CYNGOR CEFN GWLAD CYMRU
COUNTRYSIDE COUNCIL FOR WALES

CORE MANAGEMENT PLAN

INCLUDING CONSERVATION OBJECTIVES

FOR

CARMARTHEN BAY DUNES/ TWYNI BAE CAERFYRDDIN SAC (SPECIAL AREA OF CONSERVATION)

(For the conservation objectives for Burry Inlet SPA and for Burry Inlet Ramsar site please refer to the Regulation 33 document for Carmarthen Bay and Estuaries SAC)

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Approved by: **Tracey Lovering**

Cyngor Cefn Gwlad Cymru
Countryside Council for Wales

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PREFACE

This document provides the main elements of CCW's management plan for the sites named. It sets out what needs to be achieved on the sites, the results of monitoring and advice on the action required. This document is made available through CCW's web site and may be revised in response to changing circumstances or new information. This is a technical document that supplements summary information on the web site.

One of the key functions of this document is to provide CCW's statement of the Conservation Objectives for the relevant Natura 2000 sites. This is required to implement the Conservation (Natural Habitats, &c.) Regulations 1994, as amended (Section 4). As a matter of Welsh Assembly Government Policy, the provisions of those regulations are also to be applied to Ramsar sites in Wales.

1. VISION FOR THE SITE

This is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives (part 4) into a single, integrated statement about the site.

The overall aim for the SAC is to see the natural coastal and dune forming processes that determine the dynamics and proportions of habitats around Carmarthen Bay continue, but to maintain the existing habitats where possible by management of factors within human control.

Approximately 75% of the site comprises sand dunes, supporting a broad range of plant community types. Natural processes largely govern the area of the dunes which grade from shifting embryonic dunes with an abundance of bare sand (between a quarter and a half of the dune area), to a more fixed stable dune community. This range of communities, with a high proportion of sparsely vegetated and open dune slacks or wet hollows, will be maintained or increased. The condition of these habitats is dependant on a number of factors including the nutrient state of the aquatic system and quantity of water as well as the management regime.

The nationally rare and scarce plants, such as petalwort and fen orchid which are typical of and associated with the dunes, will not reduce in range within their habitats, or lose the ability to reproduce and sustain themselves through factors within human control.

The site will be managed to promote the natural diversity of the sand dune. Due to the nature of the site this will involve scrub control, as natural seral progression would otherwise result in the dunes becoming dominated by scrub and woodland. At all sites this will include control of sea buckthorn and other vegetation.

2. SITE DESCRIPTION

2.1 Area and Designations Covered by this Plan

Grid reference: SN285074 (centre)

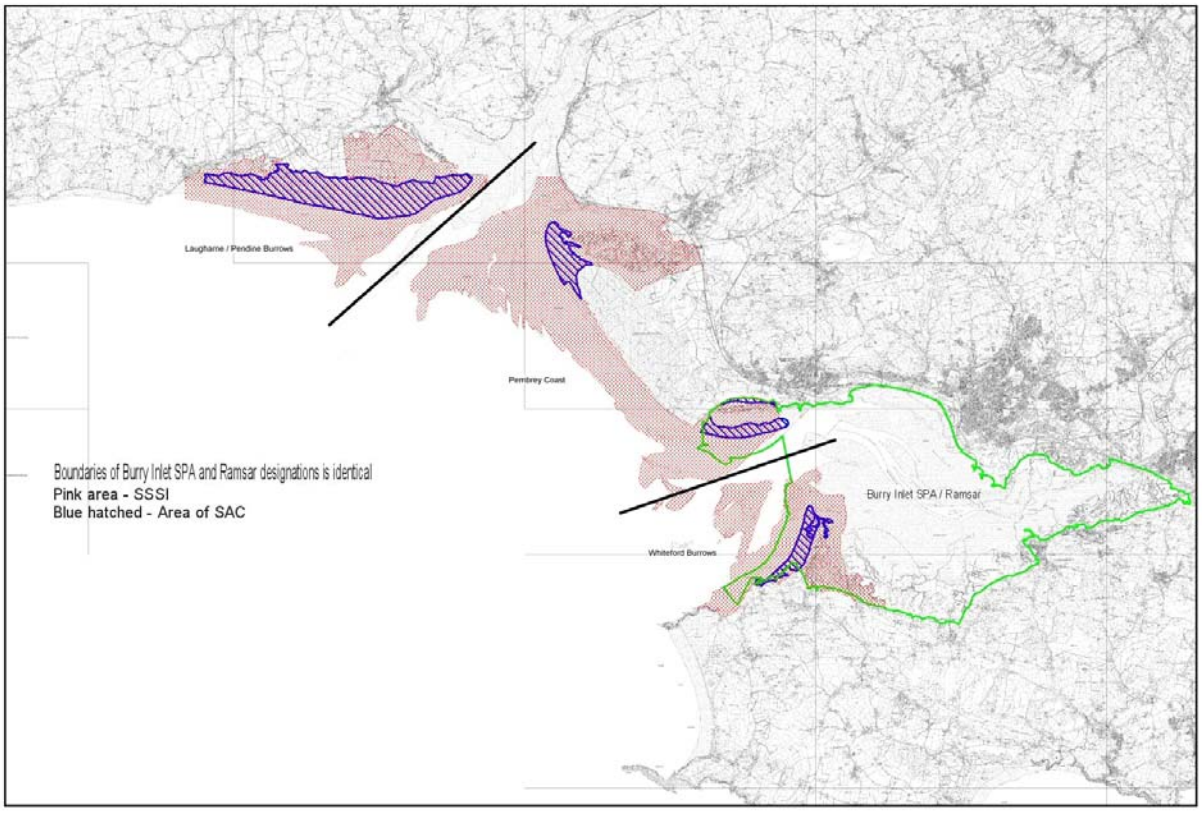
Unitary authorities: Carmarthenshire County Council, City and County of Swansea

Area (hectares): 1206.32 ha

Designations covered: Pembrey Coast SSSI; Whiteford Burrows, Landimore Marsh and Broughton Bay SSSI; Laugharne and Pendine Burrows SSSI; Burry Inlet RAMSAR; Burry Inlet SPA.

A summary map showing the coverage of this document is shown below

Carmarthen Dunes SAC, SPA and SSSI's



Produced by CCW on: 8 October 2007

Scale 1:159108

2.2 Outline Description

Carmarthen Bay Dunes SAC is located in three sections -

- Laugharne and Pendine on the Carmarthenshire coast to the south of St Clears
- Around Pembrey on the Carmarthenshire coast south west of Kidwelly
- Whiteford on the north west of the Gower peninsular

The SAC comprises 1206 hectares and encompasses three Site of Special Scientific Interest as noted in section 2.1.

The SAC is largely comprised of sand dune and associated habitat; there are additional SSSI features not included in the SAC designation; these are listed in section 3.

Burry Inlet SPA and RAMSAR overlap the SAC in the Whiteford section; however, the SPA and RAMSAR interest are wildfowl and wader species, which do not use the dune habitat. Therefore the SPA and RAMSAR element of this plan will instead be covered by the Carmarthen Bay Reg 33 plan. Please refer to that document for conservation objectives for the SPA and RAMSAR features.

Whiteford National Nature Reserve (NNR) also forms part of the area of the SAC; this comprises 782 hectares.

Laugharne and Pendine Burrows SSSI comprises the largest spit and sand dune system in west Wales, lying on the west side of Carmarthen Bay. It is of outstanding importance for its rare coastal plants and extensive dune slacks which merge into fen and swamp near Witchett Pool, a 9 hectare calcareous freshwater lake. At least 350 species of flowering plants have been recorded from the site. The extensive dune system has ridges up to 20m in heights, separated by deep, damp hollows rich in rare or uncommon plants.

2.3 Outline of Past and Current Management

The dunes at Whiteford Burrows have been grazed since the Middle Ages, being particularly valuable for dry winter grazing. Up to 2000 ewes have been known to graze the site at any one time. Currently it is managed by a combination of sheep and pony grazing with rabbits also contributing. Part of the area has been planted for timber with stands of Corsican pine, which are influencing both hydrology and sand movement. Whiteford NNR covers most of the area of the SAC in this section and is managed jointly by CCW and the National Trust as a nature reserve.

The section around Pembrey was formerly under grazing management but since 1940 much of the northern part has been used by the Ministry of Defence for training. This has precluded grazing over much of this area, leading to stabilisation and succession to scrub and woodland communities at the expense of early successional habitats. The northern tip of this section at Tywyn is actively managed for nature conservation including maintenance of the high water table which is of importance for the presence of dune slack habitat. The southern end of this section is managed by Carmarthenshire Council as a Local Nature Reserve.

Similarly, the Laugharne and Pendine section has been used more or less continuously for weapons testing since the last war, which imposes obvious constraints on the management that can be undertaken where access has to be arranged and there may be unexploded ordnance and other dangers present. Local knowledge, photographs and early habitat maps indicate there has been a decrease in the early successional stages of dune habitat since the war, and an increase in the amount of scrub, particularly sea buckthorn and carr.

It may be necessary to suspend active management in some dangerous areas and allow these to develop into woodland.

Due to the lack of grazing by domestic stock and rabbits in recent years, scrub has increased its coverage rapidly over the dunes. There are tangles of bramble, sea buckthorn and blackthorn as well as the growth of willow and alder in the wetter areas. This has led to the development of woodland which itself is deemed to be a feature of importance. In other areas the growth of scrub has directly threatened the habitat of many rare plants while at the same time becoming too dense to be of benefit to some invertebrate species. At present scrub occupies approximately 9-10% of the dune land area as a whole.

