Brechfa Forest Connection
Development Consent Order Application - Reference EN020016

Habitat Regulations Assessment
No Significant Effects Report (NSER)

December 2015

Regulation 5(2)(g) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
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1 Habitat Regulations Assessment – No Significant Effects Report (NSER)

1.1 Introduction

1.1.1 The Proposed Development is a 132 kV electrical connection to connect Brechfa Forest West Wind Farm at Brechfa Forest, Carmarthenshire to a suitable connection point on an existing tower line near Llandyfaelog, south of Carmarthen. It is a Nationally Significant Infrastructure Project (NSIP).

1.1.2 The Proposed Development crosses the Afon Tywi SAC (River Towy) near to Carmarthen. The Carmarthen Bay and Estuaries SAC is 7.35km downstream of this crossing point (following the river's course as indicated on Figure 1). The closest pole is 1.79 km east of the Carmarthen Bay and Estuaries SAC; this is also shown on Figure 1. Under the Conservation of Habitats and Species Regulations 2010 (the Habitat Regulations) these qualify as Natura 2000 sites (often called European sites).

1.1.3 The competent authority (decision-maker) for the Proposed Development is the Secretary of State for Energy and Climate Change, who will decide whether to grant a Development Consent Order (DCO) for the project. Paragraph 4.3.1 of the Conservation of Habitats and Species Regulations 2010 (the Habitat Regulations) states that the decision-maker must consider whether the project will have significant effects on a European site or any site to which the same protection is applied, either alone or in combination with other plans or projects.

1.1.4 The procedure for undertaking HRA for NSIPs is explained in Advice Note 10 Table 1, issued by the Planning Inspectorate (PINS) in August 2013, which specifies that the following activities should be undertaken during Stage 1: Screening:

- Applicant undertakes HRA and concludes likely significant effect (LSE) of project on any European site(s), and consults with statutory consultees – this current document concludes the LSE and a copy of the consultation
responses from Natural Resources Wales (NRW), Carmarthen County Council (CCC) and the Planning Inspectorate (PINs) are provided in Annex A.

- Applicant prepares and consults on Screening Matrices and, if applicable, Integrity Matrices – the Screening Matrices are presented in Annex B.

- Applicant prepares draft NSER or HRA Report and submits to Planning Inspectorate (PINs) and statutory nature conservation bodies (SNCBs) for comment – a copy of the comments received from NRW, CCC and PINs are provided in Annex A.

1.1.5 A meeting was held between Western Power Distribution (WPD), RSK and NRW on 2 October 2014 to discuss the proposed crossing methods for the Afon Tywi (River Towy) SAC and the requirements of the HRA. Specialists from NRW attended including a fish expert and the designated sites officer. A prior meeting was held between WPD, RSK and NRW (species licensing team) on 19 September 2014 to discuss European Protected Species issues. The minutes of both meetings were combined in a table for ease. A copy of the minutes from these meetings is provided in Annex A.

1.1.6 It was agreed in the 2 October 2014 meeting that the Carmarthen Bay and Estuaries SAC should be considered within the study area, as it is hydrologically connected to the Afon Tywi (River Towy) SAC. It was agreed that no other SACs required consideration. It was also agreed that there was no shad spawning habitat within or close to the proposed crossing point. Confirmation of this agreement with NRW is provided in Annex A.

1.1.7 Protected species and habitat records were requested from a number of sources, which are listed in Table 1.
### Table 1 – Summary of Relevant Ecology Desk Study Sources

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Contact and information provided</th>
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| **Natural Resources Wales (NRW)** | Internet search included:  
- Statutory designated site GIS layers  
- Statutory designated site citations  
Jonathan Rothwell, Terrestrial Mapping Specialist. Information included:  
- Phase 1 habitat GIS layers  
Huw Williams, District Team Leader. Information included:  
- Protected and notable species records  
- Information of important habitats |
| **West Wales Biodiversity Information Centre (WWBIC)** | Vicky Swann, Senior Data Enquiries Officer. Information included:  
- Protected and notable species records  
- Non-statutory designated site locations  
- Non-statutory designated site citations |
| **National Biodiversity Network (NBN)** | Internet search for specific species records in the region |
| **Natural Resources Wales (NRW) / National Biodiversity Network (NBN)** | Steven Pocock, Forestry Officer. Information included:  
- Ancient Woodland Inventory GIS layers  
- Protected and notable species records |
| **Carmarthenshire County Council (CCC)** | Internet search included:  
- Carmarthenshire Local Biodiversity Action Plan  
Richard Jones, Planning Officer. Information included:  
- Protected and notable species records  
- Information on important habitats |
| **Joint Nature Conservation Committee (JNCC)** | Full citations for SACs |

1.1.8 Ecological surveys were undertaken between January 2013 and October 2014 by RSK. Detailed otter surveys were undertaken during September and October 2014. A number of watercourses were surveyed for otter including the Afon Tywi (River
Towy) SAC and adjacent tributaries crossed by the Proposed Development (see Figure 2 for survey locations). The detailed otter surveys involved a systematic search 100m upstream and downstream of all crossing points associated with the Proposed Development, recording any field signs encountered. Field signs include spraints (droppings), footprints, slides, paths, feeding evidence, holts (underground resting places) or couches (temporary resting places).

1.2 Designated Sites

1.2.1 The following designated sites were assessed due to their proximity to the Proposed Development, or, in the case of the Carmarthen Bay and Estuaries SAC, due to its hydrological linkage to the Proposed Development. The European site citations (taken from the JNCC website) are provided in Annex C.

Afon Tywi (River Towy) SAC

1.2.2 Otter (*Lutra lutra*) and twaite shad (*Alosa fallax*) are both Annex II species and the primary reason for the selection of this site as an SAC.

1.2.3 Additional qualifying features of the site are the presence of five other fish species of conservation significance. These features are not a primary reason for the designation:

- Sea lamprey (*Petromyzon marinus*)
- Brook lamprey (*Lampetra planeri*);
- River lamprey (*Lampetra fluviatilis*),
- Allis shad (*Alosa alosa*), and
- Bullhead (*Cottus gobio*).

1.2.4 There are no other known reasons for designation, i.e. presence of Annex I habitats etc.

1.2.5 The presence of otter spraints and footprints on the Afon Twyi (River Towy) and its
tributaries during field surveys in 2014 showed that otters are present in this area, although no confirmed holts or potential resting places were recorded. The area is likely to be used for commuting and foraging only.

1.2.6 Full details are provided in the Environmental Statement Appendix 10.6 Otter and Water Vole Technical Report Volume 6.4.

1.2.7 These findings support the information provided in the citation which states that “few known [otter] breeding sites occur on the main river”.

1.2.8 Detailed fish surveys were not carried out by WPD on the Afon Tywi (River Towy) SAC or its tributaries, however during ecological scoping surveys it was confirmed that the proposed crossing points are within the tidal section of the Afon Tywi (River Towy) SAC. As the affected sections of the river and its tributaries are tidal there is no suitable spawning habitat for twaite shad (although the species will migrate through the affected sections).

1.2.9 During a meeting on 2 October 2014 (see Annex A for meeting minutes) NRW confirmed that spawning grounds are not present at the proposed crossing points which is within the tidal section of the river. It was also confirmed that the main migration period for twaite shad on the Afon Tywi (River Towy) SAC is between April and June.

1.2.10 The conservation objectives for the Afon Tywi (River Towy) SAC are summarised below. The document can be viewed in full in Annex D:

- unmodified ecological and hydrological processes and characteristics should be maintained as far as possible, or restored where necessary;
- the ecological status of the water environment should be sufficient to maintain a stable or increasing population of each feature;
- flow regime, water quality and physical habitat should be maintained in, or restored as far as possible, to a near-natural state;
- all known breeding, spawning or nursery sites of species featured should be
maintained as suitable habitat;

- flows, water quality, substrate quality and quantity at fish spawning sites and nursery areas will not be depleted by abstraction, discharges, engineering or gravel extraction activities;

- the river platform and profile should be predominantly unmodified;

- river habitat SSSI features should be in favourable condition;

- artificial factors impacting on the capability of each species feature to occupy the full extent of its natural range should be modified where necessary to allow passage;

- natural factors which may limit the natural range of a species feature should not be modified;

- flows during normal migration periods of fish species which are features of the SAC will not be depleted by abstraction to the point where passage upstream to spawning sites is hindered;

- levels of nutrient will be agreed and managed;

- water quality parameters will be agreed and measures taken to maintain pollution levels below these levels; and

- potential sources of pollution will be considered in assessing plans and projects.

Carmarthen Bay and Estuaries SAC

1.2.11 There are six Annex I habitats which are the primary reason for the designation of this site:

- Sandbanks which are slightly covered by seawater all the time;

- Estuaries;
- Mudflats and sandflats not covered by seawater at low tide;
- Large shallow inlets and bays;
- *Salicornia* and other annuals colonizing mud and sand; and
- Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*).

1.2.12 Twaite shad are also a primary reason for the designation of this site. The citation (provided in Annex C) notes that the species migrate through the waters of Carmarthen Bay to reach spawning sites in the Afon Tywi (River Towy) SAC.

1.2.13 Additional qualifying features of the site are the presence of the following species of conservation significance. These features are not a primary reason for the designation:

- Sea lamprey (*Petromyzon marinus*);
- River lamprey (*Lampetra fluviatilis*);
- Allis shad (*Alosa alosa*); and
- Otter (*Lutra lutra*).

1.2.14 A single otter couch was found within Nant Morlais woodland (Site 1 on Figure 2), which is approximately 2.6km away from Carmarthen Bay and Estuaries SAC. The spraint inside the couch was old and severely degraded, suggesting that the location has not been used recently; therefore it is considered that this does not provide evidence of an active resting site.

1.2.15 It has been agreed with NRW that all mobile species associated with the Carmarthen Bay and Estuaries SAC are considered to be present at the proposed crossing points also (NRW letter dated 16 April 2015, see Annex A).

1.2.16 The conservation objectives for the Carmarthen Bay and Estuaries SAC are summarised below. The document can be viewed in full in Annex E:

- nutrient levels in the water column and sediments to be at or below existing
statutory guideline concentrations and within ranges that are not potentially detrimental to the long term maintenance of the species populations, their abundance and range;

- contamination levels in the water column and sediments derived from human activity at or below existing statutory guideline concentrations and below levels that would potentially result in increase in contaminant concentrations within sediments or biota, or potential detrimental long-term maintenance of the feature species populations, their abundance or range;

- species ranges within the SAC and adjacent inter-connected areas should not be constrained or hindered and appropriate and sufficient food resources should be available;

- the sites and amounts of supporting habitat used by the feature species should be accessible and their extent should be stable or increasing;

- the abundance of prey species subject to commercial fishing should be secure in the long term and contamination of potential prey species should be below concentrations potentially harmful to their physiological health;

- disturbance by human activity should be below levels that suppress reproductive success, physiological health or long-term behaviour; and

- for otter only, there should be sufficient sources within the SAC and beyond of high quality freshwater for drinking and bathing.

1.3 Assessment of Likely Effects

Construction

1.3.1 The connection will consist of both overhead line (OHL) and underground cable (UCG).

1.3.2 The closest OHL pole to the Afon Twyi (River Towy) SAC is 0.2 km to the south (pole 86). The working area around each pole location is typically a 20m radius.
Existing accesses will be used wherever possible rather than new access tracks. There is no likely impact from the pole installation on any feature of the Afon Tywi (River Towy) SAC.

1.3.3 The closest OHL pole to the Carmarthen Bay and Estuaries SAC is 1.79 km to the east of the site (pole 22). There are also two new OHL poles proposed either side of the Nants Morlais woodland (poles 4 and 5) which is connected to the Carmarthen Bay and Estuaries SAC via the Nants Morlais stream (the SAC is approximately 2.7km to the east of the woodland). A disused otter couch was identified within the woodland during surveys in 2014. It is located over 100m from the OHL corridor. Currently the construction of the OHL will not impact resting otters (as the couch is not being used) however pre-construction otter surveys will be carried out at this location to update the survey results and confirm this assessment. Surveys will be carried out 100m upstream and 100m downstream of the proposed OHL.

1.3.4 Based on current information, there is no likely impact from the pole installation on any feature of this SAC.

1.3.5 In the undergrounding section, shown on Figure 1, open cut trenching will be used to install the majority of the cable in relatively unconstrained areas and horizontal directional drilling (HDD) would be used to pass under significant environmental and physical features. The following features will be crossed via an HDD technique:

- River Towy;
- Bwlch Stream and Abergwili Mill Leat;
- A40;
- Abergwili Road; and
- Nant Crychiau River

1.3.6 The watercourses listed above are tributaries of the Afon Tywi (River Towy) SAC and hence are hydrologically connected and have been assessed within this document.
1.3.7 The extent of the underground section is shown on Figure 1 together with the proposed compound, launch, reception and laydown areas. The UCG will consist of open cut trenching and Horizontal Directional Drilling (HDD) under watercourses and highways.

1.3.8 HDD will be used to cross under the Afon Tywi (River Towy) SAC, construction of the underground sections requiring boring (HDD) would take between 2-4 days (under small streams, Abergwili Road and the A40) and 1-2 weeks (under the Afon Tywi (River Towy) SAC). The HDD will be a minimum of 5m below the bed level of the river. The HDDs of the minor tributaries will be a minimum of 1.5m below the bed level of the streams. The proposed burial depths have been derived from professional experience and industry knowledge of HDD crossings of similar sized watercourses (see Annex F). These depths are considered to be deep enough to provide a robust justification for having applied the precautionary principle with regard to potential impacts from EMF, vibrations or any other emissions (i.e. Frac-Outs). There is no widely recognised guidance available which provides recommended depths for electrical cables under watercourses which support sensitive species such as shad. NRW were not able to provide guidance on the specific depths required however they did confirm in their Stage 3 consultation letter dated 16 January 2015, page 11 (in Annex A) that they ‘welcome[d] the approach outlined in Paragraph 13.5.72 that the pipeline crossing will be a minimum of 1m below the bed level of the River Towy’.

1.3.9 The HDD “launch” (or entry location) site is set up on one side of the crossing and contains the plant associated with directional drilling; for a longer crossing such as that under the Afon Tywi (River Towy) SAC the launch site may typically be 50m by 30m (but may be larger or smaller depending on detailed design and site conditions, although it will not exceed the maximum extent of the DCO order limits). For the other shorter crossings (i.e. the tributaries and the road crossings) the launch sites are typically 30m by 20m. This typically comprises the drill rig, two power units mounted on skids, bentonite storage tanks and mixing tanks, a filter for separating cuttings from the used drilling mud, control cab and ancillary equipment.
These compounds are lit at night for security purposes.

1.3.10 The HDD exit location is set up on the other side of the crossing and contains the plant associated with the exit pits; the site is typically 20m by 10 m (but may be larger or smaller depending on detailed design and site conditions, although it will not exceed the maximum extent of the DCO order limits). This typically comprises the exit pit, one power unit mounted on skids, mud pits, an excavator and ancillary equipment. Again these compounds are lit for security purposes.

1.3.11 In contrast to the sections installed by HDD, cable installation in an open cut trench will be contained within a 16m wide corridor. Trenching works have potential to impact on the SAC through pollution events. Topsoil will be stripped and laid to one side of the working width and a trench in which to lay the cable ducting will be excavated. Vehicles will use one side of the working width (the access track). The corridor will be fully reinstated once the cable has been winched through the cable ducting.

1.3.12 There may be a requirement for a temporary bridge or modifications to an existing bridge for the access track however the need and subsequent design of any bridge will be discussed with consultees prior to its construction, and subject to the mitigation measures described in this document.

*Disturbance Effects*

1.3.13 Drilling activities could impact on migrating twaite shad which are highly sensitive to noise and vibration. The HDD underneath the Afon Tywi (River Towy) SAC and its tributaries will take place outside of the migratory period for twaite shad (April to June). This will ensure that noise or vibration impacts to this species during sensitive periods in its life-cycle are avoided. This will be secured via a written requirement within the Development Consent Order (DCO).

1.3.14 The five fish species which are qualifying features of the Afon Twyi (River Towy) SAC (three of which are also qualifying features of the Carmarthen Bay and Estuaries SAC); sea lamprey, river lamprey and allis shad may also experience
disturbance from drilling activities. It is highly unlikely that any of the species would spawn at the proposed crossing points due to the tidal conditions but they may be present, and they are likely to also migrate through the area (shad and lamprey species only). Further consideration has been given to the potential impact on each species below:

- **Allis shad** - adults migrate into fresh water during late spring (April to June) (Maitland & Hatton-Ellis, 2003). Disturbance during sensitive period of life-cycle avoided as a result of proposed HDD timings.

- **Bullhead** (feature of Afon Tywi SAC only) – needs coarse, hard substrate of clean gravel and stones to breed (and shelter). Not generally found in silty habitats (such as the proposed crossing points) (Tomlinson & Perrow, 2003). No disturbance impacts are anticipated.

- **Sea lamprey** – adults migrate from sea water to fresh water in April and May (Maitland, 2003). Disturbance during sensitive period of life-cycle avoided as a result of proposed HDD timings.

- **Brook lamprey** (feature of Afon Tywi SAC only) – this species does not undertake long migrations from estuaries and the sea (like the sea and river lamprey) as its complete life cycle requirements can be found in short stretches of river (Maitland, 2003) (generally further upstream than the proposed crossing points). No disturbance impacts are anticipated.

- **River lamprey** – this species moves upstream into fresh water (to spawn) from October to December (Maitland, 2003). Therefore there is a possibility that the HDD works will disturb this species during this sensitive time in its life cycle. However the species migrate at night (Maitland, 2003) and HDD drilling works and cable installation will take place during normal working hours limiting the likelihood for disturbance. In addition the depth of the cable below the bed of the Afon Tywi (River Towy) SAC will be a minimum of 5m (and a minimum of 1.5m for the tributaries) which will reduce the likelihood of any significant noise or vibration passing through the river bed substrate into the waterbody. This
will be secured via a written requirement in the DCO.

*Disturbance Effects – Otter*

1.3.15 Temporary disruption to commuting and foraging otters along the Afon Tywi (River Towy) SAC and associated tributaries could occur as a result of construction activities. These otters are likely to be associated with the Carmarthen Bay and Estuaries SAC also as otters are highly mobile species and can travel up to 10km a day.

1.3.16 Installation of OHL poles, HDD drilling works and cable installation will take place during normal working hours limiting the likelihood for disturbance to commuting and foraging otters (which are predominantly nocturnal). Although the HDD compounds will be lit at night (for security purposes) the lighting will be directional and will not be allowed to spill onto watercourses or riparian corridors. This will be secured via a written requirement in the DCO.

1.3.17 Pre-construction otter surveys will be carried out at the proposed HDD crossing points (and at all the survey locations shown in Figure 2) prior to works commencing to check for any newly created holts or couches close to the proposed working areas (as these are more sensitive to disturbance). The requirement to carry out these surveys will be secured via a written requirement within the DCO. Works will not be able to commence until this requirement has been ‘discharged by the LPA.

*Pollution Events*

1.3.18 Pollution events during construction have the potential to impact on the following features of the Afon Tywi (River Towy) SAC:

- Twaite shad;
- Otter;
- Sea lamprey;
- Brook lamprey;
- River lamprey;
- Allis shad; and
- Bullhead

1.3.19 Pollution events during construction have the potential to impact on the following features of the Carmarthen Bay and Estuaries SAC:

- Sandbanks which are slightly covered by seawater all the time;
- Estuaries;
- Mudflats and sandflats not covered by seawater at low tide;
- Large shallow inlets and bays;
- Salicornia and other annuals colonizing mud and sand;
- Atlantic salt meadows;
- Twaite shad;
- Otter;
- Sea lamprey;
- River lamprey; and
- Allis shad.

1.3.20 There are four potential pollution pathways which are summarised below:

- sediment loading in watercourses present within or close to the underground section from topsoil stripping;
- encountering unforeseen historic ground contamination with the potential that contaminants could migrate to surface waters via leaching or surface run off;
accidental spillages of hydraulic fluid, oils and fuels, Bentonite muds and drilling fluids (from the HDD drill sites); and

- flood event/s occurring during HDD works resulting in mobilisation of pollutants contained at the drill site including Bentonite\(^1\), fuel, oil and cement.

1.3.21 The Construction Environmental Management Plan (CEMP), contained in **Volume 8.6 of the Environmental Statement** sets out in detail mitigation measures that are proposed to minimise the risk of these potential effects. Compliance with the CEMP will be secured via a written requirement within the Development Consent Order (DCO). Works will not be able to commence until this requirement has been discharged by the LPA.

1.3.22 Relevant Pollution Prevention Guidelines (PPGs) published by the Environment Agency and detailed within the CEMP will be adhered to throughout works. The CEMP also sets out details of specific measures for the potential pathways identified above, these are summarised as follows:

1.3.23 The following mitigation measures will be used in controlling sediment and pollutants released during works:

- a detailed methodology for crossing of the Afon Tywi (River Towy) SAC and tributaries will be discussed and agreed with the NRW;

- where appropriate Flood Defence Consents will be obtained;

- the HDD entry and exit compounds will be set back at least 25m from the top of the bank of the River Towy and at least 10m (apart from two locations which are approximately 6.6m and 8.9m away at the closest point) from tributaries;

- dewatering of excavations (if required) will be subject to a permit from NRW, and the process proactively managed to meet at least the permit conditions;

- no silty water to be pumped directly into any watercourse but be allowed to

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\(^1\) Bentonite is not considered a hazardous substance or mixture and is not considered to be toxic to fish however spillages can result in smothering of aquatic habitats.
settle out (for example, in settlement lagoons) or filtered (for example, using straw bales to filter out coarse particles) prior to discharge, in accordance with permit conditions;

- where settlement or filtering is not practicable or effective, alternative disposal options will be considered for example, discharge onto a grassed area (with consent from the land owner and following NRW consultation), and discharge to foul sewer (if present in the area and with consent from the local sewerage authority);

- if clean water is discharged into a watercourse, a baffle will be fitted to the discharge point to prevent disturbance of the watercourse bed;

- watercourses will be protected from contaminated surface water runoff by using French drains, cut off drains, grips, silt fences or bunds round the edge of watercourses. Numerous small, passive mitigation measures will be installed in preference to one large treatment system to prevent large scale water build up;

- existing and new surface water drains will be kept clear of silt or weed build up; and

- road and hard surfaces will be kept clean, to prevent a build up of mud and sediment that could contaminate surface water.

1.3.24 A baseline study has been undertaken which has considered the potential for contamination to be present in soils and groundwater beneath the Proposed Development. No significant sources of contamination were identified and therefore it is unlikely that contaminants will be encountered.

1.3.25 Six boreholes have been drilled at the Afon Tywi (River Towy) SAC crossing using a track mounted Dynamic drilling rig. These are referenced boreholes BH1, BH2, BH3, BH4, BH5 and BH6 and ranged in depth between 5m and 15m below ground level (bgl). No visual or olfactory evidence of contamination was encountered.

1.3.26 However, should unforeseen historic ground contamination be encountered the
following actions will be taken:

- work will be stopped, exposed soils would be protected to prevent silt or contaminant run-off as described above;
- NRW will be contacted and the local planning authority informed as soon as is practicable;
- a risk assessment will be undertaken to identify additional actions which may be required in line with guidance given in CLR11 e.g. further site investigations; and
- any proposed remedial strategy will be submitted for approval by the local planning authority, if required.

1.3.27 Mitigation to prevent and deal with accidental spillages of hydraulic fluid, oils and fuels, Bentonite muds and drilling fluids (from the HDD drill site) will comprise:

- a Frac-Out Contingency Plan will be prepared and implemented by the drilling contractor. This will be secured via a written requirement within the Development Consent Order (DCO). Works will not be able to commence until this requirement has been discharged by the LPA;
- all equipment containing hazardous fluids within the HDD compound will be of double-skinned construction (e.g. fuel tanks) or be parked on drip trays with PVC (or similar) berms to contain any fluid spills or storm water runoff;
- diesel shall be stored in fuel bowers fitted with integral bunds, designed to hold 110% of the contents of the tank;
- fuel, oils and lubricants shall be stored at least 30m away from any watercourse and at least 50m from any borehole or groundwater abstraction well;
- refuelling on the site shall be undertaken at least 20m from any given watercourses;
an impermeable bunded area for the storage of drums shall be constructed in accordance with NRW guidelines; and

refuelling bowsers and plant operating with hazardous fluids shall be equipped with “spill kits” and personnel shall be trained in their use as part of the site induction and in toolbox talks.

1.3.28 A risk assessment for Frac-Out incidents has been produced and is provided in Annex F.

1.3.29 Flood event/s occurring during works could result in mobilisation of pollutants including silt contained at the work site. This will be mitigated as follows:

- where possible topsoil stripped from within Flood Zone 3 will be stockpiled in Flood Zone 1 (or a suitable distance from the top of bank if this is not possible);

- HDD drill pits shall be bunded using subsoil;

- On receipt of warning of potential for a flood event;
  - Plant, fuel and chemicals shall be removed from the flood zone immediately;
  - Topsoil and subsoil heaps shall be further treated / protected if deemed necessary; and
  - Evacuation of personnel from the working areas at risk of flooding.

1.3.30 The above mitigation measures would be subject to a monitoring schedule to ensure that measures taken to protect watercourses, boreholes and wells are effective. A number of water monitoring locations have been established at locations along the route where construction activities have the potential to adversely impact on the water environment. The monitoring location closest to the Afon Tywi (River Towy) SAC is shown on Figure 1, referred to in the legend as ‘Mitigation Area’. It is proposed that a baseline sample will be taken from this location prior to construction works commencing.
1.3.31 During the construction phase, visual inspections will include an assessment from the river bank of the condition of the water, with photographic records taken, facing upstream and downstream of the monitoring point, for reference.

1.3.32 Monitoring will include sampling of the following basic parameters:

- Visual Inspection (e.g. for suspended solids and oil sheen);
- BOD;
- COD;
- pH;
- Total Dissolved Solids/Conductivity; and
- Temperature.

1.3.33 The frequency and duration of the monitoring programme will be agreed with the regulators prior to the commencement of monitoring activities.

1.3.34 Once the construction phase has been completed a final monitoring sample will be taken to ensure water quality is comparable to that of the baseline sample.

1.3.35 In addition to the stringent mitigation measures discussed above, the tidal nature of the Afon Tywi (River Towy) SAC limits the potential for any significant localised pollution events to occur.

1.3.36 The tidal flow of the Afon Tywi (River Towy) SAC would inhibit the settling of sediment on the river bed, and more likely result in increased suspension of sediment and transport downstream. This is a natural process in estuarine systems, and therefore any sediment displacement (caused by a pollution event during construction) would need to be on a large scale to impact on the Afon Tywi (River Towy) SAC and/or the Carmarthen Bay and Estuaries SAC.

1.3.37 There will be no water extraction from the Afon Tywi (River Towy) SAC or any associated tributary to facilitate construction. All water will be brought in by tankers
for use.

1.3.38 Any discharge to watercourses required will be subject to a permit from NRW.

1.3.39 Considering the factors above, and with the mitigation described in place, it is not considered likely that there will be any significant effects on the Afon Tywi (River Towy) SAC or Carmarthen Bay and Estuaries SAC during construction.

Operation

1.3.40 Electromagnetic fields are generated by operational power cables. Higher voltage cables create stronger magnetic fields. This impact is associated with the operational phase as the cables are not ‘live’ during the construction phase.

1.3.41 Magnetic fields generated by live cables may impair the orientation of fish and affect migratory behaviour.

1.3.42 The strength of electromagnetic fields declines with increasing distance from the cable. Therefore mitigation for this effect generally includes cable burial and shielding (e.g. sheaths surrounding the cable insulating the conductor etc.). The depth of the cable below the bed of the Afon Tywi (River Towy) SAC will be a minimum of 5m and the depth of the cable below the bed of the tributaries will be a minimum of 1.5m. It is assessed that these burial depths will reduce the exposure of sensitive fish species to electromagnetic fields (by increasing the distance of the animals to the cable). In addition the cable will be an XLPE (XLPE is cross-linked polyethylene) insulated single core cable with copper conductor and lead sheath (for armouring) which will also provide shielding.

1.3.43 NRW have reviewed the draft HRA and they have not provided any contrary information with regard to the likelihood of significant effects from electromagnetic fields at this cable depth.

1.3.44 In conclusion, there are no significant likely effects associated with the operation of the Proposed Development on any features of the Afon Tywi (River Towy) SAC or Carmarthen Bay and Estuaries SAC.
Decommissioning

1.3.45 The ducts installed underneath the Afon Tywi (River Towy) SAC will not be removed during the decommissioning phase but the cables may be removed with ducts sealed. Therefore there are no likely effects associated with the decommissioning of the Proposed Development on any features of the Afon Tywi (River Towy) SAC or Carmarthen Bay and Estuaries SAC.

1.4 In Combination Effects

1.4.1 Potential in-combination effects from all major schemes which are hydrologically connected to the Afon Tywi (River Towy) SAC and Carmarthen Bay and Estuaries SAC, (and will be constructed at the same time) has been considered. The list of developments assessed has been discussed and agreed with NRW and CCC (see Annex A for consultation responses).

1.4.2 The following developments have been assessed:

- Gravel extraction
- Llandeilo School
- West of Carmarthen Link Road
- Carmarthen West development
- Brechfa Forest West Wind Farm
- Llandeilo Bypass
- United Counties Showground site (part of)
- 19 residential dwellings

Gravel extraction (Refs E/10637 and E/22876)

1.4.3 Mineral extraction could lead to impacts on water flows which can be far reaching including disturbance to groundwater flow, changes to run off patterns, water table
or groundwater sites. The planning permission requires a system to control the surface water run-off to be approved by the local planning authority which should include measures to prevent pollution. The permission also prohibits the storage of oils, fuels and chemicals on site.

1.4.4 Following implementation of proposed mitigation measures, significant effects are highly unlikely with regard to changes in water chemistry, water quality, and off-site impacts associated with the development. Based on the above and the negligible impacts the Brechfa Forest connection project has on the water environment, there will be a negligible in combination impact on water quality and flood risk.

1.4.5 As a result in-combination effects with the Brechfa Forest Connection Project are not expected.

Llandeilo School (Ref E/27510)

1.4.6 Any new built development could increase the runoff or contribute to a pollution incident during the construction phase. Planning condition 3 requires the production of a surface water plan for the site and condition 11 requires a method statement to be prepared to control pollution during the construction phase.

1.4.7 The drainage strategy concludes that the foul water will go to mains sewer and Welsh Water has confirmed that no problems are envisaged with the Waste Water Treatment Works for the treatment of domestic discharges from the development.

1.4.8 Surface water is to be disposed of mainly by infiltration methods, thus the flood risk to the surrounding watercourses is negligible.

1.4.9 There is nothing on the council’s website relating to the discharge of condition 11, however the ground investigation for the site concludes that no elevated contamination levels were recorded in the tests carried out, and therefore mobilisation of contaminants from the discharge of surface water to ground would be negligible.

1.4.10 Subject to a suitable method statement to control pollution, the in-combination
effects of this development would be negligible.

Link Road (Ref W/23866)

1.4.11 Any new built development could increase the runoff or contribute to a pollution incident during the construction phase. Planning condition 3 requires the production of a surface water plan for the site and condition 11 requires a method statement to be prepared to control pollution during the construction phase.

1.4.12 According to the surface water drainage plan, surface water from the link road will discharge at 6l/s/ha, this is comparable to the greenfield runoff rates and therefore flood risk will not be increased as a result of the development. The attenuation pond proposed offers not only storage of storm water but a collection point for pollutants and suspended solids prior to discharge into the surrounding watercourses, thus the in-combination effects in terms of pollution and water quality of this development would be negligible.

1.4.13 Following implementation of proposed mitigation measures, significant effects are highly unlikely with regard to changes in water chemistry, water quality, and off-site impacts associated with the Link Road development.

1.4.14 As a result an increase in the in-combination effects with the Brechfa Forest Connection Project is not expected.

Carmarthen West development (Refs W/27776 and W/30286)

1.4.15 An Ecological Appraisal has been submitted in support of the planning applications. In accordance with the requirements of the planning conditions, the application must be designed and implemented in accordance with the advice contained within this section of the report. The adoption of the measures listed between points 4.6 and 4.42 will ensure there are no likely significant effects on the Afon Tywi (River Towy) SAC.

1.4.16 NRW provided a statutory response to the planning application. In terms of pollution prevention, the following was recommended:
As your Authority will be aware there can be no deterioration of water bodies under the Water Framework Directive. It is therefore vital that all appropriate pollution control measures are adopted on site to ensure that the integrity of controlled waters (surface and ground) is assured. For a development of this scale the developer should produce a site specific pollution prevention plan with particular reference given to the protection of the surrounding water environment. With the following planning conditions recommended:

- No development approved by this permission shall be commenced until a construction management plan (CMP) detailing all necessary pollution prevention measures for the construction phase of the development is submitted to and approved in writing by the Local Planning Authority. The details of the CMP shall be implemented as approved and must be efficiently communicated to all contractors and sub-contractors (for example, via toolbox talks) and any deficiencies rectified immediately.

- The development hereby permitted shall not be commenced until such time as a scheme to treat and remove suspended solids from surface water run-off during construction works has been submitted to, and approved in writing by, the Local Planning Authority. The scheme shall be implemented as approved.

- Any facilities for the storage of oils, fuels or chemicals shall be sited on impervious bases and surrounded by impervious bund walls. The volume of the bunded compound should be at least equivalent to the capacity of the tank plus 10%. If there is multiple tankage, the compound should be at least equivalent to the capacity of the largest tank, or the combined capacity of interconnected tanks, plus 10%. All filling points, vents, gauges and site glasses must be located within the bund. The drainage system of the bund shall be sealed with no discharge to any watercourse, land or underground strata. Associated pipework should be located above ground and protected from accidental damage. All filling points and tank overflow pipe outlets should be detailed to discharge downwards into the bund.”

1.4.17 Based on the above and the negligible impacts the Brechfa Forest Connection
Project has on the water environment, there will be a negligible in-combination impact on water quality and flood risk.

1.4.18 Following implementation of well-established mitigation measures, significant effects are highly unlikely with regard to changes in water chemistry, water quality, and off-site impacts associated with the Carmarthen West development. As a result in-combination effects with the Brechfa Forest Connection Project are not expected.

Brechfa Forest West Wind Farm

1.4.19 A HRA Screening Report has been carried out for the Brechfa Forest West Wind Farm. The report considered sites within 10km of the Brechfa Forest West proposal. This distance buffer was considered to cover the potential direct and indirect impacts on European Sites associated with the construction and operation of the scheme. Consideration was given to potential pathways for off-site impacts, such as hydrology.

1.4.20 Following implementation of well-established mitigation measures, significant effects on the Afon Teifi and Afon Tywi (River Towy) SACs are highly unlikely with regard to changes in water chemistry, water quality, and off-site impacts on otter habitats (decreased quality and obstruction) associated with the Brechfa Forest West Wind Farm.

1.4.21 As a result in-combination effects with the Brechfa Forest Connection Project are not expected.

Llandeilo Bypass

1.4.22 A HRA Statement to Inform an Appropriate Assessment report has been carried out for the National Transport Plan (NTP). The report indicated that the NTP Intervention of the A483 Llandeilo Bypass could have potential significant impacts on the Afon Tywi (River Towy) SAC. The likely effects on the Afon Tywi (River Towy) SAC from the Llandeilo Bypass area related to water quality and flow change.
1.4.23 The Afon Tywi (River Towy) SAC has been highlighted as a site that required Appropriate Assessment. The Appropriate Assessment findings concluded that taking into account the additional avoidance and mitigation measures that have been proposed, any adverse impacts on the Afon Tywi (River Towy) SAC relating to water quality would be avoided or mitigated.

1.4.24 Based on the above and the negligible impacts the Brechfa Forest Connection Project has on the water environment, the resulting in-combination effects with the Brechfa Forest Connection Project are not expected.

**Redevelopment of United Counties Showground site (Part of) (Ref W/32185)**

1.4.25 SUDS features are proposed to protect the Nant-y-Ci (which flows into the Afon Tywi SAC) from potential pollution impacts from the re-development of the United Counties Showground site (part of) for a caravan/motorhome sales yard. With these measures in place in-combination effects with the Brechfa Forest Connection Project are not expected.

**19 Residential Dwellings (Ref W/32424)**

1.4.26 Regarding the outline application for 19 residential dwellings the assessment has ruled out the potential for surface water run-off impacts due to the distance to the designated sites and the presence of houses, roads and abundant vegetation which would act as a barrier to any potential construction run-off. Therefore significant in-combination impacts with the Brechfa Forest Connection Project are not anticipated.

1.5 **Screening Matrices**

1.5.1 The screening matrix is provided in Annex B.

1.6 **References**

1.6.1 Advice Note 10, Habitat Regulations Assessment relevant to nationally significant infrastructure projects (NSIP), version 5. The Planning Inspectorate (August 2013).


1.7 Figures

- Figure 1 – The Proposed Development in relation to the Afon Tywi and Carmarthen Bay SACs
- Figure 2 – Otter Survey Results
Annex A

Consultation Responses
**Topics raised by PINS discussed during NRW meetings - 19.9.14 and 02.10.14**

Prepared by Victoria Gilbey, Principal Ecologist, RSK

<table>
<thead>
<tr>
<th>PINS Scoping Report Ref</th>
<th>RSK Scoping Report ref</th>
<th>Summary of points discussed at NRW meetings – 19th September 2014 and 2nd October 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Para 3.20</td>
<td>Para 8.5.36 – 8.5.38</td>
<td>All parties agree it is appropriate to scope out Pine Martin and Red Squirrel from detailed surveys. This is based on reasons outlined in the Brechfa Scoping Report.</td>
</tr>
<tr>
<td>3.21</td>
<td>Para 8.9.5</td>
<td>NRW confirmed there are no records of White-clawed crayfish from the Towy catchment. All parties agree it is appropriate to scope out impacts on White-clawed crayfish from the ES.</td>
</tr>
<tr>
<td>Para 4.9 -</td>
<td>Para 8.5.2</td>
<td>All parties agree that the assessment of potential impacts and mitigation for the River Towy SSSI can be covered in the HRA NSER and the ES, see comment below.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>All parties agree that the Allt Penycoed Stream Section SSSI (notified for its fossil assemblages) will not be impacted by the proposed overhead line and can be scoped out of the ES.</td>
</tr>
<tr>
<td>Para 3.79 and 4.2 – 4.6.</td>
<td>n/a</td>
<td>It was agreed that an outline of the proposed content of the HRA No Significant Effects Report (NSER) will be provided to NRW to comment on prior to its completion.</td>
</tr>
<tr>
<td>PINS Advice Note 10</td>
<td></td>
<td>NRW commented that the Carmarthen Bay SAC should also be included in the NSER.</td>
</tr>
<tr>
<td>Paras 4.13 – 4.18</td>
<td>n/a</td>
<td>All parties agree that the Dormouse survey results will be reported within a Draft</td>
</tr>
</tbody>
</table>
European Protected Species Licence and submitted as an appendix to the ES.

Para 3.62  
All parties agree, based on the results of the breeding and wintering bird surveys, that there is no evidence for species being present along the proposed route that are susceptible to electrocution impacts (i.e. larger species that perch or nest on wires or poles such as herons). In addition the most sensitive section of the route (for birds such as Herons) – the Towy crossing – will be undergrounded. Therefore all parties agree that electrocution impacts on birds can be scoped out of the ES.

Other points/topics to be discussed:

<table>
<thead>
<tr>
<th>NRW Scoping Response ref</th>
<th>RSK Scoping Report ref</th>
<th>Summary of points to be agreed/discussed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page 3, (1)</td>
<td>n/a</td>
<td>All parties agree that the impact of single pole installation on wet habitats is likely to be minimal and can be mitigated through standard construction practices which will be detailed in the ES. A specific section in the ES to cover impacts on hydrological functioning of wet habitats is therefore no longer required.</td>
</tr>
<tr>
<td>Page 4, (3) Fish</td>
<td>Para 8.5.39</td>
<td>All parties agree that main migration period for Shad on the River Towy is between April and June and HDD of the River Towy should be avoided during this period. NRW commented that there is a requirement to complete all ‘in-stream river works’ before the 15th October. This embargo runs until the 15th April to protect spawning salmonids. Any open cut</td>
</tr>
</tbody>
</table>
| Page 5, Bats | Para’s 8.7.11 | watercourse crossings for the Towy should be completed outside of this period. 
Please see separate email correspondence between Victoria Gilbey (RSK/WPD) and Sandra Wells (NRW). |
Ms. Victoria Robinson-Moltke
Principal Environmental Consultant
RSK
The Old School,
Stillhouse Lane
Bristol
BS3 4EB

Our ref: SH/2014/117013/03-L01
Your ref: EN020016
Date: 16 April 2015

Dear Ms. Robinson-Moltke,


Location: Brechfa

Thank you for your recent consultation regarding the above proposal, which we received on 3 March 2015. Please note that the detailed comments provided within this response relate purely to the following submissions.

For ease of reference we have endeavoured to cross reference our advice/comments to the aforementioned documents wherever practicable.

1. **Construction Environmental Management Plan (CEMP)**

1.1 We agree with the objective as stated within Para. 1.1.2.

1.2 We require detailed identification of the secondary satellite compound linked to the proposed underground cabling works (Para. 1.3.13).

1.3 We have concerns regarding the length of proposed cabling trenches – between 500 to 800 metres. It’s important to be aware of local weather conditions and to phase the work so exposed soils and open trench lengths are minimised and so reduces the potential for pollution incidents (Para. 1.3.17/18).

1.4 We require full details of the proposed Horizontal Directional Drilling and associated compound (Para.1.3.22/23). These are required to ensure both the drilling and compound are secure and that there are suitable measures in place to protect the water environment from pollution and drilling mud/lubricants.

1.5 We support the roles and responsibilities as advocated within Section 3.

1.6 Allied to Section 3 we would recommend a *joint technical working group* be formed to oversee and resolve any ongoing technical issues on site. The group would for example comprise of representatives from: WDP; Various consultants; Local Planning Authority and Natural Resources Wales. This has proved successful in previous projects including the Llandarcy redevelopment; LNG pipeline and major transport projects e.g. the Red Roses bypass.

1.7 We support the Environmental Training and Awareness proposals as stated within Section 4.

1.8 With regards to the information contained within Section 5.5 of the CEMP and the Water Management Plan, we are satisfied with the proposed approach. Any works that encroach within 7m of the main river channels may require a Flood Defence Consent. Please contact Rachel Thomas in the Flood Risk Analysis team to discuss the consent requirements further on 03000 653319.

1.9 With regards to the nature of the work being carried out, the underground sections (particularly the horizontal directional drilling [HDD] are likely to pose a higher risk to groundwater when compared to the other planned works. Accordingly detailed method statements and details of pollution precautions are required to ensure risks to groundwater are minimised.

1.10 Section 5 Management of Environmental Impacts refers to various matters and we list below several which we require comment;

   a) We support the employment of a project Ecologist & Environmental Manager.

   b) We recommend that careful implementation of Hedgerow Translocation must be consistent throughout project.

   c) We advocate there is competent monitoring of control and mitigation measures that are to be implemented.

   d) Para. 5.3.5. The crossing of main rivers requires the prior consent of
Natural Resources Wales but when crossing general watercourses/rivers this falls to be considered by the Local Authority (Carmarthenshire CC) Drainage Engineers.

e) Para 5.11. Please ensure all Herbicides are stored safely off site.

f) Para 5.14.4. We support the statement that NRW be contacted if any unsuspected contamination is found on site. Any pollution incidents or spillages should be reported to NRW incident hotline on 0800 80 70 60.

g) We would advise that the NRW Floodline can also be contacted on 0345 988 1188.

1.11 If waste exemption or permits are required then these should be in place prior to starting construction and naturally this is applicable to all relevant consents required for this project.

1.12 Prior to stripping soil and planning settlement lagoons we recommend that soil samples are taken to determine the particulate size and nature of material. Then a suitable system of settlement lagoons or treatment can be designed.

1.13 We (NRW) have a position statement on dewatering excavations which should be adhered too. Available on NRW website.

1.14 Para 5.1.26 states that no impacts on otters are expected as no otter lying up sites were found. However the otter survey submitted with the draft Environmental Impact Assessment (EIA) stated that an otter lying up site was found in the woodland adjacent to the Nant Morlais. The CEMP also does not address indirect impacts on otters, for example noise disturbance, artificial lighting affecting commuting routes and the risk of otters getting trapped in ground excavations. These issues must be addressed.

1.15 We reiterate that appears to be an apparent lack of information regarding the proximity of the open cut works to the Gwili and other smaller water courses, how water courses and their banks will be protected from disturbance/pollution during the works, and the specifics of bank reinstatement for the open cut water course crossings. The details provided in the CEMP need to be addressed. In the March meeting it was intimated that to the north of the Tywi the line will be moved away from the Gwili into the adjacent field. They will also be using directional drilling under a number of the watercourses instead of excavating. We just need clarification of the situation.

1.16 Greater clarity is required on whether any new access tracks will be permanent or temporary, and how these will be clearly demarcated or restored.

1.17 We note within the draft CEMP that it touches on dormouse mitigation which (NRW) we are awaiting further information.

a) Para 5.1.1 states that “the project Ecologist and Environmental Manager shall identify any further surveys required”. Unless this is a reference to pre-construction surveys, surveys should have been undertaken to inform any application. If this is supposed to be referring to pre-construction surveys, we recommend that the CEMP is amended to confirm this.

b) Para 5.1.1. also states that “WPD shall ensure that mitigation measures are designed and implemented in consultation with the Project Ecologist to ensure that no protected species are harmed and disturbance to their habitat is prevented or, if not possible, minimised”. We assume that this sentence refers to any additional mitigation required as a result of pre-construction surveys and this
should be clarified. The CEMP should be clear about all of the mitigation that needs to be delivered during construction.

c) Para 5.1.7. (Hedge Translocation). No timescales are given for hedge translocation in Para 5.1.7. We advise that the CEMP sets out the time of year when the translocation, if required, will occur. We recommend that translocation is undertaken at a time of year when desiccation is less likely, or if done during dry spells, that supplementary watering is carried out to avoid desiccation both before and after translocation.

d) Para 5.1.14. (Bats) requires clarification as what the term "Phase 2 surveys" means in terms of Bats and the CEMP. Our scoping advice for the proposals advised that trees identified to have potential to support roosting Bats are subject to more detailed assessment including climbing inspections, dawn re-entry and/or dusk emergence surveys as appropriate.

e) Para 5.1.15. of the CEMP should also be amended in respect of its content all Bat trees scheduled for removal or pruning/coppicing...". Additionally we advise that emergence/re-entry surveys as well as climbing inspections are undertaken prior to construction work in accordance with best practice in the Bat Conservation Trust's Bat Surveys; Good Practice Guidelines (L. Hundt, 2012).

f) If Bats are found at any stage of the project, we recommend that works cease and the Project Ecologist should be consulted immediately to determine if further consultation or a European Protected Species licence is required.

g) Para 2.1.20. (Hazel Dormice). As previously mentioned there is a need for agreement on dormouse mitigation and await further information.

h) Para 5.1.22. – We do not normally advise that nest boxes are bunged.

i) Para 5.1.22 – In respect of felling works where dormice may be implicated, we advise that felling is undertaken in a direction least likely to cause damage to retained vegetation and also advise that any planting for dormice comprises a mix of species to give an all year round source of food in accordance with best practice set out in the Dormouse Conservation handbook.

j) Para 5.1.26. (Otters). We advise that the limitation on daytime working should mirror that for Bats i.e. no working within 1 hour of sunrise and sunset. Additionally there should be no storage of materials next to watercourses where otters may rest or get caught up.

k) Para 6.2.1. (Monitoring). We recommend the CEMP is amended to confirm the post-construction monitoring will include protected species monitoring related to European Protected Species (EPS) Licences and the dormice boxes that will be erected and also the habitat re-instatement, including proposals for amended management or replacing failed planting where required.

