afon Llanfairfechan does provide a degree of natural control. In the future, to sustain defences this control would need to be substantially increased. This has the potential to further constrain the flow within the river and, as identified in the CFMP, this could result in increased flooding to the main area of the town.

The overall intent would be to continue to manage the area, not least because of the potential impact on the main transport route. However, such management needs to consider options during epoch 3 for further setting back the existing defence line and managing the defence of the natural headland in such a way as not to constrain the mouth of the river. Such realignment would almost certainly require use of the existing promenade area to create width for retaining a beach and might result in the need to move or adapt the use of property at the eastern end. Management of this area, specifically how the headland is managed, needs to be integrated with the management of defence to the west of the river. As such this whole section is seen as one policy unit with the intent to manage defence of the whole length initially holding the line but in the future planning for an approach which allows greater width in maintain a beach and natural defence.

6 Management Summary.

Over much of the coast there are only relatively local areas of existing defence. In nearly all cases it is in the medium to long term that there is significant pressure on these defences. Even then it is only in few areas where defences would have a significant impact on the larger coastal system. As such, relatively broad Management Areas have been defined covering the same areas discussed in developing policy

MA41 OUTER ESTUARY WEST: From Trwyn Maen Dylan to Llanddwyn Island (including Foryd and Abermenai)

Policy Unit		Policy Plan			Comment
		2025	2055	2105	
16.1	Pontllyfni	NAI	NAI	NAI	This would not preclude maintenance of private defence during the first epoch. Review flood risk to main road and sewage works
16.2	Pontllyfni to Dinas Dinlle	NAI	NAI	NAI	Maintain sediment supply to the north
16.3	Dinas Dinlle	HTL	MR	MR	Manage transition between Dinas Dinlle Head and open coast with the intent to manage flood risk to village on higher ground.
16.4	Morfa Dinlle	MR	MR	NAI	Develop management to self sustaining dune frontage. This would not specifically preclude management of the local area at Fort Belan subject to normal approvals.
16.5	Foryd Bay	HTL	MR	NAI	Manage flood defence initially with the intention of returning the bay to a naturally

					functioning system.
16.6	Traeth Abermenai	NAI	NAI	NAI	This would include further examination of potential flood risk to Dwyran, with the intent to provide defence.
16.7	Abermenai Spit and Traeth Llanddwyn	NAI	NAI	NAI	Removal of forestry to allow width for coastal adjustment
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

MA42 MALLTRAETH AND CEFNI: From Llanddwyn Island to Pen-y parc

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
16.8	Newborough Forest	NAI	NAI	NAI	Removal of forestry to allow width for coastal adjustment
16.9	Embankment and village	HTL	HTL	HTL	Local consideration for adaption to the front defence to the village with sea level rise.
16.10	Bodowen Cliffs	NAI	NAI	NAI	
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

MA43 INNER WESTERN SECTION OF THE MENAI STRAIT: From Foryd Bay to the Britannia Bridge and to the Mermaid Inn

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
16.11	Ffordd Yr Aber to Afon Carrog.	HTL	HTL	MR	Subject to highway funding, with future adaption of property and access.
16.12	Caernarfon	HTL	HTL	HTL	Review the need for raising defence, co-ordinated with fluvial flood management.
16.13	Waterloo Port to Glan y Mor -Y Felinheli	NAI	NAI	NAI	This would not preclude local management through private funding subject to normal approvals.
16.14	Y Felinheli	HTL	HTL	HTL	Review flood risk with sea level rise.
16.15	Glan-y-mor Lodge to Bridge	NAI	NAI	NAI	
16.16	Bridge to Barras	NAI	NAI	NAI	
16.17	Barras to Mermaid Inn	HTL	MR	NAI	Intent to maintain access but with future need for adaptation to increased flood risk.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

MA44 SOUTH EASTERN SHORE TO YNYS MON: From Britannia Bridge to Black Point.

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
16.18	Llanfair Bay	NAI	NAI	NAI	
16.19	Porthaethwy	HTL	HTL	HTL	Local management to defences to maintain historic frontage.
16.20	Pont Cadnant to Gallows point	NAI	NAI	NAI	This would not preclude private works subject to normal approvals.

16.21	Beaumaris West	HTL	HTL	MR	Maintain defence but with the potential opportunity for realignment..
16.22	Beaumaris East	HTL	HTL	MR	Adapt defences to improve defence with the intent of using the width of the Green to landscape flood defence.
16.23	Drumlin	NAI	NAI	NAI	
16.24	Llanfaes	HTL	HTL	HTL	Maintain local access road
16.25	Llanfaes to Penmon	NAI	NAI	NAI	Potential need to realign road
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

MA45 BANGOR: From Britannia Bridge to Afon Ogwen

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
16.26	Bridge to Garth	NAI	NAI	NAI	
16.27	Garth Point and Dock Yard	HTL	HTL	HTL	
16.28	Hirael	HTL	HTL	MR	Consider options for re-development and flood proofing.
16.29	Porth Penrhyn	HTL	HTL	HTL	Subject to alternative funding.
16.30	Penrhyn Headland	NAI	NAI	NAI	
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

MA46 TRAETH LAFAN AND LLANFAIRFECHAN From Afon Ogwen to Llanfairfechan

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
16.31	Afon Ogwen to Madryn	NAI	NAI	NAI	
16.32	Afon Aber	MR	MR	HTL	Adapt defences to maintain natural sediment drift with long term intent to protect transport route from potential flooding.
16.33	Llanfairfechan	HTL	HTL	MR	Maintain defences with long term aim to adjust to a more favourable alignment.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PDZ16

Management Area Statements

MA 41 Outer Estuary West

Trwyn Maen Dylan to Llanddwyn Island (including Foryd and Abermenai)

MA 42 Malltraeth and Cefni

Llanddwyn Island to Pen y parc

MA 43 Inner Western Section of the Menai Strait

Foryd Bay to the Britannia Bridge and to the Mermaid Inn

MA 44 South Eastern Shore to Ynys Mon

Britannia Bridge to Black Point

MA 45 Bangor

Britannia Bridge to Afon Ogwen

MA 46 Traeth Lafan and Llanfairfechan

Afon Ogwen to Llanfairfechan

Location reference:	Outer Estuary West
Management Area reference:	M.A. 41
Policy Development Zone:	PDZ16

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:

The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of “With Present Management” and under the “Draft Preferred Policy” being put forward through the Shoreline Management Plan.

-  In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.
- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

-  With Present Management.
-  Draft Preferred Policy.

Flood Risk Zones

-  General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency’s web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.
-  Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.
-  Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.

SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

Within this area the open shoreline is predominantly backed by soft dunes or low slowly eroding cliffs. Behind the dunes there are extensive areas within the flood risk zone. Within the outer section of the Menai Strait there are the intertidal areas of Foryd Bay and Traeth Abermenai. Along the open coast the large flood areas rely heavily on natural flood defence provided by the dune. Within the tidal inlets there are long lengths of embankment. Flood risk to the area would increase significantly with sea level rise.

Attempting to reinforce the dunes would result in lowering of beaches and would not be sustainable. It would also impact on the important designated sites with damage to nature conservation, amenity and landscape. The overall intent for management within this area is therefore to manage a change from defence and intervention to a management position where the whole area is allowed to respond more naturally. There are important communities, agricultural land use and historic features. Within this overall change in approach specific areas would continued to be managed to allow adaptation and to sustain important values as far as is feasible.

In the case of the southern cliffed section of the area, the overriding intent is to not intervene; to maintain the ability of the coast to roll back, thereby allowing development of the natural shingle ridge as a means of providing a low level of flood defence, as at present. At Pontllyfni, there would be no intent to protect against further erosion and there would be loss of properties at the seafront. The policy for this area would be for No Active Intervention. During the first epoch it might be anticipated that local private defences could be maintained. There would be increased risk to the fish farm and in the longer term to the sewage works. Management of these assets would need to assess and address potential risk of contamination to the coastal area.

At Dinas Dinlle the defence would be maintained but with no significant raising of defence. This would reduce losses both to the village and to the southern historic site. The aim would be to allow a more natural transition through to the dunes to the north, while still maintaining a beach and protection to the southern part of the village. Behind Dinas Dinlle, and over the large area of Morfa Dinlle, the approach would move towards No Active Intervention with increased flood risk from within Foryd Bay. The aim is to allow time for adaptation.

To the north of the entrance to the Menai Strait the approach would be of No Active Intervention. Consideration would be given to local defence to communities to the back of Traeth Abermenai. Management of the Newborough Forest should consider adaptation to allow the natural development of the dune system.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of the proposed changes and impacts. There is also a need for a detailed planned response to change. It will be important to relate this to national monitoring of sea level rise and more general climate change and to continued monitoring of shoreline behaviour.

Significant areas of agricultural land together with properties and Holiday centres would be affected. This would need to be planned in consultation with those affected; adapting both the management approach and land use to allow time for adaption.