For the purposes of setting conservation objectives the SAC can be broadly divided into two sections based on management options – intervention and non-intervention. These are detailed more fully in Section 5.

Non Intervention sections

- Those areas of the site which are today covered by mature scrub/woodland and deemed to be beyond realistic recovery to other dune habitats [Unit 12, these areas will be left to develop to dune/wet woodland].

- the foredune communities (embryonic dunes and shifting dunes) at the seaward edge of the site. These communities are self-perpetuating and will be retained (albeit restricted in extent) irrespective of the implementation of active management. In some cases there may be a requirement for limited intervention where scrub has established on the shifting dunes.

- Those sections of the site at Pembrey which, due to MoD concerns over destabilisation and resultant erosion, are unlikely to be actively managed.

Active management sections

- Areas where active management in the form of livestock grazing (preceded by mechanical excavation or scarification where appropriate) is required to prevent and/or reverse the successional trend to more mature dune habitats. This encompasses dunes with herbaceous vegetation and humid dune slacks, and effectively includes all remaining areas of the site not encompassed in the non-intervention section; excepting some areas where a decision has yet to be made. Of particular concern are the few remaining open slacks in the more seaward sections of the sites; these being deemed most suitable for the recovery of fen orchid.

- The various marshy grassland pastures (non-qualifying feature) on the landward side of the site which are currently managed through a regime of grazing or mowing. Those currently grazed or mown will continue to be grazed or mown.

- Dunes with herbaceous vegetation, covering an area of primarily dune grassland habitat at Pembrey. These are owned by Forest Enterprise who periodically carry out scrub control; livestock grazing should also be introduced to reverse successional trends.

- The areas of fen and open water which will be managed to ensure retention of open water and prevent scrub development

- A recently cleared area of scrub at Pembrey where fencing and horse grazing is proposed

- A scrub control program at Whiteford, with emphasis on very young slacks and slacks with potential to support fen orchid. This includes hand pulling of young seedlings and proposals for felling of mature pine trees where these are considerd to adversely affect the water table.

- Dune slacks being managed for fen orchid at Laugharne - Pendine

2.4 Management Units

The plan area has been divided into management units to enable practical communication about features, objectives, and management. This will also allow us to differentiate between the different designations where necessary. In this plan the management units have been based mainly on tenure, with reference to habitats and management practice.
A map showing the management units referred to in this plan is shown below (or in an Annex for large sites):

The following table confirms the relationships between the management units and the designations covered:

Unit number	SAC	SSSI	CCW owned	SPA	NNR	RAMSAR
Whiteford Burrows, Landimore Marsh and Broughton Bay SSSI						
1	✓	✓				
2	✓	✓		Mostly		Mostly
3	✓	✓		Mostly	✓	Mostly
4	✓	✓		✓	✓	✓
5	✓	✓		✓	✓	✓
Pembrey Coast SSSI						
6	✓	✓				
7	✓	✓				
8	✓	✓				
9	✓	✓				
10	✓	✓				
Laugharne and Pendine Burrows SSSI						
11	✓	✓				
12	✓	✓				
13	✓	✓				
14	✓	✓				
15	✓	✓				

3. THE SPECIAL FEATURES

3.1 Confirmation of Special Features

Designated feature	***Relationships, nomenclature etc***	***Conservation Objective in part 4***
SAC features		
Annex I habitats that are a primary reason for selection of this site		
1. Embryonic shifting dunes (EU habitat code 2110)	Referred to in this plan as embryonic shifting dunes	1
2. Shifting dunes along the shoreline with *Ammophila arenaria* (`white dunes`) (EU habitat code 2120)	Referred to in this plan as shifting dunes	2
3. Fixed dunes with herbaceous vegetation (`grey dunes`) (EU habitat code 2130)	Referred to in this plan as grey dunes	3
4. Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) (EU habitat code 2170)	Referred to in this plan as dunes with *Salix repens*	4
5. Humid dune slacks (EU habitat code 2190)	Referred to in this plan as humid dune slacks	5
Annex II species that are a primary reason for selection of this site		
6. Narrow-mouthed whorl snail *Vertigo angustior* (EU species code 1014)		6
7. Petalwort *Petalophyllum ralfsii* (EU habitat code 1395)		7
8. Fen orchid *Liparis loeselii* (EU habitat code 1903)		8
SPA features		
9. Pintail *Anas acuta* 10. Shoveler *Anas clypeata* 11. Teal *Anas crecca* 12. Wigeon *Anas penelope* 13. Dunlin *Calidris alpina alpina* 14. Knot *Calidris canutus* 15. Oystercatcher *Haematopus ostralaegus* 16. Curlew *Numenius arquata* 17. Grey plover *Pluvialos*	All SPA features are dealt with under the Carmarthen Bay SAC plan as this contains a far greater proportion of the required habitat for these species. This is done to prevent overlap and duplication between these two plans.	

squatarola 18. Shelduck *Tadorna tadorna* 19. Redshank *Tringa tetanus* 20. Common scoter *Melanitta nigra*		
Ramsar features		
21. Ramsar criterion 5 **Assemblages of international importance : Species with peak counts in winter** 41655 waterfowl (5 year peak mean 1998 / 99 – 2002/03)	See also SPA features	
22. Ramsar criterion 6 **Species / populations occurring at levels of international importance.** **Qualifying species / populations (as identified at designation) : Species with peak counts in spring / autumn** Common redshank *Tringa tetanus*	See also SPA features	
Species with peak counts in winter	See also SPA features	
23. Northern pintail *Anas acuta*	See also SPA features	
24. Eurasian oystercatcher *Haematopus ostralegus*	See also SPA features	
25. Red knot *Calidris canutus islandica*	See also SPA features	
Species / populations identified subsequent to designation for possible future consideration under criterion 6 **Species with peak counts in winter** 26. Northern shoveler *Anas clypeata*	See also SPA features	
SSSI features		
Note : SSSI features will be included at a later date. The following is a list of current SSSI features; where these directly relate to SAC and SPA features, they have not been listed.		
27. Saltmarsh and upper saltmarsh transition		
28. Sand dune		
29. Woodland (scrub and semi natural)		

30. Grassland (calcareous, marshy and neutral)		
31. Swamp		
32. Standing water		
33. Running water		
34. Golden plover *Pluvialis apricaria*		
35. Breeding bird assemblage of lowland open waters and their margins		
36. Water vole *Arvicola terrestris*		
37. Otter *Lutra lutra*		
38. Twaite shad *Allosa fallax*		
39. Allis shad *Allosa alosa*		
40. Dune gentian *Gentiana uliginosa*		
41. Early sand grass *Mibora minima*		
42. Assemblage of RDB and nationally scarce vascular plants		
43. Coastal macrofungi assemblage		
44. The ground beetle *Panageus cruxmajor*		
45. Weevil *Datonychus arquatus*		
46. Sand dune invertebrate assemblage		
47. Polychaete worm *Ophelia bicornis*		
48. Quaternary of Wales		
49. Exposed sand		
50. Natural inland rock exposures, screes and upland ledges		

3.2 Special Features and Management Units

This section sets out the relationship between the special features and each management unit. This is intended to provide a clear statement about what each unit should be managed for, taking into account the varied needs of the different special features. All special features are allocated to one of seven classes in each management unit. These classes are:

Key Features
KH - a 'Key Habitat' in the management unit, i.e. the habitat that is the main driver of management and focus of monitoring effort, perhaps because of the dependence of a key species (see KS below). There will usually only be one Key Habitat in a unit but there can be more, especially with large units.
KS – a 'Key Species' in the management unit, often driving both the selection and management of a Key Habitat.
Geo – an earth science feature that is the main driver of management and focus of monitoring effort in a unit.

Other Features

Sym - habitats, species and earth science features that are of importance in a unit but are not the main drivers of management or focus of monitoring. These features will benefit from management for the key feature(s) identified in the unit. These may be classed as 'Sym' features because:

a) they are present in the unit but may be of less conservation importance than the key feature; and/or
b) they are present in the unit but in small areas/numbers, with the bulk of the feature in other units of the site; and/or
c) their requirements are broader than and compatible with the management needs of the key feature(s), e.g. a mobile species that uses large parts of the site and surrounding areas.

Nm - an infrequently used category where features are at risk of decline within a unit as a result of meeting the management needs of the key feature(s), i.e. under Negative Management. These cases will usually be compensated for by management elsewhere in the plan, and can be used where minor occurrences of a feature would otherwise lead to apparent conflict with another key feature in a unit.

Mn - Management units that are essential for the management of features elsewhere on a site e.g. livestock over-wintering area included within designation boundaries, buffer zones around water bodies, etc.

x – Features not known to be present in the management unit.