2. Annex 1 - Waste Management Plan (WMP)

2.1 Para 2.3.4. We support the various methods for training and communication of the WMP.

2.2 Table 2.1. Waste Identification-Volume targets. Currently void/no details and needs completion.

2.3 Para 2.4.3. We support the use of the principles associated with the waste hierarchy to enable best practice on site.

2.4 NRW Waste team contacts:
- Waste regulation team; SWWales@cfoethnaturiolcymru.gov.uk
- Waste regulation Team leader; Jon Willington (0300 065 4070).
- Local District team: Dave Ellar (0300 065 4016)
3. Annex 2 - Pollution Prevention and Emergency Response Plan (PPERP)

3.1 Para 7.5.4. Betonite. The proposed HDD process is a key factor in the project and the careful control of spillages is paramount to ensure there is no pollution of watercourses/land. This particular activity on site warrants special attention in terms of pollution controls and requires a method statement which follows best practice.

3.2 Ensure that any project activities /compounds or storage areas are located a minimum distance of 20 metres away from a water course where possible.

4. Annex 3 - Water Management Plan (WatMP)

4.1 Para 1.5.3. Method Statement. We agree that method statements for the crossing and reinstatement of the watercourses along the cable route and for flume pipe installations shall be agreed with NRW and Carmarthenshire County Council before the commencement of works on site.

4.2 Any works within a watercourse must be undertaken outside the fish spawning season. (15 October to 15 April). Additionally may require a Flood Defence Consent from Carmarthenshire County Council if works within ordinary watercourses.

4.3 Para 1.6.3. We support the utilisation and implementation of pollution prevention measures as advocated within the EA/NRW Pollution Prevention Guidelines. Please refer to the Environment Agency website for full details.

4.4 Para 1.6.5. Any dewatering of excavations shall be subject to NRW consent/permit as required. Advice can be obtained from local District offices in Cross Hands,

4.5 Para 1.6.5. There should be no compounds or storage of materials within the floodplain.

4.6 Para 1.6.5. Surplus soils should not be spread within a floodplain.

5. Annex 5 - Habitat Management Plan (HMP)

5.1 We support the introduction of the concept of “habitat poles” or similar nesting boxes.

5.2 We support the concept of enhancing woodlands/hedgerows as advocated within Para 4.1.3 as a mitigation/compensatory measure.

5.3 We note the intention for a rolling 5 year vegetation management programme to ensure overhead line clearance but it is unlikely that hazel will fruit within that period. It is advisable that where possible hazel is only coppiced where necessary for overhead line clearance and naturally we can discuss any long term management plans for hazel.

5.4 We advise that the CEMP sets out the height and nature of the habitat that initiates line clearance, best practice for timing and methods of clearance and give consideration to dormice where relevant (Para.4.2.7). We advise that the relevant licences for such clearance are obtained as appropriate.

5.5 We recommend that planting for dormice comprises a mix of species. The CEMP (HMP) should set out the proportion of different types of species, the number to be used, planting spacing and monitoring and aftercare provisions. We advise that watering once a year is likely to be ineffective depending on weather conditions. It is advisable that flexibility is retained in respect of a watering schedule and that this is guided by weather and ground conditions, which should be regularly monitored throughout the seasons (Para 4.2.6.).
5.6 Para 4.3. (Operation Phase and Monitoring). We advise that the operational phase and monitoring should include the monitoring of dormice populations post-construction in accordance with the European Protected Species Licence and woodland management.

5.7 Para 5.1.1. (Hedgerows). This paragraph appears to give conflicting information about the number of hedgerows that need to be removed due to undergrounding, suggesting 5 rather than 6 in the main text of CEMP. Clearly this needs clarification and confirmation in relation to the location and extent of hedgerow removal along the cabling route.

5.8 Para 5.2.2 we advise that the hedgerows are ideally fenced with both rabbit and stock proof fencing.

5.9 As previously indicated there must be careful flexibility in relation to the proposed watering of new trees/hedgerows to account for local weather conditions.

5.10 Para 6.4.2. (Should be 5.3.3.) We advise the hedgerows should only be cut when required to maintain overhead line (OHL) clearance (i.e. when within 5m of the OHL). The HMP should be amended to confirm what height it will be cut to, timing and methods.


6.1 This falls outside our remit and is a matter for Carmarthenshire County Council.

7. Annex 8 - Invasive Weeds Management Plan


7.2 We support the intention to follow the latest good practice guides/measures as advocated in Para 1.4.2.

7.3 A competent monitoring regime is paramount to ensure an effective implementation of this plan.

8. Habitat Regulations Assessment (HRA)

8.1 For completeness we would recommend the inclusion of more detailed information, including copies of various prior consultation responses to both cross reference to and also support some of the conclusions indicated in the document.

8.2 Para1.1.5. There appears to be a discrepancy between the identified hydrological connectivity of Carmarthen Bay and Estuaries Special Area of Conservation (SAC), the Twyi crossing and the 2 km study area. We acknowledge that WDP are aware of this issue and will correct accordingly in due course.

8.3 Assessment of Likely Significant Effect.
   a) The proposed HDD process for underground cabling under the Twyi is paramount to the project. As previously mentioned we would welcome more details as to the extent and proposed depth of drilling and additionally the full extent of mitigation associated with laying the cables under the Twyi SAC.
   b) Para 2.8.6. of the Draft Environmental Statement (ES) states that the development of fluid pathways between the borehole and surface may result in the venting or ‘Frac Out’ of drill fluid. The submitted HRA and CEMP refers to the preparation of a ‘Frac Out’ contingency plan to be implemented by the drilling contractor. Due to the potential toxic nature of the drilling fluid, this
contingency plan must be produced to inform the HRA and CEMP and be secured in the Development Consent Order (DCO).

c) Para 2.8.9. of the Draft EIA states that the source of water extraction for the HDD is yet to be determined. If water is abstracted from local surface waters, this will need to be identified within the HRA, including details of the abstraction point(s), method and volumes. Again we recommend these details be cross referenced to the CEMP and secured through the DCO.

d) Any effect on mobile SAC species should be assessed within the Twyi River and its tributaries where appropriate. We recommend the same timings of works to avoid disturbance be used within any mitigation plan for the SAC and its tributaries. We reiterate the mitigation measures be secured through the DCO and cross referenced to the CEMP.

8.4 Operational Assessment. In addition to the potential effect during the construction phase we would welcome the assessment of any potential effect on mobile species during the operational phase of the proposed development. In particular any potential electromagnetic field impacts on migratory fish. We would envisage the cable depth and any protective coating to form part of this assessment. Additionally we would expect details of effects on migratory fish in the post construction phase.

8.5 In combination effect. We appreciate that this issue has been subject to much dialogue with my colleague Huw Williams and clearly is a moveable and ongoing issue which is receiving attention by WPD/Consultants. However in the interest of clarity we repeat some comments for our/your records. The in-combination effect must assess all significant effects from plans or projects that are hydrologically linked to the proposed Twyi cable crossing works including links to Carmarthen Bay and Estuary SAC. This area extends well beyond the 2 Km buffer currently being assessed.

We hope the above information and advice is useful for your purposes. Naturally if there any matters which you consider require further dialogue please do not hesitate to contact me.

Yours sincerely

[Signature]

Mr. David Watkins
Senior Development Planning Advisor

Direct dial 03000 65 3327
Direct e-mail david.watkins@naturalresourceswales.gov.uk
Mr Andrew Hubbold  
Western Power Distribution  
Blackpole Road  
Worcester  
WR4 9TB  

Date 16 January 2015  

Dear Annwyl Mr Hubbold  

BRECHFA FOREST CONNECTION PROJECT. STAGE 3 CONSULTATION ON THE PROPOSED DEVELOPMENT.

Thank you for consulting Cyfoeth Naturiol Cymru/Natural Resources Wales on the Brechfa Forest Connection Project Draft Environmental Statement (ES).

We welcome the opportunity to review the draft ES prior to submission to the Planning Inspectorate as part of the Development Consent Order (DCO) process. We also note from your letter that this may be our last opportunity to comment on the proposed scheme prior to its submission. We would hope that our detailed comments on the draft ES, will be used to influence the final ES. However, we would recommend ongoing discussions in respect of the points raised below and welcome the opportunity to comment on any revisions/amendments/updates to the draft ES and appendices.

Following the layout of the draft ES, our detailed comments on the following documents are provided below.


Chapter 7 – Planning Framework

As detailed within Paragraph 7.2.6, under the terms of the Habitat Regulations Assessment 2010 (as amended), the decision maker must consider, prior to granting a DCO whether the project will have a significant effect on a European designated site. In order to assist in this process sufficient information must be provided to support the
preparation of a Habitat Regulation Assessment (HRA). We acknowledge the commitment within Paragraph 7.2.6 to provide this as part of the DCO application, however, given the importance of the HRA in the DCO process we strongly recommend pre-submission discussions with us prior to the formal application. In our experience this does assist all parties in resolving any issues at the earliest opportunity.

Notwithstanding the above, we advise that any HRA prepared should include justifications for any feature which has been screened out of the assessment and detailed information on avoidance and mitigation proposed to ensure no significant effect on the features of the Afon Tywi Special Area of Conservation (SAC). In addition, the HRA must assess in-combination effects from any other plan or project within an appropriate area or which are hydrologically connected to the Afon Tywi SAC.

From the information provided we would have concerns regarding the storage, use and disposal of chemicals used in the Horizontal Directional Drilling (HDD) and undergrounding of cables beneath the Afon Tywi. We recommend that the management of these chemicals at all stages of the scheme be clearly documented to inform the HRA for the site.

We note from Chapter 7 and various references throughout the draft ES that the DCO application will be supported by a Construction Environment Management Plan (CEMP) to detail various mitigation measures associated with the proposed development. We would welcome the opportunity to comment on the draft CEMP, including the supporting Waste Management Plan (WMP), Pollution Prevention Plan (PPP), Water Management Plan (WMP), Emergency Response Plan (ERP) and Invasive Species Plan, prior to the submission of the DCO application. Additional comments on this aspect are provided under Chapter 20 Environment Management.

**Chapter 8 – Land Use, Agriculture and Forestry**

Paragraph 8.9.1 details that in order to minimise the impact on forest resources consideration would need to be given to the following points at the detailed design stage.

- Minimising the areas required to be clear felled and designing a felling plan to be compatible with the Brechfa Forest Design Plan;
- Ensuring clear felled areas are planted and/or managed for ecological gain according to the Habitat Management Plan (see Chapter 10) consistent with objectives agreed with NRW and that do not preclude return to woodland following decommissioning;
- Assessing the potential loss of FSC certification for certain stands of felled woodland; and
- Determining any need for planting new areas of woodland in compensation according to the Woodland Wales Strategy.

We note the need for a Habitat Management Plan (HMP) however, there is no reference to this under Chapter 10. As above, we would welcome the opportunity to comment on a draft HMP prior to the DCO application submission.
We note that the construction of the overhead line (OHL) will result in a loss of up to 10ha of forest. Whilst we note the commitment to compensatory planting in line with the ‘Woodlands for Wales’ strategy, justification should be clearly documented for the need for this loss. As raised by Carmarthenshire County Council in previous consultations the relocation of the sub-station to the South-West corner of the forest could negate the need for this area of clear felling. Detailed justification should be provided on this aspect of the scheme.

Chapter 9 – Landscape and Visual Assessment

We are satisfied that our previous requirements, as detailed below, have been incorporated into Chapter 9 of the draft ES.

- Optimum use of all 5 Aspects of LANDMAP to provide baseline landscape data in the assessment of landscape effects. LANDMAP Visual and Sensory Aspect data is a key factor in the identification and assessment of sensitivity for the project Landscape Character Areas (pLCAs), as detailed in Appendix 9.2;
- Assessment of effects on both the existing adopted and proposed Special Landscape Areas designation boundaries, as detailed in Appendix 9.3;
- Assessment of residential visual amenity to be included for properties within 100m of overhead line, as detailed in Paragraph 9.7;
- Locally promoted trails to be included within scope of visual assessment, as detailed in Appendix 9.6;
- Other recreational and visitor locations (e.g. camping sites) to be included in the visual assessment, as detailed in Appendix 9.8;
- Cumulative assessment includes various types of development (e.g. small scale wind turbines, solar PV sites and telecommunication masts), as detailed in Section 9.11;
- Cumulative assessment is to assess both the additional and combined effects of existing, consented and proposed developments, as detailed at Section 9.11.

Section 9.4 Assessment Methodology

We consider that the methodology is in accordance with current published guidance as set out in the Guidelines for Landscape and Visual Impact Assessment (3rd Edition 2013). It correctly distinguishes between landscape effects and visual effects, the levels of significance are defined appropriately, and the assessment process is transparent and follows recommendations as set out in current guidance.

Section 9.6 Construction Phase Effects

The likely landscape and visual effects resulting from the construction of the development are properly identified and reasonably described and assessed.

Section 9.7 Operational Phase Effects

The likely landscape and visual effects resulting from the operation of the development are properly identified and reasonably described and assessed. We agree with the
assumption made in Paragraph 9.7.1 that ‘the overhead sections of the Proposed Development have been assumed to be a permanent feature that will not be decommissioned and removed within a foreseeable timeframe’, but we note that the approach also considers the potential ‘reversibility’ of effects.

**Section 9.8 Decommissioning Phase Effects**

We note that the decommissioning phase of the landscape and visual assessment has been scoped out as confirmed by Paragraph 9.8.1.

**Section 9.9 Mitigation Measures**

Paragraph 9.9.1 of the draft ES confirms that the ‘mitigation of landscape and visual effects of both the underground and overhead sections of the Proposed Development is primarily embedded within the design of the infrastructure and its routing’. Details of design and alignment mitigation are reasonably described, together with other mitigation measures, including the landscape reinstatement works proposed to underground sections of the route.

**Section 9.11 Cumulative Effects**

We consider that the approach to the assessment of cumulative effects is in accordance with guidance contained within GLVIA 3rd Edition. Furthermore, we note the amendment made to the cumulative assessment (Paragraph 9.11.3) to include an assessment of both the combined and additional cumulative effects.

Notwithstanding the above we have concerns regarding the potential understatement of the cumulative effects in the southern corridor arising from the convergence with the existing high voltage overhead line (near Viewpoint 5). We note that Paragraph 9.4.10 does confirm that ‘landscapes with already high levels of prominent existing electricity infrastructure and telegraph poles …may display high susceptibility.’ The design should seek to avoid these ‘wirescape conflicts’ in order to reduce the landscape and visual effects – we note the commitment in the draft ES (Paragraph 9.12.1) that ‘in undertaking this draft assessment consideration has been given to the need for and practicality of further design iterations to further reduce the effects identified.’

**Chapter 10 – Ecology**

We have set out below a number of observations on the draft ES with regard to European Protected Species (EPS), which are given the highest level of protection in British law and reflected in planning policy. We advise that these matters are addressed and appropriate revisions made to the ES in order to demonstrate that there will be no detriment to the maintenance of the favourable conservation status of the species concerned.

Notwithstanding these comments, we feel that in terms of managing the likely impacts of the scheme, the ES would benefit from a comprehensive strategy for vegetation removal, reinstatement and aftercare, using as far as reasonably practicable reinstated or
translocated hedgerow stock. In principle, setting out a more detailed comprehensive approach to this within the ES or as part of a HMP could offset some of the perceived shortfalls within the survey work, outlined below.

Bats

Appendix 10.1 Bat Technical Report

Section 1.2 Methodology

We note that a search of the local records centre for bat records was undertaken to inform the draft ES although the significance of these records for the proposed development does not appear to have been considered. For example, it is not clear whether there are bat roosts close to the project’s proposed working area, and if so, what the potential implications of the project may be for these roosts (i.e. severance of flight routes).

The records obtained are displayed in Figure 2 but the scale of the illustration, the similar colours used for different species and the lack of identification of the record type (e.g. type of roost) renders the information difficult to read and interpret.

We advise that these issues are addressed within the ES and Figure 2, and presented in a way that also supports an assessment of the significance of local bat records for the project, and the conclusions drawn from that assessment.

With regards to bat activity surveys, in our response to the Environmental Impact Assessment (EIA) scoping request to the Planning Inspectorate (dated 08 August 2014), we advised that activity surveys be devised to compliment roost assessments, to facilitate the identification of key flight routes to/from roost sites, as well as identifying areas of importance to bats for foraging. This information is needed to inform an impact assessment of the development and guide mitigation requirements.

With regard to these surveys, we note from Paragraph 1.2.20 that the survey locations were chosen on the basis that they supported, or were adjacent to ‘optimal bat roosting, foraging and/or commuting habitat’. It does not appear that site selection was influenced by the results of the local records centre search, or by any information gained on potential bat roosts during the field surveys.

We advise therefore that the ES include a more detailed justification for the selection of survey sites, to explain how the sites selected are considered sufficient to assess the full impacts of the scheme, including in respect of severance, and in locations where roosts may be located nearby.

We also note that the activity surveys were undertaken in August and September, later in the bat season. The ES should explain why the surveys were undertaken at this time of year. In correspondence with your ecological consultant (email to Matt Davies, RSK, dated 16 May 2014) and our aforementioned EIA scoping opinion response, we advised that surveys should be undertaken in accordance with the Bat Conservation Trust’s
guidance (Bat Surveys: Good Practice Guidance (2012)). Our response indicated that bat surveys should be distributed throughout the period that bats are active (May-September inclusive) to establish seasonal differences.

**Draft ES**

**Section 10.6 Assessment of Impacts: Construction Phase**

In terms of the potential impacts of the scheme we advise that the significance of severance is examined and where relevant how this will be addressed detailed in the ES.

**Section 10.9 Mitigation Measures: Construction Phase**

We note the intention to replant gaps with native, mature stock, however, if habitat severance is likely to have implications for significant roosts nearby, we advise that hedgerow translocation is used to facilitate quicker reinstatement. With reference to Paragraph 10.9.25 of the draft ES, we advised your ecological consultant (email to Victoria Gilbey, RSK, dated 27 November 2014) to consider the use of hedgerow translocation wherever possible.

The ES should include measures to monitor any vegetation planted or re-instated to address gaps created in hedgerows or woodland, and address any issues of un-successful establishment/re-establishment.

We note that all trees at risk of pruning or felling to accommodate the works to install the grid connection were assessed for their potential to support roosting bats. Of these it would appear that ten were considered to have potential (Category 1 or 1* according the Bat Conservation Trust’s Bat Surveys: Good Practice Guidelines) but that upon further, more detailed inspection, none were found to have evidence of bats.

We therefore concur with Paragraph 10.9.22 and Table A1 of the Bat Technical Report (Appendix 10.1) regarding pre-felling checks. We advise that the ES confirms that surveys including emergence observations are undertaken in accordance with national guidelines by a suitably qualified and licensed ecologist. Further, we also advise that the ES confirm that these requirements also apply during the operational phase (Section 10.10 of the draft ES).

**Dormice**

**Appendix 10.4 EPS Licence Application – Dormice Method Statement**

**Section C. Survey and Site Assessment**

We note that a search of local record centre data was undertaken for dormouse records. However, the assessment of this data in Section C.1 is unclear. It is stated that none of the records are crossed by the proposed development, the closest being 1km from the proposed development, it then later states that recent records of dormice exist within the
area of the proposed development. Clarification needs to be provided in terms of the relevance of the pre-existing records in context of assessing the impacts of the scheme, (reference to Section C.6 below), taking into account habitat linkages between the records and the proposed working area.

We note that Section C.4 of this Appendix is incomplete; this needs addressing.

We advise that Section C.6 includes a detailed rationale for the selection of dormouse survey sites, to include reasons for selection of sites for nest tubes in respect of existing dormouse records obtained and the presence of suitable habitat. During pre-application discussions, it was indicated by yourselves that a sampling strategy was to be adopted with assumptions taken about the presence of dormice in any suitable habitat ‘sufficiently well connected’ to the survey sites depending on the survey results. It is not clear whether any areas have been identified where dormouse presence has been assumed. We advise that ‘sufficiently well connected’ is defined in the ES and reference given to our EIA scoping opinion response dated 06 August 2014.

The ES should also include a rationale for the density of deployment of tubes across the survey sites, which appears to be variable between the sites.

In terms of setting out the results of the surveys, we advise that the dormouse survey locations are included on one table, rather than split over two (C-1 Dormouse Survey Locations and C-2 Dormouse survey site scores) and should include all of the following:

- Reference number of dormouse survey area;
- Grid reference of dormouse survey area;
- Habitat description;
- Length (m) and/or Area (ha) of survey area (as appropriate to the habitat type); (as advised in our email to Matt Davies, RSK, dated 16 May 2014)
- The number of tubes deployed;
- Which months nest tubes, deployed between April and October were checked rather than the overall number of checks;
- The survey points; and
- Whether they were subjected to a nut search (and if not, why not).

We note that several survey sites scored less than 20 survey points, the threshold considered to constitute sufficient survey effort.

**Section D Impact Assessment and Section E Mitigation, Compensation and Monitoring**

The impact assessment focuses on the impacts to Nant Morlais woodland (Site 1), where a reasonable survey effort was undertaken and dormice were confirmed as present. We are of the view that where it has not been possible to execute the minimum level of survey work to reasonably conclude absence, as would appear to be the case at a number of sample sites, a precautionary approach is adopted. We understood as indicated above that dormouse presence would be assumed, given its widespread presence in this area.
In this context, we advise that the ES contain a strategy for vegetation removal for the whole scheme, which addresses the timing and methods of removal and proposals for reinstatement. As indicated above, we advocate the use of translocated vegetation (for example hedgerows) for more rapid reinstatement, and would be looking for this method where dormice are implicated. Where mature stock is to be used for planting, we advise that they should be native species of local provenance (Table E1 Habitat Loss and Gains Table).

With reference to Section E.1 Site Clearance Methods, where dormice are present we do not advocate clearance to ground level during the winter (October to March). We wish to see an alternative strategy employed such as a two stage clearance or vegetation removal when dormice are active but outside of the breeding season. We endorse that any areas to be cleared are checked by a suitably qualified, experienced and licensed ecologist prior to clearance commencing.

Section E.1 also contains conflicting information which needs to be addressed. The text states that vegetation will be cleared to ground level, but also that coppicing using hand tools will be undertaken.

**Section F. Post-Development Site Safeguard**

With regards to post-development monitoring we advise that a scheme is prepared to monitor the effectiveness of mitigation measures specifically implemented to address the impacts of this scheme. We would anticipate this to include monitoring the success of new or replanted vegetation put in to reinstate gaps, measures to address any issues with the failure of these measures and dormouse monitoring. We would be happy to discuss what might be reasonable with regard to the latter.

With regard to routine maintenance of the OHL post-construction, this is a separate issue to this current application. We can confirm, however, that vegetation management under power lines is an activity that Natural Resources Wales (NRW) would consider for a programme of works EPS licence application. Any such licence application would need to be submitted to NRW’s Species Licensing Team.

**Otters**

With reference to Paragraph 10.6.59 within the draft ES, we note that a survey for otters found evidence of a resting place within the Nant Morlais woodland (Otter Survey Site 1 see Figure 3 within Appendix 10.6 Otter and Water Vole Technical Report). We advise that the ES sets out the working width of the scheme through this woodland, and the likely impacts of the development on this resting place, including a consideration of the potential for disturbance.

We note also that otters were found to be moving throughout the watercourses implicated by the proposed development. We therefore advise that the ES includes working protocols as appropriate to the likely impacts of the proposed development. For example, construction activities should be confined to daylight working hours only (i.e. 1 hour after
sunrise to 1 hour before sunset), working methods should be in place to avoid otters becoming trapped in any trenches, and materials should be stored away from watercourses to avoid inadvertently creating otter resting places. If any existing otter resting places are likely to be affected, further measures may be required.

**Hedgerows**

We note from Paragraph 2.5.9 that Western Power Distribution (WPD) typically do not remove hedgerows during construction of an OHL as they are able to span over them. However, it is our understanding from pre-application discussions that farmers often request poles to be located within hedgerows rather than more centrally within fields for ease of land management. The ES should clarify whether any poles are likely to be located within hedgerows and if so, the maximum working width likely to be required to be cleared to accommodate them.

We note from Paragraph 2.5.10 that all trees within topple or contact distance of the OHL will be pruned or felled as appropriate, and that 5 metre clearance will be given underneath the OHL. However, there is no indication of the likely working width during construction within woodland blocks affected. We advise that the ES includes confirmation of the working (construction) width within woodlands and hedgerows affected by the scheme.

Paragraph 2.5.1 details that it will be necessary to temporarily remove sections of hedgerow. Where existing entrances have to be temporarily widened or trenching works undertaken the translocation of hedgerows rather than removal should be considered. Where permanent hedgerow removal is required, again where possible, we advise that these hedge sections are translocated locally.

Consideration should also be given to the laying of hedges traversed by the OHL rather than cutting back, and the provision of stock proof fencing each side, where possible. Laying the hedges would retain the trees including any lichens or insects living on them. A laid hedge would also create an excellent habitat for nesting birds as well as retaining flight-lines for bats. Double fencing of the hedges where possible would create a thick tussocky habitat at the base of the hedge especially suited to insects and small mammals. In addition, laid hedges grow slower than coppiced hedges and many of these could be maintained with a tractor mounted hedge cutter, reducing the long term maintenance costs.

**Section 42 Habitats**

As highlighted within Paragraphs 10.6.8 to 10.6.10 of the draft ES the proposed development will affect areas of priority habitat at two locations. These are the marshy grassland near Alltwalis, and the blanket bog west of Rhydargaeau. Whilst we note and accept the mitigation measures outlined in Paragraphs 10.9.5 to 10.9.7 of the draft ES clarity should be provided on why these areas cannot be avoided. When considering the ecological impacts of any development, the overriding principle is to avoid sensitive receptors. If such areas cannot be avoided, this must be clearly justified.
In addition, where poles are to be located on more ecologically sensitive habitats, details should be provided on how access across these habitats will be managed, including the use of temporary protective boarding, where necessary.

**Invasive Species**

As noted from Paragraph 10.9.18 of the draft ES, owing to the presence of invasive plant species along the proposed route an Invasive Species Management Plan will be prepared for the development. We would support this approach however, it may be prudent to incorporate a draft plan within your future DCO application.

**Watercourses/Riparian Corridors**

We note that Paragraph 10.9.17 details mitigation measures for any proposed open cut watercourse crossing points. We note the intention to utilise geotextile matting, where necessary, and welcome this commitment to the use of bioengineering techniques instead of hard engineering methods such as block stone and gabions.

With regard to any overhead crossings, pole locations in the vicinity of watercourses must be set well back from the banks. We therefore recommend a minimum 7 metre buffer be retained between any development activity and the top of the banks of the watercourse.

We note from Figure 10.2 Map 11 that the one pole appears to be sited in very close proximity to the right hand bank of the Nant Felys. As above, a 7 metre buffer is required in order to avoid damage to banks, bankside vegetation, potential soil compaction and the movement of watercourses that could give rise to future erosion issues.

**General Ecological Comments**

We note that the ES makes no provision for ecological enhancement. In line with TAN 5 Nature Conservation and Planning (September 2009), the ES should identify opportunities for the enhancement of nature conservation interest.

**Chapter 12 – Geology, Hydrology and Ground Conditions**

We note the content of Chapter 12 and welcome the mitigation measures outlined within Paragraphs 12.5.37 to 12.5.64.

We also note the intention to undertake a CEMP. As highlighted above we would welcome the opportunity to comment on the draft CEMP prior to the submission of the DCO application.

**Chapter 13 – Hydrology and Flood Risk**

As confirmed in our response to the EIA scoping request as there are no permanent structures, other than poles, to be located within our current flood outlines there is no requirement for a flood consequences assessment to support the development.
We note and welcome the approach outlined in Paragraph 13.5.72 that the pipeline crossing will be a minimum of 1 metre below the bed level of the River Towy and the entry/exit compounds will be approximately 25m from the top of bank. We would reiterate our previous advice that any associated infrastructure should be located away from any watercourse in this area given their mobile nature.

As noted in Section 13.9 Flood Defence Consents will be required from ourselves for any works within 7 metres of a main river. We can confirm that permanent consents will be required for all the proposed pipeline crossings and temporary consents will be required for the crossings to be installed via open cut trenching. As also noted Land Drainage Consents must be sought from Carmarthenshire County Council for any works which will affect the flow within any ordinary watercourse.

We are satisfied that the ES has adequately assessed the development in terms of the hydrological constraints.

In addition, we welcome the mitigation measures outlined within Section 13.9 and note that these will be secured via the CEMP. As highlighted above we would welcome the opportunity to comment on the draft CEMP prior to the submission of the DCO application.

Chapter 20 – Environmental Management

Section 20.2 Environmental Management during Construction

We note the additional plans to be produced in support of the CEMP, as outlined in Paragraph 20.2.4, we would welcome the opportunity to comment on the draft plans prior to submission of the DCO application.

Within Paragraph 20.2.4 specific mention is given to Waste Management, Pollution Prevention, Emergency Response and Water Management Plans. We would welcome the opportunity to comment on these specific draft plans prior to the submission of your DCO application. These plans should draw on the pollution prevention measures which are detailed throughout the draft ES (for example Section 13.9) and standard Pollution Prevention Guideline documents which are available from the Environment Agency’s website [www.gov.uk/government/organisations/environment-agency](http://www.gov.uk/government/organisations/environment-agency). In addition, we also request that the following points are taken into consideration to ensure that controlled waters are protected throughout the duration of the scheme.

- Access routes – a clear plan of the proposed and existing access routes, including whether these features will be permanent/temporary.
- Open cut trenches – we note from the draft ES that these will be constructed in lengths of 500-800 metres and filled with a layer of sand and stone dust. There is a risk with such long lengths of trench that during wet periods any exposed stone dust could become mobile and cause pollution to controlled waters. This is of particular relevance for the open cut sections adjacent to the Afon Tywi and along the Afon Gwili (Figure 2.1, Map 5). The monitoring of weather conditions should be
incorporated into the pollution prevention plan and a suitable measures put in place for this aspect of the scheme. We also advise that consideration be given to shorter trench lengths, where possible.

- HDD – the plan should include detailed information on the storage, handling and disposal of any fuels/oils/chemicals associated with the proposed development with particular reference given to those involved with the HDD. The plan should also address how the ‘mud pit’ from the HDD will be safely stored and disposed of without causing pollution to the Afon Tywi.

- During felling the Forest and Water Guidelines should be adhered to and suitable measures implemented to protect surrounding watercourses. Where possible, the use of brash mats is encouraged to reduce soil erosion and trap any suspended solids. Regular monitoring of watercourses should also be undertaken during the duration of the felling and construction period.

- The draft ES states that pollution incidents will be self-reported to NRW. We encourage the reporting of all environmental incidents to our hotline 0800 80 70 60 and advise that this requirement to be written into the Emergency Response Plan and disseminated to onsite personnel.

We support the commitment within Paragraph 20.2.5 that the aforementioned plans, will provide a system to monitor and audit environmental performance. With regard to ecological issues, due to the scale of the proposed works and areas of sensitive habitat involved, an Ecological Clerk of Works should oversee the proposed scheme. This should be noted within the ES as not specifically referenced in Chapter 10.

We note the commitment within Paragraph 20.2.13 for an environmental monitoring programme and we will want to review any monitoring programmes with specific reference to water related and ecological issues.

**General Comments**

There are a number of references within the draft ES and supporting appendices to our legacy body, the Environment Agency (EA), these should be amended to Natural Resources Wales (NRW) where appropriate.

If, any further consultations are received or as part of the final ES it would be useful if the amendments/additions to this draft ES are clearly highlighted for ease of reference.

We hope the above comments are of assistance. Should you wish to discuss any of the points raised above in greater detail please do not hesitate to contact David Watkins, Senior Development Planning Advisor on 0300 065 3327 or via email: david.watkins@cyfoethnaturiolcymru.gov.uk.
Yn ddifuant / Yours sincerely

Pete Jordan
Development Planning Manager, Operations South
Rheolwr Cynllunio Datblygu, Gweithrediadau De Cymru

Natural Resources Wales/Cyfoeth Naturiol Cymru
Maes Newydd, Llandarcy, Neath Port Talbot. SA10 6JQ
Ffôn/Tel: (01792) 325563
E-bost/E-mail: peter.jordan@cyfoethnaturiolcymru.gov.uk
Hi Victoria

Following our conversation and your subsequent e-mail:-

NRW is satisfied that only Carmarthen Bay and Estuaries SAC and Afon Tywi (River Towy) SAC need to be considered in any HRA impact assessment.
NRW is also satisfied that the proposed Tywi crossing point falls below the recognised spawning areas for any SAC feature and falls well within the tidal section of the Tywi river.

Kind regards

Huw
To: Watkins, David; Williams, Huw  
Cc: VGilbey@rsk.co.uk; david.kenyon@amecfw.com  
Subject: NRW confirmation needed.

David/Huw,

Further to our call this morning – I am seeking confirmation that NRW agree with the following two points.

The following point was discussed and agreed at the meeting in Llandarcy on 2nd October 2014 but I need to have written confirmation of this from NRW for the HRA.

1. It was agreed in this meeting that the Carmarthen Bay and Estuaries SAC should be considered within our study area, as it is hydrologically connected to the Afon Tywi (River Towy) SAC. Therefore the Carmarthen Bay and Estuaries SAC and Afon Tywi (River Towy) SAC would be considered within the assessment, it was agreed no other SACs required consideration.

The second point was discussed at the meeting on 19th September 2014 but I need to have written confirmation of this from NRW for the HRA – this relates to the attached email from David regarding the discussions held.

2. NRW confirmed that spawning grounds are not present at the proposed crossing points which is within the tidal section of the river.

As discussed I really need this today so we can include it in the documentation.

Many thanks in advance for your help.

Victoria

Victoria Robinson-Moltke  
Principal Environmental Consultant  
EIA, Planning & Design  
RSK  
The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB, UK  
Switchboard: +44 (0)117 947 1006  
Fax: +44 (0)117 947 1009  
Direct dial: +44 (0)117 300 4287  
Mobile: +44 (0)7768 8413 92  
email: vrobinson@rsk.co.uk
http://www.rsk.co.uk
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Before printing think about your responsibility and commitment to the ENVIRONMENT!
Hi Victoria

I can confirm that NRW is satisfied with the approach and the projects listed for inclusion in the HRA in-combination assessment.

Many thanks

Huw

Further to our recent conversations, I wanted to confirm the projects we are proposing to include for the HRA in-combination assessment are as follows:
• Brechfa Forest West Wind Farm
• Carmarthen West development (Refs W/27776 and W/30286) and Link Road (Ref W/23866)
• Llandeilo School (Ref E/27510)
• Gravel extraction (Refs E/10637 and E/22876)

I would be grateful if you could confirm that you are happy with this approach as soon as possible.

Many thanks

Victoria

Victoria Robinson-Moltke
Principal Environmental Consultant
EIA, Planning & Design
RSK
The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB, UK
Switchboard: +44 (0)117 947 1006
Fax: +44 (0)117 947 1009
Direct dial: +44 (0)117 300 4287
Mobile: +44 (0)7768 8413 92
email: vrobinson@rsk.co.uk

Before printing think about your responsibility and commitment to the ENVIRONMENT!
Hi Victoria,

I am satisfied with this approach, I will look into getting some of the HRA info for the developments to you as soon as possible.

Kind Regards.

Lindsey.

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Huw/Lindsey,

Further to our recent conversations, I wanted to confirm the projects we are proposing to include for the HRA in-combination assessment are as follows:

- Brechfa Forest West Wind Farm
- Carmarthen West development (Refs W/27776 and W/30286) and Link Road (Ref W/23866)
- Llandeilo School (Ref E/27510)
- Gravel extraction (Refs E/10637 and E/22876)

I would be grateful if you could confirm that you are happy with this approach as soon as possible.
Many thanks

Victoria

Victoria Robinson-Moltke
Principal Environmental Consultant
EIA, Planning & Design

RSK
The Old School, Stillhouse Lane, Bedminster, Bristol, BS3 4EB, UK

Switchboard: +44 (0)117 947 1006
Fax: +44 (0)117 947 1009
Direct dial: +44 (0)117 300 4287
Mobile: +44 (0)7768 8413 92
email: vrobinson@rsk.co.uk

http://www.rsk.co.uk

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Mae'r e-bost hwn ac unrhyw atodiadau yn gyfrinachol ac wedi'u bwriadu at ddefnydd yr unigolyn y'u cyfeiriwyd ato/ati yn unig. Os derbynwch y neges hon trwy gamgymeriad, rhowch wybod i'r sawl a'i hanfonodd ar unwaith, dil?wch y neges o'ch cyfrifiadur a dinistriwch unrhyw gop?au papur ohoni. Ni ddylech ddangos yr e-bost i neb arall, na gweithredu ar sail y cynnwys. Eiddo'r awdur yw unrhyw farn neu safbwntiau a fynegir, ac ni ddim o reidrwydd yn cynrychioli safbwnt y Cyngor. Dylech wirio am firyau eich hunan cyn agor unrhyw atodiad. Nid ydym yn derbyn unrhyw atebolrwydd am golled neu niwed a ll all fod wedi’i achosi gan firyau meddalwedd neu drwy rhyng-gipio’r neges hon neu ymmyrryd ? hi.

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Subject: FW: Comments on HRA for Brechfa Forest Grid Connection.

From: Richard E Jones [mailto:REJones@carmarthenshire.gov.uk]
Sent: 20 March 2015 08:31
To: ‘vrobinson@rsk.co.uk’
Cc: Hubbold, Andrew V.; ‘Kenyon, David’; Lindsey Rendle; Rosie A Carmichael
Subject: FW: Comments on HRA for Brechfa Forest Grid Connection.

Morning Victoria

Please see below comments from Lindsey regarding the HRA. Indication is also given when comments on the remaining docs will be sent.

Regards

Richard

Richard Jones
Development Management Officer / Swyddog Rheoli Datblygu
Planning Services, 8 Spilman Street, Carmarthen SA31 1JY
Tel: 01267 228892 (ext. 2892)
E-mail: REJones@carmarthenshire.gov.uk
Website: www.carmarthenshire.gov.uk/planning

From: Lindsey Rendle
Sent: 18 March 2015 12:33
To: Richard E Jones
Cc: Rosie A Carmichael
Subject: Comments on HRA for Brechfa Forest Grid Connection.

Hi Richard,

I have reviewed the HRA for the Brechfa Forest Grid Connection Project. There are still a few outstanding issues we raised as part of the last consultation which do not appear to be addressed in the HRA which are as follows:

Para 2.8.6 of the ES states that the development of fluid pathways between the bore hole and surface (for instance where site investigation bore holes have been drilled and not sealed) may result in the venting or Frac-Out of drill fluid. Potential pathways and receptors will be identified for each site and a Frac-Out Contingency Plan will be implemented. The submitted HRA and CEMP indicate that a Frac-Out Contingency Plan will be prepared and implemented by the drilling contractor. This information should be determined to inform the required Habitats Regulations Assessment (See section 7.2.6 and section 1.3.12 of the HRA document) (Other relevant sections – Table 8.4, Table 12.3, Para 12.5.47). We would also wish to have confirmation of these details prior to the DCO submission and available to fully inform the HRA.

Para 2.8.9 of the ES stated that a source of water extraction has yet to be identified, although water for drilling operations may be sourced from a local hydrant or abstracted from local surface waters. This information is should be determined to inform the required Habitats Regulations Assessment (See section 7.2.6). We would also wish to have confirmation of these details prior to the DCO submission. I cannot see...
any reference to extraction in the HRA document or the CEMP, any extraction impacts must be assessed and screened as part of the HRA.

In our previous comments we highlighted that any HRA in combination assessment must assess any major scheme in hydrological connectivity to the Afon Tywi SAC, as well as schemes within a specified buffer zone. Cumulative assessments within the ES to date do not appear to have considered hydrological connectivity, only a specified buffer distance of 2km. (Other relevant sections – 10.2.5, 10.12.1, Section 13.11, Section 1.4 of the HRA). It is recommended that this is reviewed and incorporated into the HRA or further justification is provided.

If you have any questions or seek clarification on any points please contact me. I will forward comments regarding the draft CEMP, Waste Management Plan, Pollution Prevention and Emergency Response Plan, Water Management Plan, Habitat Management Plan, Dust Management Plan, Invasive Weeds Management Plan, as necessary, hopefully sometime next week once Rosie returns from A/L

Kind Regards.

Lindsey

Lindsey Rendle
Ecolegydd Cynllunio / Planning Ecologist.
Adran Cynllunio / Planning Department.
Cyngor Sir Gaerfyrddin / Carmarthenshire County Council.
7/8 Heol Spilman/7/8 Spilman St.
Caerfyrddin/Carmarthen.
SA31 1JY.
E-bost LRendle@sirgar.gov.uk
E-Mail: LRendle@carmarthenshire.gov.uk
Ffon / Tel: (01267) 228914
Est / Extn: 2914

Mae'r e-bost hwn ac unrhyw atodiadau yn gyfrinachol ac wedi'u bwriadu at ddefnydd yr unigolyn y'u cyfeiriwyd yr unigolyn y'u hanfonodd ar unwaith, dilliwch y neges o'ch cyfrifiadur a dinistriwch unrhyw gopiau papur ohoni. Ni ddylech ddangos yr e-bost i neb arall, na gweithredu ar sail y cynnwys. Eiddo'r awdur yw unrhyw farn neu safbwntiau a fynegir, ac nid ydym o reidrwydd y cynrhychioli safbwnt y Cyngor. Dylech wirio am firy sau eich hunan cyn agor unrhyw atodiad. Nid ydym ym derbyn unrhyw atebolryd amd gollneu niwed a all fod wedi'i achosi gan firy sau meddalwedd neu drwy ryng-gipio'r neges hon neu ymyrryd â hi.

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Annex B

Screening Matrix
Annex B: Screening Matrices

Potential Impacts

Potential impacts upon the European site(s)* which are considered within the submitted Habitats Regulations Assessment report (855587 Brechfa Draft HRA NSER Rev 01) are provided in the table below.

* As defined in Advice Note 10.
Impacts considered within the screening matrices

<table>
<thead>
<tr>
<th>Designation</th>
<th>Impacts in submission information</th>
<th>Presented in screening matrices as</th>
</tr>
</thead>
</table>
| **European site name/designation:** Afon Twyi SAC | • Disturbance to migrating Twaite Shad during construction  
• Disturbance to other fish species including: sea lamprey, brook lamprey, river lamprey, allis shad and bullhead during construction  
• Disturbance to foraging and commuting otters during construction  
• Pollution during construction  
• Electromagnetic field (EMF) impacts on fish species during operation                                           | • Disturbance                                                      |
|                                                   |                                                                                                                                                   | • Pollution  
• EMF impacts                                                |
| **European site name/designation:** Carmarthen Bay and Estuaries SAC | • Disturbance to migrating Twaite Shad during construction  
• Disturbance to other fish species including sea lamprey, river lamprey and allis shad during construction  
• Disturbance to foraging and commuting otters during construction  
• Pollution during construction  
• Electromagnetic field (EMF) impacts on fish species during operation                                           | • Disturbance                                                      |
|                                                   |                                                                                                                                                   | • Pollution  
• EMF impacts                                                |
STAGE 1: SCREENING MATRICES

The European Sites included within the screening assessment are:

Afon Twyi SAC

Carmarthen Bay and Estuaries SAC

Evidence for likely significant effects on their qualifying features is detailed within the footnotes to the screening matrices below.

Matrix Key:

✓ = Likely significant effect **cannot** be excluded
✗ = Likely significant effect **can** be excluded

C = construction
O = operation
D = decommissioning

Where effects are not applicable to a particular feature the matrix cell is formatted as follows:

n/a
### Stage 1 Matrix 1: Afon Twyi SAC

<table>
<thead>
<tr>
<th>Name of European site: Afon Twyi SAC</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to NSIP: Crossed by the scheme</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>European site features</th>
<th>Likely Effects of NSIP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disturbance</td>
<td>Pollution</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Stage of Development</td>
<td>C</td>
<td>O</td>
</tr>
<tr>
<td>Twaite Shad</td>
<td>x²</td>
<td>n/a</td>
</tr>
<tr>
<td>Otter</td>
<td>x⁴</td>
<td>n/a</td>
</tr>
<tr>
<td>Sea lamprey</td>
<td>x⁷</td>
<td>n/a</td>
</tr>
</tbody>
</table>

---

2 No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. All HDD works will be undertaken outside the main migratory period, this will be secured via a written requirement within the DCO. See paragraph 1.3.6 of the NSER.

3 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25.

4 A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.

5 Daytime working hours only will reduce any likely significant disturbance to otters. Pre-construction surveys will be carried out to check for newly created breeding holts close to the proposed working areas (as these are more sensitive to disturbance), this will be secured via a written requirement within the DCO, see paragraph 1.3.9 to 1.3.11.

6 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25.

7 No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. All HDD works will be undertaken outside the main migratory period, this will be secured via a written requirement within the DCO. See paragraph 1.3.7 of the NSER.

8 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25.
Name of European site: Afon Twyi SAC

Distance to NSIP: Crossed by the scheme

<table>
<thead>
<tr>
<th>European site features</th>
<th>Likely Effects of NSIP</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disturbance</td>
<td>Pollution</td>
</tr>
<tr>
<td>Stage of Development</td>
<td>C</td>
<td>O</td>
</tr>
<tr>
<td>Brook lamprey</td>
<td>×10</td>
<td>n/a</td>
</tr>
<tr>
<td>River lamprey</td>
<td>×13</td>
<td>n/a</td>
</tr>
<tr>
<td>Allis shad</td>
<td>×16</td>
<td>n/a</td>
</tr>
</tbody>
</table>

9 A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.

10 No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. This species is unlikely to migrate through the works area. See paragraph 1.3.7 of the NSER.

11 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25.

12 A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.

13 No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. All HDD works will be undertaken during daylight hours (river lampreys migrate at night), this will be secured via a written requirement within the DCO. See paragraph 1.3.7 of the NSER.

14 A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.

15 A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.

16 No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. All HDD works will be undertaken outside the main migratory period, this will be secured via a written requirement within the DCO. See paragraph 1.3.7 of the NSER.
Name of European site: Afon Twyi SAC

Distance to NSIP: Crossed by the scheme

<table>
<thead>
<tr>
<th>European site features</th>
<th>Likely Effects of NSIP</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disturbance</td>
<td>Pollution</td>
<td>EMF Impacts</td>
<td>In combination effects</td>
<td></td>
</tr>
<tr>
<td>Stage of Development</td>
<td>C</td>
<td>O</td>
<td>D</td>
<td>C</td>
<td>O</td>
</tr>
<tr>
<td>Bullhead</td>
<td>X</td>
<td>n/a</td>
<td>n/a</td>
<td>X</td>
<td>n/a</td>
</tr>
</tbody>
</table>

17 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25
18 A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.

