

## **ANNEX 3**

### **DRAWING THE INDICATIVE BOUNDARIES FOR THE POTENTIAL SITE OPTIONS**

#### **Introduction**

Ecological principles for drawing boundaries were developed by the TAG and are described in Part 5 and Annex 2. The ecological principles were agreed as follows:

1. Sites should include a viable area of each habitat type present.
2. The shape of the site should be as compact as possible and there should be no big indentations in the site boundary shape.
3. In most instances whole habitat patches should be included, or natural features should be used to define the edges of a site.
4. Site size should be examined on a site-by-site basis.

CCW applied these ecological boundary principles to the Potential Sites and following this, the outputs were discussed by the TAG. The exception is principle 4 which was considered for each of the sites but as the ecological principle does not specify a minimum or recommended site size no changes were made to boundaries based on site size. A consistent set of steps were followed to apply the boundary principles. Practical boundary principles were not applied.

The boundaries were drawn by methodically applying the following steps:

- Step 1. The list of habitats that are present in viable patches for the Focus Site was examined and any habitats that were present in only one patch or one area were identified. The first boundary was drawn around this/these habitat(s) and a report was created using Geographical Information Software (GIS) to determine what other habitats were captured in viable amounts within this boundary (the viable habitat patch sizes are detailed in the site selection guidelines).
- Step 2. The remaining habitats were looked at to determine others that are of a limited distribution and boundaries were drawn to include them

(by including the closest patches to the Step 1 boundary). Another GIS report was created to determine which habitats were captured in viable amounts.

- Step 3 etc (iterative). This process was repeated until all of the habitats that were present in the original site list were captured.
- Final step at this stage of the process. When drawing the boundaries sequentially in this way, some habitats eventually exceeded the viability targets set. The boundary was examined to see if there was a possibility of ‘shaving off’ certain areas to reduce the size of the site, whilst maintaining enough habitat to meet viability targets. It is important to note that doing this often results in the exclusion of survey point data that support the habitat polygons. If this occurs then the confidence in that habitat presence within the site could be significantly reduced. CCW attempted to include point records where possible but this was not always achievable when trying to draw boundaries that are as small as possible. There are a number of circumstances where this has not been applied due to the variety of ways in which the site could be reduced in size. Because of this, the boundary has been left, with the amendments to be made after the consultation.

At all stages of the boundary drawing process, boundary principle 3 was followed by including whole habitat patches (for habitats other than subtidal sediments) and following natural features where feasible. Large indentations were avoided to maintain as compact a shape as possible to conform to boundary principle 2. This document shows the boundaries produced at each step of this process and also discusses the resultant boundary.

In the original Focus Sites areas of permanently modified habitat were excluded from the site, often by creating a site that contained ‘holes’ or oddly shaped excluded areas. In drawing the boundaries for the consultation this approach was not followed, as it would not be compatible with boundary principle 2 (no large indentations) or 3 (whole habitat patches). Instead, where permanently modified areas were at the edge of the site then the boundary

was drawn to exclude these areas. However, if a permanently modified area occurred in the middle of the site, with no other options for avoiding this area, then that permanently modified area has been included within the Potential Site boundary. These areas will need to be investigated further, to examine whether they are incompatible with the aims of a highly protected MCZ. Any such areas are discussed at the end of the description of the boundary drawing process for each site.

The boundaries resulting from the application of the agreed ecological principles were examined on a case by case basis to see whether the ecological value of a site could be increased. As a result a set of additional considerations, which are documented in Part 5 and Annex 2 were proposed. These additional site specific considerations have not, as yet, been agreed by the TAG but it was agreed that they could be applied at this point in the process to provide indicative boundaries for the purpose of the consultation. The extent and nature to which they will be used to determine the final site boundaries will depend upon the outcome of further consideration by the TAG, and feedback from the consultation exercise. The additional considerations are divided into ecological considerations and other scientific considerations.

The ecological considerations are:

1. Ecological quality
2. Linked habitats
3. Increasing habitat heterogeneity
4. Potential for recovery of specific localised habitats

The other scientific considerations are:

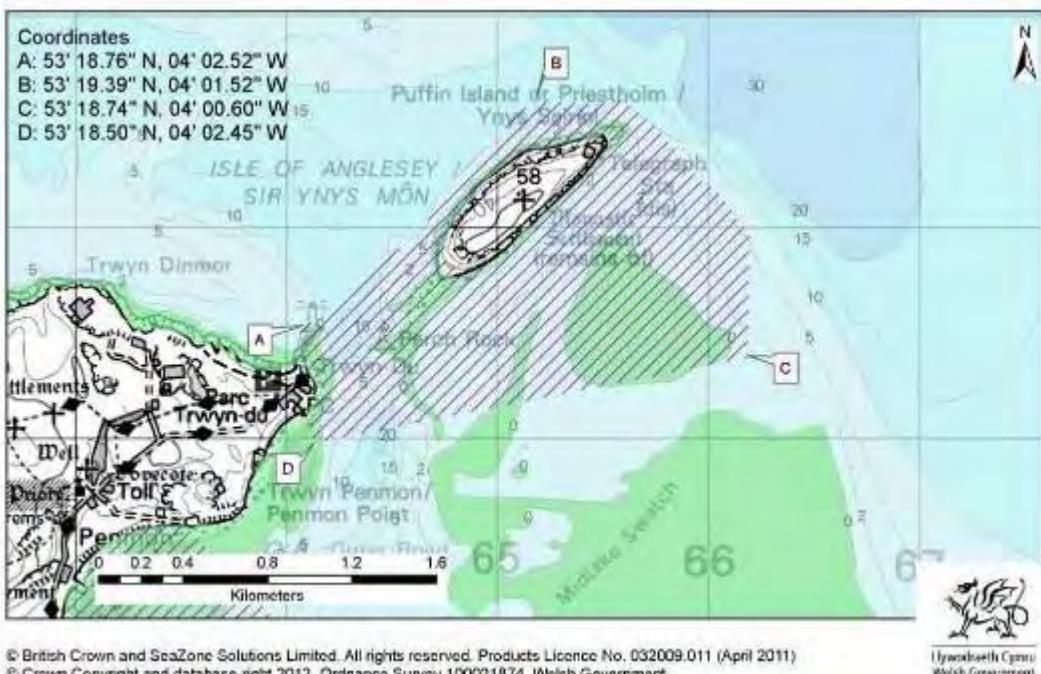
5. Areas with long term ecological datasets
6. Improving the evidence base

For more details see Annex 2.

Where the boundary resulting from the agreed ecological principles was not thought to be ecologically satisfactory, an alternative boundary based on the additional considerations above was drawn by CCW and discussed by the TAG. The steps to produce these boundaries are also discussed within this document. It is this boundary that forms the Potential Site indicative boundary for the first consultation.

## 1. Puffin Island/Ynys Seiriol

**Figure 1. Puffin Island Potential Site**



The Focus Site includes the following habitats:

- Moderate energy shallow water rock
- High energy intertidal rock
- Low energy intertidal rock
- Moderate energy intertidal rock
- Subtidal sand
- Tide swept channels
- Intertidal boulder communities
- High Productivity

### **Step 1**

Of the habitats included in the Focus Site the following habitats have only one patch of habitat within the site:

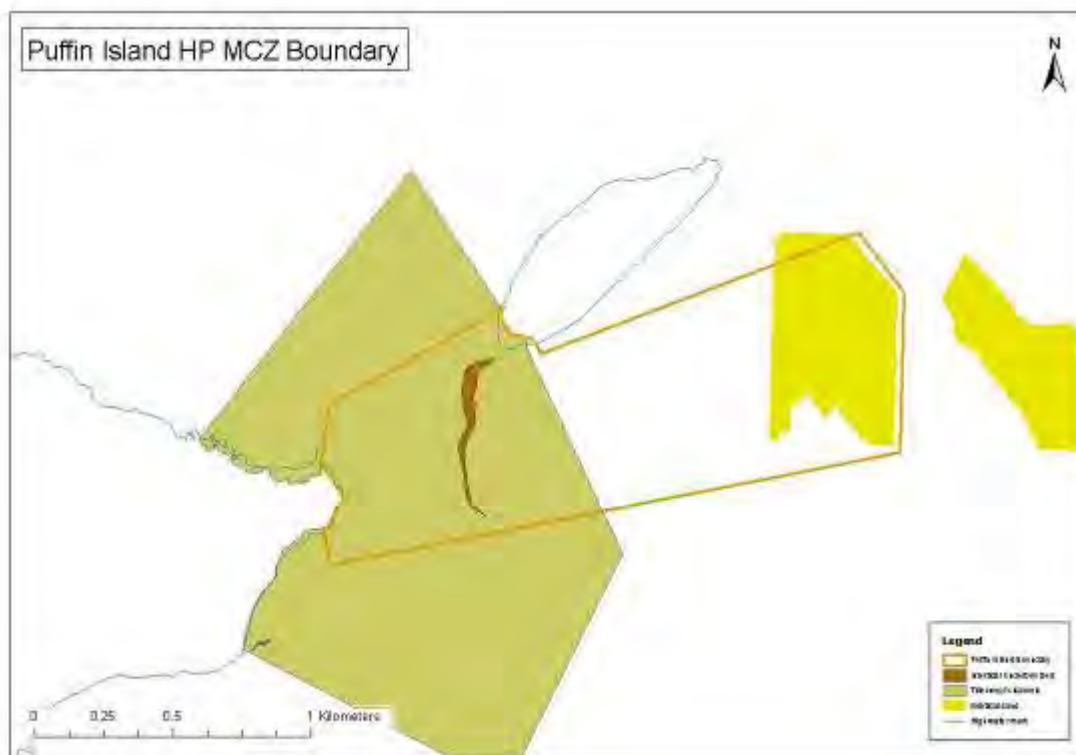
- Tide swept channels
- Intertidal boulder communities

In addition there are only two patches of subtidal sand (with data points to support them). These are shown in Figure 2.

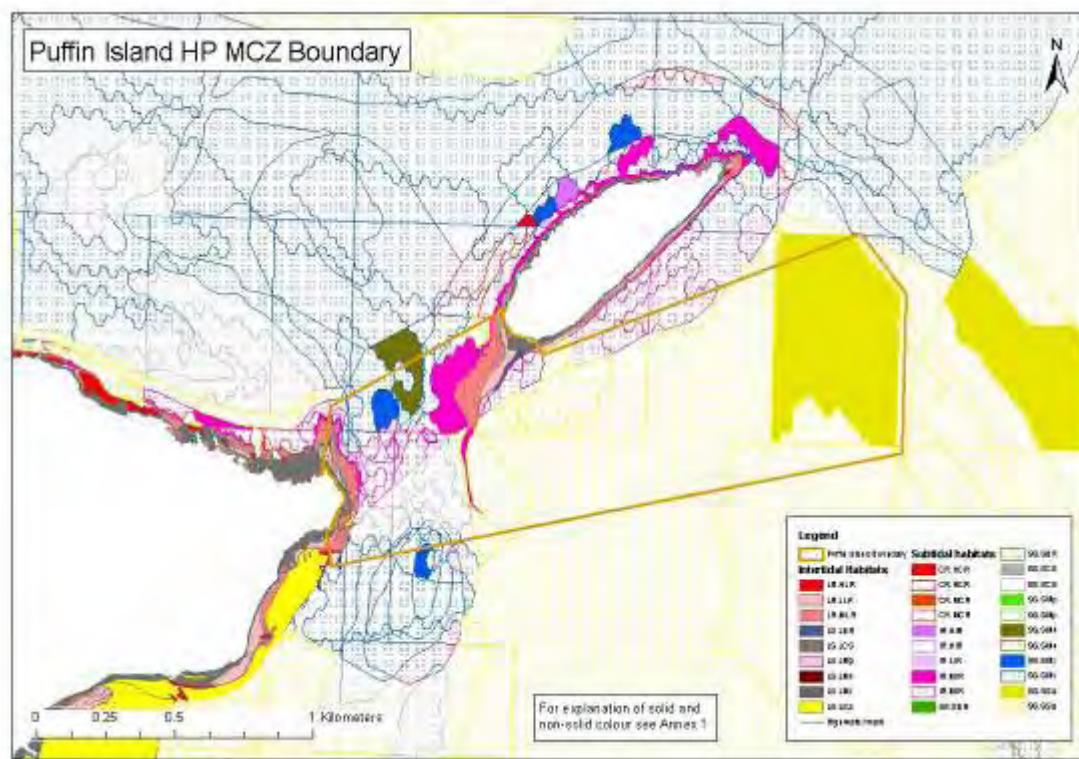
The tideswept channels habitat is defined on the original layer as quite a large area. This boundary setting exercise used a smaller area, which includes the intertidal (both sides of the channel) and the channel at its narrowest point. This is considered to be the core area of tideswept channel habitat. It is worth noting that the original hexagon(s) selected by Marxan did not include the landward intertidal area. One of the boundary principles is to include whole habitat patches, so this boundary is consistent with that approach.

Therefore an initial boundary was drawn which included the core tideswept channel area, the intertidal boulder area and most of the subtidal sand polygon closest to the former two habitats. See Figures 2 & 3.

**Figure 2. Map showing boundary at Step 1 and distribution of tide swept channels (beige / green-brown), Intertidal boulder communities (brown) and subtidal sand (yellow)**



**Figure 3. Map showing broadscale habitats captured in Step 1 (see Doc 2 to this annex for broadscale habitat codes)**



A GIS report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 1.

**Table 1. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
Moderate energy shallow water rock	0.041	0.025
Moderate energy intertidal rock	0.048	0.005
Subtidal sand	0.276	0.250
<b>Important Habitat</b>		
Intertidal boulder communities	0.015	0.002
Tide swept channels	0.583	0.250

There was also 1.494 km<sup>2</sup> of highly productive area included, which is over the target amount.

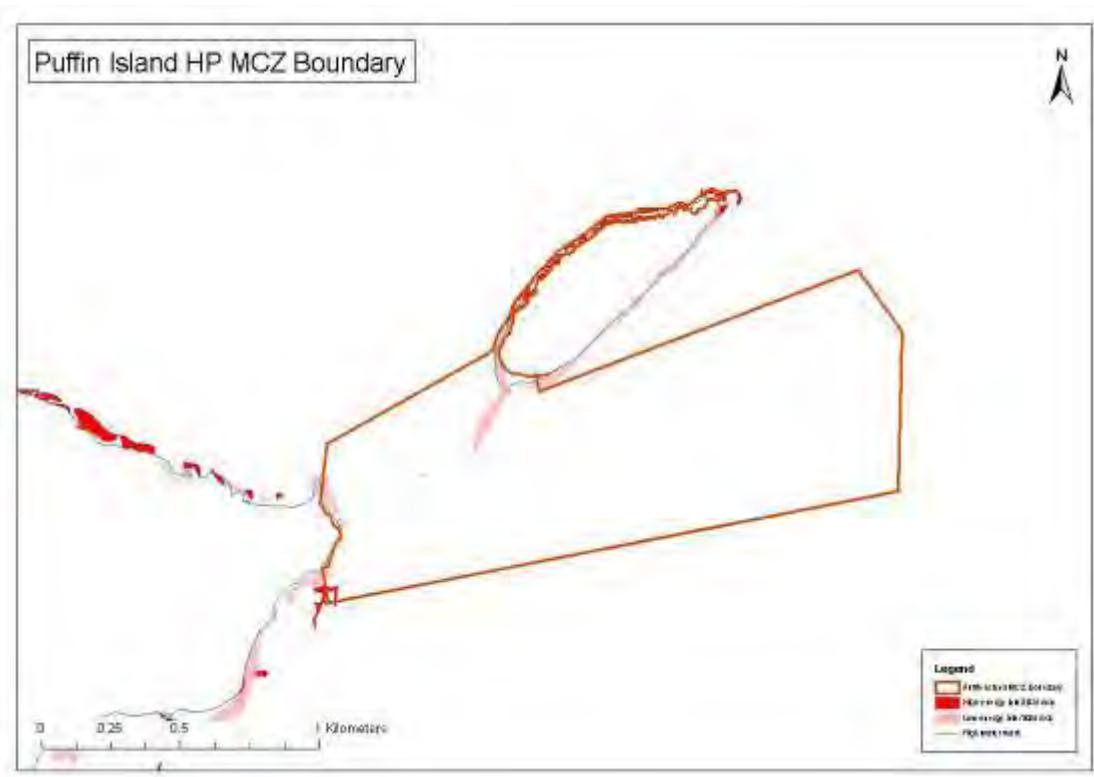
The following habitats needed to be added:

- High energy intertidal rock (needs an additional 0.005 km<sup>2</sup>)
- Low energy intertidal rock (needs an additional 0.025 km<sup>2</sup>)

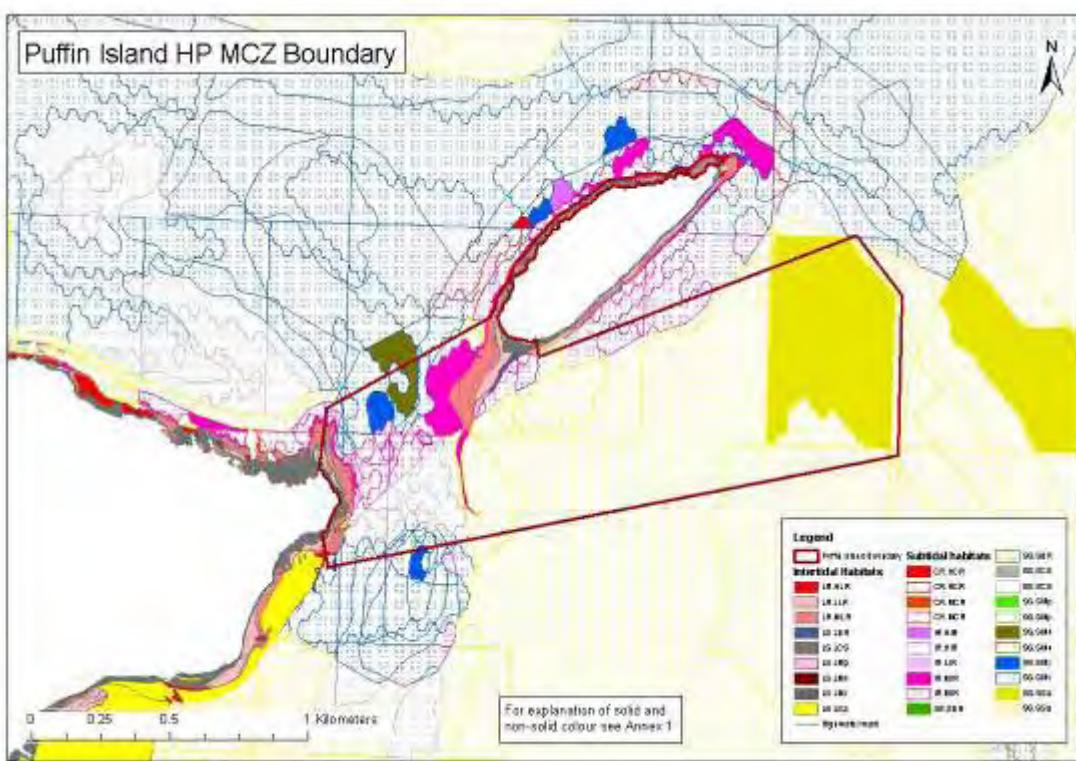
## **Step 2**

The high energy intertidal rock is mostly distributed along the north-west side of Puffin Island and therefore another boundary was drawn which includes all of this area (intertidal only). See Figures 4 & 5.

**Figure 4. Map showing boundary at Step 2 and distribution of high energy intertidal rock (dark red) and low energy intertidal rock (pale red)**



**Figure 5. Map showing broadscale habitats captured in Step 2**



A GIS report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 2.

**Table 2. Habitats with a viable patch size captured by the Step 2 boundary**

<b>Broadscale Habitat</b>	<i>Area (km<sup>2</sup>) or number of data points (pts)</i>	<i>Target area (km<sup>2</sup>)</i>
Moderate energy shallow water rock	0.046	0.025
High energy intertidal rock	0.006	0.005
Moderate energy intertidal rock	0.061	0.005
Subtidal sand	0.276	0.250
<b>Important Habitat</b>		
Intertidal boulder communities	0.015	0.002
Tide swept channels	0.583	0.250

This means that High energy intertidal rock is now sufficient.

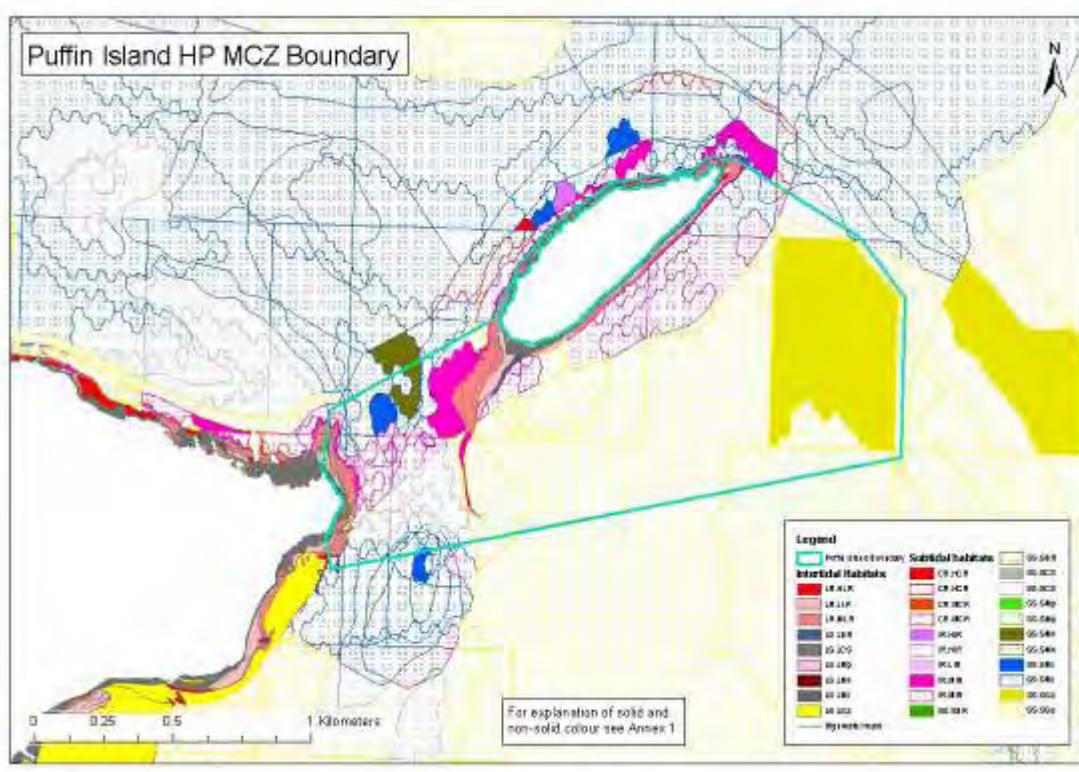
The following habitats still needed to be added:

- Low energy intertidal rock (an extra 0.008 km<sup>2</sup>)

### **Step 3**

The low energy rock is mostly along the south east side of the island (see Figure 4), so all of this area was included. If only the intertidal is included along this side of the island, it creates a large indentation and therefore the part of the boundary around the subtidal sand habitat was joined with the intertidal at the north-east tip of the island (see Figure 6). The only habitat that could be reduced in size without compromising other boundary principles is subtidal sand. However, as this would have been a relatively small change in boundary shape it has not been carried out at present.

**Figure 6. Map showing broadscale habitats captured in Step 3**



A report was run on the above boundary to see which habitats were present in viable amounts. The result is shown in Table 3.

**Table 3. Habitats with a viable patch size captured by the Step 3 boundary**

<b><i>Broadscale Habitat</i></b>	<b><i>Area (km<sup>2</sup>) or number of data points (pts)</i></b>	<b><i>Target area (km<sup>2</sup>)</i></b>
Moderate energy shallow water rock	0.047	0.025
High energy intertidal rock	0.007	0.005
Low energy intertidal rock	0.030	0.025
Moderate energy intertidal rock	0.075	0.005
Subtidal sand	0.275	0.250
<b><i>Important Habitat</i></b>		
Intertidal boulder communities	0.015	0.002
Tide swept channels	0.583	0.250

Therefore all the habitats originally listed are now present in viable amounts.

#### **Comments and additional considerations**

The site size for this boundary is **1.8 km<sup>2</sup>**.

From an ecological point of view the boundary has several disadvantages, in that it does not include the subtidal habitat along the north-west side of the island. There are several additional habitat types in this area (subtidal mixed sediments, high energy shallow water rock and high energy deeper water rock). These were not listed as component habitats of the original Focus Site, as they were not present in large enough amounts to be viable. However, this is almost certainly an artefact of the data – basically caused by not having enough data for the area. The ecological viability of the site is compromised by not including the shallow water and deeper water rock as these habitats are linked to the intertidal rock habitats.

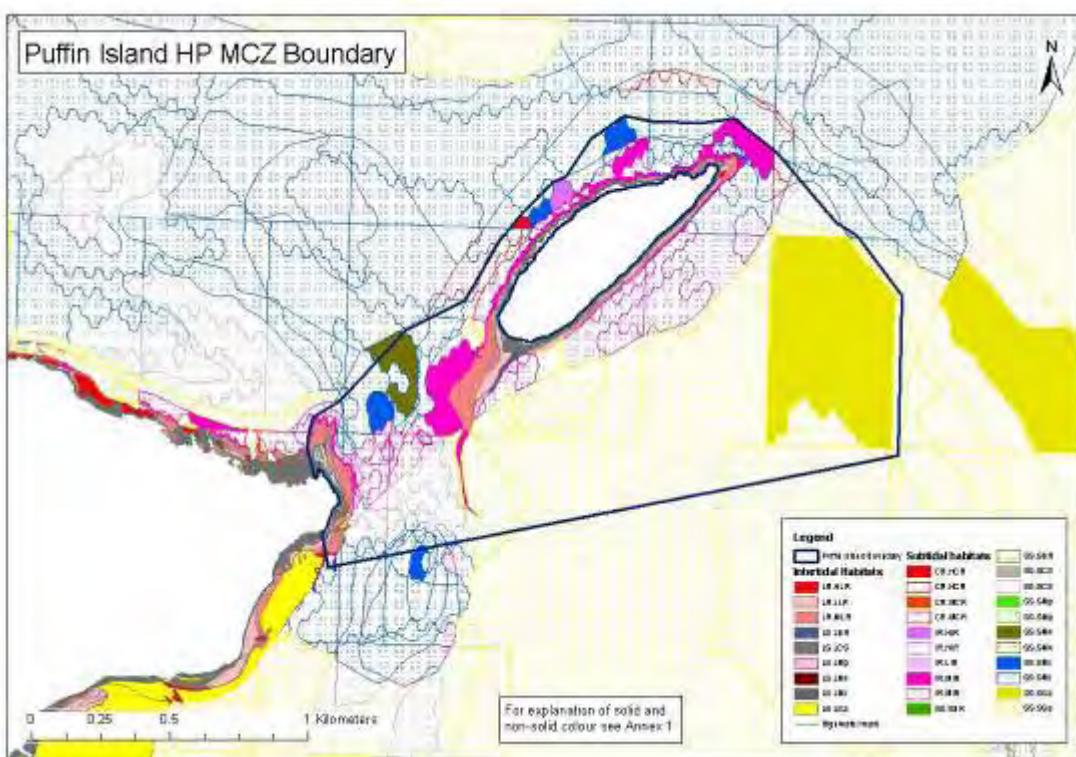
#### **Step 4 – additional considerations**

The Step 4 boundary applies the following additional considerations:

- **Linked habitats** – the new boundary includes shallow water and deep water rock that is a continuation of the intertidal rock included on the north-western side of the island.
  - **Increasing habitat heterogeneity** – the new boundary has been extended slightly to include some subtidal mixed sediment at the northern edge of the site.

See Figure 7 for the Step 4 boundary that incorporates these additional considerations.

**Figure 7. Map showing broadscale habitats captured in Step 4**



A report was run on this boundary to measure the extent of each habitat present in a viable amount. The result is shown in Table 4.

**Table 4. Habitats with a viable patch size captured by the Step 4 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or</b>	<b>Target area</b>
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	<i>number of data points (pts)</i>	<i>(km<sup>2</sup>)</i>
Moderate energy shallow water rock	0.087	0.025
High energy intertidal rock	0.007	0.005
Low energy intertidal rock	0.030	0.025
Moderate energy intertidal rock	0.075	0.005
Subtidal sand	0.292	0.250
<b><i>Important Habitat</i></b>		
Intertidal underboulder communities	0.015	0.002
Tide swept channels	0.633	0.250

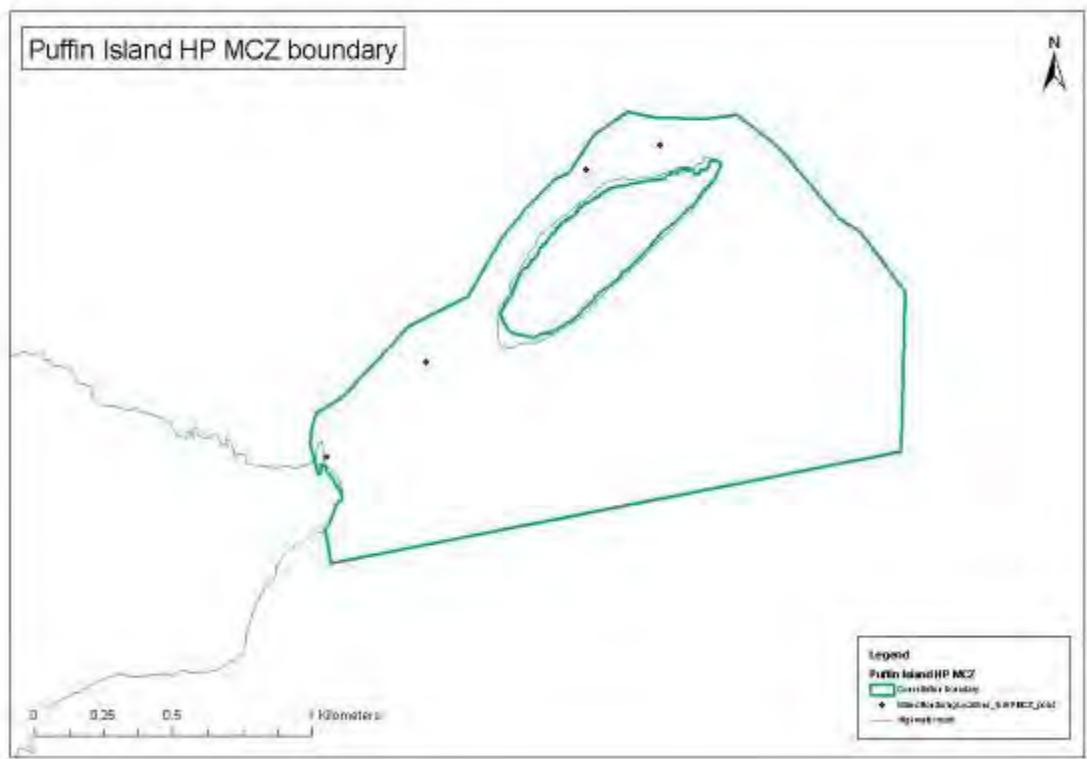
### **Step 5 – additional considerations**

At Trwyn Ddu (Penmon Point) there is a MarClim<sup>29</sup> monitoring site (Figure 8). The boundary of the site needed to be moved slightly to include this area. This also allows the whole bedrock platform in this area to be included within the site, conforming with boundary principle 3 (including whole habitat patches). The boundary is shown in Figure 9.

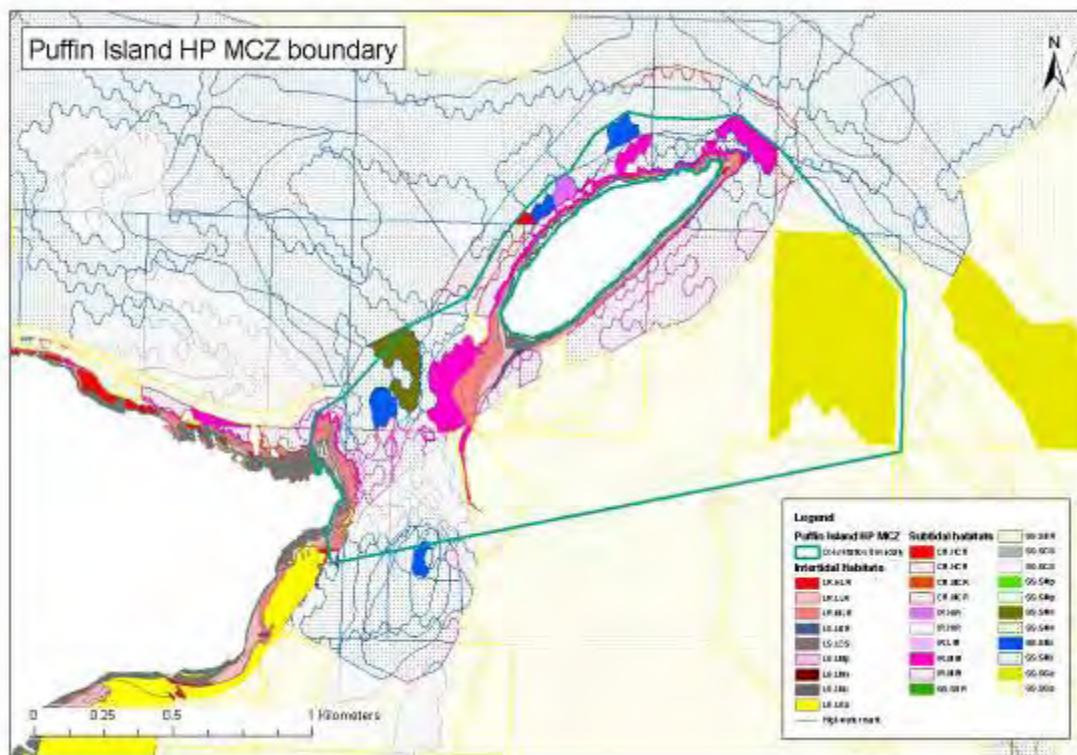
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<sup>29</sup> MarClim is a project created to investigate the effects of climatic warming on marine biodiversity. In particular the project aimed to use key intertidal species, whose abundances had been shown to fluctuate with changes in climatic conditions, as indicators of changes occurring in the intertidal and offshore

**Figure 8 Puffin Island Potential site consultation boundary showing long term ecological dataset points**



**Figure 9. Broadscale habitats captured by the Puffin Island Potential Site boundary**



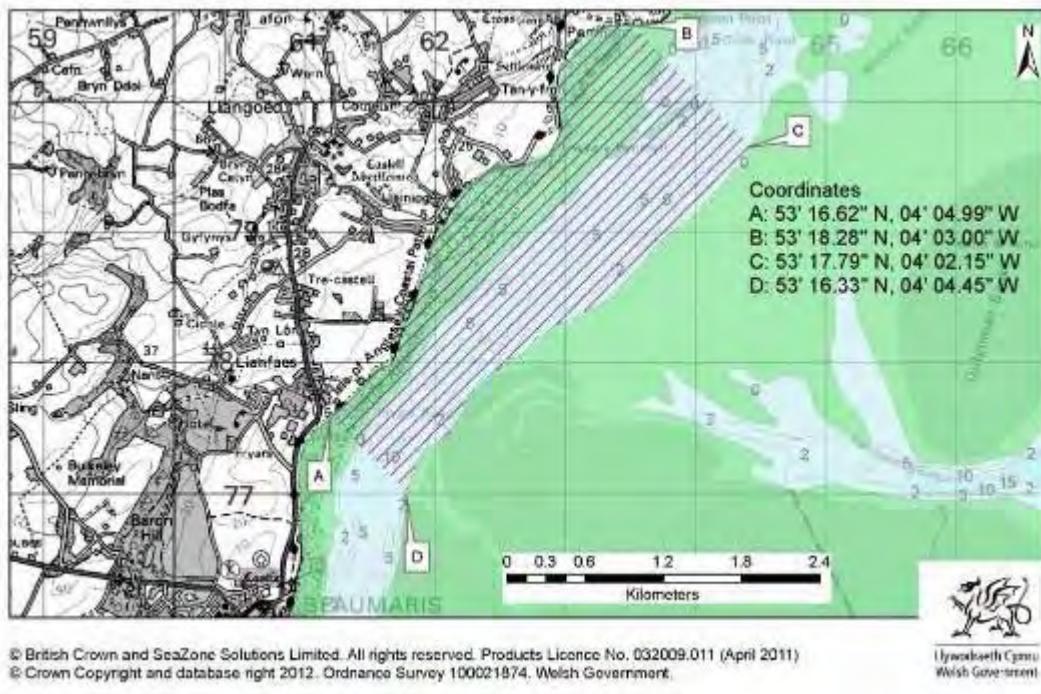
**Table 5. Habitats with a viable patch size captured by the Step 5 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
Moderate energy shallow water rock	0.088	0.025
High energy intertidal rock	0.007	0.005
Low energy intertidal rock	0.031	0.025
Moderate energy intertidal rock	0.080	0.005
Subtidal sand	0.292	0.250
<b>Important Habitat</b>		
Intertidal underboulder communities	0.015	0.002
Tide swept channels	0.644	0.250

This produces a site that is **2.0 km<sup>2</sup>**

## 2. North East Menai Strait / Gogledd Ddwyrain Y Fenai (formerly called Menai Strait)

**Figure 10. North East Menai Strait Potential Site**



The Focus Site includes the following habitats:

- High energy intertidal rock
- Intertidal coarse sediment
- Low energy intertidal rock
- Moderate energy intertidal rock
- Intertidal sand
- Subtidal sand
- Intertidal mudflats
- Sheltered muddy gravels
- Tide swept channels
- High productivity areas

## **Step 1**

There are a number of habitats that are of a limited distribution within the current boundary:

- Intertidal coarse sediment
- Moderate energy intertidal rock
- Sheltered muddy gravel
- Subtidal Sand

Sufficient subtidal sand to meet viability targets is limited to the edge of Traeth Lafan. The majority of the habitat diversity is located along the north-western edge of the site. Including the areas of subtidal sand will force the boundary of the site to cover these areas. The site boundary cannot be extended south west to incorporate subtidal sand here as it will be in the mussel Several Order area (which was previously excluded by the TAG as a key constraint).