ACTIONS:

ACTION	PARTNERS
Shoreline monitoring	GC/ Ynys Mon Council
Adaption planning <ul style="list-style-type: none"><li data-bbox="300 499 587 526">▪ Pontllyfni<li data-bbox="595 499 906 526">▪ Dinas Dinlle<li data-bbox="300 533 906 600">▪ Morfa Dinlle and hinterland.	GC Communities EA Highways NT
Assess in detail potential impact on historic environment	CADW
Examine opportunity for habitat creation	EA CCW
Notify fish farm at Pontllyfni so that plans may be put in place to minimise pollution to coastal waters	EA

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		Policy Plan			Comment
		2025	2055	2105	
16.1	Pontllyfni	NAI	NAI	NAI	This would not preclude maintenance of private defence during the first epoch. Review flood risk to main road and sewage works.
16.2	Pontllyfni to Dinas Dinlle	NAI	NAI	NAI	Maintain sediment supply to the north.
16.3	Dinas Dinlle	HTL	MR	MR	Manage transition between Dinas Dinlle Head and open coast with the intent to manage flood risk to village on higher ground.
16.4	Morfa Dinlle	MR	MR	NAI	Develop management to self sustaining dune frontage. This would not specifically preclude management of the local area at Fort Belan subject to normal approvals.
16.5	Foryd Bay	HTL	MR	NAI	Manage flood defence initially with the intention of returning the bay to a naturally functioning system.
16.6	Traeth Abermenai	NAI	NAI	NAI	This would include further examination of potential flood risk to Dwyran, with the intent to provide defence.
16.7	Abermenai Spit and Traeth Llanddwyn	NAI	NAI	NAI	Removal of forestry would allow width for coastal adjustment.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Maintain existing defences. Develop adaptation planning.
Medium term	Maintain defences while moving towards adaptive management.
Long term	Adapt defence to Dinas Dinlle.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

The most significant change is in moving to managed realignment within the Morfa Dinlle and Foryd Bay areas.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	115.6	208.4	731.4	1,055.4
Preferred Plan Damages	91.9	160.2	379.0	631.0
Benefits	23.7	48.3	352.4	424.3
Costs	0.0	478.9	387.7	866.6

FLOOD AND EROSION RISK MANAGEMENT

POTENTIAL LOSS

There is likely to be loss of 3 properties over the medium to long term and increased risk of flooding and a need for adaption to some 35 properties.

BENEFITS OF THE PLAN

The plan provides a longer term sustainable approach to defence. Part of Dinas Dinlle would continue to be protected, protecting some 6 properties. The plan would provide opportunity for adaption allowing reduced risk over the short to medium term to some 35 properties.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 16				
SEA Objective	Impact of Preferred Policy for each Epoch			
	1	2	3	Mitigation
Policy Units 16.1 to 16.33				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				Appropriate design
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				Realignment of coastal roads (PU 16.11/16.25)
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				Relocation of properties
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				Relocation
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				Relocation of trout farm (PU 16.1) and air field (PU 16.4)

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Anticipated Habitat Loss in PDZ 16 as a result of SMP Policy

Designated Site	PU	Habitat Type	Extent of Loss of Habitat (ha)			
			Epoch 1	Epoch 2	Epoch 3	Total
Menai Strait and Conwy Bay SAC	16.5	Intertidal sandflat	0.65			0.65

Afon Gwyrfai a Llyn Cwellyn SAC: **no adverse effect on the integrity of the SAC.**

Y Twyni o Abermenai I Aberffraw/ Abermenai to Aberffraw Dunes SAC: **no adverse effect on the integrity of the SAC.**

Glannau Môn: Cors heli / Anglesey Coast: Saltmarsh SAC: It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (mudflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC: It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (sandflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

Preventative/mitigation measures: Potentially move defences landward were feasible to allow mudflats and sandflats to roll back in time with sea level rise.

Risks/Assumptions: The habitat loss is considered precautionary, and where any works are to be undertaken detailed study would provide an accurate identification of whether habitat would be lost and the extent. Potentially, given the worst case assumptions, further detail of the likely actions and site specific study may conclude no habitat loss, given the worst case scenario used in this assessment. The areas of potential habitat loss are relatively large, and this is exacerbated by the fact that such low lying areas would show a large scale change, but this does not take into account accretion of sediments within the area would influence the development of intertidal sandflat and saltmarsh. Consequently, the assumptions used to determine loss are expected to have resulted in much greater extents of habitat loss than would occur.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	Environmental Objectives met?				WFD Summary Statement required?	Achievement of Any South East RBMP Mitigation Measures?	Details on how the specific South East RBMP Mitigation Measures have been attained (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	WFD2	WFD3	WFD4			
Caernarfon Bay South (Coastal – C6) (PDZ 15 and part 16) (MAN 39, 40 and part 41)	N/A	x (PDZ 16)	x (PDZ 16)	✓	Yes – Environmental Objectives WFD2 and WFD3 may not be met because of the SMPs policy in PDZ16 (MAN 41).	There were no relevant measures to the SMP2 for this water body.	N/A
Caernarfon Bay North (Coastal – C7) (PDZ part 16, part 17 and part 18) (MAN part 41, part 48, 49, part 50 and part 53)	N/A	✓	✓	✓	No - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	There were no relevant measures to the SMP2 for this water body.	N/A
Menai Strait (Coastal – C8) (PDZ part 16, part 17 and part 20) (MAN part 41, 42, 43, 44, 45, 46, 47 and 59)	N/A	✓	✓	✓	No - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	Yes (partly) – One of the three relevant mitigation measures for this water body has been implemented, which then provides potential for one of the other measures to	<ul style="list-style-type: none"> • Managed realignment of flood defence - MR within the following policies: PU 16.4, 16.5, 16.11, 16.17 will allow the coastline to be more sustainable and adaptive to sea level rise. • Removal of hard bank reinforcement - could be implemented as part of the MR. • Modify structure or reclamation.

Water body (and relevant PDZ)	Environmental Objectives met?				WFD Summary Statement required?	Achievement of Any South East RBMP Mitigation Measures?	Details on how the specific South East RBMP Mitigation Measures have been attained (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	WFD2	WFD3	WFD4			
						be put in place.	
Foryd Bay (Transitional) (PDZ part 16) (MAN part 41)	N/A	✓	✓	✓	No - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	There were no relevant measures to the SMP2 for this water body.	N/A

Water body (including the PUs that affect it)	WFD Checklist	Summary Statement	A brief description of decision making and reference to further documentation within the SMP
Caernarfon Bay South (Coastal – C6) PU16.1 (WFD 2 & 3)	Mitigation measures: have all practicable mitigation measures been incorporated into the preferred SMP policies that affect this water body in order to mitigate the adverse impacts on the status of the water body? If not, then list mitigation measures that could be required.		RBMP mitigation measures incorporated into SMP policies: <ul style="list-style-type: none"> There were no mitigation measures in the Western Wales RBMP for this Coastal Water Body. Other potential mitigation measures that could be required: <ul style="list-style-type: none"> Undertake consultation with key stakeholders (i.e. Environment Agency Wales, fish farm owners and Sewage Works owners) to advise that the defences will not be held and that there will be imminent implications for the integrity of the both the sewage works and fish farm at Pontllyfni, with detrimental effects on both the adjacent FWB and TraC water bodies if there were to be saline inundation. Determine the extent of pollution if the fish farm and sewage works were to flood and who would be responsible.
	Other issues: Can it be shown that there are no other over-riding issues that should be considered (e.g. designated sites, recommendations of the Appropriate Assessment)?		There are no Natura 2000 sites or SSSIs within this section of the SMP, or in the adjacent policy units.

Location reference:	Malltraeth and Cefni
Management Area reference:	M.A. 42
Policy Development Zone:	PDZ16

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:

The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of “With Present Management” and under the “Draft Preferred Policy” being put forward through the Shoreline Management Plan.

-  In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.
- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

-  With Present Management.
-  Draft Preferred Policy.

Flood Risk Zones

-  General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency’s web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.
-  Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.
-  Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.



SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

The intent of the plan would be to continue to maintain the defence to the Cefni Valley, reducing flood risk to the village. Consideration should be given to realignment and water level management within the Cefni Valley.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of impacts. It will be important to relate this to national monitoring of sea level rise and more general climate change and monitoring of habitat change..

ACTIONS:

ACTION	PARTNERS
Shoreline monitoring	Ynys Mon Council
Habitat Monitoring	CCW

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		Policy Plan			Comment
		2025	2055	2105	
16.8	Newborough Forest	NAI	NAI	NAI	Removal of forestry to allow width for coastal adjustment
16.9	Embankment and village	HTL	HTL	HTL	Local consideration for adaption to the front defence to the village with sea level rise.
16.10	Bodowen Cliffs	NAI	NAI	NAI	
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Maintain existing defences. Address safety issues at Abereiddi and develop realignment approach. Develop adaptation planning. Develop funding plan.
Medium term	Maintain defences while moving towards adaptive management.
Long term	Implement community based adaptation.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

No significant change.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	383.6	1,130.7	1,447.4	2,961.7
Preferred Plan Damages	199.1	202.1	312.5	713.7
Benefits	184.5	928.6	1,134.8	2,248.0
Costs	0.0	452.3	0.0	452.3

FLOOD AND EROSION RISK MANAGEMENT

POTENTIAL LOSS

There may be loss of 4 properties in the long term due to flooding or erosion at the village.