19 No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. This species is unlikely to present within the works area. See paragraph 1.3.7 of the NSER.
20 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.
21 A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.
### Stage 1 Matrix 1: Carmarthen Bay and Estuaries SAC

| Name of European site: Carmarthen Bay and Estuaries SAC |

#### Distance to NSIP: 7 km downstream

<table>
<thead>
<tr>
<th>European site features</th>
<th>Likely Effects of NSIP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disturbance</td>
</tr>
<tr>
<td><strong>Stage of Development</strong></td>
<td></td>
</tr>
<tr>
<td>Sandbanks which are slightly covered by seawater all the time</td>
<td>n/a</td>
</tr>
<tr>
<td>Estuaries</td>
<td>n/a</td>
</tr>
<tr>
<td>Mudflats and sandflats not covered by seawater at low tide</td>
<td>n/a</td>
</tr>
<tr>
<td>Large shallow</td>
<td>n/a</td>
</tr>
</tbody>
</table>

---

**Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.**

---

22 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.

23 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.

24 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.
## Name of European site: Carmarthen Bay and Estuaries SAC

**Distance to NSIP: 7 km downstream**

<table>
<thead>
<tr>
<th>European site features</th>
<th>Likely Effects of NSIP</th>
<th>Disturbance</th>
<th>Pollution</th>
<th>EMF Impacts</th>
<th>In combination effects</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stage of Development</strong></td>
<td></td>
<td>C</td>
<td>O</td>
<td>D</td>
<td>C</td>
</tr>
<tr>
<td>inlets and bays</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>X</td>
</tr>
<tr>
<td>Salicornia and other annuals colonizing mud and sand</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>X</td>
</tr>
<tr>
<td>Atlantic salt meadows (Glauco-Puccinellietalia maritimae)</td>
<td></td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>X</td>
</tr>
<tr>
<td>Twaite Shad</td>
<td></td>
<td>X</td>
<td>n/a</td>
<td>n/a</td>
<td>X</td>
</tr>
</tbody>
</table>

25 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.
26 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.
27 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.
28 No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. All HDD works will be undertaken outside the main migratory period, this will be secured via a written requirement within the DCO. See paragraph 1.3.6 of the NSER.
29 Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.
30 A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.
<table>
<thead>
<tr>
<th>Name of European site: Carmarthen Bay and Estuaries SAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to NSIP: 7 km downstream</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>European site features</th>
<th>Likely Effects of NSIP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea lamprey</td>
<td></td>
</tr>
<tr>
<td>River lamprey</td>
<td></td>
</tr>
<tr>
<td>Allis shad</td>
<td></td>
</tr>
</tbody>
</table>

³¹ No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. All HDD works will be undertaken outside the main migratory period, this will be secured via a written requirement within the DCO. See paragraph 1.3.6 of the NSER.

³² Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.

³³ A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.

³⁴ No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. All HDD works will be undertaken during daylight hours (river lampreys migrate at night), this will be secured via a written requirement within the DCO. See paragraph 1.3.7 of the NSER.

³⁵ Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.

³⁶ A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.

³⁷ No spawning sites occur within the proposed works areas. All watercourses will be crossed using HDD technique. All HDD works will be undertaken outside the main migratory period, this will be secured via a written requirement within the DCO. See paragraph 1.3.6 of the NSER.

³⁸ Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.

³⁹ A 5m cable burial depth under watercourses has been selected to reduce the exposure of sensitive fish species to electromagnetic fields; this will be secured via a written requirement within the DCO. See paragraphs 1.3.26 - 1.3.31 of the NSER.
Name of European site: Carmarthen Bay and Estuaries SAC

Distance to NSIP: 7 km downstream

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<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Disturbance</td>
</tr>
<tr>
<td>Stage of Development</td>
<td>C</td>
</tr>
<tr>
<td>Otter</td>
<td>X\textsuperscript{40}</td>
</tr>
</tbody>
</table>

\textsuperscript{40} Daytime working hours only will reduce any likely significant disturbance to otters. Pre-construction surveys will be carried out to check for newly created breeding holts close to the proposed working areas (as these are more sensitive to disturbance), this will be secured via a written requirement within the DCO, see paragraph 1.3.9 to 1.3.11.

\textsuperscript{41} Proposed pollution control measures will significantly reduce the risk of potential effects on this feature, see paragraphs 1.3.11 – 1.3.25 of the NSER.
REFERENCES

Brechfa Forest Connection Project Draft Environmental Statement, Western Power Distribution, November 2014.
Annex C

Citations
Afon Tywi/ River Tywi - Special Area of Conservation - SAC - Habitats Directive

Special Areas of Conservation (SAC)
- UK SAC summary
  - UK SAC site list
  - England site list
  - Northern Ireland
  - Scotland
  - Wales
- SAC selection
  - Summary
  - Background to site selection
  - Latest changes to the UK SAC list
  - Annex I Habitat accounts
  - Annex II Species accounts
- Browse cSACs on a map
- Notes on nomenclature
- Search for a SAC
- Other designations on UK SACs
  - cSACs in NI which adjoin cSACs in the RoI
- Annex I habitats and Annex II species occurring in the UK
- Abbreviations and acronyms
- Acknowledgements
- References

Download spatial and summary data
- Download GIS data
- Marine SACs

Afon Tywi/ River Tywi

Site details
- Country: Wales
- Unitary Authority: Caerfyrddin/ Carmarthenshire
- Centroid: SN687263
- Latitude: 51.92
- Longitude: -3.911388889
- SAC EU code: UK0013010
- Status: Designated Special Area of Conservation (SAC)
- Area (ha): 363.45

* This is the approximate central point of the SAC. In the case of large, linear or composite sites, this may not represent the location where a feature occurs within the SAC.

General site character
- Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (9%)
- Salt marshes, Salt pastures, Salt steppes (2%)
- Shingle, Sea cliffs, islets (7%)
- Inland water bodies (Standing water, Running water) (62%)
- Bogs, Marshes, Water-fringed vegetation, Fens (6%)
- Heath, Scrub, Maquis and Garrigue, Phrygrana (4%)
- Improved grassland (3%)
- Broad-leaved deciduous woodland (7%)

Boundary map and associated biodiversity information on the NBN Gateway.

Natura 2000 data form for this site as submitted to Europe (PDF format, size 30kb).

Note:
When undertaking an appropriate assessment of impacts at a site, all features of European importance (both primary and non-primary) need to be considered.

Annex I habitats that are a primary reason for selection of this site
Not applicable

Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site
Not applicable.

Annex II species that are a primary reason for selection of this site

1103 Twaite shad Alosa fallax
A large spawning population of twaite shad Alosa fallax occurs in the Tywi, south Wales, and is considered to be self-sustaining. Spawning sites occur throughout the lower reaches of the river between Carmarthen and Llangadog, with most spawning occurring downstream of Llandeilo. Water quality and quantity are considered adequate to maintain this internationally vulnerable species, and there are no impassable obstructions along the migration route, though one weir at Manarafon may be an obstacle during low flow conditions. The presence of Llyn Brianne reservoir at the headwaters provides the potential to manipulate river flows to aid shad migration.

1355 Otter Lutra lutra
The Afon Tywi is one of the best rivers in Wales for otters Lutra lutra. There are abundant signs of otters and they are regularly seen on the river. The water quality is generally good and there is an ample supply of food. There are suitable lying-up areas along the river bank, but there few known breeding sites on the main river, although cubs have been seen.

Annex II species present as a qualifying feature, but not a primary reason for site selection

1095 Sea lamprey Petromyzon marinus
1096 Brook lamprey Lampetra planeri
1099 River lamprey Lampetra fluviatilis
1102 Allis shad Alosa alosa
1163 Bullhead Cottus gobio

Many designated sites are on private land; the listing of a site in these pages does not imply any right of public access.
Carmarthen Bay and Estuaries/ Bae Caerfyrddin ac Aberoedd

Site details

Country: Wales
Unitary Authority: Abertawe/ Swansea; Caerfyrddin/ Carmarthenshire; Penfro/ Pembrokeshire

Centroid*: SS357991
Latitude: 51.66666667
Longitude: -4.37638889
SAC EU code: UK0020020
Status: Designated Special Area of Conservation (SAC)

Area (ha): 66101.16

* This is the approximate central point of the SAC. In the case of large, linear or composite sites, this may not represent the location where a feature occurs within the SAC.

General site character

Marine areas, Sea inlets (82.1%)
Tidal rivers, Estuaries, Mud flats, Sand flats, Lagoons (including saltwork basins) (13.7%)
Salt marshes, Salt pastures, Salt steppes (4.1%)
Shingle, Sea cliffs, Islets (0.1%)

Boundary map and associated biodiversity information on the NBN Gateway.

Natura 2000 data form for this site as submitted to Europe (PDF format, size 30kb).

Note:
When undertaking an appropriate assessment of impacts at a site, all features of European importance (both primary and non-primary) need to be considered.

Annex I habitats that are a primary reason for selection of this site

1110 Sandbanks which are slightly covered by sea water all the time
Carmarthen Bay and Estuaries on the south coast of Wales includes the sandbank of Helwick Bank, a linear shallow subtidal sandbank that is unusual in being highly exposed to wave and tidal action. The animal communities found in and on the bank reflect these conditions, being tolerant of high levels of disturbance. Within Carmarthen Bay there are also several other smaller sandbanks in relatively shallow waters, which support a range of species (including bivalves, amphipods and worms), many of which spend most of their time wholly or partly buried in the sediment.

1130 Estuaries
Carmarthen Bay and Estuaries provides an example of a large estuarine site on the south coast of Wales, encompassing the estuaries of the Rivers Loughor, Tâf and Tywi (coastal plain estuaries) and the Gwendraeth (a bar-built estuary). These four estuaries form a single functional unit around the Burry Inlet, with important interchanges of sediment and biota. The estuaries of this site support a range of subtidal and intertidal sediments that grade from sand at the mouth to mudflats in the upper estuary. The fauna of the sediments varies, but includes communities with polychaete and oligochaete worms and areas with extensive cockle beds and other bivalve molluscs. This site has a range of undisturbed transitions to coastal habitats.

1140 Mudflats and sandflats not covered by seawater at low tide
Carmarthen Bay and Estuaries on the south coast of Wales includes extensive areas of intertidal mudflats and sandflats. Large areas of these intertidal flats are dominated by bivalves. In areas of fine sand cockles Cerastoderma edule are abundant, along with other bivalves, amphipods and worms. In mudier sediments the sand-gaper Mya arenaria, peppery furrow-shell Scrobicularia plana and mud-snail Hydrobia ulvae are also found in large numbers. The lower Loughor Estuary is one of the few places in the UK where the worm Ophelia bicornis has been found. There are also beds of the nationally scarce dwarf eelgrass Zostera noltei.

1160 Large shallow inlets and bays
Carmarthen Bay, off the south Wales coast is an extensive shallow bay. Throughout the bay physical conditions vary considerably. Salinity varies from low (at the estuaries) to fully marine, there are gradients in wave action from sheltered to exposed, and strong tides sweep exposed headlands whilst other areas are sheltered from currents. There is a wide range of seabed types, including mud, sand and rock, although the majority of the seabed is sandy. The sediment supports a large number of species, including bivalve molluscs, worms, burrowing urchins, brittlestars and sand-stars.

1310 Salicornia and other annuals colonizing mud and sand
Carmarthen Bay in south Wales is selected as representative of pioneer grasswort Salicornia spp. saltmarsh in the south-west of the UK. It forms an integral part of the estuarine system, supporting extensive pioneer communities and contributing to a complete sequence of saltmarsh vegetation, including transitions to upper saltmeadow and to important sand dune habitats.
This extensive site in south Wales has a complete sequence of saltmarsh vegetation, from pioneer vegetation through to upper saltmarsh transitions. The grazed saltmarshes include upper margins with sea rush *Juncus maritimus* and marshmallow *Althaea officinalis*, which are a particularly distinctive ecological feature of this site. The area is also important for transitions from saltmarsh to sand dune and other habitats.

**Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site**

Not applicable.

**Annex II species that are a primary reason for selection of this site**

1103 *Twaite shad*  
*Twaite shad* *Alosa fallax* migrate though the waters of Carmarthen Bay and Estuaries cSAC to reach spawning sites in the Afon Tywi. The Taf-Tywi-Gwendraeth estuary is also an important nursery area for juveniles and it is likely that twaite shad feed in the inshore waters of Carmarthen Bay.

**Annex II species present as a qualifying feature, but not a primary reason for site selection**

1095 *Sea lamprey*  *Petromyzon marinus*  
1099 *River lamprey*  *Lampetra fluviatilis*  
1102 *Allis shad*  *Alosa alosa*  
1355 *Otter*  *Lutra lutra*

*Many designated sites are on private land; the listing of a site in these pages does not imply any right of public access.*
Annex D

Afon Tywi SAC Conservation Objectives
CORE MANAGEMENT PLAN
INCLUDING CONSERVATION OBJECTIVES

FOR

AFON TYWI / RIVER TYWI SAC
(SPECIAL AREA OF CONSERVATION)

Version: 11 (Minor map edit, August 2012)
Date: 15 April 2008
Approved by: Tracey Lovering

A Welsh version of all or part of this document can be made available on request.
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PREFACE

This document provides the main elements of CCW’s management plan for the site named. It sets out what needs to be achieved on the site, 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 site. 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.

Our vision for the Afon Tywi SAC is to maintain or, where necessary, restore the river to high ecological status, including its largely unmodified and undisturbed physical character, so that all of its special features will be able to sustain themselves in the long-term as part of a naturally functioning ecosystem. Allowing the natural processes of erosion and deposition to operate without undue interference and maintaining or restoring connectivity will maintain the physical river habitat, which forms the foundation for this ecosystem. The quality and quantity of water, including natural flow variability, and the quality of adjacent habitats will be maintained or restored to a level necessary to maintain the features in favourable condition for the foreseeable future. In places such as urban environments where natural processes are likely to cause significant damage to the public interest, artificial control measures are likely to be required.

The special fish species found in the river, both residents such as the bullhead and brook lamprey, and migratory species such as shad, river & sea lamprey, will be present in numbers that reflect a healthy and sustainable population supported by well-distributed good quality habitat. The migratory fish will be able to complete their migrations and life cycles largely unhindered by artificial barriers such as weirs, pollution, or depleted flows.

The abundance of prey and widespread availability of undisturbed resting and breeding sites will allow a large otter population to thrive. They will continue to be found along the entire length of the river and its main tributaries.

The presence of the Afon Tywi SAC and its special wildlife will enhance the economic and social values of the area by providing a high quality environment for ecotourism, outdoor activities and peaceful enjoyment by local people and visitors. The river catchment’s functions of controlling flooding and supplying clean water will be recognised and promoted through appropriate land management. The river will continue to be a focus for education to promote increased understanding of its biodiversity and the essential life support functions of its ecosystems.
2. **SITE DESCRIPTION**

2.1 Area and Designations Covered by this Plan

Grid reference: SN687263  
Unitary authority: Caerfyrddin / Carmarthenshire County Council  
Area (hectares): 363.45 ha  
Designations covered: Afon Tywi / River Tywi SSSI  
Afon Tywi / River Tywi SAC

Detailed maps of the designated sites are available through CCW’s web site: [http://www.ccw.gov.uk/interactive-maps/protected-areas-map.aspx](http://www.ccw.gov.uk/interactive-maps/protected-areas-map.aspx)
2.2 Outline Description

The Afon Tywi rises in the Cambrian Mountains and flows south for some 10km before entering Llyn Brianne reservoir. The reservoir was constructed in the early 1970’s to regulate water flows in the Tywi, enabling abstraction for public supply at Nantgaredig. From Llyn Brianne the Tywi falls steeply through mountain valleys for a further 20km before reaching the upper boundary of the SAC at Llandovery Road Bridge. The river then flows in a broadly south-westerly direction to Llandeilo, and then westerly through Carmarthen to outfall into Carmarthen Bay at Llansteffan. The Afon Tywi SAC boundary terminates in the tidal reaches just south of Carmarthen, where it enters the Carmarthen Bay & Estuaries SAC. The freshwater reaches of the Tywi are some 110km long, with just short of 80km designated as SAC. Within the SAC its course is more characteristic of a mature river, falling just 65m between Llandovery and the sea. The valley, formed by the movement of glaciers during the last ice age, has a classic U-shape, steep sided, with a wide, flat bottom. Its underlying geology of alluvium, glacial sands and gravels has resulted in an actively eroding river meandering across its wide floodplain, with generally sparse tree cover along the banks. This has led to the formation of extensive shingle shoals, ox-bow lakes and former river terraces. A number of significant tributaries flow into the designated reach, including the Llandovery Bran, Afon Dulais, Sawdde, Cennen, Cothi and Gwili.

The majority of the catchment is rural, urbanised areas are restricted to Llandovey, Llandeilo and Carmarthen. Land use is greatly influenced by geology and topography. In the mountainous upper catchment forestry and sheep farming is dominant, whilst dairy and livestock farming takes place in the middle and lower reaches. A limited amount of arable farming occurs in the middle and lower reaches, including maize for ensiling, and this has the potential to increase sediment loads in the river from field run-off over the winter period. There has been a major change from hay to silage production and increased grass production as well as an increase in the use of artificial fertilizers.

The line of the A40 trunk road and B4300 mirror the course of the Tywi on either side of the valley, coming in close proximity to the river in a number of places. The Heart of Wales railway line from Llanelli to Shrewsbury crosses the river at Llandeilo, Llangadog and Llanwrda, with significant lengths of track adjacent to the river.

The ecological structure and functions of the site are dependent on hydrological and geomorphological processes (often referred to as hydromorphological processes), as well as the quality and connectivity of riparian habitats. The more mobile species, such as migratory fish and otters, may also be affected by factors operating outside the site.

**Hydrological processes.** in particular river flow and water chemistry, determine a range of habitat factors of importance to the SAC features, including current velocity, water depth, wetted area, substrate quality, dissolved oxygen levels and water temperature. Maintenance of both high ‘spate’ flows and base-flows is essential. Reductions in flow may reduce the ability of the adults of migratory fish to reach spawning sites. The flow regime should be flows as near to natural as constraints will allow in order to support the functioning of the river ecosystem. The solid geology of the upper reaches and tributaries result in catchments which respond quickly to rainfall. The area has an extremely high annual average rainfall with variations both spatially and seasonally. Annual average rainfall is highest in the Black Mountains and the Cambrian Mountains, at 2,420mm and 2,008mm respectively. Rainfall decreases down the valley sides and into the bottoms, with lowest rainfall occurring in the coastal areas. The topography of the area is such that catchments respond quickly to rainfall events, with rapid changes in river levels along their lengths. Base flows in the Tywi are enhanced by releases from Llyn Brianne, though di-urnal variations occur below the abstraction at Nantgaredig, pumping being mainly at night and over
the weekends. This notwithstanding, the catchment is protected from low summer and drought flows.

**Geomorphological processes** of erosion by water and subsequent deposition of eroded sediments downstream create the physical structure of the river habitats. For the greater part, the river meanders over a flat valley floor, re-working previously deposited river sediments and unconsolidated drift materials of sands, tills and gravels deposited during and after the last ice age. These deposits are frequently exposed in small river cliffs, displaying evidence of the historical development of the river basin. Though rock sections are uncommon, the orientation of the river course indicates that it is controlled by features in the underlying solid geology such as faults or folds in the rocks of the valley floor.

The Tywi is the most mobile of rivers, meandering across the floodplain in its middle and lower reaches. Active erosion and deposition takes place from Llandovery all the way to Carmarthen, with gravel movement, pool filling, bank erosion and siltation occurring throughout. Large floods are responsible for larger-scale changes in channel character, while periods with higher frequencies of moderate floods are responsible for maintaining instability and large-scale movement of gravel bars and banks. The sensitivity of the river to change varies along its length, both in terms of the sequence of floods and human interventions. In addition, increases in extreme events as a result of climate change has implications for enhanced geomorphic activity.

These processes help to sustain the river ecosystem by allowing a continued supply of clean gravels and other important substrates to be transported downstream. In addition, the freshly deposited and eroded surfaces, such as shingle banks and earth cliffs, enable processes of ecological succession to begin again, providing an essential habitat for specialist, early-successional species. Processes at the wider catchment scale generally govern processes of erosion and deposition occurring at the reach scale, although locally factors such as the effect of grazing levels on riparian vegetation structure may contribute to enhanced erosion rates. In general, management that interferes with natural geomorphological processes, for example preventing bank erosion through the use of hard revetments or removing large amounts of gravel, are likely to be damaging to the coherence of the ecosystem structure and functions. Although gravel availability along the Tywi has reduced, there are many private gravel extraction sites, with commercial extraction taking place at Llwynjack below Llandovery. It is not known how much the extractions and the Llyn Brianne dam have contributed to the reduction in gravel availability. Other human interventions which have impacted on the geomorphology of the river include flood banks, river stabilisation, bank protection and construction of the railway embankment, which acts as a barrier to channel migration.

**Riparian habitats**, including bank sides and habitats on adjacent land, are an integral part of the river ecosystem. Diverse and high quality riparian habitats have a vital role in maintaining the SAC features in a favourable condition. The type and condition of riparian vegetation influences shade and water temperature, nutrient run-off from adjacent land, the availability of woody debris to the channel and inputs of leaf litter and invertebrates to support in-stream consumers. Light, temperature and nutrient levels influence in-stream plant production and habitat suitability for the SAC features. Woody debris is very important as it provides refuge areas from predators, traps sediment to create spawning and juvenile habitat and forms the base of an important aquatic food chain. Otters require sufficient undisturbed riparian habitat for breeding and resting sites. It is important that appropriate amounts of tree cover, tall vegetation and other semi-natural habitats are maintained on the riverbanks and in adjacent areas, and that they are properly managed to support the SAC features. This may be achieved for example, through managing grazing levels, selective coppicing of riparian trees and restoring adjacent wetlands. The mobility of the Tywi has resulted in the formation of significant areas of off-channel habitat in the form of ox-bows, wet woodlands, willow scrub etc. These are predominantly away from the main channel, and form important areas for otter
to rest-up in or support breeding sites. In the urban sections the focus may be on maintaining the river as a communication corridor but this will still require that sufficient riparian habitat is present and managed to enable the river corridor to function effectively.

**Habitat connectivity** is an important property of river ecosystem structure and function. Many of the fish that spawn in the river are migratory, depending on the maintenance of suitable conditions on their migration routes to allow the adults to reach available spawning habitat and juvenile fish to migrate downstream. For resident species, dispersal to new areas, or the prevention of dispersal causing isolated populations to become genetically distinct, may be important factors. Artificial obstructions including weirs and bridge sills can reduce connectivity for some species. In addition, reaches subject to depleted flow levels, pollution, or disturbance due to noise, vibration or light, can all inhibit the movement of sensitive species. The dispersal of semi-terrestrial species, such as the otter, can be adversely affected by structures such as bridges under certain flow conditions, therefore these must be designed to allow safe passage. The continuity of riparian habitats enables a wide range of terrestrial species to migrate and disperse through the landscape. Connectivity should be maintained, or restored where necessary, as a means to ensure access for the features to sufficient habitat within the SAC.

**External factors**, operating outside the SAC, may also be influential, particularly for the migratory fish and otters. Otters may be affected by developments that affect resting and breeding sites outside the SAC boundary.

### 2.3 Outline of Past and Current Management

There are many different aspects to the management of this large and complex site that may affect its conservation status. These are summarised in the Site Management Statements for the component SSSI.

### 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 on the following:

- SAC/SSSI boundary
- Artificial barriers, where they significantly affect one or more of the features’ ranges
- Major impacts, in particular major water abstractions
- Natural hydromorphology, where there are significant differences in management issues/key features between reaches
- Estuaries: the reach below the tidal limit is treated as a separate unit
- The units include one or more of EA’s River Basin Management Plan water bodies; as far as is practicable, unit boundaries coincide with these water body boundaries.

Maps showing the management units referred to in this plan are shown on the site web page.
3. THE SPECIAL FEATURES

3.1 Confirmation of Special Features

<table>
<thead>
<tr>
<th>Designated feature</th>
<th>Relationships, nomenclature etc</th>
<th>Conservation Objective in part 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SAC features</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Annex II species that are a primary reason for selection of this site</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Twaste shad <em>Alosa fallax</em></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>European otter <em>Lutra lutra</em></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td><em>Annex I habitats and Annex II species present as qualifying features, but not primary reasons for site selection</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allis shad <em>Alosa alosa</em></td>
<td>Management for this feature is effectively the same as for twaite shad</td>
<td>1</td>
</tr>
<tr>
<td>Sea lamprey <em>Petromyzon marinus</em></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Brook lamprey <em>Lampetra planeri</em></td>
<td>These two species are generally indistinguishable for the purposes of monitoring; however management requirements are similar</td>
<td>3</td>
</tr>
<tr>
<td>River Lamprey <em>Lampetra fluviatilis</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bullhead <em>Cottus gobio</em></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td><strong>SPA features</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ramsar features</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not applicable</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SSSI features</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Little ringed plover <em>Charadrius dubius</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandmartin <em>Riparia riparia</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shingle invertebrates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Club-tailed dragonfly <em>Gomphus vulgatissimus</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 focus of management and monitoring effort, perhaps because of the dependence of a key species (see **KS** below). There will rarely be more than one Key Habitat in a unit.
- **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 focus of management and 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 focus of management or 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 are 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).

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 with no special feature present but which are of importance for management of features elsewhere on a site e.g. livestock over-wintering area included within designation boundaries.

x – Features not present in the management unit.

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

<table>
<thead>
<tr>
<th>Afon Tywi (River Tywi) SSSI</th>
<th>Management unit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>SAC</td>
<td>[</td>
</tr>
<tr>
<td>SSSI</td>
<td>[</td>
</tr>
<tr>
<td>CCW ownership</td>
<td>[</td>
</tr>
</tbody>
</table>

SAC Features

Twaite shad Sym Sym KS KS KS KS KS
Allis shad Sym Sym Sym Sym Sym Sym Sym
Sea lamprey KS KS Sym Sym Sym Sym Sym
Brook lamprey Sym Sym Sym Sym Sym Sym Sym
River lamprey Sym Sym Sym Sym Sym Sym Sym
Bullhead Sym Sym Sym Sym Sym Sym Sym
European otter KS KS KS KS KS KS KS

SSSI Features

Little ringed plover Charadrius dubius KS KS KS KS KS
Shingle invertebrates Sym Sym Sym Sym Sym Sym

- Sea lamprey, brook lamprey and bullhead are recorded throughout the SAC.
- Twaite shad are recorded only infrequently in Units 1 & 2, as their distribution is constrained by flow and temperature barriers.
- The distribution of river lamprey is unknown. Single records exist for units
- Management for twaite shad and sea lamprey is expected to also be sympathetic for river/brook lamprey (spawning habitat) and bullhead.
- Specific management measures for otter relating to adjacent habitats and disturbance require its selection as a key feature in all units.
- The status of allis shad is uncertain on the Afon Tywi (River Tywi) SSSI. It is assumed to be present in the same units as twaite shad.
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 Monitoring1.

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.

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1 Web link: http://www.jncc.gov.uk/page-2199
The ecological status of the watercourse is a major determinant of FCS for all features. The required conservation objective for the watercourse is defined below.

4.1 **Conservation Objective for the watercourse**

4.1.1 The capacity of the habitats in the SAC to support each feature at near-natural population levels, as determined by predominantly unmodified ecological and hydromorphological processes and characteristics, should be maintained as far as possible, or restored where necessary.

4.1.2 The ecological status of the water environment should be sufficient to maintain a stable or increasing population of each feature. This will include elements of water quantity & quality, physical habitat, community composition & structure. It is anticipated that these limits will concur with the relevant standards used by the Review of Consents process given in Annexes 1-3.

4.1.3 Flow regime, water quality and physical habitat should be maintained in, or restored as far as possible to, a near-natural state, in order to support the coherence of ecosystem structure and function across the whole area of the SAC.

4.1.4 All known breeding, spawning and nursery sites of species features should be maintained as suitable habitat as far as possible, except where natural processes cause them to change.

4.1.5 Flows, water quality, substrate quality and quantity at fish spawning sites and nursery areas will not be depleted by abstraction, discharges, engineering or gravel extraction activities or other impacts to the extent that these sites are damaged or destroyed.

4.1.6 The river planform and profile should be predominantly unmodified. Physical modifications having an adverse effect on the integrity of the SAC, including, but not limited to, revetments on active alluvial river banks using stone, concrete or waste materials, unsustainable extraction of gravel, addition or release of excessive quantities of fine sediment, will be avoided.

4.1.7 River habitat SSSI features should be in favourable condition.

4.1.8 Artificial factors impacting on the capability of each species feature to occupy the full extent of its natural range should be modified where necessary to allow passage, e.g. weirs, bridge sills, acoustic barriers.

4.1.9 Natural factors such as waterfalls, which may limit the natural range of a species feature, or dispersal between naturally isolated populations, should not be modified.

4.1.10 Flows during the normal migration periods of each migratory fish species feature will not be depleted by abstraction to the extent that passage upstream to spawning sites is hindered.

4.1.11 Flow objectives for assessment points in the Tywi, Taf & Gwendraeths Catchment Abstraction Management Strategy (CAMS) as they relate to the Tywi SAC will be agreed between EA and CCW as necessary. It is anticipated that these limits will concur with the standards used by the Review of Consents process given in Annex 1 of this document.
4.1.12 Levels of nutrients, in particular phosphate, will be agreed between EA and CCW for each Water Framework Directive water body in the Tywi SAC, and measures taken to maintain nutrients below these levels. It is anticipated that these limits will concur with the standards used by the Review of Consents process given in Annex 2 of this document.

4.1.13 Levels of water quality parameters that are known to affect the distribution and abundance of SAC features will be agreed between EA and CCW for each Water Framework Directive water body in the Tywi SAC, and measures taken to maintain pollution below these levels. It is anticipated that these limits will concur with the standards used by the Review of Consents process given in Annex 3 of this document.

4.1.14 Levels of suspended solids will be agreed between EA and CCW for each Water Framework Directive water body in the Tywi SAC. Measures including, but not limited to, the control of suspended sediment generated by agriculture, forestry and engineering works, will be taken to maintain suspended solids below these levels.

4.1.15 Potential sources of pollution not addressed in the Review of Consents, such as contaminated land, will be considered in assessing plans and projects.

The Atlantic salmon and sea trout are the focus for much of the management activity carried out on the Tywi catchment. Their relatively demanding water quality and spawning substrate quality requirements mean that reduction in diffuse pollution and siltation impacts is a high priority for the catchment. Despite the fact that salmon are not an SAC feature on the Tywi, actions undertaken for the benefit of salmonids will in the main be beneficial to the SAC fish species and otter. Measures to address these problems include the establishment of buffer zones on reaches adjacent to intensively managed livestock grazing or arable land. Tree management, especially coppicing and pollarding to increase light levels to the channel, is also often carried out. The EAW’s Sustainable Fisheries Project has carried out much of this work in recent years.

In the Tywi catchment, the most significant sources of diffuse pollution and siltation are from agriculture, including fertiliser run-off, livestock manure, silage effluent and soil erosion from ploughed land. The most intensively used areas such as heavily trampled gateways and tracks can be especially significant sources of polluting run-off. Preventative measures can include surfacing of tracks and gateways, moving feeding areas, and separating clean and dirty water in farmyards. Farm operations should avoid ploughing land which is vulnerable to soil erosion or leaving such areas without crop cover during the winter.

Among toxic pollutants, sheep dip and silage effluent present a particular threat to aquatic animals in this predominantly rural area. Contamination by synthetic pyrethroid sheep dips, which are extremely toxic to aquatic invertebrates, has a devastating impact on crayfish populations and can deprive fish populations of food over large stretches of river. These impacts can arise if recently dipped sheep are allowed access to a stream or hard standing area, which drains into a watercourse. Pollution from organophosphate sheep dips and silage effluent can be very damaging locally. Pollution from slurry and other agricultural and industrial chemicals, including fuels, can kill all forms of aquatic life. All sheep dips and silage, fuel and chemical storage areas should be sited away from watercourses or bunded to contain leakage. Recently dipped sheep should be kept off stream banks. Used dip should be disposed of strictly in accordance with Environment Agency Regulations and guidelines. Statutory and voluntary agencies should work closely with landowners and occupiers to minimise the risk of any pollution incidents and enforce existing regulations.
Measures to control diffuse pollution in the water environment, including ‘Catchment Sensitive Farming’, may be implemented as a result of the Water Framework Directive and, along with existing agri-environment schemes, will help to achieve the conservation objectives for the SAC.

Discharges from sewage treatment works, urban drainage, engineering works such as road improvement schemes, contaminated land, and other domestic and industrial sources can also be significant causes of pollution, and must be managed appropriately. Current consents for discharges entering, or likely to impact upon the site should be monitored, reviewed and altered if necessary.

Overhanging trees provide valuable shade and food sources, whilst tree root systems provide important cover and flow refuges for juveniles. At least 50% high canopy cover to the water course/banks should be maintained, where appropriate. Some reaches may naturally have lower tree cover. Cover may also be lower in urban reaches.
4.2 Conservation Objective for Features 1-4:
- Twaite shad *Alosa fallax* (EU Species Code: 1103)
- Allis shad *Alosa alosa* (EU Species Code: 1102)
- Sea lamprey *Petromyzon marinus* (EU Species Code: 1095)
- Brook lamprey *Lampetra planeri* (EU Species Code: 1096)
- River lamprey *Lampetra fluviatilis* (EU Species Code: 1099)
- Bullhead *Cottus gobio* (EU Species Code: 1163)

Vision for features 1-4

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

<table>
<thead>
<tr>
<th>FCS component</th>
<th>Supporting information / current knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.2.1 The conservation objective for the water course as defined in 4.1 above must be met</td>
<td>Refer to sections 5.1 to 5.5 for current assessments of feature populations</td>
</tr>
<tr>
<td>4.2.2 The population of the feature in the SAC is stable or increasing over the long term.</td>
<td>Entrainment in water abstractions impacts on population dynamics through reduced recruitment and survival rates. Fish stocking can adversely affect population dynamics through competition, predation and introduction of disease.</td>
</tr>
<tr>
<td>4.2.3 The natural range of the feature in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future. The natural range is taken to mean those reaches where predominantly suitable habitat for each life stage exists over the long term. Suitable habitat is defined in terms of near-natural hydrological and geomorphological processes and forms e.g. suitable flows to allow upstream migration, depth of water and substrate type at spawning sites, and ecosystem structure and functions e.g. food supply (as described in sections 2.2 and 5). Suitable habitat need not be present throughout the SAC but where present must be secured for the foreseeable future. Natural factors such as waterfalls may limit the natural range of individual species. Existing artificial influences on natural range that cause an adverse effect on site integrity, such as physical barriers to migration, will be assessed in view of 4.2.4</td>
<td>Some reaches of the Tywi SAC will be more suitable for some features than others e.g. the main shad spawning areas are located in the lower and middle reaches between Whitemill and Dryslwyn. These differences influence the management priorities for individual reaches and are used to define the site units described in section 3.2. Further details of feature habitat suitability are given in section 5. In general, management for one feature is likely to be sympathetic for the other features present in the river, provided that the components of favourable conservation status for the watercourse given in section 4.1 are secured. The characteristic channel morphology provides the diversity of water depths, current velocities and substrate types necessary to fulfil the habitat requirements of the features. The close proximity of different habitats facilitates movement of fish to new preferred habitats with age. The presence of hard bank revetments in a number of active alluvial reaches eg. between Llanwrda and Llandeilo, adversely affects the processes that maintain suitable habitat for the SAC features. Temperature effects from the hypolimnial release at Llyn Brianne suppress river temperatures as far downstream as Llandeilo. Migration and spawning in shad are triggered by increasing water temperatures, and this is likely to be restricting their range.</td>
</tr>
</tbody>
</table>
Hydrological processes in the Tywi are currently affected by the water management regime from Llyn Brianne reservoir and the abstraction at Capel Dewi. The system is complicated, but effects can be both positive and negative, the impoundment reducing summer flood events, but also augmenting flows during low summer flows. Flow reductions downstream of the abstraction during night and weekend pumping has the potential to dry-out spawning beds and lamprey ammocoete beds.

Shad migration can be affected by acoustic barriers and by high sediment loads, which can originate from a number of sources including construction works.

4.2.4 There is, and will probably continue to be, a sufficiently large habitat to maintain the feature’s population in the SAC on a long-term basis. Allis and twaite shad are affected by range contraction due to temperature and artificial barriers to migration in the Tywi. It is likely that this loss of habitat affects their maintenance in the SAC on a long-term basis.

Performance indicators for features 1-4

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: Twaite shad (*Alosa fallax*) and Allis shad (*Alosa alosa*)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Adult run size</td>
<td>No decline in the annual run size greater than would be expected from variations in natural mortality alone</td>
<td>Adult run size should comply with an agreed target for the river. The EAW operate an acoustic and video fish counter at Ty Castell flow gauging station immediately upstream of the Capel Dewi WTW intake. The use of hydroacoustic counters for estimating run size is currently being investigated by the EAW.</td>
<td>5-6</td>
</tr>
<tr>
<td>A2. Spawning distribution</td>
<td>No decline in spawning distribution</td>
<td>Spawning distribution is assessed by kick sampling for eggs and/or observations of spawning adults. A representative sample of sites within units 5 to 6 will be monitored at 3 yearly intervals. Absence from sites within reaches 5 to 6 in 2 consecutive surveys will result in an unfavourable condition assessment.</td>
<td>1-6</td>
</tr>
</tbody>
</table>
### Performance indicators for factors affecting the feature

#### Water quality

<table>
<thead>
<tr>
<th>F1. Biological quality</th>
<th>Biological GQA class B</th>
<th>All classified reaches within the site that contains, or should contain, twaite or allis shad under conditions of high environmental quality should comply with the targets given.</th>
<th>1-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2. Chemical quality</td>
<td>RE1</td>
<td>It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3).</td>
<td>1-6</td>
</tr>
</tbody>
</table>

#### Hydromorphology

<table>
<thead>
<tr>
<th>F3. Flow</th>
<th>Targets are set in relation to river/reach type(s)</th>
<th>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). Shad are particularly sensitive to flow. The ideal regime is one of relatively high flows in March-May, to stimulate migration and allow maximum penetration of adults upstream, followed by rather low flows in June-September, which ensures that the juveniles are not washed prematurely into saline waters and grow rapidly under warmer conditions. The release of freshets to encourage salmonid migration should therefore be discouraged on shad rivers during this period.</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4. Temperature</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). Shad are particularly sensitive to temperature. The impact of the hypolimnial release from Llyn Brianne reservoir on the spawning range of shad is being assessed as part of the Review of Consents process. The release of freshets to encourage salmonid migration should therefore be discouraged on shad rivers during this period.</td>
<td>All</td>
</tr>
</tbody>
</table>
### Performance indicators for feature condition: Sea lamprey (*Petromyzon marinus*)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Distribution within catchment</td>
<td>Suitable habitat adjacent to or downstream of known spawning sites should contain <em>Petromyzon</em> ammocoetes.</td>
<td>This attribute provides evidence of successful spawning and distribution trends, and will be applied to spawning sites known to have been utilised within the previous 10 years, and historical sites considered still to have suitable habitat. Spawning locations may move within and between sites due to natural processes and new sites may be discovered over time. Silt beds downstream of all sites identified will be sampled for presence or absence of ammocoetes. Where apparently suitable habitat at any site is unoccupied feature condition will be considered unfavourable. Monitoring undertaken by APEM in 2004 failed to yield any sea lamprey ammocoetes or transformers despite reports of adult fish spawning in the system.</td>
<td>1-6</td>
</tr>
<tr>
<td>A2. Ammocoete density</td>
<td>Ammocoetes should be present in at least four sampling sites each not less than 5km apart.</td>
<td>This standard CSM attribute establishes a minimum occupied spawning range, within any sampling period, of 15km. In the Tywi, spawning sites within units 3 to 4 will be assessed against this attribute.</td>
<td>3-4</td>
</tr>
<tr>
<td>A3. Spawning Activity</td>
<td>No reduction in extent of spawning activity year on year</td>
<td>Direct observation or redd counts</td>
<td>1-6</td>
</tr>
</tbody>
</table>

Sea lamprey ammocoetes are typically much less numerous than river / brook lamprey ammocoetes, so this may be the only cost-effective means of determining that a healthy spawning population is present. Sea lampreys spawn in June – August (depending on the river) and are usually easily observed at traditional spawning sites during these months.
### Performance indicators for factors affecting the feature

#### Water quality

<table>
<thead>
<tr>
<th>Attribute</th>
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<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1. Biological quality</td>
<td>Biological GQA class B</td>
<td>All classified reaches within the site that contain, or should contain sea lamprey under conditions of high environmental quality should comply with the targets given.</td>
<td>1-6</td>
</tr>
<tr>
<td>F2. Chemical quality</td>
<td>RE1</td>
<td>It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3.)</td>
<td>1-6</td>
</tr>
</tbody>
</table>

#### Hydromorphology

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F3. Flow</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). Migration of adult sea lamprey is likely to be influenced by tide and river flows. The ideal regime is one of relatively high flows from April – June, to stimulate migration and allow maximum penetration of adults upstream to their spawning beds, followed by lower flows to help larvae disperse across suitable habitat downstream, but not be washed away.</td>
<td>All</td>
</tr>
<tr>
<td>F4. Temperature</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). The timing, consistency and duration of adult sea lamprey migration are closely related to temperature. Peak migration usually coincides with temperature above 10°C. The impact of the hypolimnial release from Llyn Brianne reservoir on the spawning range of sea lamprey is being assessed as part of the Review of Consents process.</td>
<td>All</td>
</tr>
</tbody>
</table>

### Performance indicators for feature condition: Brook lamprey (*Lampetra planeri*) & river lamprey (*Lampetra fluviatilis*)

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Age/size structure of ammocoete population</td>
<td>Samples &lt; 50 ammocoetes ~ 2 size classes</td>
<td>This gives an indication of recruitment to the population over the several years preceding the survey. Failure of one or more years recruitment may be due to either short or long term impacts or natural factors such as natural flow variability, therefore would trigger further investigation of the cause rather than leading automatically to an unfavourable condition assessment.</td>
<td>1-6</td>
</tr>
<tr>
<td></td>
<td>Samples &gt; 50 ammocoetes ~ at least 3 size classes</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Present at not less that 2/3 of sites surveyed within natural range</td>
<td>The combined natural range of these two species in terms of ammocoete distribution includes all units above the tidal limit i.e. all except unit 7. Presence at less than 2/3 of sample sites will lead to an unfavourable condition assessment.</td>
<td></td>
</tr>
</tbody>
</table>
Reduction in distribution will be defined as absence of ammocoetes from all samples within a single unit, and will lead to an unfavourable condition assessment.

**Ammocoete density**

<table>
<thead>
<tr>
<th>Optimal habitat:</th>
<th>Optimal habitat comprises beds of stable fine sediment or sand ≥15cm deep, low water velocity and the presence of organic detritus.</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;10m²</td>
<td></td>
</tr>
<tr>
<td>Overall catchment mean: &gt;5m²</td>
<td></td>
</tr>
</tbody>
</table>

**Performance indicators for factors affecting the feature**

**Water quality**

<table>
<thead>
<tr>
<th>F1. Biological quality</th>
<th>Biological GQA class B</th>
<th>All classified reaches within the site that contain, or should contain lamprey under conditions of high environmental quality should comply with the targets given.</th>
<th>1-6</th>
</tr>
</thead>
<tbody>
<tr>
<td>F2. Chemical quality</td>
<td>RE1</td>
<td>It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3).</td>
<td>1-6</td>
</tr>
</tbody>
</table>

**Hydromorphology**

<table>
<thead>
<tr>
<th>F3. Flow</th>
<th>Targets are set in relation to river/reach type(s)</th>
<th>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1).</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>F4. Temperature</td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1). River lamprey spawning in UK rivers starts when water temperatures reach 10-11°C. The impact of the hypolymnial release from Llyn Brianne reservoir on the spawning range of sea lamprey is being assessed as part of the Review of Consents process.</td>
<td>All</td>
</tr>
</tbody>
</table>

**Performance indicators for feature condition: Bullhead (Cottus gobio)**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Population densities</td>
<td>No less than 0.2 m² in sampled reaches</td>
<td>CSM guidance states that densities should be no less than 0.2 m² in upland rivers (source altitude &gt;100m) and 0.5 m² in lowland rivers (source altitude ≤100m). A significant reduction in densities may also lead to an unfavourable condition assessment.</td>
<td>1-6</td>
</tr>
<tr>
<td>A2. Distribution</td>
<td>Bullheads should be present in all suitable reaches. As a minimum, no decline in distribution from current</td>
<td>Suitable reaches will be mapped using fluvial audit information validated using the results of population monitoring. Absence of bullheads from any of these reaches, or from any previously occupied reach, revealed by on-going monitoring will result in an unfavourable condition assessment.</td>
<td>1-6</td>
</tr>
</tbody>
</table>
**A3. Reproduction / age structure**
Young-of-year fish should occur at densities at least equal to adults. This gives an indication of successful recruitment and a healthy population structure. Failure of this attribute on its own would not lead to an unfavourable condition assessment.