There are considerable permanently modified areas around Beaumaris town (Figure 11). For this reason, the initial boundary was drawn to avoid these areas where the backing of the shore has been modified, as including these areas would result in a boundary that would have large indentations. See Figure 12 for the boundary at the first step of the boundary drawing process.

**Figure 11. Menai Strait area showing permanently modified areas (in black) and habitats of limited distribution (sheltered muddy gravel – orange, moderate energy intertidal rock – pink, intertidal coarse sediment – grey, subtidal sand – yellow)**

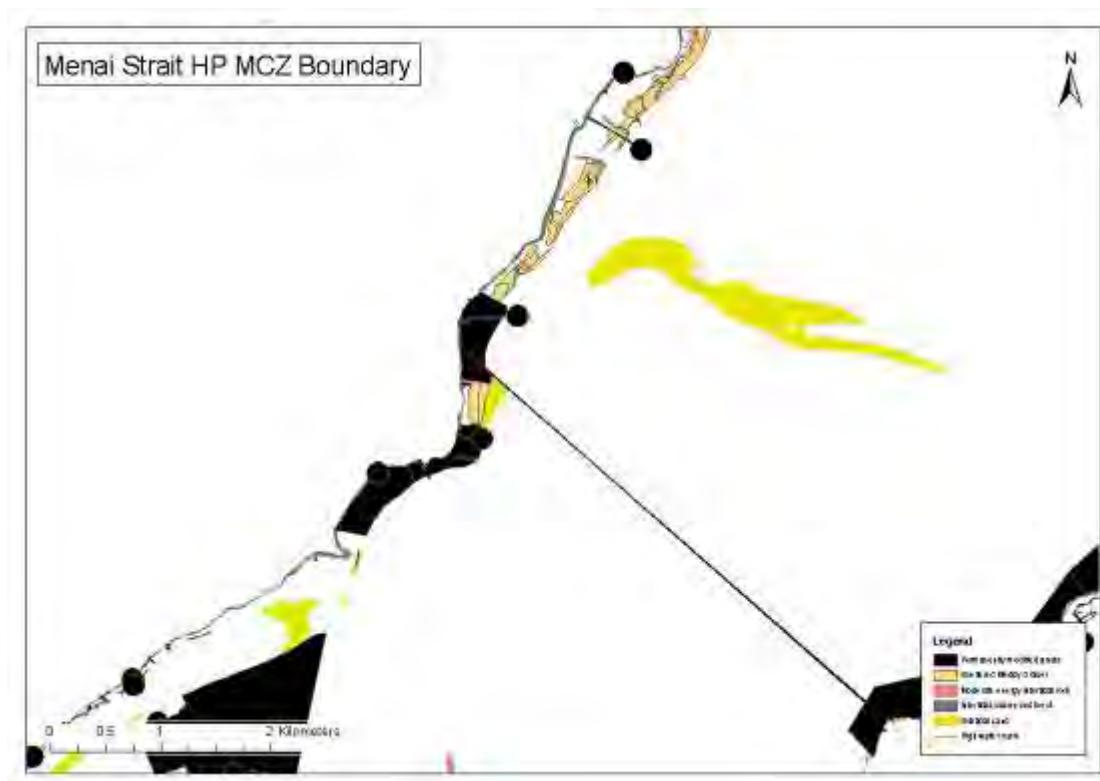
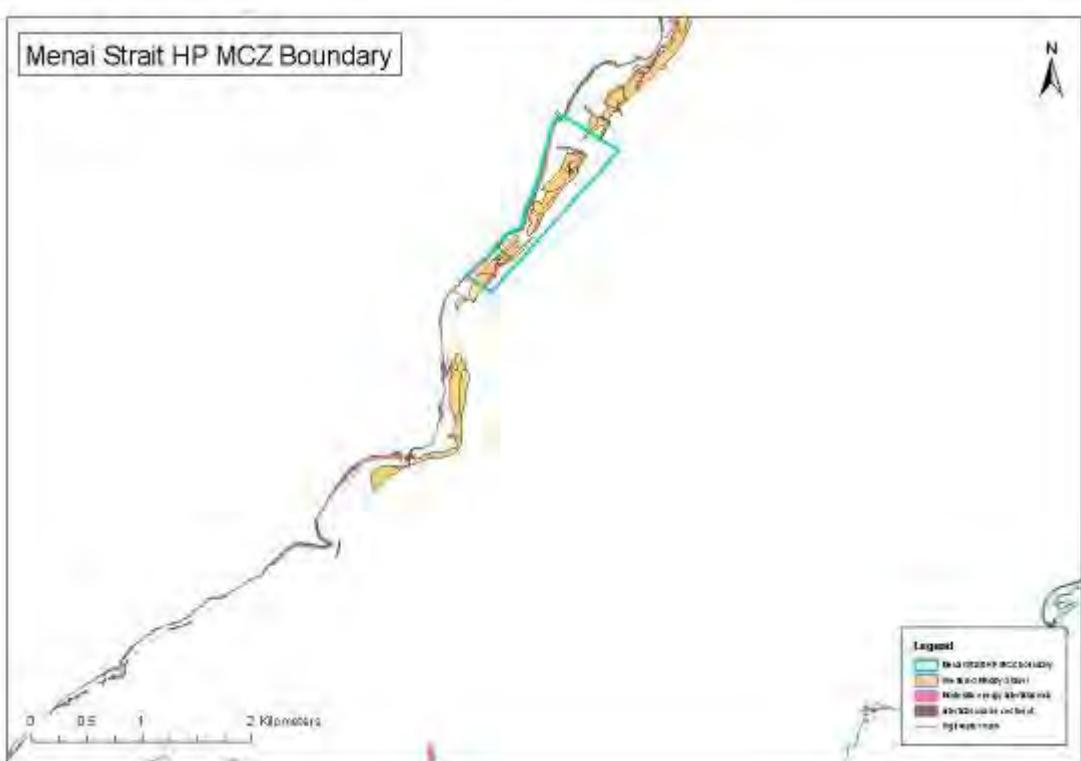


Figure 12 shows the resulting boundary that is produced to capture sufficient intertidal coarse sediment, moderate energy intertidal rock and sheltered muddy gravel.

**Figure 12. Boundary at Step 1 and limited distribution habitats (sheltered muddy gravel – orange, moderate energy intertidal rock – pink, intertidal coarse sediment – grey)**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 6.

**Table 6. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy intertidal rock	0.078	0.005
Low energy intertidal rock	0.127	0.025
Moderate energy intertidal rock	0.011	0.005
Intertidal coarse sediment	0.045	0.025
<b>Important Habitat</b>		
Sheltered muddy gravels	0.169	0.025
Tide swept channels	0.323	0.250

This boundary also captured 0.280 km<sup>2</sup> of high productivity area, sufficient to reach the viability target.

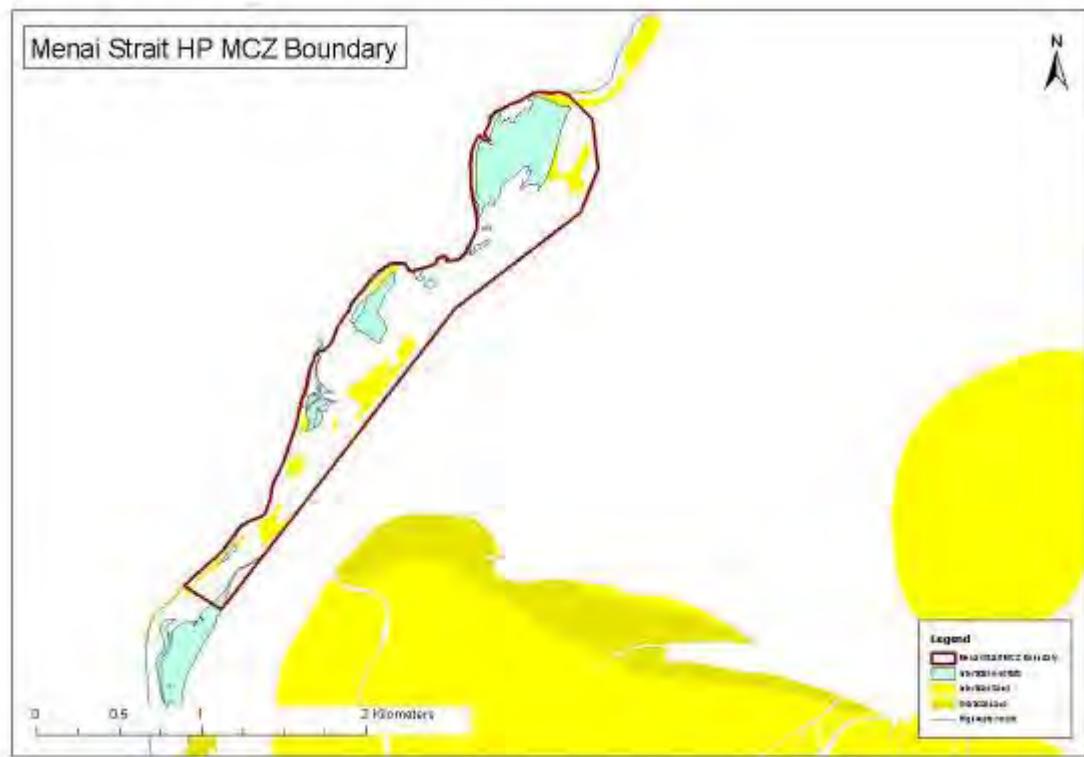
The following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 1 boundary:

- Intertidal sand: need an additional 0.146 km<sup>2</sup>
- Intertidal mudflats: need an additional 0.226 km<sup>2</sup>
- Subtidal sand

## **Step 2**

The boundary was extended north east to capture sufficient intertidal mudflat and intertidal sand habitat (Figure 13). These 2 habitats occupy the same bay and the boundary was drawn to the far end of the bay to conform with boundary principle 3 (include whole habitat patches) (Figure 14).

**Figure 13. Boundary at Step 2, showing selected habitats (intertidal mudflats – green, intertidal sand – bright yellow, subtidal sand – darker yellow)**

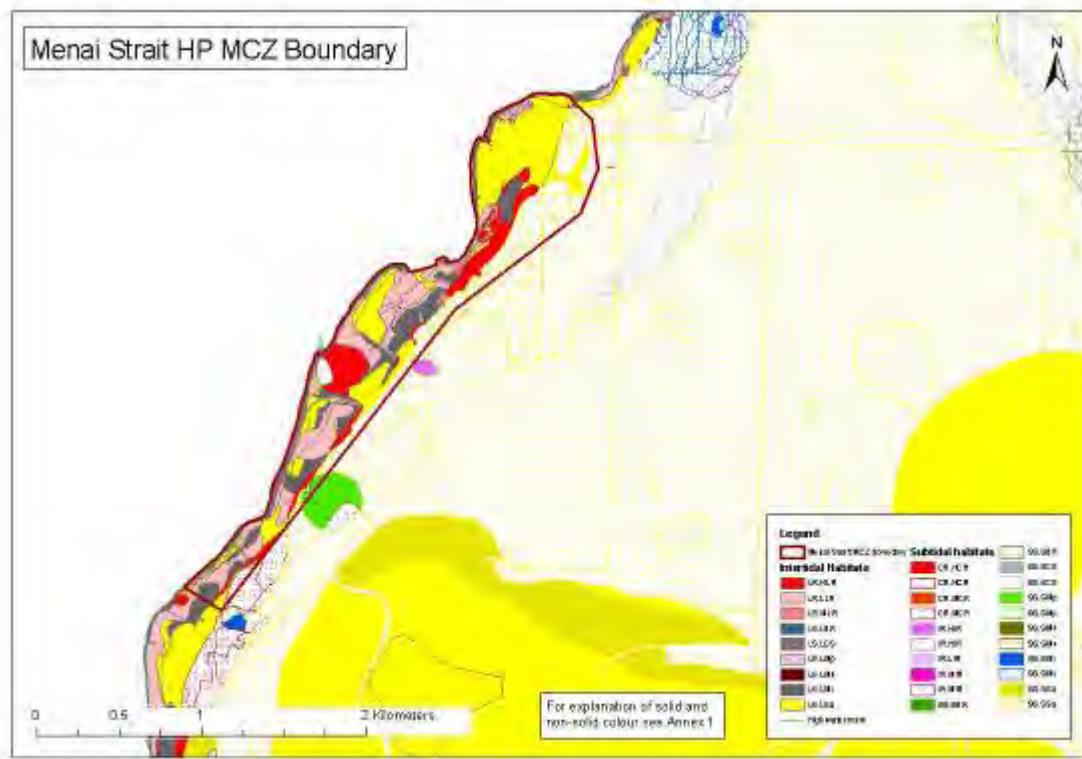


A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 7.

**Table 7. Habitats with a viable patch size captured by the Step 2 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy intertidal rock	0.182	0.005
Low energy intertidal rock	0.276	0.025
Moderate energy intertidal rock	0.034	0.005
Intertidal coarse sediment	0.087	0.025
Intertidal sand	0.451	0.250
<b>Important Habitat</b>		
Sheltered muddy gravels	0.351	0.025
Tide swept channels	0.361	0.250
Intertidal mudflats	0.308	0.250

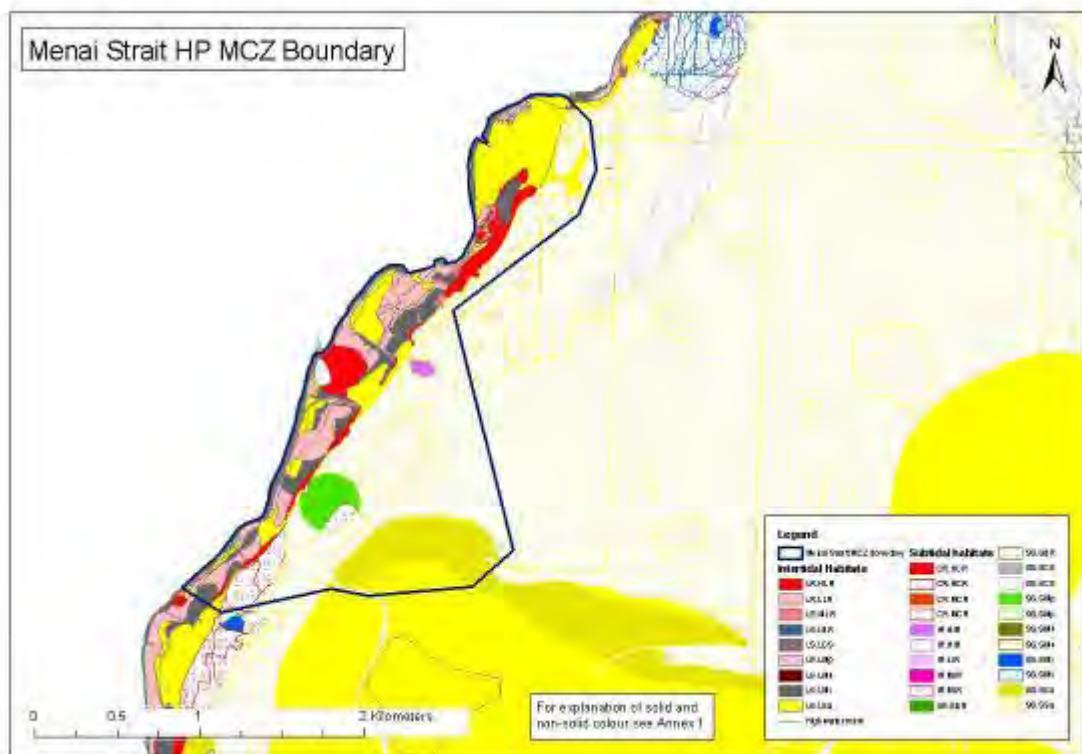
**Figure 14. Step 2 boundary – broadscale habitats**



### **Step 3**

All habitats are captured in Step 2 apart from subtidal sand. The boundary was altered to include areas of subtidal sand. See Figure 15.

**Figure 15. Step 3 boundary – broadscale habitats**



Including the subtidal sand area meant that a larger area of intertidal sand was included in the boundary. This was unavoidable and the boundary at step 3 cannot be truncated at the far north eastern end as this would result in the loss of intertidal mudflat habitat.

A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 8.

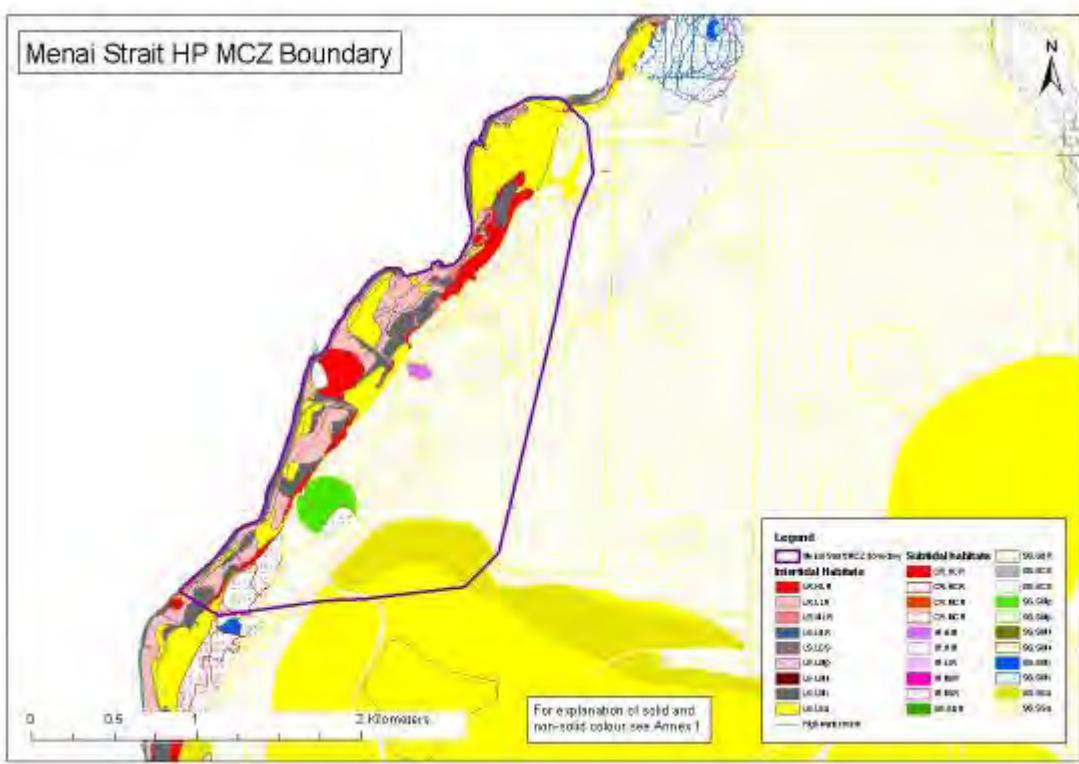
**Table 8. Habitats with a viable patch size captured by the Step 3 boundary**

<b><i>Broadscale Habitat</i></b>	<b><i>Area (km<sup>2</sup>) or number of data points (pts)</i></b>	<b><i>Target area (km<sup>2</sup>)</i></b>
High energy intertidal rock	0.182	0.005
Low energy intertidal rock	0.275	0.025
Moderate energy intertidal rock	0.032	0.005
Intertidal coarse sediment	0.074	0.025
Intertidal sand	0.540	0.250
Subtidal sand	0.259	0.250
<b><i>Important Habitat</i></b>		
Sheltered muddy gravels	0.351	0.025
Tide swept channels	1.507	0.250
Intertidal mudflats	0.308	0.250

#### **Step 4**

In this step the habitats were looked at to determine whether or not they could be reduced in size and yet still fulfil viability targets for each habitat. Minimal reductions could be made to the subtidal sand habitat. All other areas are needed to obtain viable areas of the other habitats (see note about intertidal sand above). The boundary at step 3 has a large indentation and as such does not conform to boundary principle 2. Figure 16 shows the broadscale habitats that are captured in step 4.

**Figure 16. Boundary at Step 4 – broadscale habitats.**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 9.

**Table 9: Habitats with a viable patch size captured by the Step 4 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy intertidal rock	0.182	0.005
Low energy intertidal rock	0.275	0.025
Moderate energy intertidal rock	0.032	0.005
Intertidal coarse sediment	0.074	0.025
Intertidal sand	0.542	0.250
Subtidal sand	0.253	0.250
<b>Important Habitat</b>		
Sheltered muddy gravels	0.351	0.025
Tide swept channels	1.639	0.250

Intertidal mudflats	0.308	0.250
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This step results in a more compact shape.

### **Comments and additional considerations**

The site size for this boundary is **3.0 km<sup>2</sup>**.

From an ecological point of view the site has a few disadvantages. The very extremities of Traeth Lafan are required for the inclusion of subtidal sand habitats, but to fulfil boundary principle 3 (include whole habitat patches / natural features) then it would be preferable to include either all of Traeth Lafan or none of it. However, including Traeth Lafan would extend the site boundary considerably and large areas of Traeth Lafan are excluded due to the existing sea defences combined with a *Hold the Line* shoreline defence policy. The inclusion of the subtidal sand at the edge of Traeth Lafan probably offers little contribution to ecosystem function as it appears to be a very species poor and highly mobile example of this broadscale habitat. This area is coarse sand and shell gravel that supports little more than amphipods *Bathyporeia* sp. and catworms *Nephtys* spp. However, there are also areas where there is less shell gravel supporting bivalve seashells *Spisula solidula*, *Chamelea gallina*, thin tellin *Angulus tenuis*, and the polychaete worms *Travisia forbesi* and sand mason worm *Lanice conchilega*. An alternative that applies the linked habitats additional consideration is to extend the boundary across the width of the Menai Strait to encompass subtidal habitats. Other information (CCW staff and Seasearch dives) shows that within the subtidal channel there are interesting mixed sediment habitats (with burrowing anemone *Cerianthus lloydii* and other species). It is therefore preferable to include the subtidal channel here, with a more suitable boundary but not to include the intertidal areas of Traeth Lafan. This would enhance the 'within site connectivity' by including the subtidal channel along the length of the site, probably increase the resilience of the site and contribute to ecosystem function. The channel also needs to be included for representation of tide-swept channel habitat.

## **Step 5 – additional considerations**

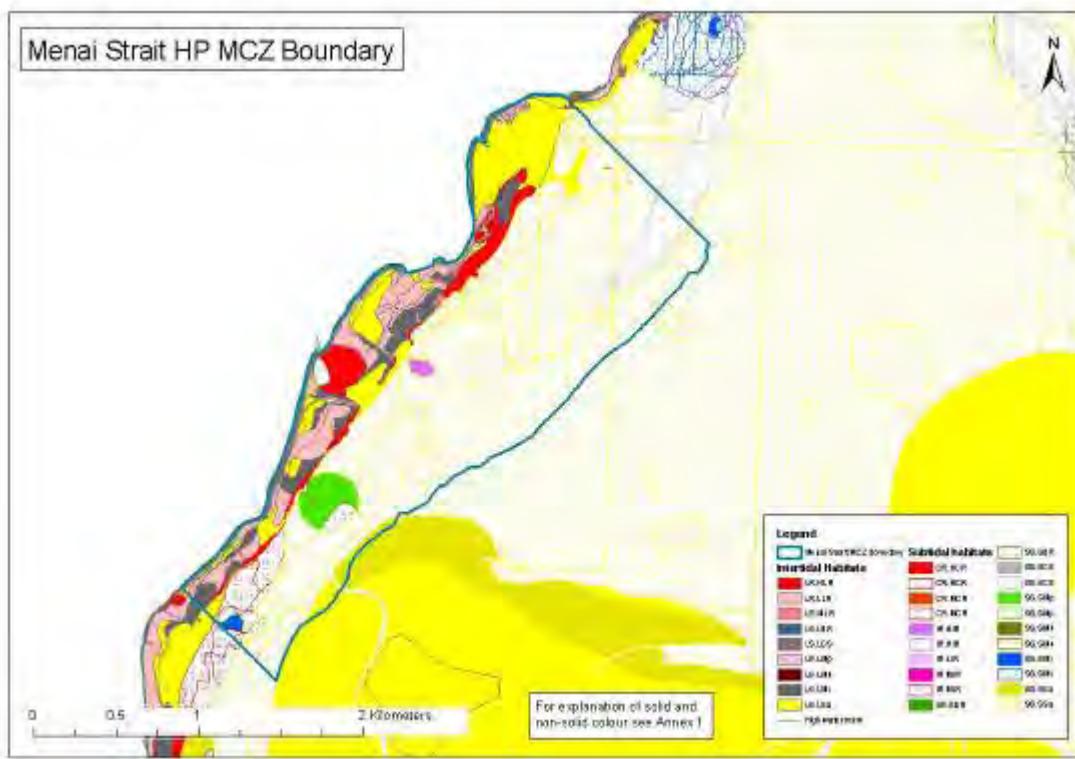
The boundary was redrawn to address the comments above. The subtidal tideswept channel boundary follows chart datum on the admiralty chart. See Figure 17.

Therefore the additional considerations applied are:

- **Linked Habitats** – the new boundary includes the subtidal part of the channel along the length of the site.
  - **Ecological quality** – a small portion of Traeth Lafan has been excluded partly on the basis of ecological quality, as it is quite mobile sand at the edge of the channel which tends to be species poor.

This area does have some intertidal interest advantages over the initial Menai Strait Focus Site boundary. This new boundary includes an increased amount of rich fully marine sheltered muddy gravel communities that are of limited distribution within Wales and the UK. It also includes tideswept communities that were not present in the original site.

**Figure 17 Potential Site boundary following additional considerations discussed above**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 10.

**Table 10: Habitats with a viable patch size captured by the Step 5 boundary**

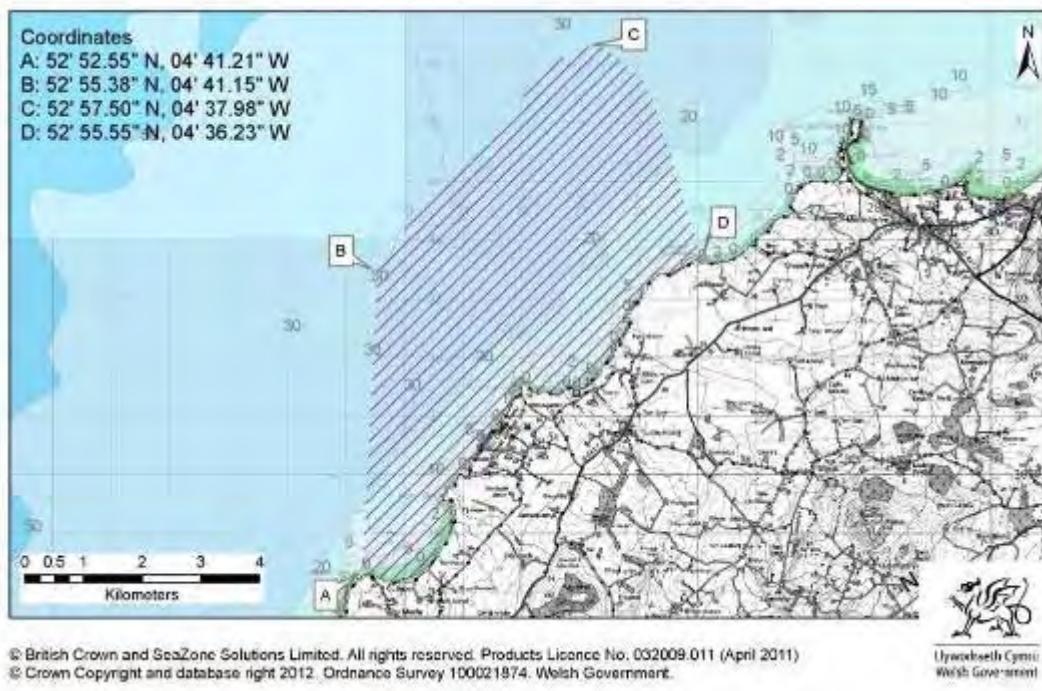
<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy intertidal rock	0.183	0.005
Low energy intertidal rock	0.276	0.025
Moderate energy intertidal rock	0.033	0.005
Intertidal coarse sediment	0.084	0.025
Intertidal sand	0.477	0.250
<b>Important Habitat</b>		
Sheltered muddy gravels	0.354	0.025
Tide swept channels	1.594	0.250
Intertidal mudflats	0.312	0.250

This produces a site size **4.1 km<sup>2</sup>**

The name of this site has been changed from Menai Strait to North East Menai Strait as this is a better reflection of the actual location of the site.

### 3. North Lleyn Peninsula / Gogledd Pen Llŷn

**Figure 18. North Lleyn Peninsula Potential Site**



The Focus Site includes the following habitats:

- Low energy shallow water rock
- High energy intertidal rock
- Intertidal coarse sediment
- High energy deeper water rock
- Moderate energy deeper water rock
- High energy shallow water rock
- Moderate energy shallow water rock
- Low energy intertidal rock
- Moderate energy intertidal rock
- Intertidal sand
- Subtidal biogenic reefs
- Subtidal coarse sediment
- Subtidal macrophyte communities
- Subtidal mixed sediments
- Subtidal sand

- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Horse mussel (*Modiolus modiolus*) beds
- Subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea*
- Subtidal mixed muddy sediments
- High productivity areas

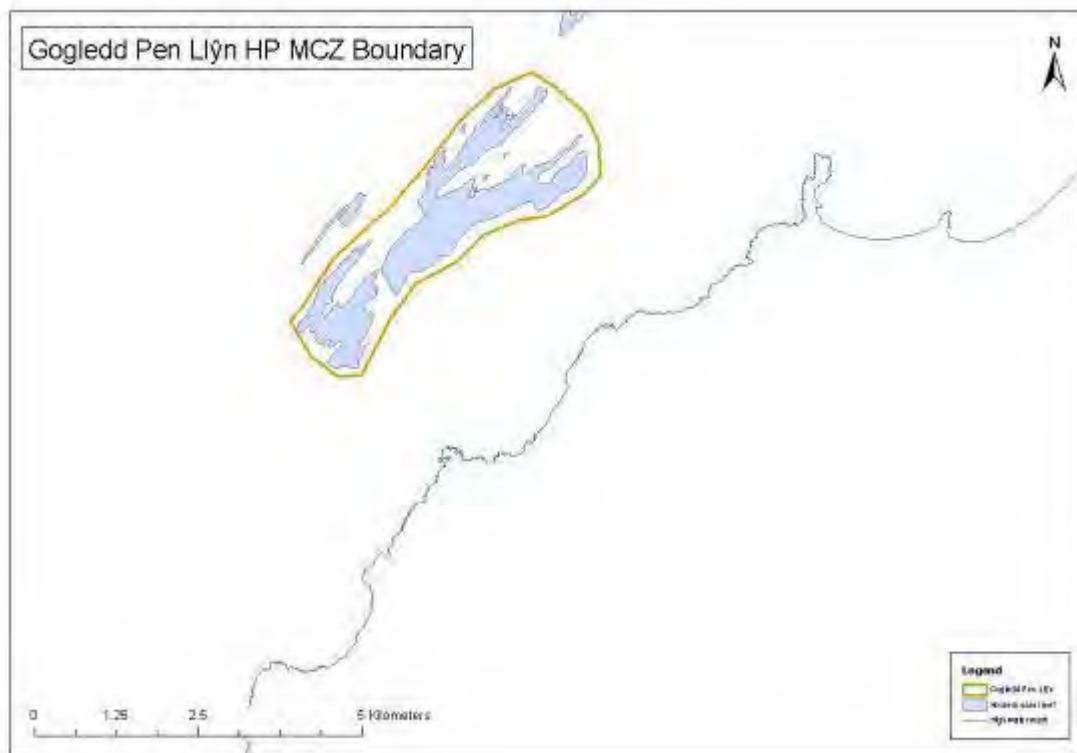
### **Step 1**

There are a few habitats of limited distribution:

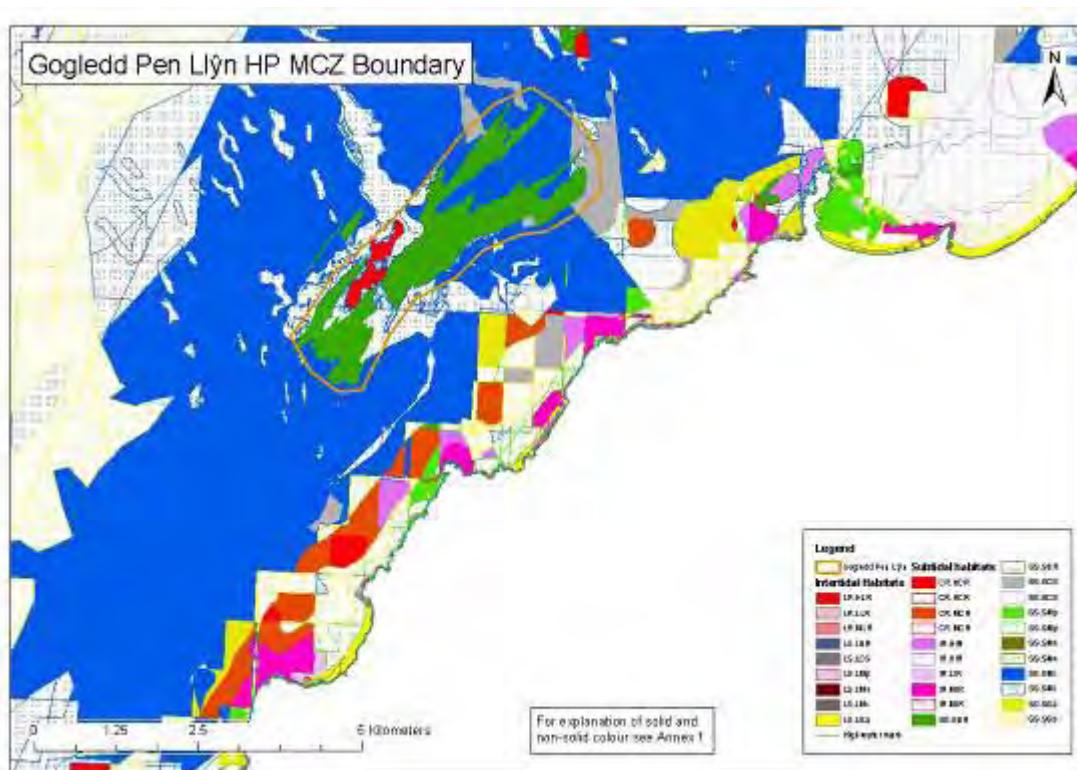
- Horse mussel bed

The horse mussel bed is only found in the north western end of the site (Figure 19). The two main patches of horse mussel bed have been incorporated into the Step 1 boundary as they were considered a whole habitat patch due to the proximity of the patches. There are a couple of other patches that are not included within the boundary. It could be considered in future boundary discussions whether these small discreet patches should be incorporated into the boundary for connectivity reasons and also to allow possible expansion of the horse mussel bed.

**Figure 19. Map showing the boundary at Step 1 and the distribution of Horse mussel beds (in blue)**



**Figure 20. Map showing the broadscale habitats captured by the Step 1 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 11.