BENEFITS OF THE PLAN

The plan provides a longer term sustainable approach to defence of the Cefni Valley providing important flood defence to critical transport routes in addition to reducing flood risk to over 100 properties.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 16				
SEA Objective	Impact of Preferred Policy for each Epoch			
	1	2	3	Mitigation
Policy Units 16.1 to 16.33				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				Appropriate design
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				Realignment of coastal roads (PU 16.11/16.25)
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				Relocation of properties
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				Relocation
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				Relocation of trout farm (PU 16.1) and air field (PU 16.4)

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Anticipated Habitat Loss in PDZ 16 as a result of SMP Policy

Designated Site	PU	Habitat Type	Extent of Loss of Habitat (ha)			
			Epoch 1	Epoch 2	Epoch 3	Total
Glannau Môn: Cors heli / Anglesey Coast: Saltmarsh SAC	16.9	Intertidal mudflat	0.17	3.30	3.65	7.11

Afon Gwyrfai a Llyn Cwellyn SAC: no adverse effect on the integrity of the SAC.

Y Twyni o Abermenai I Aberffraw/ Abermenai to Aberffraw Dunes SAC: no adverse effect on the integrity of the SAC.

*Glannau Môn: Cors heli / Anglesey Coast: Saltmarsh SAC: It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (mudflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.*

Preventative/mitigation measures: Potentially move defences landward were feasible to allow mudflats and sandflats to roll back in time with sea level rise.

Risks/Assumptions: The habitat loss is considered precautionary, and where any works are to be undertaken detailed study would provide an accurate identification of whether habitat would be lost and the extent. Potentially, given the worst case assumptions, further detail of the likely actions and site specific study may conclude no habitat loss, given the worst case scenario used in this assessment. The areas of potential habitat loss are relatively large, and this is exacerbated by the fact that such low lying areas would show a large scale change, but this does not take into account accretion of sediments within the area would influence the development of intertidal sandflat and saltmarsh. Consequently, the assumptions used to determine loss are expected to have resulted in much greater extents of habitat loss than would occur.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	Environmental Objectives met?				WFD Summary Statement required?	Achievement of Any South East RBMP Mitigation Measures?	Details on how the specific South East RBMP Mitigation Measures have been attained (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	WFD2	WFD3	WFD4			
Menai Strait (Coastal – C8) (PDZ part 16, part 17 and part 20) (MAN part 41, 42, 43, 44, 45, 46, 47 and 59)	N/A	✓	✓	✓	No - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	Yes (partly) – One of the three relevant mitigation measures for this water body has been implemented, which then provides potential for one of the other measures to be put in place.	<ul style="list-style-type: none"> • Managed realignment of flood defence - MR within the following policies: PU 16.4, 16.5, 16.11, 16.17 will allow the coastline to be more sustainable and adaptive to sea level rise. • Removal of hard bank reinforcement - could be implemented as part of the MR. • Modify structure or reclamation.
Cefni (Transitional) (PDZ part 16) (MAN 42)	N/A	x (PDZ 16)	x (PDZ 16)	✓	Yes – Environmental Objectives WFD2 and 3 may not be met because of the SMP policy in PDZ16 (MAN 42).	None of the relevant mitigation measures have been able to be implemented by the SMP2.	<ul style="list-style-type: none"> • Retain marginal and riparian habitat. • Managed realignment of flood defence. • Increase in-channel morphological diversity.

Water body (including the PUs that affect it)	WFD Summary Statement checklist	A brief description of decision making and reference to further documentation within the SMP
Cefni (Transitional – T15) PU 16.9 (WFD 2 and 3)	Mitigation measures: have all practicable mitigation measures been incorporated into the preferred SMP policies that affect this water body in order to mitigate the adverse impacts on the status of the water body? If not, then list	RBMP mitigation measures incorporated into SMP policies: <ul style="list-style-type: none"> • This TraC Water Body is classified as being heavily modified because of flood protection, and there are a number of potential mitigation measures that will aid in improving the Ecological Potential; these are to retain marginal and riparian habitat; managed realignment of flood defence; and increase in-channel morphological diversity. However, none of these mitigation measures have been achieved. Even though the remaining estuary is to be allowed to adapt naturally with sea level rise and roll back, there were previously no defences and so nothing has

Water body (including the PUs that affect it)	WFD Summary	Statement	A brief description of decision making and reference to further documentation within the SMP
	mitigation measures that could be required.		<p>changed. The flood defence along the embankment will continue with poor in-channel morphological diversity along the River Cefni landward of the embankment.</p> <p>Other potential mitigation measures that could be required:</p> <ul style="list-style-type: none"> Investigation into the possibilities of adapting the channel of the River Cefni so it reduces fluvial flooding in the long term with combined sluice management, so as to retain and improve the marginal and riparian habitats around the embankment at Malltraeth – this may be more the responsibility of the CFMP than the SMP2. Undertake a study to investigate the MR options and options to raise the road and rail so that the estuary can be opened up and adapt more naturally in the long term, this could be considered for the next SMP.
	Affect on other Water Bodies: can it be demonstrated that the preferred SMP policies do not permanently exclude or compromise the achievement of the objectives of the Directive in Water Bodies within the same River Basin District that are outside of the SMP2 area?		<p>The Environment Agency Flood Map application, Groundwater maps and the Western Wales RBMP have been consulted to check for landward freshwater and groundwater bodies that potentially could be impacted by SMP2 policies.</p> <p>There is one freshwater river that flows into this estuary, the River Cefni, which has been assessed within the Assessment Table 4. It has been concluded that the SMP2 policies within this management unit have the potential to compromise the Environmental Objectives of the WFD, by preventing GEP being achieved. Particularly, since the downstream end near the mouth of the river will continue to be constrained within a straight channel and the flow into the estuary managed through sluices; this gives little opportunity to improve the marginal aquatic and riparian habitats or the geomorphology of the channel. It is considered unlikely that the Ynys Mon (Anglesey) Minor GWB will be impacted as a result of the SMP2 policies because there is no current evidence of saline intrusion.</p>
	Other issues: Can it be shown that there are no other over-riding issues that should be considered (e.g. designated sites, recommendations of the Appropriate Assessment)?		<p>This TraC Water Body includes part of the Anglesey Coast: Saltmarsh SAC. There are also two SSSIs, the first is Newborough Warren – Ynys Llanddwyn SSSI within the main part of the estuary, which is designated primarily for its large sand-dune and estuarine systems that control the physical influences of the dunes. The second is Malltraeth Marsh SSSI on the landward side of the stone pitched embankment and sluice, which is designated primarily for its breeding bird community of lowland damp grassland and wet meadows. NAI or MR would impinge on the quality of the habitats within the Malltraeth Marsh SSSI, resulting in more saline habitats such as saltmarsh and mudflats. The Habitats Regulations Assessment concluded that though there will be an alteration in the extent</p>

Water body (including the PUs that affect it)	WFD checklist	Summary	Statement	A brief description of decision making and reference to further documentation within the SMP
				of different estuary habitats, the overall balance within the estuary will be maintained, though there will be an adverse effect on the integrity of the intertidal mudflats within the Anglesey Coast Saltmarsh SAC with the HTL policy in PU16.9.

Location reference:	Inner Western Section of the Menai Strait
Management Area reference:	M.A. 43
Policy Development Zone:	PDZ16

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:

The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of “With Present Management” and under the “Draft Preferred Policy” being put forward through the Shoreline Management Plan.

-  In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.
- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

-  With Present Management.
-  Draft Preferred Policy.