### Performance indicators for factors affecting the feature

#### Water quality

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Definition</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F1. Biological quality</strong></td>
<td>Biological GQA class B</td>
<td>All classified reaches within the site that contain, or should contain bullhead under conditions of high environmental quality should comply with the targets given.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Definition</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F2. Chemical quality</strong></td>
<td>RE1</td>
<td>It has been agreed through the Review of Consents process that RE1 will be used throughout the SAC (see Annex 3).</td>
</tr>
</tbody>
</table>

#### Hydromorphology

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Definition</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F3. Flow</strong></td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Definition</th>
<th>Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>F4. Temperature</strong></td>
<td>Targets are set in relation to river/reach type(s)</td>
<td>Targets equate to those levels agreed and used in the Review of Consents (see Annex 1).</td>
</tr>
</tbody>
</table>
### 4.3 Conservation Objective for Feature 5: - European otter (*Lutra lutra*) (EU Species Code: 1355)

#### Vision for feature 5
The vision for this feature is for it to be in a favourable conservation status, where all of the following conditions are satisfied:

<table>
<thead>
<tr>
<th>FCS component</th>
<th>Supporting information / current knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4.3.1</strong> The population of otters in the SAC is stable or increasing over the long term and reflects the natural carrying capacity of the habitat within the SAC, as determined by natural levels of prey abundance and associated territorial behaviour.</td>
<td>Refer to section 5.9 for current assessment of feature population</td>
</tr>
<tr>
<td><strong>4.3.2</strong> The natural range of otters in the SAC is neither being reduced nor is likely to be reduced for the foreseeable future. The natural range is taken to mean those reaches that are potentially suitable to form part of a breeding territory and/or provide routes between breeding territories. The whole area of the Tywi SAC is considered to form potentially suitable breeding habitat for otters. The size of breeding territories may vary depending on prey abundance. The population size should not be limited by the availability of suitable undisturbed breeding sites. Where these are insufficient they should be created through habitat enhancement and where necessary the provision of artificial holts. No otter breeding site should be subject to a level of disturbance that could have an adverse effect on breeding success. Where necessary, potentially harmful levels of disturbance must be managed.</td>
<td>Survey information shows that otters are widely distributed in the Tywi catchment. While the breeding population in the Tywi is not currently considered to be limited by the availability of suitable breeding sites, there is some uncertainty over the number of breeding territories which the SAC is capable of supporting given near-natural levels of prey abundance. The decline in eel populations may be having an adverse effect on the population of otters in the Tywi.</td>
</tr>
<tr>
<td><strong>4.3.3</strong> The safe movement and dispersal of individuals around the SAC is facilitated by the provision, where necessary, of suitable riparian habitat, and underpasses, ledges, fencing etc at road bridges and other artificial barriers.</td>
<td>Otter road deaths could have a potentially significant impact on otter populations within the Tywi catchment. 56 individuals deaths were recorded from Carmarthenshire between 1983 &amp; 2002, 12 of which were adult females. A number of mitigation schemes have been undertaken by the Trunk Roads Authority and Carmarthenshire CC Highways Dept. at sites flagged as blackspots.</td>
</tr>
</tbody>
</table>
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: Otter: *Lutra lutra*

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Specified limits</th>
<th>Comments</th>
<th>Relevant unit(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1. Distribution</td>
<td>Otter signs present at 70% of Otter Survey of Wales sites (CCW, 2005)³</td>
<td>The Otter Survey of Wales undertaken in 2002 surveyed 86 reference sites in the Tywi catchment, of which 77% were positive. This continued an upward trend in signs from 14% in 1977; 68% in 1984; 69% in 1991. The next survey is planned in 2009, but CCW are currently considering a rolling programme of sub-catchment survey every 2 years using Otter Survey of Wales full survey sites. The 3 sub-catchments identified in Morgan (2005) would therefore be surveyed once in every six years.</td>
<td>All</td>
</tr>
<tr>
<td>A2. Breeding activity</td>
<td>2 reports of cub/family sightings, or 2 reports of cub, lactating or pregnant female road casualties at least 1 year in 3.</td>
<td>Based on current information 5 centres of breeding activity have been estimated within the SAC. These sit with a reach of 67km and therefore exceed the estimate of 1 breeding female per 20km. However each of these centres includes the confluence of at least 1 major tributary, whose contribution is not take into account.</td>
<td>All</td>
</tr>
<tr>
<td>A3. Actual and potential breeding sites</td>
<td>No decline in number and quality of mapped breeding sites in sub-catchments Ref: as above</td>
<td>In the Tywi catchment, 101 actual or potential breeding sites have been identified, distributed throughout the catchment on the main river and tributaries.</td>
<td>All</td>
</tr>
</tbody>
</table>

---

² Sub-catchment A – The estuary to Abergwili (km 0 – km 29); Sub-catchment B – Capel Dewi to Llandovery (km 30 – km 86); Sub-catchment C – Llandovery to Nant-ystalwyn (km 87 – km 116)
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: Twaite shad *Alosa fallax* and Allis shad *Alosa alosa*

**Conservation status**

**Status: Unfavourable: Unclassified**

The JNCC have produced generic guidance for setting targets that relate to favourable condition status of shad species as a feature in SAC rivers. Each of the shad life-stage attributes (adult run size, spawning distribution and juvenile density) should have river specific targets set from baseline surveys over the first six years of the seven year SAC monitoring and reporting cycle. However, as yet there are no strategic monitoring programmes in place for each life stage in each of the three Welsh SACs.

The River Tywi has limited data on which to base attribute targets. Although the river has an acoustic and video counter at Nantgaredig, this has only been used to count shad in one year, which is insufficient to set a target for this attribute.

Monitoring of these species in the Tywi therefore relies on two methods:

i. Kick sampling for eggs provides qualitative information on spawning distribution,
ii. Netting for juveniles in the lower river and tidal reaches during late summer/autumn when juveniles drift downstream towards the estuary.

The baseline surveys for eggs and spawning sites are the most comprehensive of any of the Welsh rivers. Targets are difficult to set however due to apparent inter-annual variability in spawning distribution. 0+ surveys have only been conducted during the summer/autumn of one year (2002), and few shad were captured. Unfortunately, there are no data to indicate whether this lack of success was due to sampling problems or inter-annual variations in spawning success. As such, it is impossible to set a target for 0+ densities based on historical data in the River Tywi.

These methods do not distinguish between the two species. Allis shad is thought to be rare, with no recent records in the Tywi, while twaite shad is relatively common. Kick sampling for eggs is only able to give a broad scale indication of presence or absence at sampled locations. Netting for juveniles gives a quantitative estimate of abundance, though may be subject to a high degree of uncertainty due to sampling error. This uncertainty is likely to be compounded by variation between years in the size of the adult run, spawning success and resulting numbers of juveniles. Poor adult runs are likely to result from unsuitable flows during the March to June migration period, in particular prolonged low flows, while poor survival of eggs and juveniles is related to spate flows in the mid to late summer which can flush them into the estuary prematurely.

CSM guidance states that adult run size should comply with an agreed target for each river, with no drop in the annual run greater than would be expected from variations in natural mortality alone. The acoustic counters used on the Tywi by the Environment Agency to count migrating Atlantic salmon (*Salmo salar*) have been also used to try and count shad. However, to date this work is still experimental and, despite the recommendation of the LIFE in UK Rivers report, no strategic monitoring of adult shad has been established and the Environment Agency are undertaking the work on an *ad hoc* basis where funding will allow.
There are problems associated with using acoustic counters for shad, these include:

- shad exhibiting avoidance behaviour to the standard 200 kHz acoustic counter used for salmon;
- problems in counting individual fish for a species that migrates in shoals;
- problems of using standard echo integration techniques to estimate numbers in a shoal;
- problems differentiating shad from shoals of sea trout (Salmo trutta L.) on the River Tywi.

No data exist for shad from the acoustic counters at Nantgaredig and White Mill, primarily because the counters are set and used to monitor salmon. Furthermore, differentiation of shad from the large numbers of sea trout that migrate in the Tywi is not possible with acoustic systems. In 2005 and 2006 the Environment Agency trialled video camera techniques alongside acoustic counters at White Mill to aid differentiation between sea trout and shad. This allowed the numbers of individual shad migrating up- and downstream during the spawning season to be counted. However, these data are still under evaluation for the Review of Consents process.

The current unfavourable status results from a precautionary assessment of feature distribution and abundance, and from the presence of adverse factors, in particular flow depletion & physical barriers to migration. Temperature effects and entrainment are also thought to be impacting upon spawning distribution and population density, though they do not form part of the CSM assessment.

### Management requirements

The impacts of barriers to migration and flow depletion are highlighted in the assessment of conservation status for these features.

Artificial physical barriers are probably the single most important factor in the decline of shad in Europe. Impassable obstacles between suitable spawning areas and the sea can eliminate breeding populations of shad. Both species (but particularly allis shad) can make migrations of hundreds of kilometres from the estuary to spawning grounds in the absence of artificial barriers. Existing fish passes designed for salmon are often not effective for shad. Any new provisions need to take their requirements into account. The impact of existing barriers in the Tywi should be assessed on a case-by-case basis. Physical modification of barriers is required where depth/velocity/duration of flows is unsuitable to allow passage. Llangadog Creamery weir is considered to be the most significant barrier to fish migration in the Tywi. Consideration is being given to reduce or remove the effect of this barrier. An assessment of options will be carried out in conjunction with the other relevant competent authorities.

The River Tywi is a regulated river, with flows at certain times of the year primarily controlled by releases from Llyn Brianne. The reservoir controls releases of water for hydropower generation and the principal potable abstraction at Capel Dewi, and a seasonal abstraction at Manorafan. In addition, the EAW retains control over a 9092 Ml management reserve, which can be used for ecological flows. These flows are most often used as freshets for fisheries management purposes in the spring and autumn to support migration of salmonids.

The impact of flow depletion downstream of major abstractions was assessed in the Review of Consents process. The outputs of the hydraulic model suggest that changes to water depth and water velocities occurring as a result of the abstraction at Capel Dewi are unlikely to impact upon:

- the ability of adult shad to migrate through the lower reaches of the river; spawning habitat downstream of Capel Dewi;
- juvenile habitat downstream of the abstraction. However the diurnal operation of the pumps does expose marginal habitat and therefore has the potential to strand juveniles or expose sediments supporting juvenile habitat. There are also requirements for screening of intakes to reduce or remove the impact of impingement and entrainment on juvenile fish migrating downstream. Entrainment in water abstractions directly impacts on population dynamics through
reduced recruitment and survival rates. Information on likely rates of entrainment of shad eggs and juveniles is required before acceptable levels can be assessed. The screening arrangements at the DCWW intakes at Manorafon and Capel Dewi are currently being assessed as part of the Habitats Directive Review of Consents process.

Llyn Brianne is a deep reservoir that exhibits thermal stratification in the spring/summer. Releases of water from the reservoir are from a fixed discharge depth of 65 m, which is below the stratification layer and results in cold water being released into the Tywi. This results in reduced temperature conditions in the main river Tywi at certain times of year. For instance, hypolimnial releases from the reservoir during summer months average 6-8°C and can lower river temperatures for 55 km below the reservoir outflow.

Allis and twaite shad are temperature dependent in critical phases of their life history. Both species are anadromous, migrating from the sea into rivers as adults to spawn. The timing of adult migrations appears to be primarily dependent upon temperature, with migration triggered at estuarine water temperatures of 11-12°C and secondarily by river flow and tides. Peak migration activity occurs at water temperatures of 11-14°C, usually between April and June. Spawning varies regionally, but typically takes place in water temperatures of above 15°C between May and July. Eggs are sensitive to water temperatures below 16-18°C. Water temperatures of above 18°C throughout June and July are therefore considered ideal for successful shad egg incubation. Temperature is also believed to be important in triggering migration of shad larvae towards the estuary, with most juvenile thought to migrate from the River Wye into the Severn estuary once water temperatures fall below 19°C.

Recent research on shad spawning within the Tywi SAC suggests that temperature is a limiting factor in the distribution of shad adults throughout the Tywi catchment. Temperature data collected from various points throughout the main River Tywi during 2005 and 2006 suggest that current hypolimnion releases from Llyn Brianne have a significant effect on water temperatures in the upper catchment. It therefore seems likely, given the ecological requirements of the species as outlined above, that the current temperature profile of the Tywi is limiting the distribution of these features.

The use of freschet releases from Llyn Brianne to stimulate salmonid smolt migration in the spring and adult migration in the autumn are also potentially damaging. Cold water releases in the spring could delay the migration of adult shad into the system, while autumn releases can flush juvenile shad into the estuary before they are sufficiently developed to cope with changing salinity regimes. This is magnified due to the majority of shad spawning occurring in the lower reaches of the Tywi.

Biological and chemical monitoring undertaken by the EAW shows the Tywi within the freshwater reaches of the SAC is compliant with the performance indicators (Biological GQA Class B; Chemical Standard RE1). The majority of reaches have been classified as GQA class A most years, all reaches met class B standard. Shad eggs and juveniles are known to be sensitive to elevated suspended solids and high nutrient concentrations. In-river engineering works, which have the potential to generate high silt loads under low flow conditions are regulated through the EA’s Land Drainage Consent process. An embargo on works between May and late July operates within the catchment. Diffuse inputs from agricultural sources are the main cause of nutrient enrichment. The Water Framework Directive will provide a driver to tackle diffuse inputs. Catchment sensitive farming initiatives, Tir Gofal and the EA’s Sustainable Fisheries Project are encouraging the use of buffer strips to reduce these impacts.

Noise/vibration e.g. due to impact piling, drilling, salmon fish counters present within or in close proximity to the river can create a barrier to shad migration. Barriers resulting from vibration, chemicals, low dissolved oxygen and artificially high sediment levels must be prevented at key times (generally April to July).

The extent and quality of suitable shad habitat must be maintained. Spawning habitat is defined as stable, clean gravel/pebble-dominated (approximately 70%) substrate without an armoured layer and with <10% fines in the top 30 cm. Water depth during the spawning and incubation periods should be
50-75 cm. Holding areas are defined as pools of at least 200 cm depth, with cover from features such as undercut banks, vegetation, submerged objects and surface turbulence.

Anglers occasionally fish for shad, and they are sometimes taken in quite large numbers. Further research is necessary to define sustainable levels of angling. If this shows there is cause for concern a temporary cessation of fishing activity in the vicinity of known spawning grounds during the spawning period should be considered, particularly where shad are known to be taken regularly. Exploitation of shad is currently unregulated and controls are being considered through the review of freshwater fisheries legislation.

Commercial fishermen also take shad as a by-catch. Changes in fishing methods need to be promoted to minimize captures, while both anglers and trawler men should be encouraged to return alive any individuals caught.

Artificially enhanced densities of other fish may introduce unacceptable competition or predation pressure and the aim should be to minimise these risks in considering any proposals for stocking.

5.2 Conservation status and management requirements of Feature 2:

Sea lamprey *Petromyzon marinus*

Conservation status

**Status: Unfavourable: Unclassified**

Sea lamprey monitoring undertaken in 2004 failed to find juvenile sea lamprey at any sites either on the main river Tywi or any of the tributaries. Therefore the Tywi SAC failed the JNCC target threshold, and targets for spawning site & ammocoete distribution.

A lack of juvenile sea lamprey in surveys of this type is common to a number of rivers despite the presence of spawning adults. The contractors postulate that separation of habitat is occurring between brook/river lamprey and sea lamprey, the former spawning earlier in the year (March/April) compared to sea lamprey which spawn in June. They consider that juvenile sea lamprey are being excluded from optimum habitat and are having to utilise silt beds in deeper water, habitat that is not monitored as part of the standard assessment.

Migrating adult sea lamprey, spawning adults and dead individuals are reported from the Tywi, Cothi and Llandovery Bran each year.

Management requirements

The impacts of barriers to migration and flow depletion are highlighted in the assessment of conservation status for this feature. The impact of barriers should be assessed on a case-by-case basis. Physical modification of barriers is required where depth/velocity/duration of flows is unsuitable to allow passage. Llangadog creamery weir is considered to be the most significant barrier to fish migration on the Tywi. An assessment of options to reduce or remove the impact of this barrier will be carried out in conjunction with the other relevant competent authorities.

The impact of acoustic (i.e. noise/vibration) and sediment/chemical barriers arising from plans or projects should also be assessed. When arising from construction or other development related activities it may be necessary to restrict the timing of such activities.

The impact of flow depletion downstream of major abstractions was assessed in the Review of Consents process. The outputs of the hydraulic model suggest that changes to water depth and water velocities occurring as a result of the abstraction at Capel Dewi are unlikely to impact upon:
the ability of adult lamprey to migrate through the lower reaches of the river; spawning habitat downstream of Capel Dewi; or juvenile habitat downstream of the abstraction. However the diurnal operation of the pumps does expose marginal habitat and therefore has the potential to strand juveniles or expose juvenile sediment habitat.

There are also requirements for screening of intakes to reduce or remove the impact of impingement and entrainment on juvenile fish migrating downstream. Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Information on likely rates of entrainment of lamprey ammocoetes is required before acceptable levels can be assessed. The screening arrangements at the DCWW intakes at Manorafon and Capel Dewi are currently being assessed as part of the Habitats Directive review of consents process.

The impact of lowered temperatures from the hypolimnial release at Llyn Brianne on the Tywi also has the potential to impact upon lamprey. The anadromous sea lamprey are temperature dependent at critical freshwater life stages. Migration of sea lamprey into estuaries usually occurs from April onwards at temperatures of between 10-18°C, and spawning occurs when water temperatures increase above a threshold of 15°C, usually between May and June. The critical spawning temperature range for sea lamprey is considered to be 11-25°C, and eggs require temperatures of 15-25°C to hatch. Distribution of lamprey within the Tywi catchment is therefore also likely to be limited by the current river temperature regime.

Biological and chemical monitoring undertaken by the EAW shows the Tywi within the freshwater reaches of the SAC is compliant with the performance indicators (Biological GQA Class B; Chemical Standard RE1). The majority of reaches have been classified as GQA class A most years, all reaches met class B standard.

The extent and quality of suitable sea lamprey habitat must be maintained. Elevated levels of fines (particles <0.83mm) within spawning substrates can interfere with egg survival. Spawning habitat consists of well-oxygenated gravel/pebble substrate of >10cm depth in a range of water depths (0.2 to 1.5m). Sea and river lamprey tend to spawn in deeper water than brook lamprey. Nursery habitat consists of open-structured, aerated, silty and sandy substrates between 2 and 40cm depth generally in shallow (<0.5m) slack-water channel margins.

5.3 Conservation status and management requirements of Feature 3:
Brook lamprey Lampetra planeri and River lamprey Lampetra fluviatilis

Conservation status

Status: Unfavourable: Unclassified

Brook/river lamprey monitoring undertaken in 2004 showed that overall catchment mean ammocoete density considerably exceeded the JNCC target threshold\(^1\). The populations were considered to be healthy with a good recruitment of 0+ ammocoetes in most areas in 2004. However very few lampreys were caught in sub-optimal habitat, possibly indicating that optimal habitat is not limiting within the SAC. Densities in optimal habitat were 27.7 m\(^{-2}\) and sub-optimal habitat 0.3m\(^{-2}\), giving a SAC mean density for all habitats of 14.0 m\(^{-2}\) (sd=4.5). When both optimal and sub-optimal habitat are taken into account the distribution of ammocoetes within the catchment fails the performance indicator - presence at not less that 2/3 of sites surveyed within natural range, and it is for this reason together with the impacts from flow depletion (see below) that their status was recorded as unfavourable.

It has not been possible to distinguish between the two species during monitoring, due to the reliance on juvenile stages (ammocoetes), though anecdotal evidence suggests that both species are likely to be present in many reaches. More information on the relative abundance of these two species in different
parts of the Tywi SAC is desirable. Records of spawning adult river lamprey would be particularly useful.

**Management requirements**

The extent and quality of suitable habitat for brook and river lamprey must be maintained. Elevated levels of fines (particles <0.83mm) within spawning substrates can interfere with egg survival. Spawning habitat consists of well-oxygenated gravel/pebble substrate of >10cm depth in a range of water depths (0.2 to 1.5m). Sea and river lamprey tend to spawn in deeper water than brook lamprey. Nursery habitat consists of open-structured, aerated, silty and sandy substrates between 2 and 40cm depth generally in shallow (<0.5m) slack-water channel margins.

The impact of flow depletion downstream of major abstractions was assessed in the Review of Consents process. The outputs of the hydraulic model suggest that changes to water depth and water velocities occurring as a result of the abstraction at Capel Dewi are unlikely to impact upon: the ability of adult lamprey to migrate through the lower reaches of the river; spawning habitat downstream of Capel Dewi; or juvenile habitat downstream of the abstraction. However the diurnal operation of the pumps does expose marginal habitat and therefore has the potential to strand juveniles or expose juvenile sediment habitat.

Entrainment in water abstractions directly impacts on population dynamics through reduced recruitment and survival rates. Information on likely rates of entrainment of lamprey ammocoetes is required before acceptable levels can be assessed.

The impact of lowered temperatures from the hypolimnial release at Llyn Brianne on the Tywi also has the potential to impact upon lamprey. The freshwater brook lamprey and anadromous river lamprey are temperature dependent at critical freshwater life stages. River and brook lamprey start to spawn in British rivers when water temperatures reach 10-11°C, usually between March and April for river lamprey and March and May for brook lamprey. Distribution of lamprey within the Tywi catchment is therefore also likely to be limited by the current river temperature regime. Biological and chemical monitoring undertaken by the EAW shows the Tywi within the freshwater reaches of the SAC is compliant with the performance indicators (Biological GQA Class B; Chemical Standard RE1). The majority of reaches have been classified as GQA class A most years, all reaches met class B standard.

The currently favourable condition assessment suggests that there are no strongly adverse factors influencing these species. However, the species are likely to benefit from positive management for the other SAC features, and may see further improvement in condition as a result. On-going monitoring will allow a better understanding of population fluctuations, distributional changes etc.

### 5.4 Conservation status and management requirements of Feature 4:

**Bullhead Cottus gobio**

**Conservation status**

**Status: Unfavourable: Unclassified**

The current unfavourable status results from a lack of appropriate survey data. Records obtained from juvenile salmon monitoring show that bullhead are widespread in the Tywi catchment. There is a need for quantitative information on bullhead abundance.
Management requirements

Vertical drops of >18-20 cm are sufficient to prevent upstream movement of adult bullheads. They will therefore prevent recolonisation of upper reaches affected by lethal pollution episodes, and will also lead to constraints on genetic interactions that may have adverse consequences. New instream structures should be avoided, whilst the impact of existing artificial structures needs to be evaluated.

The extent and quality of suitable bullhead habitat must be maintained. Elevated levels of fines can interfere with egg and fry survival. Spawning habitat is defined as unsilted coarse (gravel/pebble/cobble) dominated substrate: males guard sticky eggs on the underside of stones. Larger stones on a hard substrate providing clear spaces between the stream bed and the underside of pebbles/cobbles are therefore important.

The importance of submerged higher plants to bullhead survival is unclear, but it is likely that where such vegetation occurs it is used by the species for cover against predators. Weed cutting should be limited to no more than half of the channel width in a pattern of cutting creating a mosaic of bare substrate and beds of submerged plants. Slack-water areas provide important refuges against high flow conditions. Suitable refuges include pools, submerged tree root systems and marginal vegetation with >5 cm water depth.

Bullheads are particularly associated with woody debris in lowland reaches, where it is likely that it provides an alternative source of cover from predators and floods. It may also be used as an alternative spawning substrate. Debris dams and woody debris should be retained where characteristic of the river/reach. Woody debris removal should be minimised, and restricted to essential activities such as flood defence.

Maintenance of intermittent tree cover in conjunction with retention of woody debris helps to ensure that habitat conditions are suitable. Some reaches may naturally have lower tree cover. Cover may also be lower in urban reaches.

Bullhead densities have been found to be negatively correlated with densities of non-native crayfish, suggesting competitive and/or predator-prey interactions. Non-native crayfish should be absent from the SAC.

The presence of artificially high densities of salmonids and other fish will create unacceptably high levels of predatory and competitive pressure on juvenile and adult bullhead. Stocking of fish should be avoided in the SAC.

Escapes from fish farms are a form of uncontrolled introduction and should be prevented by effective screening on all intakes and discharges.

Bullheads are relatively sedentary and interactions between populations in different parts of the catchment and in different catchments are likely to be limited, suggesting the existence of genetically discrete populations. Since they are of no angling interest, deliberate transfers between sites are unlikely to have been undertaken in the past, such that the genetic integrity of populations is likely to be intact. There should be no stocking/transfers of bullhead unless agreed to be in the best interests of the population.

In general, management for other SAC features is expected to result in favourable habitat for bullhead, through improvements in water quality and flow regime and maintenance of suitable physical habitat.
5.5 Conservation status and management requirements of Feature 5: European otter *Lutra lutra*

**Conservation status**

**Status: Favourable**

The conservation status of otters in the Tywi SAC is determined by monitoring their distribution, breeding success, and the condition of potential breeding and feeding habitat outlined in the Performance Indicators. Their current condition can be considered favourable, but with scope for further improvement, if habitat and other natural factors can be maintained and enhanced.

**Management requirements**

A survey undertaken in 2004 identified 101 breeding sites within the Tywi catchment, based on the European Commission’s Life Nature Programme methodology\(^{11}\). Of these 14 were in use, with a further 87 having potential\(^3\). The report suggested the catchment should be capable of supporting at least 22 breeding pairs, based on one breeding female per 20km stretch of river. It is possible that, if all the breeding sites achieve optimal habitat conditions and fish and amphibian stocks are secured, the catchment may then support further breeding animals. However, the amount of compression of home ranges that otters will accept cannot as yet be determined\(^3\).

Management should aim to ensure that there is sufficient undisturbed breeding habitat to support an otter population of a size determined by natural prey availability and associated territorial behaviour. The involvement of river users and land managers will be important in improving potential breeding habitat near to the river. Agri-environment schemes and the Better Woodlands for Wales scheme provide possible mechanisms for maintaining suitable sites, such as lightly grazed woodlands, areas of dense scrub, and tussocky fens with purple moor-grass. The low lying nature of the floodplain render large areas unsuitable as breeding sites, and it is likely that the tributaries and marginal areas away from the designated boundaries provide the major potential e.g. relict channels, scrub and woodland.

Food availability is an important factor. Fish biomass should stay within expected natural fluctuations. A potential problem appears to be the decline in eel populations, and similar concerns are apparent with respect to amphibian numbers on a UK scale.

A number of particular threats to the otter have been identified on the catchment, not least the number of road mortalities that have occurred. There is also considerable room to improve the bankside habitat along the main length of the Tywi and some of the tributaries. This presents difficulties on the main river, as its mobile nature and flood magnitude create problems with fencing to exclude stock.

Measures to ensure the safe movement of otters around the catchment will be promoted, in particular the provision of ledges, tunnels and fencing on new road bridge schemes. Where bridges are being repaired or replaced, or at especially bad locations for otter road deaths, such features may be retrofitted.

Pollution of rivers with toxic chemicals, such as PCBs, was one of the major factors identified in the widespread decline of otters during the last century. There should be no increase in pollutants potentially toxic to otters.
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.

<table>
<thead>
<tr>
<th>Unit Number</th>
<th>CCW Database Number</th>
<th>Unit Name</th>
<th>Summary of Conservation Management Issues</th>
<th>Action needed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>000734</td>
<td>Carmarthen reach</td>
<td>Reduction in flows downstream of the DCWW Capel Dewi intake during pumping, lead to drying of habitat for spawning and juvenile fish species. Invasive species, including Himalayan balsam and Japanese knotweed are present throughout the reach. They suppress local biodiversity and can lead to bank instability. Development and infrastructure pressures and the need for flood protection associated with Carmarthen.</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>000737</td>
<td>Whitemill reach</td>
<td>Reduction in flows downstream of the DCWW Capel Dewi intake during pumping, lead to drying of habitat for spawning and juvenile fish species. Potential for disruption of migration cues for fish species. Invasive species, including Himalayan balsam and Japanese knotweed are present throughout the reach. They suppress local biodiversity and can lead to bank instability.</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>000738</td>
<td>Halfway reach</td>
<td>The DCWW abstraction at the bottom of the reach has the potential to entrain significant numbers of juvenile shad, river &amp; sea lamprey in the migration down river to sea.</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>000739</td>
<td>Golden Grove reach</td>
<td>Reach is under one riparian ownership... Sea lamprey spawning occurs in a number of locations in the reach. Generally stable and inactive in the upper sections, though potential meander cut-through developing upstream of the Myddfyfi confluence. Active meanders at Rofawr, where cut-through occurred in the late 1990's and at Dryslwyn. Good otter habitat throughout.</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>000740</td>
<td>Llandeilo reach</td>
<td>Actively meandering reach of the Tywi. Private gravel extractions, extent of impacts unknown. Bank protection works to protect the Heart of Wales railway line are impacting upon the natural functioning of the system.</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>000741</td>
<td>Llangadog reach</td>
<td>Actively meandering reach of the Tywi. Private gravel extractions, extent of impacts unknown. Bank protection works to protect the Heart of Wales railway line are impacting upon the natural functioning of the system.</td>
<td>Yes</td>
</tr>
<tr>
<td>Unit Number</td>
<td>CCW Database Number</td>
<td>Unit Name</td>
<td>Summary of Conservation Management Issues</td>
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<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>1</td>
<td>000742</td>
<td>Llandovery reach</td>
<td>An actively meandering reach of the Tywi. One commercial and a number of private gravel extractions operate within the reach, the extent of impacts are unknown. Bank protection works to protect the Heart of Wales railway line are impacting upon the natural functioning of the system. The Llyn Brianne hypolimnial release is suppressing in-stream temperatures, potentially restricting the breeding range of twaite shad.</td>
<td>Yes</td>
</tr>
</tbody>
</table>
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 (CSM)**
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:
- 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 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.

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

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

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

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4 A full definition of favourable conservation status is given in Section 4.
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
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
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 AND ANNEXES


ANNEX 1 –REVIEW OF CONSENTS STANDARDS FOR FLOW

The flow target used in the Environment Agency (EA) Resource Assessment and Management Framework (RAM) utilises the Habitats Directive Ecological River Flow (HDERF) objective during the key fish migration period in April to June. The maximum permissible percentage reduction from naturalised flow levels during this period is given in Table 1.

<table>
<thead>
<tr>
<th>EW band (sensitivity)</th>
<th>Maximum % reduction from daily naturalised flow</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;Qn50</td>
</tr>
<tr>
<td>Very High</td>
<td>10</td>
</tr>
<tr>
<td>High</td>
<td>15</td>
</tr>
</tbody>
</table>

For reaches below reservoirs, the effect of abstraction from storage is excluded from the assessment, so that the target flow is a ‘benchmark’ flow, incorporating the reservoir compensation release, rather than a naturalised flow. At times of low flow, compensation releases may increase the flow downstream of the reservoir above natural levels. There may also be effects resulting from reduced water temperature.
ANNEX 2 – STANDARDS USED IN THE TYWI REVIEW OF CONSENTS FOR PHOSPHATE

INTRODUCTION
The Environment Agency, English Nature and the Countryside Council for Wales have agreed on a methodology for the determination of guideline phosphorus standards on SAC rivers. The methodology is based upon catchment geology and river size, and a set of guideline standards has been applied to the typology which permits a reasonable degree of anthropogenic change but which should be consistent with the favorable condition of SAC interest features. The full details can be found in WQTAG048b – Guideline Phosphorus Standards for SAC Rivers.

The purpose of this report is to detail how these guidelines have been applied to the Tywi SAC.

1.1 Determining River Size Class
There are three size classes, representing headwaters, river, and large river (Table 1). The division is based on the river flow categories used in the General Quality Assessment and the River Habitat Survey (Table 2). By reference to these data, the river can be allocated to one of the 3 classes.

<table>
<thead>
<tr>
<th>River class</th>
<th>GQA flow band</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – Headwaters</td>
<td>1 –2</td>
</tr>
<tr>
<td>2 – River</td>
<td>3 – 8</td>
</tr>
<tr>
<td>3 – Large river</td>
<td>9 – 10</td>
</tr>
</tbody>
</table>

Table 2. GQA Flow Bands

<table>
<thead>
<tr>
<th>GQA flow band</th>
<th>Long Term Average Natural Flow (cumecs)</th>
<th>Equivalent in ML/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;0.31</td>
<td>&lt;26.8</td>
</tr>
<tr>
<td>2</td>
<td>&lt;0.62</td>
<td>&lt;53.6</td>
</tr>
<tr>
<td>3</td>
<td>&lt;1.25</td>
<td>&lt;108</td>
</tr>
<tr>
<td>4</td>
<td>&lt;2.5</td>
<td>&lt;216</td>
</tr>
<tr>
<td>5</td>
<td>&lt;5.0</td>
<td>&lt;432</td>
</tr>
<tr>
<td>6</td>
<td>&lt;10</td>
<td>&lt;864</td>
</tr>
<tr>
<td>7</td>
<td>&lt;20</td>
<td>&lt;1728</td>
</tr>
<tr>
<td>8</td>
<td>&lt;40</td>
<td>&lt;3456</td>
</tr>
<tr>
<td>9</td>
<td>&lt;80</td>
<td>&lt;6912</td>
</tr>
<tr>
<td>10</td>
<td>&gt;80</td>
<td>&gt;6912</td>
</tr>
</tbody>
</table>

EAW monitoring for the Tywi at Dolauhirion gauging station, less than 1.5 km upstream of the SAC boundary at Llandovery, gives a mean annual flow of 10.53 cumecs, and at Nantgaredig in the lower reaches of 39.41 cumecs. This places the GQA flow band for the river within the SAC as between 7 & 8 and hence the river class as 2 - River.

1.2 Determining the Geological Class

<table>
<thead>
<tr>
<th>Geological classification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Hard upland geologies (all land over 330m)</td>
<td>Igneous, plus Cambrian to Devonian series and Carboniferous. Low porosity, poor geology with hill farming and v. low population density</td>
</tr>
<tr>
<td>B. Other Cambrian – Devonian, and Carboniferous</td>
<td>Hard mudstones, sandstones, limestones. Improved pasture plus some arable, low population density</td>
</tr>
<tr>
<td>C. Jurassic and Cretaceous</td>
<td>Soft limestones and chalk. More intensive agriculture and higher</td>
</tr>
</tbody>
</table>

39
limestones | population densities, but relatively resistant to P enrichment due to soil/geological adsorption capacity. Form major aquifers whose P levels set background P concentrations of the rivers
---|---
D. Triassic sandstones and mudstones | Soft sandstones and mudstones in lowland areas, agriculture and population densities similar to (C) but more vulnerable to P enrichment due to low adsorption capacity. Form major aquifers whose P levels set background P concentrations of the rivers
E. Mesozoic clay vales and Tertiary clays | Very low porosity, rich soils in lowland areas. Intensive agriculture and high population densities, yielding highest background P levels.

The Methodology identifies five geological types (Table 3).

The Tywi catchment geology is predominantly alluvium, glacial sands and gravels overlying silt- and mudstones and was therefore assigned to category ‘B’.

1.3 Combining River Size and Geological Class
Combining the river size and geological class information allows an appropriate guideline standard to be allocated (Figure 1).

Table 4. Phosphorus values assigned to river types (total reactive phosphorus mg/l, except * total phosphorus)

<table>
<thead>
<tr>
<th>Geological class</th>
<th>1. Headwaters</th>
<th>2. River</th>
<th>3. Large river</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural</td>
<td>Undetectable</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Standard</td>
<td>0.02</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>Threshold</td>
<td>0.04</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Standard</td>
<td>0.06</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>Threshold</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural</td>
<td>0.02</td>
<td>0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>Standard</td>
<td>0.04</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Threshold</td>
<td>0.06</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural</td>
<td>0.02</td>
<td>0.02</td>
<td>0.03</td>
</tr>
<tr>
<td>Standard</td>
<td>0.06</td>
<td>0.06</td>
<td>0.10</td>
</tr>
<tr>
<td>Threshold</td>
<td>0.10</td>
<td>0.10</td>
<td>0.20</td>
</tr>
<tr>
<td>E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural</td>
<td>0.02</td>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>Standard</td>
<td>0.06</td>
<td>0.10*</td>
<td>0.10*</td>
</tr>
<tr>
<td>Threshold</td>
<td>0.10</td>
<td>0.20*</td>
<td>0.20*</td>
</tr>
</tbody>
</table>

The Tywi SAC falls into flow category 2 ‘River’ and Geological class ‘B’, and therefore gets a P Target of 0.06 mg/l.
ANNEX 3 – STANDARDS USED IN THE TYWI REVIEW OF CONSENTS FOR WATER QUALITY

Table 1 sets out the targets specified in the EA Appropriate Assessment for the River Tywi Review of Consents. RE1 applies to all of the designated SAC reaches of the afon Tywi.

<table>
<thead>
<tr>
<th>Table 1 River ecosystem (RE) classification</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissolved Oxygen (% sat) 10%ile</td>
<td>80</td>
<td>2.5</td>
<td>0.25</td>
<td>0.021</td>
<td>6.0-9.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biological Oxygen Demand (mg/l) 90%ile</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Ammonia (mg N/l) 90%ile</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Un-ionised Ammonia (mg N/l) 95%ile</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH (lower limit as 5%ile, upper limit as 95%ile) Mean</td>
<td>≤10</td>
<td>&gt;10 and ≤50</td>
<td>&gt;50 and ≤100</td>
<td>&gt;100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardness (mg/l CaCO$_3$) 95%ile</td>
<td>5</td>
<td>22</td>
<td>40</td>
<td>112</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved Copper (µg/l) 95%ile</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Zinc (µg/l) 95%ile</td>
<td>30</td>
<td>200</td>
<td>300</td>
<td>500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RE1 70 4.0 0.6 0.021 6.0-9.0 5 22 40 112 30 200 300 500

RE2
Annex E

Carmarthen Bay and Estuaries SAC Conservation Objectives
Carmarthen Bay and Estuaries/Bae Caerfyrddin ac Aberoedd European Marine Site

comprising:

Carmarthen Bay and Estuaries/Bae Caerfyrddin ac Aberoedd Special Area of Conservation
Carmarthen Bay/Bae Caerfyrddin Special Protection Area
Burry Inlet Protection Area & Ramsar Site

ADVICE PROVIDED BY THE COUNTRYSIDE COUNCIL FOR WALES IN FULFILMENT OF REGULATION 33 OF THE CONSERVATION (NATURAL HABITATS, &c.) REGULATIONS 1994

February 2009

This document supersedes the ‘Draft Interim Advice’ June 2005
A Welsh version of all or part of this document can be made available on request.
CARMARTHEN BAY AND ESTUARIES SPECIAL AREA OF CONSERVATION
EUROPEAN MARINE SITE

ADVICE PROVIDED BY THE COUNTRYSIDE COUNCIL FOR WALES IN FULFILMENT OF REGULATION 33 OF THE CONSERVATION (NATURAL HABITATS, &c.) REGULATIONS 1994

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2.1.2 Practical requirements

2.2 OPERATIONS WHICH MAY CAUSE DETERIORATION OR DISTURBANCE

2.2.1 Legal context

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3.1.1 Sources and limitations of site information

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3.5 Operations within the SAC

3.6 MODIFICATIONS AS A RESULT OF HUMAN ACTIVITY

4 FEATURE DESCRIPTIONS

4.1 Estuaries

4.2 Mudflats and sandflats not covered by seawater at low tide

4.3 Atlantic Salt meadows

4.4 Salicornia and other annuals colonising mud and sand

4.5 Large shallow inlets and bays

4.6 Sandbanks which are slightly covered by seawater all the time

4.7 Shad Alosa spp

4.8 River lamprey (Lampetra fluviatilis) and sea lamprey (Petromyzon marinus)

4.9 Otter (Lutra lutra)

5 CONSERVATION OBJECTIVES
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Map 1</td>
<td>Boundary of the SAC</td>
</tr>
<tr>
<td>Map 2</td>
<td>Location of other designated areas wholly or partly with the SAC</td>
</tr>
<tr>
<td>Map 3</td>
<td>Indicative feature maps for the SAC.</td>
</tr>
</tbody>
</table>
SUMMARY: PLEASE READ THIS FIRST

This document contains CCW’s advice issued under Regulation 33 of the Conservation (Natural Habitats, &c.) Regulations 1994, for the Carmarthen Bay and Estuaries Special Area of Conservation namely conservation objectives and advice on operations. It also includes an explanation of the purpose and format of CCW’s “Regulation 33 advice”.

This latest version of the Regulation 33 package has been revised to improve consistency across the marine SACs in Wales. The intent of the conservation objectives and of the advice on operations which may cause deterioration or disturbance to the feature is the same as in previous versions. The Conservation Objectives are now shorter and more generic but there has been no change in what is considered to represent Favourable Conservation Status.

Section 1 is a brief introduction to the legal context for Regulation 33 advice.

Section 2 explains in more detail the legal basis and practical requirements for setting conservation objectives for Natura 2000 sites, as understood by CCW. It also explains the legal and practical basis of the operations advice.

Section 3 contains a brief overall description of Carmarthen Bay and Estuaries SAC, Carmarthen Bay SPA and Burry Inlet SPA and Ramsar site, current operations taking place with the SAC and information on modifications as a result of human activity.

Section 4 describes habitats and species for which the Carmarthen Bay and Estuaries SAC has been selected as a SAC as well as why they are considered important. The information is presented using the same headings as those used to describe the conservation objectives so that useful underpinning information in support of these objectives can easily be referenced.

Section 5 contains CCW’s advice as to the conservation objectives (Regulation 33(2)(a)) for the features for which the site has been selected as a SAC. This includes a vision statement which is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives into a single, integrated statement about the site.

Section 6 contains CCW’s advice as to the operations which may cause deterioration or disturbance of the habitats and species for which the site has been selected (Regulation 33(2)(b)). This is provided to assist the relevant authorities and others in understanding the implications of the designation of the site and the requirements of the Habitats Regulations and government policy towards it.

The Appendices provide a glossary of terms, a list of other types of protected areas within the SAC and more detail on the elements of Favourable Conservation Status. Other background information such as lists of additional species and habitats of particular note (e.g. species and habitats subject to Biodiversity Action Plans or threatened and declining species and habitats identified by the OSPAR Commission) and the variety of biotopes associated with Annex 1 features may be added in due course.

The Maps show the boundaries of the SAC, the location of other protected areas which occur within the SAC, and give an indication of the location of features for which the site was designated. Further maps, for example of adjacent designated areas or giving an indication of the location of
habitat components (e.g. types of reef or types of mudflat and sandflat), may be added in due course.
1 INTRODUCTION

The 1992 EC Habitats Directive aims to help conserve the diversity of habitats and species across the European Union. It represents one of the ways in which EU member states are fulfilling the commitments they made at the “Earth Summit” in Rio de Janeiro in 1992, for the conservation of the Earth’s biological diversity.

The Habitats Directive requires member states to take a variety of measures aimed at the conservation of biodiversity. These measures include the designation of Special Areas of Conservation (SACs) on land and sea. Each SAC is to be designated for particular habitats and species, and they are to be managed in ways that help conserve those habitats and species.

The Habitats Directive is given effect in the UK largely through the Conservation (Natural Habitats, &c.) Regulations 1994 (“the Habitats Regulations”). These Regulations set out the powers and duties of UK statutory bodies towards compliance with the requirements of the Habitats Directive. Under these Regulations, SACs together with Special Protection Areas (SPAs) classified under the 1979 EC Birds Directive for the conservation of birds, are called “European sites” and those that include marine areas are called “European marine sites”.

Regulation 33 of the Habitats Regulations requires the Countryside Council for Wales (CCW) to advise the relevant authorities for each European marine site in, or partly in, Wales as to “(a) the conservation objectives for that site, and (b) any operations which may cause deterioration of natural habitats or the habitats of species, or disturbance of species, for which the site has been designated.” This document contains CCW’s advice under Regulation 33 in relation to the Carmarthen Bay and Estuaries EMS.

None of the information contained in this document legally binds any organisation (including CCW) to any particular course of action. However, in exercising their functions in accordance with the requirements of the Habitats Directive, as required by the Habitats Regulations, and in accordance with government policy towards Ramsar sites, the relevant authorities should be guided by the advice contained in this document. This applies amongst other things to the establishment of a “management scheme,” if such a scheme is established.

Relevant authorities and others may have obligations towards the conservation of habitats and species that are not features for which the Carmarthen Bay and Estuaries EMS has been designated, and such obligations are not affected by this document.

The information contained in this document is based on best available knowledge at time of writing and is subject to review at CCW’s discretion. Further guidance relating to European marine sites is published by the National Assembly for Wales (European marine sites in England and Wales, June 1998, Department of the Environment and Welsh Office), CCW (European marine sites: an introduction to management, 1998, CCW Bangor) and European Commission Guidelines for the establishment of the Natura 2000 network in the marine environment. Application of the Habitats and Birds Directive, May 2007.

2 Biological diversity is defined as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.” (1992 International Convention on Biological Diversity, Article 2, http://www.biodiv.org/convention/)
4 “Marine area” is defined in Regulation 2 of the Habitats Regulations as “any land covered continuously or intermittently by tidal waters, or any part of the sea in or adjacent to Great Britain up to the seaward limit of territorial waters”.
5 The types of bodies that are “relevant authorities” are identified in Regulation 5 of the Habitats Regulations.
6 Regulation 34 of the Habitats Regulations.
2 EXPLANATION OF THE PURPOSE AND FORMAT OF INFORMATION PROVIDED UNDER REGULATION 33

The information provided under Regulation 33 is in two parts: the conservation objectives, and the advice on operations. The legal context for each of these elements, the format of the advice and its underlying rationale are explained here. Sections 5 (conservation objectives) and 6 (operations advice) should be read in conjunction with these explanatory notes.

2.1 CONSERVATION OBJECTIVES

2.1.1 LEGAL BACKGROUND

The conservation objectives for a European marine site are intended to represent the aims of the Habitats and Birds Directives in relation to that site. The Habitats Directive requires that measures taken under it, including the designation and management of SACs, be designed to maintain or restore habitats and species of European Community importance at “favourable conservation status” (FCS), as defined in Article 1 of the Directive (see Table 1).

Table 1: Favourable conservation status as defined in Article 1 of the Habitats Directive

<table>
<thead>
<tr>
<th>Conservation status of a natural habitat</th>
<th>means the sum of the influences acting on a natural habitat 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 within the territory referred to in Article 2.</th>
</tr>
</thead>
</table>

The conservation [sic] status of a natural habitat will be taken as ‘favourable’ when:

- its natural range and the 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
- conservation status of typical species is favourable as defined in [Article] 1(f).

<table>
<thead>
<tr>
<th>Conservation status of a species</th>
<th>means the sum of the influences acting on the species concerned that may affect the long-term natural distribution and abundance of its populations within the territory referred to in Article 2;</th>
</tr>
</thead>
</table>

The conservation status will be taken as ‘favourable’ when:

- population dynamics data on the species concerned 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

Guidance from the European Commission\(^7\) indicates that the Directive intends FCS to be applied at the level of an individual site, as well as to habitats and species across their European range. Therefore, in order to properly express the aims of the Habitats Directive for an individual site, the conservation objectives for a site are essentially to maintain (or restore) the habitats and species of the site at (or to) FCS.

2.1.2 PRACTICAL REQUIREMENTS

In practical terms, the conservation objectives for a site set the standards which must be met if the habitats and species (collectively referred to as “features”) are to be at FCS. There are four elements to this. The conservation objectives must

(i) form the basis for proactively identifying what actions, if any, need to be taken by those bodies responsible for the management of operations in and around the site, in order to conserve the features.

(ii) inform the consideration of proposed developments, or “plans or projects”\(^8\), which are likely to significantly affect the features of the site. In order for a plan or project to proceed, it must be ascertained that it will not adversely affect the “integrity of a site”\(^9\). This depends on whether or not the plan or project will adversely affect the conservation status of one or more of the features and therefore requires direct reference to the conservation objectives.

(iii) set the standard against which CCW reports to government on the conservation status of the features on the site. Government in turn will use this information, together with that from other SACs and on the status of habitats and species outside designated sites, to report to the EC on the implementation and effectiveness of the Habitats Directive.

(iv) set the standard against which the appropriateness of management can be judged. If the conservation objectives are not being met it may be due to inappropriate management of the site, or to factors originating outside the site or outside the control of those responsible for management, or a combination.

To achieve this we provide conservation objectives covering all the elements of FCS as set out in the Directive, at the same time as being suitable for guiding the preparation of management plans and testing the acceptability or otherwise of the effects of plans and projects. Table 2 indicates the various aspects of conservation status described in this package to help explain the conservation objectives. CCW also uses a related set of “performance indicators” which supports monitoring\(^10\) and allows judgements to be made about site condition\(^11\) and conservation status of features for purposes such as reporting and review of management.

The results of the monitoring of feature condition combined with information on security and suitability of management and the results of surveillance support the making of judgements about whether or not the conservation objectives are being met. Knowledge of the dynamics of many marine species and communities and their sensitivity is limited. Accordingly, in many cases it is not yet possible to identify values above or below which conservation status would be considered unfavourable. Surveillance\(^12\) is necessary to:

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8 Plans and projects are certain types of operation that the Habitats Directive and Regulations require be subject to specific procedures. Plans or projects considered likely to have a significant effect on a European (marine) site must be subject to appropriate assessment of their implications for the site in view of the site’s conservation objectives. The carrying out of an appropriate assessment must include consultation with CCW, and such consultation is a separate process to the advice in this document. The information in this document is intended to assist in the identification of plans and projects which are likely to require appropriate assessments, and will form the basis for advice given by CCW in relation to individual plans and projects.

9 “Integrity of the site” is not defined in the legislation, but has been defined by the UK government as “the coherence of its 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 was classified [i.e. designated]”. This definition is similar in intent to FCS.