**Table 11. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.315	0.250
Subtidal biogenic reefs	3.676	0.250
Subtidal coarse sediment	0.431	0.250
Subtidal mixed sediments	2.614	0.250
<b>Important Habitat</b>		
Horse mussel ( <i>Modiolus modiolus</i> ) beds	3.677	0.250
Subtidal mixed muddy sediments	1.690	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	2pts	

The following habitats that were originally included in the Focus Site were not present within the Step 1 boundary:

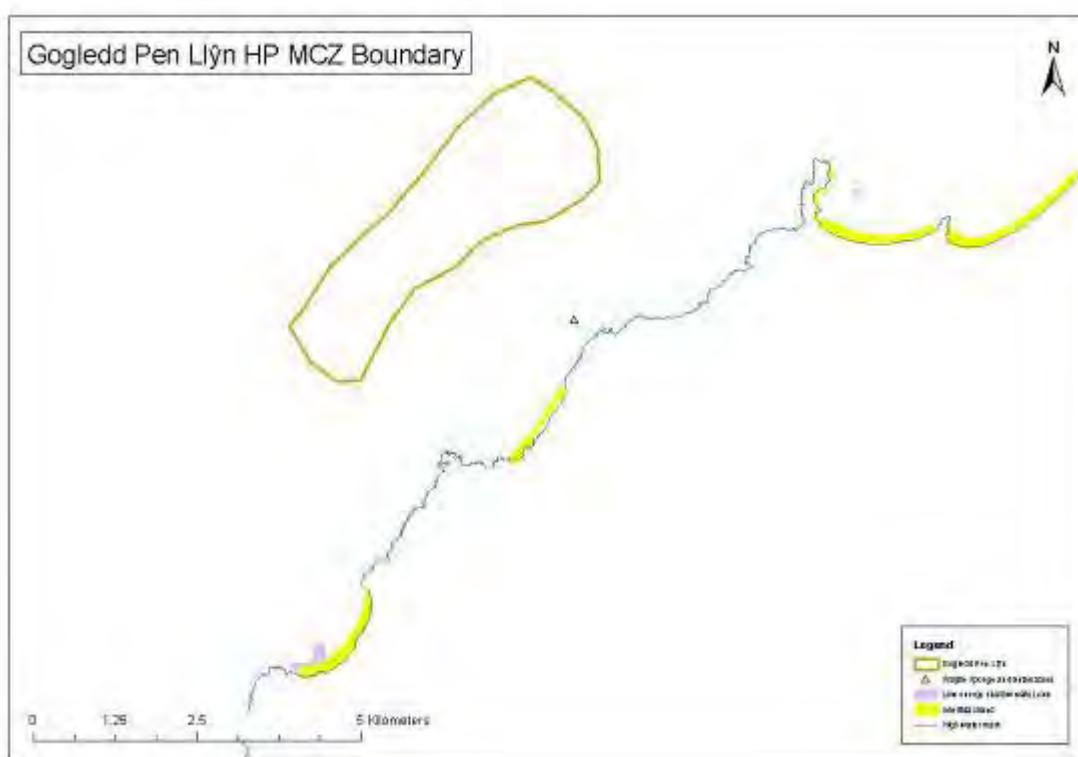
- Low energy shallow water rock
- High energy intertidal rock
- Intertidal coarse sediment
- Moderate energy deeper water rock
- High energy shallow water rock
- Moderate energy shallow water rock
- Low energy intertidal rock
- Moderate energy intertidal rock
- Intertidal sand
- Subtidal macrophyte communities
- Subtidal sand
- Fragile sponge & anthozoan communities on subtidal rocky habitats

## **Step 2**

Other habitats that are of limited distribution within the site not captured by step 1 (Figure 21):

- Fragile sponge & anthozoan communities on subtidal rocky habitats  
only 1 point found on the shoreward side of the horse mussel reef
- Intertidal sand – need to go either south-west to include Porth Colman or north-east to include Porth Dinllaen.
- Low energy shallow water rock - This is also limited to the extremities of the site at Porth Colman and Porth Dinllaen.

**Figure 21. Map showing the boundary at Step 1 and the distribution of Low energy shallow water rock (lilac), intertidal sand (yellow) and Fragile sponge & anthozoan communities (yellow triangles) on subtidal rocky habitats**



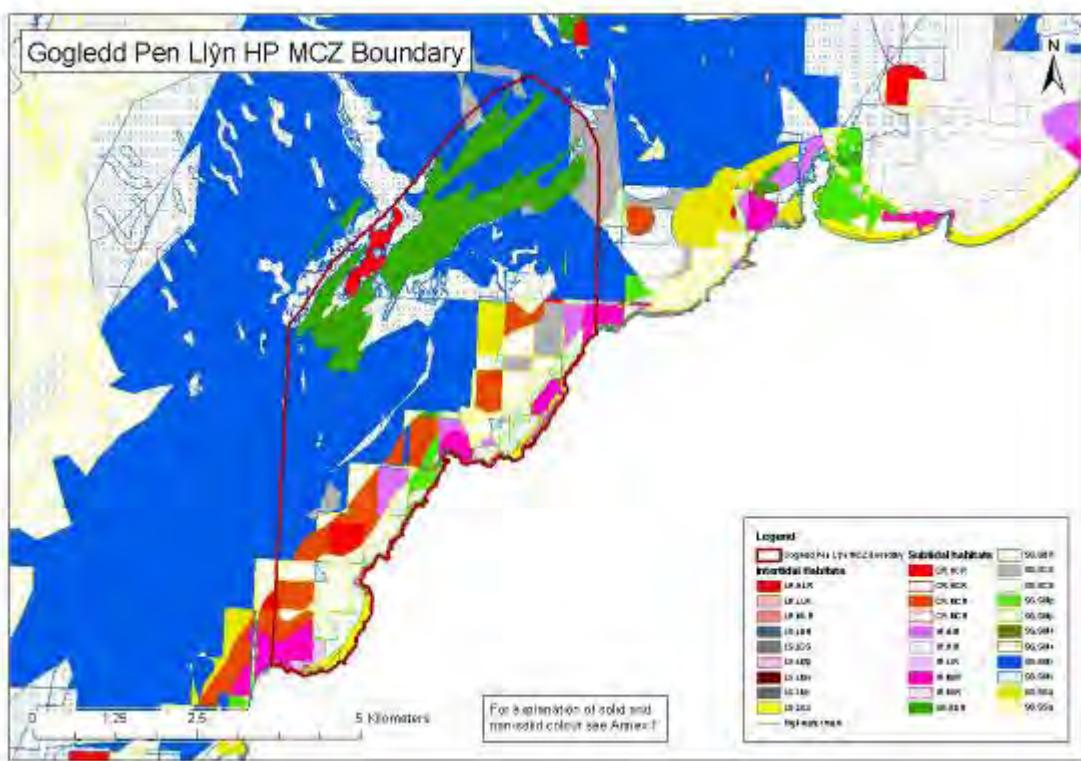
All of the other habitats are fairly evenly spread and if the area between the step 1 boundary and the coast is included then these are captured in viable amounts. There are viable amounts of intertidal sand and low energy shallow water rock at either extremities of the site. Because of this the boundary can follow 2 different options (the south-west (SW) option, or the north-east (NE) option, both described below).

## **Step 2 SW option**

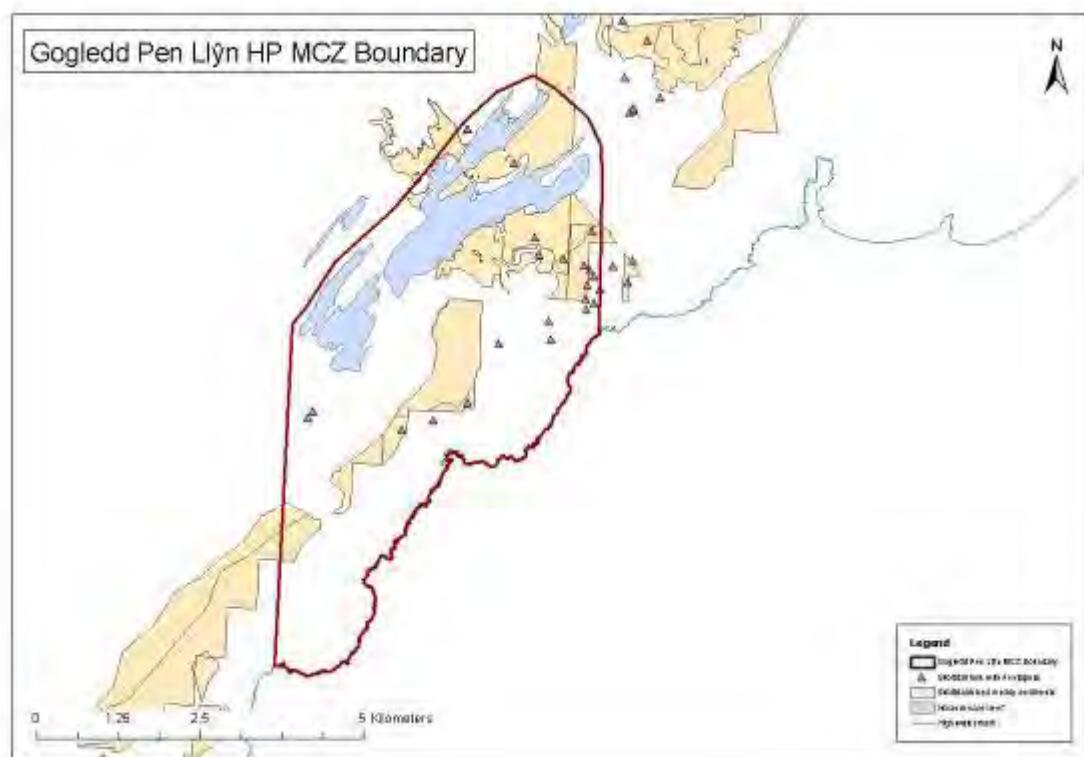
This step includes the areas that are found to the south west of the site.

The boundary was drawn to cover areas of intertidal sand and low energy shallow water rock to the south west of the horse mussel bed. The boundary was drawn to include all of Porth Colmon, to conform with boundary principle 3 using natural features to draw boundaries. The north western boundary was also drawn straight down to the coast as drawing a boundary that doesn't go directly to the coast would produce a boundary that would create large indentations (Figures 22 & 23).

**Figure 22. Map showing the broadscale habitats captured by the Step 2 SW boundary**



**Figure 23. Map showing the subtidal important habitats subtidal mixed muddy sediments (orange), horse mussel beds (blue) and Subtidal rock with *Pentapora* (triangles) captured by the Step 2 SW boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 12.

**Table 12. Habitats with a viable patch size captured by the Step 2 SW boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.579	0.250
Moderate energy deeper water rock	1.736	0.250
High energy shallow water rock	0.531	0.025
Low energy shallow water rock	0.097	0.005
Moderate energy shallow water rock	0.675	0.025
High energy intertidal rock	0.082	0.005
Low energy intertidal rock	0.026	0.025
Moderate energy intertidal rock	0.112	0.005

Intertidal coarse sediment	0.058	0.025
Intertidal sand	0.329	0.250
Subtidal biogenic reefs	3.704	0.250
Subtidal coarse sediment	1.130	0.250
Subtidal mixed sediments	9.741	0.250
Subtidal sand	0.317	0.250
<b><i>Important Habitat</i></b>		
Horse mussel ( <i>Modiolus modiolus</i> ) beds	3.677	0.250
Subtidal mixed muddy sediments	5.352	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	35pts	1pt
Fragile sponge & anthozoan communities on subtidal rocky habitats	1pts	1pt

The following habitats that were originally included in the Focus Site were not present within the Step 2 SW boundary:

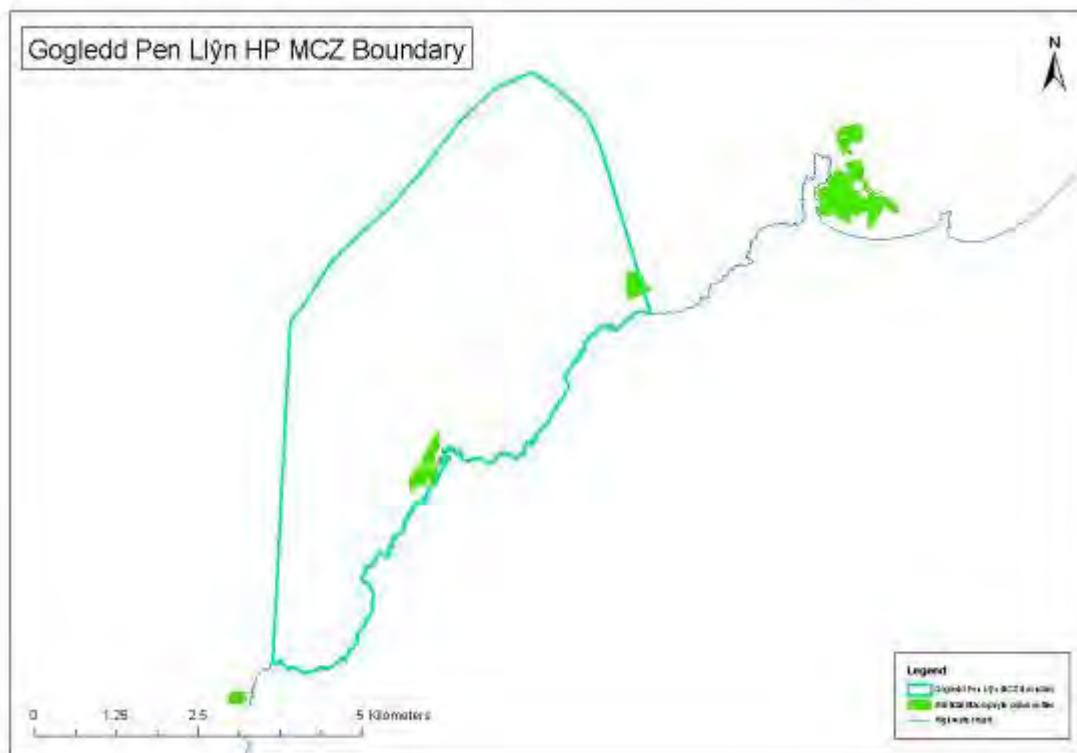
- Subtidal macrophyte communities

This boundary also captured 1.466 km<sup>2</sup> of high productivity area, sufficient to reach the viability target.

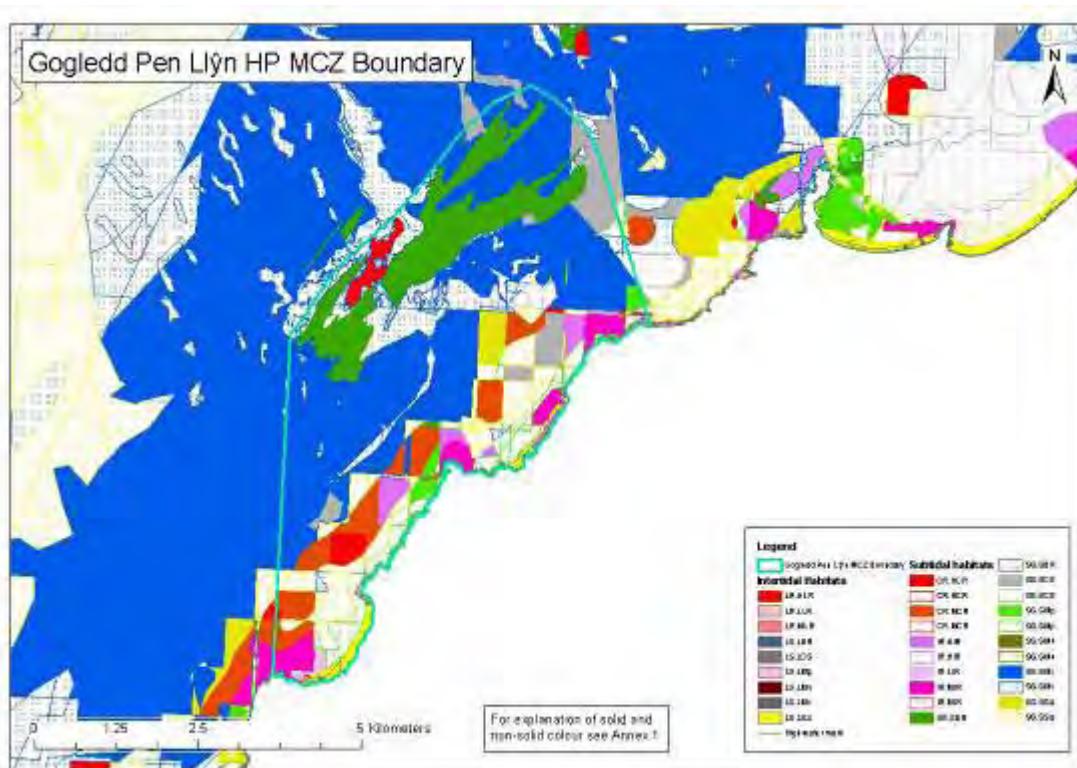
### **Step 3 SW option**

The boundary was drawn to incorporate sufficient subtidal macrophyte community. See Figures 24 & 25.

**Figure 24. Map showing the boundary at Step 3 SW and the distribution of subtidal macrophyte communities**



**Figure 25. Map showing the broadscale habitats captured by the Step 3 SW boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 13.

**Table 13. Habitats with a viable patch size captured by the Step 3 SW boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.584	0.250
Moderate energy deeper water rock	1.736	0.250
High energy shallow water rock	0.531	0.025
Low energy shallow water rock	0.097	0.005
Moderate energy shallow water rock	0.824	0.025
High energy intertidal rock	0.092	0.005
Low energy intertidal rock	0.032	0.025
Moderate energy intertidal rock	0.136	0.005
Intertidal coarse sediment	0.063	0.025
Intertidal sand	0.329	0.250
Subtidal biogenic reefs	3.704	0.250
Subtidal coarse sediment	1.318	0.250
Subtidal macrophyte communities	0.280	0.250
Subtidal mixed sediments	10.167	0.250
Subtidal sand	0.317	0.250
<b>Important Habitat</b>		
Horse mussel ( <i>Modiolus modiolus</i> ) beds	3.677	0.250
Subtidal mixed muddy sediments	5.469	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	40pts	1pt
Fragile sponge & anthozoan communities on subtidal rocky habitats	1pts	1pt

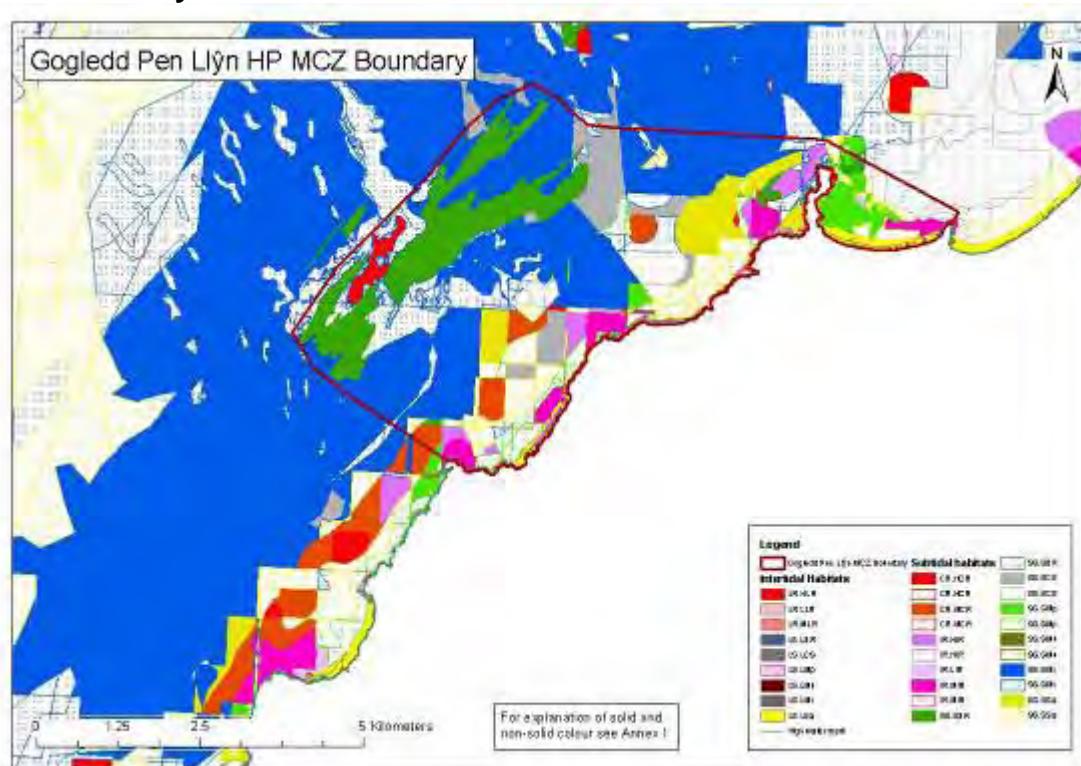
All habitats are found in sufficient amounts to meet viability targets. This boundary has not been streamlined to determine whether or not it could be made smaller. However it is unlikely that this would be possible due to the need to include sufficient intertidal sand and low energy shallow water rock in the south west and sufficient subtidal macrophyte community in the north east. Any streamlining of habitats would involve creating indentations to this boundary and a less compact shape.

Site size **26.8 km<sup>2</sup>**

## **Step 2 NE option**

This step includes the areas that are found to the north eastern end of the site. The boundary has been drawn to include all of Porth Dinllaen so as to include whole habitat patches and follow natural features (Figures 26 & 27). This has enabled sufficient intertidal sand and low energy shallow water rock to be incorporated.

**Figure 26. Map showing the broadscale habitats captured by the Step 2 NE boundary**

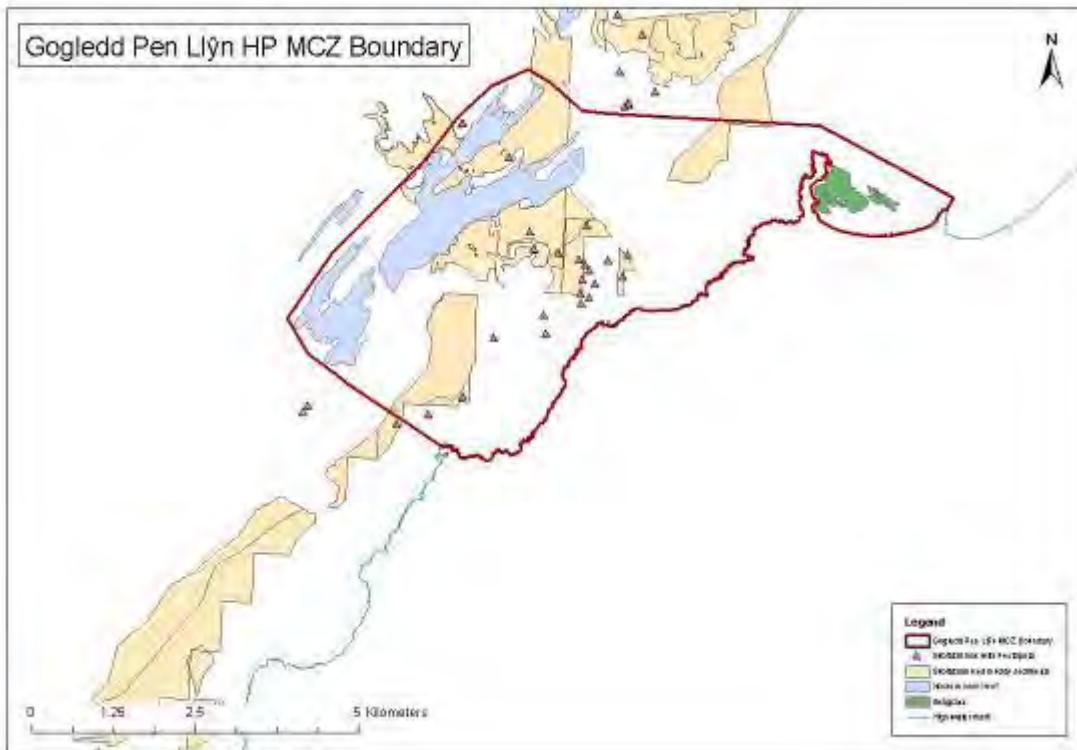


A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 14.

**Table 14. Habitats with a viable patch size captured by the Step 2 NE boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.354	0.250
Moderate energy deeper water rock	0.757	0.250
High energy shallow water rock	0.625	0.025
Low energy shallow water rock	0.023	0.005
Moderate energy shallow water rock	0.903	0.025
High energy intertidal rock	0.074	0.005
Low energy intertidal rock	0.039	0.025
Moderate energy intertidal rock	0.222	0.005
Intertidal coarse sediment	0.072	0.025
Intertidal sand	0.380	0.250
Subtidal biogenic reefs	3.869	0.250
Subtidal coarse sediment	1.745	0.250
Subtidal macrophyte communities	0.757	0.250
Subtidal mixed sediments	8.982	0.250
Subtidal sand	1.517	0.250
<b>Important Habitat</b>		
Horse mussel ( <i>Modiolus modiolus</i> ) beds	3.677	0.250
Subtidal mixed muddy sediments	5.265	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	36pts	1pt
Fragile sponge & anthozoan communities on subtidal rocky habitats	1pt	1pt
Seagrass beds	0.397	0.250

**Figure 27. Map showing the boundary at Step 3 NE and the distribution of Important Habitats** subtidal rock with *Pentapora* (triangles), subtidal mixed muddy sediments (orange), horse mussel bed (blue), seagrass bed (green)



This produces a site size of **28.0 km<sup>2</sup>**

The south west and north east options were compared with each other. The north east option is outside of the original Focus Site boundary and the hexagons selected by Marxan did not include the Porth Dinllaen area. Also, the north east option is larger than the south west option (28.0 km<sup>2</sup> cf 26.8 km<sup>2</sup>). The north east option does produce a site that has more important habitats than that of the original boundary by including the seagrass beds found at Porth Dinllaen. However, because the south west option is closer to the hexagons originally selected, this was thought to be the better option.

It was not considered necessary to apply any additional considerations to this site.

#### 4. Bardsey Island / Ynys Enlli

**Figure 28. Bardsey Island Potential Site**



The Focus Site includes the following habitats:

- High energy deeper water rock
- Moderate energy deeper water rock
- High energy shallow water rock
- Moderate energy shallow water rock
- High energy intertidal rock
- Low energy intertidal rock
- Moderate energy intertidal rock
- Subtidal macrophyte communities
- Subtidal mixed sediments
- Subtidal sand
- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Sediment habitats with long-lived bivalves
- High Productivity

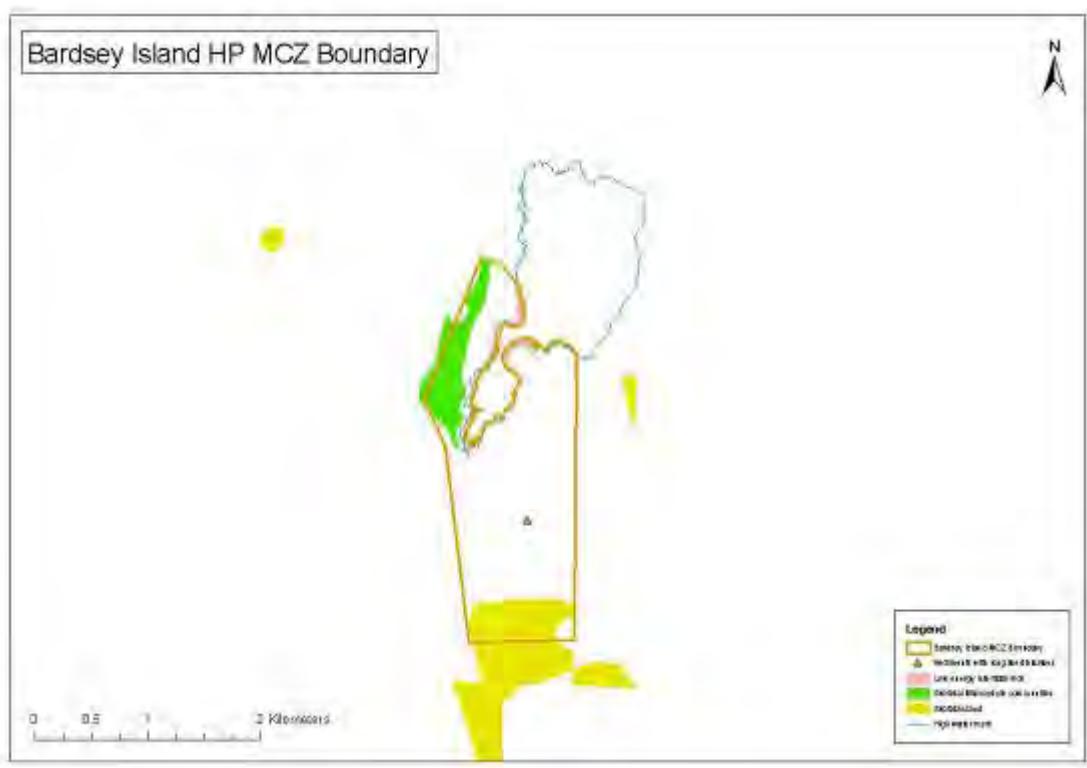
## **Step 1**

There are a number of habitats that are limited in their distribution (Figure 29).

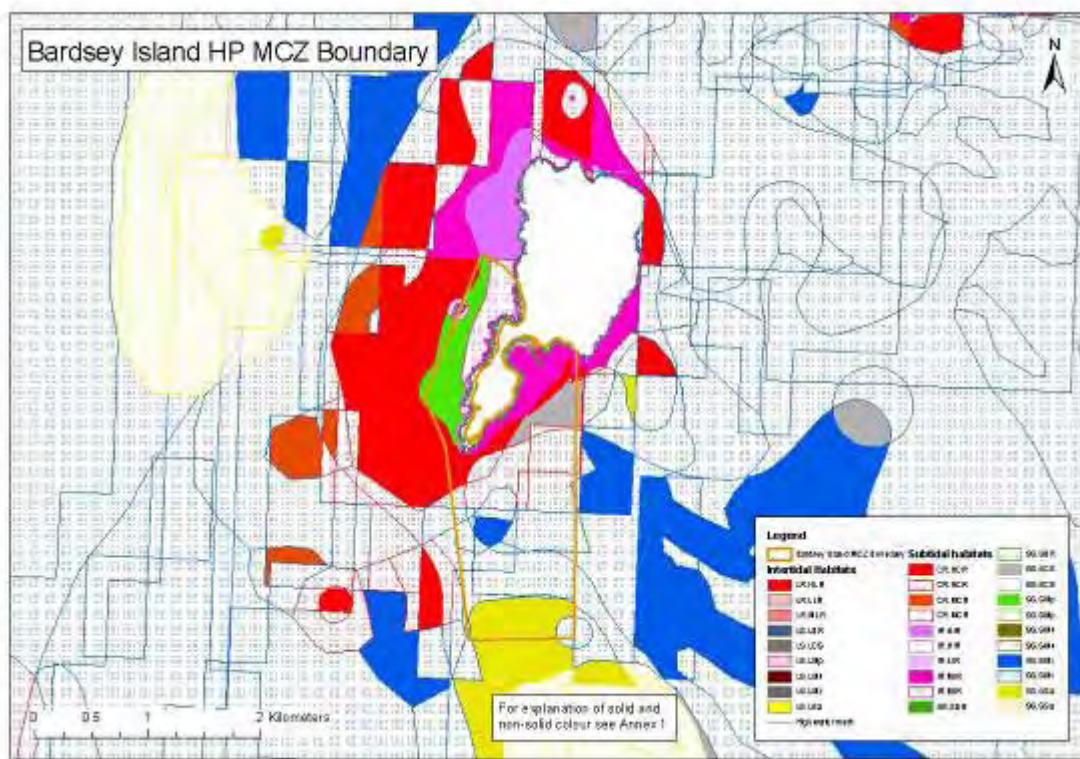
These are:

- Low energy intertidal rock – This is restricted to the relative shelter of Henllwyn and around Trywyn Dihiryn on either side of the island.
- Subtidal Sand – There are a couple of small patches, but in order to obtain enough habitat the large area recorded to the south of the island has to be incorporated.
- Sediments with long lived bivalves – only one point to the south of the island.
- Subtidal macrophyte dominated communities – restricted to the south west of the island

**Figure 29. Map showing the boundary at Step 1 and the distribution of various habitats: low energy intertidal rock (pink), subtidal macrophyte communities (green), subtidal sand (yellow), sediments with long-lived bivalves (triangles)**



**Figure 30. Map showing the broadscale habitats captured by the Step 1 boundary**



This Step 1 boundary also captured 0.363 km<sup>2</sup> of high productivity area, sufficient to reach the viability target.

A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 15.

**Table 15. Habitats with a viable patch size captured by the Step 1 boundary**

<b><i>Broadscale Habitat</i></b>	<b><i>Area (km<sup>2</sup>) or number of data points (pts)</i></b>	<b><i>Target area (km<sup>2</sup>)</i></b>
Moderate energy shallow water rock	0.209	0.025
High energy intertidal rock	0.065	0.005
Low energy intertidal rock	0.037	0.025
Moderate energy intertidal rock	0.041	0.005
Subtidal macrophyte communities	0.297	0.250
Subtidal sand	0.300	0.250
<b><i>Important Habitat</i></b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	1pt	1pt
Sediment habitats with long-lived bivalves	1pt	1pt

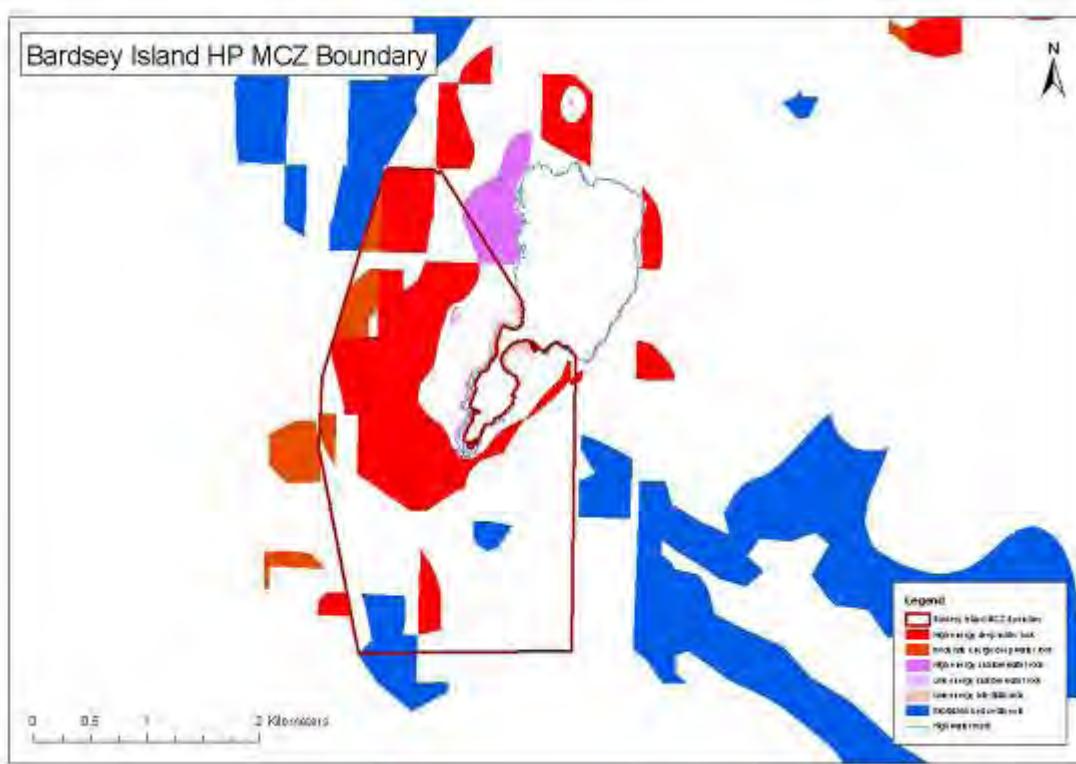
The following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 1 boundary:

- High energy deeper water rock – an extra 0.053km<sup>2</sup> needed
- Moderate energy deeper water rock – none recorded in Step 1. The majority of this habitat is to the west of the island
- High energy shallow water rock – 0.013 extra needed
- Subtidal mixed sediments - an extra 0.187 needed

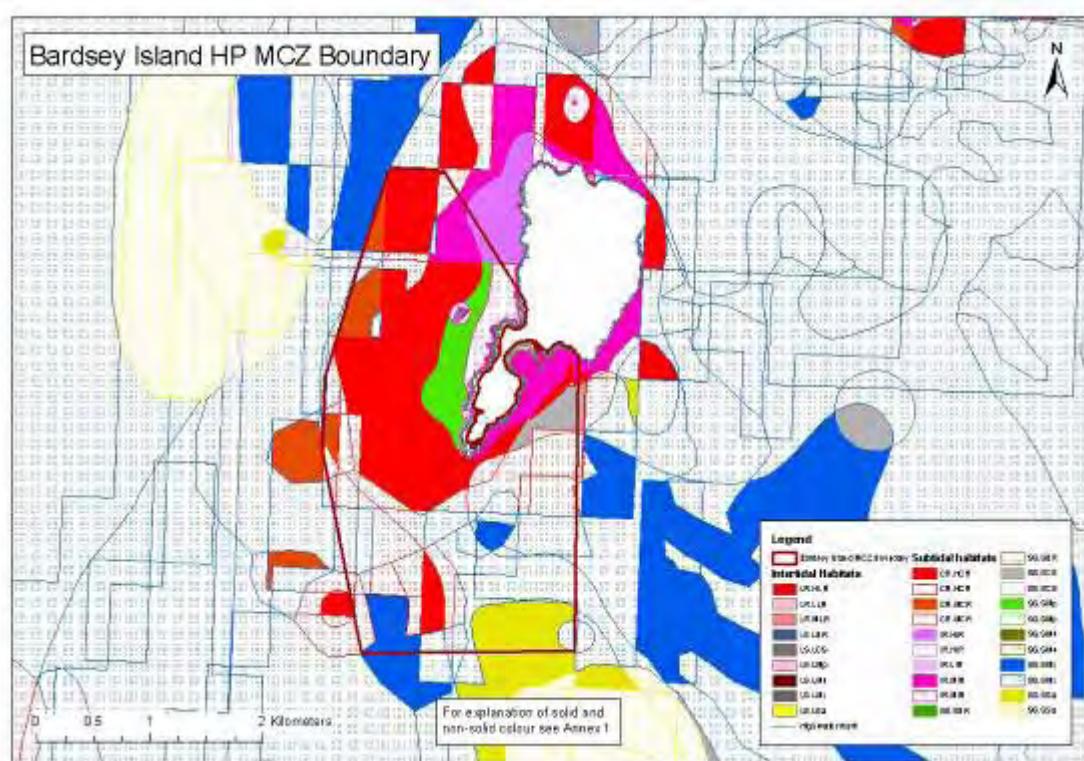
## **Step 2**

Therefore the boundary was expanded to include the missing habitats: high energy deeper water rock, moderate energy deeper water rock, high energy shallow water rock and subtidal mixed sediments (Figures 31 & 32).