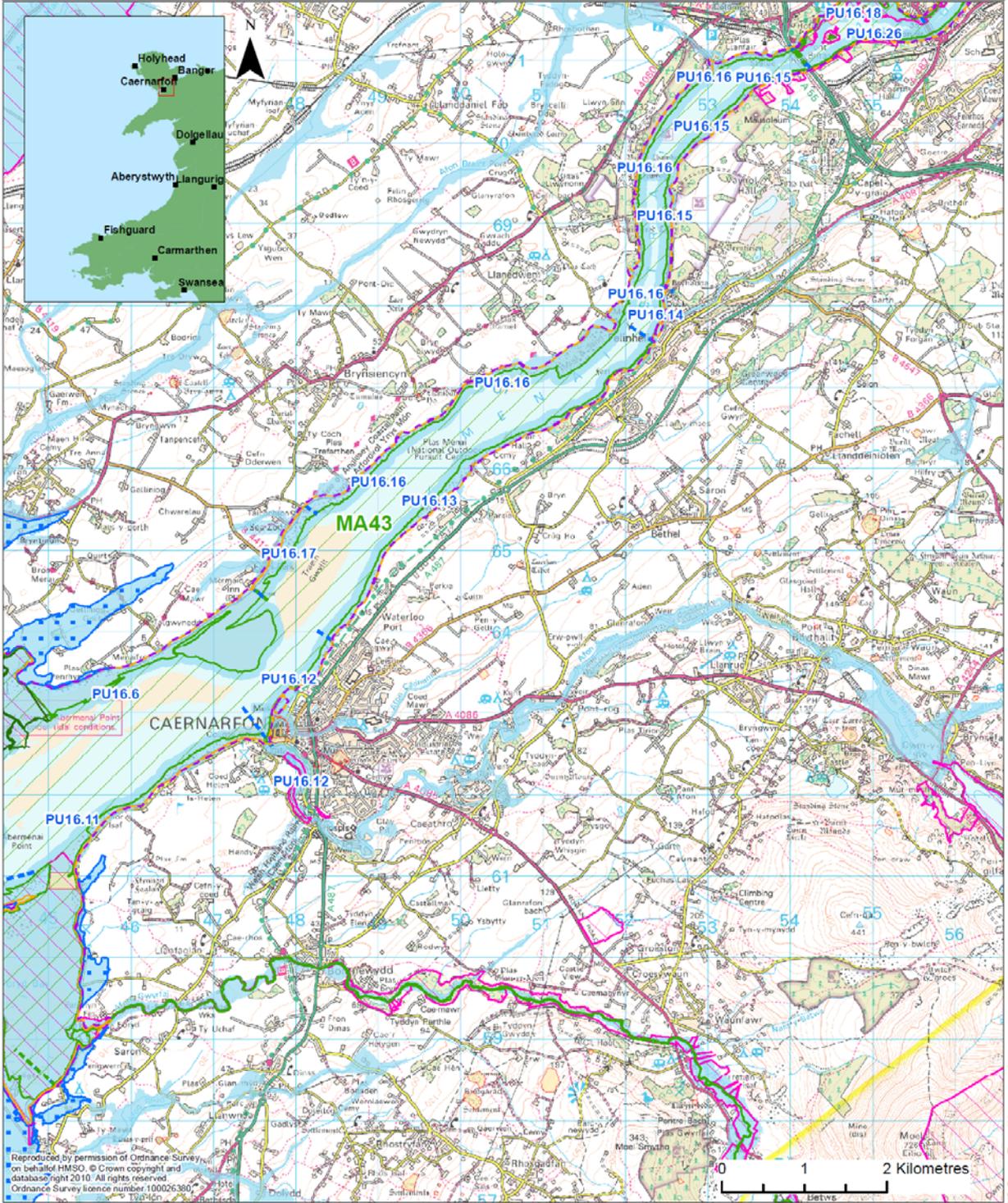
Flood Risk Zones

-  General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency’s web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.
-  Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.
-  Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.

**Shoreline Management Plan Sub Cell 10
Baseline Location Map
Management Area 43**

- Management Area
- Policy Unit
- Policy Development Zone
- Scheduled Monument



Key	
--- 100 Year Shoreline Position:	 Ramsar
--- Preferred Policy would be the same as With Present Management	 SAC
--- With Present Management where this differs from the Preferred Policy	 SPA
--- Preferred Policy where this differs from the With Present Management	 SSSI
	 NNR
	 Existing Indicative EA Flood Zone 3
	 EA Flood Risk Zone 2 where under the SMP policy there would be increased probability of flooding



SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

The aim of the plan is to maintain defence to the main settlements of Caernarfon and Y Felinheli. In other areas the plan would encourage and support adaptation over the three epochs as to allow more natural functioning of the shoreline while reducing the risk to assets. At Caernarfon there will be increased risk of tidal locking in the rivers and this needs to be considered in more detail, with planning of development and flood resilience measures. At y Felinheli the need to raise the new flood defences will need to be reviewed in the longer term.

Around the headland between Foryd Bay and Caernarfon, local defence to the road would be maintained over epochs 1 and 2, subject to highway funding, to maintain access and defence to properties. In epoch 3 the need to extend defences combined with sea level rise is likely to make sustaining the defences not an option. Between Caernarfon and Y Felinheli the policy would be for No Active Intervention, although subject to normal approvals, private funding of defence might not be precluded. There is a potential issue of contaminated land along this frontage within the flood plain. This needs to be examined further but with the intent to address this problem without increasing the need for flood defence.

Along the northern side of the Straits there are local defences principally associated with the road. Although these defences might be maintained in the short to medium term, subject to highway funding, defence is unlikely to continue through epoch 2 and over epoch 3. Alternative access would need to be considered to sustain the use of property.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of the proposed changes and impacts. There is a need for a detailed planned response to change. It will be important to relate this to national monitoring of sea level rise and more general climate change.

Where defence is associated with roads along the shoreline, funding would typically be linked with the defence of the highway. To improve defence to properties in these areas there may be need for joint funding.

ACTIONS:

ACTION	PARTNERS
Adaption planning <ul style="list-style-type: none">▪ Fford Y Aber▪ Barras	GC Communities EA
Assess in detail potential impact on historic environment	CADW
Examine opportunity for habitat creation	GC CCW
	Ynys Mon Council Highways

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		Policy Plan			Comment
		2025	2055	2105	
16.11	Ffordd Yr Aber to Afon Carrog.	HTL	HTL	MR	Subject to highway funding, with future adaption of property and access.
16.12	Caernarfon	HTL	HTL	HTL	Review the need for raising defence, co-ordinated with fluvial flood management.
16.13	Waterloo Port to Glan y Mor -Y Felinheli	NAI	NAI	NAI	This would not preclude local management through private funding subject to normal approvals.
16.14	Y Felinheli	HTL	HTL	HTL	Review flood risk with sea level rise.
16.15	Glan-y-mor Lodge to Bridge	NAI	NAI	NAI	
16.16	Bridge to Barras	NAI	NAI	NAI	
16.17	Barras to Mermaid Inn	HTL	MR	NAI	Intent to maintain access but with future need for adaptation to increased flood risk.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Maintain existing defences. Address safety issues at Aberiddi and develop realignment approach. Develop adaptation planning. Develop funding plan.
Medium term	Maintain defences while moving towards adaptive management.
Long term	Implement community based adaptation.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

No significant change.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	189.8	1,278.0	1,119.7	2,587.4
Preferred Plan Damages	129.2	174.2	279.4	582.8
Benefits	60.6	1,103.8	840.3	2,004.6
Costs	15.7	153.6	434.2	603.5

FLOOD AND EROSION RISK MANAGEMENT

POTENTIAL LOSS

Potentially 4 properties might be lost due to erosion in the long term. There would be significant residual risk of flooding throughout the area and this needs to be considered in future development and in management of tidal locking of the rivers. There could be increased flood risk to property along the north bank of the Menai Straits and to the eastern side of Foryd Bay.

BENEFITS OF THE PLAN

The plan provides a longer term sustainable approach to defence to the main communities and allows time for adaption generally throughout the area. The plan would provide continued erosion protection to nearly 100 properties and continued reduction in flood risk to some 150 properties.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 16				
SEA Objective	Impact of Preferred Policy for each Epoch			
	1	2	3	Mitigation
Policy Units 16.1 to 16.33				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				Appropriate design
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				Realignment of coastal roads (PU 16.11/16.25)
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				Relocation of properties
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				Relocation
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				Relocation of trout farm (PU 16.1) and air field (PU 16.4)

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Anticipated Habitat Loss in PDZ 16 as a result of SMP Policy

Designated Site	PU	Habitat Type	Extent of Loss of Habitat (ha)			
			Epoch 1	Epoch 2	Epoch 3	Total
Menai Strait and Conwy Bay SAC	16.11	Intertidal sandflat	0.53	3.47		4.00

Afon Gwyrfai a Llyn Cwellyn SAC: **no adverse effect on the integrity of the SAC.**

Y Twyni o Abermenai I Aberffraw/ Abermenai to Aberffraw Dunes SAC: **no adverse effect on the integrity of the SAC.**

Glannau Môn: Cors heli / Anglesey Coast: Saltmarsh SAC: It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (mudflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC: It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (sandflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

Preventative/mitigation measures: Potentially move defences landward were feasible to allow mudflats and sandflats to roll back in time with sea level rise.

Risks/Assumptions: The habitat loss is considered precautionary, and where any works are to be undertaken detailed study would provide an accurate identification of whether habitat would be lost and the extent. Potentially, given the worst case assumptions, further detail of the likely actions and site specific study may conclude no habitat loss, given the worst case scenario used in this assessment. The areas of potential habitat loss are relatively large, and this is exacerbated by the fact that such low lying areas would show a large scale change, but this does not take into account accretion of sediments within the area would influence the development of intertidal sandflat and saltmarsh. Consequently, the assumptions used to determine loss are expected to have resulted in much greater extents of habitat loss than would occur.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	Environmental Objectives met?				WFD Summary Statement required?	Achievement of Any South East RBMP Mitigation Measures?	Details on how the specific South East RBMP Mitigation Measures have been attained (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	WFD2	WFD3	WFD4			
Menai Strait (Coastal – C8) (PDZ part 16, part 17 and part 20) (MAN part 41, 42, 43, 44, 45, 46, 47 and 59)	N/A	✓	✓	✓	No - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.	Yes (partly) – One of the three relevant mitigation measures for this water body has been implemented, which then provides potential for one of the other measures to be put in place.	<ul style="list-style-type: none"> • Managed realignment of flood defence - MR within the following policies: PU 16.4, 16.5, 16.11, 16.17 will allow the coastline to be more sustainable and adaptive to sea level rise. • Removal of hard bank reinforcement - could be implemented as part of the MR. • Modify structure or reclamation.
Seiont (Transitional) (PDZ part 16) (MAN part 43)	N/A	x (PDZ 16)	✓	✓	Yes – Environmental Objective WFD2 may not be met because of the SMP policy in PDZ16 (MAN 43).	There were no relevant measures to the SMP2 for this water body.	N/A

Water body (including the PUs that affect it)	WFD Summary Statement checklist	A brief description of decision making and reference to further documentation within the SMP
Seiont (Transitional – T15) PU 16.11 & 16.12 (part) (WFD 2)	Mitigation measures: have all practicable mitigation measures been incorporated into the preferred SMP policies that affect this water body in order to mitigate the adverse impacts on the status of the water body? If not, then list	RBMP mitigation measures incorporated into SMP policies: <ul style="list-style-type: none"> • There were no mitigation measures in the Western Wales RBMP for this Transitional Water Body. Other potential mitigation measures that could be required: <ul style="list-style-type: none"> • Undertake a study to investigate ways of reducing tidal locking and subsequent fluvial flooding of the River Cadnant and Seiont-lower that flow into the Seiont Estuary. • Investigation into the implications of a MR along the west river bank of the estuary for the Afon