The tables below sets out the relationship between the special features and management units identified in this plan:

Whiteford Burrows, Landimore Marsh and Broughton Bay SSSI	**Management Unit**				
	1	**2**	**3**	**4**	**5**
SAC	✓	✓	✓	✓	✓
SSSI	✓	✓	✓	✓	✓
NNR/CCW owned			✓	✓	✓
SAC features					
Embryonic shifting dunes		**KH**	**KH**		
Shifting dunes along the shoreline with *Ammophila arenaria*		**KH**	**KH**		
Fixed dunes with herbaceous vegetation			**KH**		
Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)	Sym		**KH**	**KH**	**KH**
Humid dune slacks	**KH**	**KH**	**KH**	**KH**	**KH**
Narrow-mouthed whorl snail *Vertigo angustior*			**KS**		
Petalwort *Petalophyllum ralfsii*			**KS**	**KS**	**KS**
Fen orchid *Liparis loeselii*			Sym	**KS**	Sym

Pembrey Coast SSSI	Management Unit				
	6	**7**	**8**	**9**	**10**
SAC	✓	✓	✓	✓	✓
SSSI	✓	✓	✓	✓	✓
NNR/CCW owned					
SAC features					
Embryonic shifting dunes			**KH**	**KH**	
Shifting dunes along the shoreline with *Ammophila arenaria*			**KH**	**KH**	
Fixed dunes with herbaceous vegetation	**KH**	**KH**	**KH**	**KH**	**KH**
Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*)			**KH**	**KH**	**KH**
Humid dune slacks		**KH**	**KH**	**KH**	
Narrow-mouthed whorl snail *Vertigo angustior*			Sym		
Petalwort *Petalophyllum ralfsii*					
Fen orchid *Liparis loeselii*					

Laugharne and Pendine Burrows SSSI	Management Unit				
	11	**12**	**13**	**14**	**15**
SAC	✓	✓	✓	✓	✓
SSSI	✓	✓	✓	✓	✓
NNR/CCW owned					
SAC features					
Embryonic shifting dunes					**KH**
Shifting dunes along the shoreline with *Ammophila arenaria*					**KH**
Fixed dunes with herbaceous vegetation	**KH**				**KH**
Dunes with *Salix repens* ssp. *Argentea* (*Salicion arenariae*)	**KH**				**KH**
Humid dune slacks	**KH**				**KH**
Narrow-mouthed whorl snail *Vertigo angustior*					
Petalwort *Petalophyllum ralfsii*	**KH**				**KH**
Fen orchid *Liparis loeselii*	**KH**				

4. CONSERVATION OBJECTIVES

Background to Conservation Objectives:

a. Outline of the legal context and purpose of conservation objectives.

Conservation objectives are required by the 1992 'Habitats' Directive (92/43/EEC). The aim of the Habitats Directives is the maintenance, or where appropriate the restoration of the 'favourable conservation status' of habitats and species features for which SACs and SPAs are designated (see Box 1).

In the broadest terms, 'favourable conservation status' means a feature is in satisfactory condition and all the things needed to keep it that way are in place for the foreseeable future. CCW considers that the concept of favourable conservation status provides a practical and legally robust basis for conservation objectives for Natura 2000 and Ramsar sites.

Box 1
Favourable conservation status as defined in Articles 1(e) and 1(i) of the Habitats Directive

"The conservation status of a natural habitat is the sum of the influences acting on it and its typical species that may affect its long-term natural distribution, structure and functions as well as the long term survival of its typical species. The conservation status of a natural habitat will be taken as favourable when:

- Its natural range and areas it covers within that range are stable or increasing, and
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- The conservation status of its typical species is favourable.

The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

- population dynamics data on the species indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis."

Achieving these objectives requires appropriate management and the control of factors that may cause deterioration of habitats or significant disturbance to species.

As well as the overall function of communication, Conservation objectives have a number of specific roles:

- Conservation planning and management.

  The conservation objectives guide management of sites, to maintain or restore the habitats and species in favourable condition.

- Assessing plans and projects.

  Article 6(3) of the 'Habitats' Directive requires appropriate assessment of proposed plans and projects against a site's conservation objectives. Subject to certain exceptions, plans or projects may not proceed unless it is established that they will not adversely affect the integrity of sites. This role for testing plans and projects also applies to the review of existing decisions and consents.

- Monitoring and reporting.

  The conservation objectives provide the basis for assessing the condition of a feature and the status of factors that affect it. CCW uses 'performance indicators' within the conservation objectives, as the basis for monitoring and reporting. Performance indicators are selected to provide useful information about the condition of a feature and the factors that affect it.

The conservation objectives in this document reflect CCW's current information and understanding of the site and its features and their importance in an international context. The conservation objectives are subject to review by CCW in light of new knowledge.

b. Format of the conservation objectives

There is one conservation objective for each feature listed in part 3. Each conservation objective is a composite statement representing a site-specific description of what is considered to be the favourable conservation status of the feature. These statements apply to a whole feature as it occurs within the whole plan area, although section 3.2 sets out their relevance to individual management units.

Each conservation objective consists of the following two elements:

1. Vision for the feature
2. Performance indicators

As a result of the general practice developed and agreed within the UK Conservation Agencies, conservation objectives include performance indicators, the selection of which should be informed by JNCC guidance on Common Standards Monitoring[1].

There is a critical need for clarity over the role of performance indicators within the conservation objectives. **A conservation objective, because it includes the vision for the feature, has meaning and substance independently of the performance indicators, and is more than the sum of the performance indicators**. The performance indicators are simply what make the conservation objectives measurable, and are thus part of, not a substitute for, the conservation objectives. Any feature attribute identified in the performance indicators should be represented in the vision for the feature, but not all elements of the vision for the feature will necessarily have corresponding performance indicators.

As well as describing the aspirations for the condition of the feature, the Vision section of each conservation objective contains a statement that the factors necessary to maintain those desired conditions are under control. Subject to technical, practical and resource constraints, factors which have an important influence on the condition of the feature are identified in the performance indicators.

[1] Web link: http://www.jncc.gov.uk/page-2199

4.1 Conservation Objective for Feature 1: Embryonic shifting dunes (EU habitat code 2110)

Vision for Feature 1
The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Natural processes will be allowed to determine the time and place when the strandline and embryonic dunes exist. These processes will not be impeded by direct or indirect human intervention
- A strandline will be present at least one year in every five within the areas identified
- Embryonic dunes will be present on the seaward side of the mobile frontal dune ridge at least one year in every three
- All of the factors affecting the feature are under control

Performance Indicators for Feature 1

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Performance indicators for feature condition		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.1 Extent	The aim is to ensure that the extent and distribution of the 'embryonic shifting dunes' is maintained according to natural processes throughout this SAC. To ensure this, a target has been included that states that all SSSI within this SAC, where these features are present, must be in favourable conservation status for this SAC feature to be considered favourable overall. Embryonic dunes are defined as small mobile sand hummocks (typically <0.5m high) formed as a result of sand being trapped by small stands of *Elytrigea juncea* or *Leymus arenarius*. A strandline requires the presence of at least three of the following species on the seaward side of the frontal mobile dune ridge above the Mean High Water line: *Honkenya peploides, Cakile maritime, Salsola kali, Elytrigia juncea, Atriplex spp. and Beta vulgaris*	On all three dune systems: *Upper limit:* none set. *Lower limit:* a strandline is present at least one year in every five **And** embryonic dunes are present on the seaward side of the mobile frontal dune ridge at least one year in three **And** At least one of *Elytrigea juncea* or *Leymus arenarius* is frequent

Performance indicators for factors affecting the feature		
Factor	***Factor rationale and other comments***	***Operational Limits***
F1. Physical structure-functionality and sediment supply from both on site and off site	A continuous supply of fresh blown sand is essential for the maintenance of this early successional habitat. Without the fresh supply of sand the strand line and embryo dunes are likely to erode.	*Upper limit :* No increase in human activity leading to impacts on natural processes *Lower limit :* None set
F2. Clearance of strandline	Organic matter on the beach helps to trap the blown sand and act as a nutrient and moisture source for strand line vegetation. Unselective beach cleaning has lead to the removal of organic matter such as seaweed from beaches elsewhere.	*Upper limit:* If beach cleaning occurs no organic matter such as seaweed should be removed. *Lower limit:* None set
F.3 Vehicle or visitor damage	Physical damage of the strandline through human activity can lead to the removal of part of the strandline	*Upper limit:* No damage arising from vehicular traffic at key locations for the feature. (Management units 2,3,8,9 and 15) *Lower limit:* None set

4.2 Conservation Objective for Feature 2:
Shifting dunes along the shoreline with *Ammophila arenaria* (`white dunes`) (EU habitat code 2120)

Vision for Feature 2
The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Shifting dunes will exist as part of the dynamic natural processes which create the dune systems.
- There will be an interaction between the three dune systems such that the natural process of erosion in some parts and accretion in others will continue without direct or indirect human disturbance.
- Shifting dunes will comprise a significant part of the dune system but will increase and decrease in extent and location as natural processes determine the landscape of the dune systems
- At least two of the three sites in the SAC satisfy the limits outlined in the performance indicator below.
- All of the factors affecting the feature are under control.