10 Monitoring is defined as “Surveillance undertaken to ensure that formulated standards are being maintained. The term is also applied to compliance monitoring against accepted standards to ensure that agreed or required measures are being followed.” (A statement on Common Standards Monitoring, 1998, Joint Nature Conservation Committee, Peterborough. http://www.jncc.gov.uk/page-2198

11 The status of the site at a particular moment in time.

12 Surveillance is defined as “a continued programme of surveys systematically undertaken to provide a series of observations in time” (A statement on Common Standards Monitoring, 1998, Joint Nature Conservation Committee, Peterborough. http://www.jncc.gov.uk/page-2198
gain a greater understanding of feature and factor variability,
provide information which can assist in the interpretation of the results of monitoring of the performance indicators e.g. information on trends in other attributes and factors can assist the identification of the causes of changes observed in the performance indicators;
improve the overall level of understanding of the site, its features and the factors affecting them.

The performance indicators and surveillance requirements for the features of the site are not included in this document. Information about these will be provided by CCW in due course.

Each of the habitat features of the SAC represents part of the range and variation of that feature within the UK and Europe. The SAC and all its features makes up part of a suite of sites across the UK that were selected to represent the range and variation of all relevant features within the UK, and to become part of the pan-European network of conservation areas – Natura 2000. Additional information about the selection of SACs in the UK is provided on the website of the Joint Nature Conservation Committee13.

<table>
<thead>
<tr>
<th>TABLE 2: Elements of favourable conservation status described in this document to help explain the conservation objectives*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(I) For each HABITAT feature</strong></td>
</tr>
<tr>
<td>• RANGE – including distribution and extent</td>
</tr>
<tr>
<td>• STRUCTURE &amp; FUNCTION – including geology, sedimentology, geomorphology, hydrography &amp; meteorology, water and sediment chemistry and biological interactions</td>
</tr>
<tr>
<td>• TYPICAL SPECIES – including species richness, population dynamics and range and as defined for species features (below)</td>
</tr>
<tr>
<td>• NATURAL PROCESSES</td>
</tr>
<tr>
<td><strong>(II) For each SPECIES feature</strong></td>
</tr>
<tr>
<td>• POPULATION – including size, structure, production and physiological health</td>
</tr>
<tr>
<td>• RANGE – including areas of the site which the population/individuals use</td>
</tr>
<tr>
<td>• SUPPORTING HABITATS &amp; SPECIES – including distribution and extent, structure, function and quality and prey availability &amp; quality.</td>
</tr>
</tbody>
</table>

For both habitats and species information is provided on natural processes, current condition and modifications as a result of human activity.

More detail on why these elements are important is provided in Appendix 4

*The information is limited by the availability of data and in many cases our understanding of these elements is incomplete. All descriptions are therefore based on the best available information at the time of writing.

2.2 OPERATIONS WHICH MAY CAUSE DETERIORATION OR DISTURBANCE

2.2.1 LEGAL CONTEXT

CCW’s specific duty in Regulation 33 to give advice on operations that are potentially damaging, needs to be seen in the context of the Habitats Directive, which requires that for a SAC:

• the necessary conservation measures are established which correspond to the ecological requirements of the habitats and species on the site;

13 [http://www.jncc.gov.uk/page-2198](http://www.jncc.gov.uk/page-2198)
• appropriate steps are taken to avoid deterioration of habitats and significant disturbance of species.
• any plan or project which is likely to have a significant effect on a site is subject to an appropriate assessment in view of the site’s conservation objectives.

The operations advice, in combination with the conservation objectives, is designed to assist relevant authorities and other decision-makers in complying with these provisions. The operations advice given in this document is without prejudice to other advice given, including the conservation objectives themselves and other advice which may be given by CCW from time to time in relation to particular operations.

The term “operations” is taken to cover all types of human activity, irrespective of whether they are under any form of regulation or management. This is because the obligations in the Directive are defined by the conservation requirements of the habitats and species, not by existing regulatory or management regimes. Thus the advice contains reference to operations which may not be the responsibility of any of the relevant authorities.

2.2.2 PRACTICAL REQUIREMENTS

Operations manifest themselves through one or more factors. The conservation status of a given habitat or species could potentially be affected by many different types of factor, and hence many different types of operation. The key practical purpose of the Regulation 33 operations advice is to assist in the identification of priorities for management, by identifying operations to which features are both ‘sensitive’ and ‘vulnerable’. Sensitivity is defined as ‘the intrinsic intolerance of a habitat, community or individual of a species to damage from an external factor.’ Vulnerability is defined as ‘the likelihood of exposure of a habitat, community or individual of a species to a factor to which it is sensitive’. Thus the potential for an operation to deteriorate or disturb a feature depends both on the sensitivity of the feature to the operation – through its associated factors - and the location, intensity, duration and frequency of the operation and the factors that it affects or causes.

Formulating the operations advice has three main elements:

1. Identifying factors to which the features are sensitive.
2. Identifying the types of operation that can cause or affect those factors.
3. Assessing the likelihood of those factors (and hence the features) being affected by those operations, in other words the vulnerability of the feature to those effects.

The first and second of these elements relies on current understanding of the inherent sensitivity of features to particular factors, and the effect of operations on factors. Although there will be site-specific elements to this information, it may often rely on information from a variety of sources which are not specific to this site. The third stage is very site-specific, relying on information about the types, location, intensity, duration and so on, of operations occurring or likely to occur in or around the site.

Given that in many cases, information of the type indicated in the previous paragraph is rudimentary, or simply not available a precautionary approach is adopted for the identification of factors and

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14 The term also includes what the Habitats Directive and Regulations call “plans and projects” (see footnote 9).
15 A factor is defined as “A component of the physical, chemical, ecological or human environment that may be influenced by a natural event or a human activity” (Sensitivity and mapping of inshore marine biotopes in the southern Irish Sea (Sensmap): Final report. CCW, Bangor, December 2000.)
16 The complexity of formulating operations advice is compounded by the “many-to-many” relationship that exists between operations and factors, where an operation may manifest itself through several factors, and a factor may be affected by several operations, in different ways and to different magnitudes.
operations. This means that where there is uncertainty about the relevance or otherwise of a factor or operation, CCW favours including it in Regulation 33 advice. The output from this process is a list of operations that CCW considers may cause deterioration or disturbance to the features of the site, with accompanying information on the factors through which each operation affects the feature. The operations advice clearly has to be based on the best available knowledge at the time and is subject to continual review. It necessarily involves an element of risk assessment, both in terms of assessing the likelihood of an operation or factor occurring, and the likelihood of it having an adverse effect on a feature.

CCW’s advice to the relevant authorities is that, as a minimum, the extent and management of the operations identified in Section 6 should be reviewed in the context of the conservation objectives. The list should also help identify the types of plans or projects that would be likely to have a significant effect and should be subject to appropriate assessment, noting that such judgements will need to be made on a case-specific basis.

The advice in Section 6 of this document is not a list of prohibited operations, or operations necessarily requiring consultation with CCW, or CCW’s consent. The input of the relevant authorities and others is a legal and practical necessity in determining the management needs of the site. Thus, the operations advice is provided specifically with the intention of initiating dialogue between CCW and the relevant authorities.

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18 However, in relation to land included within the SAC, which has been notified as a Site of Special Scientific Interest (SSSI), owners or occupiers require CCW’s consent for any operations included in the SSSI notification, and statutory bodies intending to carry out or permit potentially damaging operations must notify CCW and comply with certain other provisions. (Wildlife and Countryside Act 1981, section 28, as amended by the Countryside and Rights of Way Act 2000, section 75). General guidance on the operation of SSSIs is given in the CCW leaflet Sites of Special Scientific Interest: A guide for landowners and occupiers (Countryside Council for Wales, Bangor, 2001).
3 SITE DESCRIPTION

3.1 INTRODUCTION

The Carmarthen Bay and Estuaries SAC is a large site encompassing the estuaries of the Rivers Loughor, Tâf and Tywi (coastal plain estuaries) and the Gwendraeth (a bar-built estuary) (Map 1). There are extensive areas of intertidal mudflats and sandflats with large areas of these flats dominated by bivalves. There is a complete sequence of saltmarsh vegetation, from pioneer vegetation through to upper saltmarsh transitions and it is also important for transitions from saltmarsh to sand dune and other habitats. Carmarthen Bay is an extensive shallow bay with a wide variety of seabed types, including mud, sand and rock, although the majority of the seabed is sandy. The SAC includes Helwick Bank, a linear shallow subtidal sandbank that is unusual in being highly exposed to wave and tidal action. The Burry Inlet and Three Rivers system provides a migratory route for salmonids, lampreys and shad.

The Carmarthen Bay and Estuaries SAC is a multiple interest site which has been selected for the presence of ten interest features that qualify under Annex I and Annex II of the Habitats Directive. For the qualifying habitats and species the SAC is considered to be one of the best areas in the UK for:

- Estuaries
- Mudflats and sandflats not covered by seawater at low tide
- Atlantic saltmeadows (*Glauco-Puccinellietalia maritimae*)
- *Salicornia* and other annuals colonising mud and sand
- Large shallow inlets and bays
- Sandbanks which are slightly covered by sea water all the time
- *Alosa* sp. – shad

and to support a significant presence of:

- *Lampetra fluviatilis* – river lamprey
- *Petromyzon marinus* – sea lamprey
- *Lutra lutra* - otter

The features are distributed throughout the SAC with no single feature occupying the entire SAC and with features overlapping in some locations. The SAC boundary and the general location of the Annex I habitat features are shown in Maps 1 & 3. The latter is an indicative map as the extent of most features is not known precisely and some, such as sandbanks, are dynamic and can be highly mobile. A number of habitats and species also have Biodiversity Action Plans or are on other lists specifying conservation action such as, ‘Nationally Rare and Scarce Species’.

Two Special Protection Areas occur within the Carmarthen Bay and Estuaries SAC; Carmarthen Bay SPA, and Burry Inlet SPA and Ramsar site (Map 2 ii).

3.1.1 SOURCES AND LIMITATIONS OF SITE INFORMATION

All feature descriptions are based on best available knowledge at the present time and in some cases this is limited. For example no information is available on the composition of fauna and other flora associated with the Atlantic salt meadows saltmarsh communities. Maps showing the distribution of the habitats are indicative only and the feature descriptions are provided on the basis of current knowledge and may be subject to change as knowledge improves.

3.2 SUMMARY SITE DESCRIPTION
The Carmarthen Bay & Estuaries SAC encompasses areas of sea, coast and estuary that support a wide range of different marine habitats and wildlife, some of which are unique in Wales.

In places the SAC landward boundary abuts the boundary of SACs encompassing terrestrial / coastal habitats and species and some intertidal areas that are part of the marine SAC have been notified as Sites of Special Scientific Interest (SSSI) (see Appendix 2). The health of adjacent areas such as the Carmarthen Bay Dunes SAC is intimately linked with that of the estuaries and intertidal areas. The Carmarthen Bay SAC also overlaps wholly or in part with the Burry Inlet and the Carmarthen Bay Special Protection Areas classified under the Birds Directive. The location of these SACs, SPAs and SSSIs are shown in Map 2. Carmarthen Bay is also a Geological Conservation Review site for its Coastal Geomorphology.

All references to depths should be taken as Below Chart Datum (BCD) unless stated otherwise.

a) Range
The Carmarthen Bay & Estuaries SAC covers an area from St.Catherine’s Island in the east to just west of Oxwich encompassing the Three Rivers area (Rivers Taf, Tywi and Gwendraeth), the Burry Inlet and Loughor Estuary, and the northern and western parts of the Gower peninsula. It extends out into Carmarthen Bay and includes the Helwick Bank which lies within the Bristol Channel (Map 1).

The features for which the site was selected are distributed throughout the SAC, with no single feature occupying the entire SAC and with some features overlapping in certain locations (Map 3).

b) Structure
i. Geology
Carmarthen Bay was created primarily by the underlying geological features and then infilled with the prevailing mobile substrata and modified by the hydrographic regime. The Bay is underlain and partially bound by Carboniferous and Devonian limestones and sandstones. There are small areas of natural hard substrata in the intertidal zone including bedrock (Wharley Point), scars of cobbles and boulders (Wharley Point, Ferryside, Salmon Point Scar, Whiteford) and mussel beds on cobbles (Salmon Point Scar, Ginst Point, Whiteford Point), but these are poorly represented compared with other inlets in Wales.

ii. Sedimentology
The shores of South Beach (Tenby), Waterwynch Bay, Monkstone beach and Cefn Sidan sands, between the Three River system and the Burry Inlet, are mainly mobile fine and medium sands while the mudflats and sandflats of the Three Rivers system and that of the Burry Inlet and River Loughor are mostly sandy gravel or muddy sand. Sheltered sandy gravel shores are found from the edge of Pendine Sands, stretching around into the mouth of the Three Rivers system, where a variety of different sediment types are found. The mouth of the Three Rivers system is dominated by moderately mobile fine sands that are continually shifted by waves and tidal action and Mid-Flandrian peats are present intertidally and subtidally in this system.

Sediment types range from mobile fine and medium sands, muddy sands, sandy and silty muds, and pure muds, to limited areas of exposed immobilised sandy and / or muddy gravel pavements of glacial provenance. There is a gradation within the distribution of sediments, from mud in the upper, more sheltered regions of the estuaries, to sand at the more wave-exposed mouths of the estuaries. Inputs of fine sediments from rivers into all of the estuaries are small, compared to other sources such as inward migration from the sea.

The seabed sediments of the Helwick Bank area are predominantly uniform, medium fine sands with little or no fine or organic material. The more landward side of Helwick Bank is comprised of finer sands. To the south of the Bank, in deeper water, there are some uniform gravelly sands with no bedforms, as well as irregular sand patches on gravel.

8
iii. Geomorphology
Carmarthen Bay is an excellent example of a coastline whose outline was moulded by marine and sub-aerial processes throughout the Quaternary period, but where the shoreline and its detail is much more recent in origin. The modern shoreline is a very dynamic one, as a result of the growth of spits, dune and saltmarsh development, changes in intertidal and deeper water bathymetry and erosion of both beaches and cliffs (Geological Conservation Review). There are four estuaries in the SAC formed by the rivers Tywi, Taf, Gwendraeth and Loughor. They form a single functional unit with important interchanges of sediment and biota especially within the ‘Three Rivers’ which converge and exit into Carmarthen Bay through a common mouth. There has been considerable sedimentation in the Three Rivers and Burry Inlet during and since the rise in sea level in the post-glacial era. The intertidal and subtidal sediments are thought to be derived largely from Carmarthen Bay.

The mudflats and sandflats range from narrow beaches to very expansive areas of gently sloping, almost horizontal, flats, to steeply inclined levees. Many of the saltmarshes are dissected by small creeks and channels, which provide microhabitats within more uniform areas of marsh. Saltpans and small pools add diversity to the site, and are an intrinsic part of many marshes. An important feature of the site is the undisturbed transition to coastal habitats in some areas. The marshes on the southern side of the Burry Inlet between Whiteford Point and Loughor in particular are of national significance in respect of a variety of geomorphological features.

Helwick sandbank is located in open water to the south of Worms Head off the Gower Peninsula. The feature is a linear, very shallow, subtidal sandbank that is the most highly exposed to wave and tidal action of all the Welsh sandbanks.

c) Function
i. Hydrography and meteorology
The SAC is characterised by largely mixed, variable salinity water typical of macrotidal estuaries, and in Carmarthen Bay salinity varies from low to fully marine. During spring tides the tidal range is around 7.5 m at Burry Port, whereas during neap tides it is around 3.6 m. At Ferryside on the Tywi the tidal rage at spring tides is 6.6 m and 2.7 m during neap tides. The tidal range decreases up estuary and the bathymetry of the Loughor Estuary causes a lag time in the progression of the flood tide up the estuary. In the Burry the tidal wave is symmetrical near the mouth but increasingly asymmetrical away from the mouth with the ebb becoming increasingly longer than the flood tide. This results in greater velocities on the flood than the ebb which affects sediment transport. The shallow gradients within the estuary result in large areas of intertidal flats and salt marsh within the estuary.

ii. Water and sediment chemistry
Water quality has been classified as grade A (EAW year 2000 figures) in the Three Rivers system, apart from the upper reaches of the Tywi estuary that has been classified grade B. The Loughor estuary has a water quality rating A. Available nitrogen and phosphorus levels are in excess of the criterion indicating hypernutrification in the upper estuary which has been linked to high numbers of algal cells and chlorophyll a concentrations. In addition, there have been inputs of heavy metals from industry and redundant coalmines in the estuaries.

iii Sediment processes
Within the estuaries the extensive sandflats above the mid-shore are fairly stable and flat. Below this the sandflats up to and beyond Loughor bridge are very mobile with large sandwaves and ripples. Sandbanks in the entrance are particularly mobile.

d) Typical species
A variety of intertidal and sublittoral biotopes are present reflecting the range of physiographic conditions. The estuaries of this site support a range of subtidal and intertidal sediments that grade
from sand at the mouth to mudflats in the upper estuary. The fauna of the sediments varies, but includes communities with polychaete and oligochaete worms and areas with extensive cockle beds. The populations of the cockle *Cerastoderma edule* in the Burry Inlet and the Three Rivers are very large compared with other similar estuaries such as the Taw/Torridge and Camel.

The intertidal rock biotopes are subject to sand scour resulting in low species diversity but support barnacles and mussels as well as brown seaweeds on more sheltered cobble areas. Some areas of soft sediment, such as in the Burry Inlet support marine communities characterised by the dwarf seagrass *Zostera noltei*. Seagrass stabilises the sediment and is an important source of organic matter as well as providing shelter and surface for attachment by other species and food for wildfowl. The intertidal soft sediment coastline of Carmarthen Bay is characterised by extensive and substantial strandlines with a wealth of invertebrate fauna.

Subtidal habitats are of limited extent due to the estuaries largely draining at low tide. The mobile, sandy sediments are characterised by the presence of low numbers of amphipods, isopods and robust, mobile polychaetes. Species found on the Helwick Bank are mostly characteristic of mobile sands and gravels.

The estuary systems have exceptionally well developed saltmarsh to sand dune transitions, with a complete sequence of saltmarsh vegetation, including transitions to upper saltmeadow and to important sand dune habitats.

### 3.3 BURRY INLET SPA AND RAMSAR SITE

In 1992 the Burry Inlet was recommended as a Special Protection Area under the Birds Directive (79/409/EEC) because of the site’s European ornithological interest. The site qualifies under Article 4.2 of the Directive as it is used regularly by 1% or more of the biogeographic population of regularly occurring migratory species: knot *Calidris canutus*, oystercatcher *Haematopus ostralegus*, pintail *Anas acuta*, and redshank *Tringa totanus*.

The area qualifies under Article 4.2 of the Directive by regularly supporting at least 20,000 waterfowl, including: curlew *Numenius arquata*, dunlin *Calidris alpina alpina*, grey plover *Pluvialis squatarola*, shelduck *Tadorna tadorna*, shoveler *Anas clypeata*, teal *Anas crecca*, turnstone *Arenaria interpres*, and wigeon *Anas penelope*.

The Burry Inlet SPA regularly supports large numbers of overwintering wildfowl and waders that feed in the saltmarshes and on the intertidal areas and is the most important wholly Welsh estuary for overwintering waterfowl and is particularly significant for oystercatcher.

- The site is used regularly by ca. 1.6% of the biogeographic population of migratory and overwintering oystercatcher. The 5 year peak mean for 1991/92-1995/96 was 13,590 individuals.
- The site is used regularly by ca. 3.0% of the biogeographic population of migratory and overwintering pintail. The 5 year peak mean for 1991/92-1995/96 was 1,772 individuals.
- The Burry Inlet SPA is used regularly by ca. 0.6% of the biogeographic population of migratory and overwintering knot. The 5 year peak mean for 1991/92-1995/96 was 2,153 individuals.

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19 CCW’s advice focuses on the qualifying species for which the SPA was originally classified in 1992, despite the fact that numbers and species composition may have changed on this site since that time. Such population and species composition changes have been documented through the UK SPA Network Review, led by JNCC, which will provide advice to Ministers on any changes in SPA citations required. Depending on the outcome of this review and decisions from DETR and the Welsh Assembly Government, CCW may need to reissue this advice with updated bird information required.
- The *Burry Inlet SPA* is used regularly by ca. 0.3% of the biogeographic population of migratory and overwintering redshank. The 5 year peak mean for 1991/92-1995/96 was 616 individuals.

A 5 year mean peak count in excess of 34,960 waterfowl has been recorded (30/06/1999). Waterfowl assemblage species include curlew *Numenius arquata*, dunlin *Calidris alpina alpina*, grey plover *Pluvialis squatarola*, knot *Calidris canutus*, oystercatcher *Haematopus ostralegus*, pintail *Anas acuta*, redshank *Tringa tetanus*, shelduck *Tadorna tadorna*, shoveler *Anas clypeata*, teal *Anas crecca*, turnstone *Arenaria interpres*, and wigeon *Anas penelope*.

The Burry Inlet is a large estuarine complex; it includes extensive areas of intertidal sand- and mudflats, together with large sand dune systems at the mouth of the estuary. The site contains the largest continuous area of saltmarsh in Wales (2,200 ha). The estuary experiences wide tidal fluctuations (about 8 m), which has the consequence of exposing a large extent of intertidal sediments on a regular basis. These are mostly sandy, but muddy substrates are to be found in more sheltered areas. The plethora of habitats provides for important feeding grounds and resting areas. In places, the extensive mud and sandflats support substantial populations of marine invertebrate species, which provide an important food source for the large numbers of overwintering waterfowl found here.

Specialist feeders such as oystercatcher and knot that feed exclusively on shellfish (cockle *Cerastoderma edulis* and mussel *Mytilus edulis*) outside the breeding season can be vulnerable if in competition with the commercial exploitation of these resources. There is a well established, very intensive hand-gathering cockle fishery in the Burry Inlet, and an increasing demand for mussel seed (for relaying) from the area. One policy to prevent shellfishing from harming birds is to ensure that enough food remains after harvesting to meet most or all of their energy demands. Using simulations with behaviour-based models of the Burry Inlet, Goss-Custard *et al.* (2003) showed that even leaving enough shellfish to meet 100% of the birds’ demands may fail to ensure that birds survive in good condition. Although shellfish may be sufficiently abundant, the actual distribution and density of cockle / mussel beds meant that the birds couldn't consume all these cockles. Increased cockle abundance may not actually help – it is available foraging area that is important. There is also a problem that if birds are displaced by the fishermen – they will then feed in the remaining areas at higher (bird) density and therefore lower efficiency.

Site visits have established a generally lively pattern of flight lines along and across both shorelines and estuary.

### 3.4. CARMARTHEN BAY SPA

Carmarthen Bay has been designated as a Special Protection Area under the Birds Directive (79/409/EEC) because of the site’s European ornithological interest. The site qualifies under Article 4.2 of the Directive as it is used regularly by 1% or more of the biogeographic population of a regularly occurring migratory species: common scoter *Melanitta nigra*. Non-qualifying species of interest are red throated diver *Gavia stellata*, velvet scoter *Melanitta fusca*, eider *Somateria mollissima*, Manx shearwater *Puffinus puffinus*.

The *Carmarthen Bay SPA* is used regularly by ca. 1.1% of the biogeographic population of migratory and overwintering common scoter. The 5-year peak mean for 1997/98 to 2001/02 was 16,946 individuals with the biogeographic population estimated to comprise of 1.6 million individuals. Within the U.K, Carmarthen Bay is the most important site for migratory and overwintering common scoter.

The first record of common scoter in Carmarthen Bay was made in 1938, when “1000+” were seen off Cefn Sidan. Until recently records were sporadic, often consisting of only partial counts of the Bay. These records showed the number of scoters in the bay to be very variable, probably due to differing census areas as well as reflecting actual changes in scoter numbers. However, data from
1995 to present day show that Carmarthen Bay is regularly used by large numbers of common scoter. Peak counts include 25,000 in 1974 (Sutcliffe, boat count), 19,700 in 1999, and 22,000 in 2000. Aerial surveys of the Bay have been conducted in the past. These provided quick, extensive coverage of the Bay, although ground counts in the northern part of the Bay revealed significantly larger numbers of ducks than aerial counts, indicating that birds are missed from the air. Regular land-based observations of common scoter in Carmarthen bay, particularly since the late 1990s, have established a reasonably regular pattern of numbers and distribution during the course of the winter (L. Smith pers. obs.).

Common scoter return to Carmarthen Bay in late July to early September. There are two peaks, the first relatively small in August/September as birds arrive either straight from breeding grounds or from other staging areas, when birds may moult at the site, the second (normally providing the largest annual numbers) occurring in mid to late winter (December to January). Numbers then fall as scoter start their spring migration to breeding grounds.

The timing of first arrival, the two peaks and eventual departure vary from year to year, probably in response to weather conditions and food availability at other sites in the range. Distribution of common scoter in the Bay also varies within and between years, presumably due primarily to local food availability (and particularly the spat-fall of favoured prey species). Weather and disturbance may also influence the pattern observed on individual days, although the effect of these factors is likely to be more short-lived.

The number of scoter in August 2001 was higher than in previous years, having ranged between 137 and 2,048 over the last five years (WWT Wetlands Advisory Service 2000). The concentration of the 7,299 birds in the east of the Bay, particularly around Pembrey (with only 400 in the north) contrasts with the previous three years, when, although there were far fewer scoter, the majority were located in the north. Although there was a slight decrease in September, numbers were again much higher than previous September counts (range 1,000-4,000), and may have resulted from an earlier than normal westward migration from core areas (perhaps due to weather or low food abundance). There is a fairly even distribution of Common scoter in the north (1998 & 1999) or the east (1997 & 2000).

The October total of just under 5,000 compares with October peaks in the preceding two winters of approximately 19,000. Other October counts in those years, however, show much smaller numbers (ca. 3,000), immediately prior the main winter arrival. The dip in counts at this time suggests that the initial influx of scoter to Carmarthen Bay is of birds which then move to more southerly wintering areas, replaced by a different sub-population during the winter months. Distribution remained similar to September and to previous October counts. Rhosilli supported very few scoter, although large numbers have only been recorded in this part of the Bay in the two years following the Sea Empress oil spill when western areas of the Bay were affected by oil.

The November count recorded much higher numbers, consistent with the arrival of the second influx of scoter (numbers having ranged between 2,721 and 19,710 in previous winters). Although the majority of birds were in the north, Pembrey again held a larger proportion than is usual for November. Counts in December were relatively unchanged and consistent with previous years (12,361 to 13,528). There was, however, a markedly dense concentration, particularly two 2x1 km cells, off Pembrey. Scoter in the north were more evenly spread, the distribution extending east towards Amroth as in previous Decembers. No count was made in January due to consistently poor weather. It should be noted that, in most previous years, the peak count has occurred in this month. February’s count of 20,078 was much higher than past counts for this month (range 3,200 to 8,600), the majority in the north (15,650) and fairly close inshore. Numbers remained much higher than normal in March (usually 2,900 to 8,600), although 10,631 were recorded in March 1996, the peak count of that year. Distribution remained very similar to February.

Scoter numbers in Carmarthen Bay in winter 2001/02 were thus somewhat unusual, with higher numbers at the start and end of the late summer/winter period than in previous years. Pembrey held
proportionally more birds than in previous winters, with very concentrated flocks in two 2x1 km cells suggesting perhaps high food abundance in this location, although the observed distribution may have also been an effect of more temporary factors (e.g. disturbance) and more frequent observations would have been required to confirm the consistency of this pattern.

Despite small onshore and offshore movements throughout the season, comparison of the distribution maps with the bathymetry indicated on admiralty charts shows that water depth of preferred areas has remained constant: less than 2 m at Pembrey, and less than 5 m in the north of the Bay.

The total number of common scoter observed in Carmarthen Bay 2001/02 exceeded the international 1 % threshold for common scoter (16,000, Wetlands International 2002) and was the third winter in succession that this threshold had been exceeded (L. Smith pers. comm.). Counts in the two winters prior to this (1996/97 and 1997/98) were much lower, following the Sea Empress oil spill. There has been a recovery in numbers subsequently, and the counts obtained in recent years have provided justification for designation of the site as the first UK marine SPA, which was undertaken in 2003.

Numbers of common scoter using the Bay vary throughout and between years. In summer numbers are generally very low as most scoters have migrated to breeding grounds. However, there are occasional records of very large numbers, e.g. 10,000 in July 1976. Scoter start returning from breeding grounds in July-August, leading to a peak in numbers in August. The August peak is probably due to scoter passing through to more southerly overwintering grounds, and is typically followed by reduced numbers through September to October. Numbers build again through November, and the annual peak is typically in December–January. From late January numbers slowly decrease until late April, by when most birds have left. Distribution of birds throughout the Bay also changes through the year. In late summer, Cefn Sidan and Pembrey are both very important sites in terms of numbers of scoter, but through the rest of the year Pendine to Amroth is the most favoured area. Lovegrove (1977) reported the preferred areas to be Cefn Sidan / Burry Inlet throughout the season. Whether this is due to genuine changes in distribution of overwintering flocks or to bias in the sampling method is hard to assess. There is probably much movement between sites, and changes in favoured sites, especially from year to year.

The ratio of males to females changes through the season. In late summer there is a strong dominance of males; ratios greater than 9:1 have been recorded as males head south from breeding grounds before females. The number of females increases through to mid-winter when there can be 65 % females and immature birds

Carmarthen Bay is a wide, shallow bay west of the Gower Peninsula. It is approximately 28 km from east to west by 20 km north to south. The surrounding coastline consists of extensive sandflats and dunes to the northeast, and cliffs to the west and southeast. Four important estuaries with sand, mud and saltmarsh habitats flow into the bay.

With its apex in the southwest, the arc of Carmarthen Bay forms a regularly sloping amphitheatre from around 30 m to the shore. The seabed between the 2 m and 10 m isobaths stretches uninterrupted from Worms Head in the east around to Caldey Island in the west, seemingly unaffected by the river channels of the Loughor and the Three Rivers System. An interesting feature off Rhossili Bay is the area of shallowly sloping seabed stretching to the southwest below the 10 m isobath. This area forms a relatively steep sided shelf whose contours are generally 5 m shallower than those parallel to it. To the immediate east of Caldey Island there is a fairly steep drop into deeper water.

The shallow nature of the Bay suits common scoter, which typically occupy waters less than 10 m in depth, allowing them to feed on benthic communities (on and within sand dominated bottom sediments) up to 10 km offshore.

The sediment throughout the Bay varies from clean sand, from Caldey to West Gower, with mixed muddy grounds and muddy sands to the south and west. The seafloor of Carmarthen Bay consists of
wide areas of fine and medium sand interspersed with patches of finer and coarse material. Patches of coarse material and hard ground are found in deeper water and in areas subject to current scour; foremost to mention the areas around Caldey Island and Worms Head. The inshore areas of Saundersfoot Bay are characterised by very fine sand, with further patches also apparent in Rhossili Bay. There are a series of mud and fine sand patches running parallel to the shelf feature described above. The deposition of mud and fine material and general orientation would suggest that they are under the influence of the Loughor Estuary outflow.

Outside the breeding period, common scoter are predominantly marine, resting and feeding in flocks in shallow, inshore waters, generally 500 m to ca. 2 km from land, where depth not more than 10 to 20 m and animal food are abundantly accessible. In such conditions scoter are exposed to strong wave action or rapid currents, but more rugged, sheltered coastlines rarely fulfil their requirements.

Feeding areas of the common scoter in Carmarthen Bay have been identified previously. These sites lie in an area starting at Monkstone Point in the west, stretching off Saundersfoot and Amroth, to Pendine Sands in the east, broadly corresponding to an area between the 2 and 5 metre depth isobaths. A smaller number of birds have also been recorded in deeper water (12 to 16 m) off Rhossili Bay / Worms Head.

The potential feeding area (based on distribution and abundance of prey species) within the **Carmarthen Bay SPA** is large, from north of a line stretching east from Tenby across the Bay towards Burry Holms, stopping at an approximate 8 km south of Pembrey Sands. The majority of this area is above the 10 m isobath, well within the diving ability of the common scoter. A review of nine common scoter diet studies observed that although common scoters take a wide variety of prey items (43 taxa in total), molluscs, and particularly bivalves, were prevalent in all studies. Sizes of prey were reported to range from 7.7 mm to 40 mm shell length.

In marine and brackish-water areas, scoter feed especially on blue mussel *Mytilus edulis*, fewer cockles *Cardium*, clams *Mya* and *Spisula* and other bivalves (*Venus*, *Tellina*, *Macoma*, *Solen*, *Venerupis*, *Cyprina*, *Nucula*, *Saxicava*), and gastropods, dogwhelk *Nassa recitulata*, periwinkles *Littorina*, and laver snails *Hydrobia*. They feed occasionally on crustaceans, particularly isopods (*Idotea*), amphipods (shrimps *Gammarus*), and small crabs (*Carcinus*); annelids (polychaetes); and echinoderms.

In Carmarthen Bay, the largest and most widespread group of benthic invertebrates is characterised by the polychaetes *Spiophanes bombyx*, *Magelona filiformis* and *Chaetozone setosa*, the bivalves *Fabulina fabula*, *Mysella bidentata* and *Chamelea gallina*, and the amphipod *Bathyporeia tenuipes*. This group is classified as belonging to the *Tellina* sub-community of the Shallow *Venus* community with the main biotope being “Sublittoral sand and non-cohesive muddy sand, *Fabulina fabula* and *Magelona mirabilis* with venerid bivalves in infralittoral compacted fine sand”. The above invertebrates, foremost the bivalves, are thought to form a good source of food for the scoter in the **Carmarthen Bay SPA**. However, the patchy distribution of prey species, especially those of larger year classes, may be pertinent to the distribution of the common scoter in the **Carmarthen Bay SPA**.

Past records have indicated that birds present in August are moulting. It has been suggested that Cefn Sidan is an important moult site in the Bay, although Woolmer *et al.* (2001) saw no evidence of large numbers of moulting birds. One possible reason for preference by scoter for the east at this time, rather than the mid-north, which is the preferred area throughout the rest of the year, may be its relative lack of marine disturbance. Sea duck prefer areas with low frequency of disturbance by man. This is especially true whilst birds are moulting, when they are particularly vulnerable through their inability to fly. During moult, birds need areas with low disturbance and abundant food although disturbance was suggested to be an important factor determining scoter distribution in a study which failed to find a relationship between scoter and benthic community distribution. The greater usage of Cefn Sidan in the moult period may be explained by the relative lack of disturbance at this site compared to the Pendine to Amroth area.
Common scoter often fly in long formations, and normally at low altitude, but they fly fairly high overland. Between July and October, scoter undergo a post-breeding moult, with males moulting about one month before females. During this moult they shed their flight feathers, and so cannot fly.

3.5 OPERATIONS WITHIN THE SAC

The area surrounding Carmarthen Bay and its estuaries is predominantly rural with a relatively small and steadily declining heavy industry centred at Llanelli. The site and surrounding coastline is heavily used for a wide range of commercial and recreational activities. The major coastal settlements include Tenby, Burry Port, Llanelli, Loughor and West Swansea, with Tenby, Saundersfoot and Pendine being tourism hotspots. The coastal settlements give rise to localised pressures on the marine environment.

Extensive reclamation of saltmarshes, undertaken chiefly in the 19th Century, has taken place along the southern shoreline of the Burry Inlet and along the Taf Estuary. Sea defences, including sea walls, rock armour, gabions and groynes, now bound significant stretches of the bay and its estuaries. In addition, protection of coastal railway tracks that straddle the north coast of the Burry Inlet between Llanelli and Burry Port, and between Kidwelly and Ferryside, also act as coastal defences and prevent the inland migration of coastal habitats under a rise in relative sea level.

Aggregate extraction takes place at Helwick Bank which was granted a 7-year license to dredge at a rate of 150,000 tonnes per annum. The saltmarshes found exclusively within the estuaries are extensively grazed, at times, at great intensity.

There are small to medium-scale harbour facilities at Llanelli, Burry Port, Tenby and Saundersfoot, with the total number of moorings (including at Llansteffan, Ferryside and Loughor) approaching 1,000. Some approaches and navigations channels into these facilities are being maintenance-dredged intermittently. Some of the arisings are being used locally at Tenby and Saundersfoot for beach recharge.

Recreational boating of a variety of types is popular throughout the EMS, including sailing, low and high-powered craft (including jet-skis), kayaking and kite surfing. Recreational sea angling is also extremely popular and takes place from the shore and from boats, with a number of charter boats operating within the EMS. Levels of bait collection, including for a variety of marine worms and soft shelled ‘peeler’ crab, are consequently high.

There have been historical changes in sewage treatment and disposal. A historical long-term increase was followed by a relatively recent decrease in solids and nutrients outputs, and changes in disposal points. Most recently there have been short-term variations in discharge locations, volumes and treatment, reportedly with more less-treated outputs via CSOs. Several estuaries are hypertrophic.

The area is very important for commercial shellfish and finfish fisheries. The Burry Inlet cockle fishery is regulated whilst commercial cockle gathering operations in the Three Rivers Estuary and western Carmarthen Bay are not. Since 2004, cockle mass-mortalities have occurred annually for as yet unknown reason(s). Consequently mussel and mussel seed fisheries have intensified and become increasingly more important. Capture fisheries take place for a variety of species including crabs, lobsters, whelks, bass and various flatfish, including rays.

3.6 MODIFICATIONS AS A RESULT OF HUMAN ACTIVITY

Many anthropogenic activities have the potential to affect the structural and functional characteristics of the SAC and these effects are considered to be significant where a subsequent detrimental impact
on the species and communities associated with the five habitat features of the SAC would result. An assessment of the conservation status of each of the habitat features was first reported in 2001 and then again in 2007\(^{20}\).

Various anthropogenic activities currently taking place within the EMS have an influence on the habitat and species features and Section 6 provides additional information on the ways in which activities might affect the features. Some of the activities will have a direct effect whilst others will have an indirect effect, by altering or modifying the physical, chemical and environmental factors and processes (structural and functional characteristics) which affect the habitats and species. Whilst the structural and functional characteristics of the EMS and its habitat and species features are inherently important attributes of the marine ecosystem, it is the effect that these characteristics have on the wildlife of the EMS that is of conservation importance.

Many activities have the potential to create pressure or threat by causing direct damage to habitats, or disturbance to wildlife, for example from noise or high speed activity, or by competing with wildlife for space. Activities currently believed to be actual or potential threats, and either requiring better management or further investigation include (not in any particular order):

- Aggregate extraction
- Levels of exploitation of ecologically important shellfish species (e.g. cockles, mussels and mussel seed, whelks)
- Molluscan shellfish culture (‘ranching’)
- Creation & maintenance of hard engineered coastal defence works
- Land claim
- Over-grazing
- Bait collection, particularly digging
- High speed power craft (including PWCs)
- Disposal of wastes & debris
- Military activity

In addition to human activities that directly put pressure on and threaten wildlife and their habitats, there are other potential threats to the long term sustainability of marine habitats and wildlife. These are both global and local, and may be indirectly caused or influenced by human activity and include:

- Sea level rise
- Coastal ‘squeeze’
- Inadequate fisheries management capability
- Mass mollusc (cockle) mortality events
- Water quality and nutrient enrichment
- Urban water run-off
- Waste & debris
- Modifications to sediment transport
- Short term planning policies and unsustainable development
- Poor public awareness, understanding or interest

Development and management of activities must take account of the EMS, and thus contribute to enabling people and wildlife to co-exist in harmony. However, more information is needed on the distribution, timing and intensity of all activities, but in particular on:

- All forms of commercial fishing
- Angling
- Bait collection of all kinds

• Recreational high speed boating and water-sports
• Off-road motor sports in intertidal areas
• Unregulated wildfowling
• Unregulated rubbish disposal (fly-tipping)
• Unregulated foreshore development
• Unregulated coastal protection & land claim
• Vessel maintenance (including cleaning and painting antifouling)
• Marine wildlife watching / 'eco-tourism'
• Scientific research
• Marine wildlife welfare

Many anthropogenic activities have the potential to affect the structural and functional characteristics of the EMS and these effects are considered to be significant where a subsequent detrimental impact on the species and communities associated with the habitat and species features would result.

4 FEATURE DESCRIPTIONS

4.1 ESTUARIES

Estuaries are defined in the EU Habitats Interpretation Manual\textsuperscript{21} as:

“Downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. River estuaries are coastal inlets where, unlike 'large shallow inlets and bays' there is generally a substantial freshwater influence. The mixing of freshwater and seawater and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal mud and sand-flats. Where the tidal currents are faster than flood tides, most sediments deposit to form a delta at the mouth of the estuary.”

“An estuary forms an ecological unit with the surrounding terrestrial coastal habitat types”

There are four major types of estuary recognised within the EC definition:

1. Coastal plain estuaries: formed where pre-existing valleys were flooded at the end of the last glaciation and usually less than 30m deep, with a large width-to-depth ratio. The main sub-type of estuary, by area, in the UK.

2. Bar-built estuaries: characteristically have a sediment bar across their mouth and are partially drowned river valleys that have subsequently been inundated. Bar-built estuaries tend to be small but are widespread around the UK coast.

3. Complex estuaries: formed by a variety of physical influences, such as glaciation, river erosion, sea-level change and geological constraints from hard rock outcrops. There are few examples of this sub-type of estuary in the UK.

4. Ria estuaries: drowned river valleys, characteristically found in south-west Britain. The estuarine part of these systems is usually restricted to the upper reaches. The outer parts of these systems are little diluted by freshwater and typically conform to Annex I type ‘large shallow inlets and bays’.

Estuaries are widespread throughout the Atlantic coasts of Europe, but approximately one quarter of the area of estuaries in north-western Europe occurs in the UK. The Carmarthen Bay and Estuaries SAC includes coastal plain and bar built estuaries.

4.1.1 Range

Carmarthen Bay & Estuaries SAC is a large estuarine site, encompassing the estuaries of the Rivers Tâf, Tywi, Gwendraeth and Loughor (Burry Inlet). Together they form a single functional unit around the Burry Inlet, with important interchanges of sediment and biota and represent approximately 3.4% of the UK SAC “estuary” resource. The total extent of the intertidal mudflats and sandflats, intertidal hard substrate, subtidal sediment and hard substrate communities, Salicornia communities, Atlantic salt meadows and transitional saltmarsh communities is around 9,500 ha.

The saltmarsh to sand dune transition communities are mainly distributed in the Burry Inlet at Pembrey Burrows, but are also recorded from west Taf and Tywi estuaries, west Penrhyn Gwyn and Penclacwydd (Burry Inlet). The noteworthy transitions occur between grazing marsh and dune slacks within semi-fixed dune systems. Such vegetation is present at a small scale at Morfa Uchaf and Llansteffan on the Tywi, near Ginst Point at the mouth of the Taf and, most impressively, at the western end of the Gwendraeth saltmarsh. At the latter location, conservation value is enhanced by the associated transitions from mid-marsh to tall mesotrophic inundation grassland.

4.1.2 Structure and function

The Carmarthen Bay estuaries were created primarily by the underlying geological features and then infilled with the prevailing mobile substrata and modified by the hydrographic regime. The area is underlain and partially bound by Carboniferous and Devonian limestones and sandstones. Overall the variety and distribution of intertidal sediments extends from well-sorted fine to medium sands at the mouths of the estuaries to muddy sand in their middle reaches and mud in the upper reaches and the back of the shores. The subtidal channels are dominated by mobile sands. This site has a variety of undisturbed transitions to coastal habitats.

- The Tywi is a typical ria or coastal plain estuary that was created by marine inundation of the river valley.
- The Taf is a combination of typical coastal plain and bar-built estuaries. Below Laugharne it is bar-built, due to the easterly growth of Pendine and Laugharne sands; above Laugharne it can be considered a ria or coastal plain estuary.
- The Gwendraeth is a typical bar-built estuary that was created by the north westerly extension of the dune/beach coastal barrier, of which Cefn Sidan sands forms the seaward part. The southern part of the Gwendraeth estuary drains extensive areas of saltmarsh.
- The Loughor (Burry Inlet) is a typical bar-built estuary.

Barrier beaches at the mouths of the estuaries and adjacent coast are a fundamental feature of the estuaries because they absorb wave energy and protect the lower estuary, which allows fine grained suspended sediments to be deposited on saltmarshes within the relatively sheltered estuaries. Sediment moves along the shores by longshore drift to supply recurved spits at Ginst Point, Tywyn Point, Morfa Heli and Whiteford Point. An exposure of subtidal peat to the south of Salmon Scar may have an important influence on the morphology of the Three Rivers estuaries however, further work is required to evaluate its importance.

The feature is characterised by largely mixed, variable salinity water typical of macrotidal estuaries. The mean tidal range for the estuaries is 5.5 m and the typical salinity range is from 33 - 2 °/oo. The tidal curve of these west facing macrotidal estuaries is asymmetric with an ebb duration of almost 10 hours on a spring tide and flood duration of 2-3 hours, the tidal range is at least 6.6m on spring tides.

The annual average freshwater flow is 5.6 m³/s from the Loughor, 7.4 m³/s on the Taf, 43.4 m³/s on the Tywi and 4.8 m³/s on the Gwendraeth. Total flow into the Burry Inlet is 10.2 m³/s. Recent nutrient levels in the water column are unknown, but hypernutrification has occurred in the past in some of the upper estuarine reaches. Sediment nutrient levels are also unknown, but assumed to reflect concentrations in overlying water. The levels of contaminants in the water column and sediments are unknown. However, there have been inputs of heavy metals from industry and redundant coal mines into the estuaries.
The different physiographies and hydrodynamic regimes of the estuaries provide for a wide range of combinations of wave exposure and tidal streams. Generally, above mid-shore the extensive intertidal flats are fairly stable and flat. Below mid-shore the extensive sandflats, are very mobile with frequent large sand waves and ripples. Sandbanks in the entrances of the estuaries are particularly mobile. The estuaries continue to be filled in, driven by rise in relative sea level, superimposed by changes in wind-wave climate.

The Burry Inlet and the Three Rivers system contain an important nursery area for bass *Dicentrarchus labrax* with the juvenile bass presumed to use all of the subtidal habitats during the summer months. The estuaries also provide a migratory route for salmonids, lampreys and shads.

### 4.1.3 Typical species

The estuaries contain both subtidal and intertidal habitats, although the latter are a lot more extensive in this SAC. In addition to the truly marine habitats and associated wildlife, a wealth of coastal and terrestrial habitats are all part of the estuary complex with, in undisturbed or unmodified situations, transitions from marine communities to brackish, maritime, freshwater and terrestrial habitats. A number of these habitats, such as mudflats and sandflats and saltmarshes are recognised as Annex I habitats in their own right.

The mosaic of habitats within the estuaries supports a large variety of different wildlife communities. In the intertidal and subtidal sediments, there are communities of worms, crustaceans and molluscs depending on the type of sediment, the salinity gradient and degree of exposure of the sediment to wave action and tidal streams. Where there is rocky habitat, green and brown seaweeds generally develop with some communities being characteristic of the variable salinity conditions. Transitions from saltmarsh to brackish, maritime and freshwater communities support their own particular assemblages of plants and animals. The estuaries also support an assemblage of mobile species. Estuaries can provide important nursery areas for fish species and also provide a means by which migratory fish species make the transition between the marine and freshwater environments.

The range of benthic communities in the Three Rivers is strongly influenced by the geology, topography and tidal currents, whilst in the Burry Inlet the major factors are salinity, sediment stability and substratum composition. The mobile, sandy sediments are characterised by the presence of low numbers of amphipods, isopods and robust, mobile polychaetes.

The fauna of intertidal sediments includes communities with polychaete and oligochaete worms and areas with extensive cockle beds and other bivalve molluscs. Forty-three intertidal biotopes were recorded in a mapping survey completed in 2000.