Water body (including the PUs that affect it)	WFD Summary Statement	A brief description of decision making and reference to further documentation within the SMP
	mitigation measures that could be required.	Seiont SSSI.
	Affect on other Water Bodies: can it be demonstrated that the preferred SMP policies do not permanently exclude or compromise the achievement of the objectives of the Directive in Water Bodies within the same River Basin District that are outside of the SMP2 area?	The Environment Agency Flood Map application, Groundwater maps and the Western Wales RBMP have been consulted to check for landward freshwater and groundwater bodies that potentially could be impacted by SMP2 policies. There are four freshwater rivers that flow into this estuary, all of which have been assessed within Assessment Table 3. There will be increased saline intrusion upstream of these rivers as a result of sea level rise and the containment of the estuary, with the potential to modify the BQEs from more freshwater to transitional. However, it has been concluded that the SMP2 policies within this management unit will not compromise the Environmental Objectives of the WFD, by preventing GES/GEP being achieved. The estuary also borders the Menai Strait Coastal Water Body and it was considered that the HTL policy within this estuary is unlikely to affect its Ecological Potential. Furthermore, it is considered unlikely that the Llyn and Eryri GWB will be impacted as a result of the SMP2 policies, both because there is no current evidence of saline intrusion, and because the HTL policy is preventing the saline intrusion of contaminated areas (e.g. sewage works, disused tip and industrial estate)
	Other issues: Can it be shown that there are no other over-riding issues that should be considered (e.g. designated sites, recommendations of the Appropriate Assessment)?	This water body includes part of the Menai Strait and Conwy Bay SAC up to the Aber Bridge at the entrance to the estuary. The Habitats Regulations Assessment deemed that there will be some loss of intertidal sandflats within PU 16.11 as a result of coastal squeeze against the defences with sea level rise. This combined with other losses along the Menai Strait will result in an adverse effect on the integrity of the SAC. There is also the Afon Seiont SSSI, which covers the estuary from Slate Quay to where the railway passes over the River Seiont south of the sewage works. The SSSI is designated for strata which are exposed in the west river bank (cliff), rather than for biological reasons. Any MR along this west bank may result in the loss of some of this strata with exposure further back.

Location reference:	South Eastern Shore to Ynys Mon
Management Area reference:	M.A. 44
Policy Development Zone:	PDZ16

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:

The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of “With Present Management” and under the “Draft Preferred Policy” being put forward through the Shoreline Management Plan.

-  In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.
- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

-  With Present Management.
-  Draft Preferred Policy.

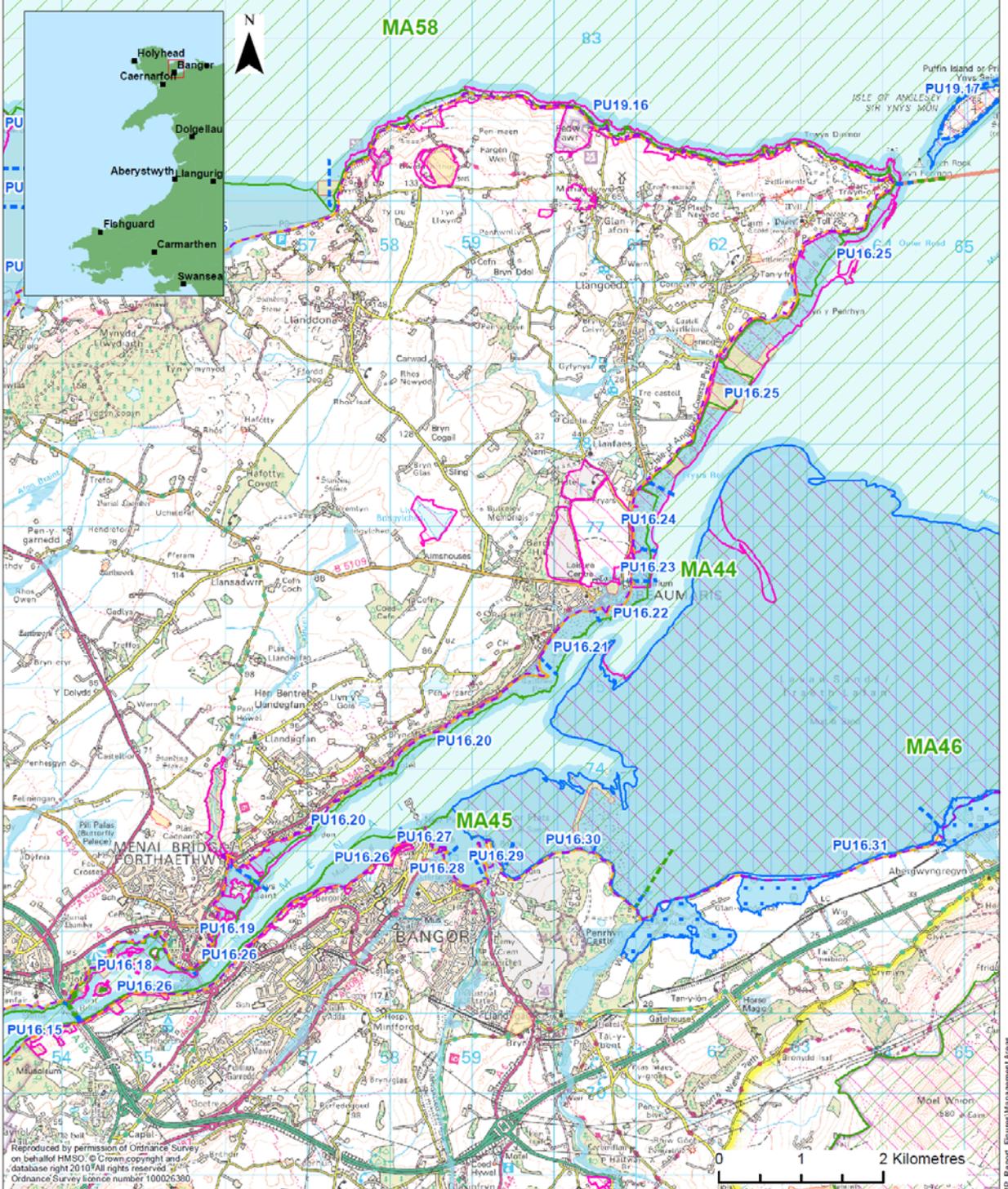
Flood Risk Zones

-  General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency’s web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.
-  Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.
-  Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.

**Shoreline Management Plan Sub Cell 10
Baseline Location Map
Management Area 44 & 45**

- Management Area
- Policy Unit
- Policy Development Zone
- Scheduled Monument



Key

— 100 Year Shoreline Position:	 Ramsar	 Existing Indicative EA Flood Zone 3
— Preferred Policy would be the same as With Present Management	 SAC	 EA Flood Risk Zone 2 where under the SMP policy there would be increased probability of flooding
— With Present Management where this differs from the Preferred Policy	 SPA	
— Preferred Policy where this differs from the With Present Management	 SSSI	
	 NNR	



SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

The intent of the plan is to maintain defence to the settlements along this section of coast and to sustain the main access roads. However, there are several sections where there are private defences and areas, particularly at Beaumaris, that will be under significant risk of flooding with sea level rise. As such the SMP identifies the potential need for change in approach to defence in the longer term.

Between the two bridges, on the northern side of the Strait, the intent would be to not manage existing private flood defences. This would have to be considered in more detail to look at the opportunity for setting back local defences.

Along the main Porthaethwy waterfront, the intent would be to maintain and support private maintenance of defences in manner both sympathetic to the character of the waterfront but also, where possible, to allow further development of shoreline habitat through local realignment. The main goal would be to reduce flood risk to the centre of the town. Further east, the plan would not preclude management of existing private defences subject to normal approval procedures.

The above approach would be also applied to Gallows Point, although it is recognised that there may be some land fill issues in this area. The Point is considered significant in terms of influencing coastal processes and, therefore, any private development at Gallows Point would need to consider the impact on defence management along adjacent frontages. Such development might be taken forward in such a manner that it might have a beneficial influence on shoreline management at Beaumaris. This would need to be considered.

At Beaumaris, the intent of the plan is to sustain the defences in such a manner as to reduce flood risk and protect property from erosion. As sea level rises, one strong potential option would be to make use of the Green to landscape flood defence within this important amenity area. The approach to defence needs to be considered in more detail generally. There are opportunities for local realignment that could result in a more sustainable defence. There might also be more significant changes that could be made in terms of opening up the entrance to the Nant y Felin as a means of retaining more sediment. Associated with such change would be the need to examine access to the town and maintaining access to the more recent development at Cae Mair. This would require long term integrated planning going beyond merely flood defence.

The intent of the plan would be to continue to defend the road along the Llanfaes frontage, However, beyond Llanfaes the approach would be more to allow the natural functioning of the shoreline. This might include looking at realignment of the road, which in places is already under pressure from erosion. The plan would not preclude local management of defences, but very much within this broader intent to restore the natural behaviour of the shoreline and subject to normal approvals.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of possible change and of the impacts. There is however a need for a detailed planned response to change considered sooner rather than later. It will be important to relate this to national monitoring of sea level rise and more general climate change and to monitoring of habitat change.