Performance Indicators for Feature 2

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Performance indicators for feature condition		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.1 Extent	While dune building through sand accretion is desirable, it is unlikely to occur on all systems concurrently. It is possible that some systems will show net erosion while others nearby are accreting sand. The Carmarthen Dunes SAC is a large site incorporating several dune systems, it is possible for sand to build up on one site at the expense of erosion on one of the others. Our requirement for only two of the three systems to meet the objective allows for sand shifting between sites. Young shifting dunes are defined as sandy hummocks <1m high situated on the seaward side of the mature foredunes, typically vegetated with tussocks of *Ammophila arenaria* and often with *Elitrigea juncea* and other strandline species e.g. *Honkenya peploides* sparsely distributed.	*Lower limit:* At least two of the three sites have >0.5ha of young shifting dunes on the seaward side of the foredune ridge, *Upper limit:* none set
A.2 Vegetation composition	Vegetation should largely be comprised mostly of one or both of *Ammophila arenaria* or *Leymus arenarius*. Flowering plants are an indication that there is movement of sand and that dunes are mobile *Hippophae rhamnoides* is absent The negative indicator species *Urtica dioica, Senecio jacobaea, Cirsium arvense, Cirsium vulgare, Lolium perenne* and *Arrhenatherum elatius* are infrequent	Vegetation composition will be within the acceptable limits where *Upper limit :* None set *Lower limit :* At least one of *Ammophila arenaria* or *Leymus arenarius* is present and plants with fruiting heads are frequent (41-60% of sample) And *Hippophae rhamnoides* is absent And Any one of the negative species is no more than frequent, or singly or in combination cover is less than 5%

Performance indicators for factors affecting Shifting dunes		
Factor	***Factor rationale and other comments***	***Operational Limits***
F1. Physical structure-functionality and sediment supply	A continuous supply of fresh blown sand is essential for the maintenance of the accreting dunes at Carmarthen Bay Dunes SAC. Cessation of the fresh supply of sand could lead to stabilisation or erosion. Natural erosion of sand and other substrates will be tolerated. However, erosion due to human activities will not.	*Upper limit:* There should be no further anthropogenic increase in factors leading to constraints to the natural mobility of the system. These could include; new coastal defence works or beach stabilisation works. *Lower limit:* None set
F2. Beach cleaning	Organic matter on the beach helps to trap the blown sand and act as a nutrient and moisture source for strand line vegetation which builds into embryo dunes and on into shifting dunes. Unselective beach cleaning may lead to the removal of organic matter such as seaweed from beaches.	*Upper limit:* If beach cleaning occurs no organic matter such as seaweed should be removed. *Lower limit:* None set Management units 2,3,8,9 and 15
F3. Grazing, and disturbance by livestock	Grazing and trampling can help keep the shifting dune vegetation open and the dunes mobile. However, heavy grazing can have a detrimental effect.	*Upper limit:* None set *Lower limit:* The dunes should be lightly grazed with vegetation composition used to determine when grazing is inappropriate Refer to limits on vegetation composition A2.
F4. Grazing and digging by rabbits	Rabbits contribute to grazing of dunes and their burrowing can help to destabilise older dunes so creating desirable movement of sand. They are prone to population rises and crashes and cannot be effectively managed. Rather they should be seen as complementary to site management though should there be periods of population booms they may require control.	No limits set
F5. *Vehicle or visitor damage*	Pressure from trampling or vehicles can cause damage to vegetation and erosion.	*Upper limit:* Vehicle or visitor damage should be absent or rare at vulnerable locations Management units 2,3,8,9 and 15 *Lower limit*: None set

4.3 Conservation Objective for Features 3:
Fixed dunes with herbaceous vegetation (`grey dunes`) (EU habitat code 2130)

Vision for Feature 3
The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Fixed dunes with herbaceous vegetation (grey dunes) will occur where older, shifting dunes become more stabilised and in early successional stages become colonised by lichens and other species indicative of the transition from less mobile habitat.
- The habitat will encompass a range of successional stages throughout the area, determined by patterns of natural factors and grazing.
- Grey dunes will comprise a significant part of the dune system but will increase and decrease in extent and location as natural processes determine the landscape of the dune systems
- All factors are under management control.

Performance Indicators for Feature 3

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Overall performance indicators for feature condition		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.1 Extent	Grey dunes should be distributed throughout this SAC. To ensure this, a target has been included that states that all SSSI within this SAC, that contain these features have to be in good condition for this SAC feature to be considered favourable overall. Some fluctuations are likely in the extent due to losses to other components of the dune system or increases at the expense of other components. These losses and gains where due to natural factors will be accepted, but there must be no loss due to direct or indirect human activities. Occurs in Management units, 3, 6-10, 11, 15	Overall *Upper limit:* none set *Lower limit:* Presence as mapped (refer to individual SSSI / NNR plans as noted in reference section)

Overall performance indicators for feature condition (cont.d)		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.2 Habitat Quality	Grey dunes should cover a range of steps to maturity from successionally young through to mature. It is desirable to have a greater proportion of earlier successional forms characterised by bare sand or the moss *Tortula ruraliformis,* and the presence of species such as *Anthyllis vulneraria, Polygala vulgaris, Hypochaeris radicata, Pilosella officinarum, Viola tricolor, Thymus polytrichus, Euphrasia sp., Centaurium erythraea, Sedum acre* and *Lotus corniculatus*	*Upper limit*: 80% of the area *Lower limit*: 60% of the area meets the following – 10-30% bare sand or a moss carpet with at least three of *Phleum arenarium, Vulpia membranacea, Cladonia foliacea, Arenaria serpyllifolia, Sedum acre* or *Thymus polytrichus* present within a radius of 50cm of any point. Or A closed sward dominated by forbs, where six of *Anthyllis vulneraria, Tortula ruraliformis, Polygala vulgaris, Hypochaeris radicata, Pilosella officinarum, Viola tricolor, Thymus polytrichus, Euphrasia sp., Centaurium erythraea, Sedum acre* and *Lotus corniculatus* are present within a 50cm radius of any point. Sward height to be between 2-10cm And
	Negative indicator species show one or a combination of, lack of grazing, over stabilisation, eutrophication. These species include – *Senecio jacobaea, Rosa spp, Cirsium arvense, Cirsium vulgare, Urtica dioica, Lolium perenne, Arrhenatherum elatius, Pteridium aquilinum, Rubus fruticosus*	Negative indicator species are not more than frequent in samples (<60%) and either singly or in combination cover more than 5%. And Scrub and tree species no more than occasional (<40% of samples) and no more than 5% cover
Performance indicators for factors affecting grey dunes		
Factor	***Factor rationale and other comments***	***Operational Limits***
F1. Grazing,	Grazing is required to prevent too much of the area being covered by later successional stages, disturbance by trampling helps to maintain bare patches of ground. Excess grazing may cause too much disturbance, with dunging leading to eutrophication.	Refer to limits on vegetation composition A2.

Performance indicators for factors affecting grey dunes (cont.d)		
Factor	***Factor rationale and other comments***	***Operational Limits***
F2. Scrub	Scrub development is a significant issue in many areas, lack of grazing in the past has allowed this to progress to the stage where restoration is difficult or not possible. Scrub removal, mechanical disturbance and follow up grazing are possible actions	Refer to limits on vegetation composition A2.
F3. Vehicle or visitor damage	Pressure from trampling or vehicles can cause damage to vegetation and erosion.	*Upper limit:* Vehicle or visitor damage should not impact on the feature, see limits on bare ground A2 above Management units, 3, 6-10, 11, 15 *Lower limit*: None set

4.4 Conservation Objective for Features 4 & 5: Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) (EU habitat code 2170) and Humid dune slacks (EU habitat code 2190)

The division between 'humid dunes' and 'dunes with *Salix repens* ssp. *argentea* is unclear and difficult to define. The humid dune slack habitat includes both successionally young and mature slacks which equate to NVC communities SD13-16. The dunes with *Salix repens* spp. *argentea* equate to drier areas of mature dune slack and the low hummocks found around dune slacks which support *Salix repens*. These are sometimes known as hedgehog dunes. Because of the difficulties in separating these two habitats, for the purposes of monitoring, these features are considered together.

Vision for Features 4 & 5

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Dunes with *Salix repens* and humid dune slacks will occur as part of the dune system, their location will be determined by natural processes and appropriate grazing management
- A range of successional stages will be found in both features
- Factors affecting the features will be under control

Performance Indicators for Features 4 and 5

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Performance indicators for feature condition at Laugharne-Pendine SSSI		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.1 Extent	Provided the stated proportion of the dunes with *Salix repens*/humid dune slack habitat is in the required condition (see below) then dune slacks will be deemed to be in favourable condition.	*Upper limit* : None set *Lower limit:* See A2 below
A.2 Habitat quality	A range of dune slack habitat should be present from early successional stages with a large proportion of bare ground through to later stages with more closed vegetation and a significant proportion of *Salix repens.* Limits have been set to reflect this range of habitat types within these two features. A relative proportion of the more open/early successional forms of slacks characterised by bare sand or a moss carpet and the presence of species such as *Salix repens Carex arenaria, Sagina nodosa, Juncus articulatus, Carex viridula* ssp. *viridula*, *Anagallis tenella, Samolus valerandi, Eleocharis quinqueflora, Ranunculus flammula* and *Liparis loeselii*, and the absence of species such as *Phragmites australis, Molinia caerulea* or *Calamagrostis epigejos*. [Working on the premise that we want slacks represented by a range of stages of maturity (condition) from successionally young through to mature, but that if we have the former we can always get the latter]. Negative indicator species show one or a combination of - lack of grazing, over stabilisation, eutrophication. These species include – *Senecio jacobaea, Rosa spp, Cirsium arvense, Cirsium vulgare, Urtica dioica, Lolium perenne, Arrhenatherum elatius, Pteridium aquilinum, Rubus fruticosus,* any tree or shrub species	In the component SSSI's – Laugharne & Pendine *Upper limit* : 70% of the dune slack area *Lower limit* : 50% of the dune slack area Pembrey *Upper limit*: 40% of the dune slack area *Lower limit*: 25% of the dune slack area Whiteford *Upper limit* : 80% of the dune slack area *Lower limit* : 60% of the dune slack area The following conditions are met – 25-50% open ground with *Salix repens* forming clonal patches and *Carex arenaria, Sagina nodosa* or *Juncus articulatus* present within a radius of 50cm of any point, **or** where a patchy mosaic of bare soil with thalloid liverworts exists with low closed vegetation, with at least four of *Carex viridula* ssp. *viridula, Juncus articulatus, Anagallis tenella, Samolus valerandi, Eleocharis quinqueflora, Ranunculus flammula* present within a 50cm radius of any point, and where none of *Phragmites australis, Molinia caerulea* or *Calamagrostis epigejos* is present within a 1m radius of the same point.