These include communities with polychaete and oligochaete worms and extensive cockle beds on intertidal sediments as well as barnacle and mussel dominated communities in areas of sand scoured intertidal rock. A species assemblage characterised by hydroids, ephemeral seaweeds and the winkle *Littorina littorea* in shallow eulittoral mixed substrata pools is more unusual because of its limited geographic distribution and because it is typically only found associated with mussel beds. Within the SAC it occurs on Salmon Point Scar, east of Burry Port, Whiteford Point, west of Penclacwydd and Loughor Bridge.

Relatively undisturbed transitions between saltmarsh and brackish systems are present. These include swamp, mire, mesotrophic grassland and open vegetation communities, and mostly occur in the mid and upper reaches of the Taf and Tywi Estuaries, around the Gwendraeth Estuary, west Pembrey Burrows, west Landimore Marsh, west and upstream of the bridge in the Loughor estuary.

### 4.1.4 Natural processes
The structure of estuaries is largely determined by geomorphological and hydrographic factors, with the original shaping forces having their beginnings in the geological origins of the adjacent land areas and the influence of major geological events such as ice ages and periods of higher and lower sea levels. The shape of the estuaries, their macro- and micro-topography, and bathymetry, are important components of the character of the habitats and influences the distribution and abundance of marine life, i.e. the features’ typical species. It is both determined by, and influences, natural environmental processes and consequently, can be impacted either directly or indirectly (through changes to natural processes) by man.

Estuaries are complex dynamic systems that have a natural tendency to accumulate sediment, thereby changing their form from their original Holocene morphology to a state where tidal energy is dissipated by sub- and intertidal sediment banks. The width and depth of the estuary will therefore change over time towards a state of dynamic equilibrium or “most probable state”.

The velocities of currents passing through the mouth are determined partly by the tidal range and partly by the cross sectional area of the mouth itself. If these velocities are higher than the sediment erosion threshold, erosion will widen the channel and lower velocities will ensue. If velocities are lower than the sediment depositional threshold, deposition will narrow the mouth and higher velocities will ensue. In this way, an equilibrium cross section will evolve which balances tidal prism, velocities and erosion/depositional thresholds. Sea level rise means that estuaries will show a natural tendency to translate inland (roll-over) and may erode at the mouth. Where changes in extent are attributable to the estuary adjusting to equilibrium, then the feature should be determined favourable. Where this process is constrained by hard sea defence, then this would be considered as coastal squeeze. (JNCC CSM Estuaries (version 4)).

A complex pattern and combination of physical, chemical and biological conditions and processes operates within estuaries, with many parameters varying temporally and spatially. These parameters establish the baseline conditions in the estuary and continually shape the estuaries and the habitats and wildlife they support. The key parameters are: the flood hydrograph; the nature of the catchment and its influence on freshwater flow and nutrient and sediment input; the nature of the estuary sediment; and the relatively high sediment levels in the estuaries resulting in low water retention within the estuary system and exposure of significant proportions of sediment at low tide. The biological communities of the estuaries have developed in response to these prevailing conditions and the daily patterns of water flow, exposure, sediment movement and water chemistry.

4.1.5 Modifications as a result of human activity

Compared to many estuaries in the UK, the extent of those in the Carmarthen Bay & Estuaries SAC are relatively uncompromised by extensive land claim although all of the estuaries have undergone significant modifications and are readjusting to their modified physical form. In more recent times saltmarsh was lost during the 20th century, largely to land claim, but half of this area has been compensated for by additional saltmarsh due to sediment infilling of the estuaries.

It is expected that tidal levels will gradually rise in response to global climate change through an increase in the rate of sea-level rise. Floodplains along the upper estuary will experience increased tidal inundation and change to saltmarsh. It is important that the upper estuarine floodplains are protected from development in order to allow changes to occur in the upper estuaries.

Available nitrogen and phosphorus levels are in excess of the criterion indicating hypernutrification in the upper estuary which has been linked to high numbers of algal cells and chlorophyll $a$ concentrations. In addition, there have been inputs of heavy metals from industry and redundant coalmines in the estuaries. Inputs of fine sediments from rivers into all of the estuaries are small, compared to other sources of material (inward migration from the sea). This is reflected in the character of the estuaries and the habitats within them.
4.2  MUDDY AND SANDY FLATS NOT COVERED BY SEAWATER AT LOW TIDE

Muddy and sandy flats not covered by seawater at low tide are defined in the EU Interpretation Manual as:

“Sands and muds of the coasts of the oceans, their connected seas and associated lagoons, not covered by seawater at low tide, devoid of vascular plants, usually coated by blue algae and diatoms. They are of particular importance as feeding grounds for wildfowl and waders……. Eelgrass communities are included in this habitat.”

In this document they are referred to as the ‘intertidal mudflats and sandflats’ feature.

There are three major categories of intertidal mudflats and sandflats although in practice they tend to be present as a continuous gradation between these categories depending on the prevailing conditions:

1. Clean sands - in areas exposed to wave action and strong tidal currents. May be found on open coast areas and estuary mouths.
2. Muddy sands – occur on more sheltered shores along the open coast and the lower reaches of estuaries.
3. Mudflats – only form in the most sheltered areas of the coast, usually where large quantities of silt derived from rivers are deposited.

Intertidal mudflats and sandflats form a major component of two other Annex I habitats (estuaries and large shallow inlets and bays) but also occur independently, sometimes covering extensive areas along the open coast.

4.2.1 Range

The SAC includes large areas of intertidal mudflats and sandflats the most extensive being the wide expanses of Llanrhidian Sands, Cefn Padrig and Dafon Sands, in the lower and middle estuary of the Burry Inlet. The mudflats and sandflats cover around 7,000 ha, thus comprising 2.4% of the UK resource and approximately 10% of the area of the SAC.

4.2.2 Structure and function

The mudflats and sandflats occur as narrow bands as well as very expansive areas. Some are almost horizontal while others, particularly those adjacent to tidal channels and creeks, are steeply inclined. This diverse range of physiographies and morphologies with varying degrees of physical exposure to wind, waves and tides, gives rise to an equally wide range of hydro- and aerodynamic settings. The sedimentary environments also vary greatly with sediment types ranging from mobile fine and medium sands, muddy sands, sandy and silty muds, and pure muds, to limited areas of exposed immobilised sandy and / or muddy gravel pavements.

There is a gradation within the distribution of sediments, from mud in the upper, more sheltered regions of the estuaries, to sand at the more wave-exposed mouths of the estuaries. The sandy shores of South beach (Tenby), Waterwynch Bay, Monkstone beach and Cefn Sidan sands, between the Three River system and the Burry Inlet, consist mainly of mobile fine and medium sands.

The mudflats and sandflats of the Three Rivers system and that of the Burry Inlet and River Loughor are mostly sandy gravel or muddy sand. Sheltered sandy gravel shores are found from the edge of Pendine Sands, stretching around into the mouth of the Three Rivers system, where a variety of different sediment types are found. The mouth of the Three Rivers system is dominated by moderately mobile fine sands that are continually shifted by waves and tidal action. The intertidal flats of the estuaries are predominantly sandy, although the upper reaches of the rivers are muddy, and each of the tributaries has areas of saltmarsh.

Salinity varies from less saline conditions within the estuaries to fully marine along the more open stretches of coastline in between. Recent nutrient levels in the water column are unknown, but hypernutrification has occurred in the past in some of the upper estuarine reaches. Sediment nutrient levels are also unknown, but assumed to reflect concentrations in overlying water. The levels of contaminants in the water column and sediments are unknown. However, there have been inputs of heavy metals from industry and redundant coalmines into the estuaries.
4.2.3 Typical species
Large areas of the intertidal mudflats and sandflats are dominated by bivalves. In areas of fine sand cockles *Cerastoderma edule* are abundant, along with other bivalves, amphipods and worms. In muddier sediments the sand-gaper *Mya arenaria*, peppery furrow-shell *Scrobicularia plana* and mud-snail *Hydrobia ulvae* are also found in large numbers. The lower Loughor Estuary is one of the few places in the UK where the worm *Ophelia bicornis* has been found. There are also beds of the nationally scarce dwarf eelgrass *Zostera noltei*.

Areas of mobile fine and medium sands such as South Beach and Cefn Sidan sands support large populations of burrowing amphipods and polychaetes. The polychaetes *Nephtys cirrosa* and *Arenicola marina*, the amphipod *Bathyporeia pelagica* and the isopod *Eurydice pulchra* are the most abundant species and, in more stable sediment areas, polychaetes and the cockle *Cerastoderma edule* are found in abundance.

The communities at the mouth of the Three Rivers system are characterised by the Baltic tellin *Macoma balthica*, thin tellin *Angulus tenuis* and polychaetes *Nephtys* spp. Stable sandflats are present in the lower estuary, generally on the upper middle shores. Here tidal streams and salinity fluctuations are reduced, resulting in greater species richness than in the lower shore areas. The communities support typical bivalve / polychaete and amphipod assemblages.

The sediments of Llanrhidian Sands, Cefn Padrig and Dafon Sands are moderately stable, fine and very fine sands. The cockle *Cerastoderma edule* is one of its most characteristic species. In the more stable areas with a higher mud content, the sand gaper *Mya arenaria*, peppery furrow shell *Scrobicularia plana*, the mud snail *Hydrobia ulvae* and amphipods *Corophium* spp. are found in increasing numbers, as are the amphipods *Bathyporeia pilosa* and *Corophium* spp. Nearer the channel muddy areas are dominated by polychaetes and the Baltic tellin *Macoma baltica*.

There are very large populations of cockles in the Burry Inlet and in the Three Rivers, covering just over 940 ha of the intertidal sandy mud and sand habitats. These in turn form the principle food source for oystercatcher in the Burry Inlet SPA and Ramsar site.

Along the high wave energy exposed coastlines of Saundersfoot to Telpyn, Marros to Pendine and along the Pembrey Coast, extensive and complete sequences of exposed sand zonations are present. Species assemblages characterised by the common heart urchin *Echinocardium cordatum* and razor shells *Ensis* sp. occur along Carmarthen Bay on the shallow lower shore where conditions are fully marine. Other associated species include the otter shell *Lutraria lutraria* and the bivalve mollusc *Pharus legumen*. Sites include North Tenby beach, Monkstone Beach, between Monkstone Point and Saundersfoot Harbour, at Marros and Pendine Sands and between Towyn Point and Pembrey Burrows.

The intertidal soft sediment coastline of Carmarthen Bay has extensive and substantial strandlines. A wealth of invertebrate fauna has been identified at locations including Pendine, Pembrey and Whiteford. Sandhoppers are the dominant order of marine invertebrates with three of the five genera found regularly feeding on the algae deposits.

In the Burry Inlet, there are areas of the scarce and specialised biotope characterised by the dwarf seagrass *Zostera noltei* along the Great Pill, between Berges Island and Landimore Marsh, and on Llanrhidian Sands and at Penrhyn Gwyn. As well as stabilising the sediment the seagrass is an important source of food for wildfowl, particularly Brent goose and widgeon that feed on the intertidal beds.

The unusual angiosperm wigeongrass *Ruppia maritima* is recorded from one location in the middle reaches of the Tywi Estuary at Morfa Uchaf. This species grows in soft sediments in sheltered shallow
coastal waters, from full salinity to nearly freshwater, but mainly in brackish waters, including those of estuaries. *R. maritima* attracts in particular waterfowl and fish to feed and rear their young. The currently considered nationally rare polychaete worm *Ophelia bicornis* has been recorded from the sand bars and flats of mobile sand along the Burry Inlet / Loughor Estuary. *Ophelia* feeds on particles of organic material in the sediment and produces swimming planktonic larvae that are very particular about the quality of the sediment that they will colonise.

### 4.2.4 Natural Processes

Intertidal mudflats and sandflats are dynamic features. Their distribution, extent, shape, topography, aspect and orientation is the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. Hydrographic functions that structure intertidal mudflats and sandflats encompass highly dynamic hydrodynamic and other properties that vary with short and long-term natural cycles, climate influences and stochastic events.

The structure of intertidal mudflats and sandflats varies depending on the physical conditions and forces acting on them (in particular the degree of exposure to wave action and tidal currents) as well as the nature of the sediments occurring in any one location. The sediments vary from mobile coarse sand in more wave exposed areas to stable, fine sediment expanses of mudflat in estuaries and other marine inlets.

Intertidal mudflats and sandflats support a variety of different wildlife communities. These are predominantly infaunal communities of a variety of different animal species such as worms, molluscs and crustaceans living within the sediment habitat. The type of sediment, its stability and the salinity of the water have a large influence on the wildlife species present.

### 4.2.5 Modifications as a result of human activity

Cockle mortality has occurred yearly in the Burry Inlet since August 2002 and in the Three Rivers Estuary since August 2005. The mortalities are of a chronic nature and occur mainly during the summer periods. Cockle numbers in the Burry Inlet altered dramatically in 2004 with very few older cockles left on the beds. Cockle numbers in the Three Rivers Estuary decreased in 2006. The mortality events are likely to be multifactoral. There is very little evidence of disease but some evidence of parasite numbers increasing immediately prior to mortality events.

Episodic events of mass mortality involving bivalves have been recorded with increasing frequency and intensity world wide since the 1970s. Mass mortalities have been attributed to a number of potential factors including environmental conditions, climate change, anthropogenic inputs, infectious agents and physiology or genetics of the organism. Environmental aspects linked to mortality include algal blooms, declines in water quality, eutrophication, temperature, salinity, and extreme events such as storms. Despite a number of preliminary investigations in the Burry Inlet and Three Rivers Estuary, the causes of the mortalities are still not clear.

### 4.3 ATLANTIC SALT MEADOWS

*Atlantic salt-meadow* (*Glaucoc-Puccinellietalia maritimae*) is defined in the EU Habitats Interpretation Manual as “Salt-meadows of Baltic, North Sea, English Channel and Atlantic shores”

Eleven different plant communities are represented by this SAC habitat in the UK which occurs on North Sea, English Channel and Atlantic shores.

Atlantic salt meadows develop when plants able to tolerate salty soil conditions colonise soft intertidal sediments of mud and sand in areas protected from strong wave action. The vegetation forms the middle and upper reaches of saltmarshes, where tidal inundation still occurs but with decreasing frequency and duration than areas nearer to the low water mark in estuaries and coastal locations.
The vegetation that is present varies with climate and the frequency and duration of tidal inundation. Grazing by domestic livestock is particularly significant in determining the structure and species composition of the habitat type and in determining its relative value for plants, invertebrates and wintering or breeding waterfowl.

4.3.1 Range

The Carmarthen Bay and Estuaries SAC includes the largest expanse of saltmarsh in Wales covering 2478 ha. The extensive saltmarshes of the Carmarthen Bay estuaries have a complete sequence of saltmarsh vegetation, from pioneer vegetation through to upper saltmarsh transitions. The area is also important for transitions from saltmarsh to sand dune and to freshwater and terrestrial vegetation. These are important features of the local saltmarshes and of great biodiversity value.

The estuarine systems have exceptionally well developed saltmarsh to sand dune transitions, where blown sand has modified the upper saltmarsh vegetation. The transition communities are mainly distributed in the Burry Inlet at Pembrey Burrows, but are also recorded from west Taf and Tywi estuaries, west Penrhyn Gwyn and Penclacwydd (Burry Inlet). The noteworthy transitions occur between grazing marsh and dune slacks within semi-fixed dune systems. Such vegetation is present at a small scale at Morfa Uchaf and Llansteffan on the Tywi, near Ginst Point at the mouth of the Taf and, most impressively, at the western end of the Gwendraeth saltmarsh. At the latter location, conservation value is enhanced by the associated transitions from mid-marsh to tall mesotrophic inundation grassland.

The feature has a variety of relatively undisturbed transitions between saltmarsh and brackish (swamp) systems. These include swamp, mire, mesotrophic grassland and open vegetation communities, totalling 98.0 ha. The transition communities are largely distributed in the mid and upper reaches of the Taf and Tywi estuaries, around the Gwendraeth Estuary, west Pembrey Burrows, west Landimore Marsh, west and upstream of the bridge in the Loughor estuary. Transitions to freshwater inundation communities are especially prominent at the western extremity of the Gwendraeth Estuary.

The grazed saltmarshes include upper margins with sea rush *Juncus maritimus* and marsh-mallow *Althaea officinalis*, which are a particularly distinctive ecological feature of this site. The area is also important for transitions from saltmarsh to sand dune and other habitats.

The Burry Inlet has around 1640 ha of Atlantic saltmeadows with the largest extent at Llanrhidian-Landimore (1094.8 ha) then Pen-clawdd (411.8 ha) the Loughor Estuary (273.1 ha) Penrhyn Gwyn (129.97 ha) and the Pembrey coast (106.86 ha). In the Three Rivers complex there is a total of 838 ha (Gwendraeth Estuary: 467 ha, Taf Estuary: 223 ha, and Tywi Estuary: 148 ha).

Transitional low-marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Sueda maritima* is present over significant areas of the Llanrhidian-Landimore marshes, and also occurs in moderately extensive areas at Pen-clawdd. Elsewhere stands were small and with the exception of the lower Loughor Estuary, poorly developed. Rayed *Aster tripolium* communities are scarce in the Burry Inlet, being present only at Loughor and Pembrey, and even here they are not well developed. In comparison, grazed and ungrazed stands of *P.maritima* communities were noted at all sites, although ungrazed stands are only extensive at the Loughor Estuary where it accounts for around 20% of all saltmarsh vegetation.

*Halimione portulacoides* saltmarsh communities are relatively poorly represented in the Burry Inlet. Sizeable ungrazed stands are restricted to Penrhyn Gwyn, where they formed good transitions with other units and grazed stands were well developed at Loughor. *Festuca rubra* communities are the second most widespread unit of the Inlet, with extensive (>100 ha) cohesive stands mapped at the Llanrhidian-Landimore site and with sizeable areas (ca. 50 ha) also mapped at Pen-clawdd and Loughor. *Artemisia maritima* communities was recorded at the Pembrey site, with particularly well developed stands along the more inland creek edges and extending towards the lower marsh, at Pen-clawdd. The area of *Juncus maritimus* saltmarsh community along the Burry Inlet is 276.97 ha.
Within the Tree Rivers complex transitional low-marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Sueda maritima* is present over a significant area (ca. 50 ha) on the Gwendraeth, but has only fragmentary representation on the Taf, and on the Tywi is restricted to a small but good quality stand at Morfa Uchaf. Rayed *Aster tripolium* communities are widespread with good stands on all three estuaries. Both grazed and ungrazed types of *P.maritima* communities are present, although ungrazed expressions are uncommon on the Tywi and the Taf. In contrast *Halimione portulacoides* communities are present in large quantities and of good quality on both the lower Taf and the Gwendraeth.

*Juncus maritimus-Triglochin maritimus* saltmarsh, is poorly represented, but the associated *J.maritimus* is a conspicuous feature of the estuary system with a total cover well in excess of 50 ha and all three sub-communities are well represented, Morfa Uchaf supports a small patch of *Eleocharis uniglumis* with halophytic associates which may be a relic of a former stand now subsumed within the surrounding inundation vegetation.

**4.3.2 Structure and function**

Many of the saltmarshes are dissected by small creeks and channels, which provide microhabitats within more uniform areas of marsh. Saltpans and small pools add diversity to the site, and are an intrinsic part of many marshes. The marshes on the southern side of the Burry Inlet between Whiteford Point and Loughor are of national significance in respect of a variety of geomorphological features, including creeks, saltpans, erosion cliffs and a variety of sediment types.

The extremely dendritic creek systems of the Burry Inlet and the Gwendraeth are the most extensive, followed by the Pembrey saltings. Short, but still profusely dendritic saltmarsh creeks, are also characteristic features of the smaller saltmarsh expanses along the Taf and the Tywi. Near Clomendy Farm on the middle Tywi Estuary, the predominantly linear pattern of tidal creeks is the result of the excavation of drainage ditches.

Landimore, Llanrhidian and Berthlwyd marshes have developed in sequence from east to west. The mature marshes at Berthlwyd display well developed terraces and an eroding marsh cliff while at Llanrhidian both pans and creeks are present and the marsh is heavily dissected. At Landimore an intricate and deep creek network is present. This sequence of marshes forms a key area for the understanding of saltmarsh dynamics, sediment transport and sea level changes.

**4.3.3 Typical species**

This extensive site has a complete sequence of saltmarsh vegetation, from pioneer vegetation through to upper saltmarsh transitions. The grazed saltmarshes include upper margins with sea rush *Juncus maritimus* and marsh-mallow *Althaea officinalis* which are a particularly distinctive ecological features of the site. The area is also important for transitions from saltmarsh to sand dune and other habitats.

Notable saltmarsh species and communities include stands containing good populations of *Althaea officinalis* that were extensive at Llanrhidian-Lanidmore, and also present on Loughor and Penrhyngwyn and stands of *Seriphidium maritimum* which were well represented at Pen-clawdd, and also occurred on the other sites, although in lesser quantity. Good populations of *Limonium vulgare* have been recorded at all sites, and were particularly well represented at Llanrhidian-Landimore. Two nationally scarce plant species also occur on the Taf Estuary, namely the rock sea-lavender *Limonium procerum* and bulbous foxtail *Alopecurus bulbosus*.

No information is currently available on the composition of fauna and other flora associated with the Atlantic salt meadows saltmarsh communities although there are descriptions of species that are typically associated with these marshes. The majority of saltmarsh insects are sap-sucking aphids or chewing grasshoppers, while deposit feeders such as *Macoma baltica*, *Corophium volutator* and *Arenicola marina* and predators like *Nereis diversicolor* and *Nephtys hombergii* are likely to be
present. *Hydrobia ulvae* grazes the microflora from sediment grains and epiphytes. Areas with high structural and plant diversity, particularly where freshwater seepages provide a transition from fresh to brackish conditions, are particularly important for invertebrates.

Saltmarshes are an important resource for wading birds and wildfowl. They act as high tide refuges for birds feeding on adjacent mudflats, as breeding sites for waders, gulls and terns and as a source of food for passerine birds particularly in autumn and winter. In winter, grazed saltmarshes are used as feeding grounds by large flocks of wild ducks and geese.

**4.3.4 Natural processes**

The location, character, and dynamic behaviour of saltmeadows are governed by four physical factors: sediment supply, tidal regime, wind-wave climate and the movement of relative sea level. There are four elements necessary for the development and growth of a salt marsh: (1) a relatively stable area of sediment that is covered by the tide for a shorter period than the time it is exposed; (2) a supply of suitable sediment available within the period of tidal cover; (3) water velocities that are sufficiently low for some of the sediment to settle out; and (4) a supply of seeds or other propagules for the establishment of vegetation cover.

The topography and microtopography of areas of Atlantic salt meadow are the product of complex interaction between hydrodynamic and sediment transport processes, sediment supply and coastal morphology. These can be highly dynamic and vary with short and long-term natural cycles, climate influences and stochastic events, including: tidal range and excursion, salinity, water temperature and suspended particulate concentrations.

The marsh-edge morphology provides information on the short to medium term trends of marsh morphodynamics. Accreting and stable seaward marsh edges have an accretional ramp upon which pioneer and low-marsh vegetation can become established. Erosional margins are characterised either by the presence of mud-mound topography or by marsh-edge cliffs fronted by toppled cliff blocks with live or dying vegetation, rotational slide or overhanging (cantilever) blocks. Terraced marsh margins indicate episodic erosion and accretion on timescales over decades to centuries.

Creeks and pans of varying size and density are frequent features of the saltmeadows. Creeks absorb tidal energy and assist with the delivery of sediment into saltmarshes. The efficiency of this process depends on creek pattern. Creek density is influenced by vegetation cover, suspended sediment load and tidal influence. Creeks allow pioneer vegetation to become established along their banks higher into the saltmarsh system. Natural salt pans can occur at any level in a saltmarsh. Major erosion of saltmarsh is indicated by internal dissection and enlargement of the drainage network, ultimately leading to the creation of mud basins. Contaminants may be tied up in saltmarsh sediments for relatively long periods of time and shifts in the dynamics of processes can lead to the remobilisation of sediments. Cyclical patterns of erosion and accretion may, therefore, lead to the release and re-deposition of pollutants within the system.

Nutrient levels are a strong influence on the growth of estuarine saltmarsh plants. Nutrient cycling within saltmarshes can also have a significant effect on coastal and estuarine water quality. In this respect, healthy, functional saltmarsh habitat may have an important role to play in the control of nutrients, which are important in determining water quality.

Given favourable conditions, depending on sediment supply and hydrodynamic regime, mudflats evolve into saltmarshes by way of substrate stabilisation by algae, diatoms and early pioneer plants, giving rise to enhanced sediment accretion rates.

**4.3.5 Modifications as a result of human activity**

Areas of unimproved saltmarsh are subject to grazing by sheep, cattle and horses. The intensity of grazing varies from severe cattle use with accompanying poaching, through moderate to heavy sheep grazing, often resulting in a tight species-poor turf to areas where grazing has been absent for a
considerable time. The grazed saltmarshes include upper margins with sea rush *Juncus maritimus* and marsh-mallow *Althaea officinalis*, which are a particularly distinctive ecological feature of this site. Over grazing can lead to loss of rare plant species and affect bird breeding and feeding habitats and under-grazing can lead to a loss of plant diversity by competitive exclusion.

### 4.4 Salicornia and other annuals colonising mud and sand

*Salicornia* and other annuals colonising mud and sand are defined in the EU Habitats Interpretation Manual as;

"Formations composed mostly or predominantly of annuals, in particular Chenopodiaceae of the genus *Salicornia* or grasses, colonising periodically inundated muds and sands of marine or interior salt marshes. Thero-Salicornietea, Frankenietea pulverulentae, Saginetea maritimae."

Of the listed sub-types the Carmarthen Bay & Estuaries SAC includes examples of glasswort swards (*Thero-Salicornietalia*). This form of saltmarsh is widely distributed throughout coastal areas of the EU. In the UK it is widespread in the saltmarshes of England and Wales, but the area of this habitat type is restricted in Scotland and Northern Ireland because of a lack of new sediment for saltmarsh development. Four different plant communities are represented by this SAC habitat in the UK.

#### 4.4.1 Range

This habitat feature is pioneer saltmarsh that colonies intertidal mud and sandflats in areas protected from strong wave action. It is an important precursor to the development of more stable saltmarsh vegetation. *Salicornia* and other annuals colonising mud and sand develops at the lower reaches of the saltmarsh where the plants are frequently flooded by the tide. It can also colonise open creek sides, depressions or pans within saltmarshes, as well as disturbed areas of upper saltmarsh.

Annual *Salicornia* saltmarsh or *Suaeda maritima* saltmarsh is scarce in the Burry Inlet but well represented on the Landimore-Llanrhidian marshes where sizeable stands forming good sequences between pioneer and transitional marsh. These communities are scarce within the Three Rivers complex with small but representative stands of *Salicornia* on both the Taf and the Gwendraeth. The reason for the paucity of the *Salicornia* community is unclear but is probably related to particle size of the substrate: *Spartina* may have the advantage as the initial pioneer.

#### 4.4.2 Structure and function

*Salicornia* grows on a wide variety of marine sediments in intertidal habitats, ranging from gravels and shelly sands, through silts to fine clays, and is invariably associated with saline, brackish or alkaline substrates. Although an early colonist of soft, unconsolidated sediments, the densest stands tend to be on firm silts and clays. The substrates of *Salicornia* span the tidal range and are often waterlogged for much or all of the time, depending on elevation and drainage conditions. The saturated sediments are typically hypoxic and may develop low redox potentials, even in the surface layers and the plants may avoid root hypoxia by relatively shallow rooting. One consequence is that hydraulic forces generated by tidal flow, perhaps associated with scouring of the sediment and wave action, can be a major source of mortality for *Salicornia* seedlings at lower elevations on a saltmarsh.

*Salicornia* is extremely tolerant of regular flooding although growth of *S. europaea* is reduced by cultivation under continuous water-logging, in comparison with free drainage at the same salinity. As a halophyte, *Salicornia* is tolerant of exceptionally low water potentials in its root environment, whether they arise from salinity, drought or a combination of both.

Individual populations and taxa of *Salicornia* may be very sensitive to elevational variations associated with microtopography on the gradient from land to sea of tidal saltmarshes. Populations on the lower shore need to be more tolerant of prolonged submergence, tidal scour and water-logging, whereas those at high elevations may experience hypersalinity in summer.

Few grazers feed on the saltmarsh plants directly. In spring and summer *Salicornia* spp. are highly productive and in autumn die back and decompose. Therefore, the majority of *Salicornia* spp.
productivity, and presumably other vascular plant (i.e. *Suaeda maritima*) productivity, enter the food web as detritus. Benthic algae and microphytobenthos play an important role in cycling nutrients, and hundreds of species of bacteria, fungi, and microalgae may be attached to surfaces of vascular plants and sediment. These are grazed by meiofauna (e.g. protozoa, foraminifera, nematodes). Mature stands of *Salicornia* and their seeds can be an important food resource for passerine birds and geese. This pioneer saltmarsh habitat also provides sheltered nursery sites for several species of fish.

4.4.3 Typical species

The site is selected as representative of pioneer glasswort *Salicornia* spp saltmarsh in the south-west of the UK. It forms an integral part of the estuarine system, supporting extensive pioneer communities and contributing to a complete sequence of saltmarsh vegetation, including transitions to upper saltmeadow and to important sand dune habitats.

Although *Salicornia* and *Suaeda* are components of several of the communities within the Burry Inlet, stands composed principally of colonising annuals forming annual *Salicornia* saltmarsh or *Suaeda maritima* saltmarsh are scarce. In the Three Rivers complex *S.maritima* saltmarsh is restricted to a single location on the Gwendraeth and stands are fragmentary although typical even though the cover of *Suaeda* is rather low; the community is probably still developing. Associates are restricted to *Salicornia* and *Spartina* with a little *Haliotomone* and scattered tillers of *Puccinella*.

The *Salicornia* spp. present in the Carmarthen Bay & Estuaries SAC reputedly includes the nationally scarce *Salicornia pusilla* at unknown location(s). Also of note is *Spartina anglica* which is presently spreading along the north Gower coastline, occupying increasingly the niche vacated by *Salicornia*, because the southward migration of the channel has increased energy levels. Dunlin, for instance, prefers *Salicornia* to *Spartina* for foraging.

No information is currently available on the composition of fauna and other flora associated with pioneer saltmarsh communities although there are descriptions of species that are typically associated with *Salicornia* marshes.

A reduced marine fauna is usually present which may include the amphipod *Corophium volutator*, the ragworm *Hediste (Nereis) diversicolor* and often the mud snail *Hydrobia ulvae*. There are often algal films, including diatoms, and algal mats over the substrate surface, but vascular companions are usually very few. Scattered plants of *Puccinella maritima* and *Spartina anglica* occur frequently.

4.4.4 Natural Processes

The location, character, and dynamic behaviour of the *Salicornia* and other annuals feature is governed by four physical factors: sediment supply, tidal regime, wind-wave climate and the movement of relative sea level. There are four elements necessary for the development and growth of a salt marsh: (1) a relatively stable area of sediment that is covered by the tide for a shorter period than the time it is exposed; (2) a supply of suitable sediment available within the period of tidal cover; (3) water velocities that are sufficiently low for some of the sediment to settle out; and (4) a supply of seeds or other propagules for the establishment of vegetation cover.

In temperate regions, such as the saltmarshes of Carmarthen Bay the growing season is generally 7-8 months, and the *Salicornia* is typically a summer-annual. Flowering occurs mainly from mid-August to mid-September and seed germination tends to coincide with low sediment salinities, in winter in Britain. Lower-marsh populations, such as *S. europaea*, tend to germinate earlier than upper marsh ones, e.g. *S. pusilla* (The lower limit of establishment of *Salicornia* on saltmarshes often appears to be set by the time necessary for the seedlings to penetrate the sediment and develop a ring of root hairs, in order to become fully anchored. A threshold period of tidal exposure of 2-3 days for rooting sufficient to resist tidal action on the low part of an estuarine marsh has been suggested.)
4.4.5 Modifications as a result of human activity
The area of pioneer *Salicornia* appears to have diminished considerably since the field survey of Charman in 1982. This may be due to a combination of changes in the main channel and vehicular erosion. The main loss appears to have been in the central coastal section of Llanrhidian Marsh. Small clumps of middle and low marsh vegetation persist on small isolated raised hummocks within an expanse of otherwise bare mud.

The waxing and waning fortunes of *Spartina* can be evidenced by their often large inter-annual differences in extent. These are generally brought about by natural environmental conditions which at times can impede the germination, root-taking and subsequent growth of the annual *Salicornia* by way of, for instance, excessive wave action or submergence time. Modifications to the extent of *Spartina* can also be brought about by poaching by livestock, vehicular erosion or by tidal channels cutting into upper mudflats.

4.5 LARGE SHALLOW INLETs AND BAYS

*Large shallow inlets and bays* are defined in the EU Habitats Interpretation Manual as;

> “Large indentations of the coast where, in contrast to estuaries, the influence of freshwater is generally limited. These shallow indentations are generally sheltered from wave action and contain a great diversity of sediments and substrates with a well developed zonation of benthic communities. These communities have generally a high biodiversity.”

In the UK, there are several physiographic types of large shallow inlet and bay that meet the EC definition: embayments which are a type of marine inlet typically where the line of the coast follows a concave sweep between rocky headlands, sometimes with only a narrow entrance to the embayment; fjords which are series of shallow basins connected to the sea via shallow and often intertidal sills; rias which are drowned river valley in an area of high relief (known as voes in Scotland).

The feature in this SAC is an embayment and is referred to as a large shallow bay in this document.

4.5.1 Range
Carmarthen Bay is a large shallow bay partially bound by rocky outcrops, with soft sediment communities occupying most of the Bay. It extends from Tenby and Caldy Island in the West to Worms Head on the Gower peninsula in the east (map 1) and covers approximately 43,492ha, comprising 6.5% of the UK resource and around 66% of the Carmarthen Bay & Estuaries SAC.

There are a variety of component habitats within Carmarthen Bay given the different seabed types which include mud, sand and rock. This includes a significant presence of one Annex 1 habitat (intertidal mudflats and sandflats) and three Annex II species which occur in the site (Shad, river lamprey and sea lamprey). These are described separately.

4.5.2 Structure and Function
The seafloor of Carmarthen Bay consists of a mixture of sediments although mostly fine sand. The outer / seaward side of the feature is more medium sand with occasional areas of coarse sand and muddy silt. A few rocky outcrops are present, the largest being off Small Ord Point, near Caldey Island. Mid-Flandrian peat beds are exposed as ledges at times along the northern and north-eastern boundary of the large shallow bay. The rocky intertidal areas around the Bay vary from steep cliffs at Tenby to bedrock platforms at Saundersfoot and areas of mixed rock and sediment at Whiteford and Telpyn which are exposed to wave action and sand source.

The physical conditions vary considerably throughout the bay with salinity ranging from low at the estuaries to fully marine. There are also gradients in wave action from sheltered to exposed, and in tidal currents which are strong around exposed headlands and sheltered elsewhere. There is an exchange of sediments with mudflat, sandflats, areas of saltmarsh and dunes all of which are dynamic environments.
The nutrient levels and levels of contaminants in the water column are unknown, but assumed to be low because of the hydrodynamic setting of Carmarthen Bay. Levels of contaminants within the sediment are also unknown, but assumed to reflect concentrations in overlying water.

4.5.3 Typical species
The main sublittoral biotope is associated with sand and non-cohesive muddy sand and generally dominated by small bivalve mussels. At the western end of Carmarthen Bay the fine sand supports abundant marine life much of it buried. This included the brittlestar *Amphiura filiformis*, the necklace shell *Euspira catena*, the burrowing crab *Corystes cassivelaunus*, and the anemone *Sagartiogeton undatus*. There were also bivalve molluscs such as razor shells *Ensis* sp., gapers *Mya* sp., Venus shells *Venus* sp. and otter shells *Lutraria lutraria*. Surface life included starfish *Astropecten irregularis*, brittlestars *Ophiura ophiura* and *O. albida*, the common whelk *Buccinum undatum*, reticulated dog whelk *Hinia reticulata*, small flatfish and gobies.

The more varied stable areas of cobble and boulders just west of Woolhouse Rocks are colonised by large numbers of mussels *Mytilus edulis* and sea squirts *Molgula manhattensis*. Where sand scouring occurs hydroids such as *Sertularia argentea*, *Abietinaria abietina*, *Halecium halecinum*, *Hydrallmania falcate* and *Obelia longissima* dominate. At The Yowan there was a wide variety of other attached life including branching sponges such as *Haliclona oculata* and barnacles as well as crustaceans and fish such as bib and poor cod.

In the intertidal zone the cliffs at Tenby and north to Saundersfoot are dominated by lichens such as *Caloplaca* spp. and *Verrucaria* spp., barnacles *Semibalanus balanoides*, and mussels *Mytilus edulis* with patches of fucoid algae *Fucus serratus* and kelps *Laminaria digitata* where the cliffs extend onto the lower shore. Sponges *Granti compressa* and *Leuconia* sp. and shade-tolerant red seaweeds *Palmaria palmata*, *Plumaria elegans* and coralline algal crusts occupy overhanging areas of bedrock on the lower shore.

The bedrock platforms from Saundersfoot to Amroth are also exposed to wave action and sand scour and are dominated by lichens, barnacles and mussels but also coralline rock pools with daisy anemone *Cereus pedunculatus* on the mid shore, and sponges and anemones in overhangs, on the lower shore.

At Whiteford Point, much of the shore is dominated by a dense cover of *Mytilus edulis*, consolidating cobbles, pebbles and small boulders in some places together with a few large hydroid pools and numerous small pools are found in depressions. These beds can be ephemeral because of winter storms. The piddock communities are present in intertidal zones either within soft (Carboniferous) limestone along Tenby Cliffs and St Catherine’s Island or in mid-Flandrian clays, along the Marros and Pendine coast and at Whiteford Burrows.

The most abundant group of organisms found within Carmarthen Bay sediments are polychaetes (accounting for over 50% of infauna), with molluscs and crustaceans also being abundant. Pembrey Sands at the mouth of the Loughor is dominated by the polychaete *Lanice conchilega*, but the polychaete *Spiophanes bombyx* is also found in large numbers in other areas of the bay. Other polychaetes commonly found are *Magelona filiformis*, *Nephtys cirrosa* and *Chaetozone setosa*. A number of molluscs are widespread in the sandy sediments of the Bay, including *Fabulina fabula*, *Mysella bidentata*, *Abra alba* and *Chamelea gallina*.

Also occurring in the bay are amphipods and echinoderms such as the heart urchin *Echinocardium cordatum* and various brittlestars, including *Ophiura ophiura* that is found in large numbers in the bay. Starfish are also present throughout the bay, as are molluscs such as the small opisthobranch *Philine aperta* and the whelks *Buccinum undatum* and *Hinia* sp.
Rare and scarce species found within the large shallow inlet and bay feature (chiefly after unpublished data from Woolmer 2003) include Acanthocardia aculeata (rare cockle), Achaetus cranchii (crab), Atrina fragilis (fan shell), Dromia personata, Ostrea edulis (native oyster), and Padina pavonica (brown alga), however, the records of Atrina fragilis, Ostrea edulis, Dromia personata and Padina pavonica date back to pre 1950, with no records since.

Atlantic salmon Salmo salar and sea trout Salmo trutta are present in many of the rivers and coastal areas of the Bristol Channel with salmon runs in a number of watercourses draining into Carmarthen Bay, including the Rivers Taf, Tywi and Gwendraeth. The migratory European eel Anguilla anguilla is commonly found throughout Carmarthen Bay and its estuaries and the SAC appears to be an important nursery and feeding area for a number of fish, including sole Solea solea, bass Dicentrarchus labrax, plaice Pleuronectes platessa and the dab Limanda limanda.

4.5.4 Natural processes
The distribution, extent and shape of inlets and bays is a reflection of the underlying geology, with some structures of resistant rock, areas of rock amenable to erosion and zones of geological weakness. Sediment shores and submerged sediment plains are much more dynamic features subject to natural change influenced by factors such as tidal flow, tidal range, currents, weather conditions and aspect.

Shallow inlets and bays are sedimentologically linked with the two couplets of mudflat and saltmarsh, and beach/sandflat and dunes. There is generally an exchange of sediments between these dynamic environments by way of bi-directional sediment transport pathways.

The types of sediment and hard substrata habitats within large shallow inlets and bays are largely determined by the underlying geology and sedimentology, along with orientation and aspect and the influence of the prevailing physical conditions such as the degree of exposure to wave action and tidal currents. These factors, combined with the influence of others, such as water quality (including turbidity) and sediment chemistry, influence the assemblages of marine species associated with the different habitats throughout large shallow inlets and bay.

Sediment granulometry and structure are primary factors in determining biological community structure. Sediment topography is the product of sediment structure and sediment transport determined by hydrodynamic process and these can vary with short and long-term natural cycles, climate influences and stochastic events. The variety of species in inlets and bays is often high as a result of wide habitat variety, the wide range of wave exposure, current strength, depth, light and substrate type, and presence of habitats that support high diversity.

4.6 SANDBANKS WHICH ARE SLIGHTLY COVERED BY SEAWATER ALL THE TIME
Sandbanks which are slightly covered by sea water all the time are defined in the EU Habitats Interpretation Manual as:

“elevated, elongated, rounded or irregular topographic features, permanently submerged and predominantly surrounded by deeper water. They consist mainly of sandy sediments, but larger grain sizes, including boulders and cobbles, or smaller grain sizes including mud may also be present on a sandbank. Banks where sandy sediments occur in a layer over hard substrata are classed as sandbanks if the associated biota are dependent on the sand rather than on the underlying hard substrata.

In this document they are referred to as ‘subtidal sandbanks’.

Within the UK’s inshore waters subtidal sandbanks can be categorised into four main sub-types:
- gravelly and clean sands
- muddy sands;
- eelgrass Zostera marina beds;
- maerl beds (composed of free-living Corallinaceae).
A variety of different sandbank types and their associated communities exist in Wales. Of the few moderate sized sandbanks in Wales there are those that are exposed to prevailing winds and currents e.g. Devils Ridge, Bastram Shoal (Pen Llyn) and Bais Bank (Pembrokeshire) and those that are less exposed to these conditions e.g. the Four Fathom Banks complex and Constable Bank (off Colwyn Bay). As well as these types that occur in fully marine environments there are also extensive mobile sandbanks that exist under reduced or variable salinity and turbid regimes in the Severn Estuary. The sandbanks of the Carmarthen Bay SAC are gravelly and clean sands.

4.6.1 Range
The SAC includes the sandbank of Helwick Bank which is located in open water to the south of Worms Head off the Gower Peninsula (Map 3). The Bank covers an estimated area of around 7,865 ha and the computed average annual volume above the 25 m contour for the years 1993 to 2002 was of the order of 175m cubic metres. With a minimum of 171 m cubic metres and a maximum of 178m cubic metres it is clear that the differences in volume from year to year can be of the order of millions of cubic metres.

4.6.2 Structure and Function
Helwick Bank is a linear, very shallow, subtidal sandbank that is the most highly exposed to wave and tidal action of all the Welsh sandbanks. The Bank is oriented in an east-west direction and is approximately 12 km in length. It consists of two shoal areas (East and West Helwick), with a slightly deeper area between known as Helwick Swatch. The Bank is closely associated with the coastal headland of Port Eynon Point and the current flows around it. The local geology underlying and adjacent to the Helwick Bank, in particular the Carboniferous limestone bedrock of Port Eynon Point close to the bank, and the underlying flat surface of Lias bedrock, are important in determining the hydrodynamic regime, sediment dispersal and deposition and morphological evolution of the sandbank.

The seabed south of the Bank rises from around 32m to between 3-4m on the crests of the East and West Helwick shoals and around 6 m on Helwick Swatch. To the north of the Bank, the seabed falls away to a shallow flat area before rising once again to the coast. To the northwest, the Bank grades into the slightly deeper sand sheet of Carmarthen Bay, and to the south and east, the seabed deepens between 20 and 30 m.

The seabed sediments of the Helwick Bank area are predominantly uniform, medium fine sands with little or no fine or organic material. The more landward side of Helwick Bank is comprised of finer sands. To the south of the Bank, in deeper water, there are some uniform gravelly sands with no bedforms, and areas of irregular sand patches on gravel. There are sand waves along the flanks of the Bank indicating large-scale sand transport and an area of megaripples to the south of the Bank, that merges to the west with an area of sand waves and gravelly sand. These ripples are superimposed on larger bedforms. The asymmetry of these sand waves (plus textural analysis and current modelling) indicate that all the bank has a clockwise sediment bedload circulation pattern, with flood dominant movement on its northern inshore side and ebb dominant movement on its southern offshore side. This circulation pattern is important in maintaining the overall geomorphology of the bank.

The salinity of the water column above the Helwick Bank and that of the interstitial sediment water is considered to be fully marine. The nutrient and contaminant levels in the water column are unknown, but assumed to be low because of the hydrodynamic setting of the Helwick Bank. Sediment nutrient and contaminant levels are also unknown, but assumed to reflect concentrations in overlying water. The oxygen content of the water column above the Helwick Bank and that of the interstitial sediment water is considered to be fully saturated.

The Helwick Bank complex lies within known spawning and nursery grounds for lemon sole Microstomus kitt, and within nursery areas for plaice Pleuronectes platessa, and whiting Merlangius merlangus. The area is also believed to be a nursery area of considerable importance for turbot.
Scophthalmus maximus, as evidenced by the presence of juveniles of this species (SWSFC, pers. comm.).

4.6.3 Typical species
The animal communities found in and on Helwick Bank are mostly characteristic of mobile sands and gravels with the exception of those to the south of the bank and many species spend most of their time wholly or partly buried in the sediment.

The sublittoral coarse sediments, mobile sand and gravels on the toe of the bank, the southern part of West Helwick, and main part of East Helwick have communities dominated by Hesionura elongata, Nephtys cirrosa, Protodriloides chaetifer. The communities on the north of the bank and in Helwick Channel are characteristic of those on sublittoral sand and non-cohesive muddy sand, with sparse fauna in infralittoral mobile clean sand. They include Gastroscaccus spinifer, Nephtys cirrosa, Pontocrates arenarius. The sublittoral coarse sediments, on the south of the bank are dominated by Bodotria arenosa, Lanice conchilega, Lagis koreni, Mediommastus fragilis.

The sandbanks show an increasing species richness in deeper waters. The polychaetes Hesionura elongata and Nephtys cirrosa, and the archiannelid Protodriloides chaetifer are all common across the Helwick Bank, and the sediments are dominated in sections by Nephtys cirrosa and the mysid Gastroscaccus spinifer. All four species are common to fine-medium sand habitats, particularly those subject to high water and sediment movements and where species richness is low. Infaunal samples found an average of 41 species per grab on the Helwick Bank (East) and 37 species per grab on the Helwick Bank (West). Species numbers from two stations on the seaward side of the Helwick Bank were highest, i.e. 102 and 103 species for Helwick Bank (East) and Helwick Bank (West) respectively. These two stations in deeper water, with more stable sandy substrates, are therefore considerably more species rich than the shallow water, high energy, sites.