Generally there is strong economic argument for continued management of defences. However, if change is to be managed in such a manner as to enhance the coastal use of the area, there would be a need to identify potential collaborative funding sources.

ACTIONS:

ACTION	PARTNERS
Shoreline monitoring	Ynys Mon Council (YMC)
Adaption planning to the east of Llanfaes	YMC Communities Highways
Long term co-ordinated spatial planning at Beaumaris	YMC Community Highways EA
Assess in detail potential impact on historic environment	CADW
Examine local opportunity for habitat creation	YMC CCW

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		Policy Plan			
		2025	2055	2105	Comment
16.18	Llanfair Bay	NAI	NAI	NAI	
16.19	Porthaethwy	HTL	HTL	HTL	Local management to defences to maintain historic frontage.
16.20	Pont Cadnant to Gallows point	NAI	NAI	NAI	This would not preclude private works subject to normal approvals.
16.21	Beaumaris West	HTL	HTL	MR	Maintain defence but with the potential opportunity for realignment.
16.22	Beaumaris East	HTL	HTL	MR	Adapt defences to improve defence with the intent of using the width of the Green to landscape flood defence.
16.23	Drumlin	NAI	NAI	NAI	
16.24	Llanfaes	HTL	HTL	HTL	Maintain local access road.
16.25	Llanfaes to Penmon	NAI	NAI	NAI	Potential need to realign road.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Maintain existing defences. Develop adaptation planning.
Medium term	Maintain defences while moving towards adaptive management.
Long term	Implement adaptation management.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

In general terms there is no substantial change from SMP 1. The onus has been placed more clearly on private individuals for defence in specific areas, subject to normal approvals. While defence to Beaumaris would continue the plan identifies the potential opportunities for undertaking this more sustainably.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	2,033.9	2,016.6	7,320.3	11,370.8
Preferred Plan Damages	435.7	511.2	955.2	1,902.1
Benefits	1,598.2	1,505.5	6,365.1	9,468.7
Costs	6.3	1,241.7	393.0	1,641.0

FLOOD AND EROSION RISK MANAGEMENT

POTENTIAL LOSS

There could be loss of upto 20 properties in the area over the long term due to erosion. There would continue to be significant residual risk of flooding in areas such as Beaumaris with sea level rise.

BENEFITS OF THE PLAN

The plan provides a longer term sustainable approach to defence, maintaining defence to the core community areas. The plan would provide protection to nearly 60 properties and would reduce flood risk to some 270 properties. Some 90 of these could be at a risk of flooding under a 1:10 year water level. The plan provides the opportunity to improve this standard of defence.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 16

SEA Objective	Impact of Preferred Policy for each Epoch			
	1	2	3	Mitigation
Policy Units 16.1 to 16.33				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				Appropriate design
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				Realignment of coastal roads (PU 16.11/16.25)
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				Relocation of properties
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				Relocation
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				Relocation of trout farm (PU 16.1) and air field (PU 16.4)

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC: It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (sandflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

Preventative/mitigation measures: Potentially move defences landward were feasible to allow mudflats and sandflats to roll back in time with sea level rise.

Risks/Assumptions: The habitat loss is considered precautionary, and where any works are to be undertaken detailed study would provide an accurate identification of whether habitat would be lost and the extent. Potentially, given the worst case assumptions, further detail of the likely actions and site specific study may conclude no habitat loss, given the worst case scenario used in this assessment. The areas of potential habitat loss are relatively large, and this is exacerbated by the fact that such low lying areas would show a large scale change, but this does not take into account accretion of sediments within the area would influence the development of intertidal sandflat and saltmarsh. Consequently, the assumptions used to determine loss are expected to have resulted in much greater extents of habitat loss than would occur.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	Environmental Objectives met?				WFD Summary Statement required?	Achievement of Any South East RBMP Mitigation Measures?	Details on how the specific South East RBMP Mitigation Measures have been attained (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	WFD2	WFD3	WFD4			
<p>Menai Strait (Coastal – C8)</p> <p>(PDZ part 16, part 17 and part 20) (MAN part 41, 42, 43, 44, 45, 46, 47 and 59)</p>	N/A	✓	✓	✓	<p>No - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.</p>	<p>Yes (partly) – One of the three relevant mitigation measures for this water body has been implemented, which then provides potential for one of the other measures to be put in place.</p>	<ul style="list-style-type: none"> • Managed realignment of flood defence - MR within the following policies: PU 16.4, 16.5, 16.11, 16.17 will allow the coastline to be more sustainable and adaptive to sea level rise. • Removal of hard bank reinforcement - could be implemented as part of the MR. • Modify structure or reclamation.

Location reference:	Bangor
Management Area reference:	M.A. 45
Policy Development Zone:	PDZ16

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:

The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of “With Present Management” and under the “Draft Preferred Policy” being put forward through the Shoreline Management Plan.

-  In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.
- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

-  With Present Management.
-  Draft Preferred Policy.

Flood Risk Zones

 General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency’s web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.

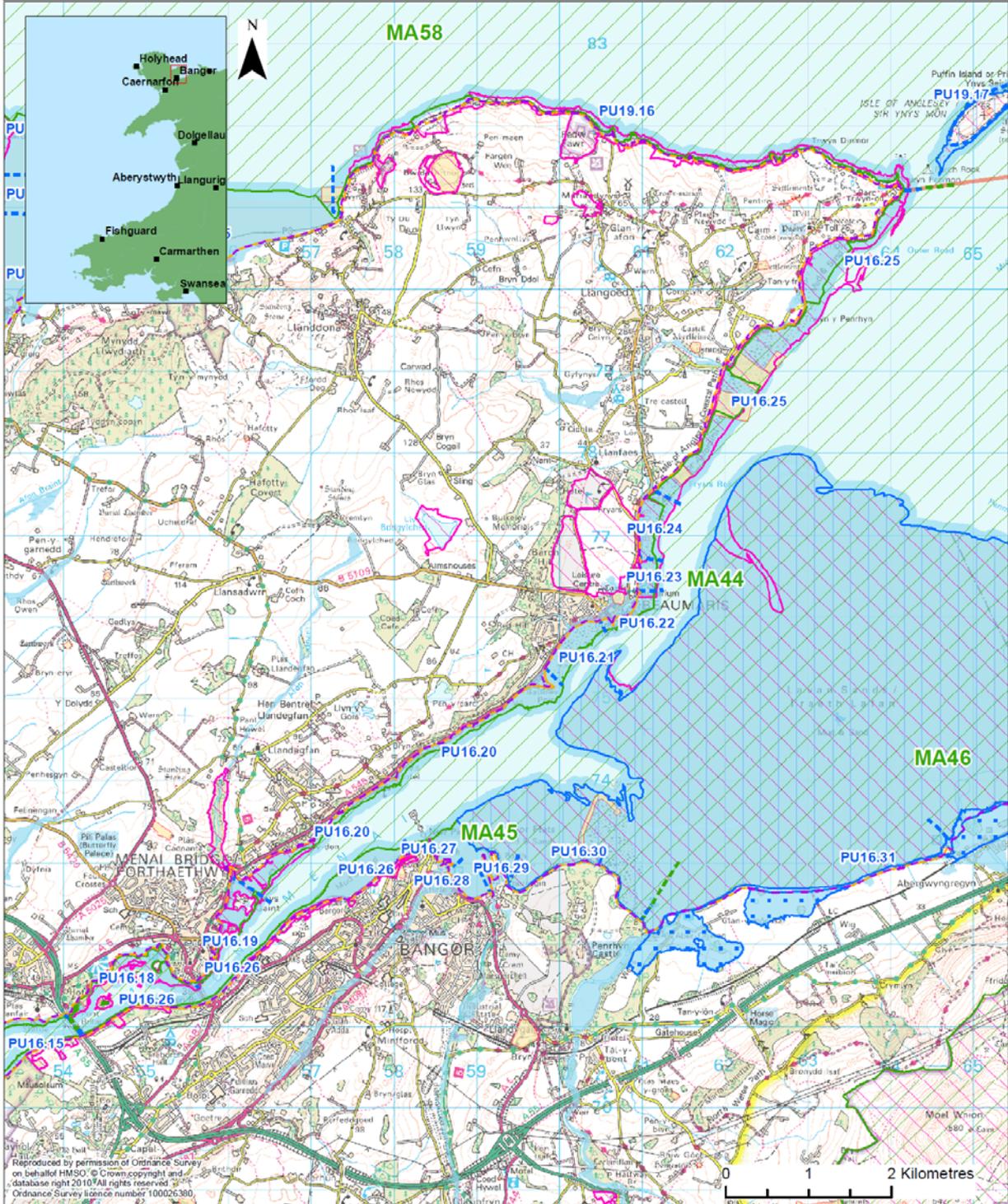
 Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.

 Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.