Performance indicators for feature condition at Laugharne-Pendine SSSI (cont.d)		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.2 Habitat quality (cont.d)		Negative indicator species are not more than frequent in samples (<60%) and either singly or in combination cover more than 5%. And Scrub and tree species no more than occasional (<40% of samples) and no more than 5% cover
Performance indicators for factors affecting grey dunes		
Factor	***Factor rationale and other comments***	***Operational Limits***
F1. Grazing,	Grazing is required to prevent too much of the area being covered by later successional stages, disturbance by trampling helps to maintain bare patches of ground. Excess grazing may cause too much disturbance, with dunging leading to eutrophication.	Refer to limits on habitat quality A2.
F2. Scrub	Scrub development is a significant issue in many areas, lack of grazing in the past has allowed this to progress to the stage where restoration is difficult or not possible. Scrub removal, mechanical disturbance and follow up grazing are possible actions Conifer seeding is also an issue in some units	Refer to limits on vegetation composition A2.
F3. Vehicle or visitor damage	Pressure from trampling or vehicles can cause damage to vegetation and erosion.	*Upper limit:* Vehicle or visitor damage should not impact on the feature, see limits A2 above *Lower limit*: None set
F.4 Conifer plantations	Causes reduction in sand movement, stabilisation, impacts on hydrology, pine seedlings	See limits set out in section A2
F.5 Hydrology	Other than the causes noted above, any activity which causes lowering of the water table, eg ditching, abstraction, drainage must be prevented	*Upper limit*: None set *Lower limit:* No human activity that will cause lowering of the water table eg ditching, drainage, abstraction

4.6 Conservation Objective for Feature 6: Narrow-mouthed whorl snail *Vertigo angustior* (EU species code 1014)

Vision for Feature 6

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Sufficient suitable habitat is present to support the populations
- The factors affecting the feature are under control

Performance Indicators for Feature 6

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Performance indicators for feature condition		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.1 Population range	The performance indicators were developed by Adrian Fowles, Clive Hurford, Dan Guest and David Painter in May 2001. The rationale behind the targets and attributes is detailed by Fowles & Guest (in Hurford & Schneider, 2006) and is summarised below. Monitoring is focussed at stands of optimal habitat. It is assumed that the snail will continue to occur at lower densities in sub-optimal habitat, providing management is maintaining the areas of optimal vegetation. Targets for the snail itself have only been set to ensure a continued presence and maintain the range of distribution across the transition zone. More detailed census targets were not included, largely because of sample variability caused by weather conditions. Turf extraction, which provides a more accurate count of numbers of snails, is considered to be too intensive and possibly too destructive.	*Upper limit*: none set *Lower limit*: *Vertigo angustior* is recorded as present in Unit 3 of Whiteford Burrows, plus any three of the remaining five sections (see Map), during a 15-minute sampling period in each section. This species has also been recently found at Pembrey, limits may also need to be extended to this section though due to the recent nature of the find the requirement to do so is currently being assessed.
A.2 Habitat extent		*Upper limit*: none set *Lower limit*: as mapped in 2000

Performance indicators for feature condition (cont.d)		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.3 Habitat quality	Rationale: *Vertigo angustior* is generally associated with *Iris* dominated areas of the transition zone, particularly the herb rich areas. The quality targets have been set to reflect this. Negative indicators have been included as these indicate when the water tables are too high and conditions are not suitable for the snail. Iris dominated marsh is defined as marsh where in any 50cm radius *Iris pseudacorus* is present at a density of >5 plants Optimal *Vertigo angustior* habitat is defined as habitat where, in any 50cm radius: • >10 *Iris pseudacorus* plants are present; • the cover of *Lotus pedunculatus* is between 10 and 60% • grass/*Iris* litter cover is >5% • *Juncus maritimus* is <10% cover **and** *Samolus valerandii, Ranunculus sceleratus, Schoenoplectus tabernaemontani* and *Oenanthe lachenalii* are absent.	*Upper limit*: All of the vegetation is optimal *Vertigo angustior* habitat. *Lower limit*: in sections A-F, the proportion of the vegetation recorded as optimal *Vertigo angustior* habitat is as follows: Section A = 20% Section B = 25% Section C = 12% Section D = 25% Section E = 20% Section F = 15% See the SSSI map for locations of Sections A – F.
Performance indicators for factors affecting the feature		
Factor	***Factor rationale and other comments***	***Operational Limits***
F.1 Habitat	Presence of sufficient habitat is the most significant factor	**See A2 and A3 above**

4.7 Conservation Objective for Feature 7: Petalwort *Petalophyllum ralfsii* (EU habitat code 1395)

Vision for Feature 7

Petalophyllum ralfsii will continue to be found at its current locations in each of the three SSSI within the SAC. The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- The species will be found where conditions are suitable in sufficient numbers to form a viable and sustainable population
- The population will vary from year to year depending on conditions, especially in drier years, but the long term population will remain steady and sustainable
- Suitable dune slacks will have patches of bare ground that is being colonised by jelly lichens (*Collema* spp.) and *Barbula* mosses.
- The factors affecting the feature are under control

Performance Indicators for Feature 7

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Performance indicators for feature condition		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.1 Extent / distribution in SAC	*Petalophyllum* is present in two of the three component SSSI's	*Upper limit*: None set *Lower limit:* The individual site based performance indicators are met in each of the following SSSI: Laugharne and Pendine Burrows Whiteford Burrows
A.2 Habitat quality and extent	*P. ralfsii* is generally associated with successionally young, open dune slack vegetation. Limits for presence of this stage of succession have been set under feature 4/5 above	*Lower limit*: every three years the density of *Petalophyllum* thalli is: >50 thalli per m^2 at more than two discrete locations which are separated by at least 10m in two or more embryo or successionally-young humid dune slacks And The *Petalophyllum* should be associated with the embryo or successionally young slack habitat
Performance indicators for factors affecting the feature		
Factor	***Factor rationale and other comments***	***Operational Limits***
F.1 Habitat	The species requires early successional dune slacks, this is the most significant factor	**See above and Feature 4/5**

4.8 Conservation Objective for Feature 8: Fen orchid *Liparis loeselii* (EU habitat code 1903)

Vision for Feature 8

The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

- Sufficient suitable habitat is present to support the populations
- The factors affecting the feature are under control

Performance Indicators for Feature 8

The performance indicators are part of the conservation objective, not a substitute for it. Assessment of plans and projects must be based on the entire conservation objective, not just the performance indicators.

Overall performance indicators for feature condition in the SAC		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.1 Species quality	See rationales for the performance indicators at specific sites	The individual site based performance indicators are met for each of the following SSSI: Laugharne and Pendine Burrows Pembrey Coast Whiteford Burrows

Performance indicators for feature condition at Whiteford Burrows		
Attribute	***Attribute rationale and other comments***	***Specified limits***
A.1 Species extent and distribution	*Liparis* is currently only found within one dune slack at Whiteford. This is not thought to be secure in the long term. Long-term surveillance (from 1976 to present) indicates that *Liparis* used to have a much wider distribution and that on any occasion it was regularly found in six or more discrete dune slacks. The target has been set to reflect this.	The individual site based performance indicators are met for each of the following SSSI: Laugharne and Pendine Burrows Pembrey Coast Whiteford Burrows Refer to separate SSSI management plans for distribution information
A.2 Species population	As above	The number of flowering spikes is >200 at three sub-populations
Performance indicators for factors affecting the feature		
Factor	***Factor rationale and other comments***	***Operational Limits***
F.1 Habitat	Habitat is the most significant factor, the species requires early successional dune slacks. Refer to feature 4/5 for dune slack objective.	**See features 4 and 5**

5. ASSESSMENT OF CONSERVATION STATUS AND MANAGEMENT REQUIREMENTS

This part of the document provides:

- A summary of the assessment of the conservation status of each feature.
- A summary of the management issues that need to be addressed to maintain or restore each feature.

5.1 Conservation Status and Management Requirements of Feature 1: Embryonic shifting dunes (EU habitat code 2110)

Conservation Status of Embryonic Shifting Dunes

The embryonic shifting dunes of the Carmarthen Dunes SAC are considered to be in **favourable** conservation status.

This is based on the monitoring report of 2006. More than 0.5ha of young shifting dunes on the seaward side of the foredune ridge was recorded on 14th June 2006 at Pembrey Coast SSSI and at Whiteford Burrows SSSI. This meets the criterion set in the monitoring report that two out of the three sites must support an area of >0.5ha of young shifting dunes, so the SAC as a whole is deemed to be favourable in terms of this feature.

Management Requirements of Feature 1

Embryonic shifting dunes are small, mobile sand hummocks (typically <0.5m high) formed as a result of sand being trapped by small stands of *Elytrigia juncea* or *Leymus arenarius.*

In most cases embryonic shifting dunes are transient and will either be displaced by marram-dominated vegetation as the dunes develop or will be washed away by storms. The continued supply of new sand from the beach into the dune system is therefore vital to the continued existence of this community, even if this sand is derived from within the same system. The habitat type is of exceptional importance as an indicator of the general structural and functional 'health' of a dune system. Creation of new dune habitat, and indeed the long-term survival of the dune system is often dependent upon the survival of this habitat type.

Embryonic dunes occur as a fairly narrow band of highly mobile dune habitat that occupies the seaward periphery of the site. The scope to increase the extent of this habitat is limited, but some increases may be brought about by e.g. blowouts in the site interior. Management requirements are to ensure that human activities both on and off shore do not interfere with the presence of the feature, this may require control over dredging and sand winning operations and prevention of vehicular access along the dune front.