Fish use the Helwick Bank in a number of ways including spawning, nursery and feeding. Nine species of fish were caught during a 2001 survey with the catch dominated by weaver fish Echiichthys vipera, spotted ray Raja montagui, grey gurnard Eutrigla gurnardus, and sand sole Solea lascaris, followed by plaice Pleuronectes platessa, and turbot Scophthalmus maximus. Blonde ray Raja brachyra, and cuckoo ray Raja naevus, are also caught in this area (SWSFC, pers. comm.). Some ray species are likely to spawn on the sandbank, for instance thornback ray Raja clavata, blonde ray Raja brachyra, small-eyed ray Raja microoculata and spotted ray Raja montagui. The area is also used as a nursery ground, possibly by thornback, small-eyed and spotted rays, because they all favour inshore nursery areas. The extent of the area used by rays is unknown, although research has shown that juvenile thornback rays appear to be highly site-specific, remaining close to the coast for several years, and thornback rays are probably ubiquitous in sand and gravel coastal waters.

Sandeels Ammodites tobianus are also thought to spawn on Helwick Bank and the surrounding, seabed. They are a common inshore species and are likely to occur along the length of the Bank and surrounding sandy substrates to a depth of around 30 m. They play a fundamental role in the local marine food web: bass Dicentrarchus labrax, whiting Merlangius merlangus, cod Gadus morhua, sole Solea spp., plaice Pleuronectes platessa, brill Scophthalmus rhombus, and flounder Platichthys flesus, are all known to feed on sandeels. These in turn attract larger predators. Notable species include the southern cumacean Cumopsis fagei which has been identified from several stations on Helwick Bank and which is not frequently recorded from British waters, the bryozoan Hippopodinella lata at the northernmost limit of its distribution, the gastropod Chrysallida interstincta which is rare in the region, and the polychaete Euzonus flabelligerus which has a limited number of recordings from UK waters. Some of these species may be under-recorded, rather than truly rare and therefore the information should be treated with caution, until further evidence is available.

4.6.4 Natural processes
Subtidal sandbanks are dynamic features with their size, shape, aspect and orientation, as well as the macro- and micro-topography and sediment characteristics largely determined by the sediment supply and the influence of the hydrodynamic processes affecting each bank. They change shape over time
and while some are ephemeral others may be relatively stable and long established. Mobile sediments that form temporary sandbanks are considered to be associated sediments that should be retained in the system but their location may change.

### 4.6.5 Modifications as a result of human activity

The Helwick Bank forms a key component of the Bristol Channel sediment system. This larger circulatory system appears to be in gradual decline as sediment is stripped from its bedload parting in the east and lost to the Celtic Sea in the west; The Helwick Bank is an open system both receiving and losing sand to adjacent areas but whose inputs depend primarily on movements from the east, which appear to be in decline.

Annual monitoring data demonstrates a net loss of sand from the Helwick Bank open system, amounting to some 300,000 m$^3$ per year from the volume contained above the -15 m CD contour. This net loss is primarily due to natural processes but losses due to aggregate extraction in the past have formed a significant proportion of the volume lost. Although it is not possible to distinguish between the processes of natural and artificial losses it is nevertheless clear that, in strictly volumetric terms, losses due to aggregate extraction have not been replenished on the upper levels of the Helwick Bank.

Sea level rise is not considered to have had a significant impact on the identification of sediment losses from the Helwick Bank. Sea level rise has averaged 0.00076 m per year over the past 200 years, an order of magnitude less than the average vertical fall in surface elevation of the crest of the Bank. Since sand removed by aggregate extraction is not re-supplied to the system, the morphology and processes of adjacent coasts may be adversely affected. The net loss of volume affects the areas of greatest concern for the geomorphological integrity of the Helwick Bank. Aggregate extraction continues to take place at Helwick Bank which was granted a new 7-year license to dredge at a rate of 150,000 tonnes per annum.

CCW consider with a very high degree of confidence that the sandbank is in morphological decline. Although this is mainly due to natural processes, it is clear that any further extraction will exacerbate the deterioration of the morphology of the bank and its associated FCS. Furthermore, the behaviour of the sandbank macro-topography, in particular its progressive / ongoing lowering of sandbank crest level relative to the tidal frame, will inevitably result in impacts on the structure, function, and ultimately, on the typical species of the sandbank habitat. The lowering of the crest level will be exacerbated by aggregate extraction, as this is the part of the sandbank where the dredging takes place. This will compromise the conservation objectives relating to the biological interests of the sandbank feature. The conservation objectives integrate the physical and biological characteristics, and all are of equal importance.

There are two concerns in terms of the potential impacts of aggregate extraction on the infauna of Helwick Bank. These are the direct effects of removal of sediment and the animals within it and possible long-term changes in the morphology and physical characteristics of the bank. Long-term changes in morphology are a concern, as a decrease in the height of the bank and/or an increase in the general stability of the bank will affect the biological character of the bank. However, it is very difficult to say precisely how much of a decrease in the height of the bank would cause a significant change in the biology.

### 4.7 SHAD *Alosa* spp.

Shad are herring-like fish that spend most of their adult lives in the sea but spawn in rivers (or, occasionally, in the upper reaches of estuaries) and usually migrate through estuaries in spring on their way to the spawning grounds. Shads in the marine environment are completely dependent on the riverine stage of their life cycle and thus on the appropriate conservation of their riverine habitats. The shad occurs in several rivers in Wales, the most important populations being in the Tywi, Usk, Wye and Severn.
4.7.1 Population dynamics
The River Tywi is thought to be one of only four rivers in Wales where the shad *Alosa sp.* spawns. Twaite shad *Alosa fallax* and Allis shad *A. alosa* have interbred/hybridised in this river and are therefore indistinguishable and genetically identical. For these reasons they are dealt with together.

Spawning success, production and survival of fry and recruitment of juveniles to the population using the site are unknown. The number of shad using the site is also unknown. Recruitment in shads has been shown to be strongly linked to abiotic factors, notably summer temperature. Recruitment seems to be highest in warm years. Contrary, high flows between May and August may result in fry being washed prematurely out to sea.

4.7.2 Range
Shad are found in the River Tywi adjoining the SAC where counts have recorded over 10,000 fish. The River Tywi is one of only four rivers in Wales where there is a known spawning population of shad. The estuary and the surrounding coastal waters are therefore extremely important for this species, as fish must migrate through this area to reach the spawning site. Fish from the other three rivers are also quite likely to use the inshore waters of the Carmarthen Bay & Estuaries SAC for feeding.

The migratory habits of shad entering the estuaries of the Carmarthen Bay & Estuaries SAC and ascending the rivers to spawn are unknown. However, it must be assumed that the SAC is an important migration route, as evidenced by the presence of both juvenile and adult shads.

4.7.3 Habitat and species
Shad migrate through the waters of the SAC to reach spawning sites in the River Tywi. The Taf-Tywi-Gwendraeth Estuary is also important as a nursery area and it is likely that shad feed in the inshore waters of Carmarthen Bay.

The habitat requirements of shad are not fully understood. On the Rivers Usk and Wye, they are known to spawn at night in a shallow area near deeper pools, where the fish congregate. The eggs are released into the water column, sinking into the interstices between coarse gravel/cobble substrates. Most adults die after spawning, though UK populations appear to have an unusually high proportion of repeat spawners – up to 25%. After hatching the fry develop and slowly drift downstream. Recruitment seems to be highest in warm years, and high flows between May and August may result in fry being washed prematurely out to sea.

The upstream migration from the estuary appears to be triggered by temperature. Claridge & Gardner (1978) found that migration started when the temperature reached 12 °C and Arahanian (1982) confirmed that peak migratory activity occurred at temperatures of 10-14 °C. Spawning runs are also influenced by other factors, notably estuarine tides and river flows. Shad appear to move up estuaries on spring tides and although migration has been recorded at its peak during relatively high discharge levels, if flows are too high then numbers drop. Obstacles to migration include natural obstacles such as waterfalls, or man-made dams and weirs. Pollution can also create a barrier to movement.

The extent and distribution of suitable habitat for the full size range of juvenile shad in the SAC is unknown, however, it must be assumed that conditions are favourable, as evidenced by their presence. Shad are thought to be adversely affected by poor water quality and temperature also appears to affect recruitment, although this may be more relevant in the riverine phase of the life cycle. Suitable habitats must also include requirements for abundant, suitable prey present.

Feeding requirements of populations within the site and the status of preferred prey species within the site is unknown. However, as the shads utilizing the site are considered to be hybrids, it is assumed that they are not exclusively planktivorous (unlike pure Allis shad), but also feed on small fish, and this is likely to be reflected in their habitat selection. The young fish will feed mainly on...
invertebrates, especially estuarine zooplankton, but as they grow they will take larger crustaceans of various types (for example, shrimps and mysids) and also small fish. Adults feed to an appreciable extent on other fish, especially the young of other Clupeidae, such as sprat and herring.

4.7.4 Modifications as a result of human activity
Population declines in many parts of Europe have been attributed to pollution, overfishing and migratory route obstructions.

4.8 RIVER LAMPREY (*LAMPETRA FLUVIATILIS*) AND SEA LAMPREY (*PETROMYZON MARINUS*)

Lampreys are primitive type of fishes that have a distinctive suckered mouth, rather than jaws. The river lamprey *Lampetra fluviatilis* is found only in Western Europe, where it has a wide distribution. The sea lamprey *Petromyzon marinus* occurs over much of the Atlantic coastal area of western and northern Europe and eastern North America where it is found in estuaries and easily accessible rivers.

River lampreys are widespread in the UK, occurring in many rivers. They spend much of their adult life in estuaries and inshore waters but spawn and spend the juvenile part of their life cycle in rivers. The larvae (ammocoetes) spend several years buried in sandy sediment in rivers feeding on organic matter before metamorphosing after around 4 years. Juveniles migrate to estuaries and inshore waters where they feed parasitically on various fish species. Once fully grown, they migrate upstream to spawn. There are a few land-locked populations, including one in Scotland. During their marine phase, river lampreys are predominantly an inshore species feeding on small fish such as herrings and sprats.

Sea lampreys have a similar life cycle to the river lamprey, although much larger and more oceanic, feeding parasitically on big species such as basking sharks. It is an anadromous species (*i.e.* spawning in fresh water but completing its life cycle in the sea). Like the river lamprey, sea lamprey need clean gravel for spawning, and marginal silt or sand for the burrowing juvenile ammocoetes. However, unlike the other species, they tend to spawn in the lower to middle reaches of rivers, in deep, fast-flowing waters. Sea lampreys occur in many Welsh rivers, including the Teifi, Tywi, Usk, Wye, Cleddau and Dee. These sites all include estuaries or areas adjacent to estuaries that are thought to be either part of the migratory route or used by river lampreys.

4.8.1 Population dynamics
River and sea lampreys are difficult to sample and rarely caught by fishermen. Little is known about the spawning success, production and survival of ammocoetes and recruitment of juveniles to the population using the site or the number of adult river and sea lamprey using the site.

4.8.2 Range
The habitat preferences and distribution of individuals within the site are unknown. The migratory habits of river lamprey entering the estuaries of the *Carmarthen Bay & Estuaries SAC* and ascending the rivers to spawn are unknown. However, it must be assumed that the SAC is an important migration route, as evidenced by the presence of ammocoetes and juveniles in the rivers adjoining the SAC. River lampreys migrate through the SAC to reach the River Tywi. Fish from the Rivers Usk and Wye are also quite likely to use the inshore waters of the SAC.

Sea lampreys migrate through the site to reach the River Tywi. Fish from the Rivers Usk and Wye are also quite likely to use the inshore waters of the SAC. Mature adults enter the estuaries from April onwards and migrate some distance upstream, providing that there are no obstacles - natural (*e.g.* waterfalls) or man-made (*e.g.* dams, weirs or pollution barriers). Peak migration usually coincides with temperatures that remain above 10°C and continues until temperatures reach 18°C. As they are larger than river lamprey this species is probably better able to swim against fast currents. The requirements of sea lamprey during the estuarine and marine phase of the life cycle are not fully
known, but as this species spends much of its time offshore while at sea, the SAC is principally a migration route.

4.8.3 Habitat and species
The spawning areas of river lamprey within or adjacent to the Carmarthen Bay & Estuaries SAC are unknown. However, it must be assumed that the area contains important spawning sites as evidenced by the presence of both ammocoetes and adult river lampreys within estuarine and fresh waters.

The feeding habits of juvenile and adult river lampreys in or adjacent to the SAC are also unknown. In the estuaries of major rivers, such as those entering SAC, young river lampreys can be found feeding on a variety of estuarine fish, but particularly herring, sprat and flounder. The adults feed on much the same species in both estuaries and coastal waters. Sprats are abundant during the winter in Carmarthen Bay and flounders are also common and therefore these are likely to be a primary food source. It is not known if lamprey attack sole and bass, which are common in Carmarthen Bay. Anecdotal evidence from anglers suggests that they often inflict extensive damage on these hosts by rasping away large amounts of flesh from the back. Salmon *Salmo salar* and sea trout *Salmo trutta* entering rivers often bear fresh scars attributable to attacks by this species.

The feeding habits of juvenile and adult sea lampreys in or adjacent to the SAC are unknown however there is little evidence for any differences in the food or feeding habits of the juvenile stage of the river lamprey.

4.8.4 Modifications as a result of human activity
River and sea lampreys are difficult to sample and rarely caught by fishermen making it is difficult to accurately assess the conservation status of these species at this site. There are no significant obstructions within the SAC, and the water quality is generally good.

4.9 OTTER (*Lutra lutra*)
The otter *Lutra lutra* is a semi-aquatic mammal which occurs in a wide range of ecological conditions, including inland freshwater and coastal areas. Populations in coastal areas use shallow, inshore marine areas for feeding but also require freshwater for bathing and terrestrial areas for resting and breeding holts. Coastal otter habitat ranges from sheltered wooded inlets to more open, low-lying coasts. Inland populations utilise a range of running and standing freshwaters. These must have an abundant supply of food (normally associated with high water quality), together with suitable habitat, such as vegetated riverbanks, islands, reed beds and woodland, which are used for foraging, breeding and resting.

At present, the majority of the otter population in Great Britain occurs in Scotland, with a significant proportion of this number being found in the north and west of the country. Other strong populations survive in Wales and Ireland. Recent surveys suggest that the otter population is recovering well and recolonising parts of its former range. While the SAC series makes a contribution to securing favourable conservation status for this Annex II species, wider countryside measures, in particular implementation of the UK’s Biodiversity Action Plan, are important to its conservation in the UK.

4.9.1 Population dynamics
The number of otters using the site is unknown as is the age frequency and sex ratio. Otters are known to breed about 1 km inland on the Gwendraeth Fach, near the SAC and use the estuary for foraging. The River Tywi SAC (adjacent to the Carmarthen Bay & Estuaries SAC) is also considered to be of significant value for otters and there has been evidence of possible breeding near Landimore Marsh. The number of otters breeding within the SAC is unknown although it is likely that they may breed

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22 Geoff Liles, pers comm.
inland, along watercourses adjacent to the SAC and utilise the SAC for foraging. There are also few details about their movement in and out of the SAC.

4.9.2 Range
Oters are known to use most areas of the coast within and adjacent to the SAC. Otters and spraints have been seen on Llanrhidian sands and Llanelli levels and it is likely that otters are coming into the estuary from the River Loughor. Otters are known to use the coast between Llanelli and Burry Port and have been seen crossing the railway line which runs along the coast. Pembrey Forest, adjacent to the SAC is well used by otters and although the Cefn Sidan sands have not been surveyed, it is very likely that otters use them.

The coast within the SAC is well supplied with rivers and streams and it is highly likely that otters travel from one watercourse to another along the coast. Otters living on the coast must have access to freshwater streams and pools for drinking and washing.

4.9.3 Habitat and species
The SAC contains important feeding areas for otters. A survey on the Gower, adjacent to the SAC found signs of otters close to or on the estuaries of many rivers suggesting that otters hunt in the salt marshes and sea surrounding the Gower. An otter has been seen hunting in the sea off Oxwich point and spraints have been found containing remains of crabs. East Marsh is known to be well used by otters where they forage in the network of ditches and dykes, and it is likely that they also use the sands (Geoff Liles, pers. comm.). The estuaries and coast in this area may be particularly important in sustaining otter populations due to the possible shortage of fish populations for example in the Gower rivers however we currently do not know what the otters feed on or the quality of food available to otters within the marine environment. The otters feeding within the SAC are probably not wholly dependent on the coast for food but that they also use the rivers adjacent to the SAC for foraging.

Coastal otters can hunt as far as 100 m offshore in water over 10 m deep, but most feeding is done much closer to shore in water less than 3 m deep. Studies on prey species taken by coastal otters in Scotland and elsewhere indicate that, fish formed more than 90% of the diet. Other important non-fish prey items taken include crabs and sea urchins, although at a lower level in relation to their abundance than fish species. The different studies of otter diet show that the abundance of different prey items may be highly seasonal. The main hunting areas for otters on the coast are largely determined by the habitat preferences of prey species.

Over most of their range, otters are nocturnal or diurnal, probably due mainly to disturbance and persecution. When otters are not active, otters may sleep in a variety of resting places known as a den, holt or couch. These can be holes in the ground, under tree roots, within rock piles, dense scrub or in quite open places. We currently do not know where otters rest within the SAC due to their secretive nature and current lack of survey work around the coast.

4.9.4 Modifications as a result of human activity
The regular presence of otters in the SAC is important because UK otters are still recovering from a sharp population decline during the 1960s and 1970s due to pollution and exacerbated by hunting and habitat loss. Otters are re-colonising marine sites at a slower rate than rivers.
5 CONSERVATION OBJECTIVES

This latest version of the Regulation 33 package has been revised to improve consistency across the marine SACs in Wales. The intent of the conservation objectives and of the advice on operations which may cause deterioration or disturbance to the feature is the same as in previous versions. The Conservation Objectives are now shorter and more generic but there has been no change in what is considered to represent Favourable Conservation Status.

In order to meet the aims of the Habitats Directive, the conservation objectives seek to maintain (or restore) the habitat and species features, as a whole, at (or to) favourable conservation status (FCS) within the site.

The Vision Statement is a descriptive overview of what needs to be achieved for conservation on the site. It brings together and summarises the Conservation Objectives into a single, integrated statement about the site.

### VISION STATEMENT

Our vision for the Carmarthen Bay & Estuaries European Marine Site is one of a high quality marine environment, where the habitats and species of the site are in a condition as good as or better than when the site was selected; where human activities co-exist in harmony with the habitats and species of the site and where use of the marine environment within the European Marine Site is undertaken sustainably.

An integral part of this vision for the Carmarthen Bay & Estuaries European Marine Site is to maintain and – where necessary – restore the site to high ecological status, so that all of its special habitat and species features will be able to sustain themselves in the long-term as part of a naturally functioning ecosystem.

The physical character of Carmarthen Bay continues to be largely unmodified and undisturbed, and the natural processes of tides, waves and currents, and the associated processes of sediment erosion and deposition are allowed to operate without any undue interference, thus forming the foundations for this special ecosystem, which supports a large number of species, including bivalve molluscs, worms, burrowing urchins, brittle-stars and sand-stars.

The four estuaries surrounding Carmarthen Bay continue to form a single functional unit, with important interchanges of sediment and biota. The estuaries of this site will support a wide range of subtidal and intertidal sediments that grade from sand at their mouths to mudflats in the upper estuaries. The fauna of the sediments remains very varied, and includes communities with polychaete and oligochaete worms and areas with extensive cockle beds and other bivalve molluscs.

The site retains its complete sequences of saltmarsh vegetation, from pioneer vegetation, such as glasswort and annual seablite, through to upper, mature saltmarsh meadows of great floral variety and high biodiversity. The area also continues to be important for undisturbed saltmarsh transitions to other coastal habitats, such as shingle, sand dunes and brackish to freshwater habitats.

The abundance of prey, proximity of freshwater and availability of undisturbed resting and breeding sites, allows a large otter population to thrive. They will continue to be found along extensive stretches of the embayment and its estuaries.

The special fish species found in the site, such as the lampreys and shads, will be present in numbers that reflect a healthy and sustainable population supported by well distributed habitat of good quality with sufficient suitable food resources. These migratory fish are allowed to migrate unhindered by
artificial barriers, such as weirs, pollution or depleted flows, and undisturbed to and from any areas of the site they may require, including feeding and spawning grounds.

The Burry Inlet will continue to provide a safe refuge for internationally important numbers of over-wintering waders and wildfowl in the long-term. Curlew, dunlin, grey plover, knot, oystercatcher, pintail, redshank, shelduck, shoveler, teal, turnstone and widgeon can rely on the permanent presence of the environmental conditions necessary to sustain their over-wintering populations, including extent and quality of supporting habitats, and abundance of prey and diversity of prey species. Waders and wildfowl are allowed to inhabit their feeding grounds and resting areas with minimum disturbance, and are allowed to move unhindered between them.

The landscape quality and conservation value of the area continues to be of a very high order, and Carmarthen Bay and its estuaries will become renowned for its recreational value, with human activities being managed and developed in a manner which ensures both compatibility between activities and the sustainable use of the site. Local communities will take pride in their surroundings and work actively to make sustainable improvements for future generations.

The Habitats Directive does not include any intention to exclude human activities (commercial or recreational) from Natura 2000 sites. The aim is to ensure that those activities are undertaken in ways which do not threaten the features the site is designated for.

**CONSERVATION OBJECTIVES FOR THE CARMARTHEN BAY AND ESTUARIES SPECIAL AREA OF CONSERVATION**

To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

**HABITAT FEATURES**

| Sandbanks which are slightly covered by seawater all the time |
| Estuaries |
| Mudflats and sandflats not covered by seawater at low tide |
| Large shallow inlets and bays |
| Atlantic salt meadows |
| Salicornia and other annuals colonising mud and sand |

**RANGE**

The overall distribution and extent of the habitat features within the site, and each of their main component parts is stable or increasing.

**STRUCTURE AND FUNCTION**

The physical biological and chemical structure and functions necessary for the long-term maintenance and quality of the habitat are not degraded. Important elements include:

- geology,
- sedimentology,
- geomorphology,
- hydrography and meteorology,
- water and sediment chemistry,
- biological interactions.
This includes a need for nutrient levels in the water column and sediments to be:
- at or below existing statutory guideline concentrations
- within ranges that are not potentially detrimental to the long term maintenance of the features species populations, their abundance and range.

Contaminant levels in the water column and sediments derived from human activity to be:
- at or below existing statutory guideline concentrations
- below levels that would potentially result in increase in contaminant concentrations within sediments or biota
- below levels potentially detrimental to the long-term maintenance of the features species populations, their abundance or range.

For **Atlantic saltmeadows** this includes the morphology of the saltmarsh creeks and pans

**TYPICAL SPECIES**

The presence, abundance, condition and diversity of typical species is such that habitat quality is not degraded. Important elements include:
- species richness,
- population structure and dynamics,
- physiological heath,
- reproductive capacity
- recruitment,
- mobility
- range

As part of this objective it should be noted that:
- populations of typical species subject to existing commercial fisheries need to be at an abundance equal to or greater than that required to achieve maximum sustainable yield and secure in the long term
- the management and control of activities or operations likely to adversely affect the habitat feature, is appropriate for maintaining it in favourable condition and is secure in the long term.

**SPECIES FEATURES**

<table>
<thead>
<tr>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otter</td>
</tr>
<tr>
<td>Shad <em>Alosa</em> spp.</td>
</tr>
<tr>
<td>River lamprey</td>
</tr>
<tr>
<td>Sea lamprey</td>
</tr>
</tbody>
</table>

**POPULATIONS**

The population is maintaining itself on a long-term basis as a viable component of its natural habitat. Important elements are population size, structure, production, and condition of the species within the site.

As part of this objective it should be noted that:
- Contaminant burdens derived from human activity are below levels that may cause physiological damage, or immune or reproductive suppression
**RANGE**

The species population within the site is such that the natural range of the population is not being reduced or likely to be reduced for the foreseeable future.

As part of this objective it should be noted that
- Their range within the SAC and adjacent inter-connected areas is not constrained or hindered
- There are appropriate and sufficient food resources within the SAC and beyond
- The sites and amount of supporting habitat used by these species are accessible and their extent and quality is stable or increasing

**SUPPORTING HABITATS AND SPECIES**

The presence, abundance, condition and diversity of habitats and species required to support this species is such that the distribution, abundance and populations dynamics of the species within the site and population beyond the site is stable or increasing. Important considerations include;
- distribution,
- extent,
- structure,
- function and quality of habitat,
- prey availability and quality.

As part of this objective it should be noted that;
- The abundance of prey species subject to existing commercial fisheries needs to be equal to or greater than that required to achieve maximum sustainable yield and secure in the long term.
- The management and control of activities or operations likely to adversely affect the species feature, is appropriate for maintaining it in favourable condition and is secure in the long term.
- Contamination of potential prey species should be below concentrations potentially harmful to their physiological health.
- Disturbance by human activity is below levels that suppress reproductive success, physiological health or long-term behaviour.
- For **otter** there are sufficient sources within the SAC and beyond of high quality freshwater for drinking and bathing.
To achieve favourable conservation status all the following, subject to natural processes, need to be fulfilled and maintained in the long-term. If these objectives are not met restoration measures will be needed to achieve favourable conservation status.

(i) The numbers of all SPA bird species are stable or increasing.

(ii) The abundance and distribution of suitable prey are sufficient and appropriate to support the numbers of all SPA bird species.

(iii) All SPA birds are allowed to inhabit their feeding grounds and resting areas with minimum disturbance, and are allowed to move unhindered between them.

(iv) All states of the Conservation Objectives for the supporting habitats and species, subject to natural processes, are fulfilled and maintained in the long-term.

Supporting habitats for bird species of the Burry Inlet SPA include:
- Estuaries
- Mudflats and sandflats not covered by seawater at low tide
- Atlantic salt meadows
- Salicornia and other annuals colonising mud and sand

‘Large shallow inlets and bays’ are the supporting habitat for the common scoter of the Carmarthen Bay SPA.

(v) The management and control of activities or operations likely to be of significant effect to the oystercatchers, is appropriate for maintaining the feature at FCS and is secure in the long-term.
5.1 UNDERSTANDING THE CONSERVATION OBJECTIVES

A dynamic marine environment
The conservation objectives recognise and acknowledge that the features are part of a complex, dynamic, multi-dimensional environment. The structures, functions (environmental processes) and species populations of habitat features are inextricably linked. Marine habitats are complex ecological webs of species, habitat structure and environmental functions that vary dynamically in time and space. Variety and change in habitat structure is primarily driven by environmental and physico-chemical factors, including water movement, water quality, sediment supply and prevailing weather conditions.

The species populations associated with these habitats also vary in time and space and this is, in part, a direct reflection of the variable habitat structure and dynamic environment. It is also the product of stochastic events and the great variation in survival and recruitment of species, particularly those with dispersive reproductive strategies.

Within the dynamism of habitats and species, there is also an element of stability and persistence, where species’ and communities’ populations as well as physical habitat structure show little overall long-term variation.

Human activities
These conservation objectives recognise and acknowledge that human activity has already modified and continues to modify habitats and species populations in various ways, to varying degrees and at varying spatial and temporal scales, either acutely or chronically. The conservation objectives do not aim to prevent all change to the habitat and species features, or to achieve an indefinable, abstract natural or pristine state, since these would be unrealistic and unattainable aspirations. Rather, they seek to prevent further negative modification of the extent, structure and function of natural habitats and species’ populations by human activity and to ensure that degradation and damage to the features that is attributable to human activities or actions is prevented. Consequently, in order to meet the requirements of the Directive and ensure the site makes its appropriate contribution to conservation of biodiversity, the conservation objectives seek to:

- Encompass inherent dynamism rather than to work against it;
- Safeguard features and natural processes from those impacts of human activity that cause damage to the features through the degradation of their range, extent, structure, function or typical species;
- Facilitate, where necessary, restoration of features or components of features that are currently damaged or degraded and in unfavourable condition.

The term degradation is used to encompass damage or deterioration resulting only from such human activities or actions as have a detrimental effect on the feature. The magnitude of any degradation is dependent on the longevity and scale of the impact and the conservation importance of the species or habitats on which the impact occurs. This is influenced by:

- the type of human action, its nature, location, timing, frequency, duration and intensity,
- the species or habitats, and their intolerance and recoverability.

Outcomes arising from human action that are likely to be considered detrimental include such effects such as:

- permanent and long-term change of distribution or reduction in extent of a feature or feature component, or temporary modification or reduction sufficiently significant to negatively impact on biota or ecological processes;
- reduction in ecological function caused by loss, reduction or modification of habitat structural integrity;
- interference in or restriction of the range, variety or dynamism of structural, functional or ecological processes, e.g.: alteration of habitat structure, obstruction of tidal streams, chronic or
acute thermal, salinity or suspended sediment elevations or reductions;
- hypertrophication or eutrophication;
- contamination by biologically deleterious substances;
- reduction in structure, function and abundance of species populations;
- change in reproductive capacity, success or recruitment of species populations;
- reduction in feeding opportunities of species populations
- reduction of health to a sub-optimal level, or injury, rendering the population less fit for, inter alia, breeding, foraging, social behaviour, or more susceptible to disease;
- increase in abundance and range of opportunist species through the unnatural generation of preferential conditions (e.g. organic enrichment), at the expense of existing species and communities.
- increase in abundance and range of non-native species.

The following table provided illustrative examples of specific changes and whether they would constitute degradation of the feature.

<table>
<thead>
<tr>
<th>Degradation</th>
<th>Not Degradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduction in grey seal reproductive potential as a result of sub optimal physiological health caused by high tissue burdens of anthropogenically derived contaminants.</td>
<td>Reduction in grey seal reproductive potential as a result of sub optimal physiological health caused by density dependent incidence of endemic disease.</td>
</tr>
<tr>
<td>Modification of a seabed community by organically rich effluent from a new sewage outfall.</td>
<td>Modification of a seabed community as a result of a reduction in organic material entering the sea from a sewage outfall.</td>
</tr>
<tr>
<td>Change in seabed community composition as a result of coastal engineering that has altered local wave exposure.</td>
<td>Change in seabed community composition as a result of a cliff fall, the debris from which has altered local wave exposure.</td>
</tr>
<tr>
<td>Change to the species composition of a seabed community as a result of an increase in scallop dredging intensity.</td>
<td>Change to the composition of a seabed community as a result of a reduction in scallop dredging intensity.</td>
</tr>
<tr>
<td>Permanent reduction of extent of sand and mud-flat as a result of new coastal development.</td>
<td>Permanent reduction of extent of sand and mud-flat as a result of long-term natural changes in sediment transport.</td>
</tr>
<tr>
<td>Changes in sediment granulometry as a result of beach recharge operations</td>
<td>Changes in sediment granulometry as a result of natural cliff fall and erosion</td>
</tr>
</tbody>
</table>

It is important to note that many human activities can either be beneficial (reduce or reverse detrimental human influence (e.g. improve water quality)), trivial (e.g. no significant and/or substantive long-term effect) or benign (no outcome) in terms of their impact on marine habitats and species.

Advice on potentially detrimental human activities is provided in Section 6 (activities or operations which may cause damage or disturbance to features).

**Use of the conservation objectives – Site management**

The components of favourable conservation status detailed in the conservation objectives have different sensitivities and vulnerabilities to degradation by human activities. Conservation and protection of site features is provided by management, which should be based on levels of risk. The form of management and degree of protection necessary will vary spatially, temporally and from one feature component to another due to their differences in conservation importance and their sensitivity and susceptibility to change as a result of human action. Therefore it needs to be understood that
these conservation objectives require a risk-based approach to the identification, prioritisation and implementation of management action.

Security of management is provided in part by sections 48 to 53 of the 1994 Conservation Regulations, which require the assessment of plans and projects likely to have a significant effect on the site.

Where there is a potential for a plan or project to undermine the achievement of the conservation objectives, CCW will consider the plan/project to be likely to have a significant effect and require appropriate assessment. Unless it is ascertained, following an appropriate assessment, that a plan or project will not undermine the achievement of the conservation objectives, the plan/project should be considered as having an adverse affect on the integrity of the site23.

Appropriate and secure management of activities may also be provided through a site management plan.

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23 Uncertainty should not result in a conclusion of no adverse affect on site integrity.
6 ADVICE AS TO OPERATIONS WHICH MAY CAUSE DETERIORATION OR DISTURBANCE TO THE FEATURES

The range of different habitat types within each of the SAC’s features is extremely wide and marine habitats and species populations are inherently dynamic. The range and scale of both natural and anthropogenic stressors on the marine habitats and species within the SAC are also very large. Human activities have the potential to impose stresses on each habitat’s structure and function in many ways that result in acute, chronic or permanent impacts at different spatial scales. Species populations may also be affected at many levels e.g. physiological, genetic, single organism, population and groups of species.

The following table identifies where there is a potential for operations or activities to have an adverse effect on a feature or component of a feature exists. This does not imply a significant actual or existing causal impact. The potential for, and magnitude of, any effect will be dependent on many variables, such as the location, extent, scale, timing and duration of operations or activities, as well as proximity to features that are sensitive to one or more factors induced or altered by the operation. Due to the complexity of the possible inter-relationships between operations or activities and the features, the factors and effects listed in this table are the predicted most likely effects and are not exhaustive.

- The ‘activity’ column lists potentially damaging operations and gives an indication of their current known status within the SAC. Operations or activities marked with an asterisk (*) may have associated consents, licences, authorisations or permissions which are (or may be) plans or projects, within the meaning of Article 6 of the Habitats Directive. (The potential effects of the construction phase of operations marked with a hash (#) are included in the general operation ‘construction’).
- The ‘key relevant factors’ columns (physical, chemical and biological factors) give an indication of the key mechanisms by which the operation or activity may cause an effect on each habitat feature.
- The ‘most likely effects’ columns indicate the most likely components of Favourable Conservation Status that might be affected by each operation or activity.
- The ‘features’ columns indicate which Annex 1 habitats and Annex II species could potentially be affected by the operation or activity.
- The ‘advice as to likely required action’ column provides an indication of the actions required (from CCW and others) to undertake specific risk assessments of relationships between the operation or activity and relevant features, including any further information that would be necessary to further refine / tailor advice.
## DOCKS, MARINAS & SHIPPING

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key Relevant factors</th>
<th>Most likely effects on FCS elements</th>
<th>Most likely effects on FCS elements</th>
<th>Features</th>
<th>Advice/Action/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dock, harbour &amp; marina structures: construction *Small to medium-scale dock / port facilities at Llanelli, Burry Port, Tenby &amp; Saundersfoot. No facility as yet that can be classified as ‘Marina’, but future developments are likely to focus on existing facilities at these locations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Treat as plan or project as appropriate. Consenting bodies ensure appropriate integration, inclusion and consultation. Consenting bodies ensure assessment of cumulative effects in association with others plans and projects</td>
</tr>
<tr>
<td>Dock, harbour &amp; marina structures: maintenance As above</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Treat as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce.</td>
</tr>
<tr>
<td>Dredging: capital * None at present. (c.f. aggregate extraction; also see dredge spoil disposal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Treat as plan or project as appropriate. Establish best operational practices suitable to secure features at FCS</td>
</tr>
<tr>
<td>Dredging: maintenance *Extent unknown. Approaches and navigation channel to Burry Port were dredged in 2007. (c.f. aggregate extraction; also see dredge spoil disposal)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Treat as plan or project if appropriate. Review, revise or establish management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Determine effects of vessel movement on sediment transport, mobilisation and turbidity. Review, revise or establish management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters to minimise risk to features FCS</td>
</tr>
<tr>
<td>Shipping: vessel traffic No data available.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Treat new mooring developments as plan or project as appropriate. Review, revise or establish management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of moorings in open coastal locations</td>
</tr>
<tr>
<td>Activity</td>
<td>Key Relevant factors</td>
<td>Most likely effects on FCS elements</td>
<td>Most likely effects on FCS elements</td>
<td>Features</td>
<td>Advice/Action/Notes</td>
</tr>
<tr>
<td>----------------------------------------------</td>
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<td>-------------------------------------</td>
<td>-----------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shipping: anchoring</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Habitats</td>
<td>Review, revise or establish management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce.</td>
</tr>
<tr>
<td>No data available.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipping: vessel maintenance (incl. antifouling)</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>Habitats</td>
<td>Review, revise or establish management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce.</td>
</tr>
<tr>
<td>Not known in site.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipping: ballast water discharge</td>
<td>✓ ✓</td>
<td>✓</td>
<td>✓</td>
<td>Habitats</td>
<td>Review, revise or establish management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce.</td>
</tr>
<tr>
<td>Presumed not to occur within site. Potential exists for effects from shipping transiting offshore in Bristol Channel.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipping: refuse &amp; sewage disposal</td>
<td>✓ ✓</td>
<td>✓</td>
<td></td>
<td>Habitats</td>
<td>Management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS</td>
</tr>
<tr>
<td>Presumed not to occur within site. Potential exists for effects from shipping transiting offshore in Bristol Channel.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Apply existing legal mechanisms, monitor compliance and enforce, to secure features at FCS</td>
</tr>
<tr>
<td>Shipping: operational discharges</td>
<td>✓ ✓</td>
<td>✓</td>
<td></td>
<td>Habitats</td>
<td>Review, revise or establish management practices and spatial, temporal &amp; technical operational limits suitable to secure features at FCS; monitor compliance and enforce.</td>
</tr>
<tr>
<td>Presumed not to occur within site. Potential exists for effects from shipping transiting offshore in Bristol Channel.</td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Shipping: accidents -may be associated with cargo / bunkers discharges</td>
<td>✓ ✓</td>
<td>✓</td>
<td></td>
<td>Habitats</td>
<td>Maintain, keep under review and improve as appropriate, shipping management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS</td>
</tr>
<tr>
<td>No data since Sea Empress Oil Spill.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Seek advice from relevant environmental agencies (CCW, EAW)</td>
</tr>
<tr>
<td>Shipping: accidents -fuel oil &amp; / or petrochemical discharges</td>
<td>✓ ✓</td>
<td>✓</td>
<td></td>
<td>Habitats</td>
<td>As above</td>
</tr>
<tr>
<td>No data since Sea Empress Oil Spill.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Key Relevant factors</td>
<td>Most likely effects on FCS elements</td>
<td>Most likely effects on FCS elements</td>
<td>Features</td>
<td>Advice/Action/Notes</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td></td>
<td>Habitat &amp; species</td>
<td>Species</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physical</td>
<td>Chemical</td>
<td>Biological</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Structure &amp; function</td>
<td>Typical species</td>
<td>Population</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>range</td>
<td>range</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shipping: accidents -non-petrochemical cargo losses / discharges</td>
<td>Rare; most recent in February 2008 when a container containing acetic anhydride came aground at Paviland Bay near Pitton Green (South Gower).</td>
<td></td>
<td></td>
<td>Maintain, keep under review and improve as appropriate, management and operational practices suitable to secure features at FCS; monitor compliance and enforce. Secure appropriate management of vessels transiting coastal waters so as to secure features at FCS Seek advice from relevant environmental agencies (CCW, EAW)</td>
</tr>
<tr>
<td></td>
<td>Shipping: accidents - salvage operations</td>
<td>No data available.</td>
<td></td>
<td></td>
<td>Maintain, keep under review and improve as appropriate, management and operational practices suitable to secure features at FCS Provide environmental advice to salvage managers and salvors.</td>
</tr>
<tr>
<td>CIVIL ENGINEERING</td>
<td>Construction</td>
<td>Widespread along the north side of Burry Inlet, with current construction hotspots at Loughor, Llanelli and Burry Port.</td>
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<td>Treat as plan or project, taking into account proposed subsequent operational use and maintenance. Consenting bodies ensure appropriate integration, inclusion and consultation. Consenting bodies ensure assessment of cumulative effects in association with others plans and projects</td>
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<td></td>
<td>Land claim</td>
<td>Past extensive reclamation of saltmarshes along the southern shoreline of the Burry Inlet and along the Taf Estuary. No proposals at present.</td>
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<td>Treat as plan or project as appropriate, taking into account proposed subsequent operational use and likely effects.</td>
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<td></td>
<td>Coast protection: hard defence (sea walls / breakwaters)</td>
<td>Locally extensive; comprehensively mapped. Worms Head – St Govans.</td>
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<td>Treat as plan or project as appropriate, taking into account proposed subsequent operational use and likely effects.</td>
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<td>Coast protection: hard defence (railways)</td>
<td>Locally extensive; coastal tracks straddle the north coast of the Burry Inlet between Llanelli and Burry Port, and between Kidwelly and Ferryside.</td>
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<td>Activity</td>
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<td>Coast protection: soft defence *#</td>
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<td>Locally extensive; comprehensively mapped.</td>
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<td>Worms Head – St Govans.</td>
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<td>Coast protection: groynes *#</td>
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<td>Worms Head – St Govans. Localised: Amroth,</td>
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<td>Ferryside (traditional timber), Llanelli (rock).</td>
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<td>Coast protection: beach replenishment *#</td>
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<td>Localised: Tenby and Saundersfoot as means of</td>
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<td>disposal of harbour dredgings. At Amroth</td>
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<td>recharge of shingle beach.</td>
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<td>Coast protection: storm surge / tidal barrage</td>
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<td>*#Historical proposal in Loughor Estuary.</td>
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<td>Local interest remains. Development interest feasible.</td>
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<td>Barrage: amenity *#</td>
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<td>Foreshore deposit of rock, rubble etc.</td>
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<td>Continued surveillance and monitoring.</td>
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<td>Anecdotal &amp; opportunistic observations</td>
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<td>Appropriate implementation of SSSI procedures.</td>
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<td>Artificial reef *#</td>
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<td>Hard-engineered freshwater watercourses *#</td>
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<td>Presence mapped.</td>
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<td>Power station *#</td>
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<td>Power / communication cables *#</td>
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<td>Inorganic wastes &amp; debris (including refuse &amp; litter)</td>
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<td>Develop and implement best practice appropriate for disposal sites</td>
<td>Develop and implement best practice appropriate for disposal sites</td>
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<td>Maintain, keep under review and improve as appropriate port waste management plans</td>
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<td>Secure appropriate promulgation &amp; enforcement of national and international dumping at sea measures so as to minimise risk to features’ FCS</td>
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<td>Treat proposed spoil disposal outwith a designated spoil disposal site as plan or project as appropriate.</td>
<td>Treat proposed spoil disposal outwith a designated spoil disposal site as plan or project as appropriate.</td>
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Treat new discharges and proposed changes to existing discharges as plan or project as appropriate.
<table>
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<tr>
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<th>Key Relevant factors</th>
<th>Most likely effects on FCS elements</th>
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**EXPLOITATION OF LIVING RESOURCES**

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<td>habitats &amp; species</td>
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<td>inlets &amp; bays</td>
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<td>estuaries</td>
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<td>Salicornia</td>
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<td>Subtidal sandbanks</td>
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<td>mud and sandflats</td>
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<td>Shads</td>
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<td>lampreys</td>
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<td>otters</td>
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<td>Cardigan Bay SPA</td>
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<td>Burry Inlet SPA</td>
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<tr>
<td>Dredging: bladed - oyster</td>
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<td></td>
<td>Treat new fisheries and new gear as plan or project as appropriate. Monitor and manage fisheries so that populations of prey species subject to existing commercial fisheries are equal to, or at greater abundance, than that required to achieve maximum sustainable yield.</td>
</tr>
<tr>
<td>Not known to occur.</td>
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<tr>
<td>Dredging: mechanical – cockle</td>
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<td>As above.</td>
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<tr>
<td>Not known to occur.</td>
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<tr>
<td>Not a “fishing instrument of an approved pattern” under SWSFC byelaw 40</td>
<td></td>
<td></td>
<td></td>
<td>As above.</td>
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</tr>
<tr>
<td>Dredging: deep hydraulic (e.g. WJID)</td>
<td></td>
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<td></td>
<td>Treat new fisheries and new gear as plan or project as appropriate. Establish, monitor and enforce operational limits (spatial, temporal, technical, effort) suitable to secure features at FCS. Monitor and manage fisheries so that populations of prey species subject to existing commercial fisheries are equal to, or at greater abundance, than that required to achieve maximum sustainable yield.</td>
</tr>
<tr>
<td>Interest exists; potential for legal or illegal development. Some forms of gear permitted under SWSFC byelaw; some forms prohibited under Welsh Statutory Instrument 2003 No. 607.</td>
<td></td>
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<tr>
<td>Dredging: shallow hydraulic (e.g. suction)</td>
<td></td>
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<td></td>
<td></td>
<td>As above.</td>
</tr>
<tr>
<td>Not known to occur.</td>
<td></td>
<td></td>
<td></td>
<td>As above.</td>
<td></td>
</tr>
<tr>
<td>Netting: bottom-set gill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Review, revise or establish, monitor and enforce operational limits (spatial, temporal, technical, effort) suitable to secure features at FCS. Monitor and manage fisheries so that populations of prey species subject to existing commercial fisheries are equal to, or at greater abundance, than that required to achieve maximum sustainable yield.</td>
</tr>
<tr>
<td>Extensively throughout Bay; information unclear as to gear type; frequency and intensity unknown, but reportedly seasonally substantial.</td>
<td></td>
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</tr>
<tr>
<td>Netting: bottom-set tangle / trammel</td>
<td></td>
<td></td>
<td></td>
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<td>As above.</td>
</tr>
<tr>
<td>Extensively throughout Bay; information unclear as to gear type; frequency and intensity unknown but reportedly seasonally substantial.</td>
<td></td>
<td></td>
<td></td>
<td>As above.</td>
<td></td>
</tr>
<tr>
<td>Netting: surface-set gill</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>As above.</td>
</tr>
<tr>
<td>Extensively throughout Bay; information unclear as to gear type; frequency and intensity unknown.</td>
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55
<table>
<thead>
<tr>
<th>Activity</th>
<th>Key Relevant factors</th>
<th>Most likely effects on FCS elements</th>
<th>Most likely effects on FCS elements</th>
<th>Features</th>
<th>Advice/Action/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Netting: beach seine</td>
<td></td>
<td><strong>Habits</strong></td>
<td><strong>Species</strong></td>
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<td>chemical</td>
<td>biological</td>
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<td>structure &amp; function</td>
<td>typical species</td>
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<td>population</td>
<td>range</td>
<td>habitats &amp; species</td>
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<td>estuaries</td>
<td>Salicornia</td>
<td>Mud and sandflats</td>
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<td>Subtidal sandbanks</td>
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<td></td>
<td>Cardigan Bay SPA</td>
<td>Burry Inlet SPA</td>
<td></td>
</tr>
<tr>
<td>Netting: beach seine</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Netting: beach seine, Carmi open beaches, Three Rivers confluence, Burry Inlet; information unclear as to gear type; frequency and intensity unknown.</td>
</tr>
<tr>
<td>Netting: demersal seine</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Netting: demersal seine, Not known to occur.</td>
</tr>
<tr>
<td>Netting: beach-set gill</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Netting: beach-set gill, Carmi open beaches, Three Rivers confluence, Burry Inlet; variable &amp; seasonal; information unclear as to gear type; frequency and intensity unknown.</td>
</tr>
<tr>
<td>Netting: other (e.g. fyke)</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Netting: other (e.g. fyke), Potential exists.</td>
</tr>
<tr>
<td>Potting: lobster / crab</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Potting: lobster / crab, Mainly confined to SW Gower coast and deep rocky areas in Bay. No quantified information.</td>
</tr>
<tr>
<td>Potting: prawn</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>Potting: prawn, Not known to occur.</td>
</tr>
</tbody>
</table>
## Activity

<table>
<thead>
<tr>
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<tr>
<td>Potting: whelk</td>
<td></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td>Review, revise or establish, monitor and enforce operational limits (spatial, temporal, technical, effort) suitable to secure features at FCS. Monitor and manage fisheries so that populations of prey species subject to existing commercial fisheries are equal to, or at greater abundance, than that required to achieve maximum sustainable yield.</td>
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<tr>
<td>Line: long-line</td>
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<tr>
<td>Line: handline</td>
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<tr>
<td>Electro-fishing: molluscs</td>
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<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td>Treat new fisheries and new gear as plan or project as appropriate. Establish, monitor and enforce operational limits (spatial, temporal, technical, effort) suitable to secure features at FCS. Monitor and manage fisheries so that populations of prey species subject to existing commercial fisheries are equal to, or at greater abundance, than that required to achieve maximum sustainable yield.</td>
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<tr>
<td>Fisheries: predator control</td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td>Enforce relevant wildlife protection legislation.</td>
</tr>
<tr>
<td>Hand gathering: cockles (excluding access issues)</td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
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</tr>
<tr>
<td>Hand gathering: mussels (excluding access issues)</td>
<td><img src="symbols.png" alt="Symbols" /></td>
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<td><img src="symbols.png" alt="Symbols" /></td>
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<td>As above</td>
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<tr>
<td>Hand gathering: mussel seed (excluding access issues)</td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
<td><img src="symbols.png" alt="Symbols" /></td>
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<td></td>
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<td>Habitat &amp; function</td>
<td>Typical species</td>
<td>Inlets &amp; bays</td>
<td>Estuaries</td>
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<td></td>
<td></td>
<td>Physical</td>
<td>Chemical</td>
<td>Biological</td>
<td></td>
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<td></td>
<td>Structure &amp; function</td>
<td>Range</td>
<td>Population</td>
<td>Range</td>
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<tr>
<td>Hand gathering: razor clam (including salting)</td>
<td>Physical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Mainly known from Saundersfoot &amp; Rhossili. Frequency and intensity unknown, though anecdotal reports suggest possibly increasing</td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hand gathering: other bivalves</td>
<td>Physical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Gathering various long-live, slow growing bivalve species (e.g. Mya, Lutraria) reported from Tenby / Saundersfoot &amp; Rhossili; frequency and intensity unknown.</td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hand gathering: winkle</td>
<td>Physical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Gower &amp; Tenby / Saundersfoot</td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hand gathering: crustacean / shellfish</td>
<td>Physical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>No information.</td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hand gathering: algae &amp; plants for human consumption (e.g. Porphyra, Salicornia)</td>
<td>Physical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Little information; none quantitative. Burry Inlet. Exact locations, frequency and intensity unknown.</td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hand gathering: access and vehicle use</td>
<td>Physical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Integral to cockle fisheries and mussel seed collection (and intertidal mussel SO)</td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Hand / mechanical gathering: algae for chemical extraction / biomass</td>
<td>Physical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>No information.</td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bait collection: digging</td>
<td>Physical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Widespread; locally intense. No quantified frequency, effort or distribution information.</td>
<td>Chemical</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>Treating new fisheries and new gear as plan or project as appropriate. Monitor and manage fisheries so that populations of prey species subject to existing commercial fisheries are equal to, or at greater abundance, than that required to achieve maximum sustainable yield.</td>
<td>Biological</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td>URGENT review and establishment of adequate spatial, temporal, technical and effort operational limits to secure features at FCS; monitor compliance and enforce appropriate implementation of SSSI procedures. Education &amp; awareness raising</td>
<td>Biological</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Activity</td>
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<tr>
<td></td>
<td></td>
<td>Physical</td>
<td>chemical</td>
<td>biological</td>
<td>Habitat &amp; Function</td>
</tr>
<tr>
<td>Bait collection: pump</td>
<td>Widespread; no quantified, frequency or effort distribution information. (Main target; black lug)</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>Urgent review and establishment of adequate spatial, temporal, technical and effort operational limits to secure features at FCS; monitor compliance and enforce appropriate implementation of SSSI procedures. Education &amp; awareness raising.</td>
</tr>
<tr>
<td>Bait collection: boulder turning</td>
<td>Widespread; locally intense. No quantified frequency, effort or distribution information.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>As above</td>
</tr>
<tr>
<td>Collection, for aquarium / curio trade</td>
<td>No quantified frequency, effort or distribution information.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>Review, revise or establish, monitor and enforce operational limits (spatial, temporal, technical, effort) suitable to secure features at FCS.</td>
</tr>
<tr>
<td>Grazing of saltmarsh</td>
<td>Significant. Stocking level information not acquired. Stock management variable.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>As above</td>
</tr>
<tr>
<td>CULTIVATION OF LIVING RESOURCES</td>
<td></td>
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</tr>
<tr>
<td>Aquaculture: algae</td>
<td>Not known to occur.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>Treat new proposed developments as plan or project as appropriate. Review consenting procedures.</td>
</tr>
<tr>
<td>Aquaculture: finfish - sea cages or impoundments</td>
<td>* Not known to occur.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>As above</td>
</tr>
<tr>
<td>Aquaculture: crustaceans - sea cages or impoundments</td>
<td>* Not known to occur.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>As above</td>
</tr>
<tr>
<td>Aquaculture: mollusc ‘ranching’</td>
<td>* Several Order applications for mussel bottom culture extant. (Subject to plan / projects assessment.)</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>As above</td>
</tr>
<tr>
<td>Aquaculture: mollusc ‘farming’</td>
<td>* (mollusc culture using trestles, ropes, cages or other structures) Not known to occur.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>As above</td>
</tr>
<tr>
<td>Aquaculture: land based semi-enclosed / recirculation</td>
<td>* Interest expressed. Ragworm farm operational at Pendine.</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓</td>
<td>Consider as industrial effluent. Treat new proposed developments as plan or project as appropriate.</td>
</tr>
<tr>
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<td>Structure &amp; function</td>
<td>Typical species</td>
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<td></td>
<td>physical</td>
<td>range</td>
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<td></td>
<td>chemical</td>
<td>range</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>biological</td>
<td>range</td>
<td></td>
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<td>range</td>
<td>range</td>
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</tr>
</tbody>
</table>

**Aquaculture: predator control**
Not known to occur yet, but likely future operation: potential potting of green crab in mussel SOs.