**Shoreline Management Plan Sub Cell 10
Baseline Location Map
Management Area 44 & 45**

- Management Area
- Policy Unit
- Policy Development Zone
- Scheduled Monument



<p>Key</p> <ul style="list-style-type: none"> — 100 Year Shoreline Position: — Preferred Policy would be the same as With Present Management — With Present Management where this differs from the Preferred Policy — Preferred Policy where this differs from the With Present Management 	<ul style="list-style-type: none"> Ramsar SAC SPA SSSI NNR 	<ul style="list-style-type: none"> Existing Indicative EA Flood Zone 3 EA Flood Risk Zone 2 where under the SMP policy there would be increased probability of flooding 	
--	--	--	--

SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

The aim of the plan is to continue manage the flood defence at Bangor. However, in the Hirael area there would be significant increase in flood risk with sea level rise and the intent recommends long term planning for realignment and redevelopment of the low lying basin to provide a more secure future for development of this waterfront area.

As such, the policies for the built up area around Garth is for Holding the Line, while along the Hirael frontage it would be for Hold the Line over the short to medium term and then Managed Realignment. This would need early discussion with residents and other interested organisations, so that opportunities and mechanism for change could be established.

At Porth Penrhyn, the intent of the plan would be for continued defence but this would need to be through collaborative funding.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of the proposed changes. There is also a need for a detailed planned response to change. It will be important to relate this to national monitoring of sea level rise and more general climate change.

The policy for MR at Hirael needs to be considered in consultation with the community and in terms of future planning of land use within the area.

ACTIONS:

ACTION	PARTNERS
Adaption planning at Hirael	GC Community EA Highways
Assess in detail potential impact on historic environment	CADW
Examine potential habitat creation within proposed realignment area.	GC CCW

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		Policy Plan			Comment
		2025	2055	2105	
16.26	Bridge to Garth	NAI	NAI	NAI	
16.27	Garth Point and Dock Yard	HTL	HTL	HTL	
16.28	Hirael	HTL	HTL	MR	Consider options for re-development and flood proofing.
16.29	Porth Penrhyn	HTL	HTL	HTL	Subject to alternative funding.
16.30	Penrhyn Headland	NAI	NAI	NAI	
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Maintain existing defences. Develop adaptation planning. Develop funding plan.
Medium term	Maintain defences while moving towards adaptive management.
Long term	Implement plans for realignment and development.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

The principal change would be at Hiraël where the long term policy changes to Managed Realignment.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	952.9	1,788.4	3,826.3	6,567.6
Preferred Plan Damages	442.1	501.1	3,272.0	4,215.1
Benefits	510.8	1,287.3	554.3	2,352.4
Costs	0.0	245.6	190.8	436.4

FLOOD AND EROSION RISK MANAGEMENT

POTENTIAL LOSS

Potentially there could be loss of 1 property due to erosion. Clearly there would be significant change with respect to possibly some 250 properties in the Hiraël area. This would need to be a planned change, reducing flood risk.

BENEFITS OF THE PLAN

The plan proposes a longer term sustainable approach to defence. Some 27 properties would benefit from protection against erosion. Over 300 properties are at risk from flooding. These properties would benefit from reduced risk over the short to medium term, and potentially into epoch 3. With planned realignment the risk of significant damage would be avoided should the defence standard of defences have been exceeded.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 16				
SEA Objective	Impact of Preferred Policy for each Epoch			
	1	2	3	Mitigation
Policy Units 16.1 to 16.33				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				Appropriate design
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				Realignment of coastal roads (PU 16.11/16.25)
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				Relocation of properties
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				Relocation
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				Relocation of trout farm (PU 16.1) and air field (PU 16.4)

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC: It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (sandflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

It is concluded that there would be no adverse effect for this specific area.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	Environmental Objectives met?				WFD Summary Statement required?	Achievement of Any South East RBMP Mitigation Measures?	Details on how the specific South East RBMP Mitigation Measures have been attained (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	WFD2	WFD3	WFD4			
<p>Menai Strait (Coastal – C8)</p> <p>(PDZ part 16, part 17 and part 20) (MAN part 41, 42, 43, 44, 45, 46, 47 and 59)</p>	N/A	✓	✓	✓	<p>No - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.</p>	<p>Yes (partly) – One of the three relevant mitigation measures for this water body has been implemented, which then provides potential for one of the other measures to be put in place.</p>	<ul style="list-style-type: none"> • Managed realignment of flood defence - MR within the following policies: PU 16.4, 16.5, 16.11, 16.17 will allow the coastline to be more sustainable and adaptive to sea level rise. • Removal of hard bank reinforcement - could be implemented as part of the MR. • Modify structure or reclamation.

Location reference:	Traeth Lafan and Llanfairfechan
Management Area reference:	M.A. 46
Policy Development Zone:	PDZ16

* Note: Predicted shoreline mapping is based on a combination of monitoring data, analysis of historical maps and geomorphological assessment with allowance for sea level rise. Due to inherent uncertainties in predicting future change, these predictions are necessarily indicative. For use beyond the purpose of the shoreline management plan, reference should be made to the baseline data.

The following descriptions are provided to assist interpretation of the map shown overleaf.

100 year shoreline position:

The following maps aim to summarise the anticipated position of the shoreline in 100 years under the two scenarios of “With Present Management” and under the “Draft Preferred Policy” being put forward through the Shoreline Management Plan.

-  In some areas the preferred policy does not change from that under the existing management approach. In some areas where there are hard defences this can be accurately identified. In other areas there is greater uncertainty. Even so, where the shoreline is likely to be quite clearly defined by a change such as the crest of a cliff the estimated position is shown as a single line.
- Where there is a difference between With Present Management and the Draft Preferred Policy this distinction is made in showing two different lines:

-  With Present Management.
-  Draft Preferred Policy.

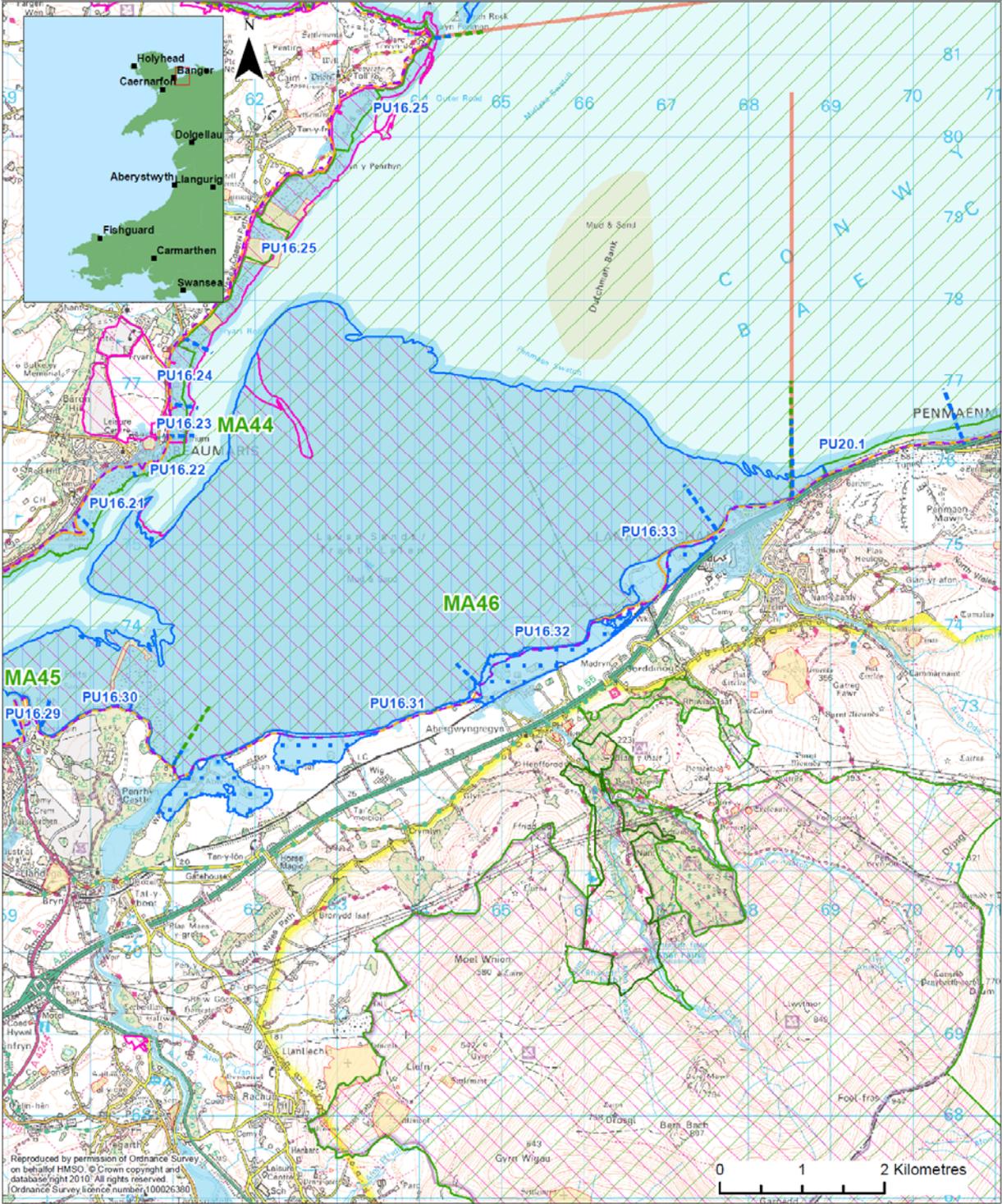
Flood Risk Zones

-  General Flood Risk Zones. The explanation of these zones is provided on the Environment Agency’s web site www.environment-agency.gov.uk. The maps within this Draft SMP document show where SMP policy might influence the management of flood risk.
-  Indicate areas where the intent of the SMP draft policy is to continue to manage this risk.
-  Indicate where over the 100 years the policy would allow increased risk of flooding.