This feature falls within the non-intervention management areas

5.2 Conservation Status and Management Requirements of Feature 2: Shifting dunes along the shoreline with *Ammophila arenaria* (`white dunes`) (EU habitat code 2120)

Conservation Status of Shifting dunes

The shifting dunes along the shoreline of the Carmarthen Dunes SAC are considered to be in **favourable condition**.

This feature was initially monitored as part of the LIFE project. A full account of this case study is outlined in Habitat Monitoring for Conservation Management and Reporting, Volume 1: Case Studies. In this case study the site is referred to by the site's former name, the Burry Inlet cSAC.

The condition assessment is based on monitoring and mapping of the shoreline of Whiteford Burrows in 2002, 2004 and 2006 and the monitoring and mapping of the shoreline of Pembrey Burrows in 2006. An area greater than 0.5 hectares was clearly present at both sites. As the target only requires young shifting dunes to be present at two out of the three sites, Laugharne and Pendine SSSI was not visited. Monitoring needs to be undertaken on the other parts of this SAC during the next two field seasons in order that the whole objective can been considered across all the habitat.

Management Requirements of Feature 2

Shifting dunes occur along the shoreline occupying a band inland of and running adjacent to the embryo dunes. The extent of such habitat will vary according to the overall mobility/stability of the site, being very narrow/absent from stable sites or, alternatively, accounting for a significant proportion of more mobile sites. Shifting dunes are maintained only by the constant movement or accretion of bare sand, bound together by marram grass and similar pioneer grass species.

This community is largely self-perpetuating - ie. it will be retained (albeit restricted in extent) in most areas irrespective of management. In the Laugharne and Pendine section there is some scrub encroachment into the dunes and some active management will be required periodically to remove this. Monitoring is limited to recording the presence of the shifting dune communities that the site is known to support.

The implementation of active management in the foreshore areas e.g. grazing or mechanical excavation to maintain/restore herbaceous dunes or slacks may also result in an increase in the extent of shifting dune communities on this site. Were this to occur it would be regarded as a 'bonus' - such an increase in cover is not a requirement of the objectives for favourable conservation status of this feature.

This area falls within the non-intervention areas, the only management required other than that noted above for this feature is to ensure no beach cleaning activities are carried out.

5.3 Conservation Status and Management Requirements of Feature 3: Fixed dunes with herbaceous vegetation (`grey dunes`) (EU habitat code **2130)**

Conservation Status of Fixed dunes with herbaceous vegetation

The fixed dunes with herbaceous vegetation of Carmarthen Dunes SAC is considered to be in **Unfavourable declining** conservation status. This is due primarily to undergrazing and scrub development.

Management Requirements of Feature 3

In some areas of the SAC there is a lack of grazing which has lead to the development of tall, rank grassland, leading in turn to scrub development and in some parts invasion by sea buckthorn. This leads to stabilisation and soil development, so causing loss of the special interest of the habitat.

Active management in the form of livestock grazing, preceded by mechanical excavation or scarification where appropriate, is required to reverse this trend and thereafter maintain (at least a proportion of) the herbaceous dune vegetation in a more open, early successional and mobile form. In some particularly stabilised areas the creation of dune blowouts may be considered.

In the Laugharne and Pendine SSSI and part of the Pembrey SSSI, management is complicated by the fact that it is Ministry of Defence training area and there is unexploded ordnance present. Close liaison with the MoD is required in these areas to ensure that conservation management work is carried out whilst meeting their requirements.

This feature falls within the active management areas, except any areas where it is deemed scrub development has progressed too far.

5.4 Conservation Status and Management Requirements of Features 4 and 5: Dunes with *Salix repens* ssp. *argentea* (*Salicion arenariae*) (EU habitat code 2170) and Humid dune slacks (EU habitat code 2190)

These two features have been considered together as the issues and management of both are intimately linked.

Conservation Status of Dunes with *Salix repens* ssp. *Argentea* (*Salicion arenariae*)

The dunes with *Salix repens* ssp.*Argentea* of Carmarthen Dunes SAC are considered to be in **unfavourable declining** conservation status.

Evidence based sampling was only undertaken at Whiteford Burrows, where both the humid dune slack feature and the dunes with *Salix repens* were assessed as together as one feature, dune slacks; agreement being reached that if the overall condition of the slacks is unfavourable then both of the underpinning Annex I habitats will be unfavourable. Dune slacks at Laugharne and Pembrey and at Pendine were assessed as unfavourable based on the visual assessment and the site manager's knowledge.

Management Requirements of Features 4 and 5

Management issues for this feature are the lack of creation of new dune slacks, dune stabilisation and succession of older slacks to scrub in some areas, though this is variable over the SAC and more recently at Whiteford concern has been overgrazing. Additionally establishment of *Hippophae rhamnoides* sea buckthorn, impacts on hydrology from conifer plantations, issues of the impact of military use and loss of populations of fen orchid which the slacks support are management factors which must be addressed.

Scrub clearance and where necessary follow up grazing is required, particularly targeted at areas where sea buckthorn has established. In order to achieve some mobility of sand dunes and prevent over-stabilisation, blow-outs may be considered as a short term management option.

Where overgrazing of slacks has occurred, this has threatened the already declining population of fen orchid and a holding pattern of management is currently in place to attempt to maintain the population until the grazing pattern can be brought under control.

Conifer plantations have an impact on the hydrology of dune systems and the long term aim must be for their removal where SAC features are affected. The potential impact of conifer removal in terms of changes to geomorphological processes needs to be addressed, where necessary research is required to determine the likely impact.

The training activities carried out by the MoD mean that conservation management activities are likely to remain restricted to some extent for the foreseeable future. However there is considerable scope for positive conservation management through continuing the current partnership approach with MoD.

These features fall within the active management areas, except any areas where it is deemed scrub development has progressed too far.

5.6 Conservation Status and Management Requirements of Feature 6: Narrow-mouthed whorl snail *Vertigo angustior* (EU species code 1014)

Conservation Status of *Vertigo angustior*

The narrow-mouthed whorl snail *Vertigo angustior* of Carmarthen Bay Dunes is considered to be in **unfavourable declining** conservation status (June 2006).

This is based on the monitoring report of *Vertigo angustior* at Whiteford Burrows (2006). Species monitoring carried out in May 2006 found that *V. angustior* was found in each of the six sections of the transition zone; the population extent attribute is therefore considered to be favourable. The same study showed that the habitat in every section is unfavourable (the tables in the monitoring report for a breakdown of the data, showing which attributes failed and with what frequency).

A recent discovery of this species has been made at Pembrey, though at present monitoring has not been put in place to ascertain the status of the species at this location.

The monitoring report includes a discussion on the usefulness of *Lotus pedunculatus* as an attribute. This species is not of direct relevance to *V. angustior* but does indicate damp ground conditions that are suitable for it. Low condition and frequency of this attribute meant that most of the samples in 2006 failed, although the habitat itself did not appear to have changed obviously, and was still considered suitable for *V. angustior*. A revised set of results excluding the *L. pedunculatus* attribute, in which all sections except one pass the performance indicators. This is considered to be a more meaningful assessment of the habitat condition. See the report for a full discussion.

As both the habitat condition and the presence and distribution of the snail have to be favourable for the feature overall to be considered favourable. As this is not the case, the feature is at present in **Unfavourable declining** conservation status.

Management Requirements of Feature 6

Continued monitoring of the population is necessary. Future management of the dune system, in particular any changes to the grazing regime, especially fencing, could impact on the snail's population due to impacts on the transition zone which is important habitat for the species. Cover of *Lotus pedunculatus* is a good indicator of levels of grazing in this transition zone and can be used to inform the likely impact on *Vertigo angustior.* Similarly an increase in scrub species particularly *Salix* would indicate an equally potentially damaging lack of grazing in this zone.

5.7 Conservation Status and Management Requirements of Feature 7: Petalwort *Petalophyllum ralfsii* (EU habitat code 1395)

Conservation Status of *Petalophyllum ralfsii*

The *Petalophyllum ralfsii* of Carmarthen Dunes SAC is considered to be in **unfavourable declining** conservation status (April 2003).

The feature is considered to be unfavourable largely because of the lack of suitable habitat at the site.

Management Requirements of Feature 7

Management of *Petalophyllum* is entirely dependant on the presence of the required habitat, early successional dune slacks. Therefore for management requirements of the species, refer to section 5.4, Humid dune slacks.

5.8 Conservation Status and Management Requirements of Feature 8: Fen orchid *Liparis loeselii* (EU habitat code 1903)

Conservation Status of Fen orchid *Liparis loeselii*

The *Liparis loeselii* of the Limestone Coast of South West Wales SAC is considered to be in **unfavourable declining** conservation status (August 2002).

This analysis is based on the most recent monitoring report for the feature, which shows that the number of plants and the number of slacks within which it occurs have decreased dramatically, particularly over the last ten years. Since 1998 *Liparis* has only been found within one dune slack at Whiteford. This is not thought to be secure in the long term. Long-term surveillance (from 1976 to present) indicates that *Liparis* used to have a much wider distribution and that on any occasion it was regularly found in six or more discrete dune slacks. A full version of the monitoring data is available (Carmarthen Dunes SAC draft monitoring report)

Management Requirements of Feature 8

Management of *Liparis* is entirely dependant on the presence of the required habitat, early successional dune slacks. Therefore for management requirements of the species, refer to section 5.4, Humid dune slacks.