**Figure 31. Map showing the boundary at Step 2 and the distribution of various habitats: high energy deeper water rock (bright red), moderate energy deeper water rock (brown-red), high energy shallow water rock (dark pink), low energy shallow water rock (lilac-pink), low energy intertidal rock (salmon pink), subtidal mixed sediments (blue)**



**Figure 32. Map showing the broadscale habitats captured by the Step 2 boundary**

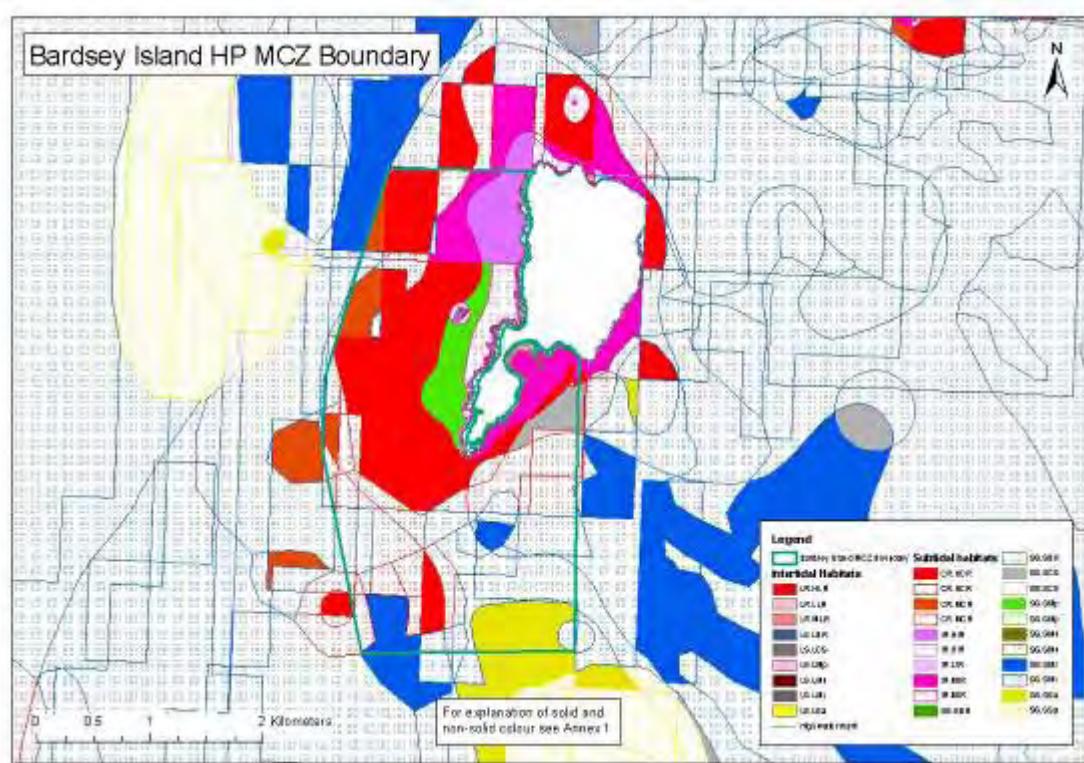


Subtidal sand	0.355	0.250
<b><i>Important Habitat</i></b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	3pts	1pt
Sediment habitats with long-lived bivalves	1pt	1pt

### **Step 3**

The boundary that is produced at Step 2 does not include some whole habitat patches. It only includes part of the western part of the island which does not conform to principle 3 (whole habitat patches), especially for the intertidal. The boundary was changed to include the whole of the western side of the island. This is where the island will become more influenced by the fast tidal streams of Bardsey Sound (Figure 33). The boundary at Step 3 conforms to the boundary principles of whole habitat patches and following natural features. Although there is an argument for considering the whole island for inclusion as a whole habitat patch, a conservative approach was taken at this point.

**Figure 33. Map showing the broadscale habitats captured by the Step 3 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 17.

**Table 17. Habitats with a viable patch size captured by the Step 3 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	2.178	0.250
Moderate energy deeper water rock	0.263	0.250
High energy shallow water rock	0.334	0.025
Moderate energy shallow water rock	0.432	0.025
High energy intertidal rock	0.092	0.005
Low energy intertidal rock	0.037	0.025
Moderate energy intertidal rock	0.048	0.005
Subtidal macrophyte communities	0.349	0.250
Subtidal mixed sediments	0.254	0.250

Subtidal sand	0.355	0.250
<b><i>Important Habitat</i></b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	4pts	1pt
Sediment habitats with long-lived bivalves	1pt	1pt

### **Comments and additional considerations**

The site size is **7.8 km<sup>2</sup>**.

When determining whole habitat patches for this site, a conservative approach was taken (see Step 3). The whole island could be considered a whole habitat patch as there is a continuity of rocky habitats around the island and into deeper water. After discussions at the TAG it was suggested that the whole of Bardsey Island should be included as this would be a whole habitat patch and would also support within site connectivity and conform to the 'linked habitats' additional consideration.

### **Step 4: additional considerations**

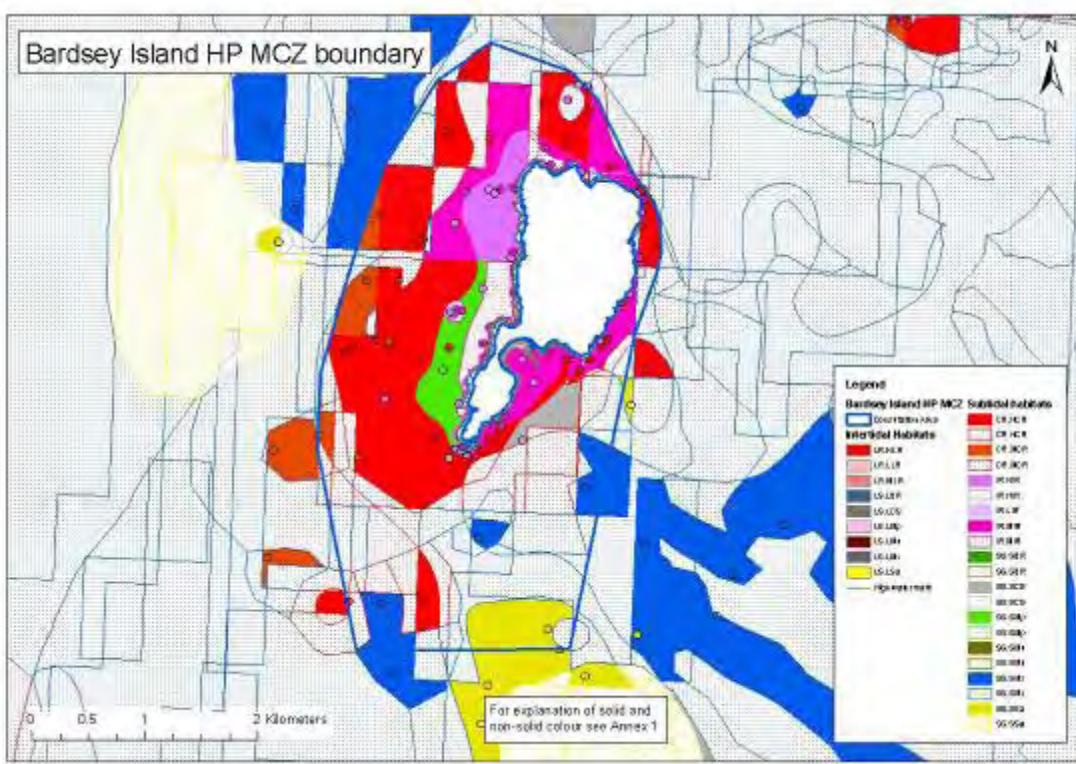
Therefore the additional considerations applied were:

- **Linked Habitats (in part)** – this consideration has been applied to support the argument that the island is a whole habitat patch

The boundary is shown in Figure 43.

Including the entire island has also included a CCW monitoring station which is on the eastern side of the island.

**Figure 34. Potential Site boundary.**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 18.

**Table 18. Habitats with a viable patch size captured by the Potential Site boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	2.805	0.250
Moderate energy deeper water rock	0.272	0.250
High energy shallow water rock	0.416	0.025
Moderate energy shallow water rock	0.958	0.025
High energy intertidal rock	0.122	0.005
Low energy intertidal rock	0.038	0.025
Moderate energy intertidal rock	0.053	0.005
Subtidal macrophyte communities	0.349	0.250
Subtidal mixed sediments	0.404	0.250

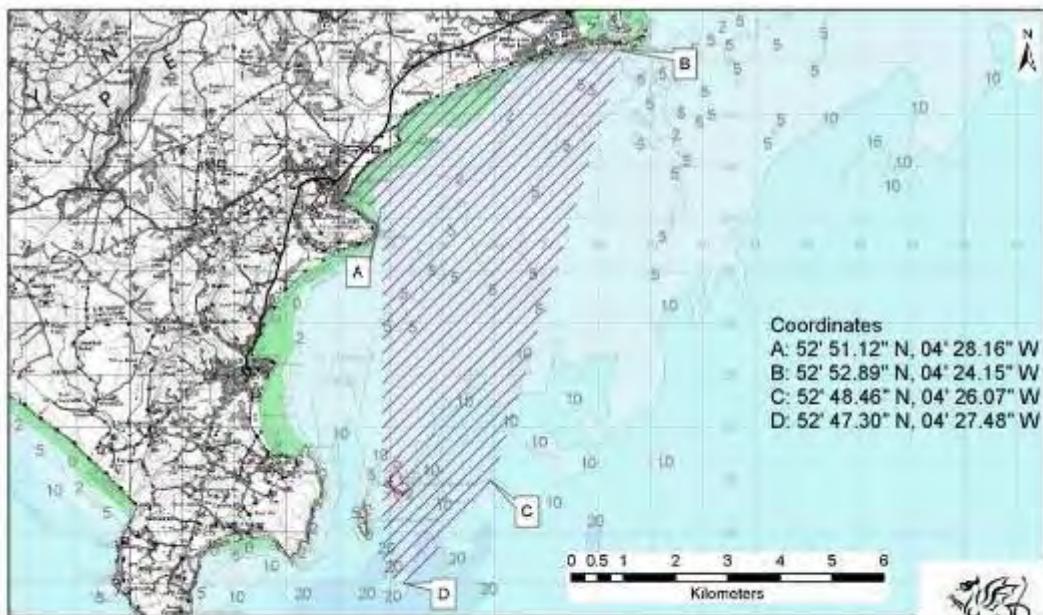
Subtidal sand	0.362	0.250
<b><i>Important Habitat</i></b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	10pts	1pt
Sediment habitats with long-lived bivalves	1pt	1pt

This boundary could be reduced in size at the southern end of the site as there is more sediment than required by the indicative viability targets. As there are a number of ways in which this could be done, the boundary has been left as it is to allow for greater flexibility when drawing a final boundary.

This produces a site size of **10.5 km<sup>2</sup>**.

## 5. St Tudwal's Island East and Llanbedrog / Ynys Ddwyreiniol Tudwal a Llanbedrog (formerly called Tudwals and Llanbedrog)

**Figure 35. St Tudwal's Island East and Llanbedrog Potential Site**



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Uwchradd Cymru  
Welsh Government

The Focus Site includes the following habitats:

- Low energy intertidal rock
- High energy intertidal rock
- Intertidal coarse sediment
- Intertidal sand
- Moderate energy shallow water rock
- High energy shallow water rock
- Moderate energy deeper water rock
- High energy deeper water rock
- Subtidal sand
- Subtidal macrophyte communities
- Subtidal mixed sediments
- Blue mussel (*Mytilus edulis*) beds
- Subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea*
- Sheltered muddy gravels

- Subtidal mixed muddy sediments
- Areas of high productivity

### **Step 1**

This site was originally two sites, one around the St Tudwal's Islands and the other around Llanbedrog. Because of this many of the habitats that are of interest are distributed around these areas. Habitats that are limited in their distribution around Llanbedrog are:

- Low energy intertidal rock
- Intertidal sand
- Intertidal coarse sediment
- Blue mussel (*Mytilus edulis*) beds
- Sheltered muddy gravels

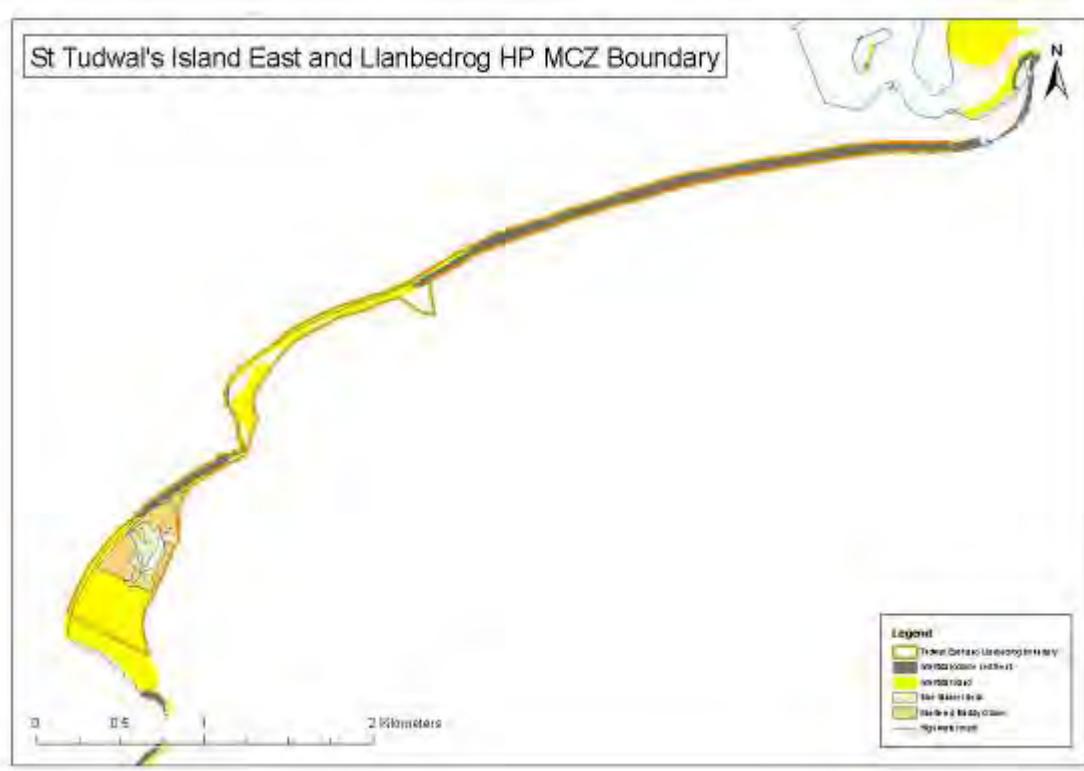
The distribution of these habitats and the boundary drawn are shown in Figures 36 & 37.

Habitats that are limited in their distribution around the St Tudwal's Islands are:

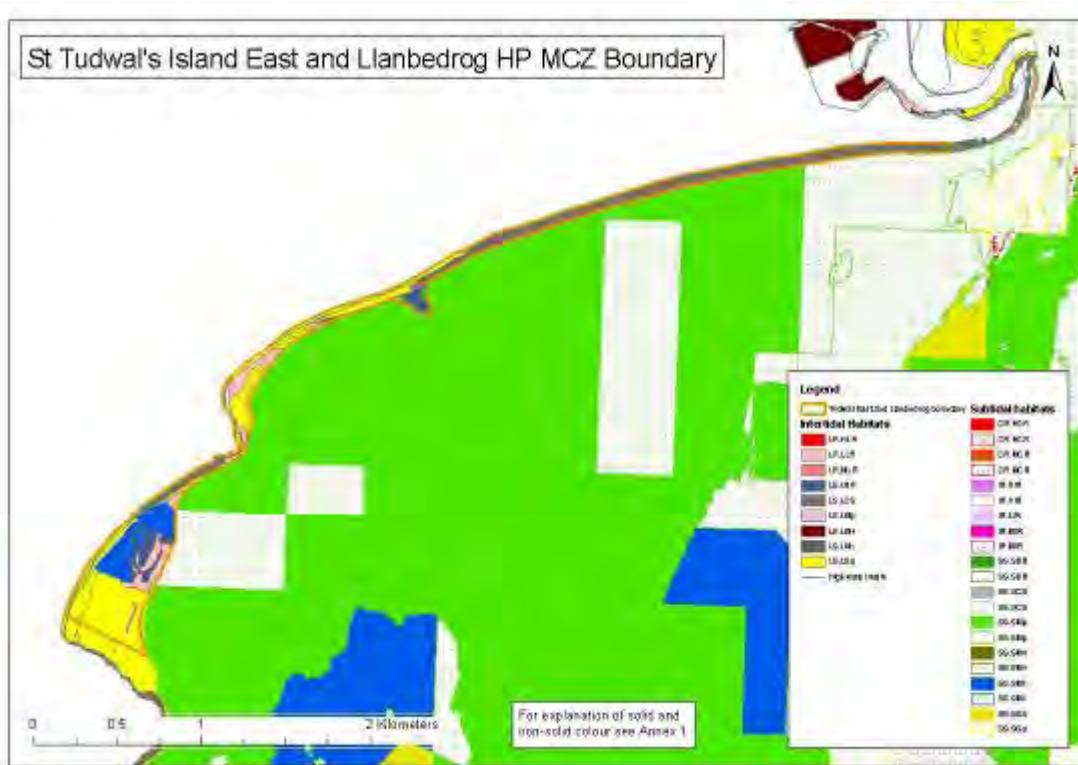
- High energy intertidal rock
- Moderate energy shallow water rock
- High energy shallow water rock
- Moderate energy deeper water rock
- High energy deeper water rock
- Subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea*

The other habitats are found between the two areas.

**Figure 36. Step 1 – limited distribution habitats around Llanbedrog: intertidal coarse sediments (grey), intertidal sand (yellow), blue mussel beds (pale green), sheltered muddy gravel (orange)**



**Figure 37. Map showing the broadscale habitats captured by the Step 1 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 19.

**Table 19. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
Low energy intertidal rock	0.071	0.025
Intertidal coarse sediment	0.232	0.025
Intertidal sand	0.291	0.250
<b>Important Habitat</b>		
Blue mussel ( <i>Mytilus edulis</i> ) beds	0.042	0.025
Sheltered muddy gravels	0.097	0.025

The site also included 0.252km<sup>2</sup> of area of high productivity enough to reach the viability targets,

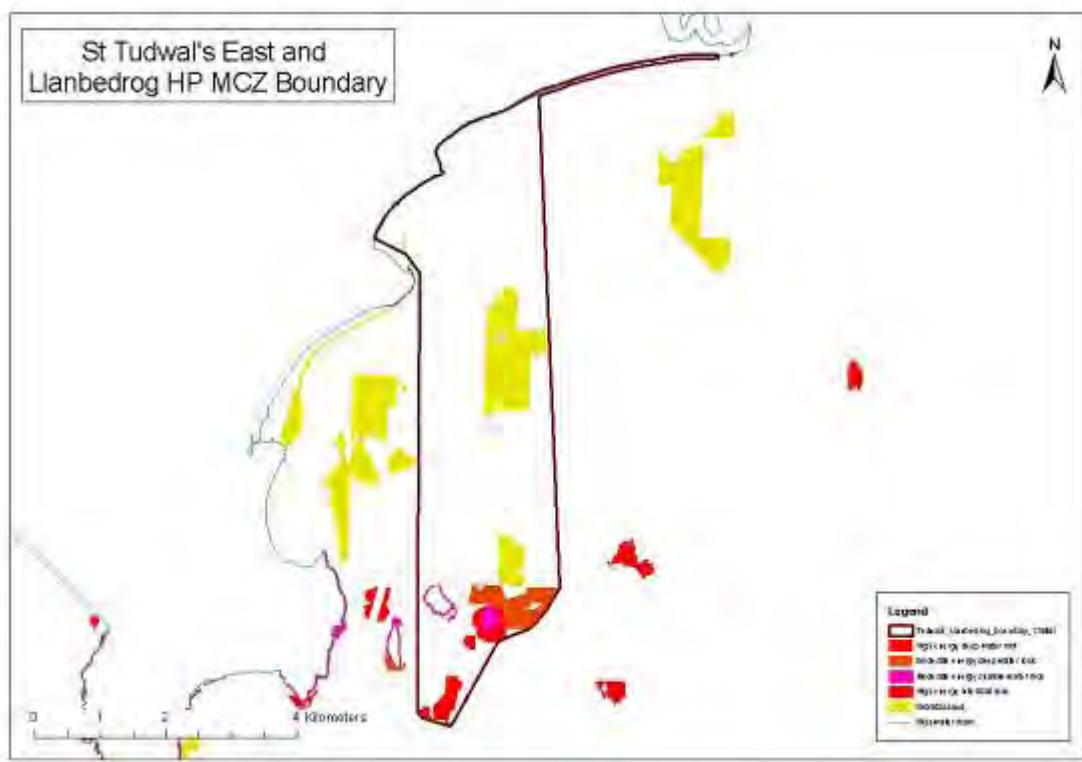
The following habitats were not captured by Step 1:

- High energy intertidal rock
- Moderate energy shallow water rock
- High energy shallow water rock
- Moderate energy deeper water rock
- High energy deeper water rock
- Subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea*
- Subtidal sand
- Subtidal macrophyte communities
- Subtidal mixed muddy sediments

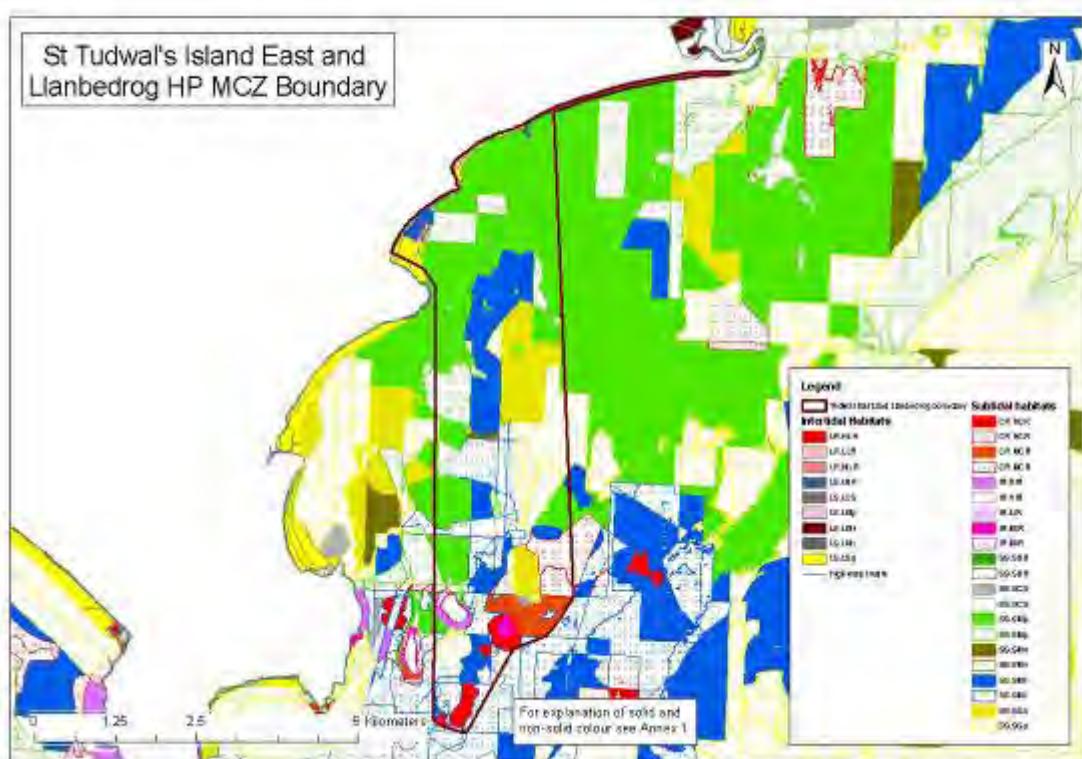
## **Step 2**

To incorporate all of the habitats above you need to include an area around St Tudwal's Island East (Figures 38 & 39).

**Figure 38. Step 2 – other limited distribution habitats: high energy deeper water rock (red), deeper water moderate energy rock (orange/brown), moderate energy shallow water rock (pink), subtidal sand (yellow)**



**Figure 39. Map showing the broadscale habitats captured by the Step 2 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 20.

**Table 20. Habitats with a viable patch size captured by the Step 2 boundary**

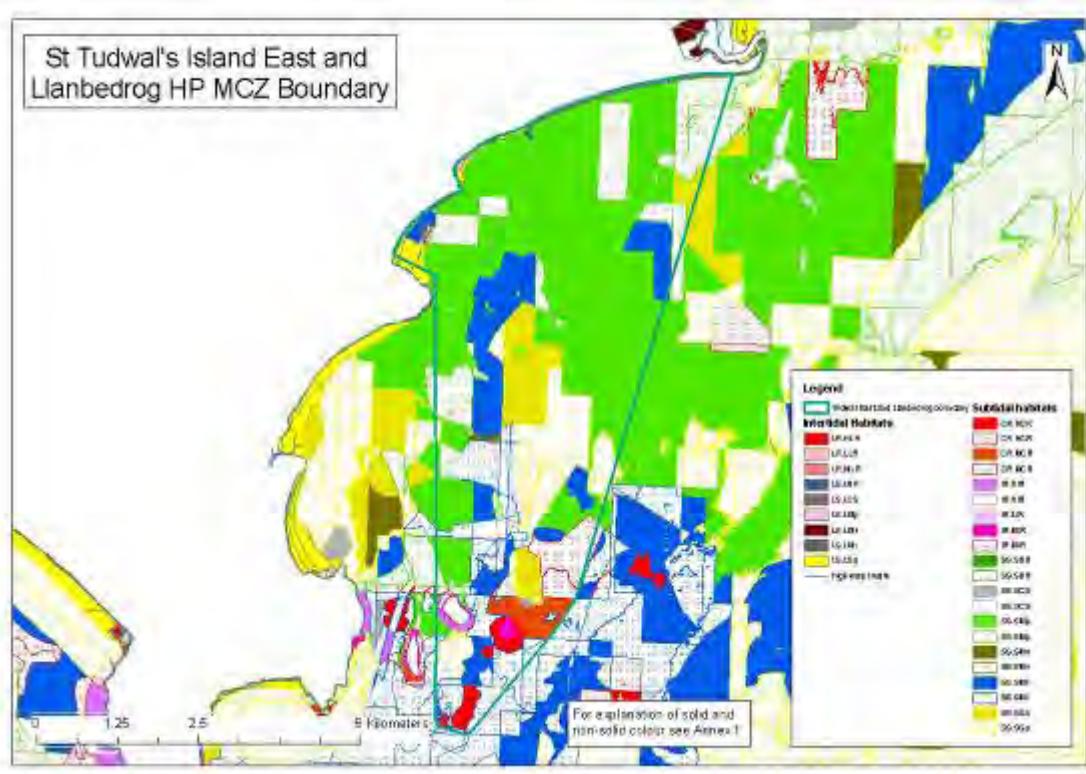
<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.399	0.250
Moderate energy deeper water rock	0.496	0.250
High energy shallow water rock	0.068	0.025
Moderate energy shallow water rock	0.074	0.025
High energy intertidal rock	0.017	0.005
Low energy intertidal rock	0.071	0.025
Intertidal coarse sediment	0.232	0.025
Intertidal sand	0.291	0.250
Subtidal macrophyte communities	5.604	0.250
Subtidal mixed sediments	2.266	0.250
Subtidal sand	1.440	0.250
<b>Important Habitat</b>		
Blue mussel ( <i>Mytilus edulis</i> ) beds	0.042	0.025
Sheltered muddy gravels	0.097	0.025
Subtidal mixed muddy sediments	1.586	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	3pts	1 pt

All habitats are captured in this boundary; however it has a very large indentation and other smaller indentations.

### **Step 3**

The indentations were removed (Figure 40).

**Figure 40. Map showing the broadscale habitats captured by the Step 3 boundary, removing the indentations**



A report was run on this boundary to see the extent of habitats present in viable amounts. The result is shown in Table 21.

**Table 21. Habitats with a viable patch size captured by the Step 3 boundary.**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.399	0.250
Moderate energy deeper water rock	0.496	0.250
High energy shallow water rock	0.068	0.025
Moderate energy shallow water rock	0.074	0.025
High energy intertidal rock	0.017	0.005
Low energy intertidal rock	0.071	0.025
Intertidal coarse sediment	0.232	0.025
Intertidal sand	0.291	0.250

Subtidal macrophyte communities	12.385	0.250
Subtidal mixed sediments	2.910	0.250
Subtidal sand	1.648	0.250
<b><i>Important Habitat</i></b>		
Blue mussel ( <i>Mytilus edulis</i> ) beds	0.042	0.025
Sheltered muddy gravels	0.097	0.025
Subtidal mixed muddy sediments	2.538	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	3pts	1 pt

### **Comments and additional considerations**

Site size 28.2 km<sup>2</sup>.

The boundary for this site is strongly influenced by being made up of two original Focus Sites. There are a number of options, but Llanbedrog has to be represented in order to obtain sheltered muddy gravel and blue mussel bed habitats which was one of the principle drivers for this site being selected. There is greater flexibility around the St Tudwal's Islands where there are more examples of the relevant habitats. Joining St Tudwal's Island East to the coast around Abersoch would enable the inclusion of intertidal sand, but intertidal coarse sediment would be less easy to include. The presence of an outfall and pipeline at Llanbedrog beach unfortunately cuts off part of the beach and as such results in only a partial habitat patch being included. It may be possible that this outfall could be included within the site, but the compatibility of this within a highly protected MCZ will need to be determined. There is considerable value in the inclusion of the subtidal mixed muddy sediments and subtidal macrophyte communities as these are diverse and typical to Tremadog Bay and some other areas of inshore Welsh waters.

The TAG agreed the presence of long term monitoring stations as an additional consideration that could be used to extend boundaries. There are a

number of these points within the boundary. There is a MarClim<sup>30</sup> station at Llanbedrog Head (Figure 41) but its inclusion would mean including an outfall, pipe and cable, which as already mentioned would need to be investigated further to determine suitability for inclusion.

**Figure 41. Map showing Marclim monitoring points**



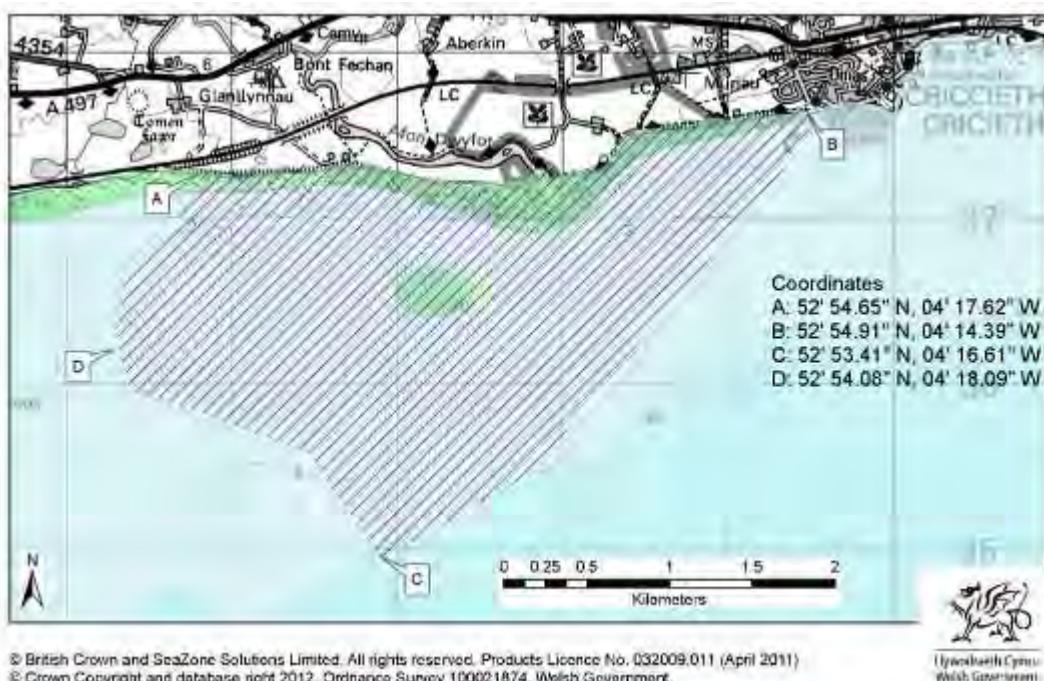
It was not considered necessary to apply any additional considerations to this site.

There are boulder sea defences in parts of this site (east of Traeth Crugan) which will need to be investigated further to decide whether their removal from the site boundary is necessary or whether inclusion within the site would be possible without compromising the ecological integrity and/or management objectives of the site.

<sup>30</sup>MarClim is a project created to investigate the effects of climatic warming on marine biodiversity. In particular the project aimed to use key intertidal species, whose abundances had been shown to fluctuate with changes in climatic conditions, as indicators of changes occurring in the intertidal and offshore.