The maps should be read in conjunction with the text within the Draft SMP document.

**Shoreline Management Plan Sub Cell 10
Baseline Location Map
Management Area 46**

- Management Area
- Policy Unit
- Policy Development Zone
- Scheduled Monument



<p>Key</p> <ul style="list-style-type: none"> — 100 Year Shoreline Position: — Preferred Policy would be the same as With Present Management — With Present Management where this differs from the Preferred Policy — Preferred Policy where this differs from the With Present Management 	<ul style="list-style-type: none"> Ramsar SAC SPA SSSI NNR 	<ul style="list-style-type: none"> Existing Indicative EA Flood Zone 3 EA Flood Risk Zone 2 where under the SMP policy there would be increased probability of flooding
---	--	--



I:\9T9001\Technical_Docs\GIS\Project\SMP_Report_Figures\Management Areas

SUMMARY OF PREFERRED PLAN RECOMMENDATIONS AND JUSTIFICATION

INTENT OF THE PLAN:

The underpinning intent of the plan is to allow the natural development of the shoreline over much of the frontage. There would be increasing flood risk to properties in the long term with sea level rise. It is uncertain whether this could be managed by local resilience measures and it is anticipated properties may be lost. This will need to be reassessed as improved information on sea level rise is collated.

The main risks in the area are at Afon Aber, at Llanfairfechan and to the area immediately to the west. This also links through to risk to the A55 and the railway. The intent of the plan is to sustain the main transport links but with the aim to realign defences in the Afon Aber area to achieve this.

At Llanfairfechan, the intent is to continue to manage the frontage, sustain the seafront of the town and provide protection to the transport routes behind. With sea level rise, the CFMP has identified increased risk of tidal locking and has recommended looking at improvement to fluvial defence in the area. At the coast, the intent of the SMP would be to maintain defence in the short to medium term but with a longer term intent to look at realignment of the actual defence line to provide a more sustainable management approach in the future.

KEY ISSUES/RISK AND UNCERTAINTY:

There are uncertainties in terms of timing of the proposed changes. There is also a need for a detailed planned response to change. It will be important to relate this to national monitoring of sea level rise and more general climate change.

There would need to be discussion with the local communities with respect to potential realignment and continued defence in the area is likely to require collaborative funding.

ACTIONS:

ACTION	PARTNERS	
Shoreline monitoring	GC	CC
Adaption planning	GC	CC
<ul style="list-style-type: none"> • Afon Aber • Llanfairfechan 	Communities	Highways
	CCW	EA
Assess in detail potential impact on historic environment	CADW	
Examine possible habitat creation opportunities	EA	CCW

DELIVERY OF THE PLAN

SUMMARY OF SPECIFIC POLICIES

Policy Unit		Policy Plan			Comment
		2025	2055	2105	
16.31	Afon Ogwen to Madryn	NAI	NAI	NAI	
16.32	Afon Aber	MR	MR	HTL	Adapt defences to maintain natural sediment drift with long term intent to protect transport route from potential flooding.
16.33	Llanfairfechan	HTL	HTL	MR	Maintain defences with long term aim to adjust to a more favourable alignment.
Key: HTL - Hold the Line, A - Advance the Line, NAI – No Active Intervention MR – Managed Realignment					

PREFERRED POLICY TO IMPLEMENT PLAN:	
From present day	Maintain existing defences. Develop integrated approach between fluvial and future coastal flood management. Develop adaptation planning. Develop funding plan.
Medium term	Maintain defences while moving towards adaptive management.
Long term	Implement adaptation plan.

IMPLICATIONS OF THE PLAN

CHANGES FROM PRESENT MANAGEMENT

There is no substantial change in management for this area.

ECONOMIC SUMMARY

Economics (£k PV)	by 2025	by 2055	by 2105	Total £k PV
NAI Damages	78.0	215.0	254.8	547.8
Preferred Plan Damages	38.6	57.4	135.0	230.9
Benefits	39.4	157.7	119.8	316.9
Costs	0.0	1,532.8	312.7	1,845.6

FLOOD AND EROSION RISK MANAGEMENT

POTENTIAL LOSS

There is the potential loss of property due to both long term flooding and erosion.

BENEFITS OF THE PLAN

The plan provides a longer term sustainable approach to defence, maintaining defence to the core community areas and to the main transport network. The plan would reduce flood risk to 40 properties but would also reduce flood risk from wave overtopping along the sea front at Llanfairfechan. This overtopping risk and the risk to the main transport routes are not evaluated in the SMP economic analysis.

SUMMARY OF STRATEGIC ENVIRONMENTAL ASSESSMENT (INCLUDING HRA)

PDZ 16				
SEA Objective	Impact of Preferred Policy for each Epoch			
	1	2	3	Mitigation
Policy Units 16.1 to 16.33				
To support natural processes, maintain and enhance the integrity of internationally designated nature conservation sites. Maintain / achieve favourable condition of their interest features (habitats and species).				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated nature conservation sites. Maintain/achieve favourable condition.				Habitat creation
To avoid adverse impacts on, conserve and where practical enhance national and local BAP habitats.				Habitat creation
To support natural processes and maintain geological exposures throughout nationally designated geological sites.				
To conserve and enhance nationally designated landscapes in relation to risks from coastal flooding and erosion and avoid conflict with AONB and National Park Management Plan Objectives.				Appropriate design
To minimise coastal flood and erosion risk to scheduled and other internationally and nationally important cultural heritage assets, sites and their setting.				Excavation and recording
To minimise the impact of policies on marine operations and activities.				
To minimise coastal flood and erosion risk to critical infrastructure and maintain critical services.				Realignment of coastal roads (PU 16.11/16.25)
To minimise coastal flood and erosion risk to agricultural land and horticultural activities.				
To minimise coastal flood and erosion risk to people and residential property.				Relocation of properties
To minimise coastal flood and erosion risk to key community, recreational and amenity facilities.				Relocation
To minimise coastal flood and erosion risk to industrial, commercial, economic and tourism assets and activities.				Relocation of trout farm (PU 16.1) and air field (PU 16.4)

This table provides a summary of the SEA (appendix E) and reference should be made to the Appendix for full details of the assessment.

These next two sections provide a headline summary of the findings of the HRA (Appendix G) and the WFA (Appendix H). Reference should be made as appropriate to these Appendices for full details.

HRA SUMMARY

Anticipated Habitat Loss in PDZ 16 as a result of SMP Policy

Designated Site	PU	Habitat Type	Extent of Loss of Habitat (ha)			
			Epoch 1	Epoch 2	Epoch 3	Total
Menai Strait and Conwy Bay SAC	16.33	Intertidal sandflat	0.03	0.40		0.43

Y Fenai a Bae Conwy/ Menai Strait and Conwy Bay SAC: It is concluded that there would be an **adverse effect on the integrity** of the intertidal habitat (sandflat) within the boundary of the SAC as a result of the SMP2 policies. There will however, be **no adverse effect on the integrity** of the other SAC features.

Traeth Lafan / Lavan Sands, Conwy Bay SPA: It is concluded that there would be an **adverse effect on the integrity** of the populations of the qualifying interests (due to the reduction in the extent of supporting habitat that is predicted) within the boundary of the SPA as a result of the SMP2 policies.

Preventative/mitigation measures: Potentially move defences landward where feasible to allow mudflats and sandflats to roll back in time with sea level rise.

Risks/Assumptions: The habitat loss is considered precautionary, and where any works are to be undertaken detailed study would provide an accurate identification of whether habitat would be lost and the extent. Potentially, given the worst case assumptions, further detail of the likely actions and site specific study may conclude no habitat loss, given the worst case scenario used in this assessment. The areas of potential habitat loss are relatively large, and this is exacerbated by the fact that such low lying areas would show a large scale change, but this does not take into account accretion of sediments within the area would influence the development of intertidal sandflat and saltmarsh. Consequently, the assumptions used to determine loss are expected to have resulted in much greater extents of habitat loss than would occur.

SUMMARY CONCLUSION FROM THE WATER FRAMEWORK ASSESSMENT

Water body (and relevant PDZ)	Environmental Objectives met?				WFD Summary Statement required?	Achievement of Any South East RBMP Mitigation Measures?	Details on how the specific South East RBMP Mitigation Measures have been attained (dark green = achieved; light green = partly achieved & red = not achieved)
	WFD 1	WFD2	WFD3	WFD4			
<p>Menai Strait (Coastal – C8)</p> <p>(PDZ part 16, part 17 and part 20) (MAN part 41, 42, 43, 44, 45, 46, 47 and 59)</p>	N/A	✓	✓	✓	<p>No - not necessary as delivery of the WFD Environmental Objectives will not be prevented by the SMP policies and in some cases will ensure they are of benefit.</p>	<p>Yes (partly) – One of the three relevant mitigation measures for this water body has been implemented, which then provides potential for one of the other measures to be put in place.</p>	<ul style="list-style-type: none"> • Managed realignment of flood defence - MR within the following policies: PU 16.4, 16.5, 16.11, 16.17 will allow the coastline to be more sustainable and adaptive to sea level rise. • Removal of hard bank reinforcement - could be implemented as part of the MR. • Modify structure or reclamation.