6. ACTION PLAN: SUMMARY

This section takes the management requirements outlined in Section 5 a stage further, assessing the specific management actions required on each management unit. This information is a summary of that held in CCW's Actions Database for sites, and the database will be used by CCW and partner organisations to plan future work to meet the Wales Environment Strategy targets for sites.

Site Name(s): Carmarthen Bay Dunes/Twyni Bay Caerfyrddin (SAC)

Unit Number	CCW Database Number	Unit Name	Summary of Conservation Management Issues	Action needed?
1	001321	South Whiteford 1	The pine plantation is not currently managed, but management is needed as all trees are a similar age and will fall at the same time. CCW will encourage management of the plantation. The only beach access runs through this unit and there are concerns about mechanical vehicles entering through here. CCW will number and monitor the dune slacks and monitor erosion in this unit.	Yes
2	001322	South Whiteford 2	There is unexploded ordnance, explosive and chemical, within this unit. The main issue is mechanical damage from motorized vehicles such as scrambling motorbikes and quad-bikes. Trampling by pedestrians is not a big issue, but litter is a problem. The dune system is accreting at present. To address these issues we will use signs to inform the public: signs to discourage vehicle use and (to a much lesser extent) trampling. Beach cleans will be organised to address the litter problem.	Yes
3	001323	Burrows	The main management issues are: **Grazing:** ponies graze all year and this grazing is fairly controlled, with the use of a pen when needed. However sheep trespass from the common land and there is no control over the sheep. In addition, the rabbit population is rising across the site. CCW needs to gain control of the grazing. **Erosion:** this is a problem along the front and at the south end, but it is building up at the north end. This will be monitored. **Illegal driving**: this is a large problem, due in part to cocklers and musselers driving onto the beach, and probably contributing to the erosion. This needs to be controlled. **Litter**: lots of beach litter is blown into the dunes. The beach needs to be litterpicked regularly. **Small pine plantation**: some pine litter is blown onto the beach, and pine seedlings are spreading. Research needs to be carried out into the effects of pine presence and removal, possibly leading to a public consultation. **Other scrub encroachment**: small numbers of sea buckthorn, some of which are female, are present. This needs to be controlled; total clearance may be necessary. **Ordnance.** As above **Hydrological issues**: lowering of the water table. Slacks are drying out which may be due to the pine plantation and maybe to unidentified factors. Drastic action is needed to help the fen-orchid.	Yes

Unit Number	CCW Database Number	Unit Name	Summary of Conservation Management Issues	Action needed?
4	001324	Whiteford north 1	This unit is a dune slack which has been fenced off to protect the fen orchid and the petalwort from sheep grazing. The main issues are: Maintenance of the fence and allowing the gate to be open periodically to allow controlled grazing. Lack of control over sheep grazing - these may need to be excluded completely or controlled by shepherding. Pine seedlings from the plantation need to be pulled regularly. Studies should be carried out into the effects of the presence/absence of pines. Nutrient enrichment from ponies and sheep. Proximity of sea buckthorn to the slack. Lowering of the water table - studies need to be conducted into this.	No
5	001325	Whiteford north 5	The issues are: Grazing: there is currently no control over sheep grazing, which needs to be addressed, possibly by excluding them completely or by investigating the possibility of shepherding. Pine seeds from the nearby plantation taking root; pulling of pine seedlings is ongoing. Studies should be carried out into the effects of the presence or absence of the pines. Lowering of the water table: this should be studied. Sea buckthorn is encroaching in several of the dune slacks.	No
6	001326	Pembrey Forestry Commission	The Forestry Commission will lead on actions for this unit. Dunes support too much scrub. Some scrub clearance work has already been carried out and the remainder of the scrub will be cleared. The dunes will require grazing in future. A suitable grazing regime will be implemented when sufficient grassland has developed.	Yes
7	001327	Wooded Defence Estates	Unless otherwise stated the Defence Estates will lead on actions for this unit. The unit contains some dune woodland, which is a feature of the SSSI. We have insufficient knowledge about the extent and quality of this rare habitat. This will be surveyed to assess the extent and quality of the dune woodland. The unit may contain scrubbed-over humid dune slacks . We have insufficient knowledge about their extent and quality. This unit will be surveyed to assess extent and quality of this SAC feature. This area of woodland and scrub provides operational benefits to RAF Pembrey. Once we have results of the two surveys specified above, a programme of restoration of the SAC features needs to be agreed with the landowners. The Defence Estates will lead on this, liaising with CCW to determine ideal feature distribution within this unit in the light of survey results. A programme of feature restoration will be drawn up and agreed with CCW, which will likely involve scrub clearance and subsequent grazing and/or mowing. This programme will then be implemented. Not much is known about the hydrology of the unit, which is an important factor for the humid dune slack feature in particular. The Defence Estates will liaise with CCW and contract a hydrological survey if necessary.	Yes

Unit Number	CCW Database Number	Unit Name	Summary of Conservation Management Issues	Action needed?
8	001328	Dune grassland Defence Estates	Unless otherwise stated, Defence Estates will lead on all actions and mechanisms for this unit. There is unwanted scrub in the north end of this unit. Young sea buckthorn will be sprayed with herbicide in early summer 2008. Parts of this unit are not receiving sufficient grazing or mowing. The Defence Estates will, with CCW, review present grazing, mowing and scarifying regimes and fence positions, with due consideration for *Gentianella uliginosa*, the dune gentian, a SSSI feature which occurs within this unit. Some dune scrapes were dug in approximately 2004/05 but follow-up management has been insufficient. A follow-up programme will be implemented, monitoring vegetation and cutting when necessary. A new scrape or scrapes will be created every few years if possible, rather than having one-off scrape creation. The next ones perhaps within unit 1327. Excessive use of vehicles on the upper beach could adversely affect embryonic shifting dunes along the shoreline. Vehicle usage will be monitored. Current levels (2007-08) are acceptable. Not enough is known about the hydrology of this unit. Defence Estates will liaise with CCW and contract a hydrological survey if necessary. The EA Review of Consents Stage 3 found that air pollution was adversely affecting some features (fixed dunes, dunes with *Salix repens*, humid dune slacks, petalwort), with the pollutant ammonia (NH3) in excess of 1 micro-gram/m3. The source was found to be agriculture within a few km of the SAC. The precise source of the pollution needs to be investigated (possibly manure stores or chicken farms). The lead organisation(s) for addressing this issue need to be clarified - CCW and/or Environment Agency.	Yes
9.1	001329	Pembrey Burrows	Invasive sea buckthorn will continue to be removed from the unit. Rabbit grazing will be retained. The grazing project will be continued and new grazing areas introduced, but will be excluded from the salt marsh. This will be reviewed over time. Small areas of scrub will be retained. Access to the burrows will be managed, and motorised vehicles, including motorbikes and scrambling bikes, will be prevented from entering. Hunting of any kind will not be permitted. The strandline and embryo dunes will be protected from disturbance and erosion. The managers will work on raising public awareness of the issues at the Burrows.	No

Unit Number	CCW Database Number	Unit Name	Summary of Conservation Management Issues	Action needed?
10	001330	Ashburton	Invasive sea buckthorn will continue to be removed from the unit. Rabbit grazing will be retained. The grazing project will be continued and new grazing areas introduced, but will be excluded from the salt marsh. This will be reviewed over time. Small areas of scrub will be retained. Access to the burrows will be managed, and motorised vehicles, including motorbikes and scrambling bikes, will be prevented from entering. Hunting of any kind will not be permitted. The strandline and embryo dunes will be protected from disturbance and erosion. The managers will work on raising public awareness of the issues at the Burrows.	Yes
11	001333	Laugharne Pendine 1	Perceived drying out of dune slacks Scrubbing over particularly with sea buckthorn Growth of rank grassland due to lack of grazing Problems caused by unexploded ordnance and day to day activities of ranges Possible extinction of fen orchid Over stabilisation of the dunes Management actions to remedy the above: Hydrological surveys, identify potential for management of water regime to benefit SAC and SSSI features Clear scrub, targetting sea buckthorn initially, treat chemically where possible Introduce or continue grazing at appropriate levels, having ensured that suitable compartments have been fenced and provided with water Ensure areas are cleared of ordnance before fencing, installing transect lines of dipwells, etc Manage livestock in accordance with the needs of firing exercises or weapons testing which limit access to danger areas Excavate slack(s) to provide suitable restoration sites for fen orchid, manage appropriately those already excavated including the possible removal of adjacent scrub and enlargement If possible identify areas where 'blow-outs' could be created to restore some mobility to the dune system Nb. Boundaries between 1 & 5 need clarification and for reasons mentioned above may be subject to some mobility as changes in range activities may allow access to some areas and restrict it in others. Some parts will be permanently inaccessible and this requires more definition. The lower seaward boundary of 5 is also subject to mobility due to the beach forming activities of the sea. As it is now drawn on Mastermap, a substantial area of 5 is already beach sand rather than dunes. The beach has moved substantially inland over the course of a few decades, resulting in the present sea defences, and probably a request for more.	No

Unit Number	CCW Database Number	Unit Name	Summary of Conservation Management Issues	Action needed?
12	001334	Laugharne Pembrey 2	The SSSI feature habitats here are dune woodland and wet woodland. There has been no active management recently. Control may be needed to prevent negative impacts on other SSSI units and features.	No
13	001335	Laugharne Pembrey 3	Unit 13 is standing water and fen and is important for a number of SSSI features. Key is Witchett Pool. A water vole survey has been carried out and it is proposed that there should be a survey for Chara species. We intend to survey/monitor bird populations for two years (there has been a request to allow access to the lake for water-based recreation). Irrespective of the outcome of these surveys it is considered that some reed management should commence (the area of open water is decreasing). It may be advisable to clear some scrub or woodland near the pool and to introduce some grazing to parts of the fen in the summer months.	No
14	001336	Laugharne Pembrey 4	This unit is marshy grassland. This and the associated grassland are probably important for water vole.	No