## 6. Mouth of the Dwyfor / Aber Afon Dwyfor (formerly called Traeth Afon Wen)

**Figure 42. Aber Afon Dwyfor Potential Site.**



This site has been selected for the following habitats:

- High energy intertidal rock
- Intertidal coarse sediment
- High energy shallow water rock
- Low energy intertidal rock
- Subtidal sand
- Intertidal boulder communities
- Blue mussel (*Mytilus edulis*) beds
- Honeycomb worm (*Sabellaria alveolata*) reefs
- Areas of High Productivity

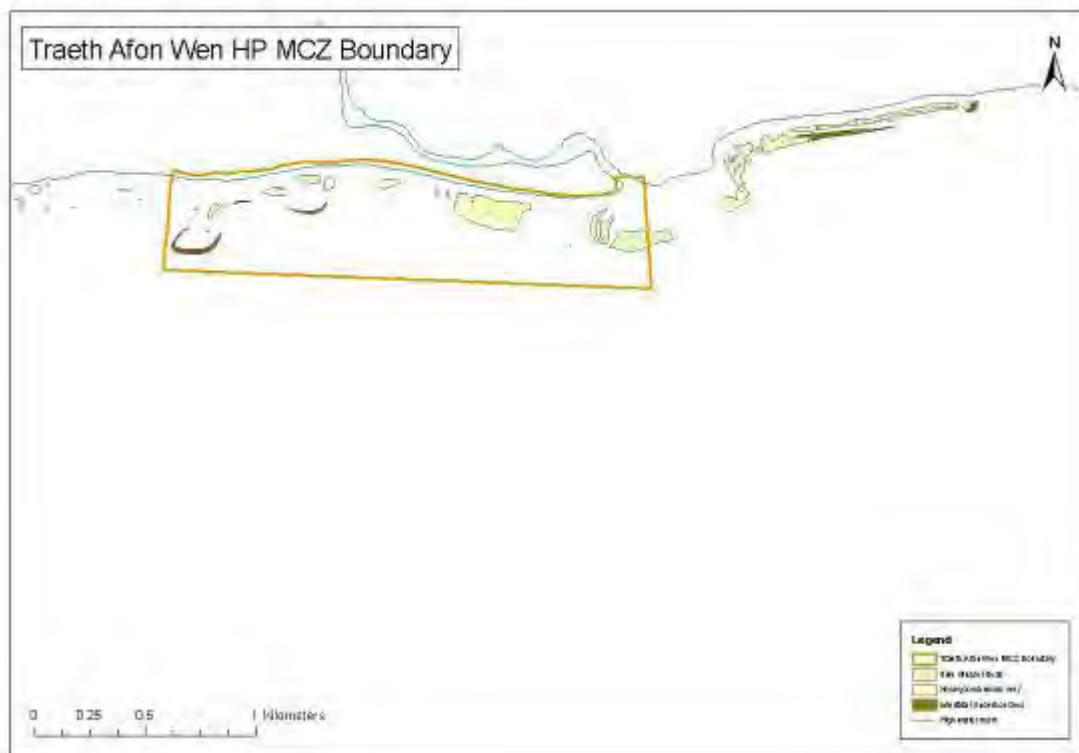
### **Step 1**

There are a number of habitats that are of limited distribution:

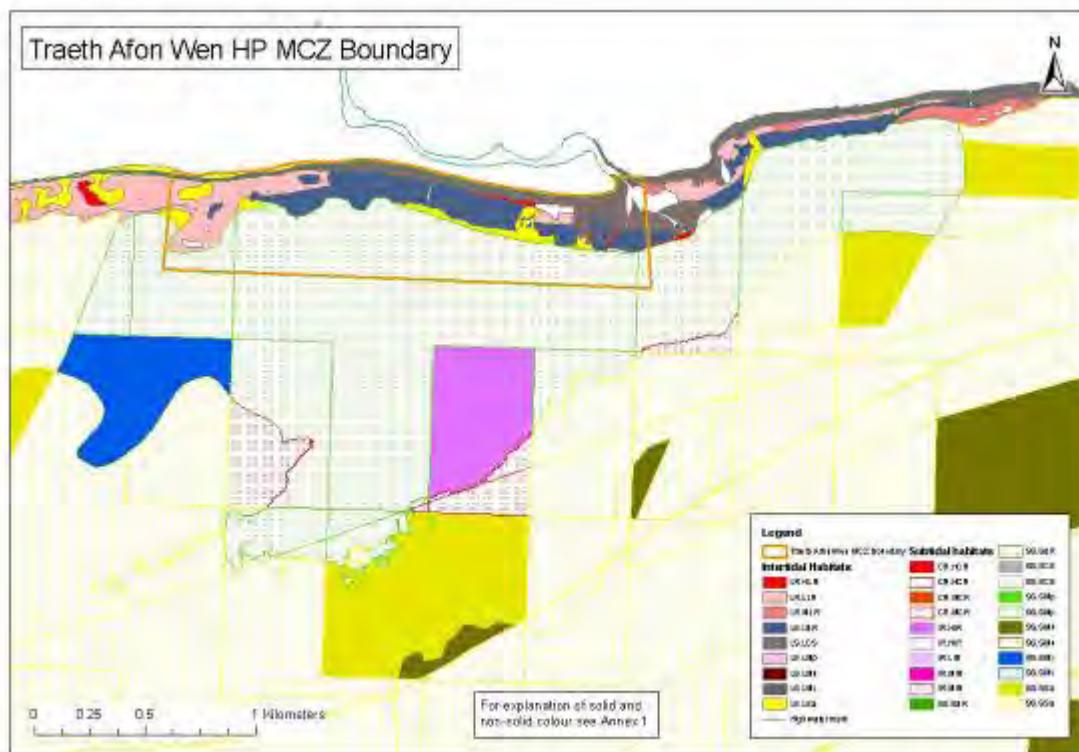
- Intertidal boulder communities
- Blue mussel (*Mytilus edulis*) beds

A boundary was drawn to include these habitats (Figures 43 & 44).

**Figure 43. Step 1 boundary – limited distribution habitats: blue mussel beds (pale green), honeycomb worm reefs (yellow), intertidal boulder communities (brown)**



**Figure 44. Map showing the broadscale habitats captured by the Step 1 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 22.

**Table 22. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy intertidal rock	0.006	0.005
Low energy intertidal rock	0.109	0.025
Intertidal coarse sediment	0.125	0.025
<b>Important Habitat</b>		
Blue mussel ( <i>Mytilus edulis</i> ) beds	0.027	0.025
Intertidal boulder communities	0.008	0.002
Honeycomb worm ( <i>Sabellaria alveolata</i> ) reefs	0.046	0.250

This boundary also captured 0.740 km<sup>2</sup> of high productivity area, enough to meet viability targets for this habitat.

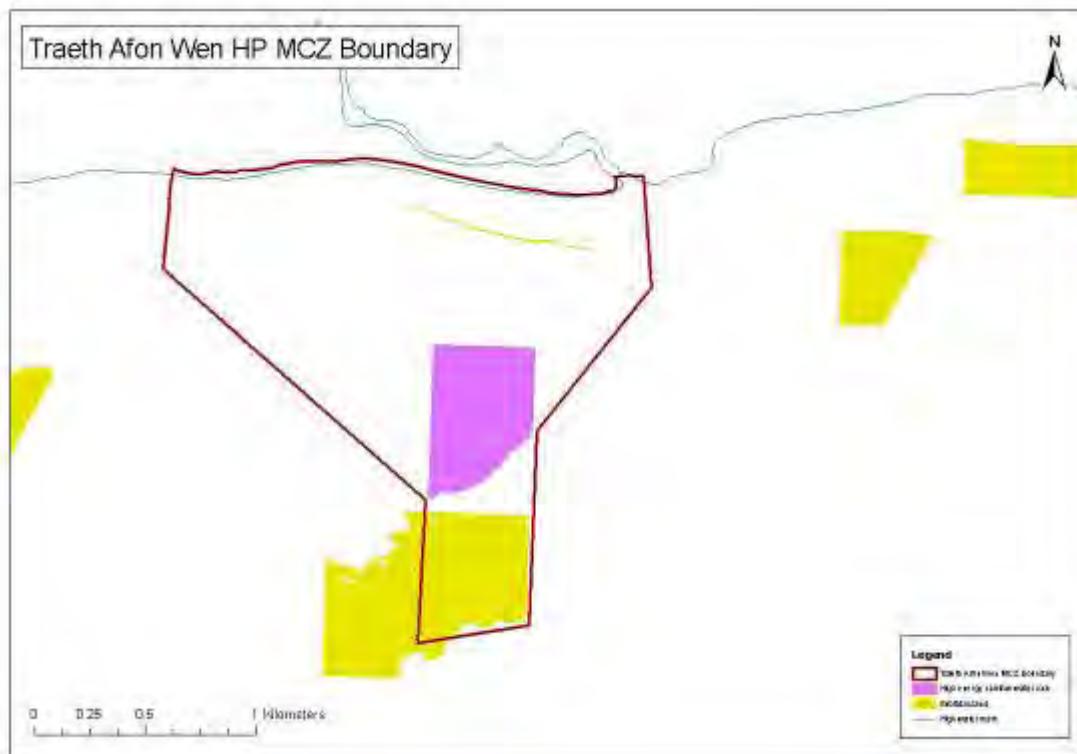
The following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 1 boundary:

- High energy shallow water rock
- Subtidal sand

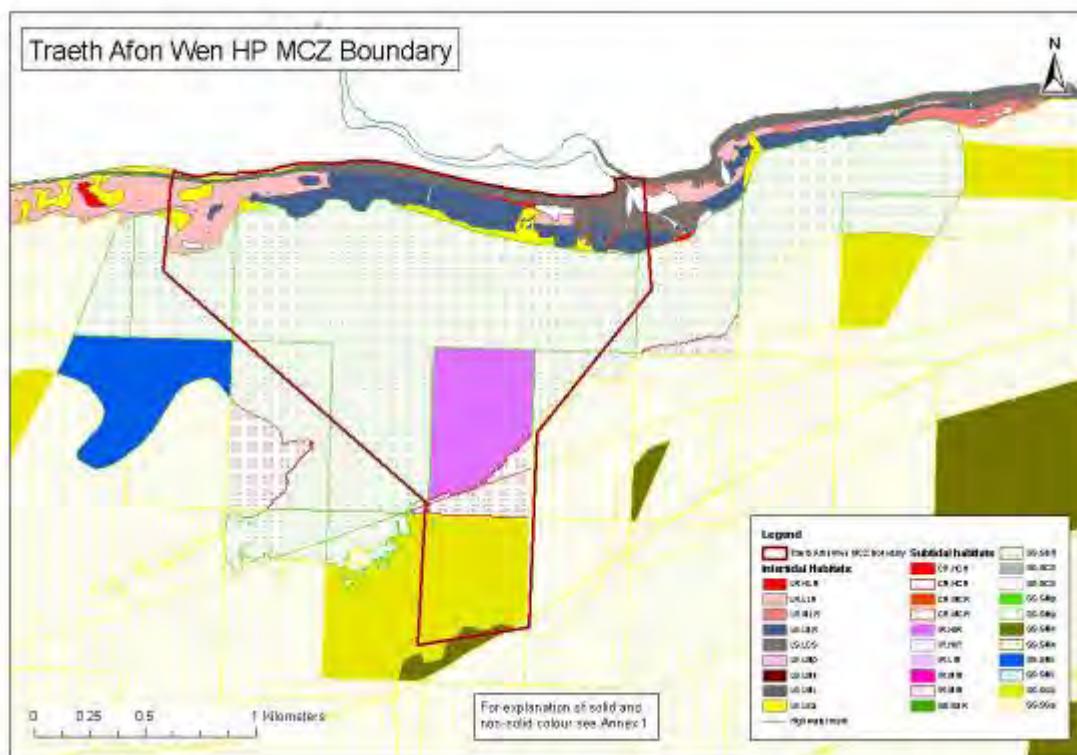
## **Step 2**

This step added the missing subtidal habitats listed above (Figures 45 & 46).

**Figure 45. Step 2 boundary – subtidal habitats: high energy shallow water rock (pink), subtidal sand (yellow)**



**Figure 46. Map showing the broadscale habitats captured by the Step 2 boundary**



All of the habitats for which this site has been selected are found in the Step 2 boundary (Table 23). The boundary however has some large indentations. It is also worth noting that this boundary does not conform to boundary principle 3 (whole habitat patches/drawn to natural features) in the intertidal area.

**Table 23. Habitats with a viable patch size captured by the Step 2 boundary**

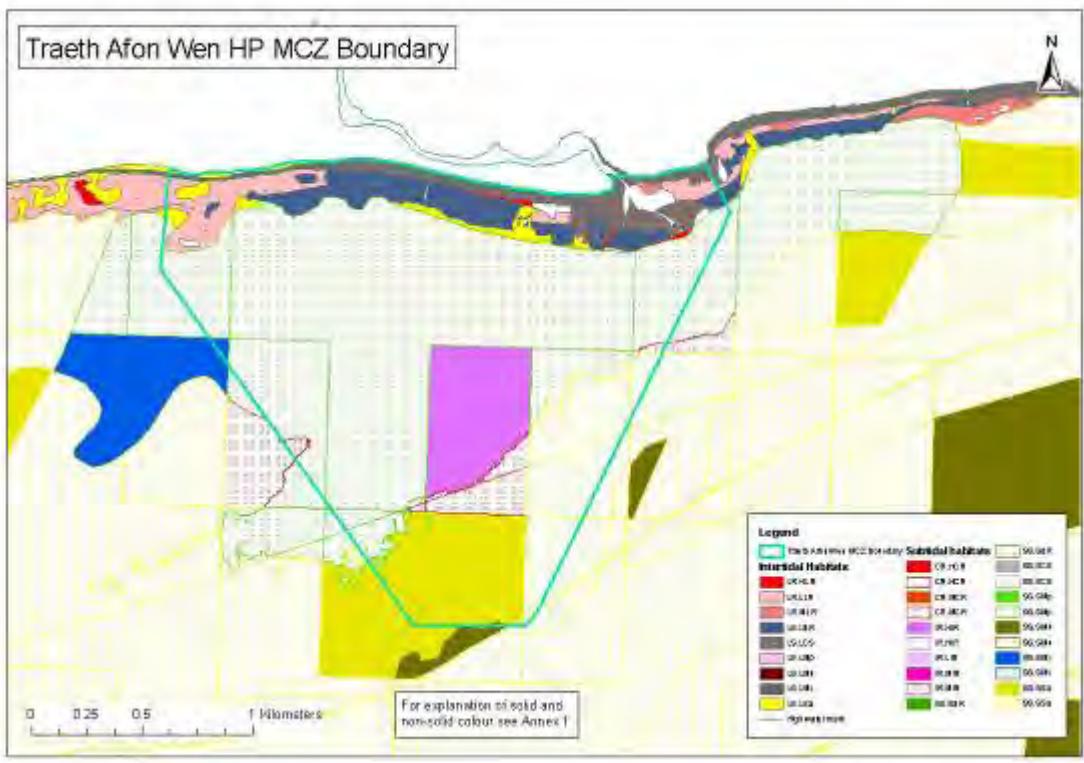
<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy shallow water rock	0.265	0.025
High energy intertidal rock	0.006	0.005
Low energy intertidal rock	0.109	0.025
Intertidal coarse sediment	0.125	0.025
Subtidal sand	0.260	0.250
<b>Important Habitat</b>		
Blue mussel ( <i>Mytilus edulis</i> ) beds	0.027	0.025
Intertidal boulder communities	0.008	0.002
Honeycomb worm ( <i>Sabellaria alveolata</i> ) reefs	0.046	0.250

### **Step 3**

This step removed the large indentations found in the site boundary created in Step 2. Also in Step 2 the blue mussel bed habitat has been truncated at the eastern end of the site and as such it does not conform to boundary principle 3 (to include whole habitat patches). The mouth of the Afon Dwyfor here results in a dynamic area where the channels and banks change positions over time. Therefore this whole area has been included in the Step 3 boundary (Figure 47).

A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 24.

**Figure 47. Map showing the broadscale habitats captured by the Step 3 boundary**



**Table 24. Habitats with a viable patch size captured by the Step 3 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy shallow water rock	0.265	0.025
High energy intertidal rock	0.009	0.005
Low energy intertidal rock	0.128	0.025
Intertidal coarse sediment	0.168	0.025
Subtidal sand	0.307	0.250
<b>Important Habitat</b>		
Blue mussel ( <i>Mytilus edulis</i> ) beds	0.032	0.025
Intertidal boulder communities	0.008	0.002
Honeycomb worm ( <i>Sabellaria alveolata</i> ) reefs	0.048	0.250

## **Comments and additional considerations**

Site size is **3.5 km<sup>2</sup>**.

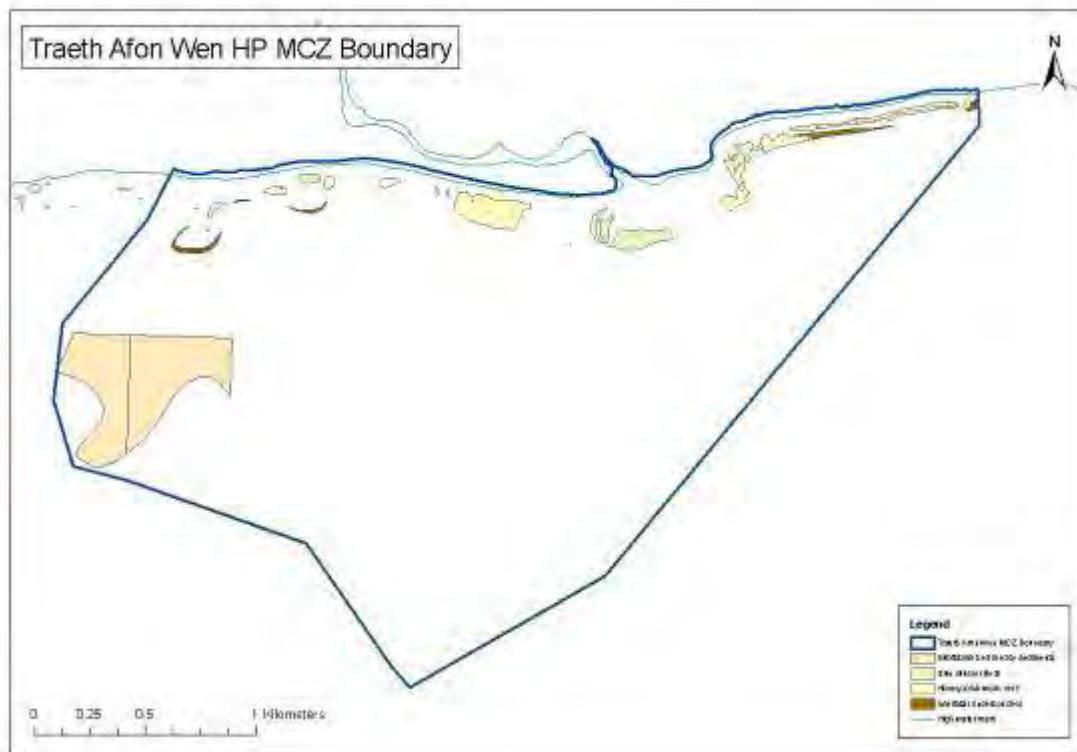
Whilst this site does meet all of the targets for the habitats for which it was selected the boundary was improved by applying the following further additional considerations:

- **Ecological quality:** This proposed eastward extension of the boundary would also encompass more honeycomb worm reef to the east of the Afon Dwyfor that is higher quality than that in the original site boundary (denser aggregations of worms). The better quality honeycomb worm reef will better support this important habitat across the whole boundary area.
- **Increasing Habitat Heterogeneity:** There are two additional habitats that would benefit from the inclusion within the site boundary, subtidal mud and subtidal mixed sediments (subtidal mixed muddy sediments). The inclusion of these habitats would boost the habitat heterogeneity of the site.

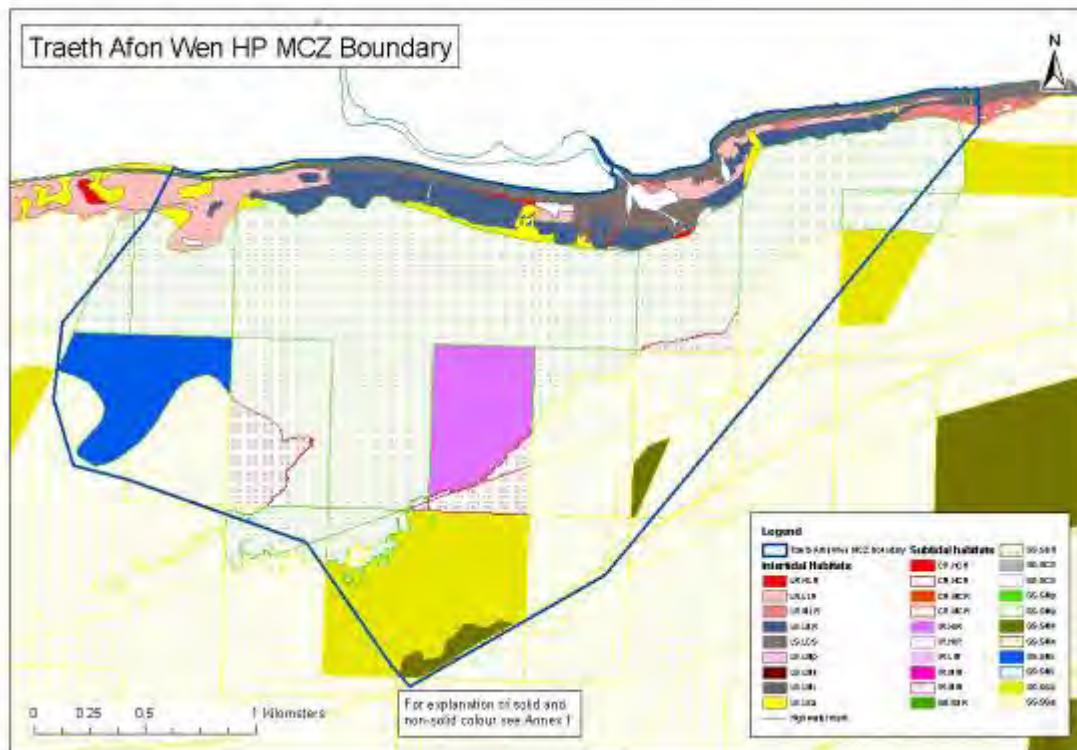
## **Step 4 – additional considerations**

Figures 48 and 49 show a boundary that addresses the above points and results in a site with higher habitat heterogeneity than originally proposed.

**Figure 48. Additional considerations (Step 4) boundary showing important habitats subtidal mixed muddy sediments (pale orange), blue mussel beds (pale green), honeycomb worm reefs (pale yellow), intertidal boulder communities (brown)**



**Figure 49. Additional considerations (Step 4) boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 25.

**Table 25. Habitats with a viable patch size captured by the Step 4 boundary.**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy shallow water rock	0.265	0.025
High energy intertidal rock	0.009	0.005
Low energy intertidal rock	0.166	0.025
Moderate energy intertidal rock	0.031	0.025
Intertidal biogenic reefs	0.255	0.025
Intertidal coarse sediments	0.233	
Subtidal mixed sediments	0.261	0.250
Subtidal sand	0.456	0.250
<b>Important Habitat</b>		
Blue mussel ( <i>Mytilus edulis</i> ) beds	0.040	0.025
Intertidal boulder communities	0.016	0.002
Honeycomb worm ( <i>Sabellaria alveolata</i> ) reefs	0.087	0.250
Subtidal mixed muddy sediments	0.261	0.250

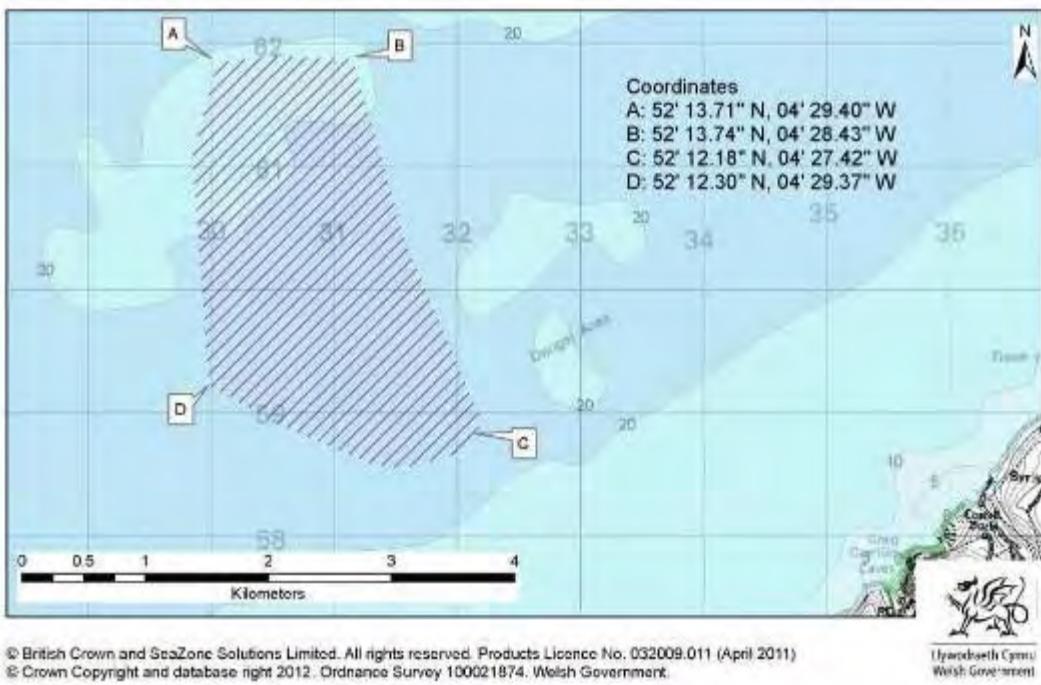
This produces a site size of **6.0 km<sup>2</sup>**

This site boundary means that the site has a broadscale habitat score of 7 and important habitat score of 4, giving the site a habitat heterogeneity score of High. The original site scored Medium (for more information about habitat heterogeneity scores see Part 6 and Annex 5).

This boundary has moved and is no longer that close to the Afon Wen and as a result the name has been changed to Aber Afon Dwyfor.

## 7. New Quay offshore / Ceinewydd (môr)

**Figure 50. New Quay Offshore Potential Site.**



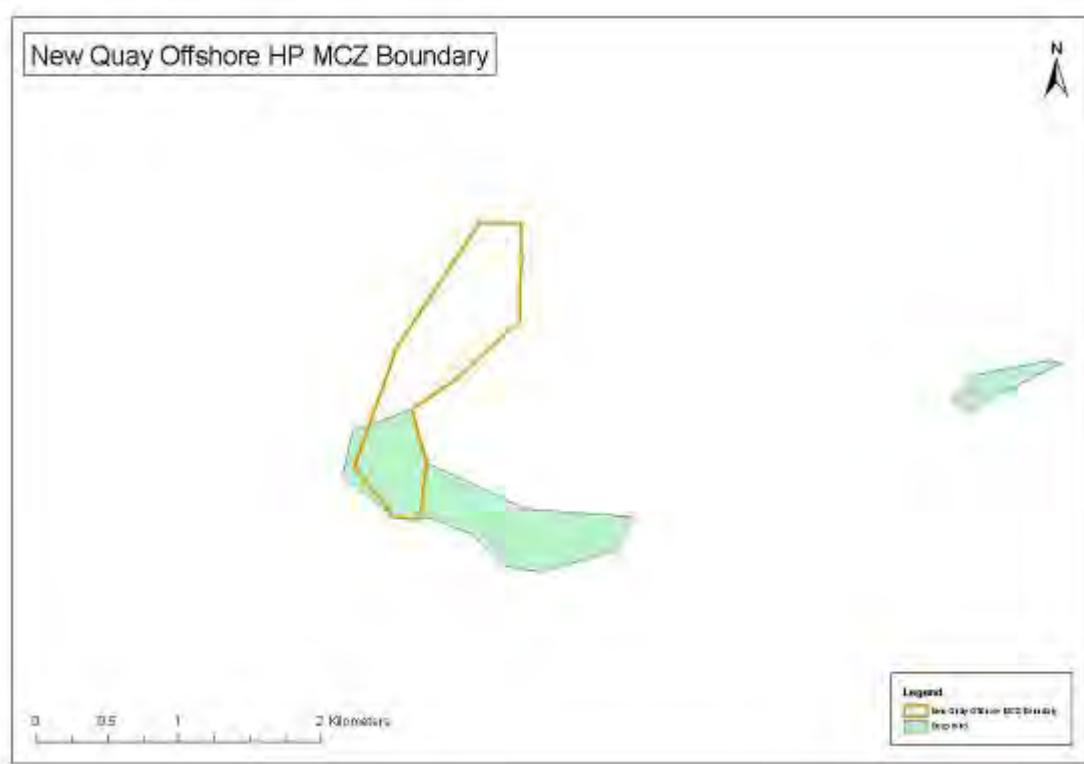
The Focus Site includes the following habitats:

- Subtidal coarse sediment
- Subtidal mud
- Subtidal mixed sediments
- Subtidal sand
- Sediment habitats with long-lived bivalves
- Mud habitats in deep water

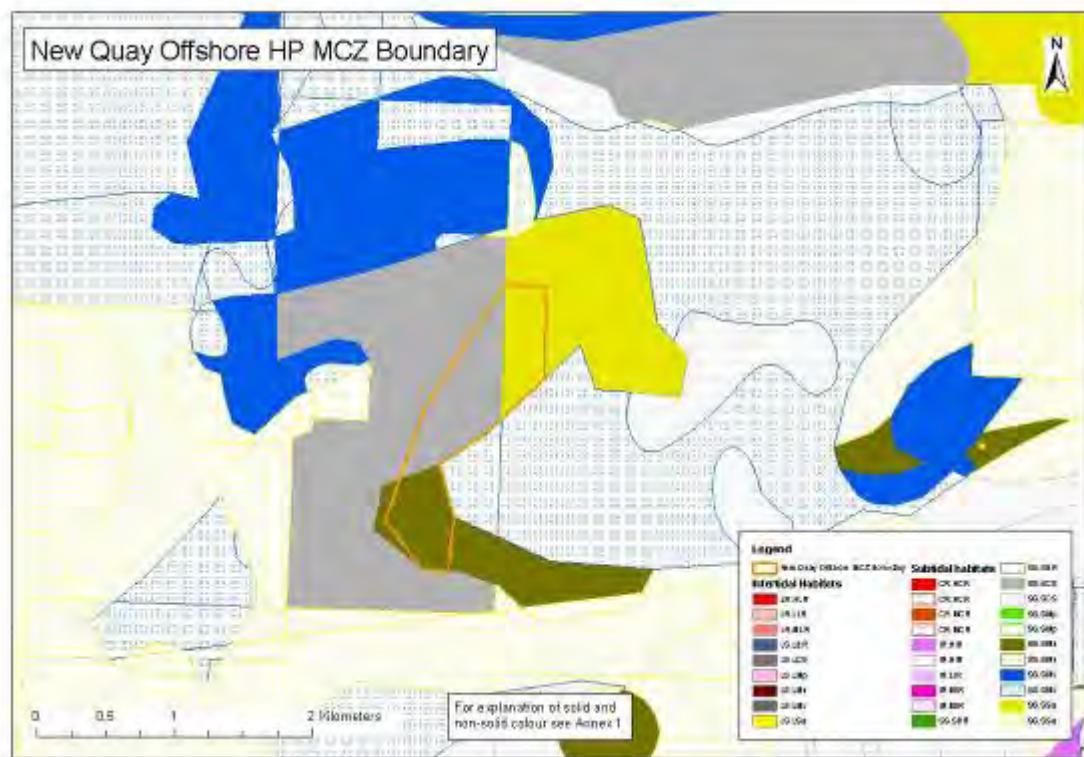
### **Step 1**

The first step required in drawing this boundary is not obvious, as each of the habitats present in this site is only found in one area, with only subtidal coarse sediment being more widespread. A boundary was drawn that includes subtidal mud, coarse sediment and sand (Figures 51 & 52).

**Figure 51. Step 1 boundary, important habitats (deep water mud)**



**Figure 52. Broadscale habitats captured by the Step 1 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 26.

**Table 26. Habitats with a viable patch size captured by the Step 1 boundary**

<b><i>Broadscale Habitat</i></b>	<b><i>Area (km<sup>2</sup>) or number of data points (pts)</i></b>	<b><i>Target area (km<sup>2</sup>)</i></b>
Subtidal coarse sediment	0.461	0.25
Subtidal mud	0.266	0.25
Subtidal sand	0.251	0.25
<b><i>Important Habitat</i></b>		
Sediment with long lived bivalves	1 pt	1 pt
Mud habitats in deep water	0.266	0.25

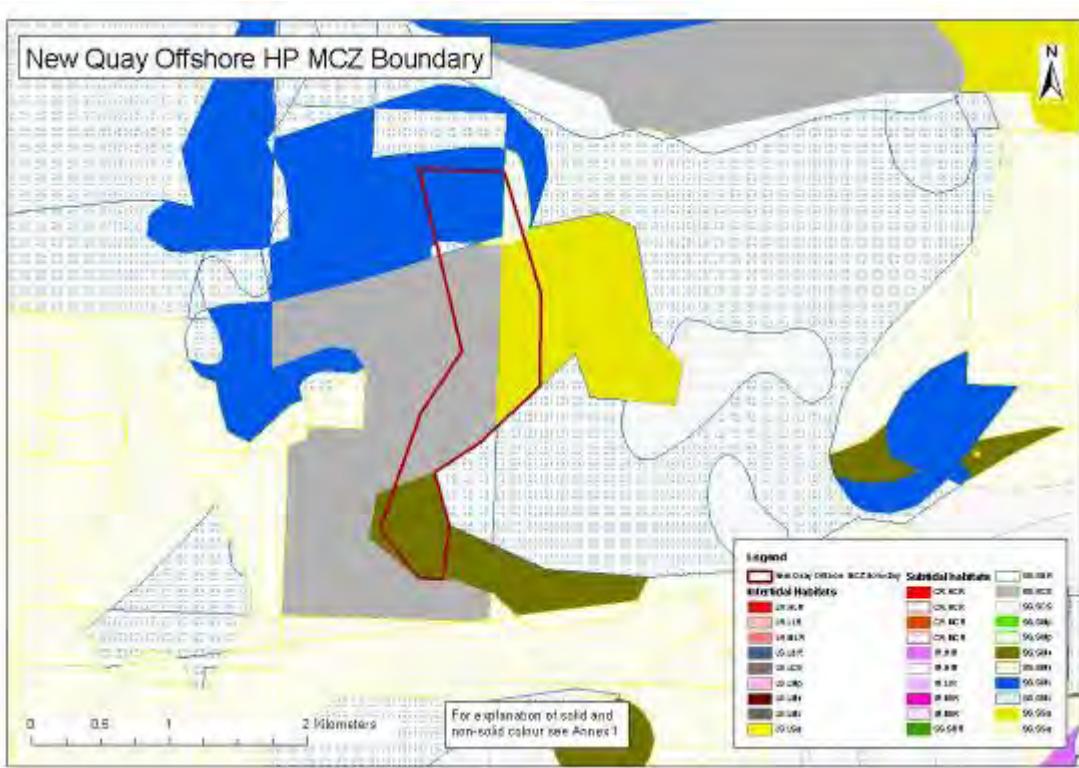
The following habitat that is originally included in the Focus Site is not present in viable amounts within the Step 1 boundary:

- Subtidal mixed sediments

## **Step 2**

The boundary was extended to include subtidal mixed sediments (Figure 53).

**Figure 53. Broadscale habitats captured by the Step 2 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 27.

**Table 27. Habitats with a viable patch size captured by the Step 1 boundary**

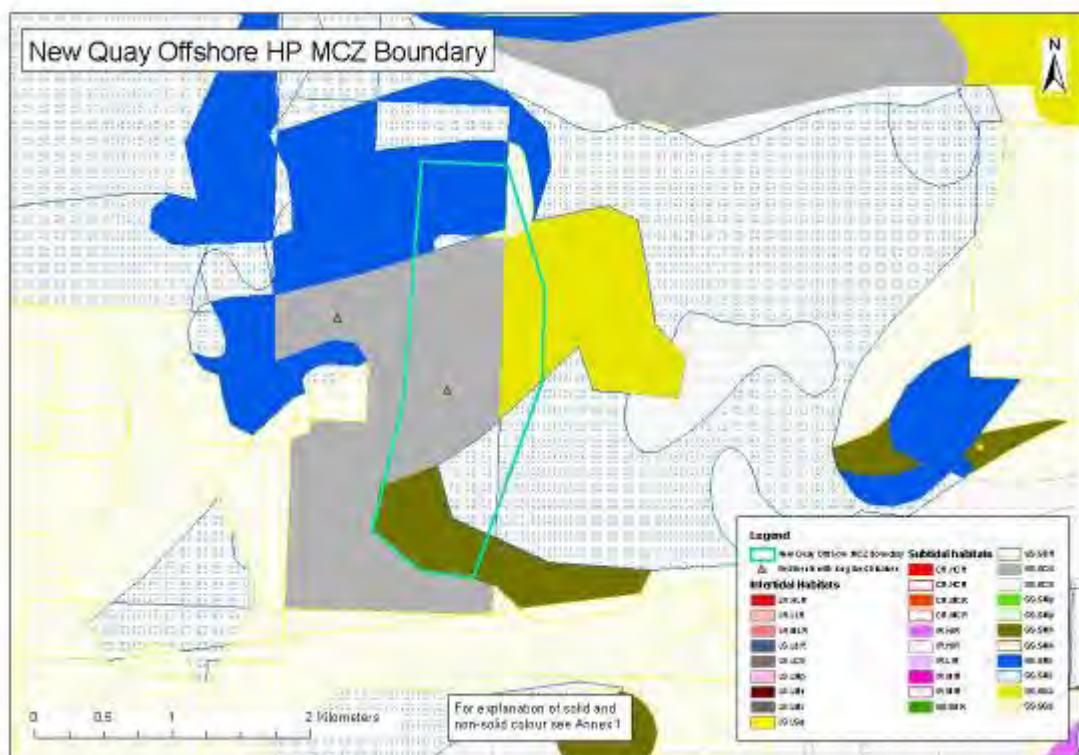
<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
Subtidal coarse sediment	0.683	0.25
Subtidal mud	0.266	0.25
Subtidal mixed sediments	0.284	0.25
Subtidal sand	0.336	0.25
<b>Important Habitat</b>		
Sediment with long lived bivalves	1 pt	1 pt
Mud habitats in deep water	0.266	0.25

The boundary at Step 2 includes all of the habitats in viable amounts that were present in original Focus Site boundary. There are, however, a number of issues with this boundary. The site is not a very compact shape and it also has a number of large indentations.