- Establish, monitor and enforce operational limits (spatial, temporal, technical, effort) suitable to secure features at FCS.

**Aggregation devices** (e.g. ‘crab tiles’)
Localised use of tyres. Tiles not known to be used.

- As above

**EXPLOITATION OF NON-LIVING RESOURCES**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Key Relevant factors</th>
<th>Most likely effects on FCS elements</th>
<th>Most likely effects on FCS elements</th>
<th>Features</th>
<th>Advice/Action/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water abstraction *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abstraction from freshwater inputs site-wide.</td>
<td>√ √</td>
<td>√ √</td>
<td>√ √</td>
<td>√ √</td>
<td>√ √</td>
</tr>
<tr>
<td>Aggregate extraction * (mineral &amp; biogenic sands &amp; gravels) Seven-year license granted in 2007 to dredge Helwick Bank at a rate of 150,000 tonnes per annum.</td>
<td>√ √</td>
<td>√ √</td>
<td>√ √</td>
<td>√ √</td>
<td>√ √</td>
</tr>
<tr>
<td>Oil &amp; gas exploration: seismic survey *</td>
<td>Unlikely to be pursued.</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Oil &amp; gas exploration &amp; production: drilling operations *</td>
<td>Unlikely to be pursued.</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Oil &amp; gas exploration &amp; production: operational * &amp; accidental discharges</td>
<td>Unlikely to be pursued.</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Renewable energy generation: tidal barrage *#</td>
<td>Historical proposal in Loughor Estuary. Local interest remains.</td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Renewable energy generation: tidal impoundment *# Development interest feasible.</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Renewable energy generation: tidal current turbine *# Low possibility of development interest; site low suitability.</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Renewable energy generation: wave energy *# Low possibility of development interest; site low suitability.</td>
<td></td>
<td>√</td>
<td>√</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>
### Activity

<table>
<thead>
<tr>
<th>Key Relevant factors</th>
<th>Most likely effects on FCS elements</th>
<th>Most likely effects on FCS elements</th>
<th>Features</th>
<th>Advice/Action/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical</td>
<td>Chemical</td>
<td>Biological</td>
<td>Range</td>
<td>Structure &amp; function</td>
</tr>
<tr>
<td>Renewable energy generation: offshore wind</td>
<td># Development interest feasible.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### POLLUTION RESPONSE

<table>
<thead>
<tr>
<th>Activity</th>
<th>Advice/Action/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil spill response: at sea</td>
<td>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill). Develop and maintain appropriate pollution response contingency plans. Inclusion and maintenance of information on site features and sensitivity to at-sea response activities in West Wales standing Environment Group pollution response advice contingency plan</td>
</tr>
<tr>
<td>Oil spill response: shore cleaning – washing</td>
<td>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill). As above</td>
</tr>
<tr>
<td>Oil spill response: shore cleaning - chemical</td>
<td>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill). As above</td>
</tr>
<tr>
<td>Oil spill response: shore cleaning - physical</td>
<td>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill). As above</td>
</tr>
<tr>
<td>Oil spill response: shore cleaning - ancillary activities (access creation, vehicular impacts, wildlife rescue)</td>
<td>Reactive only. No recent activity (since 1996-97 Sea Empress oil spill). Develop and maintain appropriate pollution response contingency plans. Inclusion and maintenance of information on site features and sensitivity to on-shore cleaning activities in West Wales standing Environment Group pollution response advice contingency plan. Treat as plan or project as appropriate.</td>
</tr>
</tbody>
</table>

### RECREATION

<table>
<thead>
<tr>
<th>Activity</th>
<th>Advice/Action/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angling</td>
<td>Unquantified observations. Throughout bay; boat and shore; no data available on frequency; intensity unknown. ‘Hotspots’. Anecdotal observations of intense pressure, e.g. competitions. Education &amp; awareness raising Effort surveillance Establish, monitor and enforce spatial, temporal, technical and effort operational limits suitable to secure features at FCS.</td>
</tr>
<tr>
<td>Bait collection: boulder turning</td>
<td>Widespread &amp; common As above</td>
</tr>
<tr>
<td>Bait collection: digging &amp; other sediment shore collection techniques</td>
<td>Common, widespread with ‘hot spots’ of activity As above</td>
</tr>
<tr>
<td>Activity</td>
<td>Key Relevant factors</td>
</tr>
<tr>
<td>----------</td>
<td>---------------------</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Recreational boating: high speed power craft (incl. PWC)</td>
<td>Unquantified; localised, mainly in vicinity of Tenby, Saundersfoot and Burry Port. PWC use off Burry Port &amp; in entrance to Burry Inlet; also western Bay.</td>
</tr>
<tr>
<td>Recreational boating: low speed power craft</td>
<td>Unquantified; localised, mainly in vicinity of Tenby, Saundersfoot and Burry Port.</td>
</tr>
<tr>
<td>Recreational boating: sailing</td>
<td>Unquantified; localised, mainly around Tenby &amp; Saundersfoot. Little / no traffic from Swansea Bay?</td>
</tr>
<tr>
<td>Recreational boating: canoeing</td>
<td>Infrequent, minimal.</td>
</tr>
<tr>
<td>Recreational boating: other non-mechanically powered craft (e.g. kite-surfing, board-sailing, etc.)</td>
<td>No information available.</td>
</tr>
<tr>
<td>Recreational boating: moorings</td>
<td>Localised; mainly Tenby / Saundersfoot (ca. 400), Llansteffan / Ferryside (ca. 250) and Burry Port / Loughor (ca. 200).</td>
</tr>
<tr>
<td>Recreational boating: anchoring</td>
<td>No data available. Localised anchoring of recreational angling vessels; mainly NE Bay and lower estuaries.</td>
</tr>
<tr>
<td>Surfing</td>
<td>No data available.</td>
</tr>
<tr>
<td>Scuba diving, snorkelling</td>
<td>No data available; limited predominantly to rocky areas in SW and SE of Bay.</td>
</tr>
<tr>
<td>Spearfishing</td>
<td>No information available.</td>
</tr>
<tr>
<td>Activity</td>
<td>Key Relevant factors</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Coastal access for recreation (bathing, dog walking, coasteering, etc.)</td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehilces on foreshore</td>
<td>✓</td>
</tr>
<tr>
<td>Widespread, occasional; unquantified observations</td>
<td></td>
</tr>
<tr>
<td>Light aircraft</td>
<td>✓</td>
</tr>
<tr>
<td>Occasional</td>
<td></td>
</tr>
<tr>
<td>Wildfowling</td>
<td>✓</td>
</tr>
<tr>
<td>Unquantified observation; assumed to be widespread and common. Foreshore lease maps available.</td>
<td></td>
</tr>
<tr>
<td>Marine wildlife watching / eco-tourism</td>
<td>✓</td>
</tr>
<tr>
<td>No data available</td>
<td></td>
</tr>
<tr>
<td>MILITARY ACTIVITIES</td>
<td></td>
</tr>
<tr>
<td>Military activity: ordnance ranges</td>
<td>✓</td>
</tr>
<tr>
<td>Regular</td>
<td></td>
</tr>
<tr>
<td>Military activity: marine exercises</td>
<td>✓</td>
</tr>
<tr>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Military activity: aircraft</td>
<td>✓</td>
</tr>
<tr>
<td>Regular</td>
<td></td>
</tr>
<tr>
<td>MISCELLANEOUS OPERATIONS &amp; USES</td>
<td></td>
</tr>
<tr>
<td>Marine archaeology &amp; salvage</td>
<td>✓</td>
</tr>
<tr>
<td>No data available</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>✓</td>
</tr>
<tr>
<td>Regular use of favoured sites</td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Key Relevant factors</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td></td>
<td>physical</td>
</tr>
<tr>
<td>Science research</td>
<td></td>
</tr>
<tr>
<td>CCW, EAW, SWSFC, Uni. of Wales. Benthic, fish</td>
<td></td>
</tr>
<tr>
<td>stock &amp; water column sampling. Scoter aerial</td>
<td></td>
</tr>
<tr>
<td>monitoring. Low tide waterfowl surveys.</td>
<td></td>
</tr>
<tr>
<td>Animal welfare operations &amp; sanctuaries</td>
<td></td>
</tr>
<tr>
<td>Bird ‘hospitals’ located Gower &amp; South</td>
<td></td>
</tr>
<tr>
<td>Pembrokeshire</td>
<td></td>
</tr>
</tbody>
</table>

- Activity surveillance
- Education & awareness raising
- Review, develop and/or implement and monitor best practice suitable to secure features at FCS
USEFUL REFERENCES


Carmarthen Bay Coastal Study, Stage II, British Maritime Technology Ltd. Ceemaid Division 1987. Volumes

Carmarthen Bay Coastal Study, Stage III, British Maritime Technology Ltd. Ceemaid Division 1989. Volumes


65


Moore, N.H. (1976) *Physical oceanographic and hydrological observations in the Loughor Estuary (Burry Inlet)*, Burry Inlet Symposium, University College of Swansea, Session 1, paper 3, pp. 15.


Posford Duvivier (1999) *Sediment transport analysis of Carmarthen Bay in support of the Bristol Channel Marine Aggregates: Resources and constraints research project*. Posford Duvivier.


**APPENDIX 1 Glossary of Terms**

Common appreciation of the meaning of the terms employed in these conservation objectives is critical to their understanding. Many terms may be understood differently and are therefore potentially ambiguous. To overcome any preconceptions and to ensure the greatest clarity, the meanings of certain terms for the purpose of this document, are defined below.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>baroclinic</td>
<td>Seawater circulation pattern arising when density and pressure gradients are perpendicular to each other.</td>
</tr>
<tr>
<td>benthos; benthic</td>
<td>The forms of marine life that live on, or in, the sea or ocean bottom. Pertaining to the sea or ocean bottom.</td>
</tr>
<tr>
<td>bioaccumulation</td>
<td>The uptake and retention of a ‘bioavailable’ chemical form from any one of, or all possible external sources (cf biomagnification qv).</td>
</tr>
<tr>
<td>biodiversity</td>
<td>Biodiversity has been widely defined and is understood in various ways. It is widely used to capture the concept of the ‘variety of life’ and includes genetic, species and community diversity.</td>
</tr>
<tr>
<td>biogenic</td>
<td>Produced directly by the physiological activities of organisms, either plant or animal (Baretta-Bekker et al 1998). Biogenic reefs – long-lived, hard, biological structures comprised of large numbers individual organisms such as mussel or sand-tube building worms <em>Sabellaria</em>.</td>
</tr>
<tr>
<td>biomagnification</td>
<td>The process whereby a chemical, as it is passed through a food chain or food web, builds to increasingly higher concentrations in the tissues of animals at each higher trophic level (cf bioaccumulation qv).</td>
</tr>
<tr>
<td>biotic and abiotic factors (qv)</td>
<td>Biotic: “Pertaining to life … influences caused by living organisms”; cf abiotic: “characteristics and elements of the environment (which) influence survival or reproduction of organisms, that are not alive themselves” (Baretta-Bekker et al ibid). Influences and elements of both a biological and non-biological nature that: contribute to the composition of a habitat, its structure, function or biology (i.e. the factors that the comprise habitat, as defined in Habitats Directive, Article 1E: “habitat of a species means an environment defined by specific abiotic and biotic factors, in which the species lives at any stage of its biological cycle”); contribute to a result or to bringing about a result; affect the course of events. Many factors are processes (qv). Biotic factors include competitive interaction (e.g. for space and food, predation, scavenging and grazing).</td>
</tr>
<tr>
<td>bioturbation</td>
<td>Biological perturbation, or reworking, of sediment by organisms, affecting the exchange of organic matter, oxygen, nutrients etc between buried sediment and the sediment surface and overlying waters.</td>
</tr>
<tr>
<td>by-catch</td>
<td>“The catch of non-target species and undersized fish of target species.” (CCW 2001). “The part of the catch that does not belong to the retained part of the target species of a fishery, … unmarketable component of target species, marketable species which were not aimed for, … accidental catches. The term is often used rather loosely” (Baretta-Bekker et al ibid).</td>
</tr>
<tr>
<td>contaminant</td>
<td>Anthropogenically synthesised chemicals (e.g. PCBs, biocides etc) and anthropogenically elevated naturally occurring chemical components (e.g. heavy metals) that are toxic or otherwise detrimental to the physiological health or well-being of typical species.</td>
</tr>
<tr>
<td>degrade</td>
<td>(degrade: to lower in rank or grade, to lower in character, value or position or in complexity; degraded: declined in quality or standard. Chambers Dictionary 1998). In this document, the meaning of degrade is applied to damage or impairment resulting from such human action as has a detrimental outcome for features. See also section 5.1</td>
</tr>
<tr>
<td>demersal</td>
<td>Living on or near the seabed.</td>
</tr>
<tr>
<td>detrimental</td>
<td>Causing damage or harm; damaging, disadvantageous.</td>
</tr>
<tr>
<td>dioecious</td>
<td>Sexes separate, i.e. not hermaphrodite</td>
</tr>
<tr>
<td>epifauna (-flora, -biota)</td>
<td>Animals (fauna), plants (flora), organisms (biota) that live on top of seabed or other organisms, either attached to them or freely moving over them; cf infauna (qv).</td>
</tr>
<tr>
<td>eutrophic</td>
<td>Waters rich in mineral and organic nutrients that promote a proliferation of plant life, especially algae, which reduces the dissolved oxygen content and often causes the reduction or extinction of</td>
</tr>
</tbody>
</table>

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<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>evolve</td>
<td>To alter with time, either remaining stable (qv) or changing</td>
</tr>
<tr>
<td>extent</td>
<td>The area a feature, or one of its components, covers within its natural range (qv) within the site.</td>
</tr>
<tr>
<td>factor</td>
<td>A circumstance, fact, influence or element that:</td>
</tr>
<tr>
<td></td>
<td>- contributes to composition of a habitat, its structure, function or biology;</td>
</tr>
<tr>
<td></td>
<td>- contributes to a result or to bringing about a result;</td>
</tr>
<tr>
<td></td>
<td>- affects the course of events.</td>
</tr>
<tr>
<td></td>
<td>Many factors are processes (qv)</td>
</tr>
<tr>
<td>functions</td>
<td>Functions are processes that may, directly or indirectly, influence:</td>
</tr>
<tr>
<td></td>
<td>- the state of a physical habitat;</td>
</tr>
<tr>
<td></td>
<td>- the marine life associated with that habitat.</td>
</tr>
<tr>
<td>habitat components</td>
<td>Contributing to the composition of a habitat. This includes physical and biological sub-habitats e.g. different types of reef, as well as different elements such as particular communities that make up reef habitats</td>
</tr>
<tr>
<td>halocline</td>
<td>The boundary zones between layers of seawater at different salinities (see also thermocline and oxyclines). Together with thermoclines, halocline have a strong influence on seawater density, circulation and species distribution</td>
</tr>
<tr>
<td>hydrodynamics</td>
<td>The mechanical effects of moving fluids; i.e. the motions of the sea. (Baretta-Bekker et al ibid)</td>
</tr>
<tr>
<td>hydrograph</td>
<td>The description of the seas: 1) “marine cartography” (coastlines, bathymetry); 2) “descriptive oceanography” (the “description of water properties, their distribution and variation”; encompasses hydrodynamics (qv) (Baretta-Bekker et al ibid)</td>
</tr>
<tr>
<td>hypertrophic</td>
<td>Waters in which mineral and organic nutrients are elevated above natural levels (cf eutrophic qv).</td>
</tr>
<tr>
<td>infauna</td>
<td>Animals that live within sediment</td>
</tr>
<tr>
<td>inherent</td>
<td>Existing in and inseparable from something else; innate; natural; the relation between a quality or attribute and its subject  (Oxford English and Chambers Dictionaries)</td>
</tr>
<tr>
<td>inhibit</td>
<td>To hold in or back; to keep back; to restrain or check; to restrict or prevent</td>
</tr>
<tr>
<td>maerl</td>
<td>A calcareous red alga (seaweed) that is an important habitat-structuring component. Maerl is very slow growing and maerl beds tend to support particularly rich and biodiverse marine communities.</td>
</tr>
<tr>
<td>maximum sustainable yield (MSY)</td>
<td>Maximum use that a renewable resource can sustain without impairing its renewability through natural growth or repleniishment. Fishing at MSY levels means catching the maximum proportion of a fish stock that can safely be removed from the stock while, at the same time, maintaining its capacity to produce maximum sustainable returns, in the long term. Considered as an international minimum standard for stock rebuilding strategies (i.e. stocks should be rebuilt to a level of biomass which could produce at least MSY). See EU press release</td>
</tr>
<tr>
<td>mega, macro, and meio- (biota / flora / fauna)</td>
<td>The sizes of plants and animals. Mega-: no internationally agreed definition, but commonly defined as large enough to be seen discriminated in photographs, 2 cm or larger. Macro - large enough to be seen by the naked eye, greater than 0.5 mm, to up to 2cm. Meio-: organisms that cannot be observed without a microscope; organisms between 0.03 or 0.06 mm and 0.5 mm (cf micro-: organisms invisible to the naked eye; smaller than meiofauna; defined as &lt;32µm) (Multiple references)</td>
</tr>
<tr>
<td>natural</td>
<td>In this document, the meaning of natural is taken to be as defined in standard English dictionaries: inherent, innate, self-sown and uncultivated, not the work of or the direct product of interference by human action; in accordance with nature; relating to or concerning nature; existing in or produced by nature; in conformity with nature; not artificial. <em>It does not mean or imply pristine</em> (i.e. an original, unmodified, state).</td>
</tr>
<tr>
<td>oxycline</td>
<td>The boundary zones between layers of seawater with different dissolved oxygen concentrations (see also halocline and thermocline). Strong influence on species distribution.</td>
</tr>
<tr>
<td>process</td>
<td>A series of actions, events or changes that vary in space and over time. In this context processes include physical, chemical and biological environmental changes which are inherently natural but which may be modified by human activity (e.g. wave action, nutrient fluxes). All processes are factors.</td>
</tr>
<tr>
<td>quality (of habitat)</td>
<td>The relative absence of anthropogenic modification of naturalness of habitat extent, structure, function and typical species as a result of, inter alia:</td>
</tr>
</tbody>
</table>
- change in distribution, extent, geology, sedimentology, geomorphology, hydrography, meteorology, water and sediment chemistry and biological interactions;
- change in species richness, population structure and dynamics, physiological health, reproductive capacity, recruitment, mobility and range or of anthropogenic modification of suitability of habitat as a result of, inter alia;
- level of disturbance
- alternation of prey/food supply
- contamination of food supply

**range**
The natural spatial distribution of a feature, habitat, habitat component or species. Depending on the context, this term either describes the global distribution of the feature or, in the context of the site, the distribution of the feature within the site.

**safe biological limits**

**salinity**
Seawater salinity is measured in parts of salt in one thousand parts water (‰).

**salt wedge**
When freshwater and seawater meet in an estuary or sheltered marine inlet, the two water masses or different density often do not mix completely. A distinguishable inflowing tongue of dense seawater beneath a less dense layer of freshwater is referred to as a salt wedge. The shape of the salt wedge in Milford Haven is measurably deflected to the south side of the Haven by the earth’s rotation.

**sessile**
Benthic (qv) organisms living attached to the seabed substrate.

**species richness**
Variety of species. The total number of species:
- among a fixed number of individuals;
- per unit of surface area (of habitat).

**spraint**
Descriptive term for otter faeces. Spraint has a distinctive smell and appearance; it contains indigestible food remains from which prey species may be identified.

**stable**
Tendency towards an equilibrium state in spite of varying external conditions.

**structure**
The composition and arrangement of those:
- parts of the feature,
- parts of the natural environment,
- circumstances, that constitute the feature or are required by the feature for its maintenance in both the long term and foreseeable future.

**stochastic**
Random, chaotic, possible but unpredictable.

**thermocline**
A boundary zone between layers of seawater at different temperatures (see also halocline and oxycline). Together with haloclines, thermoclines have strong influences on seawater density, circulation and species distribution.

**supporting sediments**
Sediments with strong geomorphological / sediment-transport links to the feature. Particularly relevant to areas of sediment exchange and supply.

**thermohaline circulation**
Seawater circulation driven by density differences caused by seawater temperature and salinity differences.

**typical species**
Species that are, from time to time, associated with a specified habitat within the site; i.e. all species that contribute to the biodiversity of the specified habitat within the site.
APPENDIX 2 List of SSSIs and SPAs partly or wholly within the SAC

Sites of Special Scientific Interest that are partly or wholly within the SAC
Tenby Cliffs & St.Catherine’s Island
Waterwynch Bay to Saundersfoot Harbour
Arfordir Saundersfoot – Telpyn/Saundersfood – Telypyn Coast
Arfordir Marros – Pentywyn/Marros – Pendine Coast
Twyni Lacham – Pentywyn/Laugharne – Pendine Burrows
Whitehill Down
Aber Taf/Taf Estuary
Afon Tywi
Arfordir Pen-bre/Pembrey Coast
Burry Inlet and Loughor Estuary
Twyni Chwitffordd, Morfa Landimore a Bae Brychdwn/Whiteford Burrows, Landimore Marsh and Broughton Bay

Special Protection Areas that are partly or wholly within the SAC
Bae Caerfyrddin/Carmarthen Bay
Burry Inlet

Locations are shown on Map 2
## APPENDIX 3 Important elements of Favourable Conservation status

**HABITATS**

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RANGE</strong></td>
<td></td>
</tr>
<tr>
<td>Distribution</td>
<td>Distribution of habitat features within the site, and also within a national and European context, has a key role in determining the distribution and abundance of typical species. Also important is the distribution within a habitat feature of components of habitat structure (e.g. Sediment granulometry) and of habitat function (e.g. Wave exposure).</td>
</tr>
<tr>
<td>Extent</td>
<td>Overall extent, large examples or extensive areas are inherently highly rated and contribute to conservation of structure and function. The extents of habitat components, both structural functional are important determining factors of habitat and species diversity.</td>
</tr>
<tr>
<td><strong>STRUCTURE</strong></td>
<td>Physical structures of habitat features and their variation are the foundation of habitat diversity and, accordingly, species diversity. Along with environmental processes (function), habitat structure strongly influences where things live.</td>
</tr>
<tr>
<td>Geology</td>
<td>Geology at all spatial scales underpins the structure of the habitats, from overall coastal structure, which determine exposure to major environmental processes, to local habitat structure. The range of rock types and the distribution of rock folding, faulting and fracturing determine the overall complexity of shape of the seabed and coast and the diversity of habitats.</td>
</tr>
<tr>
<td>Sedimentology</td>
<td>Sedimentology is the result of complex processes significantly influenced by water movement. Sediment granulometry, structure and degree of sorting (from well sorted fine – medium sands and muddy sands to poorly sorted, mixed substrata containing mud, gravel, shell and stones) creates an extremely wide range of sediment habitats.</td>
</tr>
<tr>
<td>Geomorphology</td>
<td>The gross shape of features and of individual sections of features is an essential component of habitat structure and contributes to habitat diversity.</td>
</tr>
<tr>
<td>Morphology (shape)</td>
<td>Surface relief of all substrates is a fundamentally important component of habitat structure, underpinning biological diversity through the provision of different habitats and microhabitats and a range of depths below sea level or intertidal drying heights. Rock topography, together with morphology, has a critical influence on hydrodynamic processes. Rock topography is fundamentally determined by geology. The range of rock topography is a particularly important contributor to reef biodiversity. Sediment topography is important in sediment habitats. For example granulometry and slope together determine sediment flats' ability to retain water during low tide (the amount of interstitial water retained is important in determining community composition); the breadth of the shore (related to slope) in combination with shore aspect, is important in determining the degree of wave energy expended on any part of the shore, therefore influencing community composition.</td>
</tr>
<tr>
<td>Microtopography</td>
<td>Rock microtopography is determined by geology, with surface pits, cracks, fissures, bore-holes etc providing additional niches for marine wildlife. The microtopography of sediment flats is important in determining water runoff (including the formation of rips) and retention and, in turn, influence the distribution of surface biota and granulometry.</td>
</tr>
<tr>
<td>Orientation and aspect</td>
<td>Orientation and aspect are products of morphology and topography that, in combination with functional processes such as wave or light exposure, extend the variety of niches provided by habitat features. Range and variation in orientation and aspect enhance habitat and species diversity.</td>
</tr>
<tr>
<td>Bathymetry</td>
<td>Bathymetry is determined by other structural components and by hydrodynamic and sediment processes. Depth of seabed is in turn a critical influence on hydrodynamic processes, such as wave exposure and tidal streams. In combination with water clarity, depth determines light attenuation through the water column thereby contributing directly to community structure. Bathymetric variation within and between individual parts of features enhances habitat and species diversity.</td>
</tr>
<tr>
<td><strong>FUNCTION</strong></td>
<td>Distribution, extent, abundance and variety of species populations is shaped by spatial and temporal variation of a wide range of physico-chemical and biological processes (functions).</td>
</tr>
<tr>
<td>Hydrography &amp; meteorology</td>
<td>Hydrographic &amp; meteorological processes are fundamental to the structure and function of habitats and their species populations. The magnitude of hydrographic factors varies along gradients determined by the underlying geomorphology of the site and complex interactions with other functional processes. Hydrography &amp; meteorology are of critical importance to structure, function and species population of habitats both directly – determining extent of intertidal areas and the emergence regime; and indirectly through the action of tidal streams.</td>
</tr>
<tr>
<td>Hydrometrics (water movement)</td>
<td>Water movement is a fundamentally important environmental process that determines the species composition present at any particular location, both directly and indirectly through its effect on other important processes such as nutrient, sediment and dissolved gas transport. The range of relative contributions of tidal streams, wave action and residual currents to water movement is particularly important in determining biological composition.</td>
</tr>
<tr>
<td>Tidal range and rise - fall</td>
<td>Tidal range and rise - fall is of critical importance to structure, function and species population of habitats both directly – determining extent of intertidal areas and the emergence regime; and indirectly through the action of tidal streams.</td>
</tr>
<tr>
<td>Tidal streams (currents)</td>
<td>Tidal streams (currents): the strength, patterns, relative constancy, lack of attenuation with depth, general bidirectional and spatial and temporal variations in tidal streams are important in structuring the distribution of species populations; food, sediment and chemical transport processes; water mixing.</td>
</tr>
<tr>
<td>Wave exposure</td>
<td>Wave action is one of the most physically powerful, chaotic and relatively unpredictable processes. Exposure to wave action is determined by habitat morphology, topography, aspect, attenuation with depth and meteorological processes and has a major influence on distribution of species populations; water clarity and water mixing. The range of wave exposure within the site is extreme.</td>
</tr>
<tr>
<td>Residual current</td>
<td>Residual currents modify local hydrodynamic and meteorological processes for example through inputs of water masses with elevated suspended sediment loads, temperature and / or nutrients and contaminants.</td>
</tr>
<tr>
<td>Temperature (water)</td>
<td>Water temperature strongly influences water chemistry and biological processes, such as reproduction and metabolism. The biogeographical location of the sites and the degree of buffering of winter minima and summer coastal warming by oceanic waters (North Atlantic Drift) strongly influences and limits the sea temperature range. Temperature range is important in mediating reproduction and survival of species, shielding submerged species from the more extreme temperatures experienced by intertidal species and reducing the ability of some non-native species to become established. Global processes (global warming, shifts in ocean currents), influenced by climate change, also influence local seawater temperature.</td>
</tr>
</tbody>
</table>
### ELEMENT | Rationale
---|---
light intensity (ambient seabed and water column) | Seabed light intensity has an important influence on community structure, particularly through algal species distribution, mediated by bathymetry, water transparency and localised shading (e.g. from overhangs, caves or aspect). Spatial and temporal variation in light intensity has considerable broad and local scale impacts on species population distributions and community variation. Water column light intensity in combination with shelter from extreme water movement and elevated nutrients is important in the occurrence and distribution of seasonal plankton blooms.

Seston concentrations and water transparency (clarity/turbidity) | Seston (suspended particulate matter) concentrations are critically important as a food-energy resource, is a factor in sediment processes and deposition including smothering and scouring of biota, and through absorption of light modifying light availability at seabed and in water column. Seston composition and water column loads are determined by the origins of the particulate matter – biological productivity and/or riverine, coastal or oceanic water inputs.

**Sediment processes** | Sediment erosion, transport and deposition are critical in determining extent, morphology and functional processes of sediment processes and deposition including smothering and scouring of biota, and through absorption of light modifying light availability at seabed and in water column. Seston composition and water column loads are determined by the origins of the particulate matter – biological productivity and/or riverine, coastal or oceanic water inputs.

**TYPICAL SPECIES & SPECIES FEATURES**

**ELEMENT | Rationale**
---|---
**SPECIES RICHNESS (Variety of species)** | Species richness is most likely to be applicable as a component of FCS for typical species of Habitat features. However, the variety of available prey is likely to be important to predatory species features such as dolphins, seals, otter, lamprey and shad, and, as such, it forms an important measure of a species features habitat quality. Biological variety is a key contributor to biodiversity and applies at both taxonomic and genetic levels. Species variety “typical” of different habitats is dependent on the ecological opportunities available (niche diversity), particularly the degree of stress from natural processes. Habitats and communities subject to moderate levels of disturbance tend toward high species diversity. A high proportion of the species in such highly diverse communities are usually present at low frequencies and, individually, may make a small contribution to the overall functioning of the community. Nevertheless, such “species redundancy” is a vital contribution to biodiversity in many marine habitats and communities, and is consequently extremely important in terms of the conservation of the habitat features.
**CARMARTHEN BAY REGULATION 33 ADVICE FEBRUARY 2009**

<table>
<thead>
<tr>
<th>ELEMENT</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>POPULATION DYNAMICS</td>
<td>Species population dynamics are inherently important in maintaining viability of species populations and species variety.</td>
</tr>
</tbody>
</table>

**Population size (species abundance)**

Sizes of species populations vary widely depending on their biology and ecology (e.g. Reproductive, competitive, survival and life history strategies; recruitment, habitat requirements; adaptation to natural processes and factors) and stochastic events.

For a species feature, population size is a key measure of the species ecological success or failure. Along with a typical species’ distribution, its population size determines its contribution to biodiversity and to habitat structure and function. Populations sizes of small, short-lived, rapidly reproducing species are orders of magnitude greater than large, long-lived, slowly reproducing and infrequently recruiting species. Populations of many species fluctuate widely in response to natural and artificial perturbations and opportunities; many others remain stable for long periods and many of these are particular sensitive to anthropogenic disturbance or habitat degradation.

**Contribution to the integrity of wider population***

The full range of some species features are only partly encompassed by the site. The long-term viability of the species population may therefore be in part or mainly determined by stock outside the site, and vice versa (e.g. through immigration and emigration, genetic variation etc). The contribution a species population occurring within a site makes to the wider population status is important to the long-term viability of the species as a whole, including that occurring within the site.

**Biomass**

Biomass is the potential energy of species populations, and thus fundamental to species physiological health, reproductive capacity and energy reserves, and is an energy resource for other species. Sediments with high organic input typically support a species biomass and rate of turnover (productivity) sufficiently high to contribute significantly to the maintenance of predatory typical species such as fish and waders and wildfowl. However, high biomass and low species variety may also be indicative of environmental stress or perturbation. Biomass of different reef habitats is extremely variable, varying with species composition and recruitment, age structure, health and environmental stress and consequently frequently varies widely within a small area of apparently similar habitat for a variety of reasons.

**Reproductive success**

The ability to successfully reproduce is critical to a species population’s long-term viability. Reproductive success is a function of reproductive capability and the survival of young. Reproductive capability is a function of many factors including physiological health, temperature regime and population density. Reduced physiological health and other stressors can reduce reproductive capability as, under these circumstances, most species concentrate internal resources on survival instead of reproduction. For many species (not mammals and birds) gonadal somatic index (ratio between body mass and gonad mass) is a good measure of reproductive capability. High reproductive capability does not necessarily translate to high reproductive success.

Survival of young to age of recruitment to the population is a function of reproductive strategy and varies by orders of magnitude depending on the strategy, ecological hazards and stochastic events. Dispersive invertebrate larval stages vary extremely in the numbers surviving from place to place and time to time with weather, currents, availability of food, period spent in the plankton, predation and intrinsic variability in processes killing and removing species e.g competition for food and space, predation. At the other extreme, survival of young marine mammals is very high because of the heavy parental investment in low numbers of offspring. However, the relative survival rates of all strategies are vulnerable to modification by stochastic events.

**Age frequency**

Age frequency is important in determining the degree of success of population reproduction and resilience to perturbation for many species. Variation in population structure contributes to the complexity of community mosaics and to biodiversity. Age or size frequency is an important indicator of a species population’s long-term viability.

**Sex ratio**

Sex ratio is important in determining the degree of reproductive success and therefore the long-term viability of dioecious species populations.

**Physiological health**

Physiological health is a critical component of a species population’s long-term viability. It encompasses both genetic and physiological fitness. Knowledge of the physiology of most marine species is inadequate to directly express health in positive terms. Indicators of healthiness include reproductive capacity (e.g gonadal somatic index) and immunity to disease; and of potential poor health: contaminant burden, immunosuppression, epibiota burden, nutritional state and physical damage.

**Immunity to endemic disease**

Reduced physiological health, e.g. through raised stress or chemical contamination, typically increases susceptibility to endemic diseases.

**Exposure to anthropogenic disease**

Certain species may contract diseases of humans and domesticated animals. Certain anthropogenic activity can increase the risk of this. Whilst diseases that can cross such species barriers are few, if it were to occur there is the potential for very significant impact on the wild species population.

**Distribution throughout site**

Species populations are distributed within their habitats according to their ecological requirements (particularly sessile species). The distribution of most species across and along environmental gradients results in extremely complex mosaic of communities (aggregations of species) that vary over time. The distribution and extent of species are, within constraints of species’ adaptation to physical factors and biological interaction, variable in time and space. Modification of structural and functional factors by human action will likely result in alterations to species distribution, extent and abundance.

**Distribution of specific behaviours throughout the site**

Some mobile species (e.g. dolphins, seals, spider crabs & bass) use different parts of their habitat for different behavioural purposes (e.g. feeding, moultting, breeding). The locations used are usually important for the particular behaviour displayed. Displacement of this behaviour to other less favourable locations can be detrimental to the species.

**Mobility (ability to move about the site)**

For most non-sessile species the ability to move around unimpeded is a prerequisite to maintenance of viable populations through, inter alia, successful feeding, predation-avoidance and reproduction. This includes both territorial species with localised mobility requirement and highly mobile and / or migratory...
### SUPPORTING HABITAT & SPECIES

Any components of habitat conservation status (Table 2.1 above) will apply to typical species of habitat features, and may apply to a species feature where the component is relevant to the conservation of that species feature. The most likely components of habitat conservation status that are relevant to the conservation of species features are given below.

### Distribution and extent

<table>
<thead>
<tr>
<th>Element</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferred habitat</td>
<td>The habitat used by the species within the site. For wide ranging species this will likely be the whole area of the site.</td>
</tr>
<tr>
<td>Habitats utilised for specific behaviours</td>
<td>The distribution and extent of habitat necessary for specific behaviours, such as feeding, breeding, resting and social behaviour.</td>
</tr>
<tr>
<td>Structure &amp; function</td>
<td>The structure and functions that maintain the habitat in a form suitable for the long-term maintenance of the species population. This is linked to habitat quality.</td>
</tr>
<tr>
<td>Quality of habitat</td>
<td>The natural quality of habitat features may be reduced by modification of structural components identified above and, including by: the presence and persistence of artificial inert or toxic materials (e.g. synthetic plastics and fibres, hydrocarbons) causing entanglement, smothering or ill-health; decrease in seclusion because of noise and visual disturbance. Human activity with the potential to cause disturbance, affecting behaviour or survival potential includes waterborne leisure and commercial activities, wildlife watching; competition for space, causing displacement, collision, noise and visual disturbance, increased density dependent pressure on preferred sites, exposure to disease (see above); Contamination of prey (see below);</td>
</tr>
<tr>
<td>Prey availability</td>
<td>The presence and abundance of prey within the site may contribute to the species presence and its long-term viability.</td>
</tr>
<tr>
<td>Prey contamination</td>
<td>Contamination of species feature prey can reduce the long-term viability of the species population. Contaminants that bioaccumulate and biomagnify and which affect the species physiological health would be of particular concern.</td>
</tr>
</tbody>
</table>

Species which are dependent on features for a part of their ecological requirements (inter alia otter, seals, sea and river lamprey, shad, herring). Unimpeded mobility of reproductive products, larvae and juveniles of species is critical to the maintenance of viable species populations.

Unimpeded mobility of reproductive products, larvae and juveniles of species is critical to the maintenance of viable species populations.
Annex F

Frac-Out Risk Assessment
Risk Register
WPD15045 – Brechfa Forest (underground section)

Document history

<table>
<thead>
<tr>
<th>Revision</th>
<th>Purpose description</th>
<th>Originated</th>
<th>Checked</th>
<th>Authorised</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rev 0</td>
<td>General issue</td>
<td>MB</td>
<td>AF</td>
<td></td>
<td>24/03/15</td>
</tr>
<tr>
<td>Rev 1</td>
<td>Clarify depth requirements</td>
<td>AJH</td>
<td>MB</td>
<td></td>
<td>22/05/2015</td>
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<tr>
<td>Rev 2</td>
<td>Clarify depth requirements</td>
<td>DK</td>
<td>MB</td>
<td></td>
<td>26/05/2015</td>
</tr>
</tbody>
</table>
Explanatory Note on Risk Classification

Risk is the likelihood of potential harm from a hazard being realised. The extent of risk will depend on:

- The likelihood/probability of that harm occurring
- The potential severity of that harm, i.e. of any resultant injury or adverse health effect
- The population which might be affected by the hazard, i.e. the number of people who might be exposed.

The risk assessments should be reviewed if there is reason to suspect that they are no longer valid or there has been a significant change in the matters to which they relate. (Ref: Management Regulations – Regulation 3).

Risk classification and required action:

<table>
<thead>
<tr>
<th>Probability (P) *</th>
<th>Severity (S) *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>No harm</td>
<td>-</td>
</tr>
<tr>
<td>Minor harm</td>
<td>-</td>
</tr>
<tr>
<td>Moderate harm</td>
<td>-</td>
</tr>
<tr>
<td>Serious harm</td>
<td>-</td>
</tr>
<tr>
<td>Major harm</td>
<td>-</td>
</tr>
<tr>
<td>Catastrophic harm</td>
<td>-</td>
</tr>
</tbody>
</table>

Risk rating/classification (R):

- 0 – 1 /Low: No action required
- 2 – 6 /Medium: Ensure control measures are maintained and reviewed as necessary to ensure so far as is reasonably practicable the appropriate control of residual risk
- 8 – 16 /Medium: Control measures to reduce risk rating to a level which is as low as is reasonably practicable
- 20 – 25 /High: Activity not permitted – hazard to be avoided or risk to be considerably reduced

* Probability that harm will occur:

- 0 Almost impossible: Probability close to zero
- 1 Extremely unlikely: Highly improbable, never known to occur
- 2 Unlikely: Improbable, remote chance
- 3 Likely: Possible, has happened occasionally

* Potential severity of harm:

- 0 No harm: No injury, damage, sickness or other loss
- 1 Minor harm: Minor injury with short term effect, minor damage or loss
- 2 Moderate harm: Lost time injury or illness, moderate damage or loss
- 3 Serious harm: Over 3 day injury or illness, substantial damage or loss

WPD15045
<table>
<thead>
<tr>
<th>Ref</th>
<th>Hazard</th>
<th>P</th>
<th>S</th>
<th>R</th>
<th>Response/Control Measure</th>
<th>Action Record</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bore Hole Investigation works</td>
<td>Frac-Out during the Horizontal Directional Drill (HDD) operation.</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>Bore Holes have been sealed and the locations of the bore holes are off of the HDD proposed profile. Sandbags and Gully sucker taker on site at all times.</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>River Towy (Long river crossing)</td>
<td>Frac-Out during the Horizontal Directional Drill (HDD) operation.</td>
<td>3</td>
<td>4</td>
<td>12</td>
<td>Horizontal Directional Drill to be a minimum of 5m beneath the river bed. Sandbags and Gully sucker taker on site at all times.</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Small water courses / Ditches (Short crossings)</td>
<td>Frac-Out during the Horizontal Directional Drill (HDD) operation.</td>
<td>3</td>
<td>4</td>
<td>12</td>
<td>Horizontal Directional Drill to be a minimum of 1.5m beneath all ditches. Sandbags and Gully sucker taker on site at all times.</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Abergwili Road</td>
<td>Frac-Out during the Horizontal Directional Drill (HDD) operation.</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>Horizontal Directional Drill to be a minimum of 3.5m beneath all ditches. Sandbags and Gully sucker taker on site at all times.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>A40</td>
<td>Frac-Out during the Horizontal Directional Drill (HDD) operation.</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>Horizontal Directional Drill to be a minimum of 7m beneath all ditches. Sandbags and Gully sucker taker on site at all times.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Water Extraction</td>
<td>Water Contamination</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>Water to be extracted from hydrants with full registered equipment in accordance with the local water authority into a Tanker / Bowser</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Notes:

There are no written standards or specifications for depths of directional drilling. Required depths can be specified by the land owners, utilities or other bodies responsible for the receiving environment, where the HDD will be taking place.

It is good practice, derived from professional experience and industry knowledge, to adopt a depth for a long drill under a river of between 3m and 5m beneath the bed of the river. For short crossings under ditches and smaller watercourses the normal required depth is 1.5m.