Unit Number	CCW Database Number	Unit Name	Summary of Conservation Management Issues	Action needed?
15	001337	Laugharne Pembrey 5	Sea defences limiting the formation of new dunes and the mobility of the dunes Scrubbing over of grassland particularly with sea buckthorn Range activities limiting scope for conservation management Excavation of sand for various uses on the range with potential consequences for petalwort Management actions to remedy the above: Discuss with site managers the need for sea defences and take advice from sand dune specialist, assess the likelihood of ingress of seawater that would affect freshwater habitats and features in units 12,13, 14, as well as SAC features in 11 & 15 As grazing is not practical along or near the beach or in other parts of the dunes, undertake scrub clearance, concentrating on sea buckthorn, and use chemical treatment and mechanical techniques as a follow-up on a regular basis. Management such as the above and even possibly grazing may be able to take place in areas where range activities are moved to some other location on the site Sand was removed from a spot near 'E11' to be used on some part of the range. This created conditions suitable for petalwort but was revisited and sand taken from the same place. If sand is to be extracted perhaps this could be done on some sort of rotation Nb. Boundaries between 11 & 15 need clarification and for reasons mentioned above may be subject to some mobility as changes in range activities may allow access to some areas and restrict it in others. Some parts will be permanently inaccessible and this requires more definition. The lower seaward boundary of 15 is also subject to mobility due to the beach forming activities of the sea. As it is now drawn on Mastermap, a substantial area of 15 is already beach sand rather than dunes. The beach has moved substantially inland over the course of a few decades, resulting in the present sea defences, and probably a request for more.	No
3.2	002991	BURROWS 2	This unit is considered to be under appropriate conservation management.	No
3.3	002992	BURROWS 3	This unit is considered to be under appropriate conservation management.	No
9.2	002993	PEMBREY BURROWS 2	This unit is considered to be under appropriate conservation management.	No
9.3	002994	PEMBREY BURROWS 3	This unit is considered to be under appropriate conservation management.	No

7. GLOSSARY

This glossary defines the some of the terms used in this **Core Management Plan**. Some of the definitions are based on definitions contained in other documents, including legislation and other publications of CCW and the UK nature conservation agencies. None of these definitions is legally definitive.

Action A recognisable and individually described act, undertaking or **project** of any kind, specified in section 6 of a **Core Management Plan** or **Management Plan**, as being required for the **conservation management** of a site.

Attribute A quantifiable and monitorable characteristic of a **feature** that, in combination with other such attributes, describes its **condition**.

Common Standards Monitoring A set of principles developed jointly by the UK conservation agencies to help ensure a consistent approach to **monitoring** and reporting on the **features** of sites designated for nature conservation, supported by guidance on identification of **attributes** and monitoring methodologies.

Condition A description of the state of a feature in terms of qualities or **attributes** that are relevant in a nature conservation context. For example the condition of a habitat usually includes its extent and species composition and might also include aspects of its ecological functioning, spatial distribution and so on. The condition of a species population usually includes its total size and might also include its age structure, productivity, relationship to other populations and spatial distribution. Aspects of the habitat(s) on which a species population depends may also be considered as attributes of its condition.

Condition assessment The process of characterising the **condition** of a **feature** with particular reference to whether the aspirations for its condition, as expressed in its **conservation objective**, are being met.

Condition categories The **condition** of **feature** can be categorised, following **condition assessment** as one of the following[2]:

Favourable: maintained;
Favourable: recovered;
Favourable: un-classified
Unfavourable: recovering;
Unfavourable: no change;
Unfavourable: declining;
Unfavourable: un-classified
Partially destroyed;
Destroyed.

Conservation management Acts or undertaking of all kinds, including but not necessarily limited to **actions,** taken with the aim of achieving the **conservation objectives** of a site. Conservation management includes the taking of statutory and non-statutory measures, it can include the acts of any

[2] See JNCC guidance on Common Standards Monitoring http://www.jncc.gov.uk/page-2272

party and it may take place outside site boundaries as well as within sites. Conservation management may also be embedded within other frameworks for land/sea management carried out for purposes other than achieving the conservation objectives.

Conservation objective The expression of the desired **conservation status** of a **feature,** expressed as a **vision for the feature** and a series of **performance indicators**. The conservation objective for a feature is thus a composite statement, and each feature has one conservation objective.

Conservation status A description of the state of a **feature** that comprises both its **condition** and the state of the **factors** affecting or likely to affect it. Conservation status is thus a characterisation of both the current state of a feature and its future prospects.

Conservation status assessment The process of characterising the **conservation status** of a **feature** with particular reference to whether the aspirations for it, as expressed in its **conservation objective**, are being met. The results of conservation status assessment can be summarised either as 'favourable' (i.e. conservation objectives are met) or unfavourable (i.e. conservation objectives are not met). However the value of conservation status assessment in terms of supporting decisions about **conservation management**, lies mainly in the details of the assessment of feature **condition**, **factors** and trend information derived from comparisons between current and previous conservation status assessments and condition assessments.

Core Management Plan A CCW document containing the conservation objectives for a site and a summary of other information contained in a full site **Management Plan**.

Factor Anything that has influenced, is influencing or may influence the **condition** of a **feature**. Factors can be natural processes, human activities or effects arising from natural process or human activities, They can be positive or negative in terms of their influence on features, and they can arise within a site or from outside the site. Physical, socio-economic or legal constraints on **conservation management** can also be considered as factors.

Favourable condition See **condition** and **condition assessment**

Favourable conservation status See **conservation status** and **conservation status assessment.**[3]

Feature The species population, habitat type or other entity for which a site is designated. The ecological or geological interest which justifies the designation of a site and which is the focus of conservation management.

Integrity See **site integrity**

[3] A full definition of favourable conservation status is given in Section 4.

Key Feature The habitat or species population within a **management unit** that is the primary focus of **conservation management** and **monitoring** in that unit.

Management Plan The full expression of a designated site's legal status, **vision**, **features**, **conservation objectives**, **performance indicators** and management requirements. A complete management plan may not reside in a single document, but may be contained in a number of documents (including in particular **the Core Management Plan**) and sets of electronically stored information.

Management Unit An area within a site, defined according to one or more of a range of criteria, such as topography, location of **features**, tenure, patterns of land/sea use. The key characteristic of management units is to reflect the spatial scale at which **conservation management** and **monitoring** can be most effectively organised. They are used as the primary basis for differentiating priorities for conservation management and monitoring in different parts of a site, and for facilitating communication with those responsible for management of different parts of a site.

Monitoring An intermittent (regular or irregular) series of observations in time, carried out to show the extent of compliance with a formulated standard or degree of deviation from an expected norm. In **Common Standards Monitoring**, the formulated standard is the quantified expression of favourable **condition** based on **attributes**.

Operational limits The levels or values within which a **factor** is considered to be acceptable in terms of its influence on a **feature**. A factor may have both upper and lower operational limits, or only an upper limit or lower limit. For some factors an upper limit may be zero.

Performance indicators The **attributes** and their associated **specified limits**, together with **factors** and their associated **operational limits,** which provide the standard against which information from **monitoring** and other sources is used to determine the degree to which the **conservation objectives** for a **feature** are being met. Performance indicators are part of, not the same as, conservation objectives. See also **vision for the feature**.

Plan or project **Project:** Any form of construction work, installation, development or other intervention in the environment, the carrying out or continuance of which is subject to a decision by any public body or statutory undertaker.
Plan: a document prepared or adopted by a public body or statutory undertaker, intended to influence decisions on the carrying out of **projects.** Decisions on plans and projects which affect Natura 2000 and Ramsar sites are subject to specific legal and policy procedures.

Site integrity The coherence of a site's ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it is designated.

Site Management Statement (SMS) The document containing CCW's views about the management of a site issued as part of the legal notification of an SSSI under section 28(4) of the Wildlife and Countryside Act 1981, as substituted.

Special Feature See **feature**.

Specified limit	The levels or values for an **attribute** which define the degree to which the attribute can fluctuate without creating cause for concern about the **condition** of the **feature**. The range within the limits corresponds to favourable, the range outside the limits corresponds to unfavourable. Attributes may have lower specified limits, upper specified limits, or both.
Unit	See **management unit.**
Vision for the feature	The expression, within a **conservation objective**, of the aspirations for the **feature** concerned. See also **performance indicators.**
Vision Statement	The statement conveying an impression of the whole site in the state that is intended to be the product of its **conservation management.** A 'pen portrait' outlining the **conditions** that should prevail when all the **conservation objectives** are met. A description of the site as it would be when all the **features** are in **favourable condition**.

8. REFERENCES

Hurford, C. & Schneider, M. 2006. Monitoring nauture conservation in cultural habitats: a practical guide and case studies. Dordrecht: Springer

Hurford, C. & Perry, K. 2000. *Habitat Monitoring for Conservation Management and Reporting, Volume 1: Case Studies.* Bangor: Countryside Council for Wales (CCW).

SSSI management plans for Laugharne and Pendine and Pembrey. Bangor: Countryside Council for Wales (CCW).

NNR management plan for Whiteford held on CMS. Bangor: Countryside Council for Wales (CCW).