### **Step 3**

The site was altered to remove the indentations (Figure 54).

**Figure 54. Broadscale habitats captured by the Step 3 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 28.

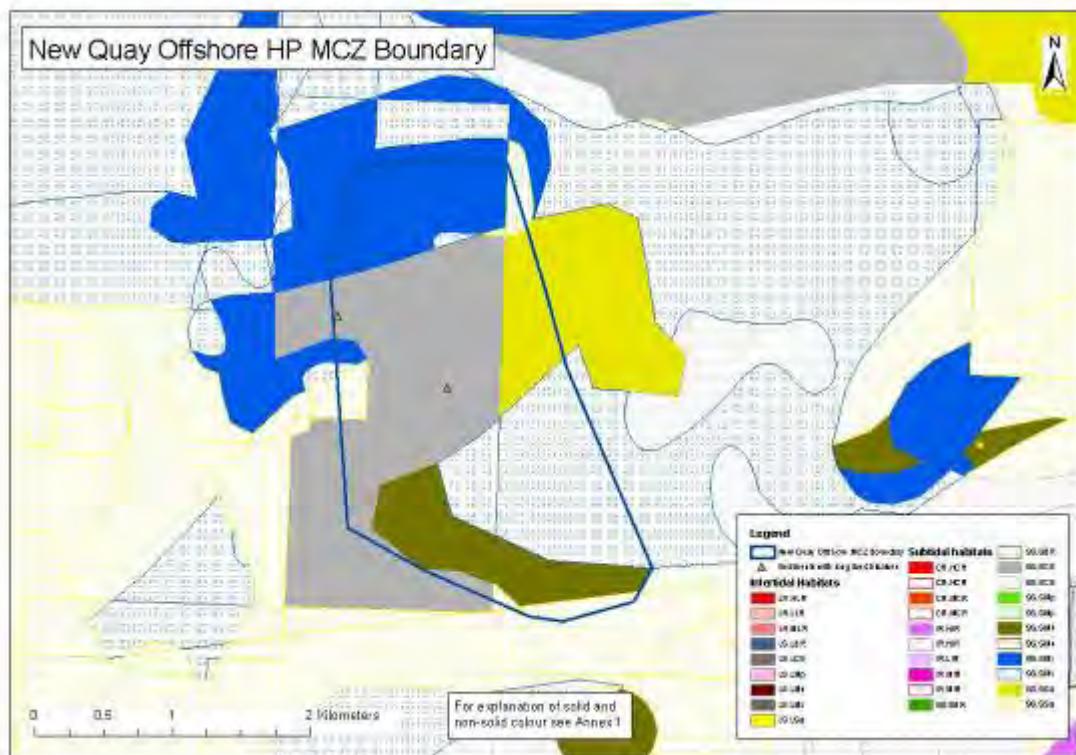
**Table 28. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
Subtidal coarse sediment	1.090	
Subtidal mud	0.399	
Subtidal mixed sediments	0.349	
Subtidal sand	0.336	
<b>Important Habitat</b>		
Sediment with long lived bivalves	1 pt	1 pt
Mud habitats in deep water	0.399	

#### **Step 4**

A boundary was drawn to make the site shape more compact (wider) (Figure 55).

**Figure 55. Broadscale habitats captured by the Step 4 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 29.

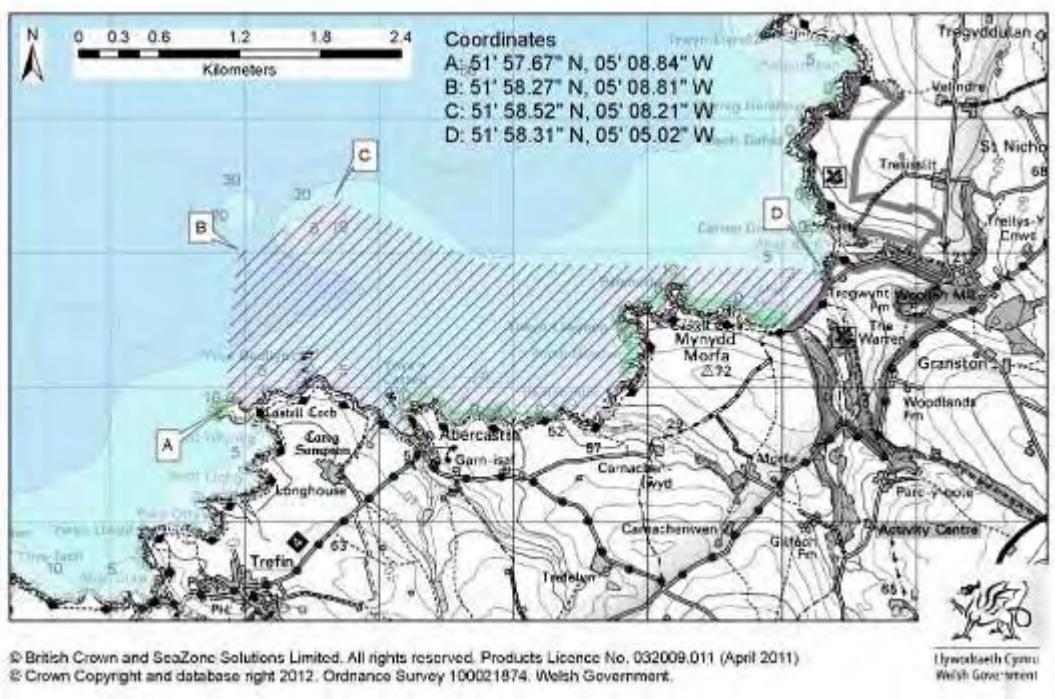
**Table 29. Habitats with a viable patch size captured by the Step 1 boundary**

<b><i>Broadscale Habitat</i></b>	<b><i>Area (km<sup>2</sup>) or number of data points (pts)</i></b>	<b><i>Target area (km<sup>2</sup>)</i></b>
Subtidal coarse sediment	1.855	0.25
Subtidal mud	0.759	0.25
Subtidal mixed sediments	0.788	0.25
Subtidal sand	0.387	0.25
<b><i>Important Habitat</i></b>		
Sediment with long lived bivalves	2 pts	1 pt
Mud habitats in deep water	0.846	0.25

This produces a site size of **5.3 km<sup>2</sup>**.

## 8. South West of Strumble Head / I'r De Orllewin o Ben Caer

**Figure 56. South West of Strumble Head Potential Site**



The Focus Site includes the following habitats:

- High energy intertidal rock
- Intertidal coarse sediment
- High energy deeper water rock
- Moderate energy deeper water rock
- High energy shallow water rock
- Moderate energy shallow water rock
- Moderate energy intertidal rock
- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea*
- Areas of high productivity

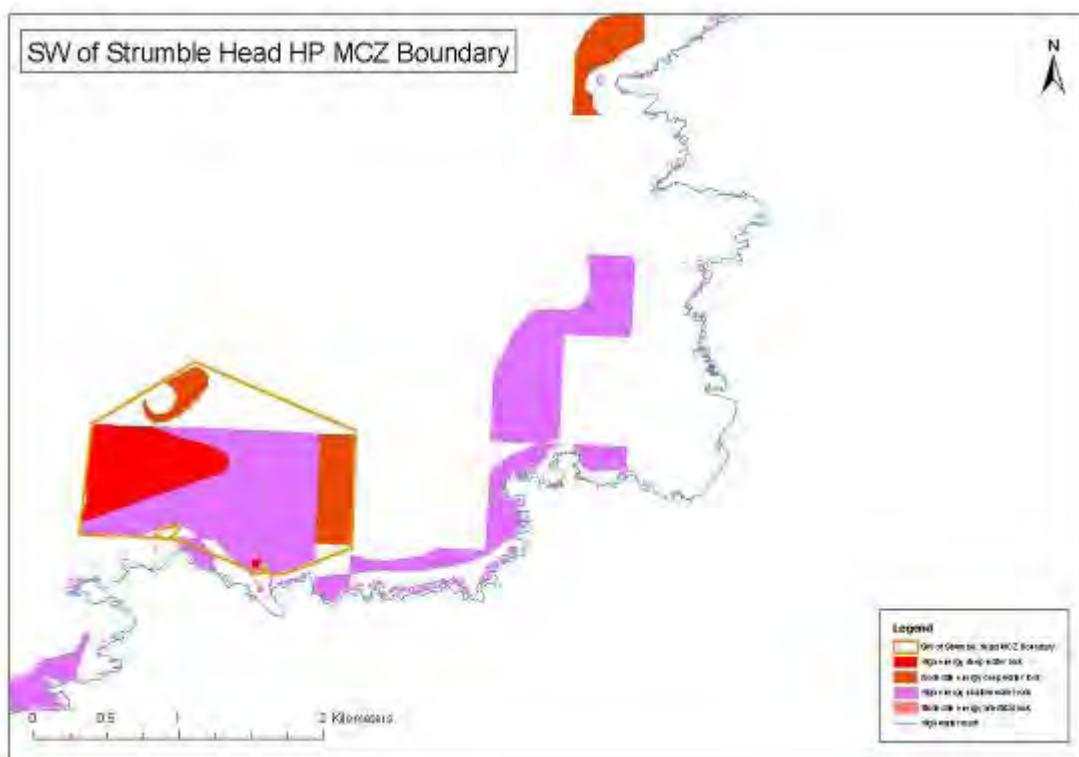
## **Step 1**

There are a number of habitats that are of limited distribution:

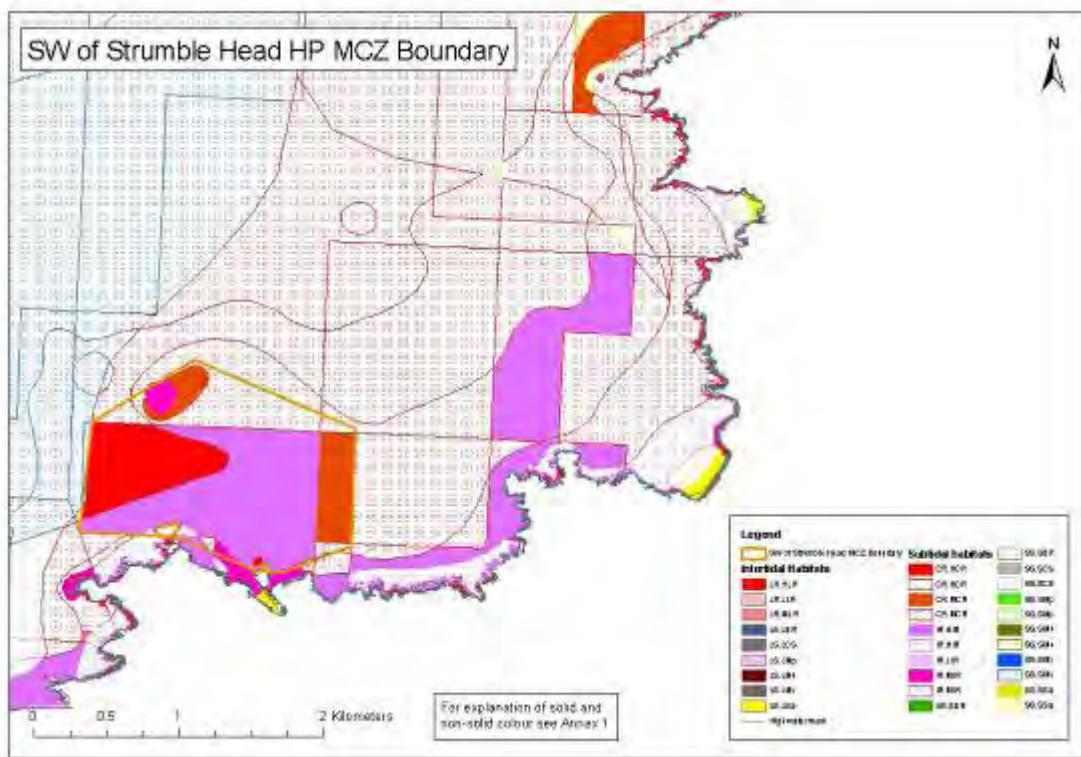
- High energy deeper water rock
- Moderate energy deeper water rock

The step 1 boundary was drawn to encompass these habitats (Figures 57 & 58).

**Figure 57. Step 1 – limited distribution habitats: high energy deeper water rock (red), moderate energy deeper water rock (orange/brown), high energy shallow water rock (pink-purple), moderate energy intertidal rock (salmon pink)**



**Figure 58. Broadscale habitats captured by the Step 1 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 30.

**Table 30. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.425	0.250
Moderate energy deeper water rock	0.255	0.250
High energy shallow water rock	0.880	0.025
Moderate energy shallow water rock	0.046	0.025
High energy intertidal rock	0.008	0.005
<b>Important habitat</b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	6 pts	1 Pt

Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	7 pts	1 Pt
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This boundary also captured 0.926 km<sup>2</sup> of high productivity area, enough to meet viability targets for this habitat.

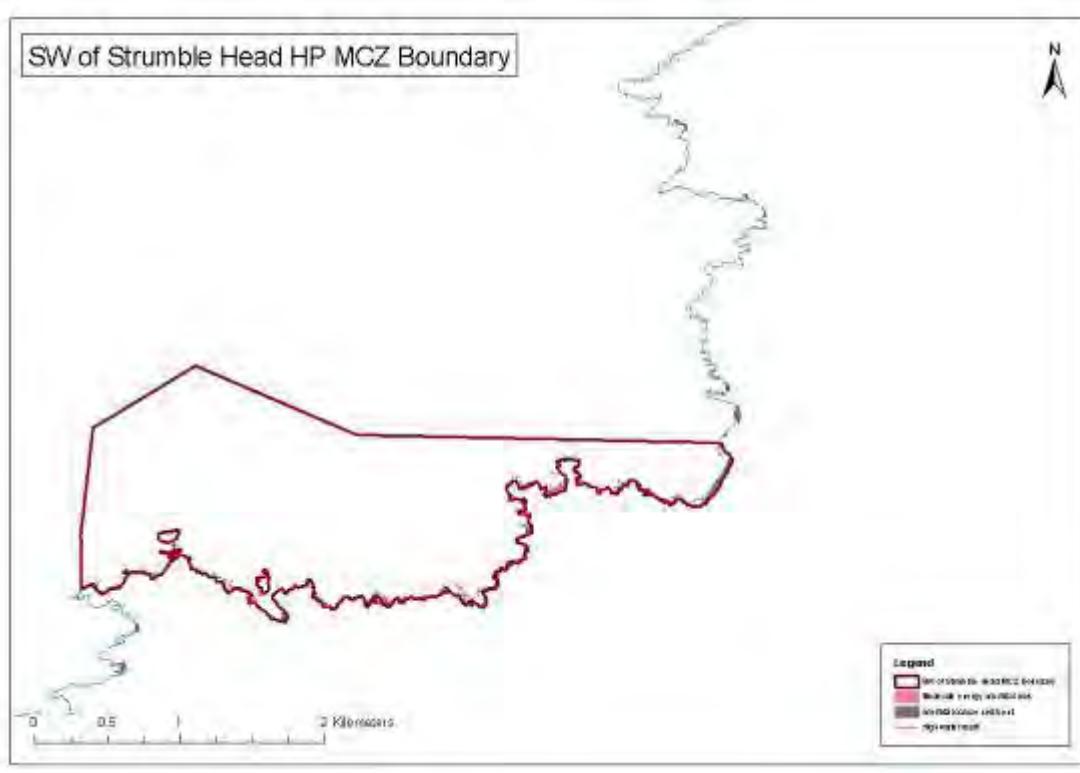
The following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 1 boundary:

- Intertidal coarse sediment
- Moderate energy intertidal rock

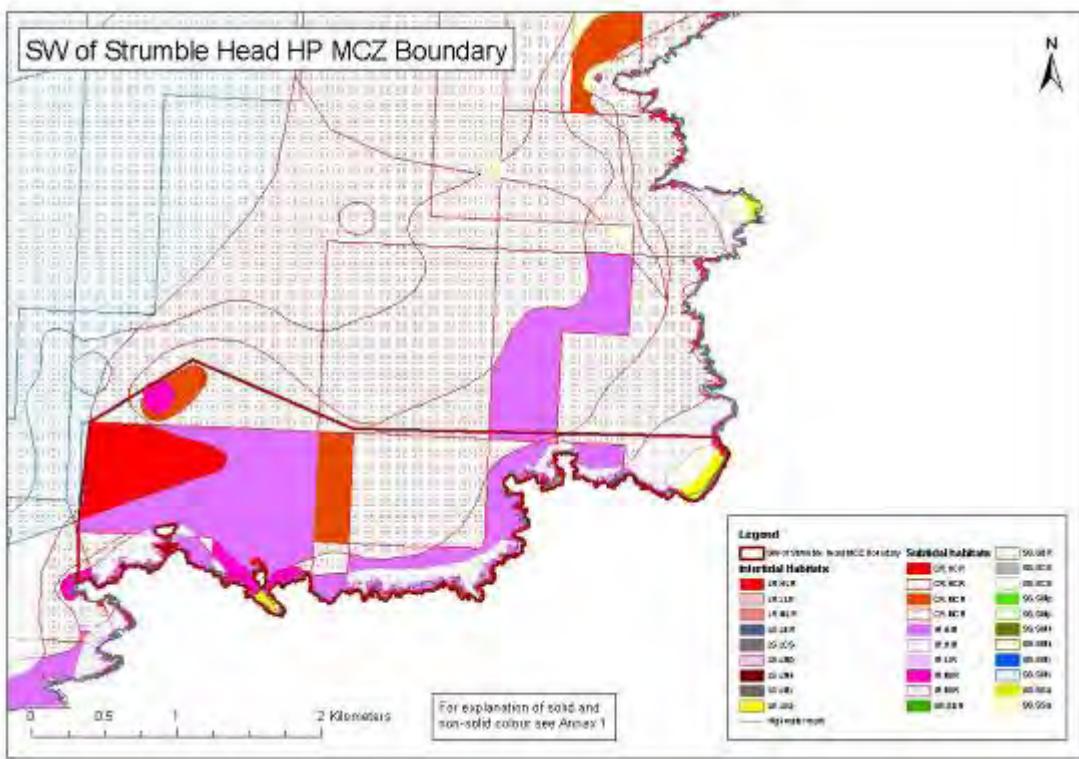
### **Step 2**

There are numerous small bays that have intertidal coarse sediment, but in order to capture sufficient amounts of this habitat you need to extend the boundary east to include Aber Mawr (Figures 59 & 60).

**Figure 59. Step 2 boundary limited distribution habitats: intertidal coarse sediment (grey), moderate energy intertidal rock (pink)**



**Figure 60. Broadscale habitats captured by the Step 2 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 31.

**Table 31. Habitats with a viable patch size captured by the Step 2 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.425	0.250
Moderate energy deeper water rock	0.255	0.250
High energy shallow water rock	0.880	0.025
Moderate energy shallow water rock	0.046	0.025
High energy intertidal rock	0.008	0.005
Moderate energy intertidal rock	0.012	0.005
Intertidal coarse sediment	0.027	0.025
<b>Important habitat</b>		
Fragile sponge & anthozoan	6 pts	1 Pt

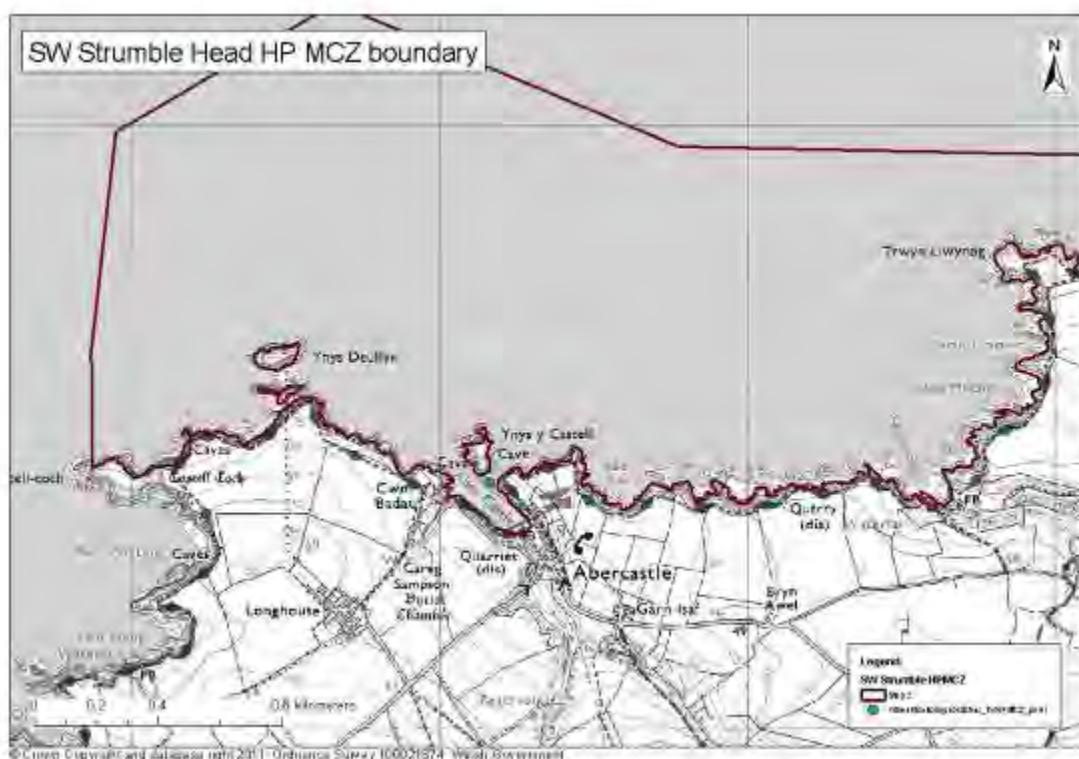
communities on subtidal rocky habitats		
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	15 pts	1 Pt

The boundary at step 2 captures all of the habitats present in the Focus Site in viable amounts.

This produces a site size of **4.2 km<sup>2</sup>**

The boundary is heavily influenced by the need to include viable areas of moderate and high energy deeper water rock. This is only found at the western end of the site. The north eastern end of the site is thought to be of equal quality in terms of rocky habitat communities, including some good quality sponge and anthozoan habitat. This end of the site includes the most northern limit of pink sea fan *Eunicella verrucosa* (the scarlet and gold cup coral *Balanophyllia regia*'s northern limit is further north, and so not within the original Focus Site area.) There is a long term monitoring station near Abercastle (Figure 61).

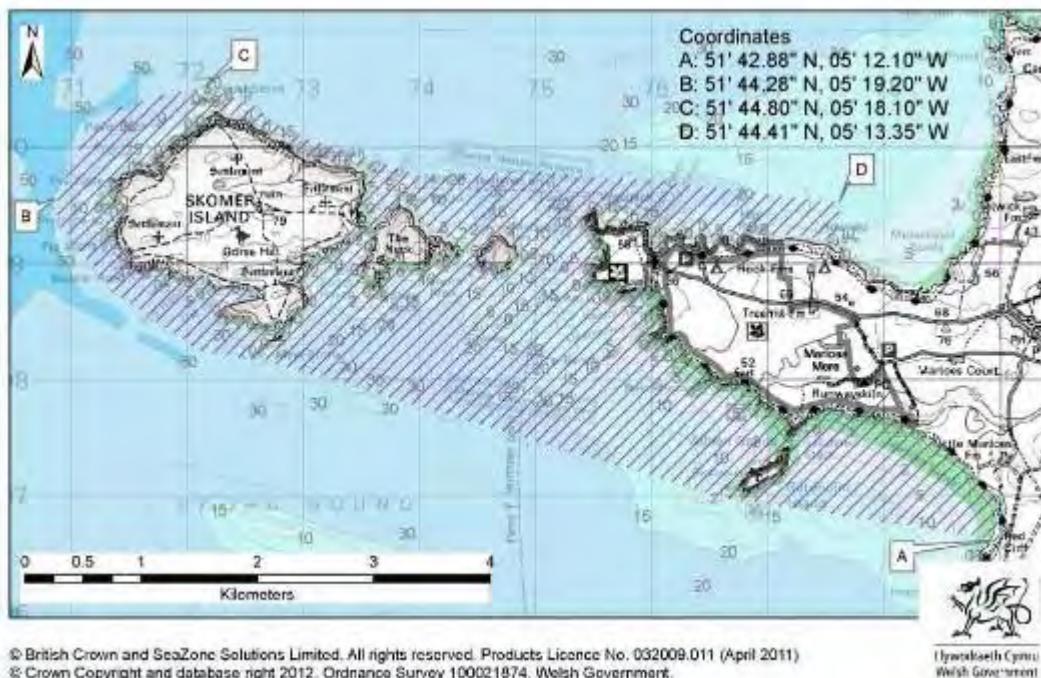
**Figure 61. Map showing MarClim monitoring station**



It was not considered necessary to apply any additional considerations to this site.

## 9. Skomer / Sgomer (formerly called Skomer Island)

**Figure 62. Skomer Potential Site**



The Focus Site includes the following habitats:

- High energy intertidal rock
- Intertidal coarse sediment
- High energy deeper water rock
- High energy shallow water rock
- Moderate energy shallow water rock
- Moderate energy intertidal rock
- Intertidal sand
- Subtidal coarse sediment
- Subtidal mixed sediments
- Subtidal sand
- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Mud habitats in deep water
- Subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea*
- Subtidal mixed muddy sediments
- Tide swept channels
- High Productivity areas

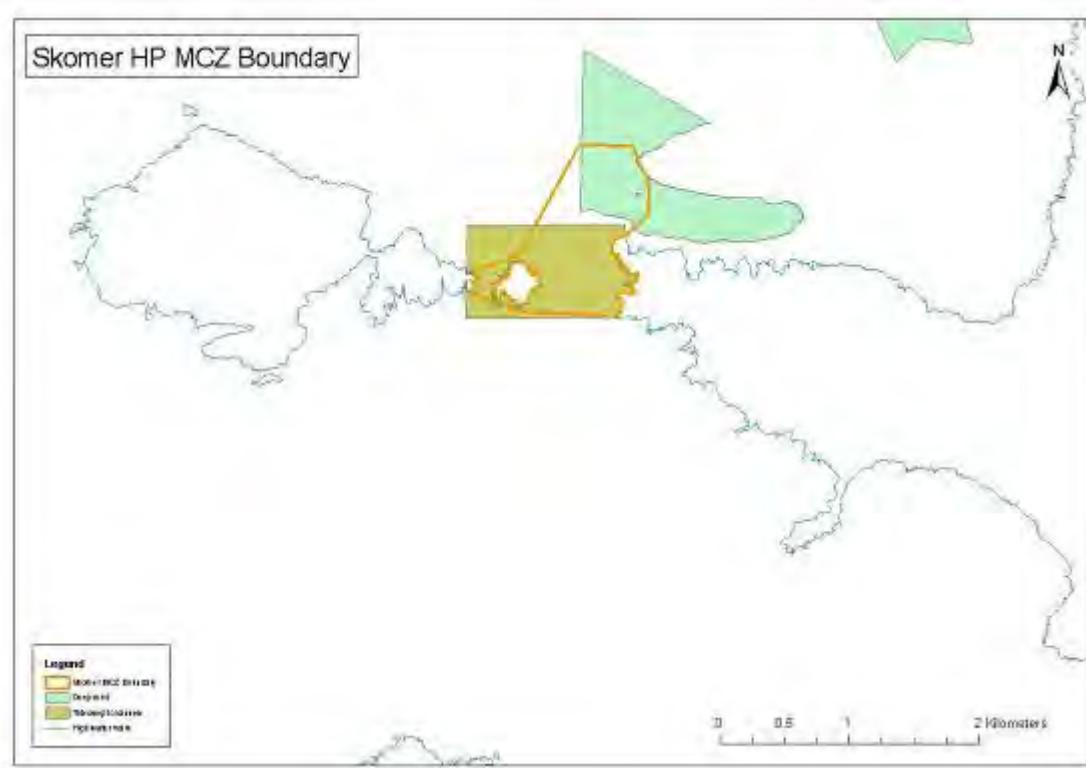
## **Step 1**

Of the habitats listed above, the following habitats have only one patch of habitat within the site:

- Mud habitats in deep water
- Tide swept channels

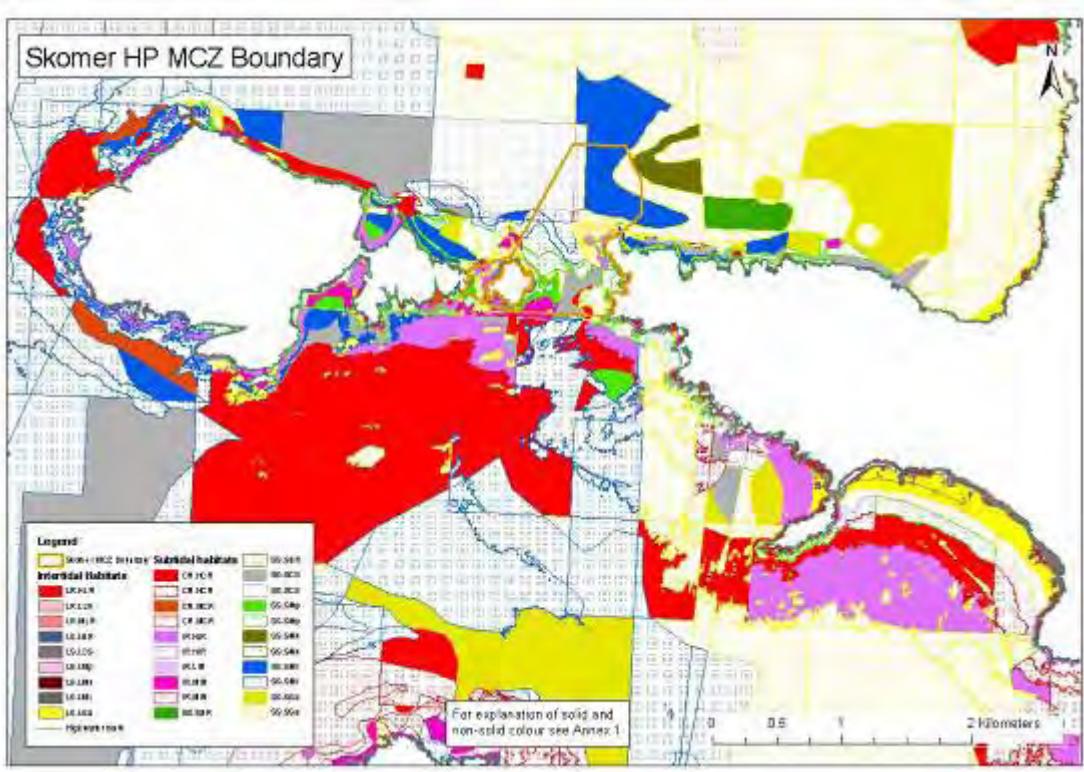
Therefore Step 1 involved drawing a boundary around the above two habitats (see Figure 63). Only the core area of the tide swept channel was included, i.e. the subtidal and intertidal areas between the islands and the mainland, Jack Sound and Little Sound. It is worth noting that the confidence in the mud in deep water habitat data is relatively low.

**Figure 63. Map showing the boundary at Step 1 and the distribution of mud habitats in deep water (green) and tide swept channels (brown/olive)**



The other broadscale habitats that were captured in the boundary drawn for Step 1 are shown in Figure 64 and Table 32 shows which of the habitats meet the viability targets for this boundary.

**Figure 64. Map showing the broadscale habitats captured by the Step 1 boundary**



**Table 32. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy shallow water rock	0.047	0.025
Moderate energy shallow water rock	0.029	0.025
High energy intertidal rock	0.038	0.005
<b>Important Habitat</b>		
Mud habitats in deep water	0.269	0.250
Tideswept channels	0.582	0.250

This boundary also captured 0.1 km<sup>2</sup> of high productivity area, sufficient to reach the viability target.

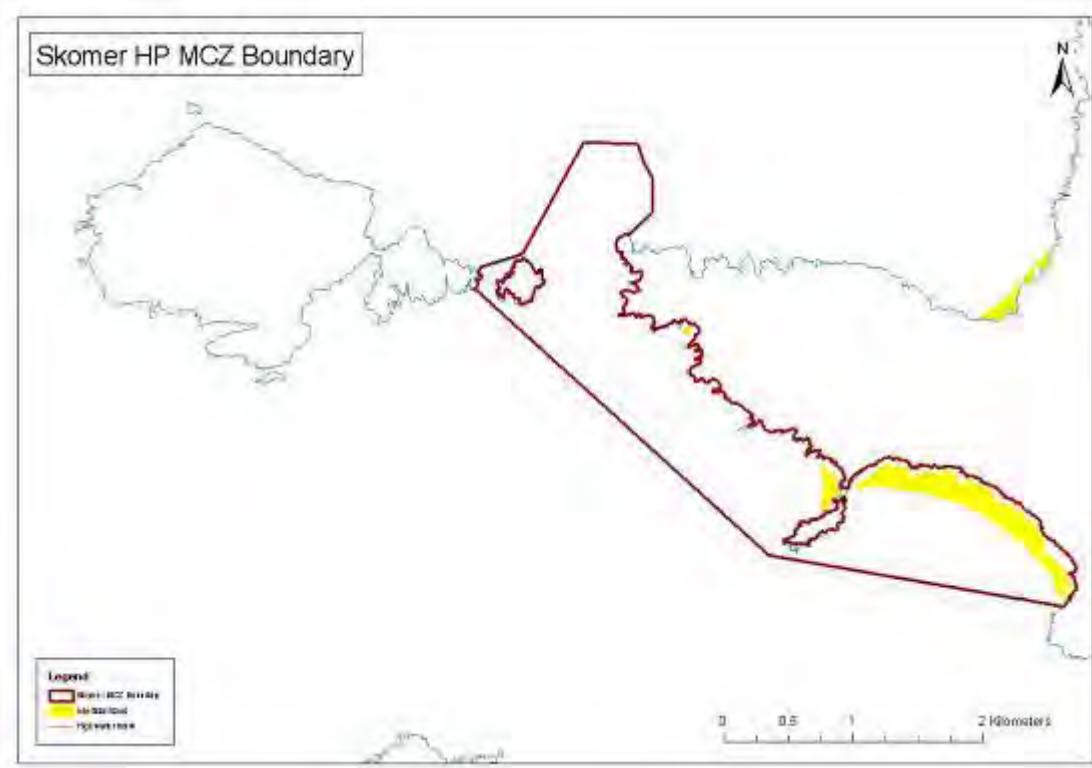
The following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 1 boundary:

- Intertidal coarse sediment
- High energy deeper water rock
- Moderate energy intertidal rock
- Intertidal sand
- Subtidal coarse sediment
- Subtidal mixed sediments
- Subtidal sand
- Fragile sponge & anthozoan communities on subtidal rocky habitats
- Subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea*
- Subtidal mixed muddy sediments

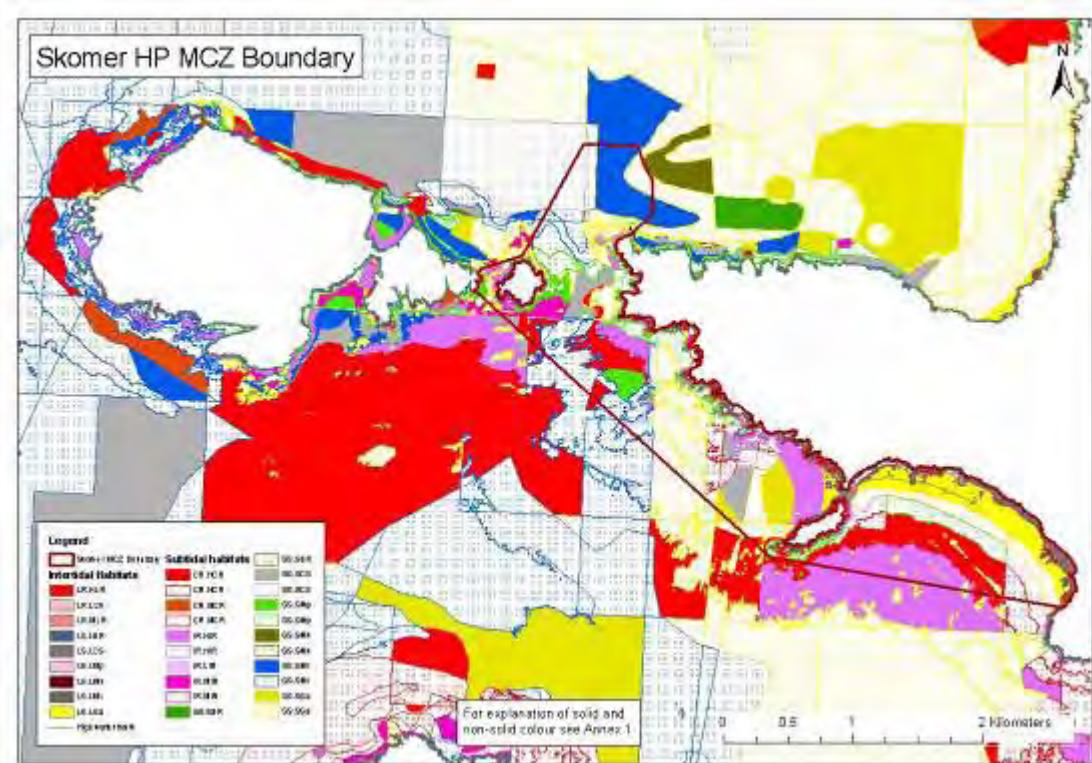
## **Step 2**

For Step 2 the above list of habitats was examined to identify habitats that had a limited distribution in the area. Intertidal sand was identified as a habitat that had one large area that needed to be included to make a viable patch size (there were several other small areas but these were much too small to make much of a contribution to the overall size targets). This meant adding Marloes Sands to the site boundary. The whole of Marloes Sands was added, in order to include whole habitat patches where possible (boundary principle 3). See Figures 65 & 66 for the Step 2 boundary. The intertidal rock between Step 1 and Marloes Sands is included as this is an extension of this habitat that is captured in Step 1 and conforms to Boundary Principle 3. This boundary does bisect a patch of shallow water rock habitat, which is something that may warrant further investigation.

**Figure 65. Map showing the boundary at Step 2 and the distribution of intertidal sand**



**Figure 66. Map showing the broadscale habitats captured by the Step 2 boundary**



The Step 2 boundary resulted in 7 broadscale habitats and 3 important habitats being present in viable amounts (Table 33).

**Table 33. Habitats with a viable patch size captured by the Step 2 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.478	0.250
High energy shallow water rock	0.484	0.025
Moderate energy shallow water rock	0.044	0.025
High energy intertidal rock	0.220	0.005
Moderate energy intertidal rock	0.029	0.005
Intertidal coarse sediment	0.101	0.025
Intertidal sand	0.310	0.250
<b>Important Habitat</b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	2pts	1 pt
Mud habitats in deep water	0.269	0.250
Tide swept channels	0.624	0.250

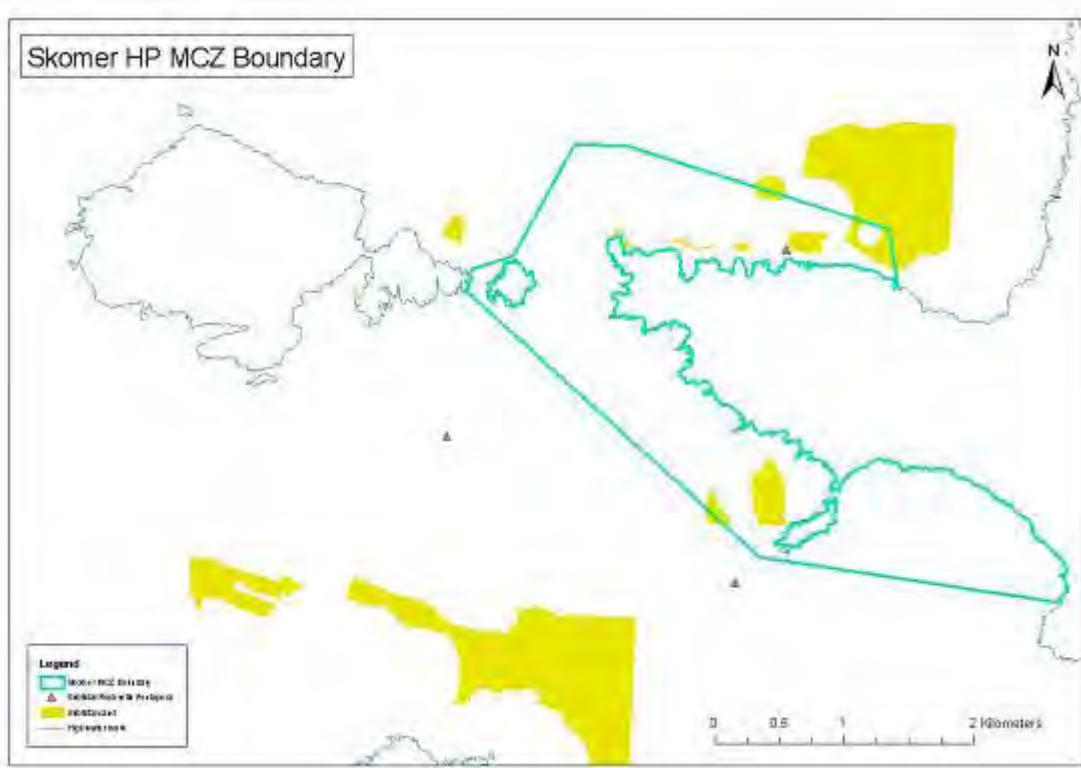
This means that the following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 2 boundary:

- Subtidal coarse sediment (need 0.07 km<sup>2</sup>)
- Subtidal mixed sediments (need 0.05 km<sup>2</sup>)
- Subtidal sand (need 0.12 km<sup>2</sup>)
- Subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea*
- Subtidal mixed muddy sediments (need 0.25 km<sup>2</sup>)

### **Step 3**

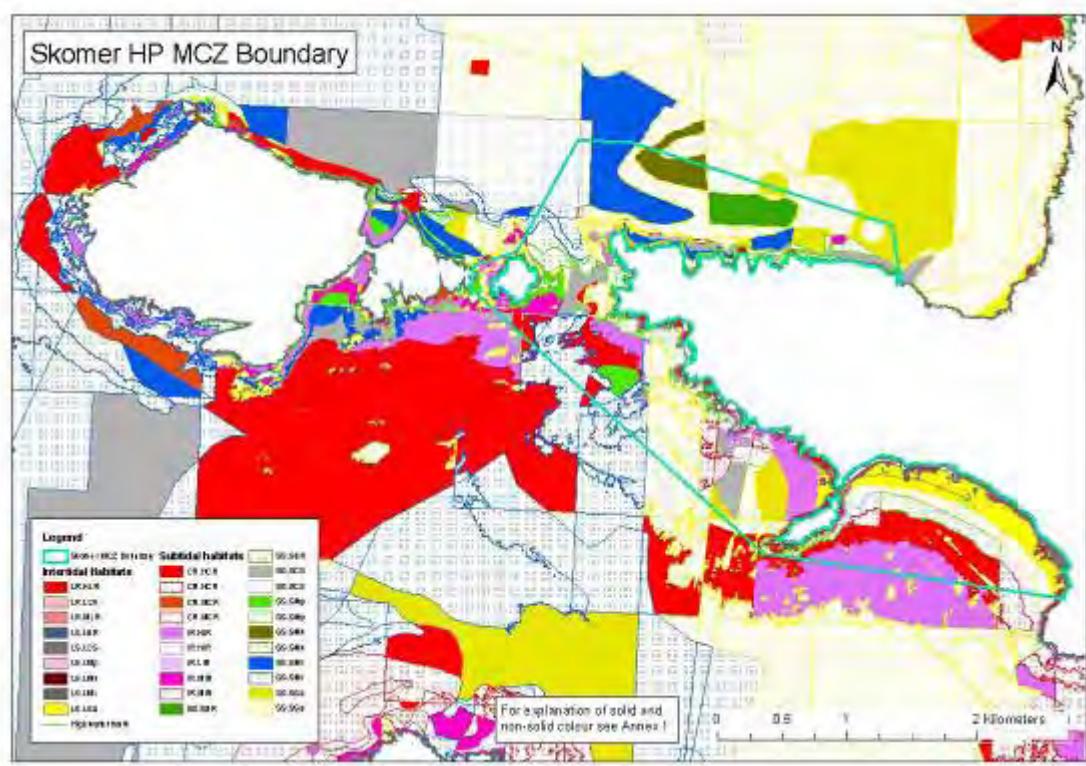
Looking at each of these features, it seems that the ones with the most limited distribution are subtidal sand and subtidal rock with Ross 'coral'. The boundary at the northern end of the site was extended eastwards to include a viable amount of subtidal sand habitat, which also resulted in the inclusion of subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea* habitat (see Figures 67 & 68).

**Figure 67. Map showing the boundary at Step 3 and the distribution of subtidal sand (yellow) and subtidal rock with Ross 'coral' *Pentapora fascialis/foliacea* (triangles)**



In order to include subtidal sand the boundary was extended eastwards towards Hopgang. The boundary has been drawn to include the intertidal rock as this is a continuation of the intertidal rock habitat captured in the previous steps. This area is however a change of aspect from the rest of the site and as such this area could be considered to not be a continuation of the same habitat type. However if the intertidal area is not included then the boundary will not be compact in shape which would be contrary to Boundary Principle 2.

**Figure 68. Map showing the broadscale habitats captured by the Step 3 boundary**



The Step 3 boundary resulted in 9 broadscale habitats and 4 important habitats being present in viable amounts (Table 34).

**Table 34. Habitats with a viable patch size captured by the Step 3 boundary**

<b>Broadscale Habitat</b>	<b>Area (<math>\text{km}^2</math>) or number of data points (pts)</b>	<b>Target area (<math>\text{km}^2</math>)</b>
High energy deeper water rock	0.483	
High energy shallow water rock	0.484	
Moderate energy shallow water rock	0.062	
High energy intertidal rock	0.267	
Moderate energy intertidal rock	0.031	
Intertidal coarse sediment	0.104	
Intertidal sand	0.310	

Subtidal mixed sediments	0.312	
Subtidal sand	0.262	
<b><i>Important Habitat</i></b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	2pts	1 pt
Mud habitats in deep water	0.676	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	1pts	1 pt
Tide swept channels	0.624	0.250

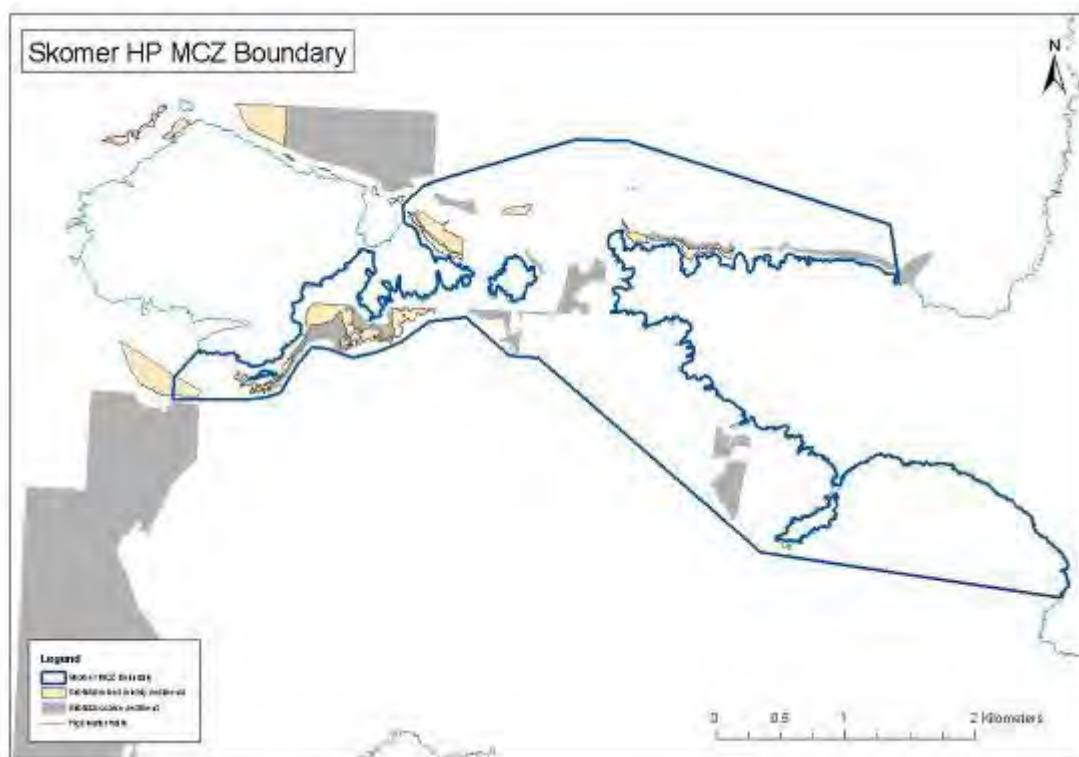
This means that the following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 3 boundary:

- Subtidal coarse sediment (need 0.07 km<sup>2</sup>)
- Subtidal mixed muddy sediments (need 0.22 km<sup>2</sup>)

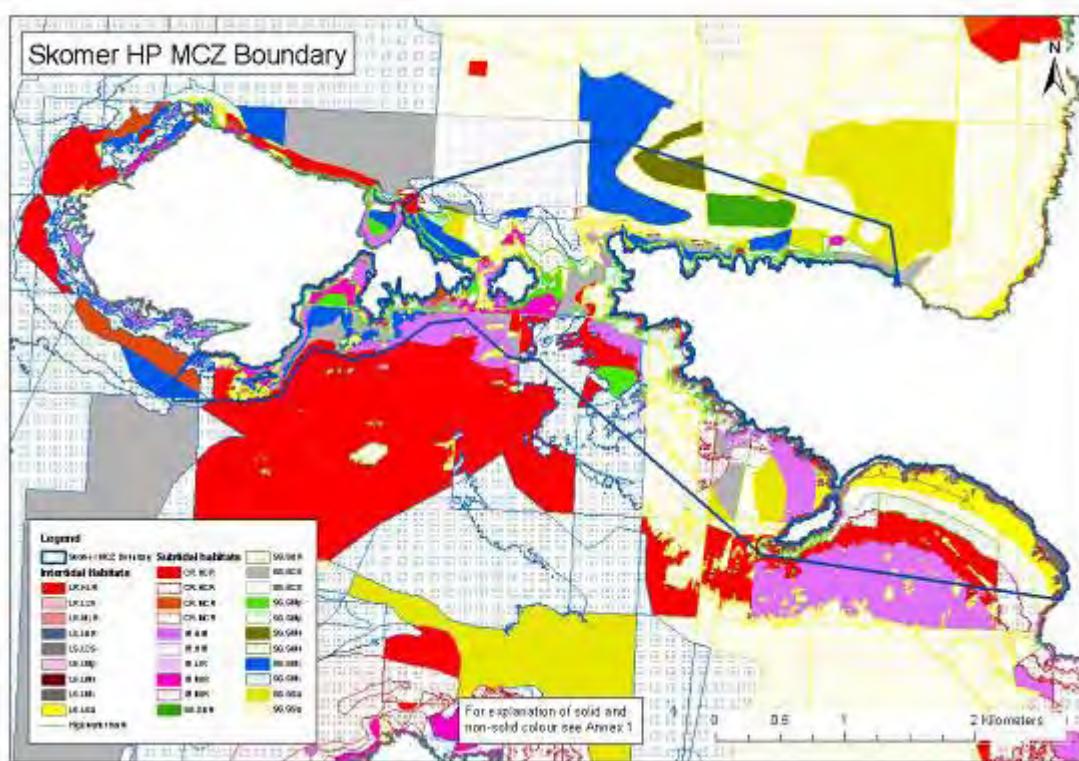
#### **Step 4**

There are patches of subtidal mixed muddy sediment north of The Neck and more extensively around the eastern side of the south coast of Skomer Island. Therefore the boundary was extended west to include these areas. Extending the boundary along the southern coast of Skomer Island also captured sufficient subtidal coarse sediment (see Figures 69 & 70).

**Figure 69. Map showing the boundary at Step 4 and the distribution of subtidal mixed muddy sediments (orange) and subtidal coarse sediments (grey)**



**Figure 70. Map showing the broadscale habitats captured in Step 4**



The Step 4 boundary resulted in all habitats being present in the required (viable) amounts (Table 35).

**Table 35. Habitats with a viable patch size captured by the Step 4 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	0.600	0.250
High energy shallow water rock	0.665	0.025
Moderate energy shallow water rock	0.152	0.025
High energy intertidal rock	0.351	0.005
Moderate energy intertidal rock	0.040	0.005
Intertidal coarse sediment	0.109	0.025
Intertidal sand	0.310	0.250
Subtidal coarse sediment	0.372	0.250
Subtidal mixed sediments	0.544	0.250
Subtidal sand	0.288	0.250
<b>Important Habitat</b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	2pts	1 pt
Mud habitats in deep water	0.676	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	1pts	1 pt
Subtidal mixed muddy sediments	0.254	0.250
Tide swept channels	0.794	0.250

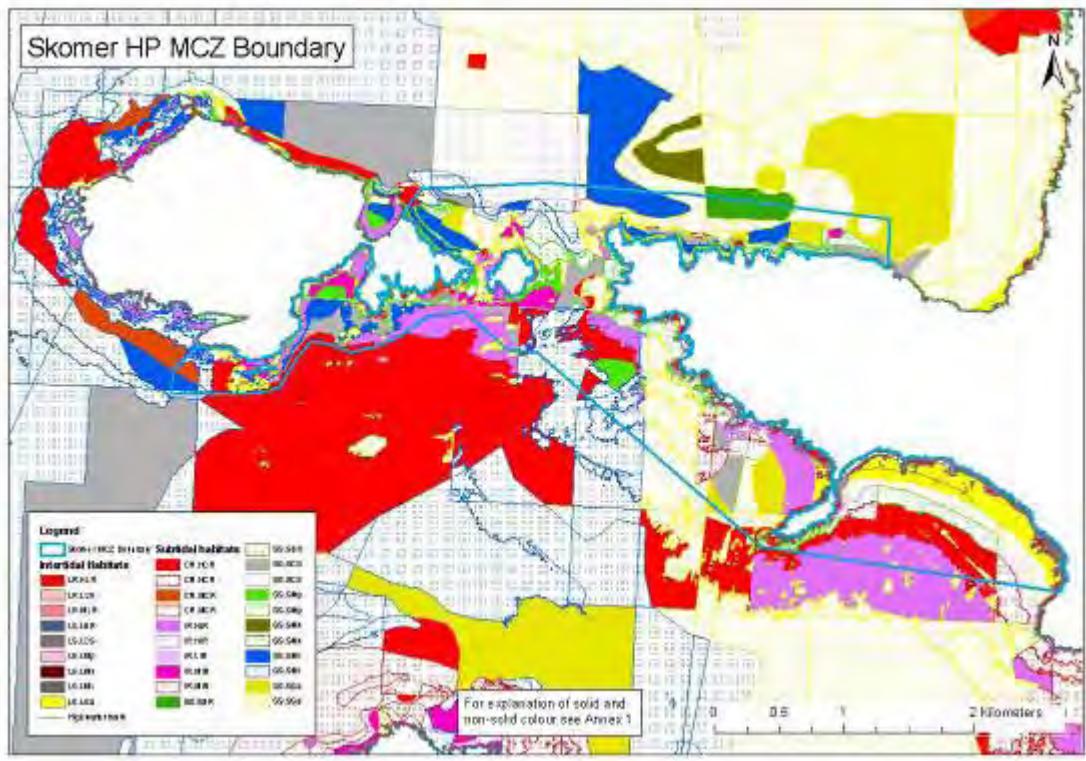
## **Step 5**

The boundary at Step 4 has a large indentation on the southern border. There are also a number of subtidal sediment habitats have larger areas than required to meet viability targets. These were examined to see whether the site boundary could be reduced in any areas. The habitats are:

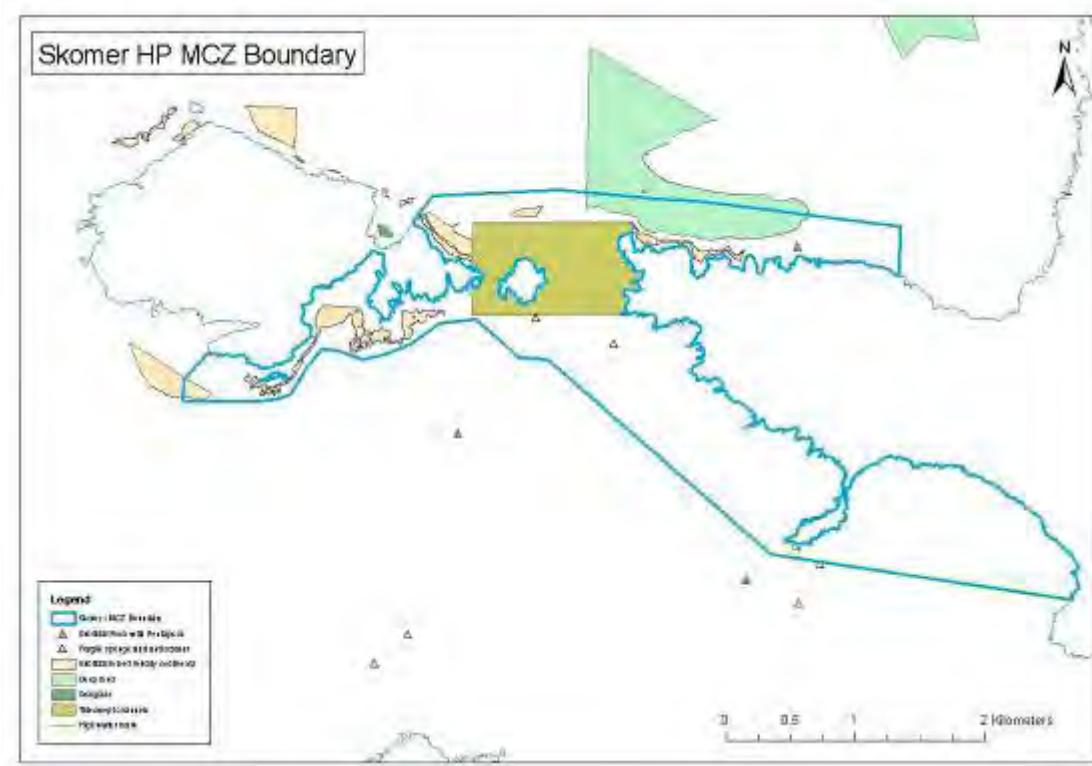
- Subtidal coarse sediment. This habitat can't be reduced as an extra area is incorporated in order to obtain sufficient subtidal mixed muddy sediment.
- Subtidal mixed sediment. Slight reductions made, however extra area incorporated to obtain sufficient subtidal sand and subtidal mixed muddy sediments.
- Subtidal sand. Slight reductions were made
- Mud habitats in deep water. Can be reduced although extra area incorporated to obtain sufficient subtidal sand.

Figures 71 and 72 show the distribution of these habitats. There is also more intertidal sand than required, but in order to obtain sufficient sand nearly all of Marloes Sands needs to be included. See comments in Step 2. For other habitats that had more than the viable area it was not possible to reduce the size of that habitat without compromising principles 2 (compact shape / no large indentations) and/or 3 (whole habitat patches). Figure 71 shows the boundary drawn.

**Figure 71. Map showing broadscale habitats captured in Step 5**



**Figure 72. Map showing important habitats captured in Step 5: subtidal mixed muddy sediments (orange), deep mud (blue/green), seagrass beds (dark green), tide swept channels (beige/olive), subtidal rock with *Pentapora* (pink triangles), fragile sponge and anthozoan communities (yellow triangles)**



A report was run on this boundary to check that habitats were present in viable amounts. The result is shown in Table 36.

**Table 36. Habitats with a viable patch size captured by the Step 5 boundary.**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	2.133	0.250
High energy shallow water rock	0.794	0.025
Moderate energy shallow water rock	0.151	0.025
High energy intertidal rock	0.348	0.005
Moderate energy intertidal rock	0.040	0.005
Intertidal coarse sediment	0.109	0.025
Intertidal sand	0.310	0.250
Subtidal coarse sediment	0.368	0.250
Subtidal mixed sediments	0.420	0.250
Subtidal sand	0.266	0.250
<b>Important Habitat</b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	2pts	1 pt
Mud habitats in deep water	0.351	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	3pts	1 pt
Subtidal mixed muddy sediments	0.253	0.250
Tide swept channels	0.793	0.250

#### Comments and additional considerations

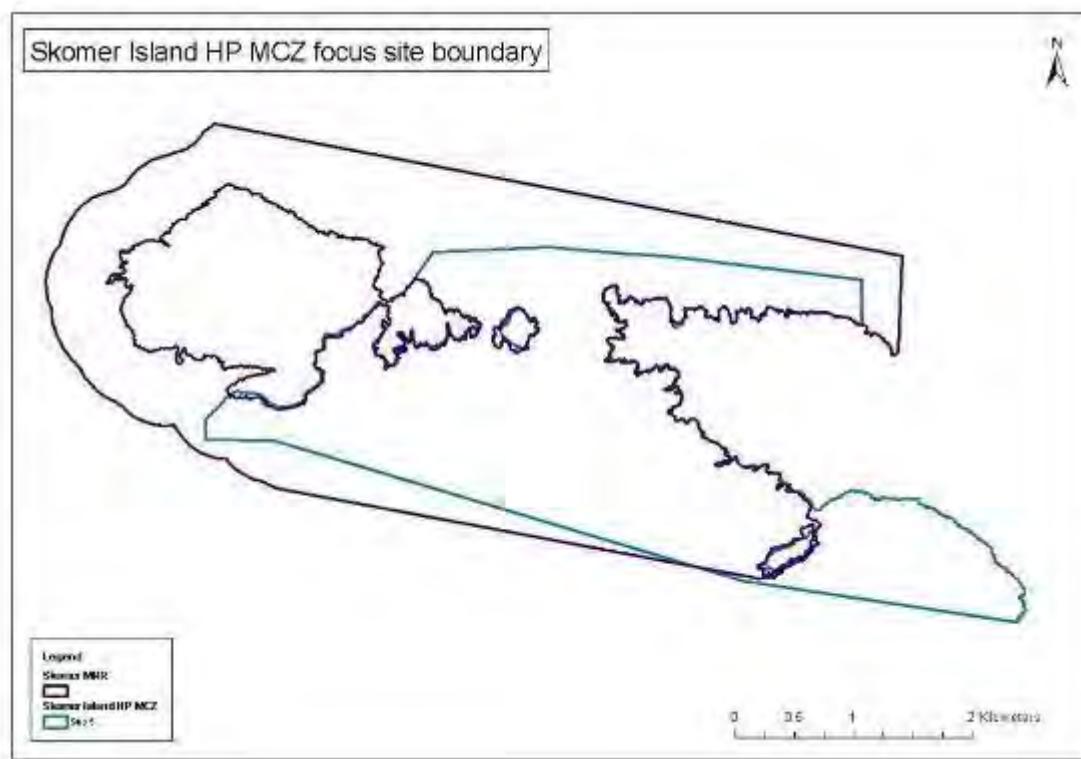
The boundary produced in Step 5 results in a boundary that is **8.8km<sup>2</sup>**.

This example site boundary has many ecological and practical disadvantages. The boundary has been heavily influenced by the presence of certain habitats; namely intertidal sand and subtidal sand.

There are a number of issues with the boundary as it stands:

- **Ecological quality.** The west and north coasts of Skomer Island are not included in the Step 5 site boundary, mainly because they contain similar broadscale habitat types to those found on the mainland coast (all of the area around Skomer Island is included in the Marine Nature Reserve boundary, see Figure 73). However, by not including these areas the boundary excludes 70% of the populations of pink seafans (*Eunicella verrucosa*) and 75% of the Ross coral *Pentapora* population, including the larger and more ecologically important colonies.
- **Ecological quality.** Areas outside of the example boundary include some very diverse algal communities for which Skomer Island was the only site nominated as a European Important Plant Area.
- **Increasing habitat heterogeneity** The seagrass bed in North Haven also falls outside of the Step 5 highly protected MCZ boundary; this is because it does not reach the theoretical viable size target and was not therefore included in the original list of habitats. Although the bed is smaller than the viable target size specified in the guidelines it has been present for decades (was first recorded in 1946, first mapped in 1979 and has been monitored regularly since 1997 during which time both shoot density and extent of bed have increased), which suggests that it is indeed viable. Therefore, inclusion of this area within the site boundary would add another habitat to the site.
- **Areas with long term ecological datasets.** The example boundary will also exclude a large part of the long-term monitoring that has been carried out at Skomer Island, especially for sublittoral and littoral rock.

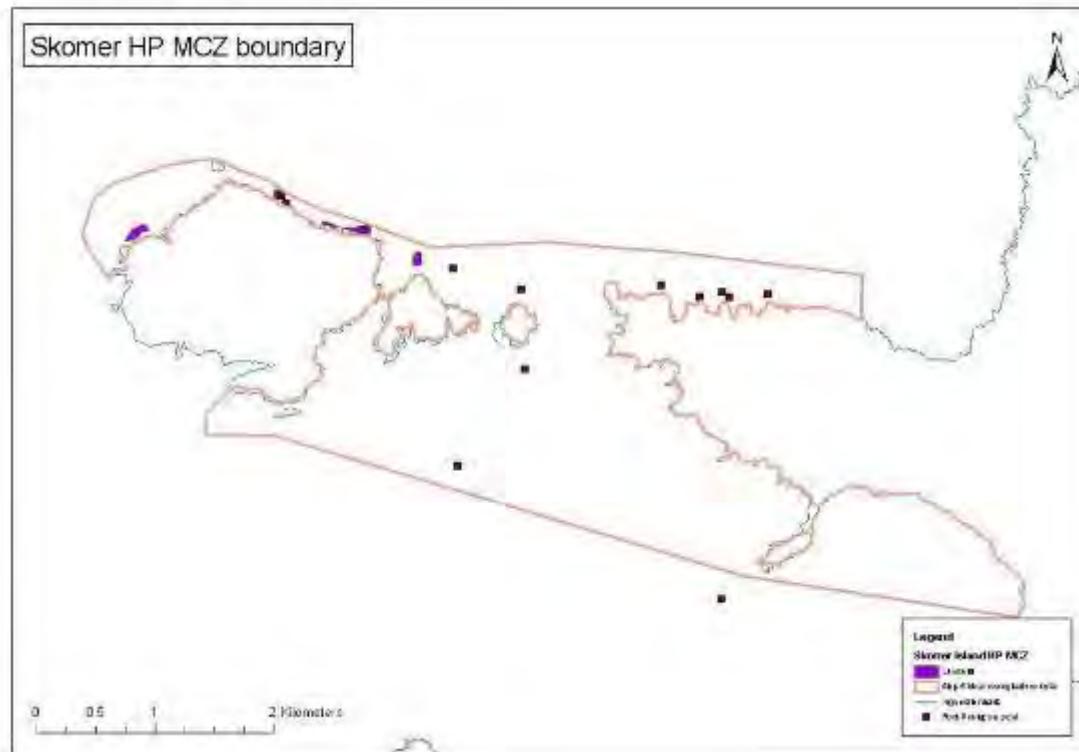
**Figure 73. Skomer Island boundary at Step 5 and the Marine Nature Reserve boundary**



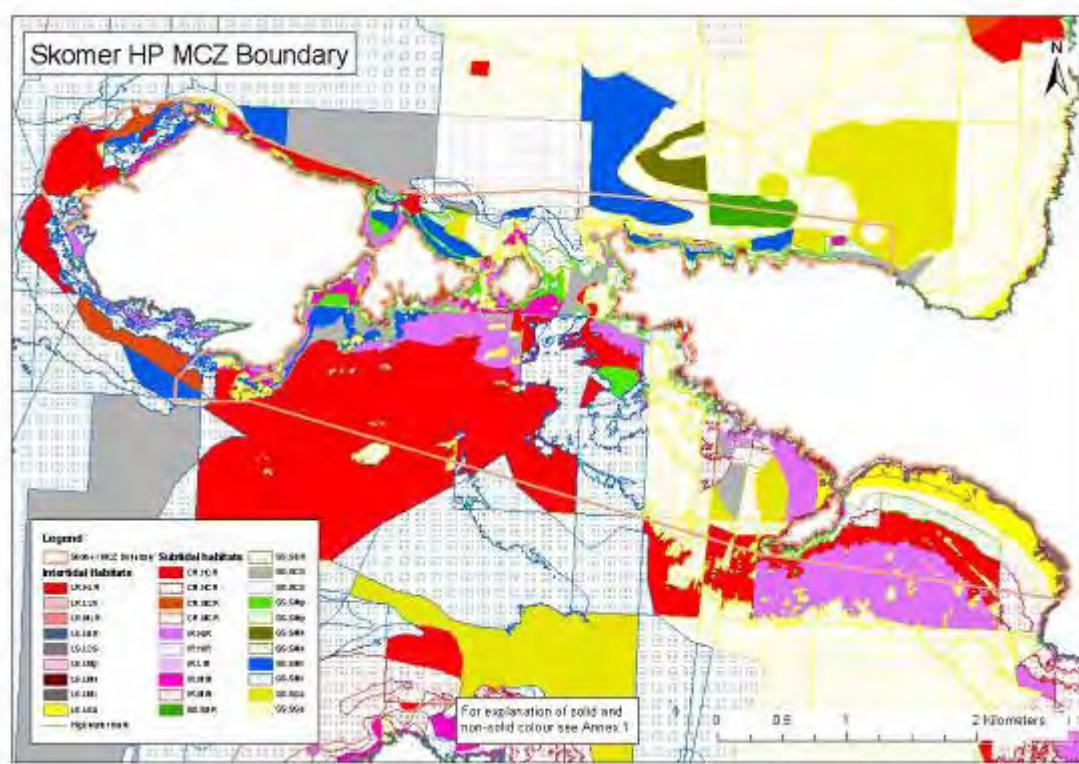
**Step 6 – additional considerations**

The above considerations have been worked into Step 6 (Figures 74 & 75).

**Figure 74. Step 6 boundary, showing areas with high density of *Eunicella verrucosa* (characterising species of the habitat *Fragile sponge & anthozoan communities on subtidal rocky habitats* - purple) and Subtidal rock with Ross coral (red squares)**



**Figure 75. Broadscale habitats captured by the Step 6 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 37.

**Table 37. Habitats with a viable patch size captured by the Step 6 boundary**

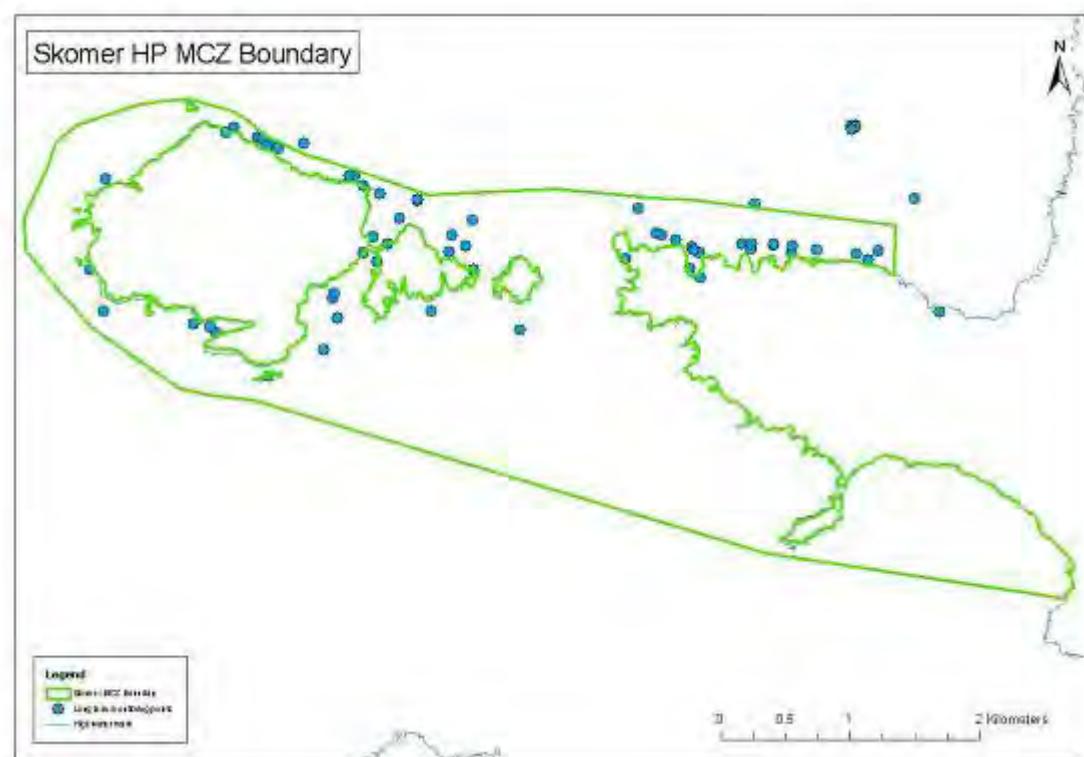
<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	2.435	0.250
High energy shallow water rock	0.829	0.025
Moderate energy shallow water rock	0.185	0.025
High energy intertidal rock	0.433	0.005
Moderate energy intertidal rock	0.047	0.005
Intertidal coarse sediment	0.112	0.025
Intertidal sand	0.310	0.250
Subtidal coarse sediment	0.379	0.250
Subtidal mixed sediments	0.487	0.250
Subtidal sand	0.266	0.250
<b>Important Habitat</b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	2pts*	1 pt
Mud habitats in deep water	0.351	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	16pts	1 pt
Subtidal mixed muddy sediments	0.294	0.250
Tide swept channels	0.793	0.250

\*there are more points found in this boundary, the data is not currently in a suitable format.

The size of the site at Step 6 is **9.8 km<sup>2</sup>**.

There are still some issues with the boundary as it stands. The boundary does not entirely conform to the whole habitat patch boundary principle, or linked habitats additional consideration. There is a continuation of rocky habitats both intertidally and subtidally around the whole island. It was suggested by the TAG that the whole of the island should be included to conform with the boundary principles and additional considerations. There are also long term monitoring stations within this area (Figure 76).

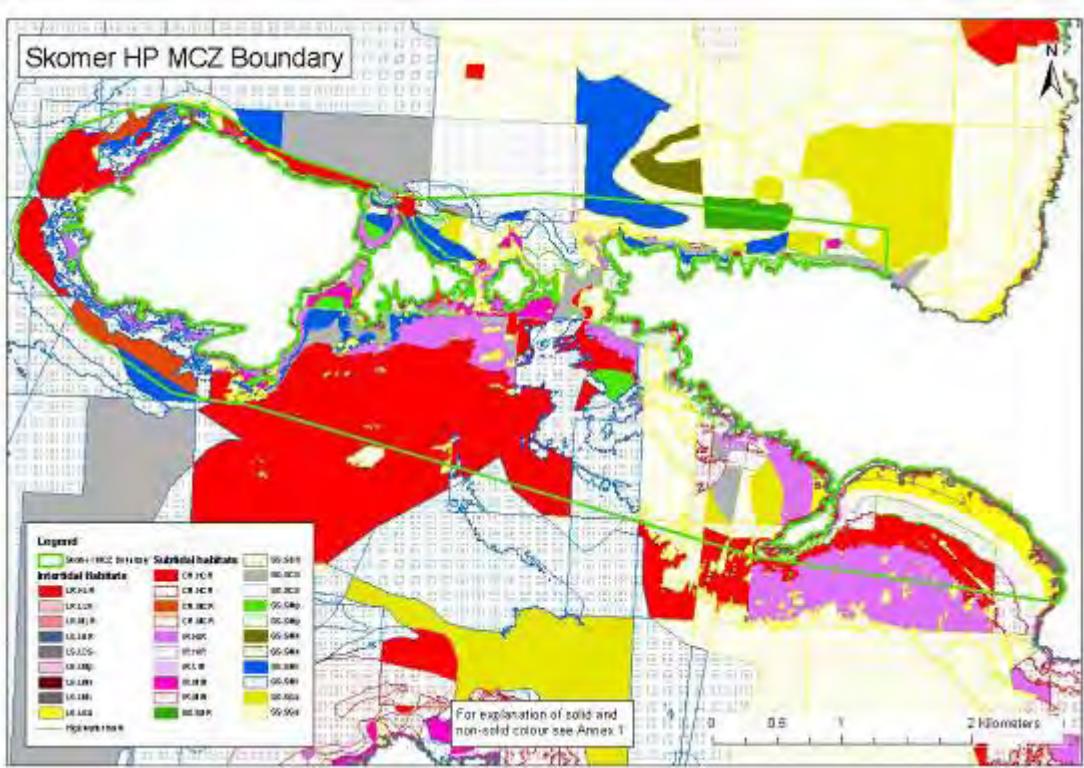
**Figure 76. Potential Site boundary (Step 7) showing long term monitoring stations**



#### **Step 7 – additional considerations**

In light of the comments raised in Step 6, a new boundary was drawn to encompass the relevant rocky patches (Figure 77).

**Figure 77. Potential Site boundary (Step 7).**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 38.

**Table 38. Habitats with a viable patch size captured by the Step 7 boundary.**

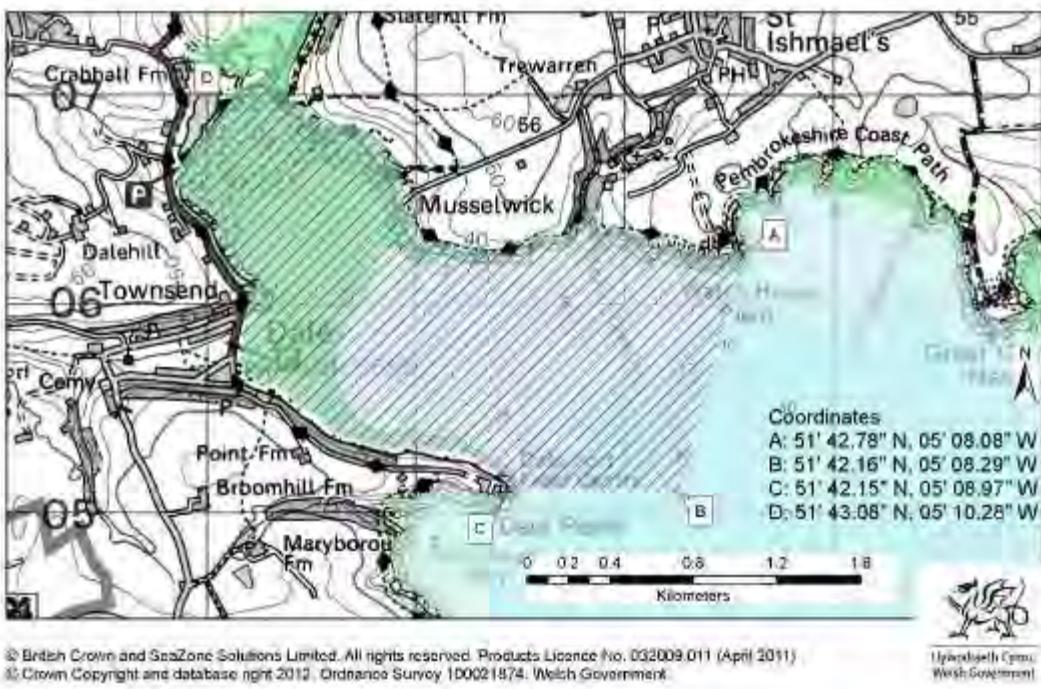
<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy deeper water rock	2.561	0.250
High energy shallow water rock	0.908	0.025
Moderate energy shallow water rock	0.185	0.025
High energy intertidal rock	0.489	0.005
Moderate energy intertidal rock	0.048	0.005
Intertidal coarse sediment	0.113	0.025
Intertidal sand	0.310	0.250
Subtidal coarse sediment	0.381	0.250
Subtidal mixed sediments	0.514	0.250

Subtidal sand	0.266	0.250
<b><i>Important Habitat</i></b>		
Fragile sponge & anthozoan communities on subtidal rocky habitats	2pts*	1 pt
Mud habitats in deep water	0.351	0.250
Subtidal rock with Ross 'coral' <i>Pentapora fascialis/foliacea</i>	16pts	1 pt
Subtidal mixed muddy sediments	0.294	0.250
Tide swept channels	0.793	0.250

This produces a site size of **10.5 km<sup>2</sup>**.

## 10. Dale

**Figure 76. Dale Potential Site**



This site has been selected for the following habitats:

- High energy intertidal rock
- Intertidal coarse sediment
- Low energy intertidal rock
- Moderate energy intertidal rock
- Intertidal mixed sediments
- Subtidal macrophyte communities
- Subtidal mud
- Subtidal mixed sediments
- Sheltered muddy gravels
- Subtidal mixed muddy sediments
- Areas of High Productivity

### **Step 1**

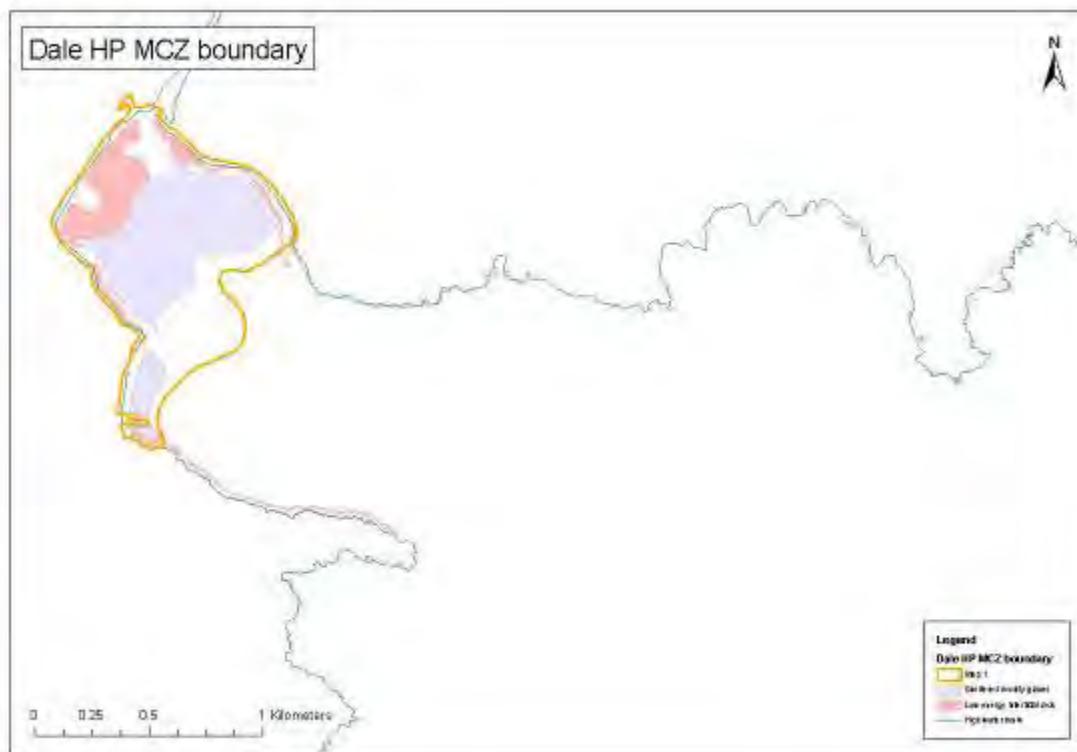
There are a number of habitats that have limited distribution:

- Sheltered muddy gravels
- Low energy intertidal rock

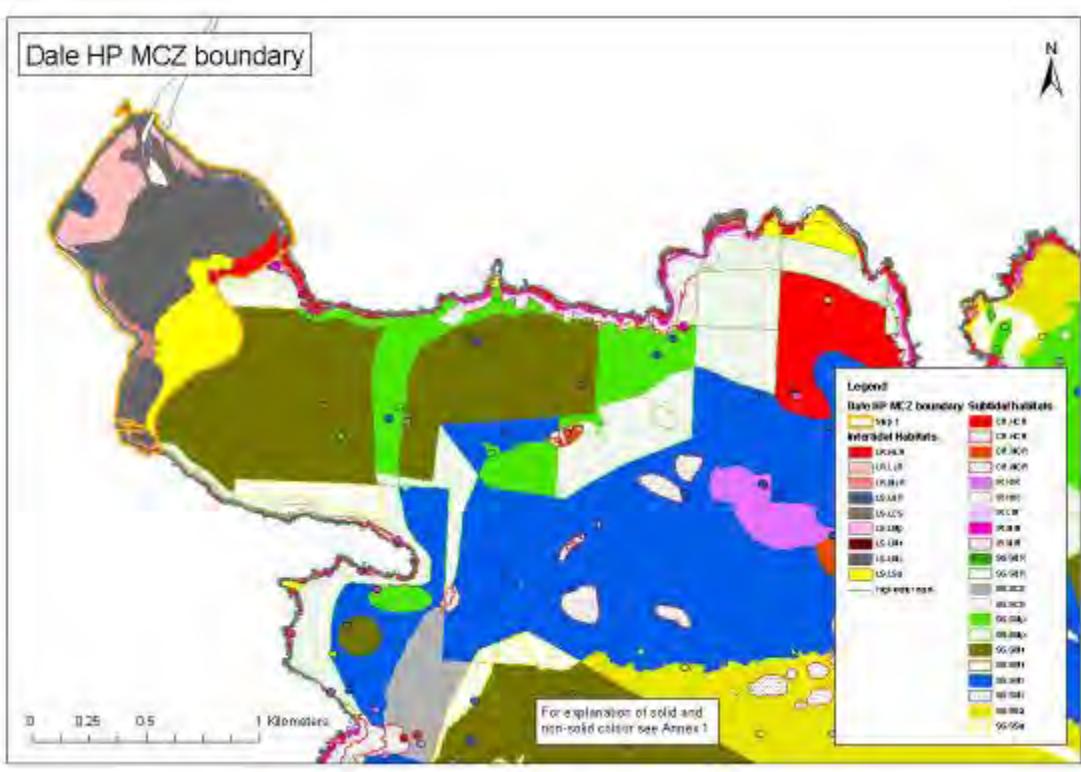
- Subtidal macrophyte communities
- Subtidal Mixed Muddy Sediments

A boundary was drawn that includes these habitats (Figures 79 & 80).

**Figure 77. Step 1 – limited distribution habitats sheltered muddy gravels (blue-purple) and low energy intertidal rock (pink)**



**Figure 80. Broadscale habitats captured by the Step 1 boundary**



The whole of the beach has been included to conform to the whole habitat patch boundary principle. The boundary currently follows the lower shore boundary.

A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 39.

**Table 39. Habitats with a viable patch size captured by the Step 1 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy intertidal rock	0.026	0.005
Low energy intertidal rock	0.131	0.025
Moderate energy intertidal rock	0.019	0.005
Intertidal coarse sediment	0.094	0.025
Intertidal mixed sediment	0.344	0.250

<b>Important Habitat</b>		
Sheltered muddy gravel	0.344	0.250

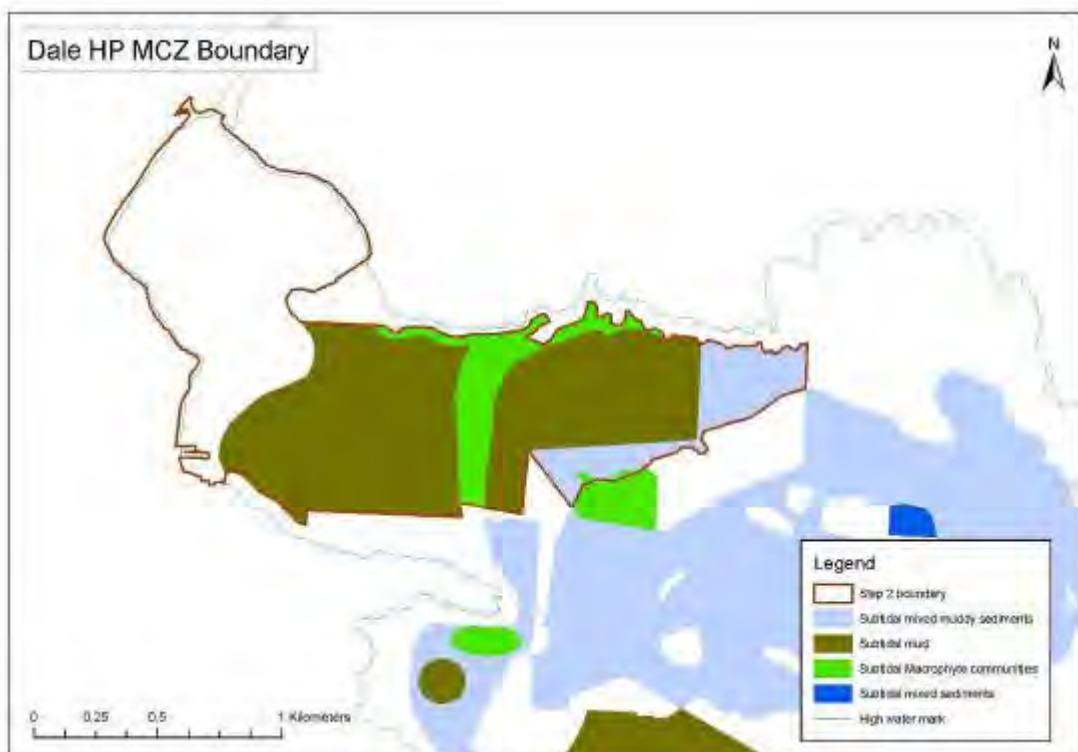
This means that the following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 1 boundary:

- Subtidal macrophyte communities
- Subtidal mud
- Subtidal mixed sediments
- Subtidal mixed muddy sediments

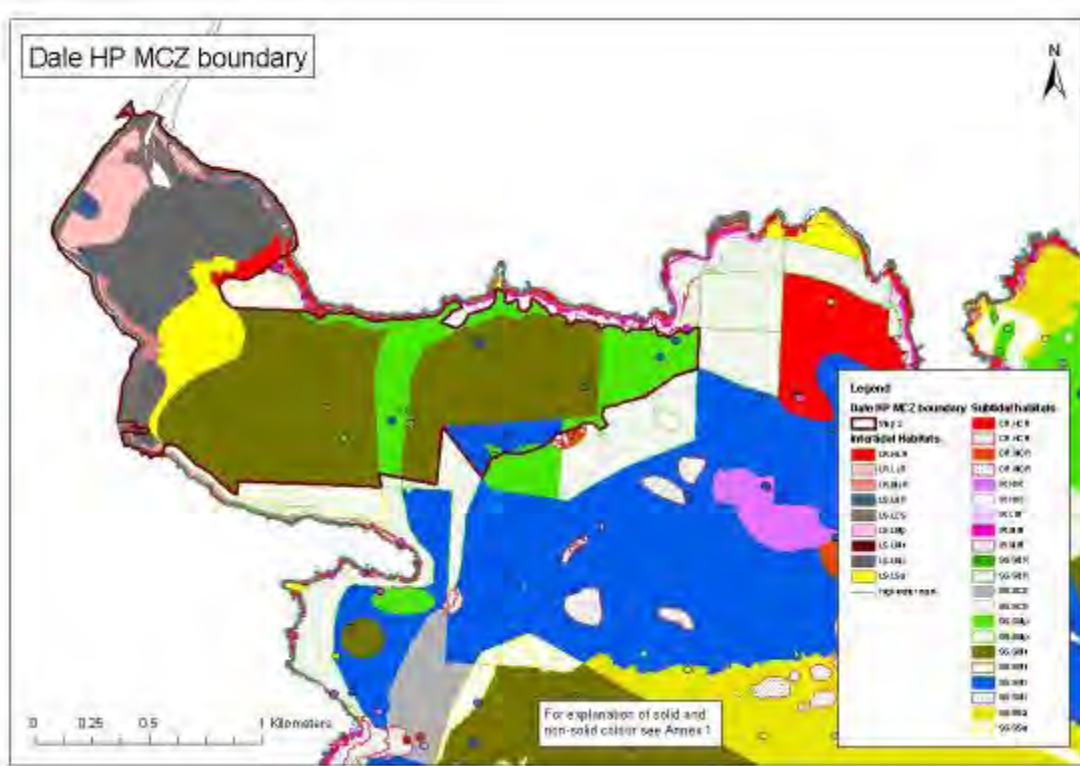
## **Step 2**

The boundary was extended to include the missing habitats: Subtidal macrophyte communities, Subtidal mud, Subtidal mixed sediments and Subtidal mixed muddy sediments (Figures 81 & 82).

**Figure 81. Step 2 boundary, subtidal habitats: subtidal mixed muddy sediments (pale blue), subtidal mud (brown-green), subtidal macrophyte communities (green), subtidal mixed sediments (dark blue). Note that in many areas subtidal mixed muddy sediments (important habitat) will overlap with subtidal mixed sediments (broadscale habitat)**



**Figure 78. Broadscale habitats captured by the Step 2 boundary**



A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 40.

**Table 40. Habitats with a viable patch size captured by the Step 2 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy intertidal rock	0.026	
Low energy intertidal rock	0.131	
Moderate energy intertidal rock	0.019	
Intertidal coarse sediment	0.094	
Intertidal mixed sediment	0.344	
Subtidal Macrophyte dominated communities on sediment	0.283	

Subtidal Mud	0.963	
<b><i>Important Habitat</i></b>		
Sheltered muddy gravel	0.344	

This means that the following habitats that were originally included in the Focus Site were not present in viable amounts within the Step 2 boundary:

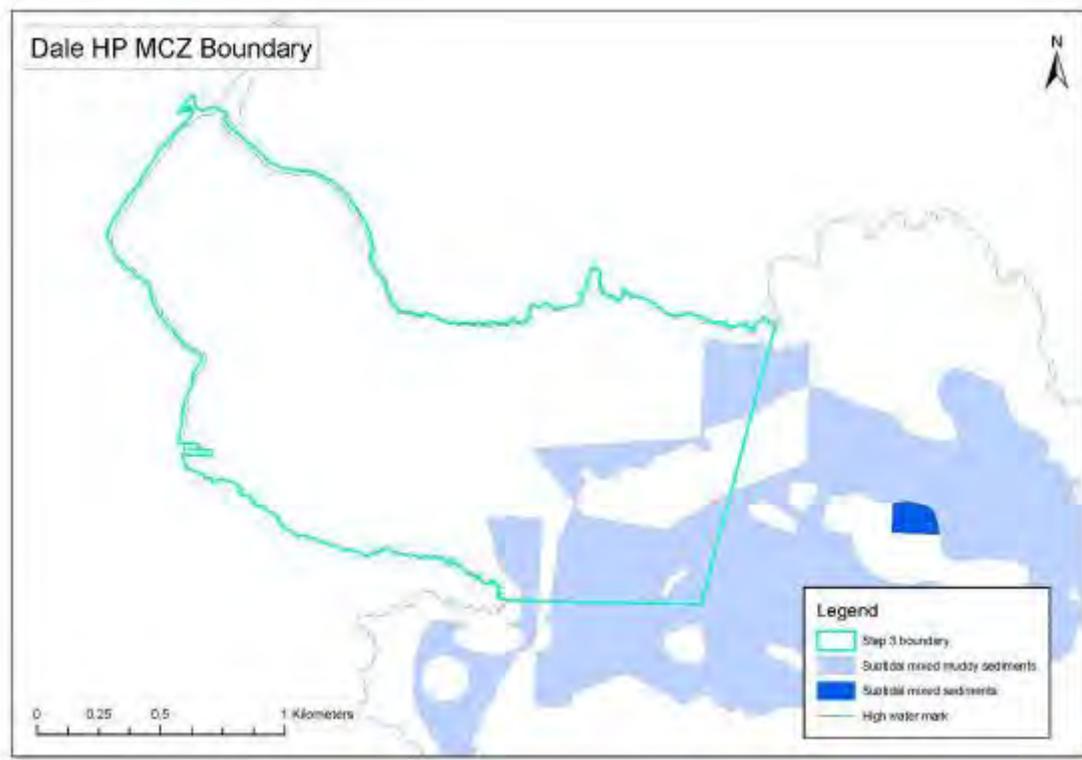
- Subtidal mixed sediments
- Subtidal mixed muddy sediments

The boundary also has a number of large indentations. There is also a large amount of subtidal mud that could be reduced whilst still retaining a viable area.

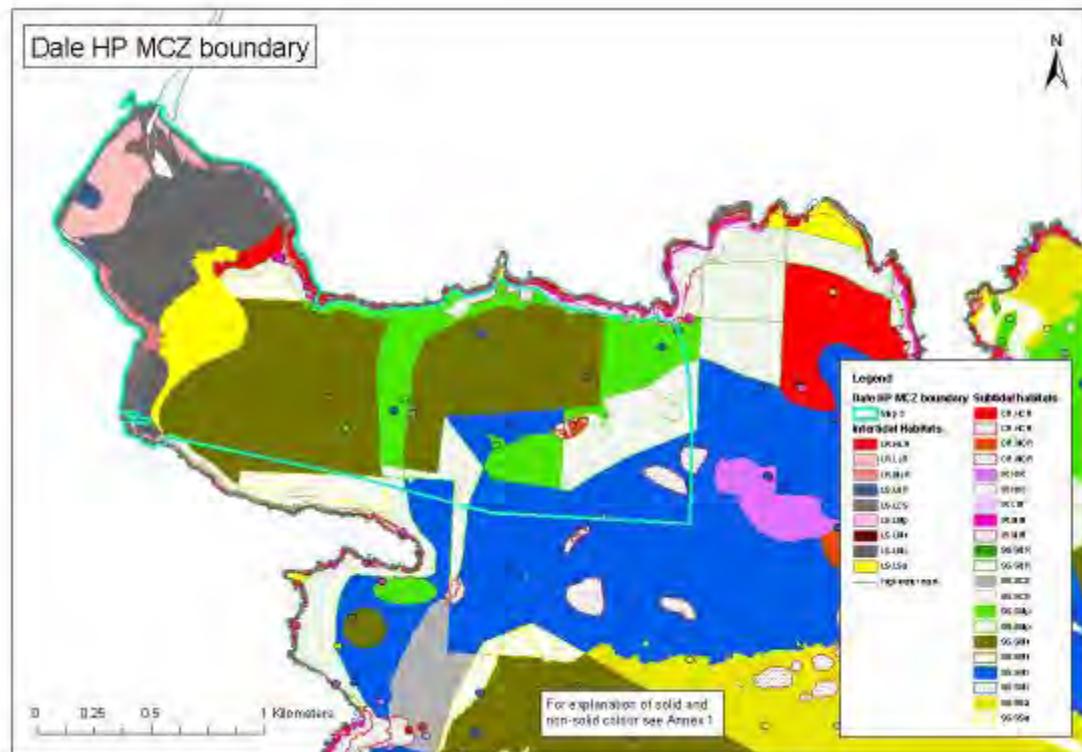
### **Step 3**

A boundary was drawn to include the missing habitats (Subtidal mixed sediments and Subtidal mixed muddy sediments) and to remove any large indentations (Figures 83 & 84).

**Figure 79. Step 3 boundary showing mixed sediment habitats.** Note that the important habitat subtidal mixed muddy sediments will almost always also be the broadscale habitat mixed muddy sediments (although the opposite is not true)



**Figure 80. Broadscale habitats captured by the Step 3 boundary.**



The boundary at Step 3 captures all of the habitats that are included in the original Focus Site in viable amounts (Table 41).

**Table 41. Habitats with a viable patch size captured by the Step 3 boundary**

<b>Broadscale Habitat</b>	<b>Area (km<sup>2</sup>) or number of data points (pts)</b>	<b>Target area (km<sup>2</sup>)</b>
High energy intertidal rock	0.035	0.005
Low energy intertidal rock	0.134	0.025
Moderate energy intertidal rock	0.022	0.005
Intertidal coarse sediment	0.094	0.025
Intertidal mixed sediment	0.344	0.250
Subtidal Macrophyte dominated communities on sediment	0.329	0.250
Subtidal Mud	0.925	0.250
Subtidal mixed sediments	0.264	0.250
<b>Important Habitat</b>		
Sheltered muddy gravel	0.344	0.250
Subtidal mixed muddy sediments	0.372	0.250

### **Comments and additional considerations**

Site size is **2.7 km<sup>2</sup>**

There are a number of issues with this boundary.

- **Linked habitats.** The boundary along the northern edge of the site runs along the infralittoral fringe or deeper into the subtidal. It would be preferable to include the intertidal along this edge to improve the within site connectivity.

- **Ecological quality.** The north shore of this bay between Gann Flats and Watch House Point is of high habitat quality. The north shore supports rich tideswept communities and intertidal boulder communities in the lower intertidal and infralittoral.
- **Increasing habitat heterogeneity.** There are patches of intertidal underboulder habitat recorded in the area mentioned above. However, the areas mapped do not meet viability targets for this important habitat. This is an artefact of the mapping rules that were employed by the CCW intertidal Phase 1 project. In areas where tideswept communities were found, this biotope was recorded and mapped in preference to the underboulder biotopes if present. This was due to the tideswept biotopes being noted as Nationally Important within the JNCC SSSI Guidelines<sup>31</sup>. The intertidal underboulder habitat is a lot more extensive than presented in the data with boulders found in Monk Haven and in gullies along this stretch of coast. There is also a large area of tideswept community mapped on the lower shore near Musselwick that supports boulder communities. This area far exceeds the viability targets for this habitat, although the exact extent of the boulder communities in this area would need to be verified.
- **Areas with long term ecological datasets.** There are long term monitoring stations along the south shore that have been studied by the Dale Fort Field Studies Council Centre and also includes a MarClim<sup>32</sup> station.

#### **Step 4 – additional considerations**

The following step 4 has been drawn to take into consideration the issues above (Figure 85), by including more intertidal areas.

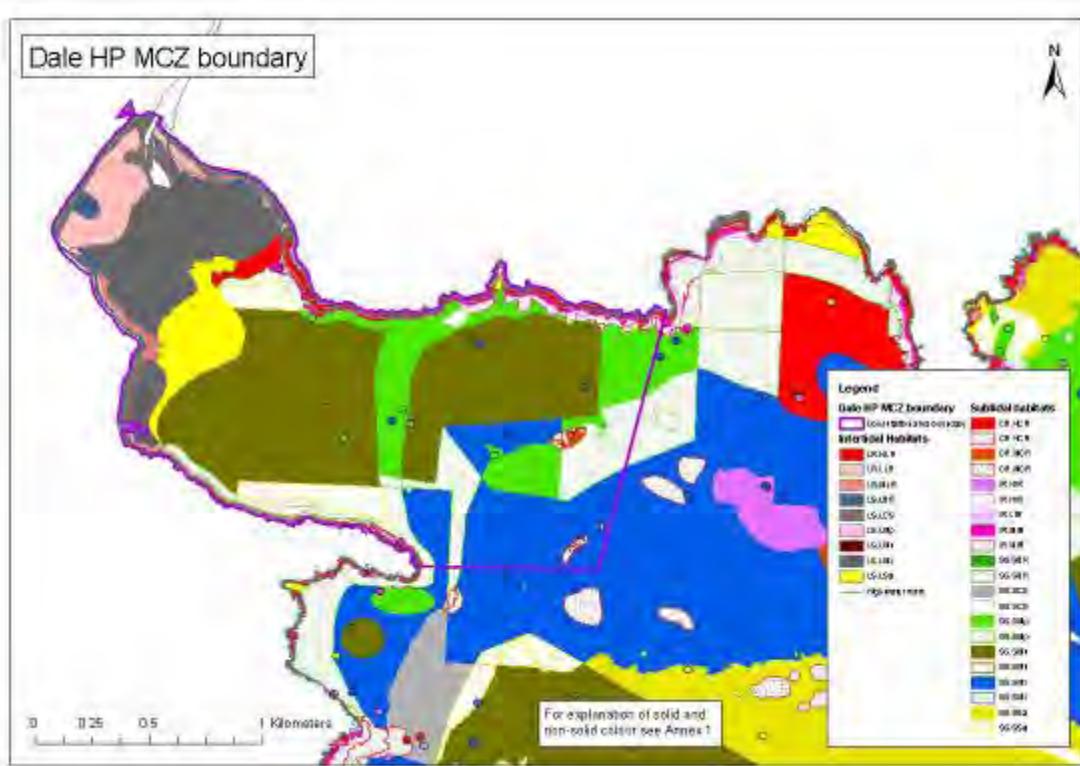
A report was run on this boundary to see which habitats were present in viable amounts. The result is shown in Table 42.

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<sup>31</sup> Joint Nature Conservation Committee. 1996. Guidelines for the selection of biological SSSIs: intertidal marine habitats and saline lagoons. Peterborough

<sup>32</sup> MarClim is a project created to investigate the effects of climatic warming on marine biodiversity. In particular the project aimed to use key intertidal species, whose abundances had been shown to fluctuate with changes in climatic conditions, as indicators of changes occurring in the intertidal and offshore.

**Figure 81. Broadscale habitats captured by the Step 4 boundary**



**Table 42. Habitats with a viable patch size captured by the Step 4 boundary**

	Area (km <sup>2</sup> ) or number of data points (pts)	Target area (km <sup>2</sup> )
Broadscale Habitat		
High energy intertidal rock	0.075	0.005
Low energy intertidal rock	0.152	0.025
Moderate energy intertidal rock	0.039	0.005
Intertidal coarse sediment	0.094	0.025
Intertidal mixed sediment	0.342	0.250
Subtidal Macrophyte dominated communities on sediment	0.305	0.250
Subtidal Mud	0.963	0.250
Subtidal mixed sediments	0.330	0.250
<b>Important Habitat</b>		

Sheltered muddy gravel	0.342	0.250
Subtidal mixed muddy sediments	0.413	0.250

This produces a site size of **2.9 km<sup>2</sup>**.

## **EXPLANATION OF HABMAP POLYGON DATA**

Subtidal broadscale habitat polygons are based on the HABMAP dataset. (Robinson et al. 2009 and Annex 6). HABMAP is a predictive modelling project that uses the relationship between physical information (e.g. sediment type, water depth, wave exposure) and biological data (i.e. biotope) to predict the biotope in areas for which there is no biological survey information. Each polygon (or cell) in the HABMAP dataset is created by combining the physical datalayers and identifying those areas that have the same physical conditions. The advantage of the HABMAP dataset is that it provides continuously mapped polygon data and can therefore be used to estimate the extent of a patch of a broadscale habitat. The disadvantage is that, as with any modelled data, it will not always be correct.

For the MCZ project, point data was combined with the HABMAP spatial (polygon) data and only those polygons (or cells) that actually contained biotope point data were used for the site selection process. The data that is supported by data points is presented as solid colour in the maps in this document. Where more than one habitat had been recorded in a polygon (e.g. where the seabed was a complex mosaic of small habitat patches), the habitat that best fitted the physical characteristics of the polygon was used for calculations of area.

For polygons (or cells) where there was no survey data, HABMAP predicted the biotopes that would be expected to occur based on the physical conditions in those polygons. This data is presented as non-solid colour in the maps in this document. It was not used for selection of the sites but provides a useful indication of the habitats that might be present.

It is important to note that the extent of each habitat in the subtidal is determined by several physical datalayers and should be considered an estimate, rather than a precise measurement (in contrast to the intertidal data where the extent values for each polygon will be much more accurate).

**TABLE EXPLAINING BROADSCALE HABITAT CODES**

Table showing broadscale habitat codes (as used in map legends)

<b>Code</b>	<b>Habitat name</b>
LR.HLR	High energy intertidal rock
LR.MLR	Moderate energy intertidal rock
LR.LLR	Low energy intertidal rock
LS.LCS	Intertidal coarse sediment
LS.LSa	Intertidal sand
LS.LMu	Intertidal mud
LS.LMx	Intertidal mixed sediments
LS.LMp	Intertidal seagrass beds
LS.LBR	Intertidal biogenic reefs
IR.HIR	High energy shallow water rock
IR.MIR	Moderate energy shallow water rock
IR.LIR	Low energy shallow water rock
CR.HCR	High energy deeper water rock
CR.MCR	Moderate energy deeper water rock
CR.LCR	Low energy deeper water rock
SS.SCS	Subtidal coarse sediment
SS.SSa	Subtidal sand

<b>Code</b>	<b>Habitat name</b>
SS.SMu	Subtidal mud
SS.SMx	Subtidal mixed sediments
SS.SBR	Subtidal biogenic reefs
SS.SMp	Subtidal macrophyte communities

### **APPLICATION OF ADDITIONAL CONSIDERATIONS TO HIGHLY PROTECTED MCZ POTENTIAL SITES**

Summary of the way in which additional considerations have been applied to each site:

Site name	Additional considerations applied?	Which additional considerations? (see list below for numbers)	Distance between original principles and additional considerations boundaries	Increase in area due to additional considerations (km <sup>2</sup> )	Final site size (km <sup>2</sup> )
Puffin Island	Yes	1, 2, 5	220 m	0.2	2.0
Menai Strait	Yes	1, 2	900 m	1.1	4.1
North Lleyn Peninsula	No				26.8
Bardsey Island	Yes	2	1200m	2.7	10.5
St Tudwals Island East & Llanbedrog	No				28.2
Mouth of Dwyfor	Yes	1, 3	1300 m	2.5	6.0
New Quay offshore	No				5.3
SW of Strumble Head	No				4.2
Skomer Island	Yes	1, 2, 3,	2000 m	1.7	10.5
Dale	Yes	1, 2, 3	300 m	0.3	2.9

The ecological considerations are:

1. Ecological quality
2. Linked habitats
3. Increasing habitat heterogeneity
4. Potential for recovery of specific localised habitats

The other scientific considerations are:

5. Areas with long term ecological datasets
6. Improving the evidence base (This consideration was not specifically applied to any of the sites, but it is worth noting that the evidence base is improved by default in most cases where other considerations have been applied.)